

2025 - 2034

State Forest Management Plan

Michigan DNR
Forest Resources Division | Wildlife Division
www.michigan.gov/DNR

Mission Statements

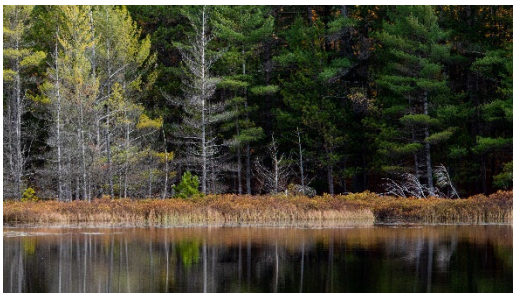
MI Department of Natural Resources (DNR)

Michigan’s Department of Natural Resources is committed to the conservation, protection, management, use and enjoyment of the state's natural and cultural resources for current and future generations.



DNR Fisheries Division

The mission of the DNR Fisheries Division is to protect and enhance Michigan’s aquatic life and habitats for the benefit of current and future generations.



DNR Forest Resources Division

To manage, protect and provide for the sustainable use of Michigan’s forest resources.



DNR Wildlife Division

To enhance, restore and conserve the state’s wildlife resources, natural communities and ecosystems for the benefit of current and future generations.



DNR Parks and Recreation Division

To acquire, protect and preserve the natural and cultural features of Michigan’s unique resources, and to provide access to land- and water-based public recreation and educational opportunities.

Land Acknowledgement

The Department of Natural Resources collectively acknowledges that the area now known as Michigan, occupies the ancestral, traditional and contemporary lands of the Anishinaabeg – Three Fires Confederacy of Ojibwe, Odawa and Potawatomi peoples. We recognize, support and advocate for the sovereignty of Michigan's 12 federally recognized Indian nations, for historic Indigenous communities in Michigan, for Indigenous individuals and communities who live here now, and for those who were forcibly removed from their homelands. By offering this land acknowledgement, the DNR affirms Indigenous sovereignty and will work to hold to the needs of American Indian and Indigenous peoples.

Plan Accessibility

This document contains complex maps and data tables. For assistance with interpreting these materials or if you require the information to be provided in an alternative format, please contact the DNR Forest Resources Division via email at DNR-Forestry@Michigan.gov, or by phone 517-284-5900.

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The Michigan DNR recognizes the valuable contributions from numerous individuals, agencies and organizations in the development of this plan. We would like to extend a sincere thank you to the many people who shared their time and expertise to the planning and production of this document, which will guide sustainable management of the state forest over the next 10 years.

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State forest management plan summary

Introduction

A century ago, after the unregulated logging of Michigan's lumber baron era, there was basically one focus for Michigan's state forests: get trees into the ground. That effort worked.

Through the combination of concentrated planting efforts and natural regeneration, a sea of stumps regrew into thriving forests for the people of Michigan to use and enjoy.

Today, Michigan's nearly 4 million acres of state forest are sustainably managed to balance a host of activities. These include timber management, wildlife viewing and hunting, improving water quality for great fishing and clean drinking water, extracting minerals, camping, hiking, biking, off-road vehicle and horseback riding and other types of outdoor fun. State forest management also includes helping rare plant and animal species thrive as well as conserving and protecting unique places that have ecological, cultural and historical significance.



Forests are important to people in Michigan. A Department of Natural Resources survey conducted in 2017 shows an overwhelming majority of Michiganders feel Michigan's forests are integral to the state and its people – even if they never visit the forests themselves. But balancing the needs and desires of the forest's many different users can be difficult and requires considerable coordination of efforts.

Comanagement

Balancing all the forest uses happens through a commitment to comanagement of the state forest. While Forest Resources Division is the lead administrator of state forest lands, multiple DNR divisions work together to manage for all the uses the state forest provides.

Wildlife Division is recognized as having equal management and decision-making authority on the state forest, harkening back to a 1946 agreement when both divisions merged lands into a new state forest system. The importance of forest management that enhances wildlife habitat is recognized by statute and forest certification standards, and this interdependent relationship between the divisions is supported by numerous Tribes, stakeholders, and members of the public.

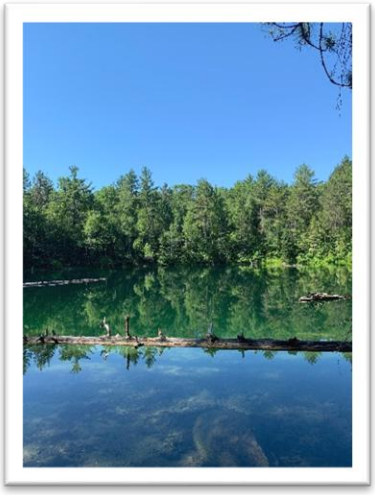
Parks and Recreation Division has management responsibility for the recreation system on the state forest, and staff between the two divisions work closely together to maintain it and adapt as needed. Staff from Fisheries Division work closely with FRD staff to enhance or minimize impacts to aquatic habitat. Finally, Law Enforcement Division works closely with all divisions to monitor for the safe and sustainable use of this vast and varied public resource.

Managing for multiple values

Taking into account the varied ways Michiganders use and value state forest land, the state forest management plan sets specific goals and objectives for the composition of the forest and how wildlife and biodiversity will be managed over the next decade (2025 - 2034). Although this plan will not provide programmatic objectives for cultural resources, rare species or uses such as recreation, it will consider these values in the context of forest management activities. The plan also considers goals and objectives from other DNR planning efforts, described in plan section 1, to better integrate and guide management of state forest land for many uses and values. This plan will help the DNR accomplish its timber and wildlife habitat management goals while taking other forest values into consideration over this 10-year planning period.

Sustainable Forest Planning

The DNR is mandated to manage the state forest "consistent with the principles of sustainable forestry" and requires the development of a management plan that describes how that will be achieved (part 525, Natural Resources and Environmental Protection Act, PA 451, as amended). Sustainable forest management includes sustainable harvest, or ensuring a steady timber supply, but it goes much further to include practices that balance economic, environmental and social values. The difficulty in fully realizing this, for land managers everywhere, has been the lack of a specific definition of what that means and the diversity of values, management objectives, and spatial and temporal scales at play. This, to large extent, has been addressed by the international 2015 Montreal Process that identified a set of criteria and indicators "for the conservation and sustainable management of temperate and boreal forests."



The current plan is different from its predecessors in that it: 1) Has a sustainable forest management framework based on the 2015 Montreal Process Criteria and Indicators; 2) Is based on an industry-standard forest harvest planning model to generate better informed harvest targets; 3) Integrates wildlife habitat into forest harvest targets for the first time; and, 4) Integrates climate change predictions and adaptive strategies in a novel way. Additionally, this plan incorporates both statewide and regional strategic direction as well as management area operational guidance.

To create this plan, representatives from Forest Resources, Wildlife, Parks and Recreation and Fisheries divisions were involved with modeling, planning, writing, and stakeholder and public engagement. Together, this multi-divisional planning team established seven core principles upon which the state forest should be managed. These seven principles and their associated goals and strategies are based on the criteria and indicators developed under the 2015 Montreal Process for sustainable forest management. The state forest principles are:

- Principle 1. The state forest is managed to conserve or enhance biological diversity.
- Principle 2. The state forest is managed for net positive growth.

- Principle 3. The state forest is managed to promote ecosystem health and vitality.
- Principle 4. The state forest is managed to conserve and protect soil and aquatic resources.
- Principle 5. The state forest is managed to provide opportunities for social and economic benefits.
- Principle 6. The state forest is managed to respond to a changing climate.
- Principle 7. The state forest is managed to steward significant cultural resources.

A total of 59 management priorities were chosen to represent the collective set of principles, goals and strategies. These management priorities are the state forest resources identified as the means to both manage for and monitor progress toward sustainable forest management. All together, the collective set of principles, goals, strategies, and management priorities establish the state forest sustainability planning framework. The entire framework is laid out in plan section 1.

Current conditions and trends, desired future conditions, and objectives and actions are provided for each management priority at statewide and regional scales in plan section 3. They were developed in consultation with subject matter experts and field staff as needed. These integrate climate change adaptation strategies based on predicted impacts and include components of sustainable forest management. Metrics were identified for management priorities based on available data, feasibility of assessment, and what would best inform progress toward desired future conditions.

Achievement of management priority objectives and actions during this planning period will set each on the path toward forest sustainability, and tracking their respective metrics over time will gauge success along the way. Implementation and effectiveness monitoring is described in plan section 7.

Sustainable harvest modeling

To better address the scope, scale and complexity of managing the almost 4 million acres of state forest land for this plan iteration, the decision was made to invest in the Remsoft Woodstock Optimization Studio®, an industry-standard forest harvest modeling platform. It uses a linear programming model that strives to find an optimal solution given a set of parameters.

To prepare for this added capacity in harvest planning, the need for programmatic updates was recognized by both the Forest Resources and Wildlife divisions.

Forest Resources Division staff:

- Conducted a wall-to-wall assessment of management availability to ensure the land base used in the model was as accurate as possible.
- Reduced the number of management areas down to thirty based on Cleland's Sub-Subsections to right-size the scale of forest planning and analysis and align with the ecological framework used by the U.S. Forest Service.
- Leveraged Forest Inventory Analysis data on the state forest to develop the growth and yield tables used in the model.
- Developed a pilot model with just two management areas to test the efficacy of the model in representing state forest management, and to identify and troubleshoot potential issues.

Wildlife Division staff:

- Revised the northern Lower and Upper Peninsula featured species to focus on those that could be integrated into the model and monitored over time.
- Developed a "wildlife habitat diversity matrix" that identified the stand inventory variables that best described either the primary or most limiting habitat for each featured species to use in the model.
- Developed a "forest diversity matrix" between landscape position (upland/lowland), management availability, age category (successional stage) and shade tolerance as a model output to provide landscape context for decision making.
- Identified Landscape Habitat Conditions to track broad geographic habitat trends associated with featured species over time using stand inventory data in the model and MiFI.

Finally, members of the planning team facilitated meetings with field staff from both Forest Resources and Wildlife divisions to determine desired future conditions for the major cover types in each management area, with consideration for featured species habitat.

Using this new Woodstock modeling software, for the first time the DNR was able to:

- Model management complexity across the state forest to determine a long-term sustainable level of harvest.
- Run multiple model scenarios to assess management alternatives, resolve management challenges, and choose a preferred solution.
- Integrate wildlife habitat goals into forest harvest targets.
- Track wildlife habitat availability over time from forest management actions.

The preferred solution described in this plan was chosen because it best represented staff-informed desired future conditions, met prescribed wildlife habitat goals, and ensured a sustainable level of harvest far into the future. Sustainable harvest is one component of sustainable forest management.

Projected statewide, management area, and special analysis unit harvest levels from the preferred solution are included in plan sections 3, 4 and 5. How the harvest projections for the current planning period will be implemented is described in plan section 6.

Draft plan review and the 2025 ice storm

In late 2024, a draft state forest management plan was released for review by Tribes, stakeholders, and members of the public. That version included a long-term average decadal harvest goal of approximately 500,000 acres from the model, and the projected harvest levels for the current planning period were described in the statewide, management area, and special analysis unit sections of the plan. By the end of the draft plan comment period, four Tribes, 21 stakeholders, and 55 members of the public had provided comments. In January 2025, the planning team began the process of reviewing, sorting, and responding to those comments.

Then, in March 2025, a generational ice storm event occurred in the northeastern Lower Peninsula affecting approximately 790,000 acres of DNR-managed lands with varying levels of severity. This ranged from almost 100% of the trees snapped in half or tipped over in the most severely impacted stands, to a combination of snapped trees and standing trees with numerous broken branches in moderately impacted stands, to some amount of standing trees with broken branches in the lighter damaged stands. The most severely impacted stands were 50- to 60-year-old planted red pine, but northern hardwoods, aspen, and other cover types were impacted to lesser degrees as well.



The impacts from the ice storm were of sufficient magnitude to necessitate a modification to the model and the resultant model projections in the plan. Though these changes only affect the northeastern Lower Peninsula, the difference in projected harvest levels also necessitates a second internal, Tribal and public review of the draft plan. This current plan version includes changes in response to DNR staff, Tribal and public comments from the 2024 draft plan review, but this second review will be focused solely on the changes made in response to the ice storm.

After the storm: long-term harvest sustainability

Model modifications were made to silvicultural regimes, actions, and growth and yield tables to represent ice storm damage. Two treatment types were added to capture ongoing and projected future salvage efforts. An action was created to reset ages to the 0-9 age class for stands with severe damage that were not eligible for harvest this planning period. And the growth of highly impacted cover types was slowed by 25% this planning period to represent the time it'll take for the remaining trees in stands to recover from open wounds and regrowing branches.

The combination of these changes resulted in a new decadal harvest projection of 472,452 acres, a decrease of approximately 30,000 acres (-6%) from the 2024 version of the draft plan.

The number of acres for harvest is projected to increase to about 50,000 acres annually over the next few decades (Figure 1). It is projected that harvested volume will stabilize in about 40 years (Period 4 in Figure 1) at about 1 million cords per year following recovery from trees killed by the emerald ash borer, beech bark disease and the 2025 ice storm.

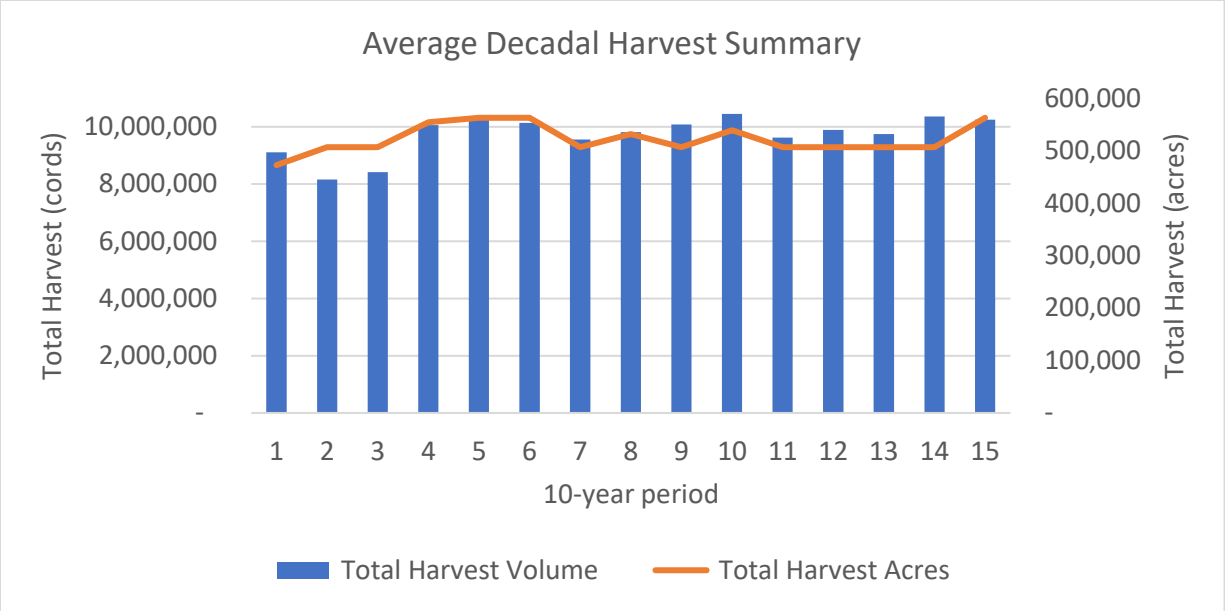


Figure 1. 150-year state forest harvest projection (acres and cords), updated to reflect ice storm impacts.

Annual harvest projections and implementation

A significant part of implementation work is focused on commercial timber harvest to shape wildlife habitat and a healthy future forest. The model was created to help ensure that management of state forest land in Michigan creates a long-term, sustainable supply of forest products and wildlife habitat while providing recreation opportunities and protecting natural and cultural resources for the people of Michigan. The projected harvests derived from the SFMP model inform the yearly harvest objectives, which are determined through the process of allocating resources to the annual harvest plan of work. Resources are allocated to prepare harvest treatments for sale that are available and unconstrained by factors such as access or operability.

Table 1. Annual harvest projections by silvicultural regime, updated to reflect ice storm impacts.

Year of Entry	Clearcut	Selection	Thinning	Shelterwood	Group Selection	Salvage Clearcut	Salvage Thinning	Total
2025	26,733	10,336	6,249	1,589	987	11,238	2,611	**59,743**
2026	26,699	12,035	6,317	1,442	296	7,492	2,611	**56,892**
2027	24,597	11,972	8,083	1,596	684	2,341	2,611	**51,884**
2028	21,992	12,516	6,425	1,255	495	936	2,089	**45,709**
2029	21,880	9,287	5,920	1,202	624	468	2,089	**41,470**
2030	21,021	8,038	6,493	1,513	294	234	3,655	**41,248**
2031	22,460	6,187	4,578	1,291	798	234	4,700	**40,249**
2032	19,024	8,732	5,662	1,388	769	234	4,439	**40,249**
2033	22,030	7,707	6,492	1,388	1,138	234	1,305	**40,295**
2034	30,226	14,065	7,419	1,567	1,438	-	-	**54,715**
Total	**236,663**	**100,876**	**63,637**	**14,231**	**7,524**	**23,412**	**26,109**	**472,452**

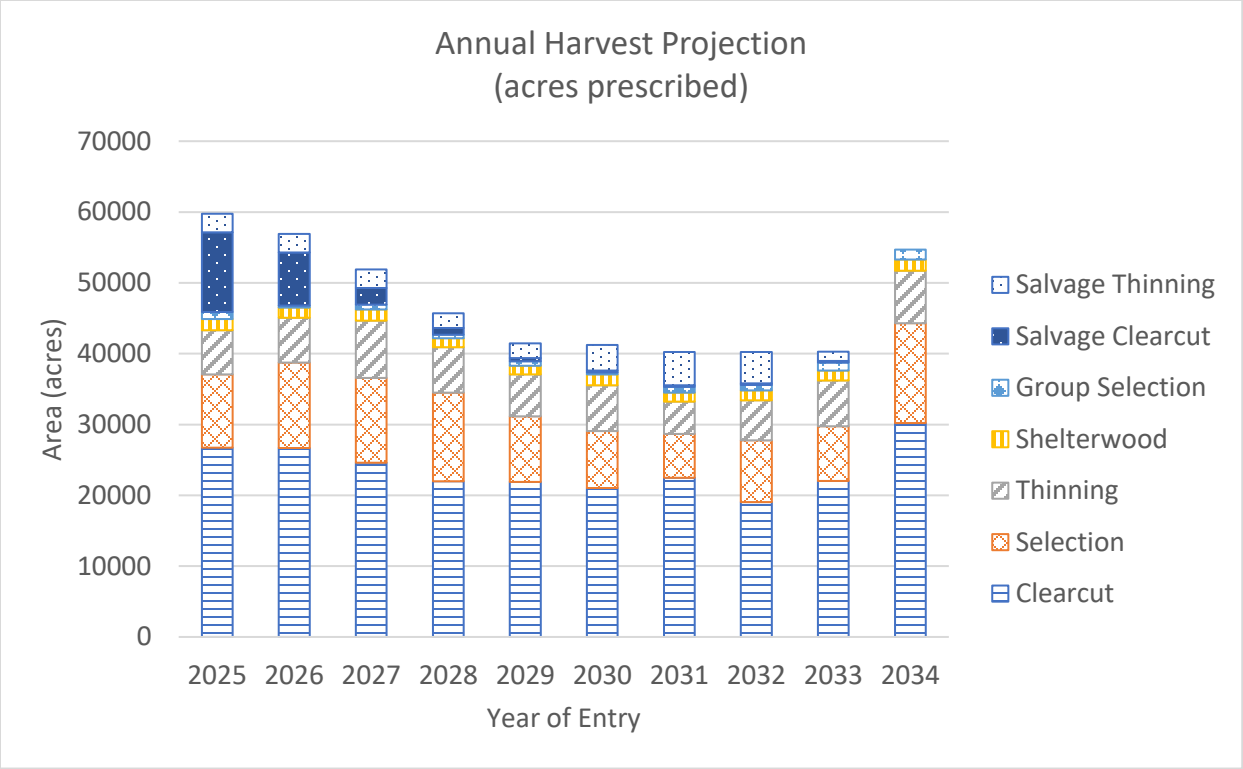


Figure 2. Annual Harvest Projection by method of harvest for this ten-year planning period.

Planning for a sustainable future

The Michigan DNR strives to be a nationally recognized leader in protecting natural and cultural resources, ensuring sustainable recreation use and enjoyment, enabling strong natural resource-based economies, improving and building strong relationships and partnerships, and fostering effective business practices and good governance.

Managing nearly 4 million acres of state forest land for a variety of forest types and conditions, monitoring forest health and vitality, and fighting invasive insects and diseases are all important tasks that will have a big impact on Michigan's future. Our state's wildlife is a remarkable resource that belongs to all of us, and the habitat it depends on must be carefully managed for a variety of species, from iconic game species including deer, turkey and elk to nongame species such as osprey, moose and Kirtland's warbler.

Michigan's diverse forests provide not only wildlife habitat but also cleaner air, cleaner water and a multitude of recreation opportunities that help boost people's physical, psychological and social well-being.

This plan provides essential guidance for the DNR to sustainably manage the state forest on behalf of the people of Michigan, ensuring the conservation, protection, management, use and enjoyment of the state forest for current and future generations.



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Introduction

State forest management and multiple use values

The state forest is managed for many purposes that represent a variety of uses and values. This can be difficult to balance, and even more so when trying to ensure continuity for future generations. These uses and values include forest products such as timber and minerals, wildlife habitat management and hunting, water quality for fish habitat and ecosystem health, recreation including camping, hiking, biking, off-road vehicles and horseback riding, mitigating impacts to rare species, and conserving and protecting places of ecological, cultural and historical importance.

Equitability among these values on the state forest can be difficult to achieve and requires considerable coordination of efforts. This responsibility falls largely across five divisions in the DNR. Forest Resources Division is the land administrator and often takes the lead in making management decisions, especially for silvicultural treatments of forested cover types and managing prescribed burns and wildfire. Wildlife Division works closely with Forest Resources on cover type management, since wildlife habitat and forest management are entwined. These two divisions also work together to manage for and mitigate threats to rare species and special places. Parks and Recreation Division takes the lead on almost all recreation opportunities offered throughout the state forest. Fisheries Division ensures that cover type management and water infrastructure promote habitat for or minimize impacts to aquatic environments or species. Finally, Law Enforcement Division ensures recreationists follow state forest policies and regulations that promote safety and resource protection.

These uses and values are explicitly stated in legislation and other mandates that define the authorities given to the DNR.

DNR legal authority

The Michigan State Constitution (1963) establishes the state's overarching legal framework by delineating the executive, legislative, and judicial branches of government and defining their respective powers. The executive branch is organized through administrative departments, including the Department of Natural Resources, to effectively implement state laws under the supervision of the governor. The Legislature was given the authority to develop laws, and it was specifically entrusted to protect the state's air, water and other natural resources. This serves as the basis for all natural resource laws in Michigan.

All DNR statutory authorities and obligations were consolidated under Public Act 451, the Natural Resources Environmental Protection Act, in 1994 (subsequently amended). This act combined environmental and natural resource laws and allowed for regulation and management of the use and impacts thereof.

Part 525 of this act, Sustainable Forestry on State Forest Lands, gave the DNR management authority over the state forest, in accordance with the principles of sustainable forestry, with the following stipulations:

- Ensuring wildlife areas and parks on state forest lands are managed for their primary purpose.

- Developing a plan to address all the forestry, conservation and wildlife considerations to be updated when necessary or appropriate, including:
    - A stable, long-term, sustainable timber supply.
    - Local and stakeholder interests.
    - Promoting use of state forests for timber and outdoor recreation.
    - A landscape plan that integrates biodiversity considerations.
    - Identification of sensitive areas, or areas that need to be treated to accommodate the needs of wildlife or rare species.
- Establishing regional yearly harvest objectives for all state forest land for a 10-year period, to be reviewed every five years, updated at least once and posted on the DNR website.
- Beginning Oct. 1, 2018, the DNR will prepare for sale a minimum of 90% of the yearly statewide harvest objective.

Part 525 also requires the DNR to seek and maintain third-party certification of state forest management that satisfies sustainable forestry standards.

Forest certification

Section 52505 of Part 525 of the Natural Resources Environmental Protection Act (Public Act 451, as amended) requires the DNR to seek and maintain third-party certification that management of the state forest satisfies the sustainable forestry standards of at least one credible nonprofit, nongovernmental organization certification program. Certification was required by Jan. 1, 2006. The DNR sought forest management certification under two standards:

1. The Regional Forest Stewardship Standard for the Lake States-Central Hardwoods Region (USA), as approved by the Forest Stewardship Council-US Board on Feb. 7, 2002, and accredited by Forest Stewardship Council International on Aug.5, 2002. Initial certification was granted on Dec. 31, 2005. It has since been updated to the current standard, Forest Stewardship Council 2010 Forest Management Standard.

2. The Sustainable Forestry Initiative 2005-2009 Standard as adopted by the Sustainable Forestry Board, Inc. on Jan. 10, 2005. Initial certification was granted on Dec. 14, 2005. The DNR is now certified under Sustainable Forestry Initiative 2022 Forest Management Standard.

Under certification, the DNR must be able to demonstrate that state forest management is sustainable, as assessed by annual third-party audits on a subset of state forest lands. Audits by both certifying bodies are concurrent and evaluate against standards in both certification systems. A recertification audit is conducted every five years in four forest management units and in Lansing. Surveillance audits in three units occur in the intervening years. Internal audits take place annually as well, prior to the third-party audits, in a good faith effort to meet continuous improvement standards. Formal management reviews are conducted in response to audit findings and can lead to policy and procedure revisions. Forest operations are guided by a set of work instructions, internally developed and revised as needed, to assure conformance with the certification standards.

There are some areas that are excluded from forest certification. These include all state parks, state wildlife areas in the lower third of Michigan, and Camp Grayling. Additionally, a few small exclusions exist in the state forest itself.

Administration of the state forest

State forest organization

The state forest, approximately 4 million acres in size, is distributed across the northern Lower and Upper peninsulas. It is administratively organized into a hierarchy of regions, districts and forest management units (Figure 1). FMUs are generally based on groupings of counties. Stand examiners (typically foresters, forest technicians, biologists and wildlife technicians) inventory and manage stands within compartments on state forest land. Compartments are blocks of land typically ranging in size from 1,200 to 11,000 acres, made up of stands that are inventoried at the same time.

The compartments are assigned to a schedule to be inventoried to establish their current condition and treatments are prescribed based on the goals of the management plan toward the desired future conditions. Each compartment is given a year of entry, which is the year they are “entered” to prepare approved treatments. This is based on a 10-year inventory cycle; therefore 10% of the state forest is inventoried every year. This effort is evenly distributed across forest management units annually. Management activities occur at the stand level, the smallest unit on the state forest. Stands are defined geographically by consistency in cover type, age class, basal area, canopy, size and/or stocking density. Cover types are characterized by a predominant species or a group of species that grow in similar conditions.

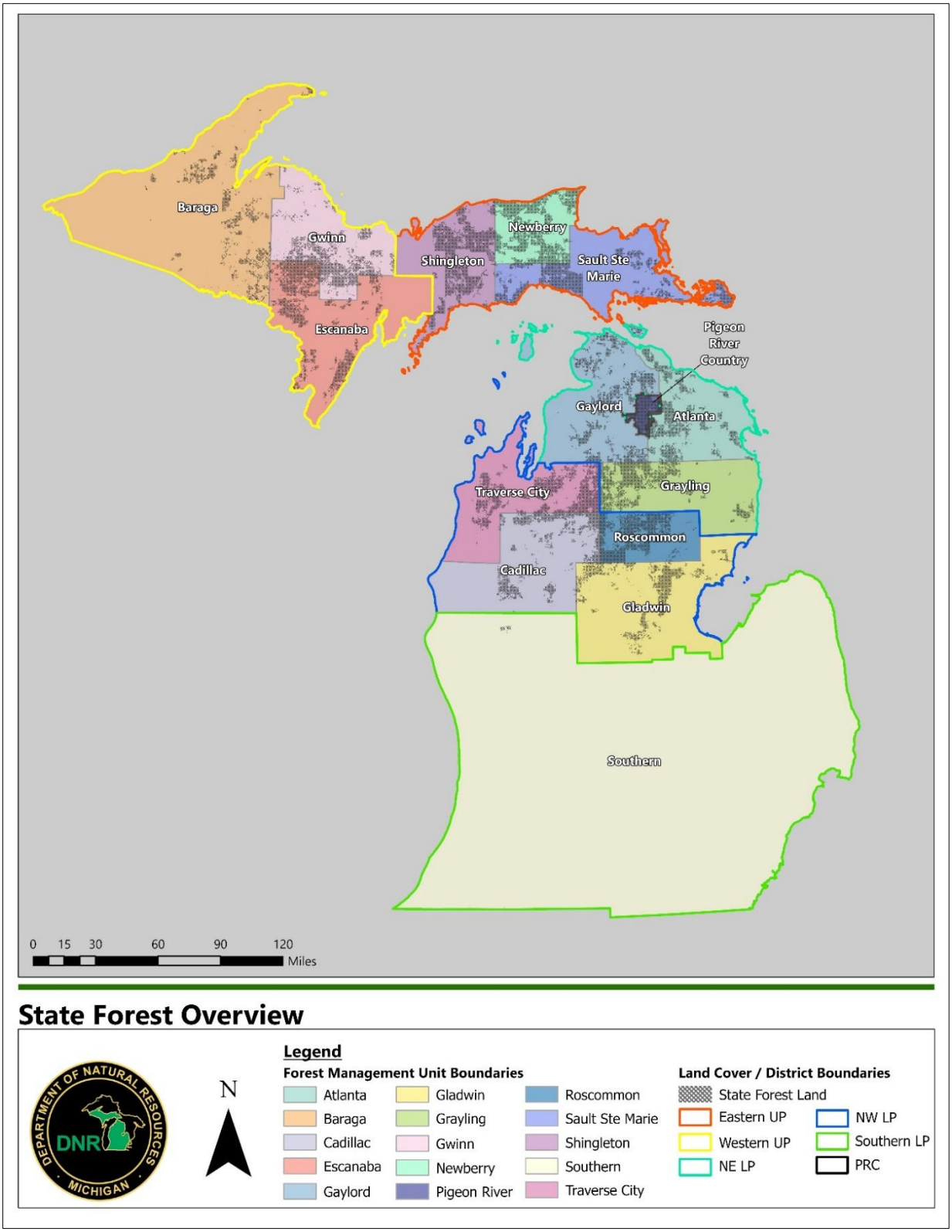


Figure 1. State forest district and forest management unit administrative boundaries.

State forest management approach

Traditional sustained yield management of forests became prominent in the United States in the late 19th century and was generally adopted as the management strategy by the present DNR in the early 20th century. This is a management approach where timber harvest does not exceed forest growth, thereby ensuring a sustained yield of timber in addition to ensuring the perpetuation of the forest. In the current system, the DNR achieves sustained yield forestry primarily through area regulation, because most cover types in the state forest are managed with even-aged management.

Area regulation balances age classes within each cover type so there is a uniform distribution of acres in each age class across the landscape. The oldest age class is typically defined by the rotation age; this also defines the annual acres eligible for harvest. Area regulation can take decades to achieve, but then provides an even flow of timber, and in some cases habitat, each year. Similarly, volume regulation is applied to cover types under an uneven-aged management system and balances the distribution of diameter classes by basal area within a stand. Both are in accordance with part 525 of Public Act 451, which calls for sustainable forest management such that "the harvest objectives for each forest region shall not exceed the sustainable yields." In setting these objectives, the DNR does consider the physical, biological, environmental and recreational objectives mentioned in the act.

State forest geographic scales

State forest management planning and activities employ an ecological framework for establishing and tracking forest cover type and habitat objectives for each forest management unit. Based generally on U.S. Forest Service ecologist D.T. Cleland's ecological sections and subsections (McNabb et al. 2009) and using Michigan Natural Features Inventory ecologist (D. Albert 1995) landscape descriptions, the state forest now consists of three ecological regions and 30 management areas (Figure 2). Compared to the 99 management areas based on ecological subsubsections in the 2013 Regional State Forest Management Plans, this current approach better facilitates effective management. It also aligns with the ecological classification system the U.S. Forest Service uses, enabling better coordination between agencies.

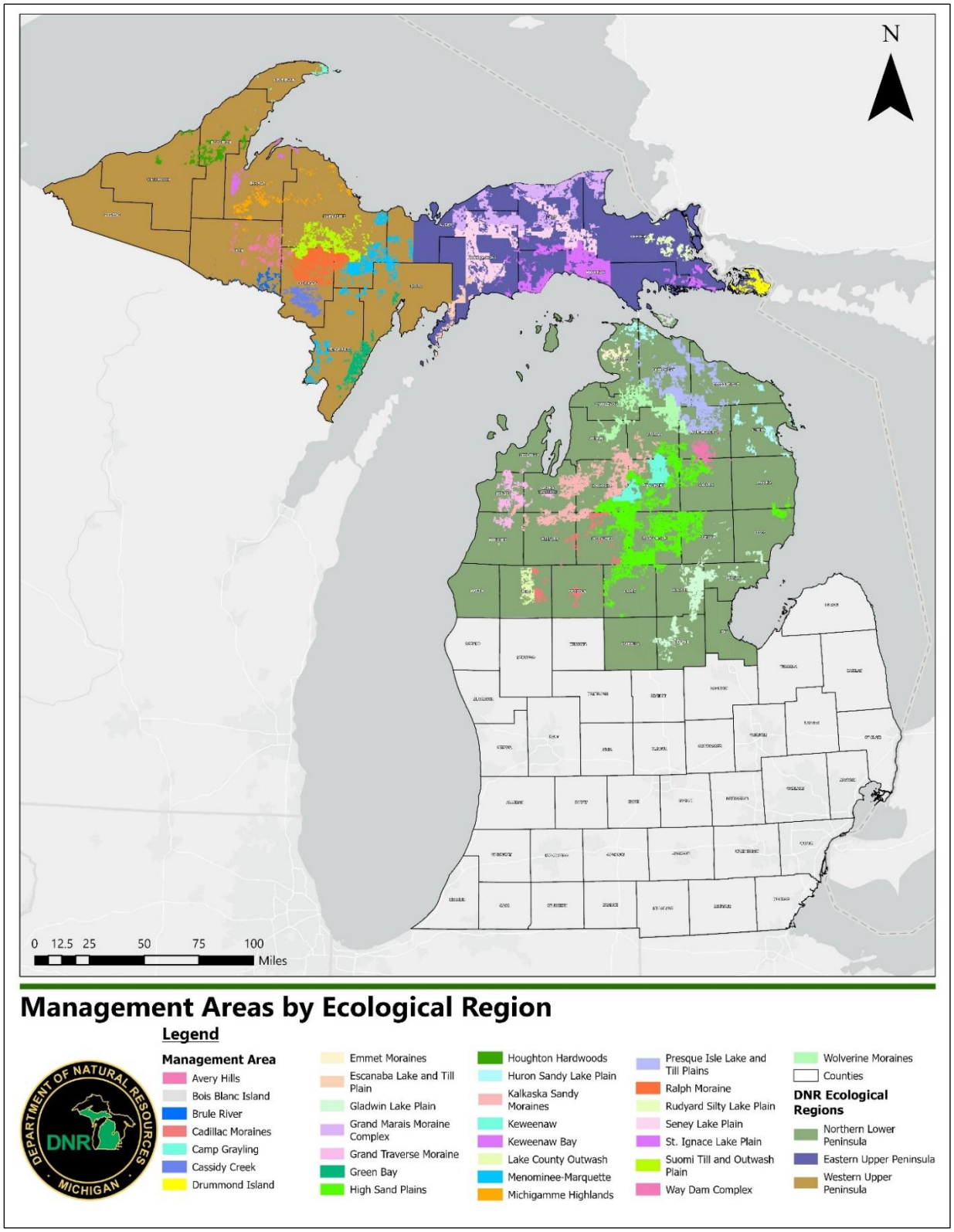


Figure 2. State forest ecoregion and management area boundaries.

The three regions recognize natural ecological boundaries that generally align with Cleland's sections. One such divide occurs in the Upper Peninsula, splitting Alger and Delta counties, which forms the boundary between the eastern and western Upper Peninsula. This is based on the inherent terrain and climate differences; the eastern Upper Peninsula climate is moderated by air flow moving over the Great Lakes, whereas the climate of the western Upper Peninsula is strongly continental, with little moderation by Lake Superior. These give rise to distinctive vegetation communities and management approaches. The northern Lower Peninsula is defined by a horizontal boundary between Bay and Oceana counties, demarcating a climate zone predominantly moderated by Great Lakes influence north of that line.

Management areas are groupings of state forest compartments that synthesize climate, physiography and geologic substrate that form ecosystems with distinctive vegetation and other unique characteristics within the landscape. These management areas form the primary context for cover type evaluation, setting goals, monitoring and tracking harvest targets. This is where strategic concepts from other plans are synthesized with silvicultural criteria and wildlife habitat goals at a landscape scale to provide operational direction.

Special analysis units are new in the 2025-2034 planning period. They are defined geographic areas, each associated with a planning effort different than the state forest at large. These areas are important to distinguish in the forest planning model as differences in rotation ages, desired age-class distributions, cover type transitions, and silvicultural methods would influence forest harvest targets and scheduling. These areas do not fit into any geographic hierarchy as they can be within or across management areas and management units. They include the Pigeon River Country State Forest, the Elk Management Area, the Kirtland's warbler area, deer wintering complexes, and grouse enhanced management sites.

State forest inventory

This management plan provides harvest targets by silvicultural method for each cover type within each management area for the 10-year planning period. Those harvest targets are then distilled into more specific guidance for each forest management unit in each year of the planning period. Stand examiners assess stand level attributes within their assigned compartments to identify stands that are operable for harvest. Because the state forest is recognized as a multiple-use system, silvicultural criteria, wildlife habitat needs, presence of rare and invasive species, occurrence of state and Tribal Historic Preservation Office records, invasive species, soil and water best management practices, effects on recreation and fisheries as well as climate change risks all are considered in cover type treatments. Stand examiners will then propose treatment prescriptions, including harvest, to meet planned management goals.

The DNR uses an interactive spatial database called Michigan Forest Inventory (MiFI), which houses information related to the physical, biological, and social information on each unit of land. It provides information regarding many aspects of forest management such as timber, wildlife, recreation, land use, treatments and reforestation efforts. The MiFI system stores information gathered during inventory to describe the composition of each stand, site factors that may limit management, and treatment prescriptions that support the goals and objectives to reach desired future conditions.

Each year of entry, proposed treatments entered into MiFI are discussed and must be approved by DNR resource divisions through the compartment review process. These include Forest Resources, Wildlife,

and Parks and Recreation, with varying input by Fisheries and Law Enforcement divisions. Staff from each of these divisions consider commercial and non-commercial management prescriptions for forested and non-forested resources. All proposed treatments are made available to the public for a 30-day review culminating in a public open house in each of the forest management units. This process constitutes an integrated management approach to sound management of state forest resources.

Approved treatments are typically prepared during their compartment's year of entry, but they may also be scheduled for preparation in any year of the planning period. Treatments involving each timber sale are implemented by creating a timber sale proposal which is combined with other sales to generate a bid packet. These sales are bid on in a sealed-bid silent auction and awarded to the highest qualified bidder. The DNR then enters into a contract with the purchaser once a 10% down payment and a bond are secured. Timber sale contracts typically span one to three years, often with extensions available upon request.

Prescribed treatments often decrease slightly in size during sale preparations due to a variety of factors that can come into play. For example, if a rare species is found, if a raptor nest is discovered, if access is limited or has changed or if conditions become unfavorable for harvest operations, a stand may become unavailable or the area of harvest may change. The actual harvest acres can differ from the planned harvest acres for any given treatment but generally results in about a 6% decrease from what was planned to the area prepared for harvest.

State forest co-management

FRD and WLD

The origin of the current state forest system is also the origin of the primary co-management relationship between FRD and WLD. Historically, predecessors of today's Forest Resources and Wildlife divisions separately administered and managed lands. Co-management was initiated through merging these lands into a new state forest system, under an agreement described in a 1946 Department of Conservation Commission Memorandum. The agreement was for the then-Forestry Division to be the primary land administrator conducting management activities on this system, but both divisions would have equal management authority, and neither could conduct work without approval from the other. This agreement was mutually beneficial in that the Forestry Division acquired more land, while wildlife biologists were freed from land management activities to focus on wildlife species management.

Recognition of this equal partnership "without one being subordinate to the other" is just as relevant today, as is the importance of collaboration between the two divisions. In 2005, this became DNR policy by jointly charging both divisions "with the responsibility of developing and implementing a comprehensive management plan" (DNR Policy and Procedure 32.22-07). In 2013, FRD and WLD chiefs jointly developed a co-management vision and set of actions and outcomes titled "Securing the Future of Michigan's Forests and Wildlife" to reaffirm their commitment and to set expectations for all staff in both divisions.

This expectation for co-management across both divisions is shared outside of the DNR as well. It is stipulated under part 525 of NREPA, to manage wildlife areas for their primary purpose and to ensure forest treatments sustain quality wildlife habitat. Forest certification standards keep us accountable to our own co-management plans and call for the protection of rare species and their habitats, and the maintenance of ecosystem functions, services and environmental values in forest management. Lastly,

various Tribes, partners, stakeholders and members of the public expect to see evidence of co-management in service of the relationship between forests and wildlife habitat, as substantiated by the number of comments on this topic received during the 2024 draft plan Tribal and public review.

While management of timber and wildlife can have some inherent conflict, they can also be mutually beneficial with similar goals achieved. Of all of the DNR resource management divisions that participate in joint decision-making during compartment review, the Wildlife and Forest Resources divisions are the only two that have equal management authority and responsibility across the entire state forest. As such, both divisions have a unique and important relationship. This State Forest Management Plan attempts to facilitate better collaboration between the two divisions by more fully integrating wildlife habitat needs and goals into strategic and operational direction.

FRD and other divisions

Parks and Recreation, Fisheries, and Law Enforcement divisions also have co-management relationships with FRD on the state forest, though to differing degrees. Part 525 of NREPA stipulates that Parks and Recreation areas will be managed for their primary purpose, and that outdoor tourism and recreation will be identified and promoted in the forest management plan. PRD has management responsibility for all recreation sites on state forest land, including state forest campgrounds, recreation trails and boating access sites. Staff from both divisions work closely when forest management activities may have an impact on a recreational site or if changes must be made to the recreation system. Likewise, many cold water streams and lakes, and other aquatic habitats important to fish, reptiles and mussels are found throughout the state forest system. Staff from FRD and Fisheries work closely when forest management activities may overlap such areas of interest to minimize negative impacts. Law Enforcement Division spends a lot of time in the state forest monitoring for the safe and sustainable use of this vast and varied public resource.

State forest land acquisition

The state forest was largely established on land acquired by the state due to the non-payment of taxes. During the early 1900s, after the land was stripped of the timber resource, a significant number of landowners stopped paying taxes and let the land revert to the state. Much of this land was then sold by the state, only to have it revert again due to farm failures and lack of timber value. This cycle of selling and reacquiring the land occurred again during the Great Depression of the 1930s. At this point, the state decided to stop this cycle and retain the land; it became the foundation for the state forest system. Although a majority of the state forest exists on land that was acquired through this tax reversion process, there has also been extensive intentional land acquisition using a variety of methods and funding sources.

Additional methods for state forest land acquisition includes transfer of land from the federal government, special legislation enacted by state government, gifts of land from private individuals, land exchanges and land purchases. Of these, land exchanges and land purchases are the most common. Land exchanges are regularly completed with private individuals, conservation partners and units of government. These transactions provide an opportunity to exchange surplus lands that are not contributing significantly to the DNR's mission for lands that consolidate well with existing state forest land, provide a valuable timber resource, and benefit both natural resource protection and public

outdoor recreation. Land purchases are funded through a variety of sources, many of which have specific purposes and requirements.

The funding sources used to acquire land for the state forest include federal, state, license fees and private donations. Federal funding sources, or those with federal implications, include the Forest Legacy Program, revenue generated from the Pittman-Robertson Wildlife Restoration and Dingell-Johnson Sport Fish Restoration acts, and hunting and fishing license fees. The latter three include added protections on acquired lands and are part of the U.S. Fish and Wildlife Service's Office of Conservation Investment.

The Forest Legacy Program, administered by the U.S. Forest Service and funded through the Land and Water Conservation Fund, is a nationally competitive grant program that provides funding to acquire land or rights in land to protect environmentally important forests. Michigan can submit up to three projects for consideration each year. As a result of the Inflation Reduction Act, there is additional funding available through the program that provides opportunities for three new project categories: large landscape level projects, state-tribal partnership projects, and small strategic tracts. This funding is expected to be obligated and fully spent by 2031. More than 4,800 acres have been added to the state forest through this funding source, with an additional 9,100 acres funded and the acquisitions pending. These lands must be managed sustainably as a working forest in perpetuity, though complementary uses such as public recreation are permitted.

Many DNR lands which are Pittman-Robertson or Dingell-Johnson acquired and/or managed are desirable to a variety of recreation users. Recreational use is not prohibited on lands purchased with funds acquired through these acts. However, when it does occur, the intensity and frequency cannot interfere with the primary purpose for which the land was acquired. Acquisition purposes could be for desired fish and wildlife habitat, species management or facilities to support wildlife administration and management. If the Office of Conservation Investment determines that the state is not adequately managing the frequency and intensity of recreation use on these lands and if a satisfactory resolution is not achieved, future funding is jeopardized. Since these funds have been significant, approximately $20 million (Pittman-Robertson) and $13 million (Dingell-Johnson) in 2021, careful management of nonhunting and non-fishing activities is very important.

Other DNR lands were acquired and/or are managed with hunting and fishing license fees. A provision of the Pittman-Robertson (1937) and Dingell-Johnson (1950) acts is that states must assent to only use state license fees for fish and wildlife services. Section 324.2010 of Michigan's Natural Resources and Environmental Protection Act states that the DNR will manage lands acquired with these funds "...through the use of scientific game species management for the primary purpose of managing habitat and thereby enhancing recreational hunting opportunities." Further, it clarifies that fund expenditures and forest treatments on lands acquired with these funds must demonstrate this primary purpose, and that any nongame benefits are a result of the primary purpose.

State funding sources that have contributed significantly to the acquisition of state forest land include the Michigan Natural Resources Trust Fund and the Land Exchange Facilitation Fund. The Natural Resources Trust Fund was established in 1976 and provides grant funding annually through a competitive application process to the DNR and local units of government to support acquisition of important lands and development of outdoor recreation. Lands acquired with the trust fund must be open to the public for recreational purposes.

The Land Exchange Facilitation Fund is managed by the DNR and funded from the proceeds of the sale of land that the state acquired through tax reversion. As surplus lands that are not contributing to the DNR's mission are sold, typically via public auction, proceeds are deposited into the facilitation fund. The DNR then uses a majority of the fund to acquire priority lands to be managed as part of the state forest, state game areas or state parks.

This variety of acquisition methods and funding sources enables the DNR to ensure ownership and management of the appropriate footprint for the state forest.

State Forest Management Plan purpose and scope

The primary purpose of the State Forest Management Plan is to provide strategic and landscape-level operational direction through specific goals and objectives for forest cover type and wildlife habitat management for 2025-2034. This plan replaces the 2008 Michigan State Forest Management Plan and the three 2013 Regional State Forest Management Plans. This plan integrates strategic planning at the forest-wide and regional levels, operational planning at the management area and special analysis unit levels, and tactical planning at the forest compartment level. The plan satisfies the planning requirements of Part 525 of the Natural Resources and Environmental Protection Act (1994 Public Act 451, as amended) and the Forest Stewardship Council and Sustainable Forestry Initiative forest certification standards. Although this plan will not provide specific objectives for other values such as recreation uses, it will consider these values in the context of forest management activities.

The plan also considers strategic direction in the form of goals and objectives from other DNR planning efforts, to better integrate and guide management of state forest land for many uses and values. The plan will help the DNR accomplish its timber and wildlife habitat management goals while taking other forest values into consideration over this 10-year planning period by:

- Effectuating the 10-year harvest schedule and long-term cover type and habitat projections from the preferred Woodstock® model scenario (Remsoft® Corporation, New Brunswick, Canada).
- Using a revised framework of management areas to provide operational-level assessments and management direction.
- Using special analysis units to provide specific management direction for unique resources and values, such as Kirtland's warbler and elk habitat.
- Ensuring all relevant values (and their respective planning direction) receive due consideration and consistent treatment within relevant geographies.
- Ensuring consistency in management direction where resource values cross boundaries of management areas or forest management units.
- Identifying current and future issues, such as climate change, as well as gaps in this plan.
- Identifying relevant management goals and objectives.
- Identifying and resolving issues between opposing objectives.
- Ensuring that forest management is transparent to all forest stakeholders.

Forest management unit staff will implement management direction within this plan for each management area through the compartment review planning process. This begins with the 2027 year of entry.

State forest planning process

No plan is an island

DNR plans provide overarching strategic direction for all divisions and are incorporated by reference in this plan. DNR divisions use a hierarchical planning framework that integrates departmental, divisional and programmatic plans (Figure 3). State forest management touches most DNR divisions as it encompasses wildlife habitat, fish habitat and water quality, cultural and mineral resources, and a multitude of recreation opportunities. These division programs and state forest management converge where forest operations may be influenced or impacted, and vice versa. This plan works within the guidance provided by each division program to inform state forest management decisions.

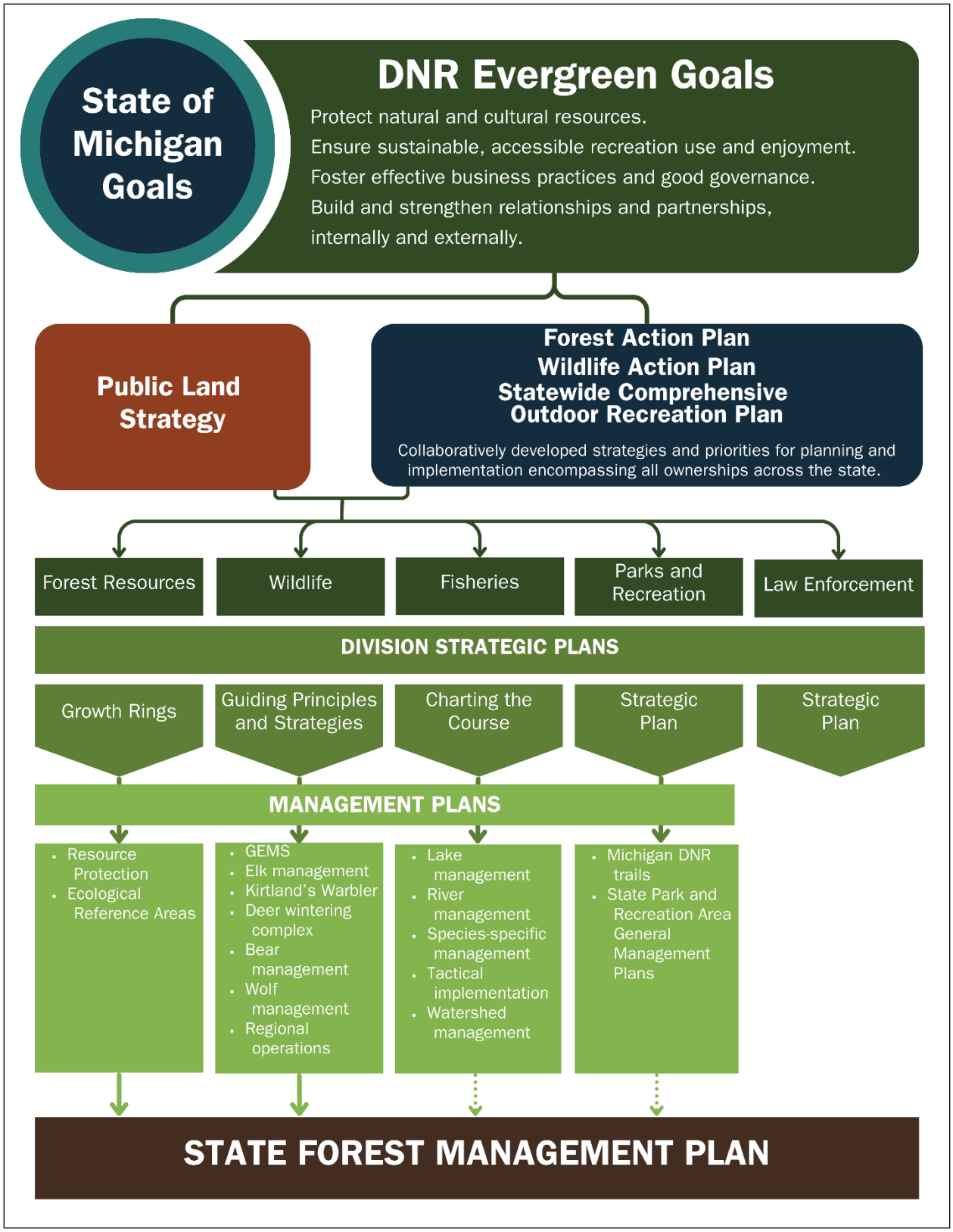


Figure 3. The State Forest Management Plan in relation to other DNR plans.

Planning approach

To satisfy statutory, policy, and departmental and division plan obligations and to facilitate sustainable co-management of the state forest, three primary approaches were identified:

- Developing a new forest planning model to guide management decisions and harvest operations.
- Integrating featured species habitat and landscape habitat conditions into the model and plan.
- Identifying climate change risks and applying mitigation strategies into forest management operations as described below.

State Forest Management Plan model design

Introduction

The 2013 Regional State Forest Management Plans used a Microsoft Excel® based model to generate 10-year harvest goals, which were then formulated into annual harvest goals for each forest management unit. Substantial limitations were recognized in using this approach as Excel® is limited in power and capacity to address the complexity and size of state forest management. It also lacks the inherent ability to design and project management scenarios into the future, which is an important function to evaluate management decisions, and didn't allow for the ability to define and track wildlife habitat over time.

For this plan update, the DNR invested in the Remsoft Woodstock Optimization Studio®, an industry-standard modeling platform. It is a suite of software applications that work together to allow users to build custom models representing different forest management strategies. Woodstock® is a linear programming model that strives to find an optimal solution (e.g., maximum or minimum) given a set of parameters represented as goals and constraints.

The DNR invested in training several staff and hired a consultant, Mason Bruce & Girard (Portland, Oregon), to help build components of the DNR's State Forest Management Plan model. The model was used to evaluate current forest cover type management strategies, assess new options and outcomes, solve management challenges, integrate wildlife habitat goals and tracking, and ultimately, determine a preferred scenario that adds confidence in harvest sustainability while achieving desired future conditions in terms of landscape-level forest composition and wildlife habitat.

Representing the land base in the model

The Woodstock® model makes use of a custom-built shape file (mapped polygons) containing important attributes of the state forest relevant to forest management including stand-level characteristics like cover type, age, and stocking, administrative and planning boundaries. These attributes become themes in the model's landscape section and are an integral part of the area section the model evaluates while executing a scenario (see Appendix G for more details). This made it possible to delineate regions, management areas, special analysis units, districts and forest management units to allow for different management approaches in each, and to produce outputs at different scales.

Representing area regulation in the model

The basic premise of any DNR model scenario is for it to represent the area regulation (area control) approach to forest management. This approach calls for setting specific age class and basal area class goals and regulating harvests to meet those goals in each planning period. The DNR uses 10-year

planning periods along with 10-year age classes for even-aged management. This makes it relatively straightforward to create desired age class levels in each applicable cover type. Harvesting and regenerating a specific amount of a given cover type over 10 years will result in establishment of a decade age class. That process is then repeated during each future planning period, resulting in establishing desired age class distribution over time.

In uneven-aged management, area regulation is accomplished with different harvesting techniques that change stand densities rather than resetting stand ages. A desired basal area distribution is defined by setting basal area-class goals that focus on maintaining stands in a condition that sustains optimal growth and stand structure. For example, the northern hardwood cover type is typically managed in a bell-shaped curve of basal area ranging from 70 square feet of basal area per acre on the low end to 120 square feet of basal area per acre on the high end. Stands are harvested when they reach the desired density and thinned to the lower density, allowing for more growth on the remaining trees. There are many variations of this general thinning approach that favor different diameter distributions or other management goals like regeneration and recruitment. Similarly, group selection is an uneven-aged approach to area regulation within a stand through small clear-cut patches harvested each decade. Variations of this system are based on patch size, re-entry period and cycle completion period. It's important to represent the basic principle of each in the model.

Forest inventory data in the model

To make the DNR's State Forest Management Plan model most useful, it needed to be built from the best representation of the current forest inventory. Given that there are approximately five years of treatments already prescribed and approved at various stages of implementation or completion, this made representing the current condition in the model a challenge. A decision was made to advance the inventory forward five years (see Appendix G) to represent what it would likely look like near the beginning of the next 10-year period when this plan is implemented. This method, however, likely resulted in an artificially inflated 0-9 age class, especially in the planted red pine cover type, when in reality some of those acres will not enter the 0-9 age class until the next planning period because of the time it takes for initial and follow-up treatments. To prepare for this plan update, the DNR completed a wall-to-wall assessment of the state forest to document each stand's management "availability" status in MiFI. A stand is deemed unavailable for commercial harvest if there are identified operability issues that prevent it. This comprehensive effort defined the manageable land base for the state forest and thereby defined the acres that were eligible for treatment in the model.

Projecting forest growth in the model

Growth and yield tables are the backbone of the Woodstock model, as these are used to "grow" cover types across periods (10-year intervals). These are based on representative tree size (height and diameter), age and site data collected to calculate cover type growth rates. Without this function, it wouldn't be possible to assess management scenarios to evaluate outcomes over time.

Though the DNR doesn't collect volumetric data to create these tables for the model, the U.S. Forest Service does in its Forest Inventory and Analysis program. This program is based on a network of sample plots across the U.S. to monitor forests by area and ownership, forest growth, removals, health, stand-level characteristics such as snags and downed wood, and other ecological and wildlife habitat attributes. Only Inventory and Analysis program plots on state forest land in Michigan were used to represent characteristics of various strata (unique combinations of cover type, age class and basal area

class) from the DNR's MiFI data. It was important to distinguish the state forest land plots from those located on private land because much of the state forest is comprised of land that was less productive in terms of soil nutrients and moisture availability. This resulted in failed farming attempts and the land ultimately reverting to the state because of delinquent tax payments. One limitation that evolved because of this approach was that fewer data points existed in each stratum resulting in growth and yield tables that are relatively coarse and only represent an average condition of each stratum across the state forest, negating the opportunity to add any geographic specificity.

Evaluation of model capabilities and usefulness

A pilot area was identified in the early stages of development to test the efficacy of the Woodstock® model in representing state forest management. Two management areas were chosen in the northern Lower Peninsula: Wolverine Moraines and Presque Isle Lake and Till Plain.

These areas both had high diversity in cover types and silvicultural methods, and they include the Pigeon River Country State Forest and Elk Management Area with established habitat objectives in associated management plans. These goals would provide a good opportunity to test if they could be directly incorporated into the model as goals or hard constraints.

Forest composition and structure goals in conjunction with habitat-related goals (where applicable) were set for each management area and drove the resulting harvest outputs and schedule in the model. Because harvests are implemented through the management units, which are aligned with county and not management area boundaries, the pilot area offered an ideal scenario to test implementation of the harvest schedule derived from goals in each management unit. The pilot area consisted of the entire Pigeon River Country management unit, as well as parts of the Gaylord and Atlanta units.

The pilot model testing quickly identified numerous challenges that needed to be overcome through modeling strategies and different approaches. The relatively small landscape offered quick solve times during the execution model, enabling a fast turnaround to analyze the results after a change was made. After several months of testing, it was determined that the Woodstock Optimization Studio® was an excellent tool for the DNR to determine a midterm (10 years) harvest schedule that would contribute to and enable long-term sustainable management eventually resulting in desired future conditions.

DNR preferred management scenario and 10-year harvest projection

One of the first decisions in building a model was to resolve whether it would help determine the management approach or improve efficiencies in the current approach. Once the latter was decided, how to combine the objective function, which defines what the model is trying to accomplish, with the goals and constraints that provide control for any given scenario needed to be determined. This is key to adapting a model to function as a surrogate for actual management on the state forest.

A set of desired future conditions was needed to establish a model scenario. The top five cover types in each management area were identified by acreage and data from the previous 10 years were summarized for conversion rates, silvicultural methods and age class distributions. Featured species were identified for each management area and associated with their habitat cover types. Meetings with foresters and biologists were held to discuss past trends and to get a consensus on future management direction. These discussions generated specific data for model inputs by cover type including the distribution of silvicultural methods by type, conversion rates between cover types, rotation ages, individual age-class goals and an overall cover type population trend. For cover types that were not in

the top five by acreage in each management area, standard silvicultural criteria were applied in the model. This formed the basis for the current DNR preferred model scenario, with some subsequent adjustments for a shift in natural pine (removal of clearcut as a viable silvicultural method) and Kirtland's warbler (use of mastication and biomass) management.

After running several scenarios with different objective functions, DNR staff chose the scenario with an objective function to maximize harvest using goals and constraints to ensure sustainable levels of cover type and wildlife habitat management. This model scenario incorporates staff input on cover type management by management area, specific cover type and habitat goals within special analysis units from area-specific plans, and featured species wildlife habitat. This scenario was vetted through forestry and wildlife staff.

This management scenario projected an approximate 50,000-acre, 10-year prescribed harvest target. This is lower than previous targets for several reasons. The last decade was characterized by a compensatory management approach, which called for higher than typical or sustainable restart acres across many even-aged cover types to build the 0-9 age class and reduce the older age classes. This was done to make room for the surplus of acres in the 30-and 40-year-old classes that would soon be reaching economic maturity in coming decades. In addition, extensive salvage cutting due to beech bark disease and emerald ash borer temporarily increased harvest acres. These circumstances emphasize the need for a planning model that can illustrate the impacts of management decisions over time. This 10-year harvest planning goal meets the statutory obligation of sustainable forest management.

Multiple use and the model

The DNR's primary intended use of the Woodstock® model was to determine a preferred management scenario that struck a balance between maximizing timber harvest and meeting forest sustainability mandates, integrating wildlife habitat goals where possible, and ensuring ecological values were sustained. Wildlife habitat values were defined by a set of featured species chosen to represent a range of forest and habitat conditions, and habitat variables for the model were identified and integrated (see below).

Ecological values on the state forest are largely represented by the conservation area network, which includes state forest lands that have some special conservation designation. These lands were not explicitly represented in the model since they were not eligible for treatment in the model. Any management or restoration actions will be specific to each designated area.

It was not possible to include other state forest values, such as rare species, non-forested habitat, recreation, water and soil quality, forest health and minerals extraction in the model. This is also not a climate change model, and it was not possible to include climate change-related parameters. This underscores the important difference between the model informing this plan update and the plan itself. The model is primarily limited to predictable and foreseeable cover-type management influences and changes over time. The plan itself more comprehensively addresses all values on the state forest. It is also suggestive of the need for model scenario runs throughout implementation during the planning period due to unforeseen events including wildfires, insect or disease outbreaks, wildlife habitat goal changes, or climate change impacts that may affect annual harvest plans.

Modifications to the model due to the 2025 Ice Storm

The ice storm that began on the evening of Friday, March 28, 2025, and lasted for the next 60 hours, until the early morning hours of Monday, March 31, left its mark on the forests of the northern Lower Peninsula. Approximately 790,000 acres of forested stands on DNR-managed lands in the eastern Lower Peninsula district were affected by ice accumulation at varying levels of severity. Over the course of the ice storm, some areas of northern Michigan were coated in up to 1 inch of ice.

Nearly 100 % of the trees snapped in half or tipped over in the most severely affected areas. This level of damage was most common in homogenous stands of 50- to 60-year-old planted red pine. Moderately damaged stands suffered from many snapped trees; those that didn't snap had numerous broken branches. Lighter damage was characterized by several trees within a stand having broken branches, but most trees not snapped or toppled.

The impacts from the ice storm were of sufficient magnitude to necessitate a modification of this plan. This final release includes modifications that incorporate the damage caused from the ice storm, the associated timber salvage efforts and the modified timber harvest projections where a loss in stem density may negate the need for treatment in this planning period (aside from potential salvage harvest of prioritized stands).

Two treatment types were added to the model to capture ongoing and projected future salvage efforts. The salvage clearcut represents harvests that will likely occur on stands where regenerating the stand is the best path forward. Salvage thinning was created to represent a partial harvest of damaged stands where there will still be a healthy, viable mature stand to manage in the future.

An action was also created in the model that represents severe damage of stands that are not eligible for harvest. Examples would include stands that were too young (sub-merchantable) or unavailable due to other constraints identified in the site conditions layer (too wet, too steep, no access, etc.). These stands have had their age projected to reset to the 0-9 age class and are shown to begin natural regeneration in this planning period.

The growth of highly impacted cover-types was also slowed by 25% for the 10-year period by applying a reduction factor to several variables of existing development types in growth and yield curves in the eastern Lower Peninsula. This change was implemented to represent the impact the ice storm is expected to have on remaining trees in stands as they recover from the damage by healing open wounds and re-growing branches.

Changes were also made to the model in response to feedback that resulted from the first release in 2024. The selection harvest projection in the northern Lower Peninsula was determined to be above achievable levels, which was likely caused by inaccurate assumptions about the distribution of actual basal area values across more coarse inventory data ranges. Essentially, there were more acres of northern hardwood forecasted to be ready for a selection harvest than what was deemed possible based on several years of testing the implementation of the model. This resulted in a reduction in selection harvest from what was projected in the first release by about 25% in most northern Lower Peninsula management areas. This reduction was nearly offset, however, by the projected need for northern hardwood salvage harvest across the management areas impacted by the ice storm. Many stands that would have otherwise gone untreated in this planning period will likely receive some sort of partial harvest, likely driven by the need to salvage damaged sawlog trees and improve the overall

health of the stand. Total salvage harvest projections as well as projections for each impacted cover type can be viewed in section 3.1 - Forested Cover Types.

Featured species and landscape habitat conditions

Featured species are target species identified by the DNR Wildlife Division as a focus for landscape-level habitat planning and management. This approach began in 2013 with an intention to review and revise the list every three years. The state forest plan update coincided with the 2019 featured species review. Given the new opportunity to integrate wildlife habitat needs into the Woodstock® planning model, it was determined that a list revision was warranted to maximize this potential. Thus, most of the forest-related featured species chosen for the update in the northern Lower and Upper peninsulas are those that may be negatively affected by normal forest management practices, and species whose habitat requirements have an impact on normal forest operations at a large scale. They were also primarily species that would be relatively straightforward to monitor, should the opportunity arise. This was done intentionally to ensure featured species habitat goals and monitoring could be incorporated in the model. This is pivotal, because for the first time, wildlife habitat treatment acres will be integrated into planned forest harvest acres.

A few forest-related featured species that were generalists or that responded to natural disturbances were chosen for the northern Lower and Upper peninsulas as well. These species couldn't be added to the model, but all featured species are included in this plan. In total, 18 forest-related featured species were chosen and went out for public review with this plan in 2024, 14 of which were incorporated into the model. In response to multiple comments on the lack of herptiles on the list and concern for moose, both wood turtle and moose were added to the plan as featured species but could not be added to the model at this planning stage. The new list of 20 featured species may look slightly different from previous lists but still includes highly valued game species and species of conservation concern.

The featured species also represent landscape habitat conditions, key elements of wildlife habitat that are often overlooked or underrepresented in typical forestry practices. Due to staffing capacity, they had not been previously implemented. Most landscape habitat conditions originated from field staff and species specialists identifying management issues over time. They were updated in conjunction with the state forest plan update to reflect tree harvest-related attributes trackable through the model and MiFI over time.

Any given landscape habitat condition has multiple featured species associated with it, and any given featured species may represent multiple landscape habitat conditions (Table 1). This, in large part, is because landscape habitat conditions are fairly broad, and associated featured species may represent differences in habitat needs within that landscape habitat condition (e.g., mature forest with open understory versus mature forest with dense understory). Young forest doesn't necessarily meet the typical landscape habitat condition criteria described above, but was included given its importance to many wildlife species. The landscape habitat conditions are:

- Young forest
- Mature forest (structural components of both closed canopy and canopy gap forests)
- Large patch or block size (area sensitivity)
- Mast (oak, hickory, beech, cherry, etc.), as a cover type and within stand component
- Mesic conifer, as a cover type and within stand component

- Big trees
- Upland openings
- Natural disturbance

Table 1. Featured species and the landscape habitat conditions they are associated with.

Featured Species	Associated Landscape Habitat Conditions
American marten	Mature forest, area sensitive, large trees, mesic conifer
American woodcock	Young forest, openings
Black bear	Mast
Black-backed woodpecker	Natural disturbance
Blackburnian warbler	Mature forest, area sensitive, large trees, mesic conifer, closed canopy
Black-throated blue warbler	Mature forest, area sensitive, large trees, closed canopy
Cerulean warbler	Mature forest, area sensitive, large trees, canopy gaps
Elk	Young forest, mast, openings
Golden-winged warbler	Young forest, openings
Kirtland's warbler	Young forest, area sensitive
Moose	Young forest, mature forest, big trees
Red crossbill	Mature conifer forest, large trees
Ruffed grouse	Young forest
Sharp-tailed grouse	Large openings
Snowshoe hare	Young forest
Spruce grouse	Mature conifer forest, canopy gaps
White-tailed deer	Mature forest in wintering complexes, mast
Wild turkey	Mast, openings
Wood thrush	Mature forest, closed canopy
Wood turtle	Openings

Featured species habitat modeling and non-model featured species

Forest inventory data is primarily used to determine whether a stand of trees requires treatment from a silvicultural perspective. Important habitat components for wildlife species are not directly measured in standard forest inventory protocols. A spreadsheet was created to align life requisites for a particular featured species to the information that field foresters collect. The resulting wildlife habitat diversity matrix created a set of forest inventory habitat attributes for each featured species that was used to define habitat for each featured species in the model. The featured species habitat in the model represents either limiting factors or priority habitats for each species. It would add too much complexity to the model to attempt to describe the entire suite of habitats for each featured species.

Of the 20 featured species, six are not addressed in the model. Black-backed woodpecker moves around the landscape where disease and insect outbreaks occur. Without substantially limiting factors, and without any important habitat impacts to or from forest management, black bear was deemed unsuitable for the model. For sharp-tailed grouse and wild turkey, openings were identified as limiting factors, but it was determined early in the modeling process that openings were not going to be addressed for this planning period. Both wood turtle and moose were added too late in the planning process.

The 14 species in the model are tied to specific, consistent and limiting forested habitat attributes that could be represented by a set of forest inventory data. For each of these 14 species, the model tracked featured species habitat over time as one of the outputs. For each species, this is an aggregate of the cover types, age classes, basal area ranges, stocking, etc., resulting in an acreage total for any of the geographic scales in the model. This new capability enables prior assessment of the impacts that management decisions may have on featured species habitat through scenario exercises. Under the preferred DNR model scenario, featured species habitat looks relatively abundant and stable over the 15 periods, or 150 years of the model run (Figure 4).

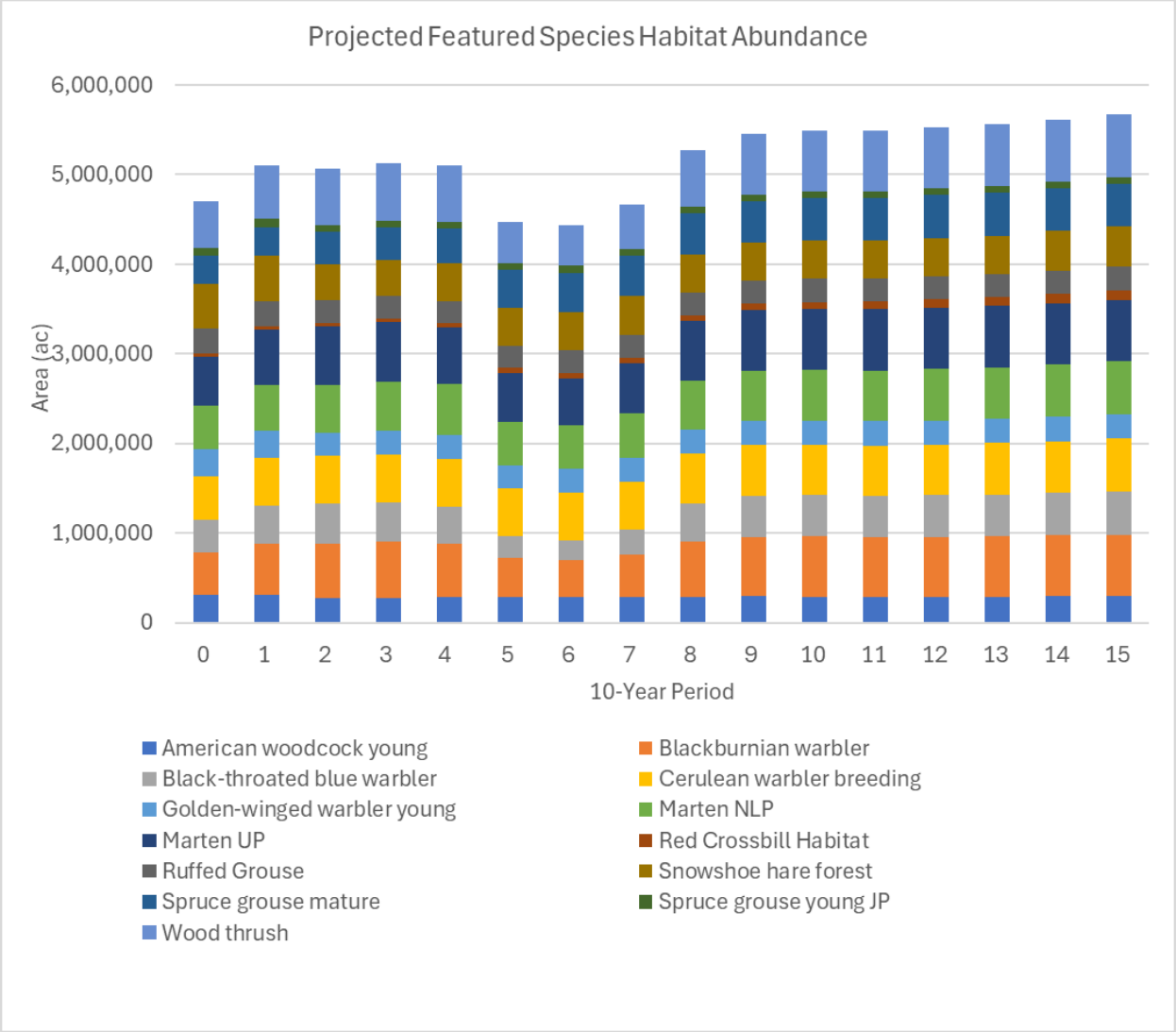


Figure 4. Model outputs for featured species habitat over 15 periods (150 years).

There are limitations on how to interpret the model outputs. As with any model, real complexities must be simplified, data gaps exist, and difficult decisions are made to create the best representation of state forest condition and management in the model. When all factors are accounted for, model outputs may be several steps removed from what is on the ground. Therefore, when tracking featured species habitat

over time in the model, it is best to put it into context as potential habitat. This potential can then be evaluated through the continuously updated MiFI inventory and verified with the help of field staff. The value of these habitat outputs lies in evaluating how much habitat (potential) is on the landscape for each featured species for the first time, and in monitoring trends over time.

Of the 14 featured species in the model, four have habitat management plans and geographically defined habitat management areas. Because of this, special analysis units were created in the model for Kirtland's warbler essential habitat, the elk management area, deer wintering complexes over 15,000 acres and grouse enhanced management sites. Each of these species habitat plan goals were added to the model so that model harvest outputs for each SAU ensure that these habitat goals are achieved. Because analysis units occur both within and across management areas, the goals are weighted higher than goals for the associated management area(s). This ensures SAU goals are met first, and then those are integrated into the management area goals as part of the solution. By doing this, the DNR has integrated wildlife habitat goals into planned forest harvest goals for the first time. For these four species, both habitat goals within SAUs and forest matrix habitat outside of them can be monitored in the model.

Not all landscape habitat conditions could be addressed in the model, aside from young and mature forest. Natural disturbances are not possible to predict; mast and within-stand mesic conifers, as well as big trees and mature forest understory, are at too fine of a scale; non-forested openings will remain static in the model this planning period; and large contiguous patches require geospatial capabilities the model does not have. For most of the landscape habitat conditions and the six species not included in the model, tracking will be done as needed through MiFI and other tools.

Forest diversity matrix

Featured species habitat exists in a broader landscape matrix that influences both habitat potential and featured species presence. The forest diversity matrix is an attempt to describe the forested landscape at a coarse scale in a way that will be useful to inform landscape habitat conditions and featured species habitat goals and track potential habitat availability as defined by the model.

The forest diversity matrix is defined by the following inventory data:

- Forest age grouping or category: young forest (0-19); intermediate forest (20-39); mid-aged forest (40-79); mature forest (80+)
- Shade tolerance versus shade intolerance
- Upland versus lowland
- Available versus unavailable (for management, as defined by site conditions)

Understanding the abundance and distribution of these broad forest matrix categories allows for high-level assessment of management potential and provides landscape context to cover type management decisions within management areas. It also is a starting point to identify broadscale habitat needs and potential. Because landscape habitat conditions represent more specific habitat requirements of featured species, they can be used to dial down analysis into evaluating, setting and monitoring featured species habitat goals.

The current condition of the state forest matrix is predominantly older age classes (mid-aged and mature) and is dominated by upland cover types available for harvest management (Figure 5). Lands

unavailable for management are largely older, lowland and shade-tolerant forest types. Available, shade-intolerant forest types dominate in the young and intermediate forests, which is likely driven by aspen and jack pine.

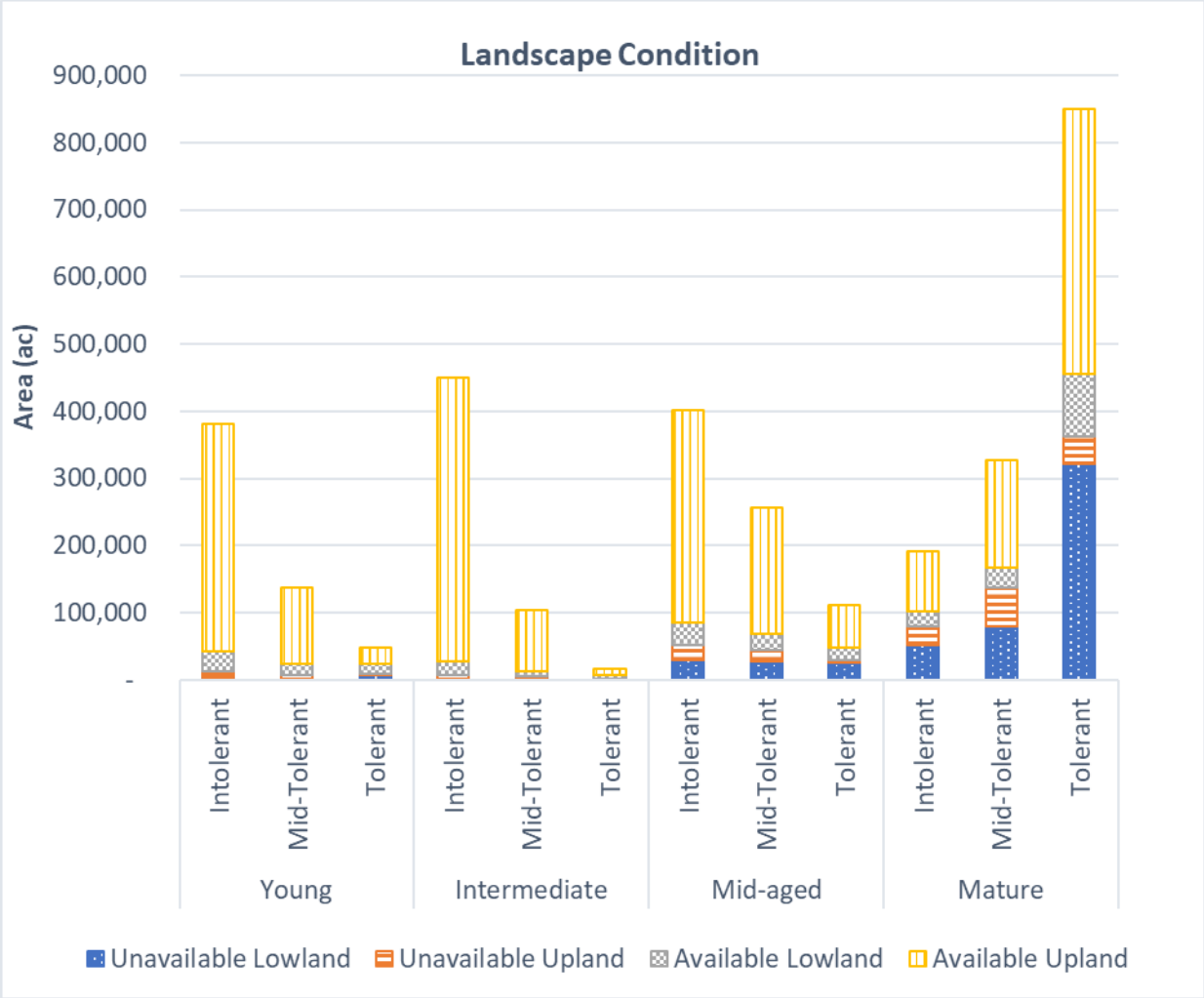


Figure 5. Forest diversity matrix showing management availability, age category, landscape position and shade tolerance by number of acres statewide.

Implementing the featured species approach

Featured species have geographic boundaries that vary in scale. Some that were chosen are specific to the northern Lower Peninsula (e.g., cerulean warbler) or Upper Peninsula (e.g., sharp-tailed grouse). Others have geographic priority areas within regions based on range-wide conservation plans (golden-winged warbler (Roth et al. 2019), American woodcock (WMI 2010). Based on differences in range, geographic prioritization, habitat potential and species occurrence, and with wildlife biologist and species specialist input, the 20 featured species were assigned to relevant management areas where habitat management will be focused. Each management area has a list of featured species to help prioritize management. There is plenty of opportunity to manage for each of these species that occupy

different habitat niches. Management area-level habitat models can provide a starting point for biologists to determine how much, where and which methods to manage for each species in conjunction with Forest Resources Division counterparts.

One of the main priorities of this state forest plan update was to integrate wildlife habitat planning and implementation as much as possible. At the statewide and regional scales, desired future conditions, objectives and management actions were developed for each featured species and landscape habitat condition. These should be used to guide featured species management and inform decisions at the management area and forest management unit levels.

The management area section of the plan includes geographically specific forest diversity matrix and landscape habitat conditions data and integrates current and future conditions for featured species habitat from the model and MiFI. Harvest goals for the 10-year planning period are described for each cover type, and featured species habitat conditions and considerations are included where applicable. It will be up to forest management unit staff to determine specific prescriptions to achieve habitat conditions at the stand level.

The special analysis unit section of the plan describes the 10-year timber harvest goals and silvicultural methods from the model outputs that achieve the desired habitat goals. Again, staff from each management unit will need to determine where and how to apply these harvest targets.

Management guidance has been stepped down through multiple geographic scales to help field staff implement goals for featured species habitat and landscape habitat conditions. Other tools will be developed to bridge remaining gaps during the planning period to support plan implementation. This includes landscape assessments of large contiguous patches of habitat for area sensitive species and habitat guidance documents for each featured species that will include prescription specifications at the stand scale.

Despite an emphasis on featured species in the model and this plan, the DNR has statutory and forest certification obligations to other species. A combination of forest certification work instructions, species-specific guidelines and best management practices provide guidance on managing for species outside of featured species. These include forest raptors, bald eagles, turtles and bats. In-stand retention guidelines and some water-quality best management practices guide on-the-ground management, mitigating forest harvest activities on wildlife. Lastly, at the stand level, rare species reviews are conducted to avoid impacts to these important plants and animals, following state and federal laws.

The intent is to benefit the broadest suite of wildlife species whose needs are not being fully met by current forest management practices. The general approach on state forest land is to ensure representative cover types, age classes and structural conditions across the landscape to maintain the broadest diversity of wildlife. The list of 20 featured species was chosen to represent those cover types, age classes and structural conditions across the state forest. Ensuring this occurs is a matter of implementing the model and this plan, and monitoring habitat over time via the model and MiFI. This will be described in more detail in the monitoring section of the plan (Section 6).

Climate change

The earth's climate, like a forest ecosystem, is dynamic. It changes constantly, but at a pace that is not always obvious. Change itself is not a problem; it is when change is unexpected that problems arise. This

might be because managers assume the climate is static or changing slowly enough to be treated like it is static. For example, managers might assume an unchanging climate and engineer culverts based on the average precipitation for the last 30 years rather than the trend of rapidly increasing heavy precipitation events. Similarly, forest plants and wildlife evolved and shifted ranges to match the climate over thousands or millions of years. The current rapid changes in climate require species to shift range, evolve in place, grow with reduced vigor or health, or be extirpated locally. Change requires adaptation.

The key challenge to forest management in the 21st century is managing for change at the right pace and the right place. The climate in Michigan is changing, and state forest managers need to anticipate those changes so that they are neither underreacting nor overreacting.

Climate is one of the fundamental drivers of forest health and species composition. Climate change amplifies threats such as forest pests and disease, and it challenges operations such as harvest over frozen ground (Angel et al. 2018). Climate change complicates most aspects of forest management. For these reasons, climate change considerations have been integrated throughout this plan. For example, climate change has been integrated into management priorities (e.g., desired future conditions, objectives and management actions) at the state forest-wide and regional scales using resources published by the Northern Institute of Applied Climate Science. Many of these were coauthored by Michigan DNR staff members (e.g., Handler et al. 2014, Janowiak et al. 2014b, Handler et al. 2022a, Handler et al. 2022b) or refined based on input from DNR staff at workshops or during review (Swanston et al. 2016). At the management area scale, field staff were surveyed to identify management areas that might be prone to certain climate change risks.

Climate change impacts in Michigan

The state forest system in Michigan is unusually vulnerable to climate change for two reasons:

- Michigan's climate, like others at high latitudes in the northern hemisphere, is changing faster than the global average. The average temperature in Michigan has risen almost 3 degrees Fahrenheit since the beginning of the 20th century; most of that warming was concentrated in the winter and spring. The frequency of extreme precipitation events (greater than 2 inches in 24 hours) has also increased; the number of extreme precipitation events for 2010-2014 and for 2015-2020 were the highest on record (Frankson et al. 2022). Both trends are projected to continue for the duration of this plan (Hayhoe et al. 2018).
- Climate vulnerability is highest along the southern edge of the geographic range of a given species (Hampe and Petit 2005), and several of Michigan's most common tree species occur at the southern edge of their geographic ranges. Of the 10 most common tree species on state forest land by area of occupancy, eight occur at or near the southern edge of their range in Michigan.

These vulnerabilities express themselves in many ways (Vose et al. 2018, Handler et al. 2022a). For example, increased temperatures have cascading effects on growing season length, snowfall and snow hardness. These in turn affect timing and persistence of frozen ground, risk of forest insect and pathogen outbreaks, impacts to vegetation from concentrated wildlife foraging, and the ability of wildlife to avoid predators, find food, or stay warm or cool. Changes in precipitation amount and seasonality affect soil moisture, humidity, streamflow and stream temperatures. These in turn affect stress, growth and often survival of organisms from fish to invertebrates to trees. Operations and

infrastructure also are impacted as less predictable frozen ground and increased flooding events affect access, erosion and maintenance costs. This is just a sampling of the ways that climate change continues to complicate forest management.

Adapting to change

Climate adaptation is what managers do in response to recent climate trends and to anticipate future changes. It can be as simple as replacing a blown-out undersized culvert with a larger one or as complicated as conducting planting trials and using climate projections to select the optimal source material for future nursery stock. Adaptation planning involves assessing how vulnerable resources are to climate change in the context of stated goals. After vulnerabilities are estimated, goals are revisited or management actions are adjusted. A great deal of scientific literature, including several good syntheses (Foden et al. 2019, Thurman et al. 2022), now exist to guide assessments of vulnerability. Planning frameworks and decision support tools now exist to structure how goals are reconsidered (Schuurman et al. 2020, Lynch et al. 2021) and how to adjust management actions (Janowiak et al. 2014a, Swanston et al. 2016, Handler et al. 2022b).

Several statewide or regional assessments of climate vulnerability exist for Michigan. These include The Forest Ecosystem Vulnerability Assessment and Synthesis reports for the northern Lower Peninsula and eastern Upper Peninsula (Handler et al. 2014) and for the western Upper Peninsula and northern Wisconsin (Janowiak et al. 2014b). They synthesize three forest modeling approaches to give a good overview of Michigan-specific forest vulnerability. The Michigan Forest Action Plan (Michigan DNR 2020) and the forest chapter of the Midwest section of the National Climate Assessment also contain good summaries of climate change and forest vulnerability. Hoving et al. (2013) conducted an analysis of 400 fish and wildlife species in Michigan, including all featured species used in state forest management planning. Species-specific vulnerability assessments exist for tree species as well, including aspen (Worrall et al. 2013), white pine (Joyce and Rehfeldt 2013) and sugar maple (Reinmann et al. 2019). The state forest management planning process leaned heavily on the assessment and synthesis reports but used information from the other literature as well.

Once goals are set, managers will need to choose strategies and actions that are likely to succeed in current and future climates. One tool used by many forest managers in the Michigan DNR is the Adaptation Workbook (Swanston et al. 2016). It provides a structured process to incorporate climate change considerations into a project or decision, and to document the thought process in logical steps. The Adaptation Workbook can be used in conjunction with several menus of adaptation options specific to contexts such as forestry, wildlife management or watershed management.

This process was applied to this plan once development of the desired future condition, objectives and actions for each of the management priorities in Section 3 was complete. That was followed by a review of predicted climate change impacts for northern Michigan based on Northern Institute of Applied Climate Science tools and these were used to create tables specific to each management priority. Based on these identified vulnerabilities, the adaptation menus were used to modify the desired future condition, objectives and/or actions of a management priority to incorporate some operational adaptations. Finally, these adaptations and the reason for them are briefly explained.

Forest carbon

Forest management can also be a part of the solution when it comes to climate change. Growing forests remove carbon dioxide from the atmosphere (climate change mitigation) through photosynthesis. Forest resources in Michigan, including managed forests, forested wetlands and urban forests, currently store large amounts of carbon. There are often win-win opportunities where climate adaptation and mitigation can work together. Typically, actions that keep forests healthy and prevent large-scale disturbances fulfill both goals (Handler et al. 2022a).

Carbon in forest ecosystems can be accounted for in pools and in fluxes. Soil carbon and live trees are two examples of carbon pools. Much of the carbon stored in forest ecosystems in Michigan occurs in soils. Some forest types have significantly less soil carbon (e.g., jack pine forests), and some have significantly more (e.g., forested wetlands). Soils lose carbon very quickly when disturbed or when soil moisture changes; it can take centuries to rebuild soil carbon stocks. Forest practices that reduce erosion and protect healthy soils are key parts of any strategy to conserve forest carbon (Handler et al. 2022a).

The other large forest carbon pool in Michigan is live tree biomass. Management that promotes forest health and greater productivity promotes carbon storage. Forest harvest and lengthening harvest rotations can increase long-term carbon storage. In forests with relatively low disturbance risk from pests, disease or climate-related mortality, lengthening rotations can increase carbon storage. In forests with greater climate risks, harvest can be a strategy to continue storing the carbon in forest products, especially if those forest products are durable goods such as building materials or furniture.

Individual birds and animals store relatively little carbon in their bodies compared to trees, but their presence can significantly alter carbon cycles in ways that increase or decrease carbon sequestration rates (Schmitz et al. 2023). For example, reduction of herbivores through predation can affect forest regeneration and thus increase carbon storage. Similarly, squirrels and birds transport seeds, increasing the density of trees in forest landscapes.

Much of the state forest system in Michigan sequesters significant amounts of carbon as it is currently managed. The Michigan DNR was the first state forest in the country to sell forest carbon credits in a carbon market. The DNR uses revenue from those carbon credits to invest in climate-friendly forest management projects. This creates a virtuous feedback loop that results in more and healthier natural resources while contributing to global efforts to combat climate change.

Climate change is a challenge. In some ways, it makes reaching our goals of forest sustainability harder. Managers will need to be intentional about adapting to a changing climate while capitalizing on opportunities to sequester carbon from the atmosphere and store it in forest soils, live biomass and durable forest products. Despite the difficulties and complications, Michigan is a leader in both climate adaptation and carbon storage. As an agency, the DNR is determined to meet the climate challenge while managing Michigan's state forest system with science, stakeholder engagement and creativity.

Forest sustainability planning framework

A framework was needed to incorporate the planning components into a comprehensive and cohesive structure for all aspects of state forest management. The DNR manages approximately 4.6 million surface acres of land and more than 6 million acres of subsurface mineral rights in trust for Michigan

residents. To ensure sustainable management of these rich and varied natural resources, as stipulated in part 525 of the Natural Resources and Environmental Protection Act (Public Act 451, as amended), a system was needed to balance the ecological, social and economic capacity of the forest.

Because deciding how to define and operate sustainable forest management has been a challenge, an international group of scientists initiated what is now known as the Montreal Process in 1994 (Montreal-Process.org). This established a set of criteria and indicators representing a large range of forest values. It provides a globally common approach and language to facilitate discussion, partnership and assessment.

The seven criteria of the Montreal Process represent the essential components of sustainable forest management. These are:

- Conservation of biological diversity
- Maintenance of productive capacity of forest ecosystems
- Maintenance of forest ecosystem health and vitality
- Conservation and maintenance of soil and water resources
- Maintenance of forest contribution to carbon global cycles
- Maintenance and enhancement of long-term multiple socio-economic benefits
- Legal, institutional and economic framework for forest conservation and sustainable management

Associated with each of these criteria is a set of indicators (54 in all) to assess progress toward meeting them. Monitoring these criteria over time provides information that allows an organization (or country) to assess its progress toward sustainable forest management.

Until now, the DNR has defined sustainable forest management through area regulation and conformance with Sustainable Forestry Initiative and Forest Stewardship Council standards. This plan outlines a monitoring framework similar to the Montreal Process. Through it, monitoring over time will assess progress toward sustainable forest management. This framework includes area regulation and certification standards.

State forest guiding principles

The Montreal Process criteria were used as a basis to develop seven sustainable state forest management principles:

- Principle 1. The state forest is managed to conserve or enhance biological diversity.
- Principle 2. The state forest is managed for net positive growth.
- Principle 3. The state forest is managed to promote ecosystem health and vitality.
- Principle 4. The state forest is managed to conserve and protect soil and aquatic resources.
- Principle 5. The state forest is managed to provide opportunities for social and economic benefits.
- Principle 6. The state forest is managed to respond to a changing climate.
- Principle 7. The state forest is managed to steward significant cultural resources.

Establishing the framework

Once the seven state forest principles were developed, the Montreal Process indicators were used to develop a set of goals and strategies associated with each principle that, taken together, achieve the guiding principles. Management priorities were then identified for each strategy. Realistic, achievable metrics that measure progress toward sustainable state forest management were identified for each management priority.

This plan encompasses three geographic scales (state forest, region, management area/special analysis unit), and four planning scales (principle, goal, strategy, management priority). To move the needle on any given management priority at the statewide or regional level, a desired future condition needed to be established. Then, a set of objectives for each was established to set interim, short-term goals toward the desired future condition. Finally, management actions were identified to meet those objectives. These planning components are all part of the state forest sustainability framework, and are defined as:

> **Principle**: The fundamental standard, serving as the basis for action, by which the state forest is administered.
>
> **Goal**: Aspirational, broad outcome statement of a state or aspect of the state forest system that adheres to a principle. The combined goals should encompass all aspects of all the principles.
>
> **Strategy**: Approach taken to achieve a goal.
>
> **Management priority**: The state forest resource or attribute that is being managed.
>
> **Desired future condition**: A narrative statement that describes the condition of a state forest resource that land managers set to achieve over a long period of time in a distinct geographic area.
>
> **Objective**: SMART (specific, measurable, achievable, relevant, timebound), mid-range targets toward achieving the desired future conditions.
>
> **Management action**: The specific tasks or steps required to achieve the objective.

The state forest sustainability framework differs from the Montreal Process to better adapt the framework to state forest management and scope of operations. The state forest is part of a vast landscape of different ownerships, land covers and land uses. Sustainable management of the state forest is not the same thing as sustainable management of Michigan's forests as a whole. The DNR recognizes that things such as soil and water quality can be influenced by external factors. The DNR also recognizes some inherent limitations in operations, capacity and administrative resources to enact all the criteria and indicators of the Montreal Process. The DNR is also subject to various statutes, mandates, policies and procedures.

Ultimately, this is a state forest management plan, and while multiple-use values are incorporated, it is not within the scope of this plan to influence changes outside of forestry activities. The sustainable forest management framework outlined in this plan reflects a good-faith effort to apply the tenets of the Montreal Process criteria and indicator framework to feasible activity on the state forest. By monitoring the state forest sustainability framework and associated metrics detailed in this plan, the DNR intends to assess progress toward sustainable state forest management over time.

Planning framework

Principle 1. The state forest is managed to conserve or enhance biological diversity.

Goal 1. Conserve or enhance ecosystem diversity.

- Strategy 1. Maintain a consistent land base that ensures continuity in management of forest ecosystems over time.
    - Management priority:
        - State forest area
- Strategy 2. Conserve or enhance forest composition, structure and terrestrial habitats through management.
    - Management priorities:
        - State forest cover types
        - Featured species habitat
        - Landscape habitat conditions:
            - Big trees
            - Mast
            - Mature forest understory
            - Mesic conifers
            - Natural disturbance
            - Nonforested openings
        - Forest and habitat age categories:
            - Young forest
            - Mid-successional forest
            - Mature forest
        - Horizontal and vertical structure
        - Patch size, arrangement and connectivity
        - Stand size
- Strategy 3. Contribute to the conservation of aquatic habitat through management of forested habitats.
    - Management priorities:
        - Riparian and lacustrine habitat.
        - Wetland habitat.
        - Vernal pools and seeps.
- Strategy 4. Conserve a range of biodiversity values on the state forest through special area designations.
    - Management priority:
        - Conservation Area Network.

Goal 2. Conserve or enhance species diversity.

- Strategy 1. Manage species of conservation concern to ensure their continued presence on the landscape.
    - Management priority:
        - Rare species
- Strategy 2. Maintain or enhance native forest species diversity.

    - Management priority:
        - Tree species

Goal 3. Conserve or enhance genetic diversity.

- Strategy 1. Manage tree species within the bounds of seed zones and manage habitat to promote viable unique populations.
    - Management priorities:
        - Seed zones
        - Unique populations

Principle 2. The state forest is managed for net positive growth.

Goal 1. Ensure long-term forest productivity to conserve forest resources.

- Strategy 1. Manage the state forest using silvicultural practices that ensure desired management outcomes.
    - Management priority:
        - Forest regeneration

Goal 2. Manage the state forest to maintain or enhance tree productivity.

- Strategy 1. Ensure forest growth rates exceed the rate of forest product removals.
    - Management priority:
        - Tree growth, mortality and removals

Principle 3. The state forest is managed to promote ecosystem health and vitality.

Goal 1. Protect forests from wildfire, pests, diseases and other damaging agents.

- Strategy 1. Manage disturbances to allow for natural ecosystem function while mitigating negative impacts.
    - Management priorities:
        - Non-native insects and diseases
        - Native insects and diseases
        - Invasive plants and animals
        - Herbivory
        - Wildfire

Principle 4: The state forest is managed to conserve and protect soil and aquatic resources.

Goal 1. Conserve and protect palustrine, lacustrine, riverine, riparian and aquatic resources.

- Strategy 1. Protect water quality in streams, lakes and other water bodies.
    - Management priorities:
        - Streamside damage
        - Riparian trails
        - Riparian roads
        - Stream crossings
        - Riparian area cover-type composition.
- Strategy 2. Protect water quantity in streams, lakes and other bodies of water.

    - Management priority:
        - Watershed vegetation cover

Goal 2. Conserve and protect soil resources.

- Strategy 1. Manage sites to ensure soil quality.
    - Management priorities:
        - Successive rotations
- Strategy 2. Manage sites to prevent soil erosion and compaction.
    - Management priorities:
        - Forestry and recreation impacts
        - Damaged sites

Principle 5. The state forest is managed to provide opportunities for social and economic benefits.

Goal 1. Provide public access for social opportunities on the state forest.

- Strategy 1. Maintain infrastructure to ensure public access.
    - Management priorities:
        - State forest roads
        - Boating access sites
        - Nonmotorized areas
- Strategy 2. Provide for and manage recreation activities to benefit residents and visitors and to promote tourism.
    - Management priorities:
        - Motorized recreation trails
        - Nonmotorized recreation trails
        - Dispersed recreation
        - Areas managed for hunting
        - State forest campgrounds
- Strategy 3. Protect state forest lands from overuse and misuse.
    - Management priorities:
        - Boundary maintenance.
        - Use permits

Goal 2. Ensure external engagement in state forest management.

- Strategy 1. Engage with tribal governments to ensure recognition of tribal rights and uses and to inform forest management through Indigenous knowledge.
    - Management priority:
        - Tribal consultation
- Strategy 2. Provide opportunities for public and stakeholder engagement in state forest management.
    - Management priorities:
        - Public review and input

        - Public observations and input
        - Outreach, engagement and education
- Strategy 3. Engage with partners to address forest management issues.
    - Management priority:
        - Collaborative partnerships

Goal 3. Provide a variety of economic opportunities.

- Strategy 1. Manage for a variety of forest products.
    - Management priorities:
        - Timber harvest volume
        - Fuelwood
        - Carbon offset credits
- Strategy 2. Provide opportunities for energy development consistent with forest conservation.
    - Management priorities:
        - Oil and natural gas.
        - Renewable energy.
- Strategy 3. Provide opportunities for mining consistent with forest conservation.
    - Management priorities:
        - Metallic minerals
        - Nonmetallic minerals
        - Sand and gravel

Principle 6. The state forest is managed to respond to a changing climate.

Goal 1. Manage the state forest through integration of adaptation and mitigation strategies.

- Strategy 1. Identify adaptation approaches and integrate these into relevant management priorities.
    - Management priority:
        - All applicable management priorities
- Strategy 2. Identify portions of the state forest that can act as a carbon sink.
    - Management priorities:
        - Carbon capture utilization and sequestration

Principle 7: The state forest is managed to steward significant cultural resources.

Goal 1. Protect the range of cultural and spiritual needs and values found on the state forest.

- Strategy 1. Acknowledge and respect tribal rights and customary uses.
    - Management priority:
        - Culturally significant natural and cultural resources
- Strategy 2. Steward cultural heritage sites worthy of preservation.
    - Management priority:
        - Heritage sites

Plan organization

The sustainable forest planning framework established a planning hierarchy that ensured the guiding state forest principles developed were stepped down through goals and strategies into operational management priorities. However, it is not the most intuitive way to organize a plan, especially one that needs to address multiple geographic scales. For example, discussion of wetlands occurs both in terms of habitat (Principle 1) and water quality and quantity (Principle 4). Likewise, different aspects of forest cover type management are addressed through principles 1, 2 and 5. All of those need to be addressed at the state forestwide, regional and management area scales. Organizing a plan by the seven state forest principles would likely result in some redundancy, cause confusion in finding information of interest, lack relevant context and result in unnecessary complexity in the plan document.

To make it as user-friendly as possible, the State Forest Management Plan is organized by topic. For example, all wetland-related management priorities are grouped under Aquatic Resources. All cover type-related management priorities are grouped under Forest and Wildlife Habitat Management. The table of contents differs substantially from the sustainable forest planning framework, but those links are maintained within each management priority write-up. The plan is organized as follows:

- **Section 1 – Introduction.** Covers the purpose of, need for and scope of the plan. Provides context by describing state forest administration and associated legal mandates. Describes the approach used to develop the plan and how it is organized.
- **Section 2 – State Forest History.** Context for both the establishment of current forest communities and Michigan's ownership of the state forest are provided through a description of events from the last major glacial episode through the 20th century.
- **Section 3 – State Forestwide and Regional Planning.** Management priorities are grouped by relevant theme and describe the current condition, future direction and strategic guidance required to achieve it at the regional and state forestwide scales. These priorities require careful consideration. They guide how the state forest is managed with other DNR divisions, stakeholders and Michigan residents.
- **Section 4 – Management Areas.** Plans for each management area including descriptions of geographically specific current conditions and desired future conditions for featured species, landscape habitat conditions, the forest diversity matrix and cover types. Summations of current and projected acres for major cover types are provided from the model, and 10-year timber harvest goals are established. Additional management priorities relevant to cover type management are included, which will help inform co-management decisions.
- **Section 5 – Special Analysis Units.** Establishes unique 10-year management goals, model outputs and management activities specific to a defined geographic area. These special analysis units have a corresponding planning/guidance document supporting the information presented in the State Forest Management Plan.
- **Sections 6 – Implementation**. Describes quantitative, landscape-level operational direction that informs decision-making during the compartment review at the forest management unit level. Annual cover type and featured species habitat goals are stepped down from the 10-year model goals. Guidelines are established for when to revisit the model scenario within the planning period based on unforeseen events or new or updated information.

- **Section 7 – Monitoring.** Explains how the metrics identified at the state forestwide and regional scales will be monitored over the planning period; can be used as an assessment of state forest sustainability. Cover type and featured species habitat goals from the management area and special analysis units will be assessed in relation to 10-year model goals.

State forest history

Glaciation to 1500s

The present physical geography of Michigan is a direct result of the Wisconsin glaciation of the Pleistocene Epoch, the last major glacial episode that totally covered the state with ice. As the ice sheet gradually receded, the southern Lower Peninsula became mostly ice-free approximately 13,000 years ago. The Upper Peninsula became ice-free approximately 10,000 years ago. The landform and soils of Michigan are the result of post-glacial lakes, rivers, erosion and soil development processes acting upon the glacial deposits, resulting in diverse terrain. These features include moraines, drumlins, eskers, kames, outwash plains and former lake beds that are interspersed with numerous lakes, streams and depressions, including four of the world's largest freshwater lakes in the Great Lakes.

It was upon this raw, post-glacial landscape that life gradually returned. The primary succession of plant life was heavily influenced by the nature of the glacial rock and sediment deposits, the climate (still very much influenced by the receding ice sheets) and the formation and disappearance of lakes formed at the edge of retreating glaciers. Theories of the succession of plant life from barren soil to tundra, and the migration of forest tree species and some animal species, are well established (Davis 1981; Pielou 1991). This post-glacial succession and development was driven by initial warming trends until approximately 5,000 years ago, when a gradual cooling cycle, which lasted 2,000 years, began (Andreson et al. 2012). These climatic fluctuations were followed by changes in vegetation, from boreal to xeric to mesic, which remains as the primary contemporary vegetation condition.

Ancestors of the Anishinaabek and other tribes settled on and utilized this post-glacial landscape, entering Michigan as early as 13,000 years ago (Talbot, Wright and Nash 2021). The resultant diversity in forest, savanna and aquatic plant and animal communities was also distinctly influenced by these first residents, most notably through hunting and fishing activities and the use of fire to promote safety, food and medicine. The combination of Anishinaabek oral history, written history and tree ring fire scar analysis strongly suggests that at least some Great Lakes ecosystems were reliant on these fire stewardship practices (Larson et al. 2025). A comprehensive description of the complexity of the post-glacial climatic and human interaction with plant and animal communities can be found in Pielou 1991.

Michigan's terrestrial landscape is comprised of four distinct ecoregions: Southern Lower Peninsula, Northern Lower Peninsula, Eastern Upper Peninsula and Western Upper Peninsula. Each ecoregion is distinct in its climate, physical features, soils and vegetation. These distinctions are a result of the peninsular configuration of the state, which creates dramatic climatic differences on both peninsulas. The distinctiveness of the warm, vegetatively diverse Southern Lower Peninsula and the cold Upper Peninsula is largely due to their latitudinal positions and the continental land masses on their southern borders. The four Great Lakes that surround the state also provide a significant influence upon the climate in portions of both peninsulas (Albert 1995).

What is known of the circa-1800 Michigan vegetation communities is based on an interpretation of the federal government's General Land Office surveys from 1816 to 1856, with surveys of the Lower Peninsula beginning in 1816 and surveys of the Upper Peninsula beginning in 1840. The interpretation of cover types on these maps is drawn from section line and corner witness trees, similar landform, surface geology and soils data. Inclusions of dissimilar cover types that do not intersect a section line may not be

reflected upon the maps. Despite these limitations, the GLO survey maps provide a consistent landscape-level perspective of cover types around 1800. The maps are useful for assessing the type and scale of Anishinaabek fire stewardship and natural disturbance regimes (fire, flooding, wind, insects and disease) and for identifying the locations of historic and presently rare natural communities and, by comparison, broad European settlement trends for different cover types. The Anishinaabek are people with shared Algonquin heritage and are linked through common culture and language. By this time in Michigan, the Anishinaabek were represented by the Council of Three Fires, a confederacy that united Ojibwe (Chippewa), Odawa (Ottawa) and Bodewadmi (Potawatomi) tribes.

The forest and other vegetation communities that existed circa 1800 consisted of a mosaic ranging from Anishinaabek-influenced savanna grasslands and southern hardwood forests in the southern Lower Peninsula to northern hardwood and pine forests in the northern Lower and Upper peninsulas. The landscape at this time was dynamic, with community types in various stages of ecological succession, driven by long-term shifts in climatic conditions and short-term natural and human-influenced disturbance cycles. Four community types dominated the northern Lower and Upper Peninsula landscapes at the time of the GLO surveys: the beech/sugar maple/hemlock northern hardwoods community, the beech/sugar maple southern hardwoods community, hemlock-dominated communities and the mixed conifer swamp community. Eight other communities occurred on the landscape: mixed oak savanna, oak/pine barrens, beech/sugar maple/northern hardwoods without hemlock, mixed oak/hickory forest, mixed hardwood swamps, red/white pine forests, white pine/mixed hardwoods and cedar swamps. Lesser communities were spruce/fir/cedar forests, seral aspen/birch forests and black ash swamps.

Pine communities covered 4.1 million acres, or 11.8% of the forested landscape. These included white pine-, red pine- or jack pine-dominated forests, mixed red/jack pine forests, mixed pine/oak forests and the previously cited red/white pine forests and white pine/mixed hardwood forests. The pine forest communities were fire-driven ecosystems, dependent upon occasional catastrophic, stand-replacing fires for regeneration and frequent, low-intensity fires that eliminated competition and – in combination with wind, insects and disease – created a patchy structure. Conservative estimates of recurrence intervals for fires in jack pine forests in the northern Lower Peninsula and Upper Peninsula ranged from 59 to 140 years. For red and white pine stands, estimates of recurrence intervals in the region ranged from 130 to 240 years, although they were likely more frequent in areas of Anishinaabek influence (Whitney 1986; Price 1994; Cleland et al. 2004, Kipfmueller et al. 2021).

White pine communities were maintained by a repeating, cyclical sequence of catastrophic fires, with light surface fires occurring at shorter intervals (Frelich 1992). White pine occurred most abundantly in areas where catastrophic fire took place every 150 to 300 years. More frequent fires, toward the 100- to 150-year interval, tended to favor red pine. Intervals greater than 300 years tended to succeed to northern hardwoods. As a mid-successional species, white pine occurred most frequently with red pine and most often followed jack pine (Frelich 1992). Noncatastrophic surface fires occurred at intervals of 20 to 40 years (Frissel 1973 as cited in Frelich 1992) and tended to kill hardwoods invading the understory. Gaps created by winds and surface fires created diversity in diameter distributions and formed increasingly multi-aged stands. White pine stands may have been maintained in the old-multi-aged stage for one to several centuries (Heinselman 1981), until another catastrophic disturbance came along.

The complexity of the landscape, composition and structure of circa-1800 forests is due to the underlying glacial landforms in the northern Lower Peninsula. Strong associations are evident between beech, sugar maple and hemlock on medium- and coarse-textured end moraines and coarse-textured ground moraines. On fine-textured ground moraines and lacustrine deposits, hemlock, white pine and beech were dominant. Fine-textured end moraines were dominated by hemlock and red and white pine. Outwash plains were dominated by communities of jack, white and red pine. The diversity of circa-1800 forests is also reflected through analysis of a northern hardwoods community in Chippewa County. Some elements of community structure are apparent by the density of 141 trees per acre (with sugar maple, hemlock, yellow birch and beech dominating in number) and the basal area of 154 square feet per acre (with hemlock, sugar maple, yellow birch and white pine dominating the canopy of the forest).

The complex community composition in the circa-1800 northern hemlock/hardwood forest community was driven by a combination of long-term, climate-driven trends and adaptations to disturbance exhibited by different tree species. A contemporary study of the Sylvania Wilderness Area in the western Upper Peninsula is informative for understanding the historical development of this forest community (Davis et al. 1994). The study included an analysis of a paleoecological record of pollen, which showed the dominance of a very fire-prone red and jack pine community approximately 7,000 years ago, correlating to the peak warm period of the current interglacial period. During the subsequent cooling trend, a somewhat less fire-prone community of white pine, oak and red maple succeeded upon the site and dominated from 7,000 to 3,000 years ago, with an average fire recurrence interval of 150 to 340 years (Frelich 1992).

Rapid increases in the abundance of hemlock and yellow birch became evident in the pollen record starting 3,200 years ago, as the frequency of fires decreased, with intervals extending to 1,400 to 2,200 years (Whitney 1986; Price 1994). Sugar maple and basswood entered the forest soon after the invasion of hemlock and yellow birch, and windthrow gradually became the predominant form of disturbance, with recurrence intervals of approximately 1,200 to 2,200 years (Whitney 1986; Frelich and Lorimer 1991; Price 1994). Where the intervals between fires were long, the white pine/oak/red maple forest was succeeded by hemlock and yellow birch at some locations and by sugar maple, yellow birch and basswood at other locations (dependent upon different soil-related conditions). This gave rise to the mosaic of hemlock, sugar maple, yellow birch and white pine northern hardwood forests that dominated the circa-1800 period.

Before European settlement, grasslands such as wet meadows, oak and pine barrens, dry sand prairies and tall grass prairies were scattered throughout Michigan, with the largest acreage in the southern Lower Peninsula. At least 39 grassland areas were present, totaling about 2.3 million acres. Fire was an important element in establishing and maintaining these grasslands. Caused by lightning and often set purposely by Anishinaabek communities, fire stimulated grass, edible plant and wildflower growth, reduced competition and discouraged encroachment of shrubs and trees.

1600s to 1900

European settlement began soon after the Great Lakes region expeditions in the 1600s by French explorers Etienne Brule and Robert René Cavelier de La Salle, beginning with Jesuit missions at Sault Ste. Marie in 1668 and at St. Ignace in 1671. Ease of access for fur trading determined the location of other early French settlements in St. Joseph in 1679, in Detroit in 1701 and at Fort Michilimackinac in 1715.

Michigan became a territory in 1805 and the 26th state in 1837. Following the GLO surveys in the southern Lower Peninsula, land was cleared for Euro-American-style agriculture at a relatively slow, laborious pace. However, northern Michigan land surveys led to the American discovery of extensive pine forests and fueled a rush by timber speculators beginning in the 1850s.

Mid-1830s government figures estimated the volume of standing pine timber in Michigan to be 150 billion board-feet (approximately 300 million cords). The lumber boom started in the 1850s in the Saginaw River watershed and quickly spread west and north. By 1897, more than 160 billion board-feet of pine had been cut, with only about 6 billion board-feet of standing timber remaining, mostly in the Upper Peninsula. In a mere 70 years, most of the original pine and hardwood forests of Michigan were gone.

The first major U.S. mining boom began in Michigan's western Upper Peninsula in the 1840s, and mining has played a significant role in shaping the region's culture, economy and natural landscape ever since. To date, mining efforts in the region have focused primarily on iron ore and copper, though silver and gold also have been mined. The region still has an abundant mineral wealth. Michigan's copper range, the greatest deposit of native copper in the world, extends in a narrow band from just south of Ontonagon to the tip of the Keweenaw Peninsula. The Keweenaw copper range was the nation's largest producer of copper from 1847 to the 1880s and a significant contributor to the regional and state economies. From the 1840s to the 1960s, more than 11 billion pounds of copper (worth $440 billion in today's dollars) were shipped from the Keweenaw Peninsula, bringing about significant increases in the area's settlement and development during the 1800s. The discovery of surface copper deposits in the western U.S. led to the decline of mining and population in the Keweenaw Peninsula.

The first European discovery of Great Lakes iron ore occurred in 1844, when a surveying party's compass readings began to fluctuate wildly at the site that would become Negaunee. Iron ore deposits and mining in Michigan have essentially been restricted to three major ranges, the Menominee, Gogebic and Marquette ranges. The Menominee and Gogebic ranges have essentially closed to mining.

Mining activities have also left significant marks on the western Upper Peninsula landscape. Copper and iron ore are typically separated from extracted rock locally. Keweenaw copper deposits are incredibly pure and were separated by crushing the ore in large stamp mills. A byproduct of the process was crushed basaltic lava, or black "stamp sands" that were discarded, often covering natural Great Lakes shorelines and local streams. Iron ore stamping has produced vast amounts of waste rock deposited in tailings that often disrupt local ecological systems, including wetlands and streams.

Mines required large amounts of timber to provide shaft supports, construct commercial and residential mine buildings, and provide heat. Local iron ore smelting, occurring either at furnaces near mines or along the Great Lake shoreline, had a huge impact on the forest resource. Smelting was an energy-intensive process, with some western Upper Peninsula furnaces estimated to have burned about 30 acres of hardwood timber a day. Copper was not smelted, so in the Keweenaw, vast tracts of hardwood were not liquidated to provide charcoal during the mining boom.

Much of the Marquette iron was smelted in Fayette, Newberry or St. Ignace, as it was easier to bring the iron to the smelter than it was to bring bulky charcoal to the mines. The intensive cutting of eastern Upper Peninsula hardwoods had begun to feed these smelters. Land clearing continued, as some soils were conducive to farming. White cedar swamps were being harvested to support building houses.

In the late 1890s, hemlock was in great demand in the eastern Upper Peninsula to extract tannin from its bark for curing leather. The bark was brought to tannery sites in Munising, Manistique and Sault Ste. Marie. As they were cut over, most of the hemlock forests converted to other forest types. Human disturbance has affected hemlock more than any other species within the eastern Upper Peninsula (Verme, 1996).

The effects of fur trading, mining and logging severely altered the Anishinaabek (Ojibwe, Odawa and Potawatomi) relationship with Michigan's land, plants and animals. For thousands of years, Michigan's forests provided the Anishinaabek with the resources to meet their needs and, in turn, they treated the land with respect and as a relative. Euro-American practices, treaties and racism catastrophically affected that interdependent relationship.

Following logging of the forests, people tried to farm cut-over lands. Vast amounts of residual slash had to be cleared from the landscape, and a common practice was to burn it. This, combined with the release of cinders from steam locomotives, sparked a period of devastating wildfires, including the firestorm of October 1871, which burned about 2.5 million acres. Fires occurred continuously over the following six decades. Notable fires took place in September 1881 (over 1 million acres), October 1908 (2.4 million acres) and July 1911 (156,480 acres). These fires killed people and consumed slash, homes and millions of trees, with an estimated 73 billion board-feet of timber. It is estimated that for every two trees that were cut for lumber, one additional tree was destroyed – mostly due to the wildfires (Dickman and Leefers 2003).

European settlement also degraded inland lakes and streams and Great Lakes water resources. Land clearing for agriculture, logging and settlement altered local streamflow patterns and volumes, eliminated some waters and introduced pollutants into others. Huge quantities of sediment from log drives and sawdust from sawmills were dumped into rivers and lakes. The mouth of the Manistee River accumulated enough sawdust to form a delta of several square miles. At sawmill locations throughout the state, sawdust dispensed into rivers created toxic and oxygen-deprived conditions for fish. These detriments, and land-clearing efforts that exacerbated soil erosion, significantly reduced the quality of fish habitat in rivers and estuaries. Drainage of wetlands and shallow water tables for agriculture did likewise. Dam and road construction fragmented formerly interconnected waters and helped eliminate or reduce many highly migratory fish populations. Dam construction also caused severe water quality changes and eliminated rare, high-gradient river sections characterized by a steep slope and fast-moving water. Overfishing of the most productive and larger bodies of water eliminated or reduced fish populations.

Intensive commercial fisheries existed both in the Great Lakes and the large rivers, and the numbers of commercial fishers increased through the mid-1800s (Garling et al. 1995). Interest in recreational fishing increased as people had more leisure time and better fishing equipment was developed. In 1859, 14 counties in the Lower Peninsula prohibited commercial fishing with nets to accommodate recreational fishing. By the late 1800s, recreational fishing was well established in inland waters, while commercial fishing still dominated in the Great Lakes. While habitat was compromised, enormous exploitation was also occurring.

The creation of the Michigan Fish Commission (the predecessor of the Department of Natural Resources Fisheries Division) in 1873 is directly linked to the demand for more fish in Great Lakes waters and more "desirable food fish" in inland waters. Michigan implemented fish stocking as a management tool and

continues the practice today. From 1873 to 1897, the Michigan Fish Commission stocked millions of lake whitefish and lesser numbers of many other species into Great Lakes waters to address the rapid declines in commercially important fish. Many of these Great Lakes species and numerous non-native fish species were also stocked in many inland waters. During this time, common carp and other popular species such as brown trout, rainbow trout and steelhead were introduced into inland waters.

Human activity during the European settlement period also had profound effects on land-dwelling wildlife. Since wildlife is inextricably connected to the habitat that supports it, large-scale changes in vegetative cover such as timber harvest, fire, agricultural land conversion and subsequent reversions back to forest cover have influenced many trends in wildlife populations. Some species benefited from these changes, while others declined. Species that benefited from the change to open plains and early successional aspen forests are white-tailed deer, sharp-tailed grouse, ruffed grouse and American woodcock. Each experienced population booms in the early through mid-20th century due to additional habitat that resulted from clearcutting forests. White-tailed deer populations were greatly influenced by harvest pressures. By 1876, market hunters were killing 70,000 deer each year to supply lumber camps and shipped what they could not sell locally to cities such as Chicago and Detroit. At about the same time, fires burned over large areas of early successional habitat, causing a loss of forage. These two factors then caused a rapid decline in deer numbers.

The decline of other species can also be directly attributed to overexploitation by hunting. Michigan gained prominence as a source of wild meat for large Eastern and Midwestern markets. Market hunters removed large numbers of waterfowl, shorebirds and small game for meat, while other birds were taken for their plumage for stuffing or to adorn hats. Wildlife species extirpated during and following this period include bison, elk, woodland caribou, cougar, wild turkey, passenger pigeon, trumpeter swan, fisher and American marten. Other wildlife and invertebrate species nearly extirpated or greatly reduced in the state from hunting and habitat loss include beaver, gray wolf, moose, black bear, resident Canada goose, lake sturgeon, piping plover, Kirtland’s warbler, prairie warbler, Karner blue butterfly, frosted elfin, Persius dusky wing, dusted skipper, Ottoe skipper, Dukes' skipper and Mitchell’s satyr.

With the industrial age and the rise of modern agricultural methods, the reliance on wildlife as meat and revenue sources declined. In many cases, these population declines were so severe that wildlife could no longer support commercial activities. Public attitudes began to change, and recovery began by increasing enforcement of laws and regulations protecting wildlife. Michigan enacted a series of laws protecting various species. Michigan’s first salaried game warden (one of the first in the country) was appointed in 1887, and Michigan’s first deer hunting license was created in 1895. In 1897, a bill was introduced in the Michigan Legislature in a futile attempt to establish a 10-year, closed season on passenger pigeons. Toward the end of the 19th century, the importance of wildlife as a commercial resource began to decline, and the importance of wildlife as an economic commodity began to evolve. The value of an animal was no longer simply measured by the price it would attract in a market. The value became recreational, measured by the amount of money spent on licenses, equipment and other amenities necessary for its pursuit. Sport hunting thus largely replaced commercial activity.

Contemporary history (1900 to the present)

Many European settlers found the climate and the sandy, burned-over soils of the northern Lower Peninsula and the Upper Peninsula to be marginally productive for farming and simply abandoned many areas. The State of Michigan thereby inherited a large portion of the cut-over pine lands of the area due

to nonpayment of taxes during the early 20th century. By 1907, almost half of homesteaded land had reverted to the state. Many properties reverted several times after being repeatedly sold by the state, and the question of what to do with these lands was a serious public policy issue.

One answer came through the rise of a new industry in Michigan in the early 1900s: recreation and tourism. This provided a new use for the miles of Great Lakes shoreline, inland lakes and streams, and other remaining natural resources. This trend was closely related to the growth of the automobile, the state highway system and a middle class whose increasing wealth and free time resulted in greater demand for recreational opportunities. During this period, it was recognized that the regrowth of forests and the recovery of natural ecosystems was the foundation for the recreation and tourism industry's well-being.

The Forest Commission Act of 1899 established an authority to oversee forests and authorized using abandoned, cut-over lands for forest reserves. The Forest Reserve Act of 1903 authorized the Forestry Commission to establish a state forest reserve on about 34,000 acres in western Crawford and Roscommon counties, which was the beginning of the state forest system. The Forestry Commission was abolished in 1909 with the creation of the Public Domain Commission, which was charged with receiving tax-reverted lands and overseeing the increasing public domain.

The federal Forest Reserve Act of 1891 gave the U.S. president the authority to establish national forests. The Huron and Hiawatha national forests were subsequently established in 1909, the Ottawa National Forest in 1931 and the Manistee National Forest in 1938.

To stabilize the forest landscape, early managers recognized that protection from wildfire was required. The post-logging slash fires burned millions of acres across the state, with many lives and much property lost and many acres of forest consumed. The state Legislature enacted the Forest Fire Act of 1903, which first authorized the designation of a chief fire warden, who was placed in charge of a fire warden force to prevent and control forest fires. Fire towers were constructed between 1912 and 1942 to provide a network for early detection. When the State Department of Conservation (precursor to the present DNR) was created in 1921, fire control upon the state forest reserves was a primary responsibility. The Forest Fire Law of 1923 authorized fire control outside of state lands.

Since 1935, the general stability of forested land in Michigan can be attributed to forest fire control and forest management, including regeneration. Between 1933 and the start of World War II, the Civilian Conservation Corps fought forest fires and planted approximately 485 million trees in Michigan, including extensive pine restoration plantings on 134,000 acres (Dickman and Leefers 2003).

Work to restore game species also continued as the CCC restored trees. In 1937, Congress passed the Federal Aid in Wildlife Restoration Act (Pittman-Robertson) to support states in wildlife restoration. This program, along with state hunting and fishing license revenues, continues to support wildlife restoration in Michigan, including adding about 640,000 acres to the state forest system.

As the landscape changed, so did the wildlife living on it. In the early 1900s, the regrowth of burned-over lands and hunting restrictions allowed white-tailed deer numbers to rebound to approximately 1.5 million by 1949. However, as the regenerating forests matured and openings closed in, forage and, subsequently, deer numbers declined starting in the 1950s. An increase in the timber market in the 1970s, along with a deer range improvement program, reversed the downward trend and led to the

highest deer numbers (approaching 2 million) in the history of Michigan in 1989. Disease concerns became a major issue, with the discovery that bovine tuberculosis was widespread in the wild white-tailed deer population of the northern Lower Peninsula in 1994.

Dedicated restoration programs facilitated the return of other wildlife species, reflecting a cultural change toward conservation. Around 1907, moose migrated (probably on winter ice from Ontario) to Isle Royale. In 1934-1937, the (then) Michigan Department of Conservation undertook a project to replenish the mainland Upper Peninsula moose herd with animals from Isle Royale. Seventy-one moose were relocated. The project was unsuccessful. In 1985 and 1987, an additional 59 moose were successfully relocated from Ontario to Marquette and Baraga counties. In 1918, seven elk from western states were released near Wolverine. 1918 also saw the enactment of the Migratory Bird Treaty Act, which stopped hunting for species such as the piping plover (primarily for its feathers). Wild turkeys were reintroduced into Michigan beginning in the 1950s. Restoration of marten populations began around 1958, with the relocation of animals from Ontario into the Porcupine Mountains in the western Upper Peninsula. Additional releases were conducted in the Upper Peninsula in the 1970s and in the northern Lower Peninsula in 1985. Fishers were first reintroduced in the 1960s in the Ottawa National Forest in the western Upper Peninsula. Resident Canada geese were relocated from Minnesota in the 1960s and 1970s. During the 1980s, Michigan began a trumpeter swan reintroduction program as part of the North American Restoration Plan. These successes were countered by the decline of other species due to less favorable habitat conditions, such as the common loon, Kirtland's warbler, prairie chicken and sharp-tailed grouse.

From 1897 through 1964, the Michigan Fish Commission (later called the Michigan Department of Conservation) did not actively manage Great Lakes waters other than to regulate commercial harvest. Regulation was without a clear understanding of limits on fish productivity and the potential effects of overharvest, essentially allowing commercial harvest to continue unencumbered.

Large changes in the fisheries of both the Great Lakes and inland waters were underway. Arctic grayling were extinct by early the 1900s despite efforts to produce the species in hatcheries. Several other species (and subspecies) were deemed extinct due, at least partially, to overexploitation: blue pike, longjaw cisco, blackfin cisco and deepwater cisco (Eagle et al. 2005). Sea lamprey invaded the Great Lakes in the early 1900s through the Erie Canal, with a high abundance of reproducing populations by the mid-1900s. With both an inland and Great Lakes component to its life cycle, this parasitic lamprey was particularly devastating to native lake trout populations. A sea lamprey control program developed through the Great Lakes Fishery Commission in 1958 continues today.

Another invasive species, alewives, became prominent in the Great Lakes in the 1950s. Lake trout numbers were very low because of commercial exploitation and sea lamprey parasitism. Without an effective predator such as lake trout, alewife numbers swelled, and die-off occurred in large magnitude along the lakeshore. At the same time, a growing interest in Great Lakes recreational fishing became apparent. The Department of Conservation introduced hatchery-raised Pacific salmonids to control alewife populations and produce a sport fishery. A similar management philosophy led to stocking lake trout in Lake Superior to supplement existing native populations. Migratory salmonids have since adapted to reproduction in fresh water, using inland rivers to spawn and as growing habitat for juveniles.

Environmental and fishery management practices since the mid-1900s assisted in rehabilitating many aquatic ecosystems. Reforestation programs have stabilized soils, hydrologic and sediment processes, and the waters therein. The federal Clean Water Act of 1972 addressed water pollution, and fisheries and wildlife management have rehabilitated many valued species on land and in the water. The ban of DDT and other persistent pesticides in the 1970s helped reduce contaminants in fish and led to a rebound of some bird populations such as bald eagles, osprey and peregrine falcons, which were hard-hit by the liberal use of pesticides shortly after World War II.

Non-native insects and diseases have counterbalanced the regrowth of Michigan's forests. Over the last century, invasive species such as chestnut blight, Dutch elm disease and, more recently, beech bark disease and emerald ash borer have caused declines in several native tree species. Oak wilt, hemlock wooly adelgid and spotted lanternfly are among the current invasive species of concern due to their potential impacts on more of Michigan's native trees.

Perhaps the most insidious invasive species that impact Michigan's forests in subtle but profound ways are earthworms. Likely due to glaciation, the Great Lakes region's vegetation communities established and evolved without earthworms until species from Europe and Asia were introduced along with European settlement. With multiple species slowly working their way across the region, earthworms are associated with changes to soil structure, nutrient dynamics, mycorrhizal (involving the symbiotic association of the mycelium of a fungus with the roots of a seed plant) relationships and arthropod communities, as well as reduction of leaf litter and maple tree seedling density and declines in herbaceous plant diversity (Corio et al. 2009).

Invasive plant species have had negative impacts on Michigan's ecosystems as well. Autumn olive, spotted knapweed, garlic mustard and Japanese knotweed outcompete native plants for resources and change vegetation composition and dynamics. Both established and new invasive species will continue to be a threat to the species and ecosystems within the state forest.

By the early 1940s, almost 5 million acres of land were under management of the Department of Conservation. As of 2020, approximately 20.1 million of Michigan's 37.4 million land acres are again forest land. This represents 53.8% of the state's total land area, and an increase of 2.1 million acres since 1980. This forest land is located predominantly in the northern two-thirds of the state. Michigan's 18.7 million acres of timberland is the fifth-largest in the United States, exceeded only by Georgia, Oregon, Alabama and North Carolina. Timberland acreage has increased 7% since 1980 (U.S. Forest Service data).

Present vegetation communities and animal populations have been in an almost constant state of instability and adaptation over the past 20,000 years. This is due, in part, to a changing climate, fundamental changes in the configuration of the land and the composition of surface materials (Davis 1986) and human activity. Particularly in the 19th century, widespread extraction of the state's natural resources (including timber, minerals, fish and game) occurred on a monumental scale. There are many legacies from this period, which include the deforestation, burning and reforestation of large portions of the state; the severe degradation and slow recovery of aquatic habitats from fragmentation, erosion and disruption of natural hydrologic cycles; the loss of many wildlife species due to loss of habitat and overexploitation; and rapid population growth of other wildlife species that were well adapted to the early successional landscape in the early to mid-20th century.

Another legacy was the formulation of progressive policies and management to restore, enhance and use natural resources in a sustainable fashion. Additionally, Michigan's 12 federally recognized tribes now partner with the Department of Natural Resources and the U.S Forest Service on various public land management practices. They also manage their own lands through tribal natural resource departments.

The past century's resource-based activity has led to several economic and social conditions, many of which carry through to the present day. For example, a transition from a timber-based economy to a diversified, timber-, recreation- and agriculture-based socioeconomic system is occurring in many areas of the northern Lower Peninsula. Changes have been more gradual in the Upper Peninsula, but a trend from a timber- and mineral-based economy to a timber- and recreation-based system can be perceived.

The state will never again see vast forests like those prior to 1800. Yet inventory data indicate that the forests have been on a steady path toward recovery since the heavy logging era of the late 1800s. Timber, wildlife recreation and other natural resource-based industries will remain significant, contributing segments of Michigan's social and economic fabric for the foreseeable future.

Forest and habitat management

Management priority: Forested area



Why forested areas matter

People, wildlife, insect and plant species all depend on forests to live. Forests offer a place for fun and recreation, as well as a place of solace and solitude. Forests filter the water we drink and the air we breathe. Forests provide critical wildlife habitat and help protect the integrity of lakes, rivers and streams. They soak up climate-altering carbon from the atmosphere and can be a great natural solution to helping slow climate change. Well-managed forests provide a sustainable flow of forest products for people to use such as building products, furniture, and even producing electricity. The sustainability and stability of the forest depend on its size and diversity. If the forest is not of sufficient size or made up of an abundance of species and conditions, it may become vulnerable to habitat degradation and loss. The Michigan Department of Natural Resources is committed to maintaining the amount of forested land across the state forest to ensure these benefits can be realized now and for generations to come.

Current condition and trend

The state of Michigan has about 20 million acres of forested land across all ownerships, including private land, state-owned land, federally owned land and tribal land. The state forest, managed by the DNR, contributes about 20 percent of that, with just shy of 4 million acres, and is distributed across the northern Lower and Upper peninsulas. The landscape of the state forest is further classified into forested (greater than or equal to 25% canopy cover of tree species) and nonforested (less than 25% canopy cover of tree species) cover types. There are currently about 3.4 million acres of forested cover types across the state forest, while the remaining 600,000 acres are nonforested (Table 1, Figure 1).

Table 1. Area of the state forest by forested vs. nonforested, region, and year (Source: Michigan DNR Forest Inventory data).

Category	1988 Area (ac)	1988 Percent	2009 Area (ac)	2009 Percent	2021 Area (ac)	2021 Percent	Change Area (ac)	Change Percent
Forested Total	**3,154,904**	**82%**	**3,323,572**	**83%**	**3,380,745**	**85%**	**225,841**	**3%**
NLP	1,694,935	44%	1,762,031	44%	1,766,709	44%	71,774	0%
EUP	729,726	19%	792,093	20%	832,205	21%	102,479	2%
WUP	730,243	19%	769,448	19%	781,831	20%	51,588	1%
Non-forested Total	**700,621**	**18%**	**661,255**	**17%**	**608,309**	**15%**	**(92,312)**	**-3%**
NLP	281,705	7%	280,797	7%	271,648	7%	(10,057)	0%
EUP	298,143	8%	271,303	7%	235,612	6%	(62,531)	-2%
WUP	120,773	3%	109,155	3%	101,049	3%	(19,724)	-1%
Grand Total	**3,855,525**	**100%**	**3,984,827**	**100%**	**3,989,054**	**100%**	**133,529**	**0%**

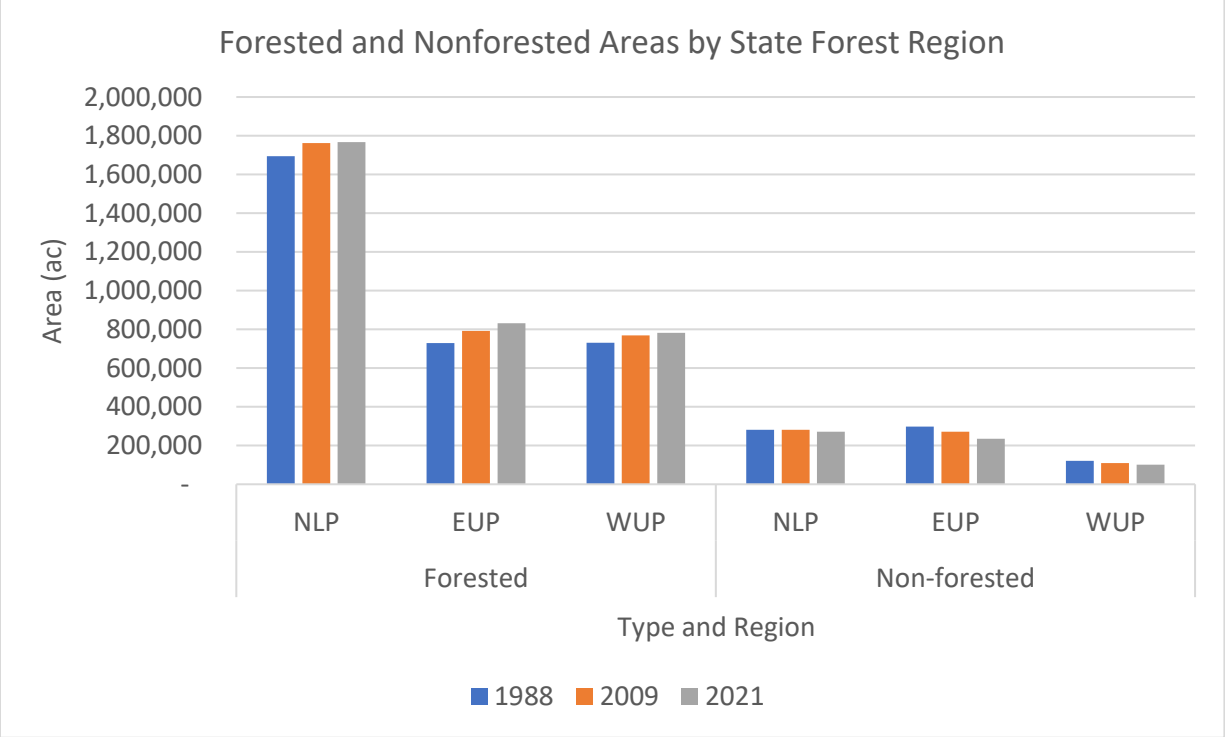


Figure 1. Area of the state forest by forested vs. nonforested, region and year (Source: Michigan DNR Forest Inventory data).

The area of forested cover types within the state forest has been slightly increasing over the last 30 years at a rate of 1 percent per decade. There has been less than a 1 percent change in overall area of state forest (through acquisitions and disposals) which means the increase in forested areas has resulted in an equal 3% decrease of nonforested cover types. This can likely be attributed to a multitude of

factors. Some are real changes on the landscape; others are a result of changes in technology and stand mapping protocols.

Most real changes are likely due to two factors: natural succession of managed forest openings to forested stands, and afforestation of undesirable open areas (bare or sparsely vegetated stands that do not contribute to open-land wildlife habitat) through tree planting.

Changes in inventory and mapping protocols have slightly modified the way the landscape has been categorized over time. Changes in forest inventory mapping protocols have encouraged a more detailed depiction of the differences across the landscape, including the size an area must be to be mapped as its own stand. For example, a stand examiner must map a 4.5-acre forested area if it is surrounded by nonforested areas. That same area can be mapped down to 1 acre if the stand examiner chooses to do so, resulting in many isolated small, forested patches being mapped and captured across the landscape, often reducing the size of the parent nonforested stands. Advances in aerial imagery resolution and color infrared raster datasets with digital mapping tools have also allowed for a more detailed depiction of the state forest, often resulting in a perceived change in cover type composition. This is merely a refinement of forest inventory stand mapping.

Desired future condition, objectives and management actions

The state forest has an abundance of forested area, sufficiently contributing to the array of forest values and ecosystem services necessary to sustainably manage the forest in a changing climate.

Objective 1. Complete another decade of forest inventory on state forest land by Oct. 1, 2033.

- Action 1. Conduct inventory of all forested and nonforested stands across the state forest following stand-mapping protocols allowing for scalable analysis to be performed.
- Action 2. Apply appropriate survey protocols to address strategic management needs and decisions.

Objective 2. Evaluate and prescribe appropriate silvicultural methods to maintain forested stands by Oct. 1, 2033.

- Action 1. Use research, past management results and scenario planning to include potential future changes in climate. Use this to create effective silvicultural prescriptions that will ensure the greatest success in achieving management objectives.
- Action 2. Continue efforts to curb cervid herbivory in regenerating stands where long-term sustainability has been identified as an issue.
- Action 3. Consider planting stands that have not successfully regenerated naturally.
- Action 4. Manage forest cover types in accordance with silvicultural guidance at harvest levels consistent with achieving long-term age-class distribution goals.

Objective 3. Develop and implement a more detailed protocol for monitoring harvest and regeneration by Oct 1, 2025.

- Action 1. Identify key metrics and create a tracking mechanism to record conditions annually.

- Action 2. Report applicable status of monitoring efforts annually at each pre-inventory meeting of the compartment review process.

Climate change

All climate change data and information listed here is pulled directly from the open-source Northern Institute of Applied Climate Science Climate Change Impacts tool and Adaptation Workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium, limited) and agreement (high, moderate, low) described in the Predicted impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the Adaptation approaches section. For more information, go to niacs.org.

Predicted impacts relevant to forest area

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Drought conditions will occur when increases in snowfall are offset by earlier snowmelt and decreased summer precipitation	Medium	Moderate	Droughts are major stressors on forests, making trees more vulnerable to insect outbreaks and other impacts, elevating the risk of stand conversion to a nonforested condition
Climate conditions will increase fire risks in northern Michigan by the end of the century	Medium	Moderate	Short-term conversion of forested stands to nonforested conditions may occur where fire intensity is high enough; most stands will regenerate to a forested condition if the fire disturbance occurs at a low to moderate fire intensity
Many invasive species, insect pests and pathogens in northern Michigan forests will increase or become more damaging by the end of the century	Limited	High	Warmer winters may allow more invasive species to expand their ranges north, increasing mortality of native tree species by invasive pests and diseases that impact forest health
Tree regeneration and recruitment will change	Medium	High	Seedlings are more vulnerable than mature trees to changes in temperature, moisture and other seedbed and early growth requirements; if conditions don't favor their growth, this could impair the regeneration capacity of the stand

Adaptation approaches

An array of adaptation strategies can be applied to help Michigan's state forest maintain the proportion of forested areas to nonforested areas. Many of these strategies are common practices when managing

the state forest, in alignment with sustainable forest management. Others may be new approaches needed in response to a changing climate.

Even modest changes in climate may cause substantial increases in the distribution and abundance of insect pests and pathogens, potentially leading to reduced forest productivity or increased tree stress and mortality (Ayres and Lombardero 2000, Dukes et al. 2009). Impacts may be exacerbated where site conditions, climate, other stressors and interactions among these factors increase the vulnerability of forests (Spittlehouse and Stewart 2003). Actions to manipulate the density, structure or species composition of a forest may reduce susceptibility to some pests and pathogens (Spies et al. 2010).

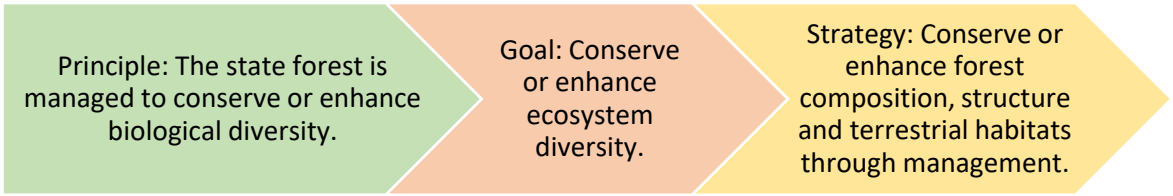
Forests within riparian areas serve important ecosystem functions such as reducing soil erosion, buffering high flows (Osterkamp and Hupp 2010; Capon et al. 2013), regulating base flows (Reiman and Isaak 2010), moderating stream temperatures, reducing evaporation from surface waters, and providing migration corridors for wildlife and plant species (Heller and Zavaleta 2009; Capon et al. 2013; Mawdsley et al. 2009). Many of these functions and benefits may be degraded if riparian forests undergo decline or extra stress from climatic shifts and extreme events. Changing conditions are expected to threaten regeneration processes for some species and may result in desired species failing to regenerate naturally. Actions to maintain or restore vegetative cover will typically be consistent with existing best management practices and prescriptions for riparian management zones but may require active intervention to compensate for forest decline and promote healthy cover and function.

Monitoring

The following metrics have been identified to track progress towards forest sustainability:

- Proportion of forested land on the state forest
- Proportion of nonforested land on the state forest
- Total area of the state forest

Management priority: Forested cover types



Why forested cover types matter

Forests are complex natural systems that have evolved in an ever-changing environment. Climate, soil nutrients, soil moisture, disturbance regimes, and landscape position all influence which tree species are naturally occurring on any one site, forming an assemblage. These species assemblages tend to repeat with some consistency on different sites that meet the same general conditions. These repeatable assemblages allow forest types to be categorized, which also translates into different wildlife habitats. Each wildlife species have both specific and general habitat requirements. With a diversity of forest types, a diversity of wildlife occur in the forest. These different assemblages also translate into different ecosystem services and recreational opportunities. Different forest types abundantly present across the landscape is an important aspect of biological diversity and an essential component of forest sustainability.

It is possible to categorize types of tree species assemblages into standard forest types based on specific guidelines. This forms the basis of the state forest inventory, where different types are grouped in a place as stands. Forest managers constantly evaluate what types are best suited to balance essential ecosystem services and the needs of society. Categorization of the different types of forest helps managers quantify the current forest condition by collecting common attributes across the landscape in each forest type. Analysis of each forest type, or "cover type," can be performed to describe the forest in its current condition and enables us to communicate what a desired future condition might be. Each forest cover type is comprised of a unique combination of tree or plant species. Stands with similar mixes of species will be identified as the same cover type.

The Michigan Department of Natural Resources uses 160 unique "level 4 cover types" to describe both forested and non-forested stands in Michigan's state forest (Appendix D). This detailed cover type classification system describes different types of forest and picks up on subtle differences in species composition and overall structure. This classification is too detailed to use in forest modeling and planning at a large landscape scale. This State Forest Management Plan (SFMP) uses an aggregation of those detailed cover types, reducing the total number from 160 to 36 (refer to appendix C for a crosswalk of cover types). These cover types will be referred to as a cover type where 25 of those cover types describe forested lands and 11 are used to describe non-forested lands.

Current condition and trend

The classification systems has changed over time as the use of one forest inventory system transitioned to another. Each change resulted in an improvement and was more precise than previous systems, although this resulted in the inability to detect change over time under the same classification system. The DNR's early forest inventory systems, such as "Diagnostic Inventory" which was used in the 1970s, and later systems like "Operations Inventory (OI)" which was used in the 1980s through the 2000s,

provided a rather coarse breakdown of cover types limited to 26 alphabetic characters to describe all forested and non-forested types. There were no upland mixed types in those systems and a lack of distinction between stands that were planted versus stands that established naturally. Those limitations, among others, were addressed in newer inventory systems allowing for a more detailed categorization of the landscape and a more detailed way to communicate management objectives, regeneration methods, and species mix objectives. The "Integrated Forest Monitoring Assessment and Prescription" (IFMAP) inventory system was the first protocol that expanded the categorization of the landscape to 160 cover types. Those same cover types and cover type rules are in place today in the current system, "Michigan Forest Inventory" or "MiFI". The IFMAP system was rolled out over several years from 2006 through 2012, leaving the inventory database with a mix of data. The state forest was not captured under one consistent protocol again until 2014, when the last OI compartment was re-inventoried under the IFMAP protocol.

The implementation of a more detailed cover type classification system complicates the ability to perform temporal analysis on forest types and detect change over time. For example, the area of the state forest captured as red pine in the OI database in 1988 now is split into many categories of planted versus natural origin stands and those with significant amounts of other species mixed in. The SFMP cover types maintain the split of planted vs. natural origin stands but does contain an aggregate of other detailed types containing species mixes. It is important to keep these details and limitations in mind when reviewing the current condition and trend of the cover type composition in the state forest.

The state forest is currently comprised of 85 percent forested cover types, with the majority of those being upland types. Within the forested upland cover types, there are over twice as many acres in deciduous types compared to coniferous forested cover types. Aspen and northern hardwood are the most prevalent of these cover types at 833,246 acres (21 percent) and 459,094 acres (12 percent) respectively (Tables 1 and 2). Together, these two cover types represent 33 percent of the total state forest. The next most prevalent forested cover types are in the lowland category where cedar represents 7 percent of the state forest and lowland conifer is next at 5 percent.

Table 1. Current cover type composition of the state forest shown in acres (Source: Michigan Forest Inventory 2021).

Land Type	Landscape Position	Forest Type	Covertype	Area (ac)	Forest Type	Landscape Position	Land Type
Forested	Upland	Deciduous	Aspen	833,246	1,611,922	2,496,176	3,380,266
			Northern Hardwood	459,094			
			Black Red Hybrid Oak	55,322			
			Northern Red Oak	54,679			
			Oak Mix	41,856			
			Mixed Upland Deciduous	167,726			
		Mixed	Upland Mixed Forest	117,371	117,371		
		Coniferous	Planted Red Pine	199,823	766,883		
			Planted Jack Pine	136,846			
			Planted White Pine	7,536			
			Planted Mixed Pine	14,671			
			Natural Red Pine	53,149			
			Natural Jack Pine	145,301			
			Natural White Pine	47,863			
			Natural Mixed Pines	78,276			
			Upland Spruce/Fir	17,071			
			Upland Conifers	53,067			
			Hemlock	13,279			
	Lowland	Deciduous	Lowland Aspen/Balsam Poplar	71,241	203,693	884,090	
			Lowland Deciduous	132,452			
		Mixed	Lowland Mixed Forest	66,881	66,881		
		Coniferous	Cedar	287,202	613,516		
			Lowland Conifers	204,818			
			Lowland Spruce/Fir	87,746			
			Tamarack	33,750			
Nonforested	Upland	N/A	Herbaceous Openland	67,571	N/A	166,773	606,356
			Upland Shrub	48,884			
			Low Density Trees	23,298			
			Bare/Sparsely Vegetated	7,879			
			Cropland	2,985			
			Urban	16,156			
	Lowland	N/A	Lowland Shrub	246,490	N/A	439,583	
			Marsh	80,070			
			Bog	21,252			
			Treed Bog	44,700			
			Water	47,071			
						Total:	**3,986,622**

Table 2. Current cover type composition of the state forest, shown as a percent of the total area of state forest land (Source: Michigan Forest Inventory 2021).

Land Type	Landscape Position	Forest Type	Covertype	Area (ac)	Forest Type	Landscape Position	Land Type
Forested	Upland	Deciduous	Aspen	21%	40%	63%	85%
			Northern Hardwood	12%			
			Black Red Hybrid Oak	1%			
			Northern Red Oak	1%			
			Oak Mix	1%			
			Mixed Upland Deciduous	4%			
		Mixed	Upland Mixed Forest	3%	3%		
		Coniferous	Planted Red Pine	5%	19%		
			Planted Jack Pine	3%			
			Planted White Pine	0%			
			Planted Mixed Pine	0%			
			Natural Red Pine	1%			
			Natural Jack Pine	4%			
			Natural White Pine	1%			
			Natural Mixed Pines	2%			
			Upland Spruce/Fir	0%			
			Upland Conifers	1%			
			Hemlock	0%			
	Lowland	Deciduous	Lowland Aspen/Balsam Poplar	2%	5%	19%	
			Lowland Deciduous	3%			
		Mixed	Lowland Mixed Forest	2%	2%		
		Coniferous	Cedar	7%	15%		
			Lowland Conifers	5%			
			Lowland Spruce/Fir	2%			
			Tamarack	1%			
Nonforested	Upland	N/A	Herbaceous Openland	2%	N/A	4%	15%
			Upland Shrub	1%			
			Low-Density Trees	1%			
			Bare/Sparsely Vegetated	0%			
			Cropland	0%			
			Urban	0%			
	Lowland	N/A	Lowland Shrub	6%	N/A	11%	
			Marsh	2%			
			Bog	1%			
			Treed Bog	1%			
			Water	1%			
						Total:	**100%**

Changes in inventory systems and protocols, as well as advancements in aerial imagery and mapping technology, have all influenced how the state forest has been categorized over the last several decades. The ability to detect change using only forest inventory data is somewhat limited and should always be qualified with an explanation of these challenges.

Given the variations caused by changing inventory classification systems and protocols, it is difficult to identify trends occurring on the ground (Table 3). "Temporal Cover type" is an amalgamation of the various cover type classification systems. This categorization combines planted and natural cover types back together, combines aspen and birch, and groups several non-forested cover types into broader categories to make comparing different data points possible. The "2021 Incremented dataset" is used as the starting condition for this modeling and planning effort (for more on this dataset, refer to Planning Approach in Section 1).

Table 3. The cover type composition trends in the state forest from 1988, 2009, and present, represented as 2026 (Source: Michigan Forest Inventory 2021).

Temporal Cover type	1988	2009	2021 Incremented Dataset	Change from 1988*	% Change from 1988
Mixed Upland Deciduous*	--	9,940	167,744	167,744	100%
Upland Conifers*	--	6,973	146,050	146,050	100%
Upland Mixed Forest*	--	6,160	117,389	117,389	100%
Cedar	187,115	246,735	287,216	100,101	53%
Lowland Mixed Forest*	--	--	66,888	66,888	100%
Lowland Shrub	201,154	206,550	246,702	45,548	23%
Upland Shrub	43,351	55,733	72,335	28,984	67%
Lowland Deciduous	107,890	139,050	132,479	24,589	23%
Lowland Aspen/Balsam Poplar	52,536	71,340	71,251	18,715	36%
Lowland Spruce/Fir	69,082	70,603	87,770	18,688	27%
Red Pine	235,249	285,187	253,041	17,792	8%
Tamarack	16,540	25,641	33,754	17,214	104%
Water	36,173	49,299	47,202	11,029	30%
Hemlock	12,580	17,983	13,279	699	6%
White Pine	55,703	96,144	55,418	-285	-1%
Marsh	93,285	113,694	80,154	-13,131	-14%
Bare/Sparsely Vegetated	39,905	23,393	24,379	-15,526	-39%
Treed Bog	60,594	62,852	44,715	-15,879	-26%
Bog	49,045	32,994	21,321	-27,724	-57%
Northern Hardwood	499,262	510,424	459,123	-40,139	-8%
Upland Spruce/Fir	65,281	52,064	17,082	-48,199	-74%
Lowland Conifers	260,426	262,922	204,835	-55,591	-21%
Oak	243,010	244,421	151,879	-91,131	-38%
Herbaceous Openland	177,114	116,740	71,499	-105,615	-60%
Aspen/Birch	948,525	915,997	833,342	-115,183	-12%
Jack Pine	401,705	361,988	282,205	-119,500	-30%
Total	**3,855,525**	**3,984,827**	**3,989,054**	**133,529**	**3%**

Upland mixed types did not exist in previous inventory systems; these cover types are made up of acres that would have been captured elsewhere in prior inventories. These mixed types are not dominated by any one species group but contain a relatively even mix of many species. If those species are more deciduous than coniferous, then they fall into the mixed upland deciduous cover type. If the species are more coniferous, they fall into the upland conifers cover type. Stands that have a relatively even mix of deciduous and coniferous species get captured in the upland mixed forest cover type.

The area of the State Forest captured as cedar shows a significant increase over the past 35 years which is largely due to a continuous refinement of the forest inventory process. Large lowland swamp conifer complexes have been delineated further with each re-examination, and important distinctions have been captured where cedar is more prevalent than other species.

Desired future condition, objectives, and management actions

Desired future conditions were established through a series of meetings with field staff, specialists and managers from both the Forest Resources and Wildlife divisions for each of the 25 forested cover types in each of the 30 management areas and five special analysis units across the state. Individual objectives established in those meetings were captured and incorporated into the SFMP model as transitions, goals, and constraints. The model was executed and outputs were analyzed to determine if the scenario resulted in desirable conditions at the management area, regional, and statewide scales. Slight modifications were necessary in a few management areas to help control distribution of harvests and resulting conditions. Overall, management-area-level cover type goals resulted in favorable regional and statewide outputs.

The desired future conditions for each cover type will be generally described in terms of what key components should become over time. The elements of the desired future condition of forested types can be further described by using four main components for each significant SFMP cover type:

- Cover type abundance – changes through transitions or conversions
- Age class distribution (even-aged cover types)
- Basal area distribution (uneven-aged cover types and even-aged cover types that may require an intermediate thinning)
- Silvicultural regimes applied to each cover type

These elements are the key components used in the DNR's area-regulation approach to forest management. Regulating an area, whether in terms of age classes or basal-area classes, is an alternative to using a system of control based on volume and/or value, which are the other most common approaches for large landowners and managers. The area regulation approach allows for moderate fluctuations in volume and value while emphasizing the importance of creating and maintaining a relatively even variety of stand conditions relative to stand age and density. This approach lends well to co-management of the state forest where wildlife habitat conditions are as important as timber volume and value.

The projected harvests for each cover type this planning period are shown in Table 4. Some cover types will undergo a variety of treatments while others are predominantly managed by using only one or two silvicultural methods. The salvage clearcut and salvage thinning treatments have been added to

represent projected salvage harvest levels due to extensive damage cause by the March 2025 ice storm. These harvests are limited to the eastern Lower Peninsula management areas.

Table 4. Harvest summary table showing projected harvests for the 10-year planning period by cover type and silvicultural method (Source: Michigan SFMP Model Results 2026).

Cover type	Clearcut	Selection	Thinning	Group Selection	Shelter-wood	Salvage Clearcut	Salvage Thinning	Total
Northern Hardwood	1,718	97,277	-	6,604	1,320	6,020	15,571	**128,509**
Aspen	111,480	-	-	-	-	6,115	-	**117,595**
Planted Red Pine	11,565	-	51,753	-	-	5,054	8,243	**76,615**
Mixed Upland Deciduous	16,257	2,694	-	-	1,770	249	-	**20,969**
Natural Jack Pine	15,297	-	-	-	-	2,336	-	**17,633**
Planted Jack Pine	9,654	-	-	-	-	3,057	-	**12,710**
Lowland Conifers	9,624	-	-	-	-	-	-	**9,624**
Northern Red Oak	7,152	-	343	720	114	290	724	**9,344**
Upland Mixed Forest	9,064	-	-	-	-	171	-	**9,236**
Lowland Aspen	9,139	-	-	-	-	-	-	**9,139**
Natural Mixed Pines	-	-	3,241	-	3,971	-	754	**7,965**
Black Red Hybrid Oak	6,957	-	630	-	332	33	-	**7,952**
Upland Conifers	6,454	-	9	-	1,168	-	-	**7,631**
Lowland Deciduous	4,697	448	-	168	1,655	-	-	**6,967**
Lowland Spruce/Fir	6,481	-	-	-	-	-	-	**6,481**
Natural White Pine	-	-	2,039	-	2,400	-	505	**4,944**
Oak Mix	4,142	-	380	-	48	88	-	**4,657**
Planted White Pine	472	-	3,198	-	-	-	-	**3,670**
Lowland Mixed Forest	2,976	-	-	-	-	-	-	**2,976**
Natural Red Pine	-	-	1,154	-	1,454	-	312	**2,921**
Upland Spruce/Fir	2,507	-	-	-	-	-	-	**2,507**
Planted Mixed Pine	103	-	890	-	-	-	-	**992**
Tamarack	839	-	-	-	-	-	-	**839**
Hemlock	-	459	-	-	-	-	-	**459**
Cedar	84	-	-	32	-	-	-	**116**
Total	**236,663**	**100,876**	**63,637**	**7,524**	**14,231**	**23,412**	**26,109**	**472,452**

Table 5. Current and 10-year projected acreage by cover type (Source: Michigan SFMP REMSOFT Model Results 2025, post ice storm modifications).

Covertype	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Aspen	833,246	837,438	4192
Northern Hardwood	459,094	460,039	944
Cedar	287,202	287,202	0
Lowland Conifers	204,818	203,184	-1634
Planted Red Pine	199,823	202,630	2806
Mixed Upland Deciduous	167,726	168,907	1182
Natural Jack Pine	145,301	146,718	1417
Planted Jack Pine	136,846	133,999	-2846
Lowland Deciduous	132,452	132,163	-289
Upland Mixed Forest	117,371	122,305	4934
Lowland Spruce/Fir	87,746	86,028	-1719
Natural Mixed Pines	78,276	78,637	361
Lowland Aspen/Balsam Poplar	71,241	71,181	-60
Lowland Mixed Forest	66,881	70,850	3969
Black-Red Hybrid Oak	55,322	52,375	-2947
Northern Red Oak	54,679	49,302	-5377
Natural Red Pine	53,149	53,188	39
Upland Conifers	53,067	50,925	-2143
Natural White Pine	47,863	48,302	439
Oak Mix	41,856	41,041	-814
Tamarack	33,750	33,521	-230
Upland Spruce/Fir	17,071	15,196	-1875
Planted Mixed Pine	14,671	14,742	71
Hemlock	13,279	13,279	0
Planted White Pine	7,536	7,115	-422
Lowland Shrub	246,490	246,490	0
Marsh	80,070	80,070	0
Herbaceous Openland	67,571	67,571	0
Upland Shrub	48,884	48,884	0
Water	47,071	47,071	0
Treed Bog	44,700	44,700	0
Low Density Trees	23,298	23,298	0
Bog	21,252	21,252	0
Urban	16,156	16,156	0
Bare/Sparsely Vegetated	7,879	7,879	0
Cropland	2,985	2,985	0
Total	**3,986,622**	**3,986,622**	**0**

The projected harvests will result in a change in acreage of some cover types. These projected conversions are summarized in Table 5 by comparing current acreage to the projected acreage of each cover type at the end of the 10-year planning period. Conversion of one cover type to another is often done to match a cover type with a better-suited site, improve productivity of a site, or to nurse along an understory of desirable species. In some instances, such as the oak cover types, it is projected because of difficulty in regenerating stands to the same species mix. This results in less oak in the regenerating stands, changing the cover type classification.

Individual forested cover type summaries

The following section is a summation of the individual management area desired future conditions for each forested cover type. It represents the statewide current condition and trend, the desired future conditions, and the corresponding objectives and management actions.

Aspen

The Aspen cover type makes up approximately 21 percent of the state forest and occupies a wide range of sites. This cover type is primarily quaking aspen, with big tooth aspen being more prevalent on higher-quality sites, especially in the northern Lower Peninsula. Associated species commonly mixed in are red maple, balsam fir, white pine, northern red oak, and black cherry (Figure 1; *Michigan Forest Inventory Data 2021)*. Historically, aspen was a minor associate tree species in several natural communities (primarily mesic northern forest, dry-mesic northern forest and dry northern forest) but was also found as a component of other communities. The natural occurrence of aspen on the landscape as a cover type was usually due to a stand-replacing disturbances such as wildfires, wind events, ice damage, or mortality due to native insects and diseases. Intensive logging associated with European settlement greatly expanded occurrence of the aspen forest type from pre-European settlement times. It is now generally managed to maintain its presence on the landscape.

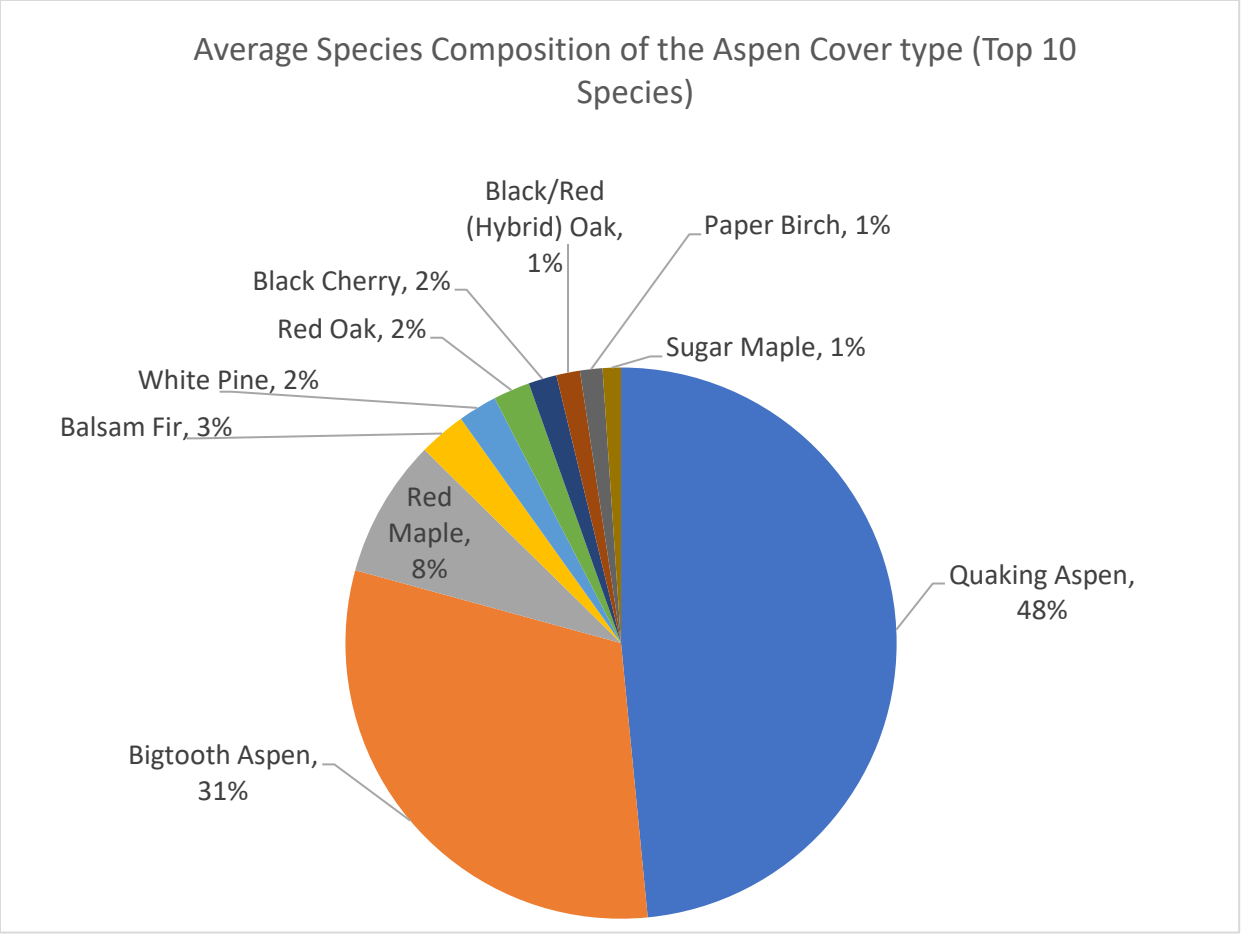


Figure 1. Average species composition of the aspen cover type, state forest wide.

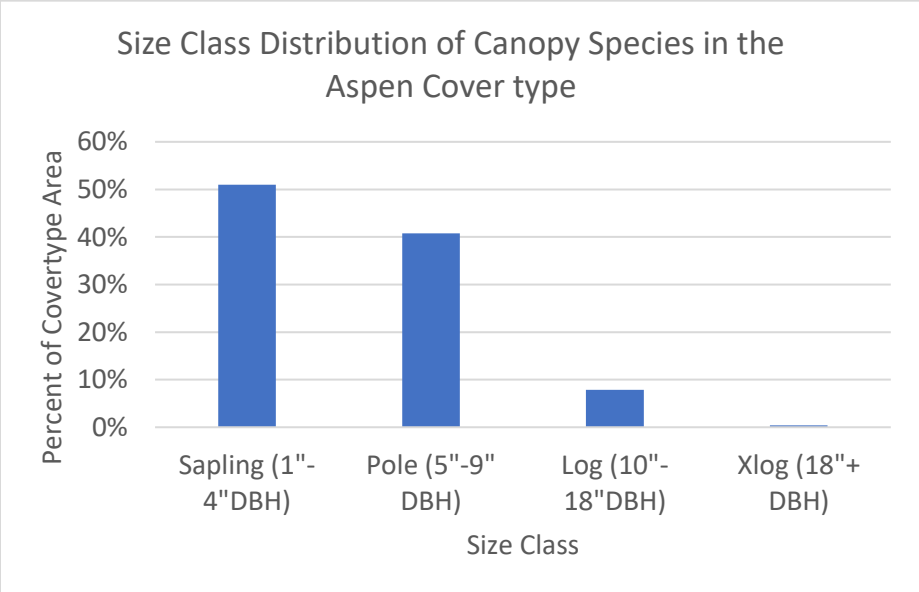


Figure 2. Average size class distribution of canopy tree species in the aspen cover type.

Cover type abundance

Aspen will continue to be the largest cover type within the State Forest, primarily on mesic sites, in a variety of desirable age classes across the landscape to provide important timber and habitat resources.

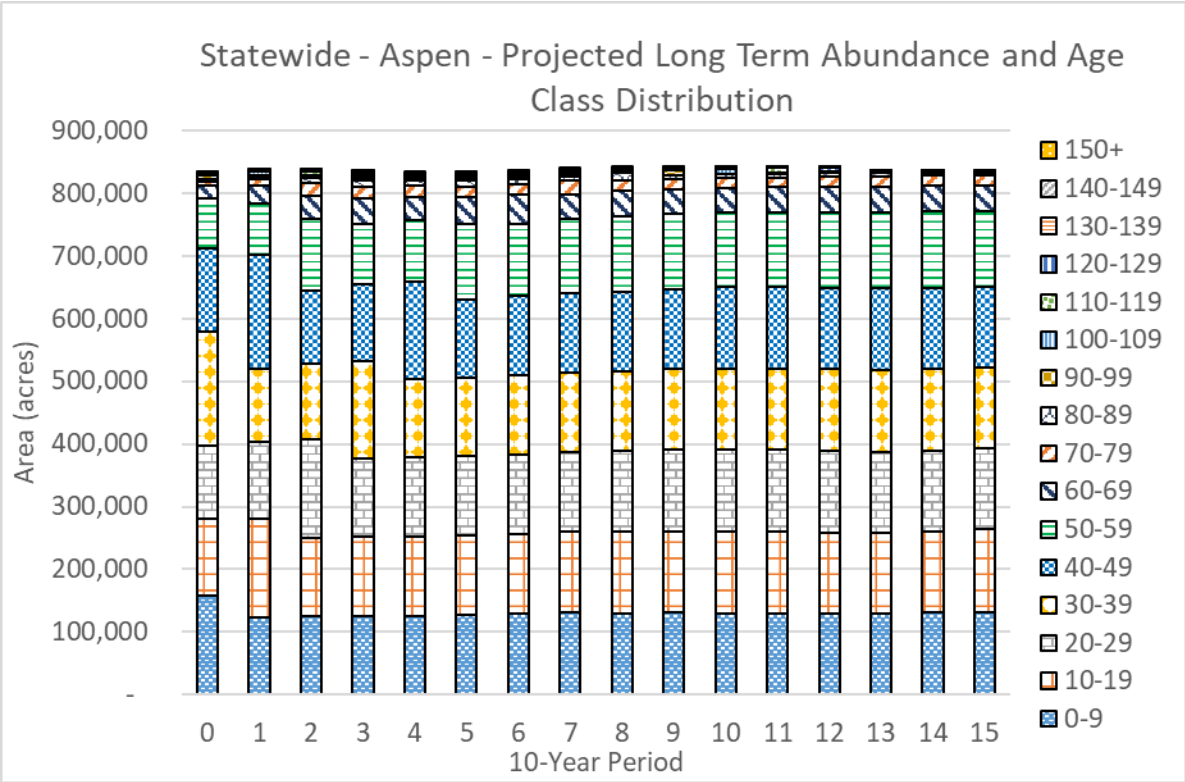


Figure 3. Aspen abundance by age class as projected through period 15 in the SFMP model.

Silvicultural regimes

The even-aged management of the aspen cover type will be accomplished through clearcutting with a focus on coppice regeneration maintaining species diversity over time. In some instances, it will be beneficial to strategically leave some existing underrepresented species to maintain species diversity and increase the structural complexity of the regenerating stand. This can be accomplished through individual tree retention or through area retention, where small pockets are left to represent pre-harvest stand conditions and the associated habitat they provide. Red pine, white pine, and northern red oak are common species selected to leave in place. This will likely result in some additional regeneration from seed when conditions are conducive to germination and seedling establishment.

Age class distribution

The statewide age class distribution of the aspen cover type is becoming more balanced because of intentional regulated harvest and subsequent regeneration efforts over the last decade. The 2013 Regional State Forest Management Plans set harvest objectives that would regenerate a desired amount of aspen in each management area, resulting in a new statewide 0-9 age class that will contribute to achieving the desired age class distribution. The targeted harvesting that took place in the 30-39 and

40–49-year-old age classes over the last decade have strategically reduced the impact of the impending age class spikes that would have reached economic maturity during this and the next two planning periods. Had these age classes not been worked in earlier than normal, there would have been more acres reaching economic maturity than would be desirable to regenerate in one decade, perpetuating the unbalanced age class distribution.

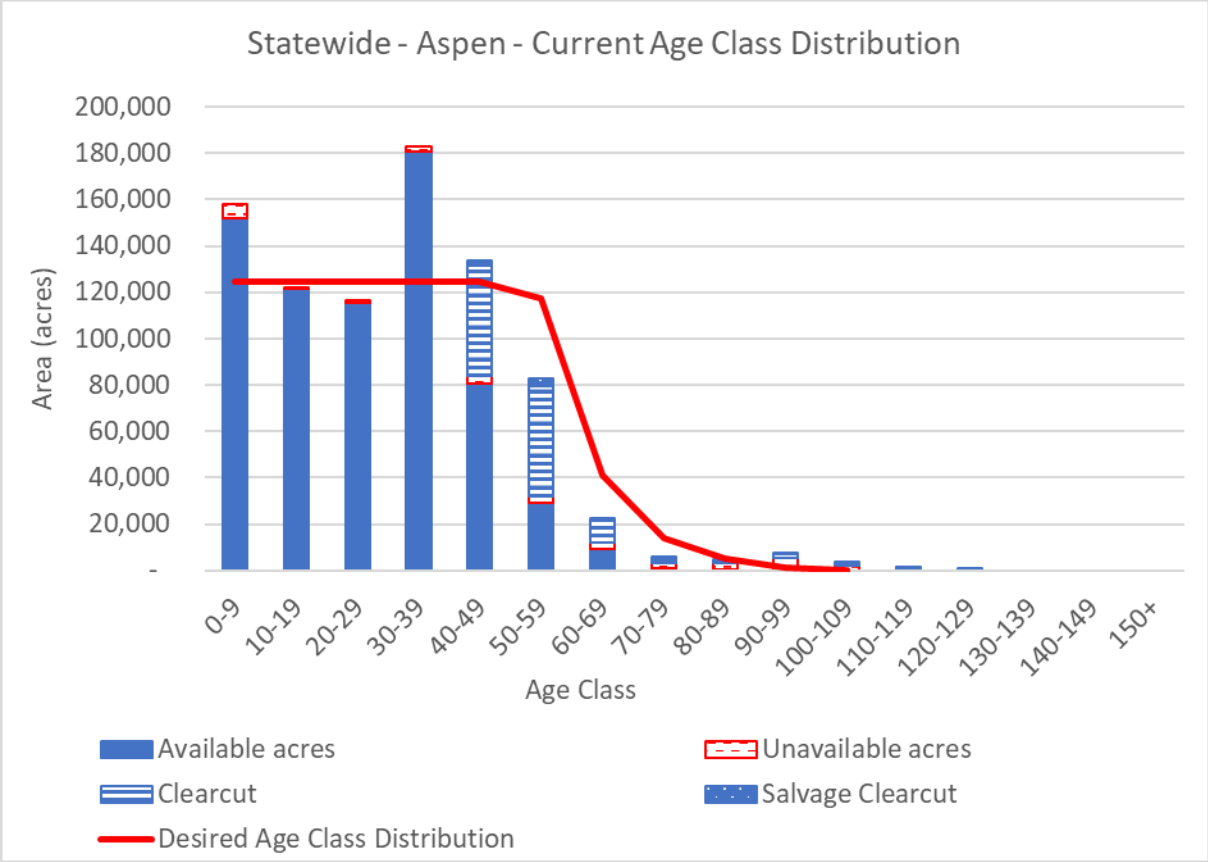


Figure 4. Current statewide aspen age class distribution, projected period one harvests and desired age class distribution.

The strategic harvesting objectives for the next planning period will be focused on ensuring the desired amount of aspen is regenerated to achieve a desirable distribution (Figures 5 and 6) while beginning to allow some acres to populate the older partial-age classes where more mature forest habitat elements are present such as snags, coarse woody debris, and trees with cavities. These older age classes also are conducive to the production of sawlog-sized trees, especially in stands situated on high-quality sites with a larger proportion of bigtooth aspen.

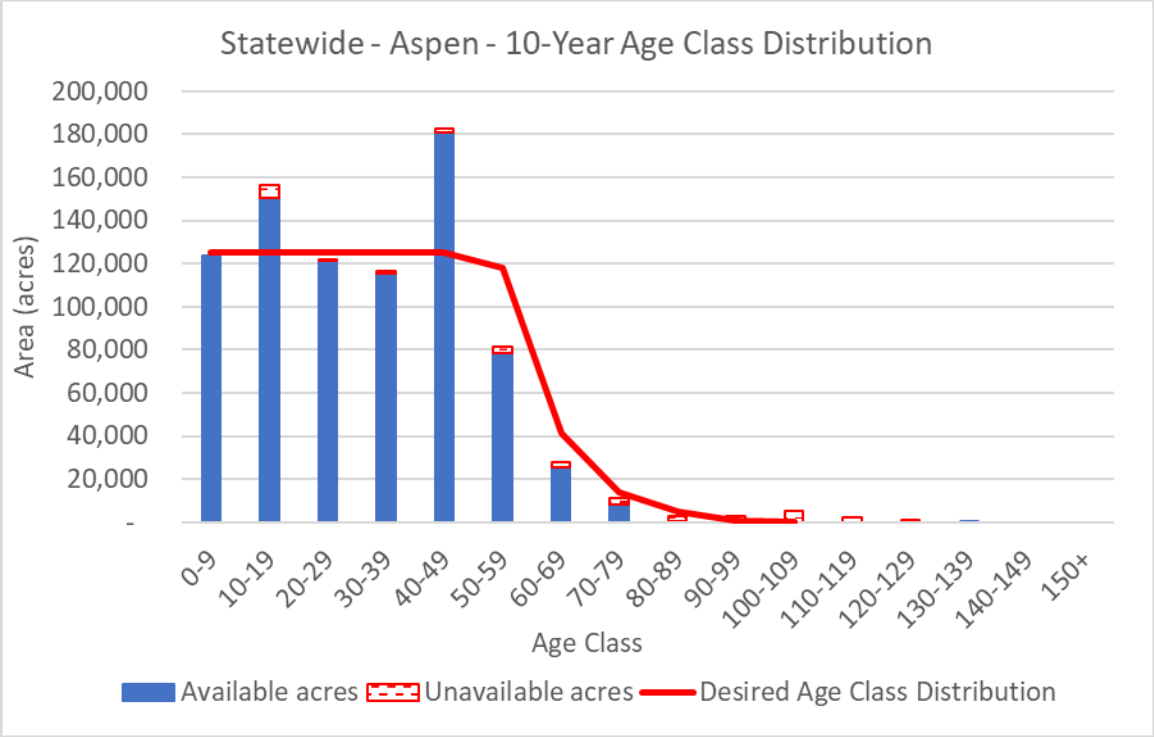


Figure 5. Projected aspen age class distribution at the beginning of period 2, showing the results of period 1 harvests.

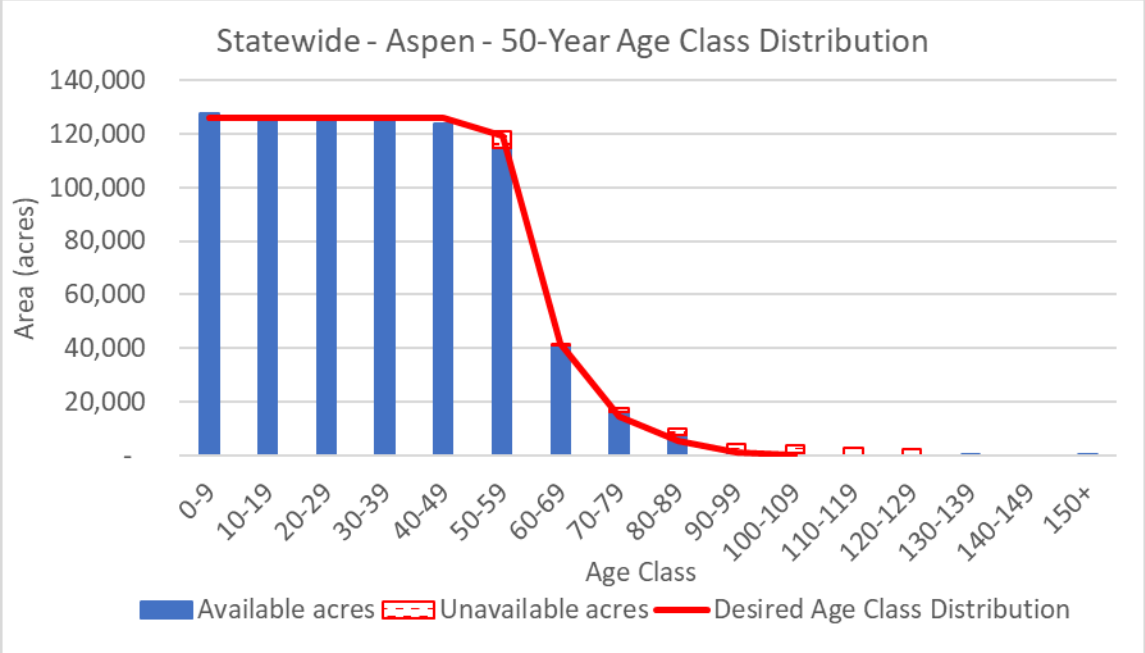


Figure 6. Projected aspen age class distribution reaching desirable conditions at the end of period 5.

Objectives and management actions

Objective 1. Increase aspen by 0.8 % over the next decade ensuring stands converting to aspen are on well-suited sites to help mitigate climate change risks (Figure 1).

Objective 2. Regenerate the desired amount of aspen during the first planning period, creating a new 0-9 age class (Figure 3) that helps achieve the long-term goal of desired age class distribution (shown by the red line in Figure 1 and represented in Figure 4).

- Action 1. Prescribe about 117,595 acres of aspen regeneration harvests (including salvage clearcut) by the end of the planning period (Figure 2), which has been adjusted to account for 1,778 acres of projected ice storm damage on stands that are not eligible for salvage harvest in the eastern Lower Peninsula.
- Action 2. Prescribe about 5,000 acres for regeneration harvests in other types to convert into aspen, resulting in a total regenerating age class of about 123,746 acres.

Objective 3. Strategically reduce the area in merchantable age classes where there is an overabundance of acres (above red line in Figure 4) throughout the next decade.

- Action 1. Prescribe merchantable acres for clearcut harvest in age classes that contain an overabundance of acres throughout the next decade.

Objective 4. Allow some mature stands to achieve older age class goals where present in each management area during the next decade.

- Action 1. Prescribe stands from each merchantable age class (40+ years old) for harvest while also allowing some of the stands to fulfill the older age class goals represented in age class tails throughout the next decade (note in Figure 1 that the 50-59 and 60-69 age classes are not projected to be completely regenerated).

Northern hardwoods

The northern hardwood cover type makes up approximately 12 percent of the state forest and is most commonly found on moraines with better site quality having higher soil nutrient content and moderate soil moistures. This cover type is comprised primarily of sugar maple, red maple, and basswood. Associated species commonly mixed in are beech, black cherry, yellow birch, northern red oak, and hemlock (Figure 7). More than 70% of northern hardwoods are of log size (Figure 8).

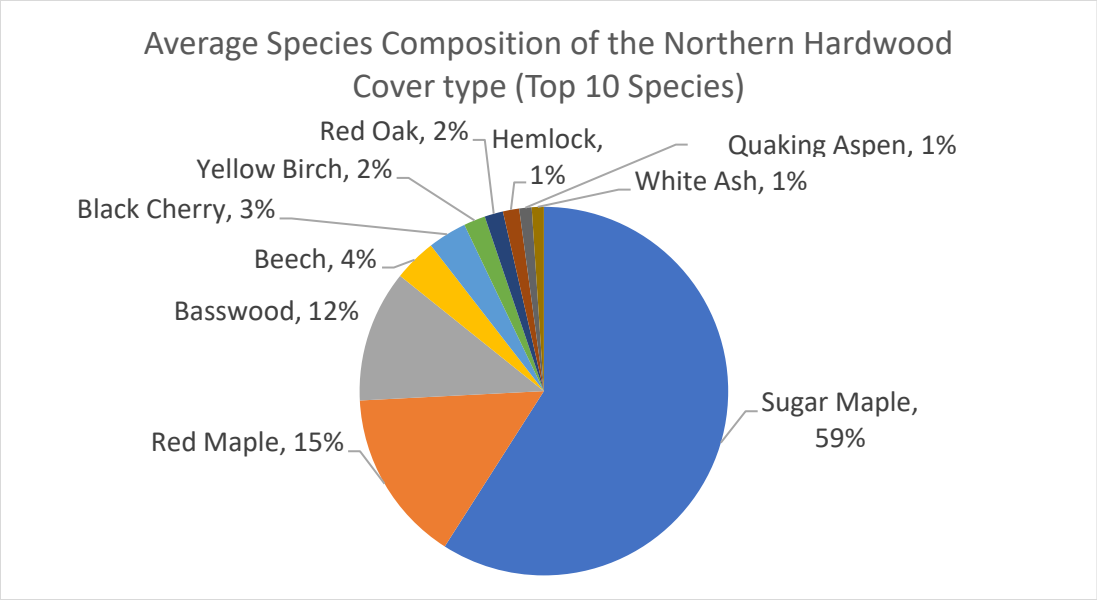


Figure 7. Average species composition of the Northern Hardwood cover type, state forest wide.

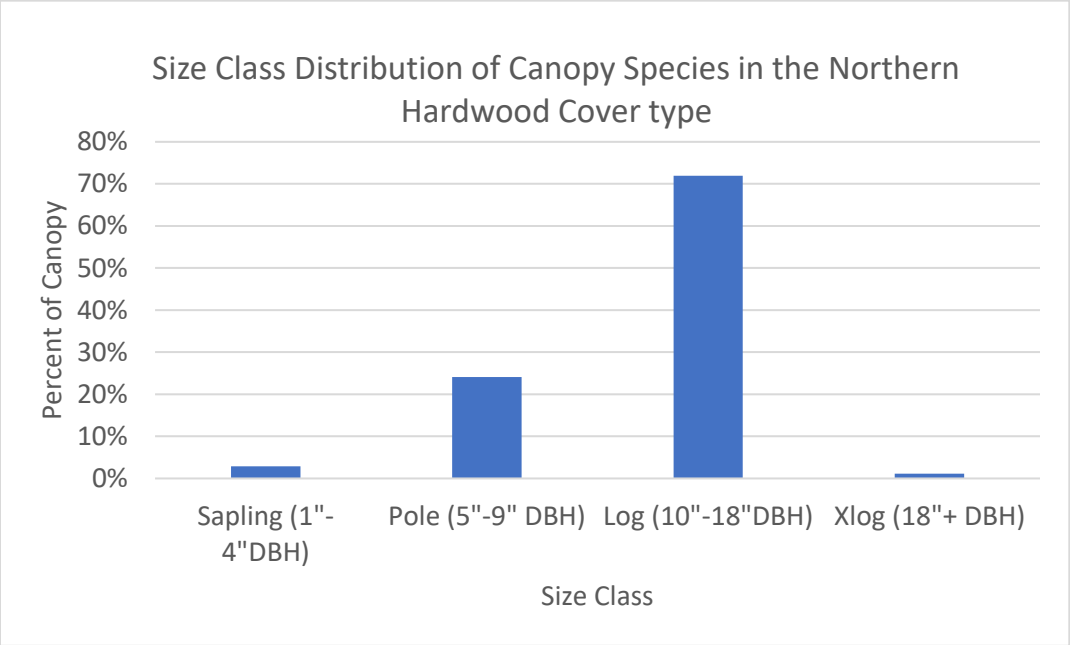


Figure 8. Average size class distribution of the northern hardwood cover type.

Cover type abundance

Northern hardwoods will continue to be the second-largest cover type in the state forest, growing primarily on mesic sites across the landscape providing important timber and habitat resources. There are currently 459,000 acres of northern hardwood in the state forest and the population is expected to climb to just over 460,000 acres during the next planning period through cover type conversions. The SFMP model projects a steady increase in acreage with current conversion rates from other cover types

into northern hardwood reaching approximately 490,000 acres if current management regimes continue.

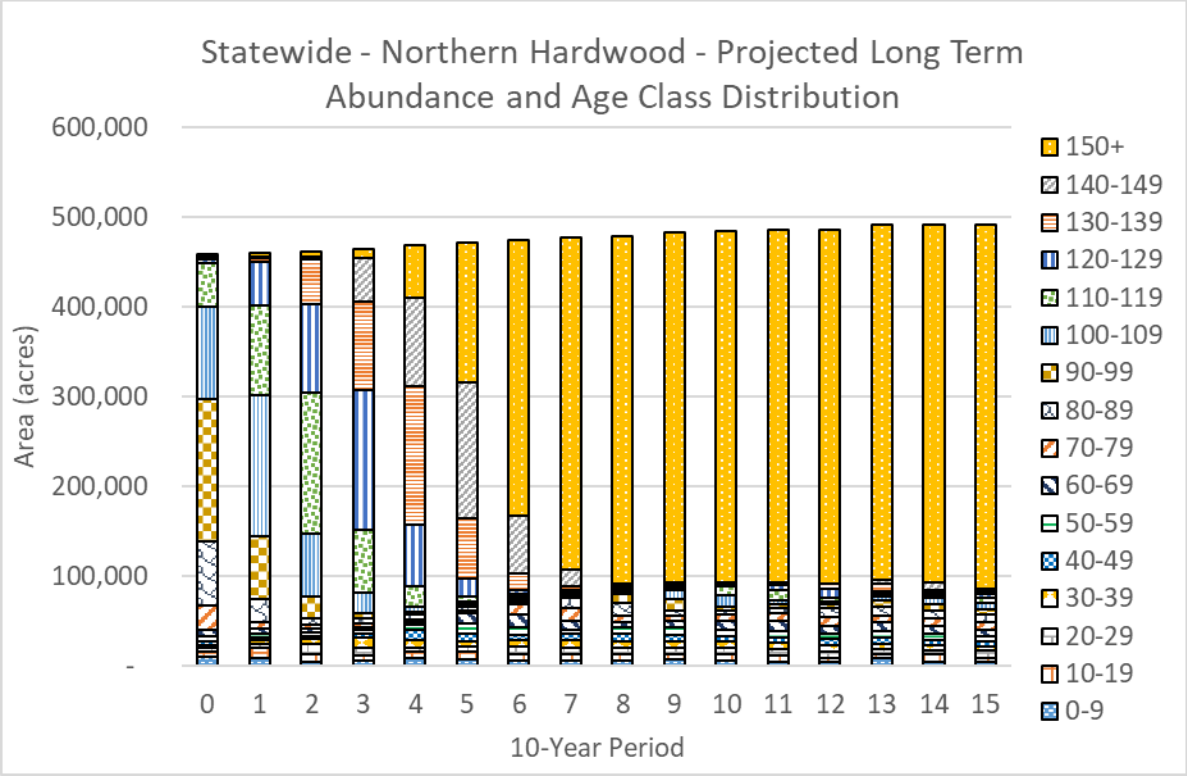


Figure 9. Northern Hardwood abundance by age class as projected through period 15 in the SFMP model.

Age class distribution

The current statewide age class distribution of the northern hardwood cover type is heavily skewed toward the 80-90, 90-100, and the 100-109 age classes because of widescale harvesting that occurred in the early 1900s through 1940 (Figure 9). Figure 10 depicts what the current dominant age cohort will represent as stands are managed into the future until they reach an uneven-aged condition where more than three distinct age cohorts exist in most stands.

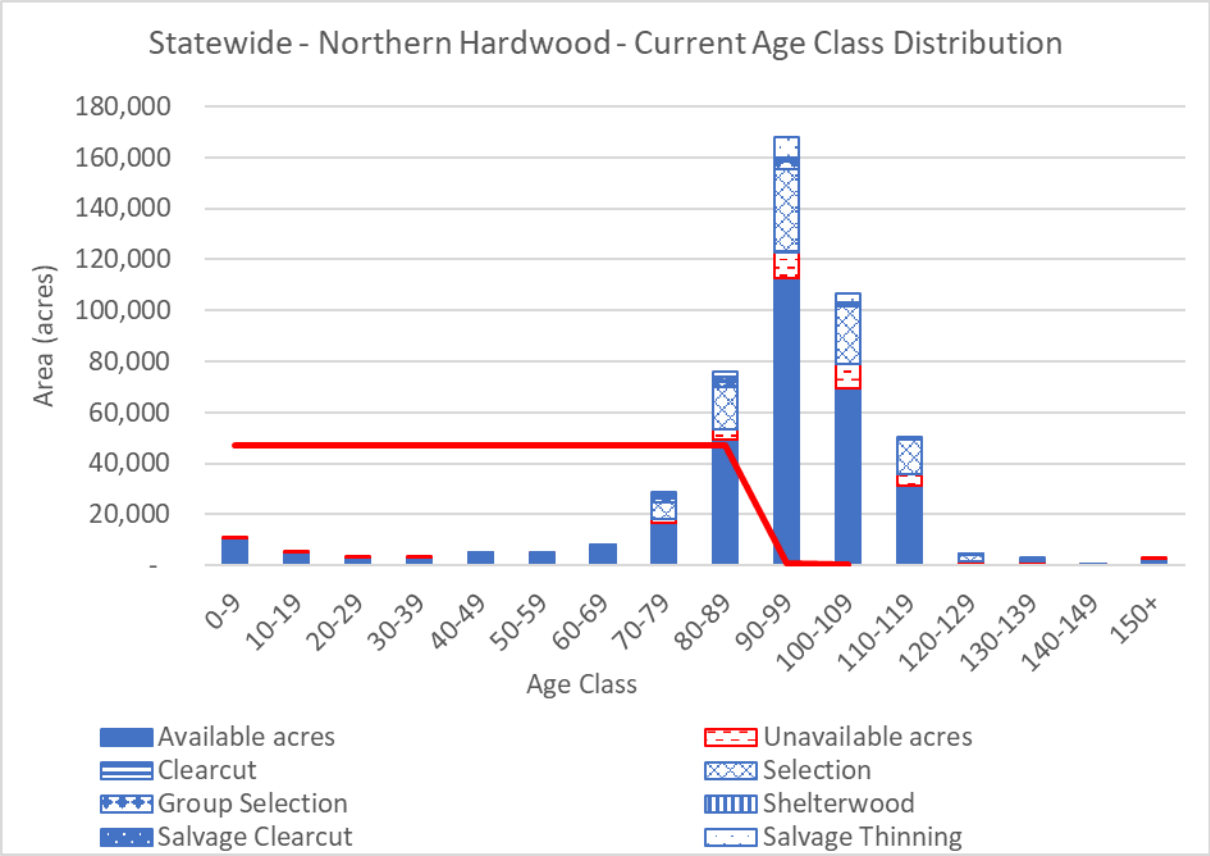


Figure 10. Current statewide northern hardwood age class distribution and projected period one harvests.

Strategic harvest objectives for the next planning period will focus on ensuring that the desired number of acres are maintained in the optimal basal area classes maximizing growth, establishing larger canopy gaps to promote better regeneration and recruitment and improving overall stand quality by removing poor quality and high-risk stems. In general, the 111-140 basal area class will be targeted for application of selection harvests with a goal of reducing the basal are to the 51-80 basal area class as shown in Figure 10 and 11. There will also be harvests prescribed in the 141-170 and a small amount projected from the 81-110 basal area classes.

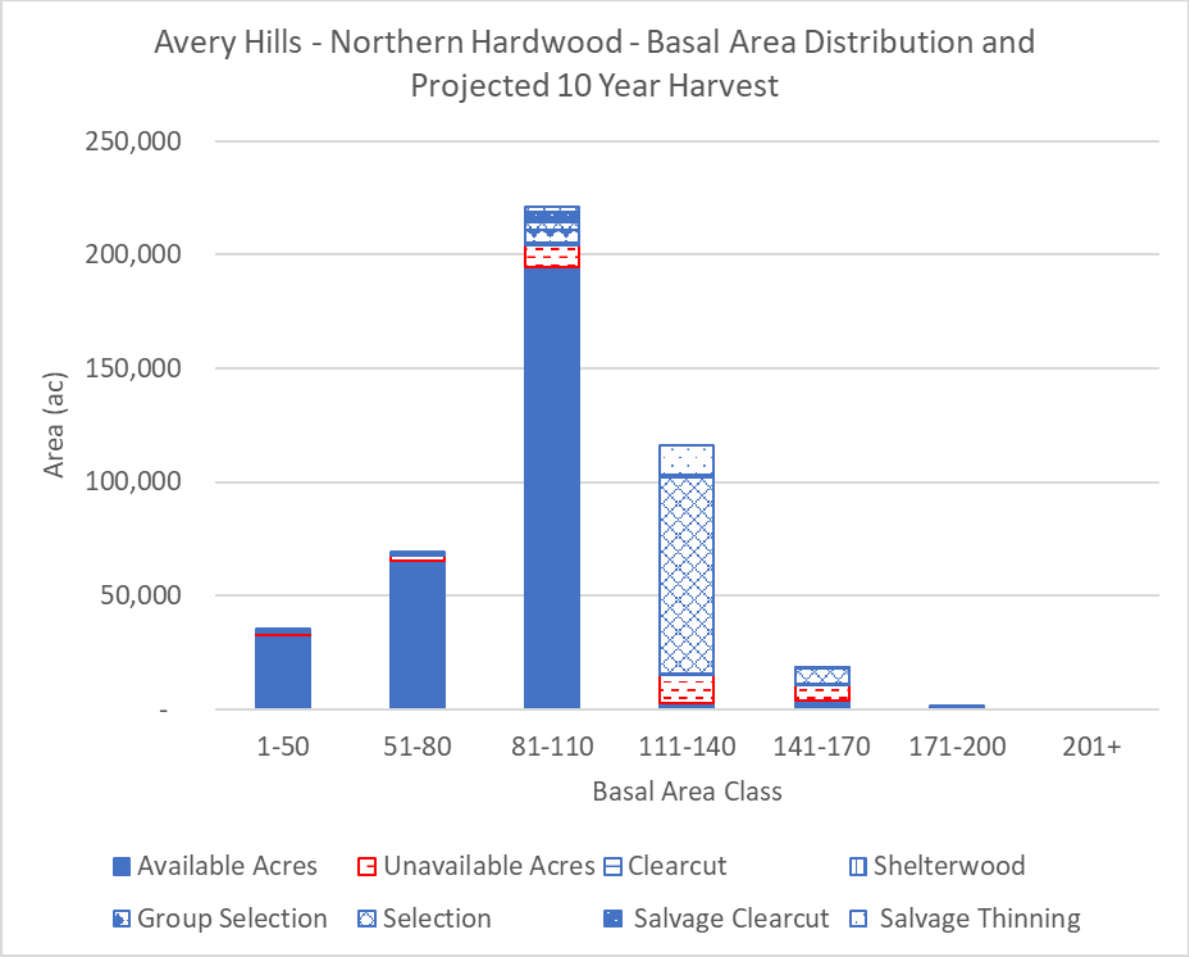


Figure 11. Graph representing the basal area distribution and projected harvests for the planning period in the northern hardwood cover type.

Silvicultural regimes

Most stands across the state forest had their first thinning in the late 1970s and 1980s, which was aimed at thinning for stand improvement (TSI). Second entries into these stands in the 1990s and 2000s focused on crop tree release, crown spacing and continued development of stand and stem quality while removing high-risk trees. The 2010s through the present have seen more emphasis on larger gap creation to stimulate more regeneration and recruitment of desirable northern hardwood species including sugar maple, black cherry, yellow birch, basswood and red maple.

Single-tree selection, small group selection, and group selection regimes will be applied to most of the northern hardwood cover type (Figure 10 and 11 and Table 4) following the newly developed interim "Gap Guidance" memo (Appendix I). These silvicultural systems are designed to maintain optimal stem density while establishing new age cohorts of seedlings. They are also intended to encourage the recruitment of new saplings, poles, and log-sized trees and, with subsequent re-entries, eventually result in an uneven-aged structure. Most stands have not yet reached an uneven-aged condition across the state due to difficulties with seedling establishment and recruitment. Some significant progress has

been made in the northern half of the Upper Peninsula at establishing successful regeneration and recruitment where herbivory is at its lowest levels.

Other silvicultural methods such as clearcut, seed tree, and shelterwood with overstory removal will be used on stands where there is an insufficient number of crop trees per acre to warrant a selection system (Table 4). In these cases, it is often desirable to "restart" a stand to improve stem density, stem quality, and species composition, resulting in a stand that can be managed on an uneven-aged system in the future.

Objectives and management actions

Objective 1. Increase northern hardwood slightly by 0.2 percent (about 1,000 acres) over the next decade, ensuring stands converting to northern hardwood are on well-suited sites to help mitigate climate change risks (Figure 8).

Objective 2. Maintain the desired basal area distribution by harvesting acres from the 111-140 and greater basal area classes with a combination of thinning and single-tree selection systems to ensure optimal growing conditions and establish larger canopy gaps. This should improve seedling regeneration and recruitment.

- Action 1. Prescribe about 103,881 acres of northern hardwood for selection and group selection harvests by the end of the planning period (Figure 11, Table 4).
- Action 2. Perform salvage thinning harvests as needed to capture volume from damaged trees and improve overall stand health on a projected 15,571 acres in the eastern Lower Peninsula.

Objective 3. Strategically select stands for regeneration harvests using a combination of clearcut, seed tree, and shelterwood systems to restart stands and improve stem quality, density, and species composition.

- Action 1. Prescribe about 4,790 merchantable acres for clearcut/seed tree and shelterwood harvests from any age or size class throughout the next decade (Table 4).
- Action 2. Perform 6,020 acres of salvage clearcut harvests on severely damaged stands of northern hardwood (Table 4).

Objective 4. Maintain or increase wildlife habitat within stands and across the landscape.

- Action 1. While selecting individual trees for harvest in selection systems, protect existing den trees and snags and retain some trees that may become future den trees or snags.
- Action 2. When selecting stands for treatments that would result in a canopy closure less than 75 percent, inform that decision with the "Contiguous Areas of Mature Forest" polygons and avoid reducing the size of these areas when possible.

Cedar

The cedar cover type makes up approximately 7 percent of the state forest and is most commonly found in lowland areas with higher soil nutrient content and high soil moistures. This cover type is comprised of primarily northern white cedar, black spruce, tamarack, and balsam fir. Associated species that are commonly mixed in are paper birch, red maple, black ash and white pine. (Figure 12, Michigan DNR Forest Inventory Data, 2021). Pole-sized logs make up about 70 percent of the cedar canopy (Figure 13).

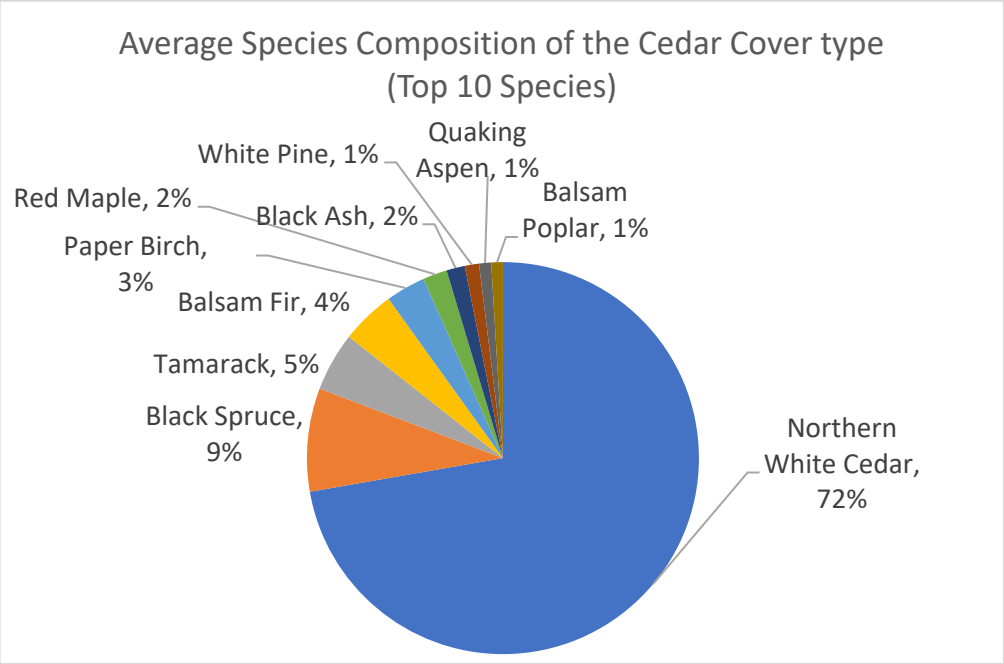


Figure 12. Average species composition of the Cedar cover type, state forest wide.

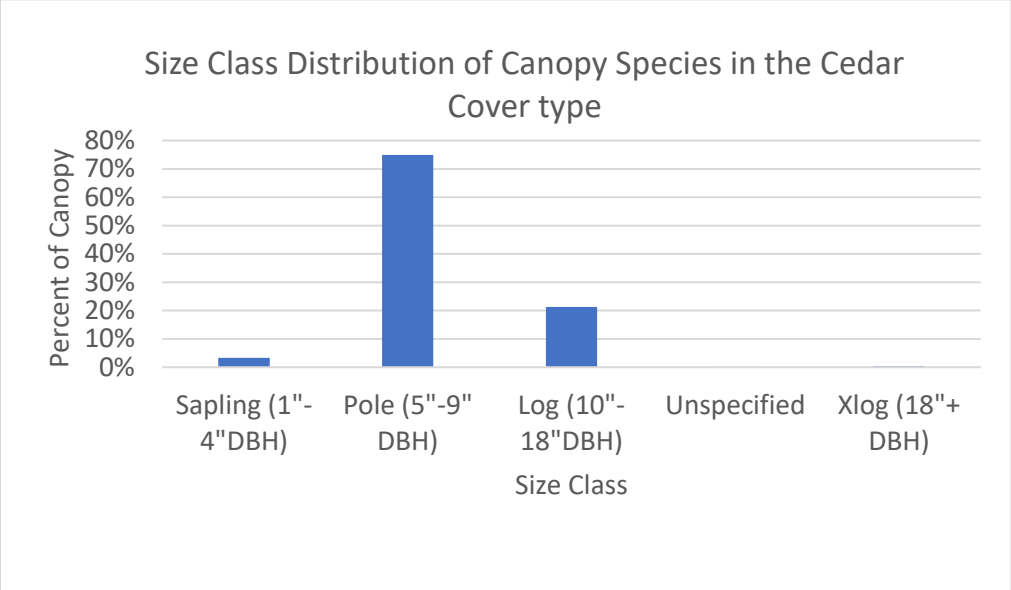


Figure 13. Average size class distribution of the cedar cover type.

Cover type abundance

Cedar will continue to be the third-largest cover type in the state forest growing primarily on hydric sites across the landscape. Cedar provides important habitat resources, most notably as shelter for white-tailed deer. There are currently about 287,000 acres of cedar in the state forest and the population is expected to remain stable during the next planning period with very minor cover type conversions.

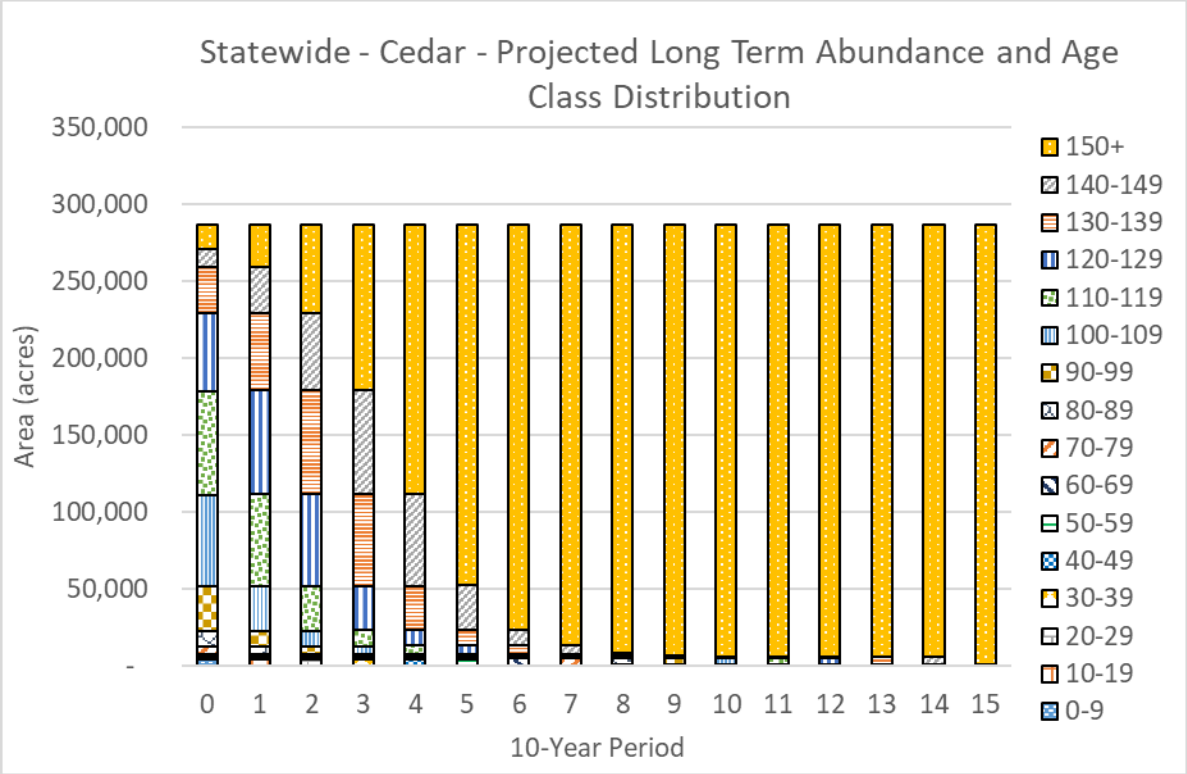


Figure 12. Cedar abundance by age class as projected through period 15 in the SFMP model.

Age class distribution

The statewide age class distribution of the cedar cover type is heavily skewed toward the 91-100 through the 130-139 age classes because of widescale harvesting that occurred in the late 1800s through 1940 (Figure 12). The majority of the cedar cover type cannot be managed and the dominant age classes will reach 150+ years old within the next 50 years. About 19 percent of the cover type is available for management (not impacted by site conditions limiting harvest operations). Current challenges regarding regeneration and recruitment need further research before available acres can be confidently managed. Long-term management of the type could eventually result in about 50,000 acres of the population represented across all 15 age classes (Figure 12).

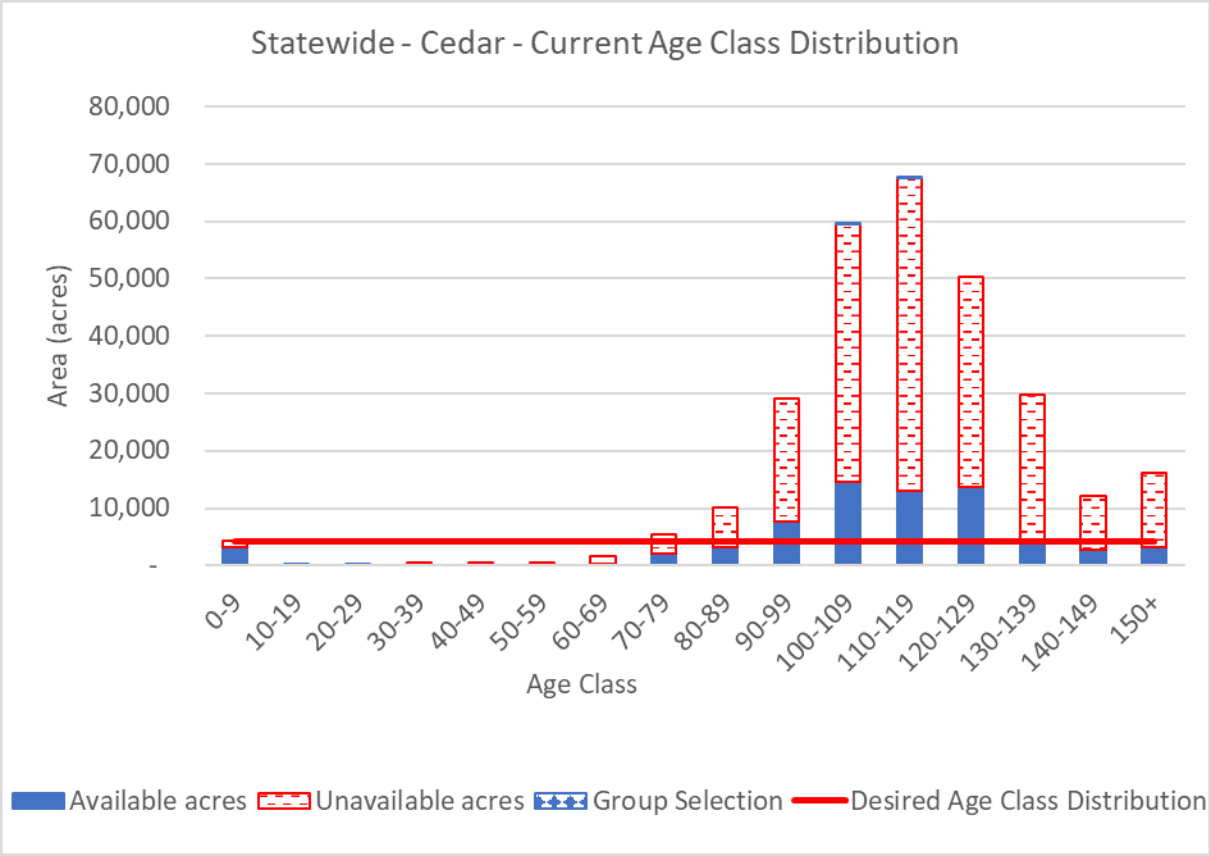


Figure 13. Current statewide cedar age class distribution, projected period one harvests and desired age class distribution.

The mid-term strategic harvesting objectives for this planning period will be limited to only a few areas where regeneration research or experimentation is occurring. The northern tier of a few management areas in the Upper Peninsula has had some past examples of success in regenerating cedar and will opportunistically continue to have some co-management prescriptions made throughout the decade. These limited harvests for the next planning period are shown in figures 13 and 14.

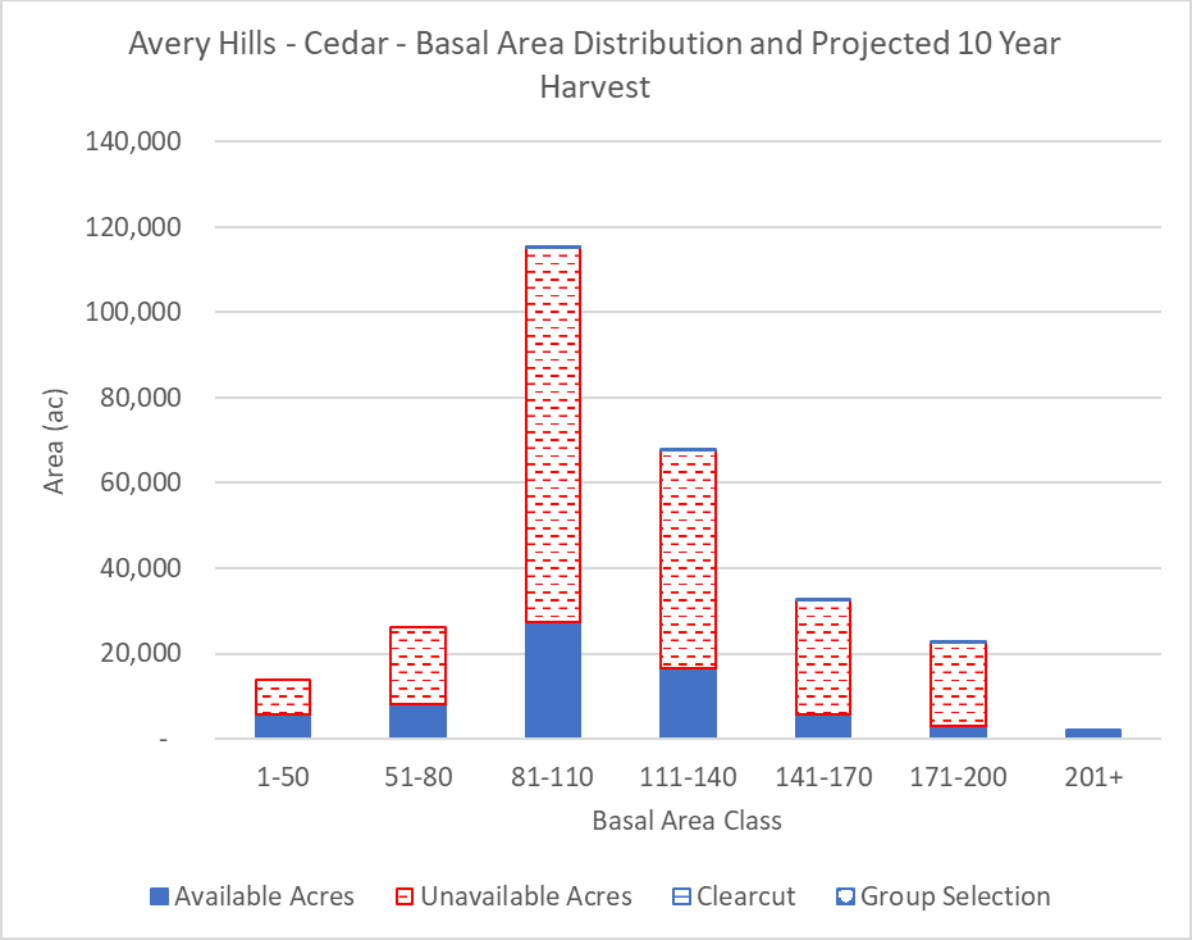


Figure 14. Graph representing the basal area distribution and projected harvests for the planning period in the cedar cover type.

Silvicultural regimes

The limited cedar harvest will be managed with both even-aged and uneven-aged silvicultural systems during the next decade. The seed tree system will be the most commonly applied even-aged system (seed tree is grouped with clearcut for modeling purposes) where the majority of stems are harvested and seed trees are left to disperse seed and establish natural regeneration across a scarified site. Uneven-aged systems such as patch cuts, strip cuts, and large group selections are also used to regenerate cedar stands while leaving a mature component of the stands intact for seed production and wildlife habitat purposes. There are less than 100 acres of harvest planned statewide over the next decade (Table 5).

Objectives and management actions

Objective 1. Maintain the cedar cover type in stable condition with no decrease in acres as a result of conversion to other cover types over the next decade (Table 5).

Objective 2. Strategically select stands for regeneration harvests using a combination of seed-tree and group selection systems to regenerate stands in alignment with research projects and experimentation.

- Action 1. Prescribe about 84 acres of cedar for clearcut/seed-tree and group selection harvests from any merchantable age or size class throughout the next decade (Table 4).

Objective 3. Maintain or increase wildlife habitat within stands and as part of deer wintering complexes across the landscape.

- Action 1. While selecting individual trees for harvest in selection systems, protect existing den trees and snags and retain some trees that may become future den trees or snags.
- Action 2. Avoid prescribing stands that are part of deer wintering complexes for treatments that would result in a loss of thermal cover for white-tailed deer and other priority species.

Objective 4. Support research projects to help determine effective ways to regenerate cedar.

- Action 1. Continue to invest in, and partner with, universities in cedar research in Michigan.

Lowland conifer

The lowland conifer cover type makes up approximately 5 percent of the state forest and is commonly found in lowland areas with moderate soil nutrient content and high soil moistures. This cover type is comprised primarily of northern white cedar, black spruce, balsam fir, tamarack, and red maple. Associated species that are commonly mixed in are paper birch, white pine, hemlock, quaking aspen, and black ash (Figure 15, Michigan DNR Forest Inventory Data, 2021). Pole-sized logs make up about 70 percent of the canopy (Figure 16).

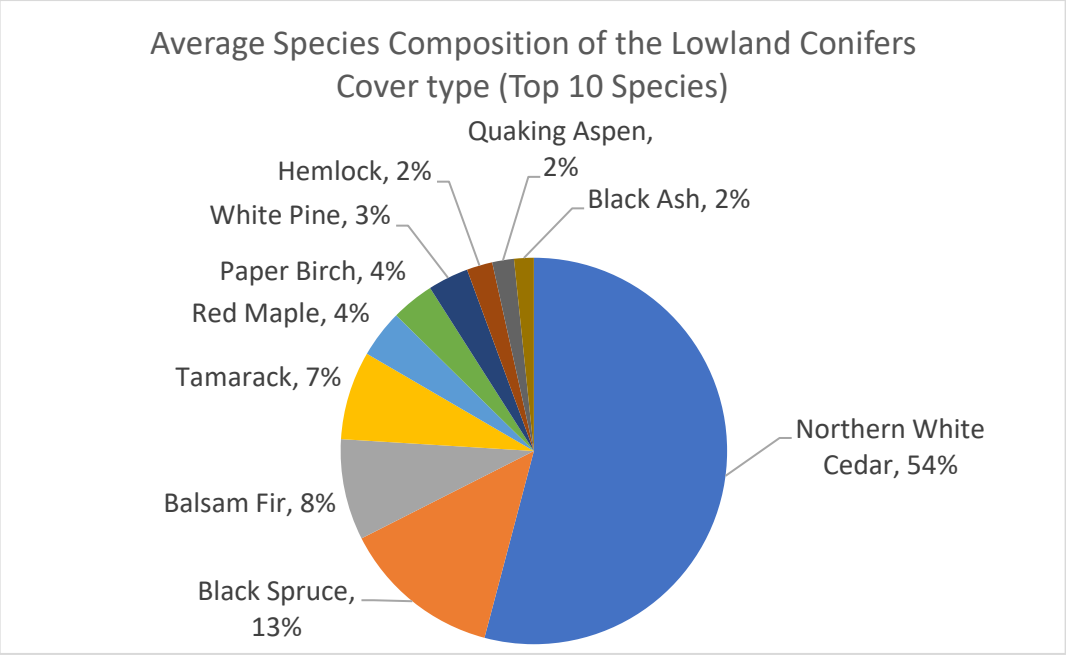


Figure 15. Average species composition of the Lowland conifer cover type, state forest wide.

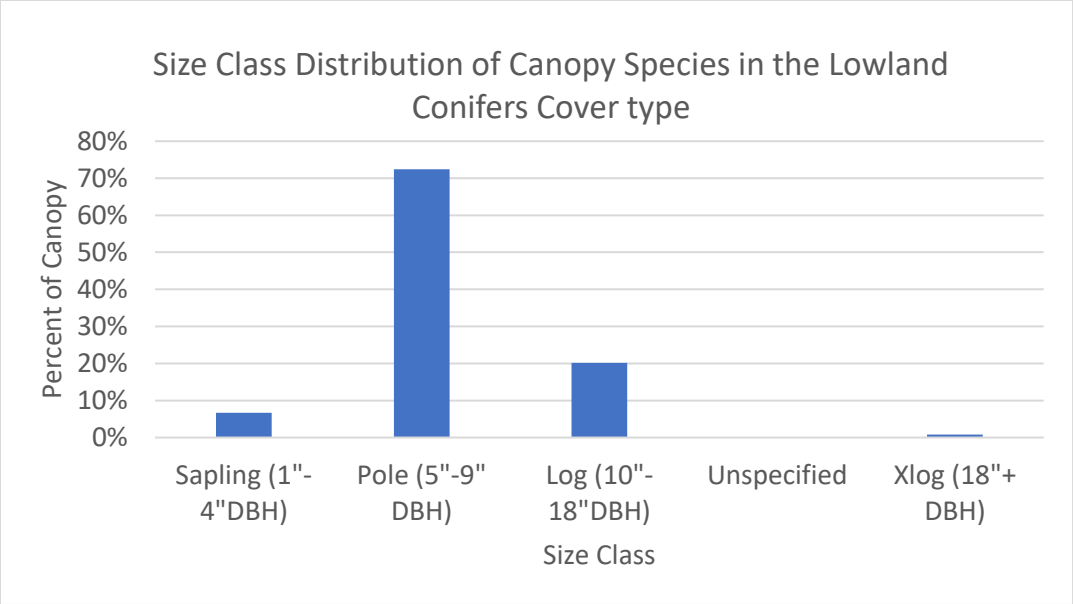


Figure 16. Average size class distribution of the lowland conifer cover type.

Cover type abundance

Lowland conifer is projected to become the fifth most abundant (currently fourth) cover type in the state forest, growing primarily on hydric sites across the landscape and providing important winter habitat resources, most notably as food and shelter for white-tail deer and snowshoe hare. There are currently about 204,800 acres of lowland conifer in the state forest and the population is expected to decrease slightly during the next planning period with only minor cover type conversions taking place, mostly to lowland mixed forest.

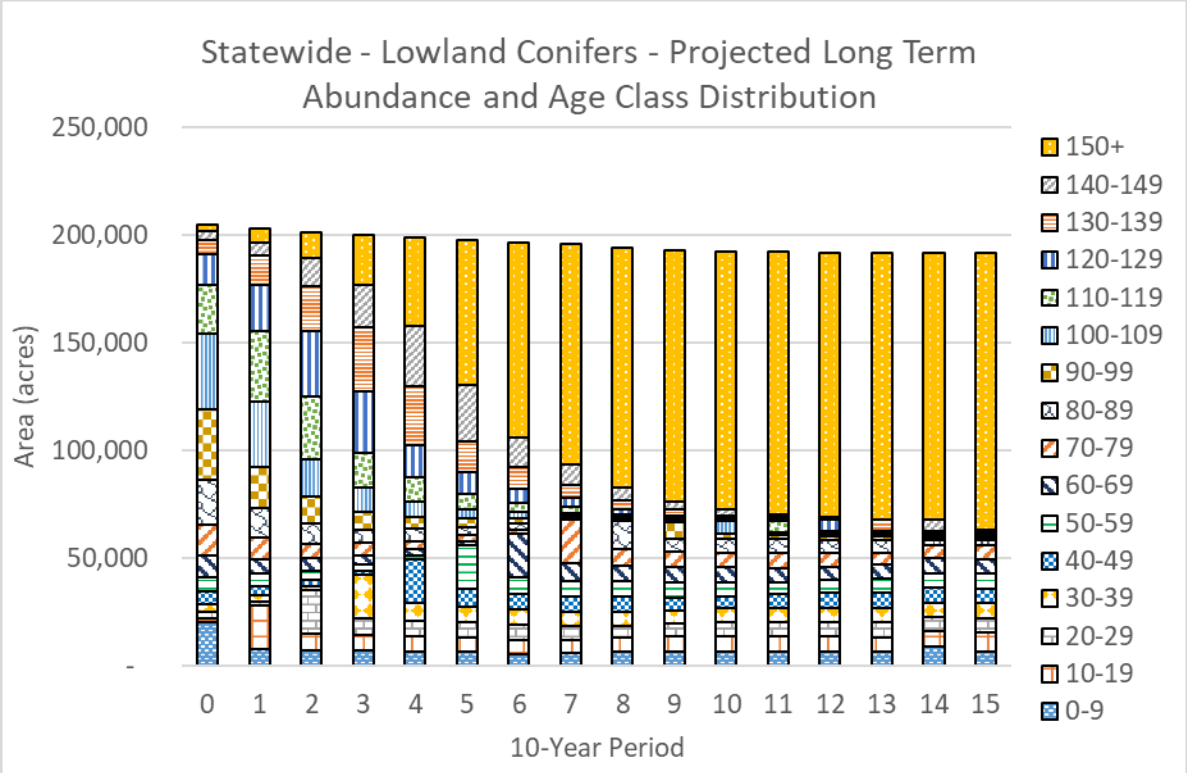


Figure 17. Lowland conifer abundance by age class as projected through period 15 in the SFMP model.

Age class distribution

The statewide age class distribution of the lowland conifer cover type is heavily skewed toward the 91-100 through the 130-139 age classes because of the wide-scale harvesting that occurred in the late 1800s through 1940 (Figure 17). Most of the lowland conifer cover type cannot be managed and the dominant age classes will reach 150+ years old within the next 50 years. About 19 percent of the cover type is projected to be managed over the long term (150 years) and will eventually result in about 50,000 acres of the population represented across all 15 age classes (Figure 18).

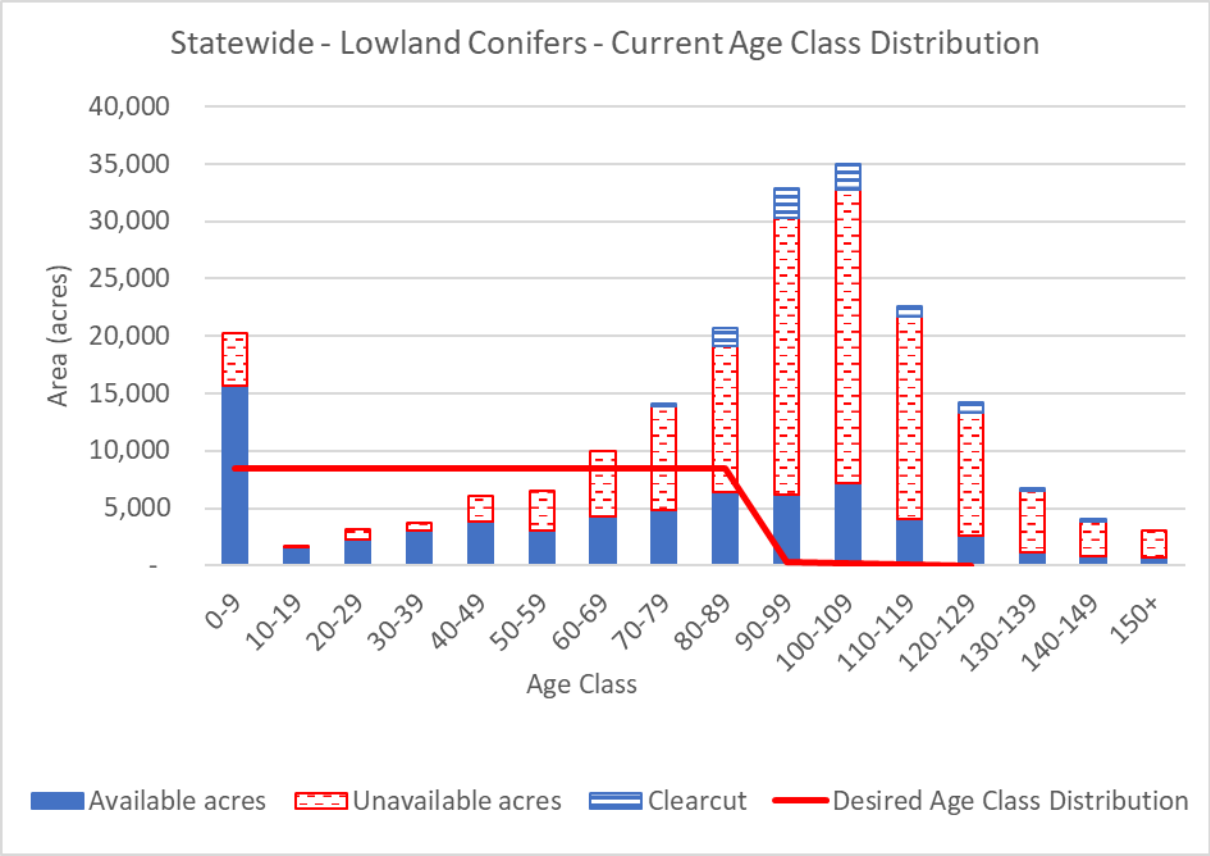


Figure 18. Current statewide lowland conifer age class distribution, projected period one harvests and desired age class distribution.

The mid-term strategic harvesting objectives for the next planning period will be limited to areas where the best chances for successful regeneration are found. The limited harvests for the next planning period will be focused on ensuring the desired amount of lowland conifer is regenerated to achieve a desirable age class distribution of the manageable population shown in blue in Figure 19. After 100 years, lowland conifers will have a balanced age class distribution, outside of the 150+ age class (Figure 20). Figure 21 shows the basal area distribution after the 10-year planning period.

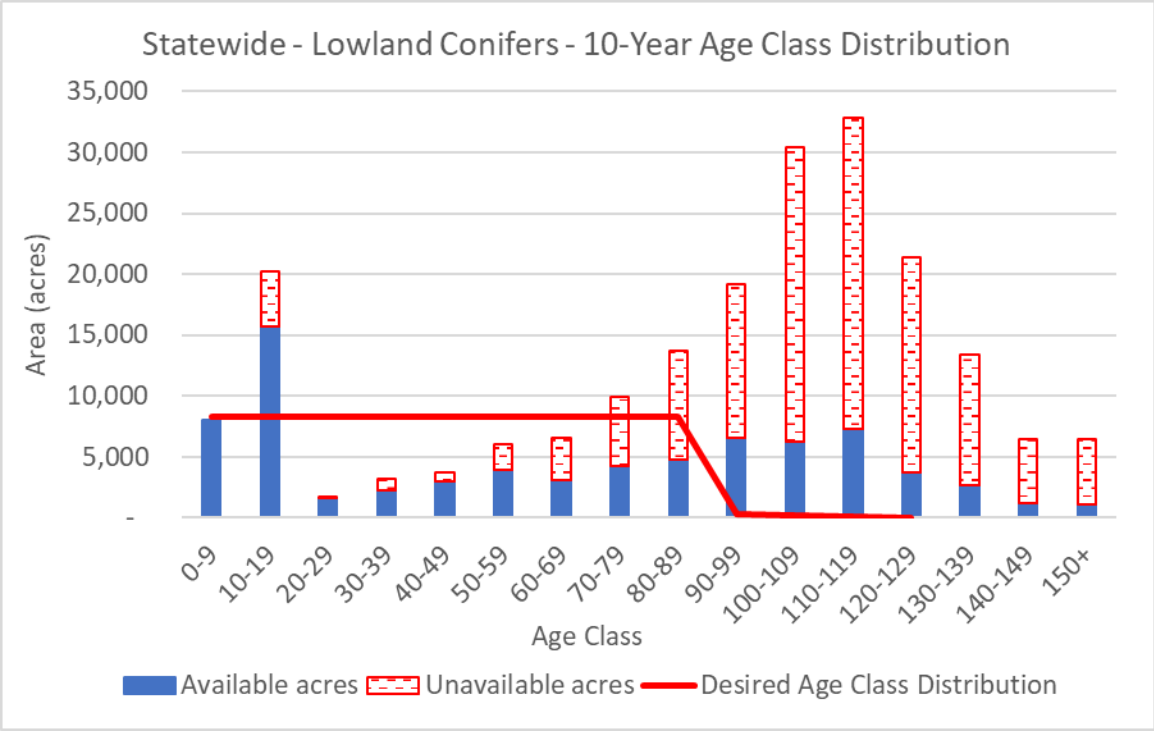


Figure 19. Age class distribution of lowland conifer cover type after this planning period's management has been implemented.

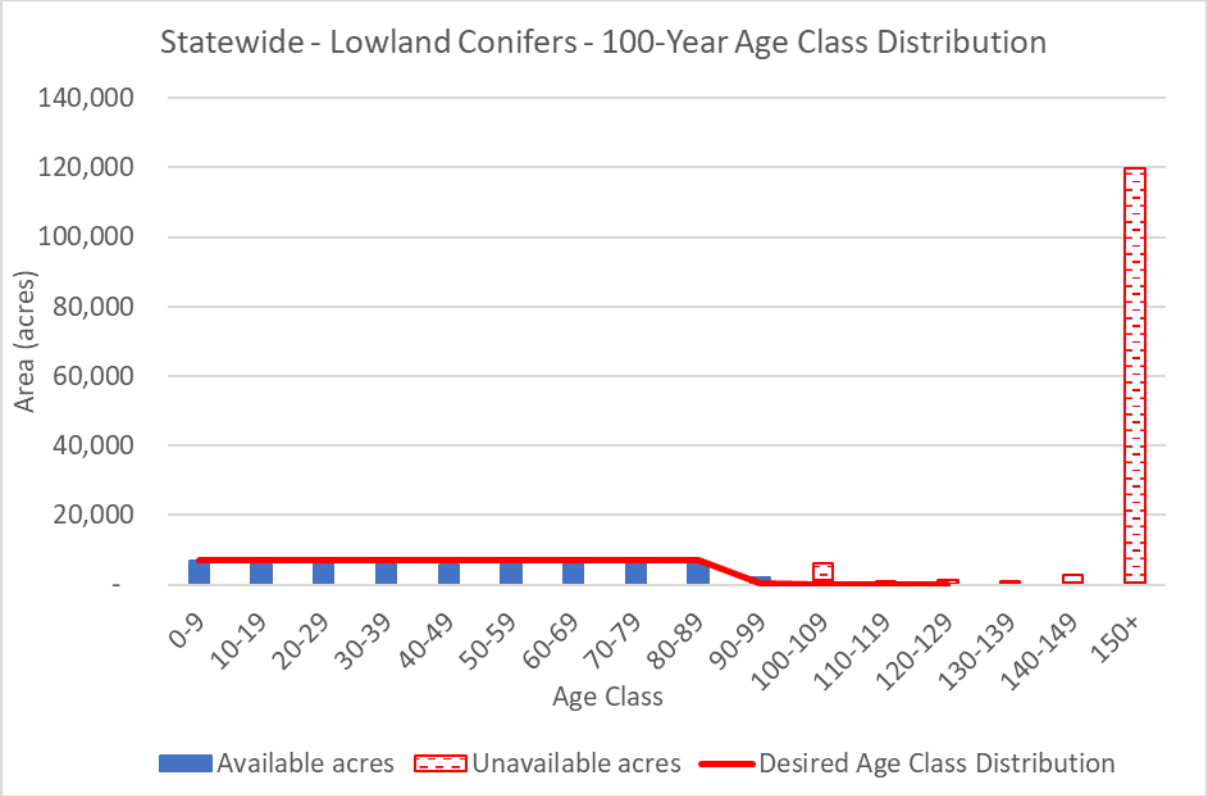


Figure 20. Balanced age class distribution after 100 years of even-aged management of the available acreage.

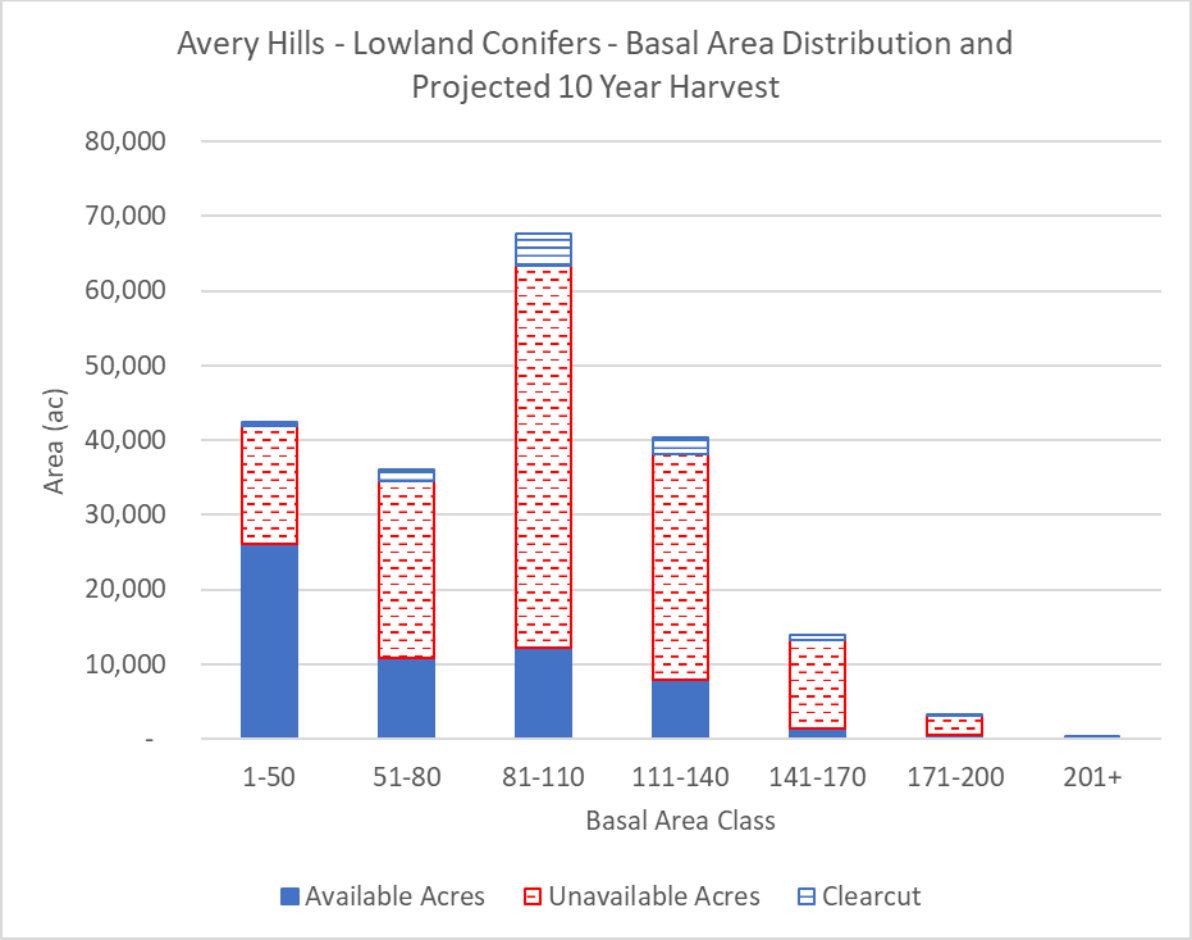


Figure 21. Graph representing the basal area distribution and projected harvests for the planning period in the Lowland conifer cover type.

Silvicultural regimes

Lowland conifer will be managed primarily with even-aged silvicultural systems during the next decade including clearcut and seed-tree harvests. There are about 9,936 acres of planned regeneration harvests over the next decade (Table 5) to help balance the age class distribution of the manageable acres.

Objectives and management actions

Objective 1. Maintain the Lowland conifer cover type in stable condition with only a minor decrease in acres projected (less than 1,936 acres or 0.9 percent) as a result of conversion to other cover types (mostly lowland mixed forest) over the next decade (Figure 8).

Objective 2. Strategically select stands for regeneration harvests using a combination of clearcut and seed-tree systems to regenerate stands and improve the age class distribution of the manageable population.

- Action 1. Prescribe about 9,624 acres of Lowland conifer for clearcut and seed-tree harvests from any merchantable age or size class throughout the next decade (Table 4).

Objective 3. Maintain or increase wildlife habitat within stands and as part of deer wintering complexes across the landscape.

- Action 1. While selecting individual leave trees in seed-tree systems, protect existing den trees and snags and retain some trees that may become future den trees or snags.
- Action 2. Identify and avoid areas of lowland conifer stands that have a greater concentration of northern white cedar and are part of deer wintering complexes for treatments that would result in a loss of thermal cover for white -tailed deer and other priority species.

Planted red pine

The planted red pine cover type makes up approximately 5 percent of the state forest and is most commonly found in upland areas with moderate soil nutrient content and lower soil moistures, although it has been established on a wide array of sites across the state forest. This cover type is comprised of primarily red pine, white pine, jack pine, red oak, and red maple. Associated species commonly mixed in with the primary canopy species are black cherry, quaking aspen, black/red hybrid oak, northern pin oak, and bigtooth aspen (Figure 22; Michigan Forest Inventory Data, 2021). Just over 50 percent of the canopy species in the planted red pine cover type are Log sized (Figure 23).

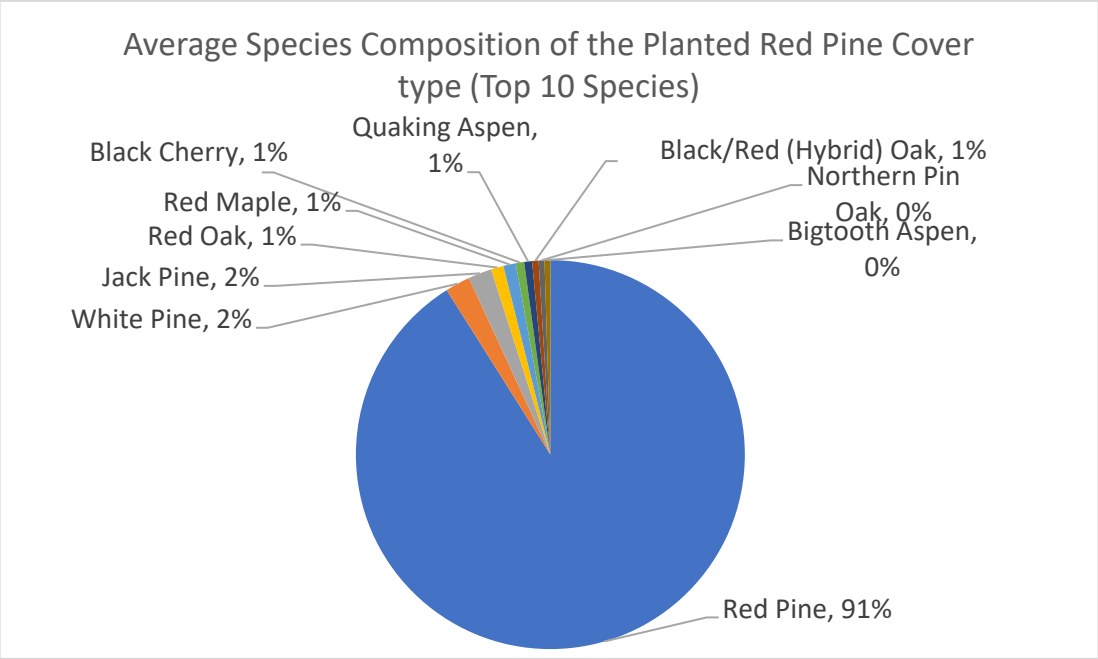


Figure 22. Average species composition of the planted red pine cover type, state forest wide.

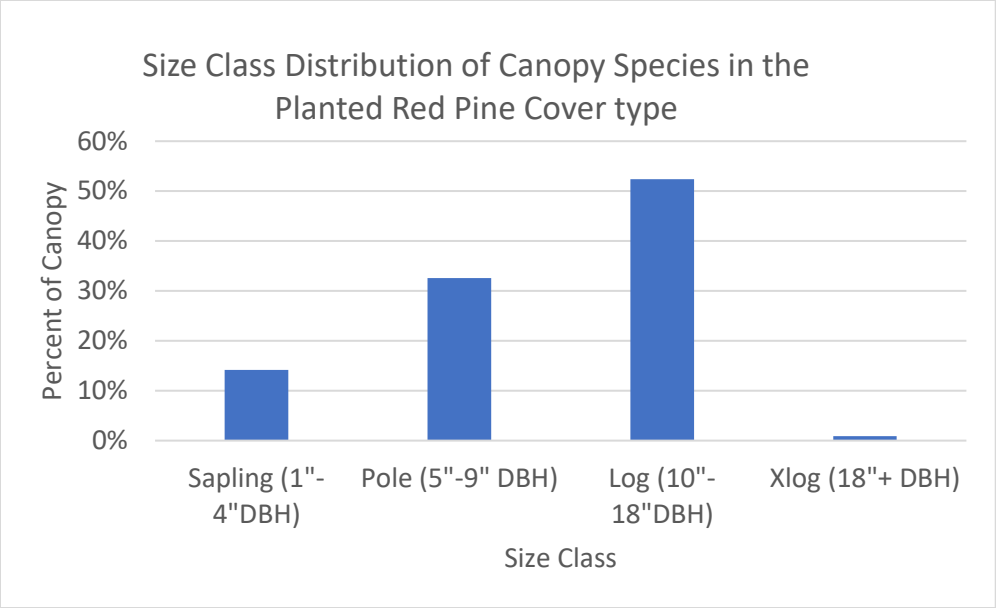


Figure 23. Average size class distribution of the planted red pine cover type.

Cover type abundance

Planted red pine is projected to stay the fifth-most abundant cover type in the state forest growing primarily on dry mesic sites across the landscape providing important timber resources, most notably as sawlog material, softwood pulp, and utility poles. There are currently about 199,800 acres of planted red pine in the state forest and the population is expected to increase slightly during the next planning period with minor cover type conversions taking place both out of and into planted red pine. Conversions from other cover types such as aspen growing on poor sites, poor -quality northern hardwood, northern hardwood stands with beech- and ash dominated sub-canopies, and poorly stocked mixed upland deciduous stands dominated by stump sprout red maple are projected to occur. Conversely, some planted red pine stands with advanced oak or northern hardwood species are planned to be converted to those respective cover types through clearcut harvests or overstory removals.

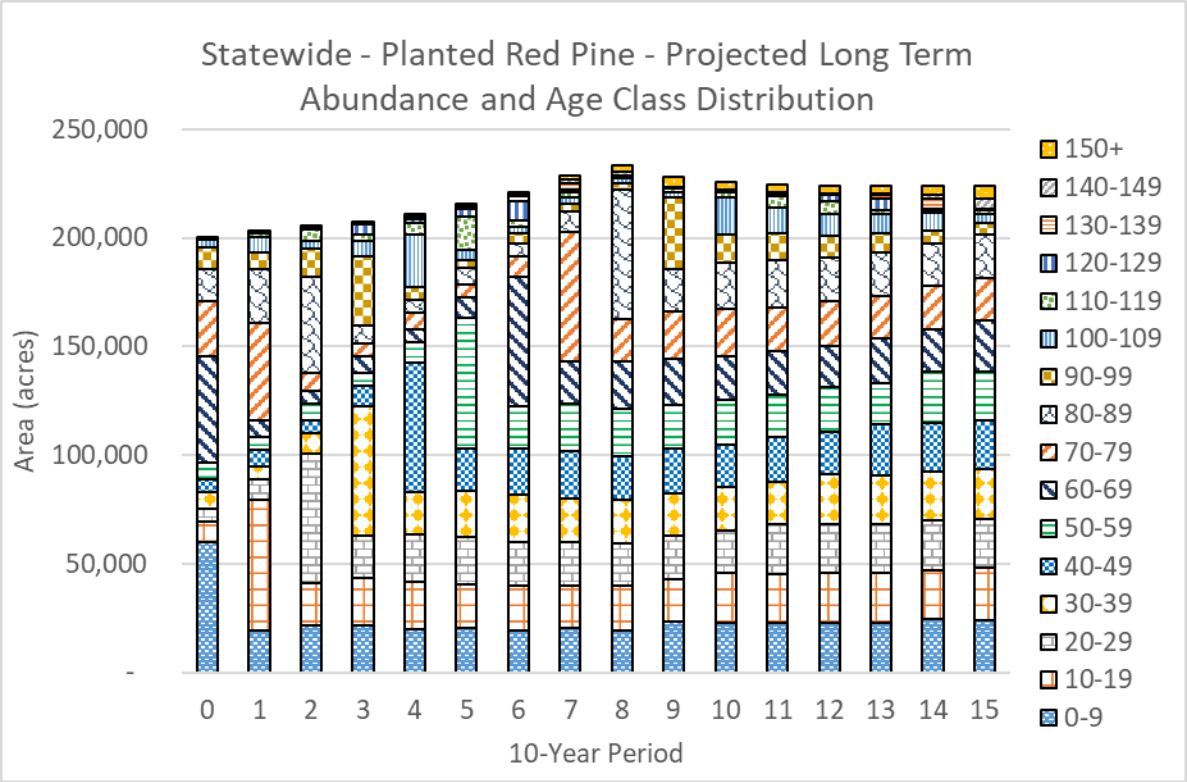


Figure 24. Planted red pine abundance by age class as projected through period 15 in the SFMP model.

Age class distribution

The statewide age class distribution of the planted red pine cover type is unbalanced with a significant portion of the population being in the youngest (0-9) or older age classes (60+ years old) with very little acreage in between (Figure 24). It is important to note that the 0-9 age class reflects a projected number of acres that will be in place once all of the acres in the process of being re-planted are accomplished. This may take more than 10 years in some instances, resulting in a portion of the current 0-9 acres shown not actually being there until the next planning period. This will result in a more even distribution between the 0-9 and 10-19 age classes at the beginning of the next planning period.

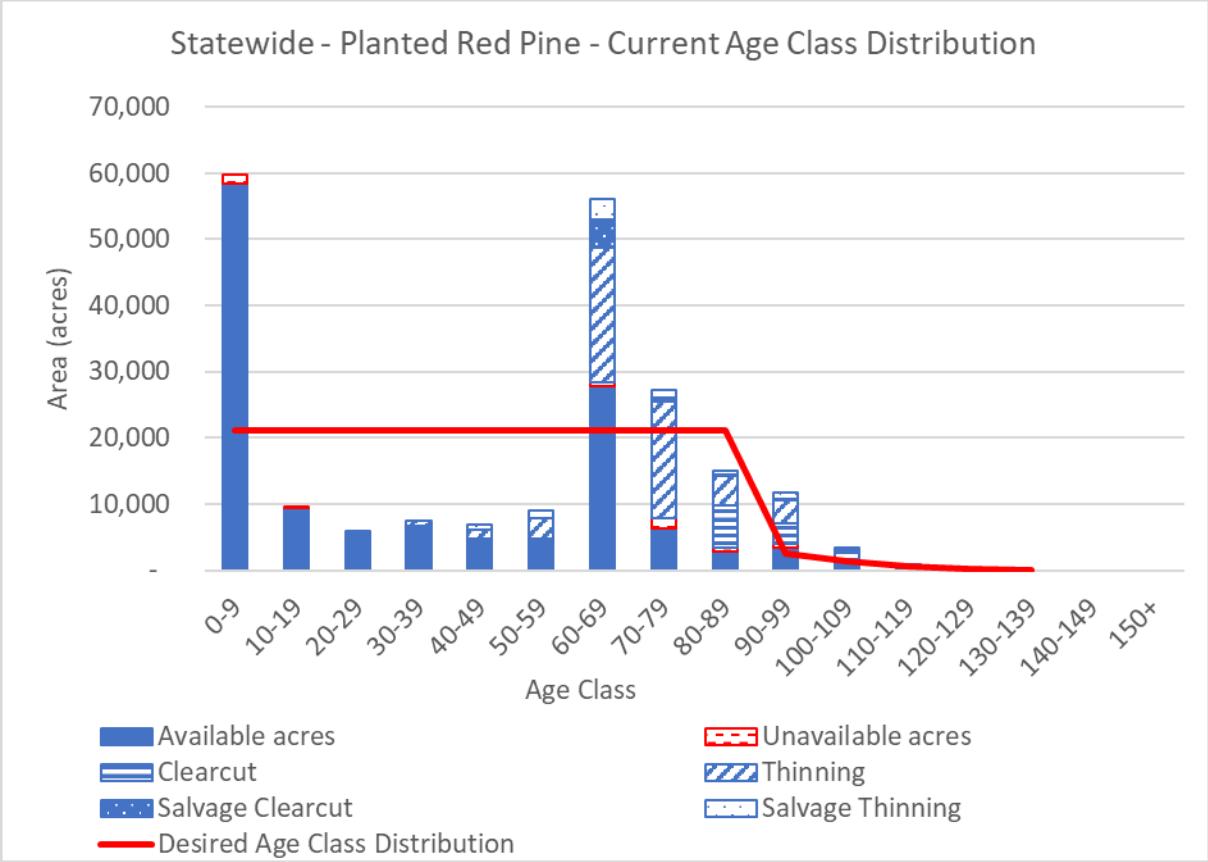


Figure 25. Current statewide planted red pine age class distribution, projected period one harvests and desired age class distribution.

The mid-term strategic harvesting objectives for the next planning period include a sharp focus on ensuring the desired amount of planted red pine is regenerated (indicated by the red line in Figure 25) to work towards a desirable age class distribution of the manageable population while ensuring the merchantable population of acres provides a relatively even flow of wood volume to the market in the interim. The lull in available acres reaching merchantable age classes must be balanced by the surplus of acres in older age classes. Intermediate thinning will also be used to maintain healthy stands of planted red pine ensuring that stems do not exceed economic maturity as the population is managed toward a more balanced condition (Figures 26 and 27). Over 80,000 acres is classified as basal area 1-50, and the next most abundant is basal area class 111-140 and 141-170, at just over 50,000 acres and about 35,000 acres respectively (Figure 28).

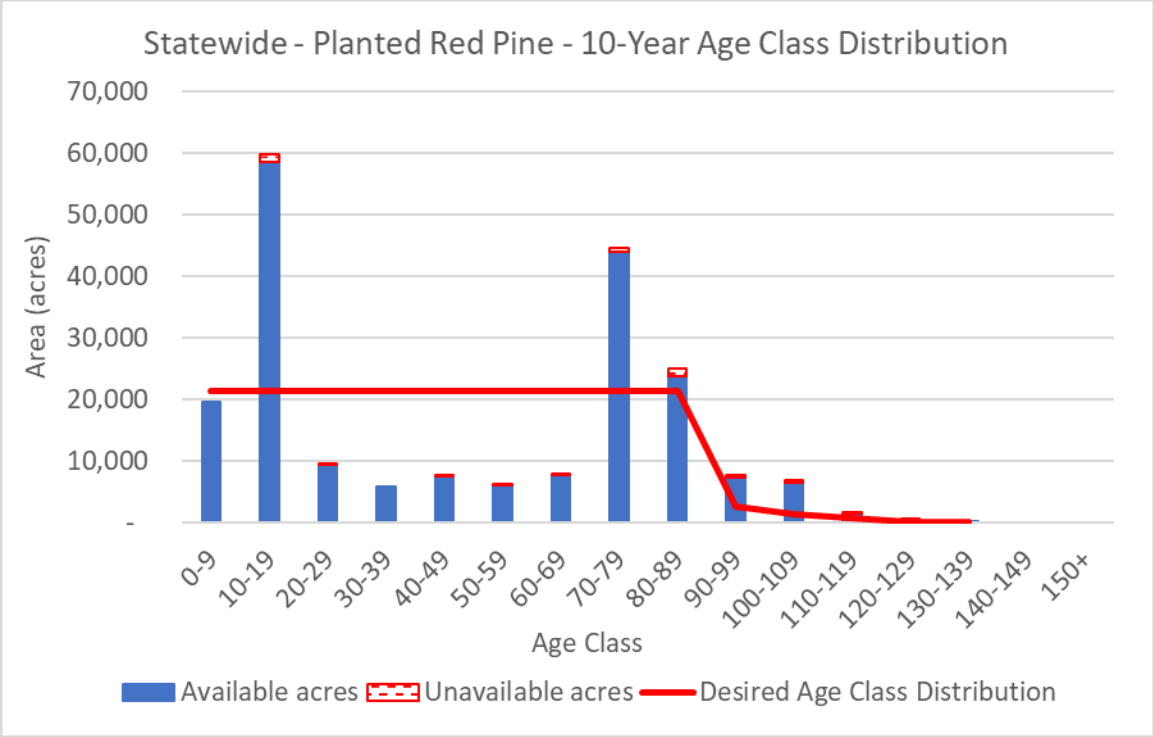


Figure 26. Age class distribution of planted red pine cover type after this planning period's management has been implemented.



Figure 27. Balanced age class distribution after 100 years of even-aged management of the available acreage.

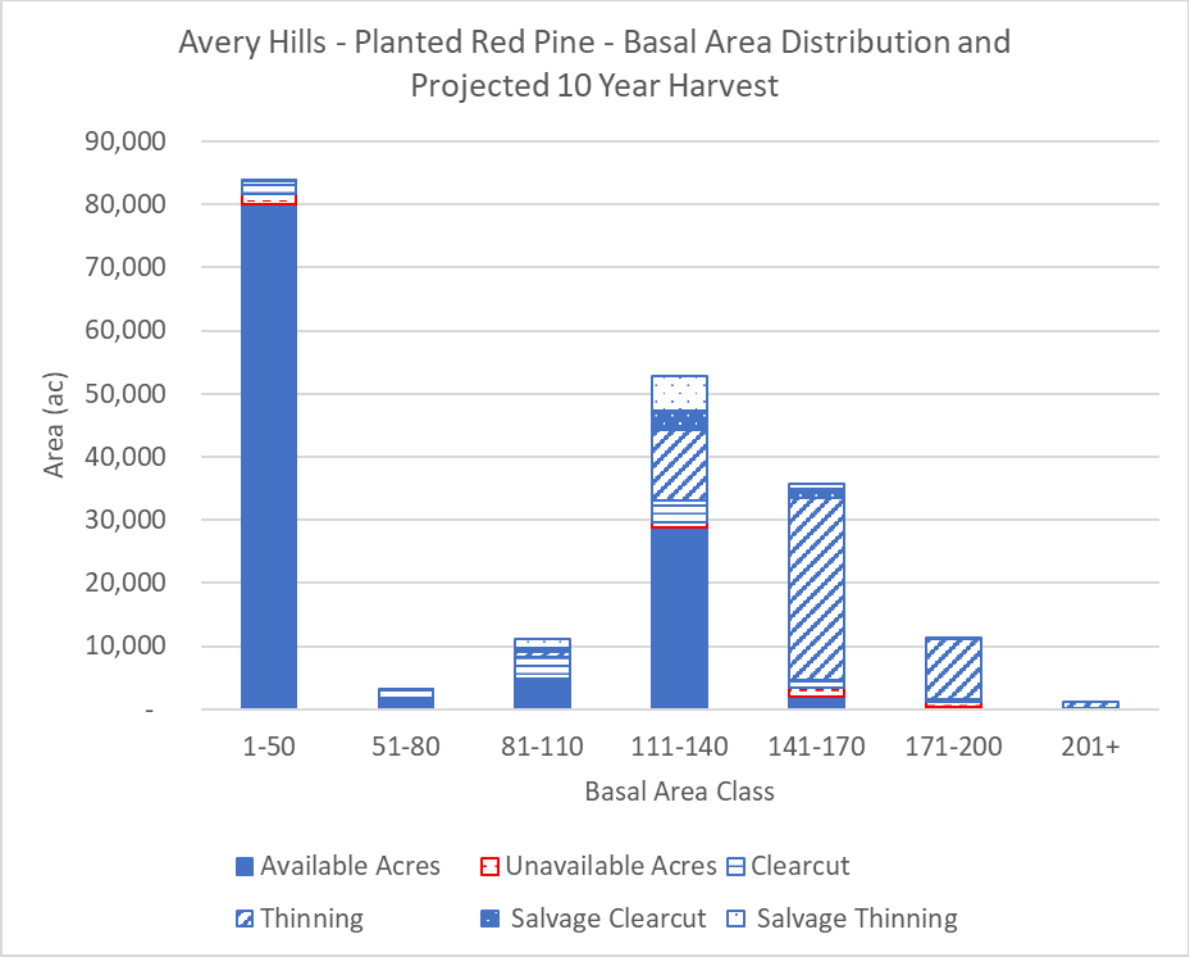


Figure 28. Graph representing the basal area distribution and projected harvests for the planning period in the planted red pine cover type.

Silvicultural regimes

Planted red pine will be managed primarily with even-aged silvicultural systems during the next decade including clearcut harvests mixed with intermediate thinning on stands not being regenerated. There are about 15,202 acres of planned regeneration harvests over the next decade to help build a balanced age class distribution of the manageable acres, as shown in the 0-9 age class of Figure 25. The majority of harvest acres will come from intermediate thinnings with a projected 57,213 acres of harvest (Table 5). These intermediate thinnings are planned on stands with basal areas at or above 140 with some limited thinning on older stands with slightly lower stem densities.

Objectives and management actions

Objective 1. Increase the planted red pine cover type acres by about 2,806 acres, or 1.4 percent, as a result of conversion from other cover types over the next decade.

Objective 2. Strategically select stands for regeneration harvests using clearcut and replant silvicultural regimes to artificially regenerate stands and improve the age class distribution of the manageable population.

- Action 1. Prescribe about 16,619 acres of planted red pine for clearcut harvests (including 6,020 acres of salvage clearcut in the eastern Lower Peninsula) from any merchantable age or size class throughout the next decade and replant to red pine (Table 4).
- Action 2. Prescribe about 2,806 acres of other cover types (e.g., mixed upland deciduous, aspen, northern hardwood) to convert to the planted red pine cover type.
- Action 3. Reduce regeneration costs by decreasing trenching and herbicide treatments and using alternatives to chemical pesticides when they are reasonably cost effective and available to meet red pine management objectives.
- Action 4. When chemical pesticides are deemed necessary and used for site preparation, select the least toxic, narrowest spectrum products labeled for the target competing species.
- Action 5. Incorporate retention of desirable advanced natural regeneration in stands as reforestation efforts are implemented, especially focusing on pockets of oak regeneration in order to increase the species diversity of future stands.

Objective 3. Select stands for an intermediate thinning harvest to maintain optimal stand stocking and maximize growth on the highest quality stems.

- Action 1. Prescribe about 59,996 acres of planted red pine for thinning (including 8,243 acres of salvage thinning) harvests over the planning period.

Mixed upland deciduous

The mixed upland deciduous cover type makes up approximately 4 percent of the state forest and is most commonly found in upland areas with moderate soil nutrient content and lower soil moistures. This cover type is primarily comprised of deciduous species, with the most abundant species being red maple, red oak, bigtooth aspen, and quaking aspen. Associated species commonly mixed in with the primary canopy species are black/red hybrid oak, paper birch, white pine, sugar maple, and white oak. (Figure 29; Michigan Forest Inventory Data, 2021). The size class of canopy species on average are fairly evenly split between sapling, pole, and log (Figure 30).

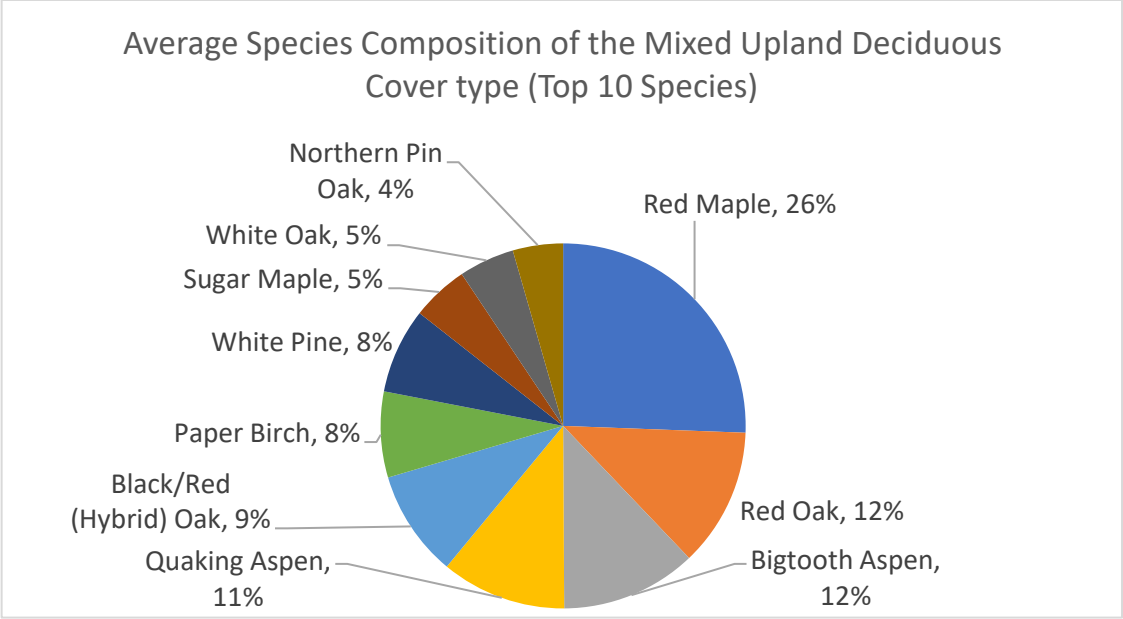


Figure 29. Average species composition of the mixed upland deciduous cover type, state forest wide.

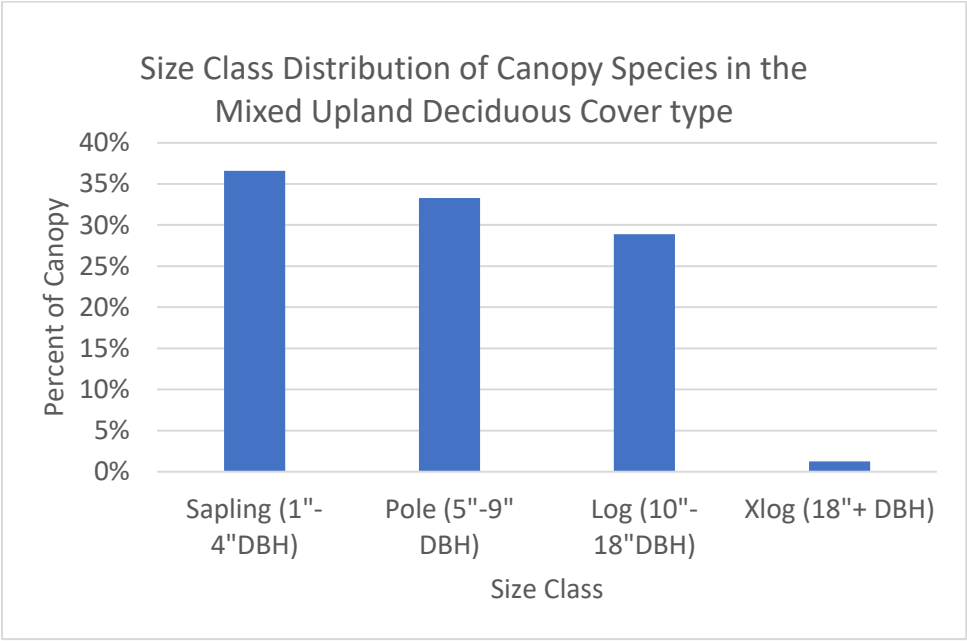


Figure 30. Average size class distribution of the mixed upland deciduous cover type.

Cover type abundance

Mixed upland deciduous is projected to remain the sixth-most-abundant cover type in the state forest, growing primarily on dry mesic sites providing a diverse mix of habitat and forest conditions typically with a substantial hard mast component. While the less desirable stump sprout origin red maple often results in only hardwood pulp production, the oak and aspen species components provide a more desirable mix of forest products and habitat. There are currently about 167,700 acres of mixed upland

deciduous in the state forest and the population is expected to increase slightly during the next planning period with minor cover type conversions taking place both out of and into mixed upland deciduous.

Conversions into this cover type from oak types are most common, as regeneration harvests are performed on the oak types. Despite the application of various silvicultural practices, it has proven very difficult to regenerate and recruit a sufficient number of oak seedlings in stands after a harvest to keep the stand in the oak cover type. Some mature mixed upland deciduous stands with low proportions of oak in their canopy are planned to be converted to planted red pineafter harvest, maintaining advanced oak regeneration in pockets where it occurs. Stands of mixed upland deciduous that have a relatively high component of aspen species will likely regenerate in the aspen cover type and this conversion has been captured in the projected slight decline of the population.

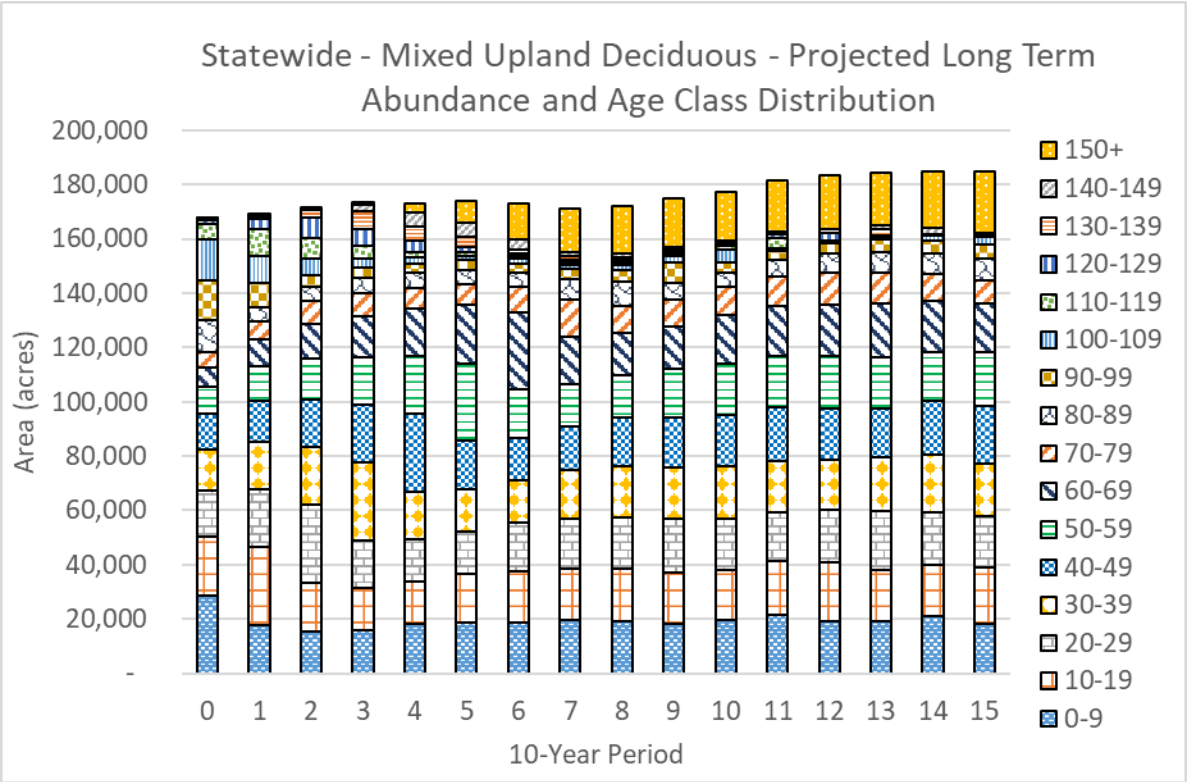


Figure 31. Mixed upland deciduous abundance by age class as projected through period 15 in the SFMP model.

Age class distribution

The statewide age class distribution of the mixed upland deciduous cover type is relatively unbalanced, with a significant portion of the population in the younger age classes (Figure 31). This skewed age class distribution can be attributed to the large amount of conversion that takes place from oak types as they are regenerated and added to the mixed upland deciduous cover type. It will take many decades to achieve a more balanced condition in this cover type as conversions stabilize (Figure 32).

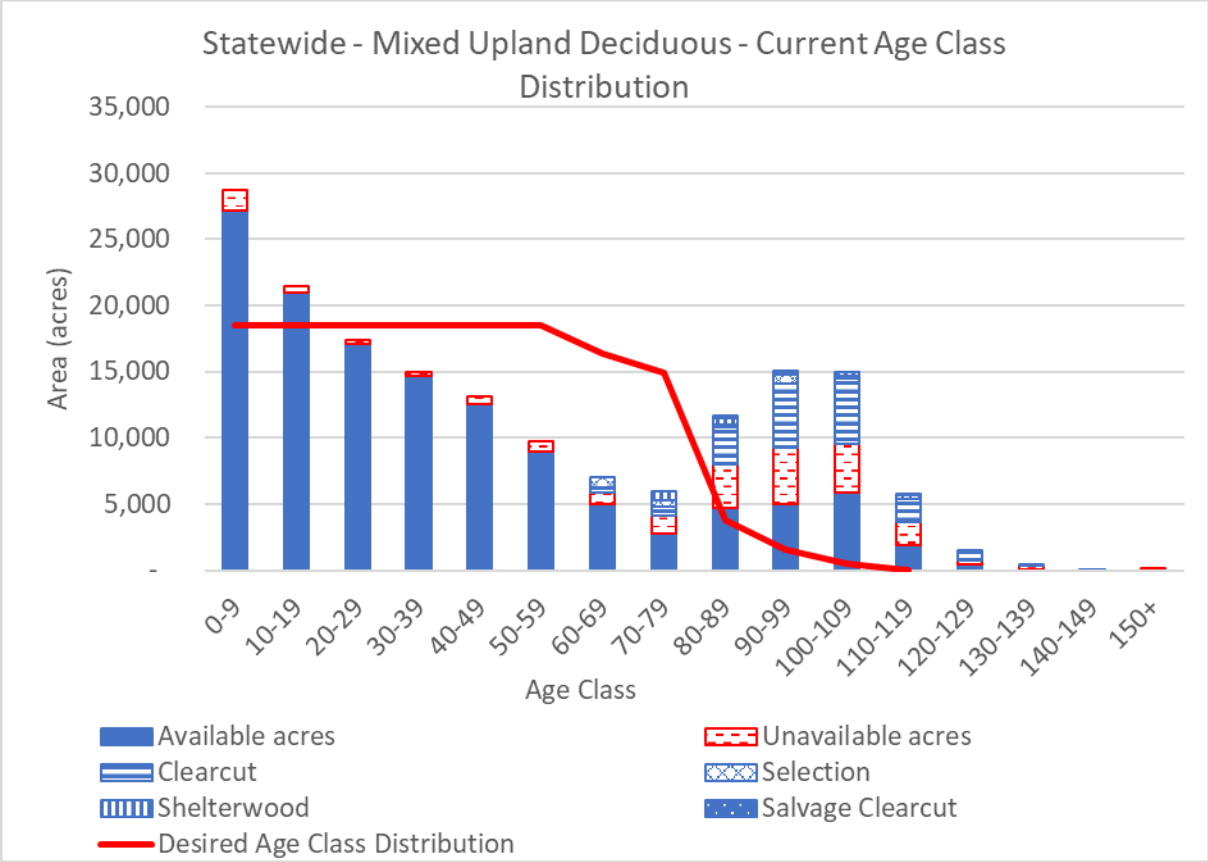


Figure 32. Current statewide mixed upland deciduous age class distribution, projected period one harvests and desired age class distribution.

The primary mid-term strategic harvesting objective for this planning period includes ensuring the desired amount of mixed upland deciduous is regenerated (indicated by the red line in Figures 32 and 34) to work towards a desirable age class distribution of the manageable population. There is also a subset of the total population that is desirable to manage with uneven-aged systems where regeneration efforts will be focused in gaps of mature stands. Many of these stands are located on higher quality sites with a high component of northern red oak. At the end of the planning period, basal area class 1-50 is the most abundant with over 90,000 acres; the rest of the age classes are below 30,000 acres (Figure 35).

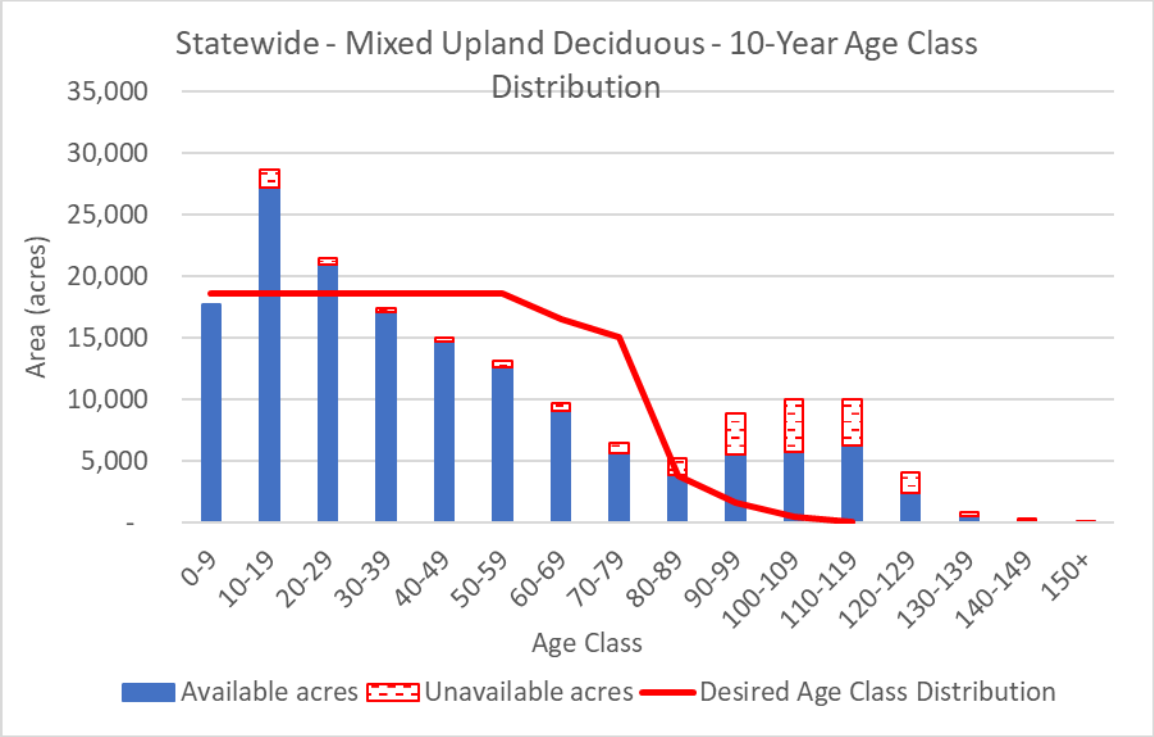


Figure 33. Age class distribution of mixed upland deciduous cover type after this planning period's management has been implemented.

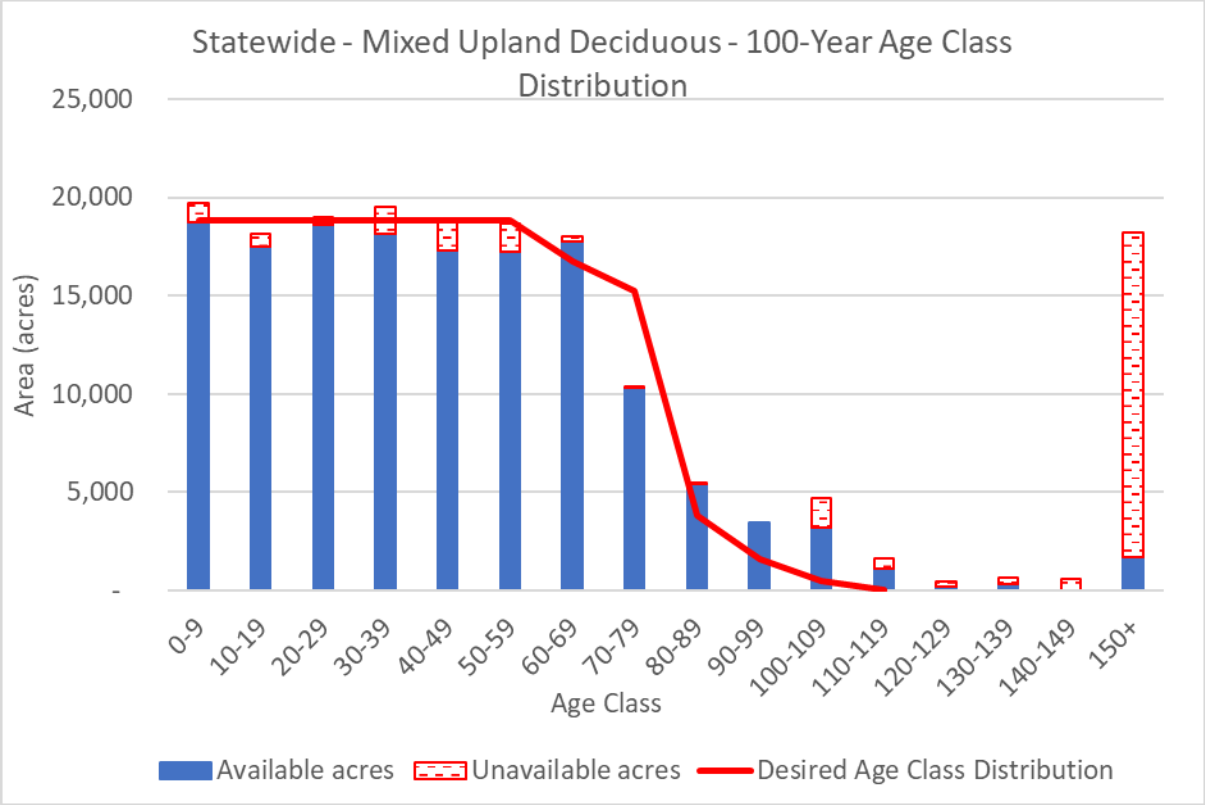


Figure 34. Balanced age class distribution after 100 years of even-aged management of the available acreage.

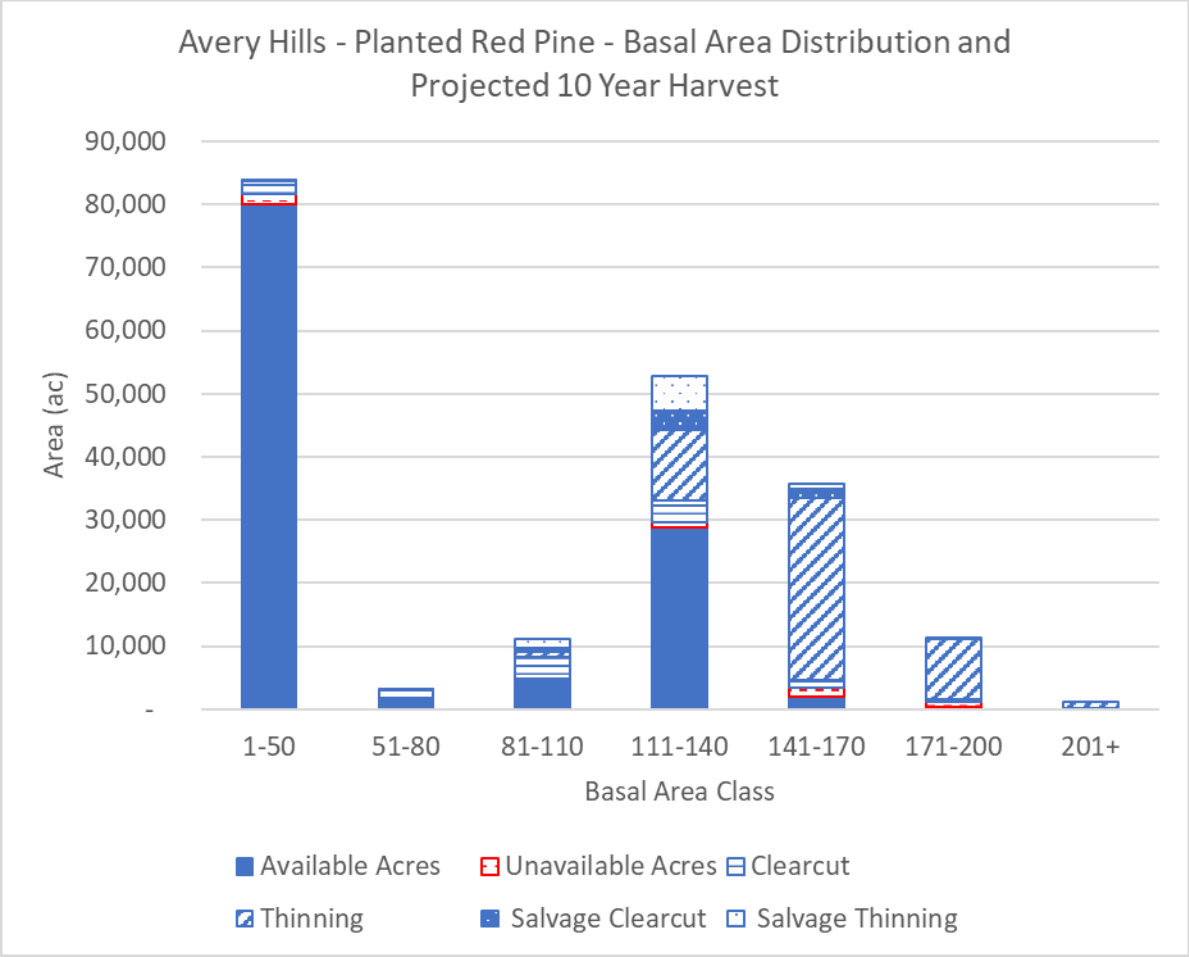


Figure 35. Graph representing the basal area distribution and projected harvests for the planning period in the mixed upland deciduous cover type.

Silvicultural regimes

Mixed upland deciduous will be managed primarily with even-aged silvicultural systems during the next decade, including about 16,506 acres of clearcut harvests (including 249 acres of salvage clearcut) and 1,770 acres of shelterwood harvests. In total, there are about 18,276 acres of planned regeneration harvests over the next decade to help build a balanced age class distribution of the manageable acres, as shown in the 0-9 age class of Figure 34. The uneven-aged harvest acres will come from selection system with a projected 2,694 acres for the decade (Table 5). These selection harvests are planned on stands with basal areas at or above 110 on higher quality sites and those with a higher component of northern red oak.

Objectives and management actions

Objective 1. Maintain the mixed upland deciduous cover type acres by achieving a balance of conversion into and out of the cover type resulting in no net change over the next decade.

- Action 1. Favor stands for conversion to planted red pine when regeneration harvest is likely to result in poor quality, multi-stemmed stump-sprout red maple, and site suitability favors red pine (dry mesic sites).
- Action 2. Favor stands for conversion to aspen when regeneration harvest is likely to result in poor quality, multi-stemmed stump-sprout red maple and 30-40 percent of the canopy is comprised of aspen species.

Objective 2. Strategically select stands for regeneration harvests to the mixed upland deciduous cover type using even-aged harvests to improve the age class distribution of the manageable population.

- Action 1. Prescribe about 16,506 acres of mixed upland deciduous for clearcut harvests (including salvage clearcut harvests) from any merchantable age or size class throughout the next decade (Table 4).
- Action 2. Prescribe about 1,770 acres of mixed upland deciduous for a shelterwood harvest retaining wind-firm northern red oak, red pine, and white pine for seed source resulting in more diverse and desirable species composition of regeneration.

Objective 3. Strategically select stands on better sites for uneven-aged management using selection harvests to favor the production of high-quality red maple, northern red oak, red pine, and white pine.

- Action 1. Prescribe about 2,694 acres of mixed upland deciduous for selection harvests from any merchantable age or size class throughout the next decade (Table 4).

Natural jack pine

The natural jack pine cover type makes up approximately 3.6 percent of the state forest and is most commonly found in upland areas with poor soil nutrient content and low soil moistures. This cover type is comprised primarily of coniferous species, with the most abundant species being jack pine. Associated species that are commonly mixed in with the primary canopy species are red pine, black spruce, white pine, quaking aspen, oak species, and red maple (Figure 36; Michigan DNR Forest Inventory Data, 2021).

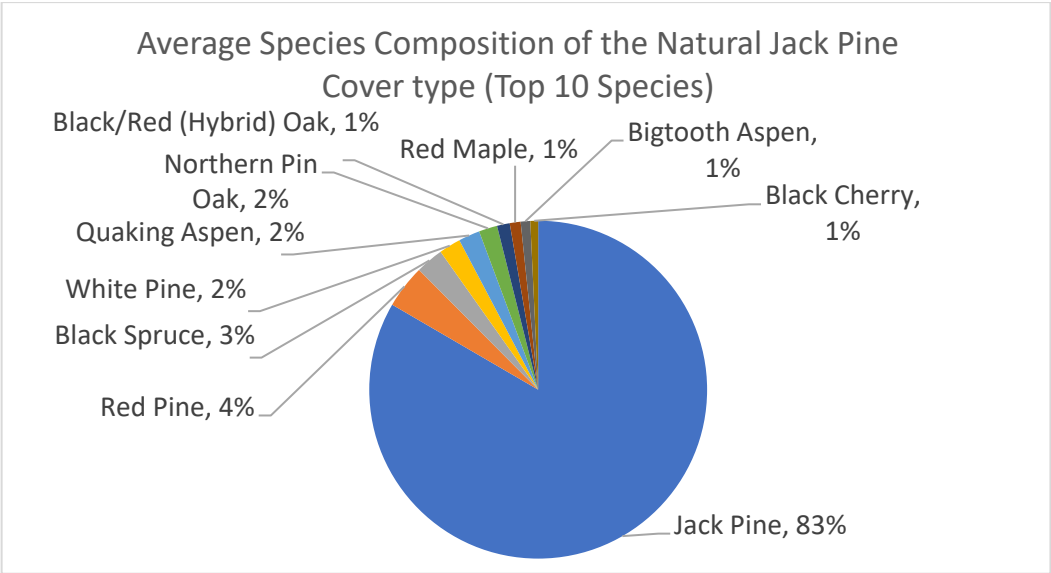


Figure 36. Average species composition of the natural jack pine cover type, state forest wide.

The natural jack pine cover type is currently dominated by sapling and pole-sized trees with very little representation in the log-size class (Figure 37). As this cover type becomes more balanced across age classes, the proportion of the cover type containing log-sized trees will increase and be better represented in future decades.

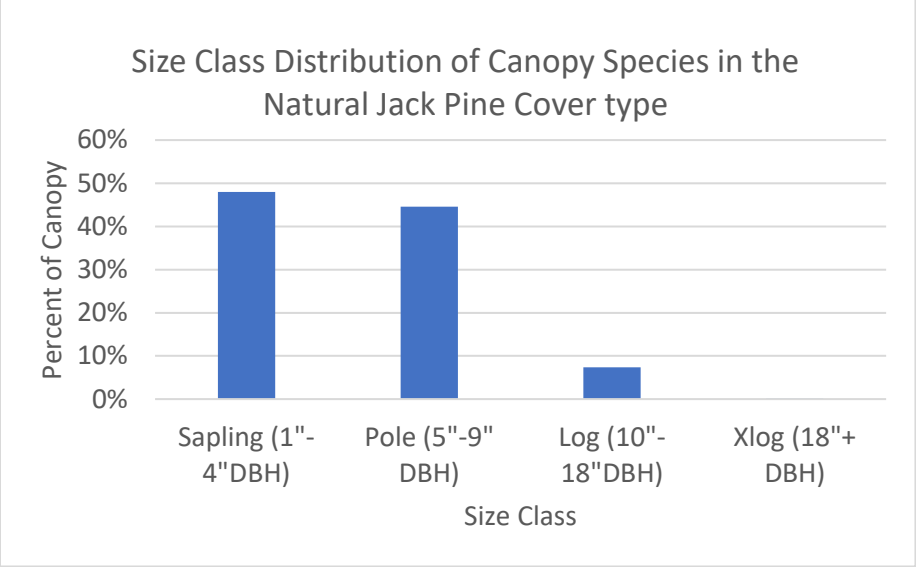


Figure 37. Average size class distribution of the natural jack pine cover type.

Cover type abundance

Natural jack pine is projected to remain the seventh most abundant cover type in the state forest, growing primarily on xeric sites across the landscape providing a unique habitat condition. Dense, young natural jack pine stands are desirable habitat for a variety of wildlife species, most notably the Kirtland's warbler. There has been a shift in silvicultural methods used over the last decade to take better advantage of naturally regenerating stands rather than defaulting to trenching and planting stands after harvest. This method is projected to continue and result in a fairly significant shift from planted jack pine stands to stands more of natural origin. There are currently about 145,300 acres of natural jack pine in the state forest and that population is expected to increase by 1.0 percent during the next planning period to 146,718 acres.

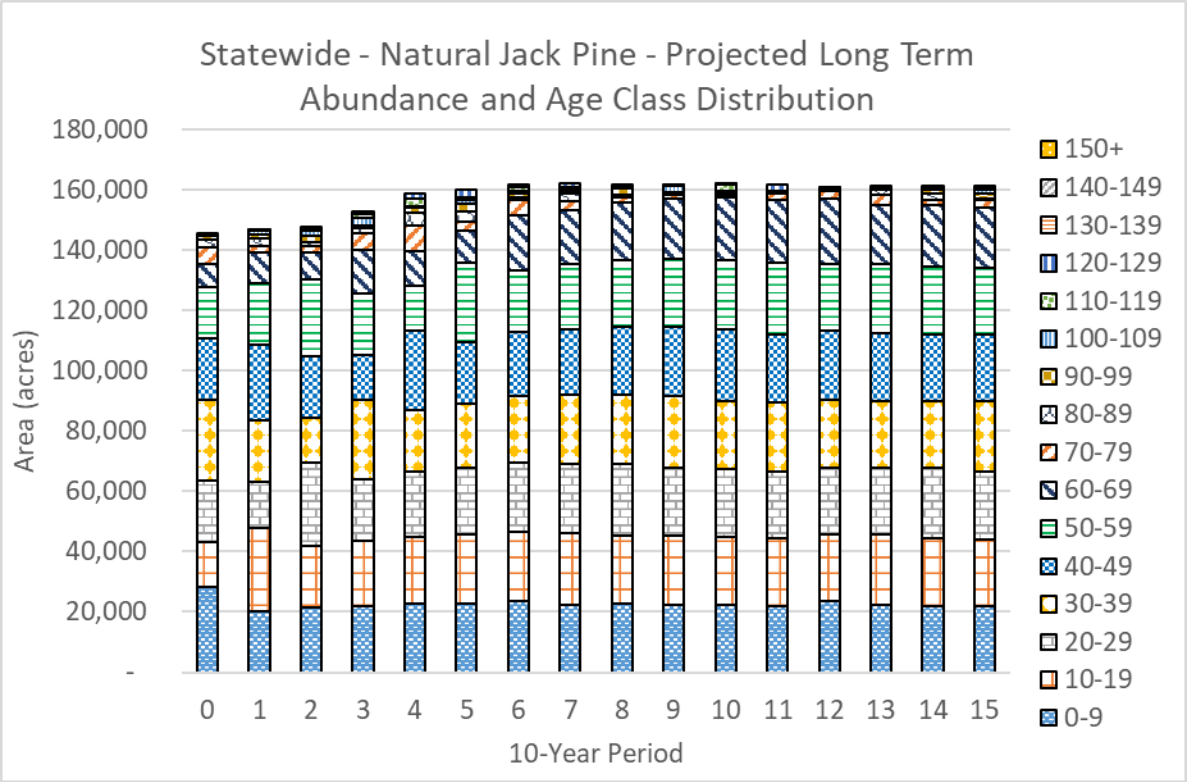


Figure 38. Natural jack pine abundance by age class as projected through period 15 in the SFMP model.

Age class distribution

The statewide age class distribution of the natural jack pine cover type is slightly unbalanced statewide, with a heavier portion of the population in the younger age classes (Figure 38). This skewed age class distribution can largely be attributed to the amount of regeneration harvests done to help recover the population of the Kirtland's warbler through habitat creation in the northern Lower Peninsula. It will take several decades to achieve a more balanced condition in this cover type as harvests and habitat creation levels stabilize (Figures 39, 40 and 41).

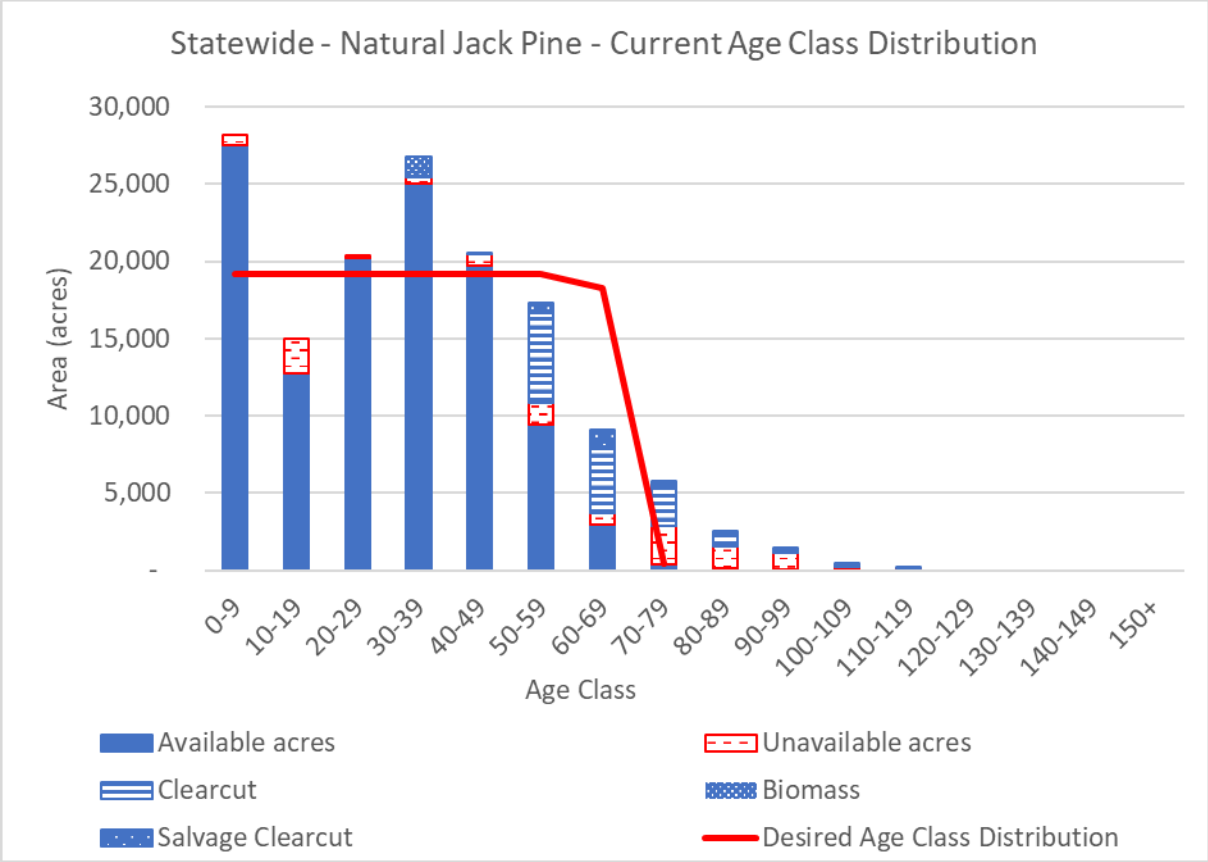


Figure 39. Current state forest natural jack pine age class distribution, projected period one harvests and desired age class distribution.

The primary mid-term strategic harvesting objective for this planning period is ensuring the desired amount of natural jack pine is regenerated (indicated by the red line in figure 40) to work towards a desirable age class distribution of the manageable population.

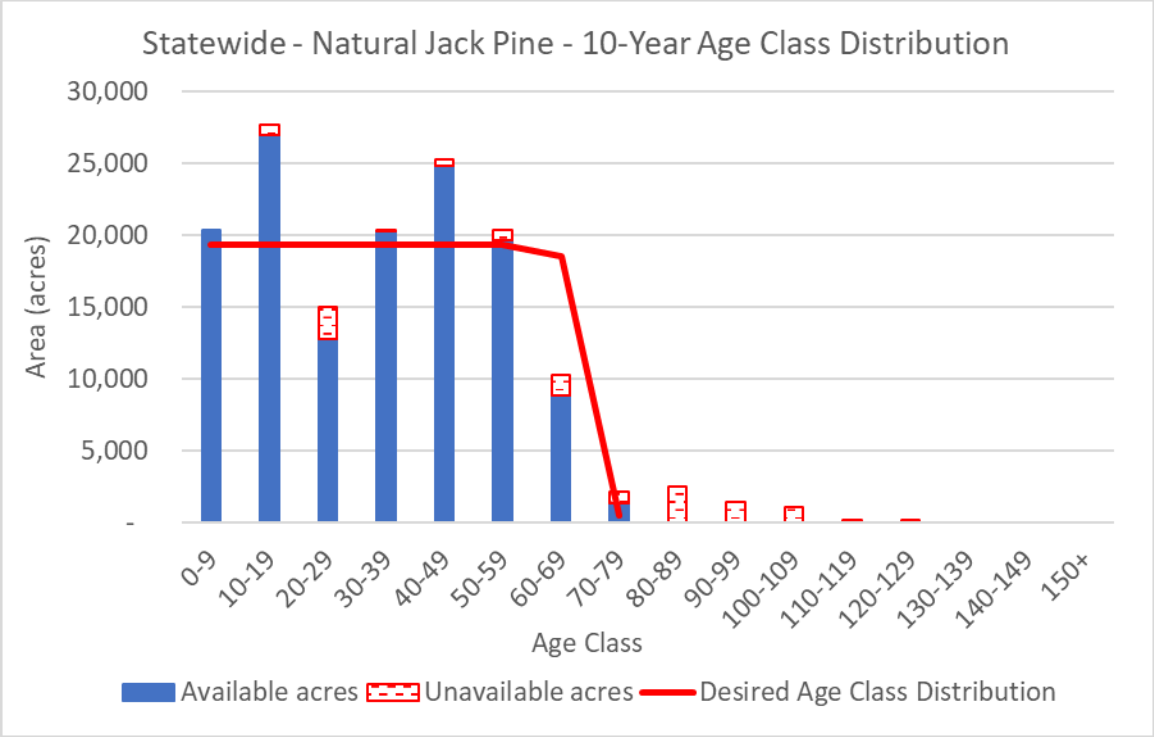


Figure 40. Age class distribution of natural jack pine cover type after this planning period's management has been implemented.

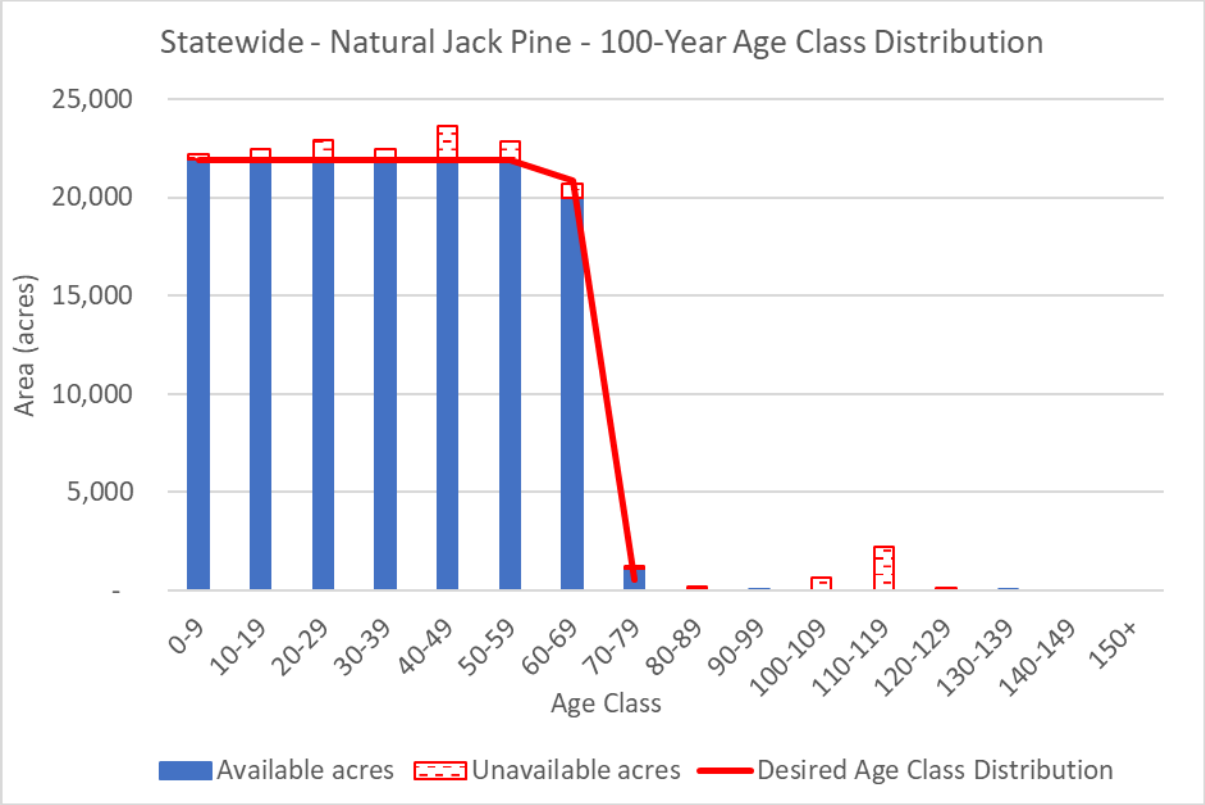


Figure 41. Balanced age class distribution after 100 years of even-aged management of the available acreage.

Silvicultural regimes

Natural jack pine will be managed primarily with even-aged silvicultural systems during the next decade including about 17,633 acres of clearcut harvests (including 2,336 acres of salvage clearcut). To maintain habitat creation obligations for the Kirtland's warbler, some harvests will be allocated to stands in younger age classes that may not be merchantable for traditional pulpwood markets. These harvests are sometimes referred to as "biomass" harvests to indicate that difference, but silviculturally they are the same as a clearcut and are grouped with clearcut harvests in the projection tables. These planned regeneration harvests over the next decade will help build a balanced age class distribution of the manageable acres, as shown in the 0-9 age class of Figure 40.

Objectives and management actions

Objective 1. Increase the natural jack pine cover type acres by about 1,215 acres, or 0.8 percent, by converting planted jack pine stands to natural jack pine over the next decade.

- Action 1. Favor stands for conversion to natural jack pine when a regeneration harvest is likely to result in sufficient scarification and seed distribution through harvesting techniques.

Objective 2. Select natural jack pine stands for regeneration using even-aged harvests to improve the age class distribution of the manageable population.

- Action 1. Prescribe about 17,633 acres of natural jack pine for clearcut harvests (including 2,336 acres of salvage clearcut) from any merchantable age or size class throughout the next decade (Table 4).
- Action 2. Prescribe about 420 acres of natural jack pine for "biomass" clearcut harvests from sub-merchantable stands in the 30-39 class throughout the next decade (Table 4).

Planted jack pine

The planted jack pine cover type makes up approximately 3.4 percent of the state forest and is most commonly found in upland areas with poor soil nutrient content and low soil moistures. This cover type is comprised of primarily coniferous species with the most abundant species being jack pine at 87 percent. Associated species commonly mixed in with the primary canopy species are northern pin and hybridized black/red oak, red pine, quaking aspen, black cherry, pin cherry, white pine, big tooth aspen, and red maple (Figure 42; Michigan DNR Forest Inventory Data, 2021).

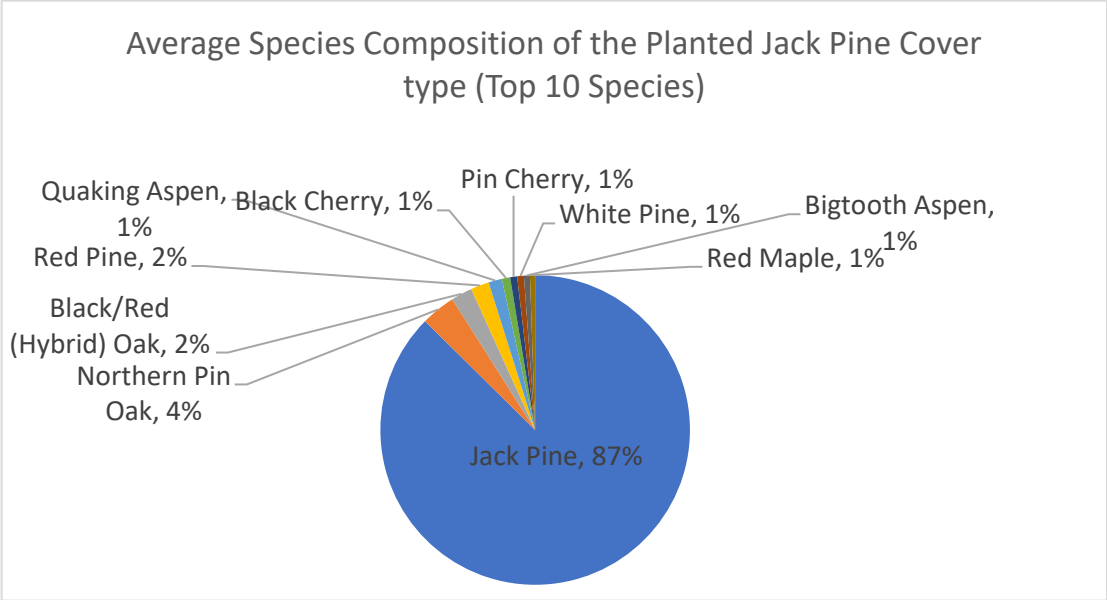


Figure 42. Average species composition of the planted jack pine cover type across the state forest.

The planted jack pine cover type is currently dominated by sapling and pole-sized trees with very little representation in the log-size class (Figure 43). As this cover type becomes more balanced across age classes, the proportion of the cover type containing log-sized trees will increase and be better represented in future decades.

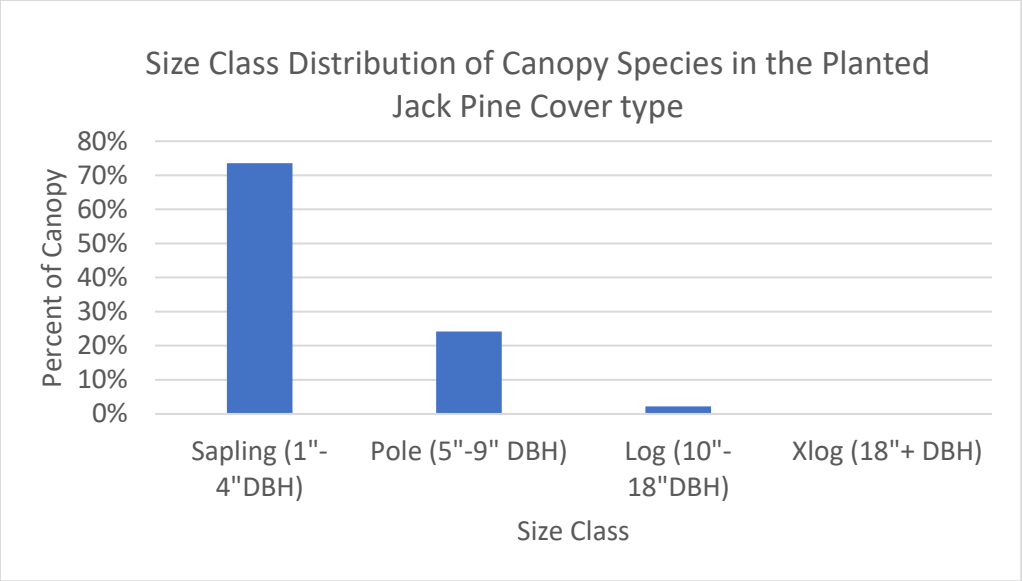


Figure 43. Average size class distribution of the planted jack pine cover type.

Cover type abundance

Planted jack pine, currently the eighth-most-prevalent cover type, is projected to drop to ninth, growing primarily on xeric sites across the landscape providing a unique habitat condition. Dense, young, planted jack pine stands are desirable habitat for a variety of wildlife species, most notably the Kirtland's warbler. There has been a shift in silvicultural methods used over the last decade taking better advantage of naturally regenerating stands rather than always defaulting to trenching and planting stands after they are harvested. This method is projected to continue and result in a fairly significant shift from planted jack pine stands to stands of natural origin. There are currently about 136,846 acres of planted jack pine on the state forest and that population is expected to decrease by 2.1 percent during the next planning period to about 133,999 acres.

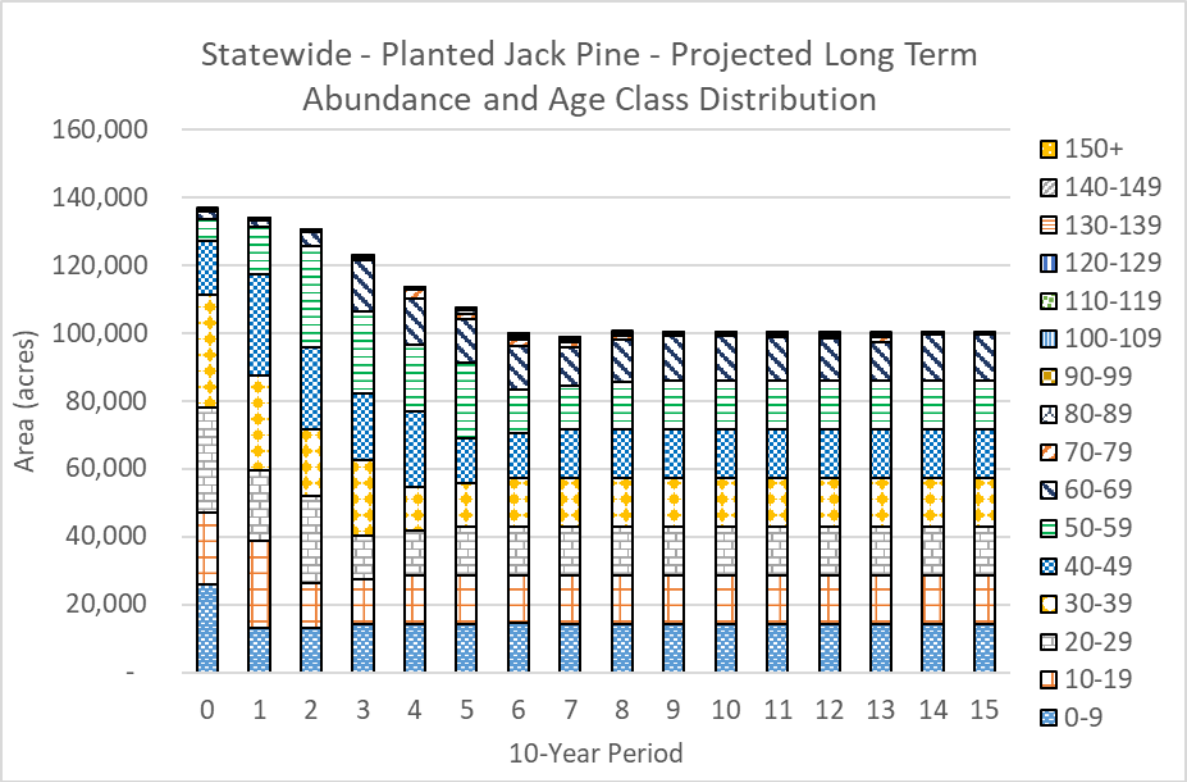


Figure 44. Planted jack pine abundance by age class as projected through period 15 in the SFMP model.

Age class distribution

The statewide age class distribution of the planted jack pine cover type is significantly unbalanced at a statewide level with a heavier portion of the population in the younger age classes (Figure 44). Similar to the natural jack pine cover type, this skewed age class distribution can be largely attributed to the amount of regeneration harvests done to help recover the population of the Kirtland's warbler through habitat creation in the northern Lower Peninsula. It will take several decades to achieve a more balanced condition in this cover type as harvests and habitat creation levels stabilize (Figures 45-47).

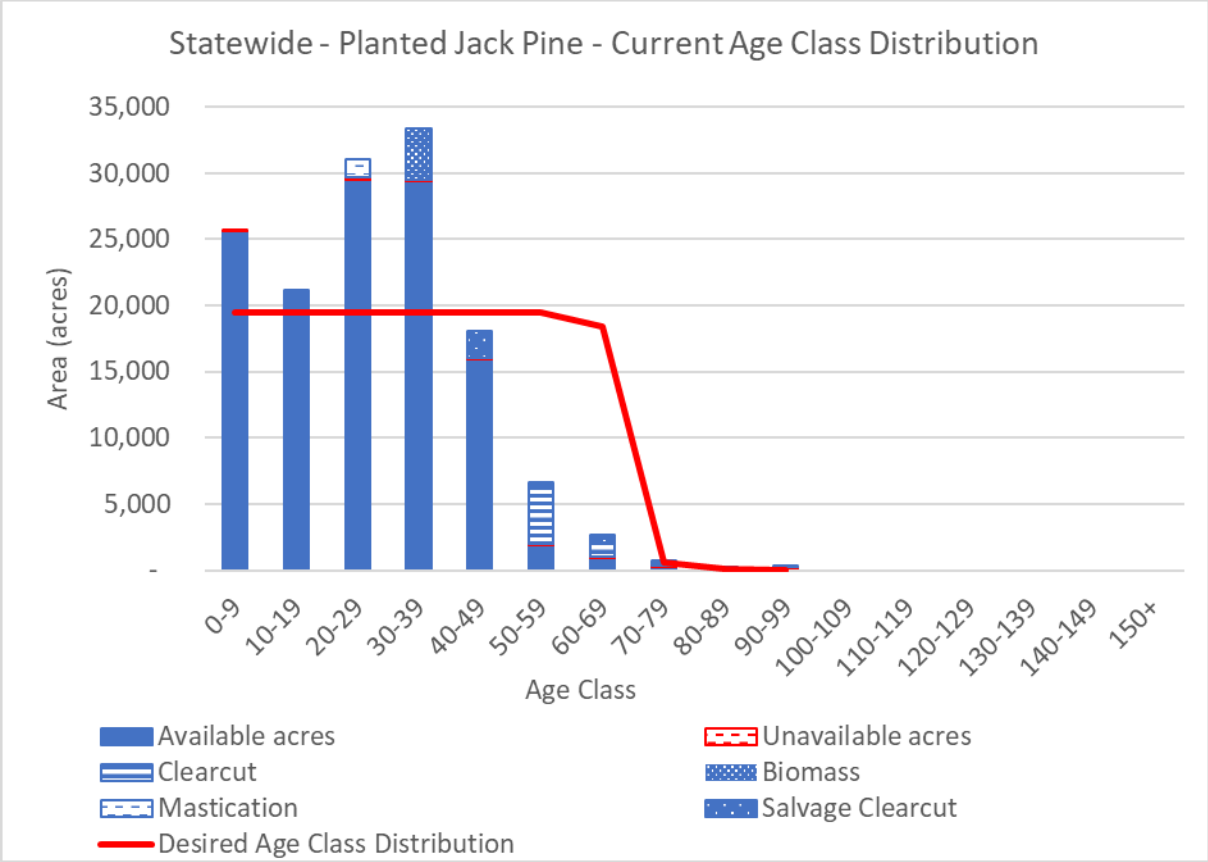


Figure 45. Current statewide planted jack pine age class distribution, projected period one harvests and desired age class distribution.

The primary mid-term strategic harvesting objective for this planning period is ensuring the desired amount of planted jack pine is regenerated (indicated by the red line in Figure 46) to work towards a desirable age class distribution of the manageable population.

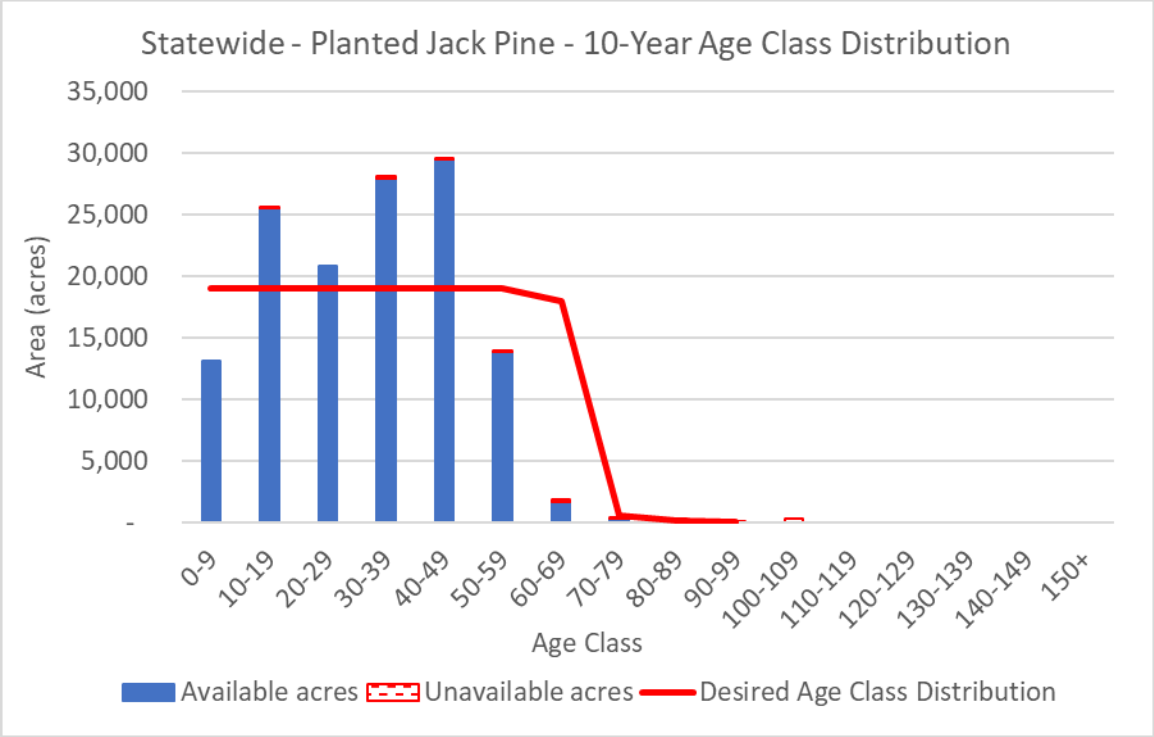


Figure 46. Age class distribution of planted jack pine cover type after this planning period's management has been implemented.



Figure 47. Balanced age class distribution after 100 years of even-aged management of the available acreage.

Silvicultural regimes

Planted jack pine will be managed primarily with even-aged silvicultural systems during the next decade including about 7,497 acres of clearcut harvests. To maintain habitat creation obligations for Kirtland's warbler, some harvests will need to be allocated to stands in younger age classes that may not be merchantable for traditional pulpwood markets. These harvests are referred to as "biomass" harvests to indicate that difference, but silviculturally they are the same as a clearcut. There is about 4,752 acres of biomass harvest expected for the decade, totaling about 12,710 acres of planned regeneration harvests (including 3,057 acres of salvage clearcut harvest)over the next decade to help build a balanced age class distribution of the manageable acres, as shown in the 0-9 age class of Figure 45. Additional non-commercial site-clearing activities using mastication will also be necessary for the next two planning periods to create the required habitat to sustain the minimum population of Kirtland's warbler. About 1,433 acres of mastication is projected throughout the planning period.

Objectives and management actions

Objective 1. Decrease the planted jack pine cover type acres by about 2,846 acres, or 2.1 percent, by converting planted jack pine stands to natural jack pine over the next decade.

- Action 1. Favor stands for conversion to natural jack pine when a regeneration harvest is likely to result in sufficient scarification and seed distribution through harvesting techniques.

Objective 2. Select planted jack pine stands for regeneration using even-aged harvests to improve the age class distribution of the manageable population and to support the habitat needs of Kirtland's warbler.

- Action 1. Prescribe about 7,959 acres of planted jack pine for clearcut harvests (including 3,057 acres of salvage clearcut) from any merchantable age or size class throughout the next decade (Table 4).
- Action 2. Prescribe about 4,752 acres of planted jack pine for biomass clearcut harvests from sub-merchantable stands in the 30-39 class throughout the next decade (Table 4).
- Action 3. Prescribe about 1,433 acres of planted jack pine for mastication from sub-merchantable stands in the 20-29 age class throughout the next decade (Table 4).

Oak cover types

The oak cover type has historically been categorized and described as one single cover type in older inventory systems, analysis, reports, and in management plans. The need for a more detailed classification of the oak cover type was identified as an area for improvement during the last planning period and has resulted in three oak sub types: black/red hybrid oak, northern red oak, oak mix. The state forest contains 151,856 acres (3.8 percent of the state forest) of oak cover types and it has recently become less prevalent than mixed upland deciduous. This is partially because many oak stands are converting when regenerated as discussed in the mixed upland deciduous section.

The black/red hybrid oak cover type captures oak stands that are dominated by species of the red oak group and those that have hybridized between three distinct oak species: northern red oak (Quercus rubra), northern pin oak (Quercus ellipsoidalis), and black oak (Quercus velutina). When compared to northern red oak, especially on better sites, the resulting individual tree is typically shorter-lived, of lesser quality from a forest products standpoint, more susceptible to disease, and less resilient to common stressors such as drought and advanced age. This cover type is typically found on poor sites with low nutrient availability and poor soil moisture. These xeric sites undoubtedly contribute to the relatively poor form of the tree and shorter natural life span, requiring a different approach to sustainable management as described below.

The Northern Red Oak cover type describes stands dominated by pure northern red oak typically found on better sites. Northern red oak found on these dry-mesic and mesic sites typically have better form, less epicormic branching, grow faster and live much longer than the hybridized black/red oak and those species growing on outwash plains in Michigan. The longer biological rotation age and higher quality tree form both contribute to the need for a different approach to management with more options between even-aged and uneven-aged management. These northern red oak stands on dry-mesic sites are commonly associated with white pine and have evolved in a cyclical pattern of canopy occupancy through natural disturbance regimes for millennia. These relationships, among other factors, contributed to the need to segregate this cover type from the general oak group and enables specific silvicultural regimes and age class distributions to be defined for the planning period.

The oak mix cover type describes those stands with a mix of species from the red oak species group and white oak (Quercus alba). It also contains stands of nearly pure white oak, but because there is a relatively low abundance of these stands statewide, this more detailed cover type was combined with the oak mix cover type for planning purposes.

Most stands converting out of the oak cover types will naturally convert to more mixed cover types such as mixed upland deciduous and upland mixed forest, but efforts will focus on retaining and regenerating a significant oak component. This conversion is not necessarily a desirable trend from a forest and wildlife management perspective, but is inevitable, at least to some extent. The expansive oak population across much of the northern Lower Peninsula and in parts of the Upper Peninsula exist because of extensive disturbances from large landscape-scale logging and subsequent wildfires from the late 1800s through the 1920s *(History of Michigan's State Forest)*. These wildfires and open canopy conditions created a very suitable condition favoring the prolific regeneration of oak species mixed with aspen, red maple, white pine, and to a lesser extent red pine. As this extensive population aged and became mature across the drier sandy outwash plains, it provided a desirable habitat condition for several game and non-game types of wildlife and resulted in a substantial timber resource as well. The most acceptable prescription on these oak stands was to do a thinning to remove less desirable aspen and red maple species along with poor quality oaks. The benefit of those thinning regimes is that they promoted more growth on residual oak stems, increased crown size, and therefore resulted in higher acorn production. These thinning regimes were widely applied for decades, from the 1980s through about 2010, to manage oak stands focusing on the mature component of stands and not focusing much on regeneration.

It is important to note that these thinning regimes did, however, result in significant regeneration of aspen and red maple into the understories of these relatively sparse stands. This now creates a challenge when trying to regenerate the less vigorous and declining oak. Stands of black/red hybrid oak established in the early 1900s are now starting to decline as they reach biological rotation age. It became clear very quickly that regeneration efforts needed to become the priority. As these stands were managed with even-aged silvicultural techniques like clearcutting, seed-tree, and shelterwood harvests, it was observed that regenerating these stands with the younger vigorous stems of aspen and red maple present and less vigorous oak species was going to be challenging. As these more vigorous stems are harvested to open the canopy for oak regeneration, they often outcompete the far fewer and slower-growing regenerating oak stems.

These factors are exacerbated by the significant herbivory of the coppice regeneration of slower growing oak stems in the form of root suckers and stump sprouts and especially those few individuals originating from acorn sprouts in each stand. Aspen and red maple sprouts also are browsed but can quickly outgrow browse height before mortality from over browsing occurs. This results in a far greater proportion of aspen and red maple than oak stems successfully recruiting and becoming the new canopy and cover type.

It is widely accepted that the lack of repetitive, low-intensity wildfires and high-intensity stand-replacing fires that occurred prior to European settlement contributes to the difficulties of maintaining a much higher component of oak in these stands. Oak is a fire-adapted species that is well suited to conditions created after a fire moves through. While more intensive harvests can emulate some of those conditions, fire's effects on soil nutrients, seed bed preparation, and control of competition from less-adapted species such as aspen and red maple cannot be accomplished simply by clearcutting a stand. The expanded use of prescribed fire in conjunction with harvesting may significantly help slow the reduction of the oak cover type across the landscape and is called for below in the objectives and actions of the various oak cover types.

The other contributing factor for the apparent “decline” in oak cover types is that the previous inventory systems either did not have a mixed upland deciduous cover type (Operations Inventory & Diagnostic Inventory) or it was not fully populated (IFMAP) with inventory data under the new protocol. Stands that contain a significant oak component but fall below the threshold for being categorized as an oak cover type (60 percent canopy occupancy) typically get classified as part of the mixed upland deciduous cover type.

Black/red hybrid oak

The black/red hybrid oak cover type, on its own, makes up approximately 1.4 percent of the state forest and is most commonly found in upland areas with poor soil nutrient content and low soil moistures. This cover type is comprised primarily of deciduous species with the most abundant species being hybridized black and red oak, white oak, and northern pin oak. Associated species commonly mixed in with the primary canopy species are red maple, white pine, big tooth aspen, northern red oak, jack pine, and red pine (Figure 48; Michigan DNR Forest Inventory Data, 2021).

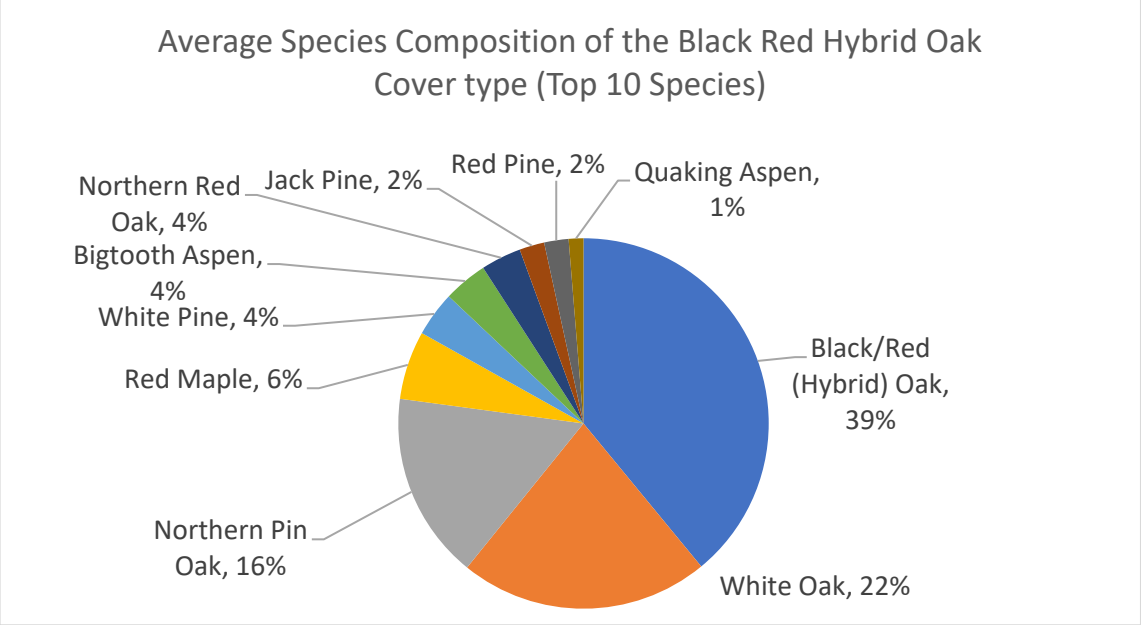


Figure 48. Average species composition of the black/red hybrid oak cover type across the State Forest.

The black/red hybrid oak cover type currently has a decent distribution of canopy size classes. Work continues this planning period to address the unbalanced distribution of age classes which are heavily skewed to the older end of the age range (Figure 49). As this cover type becomes more balanced across age classes the proportion of the cover type containing sapling and pole-sized trees will increase and be better represented in future decades.

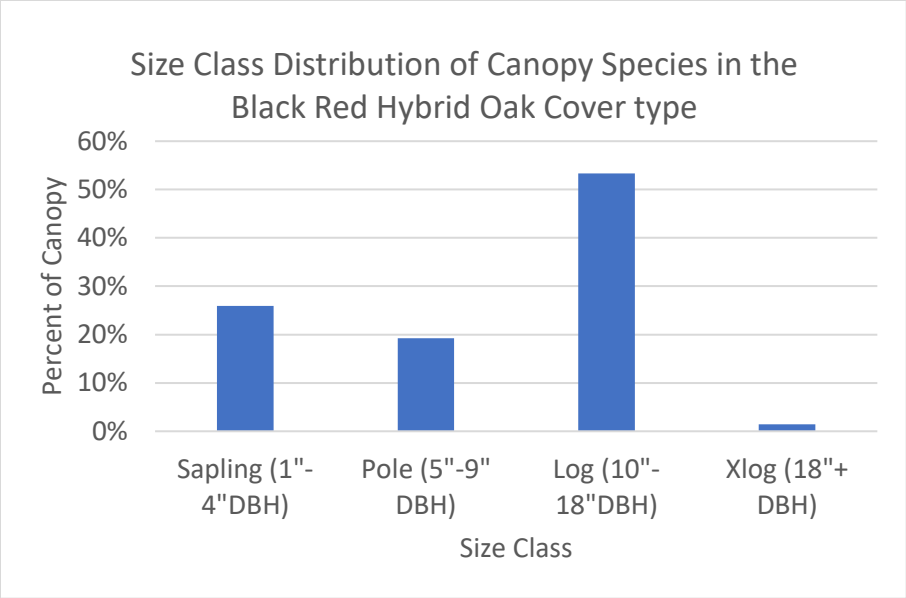


Figure 49. Average size class distribution of the black/red hybrid oak cover type.

Cover type abundance

Black/red hybrid oak, currently the 15th-most-prevalent cover type, is projected to drop to 17th in the state forest, growing primarily on xeric sites across the landscape providing important timber and habitat values. Black/red hybrid oak stands provide key habitat elements for a variety of wildlife due to their hard mast production and tendency for cavities in the stems. There are currently about 55,300 acres of black/red hybrid oak in the state forest and that population is expected to decrease by 5.3 percent during the next planning period to about 52,375 acres.

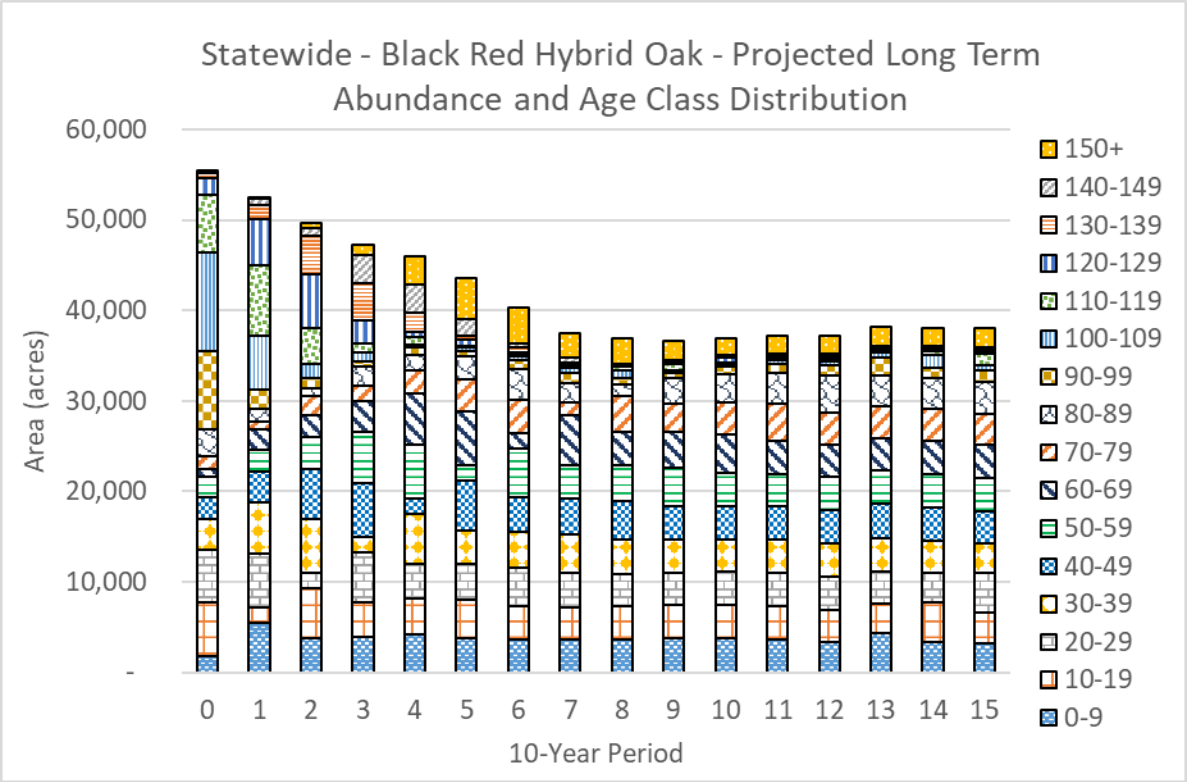


Figure 50. Black/red hybrid oak abundance by age class as projected through period 15 in the SFMP model.

Age class distribution

The statewide age class distribution of the black/red hybrid oak cover type is significantly unbalanced at a statewide level with a greater proportion of the population in older age classes beyond the desired rotation age (Figure 50 and 51). As described above, that hesitancy to perform regeneration harvests on oak stands during the 1980s, 1990s, and early 2000s has resulted in an undesirable age class distribution and a rather urgent need to regenerate stands before the existing canopy has deteriorated to the point where it lacks the vigor to regenerate once harvested. Stands with signs and symptoms of decline and advanced mortality should be prioritized for harvest first, while healthier stands are good candidates for regeneration harvests in future planning periods. It will take several decades to achieve a more balanced condition in this cover type as regeneration harvest levels and cover type conversions stabilize (Figures 51-53).

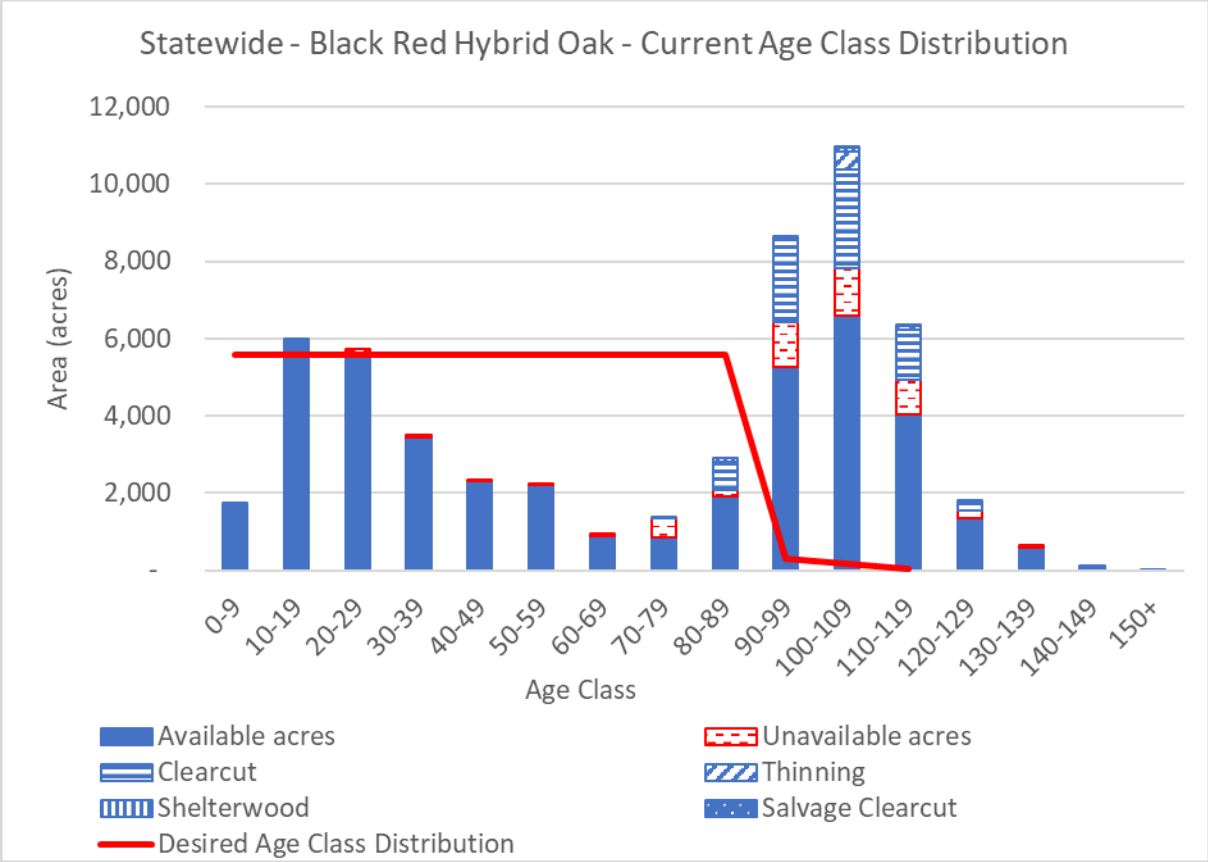


Figure 51. Current statewide black/red hybrid oak age class distribution, projected period one harvests and desired age class distribution.

The primary mid-term strategic harvesting objective for this planning period is ensuring that the desired amount of black/red hybrid oak is regenerated (indicated by the red line in Figure 52) to work towards a desirable age class distribution of the manageable population.

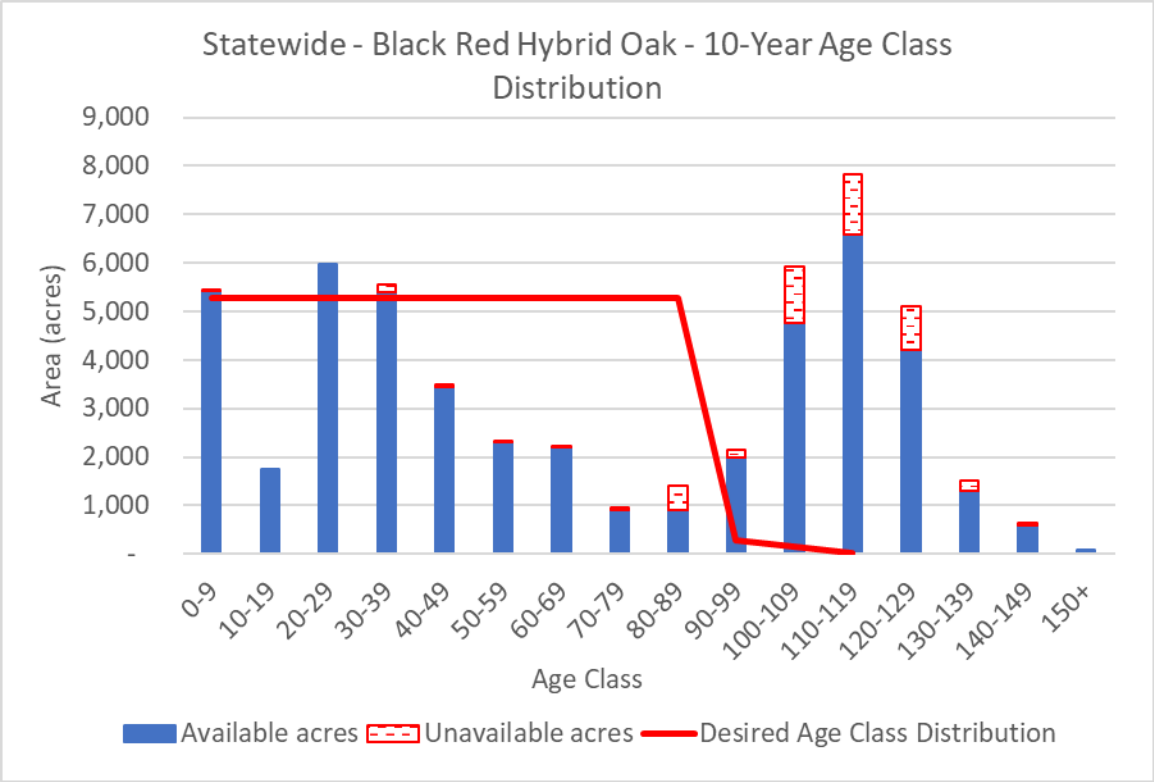


Figure 52. Age class distribution of black/red hybrid oak cover type after this planning period's management has been implemented.

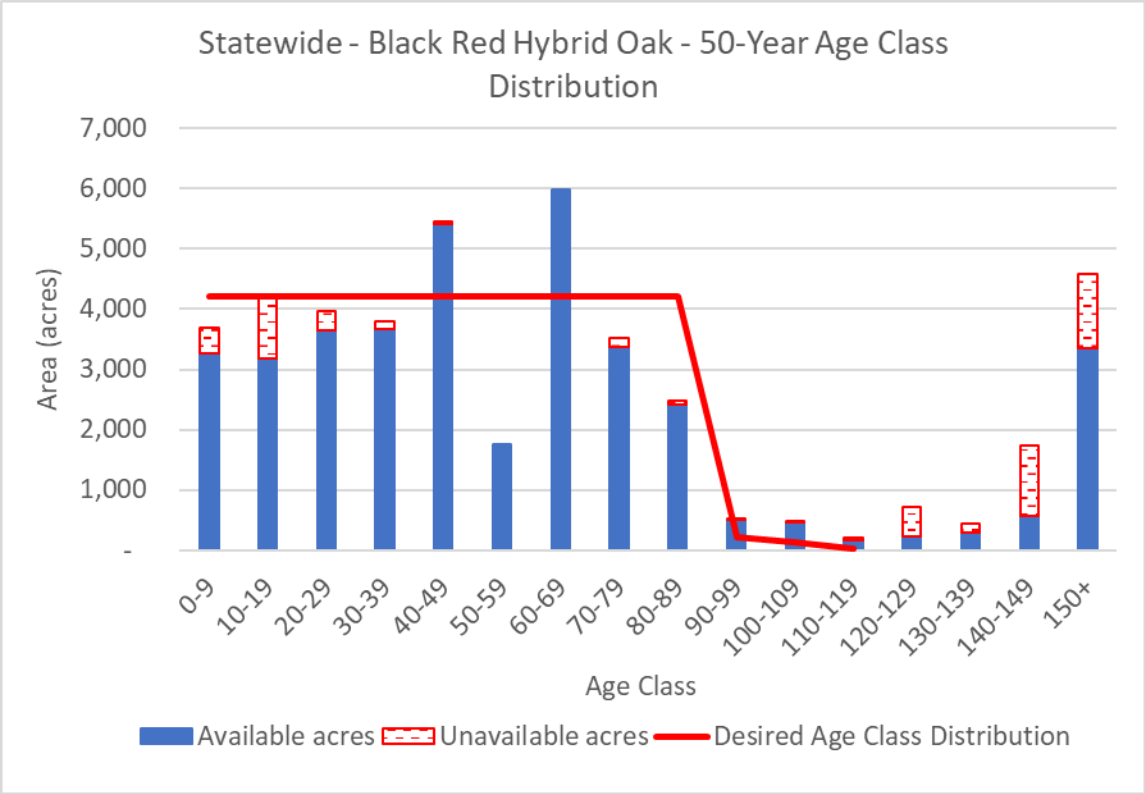


Figure 53. Balanced age class distribution after 50 years of even-aged management of the available acreage.

Silvicultural regimes

Black/red hybrid oak will be managed primarily with even-aged silvicultural systems during the next decade including about 6,990 acres of clearcut harvests (including 33 acres of salvage), 332 acres of shelterwood harvests, totaling about 7,322 acres of planned regeneration harvests over the next decade. These harvests help build a balanced age class distribution of the manageable acres, as shown in the 0-9 age class of Figure 52. There is also about 630 acres of thinning projected to be focused on stands with a desirable white pine understory that can be released and become part of the canopy of these stands over time.

Objectives and management actions

Objective 1. Minimize the decrease in the black/red hybrid oak cover type acres to about 3,476 acres, or 6.3 %, converting black/red hybrid oak stands to mixed upland deciduous, upland mixed forest, and in some cases where regeneration success is limited, planted red pine over the next decade.

- Action 1. Focus on retention and regeneration of oak species wherever possible in stands that will likely be converted to mixed types by protecting existing advanced oak regeneration and leaving large tops to help protect seedlings as they get established.
- Action 2. Prescribe conversions to planted red pine on stands where a natural regeneration harvest will likely result in little-to-no oak regeneration and high amounts of red maple stump sprouts, or be dominated by aspen. The conversion of these stands to red pine will be

done for a single, often shorter, rotation to facilitate the establishment and recruitment of oak in the understory, which can then be released by harvesting the red pine and protecting the existing desirable regeneration.

Objective 2. Select black/red hybrid oak stands for regeneration using even-aged harvests to improve the age class distribution of the manageable population and support the habitat needs of several game and non-game wildlife via mast production and cavity nesting opportunities.

- Action 1. Prescribe about 6,990 acres of black/red hybrid oak for clearcut harvests)including 33 acres of salvage clearcut) from any merchantable age or size class throughout the next decade (Table 4).
- Action 2. Prescribe about 332 acres of black/red hybrid oak for shelterwood harvests from any merchantable age or size class throughout the next decade (Table 4).
- Action 3. Prescribe about 630 acres of black/red hybrid oak for thinning harvests from any merchantable age or size class throughout the next decade (Table 4).

Northern red oak

The northern red oak cover type makes up approximately 1.4 percent of the state forest and is most commonly found in upland areas with moderate to high soil nutrient content and low to moderate soil moistures. This cover type is comprised primarily of deciduous species with the most abundant species being northern red oak. Associated species commonly mixed in with the primary canopy species are white oak, red maple, bigtooth aspen, white pine, red pine, and on lower quality sites black/red hybrid oak (Figure 54; Michigan DNR Forest Inventory Data, 2021).

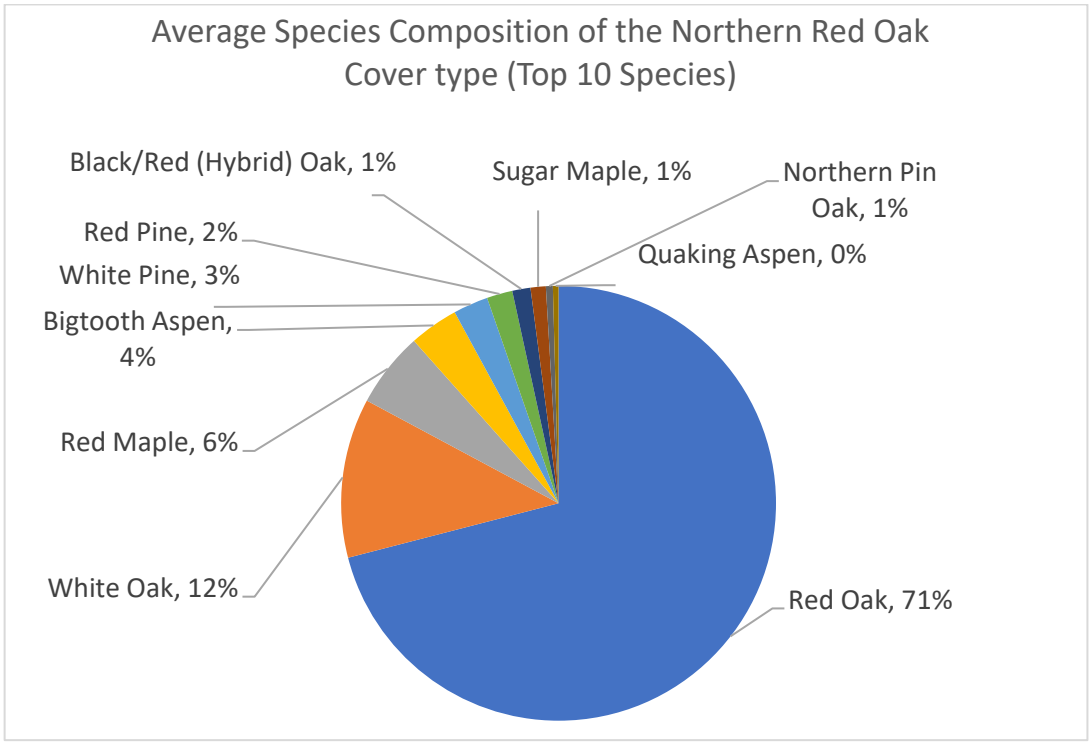


Figure 54. Average species composition of the northern red oak cover type across the state forest.

The northern red oak cover type currently has a rather unbalanced distribution of canopy size classes. Work continues this planning period to address the related unbalanced distribution of age classes which are heavily skewed to the older end of the age range (Figure 55). As this cover type becomes more balanced across age classes the proportion of the cover type containing sapling and pole-sized trees will increase and be better represented in future decades.

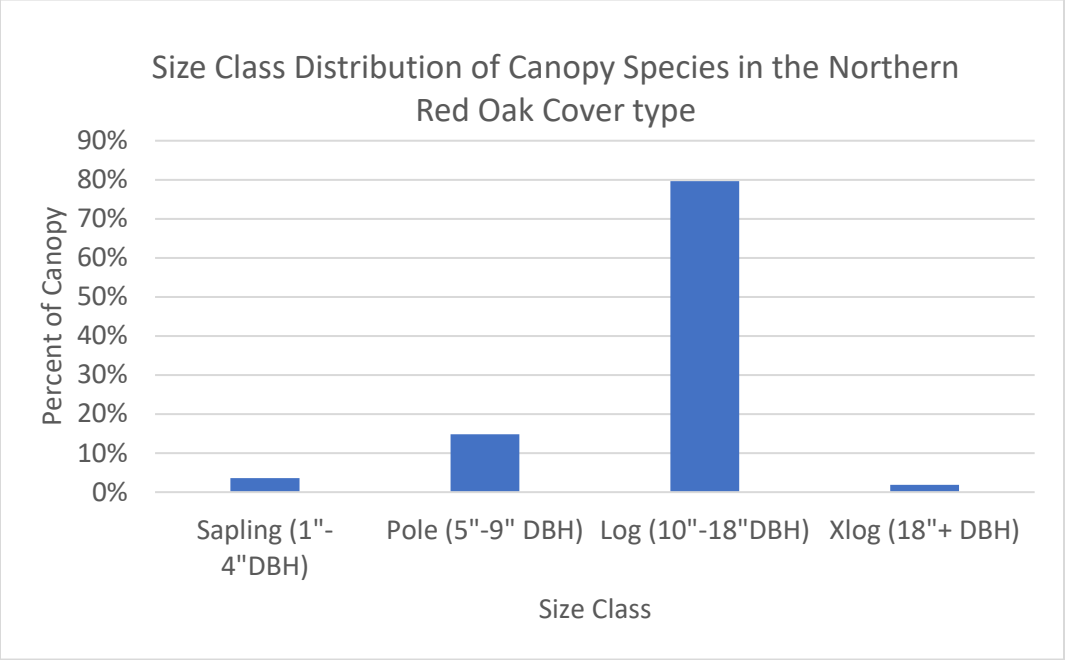


Figure 55. Average size class distribution of the northern red oak cover type.

Cover type abundance

Northern red oak, currently the 16th-most-prevalent cover type, is projected to decrease in abundance over the next decade as stands become more mixed after regeneration harvests occur, as described above. The northern red oak cover type grows primarily on dry mesic sites across the landscape providing important timber and habitat values. Northern red oak stands provide key habitat elements for a variety of wildlife due to their hard mast production. There are currently about 54,680 acres of northern red oak in the state forest and that population is expected to decrease slightly by 9.8 percent during the next planning period to about 49,302 acres. It is forecasted that in subsequent decades, like other oak types, the northern red oak cover type will significantly decline in abundance due to the challenges described above (Figure 56).

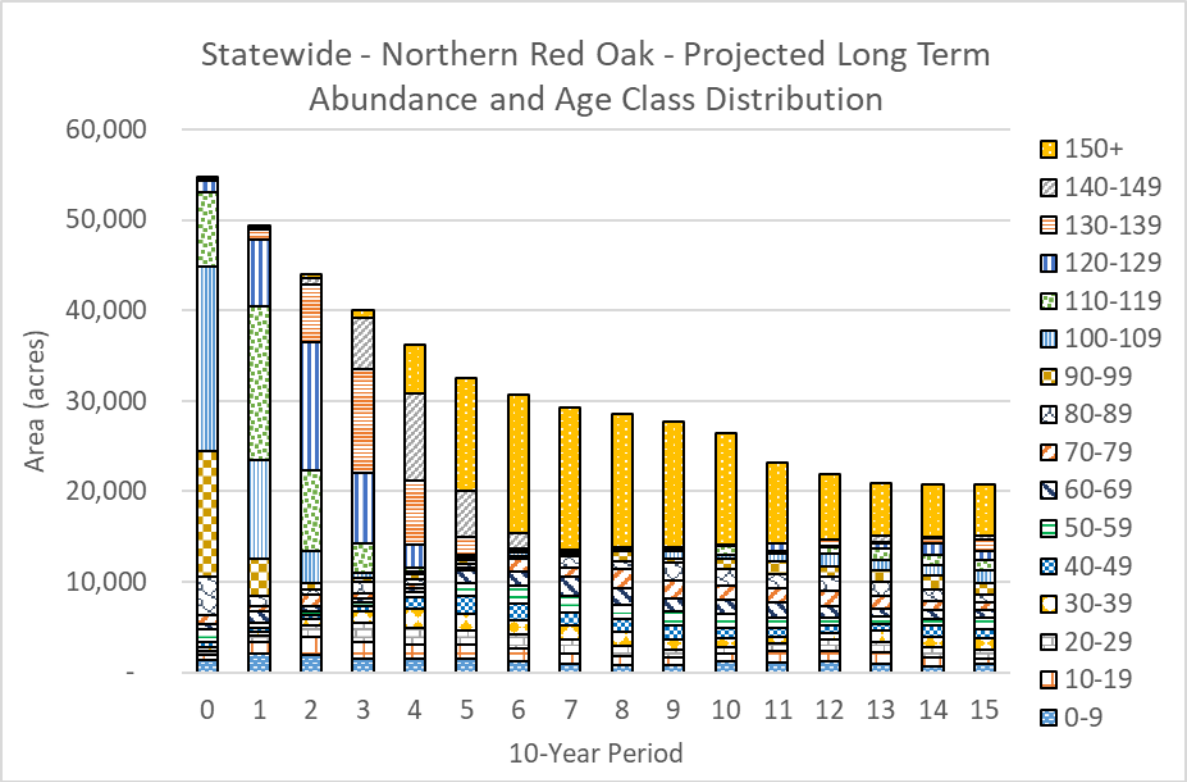


Figure 56. Northern red oak abundance by age class as projected through period 15 in the SFMP model.

Age class distribution

The statewide age class distribution of the northern red oak cover type is significantly unbalanced at a statewide level with a greater proportion of the population being in old age classes beyond the desired rotation age (Figure 57). As described above, hesitancy to perform regeneration harvests on oak stands during the 1980s, 1990s, and early 2000s has resulted in an undesirable age class distribution and a rather urgent need to regenerate stands before the existing canopy has deteriorated to the point where it lacks the vigor to regenerate once harvested. Stands with signs of decline and advanced mortality should be prioritized for harvest while healthier stands are good candidates for regeneration harvests in future planning periods. It will take several decades to achieve a more balanced condition in this cover type as regeneration harvest levels and cover type conversions stabilize (Figures 58 and 59).

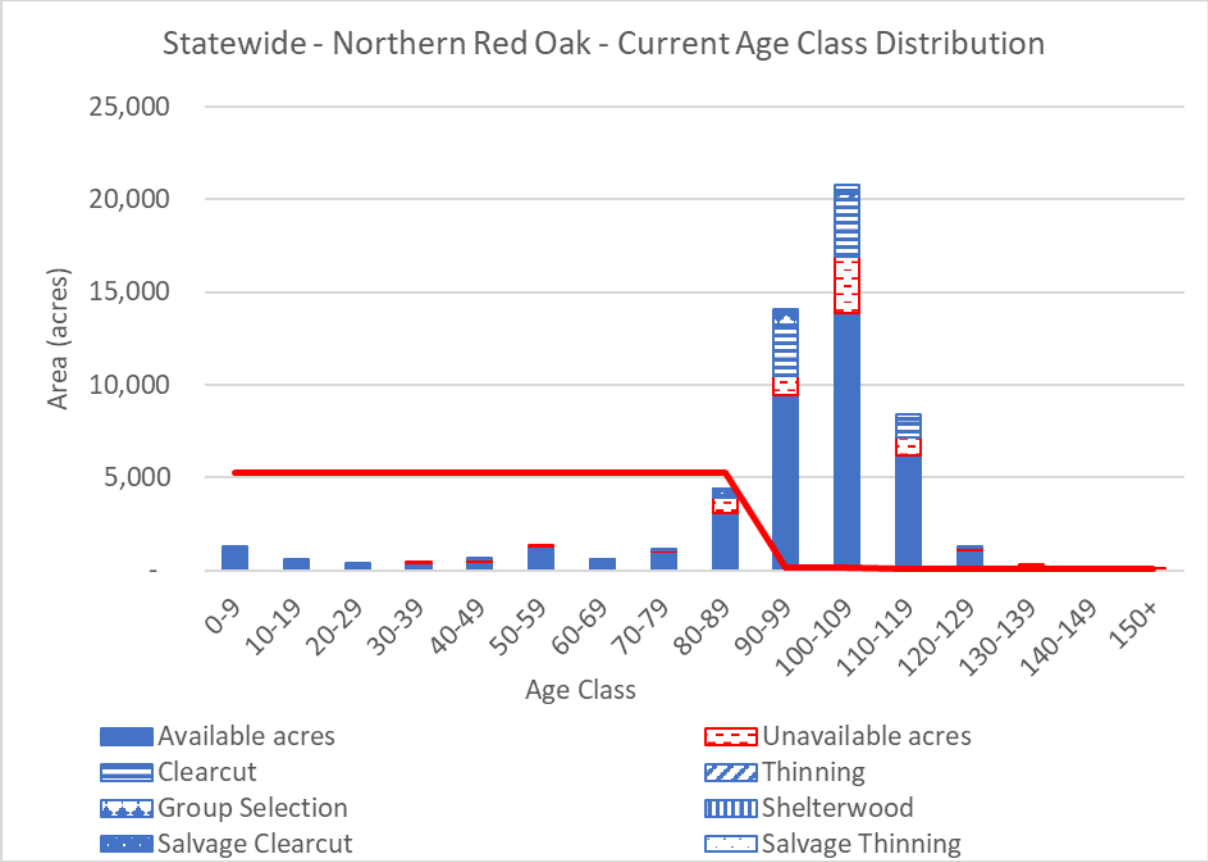


Figure 57. Current statewide Northern Red Oak age class distribution, projected period one harvests and desired age class distribution.

The primary mid-term strategic harvesting objective for this planning period is ensuring the desired amount of northern red oak is regenerated (indicated by the red line in Figure 57) to work towards a desirable age class distribution of the future manageable population (Figure 58).

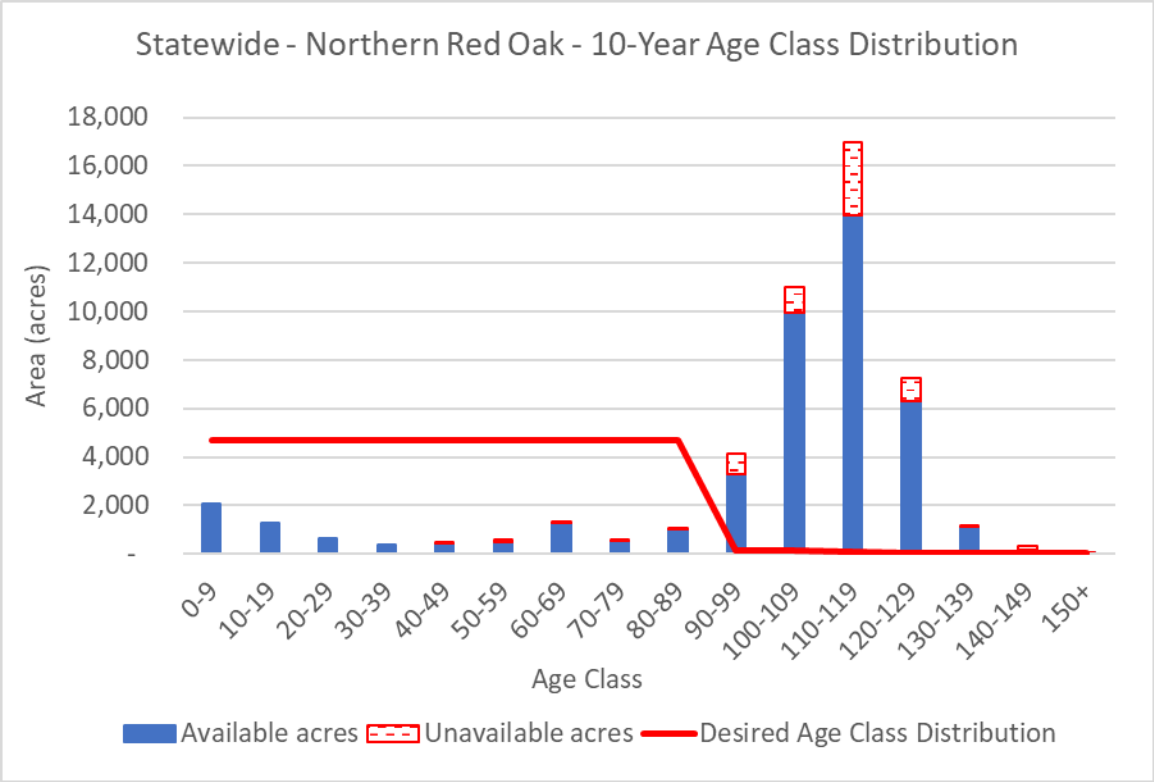


Figure 58. Age class distribution of northern red oak cover type after this planning period's management has been implemented.

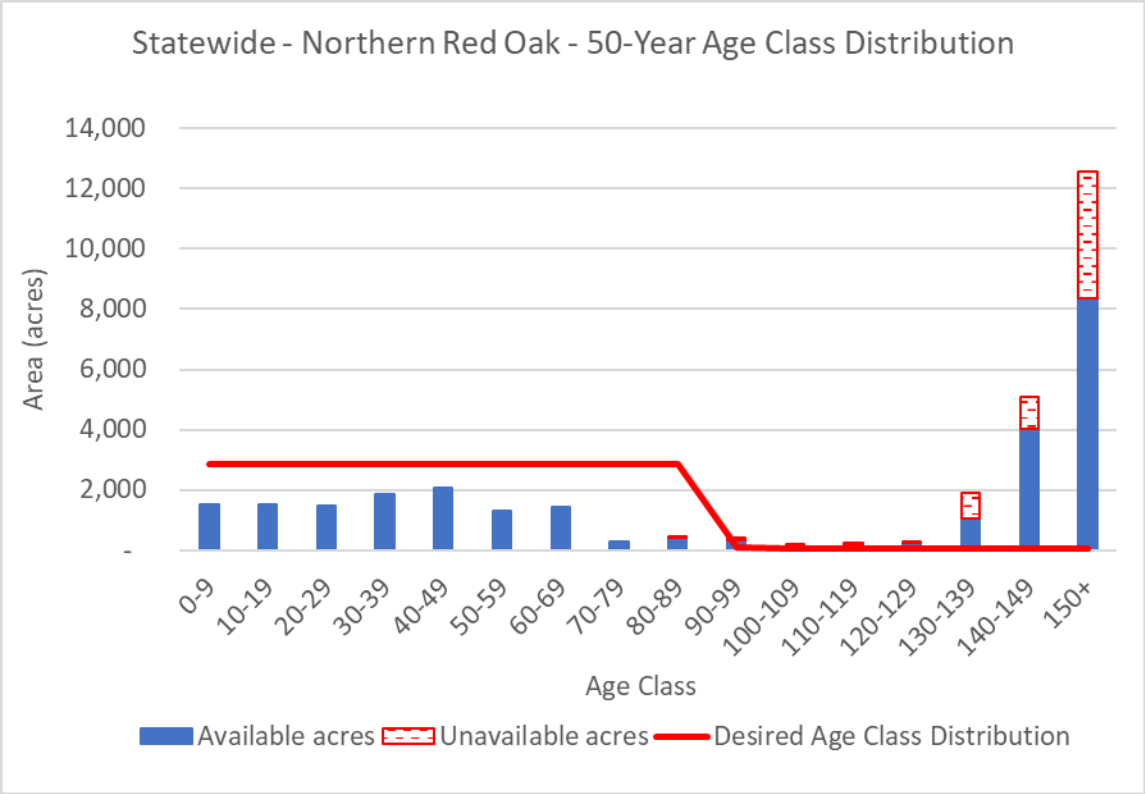


Figure 59. Balanced age class distribution after 50 years of even-aged management of the available acreage.

Silvicultural regimes

Northern red oak will be managed with a combination of even-aged and uneven-aged silvicultural systems during the next decade. The even-aged systems designed to regenerate stands include about 7,443 acres of clearcut harvests (including 290 acres of salvage clearcut in the eastern lower peninsula) and 114 acres of shelterwood harvests, totaling about 7,556 acres of planned regeneration harvests over the next decade. These harvests help build a balanced age class distribution of the manageable acres, as shown in the 0-9 age class of Figure 58. The un-even aged harvests will focus on maintaining a higher component of mast-producing trees, more complex stand structure, and regenerating portions of stands in multiple age cohorts to a variety of species. There are 343 acres of thinning/selection harvests and an additional 720 acres of group selection planned for the decade to accomplish these goals. Partial salvage harvests are also projected for an additional 724 acres due to the ice storm damage in the eastern Lower Peninsula.

Objectives and management actions

Objective 1. Minimize conversion of northern red oak cover type acres, allowing about 5,377 acres, or 9.8 percent, to convert to other types including mixed upland deciduous and planted red pine.

- Action 1. Focus on the retention and regeneration of white oak species wherever possible in oak stands by protecting existing advanced oak regeneration and leaving large tops to help protect seedlings from browsing pressure as they get established.

- Action 2. Retain and protect existing white pine and red pine components in oak stands across size classes. A component of sawlog-sized white pine should be left as seed-producing trees while adding species and structural diversity. Advanced white and red pine regeneration that exists in stands should also be protected to help encourage oak regeneration on dry mesic sites.

Objective 2. Select northern red oak stands for regeneration using even-aged harvests to improve the age class distribution of the manageable population and support the habitat needs of several game and non-game wildlife via mast production and cavity nesting opportunities.

- Action 1. Prescribe about 7,443 acres of northern red oak for clearcut harvests (including 290 acres of salvage clearcut in the eastern Lower Peninsula) from any merchantable age or size class throughout the next decade (Table 4).
- Action 2. Prescribe about 114 acres of northern red oak for shelterwood harvests from merchantable stands throughout the next decade (Table 4).

Objective 3. Select northern red oak stands for uneven-aged harvests to improve the stand structure and species composition of the manageable population and support the habitat needs of several game and non-game wildlife via mast production and cavity nesting opportunities.

- Action 1. Prescribe about 343 acres of northern red oak for selection/thinning harvests from any merchantable age or size class throughout the next decade (Table 4).
- Action 2. Prescribe about 720 acres of northern red oak for group selection harvests and an additional 724 acres of salvage thinning from merchantable stands throughout the next decade (Table 4).

Oak mix

The oak mix cover type, on its own, makes up approximately 1.0 % of the state forest and is most commonly found in upland areas with moderate to poor soil nutrient content and low soil moistures. This cover type is comprised of primarily of deciduous species with the most abundant species being northern red oak, white oak, hybridized black and red oak, and northern pin oak. Associated species commonly mixed with the primary canopy species are white pine, red pine, jack pine, aspen species, and red maple (Figure 60; Michigan DNR Forest Inventory Data, 2021).

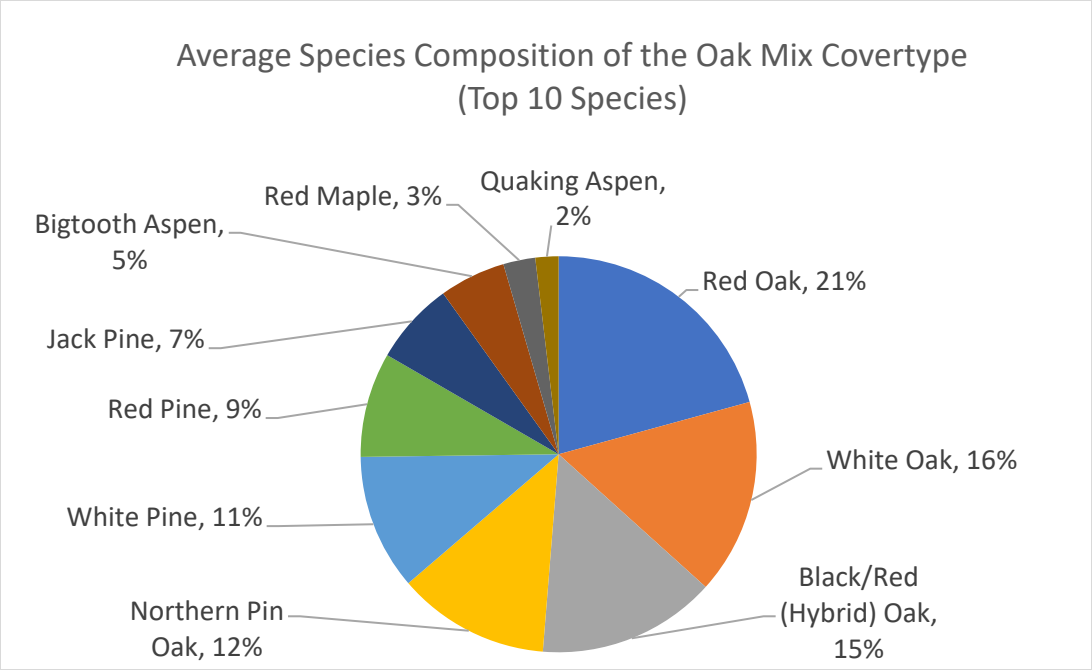


Figure 60. Average species composition of the oak mix cover type across the State Forest.

The oak mix cover type currently has a decent distribution of canopy size classes as work continues this planning period to address the unbalanced distribution of age classes which are heavily skewed to the older end of the age range (Figure 61). As this cover type becomes more balanced across age classes, the proportion of the cover type containing sapling and pole-sized trees will increase and be better represented in future decades.

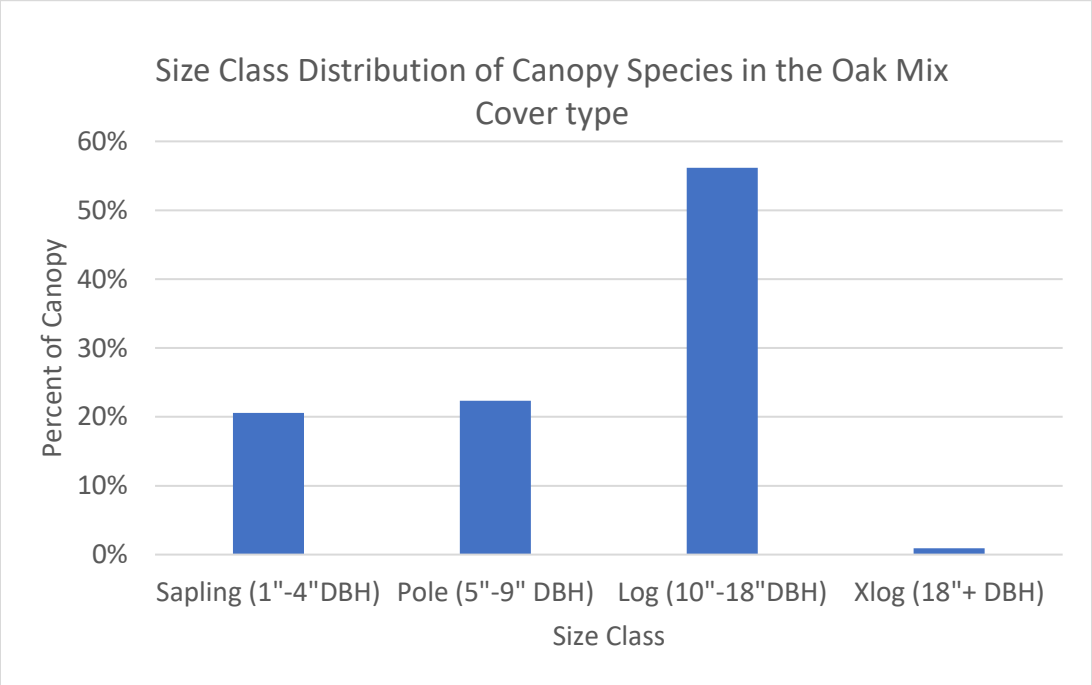


Figure 61. Average size class distribution of the oak mix cover type.

Cover type abundance

Oak mix, currently the 20th-most-prevalent cover type, is projected to have a slight increase in abundance over the next decade as management strives to increase the white oak component in many oak stands across the landscape, increasing overall resiliency to oak wilt disease. The oak mix cover type grows primarily on xeric sites providing important timber and habitat values. Oak mix stands provide key habitat elements for a variety of wildlife due to their hard mast production and tendency for cavities to develop in the stems. There are currently about 41,856 acres of oak mix on the state forest and that population is expected to decrease slightly by 1.9 percent during the next planning period to about 41,041 acres. It is forecasted that in subsequent decades, like other oak types, the oak mix cover type will also decline in abundance due to the challenges regenerating oak at current densities (Figure 62).

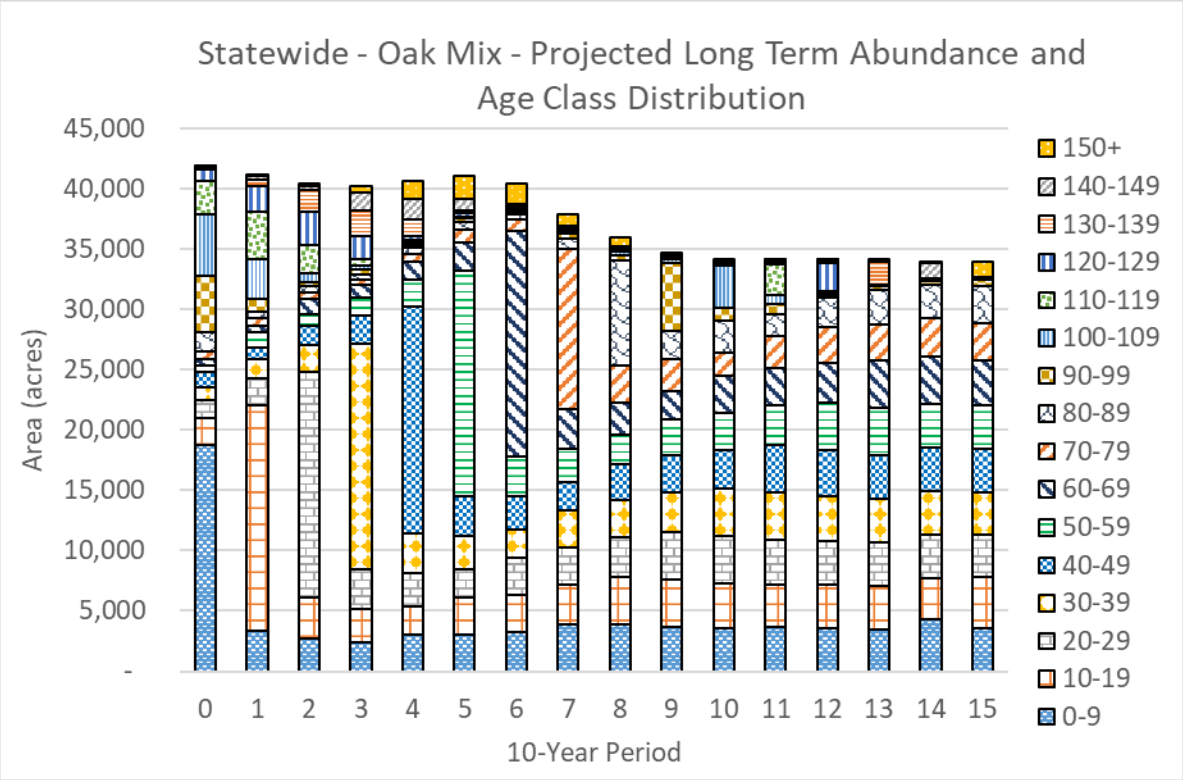


Figure 62. Oak mix abundance by age class as projected through period 15 in the SFMP model.

Age class distribution

The statewide age class distribution of the oak mix cover type is significantly unbalanced at a statewide level with a greater proportion of the population being in the 0-9 age class, and in old age classes beyond the desired rotation age (Figure 63). As described above, that hesitancy to perform regeneration harvests on oak stands during the 1980s, 1990s, and early 2000s has resulted in an undesirable age class distribution and a rather urgent need to regenerate stands before the existing canopy has deteriorated to the point where it lacks the vigor to regenerate once harvested. Stands with signs and symptoms of decline and advanced mortality should be prioritized for harvest while healthier stands are good candidates for regeneration harvests in future planning periods. It will take several decades to achieve a

more balanced condition in this cover type as regeneration harvest levels and cover type conversions stabilize (Figure 64 and 65).

The unusually high level of 0-9 acres is unintentionally exaggerated in the incremented dataset used in the SFMP model. The incrementation process, which simulates the completion of prescribed harvests, converts stands to the cover type that is specified as the management objective of each regeneration harvest. The four specific-level oak cover types that were combined to form the oak mix cover type group used in this planning effort are often mistakenly used to describe a more mixed deciduous stand with lower amounts of oak species. Stand examiners intend to communicate that the regeneration of prescribed oak stands will likely result in a mixed deciduous stand with oak as a component, while the oak mix actually describes a stand dominated by a mixed variety of oak species totaling greater than 60 percent canopy occupancy and only 40 percent or less of other tree species. The result of this trend has accumulated a modeled cover type abundance that is artificially higher than what we will likely observe in the field and capture in the inventory over time.

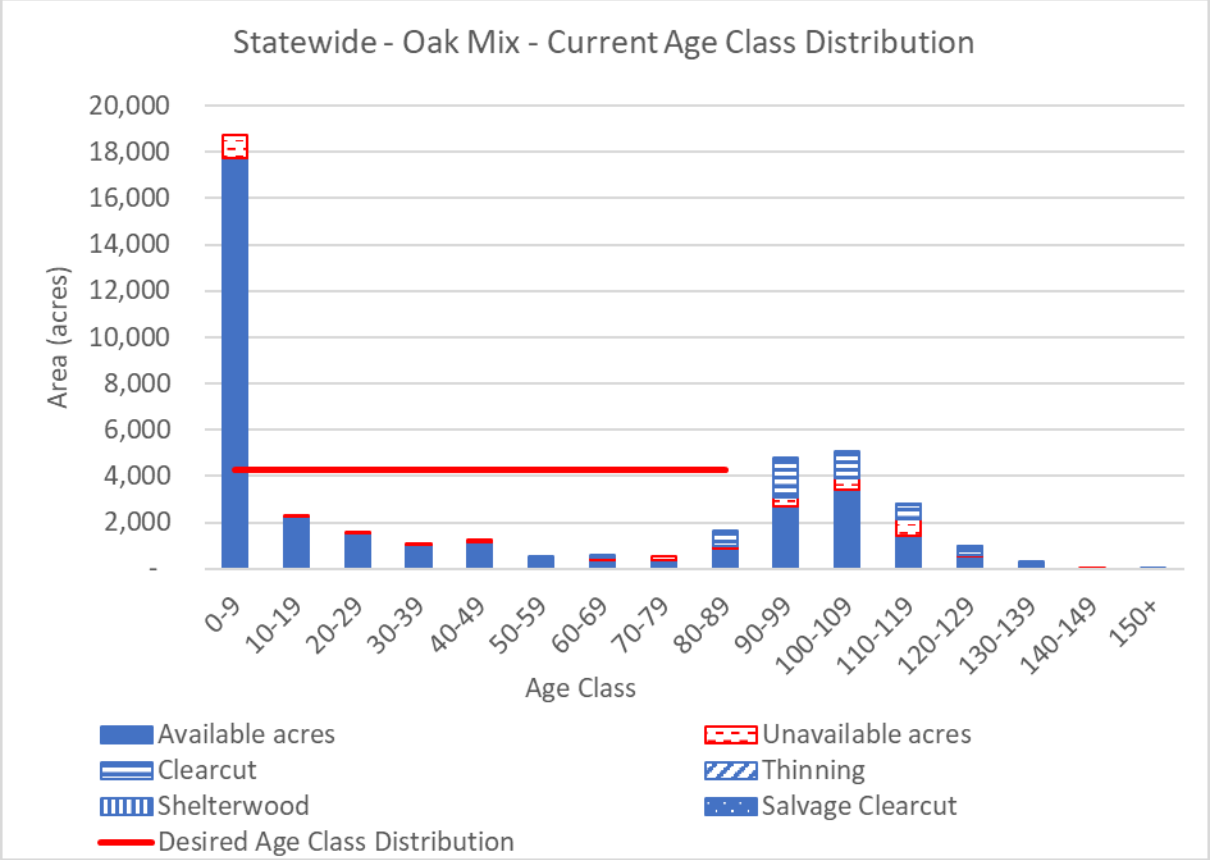


Figure 63. Current statewide oak mix age class distribution, projected period one harvests and desired age class distribution.

The primary mid-term strategic harvesting objective for this planning period is ensuring the desired amount of oak mix is regenerated (indicated by the red line in Figure 63) to work towards a desirable age class distribution of the manageable population (Figure 64).

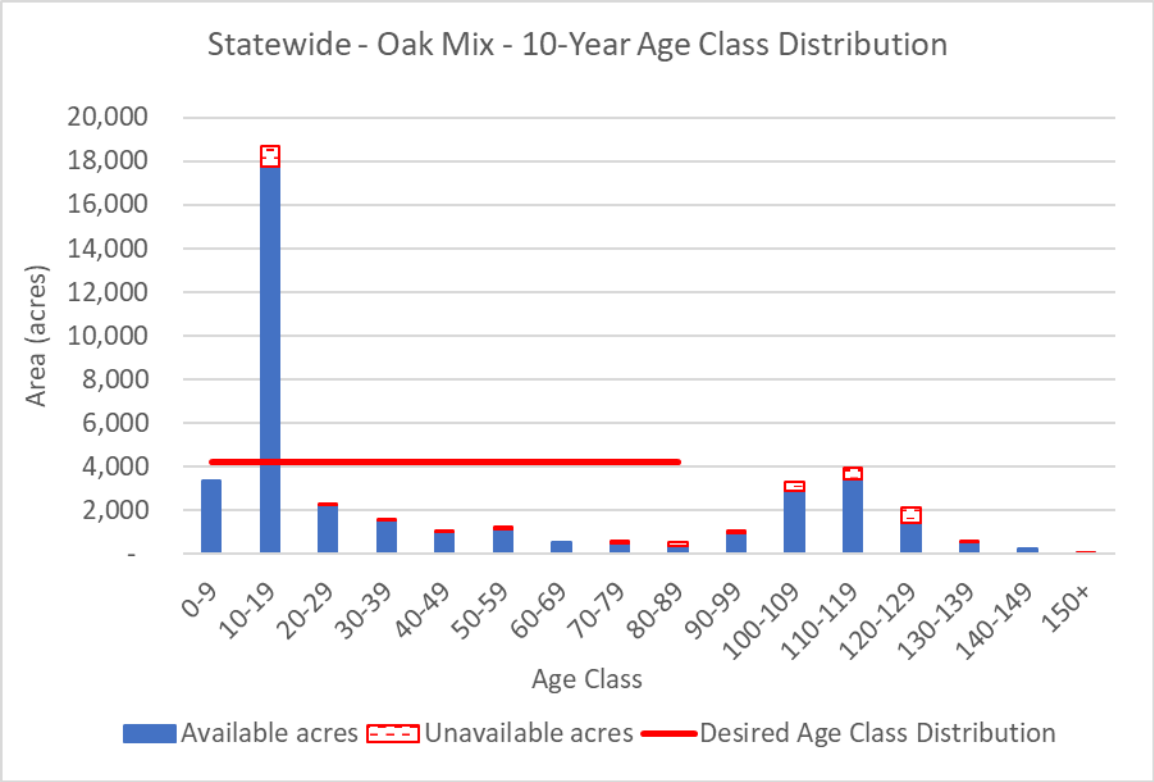


Figure 64. Age class distribution of oak mix cover type after this planning period's management has been implemented.

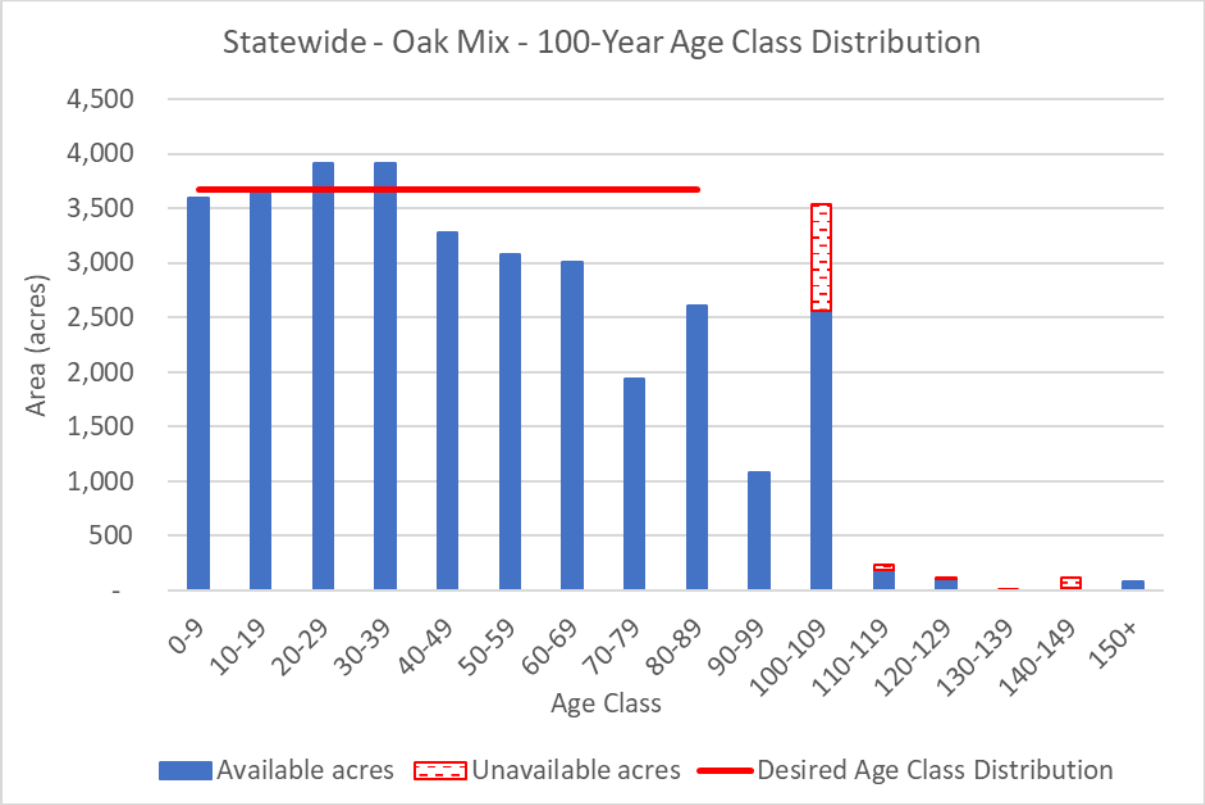


Figure 65. Balanced age class distribution after 100 years of even-aged management of the available acreage.

Silvicultural regimes

Oak mix will be managed primarily with even-aged silvicultural systems during the next decade including about 4,230 acres of clearcut harvests (including 88 acres of salvage clearcut) and 48 acres of shelterwood harvests, totaling about 4,278 acres of planned regeneration harvests over the next decade. These harvests help build a balanced age class distribution of the manageable acres, as shown in the 0-9 age class of Figures 63-65.

Objectives and management actions

Objective 1. Limit the decrease of the oak mix cover type acres to about 393 acres of conversion, or 0.9 percent.

- Action 1. Focus on retention and regeneration of white oak species wherever possible in oak stands by protecting existing advanced oak regeneration and leaving large tops to help protect seedlings from browsing pressure as they get established.
- Action 2. Retain and protect existing white pine and red pine components in oak stands across size classes. A component of sawlog-sized white pine should be left as seed-producing trees while also adding species and structural diversity. Advanced white and red pine regeneration that exists in stands should also be protected, which will help encourage oak regeneration on dry mesic sites.

Objective 2. Select oak mix stands for regeneration using even-aged harvests to improve the age class distribution of the manageable population and support the habitat needs of several game and non-game wildlife via mast production and cavity nesting opportunities.

- Action 1. Prescribe about 4,230 acres of oak mix for clearcut harvests (including salvage clearcut harvest) from any merchantable age or size class throughout the next decade (Table 4).
- Action 2. Prescribe about 48 acres of oak mix for shelterwood harvests from merchantable stands throughout the next decade (Table 4).
- Action 2. Prescribe about 380 acres of oak mix for thinning/selection harvests from merchantable stands with desirable white pine understories throughout the next decade (Table 4).

Lowland deciduous

The lowland deciduous cover type makes up approximately 3.3 % of the state forest and is most commonly found in lowland areas with moderate to high soil nutrient content and high soil moistures. This cover type is comprised primarily of deciduous species with the most abundant species being red maple and black ash. The black ash component continues to decline due to mortality from the Emerald Ash Borer. Associated species commonly mixed with the primary canopy species are paper birch, northern white cedar, balsam fir and green ash (Figure 66, Michigan DNR Forest Inventory Data, 2021).

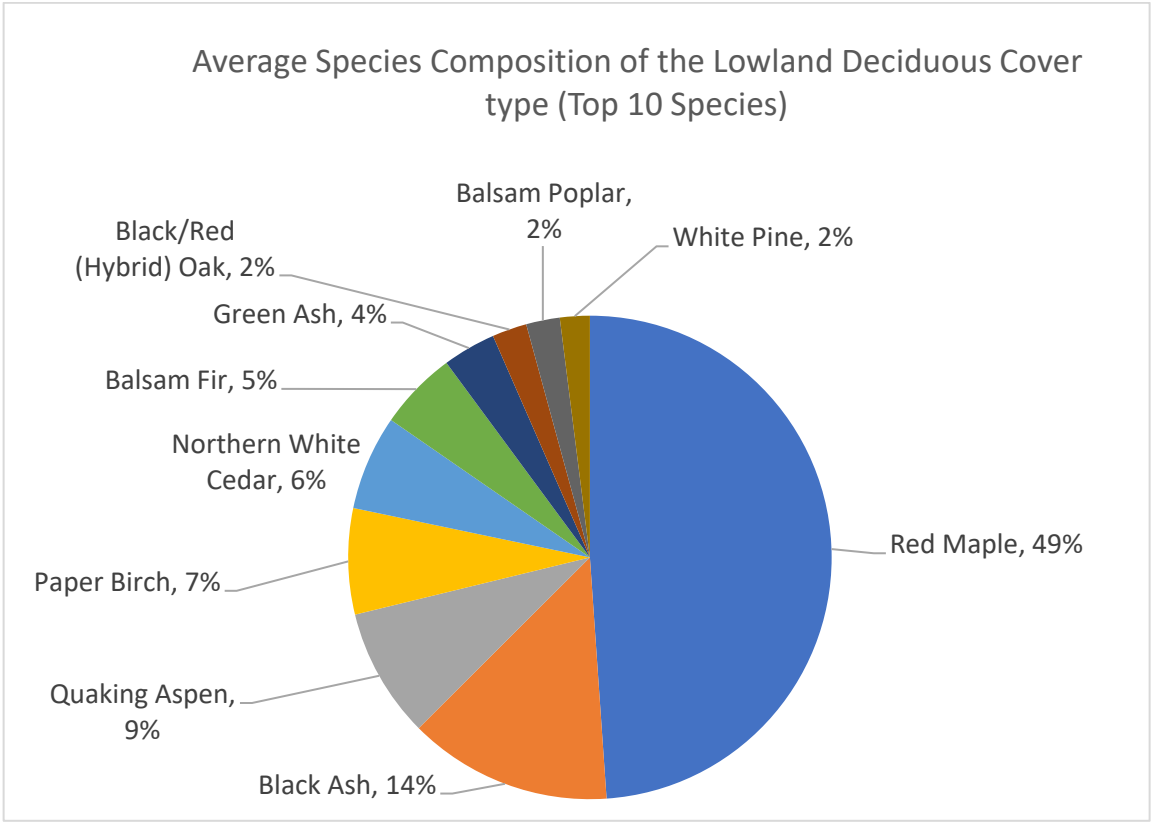


Figure 66. Average species composition of the lowland deciduous cover type across the state forest.

The lowland deciduous cover type currently has a decent distribution of canopy size classes. Work continues this planning period to address the unbalanced distribution of age classes, which are heavily skewed to the older end of the age range (Figure 67). As this cover type becomes more balanced across age classes, the proportion of the cover type containing sapling and pole-sized trees will increase and be better represented in future decades.

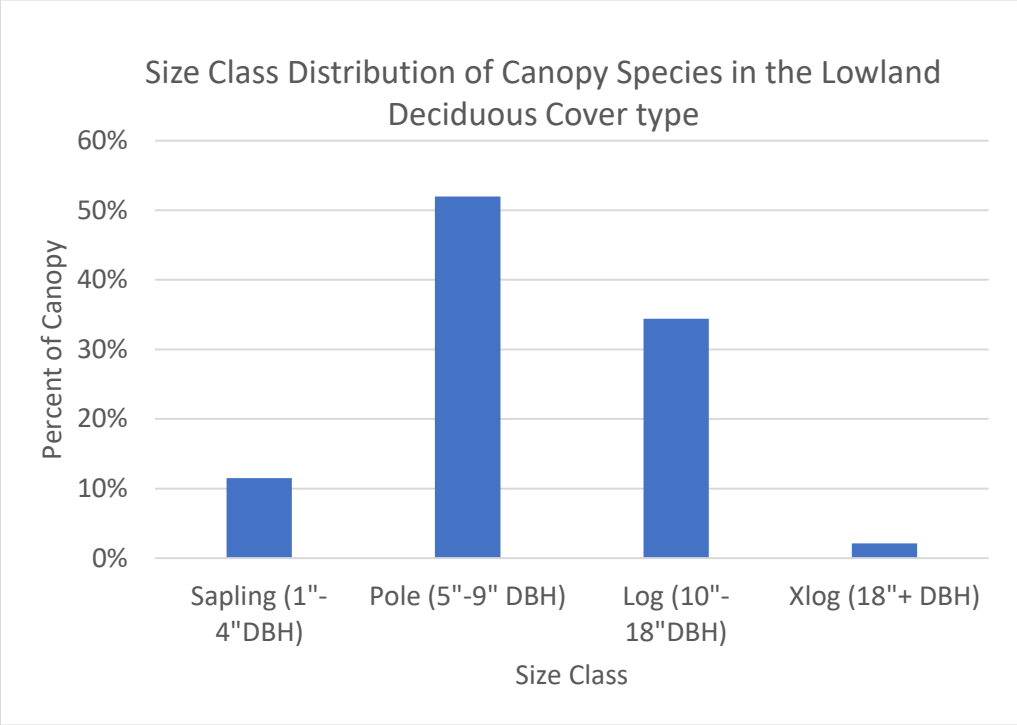


Figure 67. Average size class distribution of the lowland deciduous cover type.

Cover type abundance

Lowland deciduous, currently the ninth-most-prevalent cover type, is projected for a very slight decrease in abundance over the next decade as some limited conversion to lowland aspen takes place through regeneration harvests. The lowland deciduous cover type grows primarily on hydric sites across the landscape, providing important timber and habitat values. There are currently about 132,452 acres of lowland deciduous in the state forest and that population is expected to decrease slightly by 0.2 percent during the next planning period to about 132,163 acres. It is forecast that the abundance of the lowland deciduous cover type will gradually increase as areas of lowland aspen that are too wet to harvest will likely senesce to lowland deciduous. These stands will likely become dominated by more mid to late successional species like red maple rather than quaking aspen and balsam poplar (Figure 68).

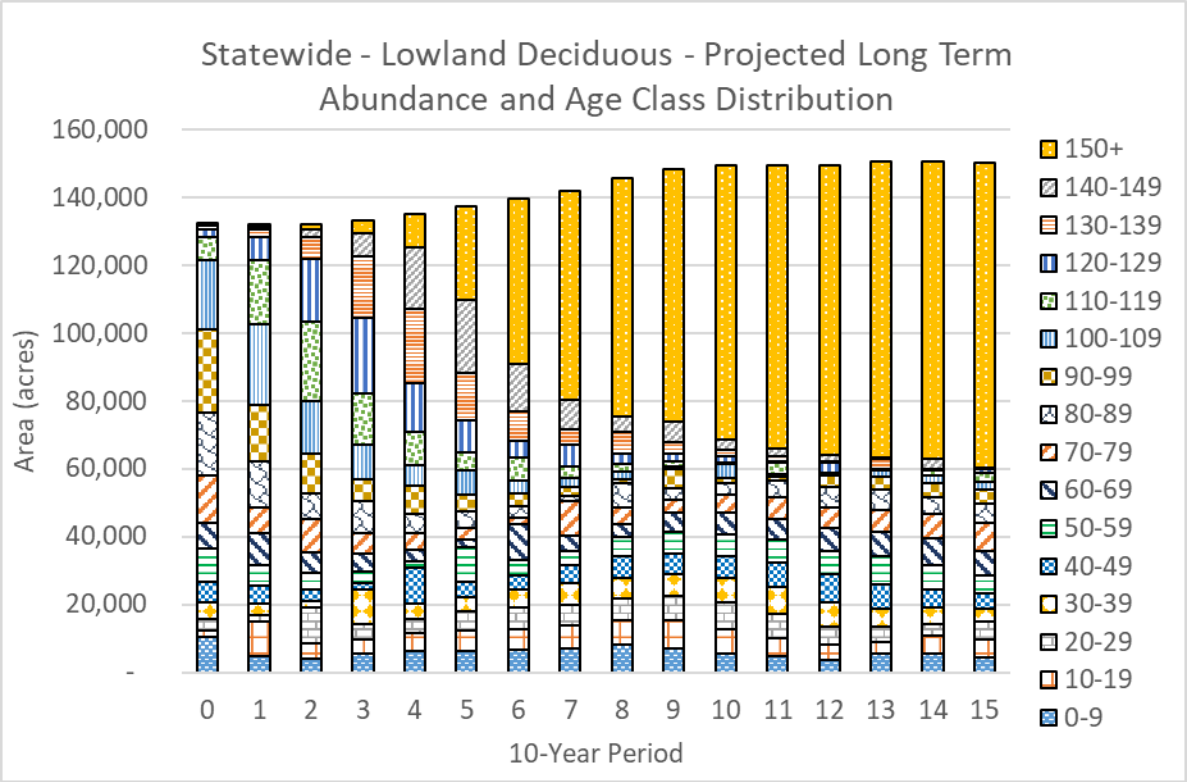


Figure 68. Lowland deciduous abundance by age class as projected through period 15 in the SFMP model.

Age class distribution

The overall (both available and unavailable areas) statewide age class distribution of the lowland deciduous cover type is significantly unbalanced at a statewide level, with a greater proportion of the population represented in old age classes beyond the desired rotation age (Figure 69). However, the manageable population is fairly well balanced considering the limitations of managing this cover type. It will take several decades to achieve a more balanced condition in this cover type as regeneration harvest levels and cover type conversions stabilize (Figure 71).

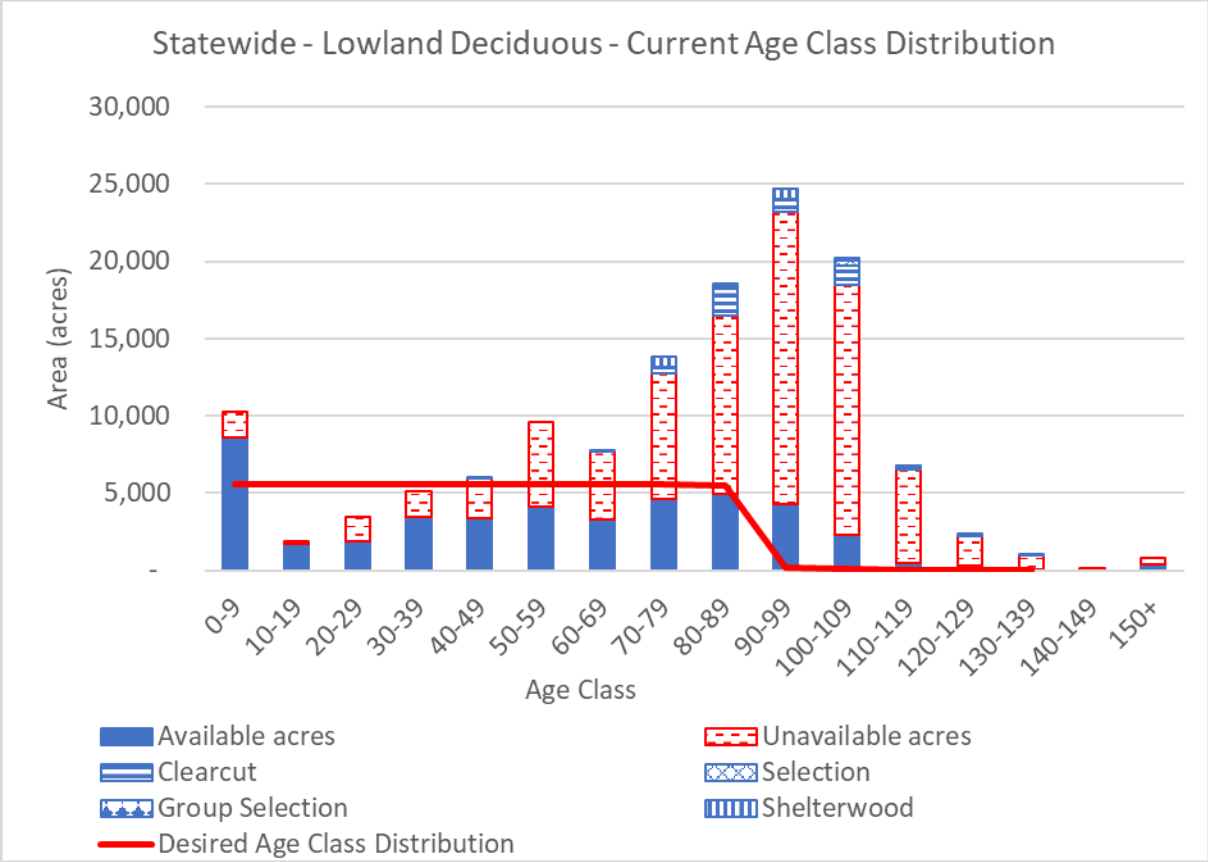


Figure 69. Current statewide lowland deciduous age class distribution, projected period one harvests and desired age class distribution.

The primary mid-term strategic harvesting objective for this planning period is ensuring the desired amount of lowland deciduous is regenerated (indicated by the red line in Figure 69) to work towards a desirable age class distribution of the manageable population (Figure 71).

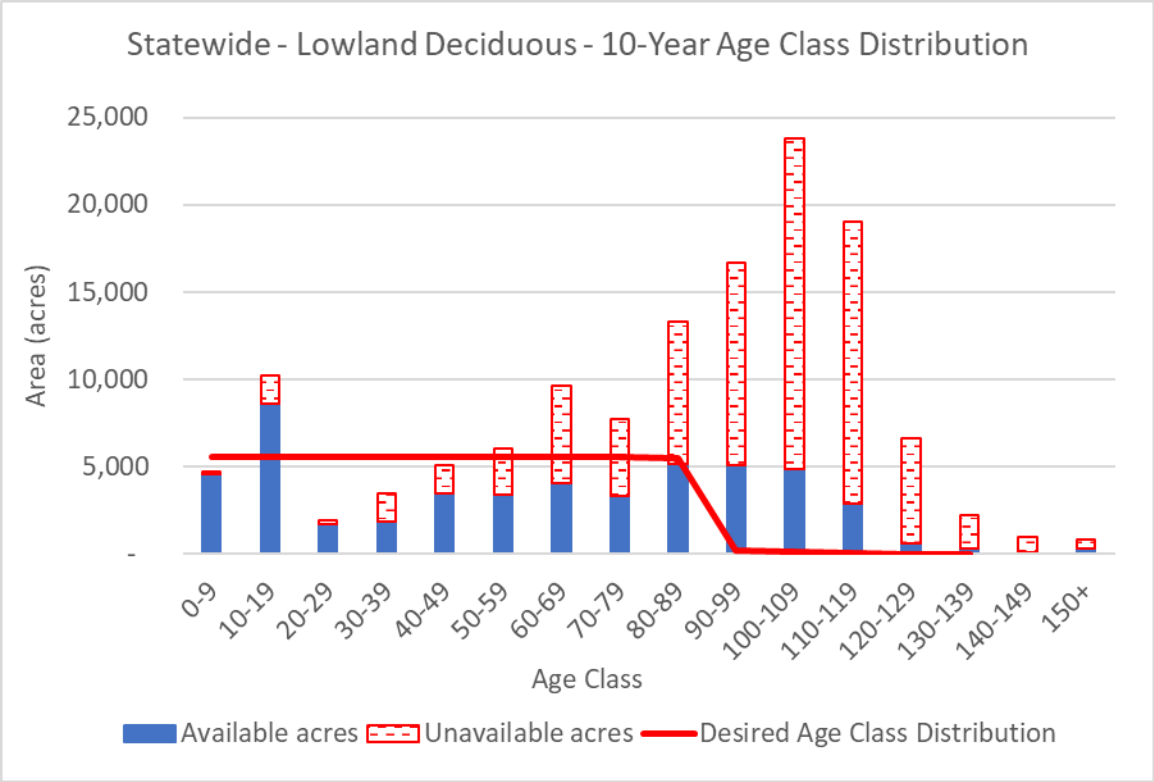


Figure 70. Age class distribution of lowland deciduous cover type after this planning period's management has been implemented.

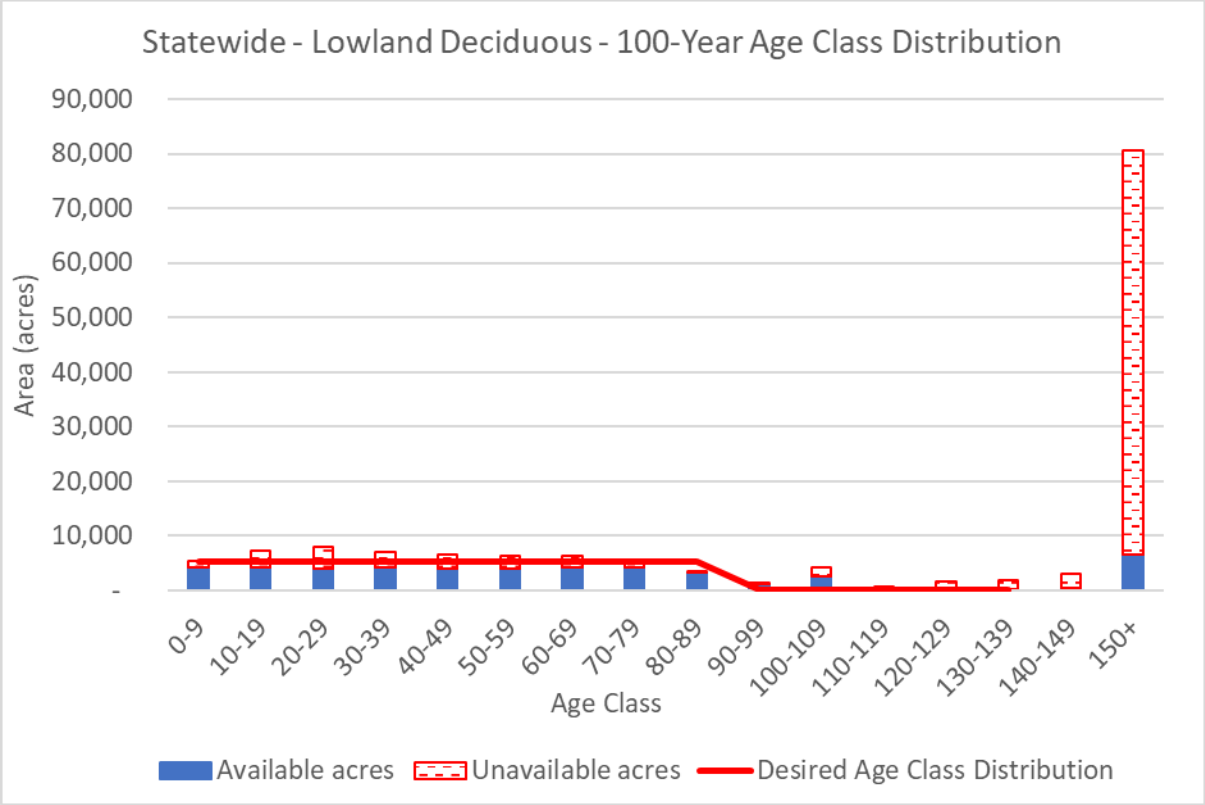


Figure 71. Balanced age class distribution after 100 years of even-aged management of the available acreage.

Silvicultural regimes

Lowland deciduous will be managed with a combination of even-aged and uneven-aged silvicultural systems during the next decade. The even-aged systems designed to regenerate stands include about 4,697 acres of clearcut harvests and 1,655 acres of shelterwood harvests, totaling about 6,352 acres of planned regeneration harvests over the next decade. These harvests help build a balanced age class distribution of the manageable acres, as shown in the 0-9 age class of Figure 70. The uneven-aged harvests will focus on maintaining a higher component of large mature trees, more complex stand structure, and regenerating portions of stands in multiple age cohorts to a variety of species. There are 448 acres of thinning/selection harvests and an additional 168 acres of group selection planned for the decade to accomplish these goals.

Objectives and management actions

Objective 1. Select lowland deciduous stands for regeneration using even-aged harvests to improve the age class distribution of the manageable population and support habitat needs of several game and non-game wildlife species.

- Action 1. Prescribe about 4,697 acres of lowland deciduous for clearcut harvests from any merchantable age or size class throughout the next decade (Table 4).
- Action 2. Prescribe about 1,655 acres of lowland deciduous for shelterwood harvests from merchantable stands throughout the next decade (Table 4).

Objective 2. Select lowland deciduous stands for uneven-aged harvests to improve the stand structure and species composition of the manageable population and support the habitat needs of several game and non-game wildlife.

- Action 1. Prescribe about 448 acres of lowland deciduous for selection/thinning harvests from any merchantable age or size class throughout the next decade (Table 4).
- Action 2. Prescribe about 168 acres of lowland deciduous for group selection harvests from merchantable stands throughout the next decade (Table 4).

Upland mixed forest

The upland mixed forest cover type makes up approximately 3.3 percent of the state forest and is most commonly found in upland areas with low to moderate soil nutrient content and low to moderate soil moistures. This cover type is comprised of a mix of deciduous and coniferous species with the most abundant species being quaking aspen, white pine, jack pine, red maple, red pine and balsam fir. Associated species commonly mixed in with the primary canopy species are bigtooth aspen, red/black hybrid oak, northern red oak and white spruce (Figure 72, Michigan DNR Forest Inventory Data, 2021).

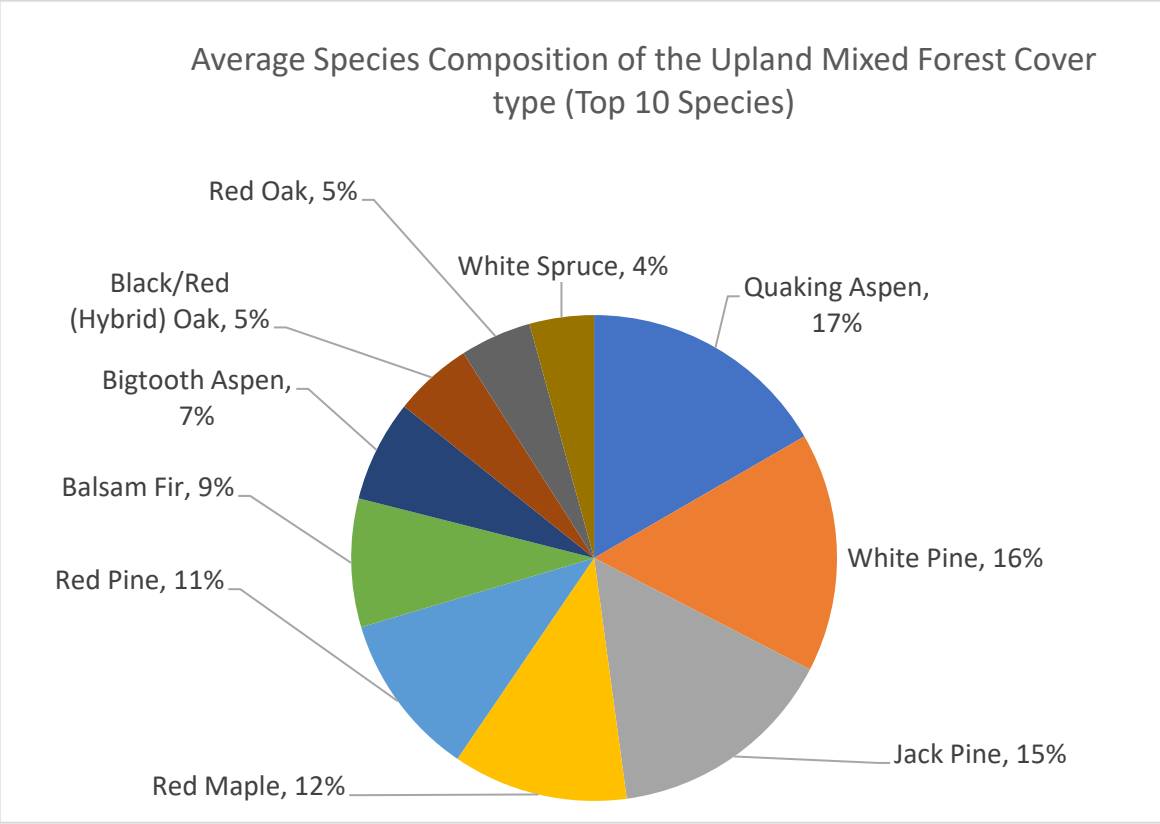


Figure 72. Average species composition of the upland mixed forest cover type across the State Forest.

The upland mixed forest cover type currently has a good distribution of canopy tree size classes (Figure 73). As this cover type becomes more balanced across age classes, the proportion of the cover type containing sapling and pole-sized trees will increase and be better represented in future decades.

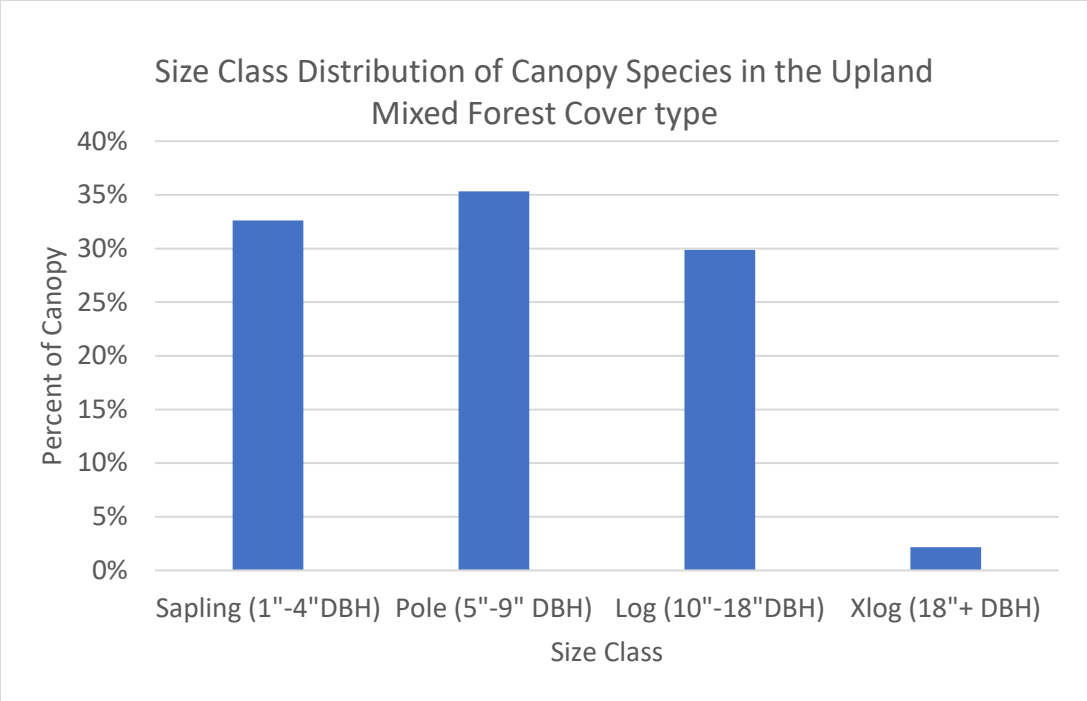


Figure 73. Average size class distribution of canopy species in the upland mixed cover type.

Cover type abundance

Upland mixed forest, currently the 10th-most-prevalent cover type, is projected to have a slight increase in abundance over the next decade as some conversion to upland mixed forest takes place through regeneration harvests of other cover types. The upland mixed forest cover type grows on a range of sites from dry xeric sites with a mix of jack pine and mixed oak to dry-mesic and mesic sites with a mix of eastern white pine, northern red oak, and red maple dominated stands. The cover type is typically quite diverse in species complexity, providing important timber and habitat values.

There are currently about 117,400 acres of upland mixed forest in the state forest and that population is expected to increase by 4.2 percent during the next planning period to about 122,305 acres. In subsequent decades the abundance of the upland mixed forest cover type is expected to gradually increase as regeneration harvests occur in non-mixed cover types such as oak and natural jack pine convert to upland mixed forest (Figure 74).

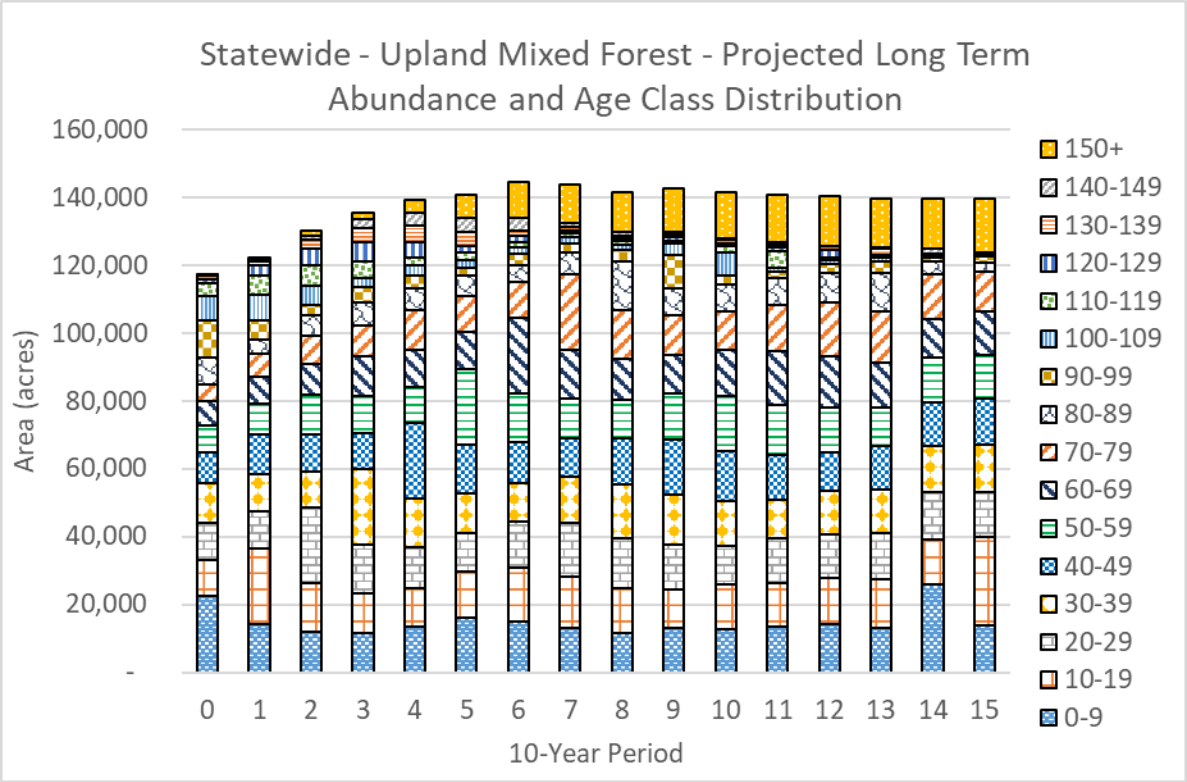


Figure 74. Upland mixed forest abundance by age class as projected through period 15 in the SFMP model.

Age class distribution

The statewide age class distribution of the upland mixed forest cover type is fairly well balanced with a slightly higher than desirable proportion of the population represented in old-age classes beyond the desired rotation age (Figure 75). It will take several decades to achieve a more balanced condition in this cover type as regeneration harvest levels and cover type conversions stabilize (Figures 76 and 77).

The unusually high level of 0-9 acres is likely due to a combination of factors, including intentional high harvest levels from the last planning period using the compensatory approach to area regulation. This resulted in a higher-than-normal amount of regeneration and also many stands converting into the mixed type after harvest.

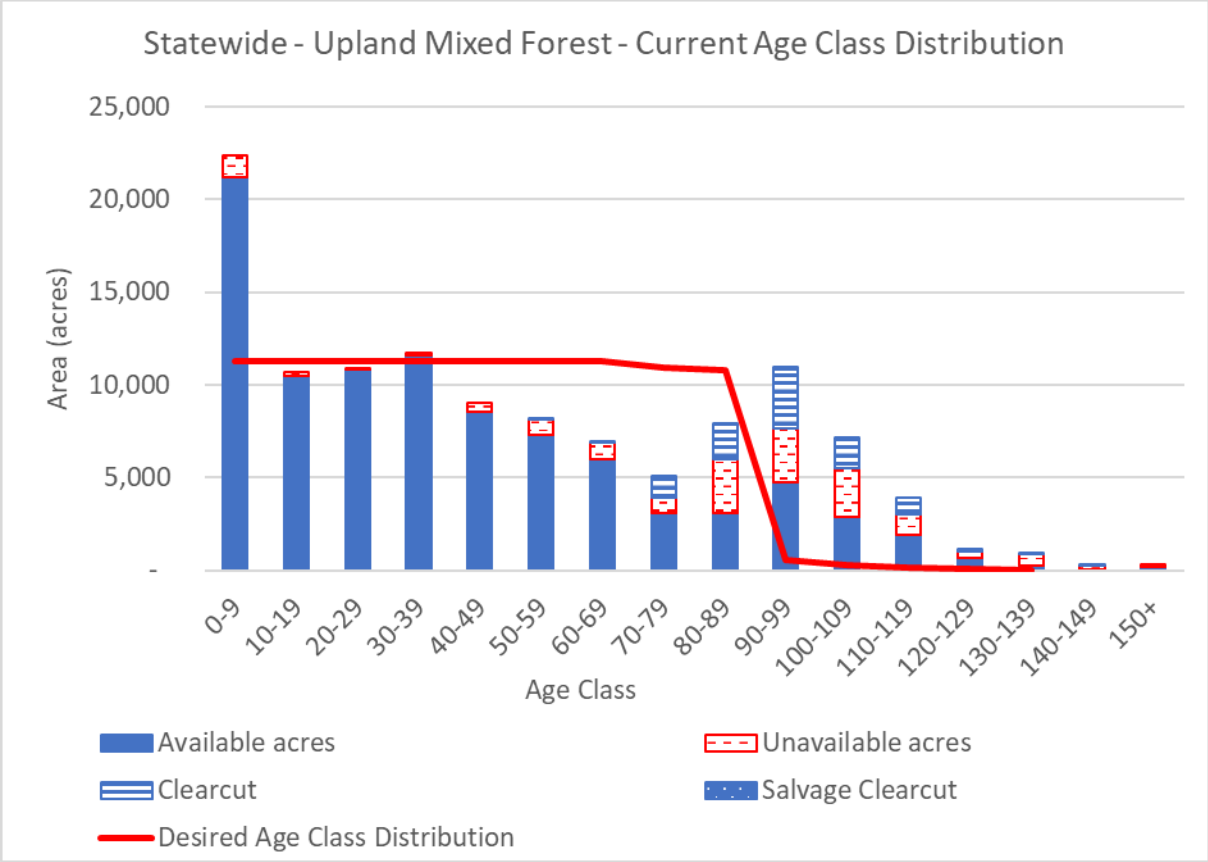


Figure 75. Current statewide upland mixed forest age class distribution, projected period one harvests and desired age class distribution.

The primary mid-term strategic harvesting objective for this planning period is ensuring the desired amount of upland mixed forest is regenerated (indicated by the red line in Figure 76) to work towards a desirable age class distribution of the manageable population (Figure 77).

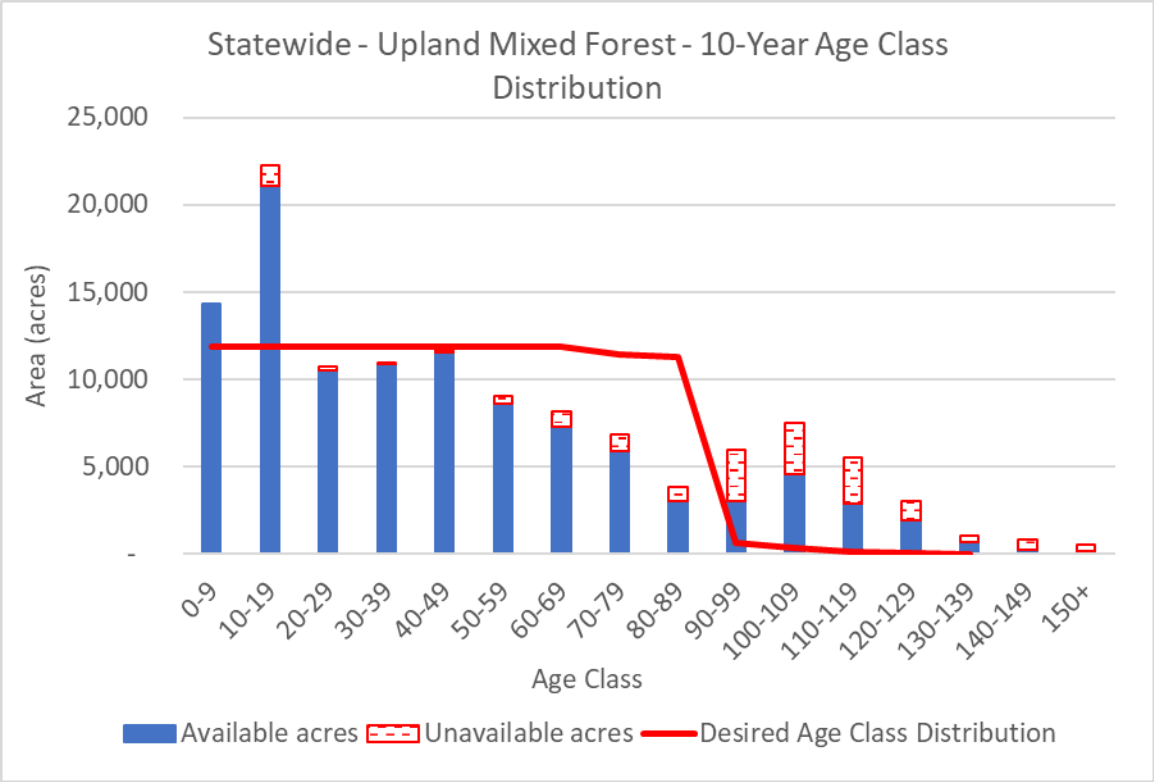


Figure 76. Age class distribution of upland mixed forest cover type after this planning period's management has been implemented.

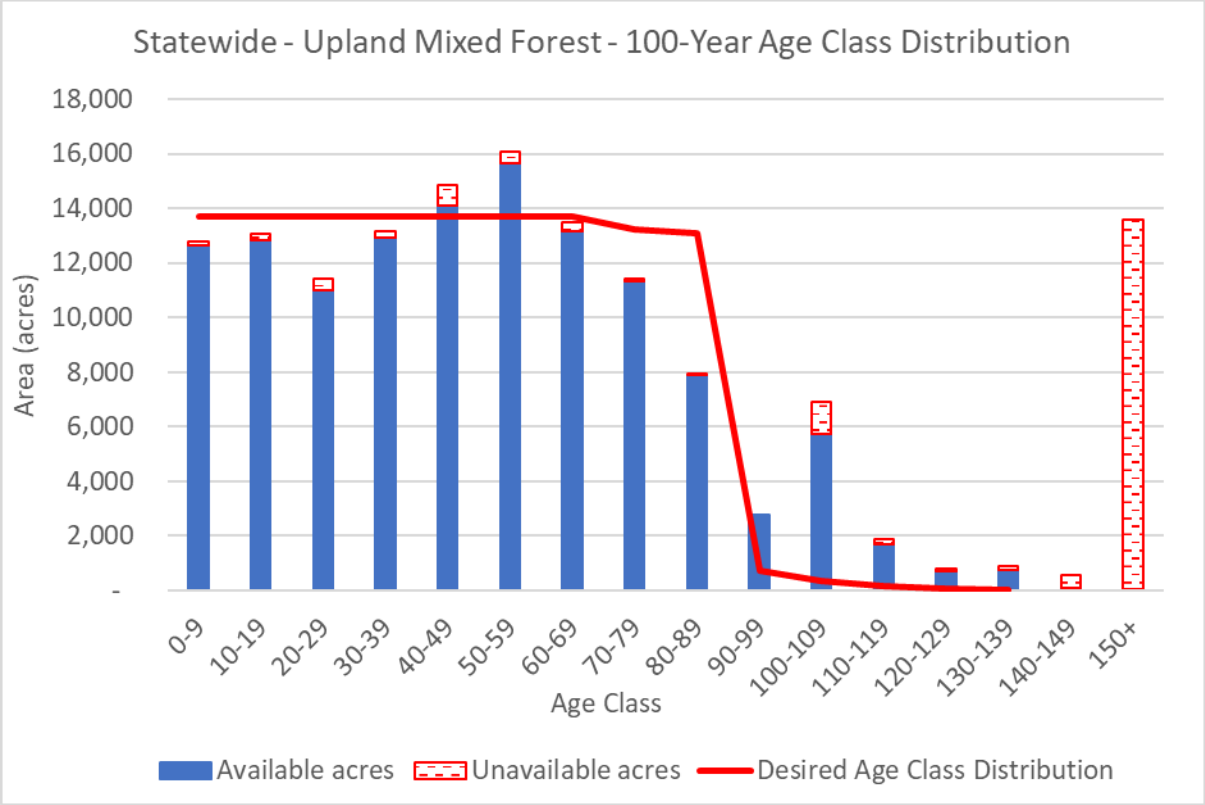


Figure 77. Balanced age class distribution after 100 years of even-aged management of the available acreage.

Silvicultural regimes

Upland mixed forest will be managed primarily with even-aged silvicultural systems during the next decade. The even-aged systems designed to regenerate stands include about 9,236 acres of clearcut and seed-tree harvests (including 171 acres of salvage clearcut) over the next decade. These harvests help build a balanced age class distribution of the manageable acres, as shown in the 0-9 age class of Figure 76.

Objectives and management actions

Objective 1. Select upland mixed forest stands for regeneration using even-aged harvests to improve the age class distribution of the manageable population and support the habitat needs of several game and non-game wildlife species.

- Action 1. Prescribe about 9,236 acres of upland mixed forest for clearcut and seed-tree harvests (including salvage harvest) from any merchantable age or size class throughout the next decade (Table 4).

Lowland spruce/fir

The lowland spruce/fir cover type makes up approximately 2.2 percent of the state forest and is most commonly found in lowland areas with moderate to low soil nutrient content and high soil moistures. This cover type is comprised primarily of coniferous species with the most abundant species being black

spruce. Associated species commonly mixed in with the primary canopy species are tamarack, northern white cedar, white pine, jack pine, balsam fir, and red maple (Figure 78, Michigan DNR Forest Inventory Data, 2021).

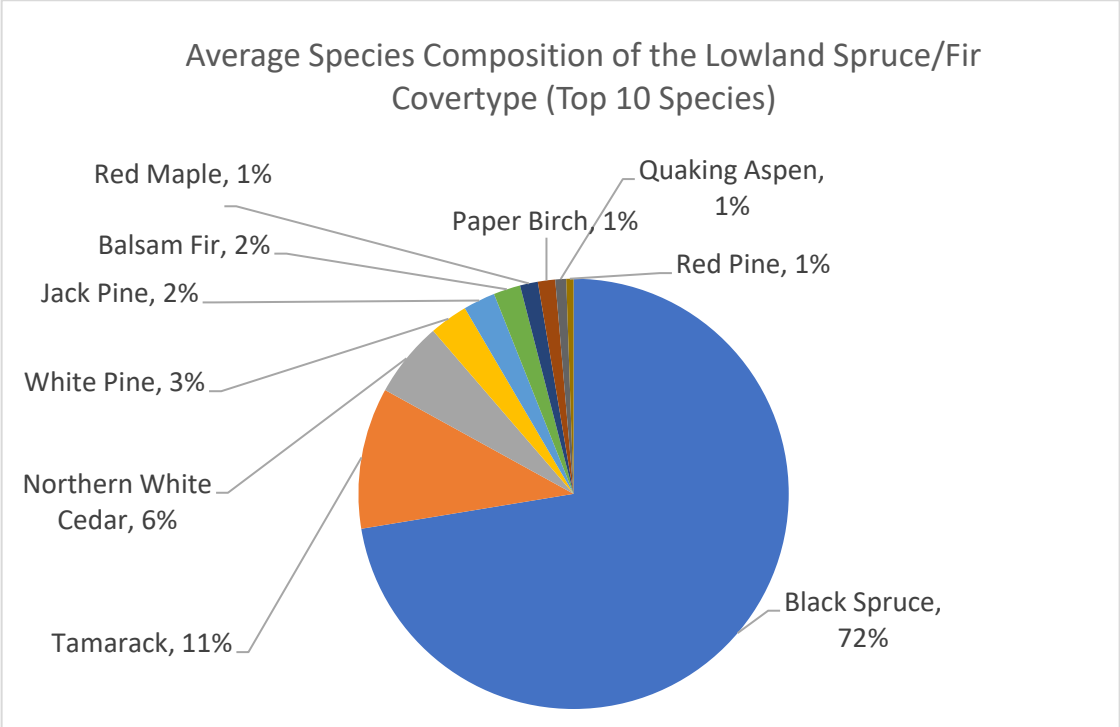


Figure 78. Average species composition of the lowland spruce/fir cover type across the state forest.

The lowland spruce/fir cover type currently has a decent distribution of canopy tree size classes (Figure 79). As this cover type becomes more balanced across age classes the proportion of the cover type containing sapling and pole-sized trees will equalize and be better represented in future decades.

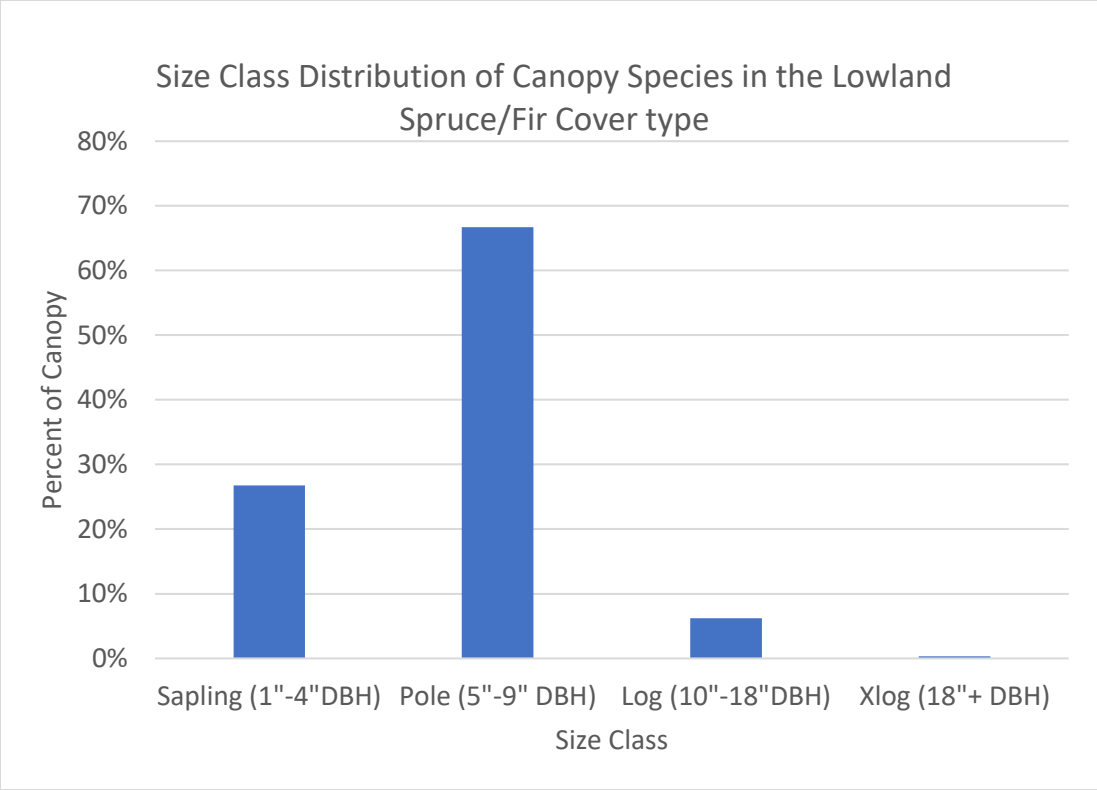


Figure 79. Average size class distribution of the lowland spruce/fir cover type.

Cover type abundance

Lowland spruce/fir, currently the 11th-most-prevalent cover type, is projected to slightly increase over the next decade as some conversion to lowland spruce/fir takes place through regeneration harvests of other cover types. The lowland spruce/fir cover type grows primarily on hydric sites across the landscape and provides important winter habitat resources, most notably as food and shelter for white-tail deer and snowshoe hare.

There are currently about 87,480 acres of lowland spruce/fir in the state forest and that population is expected to decrease slightly by 2.0 percent during the next planning period to about 86,028 acres. It is expected that in subsequent decades the abundance of the lowland spruce/fir cover type will continue to gradually decrease as regeneration harvests occur in the lowland spruce/fir cover type and result in more mixed stands with a higher component of deciduous tree species, converting some to lowland mixed forest (Figure 80).

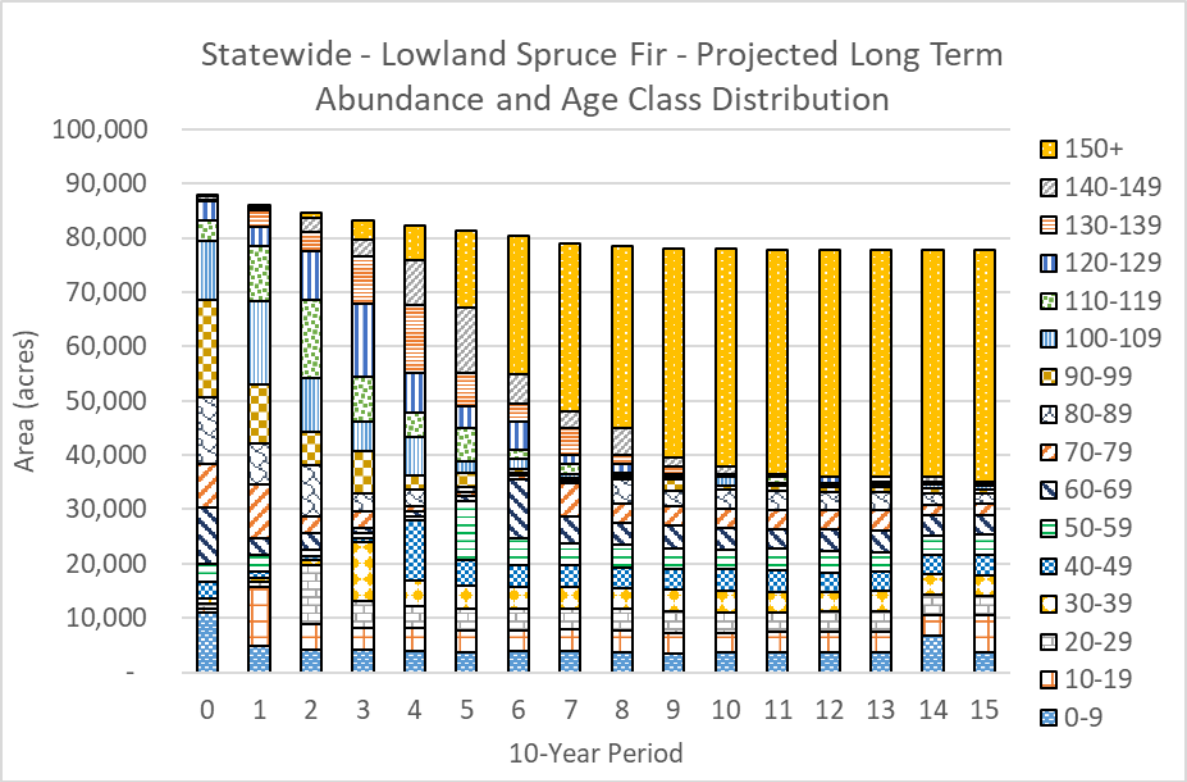


Figure 80. Lowland spruce/fir abundance by age class as projected through period 15 in the SFMP model.

Age class distribution

The statewide age class distribution of the lowland spruce/fir cover type is fairly well balanced with a slightly higher than desirable proportion of old age classes beyond the desired rotation age (Figure 81). It will take several decades to achieve a more balanced condition as regeneration harvest levels and cover type conversions stabilize (Figure 82 and 83).

The unusually high level of 0-9 acres is likely due to a combination of factors including the intentional high harvest levels from the last planning period using the compensatory approach to area regulation resulting in a higher-than-normal amount of regeneration.

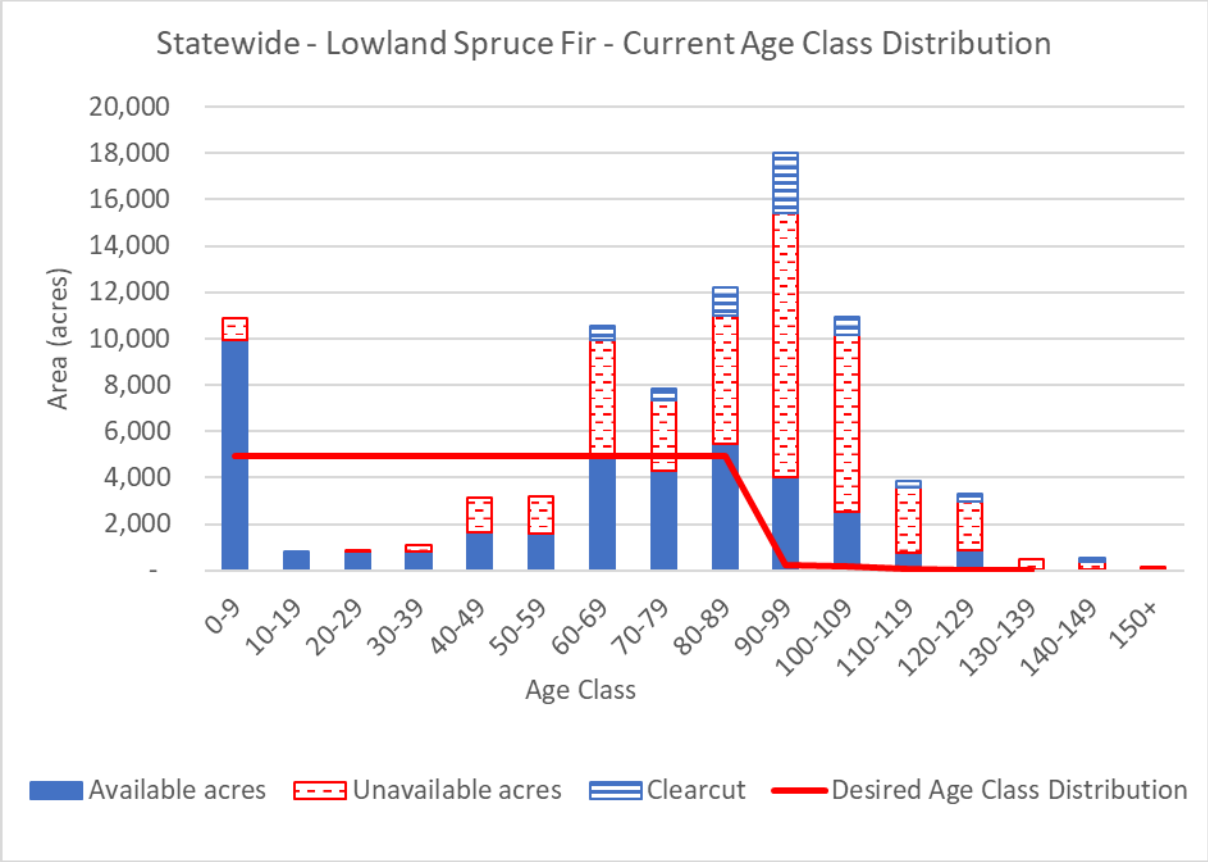


Figure 81. Current statewide lowland spruce/fir age class distribution, projected period one harvests and desired age class distribution.

The primary mid-term strategic harvesting objective for this planning period is ensuring the desired amount of lowland spruce/fir is regenerated (indicated by the red line in Figure 82) to work towards a desirable age class distribution of the manageable population (Figure 83).

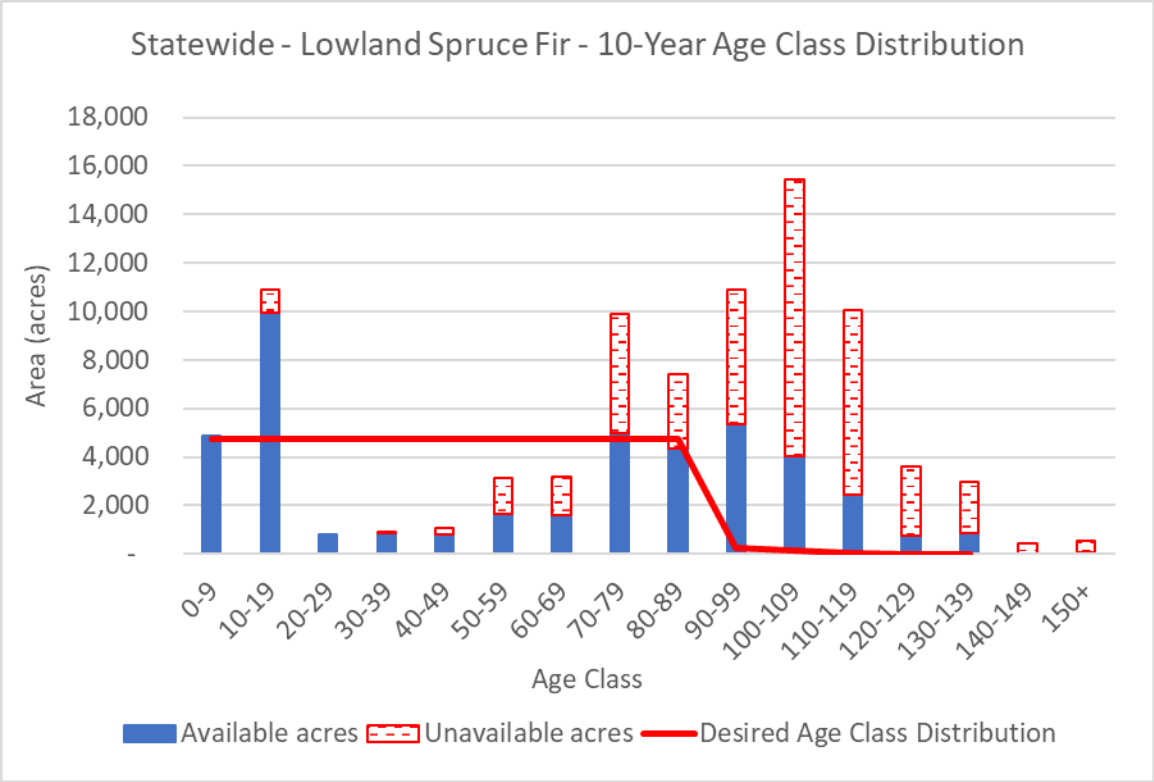


Figure 82. Age class distribution of lowland spruce/fir cover type after this planning period's management has been implemented.

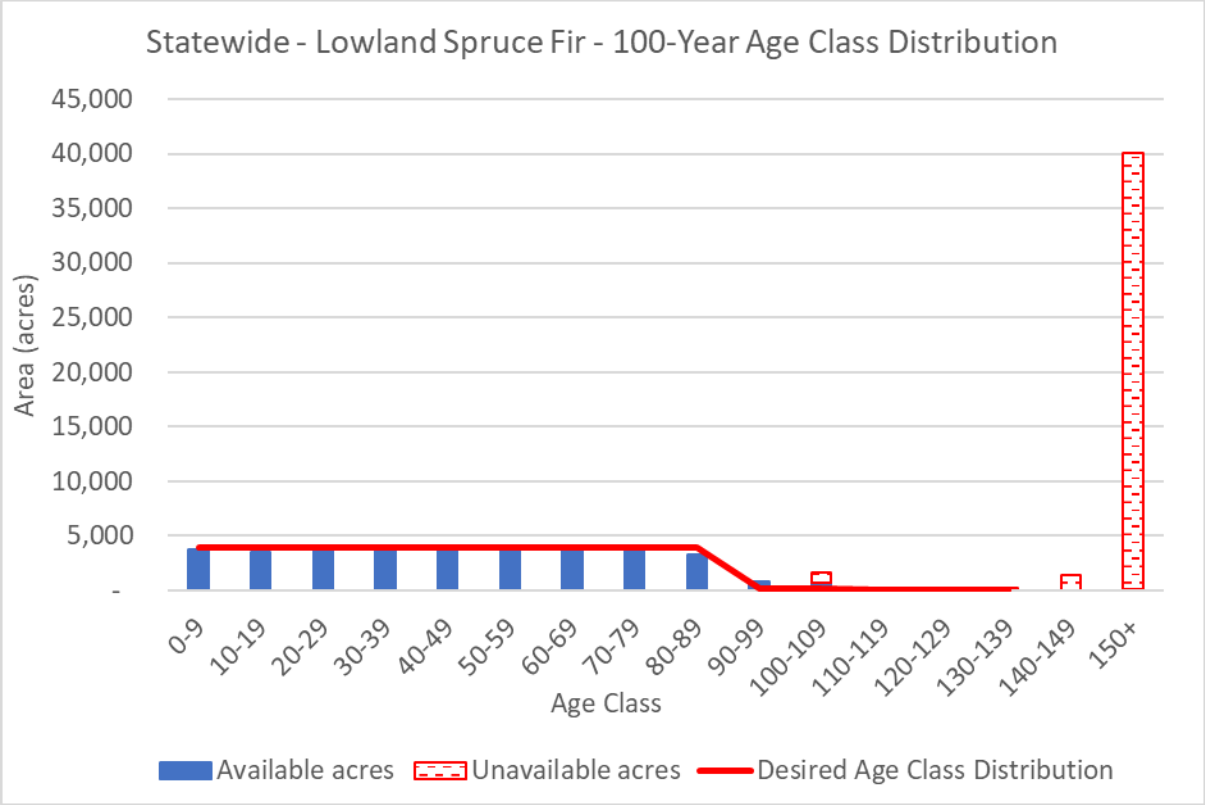


Figure 83. Balanced age class distribution after 100 years of even-aged management of the available acreage.

Silvicultural regimes

Lowland spruce/fir will be managed primarily with even-aged silvicultural systems during the next decade. The even-aged systems designed to regenerate stands include about 6,481 acres of clearcut and seed-tree harvests over the next decade. These harvests help build a balanced age class distribution of the manageable acres, as shown in the 0-9 age class of Figure 82.

Objectives and management actions

Objective 1. Select lowland spruce/fir stands for regeneration using even-aged harvests to improve the age class distribution of the manageable population and support the habitat needs of several game and non-game wildlife species.

- Action 1. Prescribe about 6,481 acres of lowland spruce/fir for clearcut and seed-tree harvests from any merchantable age or size class throughout the next decade (Table 4).

Natural mixed pine

The natural mixed pine cover type makes up approximately 2 percent of the state forest and is most commonly found in upland areas with moderate soil nutrient content and low to moderate soil moistures. This cover type is comprised primarily of coniferous species with the most abundant species being red pine, white pine, and jack pine. Associated species commonly mixed with the primary canopy

species are red maple, quaking aspen, northern red oak, and bigtooth aspen (Figure 84, Michigan DNR Forest Inventory Data, 2021).

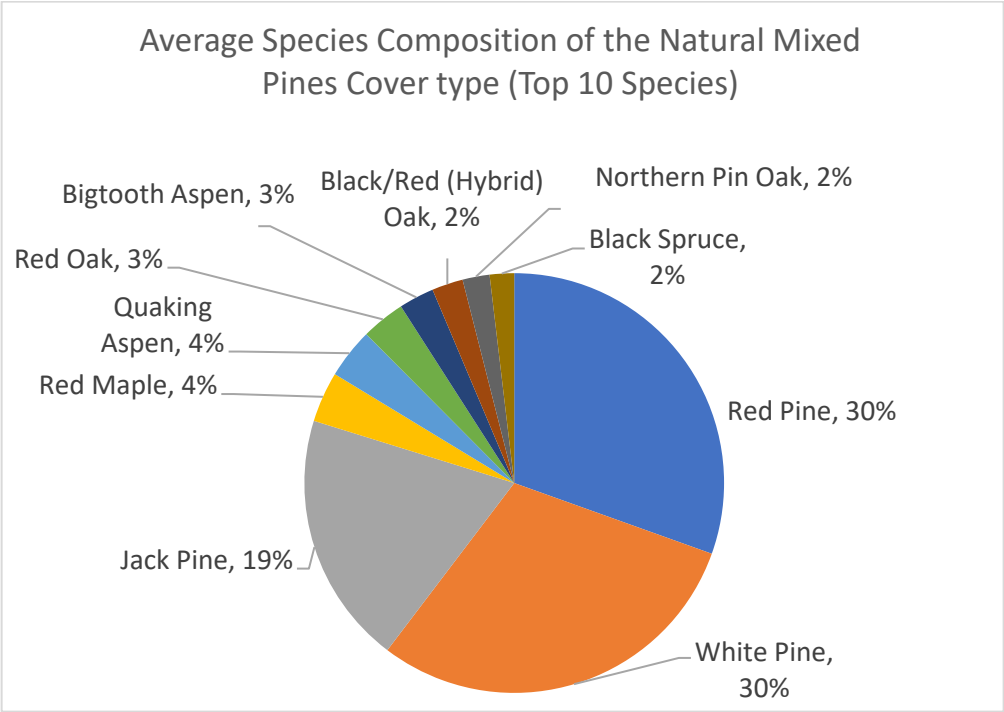


Figure 84. Average species composition of the natural mixed pine cover type, state forest wide.

The natural mixed pine cover type currently has a decent distribution of canopy size classes with a significant proportion in the log-size class (Figure 85). As this cover type becomes more structurally diverse -- both with regenerating stands and stands with regeneration integrated into gaps from selection harvest -- the sapling and pole-sized trees will increase in proportion and be better represented in future decades.

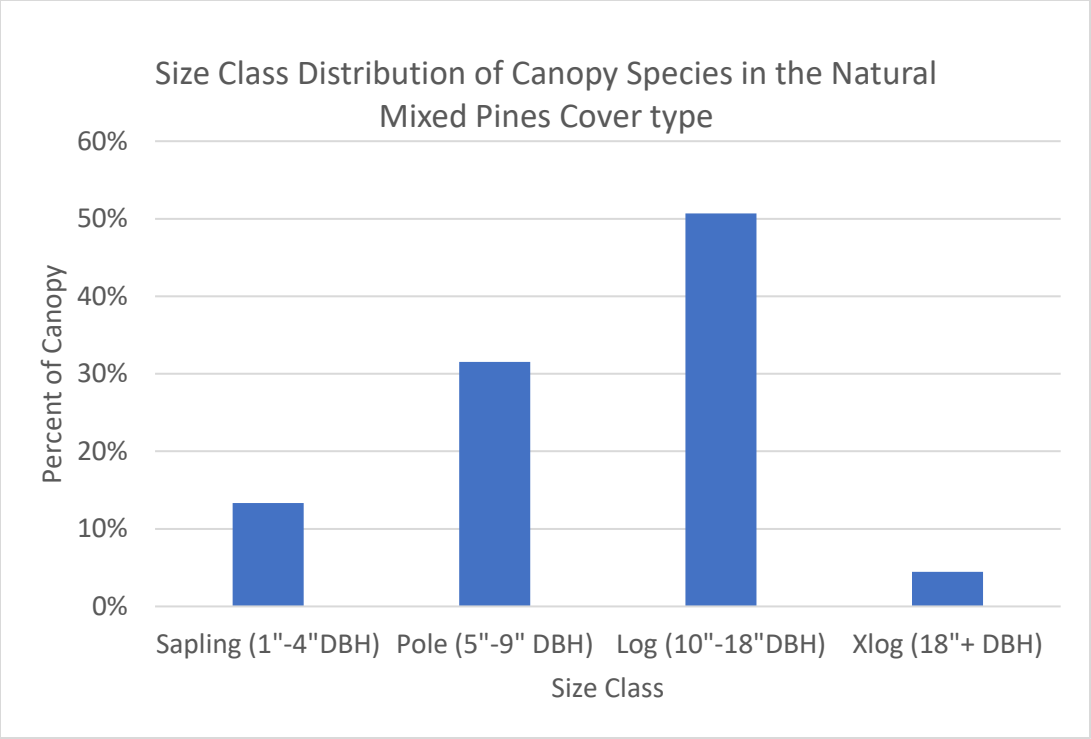


Figure 85. Average size class distribution of the natural mixed pine cover type.

Cover type abundance

Natural mixed pine, currently the 12th-most-prevalent cover type, is projected to increase very slightly over the next decade as some limited conversion to more mixed stands takes place through regeneration harvests. The natural mixed pine cover type grows primarily on dry mesic sites across the landscape providing important timber and habitat. There are currently about 78,280 acres of natural mixed pine on the state forest and that is expected to increase by 0.5 percent during the next planning period, to about 78,637 acres. It is projected that in subsequent decades the abundance of the natural mixed pine cover type will gradually increase as stands of natural red pine undergo selection harvest regimes encouraging more white pine, slowly converting a proportion of the population to natural mixed pine (Figure 86).

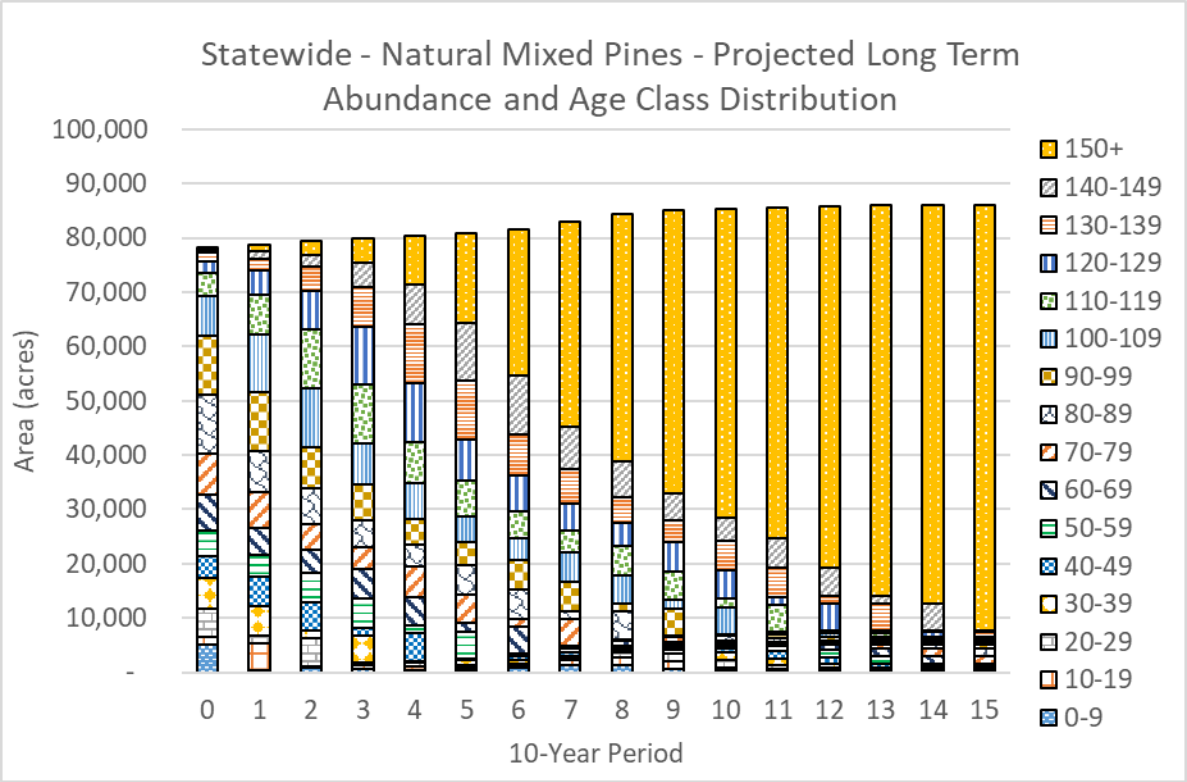


Figure 86. Natural mixed pine abundance by age class as projected through period 15 in the SFMP model.

Age class distribution

The statewide age class distribution of the natural mixed pine cover type is slightly unbalanced with a greater proportion of the population represented in older age classes (Figure 86). Several decades of successful management have made good progress toward achieving a more balanced condition in this cover type. This should continue as regeneration harvest levels and cover type conversions stabilize (Figures 88 and 89). Most of the natural mixed pine stands in the younger age classes are those with a higher component of jack pine. Stands that are dominated by a mix of red and white pine tend to be better represented in the older age classes.

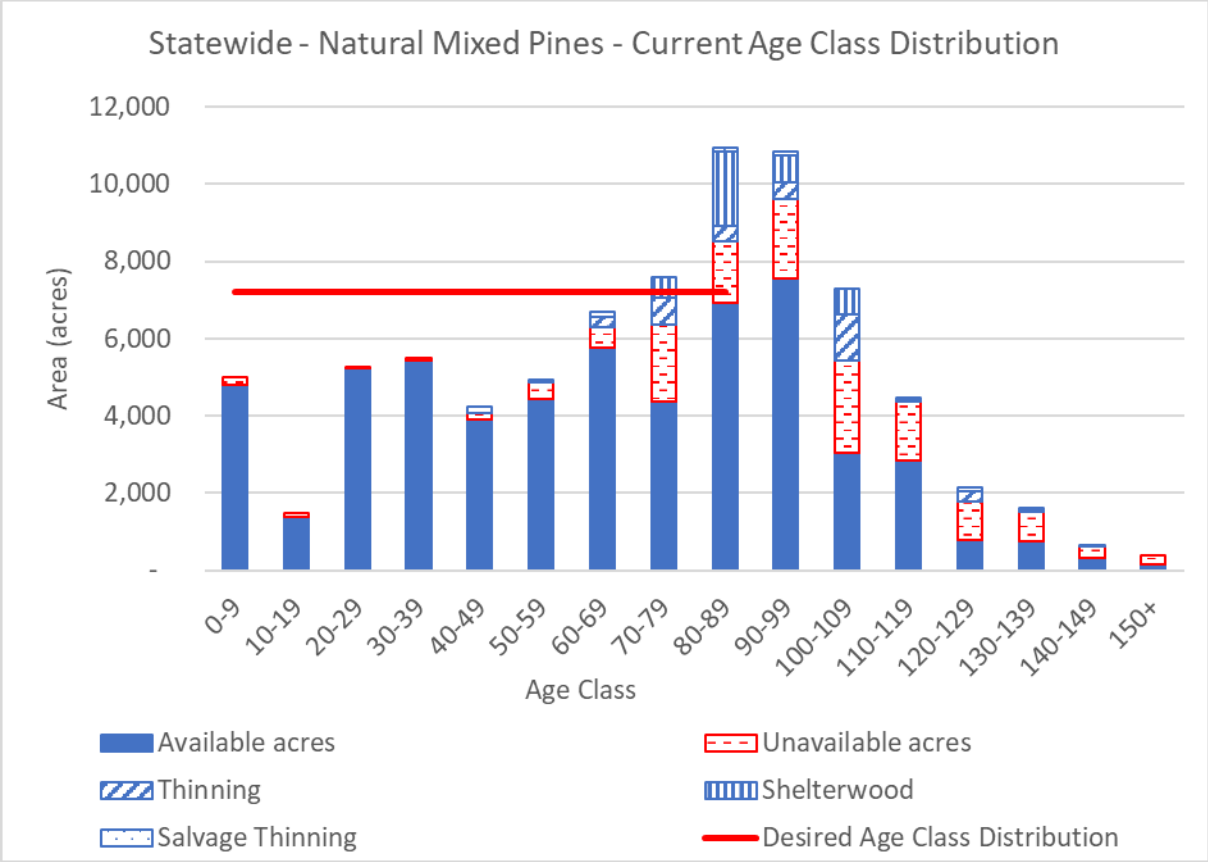


Figure 87. Current statewide natural mixed pine age class distribution and projected period one harvests.

The primary mid-term strategic harvesting objective for this planning period is ensuring the desired amount of natural mixed pine is regenerated as a sub-canopy younger cohort in stands undergoing a two-aged system of shelterwood (regular or irregular) harvest or as regeneration within gaps in one of many selection harvest options. The primary long-term goal is to work towards a desirable uneven-aged condition of the manageable population (Figure 89). Regeneration success will be dependent on post-harvest scarification to prepare the seed bed and natural seed if a seed source is present or direct seeding if it is not. Competition control may also be necessary on these stands, depending on species composition and density.

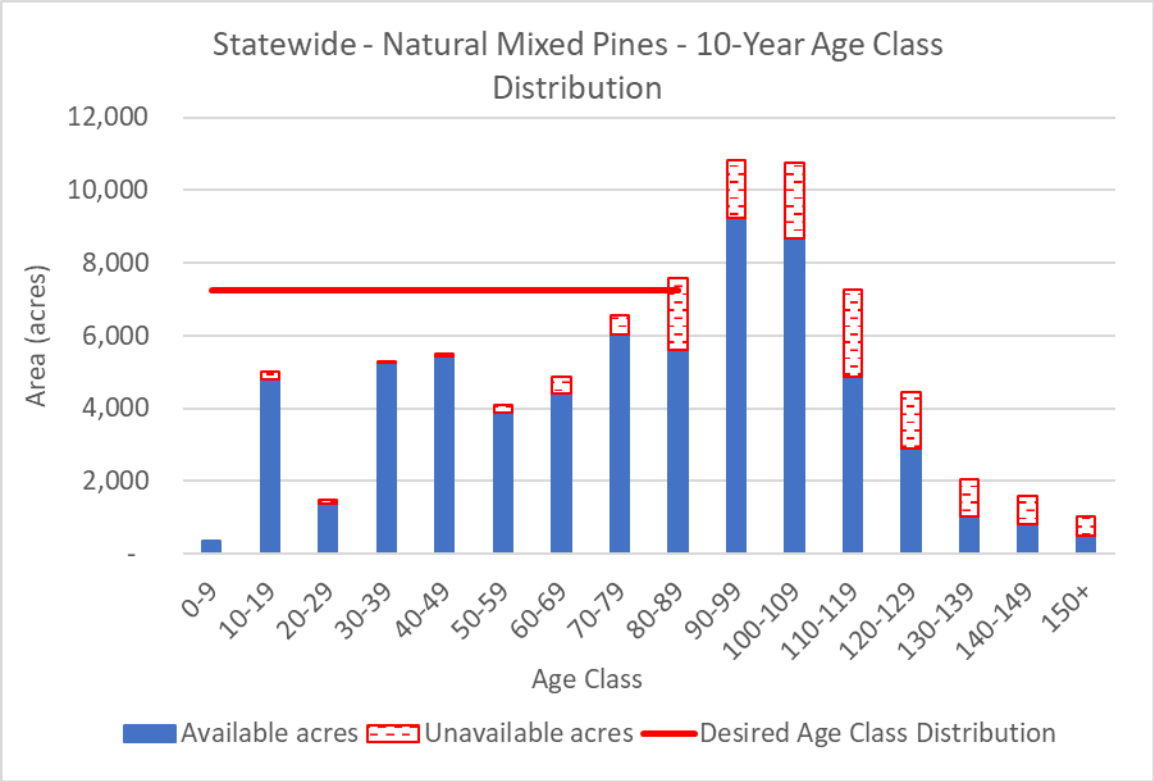


Figure 88. Age class distribution of natural mixed pine cover type after this planning period's management has been implemented.



Figure 89. Balanced age class distribution after 50 years of two-aged and uneven-aged management of the available acreage.

Silvicultural regimes

Natural mixed pine will be managed with a combination of even-aged and uneven-aged silvicultural systems during the next decade. The even-aged systems designed to regenerate stands include about 3,765 acres of shelterwood harvests over the next decade. These harvests help build a desirable condition of the two-aged manageable acres, as shown Figure 88.

The uneven-aged harvests will focus on maintaining a higher component of large mature trees, more complex stand structure, and regenerating portions of stands in multiple age cohorts to a variety of species but favoring white pine and red pine. There are 3,961 acres of thinning/selection harvests planned for the decade to accomplish these goals.

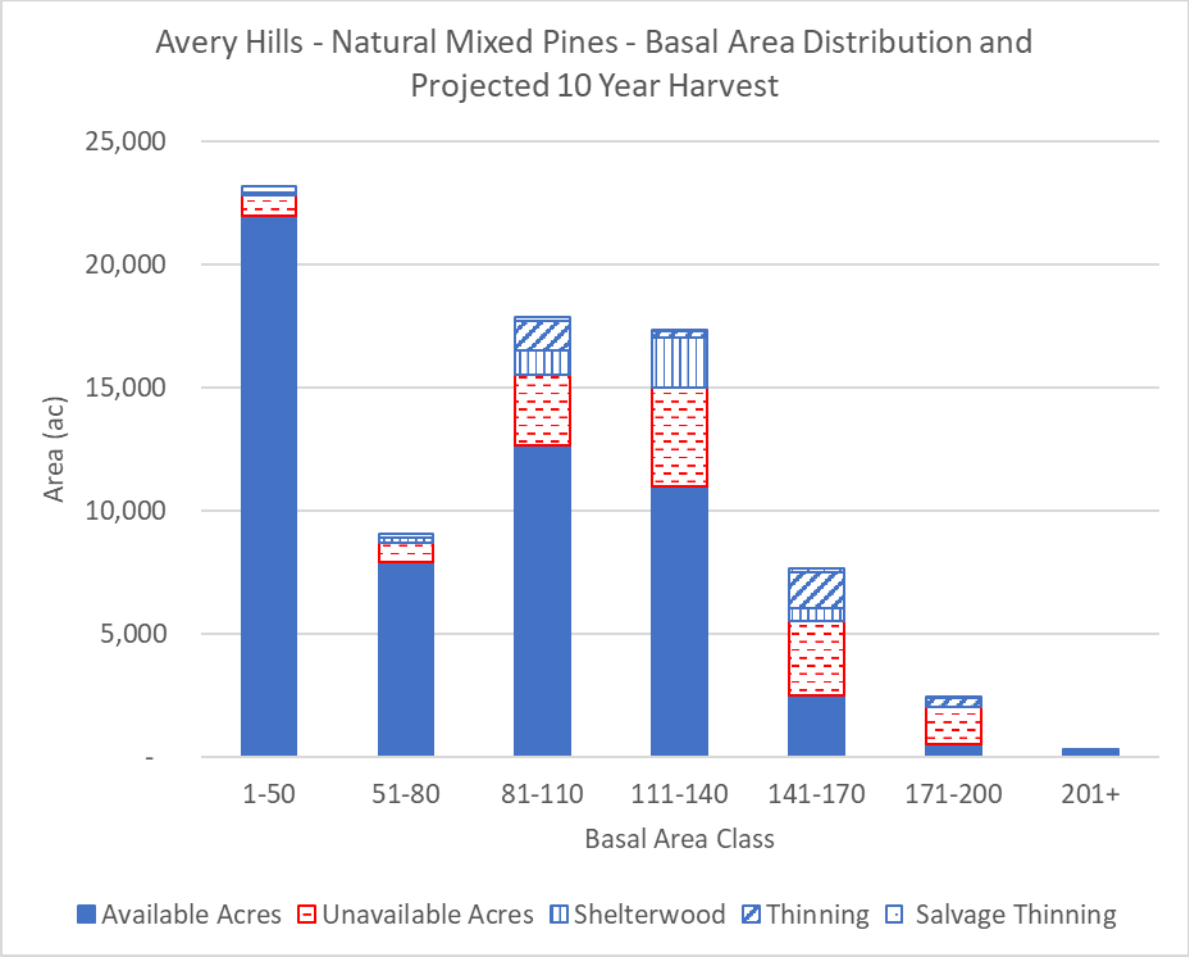


Figure 9012. Basal area distribution and projected harvests by method for the 10-year planning period.

Objectives and management actions

Objective 1. Select natural mixed pine stands for regeneration using two-aged shelterwood harvests to improve the condition of the manageable population and support the habitat needs of several game and non-game wildlife species.

- Action 1. Prescribe about 3,971 acres of natural mixed pine for shelterwood harvests from merchantable stands throughout the next decade (Table 4).

Objective 2. Select natural mixed pine stands for uneven-aged harvests to improve the stand structure and species composition of the manageable population and support the habitat needs of several game and non-game wildlife.

- Action 1. Prescribe about 3,995 acres of natural mixed pine for selection/thinning harvests (including 754 acres of salvage thinning) from any merchantable age or size class throughout the next decade (Table 4).

Minor cover type summaries

The 15 forested cover types discussed in detail above represent 75 percent of the state forest system, while the remaining 10 forested cover types are each less than 2 percent of the entire state forest and will be discussed in a condensed format. These remaining forested cover types combine to represent 10 percent of the state forest with the remaining 15 percent being non-forested (Table 7).

Table 7. Cover types of the state forest at their current condition and projected change over the 10-year period.

Cover Type	Current Acreage	Percent of Total	Projected Acreage at End of 10-Year Planning Period	Projected 10-Year Change In Acreage	Change in 10-year Planning Period
Forested Cover Types	--	--	--	--	--
Aspen	833,246	20.9%	837,438	4,192	0.5%
Northern Hardwood	459,094	11.5%	460,039	944	0.2%
Cedar	287,202	7.2%	287,202	0	0.0%
Lowland Conifers	204,818	5.1%	203,184	-1,634	-0.8%
Planted Red Pine	199,823	5.0%	202,630	2,806	1.4%
Mixed Upland Deciduous	167,726	4.2%	168,907	1,182	0.7%
Black/Red Hybrid Oak	*55,322*	*1.4%*	52,375	-2,947	-5.3%
Northern Red Oak	*54,679*	*1.4%*	49,302	-5,377	-9.8%
Oak Mix	*41,856*	*1.0%*	41,041	-814	-1.9%
Natural Jack Pine	145,301	3.6%	146,718	1,417	1.0%
Planted Jack Pine	136,846	3.4%	133,999	-2,846	-2.1%
Lowland Deciduous	132,452	3.3%	132,163	-289	-0.2%
Upland Mixed Forest	117,371	2.9%	122,305	4,934	4.2%
Lowland Spruce/Fir	87,746	2.2%	86,028	-1,719	-2.0%
Natural Mixed Pines	78,276	2.0%	78,637	361	0.5%
Lowland Aspen/Balsam Poplar	71,241	1.8%	71,181	-60	-0.1%
Lowland Mixed Forest	66,881	1.7%	70,850	3,969	5.9%
Natural Red Pine	53,149	1.3%	53,188	39	0.1%
Upland Conifers	53,067	1.3%	50,925	-2,143	-4.0%
Natural White Pine	47,863	1.2%	48,302	439	0.9%
Tamarack	33,750	0.8%	33,521	-230	-0.7%
Upland Spruce/Fir	17,071	0.4%	15,196	-1,875	-11.0%
Planted Mixed Pine	14,671	0.4%	14,742	71	0.5%
Hemlock	13,279	0.3%	13,279	0	0.0%
Planted White Pine	7,536	0.2%	7,115	-422	-5.6%
Nonforested Cover Types	--	--	--	--	--

Cover Type	Current Acreage	Percent of Total	Projected Acreage at End of 10-Year Planning Period	Projected 10-Year Change In Acreage	Change in 10-year Planning Period
Lowland Shrub	246,490	6.2%	246,490	0	0.0%
Marsh	80,070	2.0%	80,070	0	0.0%
Herbaceous Openland	67,571	1.7%	67,571	0	0.0%
Upland Shrub	48,884	1.2%	48,884	0	0.0%
Water	47,071	1.2%	47,071	0	0.0%
Treed Bog	44,700	1.1%	44,700	0	0.0%
Low Density Trees	23,298	0.6%	23,298	0	0.0%
Bog	21,252	0.5%	21,252	0	0.0%
Urban	16,156	0.4%	16,156	0	0.0%
Bare/Sparsely Vegetated	7,879	0.2%	7,879	0	0.0%
Cropland	2,985	0.1%	2,985	0	0.0%
Total	**3,986,622**	**100.0%**	**3,986,622**	**0**	**0.0%**

Lowland aspen/balsam poplar

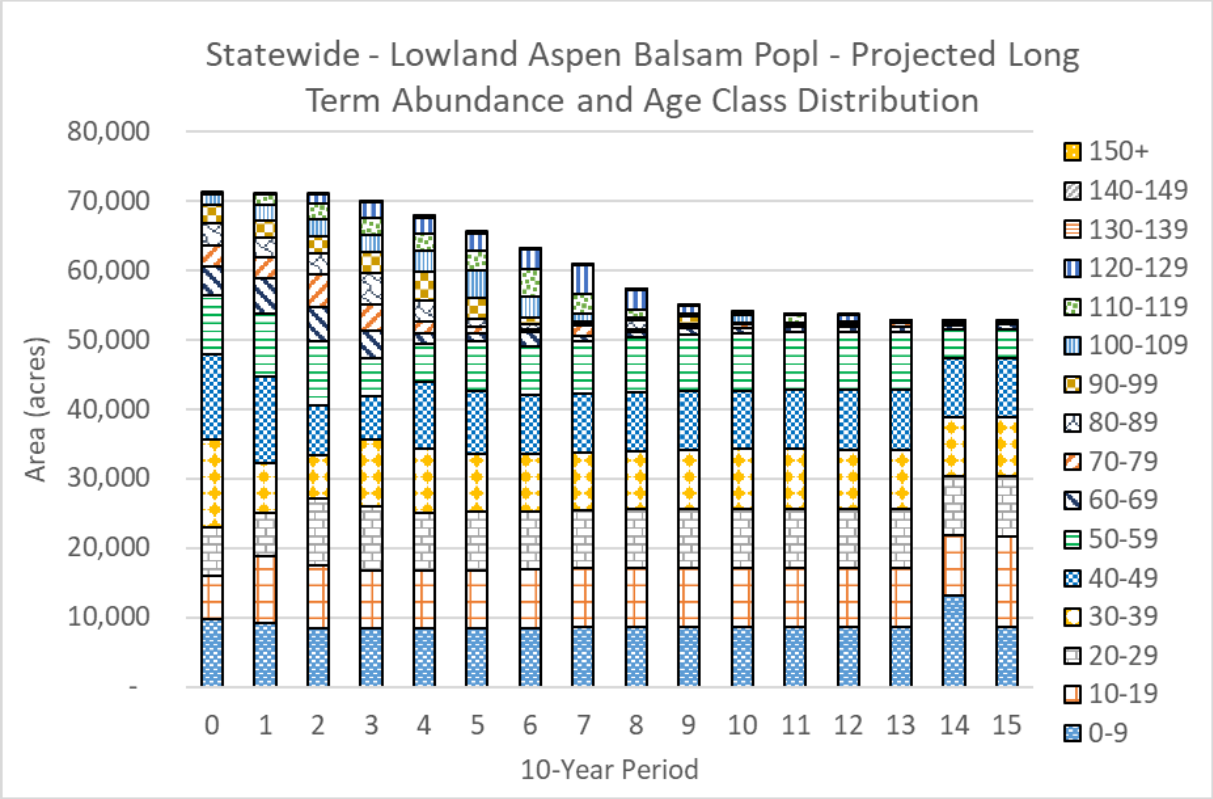


Figure 91. Lowland aspen/balsam poplar abundance by age class as projected through period 15 in the SFMP model.

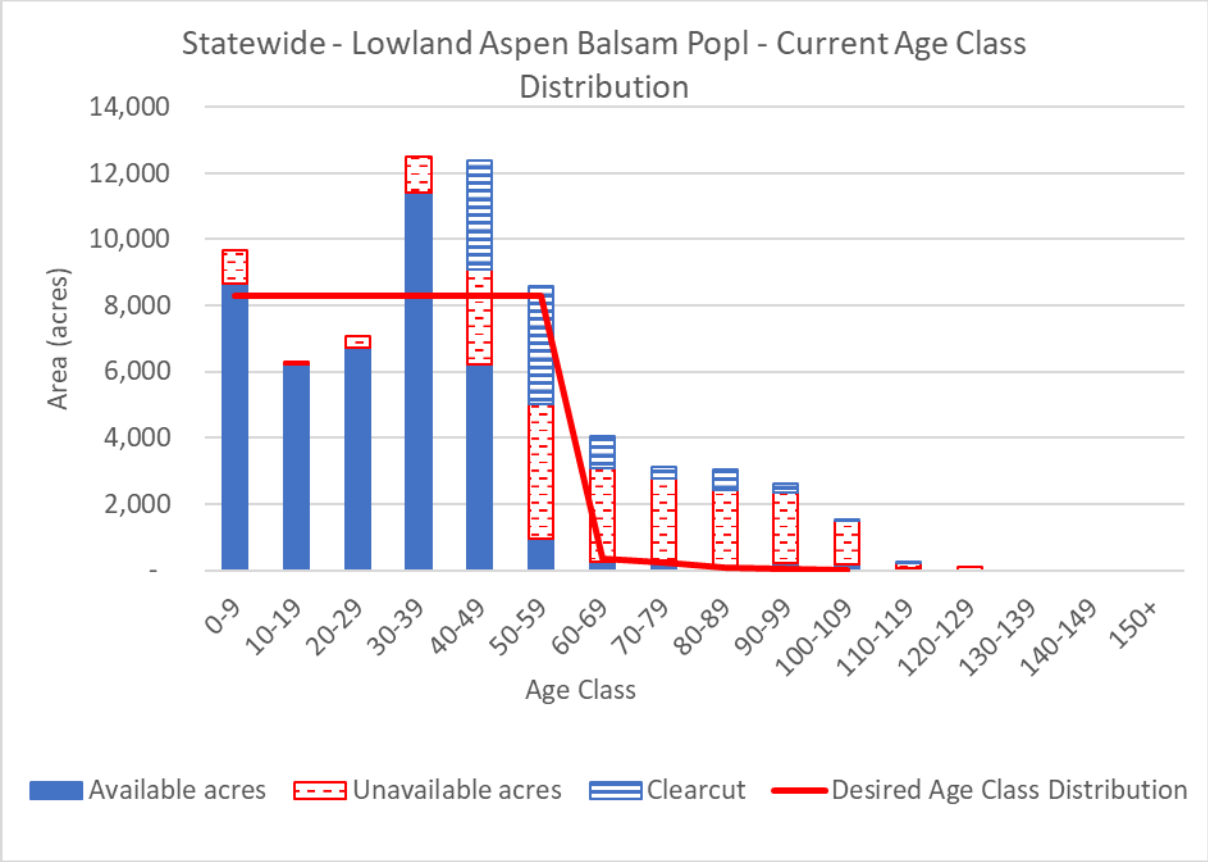


Figure 92. Current statewide lowland aspen/balsam poplar age class distribution and projected period one harvests.

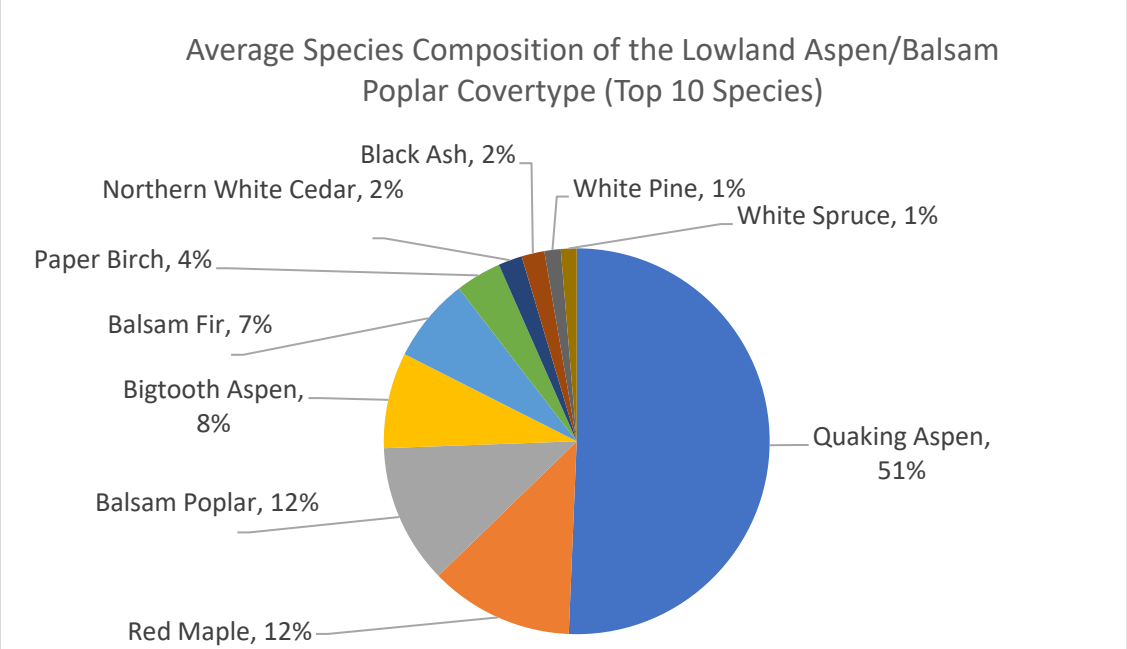


Figure 93. Average species composition of the lowland aspen/balsam poplar cover type, state forest wide.

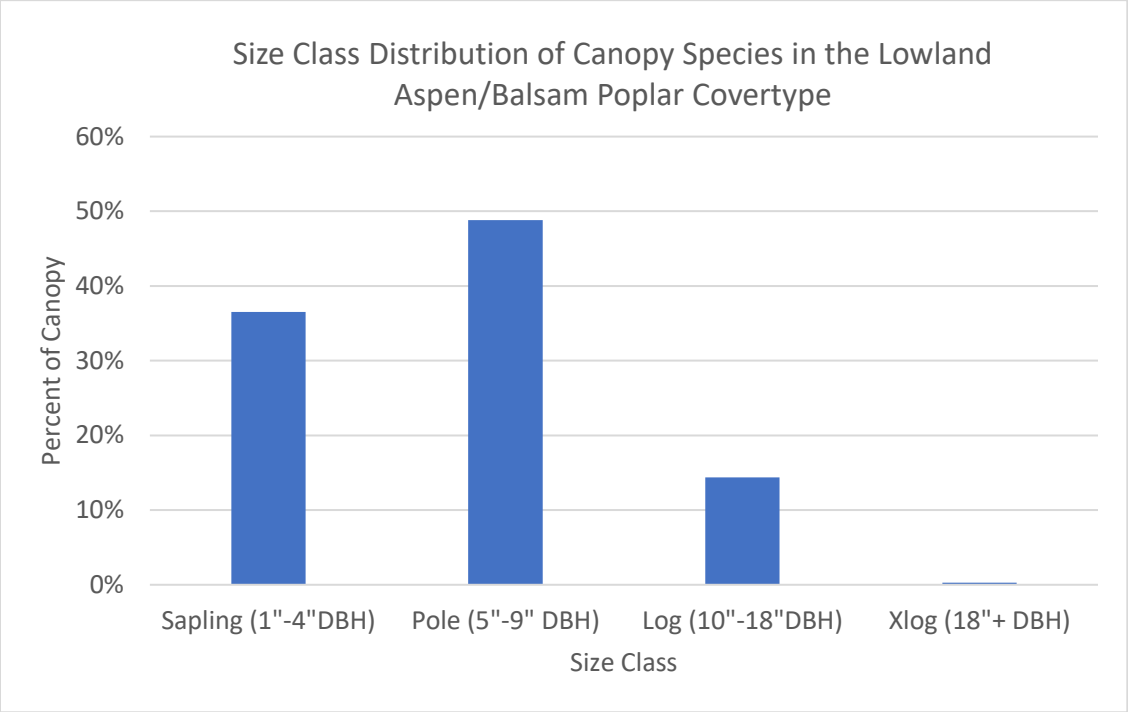


Figure 94. Average size class distribution of the lowland aspen/balsam poplar cover type.

Objectives and management actions

Objective 1. Select lowland aspen/balsam poplar stands for regeneration using even-aged seed-tree harvests to improve the age class distribution of the manageable population and support the habitat needs of several game and non-game wildlife.

- Action 1. Prescribe about 9,139 acres of lowland aspen/balsam poplar for clearcut harvests from any merchantable age or size class throughout the next decade (Table 4).

Lowland mixed forest

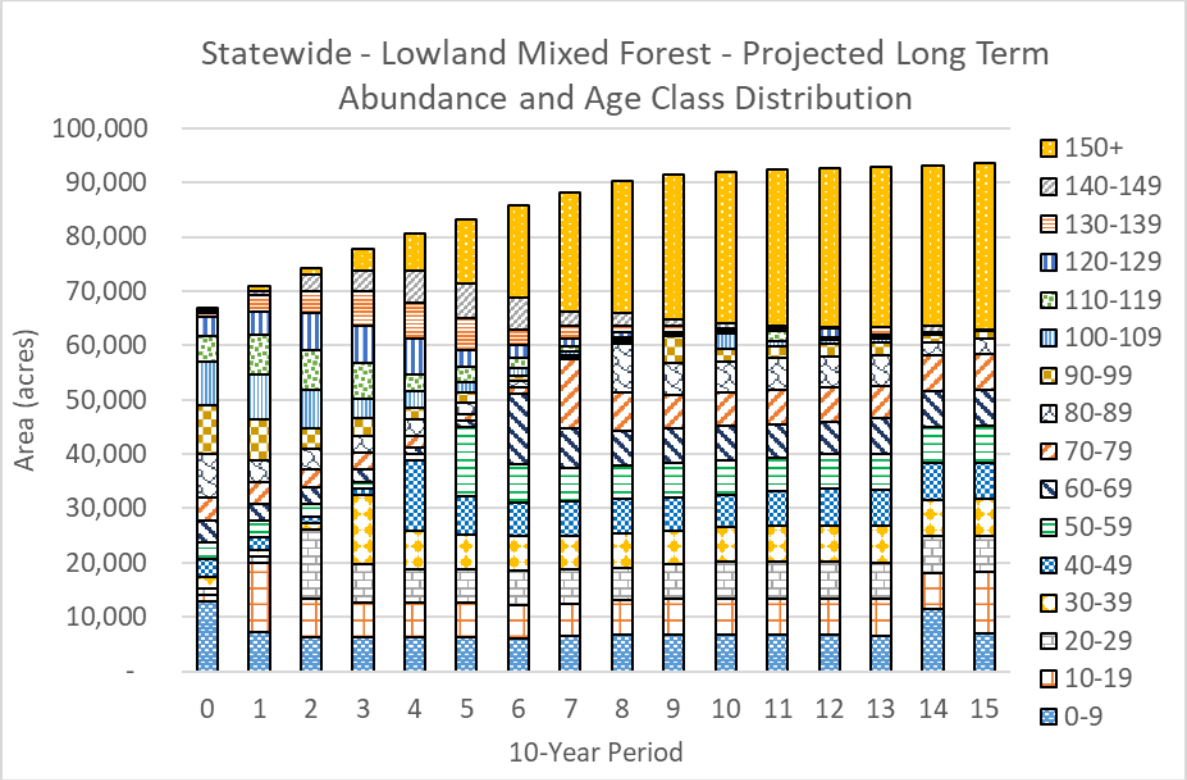


Figure 95. Lowland mixed forest abundance by age class as projected through period 15 in the SFMP model.

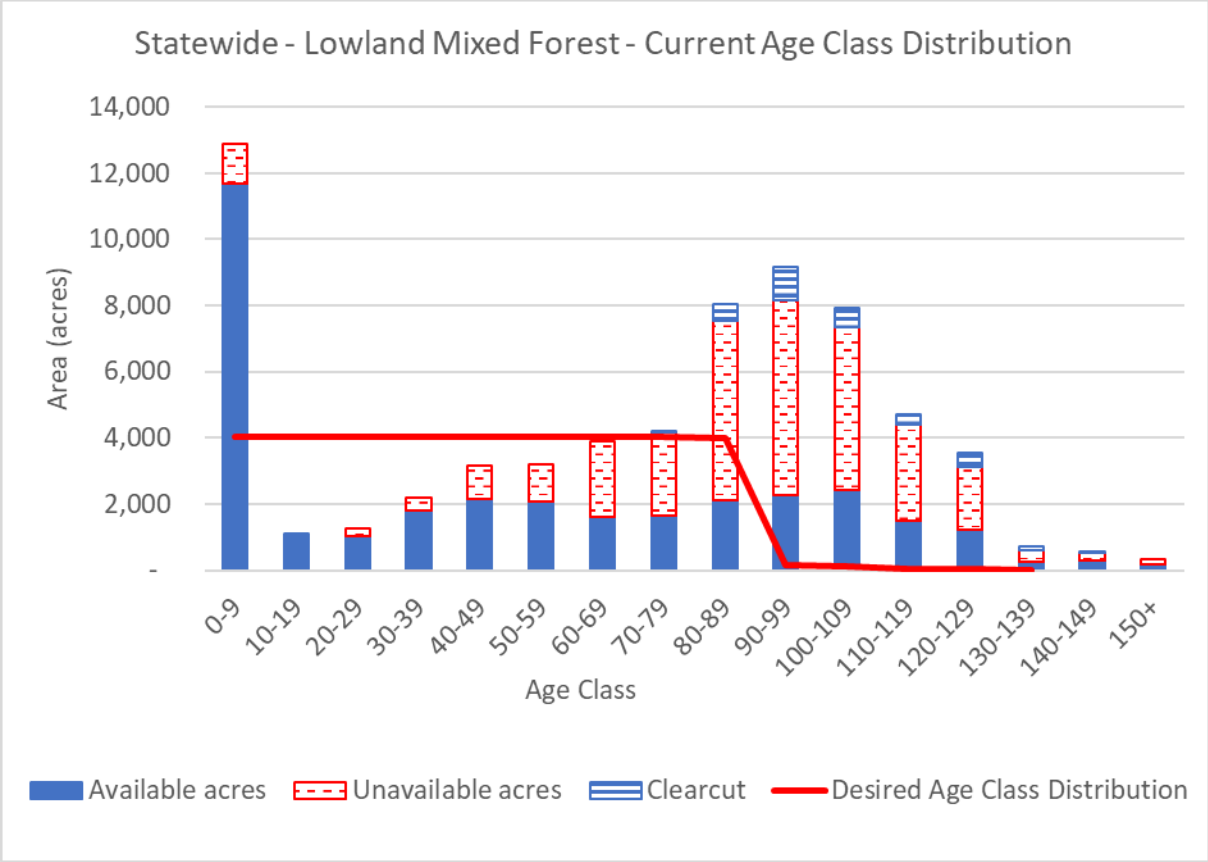


Figure 96. Current statewide lowland mixed forest age class distribution and projected period one harvests.

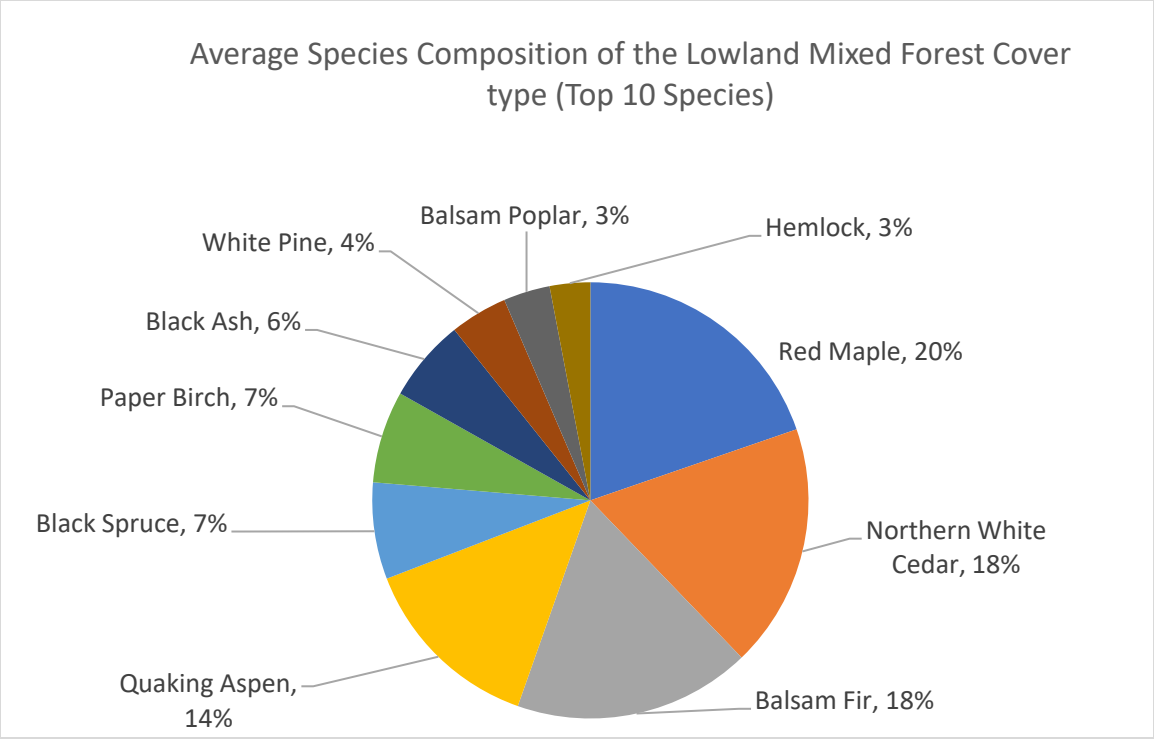


Figure 97. Average species composition of the lowland mixed forest cover type, state forest wide.

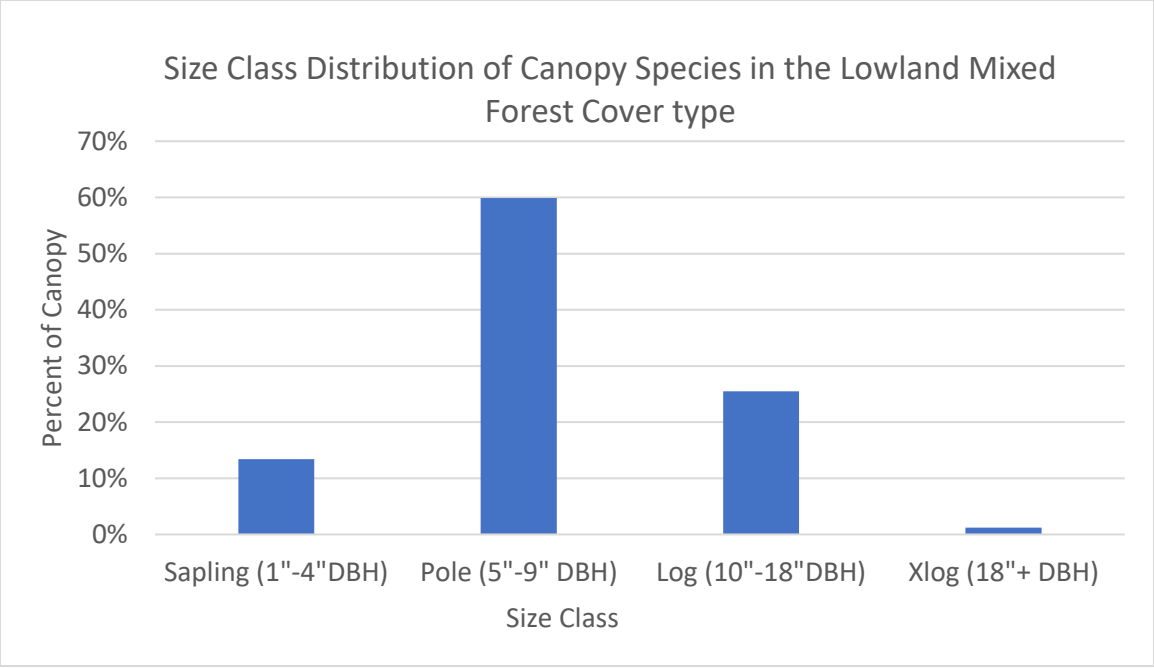


Figure 98. Average size class distribution of the lowland mixed forest cover type.

Objectives and management actions

Objective 1. Select lowland mixed forest stands for regeneration using even-aged clearcut and seed-tree harvests to improve the age class distribution of the manageable population and support the habitat needs of several game and non-game wildlife.

- Action 1. Prescribe about 2,976 acres of lowland mixed forest for clearcut harvests from any merchantable age or size class throughout the next decade (Table 4).

Natural red pine

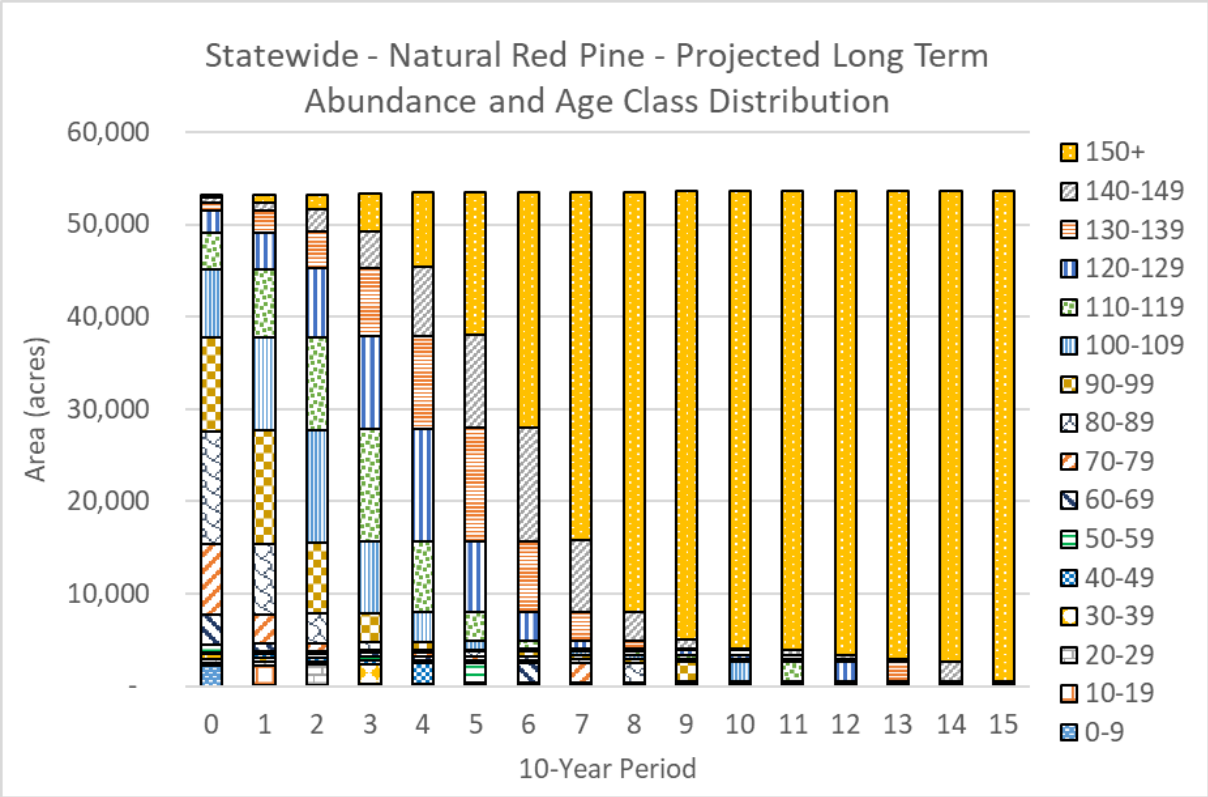


Figure 99. Natural red pine abundance by age class as projected through period 15 in the SFMP model.

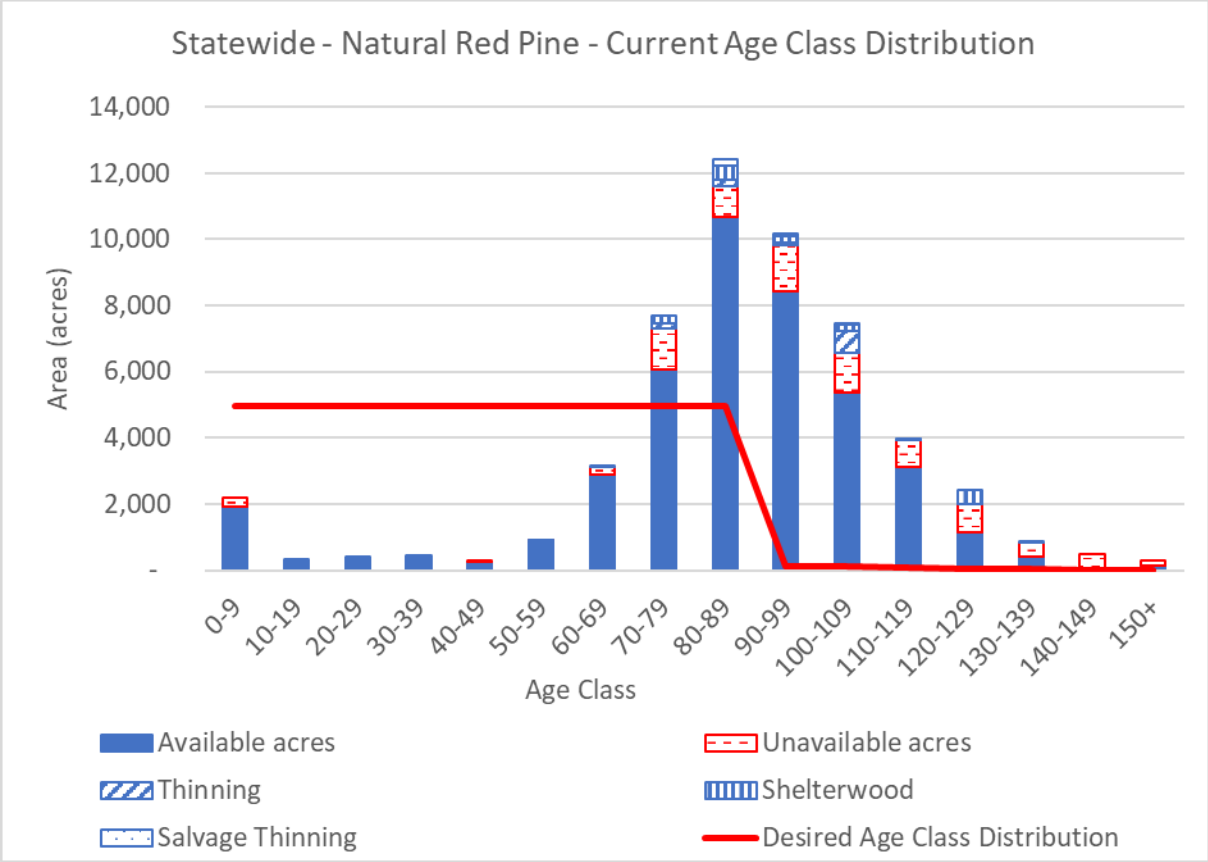


Figure 100. Current statewide natural red pine age class distribution and projected period one harvests.

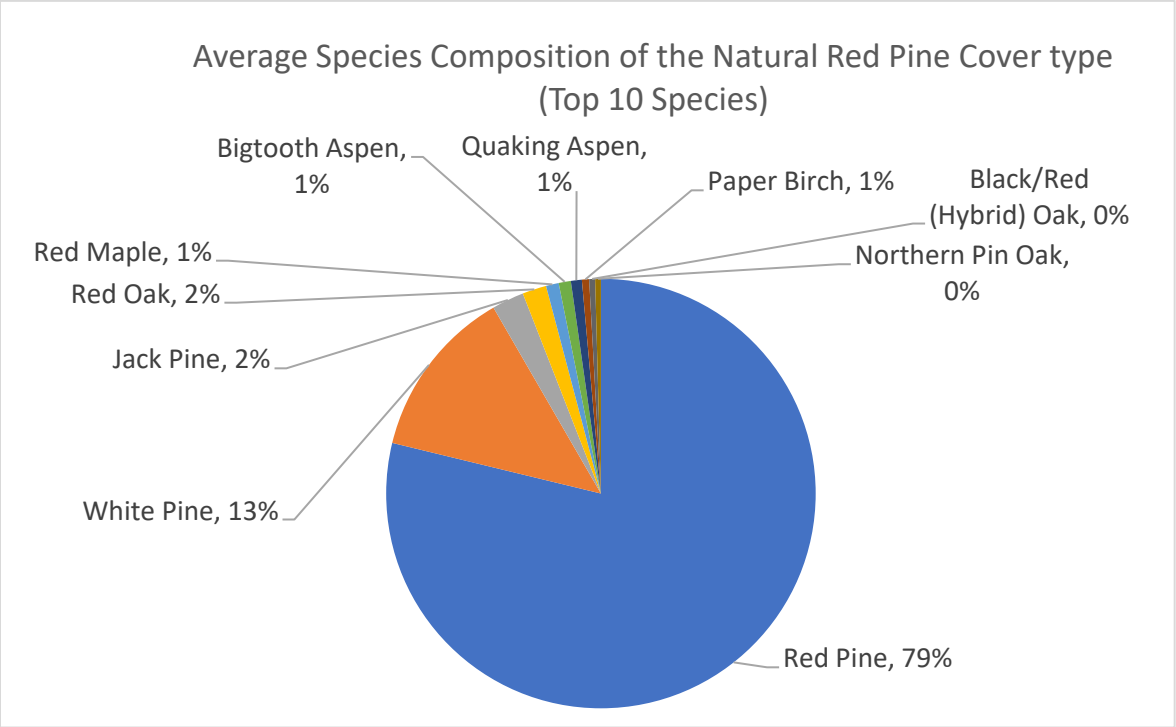


Figure 101. Average species composition of the natural red pine cover type, state forest wide.

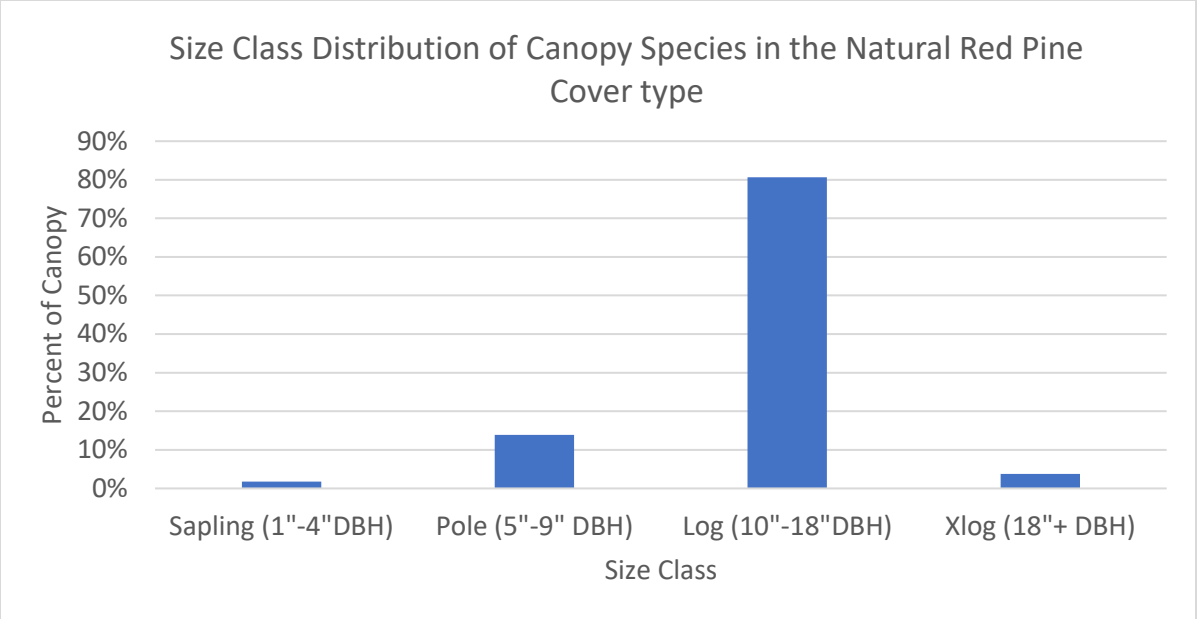


Figure 102. Average size class distribution of the natural red pine cover type.

Forest and wildlife habitat management discussion

The natural red pine cover type has become increasingly scarce across much of the landscape in northern Michigan when compared to pre-European settlement. This is due to the conversion to other cover types like aspen, mixed upland deciduous, and planted red pine through active forest management. The abundance of these stands has also diminished due to the lack of fire, either as a natural disturbance or prescribed as a management action to encourage regeneration of fire dependent/tolerant species like red pine, white pine, jack pine, and oak species and discourage other fire-intolerant species like red maple and aspen. There is now an interest in drastically slowing or eliminating that trend in conversion to other cover types by making a more concerted effort to retain red pine components in stands. This would be done through canopy tree retention using shelterwood systems and regeneration in large gaps on partial harvests. In some instances, regeneration success through natural means will be accomplished by monitoring cone production of treated stands and timing the scarification or prescribed burns accordingly. In most cases, however, it will be accomplished with post-harvest scarification to prepare the seed bed and then direct seeding. Competition control may also be necessary on these stands, depending on species composition and density.

Prescribed fire will be encouraged on stands where the likelihood for success is greatest in terms of intended effects and practicality of implementation.

Objectives and management actions

Objective 1. Select natural red pine stands for regeneration using two-aged systems like regular or irregular shelterwood harvests to improve the age class distribution of the manageable population and support the habitat needs of several game and non-game wildlife species.

- Action 1. Prescribe about 1,454 acres of natural red pine for shelterwood harvests from any merchantable age or size class throughout the next decade (Table 4).

- Action 2. Monitor regeneration and determine if initial or follow-up treatments were successful in attaining desired cover type goals. If regeneration is inadequate, supplemental planting in irregular patterns, spacing, and densities should be prescribed to avoid converting stands to other types.

Objective 2. Select natural red pine stands for uneven-aged harvests to improve the stand structure and species composition of the manageable population and support the habitat needs of several game and non-game wildlife species.

- Action 1. Prescribe about 1,466 acres of natural red pine for selection/thinning harvests (including 312 acres of salvage thinning) from any merchantable age or size class throughout the next decade (Table 4).

Objective 3. Select natural red pine stands that would benefit from prescribed fire to restore natural ecosystem processes, encourage pine regeneration, and discourage competing vegetation that could result in mesophication of stands over time.

- Action 1. Reintroduce fire in stands as needed and practical with specific objectives to achieve desirable regeneration and reduce competing vegetation. These prescriptions will likely involve recurring burns to meet mid- and long-term objectives.

Upland conifers

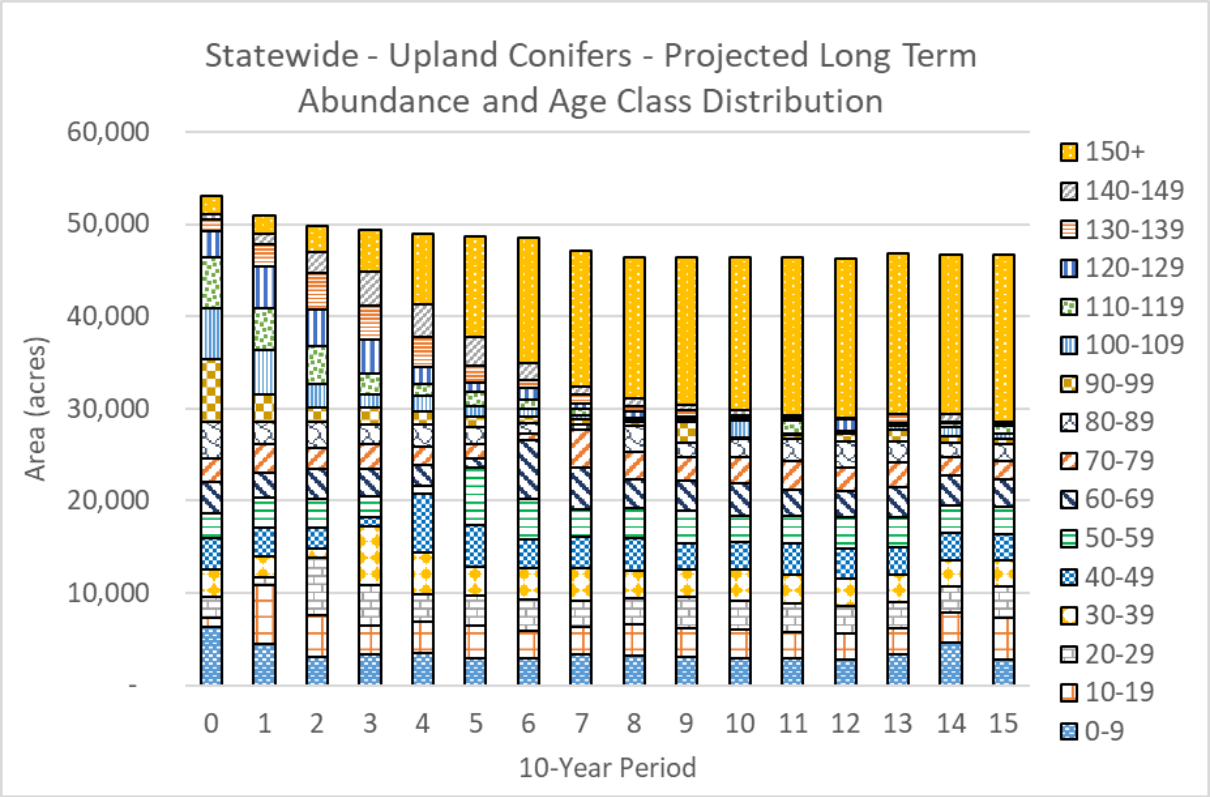


Figure 103. Upland conifers abundance by age class as projected through period 15 in the SFMP model.

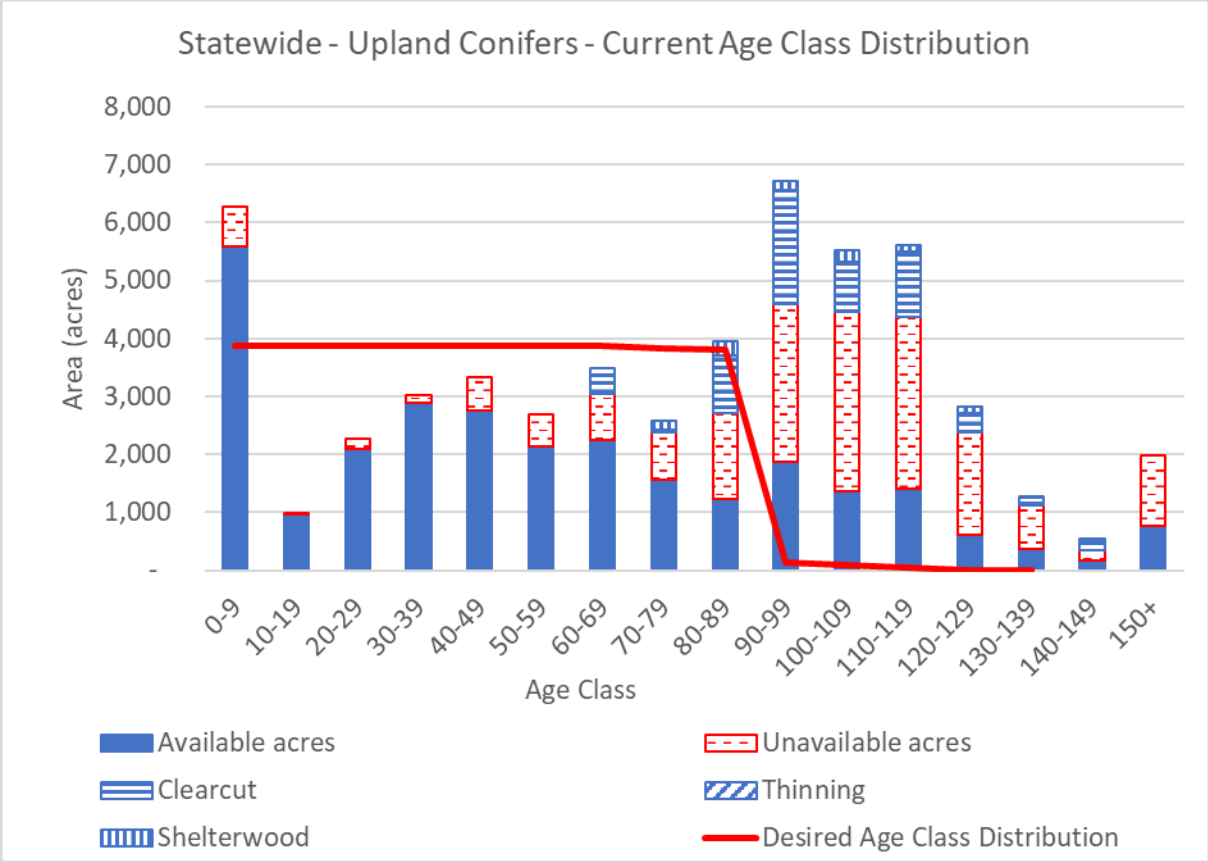


Figure 104. Current statewide upland conifers age class distribution and projected period one harvests.

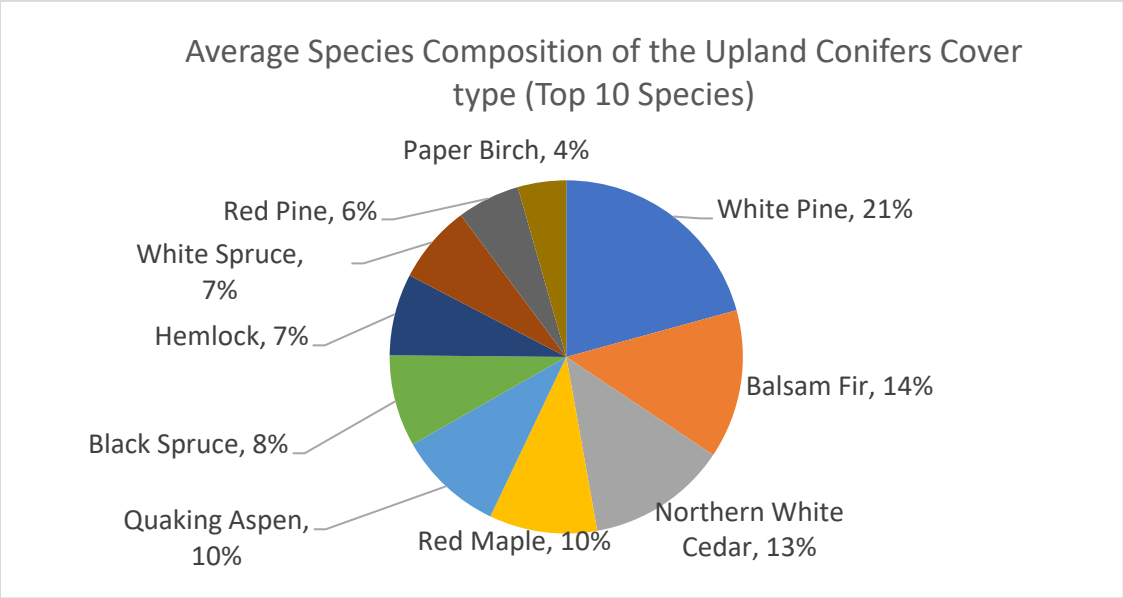


Figure 105. Average species composition of the upland conifers cover type, state forest wide.

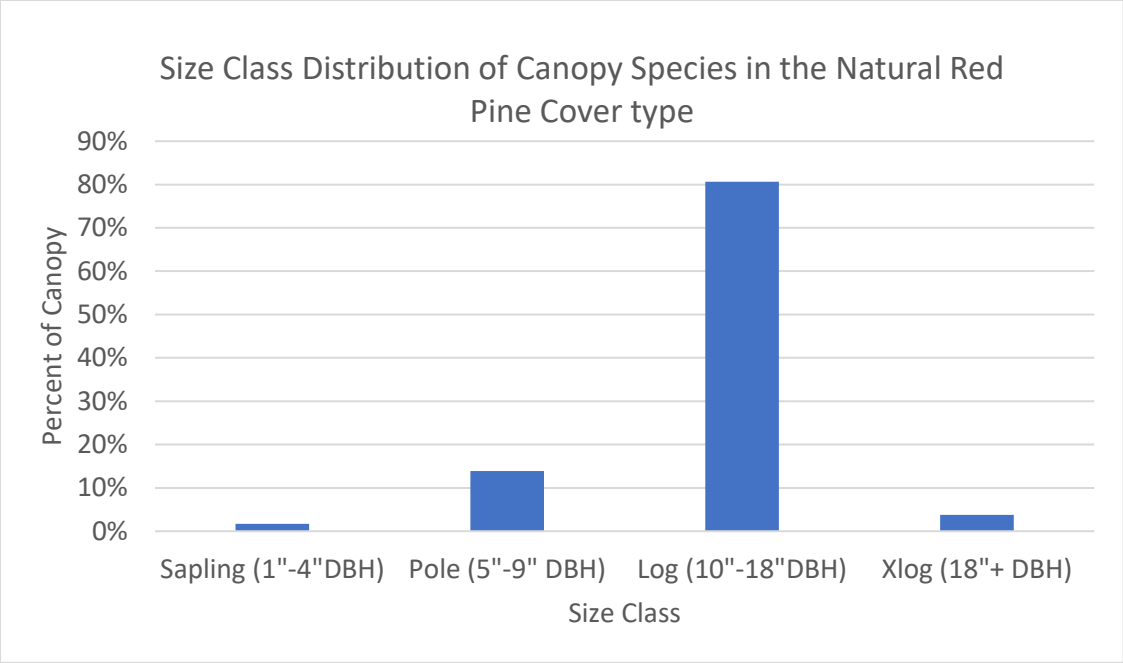


Figure 106. Average size class distribution of the upland conifers cover type.

Objectives and management actions

Objective 1. Select upland conifers stands for regeneration using even-aged clearcut and seed-tree harvests to improve the age-class distribution of the manageable population and support the habitat needs of several game and non-game wildlife.

- Action 1. Prescribe about 6,454 acres of upland conifers for clearcut harvests from any merchantable age or size class throughout the next decade (Table 4).
- Action 2. Prescribe about 1,168 acres of upland conifers for shelterwood harvests from merchantable stands throughout the next decade (Table 4).

Natural white pine

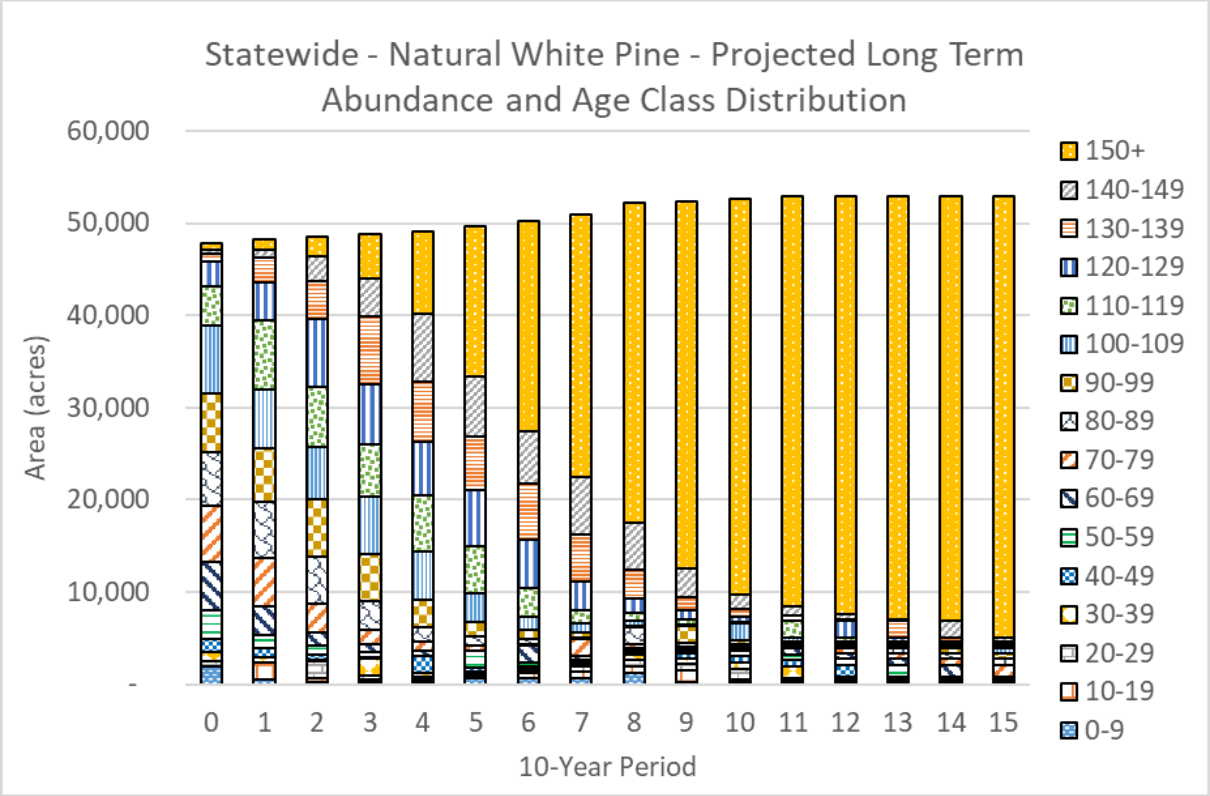


Figure 107. Natural white pine abundance by age class as projected through period 15 in the SFMP model.

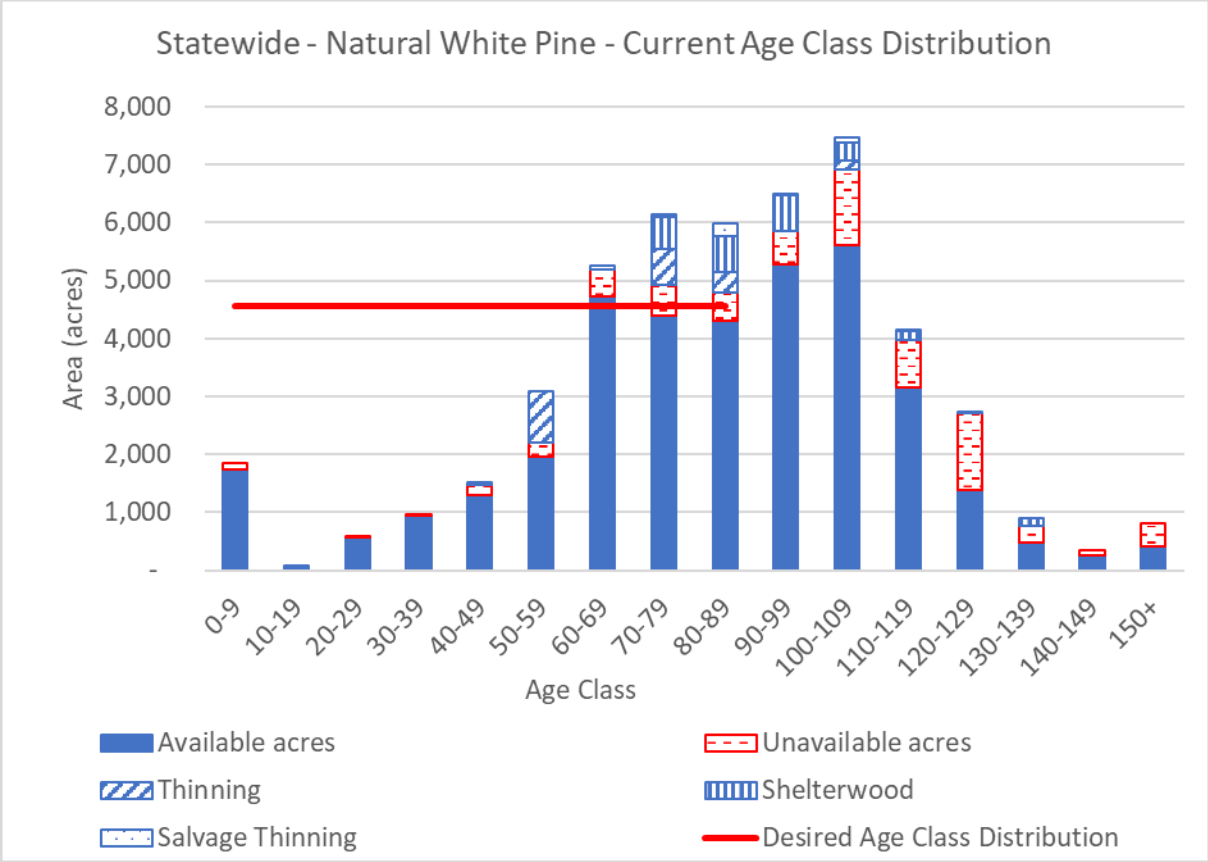


Figure 108. Current statewide natural white pine age class distribution and projected period one harvests.

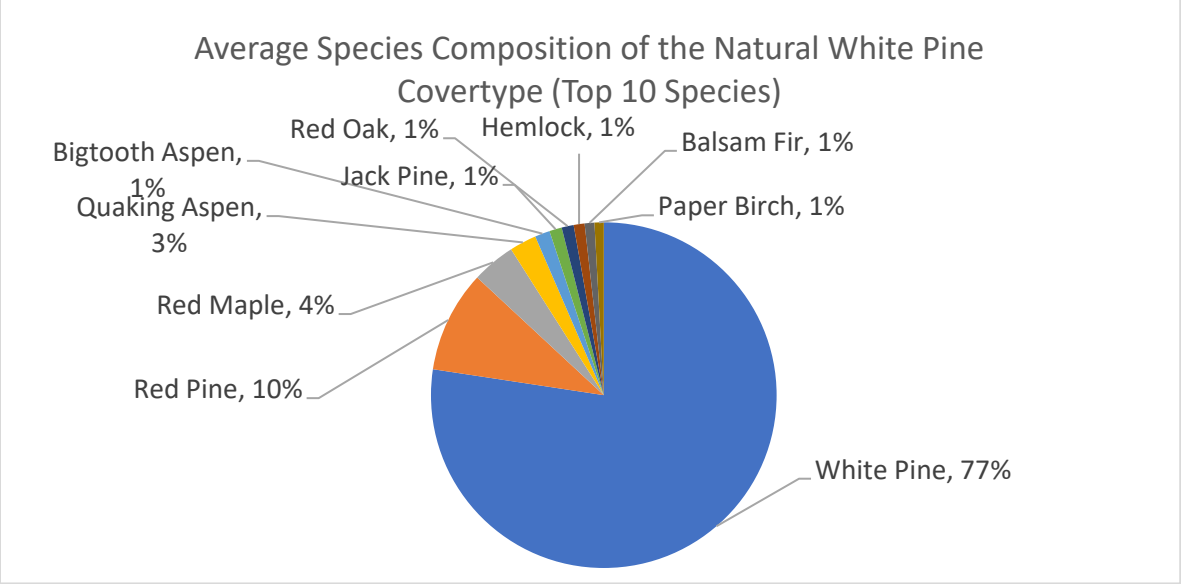


Figure 109. Average species composition of the natural white pine cover type, state forest wide.

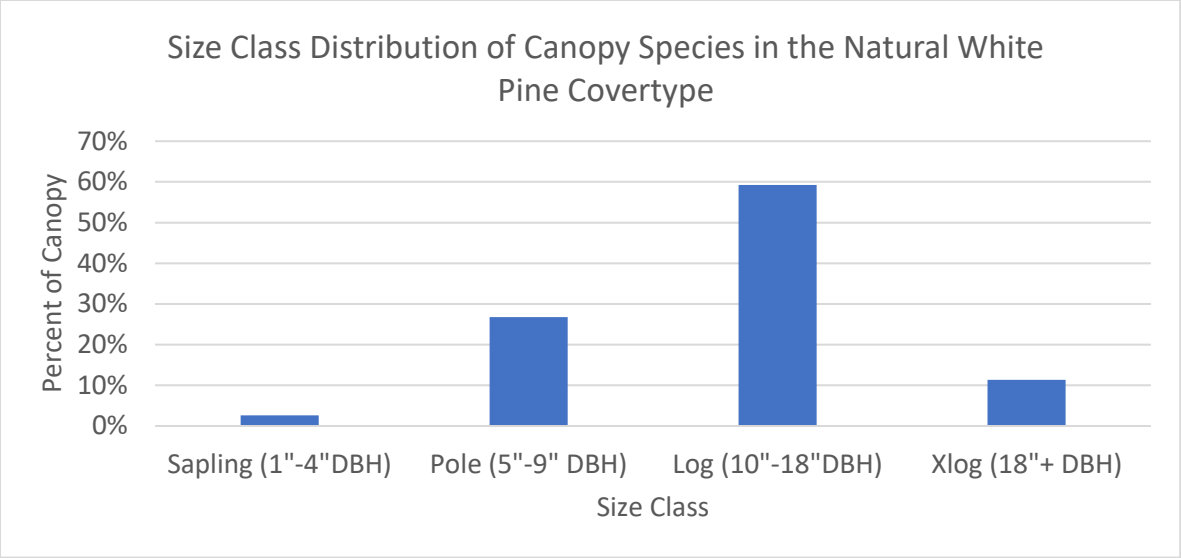


Figure 110. Average size class distribution of the natural white pine cover type.

Objectives and management actions

Objective 1. Select natural white pine stands for regeneration using even-aged harvests to improve the age-class distribution of the manageable population and support the habitat needs of several game and non-game wildlife species.

- Action 1. Prescribe about 2,400 acres of natural white pine for shelterwood harvests from merchantable stands throughout the next decade (Table 4).

Objective 2. Select natural white pine stands for uneven-aged harvests to improve the stand structure and species composition of the manageable population and support the habitat needs of several game and non-game wildlife.

- Action 1. Prescribe about 2,544 acres of natural white pine for selection/thinning harvests (including 505 acres of salvage thinning) from any merchantable age or size class throughout the next decade (Table 4).

Tamarack

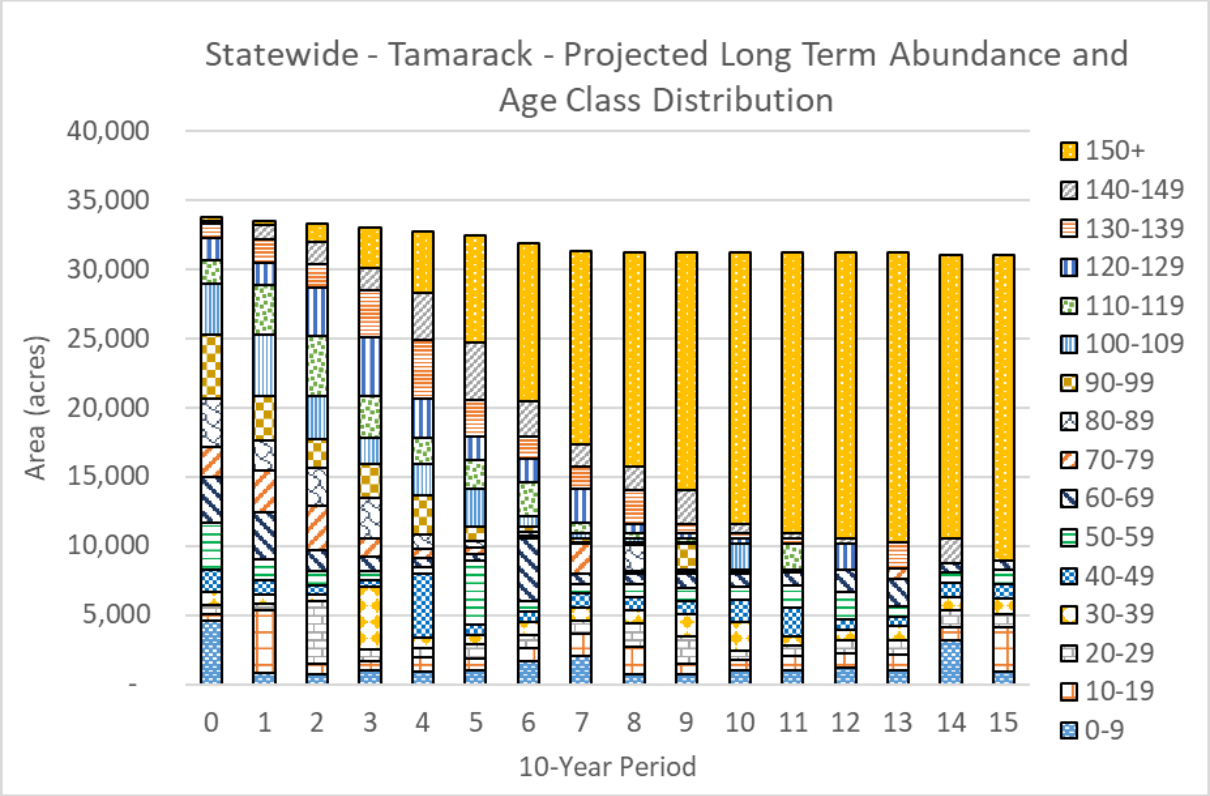


Figure 111. Tamarack abundance by age class as projected through period 15 in the SFMP model.

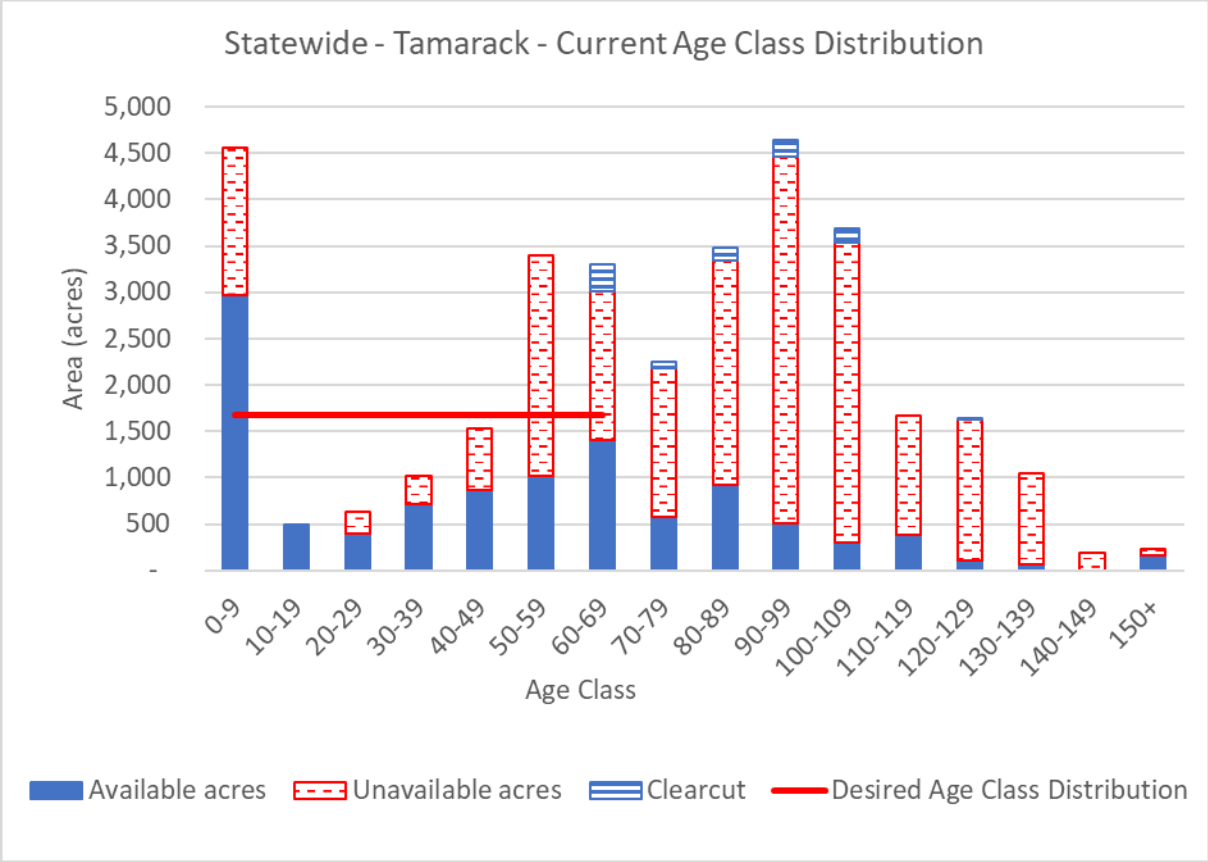


Figure 112. Current statewide tamarack age class distribution and projected period one harvests.

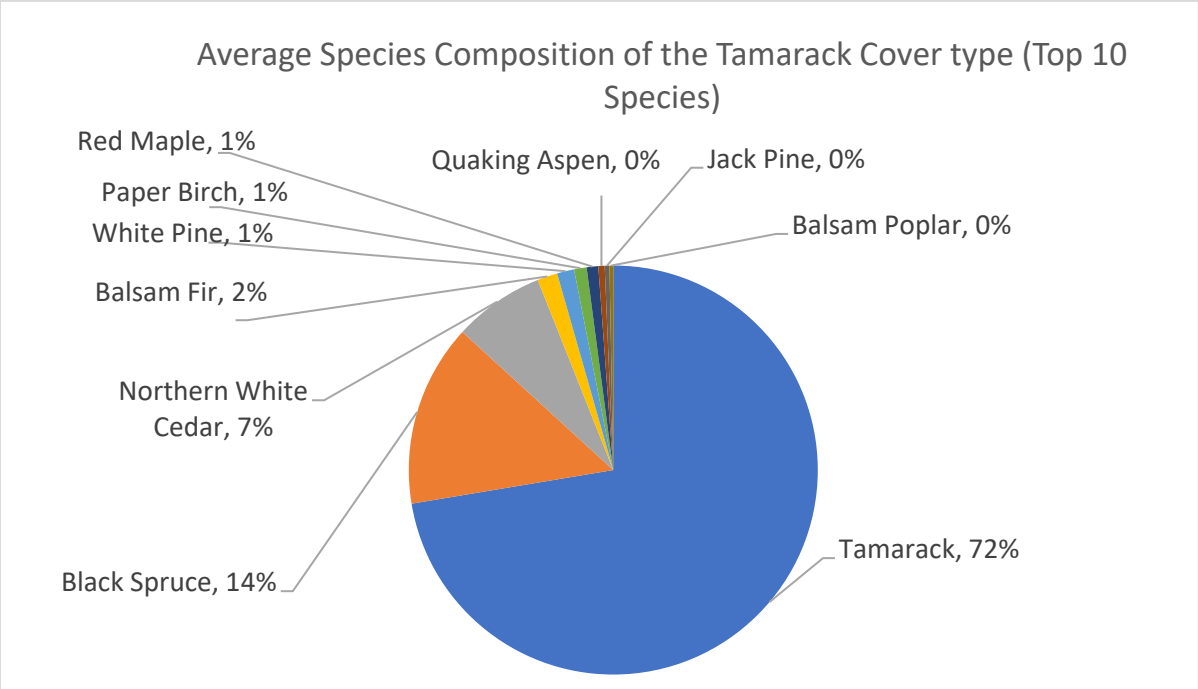


Figure 113. Average species composition of the tamarack cover type, state forest wide.

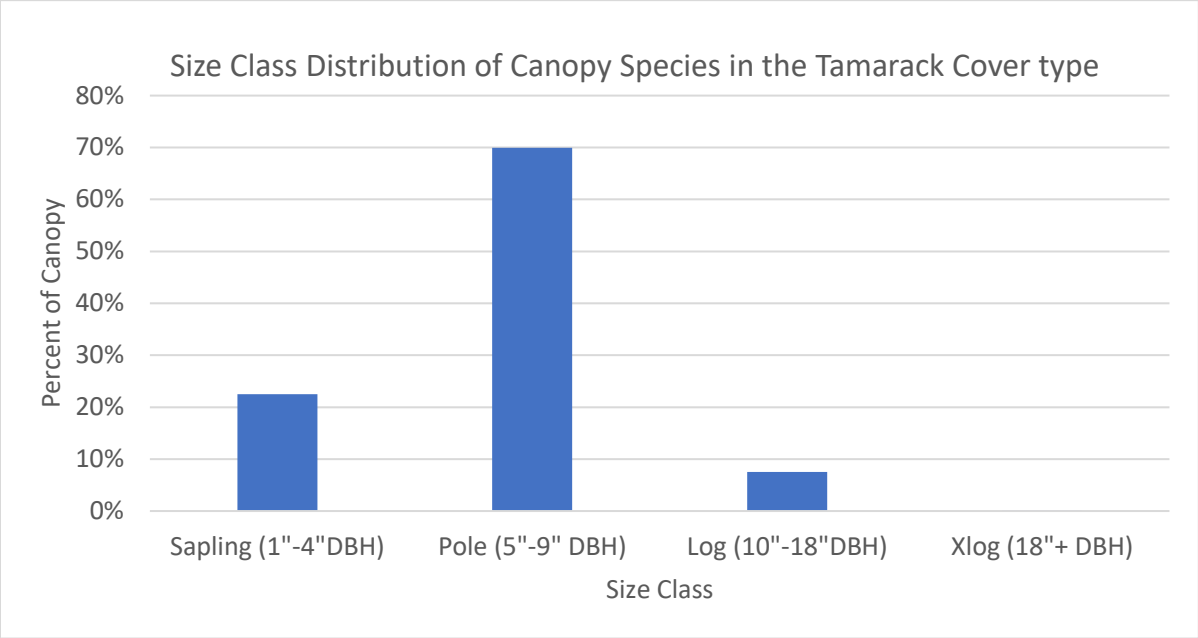


Figure 114. Average size class distribution of the tamarack cover type.

Objectives and management actions

Objective 1. Select tamarack stands for regeneration using even-aged harvests to improve the age-class distribution of the manageable population and support the habitat needs of several game and non-game wildlife.

- Action 1. Prescribe about 839 acres of tamarack for clearcut harvests from any merchantable age or size class throughout the next decade (Table 4).

Upland spruce/fir

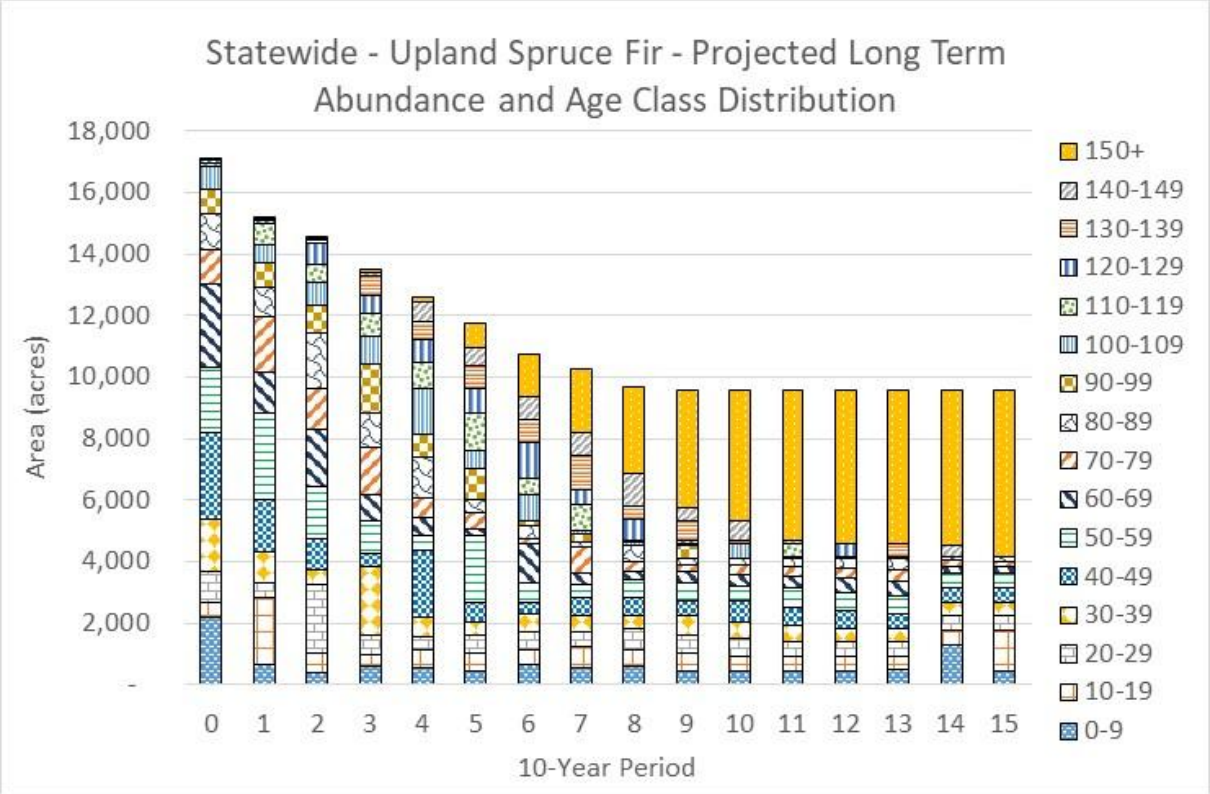


Figure 115. Upland spruce fir abundance by age class as projected through period 15 in the SFMP model.

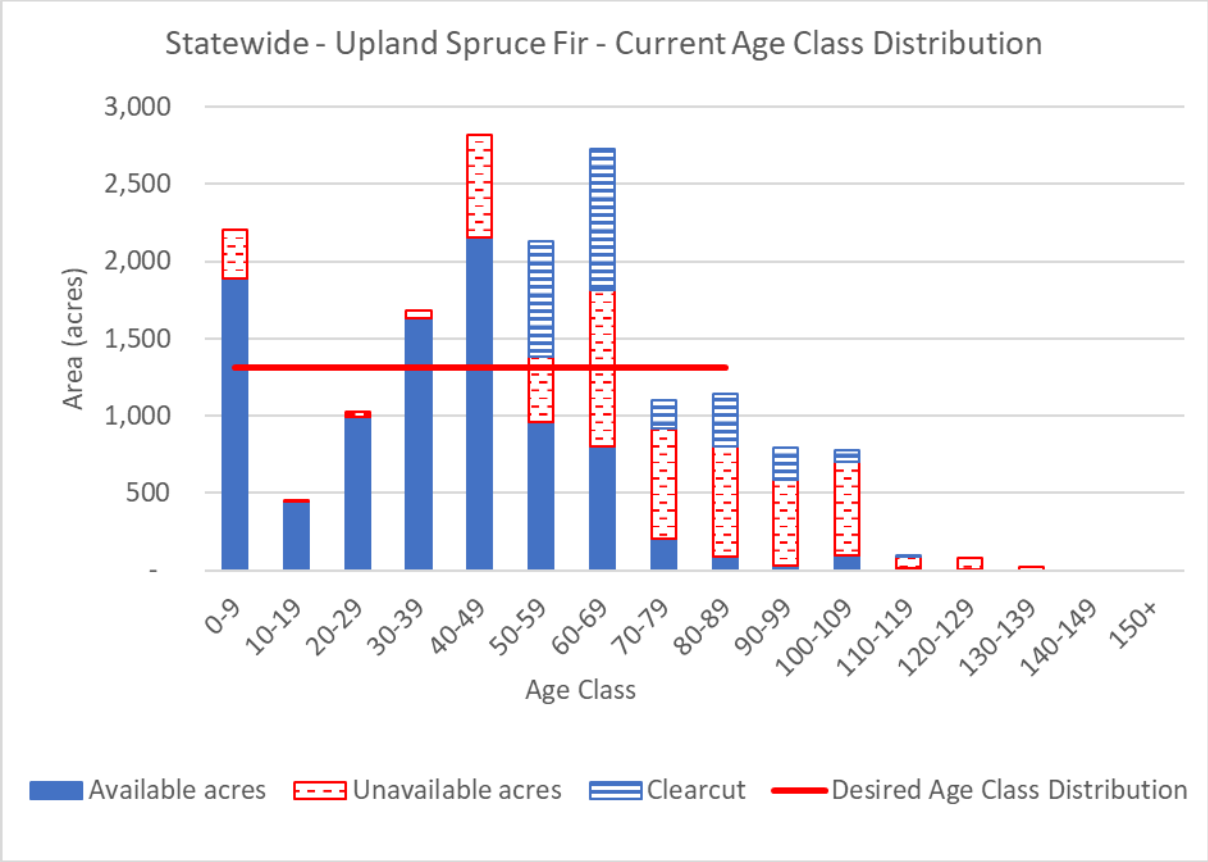


Figure 116. Current statewide upland spruce fir age class distribution and projected period one harvests.

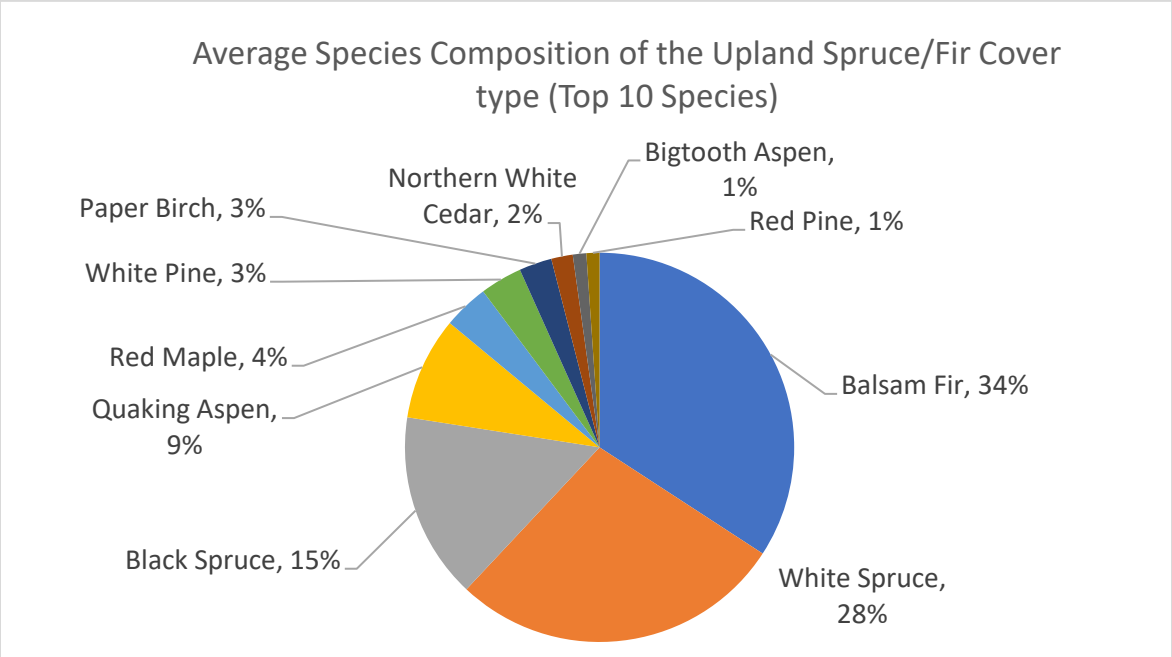


Figure 117. Average species composition of the upland spruce fir cover type, state forest wide.

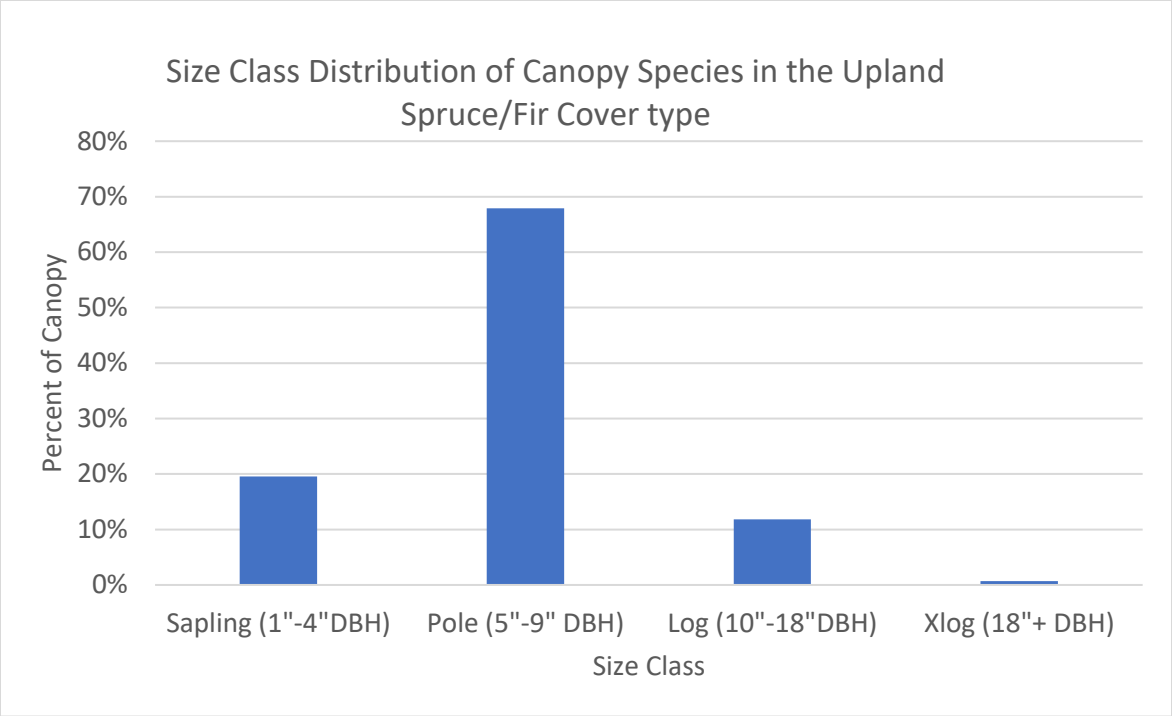


Figure 118. Average size class distribution of the upland spruce fir cover type.

Objectives and management actions

Objective 1. Select upland spruce/fir stands for regeneration using even-aged harvests to improve the age class distribution of the manageable population and support the habitat needs of several game and non-game wildlife.

- Action 1. Prescribe about 2,507 acres of upland spruce/fir for clearcut harvests from any merchantable age or size class throughout the next decade (Table 4).

Planted mixed pine

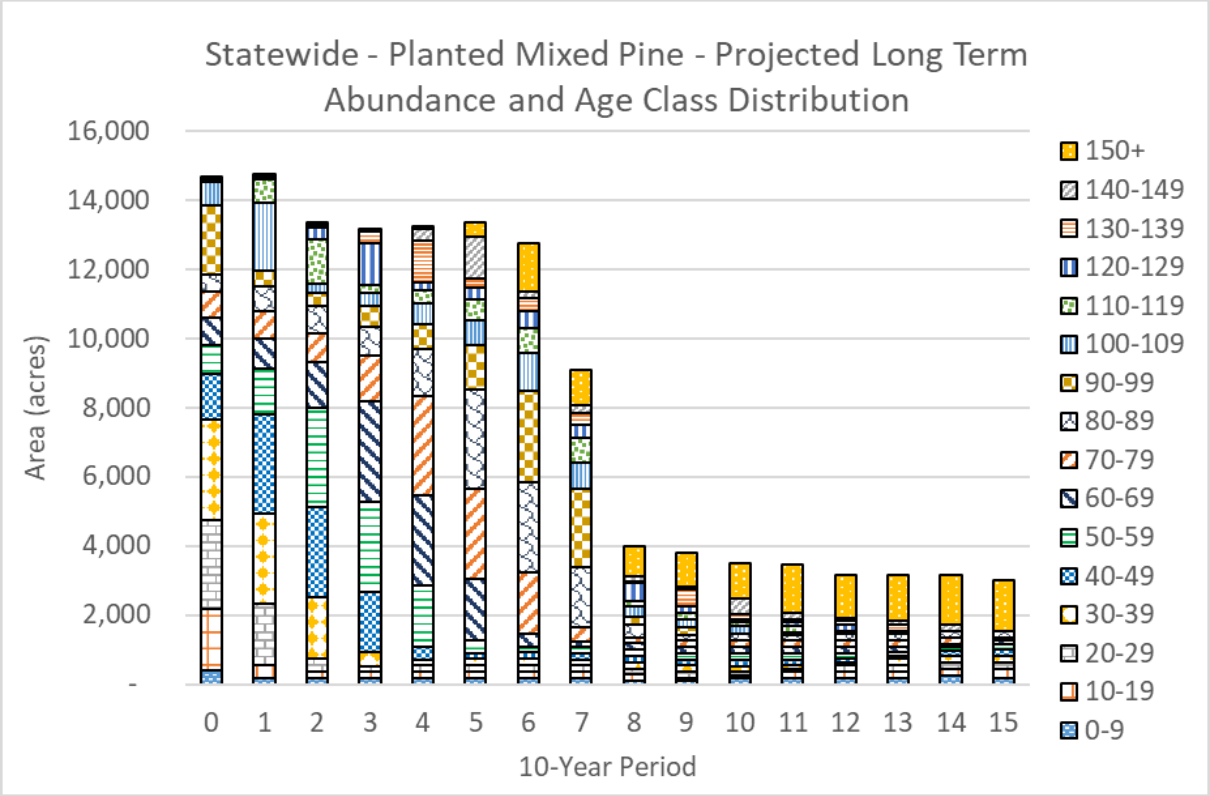


Figure 119. Planted mixed pine abundance by age class as projected through period 15 in the SFMP model.

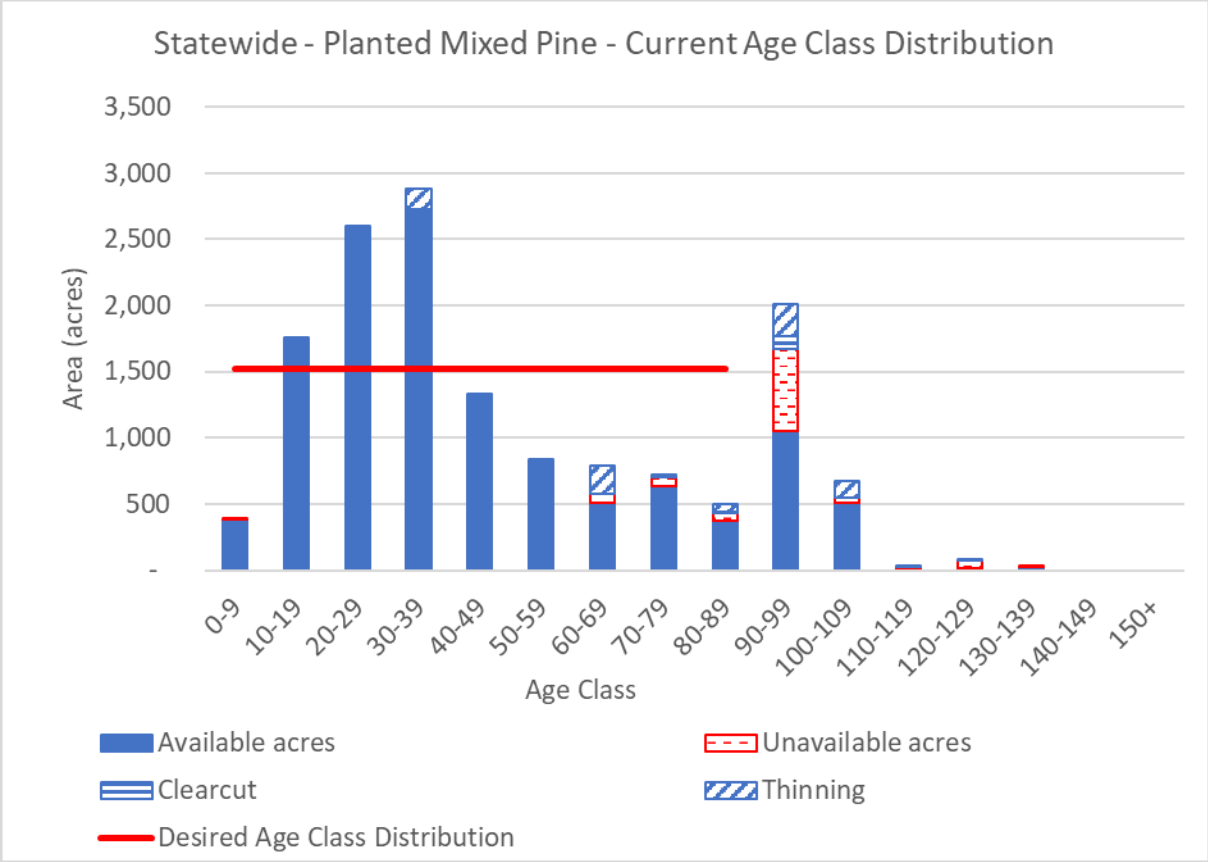


Figure 120. Current statewide planted mixed pine age class distribution and projected period one harvests.

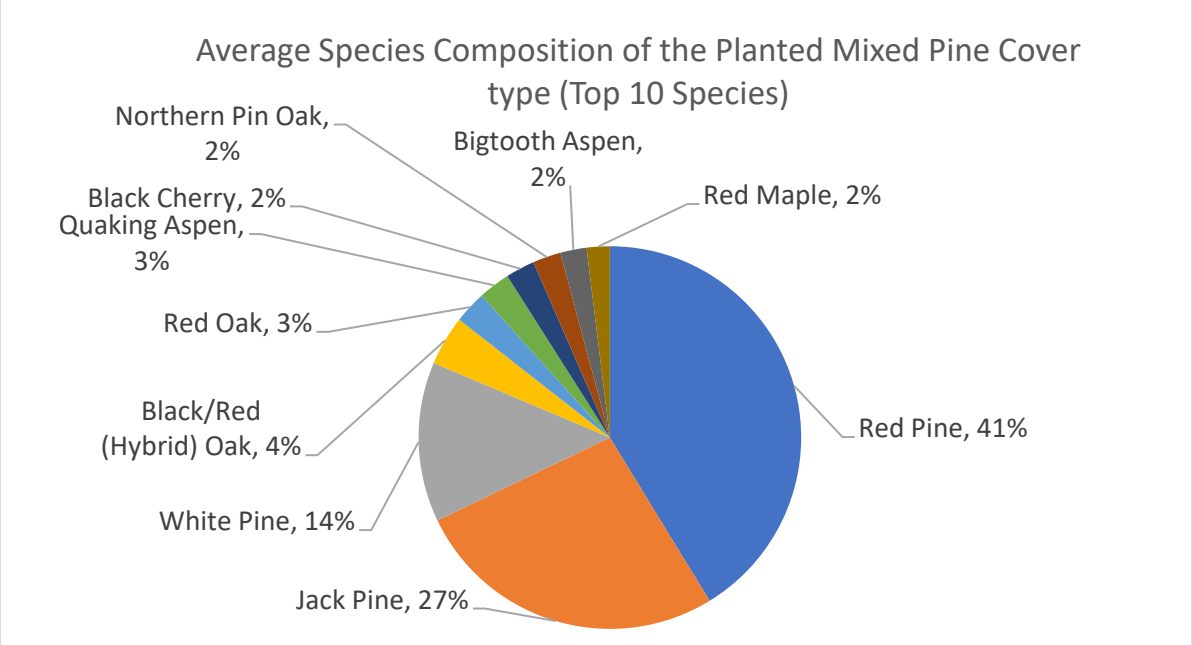


Figure 121. Average species composition of the planted mixed pine cover type, state forest wide.

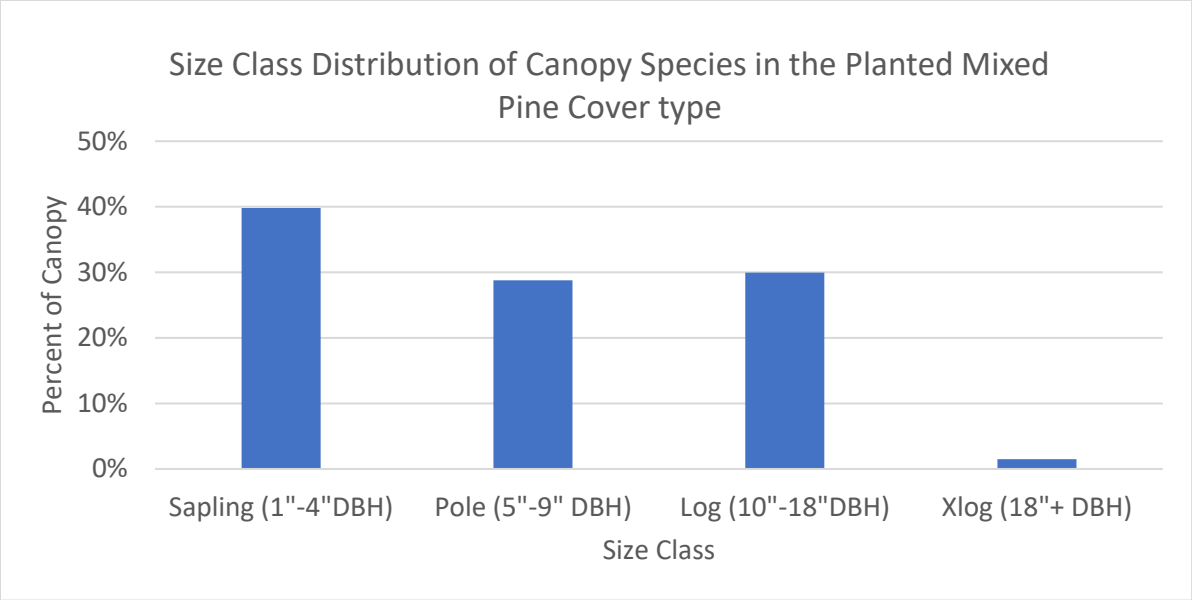


Figure 122. Average size class distribution of the planted mixed pine cover type.

Objectives and management actions

Objective 1. Select planted mixed pine stands for regeneration using even-aged harvests to convert to other cover types, which provide better timber management potential and support the habitat needs of several game and non-game wildlife species.

- Action 1. Prescribe about 103 acres of planted mixed pine for clearcut harvests from any merchantable age or size class throughout the next decade (Table 4).
- Action 2. Prescribe about 890 acres of planted mixed pine for intermediate thinning harvests from merchantable stands with sufficient basal area throughout the next decade (Table 4).

Hemlock

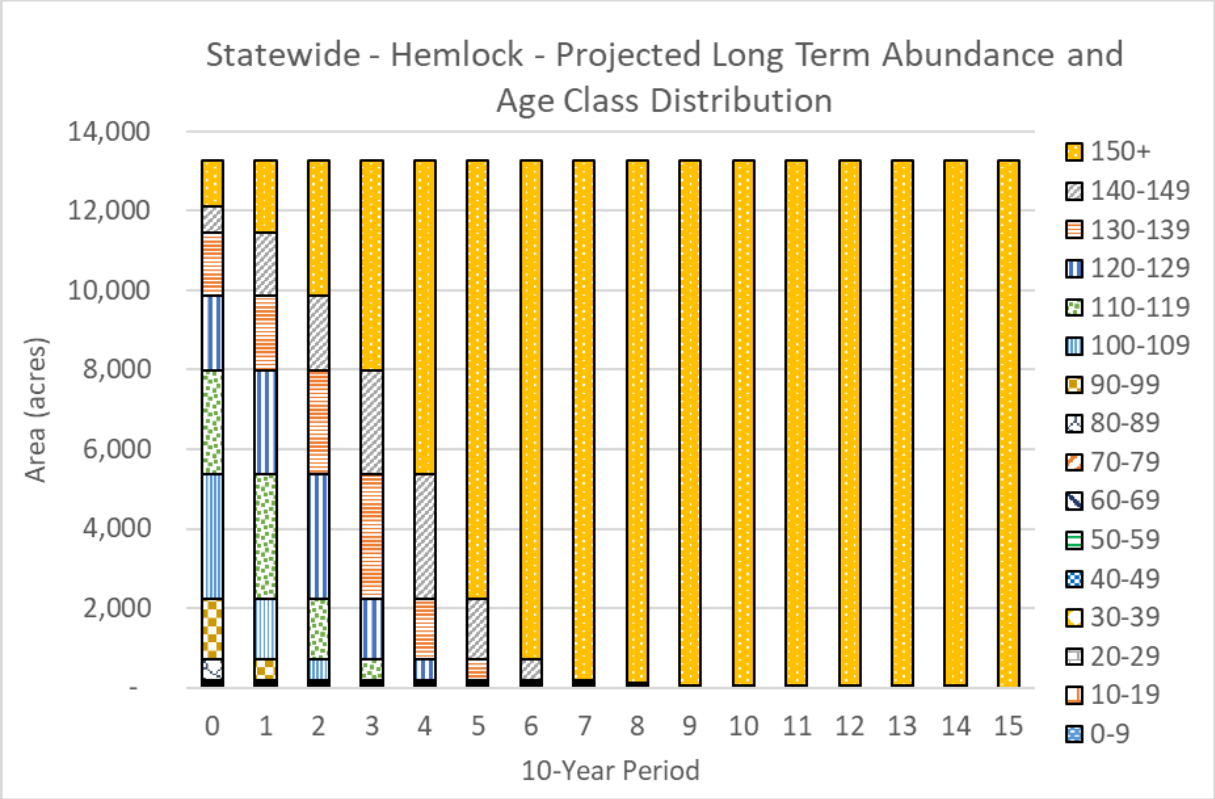


Figure 123. Hemlock abundance by age class as projected through period 15 in the SFMP model.

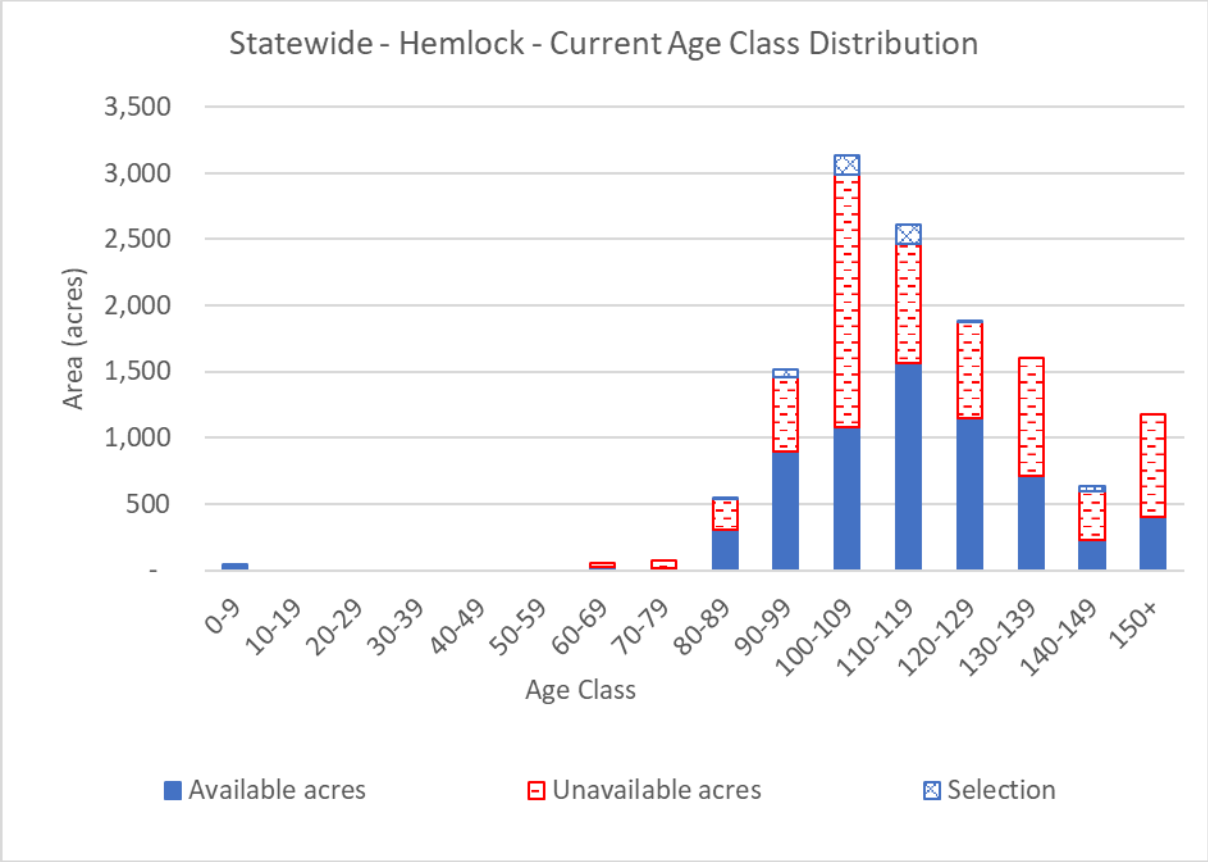


Figure 124. Current statewide hemlock age class distribution and projected period one harvests.

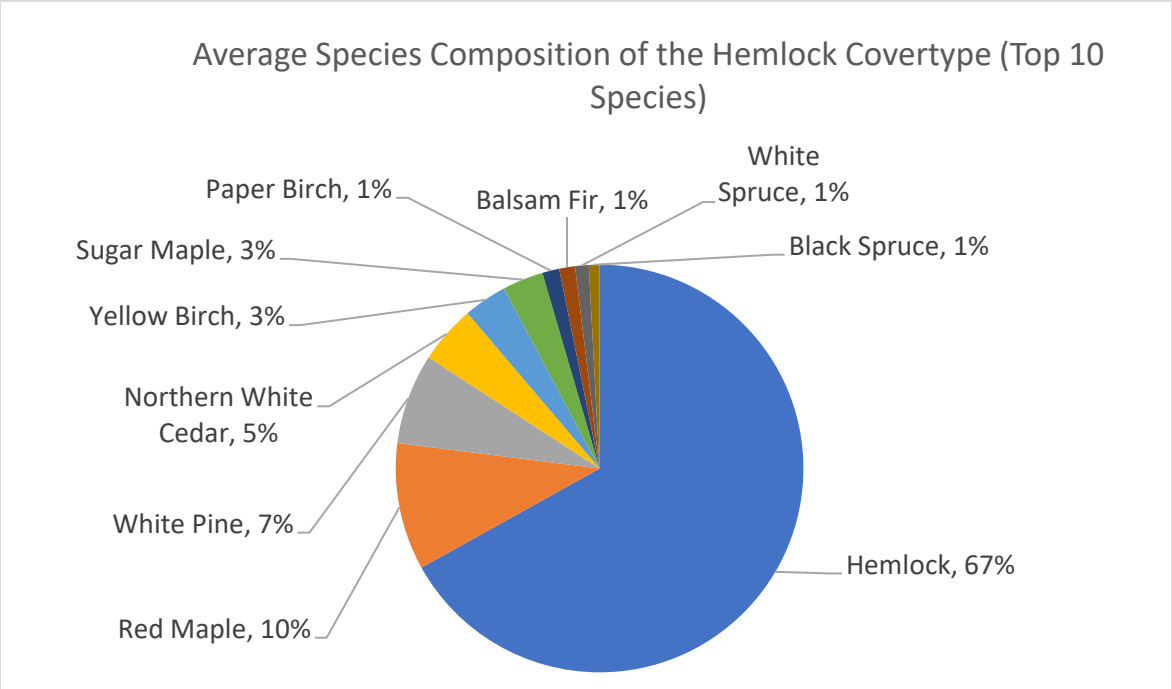


Figure 125. Average species composition of the hemlock cover type, state forest wide.

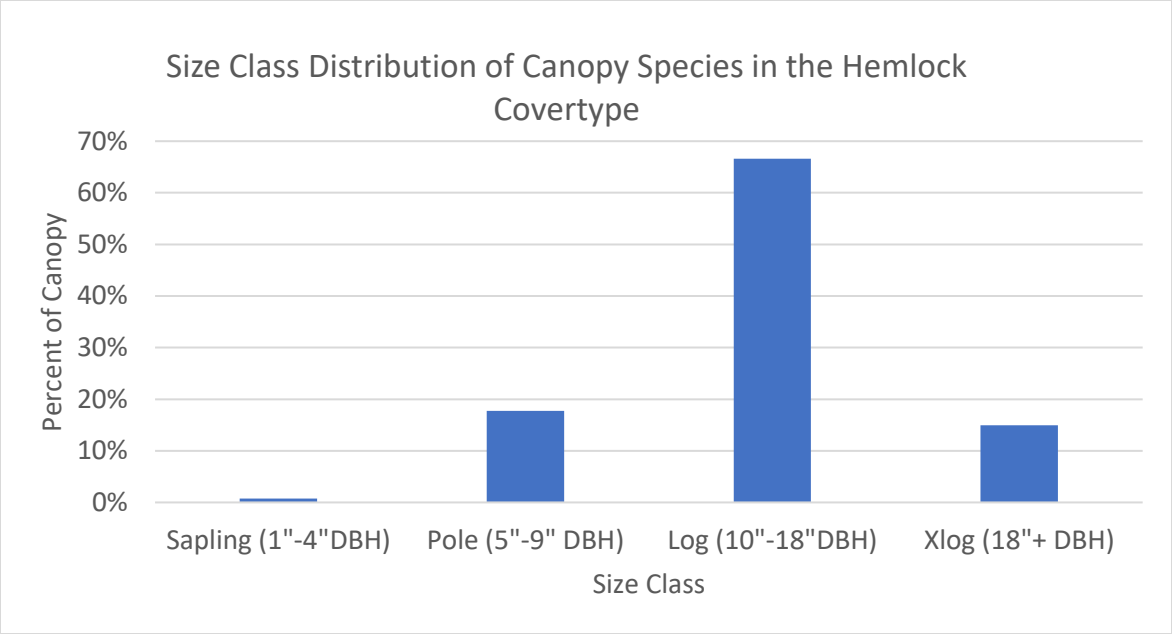


Figure 126. Average size class distribution of the hemlock cover type.

Objectives and management actions

Objective 1. Select a small proportion of hemlock stands outside of deer wintering complexes for regeneration using uneven-aged harvests to improve the stand productivity and structural composition of the manageable population and support the habitat needs of several game and non-game wildlife.

- Action 1. Prescribe about 459 acres of hemlock for selection harvests from upland stands with a significant northern hardwood component that have met the silvicultural criteria and would benefit from a selection harvest, designing the silvicultural prescriptions to overcome barriers to the successful regeneration of hemlock, including herbivory impacts (Table 4).

Planted White Pine

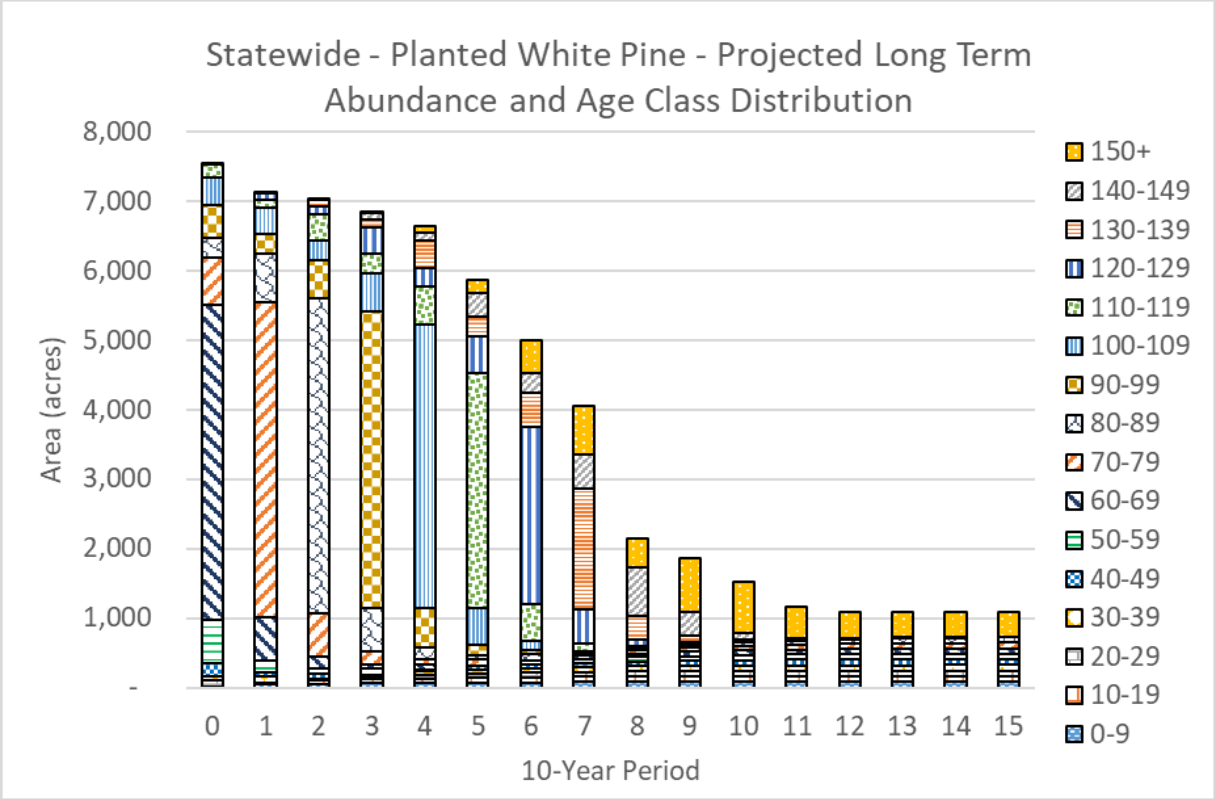


Figure 127. Planted white pine abundance by age class as projected through period 15 in the SFMP model.



Figure 128. Current statewide planted white pine age class distribution and projected period one harvests.

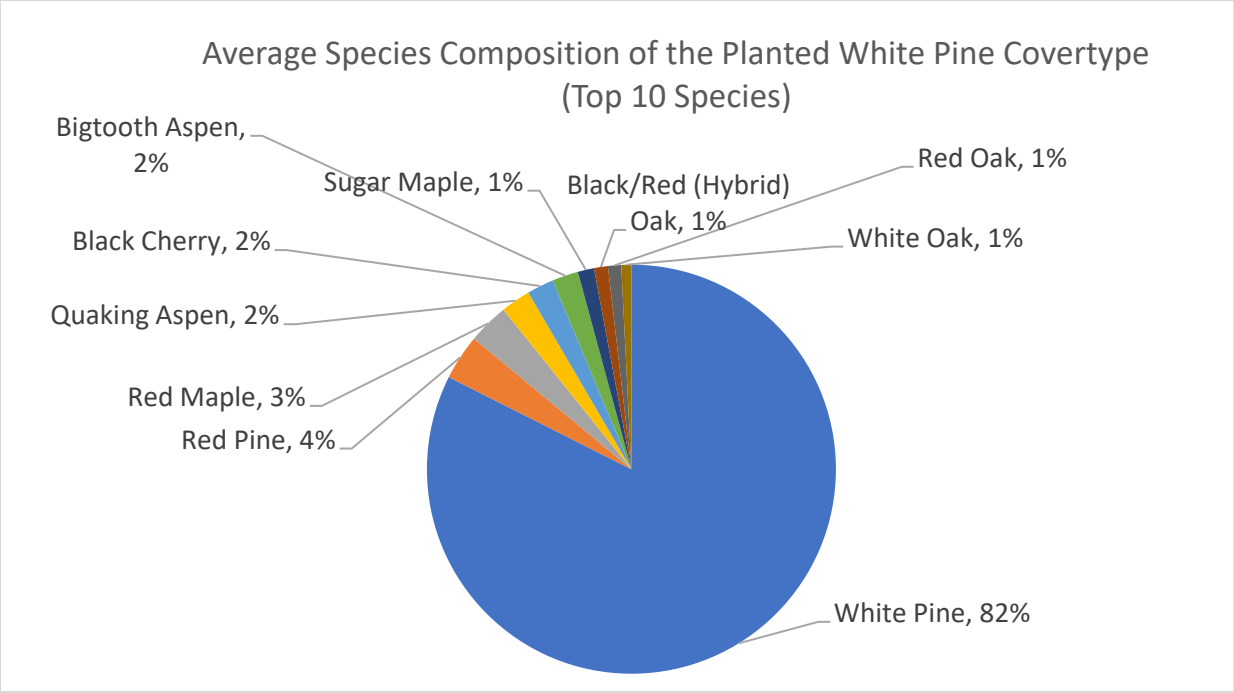


Figure 129. Average species composition of the planted white pine cover type, state forest wide.

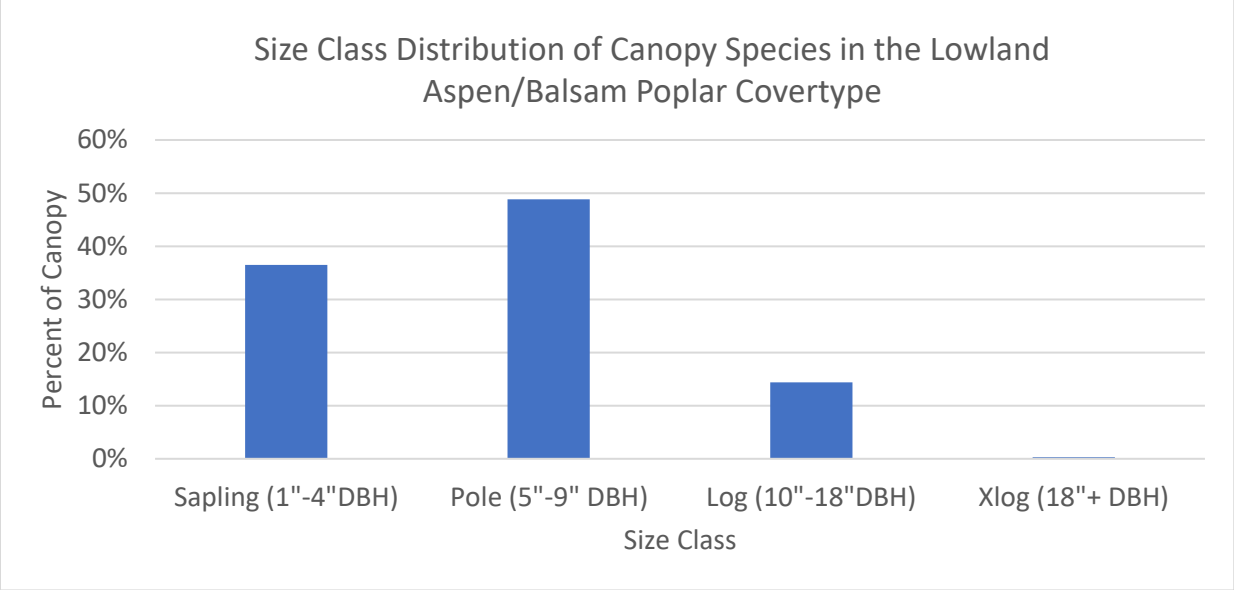


Figure 130. Average size class distribution of the planted white pine cover type.

Objectives and Management Actions

Objective 1. Select planted white pine stands for regeneration using even-aged harvests to convert to other cover types that provide better timber management potential and support the habitat needs of several game and non-game wildlife.

- Action 1. Prescribe about 472 acres of planted white pine for clearcut harvests from any merchantable age or size class throughout the next decade (Table 4).
- Action 2. Prescribe about 3,198 acres of planted white pine for intermediate thinning harvests from merchantable stands with sufficient basal area throughout the next decade (Table 4).

Climate change

All climate change data and information listed here is pulled directly from the open-source Northern Institute of Applied Climate Science (NIACS) Climate Change Impacts tool and Adaptation Workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium, limited) and agreement (high, moderate, low) described in the Predicted Impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the Adaptation Approaches. For more information, please go to www.niacs.org.

Predicted impacts relevant to forest types

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results
Northern Michigan's boreal species will face increasing stress from climate change	Medium	High	Boreal or northern species will experience reduced suitable habitat and biomass across the assessment area, and they may be less able to take advantage of longer growing seasons and warmer temperatures than temperate forest communities.
Southern or temperate species in northern Michigan will be favored by climate change	Medium	High	Many temperate species will experience increasing suitable habitat and biomass across the assessment area, and longer growing seasons and warmer temperatures will lead to productivity increases for temperate forest types. Species projected to increase includes American basswood, black cherry, white oak, and a variety of minor southern species.
Low-diversity systems are at greater risk from climate change	Medium	High	Diverse systems have exhibited greater resilience to extreme environmental conditions and greater potential to recover from disturbance than less diverse communities. This relationship makes less diverse communities more susceptible to future changes and stressors.

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results
Forest composition will change across the landscape	Medium	High	Habitat and biomass of individual tree species will change, and tree species will respond uniquely. However, few studies have specifically examined how assemblages of species may change.

Adaptation approaches

Managing cover types using even-aged, two-aged, and uneven-aged techniques inherently provides a more resilient condition to the effects of a changing climate. When a population of acres in a given cover type is comprised of an array of age classes in varying conditions, it is more likely to withstand stressors introduced over time in a changing climate as opposed to a population that was mostly over mature or very young. The management outlined above will result in increased species composition in most types and in some circumstances even a conversion to a mixed cover type that has a higher level of species diversity and richness than some non-mixed types like aspen or planted red pine. Diverse forests have a better chance of increased resiliency and resistance to the effects of climate change than forests that have been simplified to only a few cover types and/or conditions. Where possible, cover type conversions of stands to those cover types containing more tree species that are “climate winners” will help to boost the resiliency of the state forest.

Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Acres of each cover type to show progress toward conversions
- Acres of harvest by method of cut and cover type
- Acres of harvest by management objective of treatment
- Acres by age class within each even-aged cover type
- Acres harvested by basal area class in the intermediate and uneven-aged cover types

Management priority: Featured species



Why featured species matter

The DNR Wildlife Division's featured species are animals that are highly valued, are often limited by habitat availability or require active management to maintain habitat. They have been selected to focus the division's habitat management efforts. The intent of featured species habitat management is to address the primary limiting habitat need(s) for each species to ensure their persistence on the landscape, to provide hunting opportunities or, in some cases, to meet specific population goals. Featured species are not the only wildlife species that the Wildlife Division values, but they are a priority and resources will be directed toward managing their habitats. The featured species program is statewide, though it recognizes regional differences, and the list is reviewed every three years with opportunity for public comment.

As discussed in the introduction to this plan, featured species also are associated with landscape habitat conditions, or LHCs. These broad habitat conditions are either of primary management importance or are underrepresented at a large scale through standard management operations. A featured species can be associated with multiple LHCs, and multiple featured species can be associated with one LHC. This is because a species can have more than one limiting factor represented by multiple landscape habitat conditions, and each species within an LHC is emblematic of a unique niche within it. By focusing management on these relationships between featured species and LHCs, many other species will also benefit. Both LHCs and featured species help focus management and monitoring efforts.

For the state forest, featured species and LHCs were chosen that have direct impacts to, or from, forestry operations to integrate them into the Woodstock model and to facilitate planning (Table 1). More details on how these species were chosen and those that are included in the model can be found in the plan Introduction, including the addition of wood turtle and moose in response to comments received during the 2024 draft plan Tribal and public review. Each LHC is discussed separately with its own management priorities in this plan.

Table 1. State forest featured species and associated landscape habitat conditions.

Featured species (Habitat niche if specified)	Young Forest	Mature Forest	Interior Forest	Mast	Mesic Conifer	Big Trees	Natural Disturbance	Openings	Mature Forests: Dense Understory	Mature Forests: Open Understory
American marten	--	X	X	--	X	X	--	--	--	--
American woodcock	X	--	--	--	--	--	--	X	--	--
Black bear	--	--	--	X	--	--	--	--	--	--
Black-backed woodpecker	--	--	--	--	--	--	X	--	--	--
Blackburnian warbler	--	X	X	--	X	X	--	--	--	X
Black-throated blue warbler	--	X	X	--	--	X	--	--	X	--
Cerulean warbler	--	X	X	--	--	X	--	--	X	--
Elk	X	--	--	X	--	--	--	X	--	--
Golden-winged warbler	X	--	--	--	--	--	--	X	--	--
Kirtland's warbler	X	--	X	--	--	--	--	--	--	--
Moose	X	X	--	--	--	X	--	--	--	--
Red crossbill (conifer forest)	--	X	--	--	--	X	--	--	--	X
Ruffed grouse	X	--	--	--	--	--	--	--	--	--
Sharp-tailed grouse	--	--	--	--	--	--	--	X	--	--
Snowshoe hare	X	--	--	--	--	--	--	--	--	--
Spruce grouse (conifer forest)	X	X	--	--	--	--	--	--	X	--
White-tailed deer	--	X	--	X	--	--	--	--	--	--
Wild turkey	--	--	--	X	--	--	--	X	--	--
Wood thrush	--	X	--	--	--	--	--	--	--	X
Wood turtle	--	--	--	--	--	--	--	X	--	--

Featured species management occurs at the unit level within a management area context. Regional ecologists evaluated known species distribution and occurrence data along with habitat potential to begin the process of identifying appropriate management areas where individual featured species should be prioritized. These draft selections were shared with unit biologists and species specialists for final determination, which can be found in the management area section of this plan (Section 4). Management areas, special analysis units, and species focal priority areas are all large and varied enough to provide ample opportunity to manage for multiple featured species without conflict. Site level differences, Kotar habitat potential (Burger and Kotar 2003), landscape history and context will go

a long way in determining this at local scales. Featured species habitat guidance documents will be revised or developed to assist biologists in identifying appropriate large- and mid-scale landscapes and then providing stand-level management detail that will support management decisions.

Current condition and trend

Habitat attributes were identified for each featured species, recognizing that it would not be feasible to model or monitor all suitable habitat for each species. Limiting habitat factors were identified from literature reviews, and those were translated as well as possible into MiFI stand data variables, which serve as the basis for the model and forest operations. These are: cover type, age class, basal area, stocking density, canopy closure, canopy species richness, shade tolerance, upland or lowland and availability for management. Because each featured species had multiple cover types identified, the model habitat outputs are the aggregated acres across cover types in the selected ranges for the applicable MiFI variables.

The model projects potential habitat across 150 years in 10-year increments called periods; period 0 in the model represents the current condition. For featured species, period 0 model outputs could only be provided for those species that had forested habitat attributes defined. This does not include black-backed woodpecker, black bear, moose, sharp-tailed grouse, wild turkey or wood turtle. For these species, no current condition is described due to additional challenges described below.

It was not possible to quantify habitat for black-backed woodpecker, as they are a disturbance-related species, and MiFI data does not include that information. Moose and wood turtle were added as featured species too late in the planning process to determine specific habitat attributes to add to the model or inform an analysis of current inventory data. However, desired future conditions, objectives and actions were developed for both species based on input from natural resource staff from several Tribes and DNR species specialists.

It was not possible to provide openings habitat current condition data for individual featured species during this planning period. Because of the considerable effort it took to learn this new Woodstock software and to model forested cover types, it was determined that modeling nonforested cover types would have to wait until the next planning cycle. There was no time to determine openings landscape goals and then develop silvicultural regimes and cover type transition rates and relationships to adequately represent openings dynamics over time in the model. Further, the use of MiFI inventory data was stymied due to challenges parsing data for size, juxtaposition and type for species-specific openings habitat. For example, sharp-tailed grouse requirements for large openings complexes require spatial capabilities neither the model nor MiFI have when data is pooled. However, when openings data from the inventory is pooled, they can be broadly reported at the LHC level. That information is in the Nonforested Openings management priority.

For featured species associated with the mast LHC, oak cover types are the only outputs in the model that represent mast acres. The model can't track oak and other mast-bearing tree species as canopy components, so it was not possible to report combined mast acres for species habitat. However, a broad assessment of mast availability, important for both black bear and wild turkey among other featured species, is presented in the Mast LHC management priority in this plan.

For the other featured species, current forested condition is provided as period 0 from the model (Table 2). One caveat to keep in mind: While habitat attributes for each of the 14 modeled featured species were entered into the model, it was not possible to derive species-specific geographies for the model outputs. Therefore, habitat acres reported as model outputs may overrepresent actual habitat for species that have more limited ranges or patchy distribution. This is especially true for cerulean warbler, red crossbill and spruce grouse. The former has low abundance in the northern Lower Peninsula and is uncommon in the Upper Peninsula, and the latter two are more abundant in the Upper Peninsula. Further limitations of model habitat outputs are described below.

Table 2. Total forested habitat acres for each featured species, by region and state forest wide, as defined in the model. (Source: Remsoft Woodstock model period 0)

Featured Species	Northern Lower Peninsula	Eastern Upper Peninsula	Western Upper Peninsula	State Forest Total
American black bear	--	--	--	--
American marten	458,386	263,184	273,439	995,008
American woodcock	182,226	42,310	83,520	308,055
Black-backed woodpecker	--	--	--	--
Blackburnian warbler	192,087	134,037	145,061	471,185
Black-throated blue warbler	162,519	81,269	119,736	363,524
Cerulean warbler	231,933	111,720	148,643	492,296
Elk	3,381	--	--	3,381
Golden-winged warbler	189,243	33,657	83,091	305,991
Kirtland's warbler	14,083	--	--	14,083
Moose	--	--	--	--
Red crossbill	10,381	13,728	6,044	30,153
Ruffed grouse	169,321	32,538	78,102	279,960
Sharp-tailed grouse	--	--	--	--
Snowshoe hare	274,977	108,673	113,715	497,365
Spruce grouse (mature forest)	129,684	116,285	64,513	310,412
Spruce grouse (young forest)	48,960	33,719	7,441	90,120
White-tailed deer (deer wintering complexes)	--	83,911	48,263	132,174
Wild turkey	--	--	--	--
Wood thrush	267,998	106,878	146,957	521,833
Wood turtle	--	--	--	--

Habitat acres for ruffed grouse include the Grouse Enhanced Management Sites, also known as GEMS, and the state forest matrix. Habitat acres for elk (forested only), Kirtland's warbler and white-tailed deer are those that occur within their respective species management areas. These species management areas were incorporated into the model and this plan as special analysis units, also known as SAUs. Habitat and management objectives are defined in the associated management plans. For more information on the Elk Management Area, Kirtland's Warbler Management Area, GEMS and deer wintering complexes, please see Section 5.

Habitat acres provided for golden-winged warbler and American woodcock include the entire state forest matrix. However, geographic priority focal areas have been delineated for both species in their respective conservation plans based on GIS analysis and expert opinion as to where management efforts would garner the most effective population response (Roth et al. 2012, WMI 2010). These focal areas were not included in the model for two reasons: They would add an infeasible level of complexity for the model in their overlap with management areas and SAUs, and while it makes sense to prioritize management in these areas, there was also a desire to provide flexibility across the state forest where other management opportunities were identified. That said, management in these areas for these species should be given deliberate attention.

As has been discussed in other parts of the plan, the model scenario chosen to guide management for the next 10 years maximizes timber harvest while using goals and constraints to incorporate the age-class distributions, transition rates and silvicultural regimes that staff developed in each management area, and the wildlife habitat objectives in the SAUs. Age-class distributions were based on the principle of area regulation, such that age classes were balanced within a cover type in each management area. Because there were no habitat objectives incorporated into the model outside of the SAUs, model projections for featured species habitat are a result of these cover type management regimes (Figure 1).

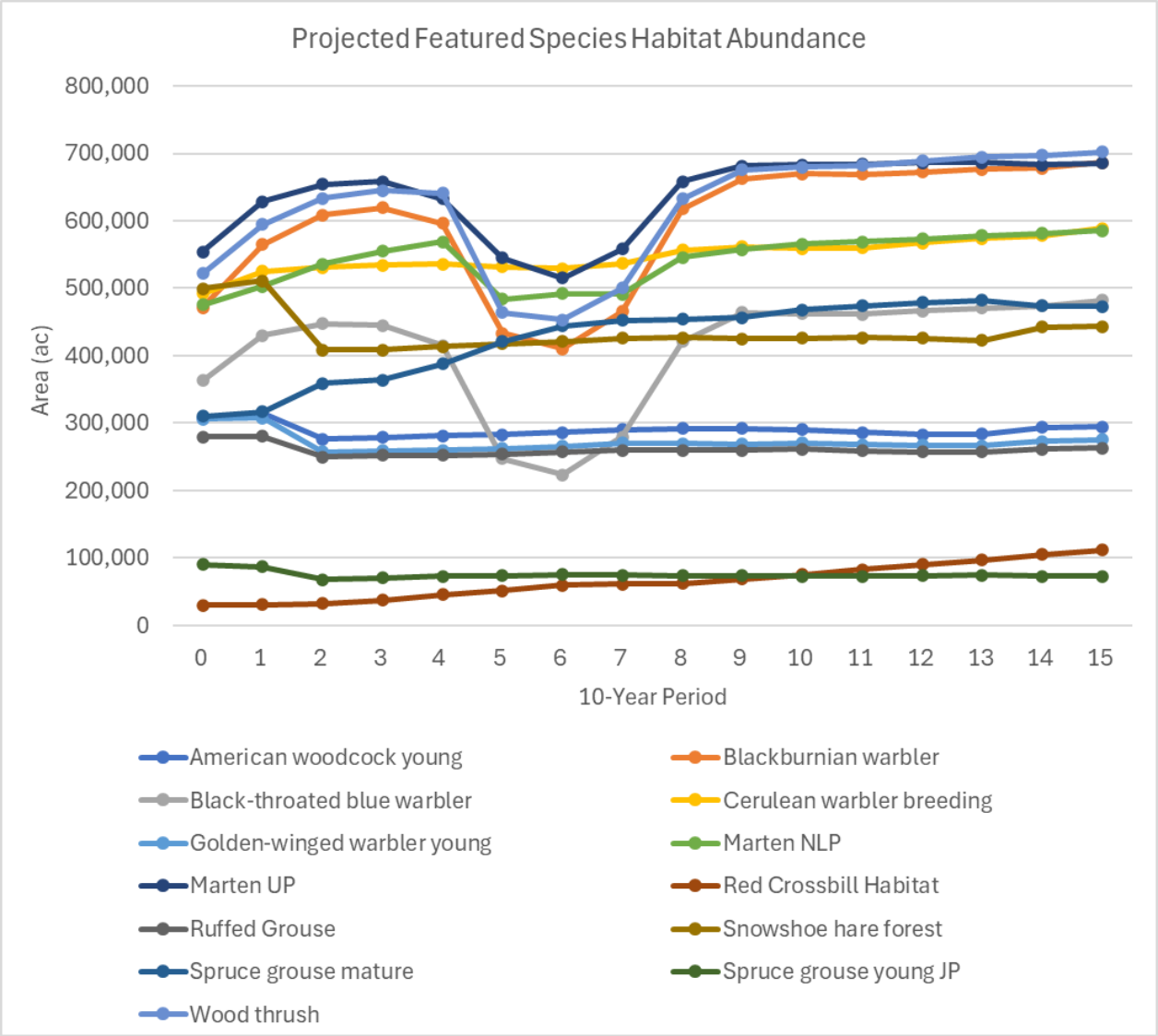


Figure 1. Model projections for featured species habitat over 150 years (10-year periods).

In evaluating these model habitat acres over time, keep caveats in mind to properly contextualize this data. As described in the introduction, the modeling effort was limited by data availability (growth and yield), capacity to address layers of complexity (situation-specific silviculture regimes) and simplification of habitat attributes into MiFI variables. It is recommended that these featured species habitat acres be viewed as acres of potential habitat, representing a condition on the landscape where the more nuanced aspects of each species' habitat requirements are likely to be found or managed for.

With that caution in mind, potential habitat for the featured species overall is largely steady or shows a slight increase by the end of the 150-year model planning horizon. Broad trends to note are that mature forest featured species have more habitat acres than young forest species do, and that trajectories for species within those two age categories are similar. The former is likely due to having more acres in the mature forest age category across the state forest, irrespective of management availability. The latter is

likely driven by management regimes for the selected cover types, especially aspen and northern hardwoods, which together comprise a third of the forested cover types on the state forest.

Blackburnian warbler, black-throated blue warbler, wood thrush and marten (Upper Peninsula and northern Lower Peninsula) show a pronounced dip in habitat acres between periods 4 and 8. Further investigation into the model output data demonstrated that the BA range dips just slightly under 81 during this time period in the northern hardwoods cover type, which was the minimum BA threshold in the model for these species. However, since the BA remains in the upper 70s during these model periods, this was not deemed any real concern for habitat availability for these species.

Many of the young forest species show some variability in acres across the first two model periods before smoothing out. This is largely reflective of past management approaches that have resulted in a surplus in acres for the current 0-9 age class, particularly in aspen, mixed upland deciduous and planted jack pine. These surplus acres are a result of an intentional effort in the previous planning cycle to temporarily cut more acres than would be sustainable long-term to compensate for high acreage spikes in older age classes. Therefore, they represent a boon in acres from the previous decade, whereas the harvest level this planning cycle and beyond represents a return to sustainable harvest levels. This surplus in the current 0-9 age class is transferred to period 1 as it ages into the 10-19 age class, before reaching a balanced age class distribution by period 2, reflecting a sustainable long term habitat maintenance scenario.

Spruce grouse shows a pronounced increase in mature forest habitat. This increase in acres is largely due to the gradual increase in stands that meet the minimum habitat thresholds (e.g., 81-plus BA) identified in the model through continued growth and maturation. Except for natural pines, many of the cover type acres for this species have been categorized as unavailable, which means they are never eligible for treatment in the model and continue to grow over all 15 periods.

Red crossbill habitat acres are comparatively low and show little variation over time. The cover types selected for this species in the model are a relatively low proportion of the state forest, comprising only about 7% of the forested cover types.

Desired future condition, objectives and management actions

American marten

Movement corridors connect mature forest landscapes so that, as climate change decreases the amount and duration of snowpack and winter prey availability, marten can move greater distances to access prey resources and sustain populations.

Objective 1. Promote marten habitat through large, contiguous mature forest management, ensuring abundance of stand-level features that provide den and resting sites as well as prey habitat and availability this planning period.

- Action 1. Identify areas within each of the management areas where marten is a featured species that are or can become quality marten habitat; establish Forest Core Interior High Conservation Value Areas.
- Action 2. Implement habitat specifications in the marten habitat guidance document.
- Action 3. Evaluate timber sale specifications and create new ones if needed to ensure that marten requirements for enough downed wood, snags and cavity trees are addressed through application within identified priority marten areas.
- Action 4. Initiate habitat implementation and effectiveness monitoring (Section 7).

Objective 2. This planning period, work with the USDA Forest Service and tribes to promote marten habitat connectivity and to facilitate movement across the landscape.

- Action 1. Conduct a landscape evaluation to identify riverine and other corridors that connect important marten habitat areas to facilitate movement and dispersal.
- Action 2. Establish protections of movement corridors through administrative tools to ensure any timber harvests promote and maintain the corridors.

American woodcock

Young forest and lowland brush, especially those on mesic sites and associated with riparian corridors that are more likely to persist in a drier climate, are promoted for American woodcock habitat, with consideration for larger stands that contain beneficial micro-climate conditions.

Objective 1. Identify opportunities to manage for young forest conditions in the aspen, lowland aspen and lowland deciduous cover types in the woodcock priority areas identified in the American Woodcock Conservation Plan, and opportunistically throughout the management areas where woodcock is selected for management.

- Action 1. Implement the habitat specifications in the American woodcock habitat guidance document.
- Action 2. Consider increasing stand size to allow micro-climate conditions to develop for optimal foraging conditions.
- Action 3. Develop timber sale specifications to facilitate habitat management.
- Action 4. Create a GIS layer of the priority areas for use in Portal.
- Action 5. Initiate habitat implementation and effectiveness monitoring (Section 7).

Objective 2. Manage for upland and lowland shrub availability on a moisture gradient in riparian corridors and near openings to ensure flexibility in foraging sites.

- Action 1. Within American Woodcock Conservation Plan priority areas, identify places to focus juxtaposition management for openings and brush along riparian corridors.
- Action 2. Implement habitat specifications for openings and lowland shrub in the American woodcock habitat guidance document.

Black bear

Promote mast-bearing species and employ adaptive climate strategies to ensure high-quality food resources to ensure black bear persist on the landscape.

Objective 1. Regenerate oak stands and maintain mast-bearing tree species within stands during the planning period.

- Action 1. Implement the habitat specifications in the black bear habitat guidance document.
- Action 2. Develop timber sale specifications to facilitate habitat management.
- Action 3. Initiate habitat implementation and effectiveness monitoring (Section 7).

Black-backed woodpecker

Natural disturbances to forests are recognized as providing important ephemeral habitat for black-backed woodpecker, and some proportion of affected trees are routinely left on site to senesce or as delayed salvage for that purpose.

Objective 1. Identify and track large-scale, natural forest disturbances in jack pine, mixed pine and spruce/fir forest as they occur during this planning period.

- Action 1. Delay a proportion of salvage logging within appropriate cover types; work with Forest Resources Division to determine how to approach this.
- Action 2. Implement the habitat specifications in the black-backed woodpecker habitat guidance document.
- Action 3. Develop timber sale specifications to facilitate habitat management.
- Action 4. Initiate habitat implementation and effectiveness monitoring (Section 7).

Blackburnian warbler

Large, contiguous patches of mesic conifer cover types and cover types with mesic species co-dominants are managed for blackburnian warblers, especially on sandy sites, to provide a buffer to climate change impacts that likely result in mesic conifer range shifts to the north.

Objective 1. Promote mesic conifer cover types and mesic conifer species within other cover types to provide habitat this planning period.

- Action 1. Identify priority large, contiguous patches of mesic conifer cover types and cover types with mesic conifer species that have good potential for blackburnian warbler habitat, especially those on sandy sites, and designate them as Forest Core Interior High Conservation Value Areas.

- Action 2. Implement the habitat specifications in the blackburnian warbler habitat guidance document.
- Action 3. Develop timber sale specifications to facilitate habitat management.
- Action 4. Initiate habitat implementation and effectiveness monitoring (Section 7).

Black-throated blue warbler

Large, contiguous patches of mature, deciduous cover types with dense understories are managed to provide black-throated blue warbler habitat and provide a buffer to climate change impacts that would likely result in a northward range shift.

Objective 1. Manage large, contiguous patches of mature forest cover types with a minimum of 500 acres beginning this planning period.

- Action 1. Identify priority large, contiguous patches of northern hardwood and mixed upland deciduous cover types, 500 acres or greater, and designate them as Forest Core Interior High Conservation Value Areas.
- Action 2. Implement the habitat specifications in the black-throated blue warbler habitat guidance document.
- Action 3. Develop timber sale specifications to facilitate habitat management.
- Action 4. Initiate habitat implementation and effectiveness monitoring (Section 7).

Cerulean warbler

Large, contiguous patches of mature, deciduous floodplain cover types are managed as important habitat and to facilitate cerulean warbler range shifts to the north in a warmer climate.

Objective 1. Manage large, contiguous patches of more than 1,000 acres of mature forest in deciduous floodplain cover types.

- Action 1. Identify priority large, contiguous patches of mature deciduous floodplain forest that meet or have the potential to meet cerulean warbler habitat needs and designate them as Forest Core Interior High Conservation Value Areas.
- Action 2. Implement the habitat specifications in the cerulean warbler habitat guidance document.
- Action 3. Develop timber sale specifications to facilitate habitat management.
- Action 4. Initiate habitat implementation and effectiveness monitoring (Section 7).

Elk

A sustainable elk population is maintained through meeting habitat management goals within the Elk Management Area, and by incorporating adaptive climate change strategies to compensate for any threats to cover or food.

Objective 1. Continue to provide habitat on state forest land for 500 to 900 elk in accordance with partner agreements and elk management plan guidelines this planning period.

- Action 1. Implement annual Woodstock model acreage targets within the Elk Management Area SAU (Section 5).

- Action 2. Implement and monitor habitat goals in the Elk Management Plan.
- Action 3. Refer to the elk habitat guidance document for a summary of habitat specifications from the Elk Management Plan.
- Action 4. Review and revise current timber sale specification options, and create new ones as needed.

Golden-winged warbler

Aspen management is conducted in a landscape context to ensure that habitat mosaics occur that meet life-stage habitat requirements for golden-winged warbler, and within-patch aspen management meets more nuanced habitat needs than traditional aspen management addresses.

Objective 1. Focus management within priority landscapes on maintaining a mosaic of lowland and grassland-shrub communities, especially alder thicket, shrub-carr and young aspen stands.

- Action 1. Implement the habitat specifications in the golden-winged warbler habitat guidance document.
- Action 2. Develop timber sale specifications to facilitate habitat management.
- Action 3. Create a GIS layer of the priority areas for use in Portal.
- Action 4. Work with FRD, American Bird Conservancy and other partners to assess the use of Dynamic Forest Restoration Blocks (Fiss et al. 2025) and identify potential sites on the state forest.
- Action 4. Initiate habitat implementation and effectiveness monitoring (Section 7).

Kirtland's warbler

A stable population of Kirtland's warbler above the recovery goal is maintained by achieving annual habitat objectives developed with partners across the northern Lower and Upper peninsulas to buffer any localized climate change impacts.

Objective 1. In the northern Lower Peninsula, continue to provide habitat on state forest land in large, contiguous blocks to annually support a minimum of 700 breeding pairs in accordance with partner agreements and breeding range conservation plan guidelines.

- Action 1. Annually implement SFMP model acreage targets in the Kirtland's warbler SAU (see Section 5).
- Action 2. Follow habitat guidance protocols set forth in the DNR Kirtland's warbler operational plan and Memo of Understanding with FRD, including prioritizing natural regeneration and managing minimum stand sizes of 500 acres.
- Action 3. Implement the Kirtland's warbler habitat guidance document for a detailed summary of the DNR Kirtland's operational plan, including the use of prescribed fire when and where appropriate and feasible. .
- Action 4. Review and revise current timber sale specifications to reflect accurate seasonal restriction dates and update silvicultural methods; create new specifications as needed for novel silvicultural methods and applications.

- Action 5. Evaluate Kirtland's warbler occupancy and management outside of currently established KW management areas and work with partners to determine management opportunities.

Objective 2. This planning period, manage for 50 breeding pairs in the Upper Peninsula in accordance with partner efforts to expand the current breeding range; that will buffer for regional climate change impacts.

- Action 1. Develop a 10-year habitat treatment plan in the U.P. to ensure an even flow of habitat over time that sustains the requisite number of birds.
- Action 2. Identify priority Kirtland's warbler habitat areas on outwash plains in the U.P. and designate them as High Conservation Value Areas to facilitate long-term habitat planning and awareness of priority areas. Action 3. Manage U.P. habitat in 200-acre blocks and adjacency in successive years to achieve landscape-level thresholds for bird abundance and productivity.
- Action 4. Look for opportunities to coordinate management across ownerships to have a larger landscape impact that will attract more birds and hold them longer.
- Action 5. Refer to the Kirtland's warbler habitat guidance document for more detailed information on habitat management in the U.P.

Moose

A self-sustaining moose population that continues to play an important ecological role as large herbivores, helping to shape forest structure and plant communities, and is managed through adaptive climate strategies that promote migration corridors and address heat stress vulnerabilities.

Objective 1. Determine moose habitat selection within this planning period.

- Action 1. Work with partners and Tribes on research to determine habitat types being used in the WUP and EUP.
- Action 2. Incorporate that information into forest planning and modeling efforts.
- Action 3. Implement habitat specifications in the moose habitat guidance document.

Red crossbill (conifer forest)

Savanna-like stands of mature conifer forests across the Upper Peninsula are maintained near black spruce and tamarack bogs to provide red crossbill habitat and a buffer to climate change impacts that may result in a range shift to the north.

Objective 1. Manage mature mixed pine, red pine, white pine, upland conifer and upland spruce fir forest to provide habitat beginning this planning period.

- Action 1. Identify geographic areas and stands within management areas to manage for mature conditions with open-moderate understory; focus especially on pine ridges within peatlands and natural pine stands.
- Action 2. Implement the habitat specifications in the red crossbill habitat guidance document.
- Action 3. Develop timber sale specifications to facilitate habitat management.
- Action 4. Initiate habitat implementation and effectiveness monitoring (Section 7).

Ruffed grouse

A huntable ruffed grouse population is sustained on the state forest through balancing aspen age classes within GEMS and management areas, including age-class tails beyond 50 years to provide mature aspen drumming sites and foraging habitat, and with an emphasis on mesic sites to buffer climate change impacts.

Objective 1. This planning period, continue to provide an even flow of young aspen across the state forest through balancing age classes, and manage GEMS with consideration of climate change adaptation strategies.

- Action 1. Implement annual Woodstock model acreage targets within management areas across the state forest (see Section 4).
- Action 2. Implement annual Woodstock model acreage targets within the GEMS special analysis units (see Section 5).
- Action 3. Implement the habitat specifications in the ruffed grouse habitat guidance document.
- Action 4. Review and revise current timber sale specification options, and create new ones as needed, with an emphasis on achieving the desired stand structure.
- Action 5. Within GEMS and management areas, assess climate change vulnerabilities (drought stress) related to site index, and implement Kotar to prioritize aspen management on mesic sites (see Section 4).

Objective 2. This planning period, implement aspen age-class tails in relevant management areas to provide mature aspen acreage for the benefit of grouse and other wildlife.

- Action 1. Implement annual Woodstock model acreage targets across the state forest in older (greater than 50 years) age classes, leaving some aspen stands to go beyond typical rotation age where possible and agreed upon (see Section 4).

Sharp-tailed grouse

Large, herbaceous opening complexes, including pine barrens, in the Upper Peninsula sustain the sharp-tailed grouse population and provide a short-term buffer to climate change impacts that may result in a range shift to the north.

Objective 1. Maintain large opening complexes composed of herbaceous openings, pine barrens, sedge meadows and other herbaceous wetland types during this planning period.

- Action 1. Implement the habitat specifications in the sharp-tailed grouse habitat guidance document, including for maintaining leks.
- Action 2. Initiate habitat implementation and effectiveness monitoring (Section 7).

Objective 2. Identify whether additional openings are needed to maintain or increase dispersal corridors across the landscape.

- Action 1. Conduct connectivity analysis.
- Action 2. Work with partners to identify additional opportunities across ownerships in a broader landscape, when possible.

Snowshoe hare

Snowshoe hare populations persist locally where brush piles and other sources of cover are common in-stand components to buffer reduced snowpack and other climate change impacts.

Objective 1. This planning period, prioritize increasing the amount of cover in snowshoe hare habitat.

- Action 1. Identify habitat priority areas for snowshoe hare with species specialists and local field staff.
- Action 2. Implement the habitat specifications in the snowshoe hare habitat guidance document.
- Action 3. Develop downed-wood timber sale specifications for snowshoe hare.
- Action 4. Apply snowshoe hare downed-timber sale specifications universally in snowshoe hare habitat.
- Action 5. Evaluate the need for additional snowshoe hare timber sale specifications that promote cover via understory protection or regeneration and apply universally where relevant.
- Action 6. Initiate habitat implementation and effectiveness monitoring (Section 7).

Spruce grouse (conifer forest)

Mature conifer forests, especially along wetland edges and river corridors and where boreal forest is likely to persist as the climate warms, are managed to provide spruce grouse cover in winter; young stands of jack pine and spruce near mature conifer forest are managed for spruce grouse nesting/brood-rearing habitat.

Objective 1. Identify and manage mature stands of mixed conifer and spruce/fir at lowland and riparian margins and near young jack pine/spruce stands to benefit spruce grouse this planning period.

- Action 1. Implement the habitat specifications in the spruce grouse habitat guidance document.
- Action 2. Develop timber sale specifications to facilitate habitat management.
- Action 3. Initiate habitat implementation and effectiveness monitoring (Section 7).

Objective 2. Prevent isolation of spruce grouse populations.

- Action 1. Identify high-density, mixed-conifer travel corridors and consider long-term management under a Wildlife Habitat Special Conservation Area designation with FRD approval.

White-tailed deer (deer wintering complexes)

Sustainable levels of functional food and cover are maintained in deer wintering complexes that will sustain white-tailed deer populations, even as increasing occurrences of disease and severe winters may have short-term localized impacts in a warmer and changing climate.

Objective 1. Develop long-term, landscape-scale treatment plans for deer wintering complexes with significant state-owned lands in obligate winter range within this planning period.

- Action 1. Plan long-range balanced timber harvest treatments working towards the sustainable harvest of food stands.

- Action 2. Incorporate existing deer-wintering range guidelines, working towards the long-term goal of providing a mix of shelter and food resources at approximately a 50:50 ratio.
- Action 3. Implement individual deer wintering complex plans through the compartment review process.
- Action 4. Initiate habitat implementation and effectiveness monitoring.

Objective 2. Manage conditional-range deer wintering complexes s to benefit deer populations.

- Action 1. Implement habitat management in conditional range using established guidelines.
- Action 2. Initiate habitat implementation and effectiveness monitoring (Section 7).

Wild turkey

Mast-bearing species and openings are maintained throughout the northern Lower and Upper peninsulas for wild turkey food sources and lekking and brood-rearing spaces, and adaptive strategies for climate change are employed as needed to address risks to mast species.

Objective 1. Regenerate oak stands and maintain mast-bearing tree species and shrubs within stands during the planning period.

- Action 1. Implement the habitat specifications in the wild turkey habitat guidance document.
- Action 2. Develop timber sale specifications to facilitate habitat management.
- Action 3. Initiate habitat implementation and effectiveness monitoring (Section 7).

Objective 2. Maintain herbaceous openings for brood cover.

- Action 1. Identify and maintain herbaceous openings through the compartment review process.

Wood thrush

Large, contiguous patches of mature, deciduous cover types with open or moderately dense understories are established for wood thrush on the landscape, especially in the Upper Peninsula, and provide a buffer to climate change impacts that likely result in a northward range shift.

Objective 1. Manage large, contiguous forest patches of a minimum of 500 acres beginning this planning period.

- Action 1. Identify priority large, contiguous forest patches of northern hardwoods, northern red oak, mixed upland deciduous and lowland deciduous cover types of a minimum of 500 acres and create Forest Core Interior High Conservation Value Areas.
- Action 2. Implement the habitat specifications in the wood thrush habitat guidance document.
- Action 3. Develop timber sale specifications to facilitate habitat management.
- Action 4. Initiate habitat implementation and effectiveness monitoring (Section 7).

Wood turtle

Desired future condition: A sustainable wood turtle population persists in forested riparian habitat through the maintenance of cold-water rivers with ample nesting habitat and through implementation of adaptive climate strategies to address adult mortality and juvenile recruitment.

Objective 1. Promote wood turtle habitat through the careful management of forests surrounding cold water rivers, ensuring that riparian habitats contain sites for foraging, basking, nesting and cover from predators.

- Action 1. Implement the habitat specifications in the wood turtle habitat guidance document.

Objective 2. Support population stability and recruitment by reducing adult mortality, conserving, and enhancing Wood Turtle nesting and early life stage habitats.

- Action 1. Implement the 2024 Michigan DNR Wood Turtle Protection Guidelines.
- Action 2. Work with Tribes and partner organizations to identify existing and potential nesting sites, including sandy riverbanks, sand and gravel edges near bridge crossings, seasonal roadsides and sandy forest openings near water.
- Action 3. Work with Tribes and partner organizations to implement monitoring surveys and nesting success to evaluate forest management planning and decision making.

Climate change and species vulnerability

Vulnerability to climate change is the likelihood that climate-induced changes will have an adverse impact on a given species, habitat or ecosystem. Vulnerability is a function of the sensitivity of a species to climate changes and also exposure to those changes. A species' capacity to adapt to climate changes also contributes to its vulnerability.

A Climate Change Vulnerability Index score is a measure of the likelihood that climate change will cause a decrease in range or abundance of a species by 2050 and focuses on changes in range or abundance.

- Extremely vulnerable (EV): Abundance and/or range extent within geographical area assessed as extremely likely to substantially decrease or disappear by 2050.
- Highly vulnerable (HV): Abundance and/or range extent within geographical area Assessed as likely to decrease significantly by 2050.
- Moderately vulnerable (MV): Abundance and/or range extent within geographical area assessed as likely to decrease by 2050.
- Not vulnerable/presumed stable (PS): Available evidence does not suggest that abundance and/or range extent within the geographical area assessed will increase or decrease substantially by 2050. Actual range boundaries may change.
- Not vulnerable/increase likely (IL): Available evidence suggests that abundance and/or range extent within geographical area assessed is likely to increase by 2050.

Population increases or declines due to geographic range shifts may not be intuitive. For example, ruffed grouse is projected to do well and is less vulnerable, but because it is at the southern edge of its range in Michigan and its range is likely to shift north with warming, it is projected to decline within the state. Other featured species that fall into this scenario include black-backed woodpecker and Blackburnian warbler. The other side of this scenario is that species at the northern edge of their range may expand in Michigan. Featured species in this category include cerulean warbler, golden-winged warbler and wild turkey.

All species' climate vulnerability assessment information is pulled directly from the Michigan Department of Natural Resources Wildlife Division Report 3564 April 2013, "Changing Climate, Changing

Wildlife," National Audubon Society Climate Change assessment tool and personal conversations with the DNR adaption specialist. The confidence measure refers to how much uncertainty there was in how species were coded for different factors within the assessment tool.

Featured species climate vulnerability

Featured species	Climate Change Vulnerability Index	Confidence	Predicted impacts*
American marten	Moderately vulnerable	Low	Decreasing snowpack is the biggest impact to the ability to forage for subnivean (under snow) prey. Snowshoe hares make up a large percentage of their diet, so impacts to their population affect marten.
American woodcock	Increase likely	Low	Range may be lost in Lower Peninsula, most of range maintained in Upper Peninsula.
Black bear	Presumed stable	Very high	No predicted impacts
Blackburnian warbler	Moderately vulnerable	Moderate	Projected range shift northward, perhaps out of the state. Impacts to mesic conifers will fade from the landscape slowly; those on sandy soils will do better.
Black-backed woodpecker	Increase likely	Very high	Increase in population likely. Projected range shift northward, perhaps out of the state. Increases in fire in pine types will be beneficial.
Black-throated blue warbler	Increase likely	Very high	Projected range shift northward, perhaps out of the state.
Cerulean warbler	Moderately vulnerable	Very high	Species may expand range northward within state. Floodplain forest becomes more important habitat. Heavy rainfall and spring heatwaves endanger young in nests.
Elk	Presumed stable	Very high	No predicted impacts
Golden-winged warbler	Increase likely	Low	Species may expand range within state. Projected range shift northward.

Featured species	Climate Change Vulnerability Index	Confidence	Predicted impacts*
Kirtland's warbler	Presumed stable	Very high	Projected range shift northward will open up areas in the U.P. to breeding habitat. Eastern U.P. and western U.P. bordering Wisconsin will be buffered. Climate change impacts in wintering grounds may decrease fecundity.
Moose	Highly vulnerable	Very high	Increasing parasite exposure with shifts in winter severity and increasing vector exposure (e.g., white-tailed deer) may reduce population capacity to persist in place at the limit of their thermal tolerance.
Red crossbill	Presumed stable	Very high	Projected range shift northward, perhaps out of the state. Heavy rainfall and spring heatwaves endanger young in nests.
Ruffed grouse	Presumed stable	Very high	Projected range shift northward, perhaps out of the state. Aspen habitat will become more prone to disease/drought and be less robust.
Sharp-tailed grouse	Presumed stable	Moderate	Projected range shift northward, perhaps out of the state.
Snowshoe hare	Highly vulnerable	Very high	Projected range shift northward, perhaps out of the state. Snowpack is the largest issue; hares turning white in an environment without snow increases vulnerability. Managing escape cover can delay impacts by decades.
Spruce grouse	Moderately vulnerable	Very high	Projected range shift northward, perhaps out of the state.

Featured species	Climate Change Vulnerability Index	Confidence	Predicted impacts*
White-tailed deer	Presumed stable	Very high	Increase likely overall in the U.P., but with some bad snow years, which can have big impacts on local populations. Epizootic hemorrhagic disease will be more prevalent.
Wild turkey	Increase likely	Moderate	Increases likely in the U.P. Decrease in snowpack increases winter survival. Vulnerability to spring rains may change vulnerability rating.
Wood thrush	Increase likely	Low	Projected range shift north from Lower to Upper Peninsula. Heavy rainfall and spring heatwaves endanger young in nests.
Wood turtle	Moderately vulnerable	Moderate	Projected range shift northward. Impacts due to increased flood mortality, habitat loss and degradation, increased conflicts with predators, and sensitivity to rapid change.

**Predicted impacts based on a 3-degree Celsius warming model.*

Adaptation approaches

There are many factors that contribute to a species' climate vulnerability score. Of these, the factors that most often increase vulnerability are related to hydrological niche, natural barriers and climate mitigation. The factors most often scored to decrease vulnerability are related to dispersal ability and habitat rarity. These factors vary across taxonomic groups. For example, birds can cross natural barriers such as the Great Lakes, but many are vulnerable to land use related to climate change mitigation policies, such as an increased dependence on wind towers for energy. The "Changing Climate, Changing Wildlife" report details these factors and provides landscape-scale adaptation strategies to mitigate impacts.

Similarly, adaptation strategies can be applied at smaller scales, including ecological subsections, management areas and at the stand level. An example at the larger end of this scale includes corridors to facilitate movement of species that are shifting their range. The presence of both small and large corridors on the landscape may help species migrate without additional assistance (Heller and Zavaleta 2009). Corridors oriented in any direction may be useful to facilitate genetic mixing, but corridors arranged along climatic or elevational gradients may be more useful if the goal is to allow for species movements along the gradient. Reforestation or restoration of riparian areas may help retain species on the landscape longer while providing a forested corridor.

An adaptation strategy example at the management area scale would be to identify habitat areas that are likely to persist due to their geographical location. For example, boreal forest natural communities and associated wildlife species may be more likely to persist in the eastern Upper Peninsula due to the mitigating effects the three surrounding Great Lakes have on the climate of this part of the peninsula.

Adaptation strategies at the stand level may help a particular wildlife species to persist longer, if applied widely across the landscape. For example, snowshoe hares change their coat color from brown to white as day length decreases. As snowpack decreases, this makes them more vulnerable to predation (as a white hare on a brown landscape). Providing escape cover in the form of brush piles or dense understory vegetation across the landscape may delay impacts for decades. Stand-level adaptation strategies will be included in the featured species habitat guidance documents.

Monitoring

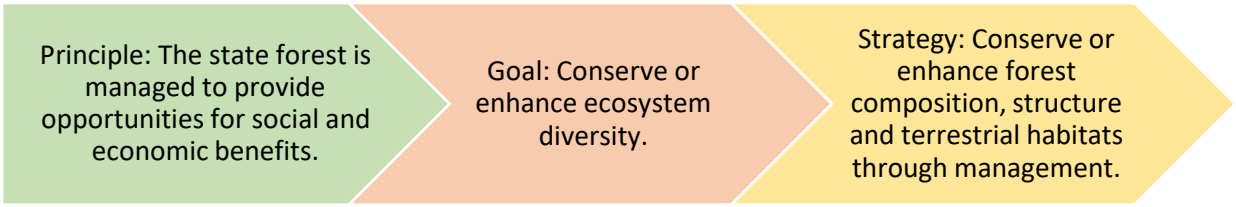
The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Acres of habitat as described in the model by featured species, at all geographic scales.
- Acres of habitat with stand level attributes in MiFI by featured species.
- Coarse population trends for applicable featured species.
- Acres by landscape habitat condition as described in the model, at all geographic scales.

Ideally, habitat monitoring would include a measure of a species' population response to management efforts as part of effectiveness monitoring. Currently, the DNR is only able to do this with two species on the state forest: elk and Kirtland's warbler. The elk population is surveyed every two years by staff via fixed-wing aircraft, and the Kirtland's warbler population is alternatively counted and surveyed by staff in different years. For these species with defined geographic areas within the state forest, population monitoring is targeted to their respective species management areas and thus is used to assess habitat management effectiveness. Despite staff capacity limitations, there is a desire to better evaluate habitat effectiveness monitoring for other featured species, both in terms of achieving the desired stand condition through forest operations and the species' population response. To this end, a new monitoring framework is outlined in Section 7.

Other population monitoring efforts can still be used to inform management decisions, even if monitoring efforts are at the wrong scale to assess habitat management efforts. Staff annually drive routes to conduct listening surveys for woodcock and ruffed grouse as part of range wide, interagency monitoring efforts. Indirect population monitoring by DNR staff includes collecting bear teeth at harvest registration to inform a population model for the species and assessing hunter and trapper harvest surveys for species such as marten and wild turkey. Likewise, other population monitoring efforts outside of the DNR, such as the Breeding Bird Atlas, the Michigan Herp Atlas and Michigan Natural Features Inventory surveys, are available statewide. Tracking population trends from these broad monitoring efforts can inform prioritization of species management efforts, especially when there are concerning declines that can be influenced through state forest habitat management.

Management priority: Big trees landscape habitat condition



Why big trees matter

Big trees -- those individuals of a tree species in a given ecosystem or cover type that are larger in diameter and height than average -- provide an array of benefits in forest stands and across the landscape. These benefits are directly related to consistent physical characteristics of big trees such as buttressing, cavities, large, well-formed crowns, large lateral branches and deeply fissured bark. These features create a diverse microhabitat on the tree itself that wildlife, insects, fungi and plants use.

Tree size can be influenced by site characteristics and climatic factors, but it is strongly correlated with age. Big trees are a habitat requirement for some mature-forest wildlife species, including cerulean warbler, black-throated blue warbler and American marten (all featured species). For these wildlife species, big trees often mean those greater than 12 inches in diameter at breast height (DBH) at a minimum density across a forested stand. These trees are preferentially used for nesting, resting, foraging and defending territories. Due to their important role in wildlife habitat, big trees were chosen as a landscape habitat condition because, while tree volume is managed for commercial purposes in the state forest, tree size and density thresholds required by wildlife are not typically measured or managed for.

Legacy trees under Forest Certification are defined as at least 150 years old or with a DBH of 26 or more inches and exhibiting certain characteristics (similar to above) listed in the DNR Forest Certification Work Instructions. Under Forest Certification, these trees, once identified in a stand, should be protected from harvest and left for structural value, though they are hard to track in MiFI. Big trees also play a role in nutrient cycling and hydrology and can affect the spatial distribution of individuals of the same species and other plants. Additionally, larger trees have greater biomass and carbon storage capacity associated with their size. For these reasons, big trees also play an important role in forest sustainability.

Featured Species Associated with the Big Trees Landscape Habitat Condition

American marten

Blackburnian warbler

Black-throated blue warbler

Cerulean warbler

Moose

Red crossbill

Current condition and trend

State forest stand inventory includes recording the mean diameter at breast height (DBH) and assigning a size class for each canopy species. Several featured species require trees a minimum of 10 or 12 inches or greater DBH, which would include the log (10-18 inches DBH) and xlog (greater than 18 inches DBH) size classes. A review of current MiFI stand data shows there are about 1.5 million acres of state forest land with at least one canopy tree species (of varying abundance) with an average of 12 inches DBH or greater (Table 1). This is just under half of the total forested acres. A closer look at these results shows that this includes cover types such as aspen, jack pine and planted pines, which together comprise 404,357 acres of the 1.5 million and are not considered habitat for the mature forest featured species. Of the million or so acres left, it is unclear how this data translates into average stand DBH or the density of big trees in the stand. A tree species only has to be 1 percent of the canopy to be recorded in the inventory; therefore, a canopy tree species average of 12 inches DBH or greater can still mean relatively few big trees in a stand. Still, it provides one way to coarsely assess tree size across the state forest.

Table 1. Area (acres) of cover type stands with at least one canopy species with an average of 12-inch or greater DBH across the state forest (Source: Michigan DNR forest inventory data 2021).

Cover Type	Acres
Northern hardwood	363,276
Aspen	270,257
Mixed upland deciduous	97,043
Cedar	92,814
Lowland conifer	90,439
Planted red pine	84,719
Upland mixed forest	69,378
Lowland deciduous	63,458
Natural mixed pine	56,200
Northern red oak	44,141
Natural red pine	42,427
Natural jack pine	38,993
Upland conifer	37,139
Natural white pine	35,771
Black/red hybrid oak	32,762
Lowland mixed forest	31,581
Oak mix	25,131
Lowland spruce/fir	23,253
Planted jack pine	22,007
Lowland aspen/balsam poplar	17,914
Hemlock	12,336
Upland spruce/fir	5,983
Planted mixed pine	5,321
Planted white pine	4,139
Tamarack	3,967
Total	**1,570,448**

Within a cover type, Michigan Forest Inventory data indicates log-size tree species in the canopy are on the low end of the log size class, ranging from an average of 12.1 to 13.9 inches DBH (Table 2). There is greater variation when tree species alone is assessed, ranging from an average of 10 to 17.3 inches DBH (Table 3), but very few are in the xlog size class, and even then, they don't go much beyond the minimum threshold for that size class. Because stands can, at times, represent a relatively equal distribution between several size classes, compound classes are also recorded. Data used in tables 2 and 3 include log, log-pole and log-xlog size classes, and this is why some of the average diameters provided are outside the DBH range of the log size class. Given that a number of these species can live for several hundred years, they are biologically young and have much more growing to do. White and red pine, for example, can grow up to 4 feet in diameter.

Table 2. Average diameter of log-size tree species within a cover type across the state forest (source: Michigan DNR forest inventory data 2021).

Cover Type	Average Diameter of Log-Size Species
Hemlock	13.9
Natural white pine	13.5
Upland conifer	13.4
Natural red pine	13.4
Natural mixed pine	13.2
Planted Mixed Pine	13.1
Aspen	12.9
Upland spruce/fir	12.9
Northern red oak	12.9
Upland mixed forest	12.9
Mixed upland deciduous	12.8
Lowland conifer	12.8
Lowland spruce/fir	12.7
Lowland deciduous	12.7
Oak mix	12.6
Northern hardwood	12.6
Planted jack pine	12.5
Lowland mixed forest	12.5
Planted red pine	12.5
Black/red hybrid oak	12.5
Planted white pine	12.4
Natural jack pine	12.3
Cedar	12.3
Lowland aspen/balsam poplar	12.3
Tamarack	12.1

Table 3. Average diameter of log-size trees by species in the state forest (Source: Michigan DNR forest inventory data 2021).

Species	Average Log-Size Tree Diameter
Sycamore	20.0
Cottonwood	19.8
Black walnut	18.2
Black willow	17.3
Pignut hickory	15.3
Swamp cottonwood	15.0
Honey locust	15.0
Willow species	14.8
White pine	14.5
Silver maple	14.5
Black maple	14.3
Red mulberry	14.0
Hackberry	14.0
Red oak	13.7
Red pine	13.4
Hemlock	13.4
Bitternut hickory	13.2
Swamp white oak	13.1
Butternut	13.0
Apple species	13.0
Black/red hybrid oak	13.0
White oak	12.8
Bur oak	12.8
Beech	12.8
Northern pin oak	12.7
Slippery elm	12.5
Yellow birch	12.4
White ash	12.4
Pin oak (southern)	12.3
Basswood	12.3
Bigtooth aspen	12.1
Green ash	12.0
Boxelder	12.0
Larch (non-native)	12.0
Quaking aspen	12.0
White spruce	12.0
Sugar maple	11.8
Balsam poplar	11.7
Black locust	11.7
Scotch pine	11.6
Black cherry	11.6
American elm	11.6

Species	Average Log-Size Tree Diameter
Red maple	11.5
Austrian pine	11.4
Northern white cedar	11.3
Black ash	11.3
Norway spruce	11.1
Eastern red cedar	11.0
Pin cherry	11.0
Tamarack	10.9
Paper birch	10.9
Black spruce	10.9
Ironwood	10.9
Jack pine	10.7
Rock elm	10.7
Balsam fir	10.4
Blue spruce	10.0
Black gum	10.0
Sassafras	10.0
Weeping willow	10.0
Choke cherry	9.0

Desired future condition, objectives and management actions

Across the landscape, big trees of at least 12 inches DBH or greater are integral stand components, especially where extended rotations and long-term retention occur. They provide important wildlife habitat and climate change resilience through water and soil quality and age-class diversity.

Objective 1. This planning period, manage mature forest stands with big trees as within-stand natural features.

- Action 1. Review Legacy Tree guidance for addition of stronger emphasis in management direction and tracking.
- Action 2. Prioritize identification, retention and tracking of Legacy trees as part of routine stand inventory.
- Action 3. Develop a Legacy Tree retention timber sale specification.
- Action 4. Retain 5 to 10 trees per 2.5 acres with highest potential to maximize size potential and with a high probability of survival; add this specification to retention guidelines when next updated.
- Action 5. Promote variable density of big trees within stands for wildlife values.
- Action 6. Add site condition indicating “Conservation values are incompatible with commercial harvest at this time.”

Objective 2. This planning period, identify some proportion of the landscape where average stand diameters can grow unimpeded.

- Action 1. Identify areas, such as Forest Core Interior Designated Habitat Areas within the Conservation Area Network, with existing or potential to grow big trees that have minimized risk of fire, drought, windstorms or other threats to their longevity.
- Action 2. Use the Kotar Ecological Classification System to promote appropriate cover types and species assemblages on suitable sites to provide best condition and potential for growth.
- Action 3. Prioritize Legacy tree and other big tree retention and recruitment in applied silviculture, including extending rotation ages.

Objective 3. Increase average stand diameter of mature floodplain forests to benefit cerulean warbler and other wildlife species over the next two planning periods.

- Action 1. Manage for a stand density of at least 40-50 trees per acre of 12-inch or greater DBH in stands over 80 years old.
- Action 2. Promote thinning in immature stands to increase tree volume.
- Action 3. In cover types with even-aged management, some proportion on the landscape in large, contiguous patches should be allowed to grow well past rotation age or have an older rotation age assigned (e.g., age class tails).

Objective 4. Increase average stand diameter in other mature cover types to benefit black-throated blue warbler and other wildlife species over the next two planning periods.

- Action 1. Manage mature cover types with a minimum of 65 percent of the stand comprised of trees 10 inches or greater DBH.
- Action 2. Implement small group selection cuts to mimic natural processes of small gap formation in northern hardwood stands.
- Action 3. Promote thinning in immature stands to increase tree volume.
- Action 4. Control beech suckers, sprouts and brush with herbicides or mechanical treatment in areas affected by beech bark disease to reduce competition where possible.
- Action 5. In Black Throated Blue Warbler cover types with even-aged management, evaluate opportunities to allow large, contiguous patches to grow past rotation age (e.g., age class tails) or have an older rotation age assigned where possible.

Climate change

All climate change data and information listed here is pulled directly from the open-source Northern Institute of Applied Climate Science Climate Change Impacts tool and Adaptation Workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium, limited) and agreement (high, moderate, low) described in the Predicted impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the Adaptation approaches section. For more information, go to niacs.org.

Predicted impacts relevant to big trees

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Northern Michigan's growing season will increase by 30 to 70 days by the end of the century	Robust	High	Changes in phenology; greater growth and productivity of trees and other plants could increase tree size if balanced with available water and nutrients.
Northern Michigan soil moisture patterns will change, with drier soil conditions later in the growing season	Medium	Moderate	Despite the potential for greater productivity in a longer growing season, drier soils due to changing precipitation regimes may lead to drought stress and reduced vigor and prevent big tree growth.

Adaptation approaches

Big trees are impacted by climate, site conditions and age. As the climate changes, the ability of species and cover types to produce big trees may be impacted by a longer growing season, late growing season drought, increased fire potential and drier soils. Promotion of age-class diversity across the landscape by extending rotations for mature forest cover types will help buffer climate change impacts. Ensuring site suitability based on an ecological habitat association, like Kotar, for cover types and species assemblages will become increasingly important, as better site suitability will promote growth and vigor. Some species have growth potential for bigger trees than others, and some of these may be at risk of range shifts. Promoting management for those species on suitable sites will promote persistence for as long as possible. Then identifying southern species with large diameter potential to supplement those species may be desirable.

Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Area (acres) of stands by cover type with at least one canopy species with 12-inch plus DBH
- Average diameter of log and xlog tree species by cover type
- Average diameter of log and xlog trees by species
- Average density of log and xlog trees within stands

Management priority: Mast landscape habitat condition



Mast matters

Mast is typically split into two categories, hard mast and soft mast. Hard mast usually refers to seeds encased in hard shells such as acorns, walnuts, hickory nuts, beechnuts and hazelnuts. Hard mast is full of protein and fat and impacts the nutrition, survivability, reproduction and distribution of species including white-tailed deer, black bear, wild turkey and wood ducks. Hard mast is a favored food for fat storage in preparation for winter. Sometimes, the hard mast definition is expanded to include soft-shelled seeds like those produced by ashes, maples, elms and birches. These are valued by gamebirds like ruffed grouse and wild turkey, some songbirds and small mammals including rabbits and squirrels. Soft mast, however, refers to the fleshy fruits produced by woody plants like cherries, mulberries and serviceberries. Soft mast tends to be high in carbohydrates and vitamins, offering quick sources of energy and moisture for migrating birds and mammals raising young.

Mast-producing trees typically take decades to reliably produce fruiting bodies, and production frequency is periodic (e.g., red oaks produce larger crops every two to five years, while white oaks do so every four to 10 years). In northern Michigan, the most common hard mast-producing tree species on the state forest have been American beech and oak species. However, beech bark disease and oak wilt are are negatively impacting their distribution and production. Additionally, oak and other cover types are being altered through a process called mesophication. Historical fire regimes maintained open forests in certain landscapes and favored fire-adapted and sun-loving species like oak. With the success of fire suppression policies, these landscapes are now characterized by closed canopy forests that promote shade-tolerant species. Mesophication is a positive feedback cycle whereby conditions created by closed-canopy, shade-tolerant species alter local environmental conditions (from dry to cool and moist) that continue to favor closed-canopy, shade-tolerant species. The resulting shift in species composition has favored species like maple but has negatively impacted oak. All of these factors, plus climate change, indicate the availability of mast for wildlife across the northern Michigan landscape is changing.

Featured species associated with the mast landscape habitat condition

Black bear

Deer (deer wintering complexes)

Elk

Wild turkey

Current condition and trend

Given that mast production comes from a variety of tree species, and Michigan's state forest is managed by cover type, there are some inherent challenges in monitoring mast trends over time. This is possible with oaks, because they are the only mast producer that is classified at the cover type level (Table 1).

Table 1. Acres of oak cover types over time; year 2026 is the incremented data set based on projection of completed harvest treatments that were in MiFI in 2021 (source: DNR OI, IFMAP, Michigan DNR Forest Inventory data 2021).

Year	Oak	Mixed Upland Deciduous
1988	243,010	--
2009	244,421	9,940
2026	151,879	167,744
Total	**639,310**	**177,684**

Past land use (post-European settlement) created unique conditions that led to a flush of oak-dominated forest stands now approaching a century old. As these oak stands are harvested, they often come back typed as mixed upland deciduous; this stand type was created in 2009 to reflect this landscape change. Since then, there has been a decline in oak cover type acres along with an associated rise in mixed upland deciduous acres. Broadly, this does represent some decline in oak availability on the landscape; classification rules for the oak cover type require a stand to be at least 60% oak, while the mixed upland deciduous cover type contains less than 60% oak by definition.

Oak and other mast species are a component of other cover types. Using MiFI, the proportion of the canopy that mast species comprise can be monitored across cover types (Table 2, Figure 1) and by cover type (Table 3, Figure 2). Mast species for this analysis include: beech, bitternut hickory, black cherry, black walnut, black/red oak, bur oak, choke cherry, northern pin oak, pignut hickory, pin cherry, pin oak (southern), red oak, scarlet oak, serviceberry (juneberry), shingle oak, swamp white oak and white oak. For the cover type analysis in Table 2 and Figure 1, the three oak cover types distinguished in the MiFI classification system were lumped together as one oak cover type, resulting in 23 cover types used for analysis instead of the typical 25.

Table 2. Proportion of occurrence of mast species across 23 cover types (source: Michigan DNR Forest Inventory data 2021).

Percent Canopy Occupancy of Mast-Producing Trees	Acres Across Cover Types (23 Cover types)
Trace	29,593
2-10	751,477
11-20	283,930
21-30	132,234
31-40	82,285
41-50	55,348
51-60	45,713
61-70	38,800
71-80	33,893
81-90	32,534
91-100	39,729
Total	**1,525,534**

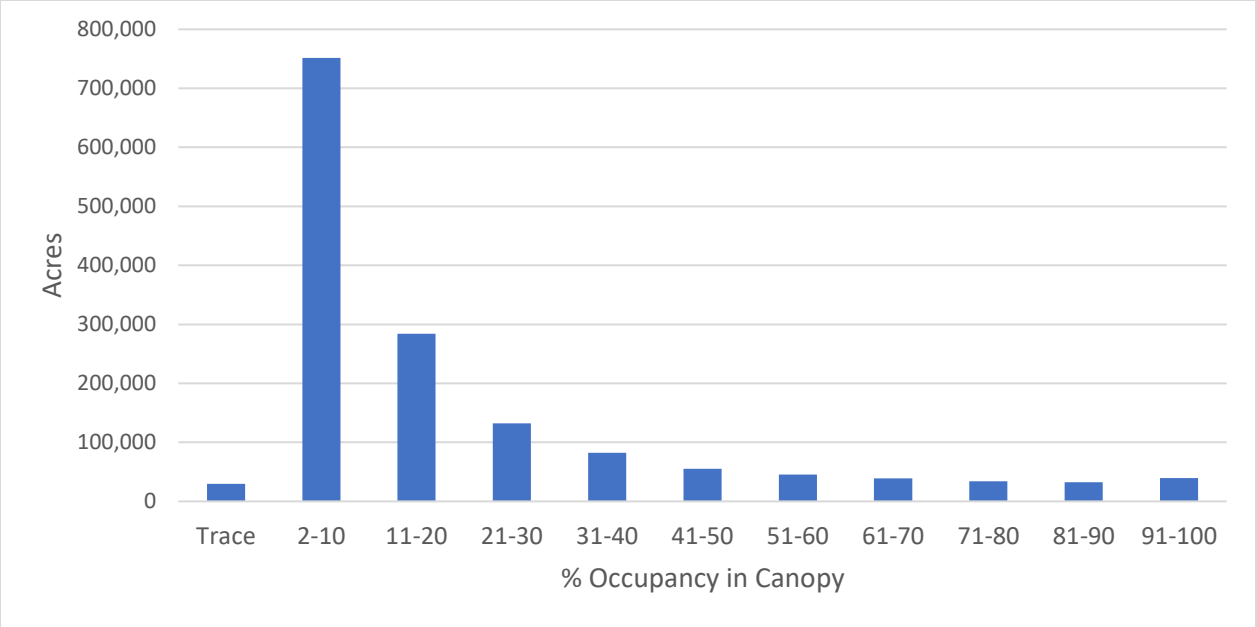


Figure 1. Area of stands with mast-producing species in the canopy, by occupancy category, across 23 cover types (source: Michigan DNR Forest Inventory data 2021).

Approximately 1 million of the 1.5 million total stand acres across cover types with mast canopy species represent 2 to 20 percent of stand occupancy. Changes in stand-mapping rules and inventory protocols have changed enough over the years that stand-level comparisons aren't possible prior to the 2010s. Therefore, trend data for mast species occurrence within a cover type is not available. However, the current condition can be used as a baseline for continued monitoring into the future.

Table 3. Cover type area (acres) of stands with mast-producing canopy species, by occupancy category for the top 10 cover types (source: Michigan DNR Forest Inventory data 2021).

Percent Canopy Occupancy of Mast-Producing Trees	Aspen	Northern Hardwood	Oak Types	Mixed Upland Deciduous	Planted Jack Pine	Planted Red Pine	Upland Mixed Forest	Natural Jack Pine	Natural Mixed Pines	Lowland Deciduous
Trace	8,031	7,173	0	748	995	4,121	676	1,436	738	807
2-10	274,347	197,613	619	17,717	50,162	52,904	21,671	33,756	19,042	14,345
11-20	106,613	75,865	495	12,930	21,292	10,701	9,806	12,956	8,845	7,663
21-30	42,477	31,317	614	16,122	6,896	3,546	7,918	4,763	7,914	4,544
31-40	18,207	12,569	1,246	22,938	3,718	1,754	8,274	1,366	6,742	2,948
41-50	8,394	4,510	1,403	25,432	403	239	12,769	149	270	1,538
51-60	2,104	2,966	15,373	19,662	26	558	3,859	76	30	948
61-70	870	1,371	29,109	5,277	73	459	802	0	38	573
71-80	260	820	28,433	2,711	0	349	804	46	64	392
81-90	90	465	27,681	3,344	328	324	223	0	18	60
91-100	57	590	35,690	2,276	0	690	331	27	9	35
Total	**461,448**	**335,258**	**140,662**	**129,157**	**83,893**	**75,643**	**67,133**	**54,576**	**43,710**	**33,853**

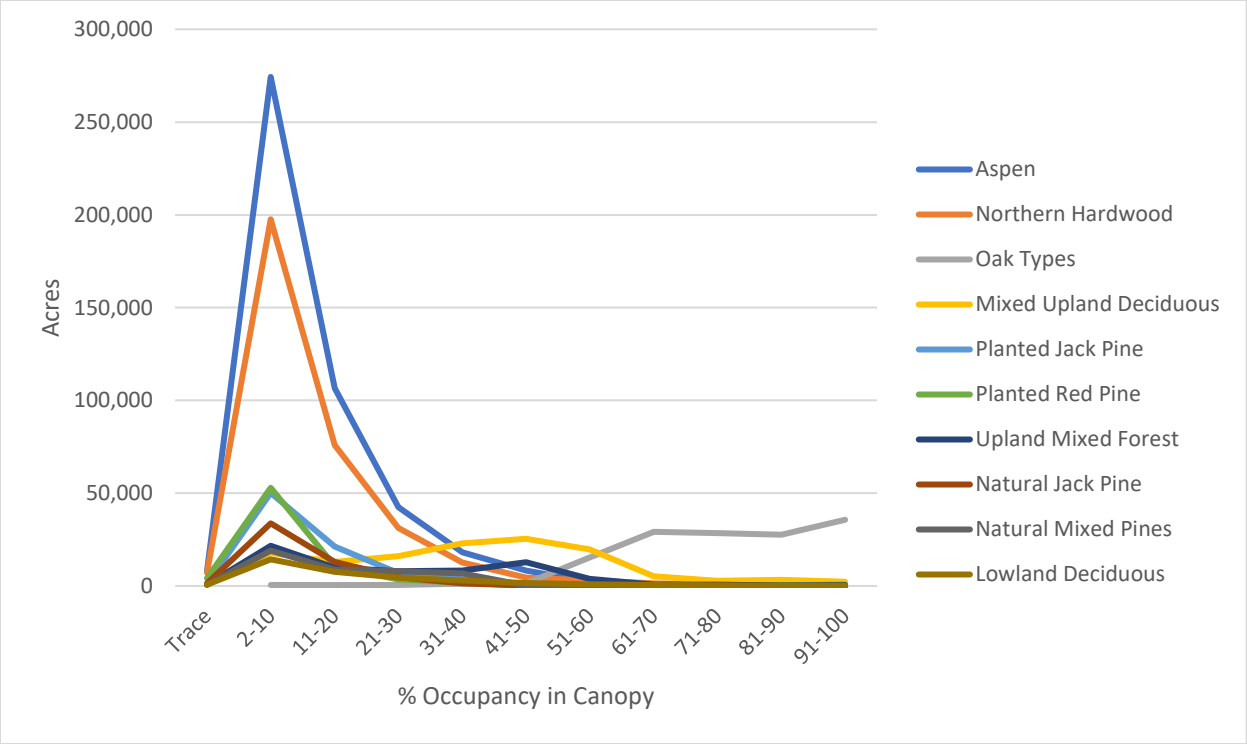


Figure 2. Area (acres) of stands with mast tree species in the canopy, by occupancy category for the top 10 cover types (source: Michigan DNR Forest Inventory data 2021).

The top 10 cover types (as defined by the number of acres with canopy mast species) are ordered in alignment with their relative cover type abundance on the state forest. Aspen, northern hardwoods and oak (combined) are the three most-prevalent cover types. Most of these 10 cover types have 2 to 10 percent occupancy of mast species in the canopy. Retention guidelines call for 3 to 10 percent retention of representative species in a stand, so that may account for some of this number. Unsurprisingly, the oak cover types are the only ones that have substantial acres greater than 60 percent canopy occupancy. Mast canopy presence in a cover type, however, does not provide information on the regeneration or recruitment success of the mast species with a stand. Given factors such as mesophication and deer browse, the future mast potential of these stands is unknown.

Regionally (Tables 4, 5 and 6), the trends are similar. The top 10 cover types are generally the same across all three regions and state forest wide, though the order changes reflecting regional differences in prevalence. Oak is not a major cover type in the Upper Peninsula. For all three regions, mast species in the canopy also occur between 2 to 10 percent for the majority of cover types, with the same exception for substantial acres greater than 60 percent occupancy in the oak types.

Table 4. Cover type area (acres) of stands with mast-producing canopy species, by occupancy category for the top 10 cover types in the northern Lower Peninsula (source: Michigan DNR Forest Inventory data 2021).

Percent canopy occupancy of mast-producing trees	Aspen	Northern hardwood	Oak types	Mixed upland deciduous	Planted jack pine	Planted red pine	Upland mixed forest	Natural jack pine	Natural mixed pines	Lowland deciduous
Trace	5,326	4,243		521	823	3,395	299	697	667	605
2-10	184,855	88,709	576	6,638	46,295	43,867	10,435	26,808	13,335	11,560
11-20	91,432	47,583	495	8,910	20,647	10,232	6,534	12,413	7,250	7,260
21-30	38,078	22,029	405	12,650	6,883	3,197	7,087	4,714	6,983	4,354
31-40	17,153	9,568	996	20,896	3,718	1,603	7,229	1,366	6,490	2,916
41-50	8,061	3,687	1,215	23,717	391	239	12,081	149	270	1,538
51-60	2,104	1,927	13,653	19,192	26	558	3,727	76	30	933
61-70	870	1,054	27,167	5,186	73	455	802		38	562
71-80	260	630	26,826	2,676		349	797	46	64	392
81-90	54	406	25,596	3,300	324	324	223		18	60
91-100	33	577	32,983	2,276		690	331	13	9	35
Total	**348,225**	**180,412**	**129,912**	**105,962**	**79,180**	**64,908**	**49,544**	**46,282**	**35,154**	**30,215**

Table 5. Cover type area (acres) of stands with mast-producing canopy species, by occupancy category for the top 10 cover types in the eastern Upper Peninsula (source: Michigan DNR Forest Inventory data 2021).

Percent Canopy Occupancy Of Mast-Producing Trees	Northern Hardwood	Aspen	Mixed Upland Deciduous	Upland Mixed Forest	Planted Red Pine	Natural Jack Pine	Natural Mixed Pines	Natural Red Pine	Upland Conifers	Oak Types
Trace	1,025	645	106	259	699	537	48	206	76	--
2-10	55,072	29,274	4,702	6,329	6,887	5,566	4,575	4,136	2,966	37
11-20	17,809	7,143	2,944	2,147	348	337	1,179	284	669	--
21-30	6,044	2,415	1,973	555	341	35	495	11	91	191
31-40	2,631	442	1,032	597	151	--	66	--	69	19
41-50	410	80	576	257	--	--	--	--	--	--
51-60	1,009	--	208	78	--	--	--	--	--	923
61-70	171	--	54	--	--	--	--	--	--	552
71-80	168	--	33	--	--	--	--	--	--	300
81-90	54	--	--	--	--	--	--	--	--	508
91-100	--	--	--	--	--	--	--	--	--	593
Total	**84,393**	**39,998**	**11,629**	**10,221**	**8,426**	**6,475**	**6,363**	**4,637**	**3,870**	**3,125**

Table 6. Cover type area (acres) of stands with mast-producing canopy species, by occupancy category for the top 10 cover types in the western Upper Peninsula (source: Michigan DNR Forest Inventory data 2021).

Percent Canopy Occupancy of Mast-Producing Trees	Aspen	Northern Hardwood	Mixed Upland Deciduous	Oak Types	Upland Mixed Forest	Upland Conifers	Planted Red Pine	Natural Mixed Pines	Planted Jack Pine	Natural Jack Pine
Trace	2,060	1,905	121		118	7	26	23	110	202
2-10	60,218	53,833	6,377	6	4,908	2,276	2,149	1,132	1,752	1,383
11-20	8,038	10,474	1,076		1,125	148	121	416	44	206
21-30	1,984	3,244	1,499	18	276	87	8	436	12	15
31-40	612	369	1,009	231	448	184		186		
41-50	254	413	1,139	187	432					
51-60		31	262	798	54					
61-70		146	37	1,389			4			
71-80		23	2	1,306	7					
81-90	36	5	45	1,576						
91-100	24	13		2,114						14
Total	**73,225**	**70,453**	**11,566**	**7,625**	**7,368**	**2,702**	**2,309**	**2,194**	**1,918**	**1,819**

Desired future condition, objectives and management actions

Hard and soft mast are available to wildlife species as canopy dominants across cover types, including southern species that are projected to be productive in a warmer climate and including fruit-bearing shrubs that make up important subcanopy.

Objective 1. Beginning this planning period, diversify oak management on the landscape to ensure its persistence over a range of sites and conditions to provide mast for wildlife.

- Action 1. Identify areas on the landscape where oak cover types are a priority to maintain or restore; apply appropriate silvicultural treatments, including prescribed fire.
- Action 2. Use thinning in immature stands to promote vigorous crowns to enhance acorn production.
- Action 2. Promote a diversity of oak species so that staggered intervals of mast production sustain acorn availability for wildlife over time.
- Action 3. On sites with intermediate quality, treat red maple competition in favor of oak regeneration and retain oak to provide continuity in mast production in the future stand.
- Action 4. On mesic sites, restore oak via planting.
- Action 5. Promote and retain large-diameter (>12 inches DBH) oaks at a minimum density of three large trees per acre or at least three islands an acre in size or greater; in some areas it may be appropriate to exceed the 3-10% retention criteria due to declining oak types and lack of mast availability.

Objective 2. Protect hard and soft mast sources within stands to ensure diversity of wildlife food availability and increase the area of stands with mast species in the canopy in the next two planning periods.

- Action 1. Retain oaks and other mast species (e.g., mature healthy beech where found, black cherry, hickory) as retention or where applicable featured species habitat is a priority, especially in the northern hardwoods, aspen, white pine, red pine and jack pine cover types.
- Action 2. Retain mast trees at least 10 inches DBH with large, vigorous crowns at a minimum density of three trees per acre or at least three islands an acre in size or greater
- Action 3. Apply and ensure implementation of the shrub protection timber sale specification on all stands, when possible.

Objective 4. Beginning this planning period, adapt to future conditions for mast management through diversifying mast sources and silvicultural application.

- Action 1. Evaluate hickory, American chestnut, black walnut, tulip-poplar and other similar species as a new source of hard and soft mast for bear and other species where appropriate.
- Action 2. Restore fire to fire-adapted ecosystems through prescribed burning.

Climate change

All climate change data and information listed here is pulled directly from the open-source Northern Institute of Applied Climate Science Climate Change Impacts tool and Adaptation Workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium, limited) and agreement (high, moderate, low) described in the Predicted impacts table. Planning strategies,

approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the Adaptation approaches section. For more information, go to niacs.org.

Predicted impacts to Mast

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Tree regeneration and recruitment will change	Medium	High	Seedlings are more vulnerable than mature trees to changes in temperature, moisture and other seedbed and early growth requirements; the regenerative capacity of mast cover types may decrease.
Climate conditions will increase fire risks in northern Michigan by the end of the century	Medium	Moderate	This may benefit oak by reducing red maple competition and restoring some fire-dependent communities containing oak.
Many invasive species, insect pests, and pathogens in northern Michigan forests will increase or become more damaging by the end of the century	Limited	High	Increase in invasive pests may lead to greater stress and mortality of oak and other mast species; more damaging in stressed forests, so there is high potential for these agents to interact with other climate-mediated stressors.

Adaptation approaches

To address conditions that have already changed from the previous century and to adapt to future changes in climate, management is encouraged to increase the availability and distribution of wildlife food sources on the state forest. Managing to diversify mast species within stands and across sites, and in a variety of age classes and soil conditions, will help ensure continuity of food resources. So, too, will encouragement of underrepresented or more southern mast-producing species. Beech bark disease has already had a substantial impact on hard mast availability for wildlife; any possible forest health mitigation steps to reduce the spread and impacts could be vital to ensuring lasting mast resources. With uncertainty around specific and local climate impacts, managing for diversity across the state forest is critical, ensuring that as some species, communities or age classes become susceptible, there is enough variation to persist.

Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Percent canopy occupancy of mast-producing species by cover type
- Percent canopy occupancy of mast-producing species across cover types
- Area of oak cover types

Management priority: Mature Forest subcanopy landscape habitat condition



Why mature forest subcanopy matters

The forest subcanopy is the layer of woody vegetation consisting of small trees and shrubs growing between the forest canopy and the forest floor. This contributes to the understory layer, which also includes nonwoody ground flora and is a critical component of forest ecosystems, typically supporting the vast majority of total ecosystem floristic diversity and providing habitat elements to wildlife species. These communities also play a central role in the dynamics and functioning of forest ecosystems by influencing long-term succession patterns and contributing to forest nutrient cycles. The understory layer in a forest contributes to both vertical and horizontal structure, which strongly influences the habitat available for nesting, feeding and roosting. The Department of Natural Resources does not systematically collect ground cover information in its inventory system, so the landscape habitat condition will focus on the subcanopy layer within mature forest conditions for featured species that require older forest conditions.

From a wildlife habitat perspective, a varying understory condition across the landscape is desirable. Species such as cerulean warbler and black-throated blue warbler prefer closed-canopy, mature forest with a dense understory, and blackburnian warbler and wood thrush prefer closed-canopy, mature forest with a more open to moderate understory.

Forest understory develops and is determined in many ways, including prevalence of forest gaps and gap size. Gaps are areas in the forest canopy where sunlight can easily reach the ground. When gaps are created, the increased sunlight stimulates seed production and, over time, the gaps fill in with trees and shrubs. In this way, a dense understory is created. For wildlife species that prefer a more open understory, gap size remains small.

Featured species associated with the mature forest understory landscape habitat condition

Blackburnian warbler

Black-throated blue warbler

Cerulean warbler

Wood thrush

Current condition and trend

Stand examiners routinely collect subcanopy information during the forest inventory process and place it in one of six categories: full, high, medium, low, trace and none. Mature forests for this wildlife landscape habitat condition are defined as stands age of 80-plus years. Open understory has subcanopy

closure categories of none, trace or low (50-100%), which is preferred by the area-sensitive featured species wood thrush and Blackburnian warbler. Northern hardwoods and lowland deciduous cover types tend to have the most habitat for these wildlife species (Table 1).

Table 1. Acres of mature forest with an open subcanopy, preferred habitat/cover type of wood thrush and Blackburnian warbler, by region (source: Michigan DNR Forest Inventory data 2021).

Cover Type	NLP	EUP	WUP	Total
Northern hardwood	9,537	8,653	13,153	**31,343**
Upland mixed forest	773	910	519	**2,202**
Mixed upland deciduous	2,458	1,384	1,278	**5,120**
Northern red oak	4,408	133	322	**4,863**
Lowland deciduous	7,684	2,937	2,736	**13,357**
Natural red pine	1,478	1,982	589	**4,049**
Natural white pine	838	1,549	171	**2,558**
Natural mixed pine	947	1,781	501	**3,229**
Upland conifer	470	2,266	1,080	**3,816**
Upland spruce/fir	126	276	570	**972**
Hemlock	434	900	1,693	**3,027**

Dense understory stands are those that fall into the full and high subcanopy categories, which have subcanopy closure of 50-100%, which is preferred by the area-sensitive featured species cerulean warbler and black-throated blue warbler (Table 2).

Trend data by cover type is limited due to changes in DNR forest inventory classification systems over recent decades. Because planted and natural pine types were combined, and mixed types were recognized only recently, it is not possible to assess specific cover-type understory trends.

Table 2. Acres of mature forest with a dense subcanopy, preferred habitat/cover type of cerulean warbler and black-throated blue warbler, by region (source: Michigan DNR Forest Inventory data 2021).

Cover Type	NLP	EUP	WUP
Northern hardwood	111,388	64,060	84,547
Mixed upland deciduous	22,517	4,524	8,610
Lowland deciduous	23,620	5,972	6,002

Desired future condition, objectives and management actions

Mature forests are managed for both open and dense understories across the landscape, enhancing structural variability and diversity to meet wildlife habitat needs and creating mature stands less vulnerable to climate change impacts.

Objective 1. Develop habitat goals for understory conditions within 3-5 years.

- Action 1. Determine across the landscape, the number of acres of each understory condition required for each featured species.

- Action 2. Incorporate this information into silvicultural guidelines and in stand retention guidelines.

Objective 2. Beginning this planning period, prescribe stands annually that promote an open understory habitat condition within mature forest understory featured species management areas.

- Action 1. In each year of entry and in each management area, select stands with good site potential within large, contiguous-acre polygons to manage for blackburnian warbler and wood thrush.
- Action 2. Manage for closed-canopy condition of stands, and use prescribed fire following thinning in the mid-age successional stage (40-80-or-so years) to maintain open understory conditions in fire-adapted cover types where possible.
- Action 3. Develop methodology to flag and track these stands in the forest inventory.

Objective 3. Beginning this planning period, prescribe stands annually that promote a dense understory habitat condition within mature forest understory, featured species management areas.

- Action 1. In each year of entry and in each management area, select stands with good site potential within large contiguous-area polygons to manage for cerulean warbler and black-throated blue warbler.
- Action 2. Retain closed-canopy structure of stands while using group selection or other appropriate silviculture to create medium/large gaps in the mature age category (80 plus – start structural development/complexity – done thinning) northern hardwoods, .
- Action 3. Develop methodology to flag and track these stands in the forest inventory.
- Action 4. Reduce risk of invasive species where possible.

Climate change

All climate change data and information listed here is pulled directly from the open-source Northern Institute of Applied Climate Science Climate Change Impacts tool and Adaptation Workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium, limited) and agreement (high, moderate, low) described in the Predicted impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the Adaptation approaches section. For more information, go to niacs.org.

Predicted impacts relevant to mature forest understory

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results fromImpacts
Low-diversity systems are at greater risk from climate change	Medium	High	Diverse systems have exhibited greater resilience to extreme environmental conditions and greater potential to recover from disturbance; the more structurally and compositionally diverse mature forests are the more resilient they are.
Deer populations will likely increase with warmer winters	Medium high	Medium	Increased number of deer may limit regeneration of hardwood species, directly impacting subcanopy layer.
Tree regeneration and recruitment will change	Medium	High	Regeneration failures will decrease subcanopy layers.

Adaptation approaches

Climate change impacts to understory vegetation includes the potential for higher uncertainty in the regenerating forest vegetation layers, increased browsing pressure from large herbivores, and greater competition from invasive species. Prioritizing management for cover type site suitability, through the use of Kotar or other site classification means, will increase regeneration potential for selected species. Landscape level planning and treatment sizes can help reduce browse pressure, and decontamination protocols and larger stand sizes can help minimize invasive species occurrence.

Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Area of mature forest (80-plus) with open understory
- Area of mature forest (80-plus) with dense understory

Management priority: Mesic conifers landscape habitat condition



Why mesic conifers matter

Mesic conifers, in the context of wildlife habitat, are upland forests and individual species of evergreens that grow on well-drained, reasonably fertile soils. “Mesic” refers to the middle area in a moisture spectrum from dry (xeric) to wet (hydric). Eastern hemlock, white pine and red pine are particularly long-lived mesic conifers, while white spruce and balsam fir are short-lived in comparison.

Mesic conifer forests provide habitat for a variety of wildlife species. Mesic conifers provide valuable winter shelter for resident songbirds, moose and white-tailed deer, shade in summer, escape cover and nesting habitat, and the seeds from cones are a valuable food source for small mammals as well as breeding and migrating birds. Some species of wildlife strongly prefer or only nest in mesic conifer stands or stands with a high conifer component to survive and successfully reproduce, including American marten, Blackburnian warbler, spruce grouse and red crossbill.

Individual mesic conifer trees within other forest cover types such as northern hardwoods are important to resident and migratory songbirds that use the foliage for thermal cover, shelter from extreme weather and predators, nesting and feeding. They provide vertical and horizontal structure within stands, and conifer crowns attract a variety of insects that birds feed on. Dense shade under species like hemlock creates a cool, moist microenvironment that is favorable to birds. White pine and red pine often achieve a position in the canopy above the rest of the trees in a stand, and these super-canopy trees are used as nesting trees by raptors and escape trees for black bear. Mesic conifers contribute to stand diversity and complexity, which is strongly correlated to higher biodiversity; the more habitat niches that are available, the more species there will be to fill them.

Featured species associated with the mesic conifer landscape habitat condition

American marten
Blackburnian warbler
Moose
Red crossbill

Current condition and trend

Trend data by cover type is limited due to changes in DNR forest inventory classification systems over recent decades. Because planted and natural pine types were recognized only recently, it is not possible to assess specific cover-type trends prior to 2009. Table 1 and Figure 1 show current inventory data. The eastern Upper Peninsula has the greatest number of mesic conifer acres of all the regions, due to the physiography of the region.

Table 1. Acres of mesic conifer cover type stands across the state forest by region and statewide (source: Michigan DNR Forest Inventory data 2021).

Cover Type	EUP	NLP	WUP	Total
Natural mixed pines	26,372	44,466	7,458	**78,296**
Natural red pine	24,227	22,688	6,258	**53,173**
Upland conifers	28,349	9,278	15,452	**53,079**
Natural white pine	19,560	22,115	6,206	**47,880**
Upland spruce/fir	6,641	3,577	6,864	**17,082**
Hemlock	4,046	1,126	8,107	**13,279**
Total	**109,196**	**103,250**	**50,343**	**262,789**

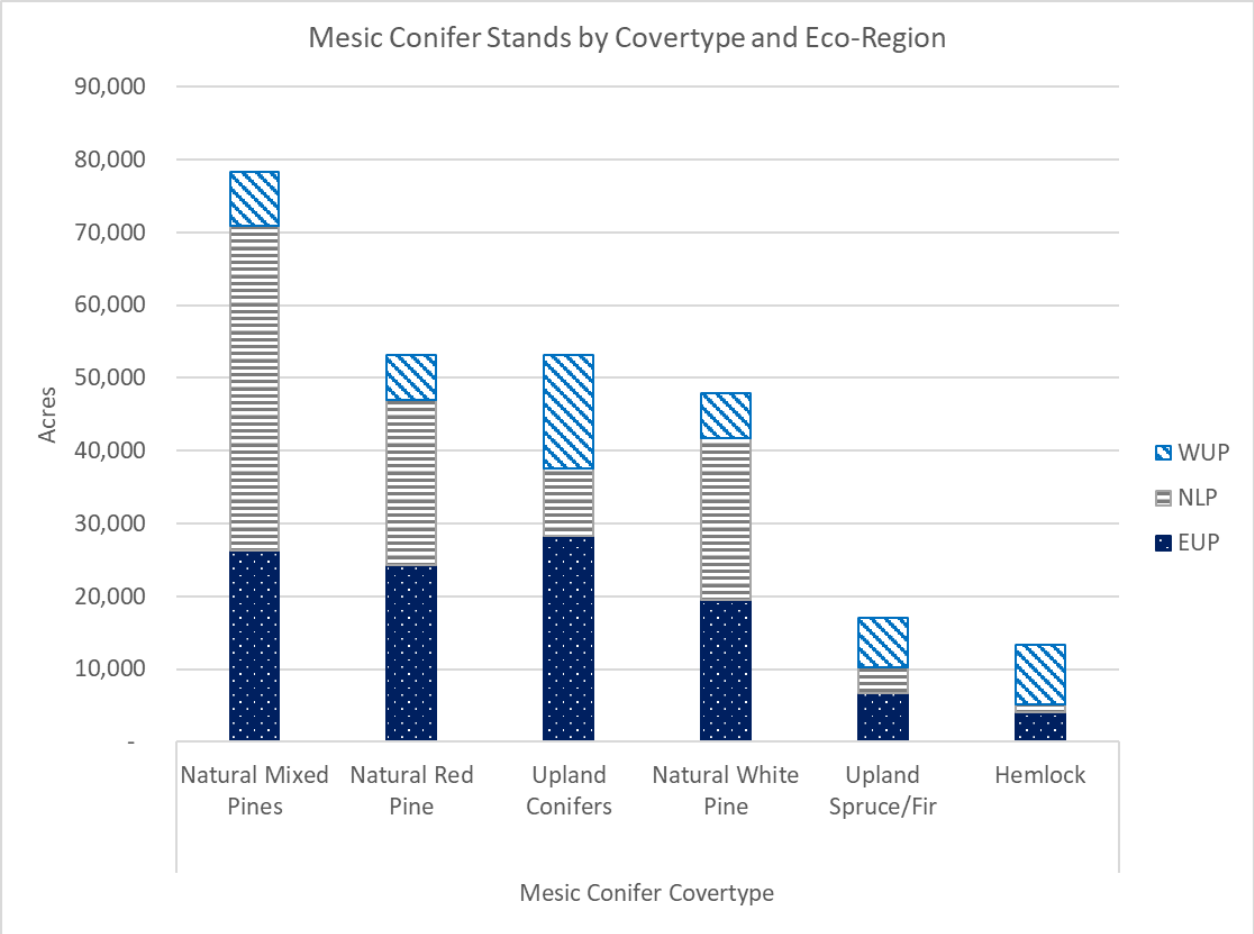


Figure 1. Mesic conifer cover type acres by region and statewide (source: Michigan DNR Forest Inventory data 2021).

Data in Table 2 describes the proportion of mesic conifer stands as compared to other stands within each ecoregion and statewide. Proportionally, mesic conifer types are a relatively small amount of the total state forest, which highlights the need to maintain or increase these habitat types.

Table 2. Percent area of mesic conifer stands on the state forest by region and statewide (source: Michigan DNR Forest Inventory data 2021).

Cover Type	EUP	NLP	WUP	Total
Natural mixed pines	10.2%	5.1%	5.7%	**6.6%**
Natural red pine	2.5%	2.2%	0.8%	**2.0%**
Upland conifers	2.3%	1.1%	0.7%	**1.3%**
Natural white pine	2.7%	0.5%	1.8%	**1.3%**
Upland spruce/fir	1.8%	1.1%	0.7%	**1.2%**
Hemlock	0.6%	0.2%	0.8%	**0.4%**

There is a trend of natural pine types being converted to planted red pine, which is primarily in traditional crop-type row plantings (Table 3). Traditional pine plantations have few niches for wildlife to occupy due to their structural simplicity. Natural pine types are more structurally complex; they have more vertical structure because they may be multi-aged, larger-diameter trees and more diverse tree species in the canopy and subcanopy, particularly as they enter mature and old forest stages. Natural stands are generally more spatially heterogeneous and have larger amounts of standing dead and downed wood compared to traditional plantation management.

Table 3. Statewide conversions of natural pine types to other forest cover types after final harvest prescription (source: Michigan DNR Forest Inventory data 2021, treatments from 2017-2021).

Cover Type When Prescribed	Planted Red Pine	Aspen	Mixed Upland Deciduous	Natural Jack Pine	Natural Mixed Pine	Natural Red Pine	Natural White Pine	Oak Mix	Planted Jack Pine	Upland Conifer	Upland Mixed Forest
Natural red pine	53%	2%	2%	3%	11%	13%	0%	0%	4%	7%	5%
Natural mixed pines	37%	5%	5%	12%	11%	0%	4%	2%	2%	10%	11%
Natural white Pine	13%	2%	14%	0%	14%	0%	40%	0%	0%	7%	9%

The data in Table 4 is the average of the number of individual mesic conifer trees within cover types; that is, this table shows on average the percent of mesic conifer tree species that make up each cover type. This does not mean that all stands have mesic conifer trees. Mesic conifer trees within mesic conifer stands more likely reflect the actual cover type and don't infer diversity within those stands. It is interesting to note that the non conifer cover types (e.g., mixed upland deciduous, northern red oak and northern hardwoods) have very low representation, on average, of mesic conifer trees. From a habitat perspective, we want to encourage the retention of mesic conifer trees within these stands to increase structural complexity and available habitat.

Table 4. Average of the sum of mesic conifer percent by species in each region statewide (Michigan DNR Forest Inventory data 2021).

Cover Type by Region	Average of the Sum of Mesic Conifer Percent
EUP	**43**
Natural red pine	92
Natural white pine	86
Hemlock	78
Upland spruce/fir	63
Natural mixed pines	62
Upland conifers	50
Mixed upland deciduous	21
Northern red oak	8
Northern hardwood	8
NLP	**30**
Natural red pine	87
Natural white pine	81
Hemlock	73
Upland spruce/fir	68
Natural mixed pines	57
Upland conifers	53
Mixed upland deciduous	13
Northern red oak	5
Northern hardwood	3
WUP	**27**
Natural red pine	92
Natural white pine	89
Hemlock	73
Natural mixed pines	73
Upland spruce/fir	61
Upland conifers	50
Mixed upland deciduous	19
Northern hardwood	6

Cover Type by Region	Average of the Sum of Mesic Conifer Percent
Northern red oak	4
Grand Total	**33**

Desired future condition, objectives and management actions

Mesic conifer species are represented across the landscape and within stands to provide wildlife habitat and forest products and increase overall diversity to decrease vulnerability to climate change impacts.

Objective 1. Over the next several decades, manage to balance age-class categories of mesic conifer-dominated stands and ensure a broad geographic range across the landscape.

- Action 1. Maintain a variety of age classes of mesic forest cover types across the landscape.
- Action 2. Harvest stands using appropriate silvicultural techniques to promote regeneration of mesic conifers.

Objective 2. Manage for mesic conifers within their natural range of variability.

- Action 1. Maintain mesic conifers across a range of soil types and landscape positions.
- Action 2. Prioritize and maintain unique sites for diversity.
- Action 3. Determine climate refugia sites in boreal forests and manage using resistance strategies to keep them on the landscape for longer.

Objective 3. Maintain natural white pine, natural red pine and natural mixed pine cover types on the landscape.

- Action 1. Use appropriate silvicultural techniques to promote regeneration of natural pine species in pine stands of natural origin, as defined in Natural Pine Silvicultural Guidelines.
- Action 2. Ensure the stand conditions are represented across relevant management areas for each of the five featured species that have natural pines included in their SFMP model habitat.
- Action 3. Designate natural origin stands as Special Conservation Areas (and/or by using site condition or long-term management objective) to track long-term management.
- Action 4. Use silviculture to emulate natural-origin stand structure in some proportion of planted red pine stands within regions.

Objective 4. Restore or retain a proportion of mesic conifer species within deciduous cover types .

- Action 1. Use within-stand retention guidelines and habitat guidelines to promote mesic conifers within stands.
- Action 2. Retain the oldest and largest trees and individual uncommon trees as biological legacies and future seed sources.
- Action 3. Restore mesic conifers (white pine, white spruce, red pine) via planting in dry mesic and mesic sites where possible.

Climate change

All climate change data and information listed here is pulled directly from the open-source Northern Institute of Applied Climate Science Climate Change Impacts tool and Adaptation Workbooks. Based on

three established climate models, there are varying levels of evidence (robust, medium, limited) and agreement (high, moderate, low) described in the Predicted impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the Adaptation approaches section. For more information, go to niacs.org.

Predicted impacts relevant to mesic conifers

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Upland spruce/fir species are near their southern range limits in Michigan	Medium-high	High	Forest type may likely be confined to lake-effect zones or cold pockets on the landscape. Increases in stand-replacing fire could provide regeneration opportunities where conditions remain suitable for the dominant species, which are prolific seeders and regenerate well after fire.
Climate conditions will increase fire risks in northern Michigan by the end of the century	Medium	Moderate	By the end of the century, most models project an increase in wildfire probability, particularly for boreal forests, temperate coniferous forests and temperate broadleaf forests.
Northern Michigan's boreal species will face increasing stress from climate change	Medium	High	Climate impact models project a decline in suitable habitat and landscape-level biomass for northern species such as balsam fir, black spruce, jack pine, northern white cedar and white spruce.
Many invasive species, insect pests and pathogens in northern Michigan forests will increase or become more damaging by the end of the century	Limited	High	Insect pests, like the native spruce budworm and the non-native balsam and hemlock woolly adelgids, may become more damaging to mesic conifers under a warmer climate, especially where forests are already stressed.

Adaptation approaches

Restoring fire regimes that attempt to mimic natural disturbance in fire-adapted systems can enhance regeneration and encourage stronger competition by fire-dependent and fire-tolerant species (Abrams

1992). These actions can simultaneously foster more complex ecosystem structure and reduce the risk of severe wildfire. Actions to manipulate the density, structure or species composition of a forest may reduce susceptibility to some pests and pathogens (Spies et al. 2010). Because herbivores preferentially browse on particular species, it may be increasingly important to protect regeneration of desired species from deer, moose and other herbivores. Management should also prioritize and maintain unique sites and sensitive or at-risk species or communities. Some sites host a higher diversity of species than adjacent sites, have many endemic species, have a sheltered topographic position or have retained species through past periods of climate change (Keppel et al. 2012). These potential refugia are formed through spatial, geophysical, and biological variation on the landscape and may be identified as unique sites that are expected to be more resistant to change, like boreal forest in the eastern Upper Peninsula.

Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Area of mesic conifer across the landscape
- Percent composition of mesic conifer species within stands

Management priority: Natural disturbance landscape habitat condition



Why natural disturbance matters

A disturbance is an event that significantly alters the pattern of variation in the structure or function of a system. Examples of natural disturbance are a fire that kills trees, windthrow, flooding, and native pests and diseases. Disturbances are normal, though infrequent, in an ecological system. In fire-prone systems, fire every few years is not a natural disturbance; however, because fire has been suppressed in these systems for so long, fire becomes an obvious disturbance because it is so rare and can impact more acres than it has historically. Epidemics of spruce budworm periodically cause extensive damage and tree mortality in spruce and fir forests across the northeastern United States and Canada. Historically, epidemics have occurred on a 30-year to 50-year cycle. Outbreaks typically last 10 to 15 years. Both of these examples are relatively common occurrences on state forest land.

Generally, when one of these natural disturbance events occur, plans are put in place to salvage timber either after the occurrence or before the occurrence begins in the case of insect outbreaks. While it is easy to see the timber dollar value of the product removal, it is much harder to see the value of retaining some of this dead and dying forest. In fact, one of the rarest natural community conditions is standing dead wood, particularly after a forest fire.

The black-backed woodpecker is a featured species that is associated with disturbance, especially forests within the first two years post-fire. Black-backed woodpeckers also colonize and breed in disturbed forests damaged by insect outbreaks. Intentionally not salvaging some portion of this habitat type would be extremely beneficial to this species of conservation concern.

Featured species associated with the natural disturbance landscape habitat condition

Black-backed woodpecker

Natural disturbance trends

Natural disturbance ecological processes such as fire played a major role in the development of forests in Northern Michigan. Severe or catastrophic crown fires had high enough heat to kill most trees and other vegetation in the areas they burned (Schilke, et. Al, 2024). These fires are estimated to have occurred with a frequency of between 100 to 320 years in pine-dominated forests in Michigan. Zhang et al. estimated a return interval of approximately 320 years for stand-replacing fires in red pine-white pine stands and 163 years for mixed pine stands in the Eastern Upper Peninsula (1999). In the Northern Lower Peninsula, Cleland et.al. estimated a fire rotation period of 107 years for the red pine-white pine community type (2004), and Whitney estimated severe crown fires occurred every 120 years in red pine-

jack pine-white pine stands (1996). Severe fires favored the initiation of pine forests in burned areas where red pine and jack pine could regenerate on exposed mineral soils in full sun and with little competition. In the Great Lakes Region, lower-intensity surface fires occurred at higher frequency in pine forests around every five to 20 years. This fire regime caused high mortality of jack pine and red pine seedlings while promoting the persistence of fire-adapted understory vegetation (Schilke, et. al, 2024).

Insect and disease outbreaks result in dying and standing dead mature trees that provide habitat for black-backed woodpecker. The two most relevant are jack pine budworm (Choristoneura pinus pinus) and spruce budworm (Choristoneura fumiferana). Jack pine budworm is a significant pest of mature jack pine. Periodic outbreaks occur every six to 12 years and last two to four years. Budworm defoliation leads to top kill of the tree and subsequent mortality. One of the most recent outbreaks occurred in the Northern Lower Peninsula in 2022 and continued into 2025, with isolated areas of the UP also affected. Spruce budworm is one of the most destructive insects in spruce and fir forests. Historically, periodic outbreaks defoliating fir and spruce occur every 30 to 50 years and last for 10 to 15 years. Older trees are killed, with balsam fir and mixed balsam fir and spruce stands being the most vulnerable. An outbreak over the past decade appears to be subsiding, though some additional defoliation may occur with much lower damage anticipated over the next decade.

Desired future condition, objectives and management actions

Climate change-related alterations in natural disturbance regimes (i.e., fire, insect pests and diseases) may change the frequency and intensity of disturbance; as salvage operations are prescribed, all or some portion of this disturbance is left as wildlife habitat.

Objective 1. Beginning this planning period, when a disturbance event occurs, identify all or some portion of the affected area that will be intentionally left unsalvaged for disturbance-dependent wildlife habitat.

- Action 1. At a landscape scale, determine amount and placement of natural disturbance habitat to remain unsalvaged.
- Action 2. At the onset of a disturbance event, reevaluate stand goals based on circumstances as other options for wildlife habitat in particular may be available.
- Action 3. Write habitat guidelines around natural disturbance events and black-backed woodpecker.

Objective 2. Promote diverse age classes within stands and across the landscape to increase resistance or resilience of stands to a wider range of disturbances.

- Action 1. Focus salvage operations on creating desired residual stand structures.
- Action 2. Emulate disturbance through variable-density treatments or irregular return intervals to encourage the development of multiple age cohorts.

Climate change

All climate change data and information listed is pulled directly from the open-source Northern Institute of Applied Climate Science Climate Change Impacts tool and Adaptation Workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium, limited) and

agreement (high, moderate, low) described in the Predicted impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the Adaptation approaches section. For more information, go to www.niacs.org.

Predicted impacts relevant to natural disturbance events

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Climate conditions will increase fire risks in northern Michigan by the end of the century	Medium	Moderate	By the end of the century, most models project an increase in wildfire probability, particularly for boreal forests, temperate coniferous forests and temperate broadleaf forests. Insect abundance in stressed and damaged trees will provide good forage for species like black-backed woodpecker.
Many invasive species, insect pests and pathogens in northern Michigan forests will increase or become more damaging by the end of the century	Limited	High	Insect pests, like the native spruce budworm and the non-native balsam and hemlock woolly adelgids, may increase, providing more forage opportunities for species like black-backed woodpecker.

Adaptation approaches

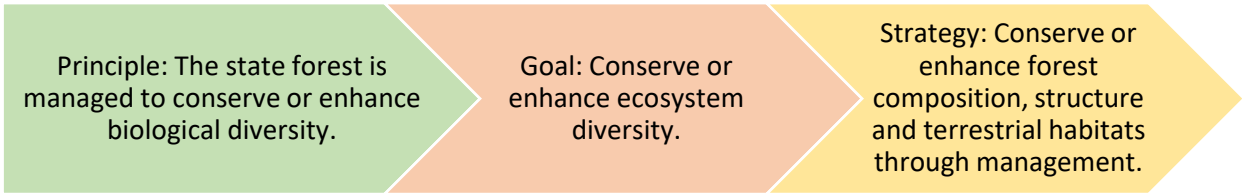
Even-aged stands are often more vulnerable to insect pests and diseases, many of which are likely to increase in range and severity with climate change. In uneven-aged systems, a smaller proportion of the population may be exposed to a particular threat at any one time, which can increase the resistance or resilience of a stand to a wider range of disturbances (O'Hara and Ramage 2013). Maintaining a mix of ages, sizes or canopy positions will help buffer vulnerability to stressors of any single age class, as well as increase structural diversity within stands or across a landscape (Noss 2001). Forests with higher levels of species diversity also are expected to be less vulnerable to declines in productivity due to climate change (Duveneck et al. 2014). Taking advantage of these disturbances will benefit disturbance-dependent wildlife.

Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Area of disturbance
- Area of disturbance not salvaged

Management priority: Nonforested openings



Why nonforested openings matter

Nonforested openings have always been part of northern Michigan's dynamic forested landscape, occurring as patches of grass, shrubs and open areas with scattered trees. Typically, this has been a result of localized wind events, flooding or fire, but it also occurs sometimes from frost pockets and either dry or wet soil conditions that inhibit vigorous tree growth. These openings increase landscape diversity, provide an opportunity for early successional plant species to flourish and serve as important habitat for wildlife species.

Some edge species, like white-tailed deer, prefer to occupy areas at the interface between forest and openings. Early-successional wildlife species, such as American woodcock and ruffed grouse, require openings for singing grounds to find mates and as brood-rearing areas with good herbaceous cover and insects for young chicks. Female eastern massasauga rattlesnakes look for upland openings adjacent to wetlands to give birth to their live young. Other species like golden-winged warblers need a range of opening types adjacent to mature forests to meet their life stage needs. Finally, species such as Karner blue butterfly and secretive locust spend their entire lives in openings, feeding on grasses and forbs within and giving birth to new generations.

Featured species associated with the nonforested openings landscape habitat condition

Deer (Deer Wintering Complexes)
Elk
Golden-winged warbler
Sharp-tailed grouse
Wild turkey
Wood turtle

Current condition and trend

The amount and spatial configuration of nonforested openings has changed over time. This is due, in part, to the nature of their origin: stochastic (randomly determined) disturbance events that are highly variable in frequency, impact and location. However, since European settlement, land use has resulted in a more heavily fragmented forest landscape due to settlements, roads, pipelines, agriculture and development, as well as forest management practices. For example, the Deer Range Improvement Program, initiated in 1971 to increase deer habitat to boost the deer population, resulted in thousands of acres of openings created and maintained annually through mowing and planting of rye and alfalfa-clover mixes. In recent decades, however, nonforested openings have been decreasing (Tables 1-4). This

is primarily driven by the large decrease in herbaceous open lands, which are succeeding into forest; upland shrub has been increasing slightly, but not enough to offset the overall decline.

Table 1. Acres of upland nonforested openings by cover type over time across the state forest; year 2026 is the incremented data set based on projection of completed harvest treatments that were in MiFI in 2021 (Source: DNR OI, IFMAP, Michigan DNR Forest Inventory data 2021).

Year	Herbaceous Openland	Upland shrub	Total
1988	177,114	43,351	**220,465**
2009	116,740	55,733	**172,473**
2026	40,114	51,152	**91,266**

Table 2. Acres of upland nonforested openings by cover type over time in the eastern Upper Peninsula; year 2026 is the incremented data set based on projection of completed harvest treatments that were in MiFI in 2021 (Source: DNR OI, IFMAP, Michigan DNR Forest Inventory data 2021).

Year	Herbaceous Openland	Upland Shrub	Total
1988	59,916	8,098	**68,014**
2009	37,479	5,125	**42,604**
2026	20,659	12,958	**33,617**

Table 3. Acres of upland nonforested openings by cover type over time in the northern Lower Peninsula; year 2026 is the incremented data set based on projection of completed harvest treatments that were in MiFI in 2021 (Source: DNR OI, IFMAP, Michigan DNR Forest Inventory data 2021).

Year	Herbaceous Openland	Upland Shrub	Total
1988	88,484	33,834	**122,318**
2009	57,330	49,066	**106,396**
2026	40,114	51,152	**91,266**

Table 4. Acres of upland nonforested openings by cover type over time in the western Upper Peninsula; year 2026 is the incremented data set based on projection of completed harvest treatments that were in MiFI in 2021 (Source: DNR OI, IFMAP, Michigan DNR Forest Inventory data 2021).

Year	Herbaceous Openland	Upland Shrub	Total
1988	28,714	1,419	**30,133**
2009	21,931	1,542	**23,473**
2026	10,727	8,225	**18,951**

Some caveats to note about this data are that herbaceous openland and upland shrub are broad inventory classification categories that include a wide range of size classes, historically including planted stands (seedlings), and currently including fuel breaks and utility rights of way. They can also include grassland- or forb-dominated communities such as barrens and large grasslands or grassland complexes. Due to challenges in parsing these nuances out and in maintaining consistency in data over time for comparison, herbaceous openland and upland shrub acres were pooled and reported out as-is. Regardless of the origin, unless dominated by invasive species, any of the openings types have some functional relevance on the landscape.

Desired future condition, objectives and management actions

Managed and unmanaged herbaceous openings in a range of sizes occur across the landscape as recognized habitat for featured and rare species and are comprised of native or forage species that are strategically adapted to future climate where warranted.

Objective 1. This planning period, conduct a scale-appropriate openings assessment to inform landscape-level planning in the context of climate change.

- Action 1. Conduct a landscape-level analysis of current openings for wildlife habitat based on the type, amount, size and distribution of managed and unmanaged openings.
- Action 2. Develop an openings plan through engagement with staff that sets nonforested openings landscape goals (e.g., percent of management areas in openings by size class and farmed vs. natural) for featured and rare species.
- Action 2. Prioritize and designate important openings and landscapes to prepare for potential solar and afforestation endeavors that may conflict with management objectives.
- Action 3. Evaluate the role of clearcuts and forest plantings in providing ephemeral openings on the landscape for wildlife.
- Action 4. For those openings within eastern massasauga rattlesnake managed lands, adhere to all relevant conservation measures as provided in the Candidate Conservation Agreement with Assurances.
- Action 5. Follow the joint Forest Resources Division and Wildlife Division 2017 Red Pine Management of State Forest Lands Interoffice Communication for guidelines pertaining to the planting of red pine in wildlife openings.
- Action 6. Where possible, plant flowering species that provide nectar for pollinators during early, middle and late phases of the growing season to account for unpredictable phenology.
- Action 7. Establish grain food plots with cultivars that are expected to tolerate future climate conditions.

Climate change

All climate change data and information listed is pulled directly from the open-source Northern Institute of Applied Climate Science Climate Change Impacts tool and Adaptation Workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium, limited) and agreement (high, moderate, low) described in the Predicted impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the Adaptation approaches section. For more information, go to niacs.org.

Predicted impacts to non-forested openings

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Climate conditions will increase fire risks in northern Michigan by the end of the century	Medium	Moderate	Most models project an increase in wildfire probability, which could result in more unplanned openings.
Many invasive species, insect pests and pathogens in northern Michigan forests will increase or become more damaging by the end of the century	Limited	High	Warmer temperatures may allow some invasive plant species, insect pests and pathogens to expand their ranges farther north. Unplanned openings could result due to loss of stands or portions of stands.

Adaptation approaches

Due to the potential for increased drought, pest and pathogen activity, as well as wildfire, there is some risk of increased unplanned nonforested openings. Other changes could include an impact on the types of herbaceous cover and timing of management activities. A longer growing season means an earlier spring and later fall and an overall warmer and drier climate, and drier soils at the end of the season could require a shift in the species used in planted openings. Mitigation measures including solar arrays and afforestation could require the use of openings, which could counteract management objectives for wildlife and other species. Advanced planning and prioritization will become important in the coming years to prevent losses in important landscapes.

Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Area, percent of nonforest openings by type and size

Management priority: Young forest landscape habitat condition



Why young forest matters

Young forests, defined as forest between 0 and 19 years, comprise a variety of land types from open fields (age 0) to stands of dense, young tree saplings of species that need a lot of sun. These forests encompass the forest successional stage called “stand initiation” and occur after a substantial disturbance kills or removes overstory trees, allowing a lot of sunlight to reach the ground, and whereby residual plants are released from competition or new plants become established. Forest succession is the gradual process of vegetation change over time, typically through a series of stages. That gradual procession can be set back, or restarted, through natural disturbances like wildfire, large wind events, floods, and ice storms. Management practices such as even-aged timber harvest methods (e.g., clearcut, seed tree, and shelterwood) and prescribed fire can mimic these large disturbances for a similar effect. Young forests are ephemeral and will soon grow out of this stage without recurring disturbance. Alternatively, young forest patches can move around the landscape according to the stochastic nature of natural disturbances, or the planned management of cover types.

Young forest, or early successional habitat, is an important landscape component. Representative diversity of forest successional stages in a given landscape increases both biodiversity and landscape resiliency to catastrophic events and climate change impacts. The Montreal Process identifies area and percent of forest successional stages as one of the indicators of ecosystem diversity. Further, ensuring diversity of structural compositions, cover types, moisture gradients, landforms, and geographies within the young forest successional stage is also important for the same reasons. Tracking young forest provides information about forest succession, which is an important component of forest sustainability.

Many species of wildlife rely on young forest for mating, nesting, brood-rearing and foraging, which was why it was identified as an important landscape habitat condition. Seven featured species are associated with the young forest LHC, of which aspen and jack pine are the primary managed cover types. American woodcock famously use forest openings as singing grounds and dense shrubs for nesting. Golden-winged warbler use recently cut aspen or alder stands with overstory residuals for nesting, if adjacent to mature forests for brood-rearing. Ruffed grouse use dense young aspen stands as drumming grounds, adjacent to mature forests for nesting and brood-rearing. Elk and moose rely on young aspen to provide woody browse. Wild turkey use forest openings for foraging during nesting and brood-rearing. Finally, Kirtland’s warbler is inextricably linked to young jack pine forests between 5 and 15 years old, and the species’ continued conservation depends upon maintenance of these forests.

Featured species associated with the young forest landscape habitat condition

American woodcock
Elk
Golden-winged warbler
Kirtland's warbler
Moose
Ruffed grouse
Snowshoe hare

Current condition and trend

According to DNR forest inventory records (Table 1), young forest has been increasing in the Upper Peninsula over the last four decades and has increased in the last two decades in the northern Lower Peninsula.

Table 1. Acres of young forest over time by region and across the state forest; year 2026 is the incremented data set based on projection of completed harvest treatments that were in MiFI in 2021 (source: DNR OI, IFMAP, Michigan DNR Forest Inventory data 2021).

Region	1988	2009	2026
NLP	404,114	266,570	390,679
EUP	81,325	104,668	144,899
WUP	106,302	102,517	142,360
Total	**591,741**	**473,755**	**677,938**

Trend data by cover type is limited due to changes in DNR forest inventory classification systems over recent decades. Because planted and natural pine types were combined, and mixed types were recognized only recently, it is not possible to assess specific cover type trends prior to 2009. Therefore, cover types were grouped into lowland and upland deciduous and coniferous types to evaluate trends dating back to 1988, the earliest inventory the DNR has on record (Table 2). Consistent with Table 1, all cover type groups in the EUP and WUP increased, sometimes substantially, from 1988 values. The NLP showed overall increases in both lowland and upland conifers but decreased overall in both lowland and upland deciduous types from 1998. The majority of cover types on the state forest are managed using even-aged timber harvest methods, but aspen and jack pine are the primary managed cover types with the youngest rotation ages around 50 years.

Table 2. Acres of young upland and lowland coniferous and deciduous cover type groupings over time; year 2026 is the incremented data set based on projection of completed harvest treatments that were in MiFI in 2021 (source: DNR OI, IFMAP, Michigan DNR Forest Inventory data 2021).

Cover Type Group by Region	1988	2009	2026
NLP	--	--	--
Lowland Coniferous	1,331	705	7,354

Cover Type Group by Region	1988	2009	2026
Lowland Deciduous	5,485	10,795	4,158
Upland Coniferous	96,992	94,825	123,600
Upland Deciduous	300,306	160,245	255,508
EUP	--	--	--
Lowland Coniferous	5,957	4,201	28,422
Lowland Deciduous	328	7,507	4,016
Upland Coniferous	39,639	44,614	66,587
Upland Deciduous	35,401	48,346	45,875
WUP	--	--	--
Lowland Coniferous	2,650	2,422	21,287
Lowland Deciduous	458	2,670	3,983
Upland Coniferous	12,458	20,174	25,417
Upland Deciduous	90,736	77,251	91,672

Available acres form the basis of forest management operations, but management decisions need to be informed by landscape-level context. Understanding how age structures are distributed across the landscape in terms of management availability, shade tolerance and landscape position can inform better choices and ensure representation across the state forest (Table 3). All young forest data includes planted cover types, as long as they meet the age criteria; these are typically not what is meant by early successional habitat, however, this is intended to be a coarse landscape level assessment of the overall age of the state forest. Newly planted types do have some of the same young forest characteristics that young forest species require, and species like American woodcock, Kirtland's warbler and snowshoe hare use young planted stands to meet habitat needs.

Table 3. Young age category by shade tolerance, management availability and landscape position (source: Michigan DNR Forest Inventory data 2021).

Shade Tolerance	Unavailable Lowland	Unavailable Upland	Unavailable Total	Available Lowland	Available Upland	Available Total	Grand Total
Tolerant	7,641	1,015	**8,656**	19,383	26,235	**45,618**	**54,274**
Mid-Tolerant	2,338	6,080	**8,417**	19,200	150,906	**170,106**	**178,523**
Intolerant	2,943	10,863	**13,806**	32,542	396,487	**429,029**	**442,835**

Shade Tolerance	Unavailable Lowland	Unavailable Upland	Unavailable Total	Available Lowland	Available Upland	Available Total	Grand Total
Grand Total	**12,921**	**17,958**	**30,879**	**72,237**	**574,715**	**646,952**	**677,831**

Because both aspen and jack pine are of primary management and habitat importance, it's worthwhile to assess them individually within the young forest age category. Across the state forest, both aspen (upland and lowland big tooth and quaking) and jack pine (planted and natural) cover types have less acreage than they did in 1988; however, combined, they have been more or less stable since 2009 (Tables 4, 5, 6). This is due to a concomitant increase in aspen and decrease in jack pine in that time frame.

Table 4. Abundance of aspen and jack pine young forest (0-19 years) over time across the state forest; jack pine includes both planted and natural stands. Year 2026 is the incremented data set based on projection of completed harvest treatments that were in MiFI in 2021 (source: DNR OI, IFMAP, Michigan DNR Forest Inventory data 2021).

Year	Aspen	Percent Change	Jack Pine	Percent Change
1988	945,815	--	401,705	--
2009	954,902	0.96	361,988	-9.89
2026	904,593	-5.27	282,205	-22.04

Table 5. Aspen (upland and lowland) abundance by region and age class over time; aspen includes both quaking and big tooth species. Year 2026 is the incremented data set based on projection of completed harvest treatments that were in MiFI in 2021 (source: DNR OI, IFMAP, Michigan DNR Forest Inventory data 2021).

Region and Age Class	1988	2009	2026
NLP	--	--	--
0-9	143,632	40,394	110,254
10-19	128,083	91,754	67,824
EUP	--	--	--
0-9	22,136	16,174	16,613
10-19	10,103	35,226	21,688
WUP	--	--	--
0-9	60,080	22,012	40,857
10-19	29,530	54,783	38,682

Table 6. Jack pine abundance by region and age class over time; this includes both planted and natural stands. Year 2026 is the incremented data set based on projection of completed harvest treatments that were in MiFI in 2021 (source: DNR OI, IFMAP, Michigan DNR Forest Inventory data 2021).

Region and Age Class	1988	2009	2026
NLP	--	--	--
0-9	43,126	32,493	29,275

Region and Age Class	1988	2009	2026
10-19	28,767	46,846	19,685
EUP	--	--	
0-9	16,628	15,333	20,234
10-19	12,305	19,228	13,492
WUP	--	--	--
0-9	5,017	3,282	4,455
10-19	2,064	8,091	2,986

To properly contextualize these cover type trends, it's important to understand the land use history (see state forest history section) and how it impacted both cover types. Prior to the 1800s, aspen/birch forests comprised less than 1 percent of Michigan's forests. They established in pockets on the landscape after disturbances such as fire and windstorms created openings. Considered early successional species, or species that are first to establish after a disturbance, they are eventually replaced by species and communities that are longer-lived and more stable on the landscape. In places where there was frequent disturbance, aspen/birch forests subsisted longer in dense stands.

Jack pine was found mixed with red and white pine on dry sites and barrens, and together dry conifer forests totaled approximately 1.3 million acres. This was largely concentrated in the north-central Lower Peninsula; with fire as a frequent occurrence, there was a higher relative proportion of barrens, specifically in Crawford, Iosco, Lake, Oscoda and Roscommon counties. With the exception of Lake County, these counties represent the core area for Kirtland's warbler management for this reason.

When the logging era began in earnest in the mid-1800s, aspen and jack pine responded positively. Extensive forest clearing and slash burning changed soil chemistry and allowed aspen/birch communities to colonize more extensively. Between 1900 and 1966, aspen increased from approximately 290,000 to 4.2 million acres. Land managers discovered that aspen responded well to management and could be maintained on the landscape at higher levels than historically from natural disturbances. Since then and through the early 2000s, aspen was steadily decreasing as the forest matured to longer-lived species like oak, maple and pine, especially on private lands. DNR cover type goals have maintained aspen at relatively stable levels since then to meet both timber and wildlife habitat needs.

For jack pine, red and white pine were preferentially selected for harvest, and this, in combination with the slash fires, left jack pine to colonize newly opened areas more extensively than before. As the forest matured and with the removal of fire on the landscape, jack pine began to mature and decrease in acres as it converted to longer-lived species. DNR land managers discovered that jack pine, similar to aspen, was a viable forest product and responded well to clear-cutting, and concern over Kirtland's warbler populations resulted in an intensive jack pine habitat management program. Historically, the DNR relied on clearcutting and planting jack pine stands; however, in 2018, jack pine management switched to promoting natural regeneration where possible. The apparent decrease in the jack pine cover type over the last several decades of management is due to changes in cover type classification rules. Jack pine mixed with oak is fairly common, and that subset of acres got reclassified from jack pine to upland mixed forest in the current cover type classification.

Desired future condition, objectives and management actions

Young forest is represented across different landscape positions and management availabilities to promote ecological and economic sustainability, provide wildlife habitat and buffer climate change vulnerabilities related to age-class stressors.

Objective 1. Beginning this planning period, promote young forest over a range of landscape sites and conditions to buffer climate risks.

- Action 1. Manage young forest on a variety of soil types and landscape positions.
- Action 2. Implement a variety of forest management activities or silvicultural prescriptions across multiple stands or areas with similar starting conditions to diversify forest conditions and evaluate different management approaches.

Objective 2. Manage aspen and jack pine to meet habitat needs for species including Kirtland's warbler, ruffed grouse, American woodcock and golden-winged warbler over a range of sites and conditions and facilitate movement through corridors to aid transitions north.

- Action 1. Establish or restore young forest along rivers or ridges to provide habitat for ruffed grouse, American woodcock and golden-winged warbler, and build on natural linear features that connect larger forests.
- Action 2. Continue to manage for high stem densities in restarting aspen stands.
- Action 3. Maintain enough young jack pine forest in upland, available acres to support 750 breeding Kirtland's warbler pairs across the northern Lower and Upper peninsulas.

Climate change

All climate change data and information listed herein is pulled directly from the open-source Northern Institute of Applied Climate Science Climate Change Impacts tool and Adaptation Workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium, limited) and agreement (high, moderate, low) described in the Predicted impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the Adaptation approaches section. For more information, go to niacs.org.

Predicted impacts relevant to young forest

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Northern Michigan's boreal species will face increasing stress from climate change	Medium	High	Jack pine will be much reduced in area, will be found only in localized refugia, or will be gone from the state forest.
Soil moisture patterns in northern Michigan will change, with drier soil conditions later in the growing season	Medium	Moderate	Aspen is sensitive to drought stress, potentially resulting in higher mortality on dry and poor-quality sites; mesic sites could become more xeric, favoring jack pine over other pines.

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Climate conditions will increase fire risks in northern Michigan by the end of the century	Medium	Moderate	A more intense or more frequent fire regime could favor jack pine relative to other types, but if too intense, might hurt regeneration and cause jack pine forests to shift to barrens.
Many invasive species, insect pests and pathogens in northern Michigan forests will increase or become more damaging by the end of the century	Limited	High	Insect pests like jack pine budworm and spongy moth, and diseases like Scleroderis and hypoxylon canker, may become more damaging under a warmer climate, negatively impacting both jack pine and aspen.

Adaptation approaches

Species are vulnerable to stressors at different stages in their life cycles. Especially for single-species cover types in even-aged management systems, vulnerabilities to age-related stressors can result in impacts to the distribution of successional stages on the landscape. Climate change resiliency improves through diversification, and this applies at both the stand and landscape scales. Increasing species and age composition within a stand helps buffer age- and species-related stressors, as does distributing cover types and successional stages across different landscape positions and management availabilities. As soil-related factors change through predicted climate change impacts, so might management availability, opening up new management opportunities in sites currently inaccessible. Or, conversely, if they remain inaccessible and unmanaged, they may retain higher levels of within-stand diversity that maintains the successional stage despite species or age-related stressors. Likewise, successional stages represented across soil moisture gradients may provide a buffer to age-related stressors through a range of available water and nutrients.

Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Area and percent of young forest state forestwide
- Area and percent of young forest by landscape position, shade tolerance, and availability by region
- Acres of aspen and jack pine by landscape position and availability

Management priority: Midsuccessional forest



Why midsuccessional forest matters

Midsuccessional forest refers to the decades of forest growth that occur after the establishment of pioneer tree species and before development of the structural characteristics and complex ecological dynamics of mature forests. Forest succession is the gradual process of vegetation change over time, typically through a series of stages. This plan will address two midsuccessional stages, Intermediate and Mid-Aged.

Intermediate forest is defined as between 20 and 49 years old. It loosely correlates with a phase of forest succession known as “stem exclusion,” which is when, toward the end of the stand initiation stage, access to sun and soil has become limited and competition for those resources between stems begins. This results in those plants that have garnered some advantages, such as a large-crown trees or trees with a faster growth rate, outcompeting other trees that eventually die. Those stems that are left continue to increase in volume. In forest management, two things are happening at this stage: Stand density is kept high to promote self-pruning, and a thinning occurs to promote the best-performing trees. Invasive species, if not treated earlier, can slow conversion from young to intermediate forest. This intermediate stage continues to be important for some young forest wildlife species such as ruffed grouse and white-tailed deer, in addition to being important for some more mature forest species including wood thrush.

Mid-aged forest is defined as being 50 to 79 years old. This age category loosely correlates with a stage of forest succession called “understory reinitiation,” occurring right after stem exclusion, which is when trees in a stand begin to reach sexual maturity and produce seeds. Stand dynamics are changing in this age category as longer-lived species replace shorter-lived species in dominance, and tree regeneration of more shade-tolerant species is incorporated in the understory. Maintaining the full range of forest successional stages and ages on the landscape supports forest sustainability and ensures the ability to meet the life requisites for many other species. Wildlife species including black bear, wild turkey and wood thrush make use of mid-aged forest habitats.

Representative diversity of forest successional stages in a given landscape increases both biodiversity and landscape resiliency to catastrophic events and climate change impacts. The Montreal Process identifies area and percent of forest successional stages as one of the indicators of ecosystem diversity. Further, ensuring diversity of structural compositions, cover types, moisture gradients, landforms, and geographies within the mid-successional forest successional stages is also important for the same reasons. Tracking intermediate and mid-aged forests provides information about forest succession, which is an important component of sustainability.

Current condition and trend

Intermediate forest

Due to the history of mass logging and widespread and intense slash fires around the turn of the 20th century, the state forest is relatively young by ecological standards. Overall, this intermediate forest category has been increasing since 1998, the earliest inventory record the DNR has available, with the exception of a slight dip in 2026 for the northern Lower Peninsula (Table 1).

Table 1. Acres of intermediate forest over time by region and across the state forest; year 2026 is the incremented data set based on projection of completed harvest treatments that were in MiFI in 2021 (source: DNR OI, IFMAP, Michigan DNR Forest Inventory Data 2021).

Year	EUP	WUP	NLP	Total
1988	69,322	49,523	210,099	**328,944**
2009	91,368	120,899	350,804	**563,071**
2026	119,084	130,075	319,345	**568,504**

Trend data by cover type is limited due to changes in DNR forest inventory classification systems over recent decades. Because planted and natural pine types were combined, and mixed types were recognized only recently, it is not possible to assess specific cover type trends prior to 2009. Therefore, cover types were grouped into lowland and upland deciduous and coniferous types to evaluate trends dating back to 1988, the earliest inventory the DNR has on record (Table 2).

Table 2. Acres of intermediate upland and lowland coniferous and deciduous cover type groupings over time; year 2026 is the incremented data set based on projection of completed harvest treatments that were in MiFI in 2021 (Source: DNR OI, IFMAP, Michigan DNR Forest Inventory data 2021).

Cover Type Groupings by Region	1988	2009	2026
NLP	--	--	--
Lowland Coniferous	4,733	3,402	4,099
Lowland Deciduous	2,438	20,831	5,468
Upland Coniferous	114,762	71,167	103,002
Upland Deciduous	88,166	255,404	206,776
EUP	--	--	--
Lowland Coniferous	8,659	6,508	7,463
Lowland Deciduous	667	3,593	1,054
Upland Coniferous	38,543	34,220	48,584
Upland Deciduous	21,453	47,047	61,983
WUP	--	--	--
Lowland Coniferous	5,215	2,160	2,781
Lowland Deciduous	493	2,332	2,031
Upland Coniferous	12,094	13,222	22,758
Upland Deciduous	31,721	103,185	102,504

Across all three regions, the biggest gains were in upland deciduous types, which saw large increases in 2026 compared to 1988. Lowland conifers, conversely, decreased across all three regions, though the

changes were relatively small. The lowland types in general have fewer acres than upland types, so the overall trend did not really change.

Available acres form the basis of forest management operations, but management decisions need to be informed by landscape-level context. Understanding how age structures are distributed across the landscape in terms of management availability, shade tolerance and landscape position can inform better choices and ensure representation across the state forest (Table 3).

Table 3. Acres of unavailable vs. available upland and lowland intermediate age category by shade tolerance (source: Michigan DNR Forest Inventory data 2021).

Management Availability by Landscape Position	Intolerant	Mid-tolerant	Tolerant	Total
Unavailable Lowland	3,903	4,266	3,153	**11,322**
Unavailable Upland	6,464	2,347	294	**9,105**
Unavailable Total	**10,367**	**6,613**	**3,447**	**20,427**
Available Lowland	25,275	10,189	6,570	**42,034**
Available Upland	441,459	90,947	9,320	**541,726**
Available Total	**466,734**	**101,136**	**15,890**	**583,759**
Grand Total	**477,102**	**107,749**	**19,336**	**604,187**

The vast majority of intermediate forest acres are found in the available, upland, intolerant categories, with very little acres distributed anywhere else. This is likely due to a focus on even-aged management in many cover types that have a rotation age between 40 and 60 years.

Mid-aged forest

The mid-aged category has been decreasing steadily in acreage since 1988 (Table 1). This is likely due to various factors including the overall aging of the forest and the fact that not many cover types are managed in this age range beyond aspen and jack pine.

Table 1. Acres of mid-aged forest over time by region across the state forest; year 2026 is the incremented data set based on projection of completed harvest treatments that were in MiFI in 2021 (source: DNR OI, IFMAP, Michigan DNR Forest Inventory data 2021).

Region	1988	2009	2026
NLP	942,990	617,167	451,683
EUP	424,460	254,852	179,872
WUP	466,001	192,493	134,668
Total	1,833,451	1,064,512	766,223

Trend data by cover type is limited due to changes in DNR forest inventory classification systems over recent decades. Because planted and natural pine types were historically combined, and mixed types were recognized only recently, it is not possible to assess specific cover type trends prior to 2009. Therefore, cover types were grouped into lowland and upland deciduous and coniferous types to evaluate trends dating back to 1988, the earliest inventory the DNR has on record (Table 2).

Table 2. Acres of mid-aged upland and lowland coniferous and deciduous cover type groupings over time; year 2026 is the incremented data set based on projection of completed harvest treatments that were in MiFI in 2021 (source: DNR OI, IFMAP, Michigan DNR Forest Inventory data 2021).

Region and Cover Type Grouping	1988	2009	2026
NLP	--	--	--
Lowland Coniferous	100,644	37,361	30,531
Lowland Deciduous	47,402	49,377	26,077
Upland Coniferous	205,638	242,706	171,135
Upland Deciduous	589,306	287,723	223,941
EUP	--	--	--
Lowland Coniferous	104,848	54,989	44,741
Lowland Deciduous	4,427	11,309	6,401
Upland Coniferous	111,495	98,687	77,510
Upland Deciduous	203,690	89,867	51,220
WUP	--	--	--
Lowland Coniferous	104,033	42,365	19,066
Lowland Deciduous	11,342	8,602	4,709
Upland Coniferous	55,545	27,508	26,296
Upland Deciduous	295,081	114,018	84,597

Regional analysis maintains the declining trend overall, with a couple of exceptions. Lowland deciduous types in the east Upper Peninsula are the only mid-aged group that increased since 1988, though it is down from 2009. In other cases, there were increases seen between 1988 and 2009, but that ultimately decreased to below 1988 levels; this occurred in lowland deciduous and upland coniferous types in the northern Lower Peninsula. While declines of any kind can seem concerning, the mid-aged category is nearing the acreage it would be if all four of the age categories were divided evenly across state forest forested acres. Balancing age classes and balancing age categories or forest successional stages ensures a balance in habitat conditions to meet wildlife needs.

Available acres form the basis of forest management operations, but management decisions must be informed by landscape-level context. Understanding how age structures are distributed across the landscape in terms of management availability, shade tolerance and landscape position can inform better choices and ensure representation across the state forest (Table 3).

Table 3. Mid-aged shade tolerance category by management availability and landscape position (source: Michigan DNR Forest Inventory data 2021; not incremented).

Shade Tolerance	Unavailable Lowland	Unavailable Upland	Unavailable Total	Available Lowland	Available Upland	Available Total	Grand Total
Intolerant	32,885	25,286	**58,172**	36,826	335,403	**372,228**	**430,400**
Mid-tolerant	34,211	21,541	**55,752**	28,607	211,575	**240,182**	**295,934**
Tolerant	35,499	5,475	**40,974**	21,660	92,455	**114,115**	**155,090**
Total	**102,595**	**52,302**	**154,898**	**87,093**	**639,433**	**726,526**	**881,423**

Desired future condition, objectives and management actions

Midsuccessional forest is maintained at near-current levels in a range of conditions across the landscape to promote ecological and economic sustainability, provide wildlife habitat and buffer climate change vulnerabilities related to age-class stressors.

Objective 1. Beginning this planning period, manage intermediate and mid-aged forest over a range of sites and conditions to promote forest sustainability and buffer climate risks.

- Action 1. Manage for intermediate and mid-aged forest on a variety of soil types, landscape positions and shade tolerances on both available and unavailable lands.
- Action 2. Diversify forest successional stage structures by implementing a variety of forest management activities or silvicultural prescriptions within intermediate and mid-aged forests to diversify forest conditions.

Climate change

All climate change data and information listed here is pulled directly from the open-source Northern Institute of Applied Climate Science Climate Change Impacts tool and Adaptation Workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium, limited) and agreement (high, moderate, low) described in the Predicted impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the Adaptation approaches section. For more information, go to niacs.org.

Predicted impacts relevant to intermediate forest

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Many invasive species, insect pests and pathogens in northern Michigan forests will increase or become more damaging by the end of the century	Limited	High	If not treated earlier, invasive species can slow conversion from young to intermediate forest and from intermediate to mid-aged forest.
Low-diversity systems are at greater risk from climate change	Medium	High	Maintaining midsuccessional age categories on the landscape as well as diversity within intermediate and mid-aged cover types will increase resilience to extreme environmental conditions and greater potential to recover from disturbance than less diverse communities.

Adaptation approaches

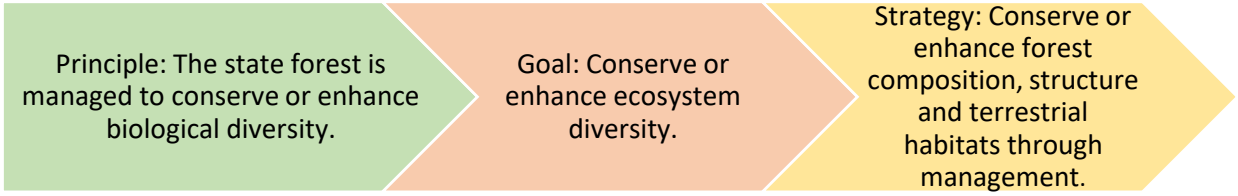
There are many age-related stressors for forest species that make them more vulnerable to climate change impacts, especially in single-age stands or when age classes are distributed unevenly across landscape conditions. Promoting diversity in age classes and structural complexity, in a stand or landscape, is a way to infuse resiliency by ensuring only a portion of a stand or landscape is impacted by any given age-related threat. Successional stages, while representing more than just age, can still be subject to similar age-related vulnerabilities. Uneven distribution in successional stages across landscape conditions could also result in disproportionate or more severe impacts. Promoting diversity across landscape types, positions and management availability may buffer these impacts.

Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Area and percent of intermediate forest throughout the state forest
- Area and percent of intermediate forest by landscape position, shade tolerance and availability by region
- Area and percent of mid-aged forest state forestwide
- Area and percent of mid-aged forest by landscape position, shade tolerance, and availability by region

Management priority: Mature forest landscape habitat condition



Why mature forest matters

In this plan, mature forest is defined as being 80 years of age or greater. In an ecological sense, a forest that is 80 years old is still relatively young; however, in a managed forest, few cover types are managed beyond 100 years. Exceptions to this are cover types managed by basal area and not age, special areas included within the Conservation Area Network (e.g., Type 1 and Type 2 Old Growth) and those areas of the state forest where accessibility for management is limited. This age group is loosely correlated with a forest successional stage called “steady state.” This is a simplistic name for a mature forest stand where the canopy consists of species that can continue to regenerate with low light availability, or that depend on a large disturbance to reestablish dominant species. Forest succession is the gradual process of vegetation change over time, typically through a series of stages.

Representative diversity of forest successional stages in a given landscape increases both biodiversity and landscape resiliency to catastrophic events and climate change impacts. The Montreal Process identifies area and percent of forest successional stages as one of the indicators of ecosystem diversity. Further, ensuring diversity of structural compositions, cover types, moisture gradients, landforms, and geographies within the mature forest successional stage is also important for the same reasons. Tracking mature forest provides information about forest succession, which is an important component of forest sustainability.

In the absence of large-scale disturbances (natural or through management), these stands attain many attributes that provide a multitude of benefits. Mature forests influence different abiotic systems, including hydrological processes, and tree age and size are associated with higher carbon sequestration. They are also important for many species of wildlife. Mature forest trees grow taller and bigger in size (see Big trees), tree bark becomes thicker and more coarse, trees die and are left standing as snags or fall as woody debris on the ground (see Horizontal and vertical structure), canopy gaps open through senescence or small-scale disturbance and create patches of regeneration and variability in vertical structure (see Horizontal and vertical structure) and a shade-tolerant understory is well developed (see Mature forest with understory). More complex horizontal and vertical structure results in variable distribution of water, sun and nutrients across the stand. The diversity of habitat niches that result make this age category important for a variety of organisms, including plants, fungi, lichen and wildlife. In this way, it has a disproportionately positive contribution to retaining biological diversity on the landscape and is why it was identified as a Landscape Habitat Condition. There are nine featured species associated with this LHC that rely on the stand structures found in older forests. While the majority of the state forest is managed, it is still possible to achieve mature forest conditions through silvicultural methods in the older age classes.

Featured species associated with the mature forest landscape habitat condition

American marten
Blackburnian warbler
Black-throated blue warbler
Cerulean warbler
Deer (deer wintering complexes)
Moose
Red crossbill
Spruce grouse
Wood thrush

Current condition and trend

Due to the history of mass logging and widespread and intense slash fires around the turn of the 20th century, the state forest is relatively young by ecological standards. Mature forest has been increasing since 1988, the earliest inventory record the DNR has available (Table 1). This is likely due to several reasons: the aging of the state forest, especially those acres unavailable for management, and the cover types that are managed in this age range. Acres unavailable for management are generally left to age without intervention due to lack of accessibility for harvest operations, though noncommercial cutting can occur in these acres on a small scale. Cover types including oak, planted red pine, mixed oak and pine types, and lowland conifers are generally managed on rotation ages between 80 and 100 years, while other cover types managed by basal area, such as northern hardwoods, continue to age and are currently approximately around 100 years old.

Table 1. A*cres of mature forest over time by region and across the state forest; year 2026 is the incremented data set based on projection of completed harvest treatments that were in MiFI in 2021 (source: DNR OI, IFMAP, Michigan DNR Forest Inventory data 2021).*

Region	1988	2009	2026
NLP	65,818	476,186	605,686
EUP	88,506	281,753	388,372
WUP	74,710	311,675	374,731
Total	**229,033**	**1,069,614**	**1,368,788**

Trend data by cover type is limited due to changes in DNR forest inventory classification systems over recent decades. Because planted and natural pine types were combined, and mixed types were recognized only recently, it is not possible to assess specific cover type trends prior to 2009. Therefore, cover types were grouped into lowland and upland deciduous and coniferous types to evaluate trends dating back to 1988, the earliest inventory the DNR has on record (Table 2). Each type across all three regions increased substantially since 1988, with the west Upper Peninsula lowland deciduous types as the exception.

Table 2. Acres of mature upland and lowland coniferous and deciduous cover type groupings over time; year 2026 is the incremented data set based on projection of completed harvest treatments that were in MiFI in 2021 (source: DNR OI, IFMAP, Michigan DNR Forest Inventory data 2021).

Cover Type Group by Region	1988	2009	2026
NLP	--	--	--
Lowland coniferous	37,046	130,853	166,915
Lowland deciduous	3,995	39,635	50,964
Upland coniferous	6,980	51,539	95,923
Upland deciduous	17,797	254,159	291,259
EUP	--	--	--
Lowland coniferous	62,008	148,123	180,609
Lowland deciduous	1,458	8,241	12,269
Upland coniferous	12,202	42,156	81,549
Upland deciduous	12,838	83,233	113,922
WUP	--	--	--
Lowland coniferous	55,823	140,366	167,195
Lowland deciduous	1,885	11,659	11,349
Upland coniferous	5,840	22,163	42,103
Upland deciduous	11,162	137,487	154,083

Available acres form the basis of forest management operations, but management decisions need to be informed by landscape-level context. Understanding how age structures are distributed across the landscape in terms of management availability, shade tolerance and landscape position can inform better choices and ensure representation across the state forest (Table 3). All mature forest data includes planted cover types as long as they meet the age criteria. Tthese are typically not what is meant by “mature forest” in the literature; however, this is intended to be a coarse landscape level assessment of the overall age of the state forest. These planted types do have some of the same big tree characteristics, and species like marten can use them (e.g., planted red pine) when there are other species inclusions. See the Conservation Area Network management priority for information on Type 1 and Type 2 Old Growth designations.

Table 3. Mature age category by shade tolerance, management availability and landscape position across the state forest (source: Michigan DNR Forest Inventory data 2021).

Shade Tolerance	Unavailable Lowland	Unavailable Upland	Unavailable Total	Available Lowland	Available Upland	Available Total	Grand Total
Tolerant	321,474	41,375	362,849	92,491	394,374	486,864	**849,714**
Mid-tolerant	79,108	57,587	136,695	30,033	160,621	190,653	**327,348**
Intolerant	51,582	27,942	79,524	22,241	89,906	112,147	**191,671**

Shade Tolerance	Unavailable Lowland	Unavailable Upland	Unavailable Total	Available Lowland	Available Upland	Available Total	Grand Total
Total	**452,164**	**126,903**	**579,068**	**144,764**	**644,900**	**789,665**	**1,368,732**

Desired future condition, objectives and management actions

Mature forest continues to have a higher relative proportion of all age categories on the landscape to promote ecological and economic sustainability, provide important biodiversity and wildlife habitat, and buffer climate change vulnerabilities related to age-class stressors.

Objective 1. Over the next several decades, continue to maintain a higher proportion of the mature forest age category relative to the other age categories across the landscape, including unavailable lands.

- Action 1. Continue mature forest management across mid-late successional cover types through maintaining or extending rotation ages of 80 years or greater, as applicable.
- Action 2. In mid-late successional cover types managed by BA, promote mature forest through the prioritization of multi-cohort silviculture.
- Action 3. Prioritize the evaluation of proposed and the identification of new Type 1 and Type 2 Old Growth areas for designation and conservation.
- Action 4. Promote age-class tails across cover types, to ensure some proportion is left to age beyond the standard rotation age prior to harvest.
- Action 5. Identify, monitor and increase, where possible in suitable cover types, age classes to 120 years or greater.
- Action 6. Add site condition for mature forest which includes “conservation values are incompatible with commercial harvest at this time.”

Action 7. Monitor and report progress with each state forest management plan update.Objective 2. Beginning this planning period, manage mature forest over a range of sites and conditions to buffer climate risks.

- Action 1. Manage the mature forest age category across appropriate cover types on a variety of soil types and landscape positions.
- Action 2. Implement a variety of forest management activities or silvicultural prescriptions across multiple stands or areas with similar starting conditions to diversify forest conditions and evaluate different management approaches.
- Action 3. Ensure mature forest is maintained across available and unavailable lands within and outside of the Conservation Area Network.
- Action 4. Coordinate with partners to manage mature communities existing on a variety of suitable sites across ownerships.

Objective 3. In the next 10 years, evaluate the landscape for important wildlife corridors on the state forest, and establish a network of connected mature forest landscapes.

- Action 1. Establish or restore mature forest cover along rivers or ridges to build on natural linear features that connect larger forests.
- Action 2. Control invasive species within a corridor to minimize competition with desired species.
- Action 3. Work with partners to identify high-priority sites to protect for landscape-scale corridors or habitat.

Climate change

All climate change data and information listed here is pulled directly from the open-source Northern Institute of Applied Climate Science Climate Change Impacts tool and Adaptation Workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium, limited) and agreement (high, moderate, low) described in the Predicted impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the Adaptation approaches section. For more information, go to niacs.org.

Predicted impacts relevant to mature forest

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Many invasive species, insect pests and pathogens in northern Michigan forests will increase or become more damaging by the end of the century.	Limited	High	Older trees are more vulnerable to moisture stress, which increases their susceptibility to decline and mortality from age-related stressors including invasive pests and disease.
Low-diversity systems are at greater risk from climate change.	Medium	High	Maintaining mature forest as a landscape age category, and a diversity of mature forest cover types on the landscape may ensure greater resiliency of older forests across the landscape.

Adaptation approaches

Many age-related stressors for forest species make them more vulnerable to climate change impacts, especially in single-age stands or when age classes are distributed unevenly across landscape conditions. Promoting diversity in age classes and structural complexity, in a stand or landscape, is a way to infuse resiliency by ensuring only a portion of a stand or landscape is impacted with any given age-related threat. Successional stages, while representing more than just age, can still be subject to similar age-related vulnerabilities. Uneven distribution in successional stages across landscape conditions, then, could also result in disproportionate or more severe impacts. Promoting diversity across landscape types, positions and management availability may buffer these impacts.

The presence of landscape corridors, especially those oriented north-south, can be advantageous for species moving along a climatic gradient. Especially in peninsular Michigan, this may allow species to reach places of predicted climate change refugia. Forested corridors can also function as habitat and retain species on the landscape longer than otherwise, while also providing a movement corridor.

Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Area and percent of mature forest state forestwide
- Area and percent of mature forest by landscape position, shade tolerance, and availability by region
- Area of mature forest that is 120 years old or greater by availability, shade tolerance and landscape position

Management priority: Horizontal and vertical structure



Why horizontal and vertical structure matters

Forest structure refers to the physical arrangement of a stand, and there are two commonly described components. Vertical structure describes the plant layers in a forest stand from the ground up to the canopy. This includes the understory, or the ground cover and subcanopy (woody plants below the main canopy); the tree canopy and trees taller than the main canopy (or super-canopy trees; see the Big Trees section for Legacy Tree discussion). Horizontal structure is the spatial distribution of trees, plants and woody debris across the stand. This often includes the density and distribution of standing dead trees, called snags, and coarse and fine woody debris on the ground. Both dimensions of structure combine in various ways to create different ecosystems. As plant species and layers increase, so does stand diversity and complexity. Stand diversity and complexity have been linked to more consistent growth rates over time, higher growth rates and biomass production, and higher rates of carbon sequestration (Gough et al. 2019, Murphy et al. 2022, Schnabel et al. 2021). This is due to the variations in how different species use water, light, carbon and nutrients, as well as how different species functionally complement each other to increase efficiencies. Stand diversity and complexity are also associated with lower invasive species occurrence, and higher biodiversity – the more habitat niches that are available, the more species there will be to fill them. Many wildlife species rely on the niches these structurally complex habitats provide. Featured species examples include black-throated blue warbler and cerulean warbler, which both require dense understories for nesting, foraging and protection from predators; marten, which requires cavity trees for resting and an abundance of downed woody debris for foraging; and snowshoe hare, which requires low branches, shrubs and downed wood for cover. Horizontal and

vertical structure are important components of biodiversity, which, in turn, is an essential component of forest sustainability.

Current condition and trend

Stand-level data taken as part of state forest inventory includes recording subcanopy species by density categories as a percent of the sky occupied (ignoring the canopy layer; Table 1). Because this data is categorized at the species level within a stand during inventory, a stand density index was created to extrapolate that information across the stand to allow for cover-type subcanopy categorization. The subcanopy density index used the following categories: No subcanopy (0%), Trace (0-1.9%), Low (2-10%), Medium (11-40%), High (41-70%) and Full (71-100%).

Table 1. Area (acres) of stands by subcanopy density index category (source: Michigan DNR forest inventory data 2021).

Subcanopy Density Index Category	Acres	Percent of Total
No subcanopy	303,060	12.40%
Trace	3,608	0.15%
Low	137,172	5.61%
Medium	726,205	29.70%
High	546,713	22.36%
Full	728,205	29.78%
Total	**2,444,964**	**100.00%**

It is evident that the highest-forested acres fall into the medium density category and greater. However, this can be misleading given that the medium category ranges from 11 percent to 40 percent, therefore includes quite a range of variation, and still represents subcanopy densities less than 50 percent of a stand. Totaling the highest two density categories, which gives a density range between 41 to 100 percent, results in slightly greater than half (52 percent) of the forested acres across the state forest having what could be interpreted as a well-developed subcanopy. There are some clear differences in subcanopy densities within cover types (level 3), likely due to treatment methods and management objectives (Table 2).

Table 2. Area (acres) of stands by subcanopy occupancy index, by cover type (level 3; source: Michigan DNR forest inventory data 2021).

Cover Type (Level 3)	No sub-canopy	Trace	Low	Medium	High	Full	Total
Northern hardwood	25,637	315	12,560	108,514	108,531	198,652	**454,209**
Aspen	44,338	303	23,477	138,661	95,079	93,068	**394,925**
Cedar	44,541	482	22,698	101,508	54,210	61,068	**284,506**
Red pine	33,432	989	19,755	61,682	37,911	41,479	**195,248**
Lowland conifers	32,738		6,944	45,437	40,965	55,877	**181,961**
Oak	7,994	463	5,009	34,749	33,058	48,334	**129,607**
Lowland deciduous	16,132	28	4,701	31,008	26,149	39,483	**117,500**
Jack pine	30,317	553	15,855	38,138	12,036	5,726	**102,624**
Mixed upland deciduous	9,021	143	3,562	28,632	25,762	34,813	**101,932**

Cover Type (Level 3)	No sub-canopy	Trace	Low	Medium	High	Full	Total
Natural mixed pines	6,738	88	2,411	23,409	19,426	21,875	**73,947**
Upland mixed forest	6,543	4	2,173	22,049	18,302	23,386	**72,456**
Lowland spruce/fir	11,254	107	4,354	23,827	14,452	13,382	**67,375**
White pine	4,812	19	2,639	14,666	13,753	20,237	**56,126**
Lowland mixed forest	9,224	6	1,611	13,275	12,651	17,530	**54,296**
Lowland aspen/balsam poplar	4,924	63	1,396	11,600	10,466	16,696	**45,145**
Upland conifers	4,260	16	2,392	10,351	8,882	16,017	**41,917**
Tamarack	3,842		2,035	5,883	6,321	8,520	**26,600**
Upland spruce/fir	3,494	1	1,097	5,118	2,862	3,445	**16,016**
Hemlock	1,591	30	1,504	3,284	2,442	4,639	**13,491**
Planted mixed pines	1,205		912	3,436	2,455	1,988	**9,996**
Paper birch	1,024		89	977	1,002	1,994	**5,086**
Grand total	**303,060**	**3,608**	**137,172**	**726,205**	**546,713**	**728,206**	**2,444,964**

Unsurprisingly, given that it is intended to be managed as an uneven-aged system, northern hardwoods have the highest numbers of any cover type in the two highest density categories. Also unsurprisingly, the majority of conifer cover type acres represent understory densities of 40 percent or lower, with jack pine as the most obvious example. Planted stands, which are included in both the jack and red pine cover types in this table, are managed to produce near-monocultures in an even-aged management system. Between retention (3-10 percent of a stand) and the “free to grow” (20 percent other species) approach, especially for red pine, planted stands can have up to 30 percent species diversity, and intermediate thinning can promote some regeneration of other species.

For every canopy species comprising at least 1 percent of a stand, DNR forest inventory practices assign a size class representative of the majority of individuals. Size class is based on the DBH (diameter at breast height), with categories of sapling (1-5 inches), pole (5-10 inches), log (10-18 inches) and large log (or xlog; greater than 18 inches). Compound classes may be used when needed, but classes can’t be skipped. While stand notes can include opportunistic mention of super-canopy species, or trees exceeding the height of the main canopy, there is no mandate to record those occurrences as part of the state forest inventory protocol. Because xlog trees are the highest size class, defined as being above 18 inches in diameter, they are the largest trees in any stand. This can also mean that they include super-canopy individuals. Therefore, the xlog size class can be used as a surrogate for assessing at least the highest potential for stands with super-canopy tree occurrence across the state forest. Because size class data is collected by species within a stand, the potential for super-canopy tree occurrence can be monitored over time through xlog or compound xlog size classes (Table 3).

This level of stand detail, for both subcanopy and size class, has not been historically retained in DNR records, so no trend data is available. Instead, this current condition will serve as a baseline for future monitoring.

Table 3. Acres of stands by cover type with at least one species in the xlog size class (source: Michigan DNR forest inventory data 2021).

Cover Type	EUP	NLP	WUP	Total
Northern hardwood	29,487	68,836	31,692	**130,016**
Aspen	2,986	37,571	15,523	**56,080**
Lowland conifers	10,181	21,033	8,002	**39,216**
Red pine	9,416	24,499	2,888	**36,803**
Mixed upland deciduous	3,646	21,683	7,032	**32,361**
Cedar	6,426	17,001	7,433	**30,859**
Oak	470	27,956	1,760	**30,186**
Natural mixed pines	8,918	16,023	3,776	**28,717**
Upland mixed forest	5,548	14,122	6,004	**25,674**
Lowland deciduous	2,655	19,932	2,400	**24,986**
Upland conifers	8,107	3,854	4,719	**16,680**
Lowland mixed forest	2,868	8,614	2,243	**13,725**
Jack pine	2,264	6,600	458	**9,322**
Lowland spruce/fir	3,211	2,259	2,310	**7,780**
Hemlock	2,733	557	4,349	**7,638**
Lowland aspen/balsam poplar	682	4,271		**4,954**
Planted mixed pines	738	2,285		**3,022**
Upland spruce/fir	757	404	1,254	**2,414**
Paper birch	279	550	179	**1,007**
Tamarack	130	473	255	**858**
Total	**101,500**	**298,523**	**102,276**	**502,298**

Approximately 21 percent of the state forest has stands with species in the xlog size class, or with high potential for super-canopy trees. While super-canopy trees can be virtually any species, they are typically one of the longer-lived pine types, such as white or red pine. These species are often components of other stands, including northern hardwoods and aspen, which have the highest acres of stands with at least one species in the xlog size class (or compound size class that includes xlog). Though supercanopy trees may include Legacy trees, please see the Big Trees management priority for more information.

Standard DNR forest inventory protocols do not include recording dead or downed wood. However, Forest Inventory Analysis data from the U.S. Forest Service does. Complete FIA panels provide data for all forests in the state and provide flexibility in parsing data, including by ownership. Panels were completed in 2010 and 2018 (Tables 4-6); this data was not available prior to 2010 and the next complete panel is expected in 2025. Data was averaged across FIA plots on the state forest regardless of cover type or harvest treatment.

Table 4. Coarse woody debris volume (cubic feet per acre) by region and across the state forest (source: FIA data).

Year	EUP	NLP	WUP	Total
2010	591.92	465.53	353.33	**459.36**
2018	414.35	436.07	590.82	**489.60**

Table 5. Fine woody debris volume (cubic feet per acre) by region and across the State Forest (Source: FIA data).

Year	EUP	NLP	WUP	Total
2010	158.24	171.86	201.30	**168.68**
2018	143.69	165.18	183.52	**164.99**

Table 6. Standing dead tree density (stems per acre) by region and across the state forest (Source: FIA data).

Year	EUP	NLP	WUP	State forest-wide
2007	22.90	16.41	16.85	**18.2**
2012	26.26	16.93	20.34	**20.1**
2019	25.67	20.20	20.75	**22.2**

While there is no set threshold for ideal volumes of dead and downed wood, several studies have shown that unmanaged stands tend to have higher volumes, and snags tend to be larger in size and have a higher basal area when compared to managed stands. Differences between studies due to site selection, site history and study methodology (including size and decay categorization) make it difficult to make universal conclusions or to set guidance. However, monitoring these numbers over time can still provide useful trend data to inform management.

Desired future condition, objectives and management actions

Structural complexity in the form of cavity trees, snags, downed wood and a multilevel subcanopy is an integral stand component for wildlife habitat, forest productivity and climate change resilience.

Objective 1. This planning period, implement techniques to increase structural diversity through within-stand age and species variability to boost resilience in a changing climate.

- Action 1. Use forest management techniques such as variable-density treatments or irregular return intervals to encourage the development of multiple age cohorts.
- Action 2. Retain survivors of pest or disease outbreaks, droughts, windthrow events or other disturbances during salvage or sanitation operations and focus on creating desired residual stand structures even if merchantable timber is retained and some less merchantable timber is removed.
- Action 3. Retain individual trees of uncommon species to maintain their presence on the landscape.
- Action 4. Retain underrepresented but ecologically appropriate species including mast-producing species, conifers in deciduous stands (white pine, white spruce and hemlock in particular) and vice versa, and long-lived species in short-rotation stands and vice versa.
- Action 5. Plant species with a diverse timing of phenological events (e.g., flowering, fruiting, leaf out, leaf drop) to provide necessary resources over a longer time frame to forest-dependent wildlife species.
- Action 6. Develop timber sale specifications for any applicable horizontal and vertical stand attributes.

Objective 2. Increase the number of acres with a full subcanopy density index, especially in northern hardwood, mixed upland deciduous and lowland hardwood cover types to benefit wildlife species including black-throated blue and cerulean warblers over the next two planning periods.

- Action 1. Manage for a variety of canopy gap sizes through silviculture while maintaining greater than 80% canopy cover.
- Action 2. Retain understory species including shrubs, ironwood, basswood, balsam and other underrepresented and small-diameter species during timber harvest.
- Action. 3. Use silvicultural treatments to promote and enhance diverse regeneration of native species, including site scarification, planting, nurse logs, tip-up mounds or other techniques to support adequate natural regeneration.

Objective 3. Maintain or increase the number of acres containing at least one super-canopy tree on the state forest over the next two planning periods.

- Action 1. Retain existing super-canopy trees where they are during harvest, or at a minimum of at least one super-canopy tree every 10 acres wherever possible, paying particular attention to those that may qualify as legacy trees.
- Action 2. Retain the oldest and largest trees with good vigor during forest management activities to recruit super-canopy trees, especially through retention of white spruce, hemlock, white pine and red pine in mixed stands.
- Action 3. Create a timber sale specification to retain super-canopy trees.

Objective 4. Promote snag retention and/or creation in all treated stands and evaluate implementation at least once this planning period.

- Action 1. Create and implement a timber sale specification to retain at least three living cavity trees per acre, and between 5-10 per acre as a combination of living cavity trees and dead and dying snags.
- Action 2. Promote and retain senescing (aging and deteriorating) trees when managing a forest stand.

Objective 5. Promote downed woody debris from a variety of species and size classes over the next two planning periods and reduce removal in areas managed for wildlife or mature forest conditions.

- Action 1. Encourage loggers to leave unmerchantable boles in timber sales to provide larger-diameter downed wood.
- Action 2. In areas with a wildlife habitat focus, implement the timber sale specification for creating dead and downed wood.
- Action 3. Minimize the amount of salvage harvesting during a forest disease or pest outbreak so that downed wood is left on site.
- Action 4. Prohibit firewood removal in Ecological Reference Areas, Dedicated Habitat Areas, and Special Conservation Areas managed with a wildlife habitat objective.

Climate change

All climate change data and information listed here is pulled directly from the open-source Northern Institute of Applied Climate Science Climate Change Impacts tool and Adaptation Workbooks. Based on

three established climate models, there are varying levels of evidence (robust, medium, limited) and agreement (high, moderate, low) described in the Predicted impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the Adaptation approaches section. For more information, please go to niacs.org.

Predicted impacts relevant to horizontal and vertical structure

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Tree regeneration and recruitment will change	Medium	High	Seedling survival is key to increasing structural complexity in stands.
Climate conditions will increase fire risks in northern Michigan by the end of the century	Medium	Moderate	Patchy fire may introduce more structural complexity in stands by openings up gaps, creating snags and downed wood.
Many invasive species, insect pests and pathogens in northern Michigan forests will increase or become more damaging by the end of the century	Limited	High	Patchy pest and disease distribution in stands may increase structural complexity by creating gaps and snags; may reduce compositional diversity.

Adaptation approaches

Increasing structural diversity components of a stand benefits the forest in a number of ways, including increasing productivity and recycling nutrients. It also increases the resiliency of those stands to withstand potential climate change impacts and stressors. Species variability buffers a community from climate risks because even if individual species are more susceptible, the community overall will prevail. Likewise, even-aged stands are more vulnerable to pests and pathogens, which are likely to increase in a warmer climate. Uneven-aged management not only promotes structural diversity, which is beneficial for wildlife species, but multiple age cohorts in a stand can withstand infestation better, as those impacts are often age-related. Maintaining a mix of ages, sizes or canopy positions will help buffer vulnerability to stressors of any single age class, as well as increase structural diversity within stands or across a landscape. The management actions in this section seek to achieve this through reducing impacts to soils and nutrient cycling; reducing competition for moisture, nutrients, and light; preventing establishment of invasive species; protecting future-adapted seedlings and saplings; managing herbivory to promote successful regeneration; and creating dead and downed wood.

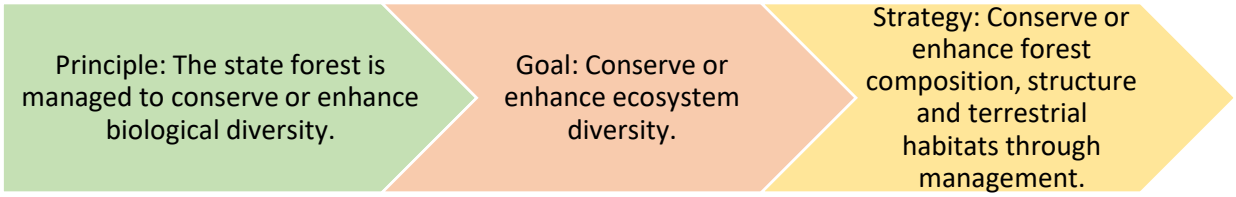
Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Area of stands by subcanopy density index
- Area of stands with supercanopy tree presence

- Volume of dead and downed fine and coarse woody debris (FIA cubic feet/acre)
- Count of standing dead greater than 5 inches DBH (FIA trees per acre)
- Percent of timber sales with snags or cavity trees retained

Management priority: Patch size, arrangement and connectivity landscape habitat condition



Why patch size, arrangement and connectivity matters

A patch is a relatively homogeneous, nonlinear area that differs from its surroundings. Patches can be large or small, rounded or elongated, and have straight or convoluted boundaries. Patch characteristics are important from a habitat perspective because different wildlife species or groups of species have different habitat needs that patches can provide. For example, many game species such as ruffed grouse prefer small patches of different-aged aspen that are arranged closely on the landscape. Other species such as black-throated blue warbler require larger, contiguous patches; these species are considered "area-sensitive" and are also called "forest-core interior" species.

Patches, corridors and matrix (which is the "background" ecosystem in a mosaic characterized by extensive cover and high connectivity) are elements of the overall landscape which is a mosaic (or pattern) of these elements.

Connectivity is a measure of how connected or spatially continuous a corridor, network or matrix is. The fewer gaps, the higher the connectivity. Some species of wildlife, such as American marten, require high connectivity to disperse across the landscape. This dispersal is important from both a species population perspective and a genetic (gene flow) perspective.

There is a relationship between patch size, shape and connectivity to species diversity. Generally speaking, the larger the patch size, the less edge a patch has; or conversely, the more interior habitat a patch has, and the more connected patches are across the landscape, the more diverse the landscape is.

From a wildlife habitat perspective, it is important to have a diversity of patch sizes to provide habitat for multiple wildlife species. Having large patches of mature forest with a high degree of connectivity is a habitat that is limited within the state forest.

Featured species associated with the patch size, arrangement and connectivity landscape habitat condition

American marten: area-sensitive, connectivity
Blackburnian warbler: area-sensitive
Black-throated blue warbler: area-sensitive
Cerulean warbler: area-sensitive
Kirtland's warbler: area-sensitive

Current condition and trend

An analysis of stands for the above set of featured species was done using a wildlife habitat matrix that details the habitat requirements of the species cross-walked to forest inventory data. Stand boundaries were dissolved, and the resulting polygons were divided into categories that are 250-499 acres, 500-4,999 acres, and 5,000-plus acres. The tables below illustrate that there are multiple patches in both the 250-499 and 500-4,999-acre categories, but relatively few in the 5,000-plus-acre category. This is our baseline data.

Table 1. Number of patches by region for black-throated blue warbler (BTBW) that are within the acreage categories of 250-499, 500-4,999, 5,000+. (source: Michigan DNR Forest Inventory data 2021).

Region	Number of BTBW Patches Between 250-499 Acres	Number of BTBW Patches Between 500-4,999 Acres	Number of BTBW Patches 5,000+ Acres	Total Number of BTBW Patches
NLP	52	58	1	**111**
EUP	46	29	--	**75**
WUP	65	26	--	**91**
Total	**163**	**113**	**1**	**277**

Table 2. Acres of black-throated blue warbler (BTBW) patches in patch size categories (250-499, 500-4,999, 5,000+ acres); this warbler requires patch sizes of 250 acres or greater (source: Michigan DNR Forest Inventory data 2021).

Region	BTBW Patch Acres in the 250-499 Acre Patch SIze	BTBW Patch Acres in the 500-4,999 Acre Patch Size	BTBW Patch Acres in the 5,000+ Acre Patch Size	Total BTBW Patch Acres
NLP	18,265	77,656	5,444	**101,364**
EUP	15,527	32,627	--	**48,154**
WUP	22,327	23,440	--	**45,767**
Total	**56,119**	**133,723**	**5,444**	**195,286**

Table 3. Number of cerulean warbler (CERW) patches by region that are within the acreage categories of 250-499, 500-4,999, 5,000+. (source: Michigan DNR Forest Inventory data 2021).

Region	Number of CERW Patches Between 500-4,999 Acres	Number of CERW Patches 5,000+ Acres	Total Number of CERW Patches
NLP	63	3	**66**
EUP	32	--	**32**
WUP	32	--	**32**
Total	**127**	**3**	**130**

Table 4. Acres of cerulean warbler (CERW) patches in patch sizes 500-4,999 and 5,000+ acres by region; CERW requires patch sizes of at least 1,000 acres (source: Michigan DNR Forest Inventory data 2021).

Region	CERW Patch Acres in the 500-4,999 Acre Patch Size	CERW Patch Acres in the 5,000+ Acre Patch Size	Total CERW Patch Acres
NLP	76,832	18,982	**95,814**
EUP	39,268	--	**39,268**
WUP	30,739	--	**30,739**
Total	**146,839**	**18,982**	**165,821**

Table 5. Number of patches by region for blackburnian warbler (BLBW) that are within the acreage categories of 250-499, 500-4,999, 5,000+. (source: Michigan DNR Forest Inventory data 2021).

Region	Number of BLBW Patches Between 250-499 Acres	Number of BLBW Patches Between 500-4,999 Acres	Number of BLBW Patches 5,000+ Acres	Total Number of BLBW Patches
NLP	74	65	2	**141**
EUP	79	52	--	**131**
WUP	69	46	--	**114**
Total	**222**	**162**	**2**	**386**

Table 6. Number of acres by region that are within the acreage categories of 250-499, 500-4,999, 5,000+ for blackburnian warbler (BLBW); this warbler requires patch sizes of at least 250 acres (source: Michigan DNR Forest Inventory data 2021).

Region	BLBW Patch Acres in the 250-499 Acre Patch Size	BLBW Patch Acres in the 500-4,999 Acre Patch Size	BLBW Patch Acres in the 5000+ Acre Patch Size	Total BLBW Patch Acres
NLP	25,102	86,766	10,960	**122,827**
EUP	27,579	61,736	--	**89,315**
WUP	23,795	44,204	--	**67,999**
Total	**76,475**	**192,706**	**10,960**	**280,141**

Table 7. Number of patches by region that are within the acreage categories of 250-499, 500-4,999, 5,000+, for American marten in the Upper Peninsula. (source: Michigan DNR Forest Inventory data 2021).

Region	Number of Marten Patches Between 250-499 Acres	Number of Marten Patches Between 500-4,999 Acres	Number of Marten Patches 5000+ Acres	Total Number of Marten Patches
EUP	104	101	5	**210**
WUP	121	107	2	**230**
UP Total	**225**	**208**	**7**	**440**

Table 8. Acres of American marten patches by Upper Peninsula region within the acreage categories of 250-499, 500-4,999, 5,000+; marten require large patches with high connectivity (source: Michigan DNR Forest Inventory data 2021).

Region	Marten Patch Acres in the 250-499 Acre Patch Size	Marten Patch Acres in the 500-4,999 Acre Patch Size	Marten Patch Acres in the 5,000+ Patch Size	Total Marten Patch Acres
EUP	36,020	120,696	53,213	**209,929**
WUP	43,029	131,871	17,245	**192,145**
UP Total	**79,048**	**252,567**	**70,458**	**402,073**

Table 9. Number of patches by region that are within the acreage categories of 250-499, 500-4,999, 5,000+ for American marten in the northern Lower Peninsula. (source: Michigan DNR Forest Inventory data 2021).

Region	Number of Marten Patches Between 250-499 Acres	Number of Marten Patches Between 500-4,999 Acres	Number of Marten Patches 5000+ Acres	Total Number of Marten Patches
NLP Total	**230**	**174**	**9**	**413**

Table 10. Number of American marten patch size acres by region that are within the acreage categories of 250-499, 500-4,999, 5,000+ in the northern Lower Peninsula; marten require large patches with high connectivity (source: Michigan DNR Forest Inventory data 2021).

Region	Marten Patch Acres in the 250-499 Acre Patch Size	Marten Patch Acres in the 500-4,999 Acre Patch Size	Marten Patch Acres in the 5,000+ Patch Size	Total Marten Patch Acres
NLP Total	**81,119**	**182,698**	**73,804**	**337,622**

Desired future condition, objectives and management actions

Large, contiguous forest habitat patches are managed throughout the state forest for area-sensitive wildlife species, and forest stand size and juxtaposition are considered in management decisions based on wildlife habitat mosaic requirements and connectivity needs.

Objective 1. Beginning this planning cycle, manage for large, contiguous forest habitat patches to benefit area-sensitive featured species in appropriate landscapes, including within the Conservation Area Network, in perpetuity.

- Action 1. Develop selection criteria to enhance/protect diversity under current and future climates.
- Action 2. Create Special Conservation Areas with the “wildlife habitat” objective for all 5,000 acres and selected 500- and 250-acre contiguous habitat patches to ensure long-term management for area-sensitive, mature-forest featured species outside of the high conservation value area network.
- Action 3. Manage for a minimum of 500-acre jack pine stand sizes in Kirtland's warbler habitat in the northern Lower Peninsula and one patch of at least 200 acres annually in Upper Peninsula outwash plains.
- Action 4. Manage for large contiguous patches within the high conservation value area, ecological reference area, natural area and other applicable Conservation Area Network designations.

Objective 2. Beginning this planning period, implement a landscape-level approach to managing habitat for featured species that require a mosaic of habitat types.

- Action 1. Each year of entry, especially within featured species geographic priority areas, identify stands to manage to ensure an appropriate mix of habitat requirements in juxtaposition based on featured species habitat management guidelines.

Objective 4. Determine connectivity needs for featured species within this planning cycle and consider evaluating migration corridors along climatic gradients to facilitate movements for species responding to climate change impacts.

- Action 1. Identify those species that have restrictive habitat requirements that may need more targeted migration corridor management.
- Action 2. Work with species experts to identify areas of climate refugia and movement corridors for featured species and delineate them using the SCA Habitat Areas and Corridors designation and DNR GIS feature layer.
- Action 3. Work with the FRD Biodiversity Coordinator to add attribute data that denotes the species of management interest to the SCA Habitat Areas and Corridors GIS feature layer.
- Action 4. Treat invasive species within migration corridors to reduce competition for migrating species.
- Action 5. Determine metrics for landscape connectivity.

Climate change

All climate change data and information listed here is pulled directly from the open-source Northern Institute of Applied Climate Science (NIACS) Climate Change Impacts tool and Adaptation Workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium, limited) and agreement (high, moderate, low) described in the Predicted impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and

management actions relevant to each management priority and are summarized in the Adaptation approaches section. For more information, go to niacs.org.

Predicted impacts relevant to patch size, arrangement and connectivity

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Species in fragmented landscapes will have less opportunity to migrate in response to climate change	Limited	High	Connectivity becomes increasingly important, especially for species with unique or isolated habitats or habitats that are particularly vulnerable to other climate change impacts and stressors.
Forest composition will change across the landscape	Medium	High	Patch size and arrangement may change for some wildlife species as forest composition changes.

Adaptation approaches

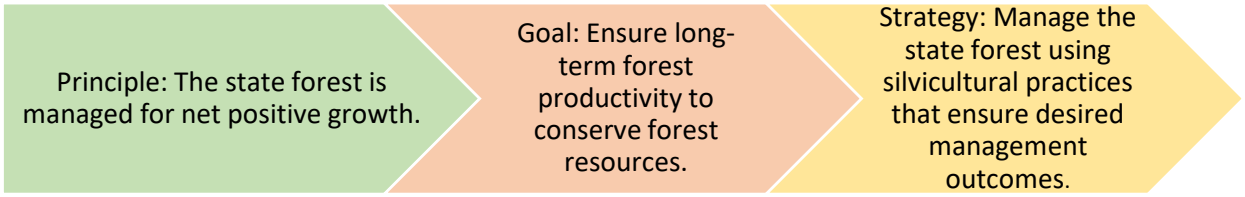
Adaptation approaches specific to wildlife habitat include focusing on protecting areas that are large, intact or aggregated, are oriented in ways that span gradients in climate, and that maximize topographic and geologic variety. Managing at a landscape scale for stepping stones and corridors can support natural movements of plants and animals. Continue to reduce landscape fragmentations and maintain and enhance species and structural diversity. This includes prioritizing and maintaining sensitive or at-risk species or communities and managing herbivory to promote regeneration of desired species. Managing for diversity can support the forest's ability to resist pests and pathogens.

Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Area of mature forest greater than 250 contiguous acres
- Area of mature forest greater than 250 contiguous acres
- Area of mature forest greater than 5,000 contiguous acres

Management priority: Forest regeneration



Why forest regeneration matters

Forest regeneration is the process of re-establishing tree cover by ensuring that seedlings and saplings in the understory survive and grow; this is one of the most basic and important elements of sustainable forest management. Successful regeneration is vital to forest health and productivity, particularly after a harvest, pest or other disturbance event. This success is based on environmental factors such as sunlight and rainfall, biotic factors such as disease, competition and allelopathy in other plants, and browsing damage from species like deer and elk. Regenerating trees contribute to vertical and horizontal structure within stands, which provides a variety of important habitat values for different wildlife species. The composition of this regrowth determines the future makeup of the forest. The forest composition, in turn, determines the type of forest products, recreational opportunities and habitat availability. Additionally, the forest composition can influence resistance to pests and diseases, as well as carbon storage capacity. Forest regeneration is critical to forest sustainability.

Current condition and trends

The DNR transitioned from planting bare-root seedlings to containerized seedlings in 2022 for to increase seedling survival and growth, and multiple years of regeneration survey data have been collected within these planted stands. Planted stands are checked at one- and three-year intervals for regeneration success. Regeneration survey results indicate planted red and jack pine stands are regenerating well. Year one surveys of planted red pine stands show very low seedling mortality across a majority of stands (Figure 1) and mortality increased modestly by the end of the third growing season (Figure 2). Year three surveys also indicate that a large majority of planted red pine stands are free to grow, meaning seedling growth is not impeded by competing vegetation (Figure 3).

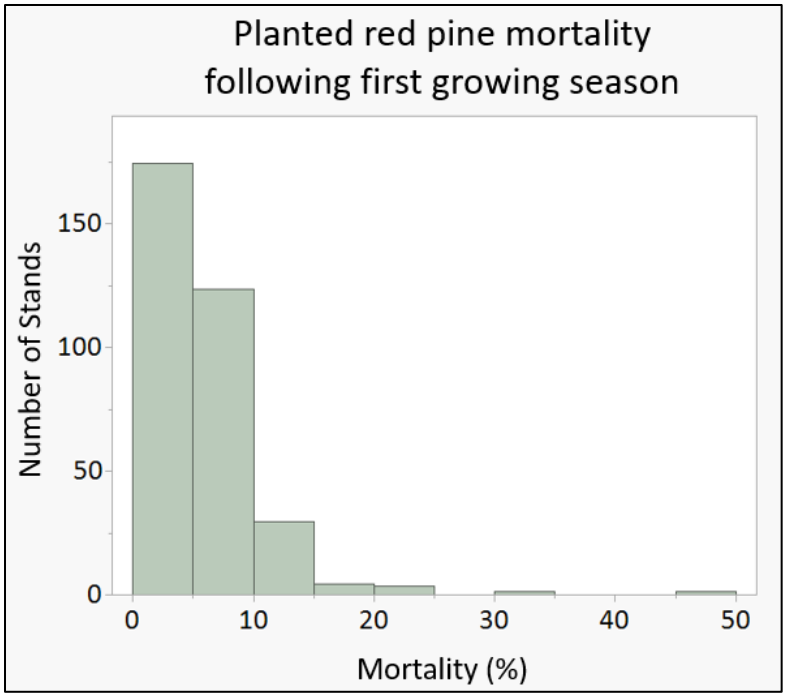


Figure 1. Stand-level mortality results of planted red pine at the end of the first growing season.

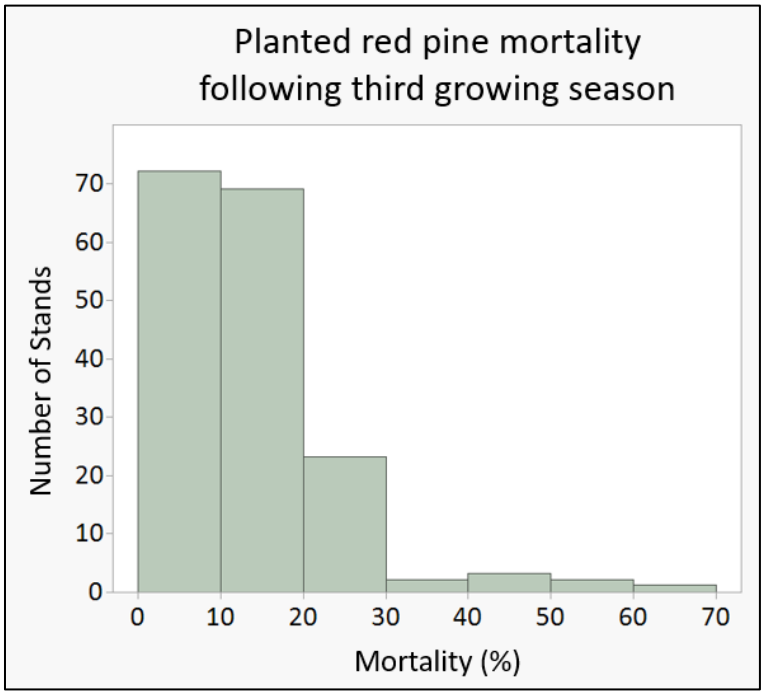


Figure 2. Stand-level mortality results of planted red pine at the end of the third growing season.

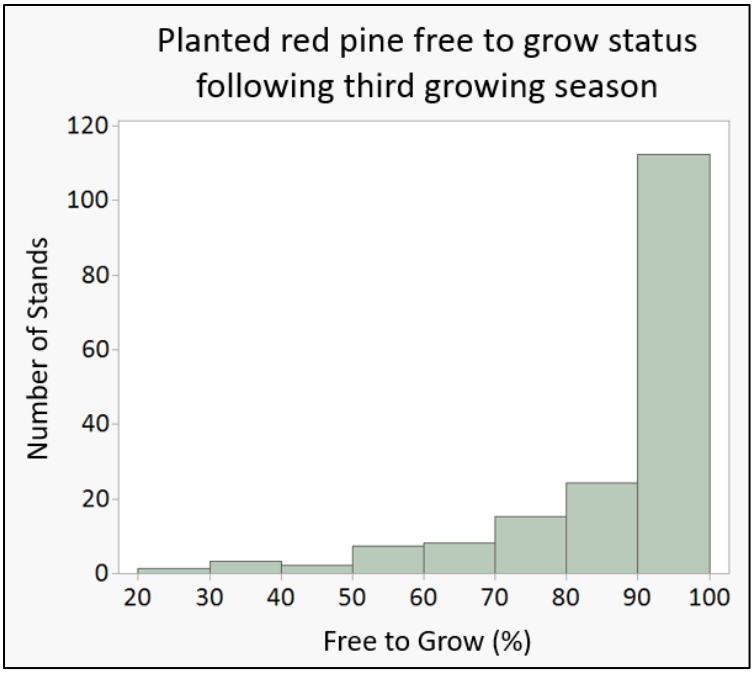


Figure 3. Stand-level free to grow results for planted red pine at the end of the third growing season.

The regeneration success for planted jack pine is measured in terms of surveyed trees per acre (TPA). The initial planting density for production jack pine is 900 TPA and for Kirtland's warbler jack pine planting the target planting density is 900-1,452 TPA. Year three (2024) regeneration surveys indicate a large proportion of planted stands are meeting or exceeding the target TPA for both production jack pine (Figure 4) and jack pine planted for Kirtland's warbler habitat (Figure 5), with survey TPA results reflecting the sum of both planted and naturally regenerating jack pine within stands.

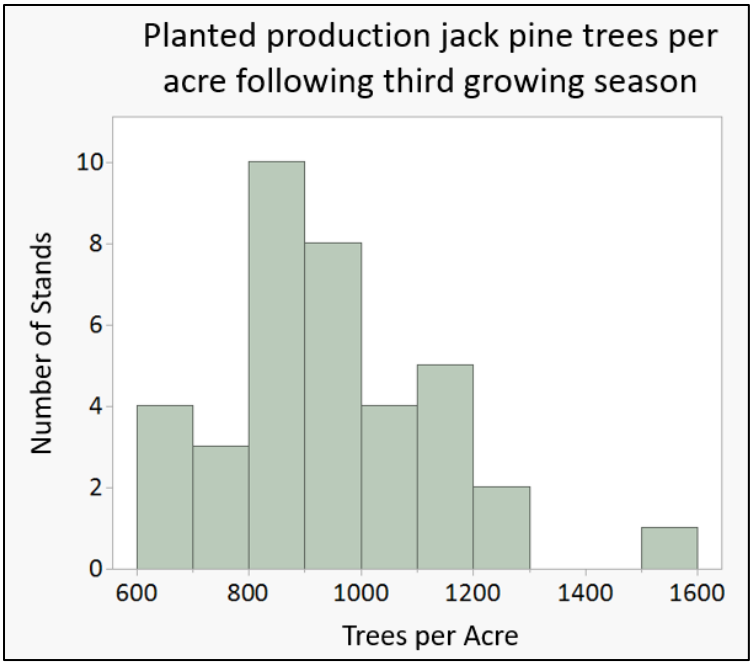


Figure 4. Stand-level trees per acre estimates of planted production jack pine at the end of the third growing season.

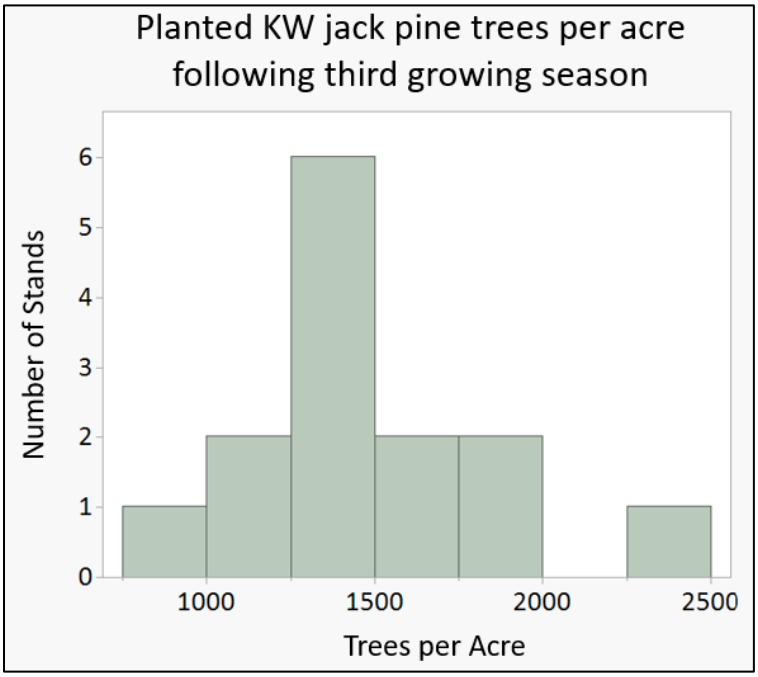


Figure 5. Stand-level trees per acre estimates of jack pine planted for Kirtland's warbler (KW) habitat.

A lack of consistent data collection on naturally regenerated stands makes it difficult to establish long-term trends. Forests that are naturally regenerated typically get reassessed for success at the next 10-year inventory cycle. Browsing damage from deer and elk can have a substantial impact on regeneration, particularly for species like oak, cedar, hemlock, maple, white pine and aspen, but this is difficult to quantify (see the herbivory management priority section). Species such as aspen are reliable regenerators in all but the most heavily browsed landscapes. Additional research is being conducted on hard-to-regenerate forest types such as cedar and northern hardwoods.

Desired future condition, objectives and management actions

Across the landscape, forested cover types are regenerated after harvest or disturbance events using appropriate silvicultural techniques and climate adaptation strategies to minimize failures.

Objective 1. Improve systematic collection and reporting of regeneration checks across plantations and natural regeneration within the planning period.

- Action 1. Develop a uniform database for reporting regeneration success or failure.
- Action 2. Ensure that regeneration checks are done in a timely manner, following the DNR's Forest Regeneration Survey Manual.
- Action 3. Report annually on the success or failure of regeneration efforts.

Objective 2. Reduce regeneration failure rates to acceptable levels based on the DNR's Forest Regeneration Survey Manual this planning period.

- Action 1. Identify cover types with high failure rates and probable causes.
- Action 2. Reevaluate the 3-year monitoring window and elongate for cover types that require more time for establishment.
- Action 3. Where appropriate, incorporate adaptive actions and techniques for regeneration treatments, including assessments and retention of seed sources, the timing of and intensity of scarification, invasive plant and prescribed fire treatments.
- Action 4. Identify species expected to be better adapted to future conditions.
- Action 5. Identify forest regeneration research needs.

Climate change

All climate change data and information listed here is pulled directly from the open-source Northern Institute of Applied Climate Science Climate Change Impacts tool and Adaptation Workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium, limited) and agreement (high, moderate, low) described in the Predicted impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the Adaptation approaches section. For more information, go toniacs.org.

Predicted impacts relevant to forest regeneration

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Tree regeneration and recruitment will change	Medium	High	Seedlings are more vulnerable than mature trees to changes in temperature, moisture, and other seedbed and early growth requirements; they also are expected to be more responsive to favorable conditions.

Adaptation approaches

Warmer temperatures, changing precipitation regimes, longer and drier growing seasons and lower soil moisture may all have impacts on both natural tree regeneration as well as survival of planted tree seedlings. More intentional pairing between tree species with the right soil moisture types will be key to landscape cover type planning. Planting species expected to be adapted to future conditions and resistant to insect pests or present pathogens, planting larger individuals to increase survivability are adaptations for artificial regeneration. For natural regeneration, creating suitable physical conditions through site preparation and monitoring areas of natural regeneration on a more frequent basis and prioritizing planting or seeding where natural regeneration is slow to succeed are options for certain cover types.

Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Proportion of planted sites with successful regeneration at one and three years
- Proportion of planted sites with failed regeneration at one and three years
- Proportion of planted sites with hard-to-regenerate cover types with successful regeneration at five-year check
- Proportion of planted sites with hard-to-regenerate cover types with failed regeneration at five-year check

Management priority: Tree growth, mortality and removals

Principle: The state forest is managed for net positive growth.

Goal: Manage the state forest to maintain or enhance tree productivity.

Strategy: Ensure forest regeneration and recruitment to offset mortality and harvest removals.

Why tree growth, mortality and removals matter

Tree growth, removal and mortality are indicators of forest productivity and sustainability. Tree growth describes how much trees have grown in the forest, removals are what has been harvested, and the mortality is a measure of tree loss due to natural deaths (e.g., windfall, pests, disease). Each forest type differs in productivity based on many factors such as soils, nutrients, landscape context or management. A sustainable forest has stable or increasing tree growth relative to loss from mortality or removals.

Current condition and trend

From available summarized Forest Inventory and Analysis data, total growth appears to be rising slightly due to sustainable management. Figure 1 below shows the total growth in the state forest over time, represented by the green line. The bars in the figure show mortality (blue) and removals (yellow). Mortality is on the rise, likely due to recent outbreaks of insect pests, including emerald ash borer, spruce budworm and beech bark disease.

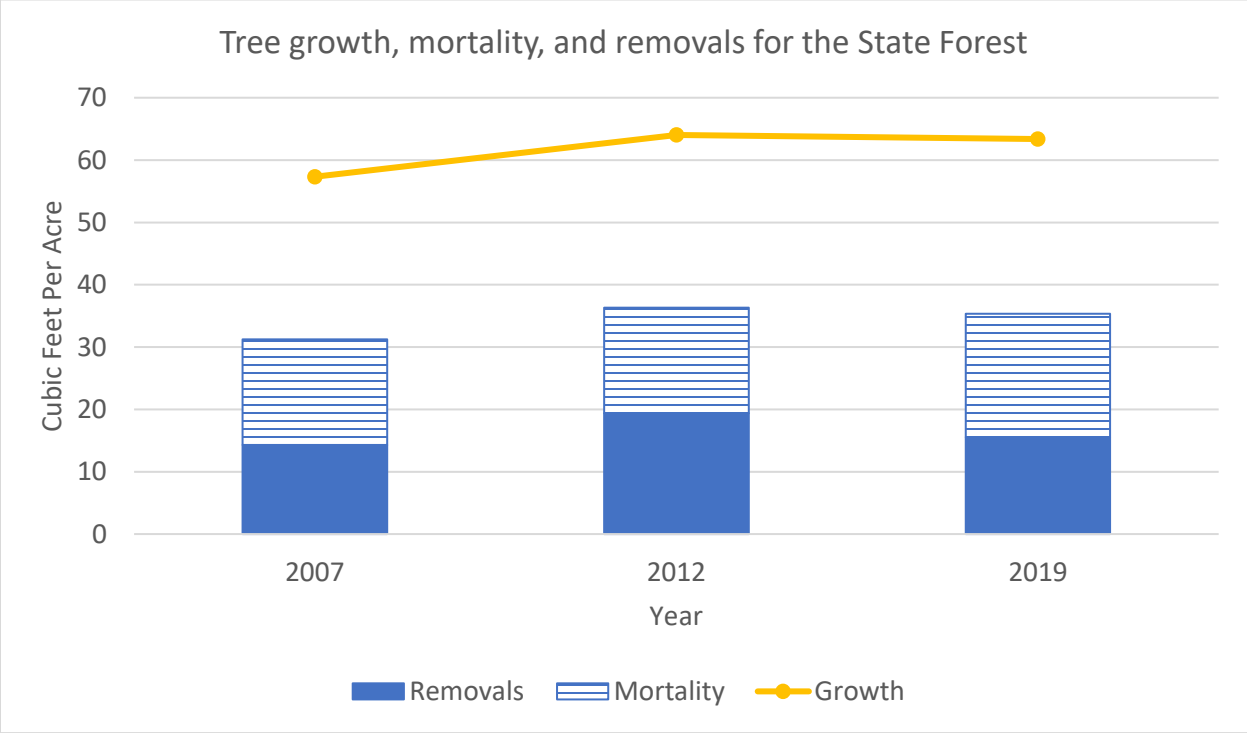


Figure 13. Growth, mortality and removals within the state forest by year (source: FIA data).

Desired future condition, objectives and management actions

Tree mortality and removals will be less than tree growth to sustain healthy, productive forests in a changing climate.

Objective 1. Monitor tree growth, mortality and removals across the state forest to ensure sustainability.

- Action 1. Continue to review FIA summary data to track trends in total tree growth, mortality and removals.
- Action 2. Continue to manage the state forest at sustainable harvest levels using Remsoft Woodstock modeling software and implementing results.

Climate change

All climate change data and information listed here is pulled directly from the open-source Northern Institute of Applied Climate Science Climate Change Impacts tool and Adaptation Workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium, limited) and agreement (high, moderate, low) described in the Predicted impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the Adaptation approaches section. For more information, go to niacs.org.

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Northern Michigan's forest productivity will increase by the end of the century	Medium	Moderate	Model projections and other evidence support modest productivity increases for forests across northern Michigan under climate change.
Northern Michigan soil moisture patterns will change, with drier soil conditions later in the growing season	Medium	Moderate	Driers soils may increase rates of mortality directly due to drought stress or indirectly due to greater vulnerability to insect, disease and other stressors as a result of drought stress.

Adaptation approaches

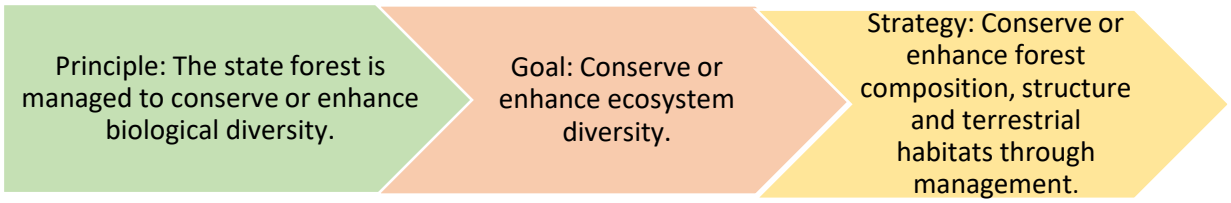
Forest growth is a complex metric with many facets that are affected by climate change. This includes projected increases in growth due to longer growing seasons contrasted by the potential for increased mortality due to more frequent insect and disease outbreaks, herbivory and changing wildfire regimes. In addition, public demand for multiple benefits from forests may put increased pressures on forest ecosystems. Increased productivity of the forest and the control of insect and disease outbreaks, along with increases in utilization of forest products, may help to keep forest growth in a positive balance.

Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- FIA summary data on total tree growth, net growth, mortality and removals

Management priority: Stand size



Why stand size matters

The basic unit of forest management is the stand. A stand is an area where the plant composition, age, size, density and structure are relatively uniform. These stand attributes are what stand examiners use to classify a stand, and it is the unit upon which any management activity takes place. This is generally because the uniformity suggests similar enough site conditions that management actions should have similar results across the stand. Typically, it is also this uniformity in stand composition that determines stand size; however, sometimes other considerations influence the management objectives, and that can result in stands being split (e.g., for age-class diversity or to create more early successional forest) or grouped together (e.g., to create larger patches for wildlife habitat). DNR mapping conventions for stand inventory require any nonforested stand to be a minimum of 1 acre and any forested stand to be a minimum of 5 acres (with some limited exceptions); however, beyond that, there are no other size guidelines. Therefore, stand sizes can vary across the state forest.

Patch is a similar term used when managing forests. It is also defined generally as an area with relatively homogenous vegetation and at times can be used interchangeably with stand. However, in conventional use, patch is a more general term that can refer to a residual area within a stand, like a retention island, or it can refer to a larger landscape of similar stand mosaics. Patches are used more often in a wildlife management context, where habitat attributes are emphasized over the administrative management delineations that make up stand boundaries. In relatiuon to wildlife, patch size, shape, juxtaposition and connectivity influence the abundance, dispersal and spatial distribution of species.

Though stand and patch size aren't direct measures of forest sustainability, they do help provide an indication of the heterogeneity and continuity (or fragmentation) of the state forest at various spatial scales. They also allow for comparisons between available stands and those classified as unavailable or that are under a conservation designation. Changes over time in stand and patch size can be assessed with regard to connectivity, juxtaposition and edge impacts, which influence wildlife species diversity and distribution. Patch size is discussed further in the management priority section titled Patch size, arrangement and connectivity. Stand size can also have impacts on operational costs and efficiencies.

Current condition and trend

Stand sizes on the state forest have changed over time (Table 1) due a number of factors, including changes in management approaches and priorities. Some of this can be attributed to changes in business practices. Improvements in technology have resulted in more accurate, and thus often smaller, stand delineations, as remote sensing and aerial images have vastly improved over the last several decades and GIS digitization tools have become the norm. This is especially true for non-forested stands. Historically water, marsh and other lowlands were lumped together, as were unavailable uplands.

Several forest inventory classification systems in place over the last few decades have resulted in the addition of more cover types. The increase in cover type classifications, from 26 to 35, has decreased average stand sizes since the land base is divided into more categories. This more detailed delineation over the years has caused a decrease in average stand size of the more mixed lowland conifer cover types and a consequent increase in average stand size of cedar. The land base itself has changed over time as parcels have been sold and acquired.

Management objectives have also played a role in the decline in average stand acres. For example, ruffed grouse management recommendations beginning in the 1970s were to manage small blocks of aspen in close proximity in 10-year rotations so that all the life-stage needs for the bird were in one local area. Moreover, stand delineation guidelines likely lend themselves more to splitting than lumping given slight changes in composition or structure. It has also been common practice to break up large, contiguous blocks of cover types in the same age class into smaller patches by harvesting smaller parts of the stand each entry, resulting in smaller future stands. This is especially common in even-aged cover types, where an even age-class distribution across the landscape is a desirable condition.

Table 1. Historical average stand acres between 1988 and 2013 across the state forest for the eight cover types where reliable trend data was available (source: DNR OI, IFMAP, Michigan DNR Forest Inventory data 2021).

Cover Types	1988	1997	2005	2013	Change in Acres	Percent Change
Aspen	38.0	33.7	27.1	27.5	-10.5	-28%
Cedar	39.6	36.7	34.2	41.6	2.0	5%
Hemlock	26.2	23.2	19.0	21.1	-5.0	-19%
Jack pine	43.9	39.5	30.6	33.4	-10.5	-24%
Northern hardwood	46.7	41.3	33.2	35.6	-11.2	-24%
Oak mix, northern red oak, black/red hybrid oak	41.4	34.9	28.1	28.3	-13.0	-31%
Lowland conifers	42.6	37.0	29.5	29.9	-12.8	-30%
Red pine	36.0	31.1	21.9	23.4	-12.6	-35%

Across the state forest, all cover types show decreasing average stand sizes over the last few decades, with the exception of cedar, which also had the largest average stand size at approximately 42 acres. By region (Table 2), current data indicates that the average stand size for cedar has increased to 45 acres, and it is the second-largest average after planted jack pine at 51 acres. Jack pine guidance for Kirtland's warbler management in the northern Lower Peninsula in the last couple of years has been to increase stand sizes to a minimum of 300 acres. As that new guidance continues to go into effect, the average jack pine stand size is expected to increase. Cedar and jack pine are followed by treed bog (40 acres) and northern hardwoods (38 acres). The rest of the forested cover types are averaging between 13 and 30 acres. For a state forest land base of almost 4 million acres, this would tend to suggest a highly heterogenous, patchy state forest landscape.

Table 2. Average stand acres by cover type and region (2026). Year 2026 is the incremented data set based on projection of completed harvest treatments that were in MiFI in 2021. (source: *Michigan DNR Forest Inventory data 2021)*

Cover Type	NLP	EUP	WUP	Average Across Regions
Aspen	26	28	33	**28**
Bare sparsely vegetated	4	13	12	**7**
Black red hybrid oak	26		16	**25**
Bog	9	16	21	**13**
Cedar	34	55	46	**45**
Cropland	6	13	36	**11**
Hemlock	11	19	29	**22**
Herbaceous openland	5	18	7	**7**
Low-density trees	11	23	10	**12**
Lowland aspen balsam poplar	21	28	23	**23**
Lowland conifers	28	31	30	**29**
Lowland deciduous	22	25	23	**22**
Lowland mixed forest	25	26	29	**26**
Lowland shrub	18	35	23	**24**
Lowland spruce fir	18	23	26	**23**
Marsh	18	39	16	**24**
Mixed upland deciduous	25	23	28	**25**
Natural jack pine	26	31	26	**28**
Natural mixed pines	20	23	24	**21**
Natural red pine	16	22	19	**19**
Natural white pine	14	23	20	**17**
Northern hardwood	40	38	36	**38**
Northern red oak	29	27	29	**29**
Oak mix	29	28	33	**29**
Planted jack pine	58	41	33	**51**
Planted mixed pine	31	23	27	**30**
Planted red pine	27	31	26	**28**
Planted white pine	20	22	28	**20**
Tamarack	26	25	31	**27**
Treed bog	16	44	37	**33**
Upland conifers	15	29	25	**24**
Upland mixed forest	22	29	27	**25**
Upland shrub	15	21	11	**15**
Upland spruce fir	10	16	13	**13**
Urban	6	7	6	**6**
Water	14	11	13	**13**
Region Average	**22**	**30**	**28**	**25**

Desired future condition, objectives and management actions

Forest stand sizes are variable across the landscape and encompass needs for timber operations, wildlife habitat and movement corridors, and natural disturbance regimes where applicable, thereby increasing climate change resiliency through landscape diversity and migration pathways.

Objective 1. Stabilize the decline in average stand size by cover type this planning period and increase average stand sizes to 40 acres in the next two planning cycles (20 years).

- Action 1. Minimize the practice of splitting larger stands for age-class diversity.
- Action 2. Allow for small inclusions of some structural diversity within a stand boundary if that reduces the practice of stand splitting.
- Action 3. Reevaluate age class diversity site conditions to recombine adjacent stands that are similar in composition, age class, basal area, density and/or structure where possible.
- Action 4. Where possible -- especially for long-lived cover types such as northern hardwoods, cedar and natural pines -- identify opportunities for stand enlargement based on adjacent cover type, landform, Kotar habitat, etc., and use the long-term management objective in the new MiFI (October 2024), site conditions and/or Special Conservation Areas to identify stands to combine with in the future through silvicultural application.

Climate Change

All climate change data and information listed here is pulled directly from the open-source Northern Institute of Applied Climate Science Climate Change Impacts tool and Adaptation Workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium, limited) and agreement (high, moderate, low) described in the Predicted impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the Adaptation approaches section. For more information, go to niacs.org.

Predicted impacts relevant to stand size

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Species in fragmented landscapes will have less opportunity to migrate in response to climate change	Limited	High	Small stand sizes through administrative decisions will further exacerbate habitat fragmentation and impede the ability of species to migrate to areas of suitable habitat in a changing climate.
Systems that are limited to particular environments will have less opportunity to migrate in response to climate change	Limited	High	Reducing stand sizes based on administrative decisions can geographically minimize already limited systems to a smaller portion of the landscape and make it even harder for species with particular habitat requirements to find climate-induced migration pathways.

Adaptation approaches

One concern with small stand sizes is that the high heterogeneity on the landscape hinders movement of wildlife and plant species due to a lack of contiguity or connectivity between habitats. Climate change impacts may further impede the ability of species to move due to changes in temperature, precipitation, soil moisture and growing season. Combined with the expectation that tree species will respond individually to these changes, competitive advantage will be given to those species that have a wider range of environmental tolerance and possibly to southern species moving north. Identifying species with the lowest ranges of environmental tolerance that may be migration-challenged and managing for movement corridors will mitigate these impacts.

Smaller stand sizes are also likely more susceptible to impacts from invasive plants, pest and pathogens. More small stands on the landscape means more visits by field staff for inventory, timber sale preparation and administration, and it means more logging equipment being hauled around any given area. There is higher potential, then, ofinvasive species moving around the landscape. Small stand sizes have a higher edge-to-interior ratio, and this likely makes them more susceptible to establishment of invasive species. Managing for larger stand sizes and ensuring proper decontamination protocols are established and followed by staff and contractors will be important.

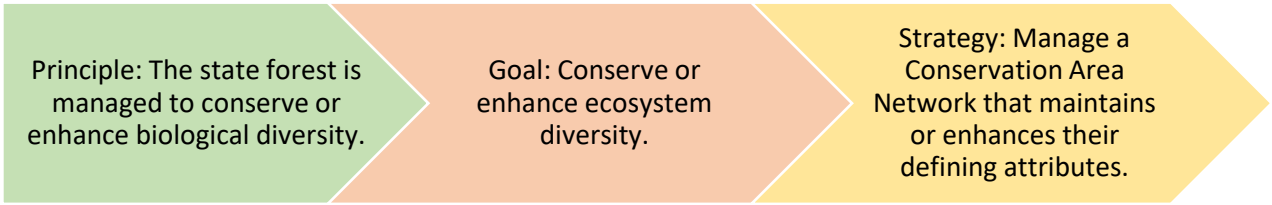
Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Average stand size by cover type by management availability
- Average stand size by cover type by Conservation Area Network designation

Biological diversity

Management priority: conservation area network



Why a conservation area network matters

The Michigan Department of Natural Resources has used many mechanisms to recognize areas that may hold particular or special biological/ecological, social, economic or conservation-based values. For example, some state natural areas have been dedicated by Natural Resource Commission resolutions, some by land use orders under the authority of the Director, and some areas are managed through memorandums of understanding and statute.

Over time, it has become challenging to sift through naming conventions and designations to understand the broad range of conservation values within the state forest system. This section provides a description of areas of the state forest identified with specific or special attributes that are considered in management planning activities. Most of these areas are noted for renewable resource conservation values. However, some social and nonrenewable categories (e.g., concentrated recreation areas) have been included to document their presence.

Areas with specific conservation values are sorted into two primary categories: Special Conservation Areas (SCAs) and High Conservation Value Areas (HCVAs). Together, they comprise the Conservation Area Network for the state forest. Each category of SCA and HCVA has a conservation value trait and a "level of recognition" trait. When combined, they determine whether an area is identified as an HCVA or SCA. Specific areas can be added, removed, or moved between these categories over time, based on conservation values and level of recognition.

Identified HCVAs and SCAs are managed to conserve, protect and/or enhance the defined conservation objective or value. The methods used will vary, depending on the objective and type of designation. Methods can include active management or allowing access for multiple resource values that are compatible with the defined conservation objective or value. All areas are managed to protect immediate natural resource values as well as human health and safety. Areas designated as HCVAs and SCAs may overlap one another and are not mutually exclusive.

The Conservation Area Network is an important component of a robust climate adaptation strategy for state forest lands. Lands within the network provide places where fundamental ecological functions such as soil nutrient cycling and hydrology are sustained. In addition, lands within the network include some areas that have been generally undisturbed by humans, providing refugia (an area where organisms can survive through a period of unfavorable conditions) and reference conditions (the standard or benchmark against which current condition is compared).

By design, the Conservation Area Network functions to conserve biological diversity, which can be defined in this case as a variety of species and ecosystems that occur on state forest land. By conserving biodiversity, ecosystem functions such as soil, air, and water quality also remain intact. The DNR has a goal to preserve working natural resource lands, conservation lands and freshwater resources to provide biological diversity, climate change resilience and recreational access for generations to come.

Management direction for SCAs and HCVAs is provided in DNR Forest Certification Work Instruction 1.4 - Biodiversity Management on State Forest Lands.

Special Conservation Areas

Areas of state forest with one or more identified conservation objectives interest, or element are recognized as SCAs. Conservation objectives listed in the SCA category have been identified through a variety of methods, and it is important to understand how each objective was determined. The type and strength of recognition — and possible management options — will vary depending on the process used to identify the conservation value. For example, some objectives are detailed land use orders of the Director (carrying the force of law) while others may be identified through cooperative agreements (administrative direction). Conservation objectives also are specified through DNR guidelines for areas such as deer wintering complexes and riparian buffers, or the lands around bodies of water. The SCA category may also be used to document areas identified by an external group or organization, such as the National Audubon Society's Important Bird Areas Program. The SCA definition is purposely broad to encompass a spectrum of conservation interests and elements. It provides the land manager and/or stand examiner with information to make informed management decisions. Some SCA categories are reviewed and updated through the compartment review process, while others are what we refer to as static, because they rarely change and require a higher level of review.

The types of SCAs include Wild and Scenic Rivers; Potential Type I and Type II Old Growth; Common Natural Heritage Element Occurrences; Concentrated Recreation Areas; Visual Management Areas; Cold Water Lakes and Streams; Non-dedicated Natural Areas; Habitat Areas and Corridors; Research Areas; Great Lakes Islands; Contiguous Resource Areas; Archaeological Sites; Cultural or Customary Use Areas; Springs Wetlands and Riparian Areas; Military Lease Lands; and Mineral Resource Areas.

Wild and Scenic Rivers

Wild and Scenic Rivers preserve a selection of our state's finest river systems in free-flowing condition for current and future generations to enjoy and use. Wild and scenic rivers are established under authority of the National Wild and Scenic Rivers Act, Public Law 90-542, as amended. The process for establishing a wild and scenic river includes nomination, development of a management plan, public hearings, and action by the U.S. Congress. Each Wild and Scenic River has a river-specific federal management plan, and state agencies may enter into written cooperative agreements with the administering federal agency to manage Wild and Scenic Rivers that are on state-owned lands.

Potential Type 1 and Type 2 Old Growth

This SCA category contains areas of the state forest that field staff identify and recommend for evaluation as potential old growth forest. Old growth forest (also termed primary forest, ancient forest, virgin forest, or primeval forest) is an area of forest that has few or no signs of human disturbance and exhibits unique ecological features related to age, composition, and associated structure. Old growth

forests are of natural origin. They may be dominated by late successional forest species (i.e. sugar maple and American beech) or may be a very old example of a stand dominated by long-lived early- or mid-seral species (i.e. oak, or red pine).

Actively or passively managed second-growth forest stands (of natural or planted origin) which were effectively clearcut in the late 1800s and early 1900s but have subsequently developed late-successional or old growth structure, composition, and function are not considered to be Type 1 or Type 2 Old Growth.

Old growth stands and forests include:

- **Type 1 Old Growth**: A forested area, 3 acres or more in size, that has never been logged and that displays old-growth characteristics.
- **Type 2 Old Growth**: A forested area of 20 acres or more that has been logged (minor cutting), but which does not result in the elimination of any major canopy species and that retains (never lost) significant original elements of old-growth structure and functions.

Criteria for evaluation of potential Type 1 and Type 2 Old Growth characteristics are described in DNR forest certification Work Instruction 1.4 – Biodiversity Management on State Forest Lands. Upon completion of evaluation, an area that is verified to meet the criteria for Type 1 or Type 2 Old Growth will become a High Conservation Value Area.

Common Natural Heritage Element Occurrences

The Michigan natural heritage database is maintained by the Michigan Natural Features Inventory (MNFI) and contains records (element occurrences) of both rare and common natural communities that are known to Michigan. Element occurrences are notable and representative examples of natural communities in Michigan as determined by MNFI using an internationally recognized natural heritage methodology developed and used by NatureServe.

All rare and representative subsets of the highest-quality common natural communities on state forest land are designated as HCVA Ecological Reference Areas, which are discussed further in the HCVA section below. This SCA category is comprised of those remaining common element occurrences that are not designated as an ERA.

Common natural community element occurrences upon state forest land in this SCA category are mostly wetland or Great Lakes shoreline communities and are emergent marsh, inundated shrub swamp, muskeg, northern shrub thicket, northern wet meadow, poor conifer swamp, submergent marsh and volcanic cobble shore, but do contain some rare community occurrences of mesic northern forest and dry-mesic northern forest that were not selected for a HCVA.

Concentrated Recreation Areas

Concentrated recreation areas are designed and maintained for routine or heavy recreational use, including state forest campgrounds, motorized and non-motorized trails, trailheads, staging areas and public boating and fishing access sites. Many of these areas have had long-term historic use which has led to the more formal establishment of recreation facilities.

Recreational resources provide the basis for significant components of many regional and local economies. Economic benefits range from direct spending on equipment and related supplies to indirect support from local hotels, restaurants and other businesses. Many social and historical traditions are also associated with recreational resources and the maintenance and preservation of these resources for future generations is important to society.

Natural Beauty Roads

PA 357, Natural Beauty Roads, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended, provides for county road commissions to designate natural beauty roads. The purpose of natural beauty roads is to preserve native vegetation scenic values in a road right-of-way from destruction or substantial damage by cutting, spraying, dusting, mowing, or other means. However, guidelines adopted by county road commissions cannot prohibit the application of accepted principles of sound forest management along a natural beauty road.

Visual Management Areas

The state forest possesses aesthetic values that provide important social and economic benefits to many local communities, including a social appreciation of exceptional scenic vistas. Fall color tours are an important component of many regional and local economies, offering significant direct support of local hotels, restaurants, and tourist-related businesses. The maintenance and preservation of scenic resources for future generations is important to our society. Types of Visual Management Areas include scenic turnouts.

Designated Trout and Cold-Water Streams

Trout streams and trout lakes provide habitat for cold-water species and are established by the DNR director's action and by Fisheries Order 210 and Fisheries Order 200, respectively. Cold-water fisheries provide important habitats and thermal conditions for cold-water aquatic species across the Michigan landscape. They are also recreational resources, serving as significant components of many regional and local economies. Economic benefits range from direct spending on equipment and related supplies to indirect support of local hotels, restaurants, and other businesses. Many social, cultural, and historical traditions also are associated with cold-water resources. Maintaining and preserving these resources for future generations is critically important.

Non-dedicated Natural Areas

This SCA category contains areas which may be good candidates for, but are not legally dedicated as, Natural Areas (NAs), as per the requirements of Part 351, Wilderness and Natural Areas, 1994 PA 451, as amended. There are multiple types of recognition within this category as identified in the Michigan Natural Areas Strategic Plan (Michigan Department of Natural Resources 2000) that include natural areas, wilderness areas and wild areas that have been nominated or proposed for legal dedication. Natural areas provide recreational opportunities for those who appreciate the inherent or intrinsic value they may hold and provide valuable and important research and educational opportunities.

Habitat Areas and Corridors

These SCAs are areas recognized through an administrative designation via agreements or Division initiatives and provide specific annual habitat needs for wildlife species.

Habitat areas include obligate and conditional deer winter range; occupied and potential wood turtle habitat; freshwater mussel streams; important bird areas (as identified by the National Audubon Society); and grassland openings and savannas.

Habitat areas are distinct from HCVA Dedicated Habitat Areas as they are more general in nature and are not primarily associated with threatened or endangered species that have species management plans developed in cooperation with federal agencies.

Stream riparian and adjacent upland areas are important nesting habitat for wood turtle and other turtle species. Facing substantial declines over the last century, wood turtles are designated as a state threatened species in Michigan and the U.S. Fish and Wildlife Service has been petitioned to list them under the Federal Endangered Species Act.

In North America, freshwater mussels have been identified as the most imperiled of any major group of animals. Of the 44 mussel species found in Michigan, 19 (43%) are listed as either endangered or threatened pursuant to Part 365, Endangered and Threatened Species, of the Michigan Natural Resources and Environmental Protection Act (1994 PA 451). Five of these species are also federally listed and receive additional protection pursuant to the Endangered Species Act (87 Stat. 884, as amended 16 U.S.C.§ 1531 et seq.). An additional 12 species are in decline and are identified as species of special concern.

Freshwater mussels are an important component of the biodiversity of Michigan's aquatic ecosystems. They have a unique ecological role in both rivers and lakes and are valuable indicators of ecosystem integrity and function. Mussels are of significant value to the health of aquatic ecosystems, functioning as a food source for some fish and terrestrial animals. They often comprise a significant amount of the total biomass of all benthic invertebrates. The spent shells also serve as physical habitat and are often colonized by a variety of aquatic insects and other macroinvertebrates. Since they are filter feeders, they play an important role in nutrient uptake and increasing water clarity. Freshwater mussels are sensitive to declines in physical habitat and water quality; this is especially true during early life stages which are likely one of the most sensitive of aquatic organisms. Because mussels are generally long-lived, relatively immobile, and reliant on fish hosts for reproduction and dispersal, their community status can provide an integrative view of physical, chemical and biological changes in a watershed.

Freshwater mussel stream groups are determined by a linear model that incorporates Michigan Natural Features Inventory element occurrence data and predictions of where special concern, threatened, or endangered species are likely to occur within a given HUC10 watershed based on habitat and connectivity. There are three groups, which determine the degree of survey needed and appropriate survey protocol(s). Group 1 waters are river or stream segments known to support special concern mussel species and have suitable habitat but lack mussel occurrence data. Group 2 waters are stream and river segments with state threatened or endangered species expected. Group 3 waters are stream and river segments where federally listed mussel species are expected.

The Great Lakes, particularly coastal and nearshore areas, provide globally or continentally important stopover sites for all groups of migratory birds: waterfowl, shorebirds, landbirds (defined here as songbirds and raptors) and waterbirds (loons, grebes, cormorants, herons, rails, cranes, gulls, and terns). The Great Lakes shoreline provides essential stopover habitat for birds to rest, feed, and shelter during migration. Some of these areas are classified by Michigan Audubon as Important Bird Areas (IBAs), including Whitefish Point, where thousands of birds migrate through every spring and fall.

Habitat corridors are often associated with lowland riparian and wetland communities. Corridors provide connective cover between different community types that are used by a wide variety of wildlife species whose life cycles require multiple types of habitats. They are increasingly important to maintain connectivity in highly fragmented forested landscapes. High quality habitat areas and corridors are essential for maintaining populations of both game and nongame wildlife species, a primary social expectation of the public.

Research Areas

Research areas include the Forest Fire Experiment Station in Roscommon and the Wyman Nursery in Manistique. Other research areas are specifically identified though a site condition code where active research projects are occurring upon state forest land, typically conducted through university partnerships.

Great Lakes Islands

This is an administrative designation established through DNR policy. There are an estimated 32,000 islands in the Great Lakes, including connecting channels, which is the largest number of freshwater islands in the world. Michigan's share is approximately 1,709 of these islands, and they support a globally significant group of flora, fauna, and natural communities. Important island features include nesting habitat for colonial waterbirds, stopover and staging sites for migratory birds, and spawning and nursery areas for numerous fish species. Larger Great Lakes Islands within the state forest includes Drummond, Bois Blanc, and Manitou. There are challenges when it comes to island forest management, specifically commercial harvest, where access and logistics can play a role in how forests are managed. Drummond Island has its own management plan, developed with stakeholders. Management of DNR-administered Great Lakes Islands is guided by NRC Policy 2005, Island Management, issued Feb. 10, 1994; and DNR Policy and Procedure 29.20-05, Management of State-Owned Island Properties, issued July 11, 2005.

Contiguous Resource Areas

This SCA category addresses forestlands adjacent to other land ownerships which are administratively identified and managed for specific objectives and values. For example, there are state forest parcels adjacent to state parks, federal parks and national wildlife refuges, conservancy lands, and private lands such as the vast Huron Mountain Club in the Upper Peninsula. Management goals for these parcels may or may not be similar or complementary to those of the state forest.

Archaeological Sites

Archaeological sites identify, protect and preserve locations of cultural heritage and historical significance. Sites may be identified by natural heritage data from the Michigan History Center, State

Historic Preservation Office and DNR archaeologists. By statute, property rights of archaeological artifacts and sites are reserved to the State of Michigan and are protected and administered by Department of History, Arts and Libraries. In addition, archaeological sites have intrinsic social value. Their identification, protection and preservation are important to public interest.

Cultural and Customary Use Areas

These areas include administratively identified sites which possess and provide significant recognized values and purposes for Native American Tribes and other ethnic or religious groups, or sites that have been traditionally used by Tribes and/or the public for specific purposes such as collecting sap for maple syrup, harvesting wild fruit, and other plant-gathering areas and habitats. These may include sites established by right through the 2007 Inland Consent Decree. The 2007 Inland Consent Decree is a settlement negotiated between the State of Michigan, five sovereign Michigan Tribes that are signatory to the 1836 Treaty of Washington, and the United States. It is a legal document that defines the extent of Tribal rights and describes how the State of Michigan and Tribes will cooperatively manage natural resources.

Springs Wetlands and Riparian Areas

The general locations of wetlands and floodplains have been identified and are regulated by the Michigan Department of Environment, Great Lakes, and Energy. Forested and non-forested wetlands are also spatially identified in the Michigan Forest Inventory. Springs, wetlands and riparian zones are often areas of high biodiversity that provide unique habitat for many obligate birds, mammals, reptiles and amphibian species.

Many cultural and historical traditions are associated with riparian resources and the maintenance and preservation of these resources for future generations is important to our society. Wetlands also provide pollution treatment and abatement services that are of economic value.

Military Lease Lands

There are over 144,000 acres of state forest land leased to the Michigan Department of Military and Veterans Affairs for military purposes and are collectively identified as Camp Grayling.

Mineral Resource Areas

Mineral resources in the form of oil, natural gas, metallic and non-metallic minerals provide the basis for significant components of many regional and local economies and provide for a portion of the energy and other resource needs of our society. Royalties from leases of such resources on state-owned lands also provide a large amount of income for the Natural Resource Trust Fund, which provides the means for acquisition of properties containing significant natural resources (frequently including biodiversity values) and/or which are in-holdings within the larger matrix of the state forest.

High Conservation Value Areas

Areas of the state forest which have been recognized for their contribution to specific conservation values, objectives and ecological attributes or important social values, and have a significant public consultation and/or public review as part of their identification process are classified as HCVAs. Examples of recognized DNR processes include Natural Resources Commission orders, DNR Director's

orders, and Legislative action (i.e. statute). These processes all have a public involvement or participation component. Consideration of additional types of High Conservation Value Areas will be accomplished through periodic revision of this plan and the public input associated with the revision and review process. The compartment review process also has a public participation component, but that is not used to establish HCVAs.

HCVAs are intended to address forest certification standards which require maintenance of High Conservation Value Forests/Forests of Exceptional Conservation Value.

HCVAs on the state forest are Ecological Reference Areas; Natural Rivers; Critical Dune Areas; Dedicated Habitat Areas; Dedicated Management Areas; Coastal Environmental Areas; and Verified Type 1 and Type 2 Old Growth.

Ecological Reference Areas

Ecological Reference Areas (ERAs) are higher-quality examples of functioning ecosystems that are primarily influenced by natural ecological processes. ERAs occur primarily on DNR-administered lands but may also occur on other ownerships including national forests, parks and wildlife refuges, conservancy lands and some local government lands. ERAs located on DNR-administered lands conform to the requirements of Representative Sample Areas in the Forest Stewardship Council® National Forest Management standard, and for Forests with Exceptional Conservation Value in the Sustainable Forestry Initiative® Forest Management Standard.

ERAs are based on a nationally recognized biological inventory system (NatureServe) and database (Michigan Natural Features Inventory) of known natural community sites (Element Occurrences). They are framed in the context of the natural community types. ERAs are comprised of two categories:

1. **Common Communities**. A representative selection of natural communities with a Global (G) or State (S) Rank of S3 (vulnerable and less sensitive to typical forest management practices), G4 and S4 (apparently secure and uncommon), and G5 and S5 (secure and common), and an Element Occurrence (EO) Rank of A or B (The site is an “excellent or good” example of the natural community), and;
2. **Rare Communities**. All natural communities with a Global (G) or State (S) Rank of G1 and S1 (critically imperiled), G2 and S2 (imperiled), and G3 (vulnerable), and S3 (vulnerable and more sensitive to typical forest management practices), with an Element Occurrence (EO) Rank of A, B, C, or D.

All examples of Rare Natural Community types are identified and managed as ERAs on state forest land. Representative examples of Rare and Common Natural Communities on state forest land or other state lands also are identified and managed as ERAs. The goal is to identify three examples of each natural community type per ecoregion for ecoregions in which the natural community is likely to be present. Preference is given to examples with viability/quality ranks of A or B on state forest land, yet lower rank examples or examples on other state ownership within the ecoregion are included if insufficient examples are available.

Natural Rivers

Natural Rivers are established under authority of Part 305, Natural Rivers, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. This is a river protection effort that protects the natural quality of select river systems throughout the state by regulating their use and development through zoning rules. The Natural Rivers Program was developed to preserve, protect, and enhance our state's finest river systems for the use and enjoyment of current and future generations. It allows property owners to have their right to reasonable development while protecting Michigan's unique river resources.

The process for establishing a natural river and the natural river district (land adjacent to the river) includes nomination, development of a management plan, public hearings, and action by the DNR Director. Each Natural River has a river-specific approved management plan and administrative rules.

Critical Dune Areas

Critical Dune Areas (CDAs) are established under authority of Part 353, Sand Dunes Protection and Management, Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. These CDAs include public and private lands representing the tallest and most spectacular dunes along Lake Michigan's shoreline in the Lower and Upper peninsulas and along the shores of Lake Superior. Developmental, silvicultural and recreational activities are regulated under the act. Permits are required to conduct activities which have the potential to alter the physical character of the CDAs and are issued by the Department of Environment, Great Lakes, and Energy (EGLE) or local units of government that administer the program through local ordinances.

Dedicated Habitat Areas

A Dedicated Habitat Area (DHA) identifies a geographic area where there is an emphasis on management for species specific habitat with a long-term goal of ensuring that these species are conserved as examples of our state's biodiversity. These include:

1. Habitat areas for threatened or endangered species, such as the Kirtland's warbler, piping plover, eastern massasauga rattlesnake and northern long-eared bat, in association with plans that have been developed in cooperation with the U.S. Fish and Wildlife Service and other federal land managing entities such as the U.S. Forest Service; and
2. Habitat areas for representative species requiring core interior forest habitat (in conformance with FSC National Forest Stewardship Standards), including American marten, cerulean warblers, red-shouldered hawks and northern goshawks.

Several threatened and endangered species plans and agreements have been developed in cooperation with the US Fish and Wildlife Service and other partners which include state forest lands. These plans and agreements include the Recovery Plan for the Great Lakes Piping Plover (2003), The Kirtland’s Warbler Breeding Range Conservation Plan (2016), The Candidate Conservation Agreement with Assurances for the Eastern Massasauga Rattlesnake in Michigan (2016), and the Lakes States Forest Management Bat Habitat Conservation Plan (2023). The intent of these plans is to increase and maintain populations of specific species to levels and conditions that mitigate threats to their continued existence. This is typically done through management of designated habitat.

DHAs are designated for the state-threatened Kirtland's warbler (KW Essential Habitat), federally endangered Great Lakes piping plover (Piping Plover Critical Habitat), the federally threatened eastern massasauga rattlesnake (EMR Managed Lands), and the federally endangered northern long-eared bat (NLB maternity roost tree buffer and hibernacula buffers).

Dedicated Management Areas

Dedicated Management Areas are established through specific public processes and may have associated Land Use Orders of the Director for specific purposes. These include legally dedicated natural, wilderness or wild areas; state game areas (SGA), state wildlife floodings and the Houghton Lake State Wildlife Research Area (SWRA); the elk management area; deer wintering complexes; and the Grouse Enhanced Management System (GEMS).

GEMS is a network of areas dedicated to management of upland game birds such as ruffed grouse and American woodcock. These are managed to benefit the birds' needs throughout the year and offer recreational opportunities. GEMS have been modeled as a special analysis unit, with more focused discussion in section 5 of this plan.

Legally dedicated natural areas, wilderness, or wild areas (NAs) are established under authority of Part 351, Wilderness and Natural Areas, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. Natural areas, wilderness and wild areas provide recreational sites for people who appreciate such areas for their inherent or intrinsic ecological values. They offer unique opportunities for solitude or primitive and unconfined types of recreation. They can provide economic opportunities for local communities as well as valuable and important research and educational opportunities.

Very little research now occurs in the State Wildlife Research Area, and it is presently managed for other purposes and values. The primary use of these areas includes dispersed, non-intrusive recreation such as hunting, trapping, wildlife viewing, hiking, cross-country skiing and snowshoeing.

The Michigan elk herd in the elk management area dates back to the reintroduction of seven animals in 1918 about three miles southeast of Wolverine, with the goal of restoring a population that was extirpated from Michigan in the late 1800s. Due to a declining population because of successional changes in habitat over time, the DNR wrote a Michigan Elk Plan in 1975 (updated in 1984 and again in 2023) that identified a specific management area for elk habitat. The values of the elk herd include hunting through an annual lottery drawing, viewing by wildlife enthusiasts, and the intrinsic value of the species being recovered in the state. The elk management area has been modeled as a special analysis unit, with more focused discussion in section 5 of this plan.

Deer wintering complexes provide up to 401,822 acres of state forest in the Upper Peninsula where deer migrate for winter shelter and food. Deer wintering complexes have been modeled as a special analysis unit, with more focused discussion in section 5 of this plan.

Coastal Environmental Areas

Coastal Environmental Areas have been established under the authority of Part 323, Shorelands Protection and Management, Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. Coastal Environmental Areas are Great Lake shorelines regulated to protect habitat necessary to preserve and maintain fish and wildlife. Many Coastal Environmental Areas contain Great Lakes

marshes, and other important habitats such as upland ridges and islands. In several instances, upland areas are involved in habitat protection for shore birds.

The statute identifies uses that require review by the state's department of Environment, Great Lakes and Energy Department (EGLE). These include dredging, filling, grading, other alterations of soil, alterations of natural drainage, alteration of vegetation used by fish or wildlife, or both, including timber harvest in identified colonial bird nesting areas and placement of permanent structures. Activities which do not require a permit include maintaining existing dikes, farming (conforming to specific provisions) and timber harvest if outside a colonial bird nesting area.

Designation of these sensitive coastal shorelands assures an increased level of protection for these valuable resources. Studies and surveys conducted by EGLE and others have recorded more than 25 fish species, 12 mammal species, and 131 bird species using these valuable coastal habitats. In addition, typically unseen and overlooked species, which are equally essential for maintaining healthy fish and wildlife populations, also are protected under this coastal designation.

Verified Type 1 and Type 2 Old Growth

Old growth forest (also termed primary forest, ancient forest, virgin forest, or primeval forest) is an area of forest that has few or no signs of human disturbance and exhibits unique ecological features related to age, composition, and associated structure. Old growth forests are of natural origin. They may be dominated by late successional forest species (i.e. sugar maple and American beech) or may be a very old example of a stand dominated by long-lived early- or mid-seral species (i.e. oak, or red pine).

Actively or passively managed second-growth forest stands (of natural or planted origin) which were effectively clearcut in the late 1800s and early 1900s but have subsequently developed late-successional or old growth structure, composition, and function are not considered to be Type 1 or Type 2 Old Growth.

Verified old growth forest are areas that DNR staff have evaluated and confirmed to meet the following criteria:

- **Type 1 Old Growth**: A forested area, 3 acres or more in size, that has never been logged and that displays old-growth characteristics.
- **Type 2 Old Growth**: A forested area of 20 acres or more that has been logged (minor cutting), but which does not result in the elimination of any major canopy species and that retains (never lost) significant original elements of old-growth structure and functions.

The criteria for evaluation of potential Type 1 and Type 2 Old Growth characteristics are described in DNR forest certification policy for biodiversity management.

Special Conservation Areas current condition and trend

Wild and Scenic Rivers

There are 18 miles of federally designated wild and scenic rivers that are located within the state forest, including portions of the East Branch Tahquamenon, Indian, Manistee, Ontonagon, Paint, Pere Marquette, Pine, and Presque Isle rivers. Portions of the Au Sable, Pine, and Pere Marquette wild and scenic rivers are co-designated as state natural rivers. The number and extent of wild and scenic rivers have not changed within the past decade.

The maintenance of wild and scenic rivers is important for habitat, natural ecological function, aesthetics and for the recreational fishery and boating industries, which are significant economic sectors for many areas of the state.

Possible Type 1 and Type 2 Old Growth

There are 10,194 acres of state forest that have been identified as potential Type 1 and Type 2 Old growth that will be evaluated over the planning period (Table 1). Upon evaluation, those areas verified as old growth will eventually become a High Conservation Value Area. Areas determined not to be old growth will be removed as an SCA and adjusted before the next iteration of this plan.

Table 1. Possible Type 1 and Type 2 Old Growth on the state forest.

Old Growth Type	Acres
Possible Type 1 Old Growth	80
Possible Type 2 Old Growth	10,114
Total	**10,194**

Common Natural Heritage Element Occurrences

There are 19,745 acres of common natural community elements on state forest land (Table2). This is a new SCA category, so data has not been tracked over time, but the number of these communities has generally increased as new element occurrences which are identified through routine annual survey work conducted by MNFI staff on state forest land. These are not considered Ecological Reference Areas, due to their state and global rank.

Table 2. Summary of natural community element occurrences on the state forest.

Community Type	Element Occurrence Rank	State Rank	Global Rank	Acres
Bog	AB	S4	G3G5	79
Bog	B	S4	G3G5	68
Dry-mesic Northern Forest	AB	S3	--	14
Dry-mesic Northern Forest	B	S3	--	95
Dry-mesic Northern Forest	BC	S3	--	14
Dry-mesic Northern Forest	C	S3	--	325
Dry-mesic Northern Forest	--	S3	--	30
Dry-mesic Northern Forest	CD	S3	--	10
Emergent Marsh	AB	S4	GU	1
Hardwood-Conifer Swamp	B	S3	--	35
Hardwood-Conifer Swamp	BC	S3	--	163
Hardwood-Conifer Swamp	C	S3	--	466
Mesic Northern Forest	AB	S3	--	111
Mesic Northern Forest	BC	S3	--	721
Mesic Northern Forest	C	S3	--	97

Community Type	Element Occurrence Rank	State Rank	Global Rank	Acres
Mesic Northern Forest	CD	S3	--	190
Muskeg	A	S3	--	4,242
Muskeg	AB	S3	--	5,252
Muskeg	B	S3	--	814
Muskeg	BC	S3	--	603
Muskeg	C	S3	--	51
Muskeg	--	S3	--	242
Northern Shrub Thicket	AB	S5	G4	78
Northern Shrub Thicket	B	S5	G4	79
Northern Shrub Thicket	BC	S5	G4	169
Northern Shrub Thicket	C	S5	G4	891
Northern Wet Meadow	A	S4	G4G5	201
Northern Wet Meadow	AB	S4	G4G5	99
Northern Wet Meadow	B	S4	G4G5	279
Northern Wet Meadow	BC	S4	G4G5	240
Northern Wet Meadow	C	S4	G4G5	250
Northern Wet Meadow	--	S4	G4G5	16
Poor Conifer Swamp	AB	S4	G4	1,140
Poor Conifer Swamp	B	S4	G4	644
Poor Conifer Swamp	BC	S4	G4	63
Poor Conifer Swamp	C	S4	G4	64
Poor Fen	B	S3	--	6
Volcanic Cobble Shore	A	S3	--	7
Rich Conifer Swamp	BC	S3	--	457
Rich Conifer Swamp	C	S3	--	225
Rich Conifer Swamp	CD	S3	--	682
Rich Conifer Swamp	D	S3	--	60
Northern Hardwood Swamp	B	S3	--	24
Northern Hardwood Swamp	CD	S3	--	403
Dry Northern Forest	D	S3	--	44
Total	**--**	**--**	**--**	**19,745**

Concentrated Recreation Areas

The current condition and trends for concentrated areas is discussed in detail in Section 3.6 Recreation and is not repeated here.

Natural Beauty Roads

There are seven miles of Natural Beauty Roads on the state forest, which have not changed status in decades.

Visual Management Areas

There are 31 Visual Management Area SCAs identified on state forest lands, which have not changed status in more than a decade.

Designated Trout Lakes and Cold-Water Streams

There are 3,445 miles of cold-water streams and 91 cold-water lakes (2,447 acres) located on the state forest. The extent of these resources is subject to reclassification based on new survey data and modeling of stream segments.

Non-dedicated Natural Areas

There are 18 non-dedicated natural areas or wild areas on 16,687 acres of the state forest (Table 3). There is one non-dedicated national natural landmark in the state forest: the 11,664-acre Dead Stream Swamp in the Cadillac and Roscommon Forest management units (Table 3). There have been no additional/proposed natural areas for several decades. Any proposed and nominated natural areas that are evaluated through the formal Natural Areas review process and become legally dedicated will become High Conservation Value Areas.

Table 3. Non-dedicated Natural Areas on the state forest.

Site Name	Type of Natural Area	Forest Management Unit	County	Acres
Crawford Red Pines	Non-dedicated natural area	Grayling	Crawford	17
Dead Stream Swamp	Non-dedicated National Natural Landmark	Roscommon/ Cadillac	Roscommon/ Missaukee	11,664
Duck-Mud Lake Chain site	Non-dedicated natural area	Gaylord	Cheboygan	253
Jordan River Valley	Non-dedicated natural area	Gaylord	Antrim	1,570
Lake Sixteen	Non-dedicated natural area	Atlanta	Presque Isle	133
Little Presque Isle	Non-dedicated natural area	Gwinn	Marquette	544
Little Presque Isle	Non-dedicated wild area	Gwinn	Marquette	15
Maxton Plains - Middle	Non-dedicated natural area	Sault Ste. Marie	Chippewa	520
Maxton Plains - West	Non-dedicated natural area	Sault Ste. Marie	Chippewa	972
Pigeon River State Forest—Dog Lake	Non-dedicated wild area	Pigeon River Country	Cheboygan	659
Pigeon River State Forest—Pine Tract	Non-dedicated natural area	Pigeon River Country	Cheboygan	180

Site Name	Type of Natural Area	Forest Management Unit	County	Acres
Pigeon River State Forest—Grindstone Creek	Non-dedicated wild area	Pigeon River Country	Cheboygan	160
Point Detour	Non-dedicated natural area	Escanaba	Delta	369
Rocking Chair Lakes	Non-dedicated natural area	Gwinn	Marquette	235
Seiner's Point	Non-dedicated wild area	Sault Ste. Marie	Mackinac	690
Shakey Lakes	Non-dedicated natural area	Escanaba	Menominee	1,527
South Branch of the Au Sable River area	Non-dedicated natural area	Grayling	Crawford	3,182
Vermilion Point	Non-dedicated natural area	Newberry	Chippewa	58
Total	--	--	--	**16,687**

Freshwater Mussel Streams

Freshwater mussel stream groups were first identified in 2018. They are updated periodically as more survey data by the U.S. Fish and Wildlife Service become available, which occurred in 2022 and 2025. Three mussel stream groups have been identified based on species status, which include Group 1-state special concern, Group 2-state threatened or endangered, and Group 3-federally threatened or endangered (Table 4).

Table 4. Freshwater mussel stream reaches by miles of stream length and stream group category in the state forest.

River/Stream Name	Stream Length (Miles)
Mussel Stream Group 1 - State Special Concern Subtotal	**29.4**
Backus Creek	5.1
Black Creek-Sturgeon River	0.0
Bowen Creek-Black River	6.2
Cranberry Creek-Muskegon River	0.1
Dead Stream Flooding-Muskegon River	1.1
Dice Drain-Chippewa River	3.8
Dishwash Creek-Muskegon River	0.6
Erskine Creek-North Branch Thunder Bay River	1.6
Fletcher Pond-Upper South Branch Thunder Bay River	0.5
Gaffney Creek-Thunder Bay River	2.4
Jewett Creek-Thunder Bay River	1.3
Lost Lake-North Branch Thunder Bay River	1.5
Molasses River	2.8
Parks Creek-Paint River	0.0
Pine Creek	0.9
Silver Creek-Paint River	0.4

River/Stream Name	Stream Length (Miles)
Sunken Lake-North Branch Thunder Bay River	0.5
Twin Falls Dam-Menominee River	0.8
Mussel Stream Group 2 - State Threatened or Endangered Subtotal	**38.2**
Backus Creek	3.6
Beaver Creek-Sturgeon River	1.2
Black Creek-Sturgeon River	0.9
Bluff Creek	0.1
Carp Lake River	2.2
Cassidy Creek-Sturgeon River	0.0
Collison Creek-Platte River	3.2
Cunnerson Creek-Clam River	0.0
Dead Stream Flooding-Muskegon River	2.1
Devils Creek	1.3
Dishwash Creek-Muskegon River	0.8
Dyer Lake-Clam River	1.5
East Branch Au Sable River	0.6
East Branch Tittabawassee River	0.5
Elwood Creek-Cedar River	0.5
Gaffney Creek-Thunder Bay River	0.9
Grand Rapid Dam-Menominee River	2.5
Hancock Creek-East Branch Sturgeon River	2.5
King Creek-Lower South Branch Thunder Bay River	0.3
Klacking Creek-Rifle River	1.1
Locke Creek-Manistique Lake	0.2
Middle Branch River	0.1
Mill Pond-West Branch Sturgeon River	0.3
Molasses River	0.4
Mullet Lake	0.0
Peronto Lake-East Branch Sturgeon River	3.3
Skunk Creek-East Branch Sturgeon River	0.7
Sunken Lake-North Branch Thunder Bay River	1.0
The Oxbow-Menominee River	1.1
West Branch Clam River	0.5
West Branch Sturgeon River	3.2
Wolf Creek	1.8
Mussel Stream Group 3 - Federally Threatened or Endangered Subtotal	**2.0**
Black Creek-Tittabawassee River	0.1
East Branch Tittabawassee River	0.3
Middle Branch Tittabawassee River	1.6
Grand Total	**69.6**

Wood Turtle

Specific habitat for wood turtles on the state forest is based on riparian buffers applied to stream reaches of both documented and modeled habitat, which was first established in 2025 (Table 5).

Table 5. Riparian buffers for predicted (100 feet) and known (600 feet) wood turtle occupancy within the state forest.

River Name	Acres
Wood Turtle Stream 100-foot Buffer Subtotal	**4,911**
Unnamed tributaries	47
Au Gres River	13
Au Sable River	71
Bear Creek	125
Betsie River	230
Big Cannon Creek	103
Black River	113
Boardman River	30
Brule River	98
Cedar River	270
Chippewa River	60
Creighton River	12
Duck Creek	28
East Branch Sturgeon River	10
Elm Creek	13
Escanaba River	36
Fence River	5
Ford River	134
Grass Creek	32
Greenier Creek	9
Indian River	17
Johnson Creek	8
Little Manistee River	26
Manistee River	988
Manistique River	311
Maple River	21
Mead Creek	42
Menominee River	36
Michigamme River	97
Middle Branch Escanaba River	51
Middle Branch Tittabawassee River	35
Misery River	13
Mud Creek	17
Muskegon River	273

River Name	Acres
Nesters Creek	27
Net River	1
North Branch Au Sable River	12
North Branch Ford River	29
Ocqueoc River	115
Paint River	120
Pigeon River	141
Pine River	74
Platte River	195
Rifle River	8
Salt Creek	53
Salt River	18
Shelldrake River	10
South Branch Au Sable River	26
Sturgeon River	336
Stutts Creek	68
Third Creek	66
Thunder Bay River	34
Upper South Branch Thunder Bay River	9
Waiska River	1
West Branch Escanaba River	53
West Branch Huron River	4
West Branch Maple River	83
West Branch Sturgeon River	3
Wolf Creek	53
Wood Turtle Stream 660-foot Buffer Subtotal	**30,181**
Unnamed tributaries	394
Au Gres River	109
Au Sable River	689
Bear Creek	766
Betsie River	1,167
Big Cannon Creek	682
Black River	778
Boardman River	226
Brule River	599
Cedar River	1,585
Chippewa River	335
Creighton River	104
Crumley Creek	9
Duck Creek	174
East Branch Sturgeon River	78
Elm Creek	106

River Name	Acres
Escanaba River	273
Fence River	51
Ford River	780
Grass Creek	203
Greenier Creek	47
Indian River	110
Johnson Creek	37
Little Manistee River	172
Manistee River	5,731
Manistique River	1,804
Maple River	123
Mead Creek	243
Menominee River	269
Michigamme River	687
Middle Branch Escanaba River	350
Middle Branch Tittabawassee River	236
Misery River	98
Mud Creek	115
Muskegon River	1,479
Nesters Creek	189
Net River	14
North Branch Au Sable River	80
North Branch Ford River	184
North Branch Milakokia River	4
Ocqueoc River	688
Ontonagon River	7
Paint River	872
Pigeon River	960
Pine River	405
Platte River	1,285
Portage River	52
Rapid River	3
Rifle River	50
Salt Creek	279
Salt River	99
Shelldrake River	64
South Branch Au Sable River	197
Sturgeon River	1,913
Stutts Creek	347
Third Creek	424
Thunder Bay River	193
Upper South Branch Thunder Bay River	63

River Name	Acres
Waiska River	20
West Branch Escanaba River	319
West Branch Huron River	27
West Branch Maple River	482
West Branch Sturgeon River	43
Wolf Creek	312
Grand Total	**35,092**

Conditional Deer Winter Range

Conditional deer range refers to landscapes where deer migrate infrequently and/or smaller distances in response to severe winters. These are found primarily in the southern Upper Peninsula and Northern Lower Peninsula (Table 6). Resident or non-migratory deer are those which remain in their summer range during the winter.

Table 6. Conditional deer winter range within the state forest.

Dear Winter Range	Acres
Upper Peninsula Conditional	211,358
Lower Peninsula Conditional	1,994,306
Total	**2,205,665**

Important Bird Areas

There are seven important bird areas identified by Audubon whose polygons intersect the state forest (Table 7).

Table 7. Important Bird Areas that intersect with the state forest.

Important Bird Areas	Acres
Baraga Plains	5,822
Dollarville Flooding	1,115
Gladwin Lake Plain	143,020
Grand Traverse Bay basin (Albert Ecoregion Vii.5.2)	42,359
Helmet Shoal and Saddlebag Island	1
Kirtland's Warbler Management Units & Guide's Rest	145,205
Lauterman Lake	8
Little Bay de Noc (inc. Portage Marsh & Aronson Island sandbar)	370
Lower Au Sable River and Iosco Co. Northern Goshawk IBA	11,408
Lower St. Mary's River and Potagannissing Bay	104
Mackinac Straits Hawk Watch	4
Manistee National Forest Red-shouldered Hawk IBA	82,772
North Point	316

Important Bird Areas	Acres
Peshekee HIghlands LTA	14,912
Pigeon Country moraines	155,020
Raco Plains & Wilwin Wetland	2,596
Rudyard Clay Plain	817
Sand Products and Epoufette Island shoal	0
Sault Sainte Marie Clay Plain	386
Scarecrow Island	251
Seney National Wildlife Refuge	338
Sleeper Lake burn	14,331
St. Vital Point beaches (Piping Plover)	27
Sturgeon River Sloughs Wildlife Area	5,828
Tahquamenon Falls State Park and Munising Moraine IV LTA	2
Whitefish Point	27
Winegar Moraine and Iron Co. Northern Goshawk IBA	5
Yellow Dog Plains	3,269
Total	**630,315**

Research Areas

Formally designated research areas on the state forest include the 5,847-acre Forest Fire Experiment Station and the 125-acre Wyman Nursery.

Informally designated research areas involve active partnerships with Michigan State University to evaluate silvicultural techniques for northern hardwood management, management of jack pine for Kirtland's warbler habitat, and common garden plots for assisted tree migration. A partnership with Michigan Technological University is evaluating silvicultural techniques for management of lowland conifer species. Over the past decade, university research projects have increased from none to these four projects.

Great Lakes Islands

Great Lakes islands in the state forest include Bois Blanc Island Management Area (10,882 acres), Drummond Island Management Area (47,802 acres), Summer Island (1,373 acres) and Little Summer Island (115 acres) in the Escanaba Lake Plain Management Area, and Manitou Island (318 acres) in the Keweenaw Management Area.

Contiguous Resource Areas

Contiguous Resource Areas provide an opportunity to add additional protection or management within an area where several features, typically Element Occurrences, are in relatively close proximity to each other. Current contiguous resource areas include the Carney Fen Buffer and the Pictured Rocks National Lakeshore Buffer, which have not changed status for decades.

Archaeological Sites

The known number and location of archaeological/cultural heritage features in the state forest is confidential data. Additional possible and previously unknown archaeological/cultural heritage sites are routinely discovered during normal field work and are reported to DNR archaeology staff.

Cultural and Customary Use Areas

These areas may be identified as having significant cultural and customary significance and are protected through this SCA designation. There are 11 recognized Cultural and Use Area SCAs on state forest lands.

Springs Wetlands and Riparian Areas

The current condition and trends for wetlands, riparian areas and springs/seeps are discussed in detail in Section 3.3 Aquatic Resources and is not repeated here.

Military Lease Lands

The acreage and jurisdiction for use on the various types of military leased lands have not changed status for several decades (Table 8).

Table 8. Military lease lands by lease classification (acres).

Classification	County	Acres	DNR/DMVA Jurisdiction
Hanson Reserve Lands	Crawford	14,067	Military training has precedence over resource management activities. The DNR manages the forest, game and fish resources if management activities do not conflict with military needs. Hunting is prohibited.
Military Board Lands	Crawford, Kalkaska	18,146	Military training has precedence over resource management activities. The DNR coordinates all prescribed activities with the National Guard to ensure they are compatible with military training needs. Lands are open to hunting.
Military Lease Lands	Crawford, Otsego	56,769	Military training has precedence over resource management activities. The DNR coordinates all prescribed activities with the National Guard to ensure compatibility with military training needs.
10-year Management Agreement Lands	Crawford, Kalkaska	43,541	DNR management activities take precedence with consideration to making management activities compatible with National Guard training needs.
DMA Acquired Lands	Crawford	11,938	DNR has jurisdiction for hunting and forest management.
Total	--	**144,461**	--

Mineral Resource Areas

The current condition and trends for metallic and non-metallic minerals and oil and gas are discussed in detail in Section 3.8 – Forest Products and are not repeated here.

High Conservation Value Areas current condition and trend

The types of HCVAs include Ecological Reference Areas, Legally Dedicated Natural, Wilderness or Wild Areas; Natural Rivers; Critical Dune areas; Dedicated Habitat Areas (e.g., Kirtland's Warbler Management Areas, and interior core forest habitats); Dedicated Management Areas (landscape-level forests like the Sand Lakes Quiet Area) and Coastal Environmental Areas. Type 1 and Type 2 Old Growth areas are a new HCVA category in this plan revision.

Ecological Reference Areas

There are 615 designated Ecological Reference Areas (ERAs) comprising 117,090 acres located on state forest land (Table 9). After an ERA review in 2026, those Element Occurrences which automatically meet ERA criteria based on global and state rank per NatureServe and FSC and SFI forest certification standards were added to the 2026 proposed ERA list as shown in Table 9.

From 2015 to 2021, based on surveys of Element Occurrences and monitoring data, 16 ERAs have increased in quality rank; 37 ERAs have decreased in quality rank; 80 ERAs have increased in area through re-survey and improved mapping; and 46 ERAs have decreased in area through improved mapping or because of conflicting/detrimental treatments. Since 2015, one ERA was eliminated because of merging into an adjacent ERA; three ERAs have had community-type changes; three ERAs are element occurrences that have been eliminated from the network because of conflicting/detrimental forest treatments. All ERAs not owned by the DNR have been dropped because they are no longer eligible for inclusion on the network.

Table 9. Acres and count of Ecological Reference Areas by Community Type in the state forest.

Year Added	Community Type	Number of Occurrences	Acres
2014 ERA	Alvar	4	1,354
2014 ERA	Bog	28	782
2014 ERA	Boreal Forest	12	1,550
2014 ERA	Cave	1	0
2014 ERA	Cirsium hillii	1	154
2014 ERA	Coastal Fen	3	9
2014 ERA	Dry Northern Forest	15	1,573
2014 ERA	Dry-mesic Northern Forest	44	3,975
2014 ERA	Emergent Marsh	4	32
2014 ERA	Floodplain Forest	7	1,029
2014 ERA	Granite Bedrock Glade	11	520
2014 ERA	Granite Cliff	12	20
2014 ERA	Great Lakes Marsh	15	3,054
2014 ERA	Hardwood-Conifer Swamp	4	247
2014 ERA	Interdunal Wetland	4	9
2014 ERA	Intermittent Wetland	14	679
2014 ERA	Limestone Bedrock Glade	9	618
2014 ERA	Limestone Bedrock Glade	2	20

Year Added	Community Type	Number of Occurrences	Acres
2014 ERA	Limestone Bedrock Lakeshore	8	152
2014 ERA	Limestone Cliff	3	70
2014 ERA	Limestone Cobble Shore	8	126
2014 ERA	Mesic Northern Forest	38	2,356
2014 ERA	Muskeg	20	12,508
2014 ERA	Northern Fen	22	1,106
2014 ERA	Northern Hardwood Swamp	2	32
2014 ERA	Northern Shrub Thicket	22	585
2014 ERA	Northern Wet Meadow	13	801
2014 ERA	Oak-Pine Barrens	3	787
2014 ERA	Open Dunes	4	72
2014 ERA	Patterned Fen	15	19,230
2014 ERA	Pine Barrens	15	996
2014 ERA	Poor Conifer Swamp	11	1,100
2014 ERA	Poor Fen	24	6,358
2014 ERA	Rich Conifer Swamp	60	19,780
2014 ERA	Rich Tamarack Swamp	2	846
2014 ERA	Sand and Gravel Beach	5	104
2014 ERA	Sandstone Bedrock Lakeshore	7	11
2014 ERA	Sandstone Cobble Shore	5	16
2014 ERA	Sandstone Lakeshore Cliff	4	18
2014 ERA	Sinkhole	2	117
2014 ERA	Submergent Marsh	6	116
2014 ERA	Volcanic Bedrock Glade	3	95
2014 ERA	Volcanic Bedrock Lakeshore	10	36
2014 ERA	Volcanic Cliff	1	3
2014 ERA	Volcanic Cobble Shore	5	11
2014 ERA	Wet-mesic Sand Prairie	2	34
2014 ERA	Wooded Dune and Swale Complex	24	23,140
2026 ERA	Boreal Forest	7	558
2026 ERA	Dry Northern Forest	6	1,024
2026 ERA	Granite Bedrock Glade	3	315
2026 ERA	Granite Cliff	4	13
2026 ERA	Great Lakes Marsh	1	41
2026 ERA	Interdunal Wetland		17
2026 ERA	Intermittent Wetland	4	34
2026 ERA	Limestone Bedrock Glade	2	11
2026 ERA	Limestone Bedrock Lakeshore	2	1
2026 ERA	Limestone Cobble Shore	2	11
2026 ERA	Northern Fen	6	2,581

Year Added	Community Type	Number of Occurrences	Acres
2026 ERA	Northern Hardwood Swamp	1	2
2026 ERA	Open Dunes	1	65
2026 ERA	Patterned Fen	2	94
2026 ERA	Pine Barrens	15	2,533
2026 ERA	Poor Fen	11	1,105
2026 ERA	Rich Conifer Swamp	3	2,070
2026 ERA	Sand and Gravel Beach	1	5
2026 ERA	Sandstone Cobble Shore		2
2026 ERA	Sandstone Lakeshore Cliff	1	0
2026 ERA	Volcanic Bedrock Glade	1	2
2026 ERA	Wooded Dune and Swale Complex	3	361
2026 ERA	Granite Bedrock Lakeshore	3	14
2026 ERA	Granite Lakeshore Cliff	2	0
2026 ERA	Volcanic Lakeshore Cliff	1	0
Total	--	**615**	**117,090**

There are 157 non-ERA natural community Element Occurrences that have been identified which comprise 19,745 acres of state forest land as shown in Table 10.

Table 10. Number of non-ERA Element Occurrences by Community Type.

Community Type	Number of Occurrences	Acres
Bog	4	146
Dry-mesic Northern Forest	18	488
Emergent Marsh	1	1
Hardwood-Conifer Swamp	10	664
Mesic Northern Forest	21	1,120
Muskeg	16	11,205
Northern Shrub Thicket	15	1,218
Northern Wet Meadow	29	1,086
Poor Conifer Swamp	21	1,911
Poor Fen	1	6
Volcanic Cobble Shore	1	7
Rich Conifer Swamp	14	1,423
Northern Hardwood Swamp	4	427
Dry Northern Forest	2	44
Total	**157**	**19,745**

Natural Rivers

Natural rivers are located on both public and private lands. There are 11 natural rivers partially located in the state forest: the Fox and Two Hearted rivers in the Upper Peninsula; and the Au Sable, Betsie, Boardman, Jordan, Pere Marquette, Pigeon, Pine, Rifle and Upper Manistee rivers in the northern Lower Peninsula. The designation includes the mainstream as well as most of the tributaries. Nearly all construction, land change/earth moving, and placement of structures are regulated within 400 feet of any designated stream segment. The area within the dedicated zoning district of these natural rivers covers 45,049 acres of the state forest. The number and category of Natural rivers has been unchanged, with no new designations in the past decade.

Critical Dune Areas

There are 15 critical dune areas on state forest land that provide 9,290 acres of habitat, with additional acres located on other public and private lands throughout northern Michigan. Many state parks, national lakeshores and coastal areas of the state forest contain exemplary occurrences of sand dunes (parabolic, perched, linear, and traverse dunes). Several Natural Community Element Occurrences/ERAs occur within critical dune areas and include open dunes, wooded dune and swale complexes, sand/gravel beaches, interdunal wetlands, and Great Lakes barrens.

Dedicated Habitat Areas

Essential habitat for Kirtland's warbler in the northern Lower Peninsula changed noticeably on the landscape but resulted in a minor shift in total acreage. This was based on a programmatic review where revisions were deemed necessary to better reflect what was truly manageable for Kirtland's warbler habitat. Aside from minor revisions around fragmenting features within management areas, two new management areas were added, Black Lake in the Gaylord unit and Brush Creek in the Atlanta unit, because of historic Kirtland's warbler management or the presence of birds due to the abundance of jack pine. The addition of these management areas compensated for the removal of the Wurtsmith management area in the Grayling unit because of identified management challenges from unexploded ordnance around the decommissioned air force base and the preponderance of oak. The net result of 90,273 acres of essential habitat now occurs across 19 management areas.

There are six areas of Piping Plover Critical Habitat on state forest land, totaling 8,217 acres, which has not changed since 2014. There are 56,901 acres of managed lands for the eastern massasauga rattlesnake on state forest land in 21 separate areas, which are new designations since 2014. There are 55 separate hibernacula and maternity roost tree buffer areas for the northern long-eared bat, totaling 890 acres, which are also new since 2014.

There are 35 Core Interior Forest areas on the State Forest totaling 56,819 acres, these numbers have not changed since 2014, as shown in Table 11.

Table 11. Core interior forest areas on state forest land in acres.

Name	Forest Type	Region	Acres
Betsie River	Lowland Mixed Forest	NLP	1,052
Deadstream Swamp	Lowland Conifer Forest	NLP	1,291
Dollar Lake	Upland Deciduous Forest	UP	1,413
Fourth Lake	Upland Deciduous Forest	UP	2,170
Gogomain Swamp	Lowland Coniferous Forest	UP	4,322
Grass Lake	Lowland Conifer Forest	NLP	957
Green Swamp	Lowland Conifer Forest	NLP	3,713
Grindstone Creek	Upland Deciduous Forest	NLP	447
Groveland Mine	Upland Mixed Forest	UP	341
Jordan River Valley	Upland Deciduous Forest	NLP	3,410
Keweenaw Point	Upland Mixed Forest	UP	757
Le Vasseur Creek	Lowland Coniferous Forest	UP	666
Lighthouse Point	Upland Mixed Forest	UP	1,935
Little Presque Isle	Upland Mixed & Deciduous Forest	UP	3,118
Lost Lake	Upland Mixed Forest	UP	558
Minnehaha Swamp	Lowland Conifer Forest	NLP	969
North Summer Island	Upland Deciduous Forest	UP	1,340
Platte Lake	Lowland Conifer Forest	NLP	1,025
Pretty Lakes	Upland Mixed Forest	UP	2,245
Sand Lakes	Upland Mixed Forest	NLP	2,992
Simmons Woods	Upland Mixed Forest	UP	9,919
Skegemog Swamp	Lowland Conifer Forest	NLP	1,242
Skidmore Branch	Lowland Coniferous Forest	UP	1,830
Solon Swamp	Lowland Conifer Forest	NLP	1,517
Summer Meadow Creek	Lowland Mixed Forest	UP	4,444
Thomas Lake	Upland Deciduous Forest	UP	892
Tin Shanty Hardwoods	Upland Mixed & Deciduous Forest	NLP	1,859
Two-Hearted River	Lowland Mixed Forest	UP	723
Werners Creek	Lowland Deciduous Forest	UP	697
Total	--	--	**56, 819**

Dedicated Management Areas

GEMS

There are 15 Grouse Enhanced Management System areas on 60,103 acres (Table 12) that are now new dedicated management areas.

Table 12. Grouse Enhancement Management System areas on the state forest.

Grouse Enhanced Management System Area	Acres
Backus Creek	4,329
Bill Rollo Memorial	6,838
Cedar River	3,088
Drummond	2,847
Garden Grade	6,304
Greasy Creek	1,078
Halifax	2,705
Hazel Swamp	2,375
Lame Duck Foot Access Area	11,335
LeeGrande Ranch	2,336
Little Betsie	4,181
Mark Knee Memorial	4,024
Melstrand	1,219
Ralph	5,276
Strickler	2,167
Total	**60,103**

Elk Management Area

A portion of the elk management area has been specifically modeled for the SFMP as a special analysis unit spanning 166,489 acres of state forest, with the core range focused on the Pigeon River Country forest management area. The acreage of the elk management area has increased over time and will continue to increase as the DNR specifically acquires additional state forest land in the Pigeon River Country.

State Game Areas, State Wildlife Areas, State Wildlife Research Areas

There are numerous State Game Areas, State Wildlife Floodings and State Wildlife Research Areas (Table 13) on the state forest which are identified in Section 3.6 Recreation – Areas Managed for Hunting and not repeated here.

Table 13. State Wildlife Management Areas and State Wildlife Research Areas on the state forest.

State Game or Wildlife Area Type and Name	Acres
State Wildlife Management Areas Subtotal	**94,307**
Backus Lake Flooding SWMA	1,658
Bear Creek Flooding SWMA	986
Beaver Lake Flooding SWMA	475
Bentley Marsh Flooding SWMA	1,474
Black Creek Flooding SWMA	2,637

State Game or Wildlife Area Type and Name	Acres
Blind Sucker River Flooding SWMA	4,756
Bloomgrens Marsh SWMA	582
Bullock Ranch Flooding SWMA	12,635
Cannon Creek 1 and 2 Floodings SWMA	475
Connors Marsh Flooding SWMA	1,057
Cranberry Lake Flooding SWMA	84
Denton Creek Flooding SWMA	805
Dingman Marsh Flooding SWMA	4,580
Dog Lake Flooding SWMA	812
Dollarville Flooding SWMA	2,980
Felch Mountain Flooding SWMA	702
French Farm Lake Flooding SWMA	2,927
Genes Pond Flooding SWMA	3,352
Goose Creek Flooding SWMA	45
Grass Lake Flooding SWMA	469
Groveland Mine Flooding SWMA	6,867
Hancock Creek Flooding SWMA	686
Hardwood Reservoir Flooding SWMA	906
Headquarters Lake Flooding SWMA	293
Houghton Lake Flats (North and South) Flooding SWMA	857
Lake 36 Flooding SWMA	987
Lake DuBonnet / Mud Lake Flooding SWMA	632
Molasses Impoundments 4 Flooding SWMA	1,801
Molasses Impoundments 5 Flooding SWMA	1,481
Molasses River Flooding No.1 SWMA	1,642
Molasses River Flooding No.2 SWMA	1,510
Munuscong Bay SWMA	13,806
Old Fur Farm Flooding SWMA	1,975
ONeal Lake Flooding SWMA	112
Portage Marsh SWMA	273
Reedsburg Damn Flooding SWMA	1,024
Robinson Creek Flooding SWMA	2,566
Skegemog Lake SWA	1,951
Stanley Lake Flooding SWMA	2,357
Stoney Creek Flooding SWMA	1,158
Sturgeon River Sloughs SWMA	7,621
Widewaters Flooding SWMA	38
State Wildlife Research Areas Subtotal	**10,986**
Houghton Lake SWRA	10,986
Grand Total	**105, 293**

Legally Dedicated Natural Areas

There are six legally dedicated natural areas totaling 6,503 acres (Table 14). The most recently dedicated state forest natural area was Carney Fen in 2009, with no new dedications occurring since that date. There are no legally dedicated wilderness or wild areas located in the state forest.

Table 14. Legally dedicated natural areas on state forest land (acres).

Site Name	Recognition	Forest Management Unit	County	Acres
Bois Blanc Island-Mixed Forest	Legally Dedicated	Gaylord	Mackinac	993
Bois Blanc Island-Snake Island/Mud Lake	Legally Dedicated	Gaylord	Mackinac	272
Bois Blanc Island-North Shore	Legally Dedicated	Gaylord	Mackinac	833
Carney Fen	Legally Dedicated	Escanaba	Menominee	3,510
Little Brevort Lake – Scenic Site	Legally Dedicated	Sault Ste. Marie	Mackinac	736
Roscommon Red Pines Nature Study Area	Legally Dedicated & NPS National Natural Landmark	Roscommon	Roscommon	159
Total	--	--	--	**6,503**

There are 13 Dedicated Management Areas on state forest lands totaling 83,419 acres that are designated with Land Use Orders of the Director (LUOD) and specific management plans (Table 15).

Table 15. Dedicated management areas on state forest land (acres).

Dedicated Management Area-LUOD	Forest Management Unit	Land Use Order Number	Acres
Baraga Plains Waterfowl Management Area	Baraga	3.21	2,503
Deward Tract	Grayling	4.9	4,441
Gladwin Field Trial Area	Gladwin	4.19	4,749
Green Timbers Management Unit	Pigeon River Country	4.34	6,258
Jordan River Valley	Gaylord	4.8	21,304
Kawkawlin Creek Flooding	Gladwin	4.32	2,742
Lame Duck Foot Access Area	Gladwin	4.20	13,818
Little Presque Isle	Gwinn	4.30	3,134
Mason Tract	Grayling	4.16	4,353
Munuscong Wildlife Area	Sault Ste Marie	4.14	14,700
Sand Lakes Quiet Area	Traverse City	4.25	2,996
Skegemog Lake Wildlife Area	Traverse City	4.24	2,421

Dedicated Management Area-LUOD	Forest Management Unit	Land Use Order Number	Acres
Total	--	--	**83,419**

Environmental Areas

There are 33 Environmental Areas on state forest lands totaling 1,280 acres, concentrated in Alpena, Mackinac, Chippewa, Delta and Baraga counties. No new environmental areas have been identified over the past decade.

Type 1 and Type 2 Old Growth

Sixty-five forested areas totaling 4,160 acres are newly designated as Type 1 or Type 2 Old Growth on the state forest (*Table 16*). Eight areas totaling 123 acres are in the eastern Lower Peninsula (ELP) district. Nine areas totaling 140 acres are in the western Lower Peninsula (WLP) district. Thirteen areas totaling 195 acres are in the eastern Upper Peninsula (EUP) district. Thirty-five areas totaling 3,702 acres are in the western Upper Peninsula (WUP) region.

Table 16: New designations of Type 1 and Type 2 Old Growth on the state forest.

Eco-region	District	Management Area	Forest Management Unit	Cover type	Type	Assigned Name	Acres
NLP	ELP	High Sand Plains	Gaylord	Natural White Pine	1	Gatesy Old Growth	17
NLP	ELP	High Sand Plains	Gaylord	Natural White Pine	2	52013 Old Growth	25
NLP	ELP	High Sand Plains	Grayling	Natural Red Pine	1	Crawford Red Pines	18
NLP	ELP	High Sand Plains	Grayling	Natural White Pine	1	72007042 Old Growth	6
NLP	ELP	Presque Isle Lake and Till Plains	Gaylord	Lowland Conifers	1	Comp 169 Old Growth	11
NLP	ELP	Presque Isle Lake and Till Plains	Gaylord	Natural Mixed Pines	1	C153 OGT1	4
NLP	ELP	Presque Isle Lake and Till Plains	Gaylord	Natural Mixed Pines	2	Klieber Pond Red Pine	28
NLP	ELP	Wolverine Moraines	Gaylord	Hemlock	1	Walloon Lake State Forest	16
NLP	**ELP Total**	--	--	--	--	--	**123**
NLP	WLP	High Sand Plains	Roscommon	Hemlock	2	71072026	39

Eco-region	District	Management Area	Forest Management Unit	Cover type	Type	Assigned Name	Acres
NLP	WLP	High Sand Plains	Roscommon	Natural Mixed Pines	1	Roscommon Red Pine	17
NLP	WLP	High Sand Plains	Roscommon	Natural Mixed Pines	2	71033073	9
NLP	WLP	High Sand Plains	Roscommon	Natural Mixed Pines	2	71047086	8
NLP	WLP	High Sand Plains	Roscommon	Natural Mixed Pines	2	Townline 157 red pine.	2
NLP	WLP	High Sand Plains	Roscommon	Natural Red Pine	1	Roscommon Red Pine	26
NLP	WLP	High Sand Plains	Roscommon	Natural Red Pine	2	Townline 157 red pine.	9
NLP	WLP	High Sand Plains	Roscommon	Natural White Pine	2	71107023	10
NLP	WLP	Kalkaska Sandy Moraines	Traverse City	Natural Mixed Pines	2	Arbutus Lake Conifers	21
NLP	**WLP Total**	--	--	--	--	--	**140**
EUP	EUP	Grand Marais Moraine Complex	Newberry	Upland Mixed Forest	1	Swamp Lakes	1
EUP	EUP	Grand Marais Moraine Complex	Shingleton	Cedar	1	41162076 Old Growth	9
EUP	EUP	Grand Marais Moraine Complex	Shingleton	Cedar	2	41103056 Old Growth	32
EUP	EUP	Grand Marais Moraine Complex	Shingleton	Hemlock	2	41133014 Old Growth	18
EUP	EUP	Grand Marais Moraine Complex	Shingleton	Hemlock	2	41133077 Old Growth	9
EUP	EUP	Rudyard Silty Lake Plain	Sault Ste. Marie	Lowland Conifers	1	Wilson Rd Old Growth	30
EUP	EUP	Rudyard Silty Lake Plain	Sault Ste. Marie	Upland Conifers	1	Wilson Rd Old Growth	15
EUP	EUP	Seney Lake Plain	Newberry	Lowland Conifers	1	Beavertown Lakes	13
EUP	EUP	Seney Lake Plain	Newberry	Lowland Deciduous	1	Beavertown Lakes	7
EUP	EUP	Seney Lake Plain	Newberry	Upland Conifers	1	Beavertown Lakes	32

Eco-region	District	Management Area	Forest Management Unit	Cover type	Type	Assigned Name	Acres
EUP	EUP	Seney Lake Plain	Shingleton	Lowland Conifers	1	c163 s8	6
EUP	EUP	St. Ignace Lake Plain	Sault Ste. Marie	Hemlock	1	45161016 Old Growth	8
EUP	EUP	St. Ignace Lake Plain	Sault Ste. Marie	Hemlock	1	45161028 Old Growth	14
EUP	**EUP Total**	--	--	--	--	--	**195**
WUP	WUP	Keweenaw	Baraga	Aspen	2	Baraga POG 1	395
WUP	WUP	Keweenaw	Baraga	Cedar	2	11075003 Old Growth	50
WUP	WUP	Keweenaw	Baraga	Cedar	2	11075011 Old Growth	139
WUP	WUP	Keweenaw	Baraga	Cedar	2	11075013 Old Growth	64
WUP	WUP	Keweenaw	Baraga	Cedar	2	11075026 Old Growth	34
WUP	WUP	Keweenaw	Baraga	Cedar	2	Baraga POG 2	180
WUP	WUP	Keweenaw	Baraga	Cedar	2	Keweenaw Point	31
WUP	WUP	Keweenaw	Baraga	Lowland Conifers	2	11075004 Old Growth	90
WUP	WUP	Keweenaw	Baraga	Lowland Conifers	2	11075033 Old Growth	33
WUP	WUP	Keweenaw	Baraga	Lowland Conifers	2	11075034 Old Growth	290
WUP	WUP	Keweenaw	Baraga	Lowland Conifers	2	Baraga POG 2	98
WUP	WUP	Keweenaw	Baraga	Lowland Conifers	2	Keweenaw Point	177
WUP	WUP	Keweenaw	Baraga	Lowland Spruce/Fir	2	11075015 Old Growth	40
WUP	WUP	Keweenaw	Baraga	Lowland Spruce/Fir	2	11075016 Old Growth	116
WUP	WUP	Keweenaw	Baraga	Lowland Spruce/Fir	2	11075023 Old Growth	139
WUP	WUP	Keweenaw	Baraga	Lowland Spruce/Fir	2	Baraga POG 2	105
WUP	WUP	Keweenaw	Baraga	Lowland Spruce/Fir	2	Keweenaw Point	464
WUP	WUP	Keweenaw	Baraga	Mixed Upland Deciduous	2	Baraga POG 1	95

Eco-region	District	Management Area	Forest Management Unit	Cover type	Type	Assigned Name	Acres
WUP	WUP	Keweenaw	Baraga	Mixed Upland Deciduous	2	Baraga POG 2	28
WUP	WUP	Keweenaw	Baraga	Natural White Pine	2	Baraga POG 2	13
WUP	WUP	Keweenaw	Baraga	Natural White Pine	2	Keweenaw Point	8
WUP	WUP	Keweenaw	Baraga	Northern Hardwood	2	Baraga POG 1	27
WUP	WUP	Keweenaw	Baraga	Upland Conifers	1	Baraga POG 2	6
WUP	WUP	Keweenaw	Baraga	Upland Conifers	2	11075029 Old Growth	70
WUP	WUP	Keweenaw	Baraga	Upland Conifers	2	Baraga POG 2	34
WUP	WUP	Keweenaw	Baraga	Upland Conifers	2	Keweenaw Point	408
WUP	WUP	Keweenaw	Baraga	Upland Mixed Forest	2	11075032 Old Growth	282
WUP	WUP	Keweenaw	Baraga	Upland Spruce/Fir	2	Keweenaw Point	90
WUP	WUP	Michigamme Highlands	Baraga	Lowland Conifers	2	Tama Creek	6
WUP	WUP	Michigamme Highlands	Baraga	Natural White Pine	2	Tama Creek	79
WUP	WUP	Michigamme Highlands	Baraga	Northern Hardwood	2	Tama Creek	50
WUP	WUP	Michigamme Highlands	Baraga	Upland Conifers	2	Tama Creek	7
WUP	WUP	Michigamme Highlands	Gwinn	Natural White Pine	1	32212011	20
WUP	WUP	Ralph Moraine	Crystal Falls	Natural Red Pine	1	Lake 36 Red Pine	11
WUP	WUP	Suomi Till and Outwash Plain	Gwinn	Upland Conifers	1	SCA1	23
WUP	**WUP Total**	--	--	--	--	--	**3,702**
Grand Total	--	--	--	--	--	--	**4,160**

Desired future condition, objectives, and management actions

High Conservation Value Areas and Special Conservation Areas collectively form the Conservation Area Network, comprise at least 10% of the state forest, represent the range of natural diversity and ecological reference conditions historically present in the forest landscape, and are resilient to adverse impacts from climate change.

Objective 1. Over the planning period, develop and maintain management direction for each of the designations within the Conservation Area Network.

- Action 1. Update Forest Certification Work Instruction 1.4 to include management direction and timber sale specs where applicable for all SCAs and HCVAs.

Objective 2. Within five years, evaluate, develop, and revise conservation plans for HCVAs.

- Action 1. Complete ERA plans by 2026.
- Action 2. Prioritize and update management plans for Dedicated Management Area.
- Action 3. Conduct site evaluations of all potential Type 1 and Type 2 Old Growth.

Objective 3. Within five years, conduct a review and update of the ERA network.

- Action 1. Redesign ERA (representative sample areas) to conform to FSC standard revisions.
- Action 2. Update Rare Community ERAs based upon community rank changes and new records.
- Action 3. Compile, prioritize, and develop an implementation process for planned ERA management actions.
- Action 4. Evaluate inclusion of D rank community EOs as rare ERAs.

Objective 4. Within the planning period, evaluate SCA categories for relevance and redundancy and recommend improvements.

- Action 1. Evaluate SCA potential for stands with unavailable site conditions and no existing designations that may provide a conservation benefit (buffers, etc.).

- Action 2. Evaluate and adjudicate the status of non-dedicated/proposed Natural Areas.
- Action 3. Review SCA nomination and designation process, update as needed.

Objective 5. Coordinate with staff and partners within the planning period to improve management of the state forest Conservation Area Network.

- Action 1: Explore longer-term (five to 10-year) partnership agreements with Cooperative Invasive Species Management Areas and other partners to reduce and minimize the impact of biological stressors, including survey and treatment of invasive species and non-native forest pests within SCAs and HCVAs.
- Action 2. Coordinate with adjacent landowners on potential protection and management of SCAs and HCVAs.
- Action 3. Work with partners to identify and restore, improve, or maintain corridors for landscape-level connectivity.
- Action 4. Work to increase the application of prescribed fire within fire-adapted HCVAs.

- Action 5. Foster coordination of conservation of biological diversity where appropriate among other agencies, identify landscape connectivity.
- Action 6. Provide frequent biodiversity conservation training to staff, with an emphasis on the identification of Type I and Type II old growth and legacy trees

Objective 6. Within the planning period, implement climate change adaptation strategies to maintain and enhance diversity within the state forest conservation area network.

- Action 1. Favor and restore native species and genotypes that are expected to be adapted to future climate conditions.
- Action 2. Maintain and restore the compositional diversity of native plants to help provide biotic resistance to adverse impacts from climate change and invasive species.
- Action 3. Where possible and prudent, use seeds and other genetic material from across a greater geographic range.

Climate change

All climate change data and information listed herein is pulled directly from the open-source Northern Institute of Applied Climate Science (NIACS) Climate Change Impacts tool and Adaptation Workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium, limited) and agreement (high, moderate, low) described in the Predicted Impacts (Table 17). Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the Adaptation Approaches. For more information, please go to www.niacs.org.

Predicted climate change impacts relevant to the Conservation Area Network

Table 17. Predicted climate change impacts relevant to the Conservation Area Network

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Northern Michigan's winter snowpack will be reduced from 30-80% by the end of the century	Robust	High	Less snowpack will increase risk of deer browse impacts to natural community quality.
Growing seasons will increase by 20 to 70 days	Robust	High	Phenology may shift for plant species that rely on temperature as a cue for the timing of leaf-out, reproductive maturation, and other developmental processes, potentially impacting rare plants and wildlife species.
Boreal species will face increasing stress	Medium	High	Warmer temperatures will be more favorable to natural communities and

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
			species located at the northern extent of their range and less favorable to those at the southern extent.
Increase of fire risk	Medium	Moderate	May benefit fire-dependent communities and early successional wildlife species.
Many invasive species, insect pests, and pathogens in northern Michigan forests will increase or become more damaging by the end of the century	Limited	High	Warmer temperatures may allow some invasive plant species, insect pests, and pathogens to expand their ranges farther north, adversely impacting natural community quality.
Systems that are limited to environments will have less opportunity to migrate in response to climate change	Limited	High	Some species and forest types are confined to habitats on the landscape, whether through requirements for hydrologic regimes, soil types, or other reasons; isolated species and systems face additional barriers to migration.
Systems that are more tolerant of disturbance have less risk of declining on the landscape	Medium	High	Natural communities that are more tolerant of drought, flooding, or fire are expected to better withstand climate-driven disturbances
Forest composition will change across the landscape	Medium	High	Habitat and biomass of individual tree species will change, with natural community species composition responding accordingly.

Adaptation approaches

Climate change will have substantial effects on a suite of ecosystem functions, such as carbon storage, nutrient cycling, habitat, or water provisioning. As a result, many management actions will need to work both directly and indirectly to maintain the integrity of ecosystems in the face of climate change.

Maintaining ecological processes and natural community species composition and diversity are key factors to supporting these special state forest places.

Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Number and extent of HCVAs and SCAs by type
- Numbers and area of deer winter range
- Area of Riparian Management Zones on High Priority Trout Streams
- Acres of stands with unavailable site conditions and without a HCVA/SCA designation
- Annual acres of newly established Kirtland's warbler habitat

Management priority: Rare Species



Why rare species matter

Rare species are plants, fish and wildlife that have been identified as Endangered (E) or Threatened (T) and afforded federal protection under the federal Endangered Species Act of 1973 (16 U.S.C. 1531-1544) and/or state protection under the Endangered Species Act of the State of Michigan (Part 365 of PA 451, 1994 Michigan Natural Resources and Environmental Protection Act). Rare species conservation in Michigan also is guided by the State Wildlife Action Plan (SWAP); a strategic framework to cooperatively conserve Species of Greatest Conservation Need and their habitats. The SWAP identifies: focal habitats and associated species, conservation actions to recover and restore those species and links to other conservation and restoration plans. The SWAP also connects the DNR with partner groups through shared goals and priorities identified during the plan's creation and revision.

The purpose of these protections is to stabilize and recover species that risk extinction. For the purposes of this plan in accordance with DNR forest certification work instructions, rare species also include state species of Special Concern. While not afforded legal protection under the state Act, many of these species are declining in population. Proactive conservation of Special Concern species now would prevent the need to list them as threatened or endangered in the future by maintaining adequate numbers of self-sustaining populations within Michigan. Conserving rare species is an important tenet of forest sustainability.

Current condition and trend

Michigan's rare species occurrence data is housed in a database hosted by the Michigan Natural Features inventory (MNFI), which is part of the NatureServe Network. This network is a group of state- and province-based entities across the U.S. and Canada that collect and manage data on rare plants and animals using a standardized ranking system and in accordance with consistent data standards.

These rare species occurrence records are referred to as element occurrences (EOs). At the time of observance, EOs are given an "EO rank" which is a viability assessment for each occurrence. EO rank H stands for historical (more than 20 years old) and EO rank X stands for extirpated. All other EO ranks qualify extant species occurrence data.

Rare plant and animal records in the MNFI database are a combination of opportunistic verified observations in addition to intentional survey efforts by qualified staff. This means the data may be biased towards certain areas, species of particular interest or by funding sources and other project initiatives. Given the size of the state forest and the number of rare species, it would be a challenge to attempt or to sustain a uniform monitoring effort. This is an important consideration when assessing and interpreting MNFI rare species data. This is also why establishing current condition and trend data for them is so challenging.

Despite these challenges, a review of the database was conducted to assess the amount and quality of rare species EOs on the state forest and to attempt to assess the relative importance of the state forest for rare species conservation in the state. Statewide across ownerships, there are 15,486 extant EOs, excluding those that have H and X ranks. Of the existing EOs, 4,451 occur on DNR lands, and 1,954 of those occur on the state forest. There were 744 new EOs added to the state forest in the last 10 years. The state forest accounts for 44% of all extant EOs on DNR lands, and 13% of all extant EOs across ownerships statewide. EOs are unevenly distributed across the state forest (Table 1), with most in the NLP and least in the WUP, which is likely more indicative of survey effort and related logistical factors than anything else. EOs are unevenly distributed across taxa as well. Vertebrate animals, and specifically birds, far outnumber most other categories (Table 2).

Table 1. Total existing EO count and percent of the state forest by region.

Region	EO Count	EO Percent Total State Forest
NLP	1,130	58.79%
EUP	502	26.12%
WUP	290	15.09%

Table 2. Total existing EO counts by taxonomic group by region.

Taxonomic Group	NLP EO Count	EUP EO Count	WUP EO Count
Invertebrate Animal	**106**	**67**	**43**
Vertebrate Animal	**768**	**204**	**184**
Mammal	4	5	8
Bird	540	162	128
Reptile	176	13	23
Amphibian	31	22	22
Fish	16	5	3
Vascular Plant	**256**	**231**	**63**

Ownership types are nested with state forest land included in DNR lands and DNR lands included in all ownerships. Within ownership types, the number of EO records for each EO rank was translated into the percent of the total number of EOs for that ownership (Table 3). Comparing individual EO rank percentages across ownership types shows a tenuous pattern where DNR lands have a slightly higher proportion than state forest land alone, and all ownerships combined are lower than state forest land alone, at least from EO ranks A-BD. The highest proportion of EOs for each ownership type are the same (EO ranks BC, C, E). Thus, there may be some conservation benefit to EOs found on state forest land and DNR lands in general, having slightly more EOs with high viability EO ranks. This could be due to higher viability EOs being more likely to be found on DNR land or more likely to be conserved on DNR lands. However, the difference across ownership types isn't substantial enough to draw definitive conclusions.

Table 3. EO rank by percent of the total ownership type, for each ownership category.

EO Rank	EO Rank Definition	Percent State Forest Total	Percent DNR Land Total	Percent All Ownerships Total
A	Excellent	2.56%	2.38%	1.94%
A?	Possibly excellent	0.05%	0.11%	0.08%

EO Rank	EO Rank Definition	Percent State Forest Total	Percent DNR Land Total	Percent All Ownerships Total
AB	Excellent or good	2.81%	3.66%	2.69%
AC	Excellent, good or fair	0.87%	0.99%	0.74%
B	Good	6.09%	6.63%	5.33%
B?	Possibly good	0.31%	0.52%	0.56%
BC	Good or fair	5.99%	7.01%	5.99%
BD	Good, fair or poor	0.77%	0.49%	0.39%
C	Fair	9.01%	9.17%	8.69%
C?	Possibly fair	0.92%	1.24%	1.07%
CD	Fair or poor	2.81%	4.18%	4.38%
D	Poor	2.41%	4.09%	4.43%
D?	Possibly poor	0.05%	0.22%	0.31%
E	Verified extant, no viability assessment	63.15%	56.98%	61.41%
F	Failed to find	1.54%	1.62%	1.43%
F?	Possibly failed to find	0.67%	0.67%	0.29%

On the state forest, just over half of all plant EOs (including those with EO ranks H and X) have an excellent to fair viability rating (EO ranks A-C?), which is the probability of persistence (Table 4). This may be due to landform and landscape factors as well as its protection status on the state forest. Both invertebrate and vertebrate animals fare less well.

Table 4. Percent of each taxonomic group EOs with EO ranks A-C? state forest wide.

Taxonomic Group	Number EOs in EO Ranks A-C?	Percent EOs in Ranks A-C?
Invertebrate Animal	75	16.5%
Vertebrate Animal	116	7.7%
Vascular Plant	365	52.1%

Desired future condition, objectives, and management actions

The state forest provides habitat suitable for the recovery, maintenance, and expansion of federal and state threatened and endangered species and special concern plants and animals.

Objective 1. Protect known and existing occurrences of federal- and state-listed threatened, endangered, and special concern species and their habitats in the state forest throughout the planning period.

- Action 1. Use Rare Species Review Tool and/or consult MNFI Biotics via the Conservation Area Viewer in Portal to evaluate potential impacts on rare species for all proposed management prescriptions and land use permits on the state forest and apply conservation measures as required.
- Action 2. Update rare species guidance and conservation measures as new information becomes available.

- Action 3. Conduct recurring training for staff on rare species agreements, legal requirements, identification, management, and conservation.

Objective 2. Manage priority rare species habitat to achieve identified species population goals in conservation plans such as Michigan's Wildlife Action Plan throughout the planning period.

- Action 1. Cooperate with partners to develop and update rare species conservation plans, determine if measurable targets for species conservation can be identified.
- Action 2. Implement rare species management actions in accordance with species conservation plans.
- Action 3. Monitor rare species in accordance with conservation plans.
- Action 4. Implement control treatments for identified invasive species that directly threaten rare plant and animal species habitat and populations.

Objective 3: After the 2025 update to Michigan's Wildlife Action Plan, implement a program to improve management of rare species and other Species of Greatest Conservation Need (SGCN), especially for those most vulnerable to impacts from forest management and other forest land use activities.

- Action 1. Identify species most vulnerable to site-level impacts from forest management and other forest land use activities.
- Action 2. Report rare species observations to MNFI via the Survey123 mnfi.anr.msu.edu/species/report
- Action 3. Develop habitat and/or detailed distribution models for most vulnerable species.
- Action 4. Implement habitat improvements for priority species.
- Action 5. Develop a program to conduct pre-treatment surveys and avoidance measures for most vulnerable species based upon likely occurrence.
- Action 6. Conduct and record after-action reviews for known, inadvertent impacts on rare species.
- Action 7. Develop a program to monitor the effectiveness of measures to avoid rare species.

Climate change

Climate change data and information listed here is pulled directly from the open-source Northern Institute of Applied Climate Science Climate Change Impacts tool and adaptation workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium, limited) and agreement (high, moderate, low) described in the Predicted impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the Adaptation approaches section. For more information, please go to niacs.org.

Predicted climate change impacts relevant to rare species habitat

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Increased fire risk	Medium	Moderate	May be beneficial for rare species requiring openings, barrens and other early successional habitat
Michigan forests invasive species, insect pests, and pathogens will increase or become more damaging	Limited	High	Invasive pests and diseases may displace, increase mortality of, or threaten the habitat or ecological systems native rare species rely on
Reduced suitability for boreal species	Medium	High	Rare species that rely on boreal species or systems that support boreal species may be disproportionately negatively affected
Systems limited to environments will have less opportunity to migrate in response to climate change	Limited	High	Rare species confined to specific areas on the landscape based upon hydrologic regimes, soil types or other reasons are less adaptable

Adaptation approaches

Climate-induced changes will impact species differently depending on the vulnerability of their habitats, their specific life history needs, and their ability to adapt. Prioritizing the maintenance of these unique areas is important. Developing specific management approaches for these unique and rare habitat areas can help buffer these areas from climate-related impacts; early detection and rapid response will be important. Identifying and establishing corridors or stepping-stone areas may be an important tool to allow rare species natural movements to find new suitable habitat and for genetic exchange between populations. Identification and protection of high-viability populations will be important. Translocations of populations should be considered carefully. A comprehensive species climate vulnerability assessment was conducted and is detailed in Changing Climate, Changing Wildlife (DNR 2013).

Monitoring

These metrics have been identified for this management priority to track progress towards forest sustainability:

- Proportion of EOs with A-C viability rankings by taxon
- Proportion of EOs with a recent Last Observed Date on state forest land by taxon
- Number of rare species with a large proportion of EOs on state forest land
- Number of rare species with a large number of EOs on state forest land
- Number of rare species with a large proportion of EOs by management area
- Number of rare species with a large number of EOs by management area

Management priority: Tree taxonomic diversity



Why tree species diversity matters

Diversity is essential to healthy ecosystems. Tree taxonomic diversity is no exception. Promoting and maintaining forests with high taxonomic diversity can improve resilience, reduce negative impacts of environmental stressors such as insects and pathogens and decrease vulnerability to climate-related stress. Diverse forests provide food and shelter to wildlife species and countless ecological, economic, and cultural values.

Sustainable forest management involves recognizing the interconnections among ecological, social, and economic systems to preserve options for future generations while meeting the needs of the present (U.S. Forest Service 2002).

In their writings, Lammerts, van Bueren and Blom (1997) provide a working definition of forest sustainability from the Helsinki process which, like the Montreal process, focuses on boreal and temperate forests.

It reads: “Sustainable management means the stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfill, now and in the future, relevant ecological, economic and social functions, at a local, national and global level, and that does not cause damage to other ecosystems.”

For the purposes of this plan, evenness and diversity values are used to describe the state forest’s taxonomic diversity. Evenness can be an indicator of ecosystem stability as it describes the relative abundance of individual species in a community (Figure 1). When species are consistently distributed across a community, it will have higher evenness. Diversity describes the number of species present in a community combined with the relative abundance of each species.

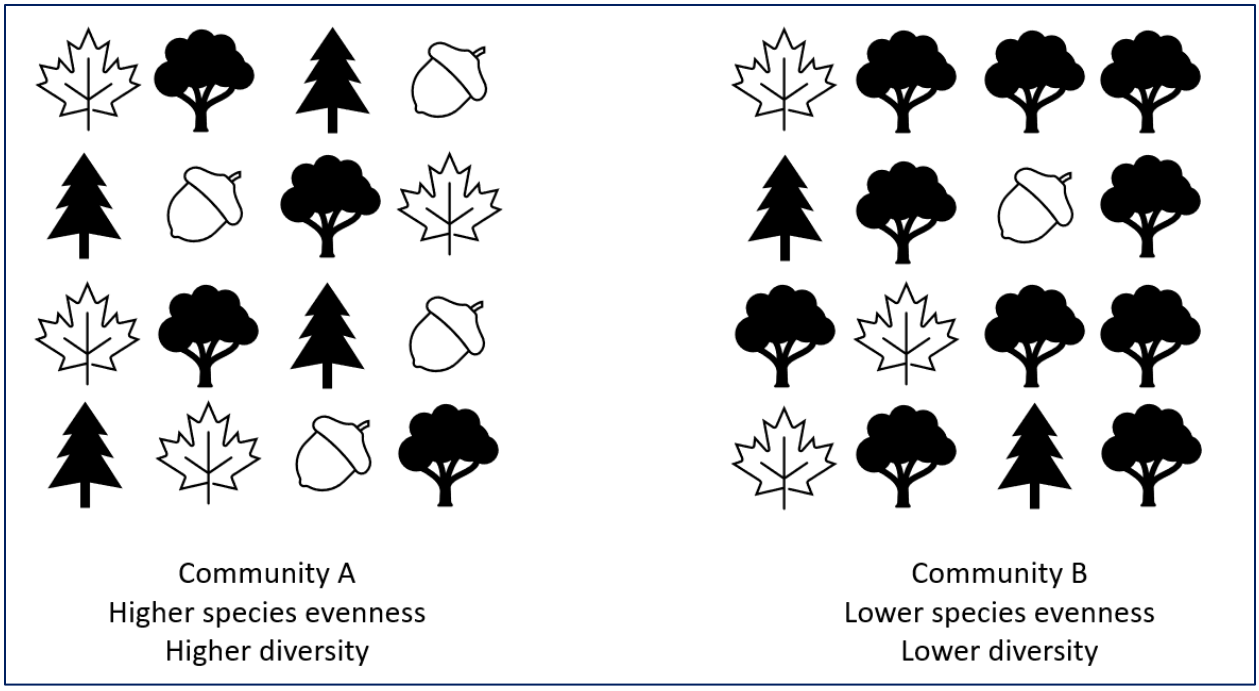


Figure 1. Comparison of communities with high and low species evenness and diversity.

Current condition and trend

The Montreal Process and Indicator Framework is the standard for assessing forest sustainability in temperate and boreal forest. Any estimate of diversity needs to have population information for each taxon of interest, which requires a rigorous sample design and periodic sampling. It is highly improbable that diversity estimates for any taxon other than trees will be part of the biodiversity assessments for reporting on forest sustainability. Diversity assessments for non-tree taxa could be generated based on research projects designed for this purpose but are likely to be periodic and apply to only a small subset of the landscape of interest.

To assess biological diversity and species evenness, a metric describing the variability of species abundance was calculated for both deciduous and coniferous species for three different tree size classes (1" Diameter at Breast Height (DBH), 1-5" DBH, and 5" DBH and larger) using data published in 2007, 2012 and 2019. Species evenness and diversity are greatest when the values are closer to 1. Across the entire state forest, conifer tree diversity appears stable for all three size classes, with conifer evenness is increasing for the 1" size class, slightly declining for the 1-5" size class and strongly declining for conifers larger than 5" (Table 1). Deciduous tree diversity appears to be stable for the 1-5" size class and slightly declining for the 1" and 5" size classes. Deciduous evenness is slightly increasing for all three size classes.

Table 1. Trees species evenness and diversity across the state forest categorized by diameter at breast height from 2007 through 2019. (Source: U.S. Forest Inventory Analysis).

DBH and Year	Coniferous: Number of Species	Coniferous: Diversity Value	Coniferous: Evenness Value	Deciduous: Number of Species	Deciduous: Diversity Value	Deciduous: Evenness Value
1-inch DBH	--	--	--	--	--	--

DBH and Year	Coniferous: Number of Species	Coniferous: Diversity Value	Coniferous: Evenness Value	Deciduous: Number of Species	Deciduous: Diversity Value	Deciduous: Evenness Value
2007	14	0.7881	0.6894	58	0.8829	0.6517
2012	13	0.7805	0.6996	49	0.88	0.6746
2019	13	0.7871	0.71	49	0.8737	0.6635
1- to 5- inch DBH	--	--	--	--	--	--
2007	10	0.7442	0.7303	52	0.8793	0.6651
2012	12	0.7358	0.6719	41	0.8782	0.7042
2019	12	0.7494	0.689	40	0.8721	0.6972
5-inch DBH	--	--	--	--	--	--
2007	10	0.8013	0.8207	41	0.8854	0.6671
2012	10	0.7952	0.8151	34	0.877	0.7006
2019	12	0.8027	0.7638	35	0.8697	0.6826

In the western Upper Peninsula, diversity values are slightly increasing for conifer trees in the 1" size class, slightly declining for the 1-5" size class, and strongly increasing for conifers 5" and larger. Evenness values were strongly increasing for conifer trees in the 1" size class, stable for conifers in the 1-5" size class, and strongly increasing in the 5" and larger class (Table 2). Western UP deciduous diversity values are slightly increasing in all three size classes. Deciduous evenness values are strongly increasing in the 1" and 1-5" size classes and is stable in deciduous trees greater than 5".

Table 2. Coniferous and deciduous trees species evenness and diversity across the western Upper Peninsula categorized by diameter at breast height from 2007 through 2019. (Source: USDA Forest Inventory Analysis).

DBH and Year	Coniferous: Number of Species	Coniferous: Diversity Value	Coniferous: Evenness Value	Deciduous: Number of Species	Deciduous: Diversity Value	Deciduous: Evenness Value
1-inch DBH	--	--	--	--	--	--
2007	10	0.7619	0.7378	27	0.833	0.6645
2012	10	0.764	0.7522	27	0.8287	0.6636
2019	9	0.7635	0.784	25	0.8518	0.7007
1- to 5-inch DBH	--	--	--	--	--	--
2007	9	0.7394	0.7386	25	0.8212	0.6684
2012	9	0.7343	0.7438	22	0.8137	0.696
2019	9	0.7322	0.7407	22	0.8329	0.7024
5-inch DBH	--	--	--	--	--	--
2007	10	0.7633	0.7725	17	0.8261	0.7295

DBH and Year	Coniferous: Number of Species	Coniferous: Diversity Value	Coniferous: Evenness Value	Deciduous: Number of Species	Deciduous: Diversity Value	Deciduous: Evenness Value
2012	9	0.79	0.8372	18	0.8315	0.7272
2019	9	0.7984	0.8424	21	0.8437	0.7165

In the eastern Upper Peninsula, diversity values increased for conifer trees in the 1" and 1-5" size classes; they were stable for conifers 5" and larger. Evenness values for conifers in the 1" and 1-5" size classes strongly increased and were stable for conifers 5" and larger (Table 3). Diversity values were stable for deciduous species in the 1" and 1-5" size classes and slightly declined for the deciduous trees 5" and larger. Deciduous evenness slightly increased in the 1" and 1-5" size classes but declined for deciduous trees 5" and larger.

Table 3. Coniferous and deciduous trees species evenness and diversity across the Eastern Upper Peninsula categorized by diameter at breast height from 2007 through 2019. (Source: USDA Forest Inventory Analysis).

DBH and Year	Coniferous: Number of Species	Coniferous: Diversity Value	Coniferous: Evenness Value	Deciduous: Number of Species	Deciduous: Diversity Value	Deciduous: Evenness Value
1-inch DBH	--	--	--	--	--	--
2007	9	0.7551	0.7666	24	0.833	0.6925
2012	9	0.7649	0.7905	22	0.8272	0.7029
2019	9	0.7872	0.8163	24	0.8331	0.7022
1- to 5-inch DBH	--	--	--	--	--	--
2007	9	0.7196	0.7207	24	0.8309	0.6916
2012	9	0.7291	0.7448	22	0.8255	0.693
2019	9	0.762	0.7802	24	0.8341	0.7028
5-inch DBH	--	--	--	--	--	--
2007	9	0.7811	0.8404	15	0.8238	0.7522
2012	9	0.7755	0.8386	14	0.8054	0.7436
2019	9	0.7892	0.848	15	0.8062	0.734

In the Northern Lower Peninsula, the picture is different. Both the diversity and evenness values for conifers in the 1" size class were strongly declining. A similar situation was found for conifers in the 1-5" size class with the diversity value strongly declining and the evenness value slightly declining. Conifers 5" and larger showed a stable value for diversity and slightly increasing for evenness (Table 4). Diversity for deciduous species declined for all three size classes. Deciduous *ev*enness slightly increased for the 1" size class and strongly increased for the 1-5" size class but declined for deciduous species 5" and larger.

Table 4. Coniferous and deciduous trees species evenness and diversity across the Northern Lower Peninsula categorized by diameter at breast height from 2007 through 2019. (Source: USDA Forest Inventory Analysis).

	Coniferous: Number of Species	Coniferous: Diversity Value	Coniferous: Evenness Value	Deciduous: Number of Species	Deciduous: Diversity Value	Deciduous: Evenness Value
1-inch DBH	--	--	--	--	--	--
2007	11	0.8019	0.747	42	0.8779	0.6812
2012	10	0.7765	0.7328	34	0.8687	0.7089
2019	11	0.7712	0.7107	35	0.8584	0.6894
1- to 5-inch DBH	--	--	--	--	--	--
2007	11	0.745	0.6815	37	0.8736	0.6989
2012	9	0.7106	0.6859	32	0.8643	0.7183
2019	10	0.7062	0.6655	30	0.8568	0.7347
5-inch DBH	--	--	--	--	--	--
2007	10	0.771	0.7433	25	0.8871	0.7507
2012	10	0.7647	0.7365	23	0.869	0.7426
2019	10	0.7756	0.7502	26	0.8751	0.7301

There is no existing threshold, goal or objective for diversity and evenness values at state or regional scales. More research is required to determine if a threshold can be identified and how diversity and evenness react to forest management activities. Declining diversity and/or evenness trends are not desirable and may carry an unassessed risk to biodiversity.

Diversity and evenness values may be influenced by harvesting, mortality and recruitment of seedlings and saplings into larger diameter classes. There is a poor understanding of how these processes influence changes in diversity and evenness and how sensitive measurements are to those changes. These are all areas of potential research needs.

Without a full understanding of the factors influencing these measures, the sensitivity of the measures to changing forest conditions and the sensitivity of our measurements to detect significant changes, we can only speculate on the importance of the trends that we have noted. They require further surveys and research. Declining trends over the longer term are not desirable.

The tree species selected for removal and retention in timber harvests are likely key factors that can influence trends, despite a poor or theoretical understanding of the mechanisms at work. Management action to promote better seed germination, seedling survival and sapling recruitment are also very likely to influence current trends.

Desired future condition, objectives, and management actions

The desired future condition is to have and maintain high species diversity, both within and across native deciduous and coniferous taxonomic groups, contributing to climate change resiliency and long-term forest sustainability.

Objective 1: Encourage the management of intact, functional landscapes, ecosystems, and communities through the planning period.

- Action 1. Develop management area plans and guidance.
- Action 2. Maintain and enhance High Conservation Value Areas.
- Action 3. Evaluate the effectiveness of within-stand retention guidance.
- Action 4. Maintain a diverse mix of forest community types, species composition, age classes, and stand structures.
- Action 5. Avoid forest conversion to non-forest land uses while accommodating departmental priorities.
- Action 6. Reforest lands that have been deforested and afforest, or plant trees on, unforested suitable sites while accommodating departmental priorities.
- Action 7. Enhance forest recovery after disturbance with diverse species that are adapted to future climate conditions.
- Action 8. Identify and implement appropriate protection measures for future-adapted seedlings and saplings.

Objective 2: Gain a better understanding of the effects of forest management and other factors (mortality, climate change, regeneration) on species diversity and evenness by the end of the planning period.

- Action 1. Partner with universities in the Great Lakes Region/Canada on research projects for this objective.
- Action 2. Maintain continuous evaluation/monitoring of species diversity.
- Action 3. Improve forest inventory data collection to include better regeneration information.
- Action 4. Increase ecosystem redundancy across the landscape.

Objective 3: Maintain and enhance species and structural diversity throughout the planning period.

- Action 1. Promote diverse age classes.
- Action 2. Maintain and restore a diversity of native species that are expected to be adapted to future conditions.
- Action 3. Retain biological legacies to enhance species and structural diversity, serve as a seed source and provide suitable conditions for seed germination (scarification, nurse logs, etc.).
- Action 4. Promote landscape connectivity through reduction in landscape fragmentation and maintaining and creating habitat corridors.
- Action 5. Reduce risk and long-term impacts of severe disturbances by altering stand structure to reduce severity of wildfire, wind and ice damage.

Climate change

Predicted impacts relevant to coniferous tree species diversity

All climate change data and information is pulled directly from the open-source Northern Institute of Applied Climate Science (NIACS) Climate Change Impacts tool and adaptation workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium, limited) and agreement (high, moderate, low) described in the Predicted Impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the Adaptation Approaches. For more information, please go to www.niacs.org.

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Increased length of growing season	Robust	High	Longer growing seasons could result in greater growth and productivity of trees and other vegetation, but only if balanced by available water and nutrients
Many invasive species, insect pests, and pathogens will increase or become more damaging	Limited	High	Increased stress and damage and stress to forests
Boreal species will face increasing stress	Medium	High	Projected decline in suitable habitat and landscape-level biomass
Systems limited to environments will have less opportunity to migrate	Limited	High	Decreased presence and abundance across landscape; increase effects of environmental perturbations
Low-diversity systems are at greater risk	Medium	High	More susceptible to future changes and stressors
Systems more tolerant of disturbance have less risk of decline	Medium	High	Forest systems that are more tolerant of drought, flooding, or fire are expected to be better able to withstand climate-driven disturbances
Forest composition will change across landscape	Medium	High	Habitat and biomass of individual tree species will change and respond uniquely
Tree regeneration and recruitment will change	Medium	High	Seedlings are more vulnerable; expected to be more responsive to favorable conditions

Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Tree species diversity and evenness values from FIA data

Biological Diversity

Management priority: Seed zones



Why seed zones matter

A seed zone is a contiguous area that represents the origin of seed and is the smallest area for defining locality for plants. Historically, seed zones represented a geographic area in which seed transfer can be done with little risk of seeds failing. In today's context, there is a concerted effort to separate the idea of seed origin from seed transfer (or where it should be planted). The science of seed transfer is evolving and can be based on climate-based models and/or biophysical models. Precipitation, spring frost and elevation may be key components of the models. Smaller seed zones tend to be best, as seed lots can be combined, but not separated once they have been combined.

Trees have adapted to grow and survive environmental conditions within the areas where they originate – they have become adapted to the specific conditions of local climates and sites. Trees that are moved (via seed), even to a different location within their range, may suffer from spring or fall frosts, moisture stress, heat stress or damage from snow and cold temperatures. These stresses can result in reduced growth and vigor, which makes them more susceptible to insect and disease damage. With a changing climate they may also be more likely to die. If there is a lack of genetic potential, no amount of tending, fertilizing, irrigation, or pest control will help the tree to survive and thrive.

Generally, seed sources from warmer climates tend to grow faster than sources from cooler climates. Seed sources originating from a site warmer than the planting site tend to grow more slowly due to insufficient cold tolerance. Thus, a seed source from a location that is 5 to 10 degrees F warmer than the planting site should be used. This roughly translates into 110 miles. Transfer from a cool to a warm climate should be avoided.

Trees vary in their success when moved. White spruce seeds can be moved greater distances (200 miles north and 535 miles east or west) than the general rule. Red pine has very low genetic diversity and is not very tolerant of precipitation gradients, which means seed cannot do as well in conditions dissimilar to its native range. The farther seed is moved in any direction, the more likely changes in conditions will be experienced, and the seed becomes less likely to produce vigorous and healthy trees.

Current condition and trend

The seed zone origin of the seeds the DNR plants is largely unknown, and the use of seed zone information is not as rigorous as it could be. One of the challenges for implementing its use is the field collection program for cones. Red pine and jack pine are the primary species planted on the state forest, historically and currently. Historical records on seed sources used to establish older stands are not

available and seed collectors often use planted stands to find cones. It's also difficult for some of them to accurately determine if a stand is planted or natural. Therefore, it's difficult to decipher if a cone collected in a particular location has local genetics.

The DNR is beginning an assisted tree migration study to help identify the genetics of future climate-adapted trees which will be used to establish new seed orchards. Seeds for the project will be sourced and evaluated from multiple seed zones.

Desired future condition, objectives, and management actions

Trees planted on the state forest originate from individuals with genotypes that are expected to improve timber quality and productivity, and to do well in future climates as indicated by research.

Objective 1. This planning period, continue programmatic improvements to the reforestation program by increasing knowledge of current seed sources, and assessing future seed sources for timber quality, productivity, and climate change resilience through provenance trials and genetic analysis.

- Action 1. Improve tracking of seed lot provenance for all trees and herbaceous plants that are planted on state forest land, using the latest U.S. Forest Service Eastern Seed Zone Map when applicable.
- Action 2. Work with research partners to conduct genetic analysis on seeds collected in the Pine Cone Picking Vendor program.
- Action 3. Transition from ad hoc field collection of pine cones to intentional collection from stands with desired genotypes, based on genetic analysis data.
- Action 4. Establish and monitor rangewide assisted migration research common gardens to assess timber quality, production, and climate resilience across various provenances.

Climate change

All climate change data and information listed here is pulled directly from the open-source Northern Institute of Applied Climate Science (NIACS) Climate Change Impacts tool and adaptation workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium, limited) and agreement (high, moderate, low) described in the Predicted Impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the Adaptation Approaches. For more information, please go to www.niacs.org.

Predicted climate change impacts on seed zones

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Southern or temperate species in northern Michigan will be favored by climate change	Medium	High	Many temperate species will experience increasing suitable habitat and biomass across the assessment area. Longer growing seasons and warmer temperatures will lead to productivity increases for temperate forest types; seed zones may change in recognition of this. This may open opportunities to source genetic material from farther south than is currently viable.

Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Proportion of stands in the state forest planted with known provenance data
- Number of species tested in common gardens for future use in the reforestation program

Management priority: Unique populations



Why Unique populations matter

Unique populations are individuals of a species in each area physically and/or genetically isolated from other populations of the same species. A population can become isolated due to fragmentation, or due to highly patchy habitat distribution, or because it only occurs in one geographic area. These populations have little to no interactions with other individuals of the species and therefore, little to no exchange of outside genetic material. Over time, this can lead to a loss in genetic diversity in the isolated population. This can also mean that any local genetic adaptations in the isolated population are not commonly represented in the larger population due to lack of genetic exchange.

Genetic diversity is the foundation of all biological diversity. For a species or population, it is important because it offers greater ability to withstand changing circumstances spurred by events such as climate change or through natural or human-caused catastrophic events. Losses in genetic diversity can increase the risk of extinction in general, and isolated populations are especially vulnerable to elimination. This risk is heightened for species of conservation concern, which are already facing populations declines. Sustainable forest management must also include consideration for these vulnerable features.

Current condition and trend

With almost 4 million acres of state forest land and 701 species of greatest conservation need statewide it is a challenge to evaluate each species for geographic or genetic diversity. Direct assessments of genetic diversity are outside the scope of the DNR; however, tracking species in terms of their potential for genetic losses may be possible. Geographically disjunct populations and the population status of leading and trailing edge species of concern can be used as indirect measures. Tracking these metrics would help the DNR prioritize management.

Of the 701 species of greatest concern in Michigan, approximately 235 have been documented on, or their range overlaps with, the state forest. That is too many species to routinely survey or monitor over time. Any survey efforts conducted so far have been species- or location-based, and some species have been focused on more than others due to funding availability, management concern, or capacity. Animal populations are much harder to survey and to assess population parameters. The following data is focused on plants (Table 1).

Table 1. Rare plant species populations in the state forest at greatest risk of losses in genetic diversity due to limitations in geographic occurrence (Source: T. Bassett and B. Slaughter, personal communication).

Scientific Name	Common Name	State Status	Genetic or Geographic Restriction
Adlumia fungosa	Climbing fumitory	T	Limited to Niagara escarpment

Scientific Name	Common Name	State Status	Genetic or Geographic Restriction
Agoseris glauca	Prairie or pale agoseris	T	Disjunct species with limited distribution in Michigan
Amerorchis rotundifolia	Small round-leaved orchid	E	One known population
Ascelipias ovalifolia	Dwarf milkweed	E	Very local and scattered in Menominee County
Asplenium rhyzophyllum	Walking fern	T	Highly local
Botrychium mormo	Goblin moonwort	E	Eastern edge of extant range
Cirsium hilli	Hill's thistle	SC	Chippewa County populations occur on alvar and likely have a unique genetic variant
Dalibarda repens	False violet	T	Disjunct population; only two extant locations in Michigan
Draba cana	Ashy whitlow grass	E	Disjunct and restricted to limestone outcrops
Festuca alteaica	Rough fescue	SC	Disjunct population limited to pine barrens in NLP
Geum triflorum	Prairie smoke	T	Only two known locations; Chippewa County Island populations are isolated from other limestone populations
Juncus vaseyi	Vasey's rush	T	Very few records
Minuartia dawsonensis	Rock sandwort	T	Restricted geographically
Panicum philadelphicum	Philadelphia panic-grass	E	Only known from Drummond Island
Petasites sagittatus	Sweet coltsfoot	T	Eastern edge of range; geographically isolated
Platanthera unalescensis	Alaska orchid	SC	Edge of range
Prunus umbellata	Allegheny plum	SC	Very limited distribution in Michigan; globally rare
Rumex occidentalis	Western dock	E	Disjunct population limited to one county in Michigan
Sisyrinchium strictum	Blue-eyed-grass	T	Local where it occurs; geographically limited in Michigan
Solidago vossii	Voss' goldenrod	E	Only known from Camp Grayling
Vaccinium cespitosum	Dwarf bilberry	T	Highly disjunct
Viola novae-angliae	New England violet	T	Very few records
Woodsia obtusa	Blunt-lobed woodsia	T	Very few records

Species range shifts occur at the edges. In a climate-change scenario, where migration is generally to the north along climatic gradients, leading and trailing edge species are those that are on the high and low latitude edges of their ranges, respectively. While each species will respond variably to climate change

impacts over space and time dependent on many factors, trailing edge species are generally thought to be at greater risk of population (thus genetic) losses. This is because species are expected to move slower than their habitat will change, and the southern edge of a species range generally indicates a species is at or near its thermal tolerance threshold.

To identify and monitor these risks in the state forest, a subset of SGCN species were separated into leading and trailing edge (Tables 2, 3). This subset of species represents those that were included in a climate change impact analysis of 400 wildlife species in Michigan (Hoving et al. 2013). This analysis rated species as Insufficient Evidence (IE), Increase Likely (IL), Presumed Stable (PS), Moderately Vulnerable (MV), Highly Vulnerable (HV) an Extremely Vulnerable (EV) as an indication of whether climate change would impact the range or abundance of a species, by region, by 2050. Zeroes indicate no occurrence.

Table 2. Rare species in the state forest at the leading edge of their ranges (based on Hoving et al. 2014)

Species	Scientific Name	WUP	EUP	NLP	State Status
Henslow's sparrow	*Ammodramus henslwii*	0	0	0	E
King Rail	*Rallus elegans*	0	0	0	E
Migrant Loggerhead Shrike	*Lanius ludovicianus migrans*	0	0	0	E
Rusty-patched bumble bee	*Bombus affinis*	0	0	PS	E
Bobolink	*Dolichonyx oryzivorus*	IL	IL	IL	Proposed SC 2025
Blanding's turtle	*Emydoidea blandingii*	HV	HV	HV	SC
Butler's garter snake	*Thamnophis butleri*	0	0		SC
Dickcissel	*Spiza americana*	IL	IL	IL	SC
Dusted skipper	*Atrytonopsis hianna*	0	0	MV	SC
Eastern meadowlark	*Sturnella magna*	PS	PS	PS	SC
Grasshopper sparrow	*Ammodramus savannarum*	PS	0	PS	SC
Marsh wren	*Cistothorus palustris*	PS	PS	PS	SC
Mudpuppy	*Necturus maculosus*	MV	MV	MV	SC
Pickerel frog	*Rana palustris*	MV	MV	MV	SC
Red-shouldered hawk	*Buteo lineatus*	PS	PS	PS	SC
Secretive locust	*Appalachia arcana*	0	0	MV	SC
Sedge wren	*Cistothorus platensis*	PS	PS	PS	SC
Woodland vole	*Microtus pinatorum*	0	0	PS	SC
Cerulean warbler	*Setophaga cerulea*	0	0	0	T
Common gallinule	*Gallinula galeata*	0	0	PS	T
Eastern massassauga rattlesnake	*Sistrurus catenatus catenatus*	0	0	HV	T
Golden-winged warbler	*Vermivora chrysoptera*	IL	IL	IL	T
Least bittern	*Ixobrychus exilis*	0	MV	MV	T

Species	Scientific Name	WUP	EUP	NLP	State Status
Northern blue butterfly	*Lycaeides idas nabokovi*	HV	HV	0	T
Spotted turtle	*Clemmys guttata*	0	0	HV	T
Tricolored bat	*Perimyotis subflavus*	PS	0	0	T
Upland sandpiper	*Bartramia longicauda*	IL	IL	IL	T
Whip-poor-will	*Caprimulgus vociferus*	IL	IL	IL	T
Wood turtle	*Glyptemys insculpta*	MV	MV	MV	T

Table 3. Rare species in the state forest on the trailing edge of their ranges (based on Hoving et al. 2014).

Species	Scientific Name	WUP	EUP	NLP	State Status
Lynx	*Lynx canadensis*	HV	HV	0	E
Piping plover	*Charadrius melodus*	0	MV	MV	E
Marten	*Martes americana*	MV	MV	0	Proposed SC 2025
Bald eagle	*Haliaeetus leucocephalis*	IL	IL	IL	SC
Black-backed woodpecker	*Picoides arcticus*	IL	IL	IL	SC
Boreal chickadee	*Poecile hudsonica*	PS	PS	0	SC
Connecticut warbler	*Oporornis agilis*	PS	PS	0	SC
Freija fritillary	*Boloria freija*	HV	HV	0	SC
Gray wolf	*Canis lupus*	PS	PS	0	SC
Merlin	*Falco columbarius*	PS	PS	0	SC
Moose	*Alces americana*	HV	HV	0	SC
Northern flying Squirrel	*Glaucomys sabrinus*	MV	MV	MV	SC
Osprey	*Pandion haliaetus*	PS	PS	PS	SC
Sharp-tailed grouse	*Tympanuchus phasianellus*	PS	PS	0	SC
Yellow-banded bumble bee	*Bombus terricola*	PS	PS	PS	SC
Black tern	*Chilodonias niger*	MV	MV	MV	T
Common loon	*Gavia immer*	HV	HV	HV	T
Common tern	*Sternia hirundo*	0	MV	MV	T
Evening grosbeak	*Coccothraustes vespertinus*	IL	IL	0	T
Northern goshawk	*Accipiter gentilis*	PS	PS	PS	T
Spruce grouse	*Falcipennes canadensis*	MV	MV	MV	T
Yellow rail	*Coturnicops noveboracensis*	MV	MV	MV	T

Desired future condition, objectives, and management actions

Unique animal and plant populations are managed to promote gene flow or to protect local adaptive traits. Trailing- or leading-edge populations are managed to increase capacity to persist longer or move through a changing landscape.

Objective 1. Within five years, determine where unique or disjunct populations occur on state forest land across taxonomic groups and develop management guidelines.

- Action 1. Work with partners to develop a process to identify and assess at-risk populations across taxonomic groups.
- Action 2. Develop habitat management guidelines for disjunct populations that incorporate promotion of gene flow or protection of unique genetic variation, depending on circumstances.
- Action 3. Treat invasive species as needed; these populations will be particularly vulnerable based on their rarity.
- Action 4. Monitor identified disjunct populations over time.
- Action 5. Identify and protect landscapes with high phylogenetic and/or phenotypic diversity, and with traits restricted to their communities.

Objective 2. By the end of the planning period, develop management guidance for trailing and leading-edge species in need of management intervention.

- Action 1. Expand trailing and leading-edge species assessments to include other rare and featured species.
- Action 2. Prioritize guidance for species based on climate change vulnerabilities and feasibility of intervention.

Climate change

Climate change data and information listed here is pulled directly from the open-source Northern Institute of Applied Climate Science Climate Change Impacts tool and adaptation workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium, limited) and agreement (high, moderate, low) described in the Predicted impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the Adaptation approaches section. For more information, please go to niacs.org.

Predicted impacts relevant to unique populations

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Northern Michigan's growing season will increase by 30 to 70 days by the end of the 21st century	Robust	High	Changes in phenology; greater growth and productivity of trees and other plants if balanced with available water and nutrients; could alter local community dynamics putting unique populations at greater risk
Southern or temperate species in northern Michigan will be favored by climate change	Medium	High	Most species will likely migrate more slowly than their habitats will shift, putting unique populations at a disproportionate risk of elimination
Low-diversity systems are at greater risk from climate change	Medium	High	Species with high genetic variation have better odds of producing individuals that can withstand extreme events and adapt to changes over time; the more isolated a population is, the lower these odds become
Systems that are limited to environments will have less opportunity to migrate in response to climate change	Limited	High	Those species confined to habitats face additional barriers to migration; since this is likely already the case with unique populations, this puts them at even greater risk in a changing climate

Adaptation approaches

Maintaining and enhancing genetic diversity is a key component of climate change resiliency. This can mean facilitating gene flow or population movement to prevent losses in genetic diversity, and it can mean protecting endemism where local genetic adaptations confer survival traits. These species are also highly at risk from invasive species. It's important to identify at-risk populations and develop management strategies to increase the adaptive potential of these populations, while mitigating invasive species and other threats.

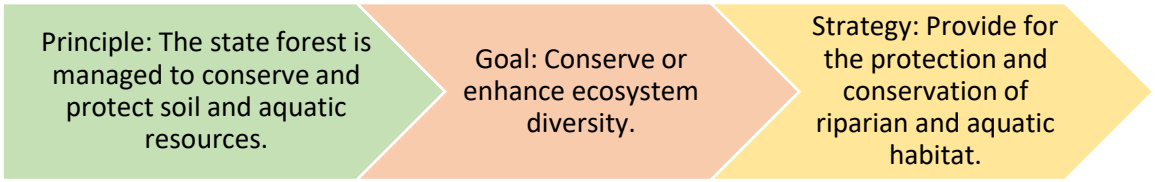
Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Number of species with geographically restricted populations by state status
- Number of leading-edge species by state status
- Number of trailing-edge species by state status

Aquatic resources

Management priority: Riparian and lacustrine habitat



Why riparian and lacustrine habitat matters

A riparian area is the area of transition between aquatic and terrestrial ecosystems. Riparian areas (within 100 meters of a lake or stream) are highly diverse in vegetation, and major cover types include lowland shrubs and conifers, aspen and cedar. Due to the unique conditions near water, riparian areas harbor a high diversity of plants and wildlife. Riparian areas are critical to watersheds, wildlife, fish, trees, and people for many reasons. For example, these areas provide migratory corridors for many species of wildlife and provide cover and refuge areas along the margins of waterbodies for aquatic species. They are the last line of defense against pollutants flowing toward waterways – helping to protect the waters' quality.

Lacustrine habitat refers to open freshwater ecosystems (e.g., ponds, lakes). Lakes and streams provide habitat for fish species such as trout, walleye, cisco and lake sturgeon and other aquatic species such as mussels, wild rice and loons across the Michigan landscape. Priority lakes and streams are identified in fisheries orders 200, 210, 252, 253 and 254. Examples of potential information for consideration of future management include the Management Plan for Walleye in Michigan's Inland Waters; Michigan's State Wildlife Action Plan; Mussel Protocol Stream Groups; and the current and potential future presence of and management for priority aquatic species. These lakes and streams are also recreation resources serving as significant components of many regional and local economies. Economic benefits range from direct expenditures for equipment and related supplies to indirect support of local hotels, restaurants and other establishments.

Current condition and trend

Cover types within 100 meters of streams and lakes across the state forest tend to be clustered in lowland shrub, aspen, cedar and northern hardwoods. Table 1 is a summary of the cover types occurring within riparian and lacustrine areas across the state forest.

Table 1. Cover type composition (acres) within the riparian and lacustrine areas (100 meters) in the northern, western and eastern regions of the state forest. (Source: Michigan DNR Forest Inventory data 2021).

Cover Type	Northern Lower Peninsula	Eastern Upper Peninsula	Western Upper Peninsula	Total
Lowland Shrub	31,585	31,921	24,647	**88,153**
Aspen	30,721	9,389	19,437	**59,547**
Cedar	13,303	14,504	12,931	**40,737**
Lowland Conifers	16,588	10,621	9,790	**36,999**
Northern Hardwood	12,255	9,539	14,507	**36,300**
Water	15,028	13,051	7,666	**35,745**
Marsh	14,052	10,898	3,732	**28,683**
Lowland Deciduous	18,611	4,561	5,093	**28,265**
Mixed Upland Deciduous	7,411	3,650	6,063	**17,123**
Upland Mixed Forest	4,480	3,074	4,503	**12,057**
Lowland Mixed Forest	5,193	3,039	2,753	**10,984**
Lowland Spruce/Fir	1,237	3,518	5,157	**9,911**
Upland Conifers	1,767	4,671	3,450	**9,888**
Lowland Aspen/Balsam Poplar	6,181	2,233	1,101	**9,515**
Natural Mixed Pines	4,225	3,878	1,329	**9,433**
Planted Red Pine	5,101	2,473	507	**8,081**
Natural Jack Pine	2,632	4,642	616	**7,890**
Natural White Pine	2,378	3,009	679	**6,066**
Natural Red Pine	1,493	2,925	923	**5,341**
Herbaceous Openland	2,666	1,734	899	**5,299**
Upland Spruce/Fir	759	1,433	2,250	**4,442**
Treed Bog	444	2,215	1,174	**3,834**
Planted Jack Pine	1,825	1,102	424	**3,351**
Tamarack	947	1,027	1,352	**3,326**
Bog	1,008	1,147	1,033	**3,187**
Northern Red Oak	2,193	75	200	**2,469**
Black-Red Hybrid Oak	2,338	0	72	**2,410**
Upland Shrub	1,282	647	459	**2,388**
Bare/Sparsely Vegetated	427	1,543	255	**2,225**
Hemlock	251	536	1,168	**1,955**
Urban	849	626	350	**1,825**
Low-Density Trees	872	485	237	**1,595**
Oak Mix	1,375	123	24	**1,522**
Planted Mixed Pine	473	173	21	**667**
Planted White Pine	291	32	5	**328**
Cropland	124	0	116	**239**

Desired future condition, objectives and management actions

Ecologically intact riparian zones and upland nearshore zones of lakes that maintain and enhance aquatic and wildlife habitat as well as natural aesthetic values while being resilient and adaptive to a changing climate and minimally disturbed by invasive species.

Objective 1. Protect waters from sedimentation, preserve nearshore wildlife habitats and corridors, and conserve large woody material that enhances aquatic habitat when it falls into waterways throughout the planning period.

- Action 1. Continue to operate using Michigan Forestry Best Management Practices for Soil and Water Quality.
- Action 2. Update Michigan Forestry Best Management Practices for Soil and Water Quality based on best available information related to forest management practices to reduce nutrient and sediment pollution to surface waters.
- Action 3. Continue to protect sensitive wetland habitats through the Department of Environment, Great Lakes, and Energy permit review process.
- Action 4. Management prescriptions should maintain and restore forest canopy cover over stream corridors (riparian management zones).
- Action 5. Manage riparian areas located within designated state Natural Rivers in accordance with Part 305 statute, rules, and approved Natural Rivers plans.
- Action 6. Manage riparian areas located within designated Federal Wild and Scenic River systems in accordance with federal management plans.
- Action 7. Work toward updating resource management zone best management practices that reflect current- and emerging-science for protection of priority aquatic species (e.g., Walleye, Cisco, Lake Whitefish, Lake Sturgeon, mussels, amphibians, etc.) in cool- and coldwater lakes and streams as identified in species management plans (e.g., Management Plan for Walleye in Michigan's Inland Waters, Michigan's State Wildlife Action Plan, etc.).

Climate change

All climate change data and information listed herein is pulled directly from the open-source Northern Institute of Applied Climate Science climate change impacts tool and adaptation workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium and limited) and agreement (high, moderate and low) described in the table below. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the adaptation approaches. For more information, go to NIACS.org.

Predicted impacts relevant to riparian and lacustrine habitat.

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
More frequent intense precipitation events	Medium	Moderate	Increased potential for sediment runoff which can degrade aquatic habitats.
Surface water temperatures are expected to rise due to warming air temperatures	Not given	Not given	Increased water temperatures of rivers and lakes that alter habitat; decreased winter ice cover.
Continued warming of inland lakes will decrease seasonal mixing and reduce available dissolved oxygen	Not given	Not given	Decreased availability of aquatic habitat for animals; mortality of aquatic organisms.
Low streamflow events may become more frequent and deliver lower water volumes	Not given	Not given	Perennial systems may shift to intermittent, decreasing availability of aquatic habitat for animals.

Adaptation approaches

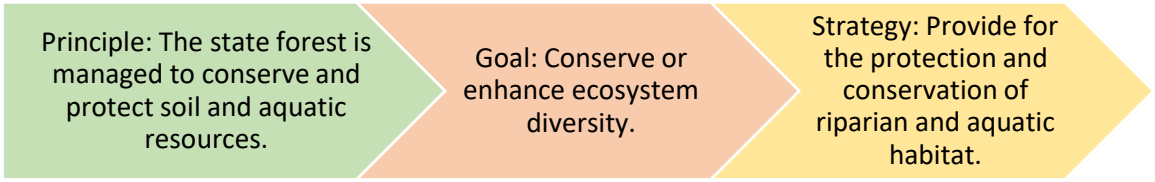
Management will strive to mitigate and adapt to the variable effects of altered precipitation events and regional air temperature warming trends. This will occur through maintenance and restoration of canopy cover in riparian and lacustrine zones to provide for the protection of habitats, soils, and water quality/quantity through continued implementation of Michigan Forestry Best Management Practices for Soil and Water Quality and management plans (e.g., Natural Rivers). This should result in riparian and lacustrine areas that provide a multitude of values (e.g., forest products, wildlife habitat, cultural resources).

Monitoring

The following metrics have been identified for this management priority to track progress toward forest sustainability:

- Acres of cover types in riparian areas (100 meters)
- Acres of cover types in lacustrine areas (100m)

Management priority: Wetlands habitat



Why wetland habitat matters

Wetlands are areas that are flooded or saturated by water permanently or seasonally. Diverse hydrologic and geomorphic landscape settings provide an array of wetland types, supporting diverse and productive plant and animal species. They also are recognized as carbon sinks. Wetlands in northern Michigan are typified by strong groundwater sources and northern species of vegetation and animals. Many wetlands are found at the interface of lakes, rivers and streams, and provide high-quality water and habitat for fish and wildlife. Extensive wetland ecosystems are supported inland by the humid and cool climate combined with widely distributed porous soils.

Current condition and trend

Wetlands (emergent, forested, riverine) are commonly found on the state forest; a summary of the proportion of state forest that is wetlands by type can be found in Table 1.

Table 1. Percentage of state forest land classified as emergent, forested and riverine wetland types across the northern, western and eastern state forest ecoregions (Source: Michigan DNR Forest Inventory data 2021).

Region	Emergent Wetland	Forested Wetland	Riverine Wetland	Total Wetlands
Northern Lower Peninsula	1.3%	22.3%	0.2%	**23.8%**
Eastern Upper Peninsula	2.7%	45.1%	0.3%	**48.1%**
Western Upper Peninsula	1.4%	35.8%	0.3%	**37.5%**

Desired future condition, objectives and management actions

Wetlands are protected to maintain ecological integrity and support ecosystem resilience and biodiversity, water quality, and aquatic and wildlife habitats and minimally influenced by invasive species.

Objective 1. Maintain acreage of all wetland types across the state forest during the planning period.

- Action 1. Implement Michigan Forestry Best Management Practices for Soil and Water Quality.
- Action 2. Protect all regulated wetland habitats through the Department of Environment, Great Lakes, and Energy permit review process.
- Action 3. Protect all non-regulated wetland habitats to the standards established by the Department of Environment, Great Lakes, and Energy for regulated wetlands.

Objective 2. Contribute to the statewide objectives of restoring and/or creating wetlands and contiguous grasslands throughout the planning period.

- Action 1. Identify wetland complexes influenced by invasive species that should be considered high priority for restoration.
- Action 2. Work with conservation partners to identify and restore critical wetlands.
- Action 3. Remove obsolete dams and replace improperly sized road-stream crossings to restore rivers and streams to free-flowing conditions.
- Action 4. Favor and restore native species and genotypes, including those that are expected to adapt to future habitat conditions.

Objective 3. Manage systems to cope with potential water levels given the uncertainty of future local variable precipitation trends and variable water availability throughout the planning period.

- Action 1. Manage the transition of open wetlands to shrub-dominated wetlands by selectively controlling invasive shrubs.
- Action 2. Plan for and take advantage of lower water levels by controlling invasive species and/or establishing desirable native species on newly exposed soil.
- Action 3. Identify and map aquifer recharge zones as an additional protection measure for these wetland features.
- Action 4. Control the encroachment of invasive species that respond to potential higher water levels (e.g., Phragmites australis var. australis).

Climate change

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Predicted climate change impacts relevant to wetland habitat

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Altered soil moisture patterns with drier soil conditions later in the growing season	Medium	High	Wetland cover types may become moisture limited.
Southern temperate species will become favored	Medium	High	Wetland cover types and/or vegetation species will change, potentially altering habitat.
Decreased days ground will be frozen during the winter	Robust	High	Increased water infiltration and reduced runoff with greater water losses through increased evapotranspiration.
Precipitation events will become more intense and frequent	Medium	Moderate	Increased total runoff and peak streamflow; increased soil erosion.

Adaptation approaches

Management will strive to mitigate and adapt to the variable effects of altered precipitation events and regional air temperature warming trends by maintaining and restoring vegetative cover types throughout all wetland types that provide for the protection of animal habitats, soils, and water quality/quantity through continued implementation of Michigan Forestry Best Management Practices for Soil and Water Quality and management plans. Implemented management will result in wetlands that provide a multitude of values (e.g., forest products, wildlife habitat, cultural resources).

Monitoring

The following metrics have been identified for this management priority to track progress toward forest sustainability:

- Number of wetlands by type.
- Acreage of wetlands by type.

Management priority: Vernal pools and seeps habitat



Why Vernal Pools and seeps habitat matters

Vernal pools and seeps are small, isolated wetlands. These wetlands are used by a variety of birds, mammals, reptiles and amphibians, some of which rely on these small ecosystems for critical life stages. These areas often have high biodiversity and sustain many rare plant and animal species. These features can provide other important services including flood control and improved water quality. They catch runoff and trap water and sediments. They also support groundwater recharge, which helps to support the abundance of high-quality coldwater trout habitat in the state forest. They contribute to the overall biodiversity of the state forest.

Current condition and trend

Summary tables for the number and acreage of vernal pools and seeps across the state forest can be found in Tables 1 and 2. Generally, each habitat type is mapped or identified by foresters during field surveys.

Table 1. Number and acreage of inventoried vernal pools across state forest regions (Source: Michigan DNR Forest Inventory data 2021).

Region	Number	Acres
Northern Lower Peninsula	390	10,923
Eastern Upper Peninsula	59	2,832
Western Upper Peninsula	214	10,829
Totals	**663**	**24,585**

Table 2. Number and acreage of inventoried seeps across state forest regions (Source: Michigan DNR Forest Inventory data 2021)

Region	Number	Acres
Northern Lower Peninsula	422	15,628
Eastern Upper Peninsula	44	1,788
Western Upper Peninsula	86	4,486
Totals	**552**	**21,902**

Desired future condition, objectives and management actions

Vernal pools and seeps are protected on the landscape as functioning systems to provide unique habitat for wildlife and plants and water quality benefits such as the attenuation of flood flow.

Objective 1. Protect sensitive natural areas during forest treatment activities.

- Action 1. Continue to implement Michigan Forestry Best Management Practices for Soil and Water Quality, including implementing and maintaining buffers surrounding vernal pools and seeps.
- Action 2. Work toward populating an inventory of vernal pool and seep locations (approximately 10% of the state forest per year) that is annually updated.
- Action 3. Identify and map aquifer recharge zones as an additional protection measure for these wetland features.

Objective 2. Ensure field staff are aware of the latest spatial information available for their management areas related to vernal pools and seeps.

- Action 1. Provide guidance/training to staff to encourage and help facilitate identification and protection of vernal pools and seeps.

Climate change

All climate change data and information listed herein is pulled directly from the open-source Northern Institute of Applied Climate Science Climate Change impacts tool and adaptation workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium and limited) and agreement (high, moderate and low) described in the predicted impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the adaptation approaches. For more information, go to NIACS.org.

Predicted climate change impacts relevant to vernal pools and seeps

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Reduction of snowfall, snow depth and snowpack duration	Robust	High	Decreased available water in spring season
Altered soil moisture patterns with drier soil conditions later in the growing season	Medium	High	Forest cover types may become moisture limited
Decreased days ground will be frozen during the winter	Robust	High	Increased water infiltration and reduced runoff with greater water losses through increased evapotranspiration
Systems that are limited to particular environments will have less opportunity to migrate	Limited	High	Increased habitat fragmentation

Adaptation approaches

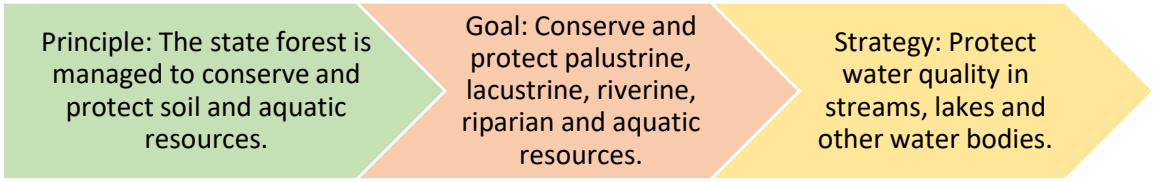
Management will strive to buffer vernal pools and seeps from the variable effects of altered precipitation events and regional air temperature warming trends through maintenance and protection of cover types surrounding areas of vernal pools and seeps for protection of habitats, soils and water quality/quantity through continued implementation of Michigan Forestry Best Management Practices for Soil and Water Quality. Results of implemented management will result in areas that provide a multitude of values (e.g., forest products, wildlife habitat, cultural resources).

Monitoring

The following metrics have been identified for this management priority to track progress toward forest sustainability:

- Stands containing vernal pools (opportunistic)
- Stands containing seeps (opportunistic)

Management priority: Streamside damage



Why streamside damage matters

Streamside damage can negatively impact soil and water resources, which forests rely on for ecological and hydrological functions. Here, "streamside" refers to areas alongside streams, lakes and wetlands. Soil erosion and sedimentation can change water and soil quality and can affect species composition and forest structure. When damage occurs, timely reporting, remediation, and monitoring efforts, specifically on sites with proximity to aquatic resources are crucial to support a healthy forest ecosystem.

Current condition and trend

Streamside damage is reported and recorded in the DNR Resource Damage Reporting database. In the state forest, there is not an identifiable trend in the number of sites with streamside damage. The highest number of streamside damage reports were in 2011, 2014 and 2017.

Table 1. Number of sites with streamside damage by damage type that were reported in the state forest between 2010 and 2021. (Source: DNR Resource Damage Reporting database).

Years	Soil Entering Water	Water Drainage Issues	Total
2010	7	9	**16**
2011	5	18	**23**
2012	4	9	**13**
2013	3	17	**20**
2014	4	20	**24**
2015	3	6	**9**
2016	10	10	**20**
2017	6	24	**30**
2018	11	11	**22**
2019	8	14	**22**
2020	8	12	**20**
2021	6	8	**14**
Total	**88**	**172**	**260**

Desired future condition, objectives and management actions

State forest management follows best management practice guidance to minimize risk of streamside damage.

Objective 1. Protect and maintain water quality within the state forest for the duration of this plan.

- Action 1. Follow Michigan Forestry Best Management Practices for Soil and Water Quality.

- Action 2. Reduce soil erosion and sediment deposits.
- Action 3. Promptly revegetate areas after management, recreation or significant natural disturbances.
- Action 4: In areas where soils can erode, employ proper road construction and maintenance and appropriate stream crossings, take erosion control measures, and increase forested acreage adjacent to open wetlands to "slow the flow" of runoff to limit forming gullies or ravines.
- Action 5: Adopt “Work Clean Go” ethic in areas susceptible to damage.

Objective 2. Improve monitoring of streamside damage within next five years.

- Action 1. Develop procedures and standards for data collection.
- Action 2. Consider updates to Resource Damage Reporting database to capture additional qualitative and quantitative data.
- Action 3. Develop a long-term plan for continued streamside damage monitoring.

Climate change

All climate change data and information listed herein is pulled directly from the open-source Northern Institute of Applied Climate Science Climate Change impacts tool and adaptation workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium and limited) and agreement (high, moderate and low) described in the predicted impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the adaptation approaches. For more information, go to NIACS.org.

Predicted climate change impacts relevant to streamside damage

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
More winter precipitation as rain, more snowmelt between snowfall events	Robust	High	Increased water levels and flooding potential in winter and spring
Fewer days of frozen ground	Medium	High	Increase water infiltration into the soil, reducing runoff
More frequent heavy precipitation events and higher rainfall per event	Medium	Moderate	Increasing magnitude and frequency of flooding, especially in summer
Soil saturation will influence magnitude and duration of flood events	Not given	Not given	Frequency of multiple high flow days in a row will increase

Adaptation approaches

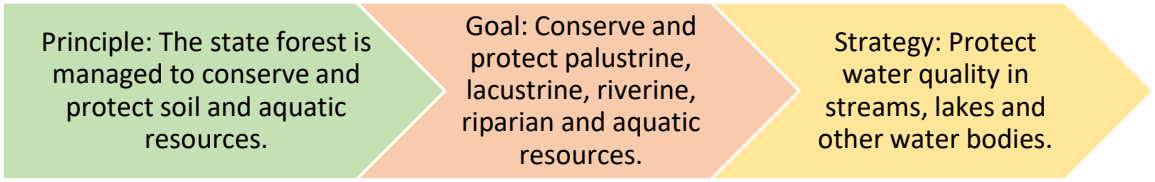
Continued use and guidance from the Michigan Forestry Best Management Practices for Soil and Water Quality will be crucial to minimize streamside damage. With the potential for increased water level fluctuations and heavier precipitation, regular assessment and timely on-the-ground restoration efforts will be needed to reduce impacts to water quality.

Monitoring

The following metrics have been identified for this management priority to track progress toward forest sustainability:

- Number and types of streamside damage will be assessed every three years.

Management priority: Riparian trails



Why riparian trails matter

The riparian area is the area of transition between aquatic and terrestrial ecosystems. Riparian areas (within 100 meters of a lake or stream) are vegetatively highly diverse and major cover types include lowland shrubs and conifers, aspen and cedar. Riparian areas with natural vegetation protect aquatic resources by stabilizing stream banks and capturing sediments, nutrients and pollutants before they wash into the stream. They also provide habitat for wildlife species and can be important travel corridors for some species, including people. These areas may have historic and cultural value.

Michigan strives to provide a cutting-edge trails system for diverse trail users. According to the Michigan DNR Trails Plan (2022-2032): "well-planned trails will connect people, communities and destinations of interest. They support health and wellness, enhance economies and contribute to a region's unique character and sense of place." Riparian trails can provide access to remote areas for wildlife viewing, hunting, fishing, hiking or enjoying scenery.

A well-managed riparian trail system is important. Poorly designed riparian trails can negatively affect ecosystems by reducing vegetation and increasing sedimentation, which can decrease water quality. Considerations for trail design and location, development, maintenance and replacement must be carefully evaluated to ensure impacts are minimized or mitigated. Additionally, riparian trails can be cared for when users regularly decontaminate themselves and their equipment; utilizing the "Play Clean Go" message to tie Michigan's forests to work happening throughout North America strengthens all efforts.

Current condition and trend

The DNR manages different types of trails on state forest land to accommodate a range of recreation interests, and many of these occur in riparian areas. The DNR's Parks and Recreation Division has responsibility for establishing and maintaining trails statewide, including in the state forest in collaboration with the Forest Resources Division. The substrate for these trails is dirt, though each recreation type requires different trail widths and different levels of maintenance. Eight trail types are found in riparian areas in the state forest (Table 1), though some trails are designated for multiple uses. While the sum of miles of all riparian trail types combined is 163.4, the actual mileage is 120.1 miles when double counting for trails with multiple uses is removed. Currently, the DNR does not track the condition of trails in a systematic way; it only tracks whether they are open or closed.

Table 1. Mileage of different trail types within riparian areas in the state forest.

Trail Type	Mileage
Hiking	80.2

Trail Type	Mileage
Biking	34.5
Equestrian	4.5
Water	0.24
Snowmobile	14.7
ORV route	7.6
ATV trail	7.3
Motorcycle	14.4
Total	**163.4**

Michigan's Natural Rivers program is a river protection effort that protects the natural quality of select river systems throughout the state by regulating their use and development through zoning rules. The Natural Rivers program was developed to preserve, protect and enhance our state's finest river systems for the use and enjoyment of current and future generations by allowing property owners their right to reasonable development while protecting Michigan's unique river resources. Nearly all construction (including trails in riparian areas), land change/earth moving, and placement of structures is regulated within 400 feet of any designated stream segment.

Desired future condition, objectives and management actions

A well-designed state forest trail system that provides strategic access to riparian areas in places with minimal impacts to water quality, aquatic habitat productivity and connectivity; designed to withstand a range of climate change impacts.

Objective 1. Work with Parks and Recreation Division to assess current conditions and locations of trails in riparian areas throughout the planning period.

- Action 1. Work with DNR Parks and Recreation Division to evaluate trails.
- Action 2. Identify and prioritize maintenance and enhancements of trails in sensitive natural areas.
- Action 3. Minimize impacts of existing trails that are compromised by changing conditions related to climate.
- Action 4. Work with Parks and Recreation Division to implement the Trails Plan to elevate maintenance of existing trails and prioritize quality trail experiences over quantity of trails.

Objective 2. Work with Parks and Recreation Division to evaluate trails in riparian areas for negative impacts to streams, rivers, lakes and wetlands by 2034.

- Action 1. Work with Parks and Recreation Division to evaluate if existing trails are degrading resources.
- Action 2. Consider opportunities to relocate trails to areas with less risk of climate-exacerbated damage.

Objective 3. Protect and sustain key trail infrastructure for the duration of the planning period.

- Action 1. Approach shoreline infrastructure vulnerability with relocation or retreat as primary response, followed by bioengineering or other natural system approaches and last resort stabilization with mitigation.
- Action 2. Maintain, improve and construct infrastructure using materials that can withstand a range of climate stressors and variable water levels.
- Action 3. Employ measures to minimize damage from disturbance events.
- Action 4. Remove or decommission vulnerable infrastructure.

Climate change

All climate change data and information listed herein is pulled directly from the open-source Northern Institute of Applied Climate Science Climate Change impacts tool and adaptation workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium, limited) and agreement (high, moderate, low) described in the predicted impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the adaptation approaches. For more information, go to NIACS.org.

Predicted impacts relevant to riparian trails

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
More winter precipitation as rain, more snowmelt between snowfall events	Robust	High	Increased water levels and flooding potential in winter and spring can increase erosion and sedimentation rates along riparian trails.
More frequent heavy precipitation events and higher rainfall per event	Medium	Moderate	Increasing magnitude and frequency of flooding, especially in summer when trails are in high use, can impact access to trails, as well as increase erosion and sedimentation rates along riparian trails.
Soil saturation will influence magnitude and duration of flood events	Not given	Not given	Frequency of multiple high-flow days in a row will increase, potentially increasing erosion and sedimentation rates along riparian trails.

Adaptation Approaches

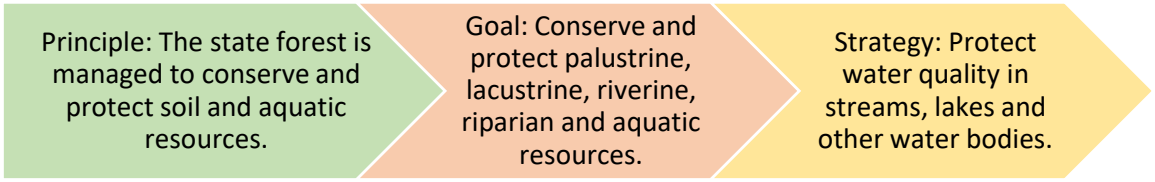
With increased potential for precipitation-related impacts in riparian areas, evaluating the distribution of the current trail system and associated trail infrastructure will allow for an assessment of each trail to determine vulnerability to climate change and the potential for negative impacts on water resources. This vulnerability assessment can be addressed through different adaptive tactics including improving infrastructure, moving trails and decommissioning trails in riparian areas.

Monitoring

The following metrics have been identified for this management priority to track progress toward forest sustainability:

- Number of trails (by type) in riparian zones (100 meters).
- Miles of trails by type in riparian zones (100 meters).
- Density of trails in riparian zones (100 meters).
- Number of trails relocated or decommissioned in riparian zones.

Management priority: Riparian roads



Why Riparian roads matter

The riparian area is the area of transition between aquatic and terrestrial ecosystems. Riparian areas (defined as within 100 meters of a lake or stream) have highly diverse vegetation with major cover types including lowland shrubs and conifers, aspen and cedar. Riparian areas with natural vegetation protect aquatic resources by stabilizing stream banks and capturing sediments, nutrients and pollutants before they wash into the stream. They also provide habitat for wildlife and can be important travel corridors for some species. Roads in the riparian zone may have historical and cultural value because riparian areas were often used by past and current communities. They can provide access to water for fishing and recreation, provide access to hunting and camping sites, as well as scenic drives. These roads can be made of many types of surface materials. If inadequately maintained or constructed, they can degrade an entire riparian system. Additionally, riparian trails can be cared for when users regularly decontaminate themselves and their equipment; utilizing the “Play Clean Go” message to tie Michigan’s forests to work happening throughout North America strengthens all efforts.

Current condition and trend

In 2022, there were about 1,020 miles of roads within riparian areas in the state forest; human use of riparian areas increased during 2006-2016 (*Table 1*). The increase in density of riparian roads across all regions of the state forest, will likely be associated with loss or an impact on wildlife habitats and populations as well as riparian ecosystems. As public land use increases, balancing a demand for access while limiting new roads and maintaining current roads will be complex.

Table 1. Road densities measured in miles per square mile between 2006-2016. (Source: Recovery Potential Screening: Comparting Watershed Condition and Restorability, U.S. Environmental Protection Agency).

Year	State Forest	Eastern Upper Peninsula	Northern Lower Peninsula	Western Upper Peninsula
2006	1.42 mi/sq mi	0.57 mi/sq mi	0.40 mi/sq mi	1.23 mi/sq mi
2011	0.90 mi/sq mi	0.54 mi/sq mi	0.35 mi/sq mi	0.68 mi/sq mi
2016	1.86 mi/sq mi	0.74 mi/sq mi	0.56 mi/sq mi	1.57 mi/sq mi

Desired future condition, objectives and management actions

The state forest has a network of riparian roads managed and maintained to provide public and management access that reduces or minimizes fragmentation and impacts on water quality and habitat, while accommodating future climate changes to hydrologic regimes.

Objective 1. Limit the expansion of roads in riparian areas only to those needed to provide adequate access for forest management and access for recreation. This will reduce fragmentation and promote landscape connectivity.

- Action 1. During this planning period, implement specifications in timber sale contracts to minimize road construction in and around riparian areas or provide alternate means of access, when possible.
- Action 2. Align maintenance and development with the Michigan DNR Trails Plan for existing roads or trails during this planning period.
- Action 3. Continue to follow best management practices for soil and water quality during this planning period.
- Action 4. Establish priorities, identify roles and responsibilities for road and trail management of invasive species for the duration of this planning period.

Objective 2. Identify roads that significantly contribute to degradation of water quality, habitat connectivity and productivity in streams, lakes and other water bodies.

- Action 1. Clearly define and develop standards for significant contributions to degradation within two years.
- Action 2. Explore opportunities to add attributes to roads data to capture and describe degradation within one year.
- Action 3. Evaluate the use and effectiveness of the DNR Resource Damage Reporting database, reporting process and data collection efforts for roads data within two years.
- Action 4. Evaluate infrastructure that is vulnerable to changing hydrologic regimes and consider removal or decommissioning of infrastructure then restore to natural conditions, if necessary, within the planning period.

Objective 3: Protect, sustain or enhance key infrastructure to minimize damage or impacts from variable precipitation.

- Action 1. For the duration of the planning period, maintain, improve and construct infrastructure using materials that can withstand a range of climate stressors to reduce impacts from variable water levels.
- Action 2. Identify key infrastructure and apply protective measures to minimize damage from disturbance events within the planning period.

Climate change

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Predicted impacts relevant to riparian roads

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
More winter precipitation as rain, more snowmelt between snowfall events	Robust	High	More freeze/thaw cycles will damage roads; higher potential of erosion and sedimentation issues throughout the year.
More frequent heavy precipitation events and higher rainfall per event	Medium	Moderate	Compact soils of forest roads will increase precipitation run-off and lead to higher rates of erosion and sedimentation of adjacent water bodies.
Soil saturation will influence magnitude and duration of flood events	Not given	Not given	Frequently flooded roads will reduce access and increase maintenance costs.

Adaptation approaches

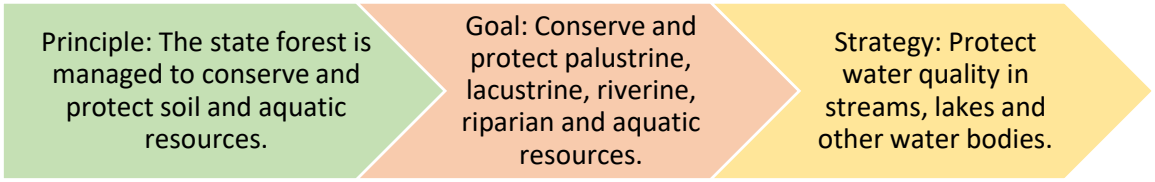
As precipitation events change and lead to increased potential for water level changes, it is increasingly important to ensure current infrastructure, design and placement of roads is suited to withstand climate change and the potential impacts. Development and enhancement of effective identification and monitoring tools can provide information to develop a baseline for riparian roads in the state forest and support prioritization efforts.

Monitoring

The following metrics have been identified for this management priority to track progress toward forest sustainability:

- Miles of riparian road.
- Number of riparian road improvements.

Management priority: Stream crossings



Why stream crossings matter

Stream crossings are where roads or trails cross a body of water including rivers, streams, intermittent streams or wetlands. Stream crossings can include different types of roads, including bridges or culverts, each with their own surface materials and construction mechanisms. The quality and condition of stream crossings is an important factor in allowing effective travel across the body of water for management, business and recreation. The quality and condition of stream crossings is also critically important to the protection of aquatic and wetland habitats, the natural water flows, control of erosion and stream sedimentation and potential disruptions caused by invasive species. With changes in precipitation related to climate, ensuring stream crossings are sufficient to handle more frequent flooding events and changes in magnitude of flooding is important to their long-term sustainability.

Current condition and trend

The Great Lakes Stream Crossing Inventory is a comprehensive initiative covering the Great Lakes region and is aimed at identifying and assessing the effects on stream health, stability, aquatic organism passage, erosion-related issues, habitat connectivity, and human and environmental safety. The initiative provides a protocol that was developed by state and federal agencies, conservation organizations, educational institutions and road commissions, to promote consistent data collection practices across the Great Lakes region and provides crucial information to stakeholders and data users.

To date, over 24,000 stream crossings have been surveyed with over 19,000 bridges and over 4,000 bridges having been identified. All collected data can be accessed on the Michigan DNR's Great Lakes Stream Crossing Inventory data hub.

There is no threshold or objective for this value at either the state or regional scale, other than recognizing that an increase in the number of stream crossings is not desirable from a water quality, habitat connectivity, infrastructure burden and waterway perspective. Undersized road-stream crossings fragment rivers and streams which inhibits the passage of aquatic organisms, sediment and organic matter throughout a watershed. All road stream crossings should be properly sized (either when initially installed or when replaced) to permit the passage of bankfull flow conditions to restore stream connectivity. There are several DNR policies and procedures that provide guidance on stream crossings; new stream crossings should be given careful consideration and meet these rigorous guidelines. Additional information and data are being collected and made available on the Stream Crossing Dashboard assembled by the DNR.

Desired future condition, objectives and management actions

The state forest has appropriate stream crossing infrastructure across the landscape that sustains fundamental hydrologic processes, minimizes impacts to water quality and aquatic habitat in streams, lakes and other water bodies, while accommodating future climate changes to hydrologic regimes.

Objective 1. During this planning period, limit the expansion of roads in riparian areas to those only necessary to provide adequate access for the management of the forest and access for recreation to reduce fragmentation and promote landscape connectivity.

- Action 1. During this planning period, implement specifications in timber sale contracts that minimize road construction in and around riparian areas or provide alternate means of access, when possible.
- Action 2. Align maintenance and development with the DNR Trails Plan for existing roads or trails during this planning period.
- Action 3. Continue to follow Michigan Forestry Best Management Practices for Soil and Water Quality during this planning period.
- Action 4. Establish priorities, identify roles and responsibilities for road and trail management of invasive species for the duration of this planning period.

Objective 2. Identify roads that significantly contribute to degradation of water quality in streams, lakes and water bodies by year five of this plan.

- Action 1. Clearly define and develop standards for significant contributions to degradation within two years.
- Action 2. Explore opportunities to add attributes to roads data to capture and describe degradation within one year.
- Action 3. Evaluate the use and effectiveness of the DNR Resource Damage Reporting database within two years.
- Action 4. Evaluate infrastructure that is vulnerable to changing hydrologic regimes and consider removal or decommissioning of infrastructure then restore to natural conditions, if necessary, within the planning period.

Objective 3: Protect, sustain or enhance key infrastructure to minimize damage or impacts from variable precipitation throughout the planning period.

- Action 1. For the duration of the planning period, maintain, improve and construct infrastructure using materials that can withstand a range of climate stressors to reduce impacts from variable water levels.
- Action 2. Identify key infrastructure and apply protective measures to minimize damage from disturbance events within the planning period.

Climate change

All climate change data and information listed herein is pulled directly from the open-source Northern Institute of Applied Climate Science Climate Change impacts tool and adaptation workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium and limited) and agreement (high, moderate and low) described in the predicted impacts table. Planning strategies,

approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the adaptation approaches. For more information, go to NIACS.org.

Predicted impacts relevant to stream crossings

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
More winter precipitation as rain, more snowmelt between snowfall events	Robust	High	Increased water levels and flooding potential in winter and spring.
More frequent heavy precipitation events and higher rainfall per event	Medium	Moderate	Likely increase in the high water flow level and number of high water flow days.
Low streamflow events may become more frequent and deliver lower water volumes	Not Given	Not Given	Seasonal low water flow days may become more frequent.

Adaptation approaches

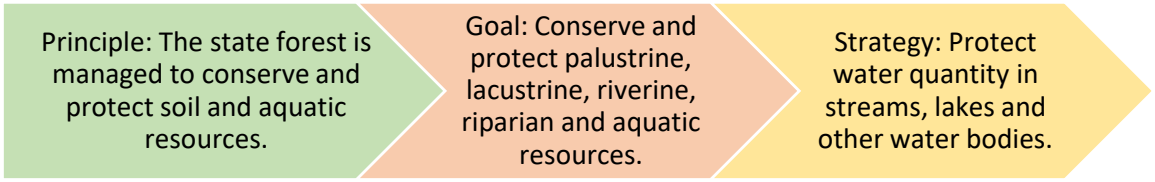
As precipitation events change and lead to increased potential for water level changes, it is increasingly important to ensure current infrastructure, design and placement of roads is suited to withstand climate change and the potential impacts. A complete inventory of current infrastructure will establish a baseline to ensure potential climate impacts are mitigated and to support prioritization efforts. Increased emphasis on appropriate infrastructure to accommodate future precipitation events and changing hydrologic patterns will be needed.

Monitoring

The following metrics have been identified for this management priority to track progress toward forest sustainability:

- Number and condition of stream crossings will be assessed every five years.

Management priority: Watershed vegetation cover



Why watershed vegetation cover matters

The hydrologic cycle, or the movement of water from the atmosphere to the earth's surface and back again, can be affected by plants. This occurs through the interception of water and evapotranspiration, the evaporation of water from surfaces into the air and transpiration (release) of water from plants.

When precipitation reaches the surface in vegetated areas, a certain amount is retained on, or intercepted by, the vegetation and does not reach the ground. Rainfall that is not intercepted is referred to as throughfall. Water that reaches the ground via the trunks and stems of vegetation is called stemflow. These processes are a direct function of the type and density of vegetation present in a watershed. A watershed is the area of land where all the water that falls on it and drains from it goes to a common outlet. Watersheds can be as small as a footprint or vast enough to encompass all the land that drains into rivers that feed the Great Lakes.

Well-established vegetation helps slow water movement across the landscape, reducing soil erosion and allowing recharge of wetlands and groundwater resources, which is especially important in source water protection areas for public drinking water systems that utilize surface and ground water as a drinking water source. Different types of vegetation impact rates of water movement. Forests filter and regulate the flow of rainwater, in large part due to their leafy canopy that intercepts rainfall, slowing its fall to the ground. The forest floor acts like an enormous sponge, typically absorbing precipitation (depending on soil type) before gradually releasing it to natural channels and recharging ground water (including drinking water). Trees and ground vegetation in forest ecosystems play an important ecological role in preserving water quantity and quality within state forest watersheds. Healthy and intact watershed vegetation matters in the context of long-term forest sustainability.

Given the close tie between vegetation and the hydrologic cycle, forest management can impact water quantity and understanding this relationship can inform management decisions. As the forest canopy is removed and replaced with restarting forests, nonforested cover and impervious surfaces (e.g., roads, parking lots, driveways) the rate and amount of water received by streams and lakes in a watershed can change. A faster rate of runoff leads to flooding, stream bank erosion, stream widening and sediment deposition. It can also cause alteration of fish habitat and decline in water quality and water infiltration.

Current condition and trend

Watersheds are hierarchical in nature, and as such, are ascribed a Hydrologic Unit Code (HUC) by the U.S. Geological Survey as a way to classify the geographic area of watersheds. They range from two-digit codes to 12-digit codes that describe watersheds at a national scale all the way down to a sub-watershed, or local, scale. Here, HUC 12 is used for analysis, which means these watershed boundaries equal tributary systems of 10,000 to 40,000 acres. This sub-watershed scale relates to local streams and rivers that would be found in forest compartments located in each state forest region.

Within each state forest region, there are many HUC 12 watersheds. Because of this, the cover type category was averaged across HUC 12 watersheds within each region to evaluate the amount and type of watershed vegetation cover (Table 1). Forested cover types are the most common, constituting most of the land cover on state forest land within watersheds across each region. Urban and cropland nonforested cover types are less than 1% of the area in each region of the state forest. On state forest land, HUC 12 watersheds have high levels of natural vegetation cover overall and very little impervious surface.

Table 1. Percentage of forested and nonforested cover types in HUC 12 watersheds across the northern Lower Peninsula, and eastern and western Upper Peninsula regions of the state forest (Source: Michigan DNR Forest Inventory data 2021).

Region	Number Of HUC 12 Watersheds	Percent Forested Cover (Average)	Percent Nonforested Cover (Average)	Percent Urban and Cropland Cover (Average)
Northern Lower Peninsula	433	86.8	12.6	0.6
Eastern Upper Peninsula	199	77.6	22.1	0.3
Western Upper Peninsula	268	88.5	11.1	0.4

Michigan has approximately 1,300 community water systems using groundwater with source water protection areas, 15 of which intersect with state forest land (Figure 1) and contribute ground water to a public water system well. Drinking water sources, both groundwater and surface water, located in forested areas of the state are in general of higher quality and are less impacted by land use in other areas of the state.

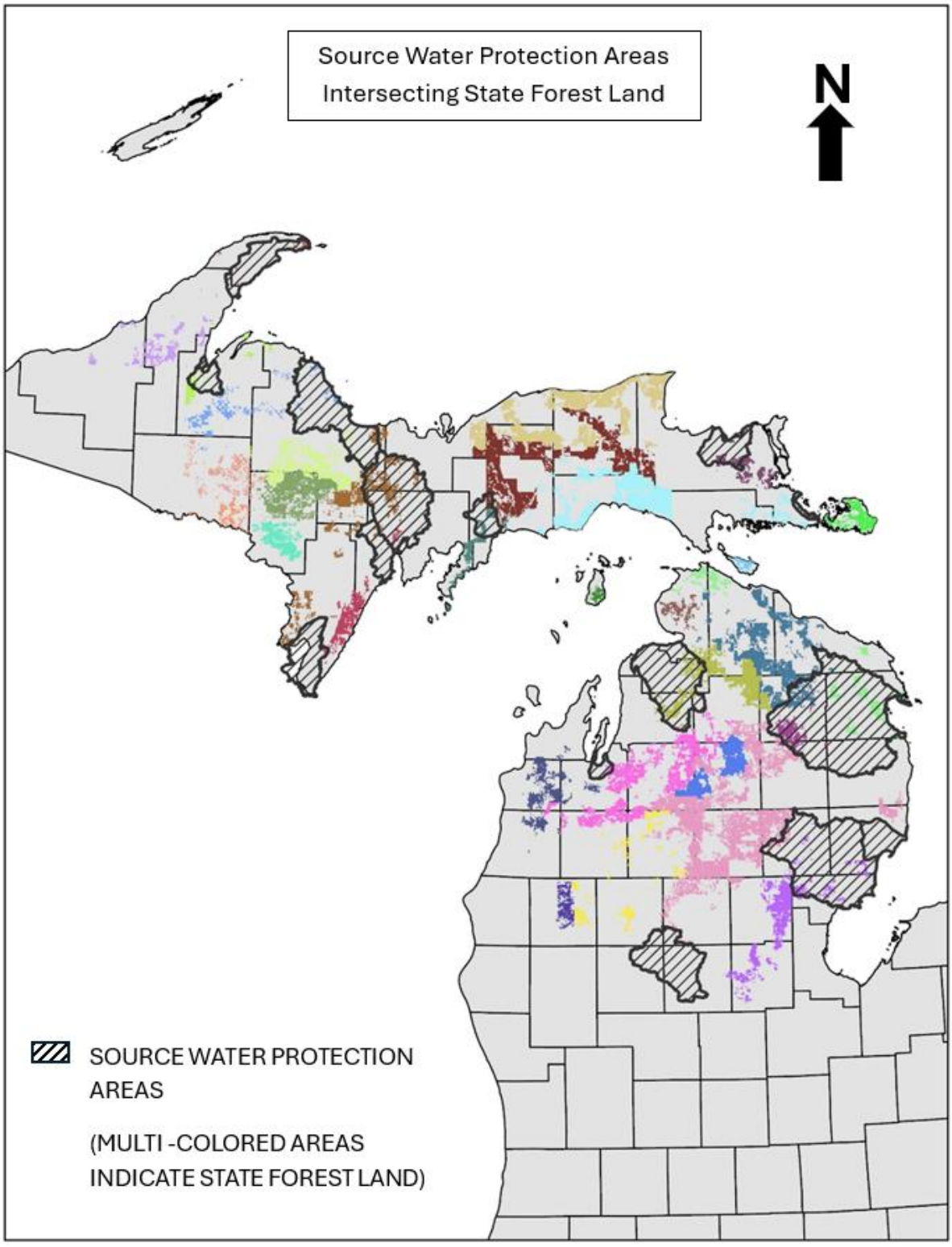


Figure 1. Source water protection areas that intersect with state forest land (Source: Michigan Department of Environment, Great Lakes, and Energy Drinking Water and Environmental Health Division data 2025).

Desired future condition, objectives and management actions

Functional watershed ecosystems are maintained through thoughtful forest management, considering the amount of vegetation type removed in each planning period to ensure watersheds are resilient and adaptive to a changing climate while protecting and improving water quantity.

Objective 1. Maintain current levels of forested/nonforested cover types within watersheds of the state forest during the planning period.

- Action 1. Minimize loss of natural cover and construction of new impervious surfaces within the state forest, particularly in identified source water protection areas.

Objective 2. This planning period, maintain and enhance infiltration and water storage capacity of forest soils.

- Action 1. Leave dead and downed wood (coarse woody debris) following Within Stand Retention Guidelines in the uplands and riparian areas to enhance moisture.
- Action 2. Enhance soil structure in highly compacted areas with mechanical treatments such as tilling, soil ripping or chisel plowing; promptly revegetate.
- Action 3. Consider long-term plans for areas invaded by invasive species before taking restorative actions. Balance the need for cover with the desire for noninvasive plants as, at least in the short term, it may be best for an invasive to remain in place to maintain water infiltration and floodplain function.
- Action 4. Apply standard riparian management zone buffers for forest treatments, particularly in source water protection areas.

Objective 3. Maintain and restore floodplain connectivity throughout the planning period.

- Action 1. Where needed, reconnect natural floodplain conditions and native habitats (such as bottomland forest, wetlands, and wet prairie and other habitats), especially adjacent to incised river channels using stream restoration techniques.
- Action 2. Maintain floodplains as undeveloped areas to be used only as floodwater storage.

Objective 4. Moderate temperature increases in surface water throughout the planning period.

- Action 1. Continue to implement Michigan Forestry Best Management Practices for Soil and Water Quality.
- Action 2. Maintain and reconnect floodplains and wetlands to surface waterways to increase groundwater recharge and promote flow of cool groundwater in the system.
- Action 3. Maintain and restore groundwater-fed headwater wetlands to promote cooler, late summer flows to downstream wetlands.
- Action 4. Where feasible, leave beaver dams in place in headwater wetlands. Beaver dams can add habitat complexity to watersheds.
- Action 5. Seek to maintain at least 75% forested-land cover in the watershed of priority lakes and streams for trout, walleye, cisco and other fishes and in identified source water protection areas.

Climate change

All climate change data and information listed herein is pulled directly from the open-source Northern Institute of Applied Climate Science Climate Change impacts tool and adaptation workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium and limited) and agreement (high, moderate and low) described in the predicted impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the adaptation approaches. For more information, go to NIACS.org.

Predicted impacts relevant to watershed vegetation cover

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Decreased days that the ground will be frozen during the winter	Robust	High	Reduced water storage due to greater water losses through increased evapotranspiration.
Precipitation events will become more intense and frequent	Medium	Moderate	Increased total runoff and erosion resulting in reduced soil infiltration and water storage; flood events without critical water storage areas impact downstream water quantity.

Adaptation approaches

Management will strive to mitigate and adapt to the variable effects of altered precipitation events and regional air temperature warming trends through maintaining and restoring vegetative cover types throughout watersheds that provide for the protection of animal habitats, soils and water quality/quantity. This will be accomplished through continued implementation of Michigan Forestry Best Management Practices for Soil and Water Quality and management plans. Results of implemented management will result in watersheds that provide a multitude of values (e.g., forest products, wildlife habitat, cultural resources) for users of the forest community.

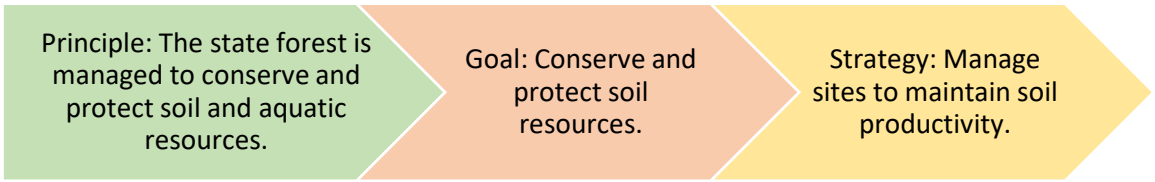
Monitoring

The following metrics have been identified for this management priority to track progress toward forest sustainability:

- Acres of forested, nonforested and urban by watershed by region.

Soil resources

Management priority: Successive rotations



Why successive rotations matter

Successive rotations of a forest cover type result when the same cover type is harvested and regenerated multiple times at the same site. It is typically accomplished through an even-aged silvicultural system that removes most or all trees on the site. Trees and soils have a reciprocal relationship known as nutrient cycling, where trees remove soil nutrients for growth and then return nutrients back to the soil upon decomposition. The removal of most trees at a site has the potential to negatively impact soil health by interrupting this cycle.

The DNR manages most of the state forest cover types with an even-aged silvicultural system. Depending on individual treatment prescriptions, whole trees (stem, top and branches) or just the stem of the tree can be removed during harvest. It is not well understood if or to what extent repeated removal of tree biomass impacts soil health. Healthy soils are essential for forest sustainability and depend on the maintenance of their physical, chemical and biological properties.

Determining where best to manage forest types on the landscape, particularly those managed through successive rotations, is directly related to soil productivity and health. The potential capacity for tree growth and productivity is variable across a range of poor-to-rich soil types. Successive rotations of tree biomass removal and regrowth of same forest type may have negative impacts upon soil health and productivity and long-term forest sustainability. This effect is most pronounced and of concern on poor soil types.

Current condition and trend

Most of the 25 forested cover types on the state forest are managed under an even-aged silvicultural system on over 2 million acres of state forest land that is available for timber management, with clear-cut harvests that promote successive rotations on the same site (Table 1). These 2 million acres indicate the scope of potential impacts if there are any negative soil impacts associated with this successive rotation management approach.

Table 1. Even-and uneven-aged management on available, forested cover types (acres and percent). (Source: DNR model)

Region	Acres of Even-aged Cover Types	Percent Even-aged Cover Types	Acres Uneven-aged Cover Types	Percent Uneven-aged Cover Types
NLP	1,173,639	58%	243,773	45%

Region	Acres of Even-aged Cover Types	Percent Even-aged Cover Types	Acres Uneven-aged Cover Types	Percent Uneven-aged Cover Types
EUP	432,989	21%	145,721	27%
WUP	415,992	21%	150,199	28%
Total	**2,022,620**	**100%**	**539,693**	**100%**

The DNR does not maintain a database of forest type history for each stand, collect soil data (including nutrient composition and abundance), nor include an evaluation of site productivity as part of the standard inventory process for forest stands, so it is not possible to assess any current condition or trends in soil productivity due to successive tree rotations.

The DNR does use an ecological site classification system, Kotar Habitat Classification (Burger and Kotar 2003), to help determine site suitability for more effective cover type management. This tool groups sites for their capacity to produce similar late successional communities based on repeatable understory plant associations. During forest inventory, assessment of the current cover type of the stand, in addition to the Kotar Habitat Classification, can provide stand examiners with better information to make stand management decisions. The benefit of using the classification system is while numerous disturbance-based cover types can grow on specific sites, the focus of habitat types is on the potential for late successional communities achieved through natural succession. Using Kotar habitat types to inform forest type management decisions should lessen potential adverse soil nutrient impacts, as these habitat groups narrow the range of site suitability for forest types, better aligning the biological needs of a forest type to appropriate soil resources. Unfortunately, the Kotar classification only addresses upland forest resources and has not yet been completed for all state forest land, which limits the scope of its use and effectiveness.

The impacts of forestry practices on soil health and productivity are nevertheless a concern. Two recent studies in the Great Lakes region assessed the impacts of successive rotations on soil health for aspen and jack pine forest types, which are both early successional species. Aspen is managed on over 833,000 acres under the even-aged silvicultural system, mostly on moderate-to rich-site productivity soils, with most stands on the second and some on their third rotation on the same site. Jack pine is managed on more than 282,000 acres of state forest under the even-aged silvicultural system, almost entirely on low productivity soils. As a short-lived, fire-prone species, most jack pine is also on its second to third rotation.

The aspen study (Curzon et al. 2022) assessed the 25-year post-harvest impacts of different biomass removal treatments (whole tree versus stem-only versus forest floor removal) and soil compaction on three sites that differ in soil productivity. Generally, the results indicated that with greater increases in biomass removal, there were corresponding decreases in soil carbon and nitrogen across sites, indicating that the interruption to the nutrient cycle does result in some soil nutrient losses. These results were most acute at the low-soil productivity site, where there were reductions in the aboveground biomass and density as well as soil carbon levels at the site. In other words, not only were there losses in soil nutrients on the poorest site, but there was also a loss in aspen tree vigor and volume.

The jack pine study (Rothstein et al.) evaluated the impacts of the 40-year history of whole tree harvest in the Kirtland's warbler management area. These sites are characterized by droughty, sandy soils and the history of intensive management has included whole tree final harvests at 50 years followed by trenching and replanting to jack pine at relatively high densities for the warblers' habitat. The study found that while most soil nutrients maintained a positive input-output balance, soil potassium declined with both whole tree harvest with rotation ages of 50 years or less. Stem-only harvests with a 50-year rotation shifted soil potassium back to a positive balance, while improving the balance of other soil nutrients. The study recommended stem-only harvests and cautioned against maximizing biomass removals, with whole tree harvest and short rotations as a long-term management approach.

Both studies suggest that leaving biomass at any site is important to maintaining soil nutrients, with an emphasis on the lowest productivity sites which are at greatest risk for cumulative site impacts. The DNR has generally implemented the Michigan Woody Biomass Harvesting Guidance since it was developed in 2010, which calls for leaving between one-sixth and one-third of tree biomass on site after harvest. However, the DNR does not monitor how much is left at each site, how consistently this is applied, and how effective it is. At the very least, given the results from the two studies, consistently retaining the higher end of the biomass guidance on lower-productivity sites should be prioritized.

Desired future condition, objectives and management actions

Successive cover type rotations are strategically planned across the landscape and are informed by ecological site suitability and climate change risks to prevent degradation of soil productivity and impacts from drought stress.

Objective 1. Throughout this planning period, conduct monitoring and research to assess successive rotation impacts to soil and regeneration.

- Action 1. Work with partners to continue research on soil impacts of successive rotations in the Great Lakes region.
- Action 2. Develop monitoring strategy or protocol in cooperation with academic partners.

Objective 2: Manage forests to minimize impacts from successive rotations for the duration of the planning period.

- Action 1. Limit whole tree harvesting operations; where necessary follow Woody Biomass Harvesting Guidance, leaving a greater volume of biomass on nutrient poor sites. Develop a protocol to assess and record how much is left on site.
- Action 2. Fully implement the use of the Kotar Habitat Classification in the management decision process.
- Action 3. Improve data collection to assess site soil quality.
- Action 4. Reduce soil nutrient competition and allelopathy through invasive species control measures.

Objective 3. In this planning period, implement climate adaptation strategies to reduce impacts on soil health due to successive rotations in a warmer climate.

- Action 1. Evaluate aspen management on mesic sites to buffer more vulnerable forest systems from climate-related drought stress.

- Action 2. Restore or maintain fire in fire-adapted systems to burn at low intensities to improve nutrient cycling.

Climate Change

All climate change data and information listed herein is pulled directly from the open-source Northern Institute of Applied Climate Science Climate Change impacts tool and adaptation workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium and limited) and agreement (high, moderate and low) described in the predicted impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the adaptation approaches. For more information, go to NIACS.org.

Predicted climate impacts relevant to successive rotations

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Growing seasons will increase by the end of the century	Robust	High	Greater growth and productivity of trees and other vegetation, only if balanced by available water and nutrients.
Soil moisture patterns will change, drier conditions later in the growing season	Medium	Moderate	Net drying effect as more moisture is pulled from plants and soils, forests may become moisture-limited.
Forest productivity will increase	Medium	Moderate	Warmer temperatures expect to speed nutrient cycling; longer growing seasons could result in greater growth and productivity.
Systems that are more tolerant of disturbance have less risk of declining on the landscape	Medium	High	Declines in soil moisture can impact systems dependent on more mesic conditions; systems more tolerant to drought, flooding or fire are expected to better withstand climate-driven disturbances.

Adaptation approaches

With warming temperatures, changing precipitation regimes, longer growing seasons and increased probabilities for fire and drought, climate change has the potential to impact soil heath and its ability to sustain and support vegetation. Proactive landscape planning which pairs drought-sensitive cover types with appropriate soil-moisture types, and silvicultural approaches that adjust the amount of biomass left on a harvest site based on soil quality are part of a the DNR's climate change adaptation response.

Monitoring

The following metrics have been identified for this management priority to track progress toward forest sustainability:

- Number of research or monitoring projects assessing successive rotation impacts upon soils.
- Number or percent of stem-only harvests.
- Average percent woody biomass left on site.
- Percent of stands with Kotar Habitat Classification data.

Management priority: Forestry and recreation impacts



Why forestry and recreation impacts matter

In addition to forest management practices, public recreation opportunities are abundant on state forest land. Impacts upon soils from these activities can affect the overall health and productivity of the forest and wildlife habitat. Soil compaction can affect surface and groundwater flow and affect delivery of nutrients. Soil erosion can lead to pollution and sedimentation, which adversely affect the quality and quantity of aquatic resources. While both forestry and recreation activities are important to Michigan's residents and stakeholders, management actions preventing soil erosion and compaction can help ensure these activities continue with minimal impact. Impacts can occur due to trail placement (e.g., steep slopes), misuse or overuse and unauthorized off-trail use. Soil resources are an important indicator of forest sustainability, which amplifies the need to conserve and protect soil resources across the state forest.

Current condition and trend

DNR employees are required to adhere to Michigan Forestry Best Management Practices for Soil and Water Quality as part of state forest operations and to watch for and report soil damage in the state forest.

Incidences of soil erosion and compaction are collected during routine field work and information is entered into a Resource Damage Reporting database. This data collection effort is opportunistic in nature and has led to inconsistencies in collection across the state forest. Additionally, the current reporting system provides limited information pertaining to the scale of damage at a site, though the primary cause or source of damage and associated impacts can be collected.

Off-road vehicles were the leading cause of soil-related damage across the entire state forest and within regions between 2012 and 2021 (Tables 1-4), with the northern Lower Peninsula having the most reports.

Table 1. Number of soil-related damage reported between 2012 and 2021 by primary damage cause. (Source: DNR Resource Damage Reporting database).

Primary Cause of Damage	Soil Erosion on Steep Slopes	Exposed Soil	Excessive Soil Disturbance	Soil Compaction	Total
Beavers	0	1	1	0	**2**
Foot Traffic	1	0	2	0	**3**
Logging Equipment	1	0	2	0	**3**
Off-road Vehicles	37	29	48	8	**122**

Primary Cause of Damage	Soil Erosion on Steep Slopes	Exposed Soil	Excessive Soil Disturbance	Soil Compaction	Total
Vehicles-Conventional	5	4	11	4	**24**
Other	4	2	5	0	**11**
Total	**48**	**35**	**69**	**12**	**164**

Table 2. Total number of damaged sites identified by primary cause of damage in the western Upper Peninsula between 2012 and 2021 (Source: DNR Resource Damage Reporting database).

Primary Cause of Damage	Soil Erosion on Steep Slopes	Exposed Soil	Excessive Soil Disturbance	Soil Compaction	Total
Off-road Vehicles	1	3	2	5	**11**
Vehicles - Conventional	0	1	0	0	**1**
Total	**1**	**4**	**2**	**5**	**12**

Table 3. Total number of damaged sites identified by primary cause of damage in the eastern Upper Peninsula between 2012 and 2021 (Source: DNR Resource Damage Reporting database).

Primary Cause of Damage	Soil Erosion on Steep Slopes	Exposed Soil	Excessive Soil Disturbance	Soil Compaction	Total
Off-road Vehicles	2	0	5	0	**7**
Vehicles - Conventional	1	0	2	0	**3**
Other	1	1	0	0	**2**
Total	**4**	**1**	**7**	**0**	**12**

Table 4. Total number of damaged sites identified by primary cause of damage in the northern Lower Peninsula between 2012 and 2021 (Source: DNR Resource Damage Reporting database).

Primary Cause of Damage	Soil Erosion on Steep Slopes	Exposed Soil	Excessive Soil Disturbance	Soil Compaction	Total
Beavers	0	1	1	0	**2**
Foot Traffic	1	0	2	0	**3**
Logging Equipment	1	0	2	0	**3**
Off-road Vehicles	34	26	38	6	**104**
Other	3	1	4	0	**8**

Primary Cause of Damage	Soil Erosion on Steep Slopes	Exposed Soil	Excessive Soil Disturbance	Soil Compaction	Total
Vehicles - Conventional	4	4	9	3	**20**
Total	**43**	**32**	**56**	**9**	**140**

Variation in the number of reports by region and the relatively low numbers of reports across the 4-million-acre state forest is likely due to several factors, including density of roads and trails and the intensity of use, with higher density and use occurring in the northern Lower Peninsula. The number of damaged soil sites has been generally increasing with the opening of more state forest roads in the northern Lower Peninsula for ORV use and the increasing public popularity of ORV recreation.

Desired future condition, objectives and management actions

Forest management follows best management practices and restoration of soil damage or erosion to maintain the health, integrity and sustainability of soil productivity.

Objective 1. Increase identification and reporting of incidences of soil erosion and compaction on state forest land during this planning period.

- Action 1. Consider updates to DNR Resource Damage Reporting database to capture additional qualitative and quantitative data.
- Action 2. Establish guidance and definitions for damaged sites.
- Action 3. Explore opportunities to combine data collection with other inventory efforts.
- Action 4. Conduct staff training on best management practices for forestry harvest operations to control erosion, compaction and sedimentation.

Objective 2. Continue to restore or improve damaged soils within the planning period.

- Action 1. Work in collaboration with other divisions during restoration projects.
- Action 2. Seek funding for DNR Resource Damage Reporting database restoration projects.
- Action 3. Explore opportunities for district or regionwide restoration plans.

Objective 3. Monitor and assess the impacts of forestry operations and recreation use on soil conditions throughout the planning period.

- Action 1. Assess conditions and potential risks of proposed management during the annual inventory process.
- Action 2. Promptly revegetate sites after disturbances, evaluating future-adapted species for some restoration areas.
- Action 3. Align significantly disrupted ecosystems for expected future climate conditions.
- Action 4. Cooperate with trails groups to include invasive species management in trail maintenance grants.

Climate change

All climate change data and information listed herein is pulled directly from the open-source Northern Institute of Applied Climate Science Climate Change impacts tool and adaptation workbooks. Based on

three established climate models, there are varying levels of evidence (robust, medium and limited) and agreement (high, moderate and low) described in the predicted impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the adaptation approaches. For more information, go to NIACS.org.

Predicted impacts relevant to forestry and recreation impacts

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Fewer days of frozen ground	Medium	High	Increase in soil susceptibility to damage from rutting and compaction; reduction in the opportunities for forestry activities in lowland areas.
More frequent heavy precipitation events and higher rainfall per event	Medium	Moderate	Frequency of high-flow days will increase, requiring improved stream crossing infrastructure for forestry equipment.
Soil saturation will influence magnitude and duration of flood events	Not given	Not given	Increasing magnitude and frequency of flooding can cause soil erosion.
Soil moisture patterns will change, with drier soil conditions later in the growing season.	Medium	Moderate	Forests may become moisture limited; increased susceptibility to compaction.

Adaptation approaches

A warmer, drier climate with changing precipitation regimes will impact soil health. The potential for rutting, erosion and compaction from forestry and recreation impacts will be exacerbated with these fundamental ecosystem changes. Maintaining the integrity of soil quality is essential to ecosystem function. Best management practices may include changing timing of harvests to reduce impacts to soil and water, modifying harvest tools and techniques, retaining more coarse woody debris to maintain soil moisture and nutrient cycling, and restricting certain types of recreational access to sites more vulnerable to erosion and compaction.

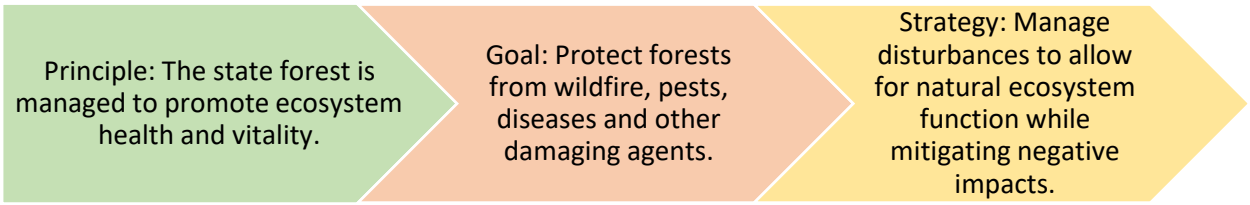
Monitoring

The following metrics have been identified for this management priority to track progress toward forest sustainability:

- Number and type of damaged sites reported annually.
- Number of restored sites annually.
- Effectiveness and permanence of site restoration.

Forest health

Management priority: Native insects and diseases



Why native insects and diseases matter

Several species of insects are native to Michigan forests and occasionally cause undesirable adverse impacts to forest health and productivity across large landscapes. Insect populations can remain at low, or endemic, levels for many years. When favorable conditions periodically occur, their populations can rapidly build to damaging levels. These insects may cause a loss of vigor, dieback and reduced timber quality. They can kill or damage trees through defoliation, tunneling under bark or through wood or by damaging roots or new shoots.

Native tree diseases are a normal part of nature, and they are among many ecological factors that help shape the forest. However, native forest pathogens can cause undesirable impacts on trees when they reduce water and nutrient uptake by destroying roots; cause cankers, which are localized infections of the bark and cambium (tissue directly under the bark); or cause wilt diseases that reduce the flow of water to tree leaves. They also can cause leafspots and defoliation that reduces a tree's carbohydrate reserves.

Many of these native insects and diseases only kill trees that already are weakened by other factors, such as climate fluctuations and weather events such as drought, excessive moisture, ice, hail, windstorms and late frosts. Advanced tree age and other types of site disturbance frequently play a role. These natural processes allow for the growth of new, vigorous trees within the forest, and the dead trees provide positive ecological values such as wildlife habitat and returning organic matter and nutrients to the forest soil. However, gaps created when trees are killed can also be occupied by invasive plants, creating additional management challenges.

Understanding native insect and disease cycles and their impact helps improve forest management and promotes healthy, productive forests.

Current condition and trend

Native insect and disease outbreaks tend to be cyclic in nature. Outbreaks of native insect pests across large areas are common. Native disease outbreaks frequently occur when trees become stressed; they often affect stands of specific forest types. During forest health monitoring activities, data is collected on species of concern and compiled in annual reports. Foresters report outbreaks and unusual occurrences to forest health staff, who answer questions and assist with management decisions in response to outbreaks. There are six common native insects that periodically affect the state forest (Table 1).

Table 1. Common native forest insect pests in Michigan.

Species	Host	Outbreak frequency	Outbreak length	Management
Eastern larch beetle	Tamarack	variable	variable	Reduce tree stress; pre-salvage when damage noted
Forest tent caterpillar	Hardwoods	8-12 years	2-3 years	Promote stand health and vigor
Jack pine budworm	Jack pine	6-12 years	2-4 years	Harvest mature stands
Large aspen tortrix	Aspen	variable	2-3 years	Promote stand health and vigor
Redheaded pine sawfly	Jack pine, red pine	10 years	3 years	Monitor pine <15 feet tall, apply insecticides when necessary
Spruce budworm	Fir and spruce	30-40 years	10-15 years	Harvest mature stands

Eastern larch beetle (*Dendroctonus simplex*) is a bark beetle that attacks stressed tamarack. Historically, outbreaks last a few years and often begin after repeated defoliation by the non-native larch casebearer, as well as drought, flooding or frost damage. Outbreaks can move quickly, affecting entire stands, and harvest should be considered when the first trees are attacked or when stands reach rotation age. The impact of the beetle in the state forest over the past several years has been limited.

Forest tent caterpillar (*Malacosoma disstria)* can cause extensive defoliation of aspen, oak and sugar maple about every eight to 12 years, with outbreaks typically lasting up to three years. Stand impacts are usually minimal unless the stand also has other health stressors. In the northern Lower and eastern Upper peninsulas, the most recent outbreak peaked in 2018-2019. Significant defoliation in the west Upper Peninsula is increasing as of 2022.

Jack pine budworm (*Choristoneura pinus pinus)* is a significant pest of mature jack pine. Periodic outbreaks occur every six to 12 years and last two to four years. Budworm defoliation leads to topkill and mortality and dead trees provide fuel for intense wildfires. Harvest stands affected by his pest and vulnerable mature stands to reduce the impact. An outbreak began in the northern Lower Peninsula in 2022 and continued into 2024.

Large aspen tortrix (*Choristoneura conflictana)* defoliates aspen by feeding on buds and leaves. Periodic outbreaks last two to three years before the population collapses; they rarely result in significant stand impacts unless the stand is older or has other health stressors. The impact is currently moderate in the state forest.

Redheaded pine sawfly (*Neodiprion lecontei)* causes periodic defoliation of young red and jack pine less than 15 feet tall. Moderate defoliation can stunt trees or cause forking. Complete defoliation kills trees. Young plantings should be monitored as outbreaks can build rapidly and may require insecticide treatment to prevent excessive damage. Outbreaks generally occur regionally on a 10-year cycle and

subside after a few years. Recent outbreaks subsided in 2017 in the northern Lower Peninsula and in 2022 in the northeast Upper Peninsula.

Spruce budworm (*Choristoneura fumiferana*) is one of the most destructive insects in spruce and fir forests. Periodic outbreaks defoliate fir and spruce, occur every 30 to 50 years and last for 10 to 15 years. Older trees are killed, with balsam fir and mixed balsam fir and spruce stands being most vulnerable. Heavily impacted stands should be harvested. An outbreak over the past decade appears to be subsiding. Some additional defoliation may occur, with much lower damage anticipated over the next decade.

While native diseases are common, three are commonly noted.

Armillaria root rot is caused by multiple *Armillaria* species and is commonly observed on dead and dying trees throughout Michigan. The fungus often causes no apparent damage to healthy trees until the trees becomes stressed. Good stand management is key to preventing or suppressing Armillaria infection.

Diplodia shoot blight (*Diplodia sapinea*) affects several pine species. In forestry settings, impacts to red and jack pine are potentially significant when trees become stressed by drought, hailstorms, or other stressors from potential climate change or are predisposed by unfavorable environmental conditions. Spores from overstory trees can rain down on small seedlings or saplings and cause extensive mortality and growth loss. Natural pine guidance is being developed with additional information on Diplodia management.

Heterobasidion root disease (*Heterobasidion irregulare*) causes a root disease of many conifer species. In Michigan, it is primarily an issue in previously thinned, planted red pine stands. There, the disease slowly spreads, causes extensive mortality, and potentially requires conversion of the site to another forest type after final harvest. See the Forest Health *Advisory for Preventing Heterobasidion Root Disease in Michigan* for more information.

In addition to these diseases, “oak decline” can cause periodic mortality of oak species. It is caused by a combination of several factors including advanced age, poor site conditions, environmental conditions, various insects and diseases. An episode in the northern Lower Peninsula is causing significant mortality. Old, low-vigor red and northern pin oak stands on lower quality sites should be regenerated. However, older stands and stands where decline symptoms are extensive may not regenerate well to oak.

Forest Resource Division’s Forest Health Program helps monitor, protect, and manage state-managed forests faced with forest health concerns. Data collection, technical and management assistance occurs across jurisdictions as forest health issues on one land ownership impact all land ownerships. An annual summary of activities is available in the Forest Health Highlights report.

Desired future condition, objectives, and management actions

Native insects and disease outbreaks will be mitigated through best management practices, monitored and treated when severe resource damage is threatened.

Objective 1. Establish management regimes that reduce susceptibility to major outbreaks of native insects and diseases.

- Action 1. Thin to reduce the density of host species when higher stocking levels and lower vigor will contribute to pest damage.
- Action 2. Adjust the rotation length when necessary to reduce impacts caused by insects and diseases that affect older age classes.
- Action 3. Create a diverse mix of forest or community types, age classes, and stand structures to reduce the availability of host species for pests and pathogens.

Objective 2. Monitor native insect and disease outbreaks as they occur and treat as necessary throughout the planning period.

- Action 1. Conduct aerial surveys to map damage and collect reports from ground observations.
- Action 2. Local staff should report forest health concerns to the forest health program.
- Action 3. Identify areas susceptible to outbreaks.
- Action 4. Identify stands that will be susceptible to severe damage from outbreaks.
- Action 5. Develop thresholds for damage that would trigger treatment.

Climate change

All climate change data and information listed here is pulled directly from the open-source Northern Institute of Applied Climate Science (NIACS) Climate Change Impacts tool and adaptation workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium, limited) and agreement (high, moderate, low) described in the Predicted Impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the adaptation approaches. For more information, please go to www.niacs.org.

Predicted climate change impacts related to native insect and disease pests

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Northern Michigan's growing season will increase by 30 to 70 days by the end of the century	Robust	High	Longer growing seasons allow additional insect generations to occur, resulting in greater impacts on tree species
Many invasive species, insect pests, and pathogens in Michigan will increase or become more damaging	Limited	High	Warmer winters increase survivability of insects and pathogens, extending their ranges north; increase in temperature and moisture stress can make trees more vulnerable to insect and disease stressors

Adaptation approaches

Changes in climate are expected to cause substantial increases in the distribution and abundance of native insect pests and pathogens, leading to reduced forest productivity or increased tree stress and mortality. Impacts may be exacerbated where interactions between site conditions, changing climate and other stressors increase the vulnerability of forests. Promoting landscape diversity reduces host species availability at a broad scale, thereby reducing overall impacts from infestation. Silvicultural approaches such as adjusting rotations or thinning stands can also reduce overall impacts.

Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Area of state forest impacted by insect and disease outbreaks (aerial survey)
- Metrics included in the Michigan Forest Health Highlights annual report

Management priority: Non-native Insects and diseases



Why non-native insects and diseases matter

Some non-native insects and disease pathogens from other parts of the world become invasive in Michigan's forests and are highly destructive. They are successful in their new ecosystems because they reproduce and grow rapidly, there are no natural predators, and/or their new hosts have not developed defenses. The resulting disturbances may also favor establishment or an increase in invasive plants. As a result, invasive insects and diseases can threaten native species in Michigan's forests and disrupt important ecosystem processes.

Current condition and trend

Invasive insect and disease outbreaks are increasing as invasive species are detected in new areas of the state and others are introduced for the first time. Large outbreaks of invasive insects and diseases may occur in a moving front as they establish across the state. Human-assisted movement of infested materials may allow these species to rapidly spread to new locations. Once widely established, impacts vary. Some, such as spongy moth, have become naturalized with a predictable cycle of periodic large outbreaks, like native defoliators. Others have dramatically reduced the prevalence of susceptible tree species in our forests. The loss of a tree species can have significant repercussions. For example, emerald ash borer has rapidly eliminated black and green ash from forested wetlands, in some cases changing hydrology and generating nonforested conditions, a massive change in covertype and habitat. Good forest and stand management practices that increase the health, vigor, and diversity of our forests can reduce the impact of current and future invasive forest insects and diseases.

The DNR Forest Health Program works closely with several partners to monitor pathways for introduction of new invasives and specifically with the Michigan Department of Agriculture and Rural Development, the agency responsible for establishing quarantines to prevent introductions of new invasive species.

When new invasive forest insects and diseases are detected early, prior to widespread establishment, it is sometimes possible to eradicate them or slow their spread. Reporting new pests or diseases in new areas can have a large impact. Some invasive pests of concern for Michigan forests include:

Asian longhorned beetle (ALB), *Anoplophora glabripennis,* has not been detected in Michigan as of 2024. However, establishment would be devastating to maple and other species including birch, elm and willow. When detected early, this pest can be eradicated. Watch for conspicuous 1-inch glossy black beetles with long antennae, oviposition pits (circular divots chewed in the bark) and exit holes about the size the eraser end of a pencil.

Balsam woolly adelgid (BWA), *Adelges piceae*, causes decline and mortality of balsam fir and other fir species over several years. A quarantine since 2014 restricts movement of materials from infested areas into Michigan. As of 2023, there have been three detections in Michigan, all in the Lower Peninsula. At least one location is thought to have been eradicated.

Beech bark disease (BBD), caused by the combination of beech scale, *Cryptococcus fagisuga*, and *Neonectria* fungi, results in decline and mortality of larger beech trees as well as "beech snap" where infected trees with live crowns are prone to breakage. Across much of the range of beech in northern Michigan, the disease has killed or is killing susceptible trees and slowly moving further south, where the beech resource is more fragmented on the landscape.

Beech leaf disease, caused by *Litylenchus crenatae*, affects American beech (including trees resistant to beech bark disease). It has caused mortality in as little as two years after symptom observation for small understory trees and six or more years for large overstory trees. There are many unknowns about the disease. As of 2024, BLD is present in at least seven southeast Michigan counties. It is unclear if or when symptoms can be anticipated in northern Michigan.

Dutch elm disease (DED) has been present in Michigan for several decades. Elm trees often survive long enough to reproduce, however trees become more vulnerable as they mature. Make sure to report large surviving elms.

Emerald ash borer (EAB), *Agrilus planipennis*, has spread throughout Michigan since infestation began in the early 1990s and has caused significantly mortality in white, green and black ash forests, in some areas converting forested wetlands to non-forest conditions and altering hydrology. As of 2024, EAB is present in all counties. Mortality is not yet widespread across some areas in the northern Lower and western Upper Peninsula.

Hemlock woolly adelgid (HWA), *Adelges tsugae*, causes hemlock decline and mortality four to 10 years after infestation. As of 2024, nine west Lower Peninsula counties bordering Lake Michigan have established populations of HWA; however, HWA has not been detected on state forest lands. A coordinating committee composed of state agencies, partners from universities, USDA Forest Service and others developed a statewide strategic plan in 2017. A variety of partners conduct surveys at high-risk locations. Targeted treatments slow the spread of HWA into the large hemlock resource in the northern Lower and Upper peninsulas. A quarantine restricts movement of potentially infested hemlock materials into non-infested areas within Michigan and in other states.

Oak wilt, caused by *Bretziella fagacearum*, continues to spread across the Lower Peninsula and along the border in Wisconsin in the Upper Peninsula. It particularly spreads from activities and natural events that wound oaks during the "high-risk period" of April 15 to July 15.

Spongy moth, *Lymantria dispar*, causes periodic defoliation of oak, aspen, poplar and other species statewide. During outbreaks, defoliation tends to be most extensive in the northern Lower Peninsula, with localized pockets of defoliation in the Upper Peninsula. Outbreaks occur about every 10 years and coincide with warm, dry springs that reduce the impact of the introduced fungus *Entomophaga maimaiga*. The most recent outbreak peaked in 2021 with 1.3 million acres defoliated. Extensive spongy moth defoliation stresses several deciduous tree species, but only contributes to decline and mortality when combined with other factors such as drought, poor quality sites, or over-maturity. Conifers are not preferred hosts but can die when heavily defoliated during outbreaks.

The number of invasive insects and diseases in Michigan has been increasing, especially since the 1990s. The area of impacted forest has also increased (Table 1). As of summer 2024, there is no active infestation of balsam woolly adelgid known in Kent and Oceana counties.

Table 2. Recent (2024) status of some invasive forest insects and diseases.

Species	Year Establishment Detected	Current Status	Management
Dutch elm disease	Prior to 1950	Statewide	Identify and report potentially resistant trees
Oak wilt	Early 1950s	More than 60 counties	See management guidance
Spongy moth	1950s	Outbreaks on 10-year cycle	Promote stand health
Beech bark disease	2000	Most of beech range in northern Michigan, moving south	See beech guidance
Emerald ash borer	2002	Statewide	See ash guidance
Hemlock woolly adelgid	2015	Lower Peninsula Lake Michigan shoreline	See HWA Statewide Strategy
Beech leaf disease	2021	Southeast Michigan	Monitor
Balsam woolly adelgid	2023	Infestation in Missaukee County, eradication in Kent, Oceana counties**	Eradicate new populations when possible

Desired future condition, objectives, and management actions

Treatments for non-native insects and diseases use best available methods to minimize the adverse impact upon forest resources and are mitigated through a variety of integrated pest management techniques including chemical or silvicultural treatments and the adaptation of biological controls or genetic adaptation strategies. Other methods may be used or added when available and appropriate.

Objective 1. During the planning period, establish management regimes that reduce susceptibility to major outbreaks of non-native insects and diseases.

- Action 1. Thin to reduce the density of host species, when higher stocking rates and lower vigor will contribute to damage.
- Action 2. Adjust rotation length for species that become increasingly vulnerable to insects and diseases as they mature.
- Action 3. Create a diverse mix of forest or community types, age classes, and stand structures to reduce the vulnerability of host species or stands.

- Action 4. Retain potentially resistant or tolerant impacted species (ash, beech, elm, hemlock) where management needs or safety don't preclude it, providing an opportunity to maintain genetic material and potentially identify tolerant/resistant specimens that could be lost through salvage harvesting.

Objective 2. Throughout the planning period, monitor non-native insect and disease outbreaks.

- Action 1. Conduct aerial surveys to map damage and collect data from ground observations and reports.
- Action 2. Identify areas susceptible to outbreaks.
- Action 3. Use impact models and monitoring data to anticipate the arrival of pests and pathogens and prioritize management actions.
- Action 4. Report potential invasive forest health threats to the forest health program staff.

Objective 3. Treat outbreaks of non-native insects and diseases throughout the planning period.

- Action 1. Identify stands that will be susceptible to severe damage from outbreaks.
- Action 2. Develop contingency plans for treating outbreaks of emergent threats.
- Action 3. Treat outbreaks as appropriate and resources allow.
- Action 4. Restrict harvest and transportation of logs near stands already heavily infested with known pests or pathogens.

Objective 4. During the planning period, take action to adapt and restore affected tree species to the forest landscape.

- Action 1. Continue work to identify beech bark disease-resistant beech, lingering ash, Dutch elm disease tolerant elm and evaluate in test plots for eventual restoration of species into the forest. Begin to identify and evaluate potential HWA tolerant hemlock as opportunities arise. Action 2. Continue work with partners to identify effective management actions to address HWA, EAB and BBD, allowing host species to persist in Michigan forests.

Climate change

All climate change data and information listed here is pulled directly from the open-source Northern Institute of Applied Climate Science (NIACS) Climate Change Impacts tool and adaptation workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium, limited) and agreement (high, moderate, low) described in the Predicted Impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the adaptation approaches. For more information, please go to www.niacs.org.

Predicted climate change impacts related to non-native insect and disease pests

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Northern Michigan's growing season will increase by 30 to 70 days by the end of the century	Robust	High	Longer growing seasons allow additional insect generations to occur, resulting in greater impacts on tree species
Many invasive species, insect pests, and pathogens in Michigan will increase or become more damaging	Limited	High	Warmer winters increase survivability of insects and pathogens, extending their ranges north; increase in temperature and moisture stress leads to greater tree vulnerability to insect and disease stressors

Adaptation approaches

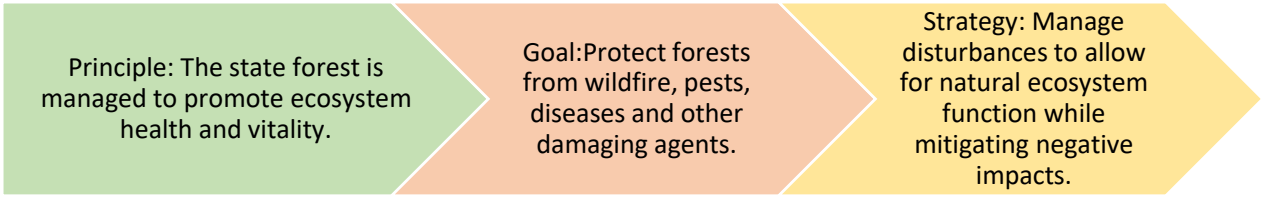
Changes in climate are expected to cause substantial increases in the distribution and abundance of non-native insect pests and pathogens, leading to reduced forest productivity or increased tree stress and mortality. Impacts may be exacerbated where interactions between site conditions, changing climate and other stressors increase the vulnerability of forests. Promoting landscape diversity reduces host species availability at a broad scale, thereby reducing overall impacts from infestation. Silvicultural approaches like adjusting rotations or thinning stands can also reduce overall impacts.

Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Number of new non-native insects and diseases detected
- Aerial survey acres affected by non-native species annually
- Acres treated annually
- Metrics in annual Forest Health Highlights report

Management priority: Invasive plants and animals



Why invasive plants and animals matter

Invasive plants and animals are defined as non-native species that are harmful to ecosystems, the economy, or human health.. They outcompete native species, alter soil and water resources, increase fire risks, damage infrastructure, and necessitate costly control efforts. Addressing invasive plants and animals is essential for preserving biodiversity, maintaining healthy ecosystems, and sustaining human well-being.

Current condition and trend

There is an increasing trend of invasive plant observations across state forest lands. It can be attributed in part to new introductions but also to increased effort to identify and treat invasive plant introductions (Table 1). The DNR currently doesn't collect data consistently enough to reliably track trends over time on state forest lands. Invasive animals such as the Russian boar and jumping worm occur in very low numbers and in very few areas in the state forest. This trend will remain stable so long as prevention and management efforts are sustained.

There are many invasive plants known in Michigan (over 300), and the Michigan Invasive Species Program (https://www.michigan.gov/invasives) has created the Watch List (https://www.michigan.gov/invasives/id-report/watchlist) to prioritize species that are not yet widespread in Michigan. Additional prioritization by region, habitat type, and use is critical for proper management. Even established invasive species, like spotted knapweed, autumn olive, and garlic mustard, are always important to prevent spread of and to manage populations under proper prioritization. Additional, regional prioritization by MISP is underway – contact MISP or Forest Health staff for the most up-to-date information.

Invasive plant spread through ice storm recovery is under-studied, but disasters and recovery efforts are known risk factors for invasive species (https://www.doi.gov/invasive-species-and-disasters), as seen with Asian longhorn beetle following the 2008 ice storms in the northeastern US. The seeds of TIS Watch List species can easily be transported on vehicles and equipment from infested areas to storm-damaged areas, particularly in an emergency response situation. Brush dump sites, both sanctioned and informal, and staging areas where out-of-state vehicles and equipment parked are also key areas to monitor for introduction of new and/or high-priority species.

Table 1. Top 10 invasive plant observations on state forest from 2006 to 2021 (MISIN Data).

Top 10 Invasive Plant Observations	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	No Date	Total
Spotted knapweed	6	5	85	18	1	8	388	184	358	4	7	195	1	**1,291**
Phragmites (Invasive)	39	2	41	166	29	159	92	97	99	21	4	7	4	**764**
Purple loosestrife	227	4	3	18	20	6	12	17	34	144	33	6		**532**
European swamp thistle		4	372	8	7	3	48	43			2	8	1	**503**
Autumn olive		3	9	20	2	5	150	88	82	54		87	1	**502**
Common St. John's wort	1	4	6	2	1	5	168	109	86	3	6	60	1	**459**
Garlic mustard	72	10	7	193	48	7	19	26	39	15	9	7	1	**459**
Reed canary grass		16	110	46	3	1	7	48	2	4	100	11	4	**369**
Bladder campion			70				68	79	6			79		**302**
Common mullein				4		2	36	37	121	1	5	20		**231**
Total	**345**	**48**	**703**	**475**	**111**	**196**	**988**	**728**	**827**	**246**	**166**	**480**	**13**	**5,412**

Desired future condition, objectives, and management actions

Eliminate or greatly reduce new introductions of invasive plants and animals and minimize impacts of those that are already established to promote fundamental ecological processes and climate change resiliency.

Objective 1. Monitor for invasive plants and animals during the planning period.

- Action 1. Develop and implement staff training in identification of invasive plant species.
- Action 2. Work with partners to provide training on invasive species for staff.
- Action 3. Prioritize invasive plant surveys along trails, timber landings, other high-traffic or disturbed areas, and in high conservation value areas.
- Action 4. Continue to populate the invasive species database of known invasive plant locations and implemented treatment actions on state forest lands.
- Action 5. Report observations of invasive animals as encountered.

Objective 2. Prevent new introductions of invasive plants when and where possible throughout the planning period.

- Action 1. Clean equipment prior to forest operations to prevent the spread of invasive plants during site preparation, harvesting, or other activities in accordance with the decontamination policy (QOL-2-2014).
- Action 2. Incorporate decontamination language into timber sale contracts and other use agreements (e.g. leases).
- Action 3. Maintain closed-canopy conditions to reduce the establishment of light-loving invasive species in the understory.
- Action 4. Encourage the use, or require the use by contractors of, certified invasive species-free landscape products, including fill, gravel, and mulch. (https://naisma.org/programs/weed-free-products)

Objective 3. Manage invasive plant populations over the planning period.

- Action 1. Use a framework of resistance, accepting, and directing to prioritize management actions concerning invasive plant species.
- Action 2. Develop treatment protocols for:
    - Specific high-priority species, such as those on the Watch List, and priorities informed by the Michigan Natural Features Inventory treatment prioritization model.
    - Invasive species in or threatening areas of high conservation value.
    - Species that are high priority for the location, including those widely distributed in the state but not widely distributed locally.
    - High-traffic areas, including timber landings, for all invasive plants.
    - Non-herbicide treatments, including biocontrol and cultural control, as feasible for the target species and location.
- Action 3. Treat invasive plants as resources allow.
- Action 4. Work with local partners, including Cooperative Invasive Species Management Areas (CISMAs) and MSAF to reduce costs, improve prioritization, and enhance partner buy-in.
- Action 5. Track treatment effectiveness.

- Action 6. Consider alternate management strategies, such as closing a highly invaded timber landing, to minimize invasive species impacts while reducing long-term costs.

Climate change

All climate change data and information listed here is pulled directly from the open-source Northern Institute of Applied Climate Science (NIACS) Climate Change Impacts tool and adaptation workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium, limited) and agreement (high, moderate, low) described in the Predicted Impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the adaptation approaches. For more information, please go to www.niacs.org.

Predicted climate change impacts related to invasive plants and animals

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Many invasive species, insect pests, and pathogens in northern Michigan forests will increase or become more damaging by the end of the century	Limited	High	Warmer temperatures may allow some invasive plant species to expand their ranges farther north
Forest composition will change across the landscape	Medium	High	Forest impact model results predict that habitat and biomass of individual tree species will change, and that species will respond uniquely

Adaptation approaches

Hundreds of invasive plant species are present in the Midwest and Northeast that are not yet present in Michigan. Climate change is expected to increase habitat for many of these species, which may then outcompete native species. Consistently applying decontamination protocols, monitoring for invasive species and working with partners on rapid response are priorities to reduce impacts to native species and forest ecosystems.

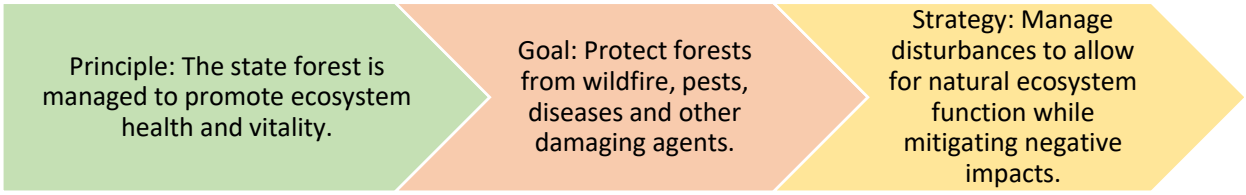
Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Number of acres surveyed for invasive species
- Number of sites receiving management for invasive species (including sites with changed management/use, not just treatments)
- Number of acres treated annually (including pull, spray, burn, etc.)
- Number of acres that need retreatment

- Area (acres) of adverse effect

Management priority: Herbivory



Why herbivory matters

Herbivory – animals eating vegetation -- is a key ecosystem process that reduces biomass and density of plants or plant materials, transfers mass and nutrients to the soil or water and affects habitat and resource conditions for other organisms. Excess herbivory can inhibit the regeneration of valued species such as sugar maple, oak species and northern white cedar.

Current condition and trend

Currently there is no systematic data on the current conditions and trends of cervid herbivory on state forest lands. Anecdotal evidence from foresters indicate that they are seeing reduced regeneration and recruitment of some species which can be directly attributed to herbivory. Deer herbivory has more frequent and more consistently negative effects on native plants than invasive plants have. Impacts are also cumulative, hitting preferred plant species especially hard as they decline in density, generating difficult to reverse effects.

Desired future condition, objectives and management actions

The state forest is managed to limit herbivory in key areas through a variety of mechanisms to promote desired forest regeneration and a developed understory.

Objective 1. Develop a monitoring regime for cervid herbivory over the planning period.

- Action 1. Develop standard metrics for herbivory.
- Action 2. Integrate herbivory metrics into normal inventory process.

Objective 2. Work to limit regeneration damage from excessive herbivory over the planning period.

- Action 1. Develop thresholds of damage that require remedial action.
- Action 2. Protect tree regeneration using appropriate tools in priority areas where possible (e.g., fencing, tubes, slash piles).
- Action 3. Continue to research actions or treatments that limit herbivory.

Climate change

All climate change data and information listed here is pulled directly from the open-source Northern Institute of Applied Climate Science (NIACS) Climate Change Impacts tool and adaptation workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium, limited) and agreement (high, moderate, low) described in the Predicted Impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and

management actions relevant to each management priority and are summarized in the adaptation approaches. For more information, please go to www.niacs.org.

Predicted climate change impacts related to herbivory

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Northern Michigan's winter snowpack will be reduced 30-80% by the end of the century	Robust	High	Herbivory will likely increase due to more winter precipitation delivered as rain and snowmelt between snowfall events

Adaptation approaches

Climate change will probably affect populations of forest herbivores such as moose (generally expected to decrease) and white-tailed deer (generally expected to increase). Because herbivores preferentially browse on particular species, it may be increasingly important to protect regeneration of desired species from deer, moose, and other herbivores.

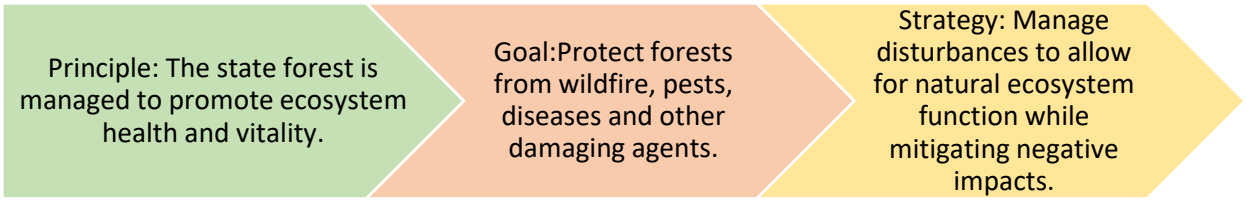
Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

Metrics:

- Area adversely affected by herbivory, arranged by severity categories.

Management priority: Wildfire



Why wildfire matters

Wildfires are uncontrolled fires that burn in wildland vegetation. They have been doing so for millennia in Michigan triggered by both lightning strikes and historical Anishinaabe fire stewardship of vegetation resources. The historical landscape was largely conifer dominated across a range of landforms and soil moisture gradients, except for northern hardwoods on glacial moraines. Depending on these and other local factors, fires could be large, catastrophic, stand-replacing events or smaller, patchy, community maintenance events.

Once started, weather conditions determine how much a wildfire grows. Wind, high temperatures, and a lack of rainfall can dry trees, shrubs, fallen leaves and limbs to provide ready fuel for a fire. Topography also plays a role in fire behavior, as flames burn uphill faster than they burn downhill. Wildfires can burn in vegetation located both in and above the soil. Ground fires typically ignite in soil thick with organic matter. Ground fires can smolder for a long time — even an entire season— until conditions are right for them to grow to a surface or crown fire. Surface fires burn in dead or dry vegetation lying on or growing just above the ground. Parched grass or fallen leaves often fuel surface fires. Crown fires burn in leaves and canopies of trees and shrubs. Wildfires that burn near communities can become dangerous or deadly if they grow out of control.

Despite these dangers, wildfires also provide ecosystem benefits for recycling nutrients and providing wildlife habitat. They are essential to the continued survival of some plant species. For example, jack pine cones need to be heated before they open and release their seeds. The regenerated forest can provide appropriate habitat for the Kirtland's warbler. Wildfires help keep ecosystems healthy by killing insects and diseases that harm trees. By clearing scrub and underbrush, fires can make way for new grasses, herbs, and shrubs that provide food and habitat for animals and birds. At a low intensity, fire can clear debris and underbrush on the forest floor, add nutrients to the soil, open space to let sunlight through to ground vegetation and give larger trees room to grow and flourish.

Current condition and trend

Wildfire on state land is rare, averaging less than 3,000 acres a year since 2006 when compilation of data began (Figure 1). Omitting the very high fire years of 2007 and 2012, the average falls to just over 1,000 acres annually burned by wildfire. Most fires occur in the pine and grass cover types. These fires can be fast-moving and pose a significant threat to property and forest resources. Large fires are highly sporadic and tend to happen once or twice a decade.

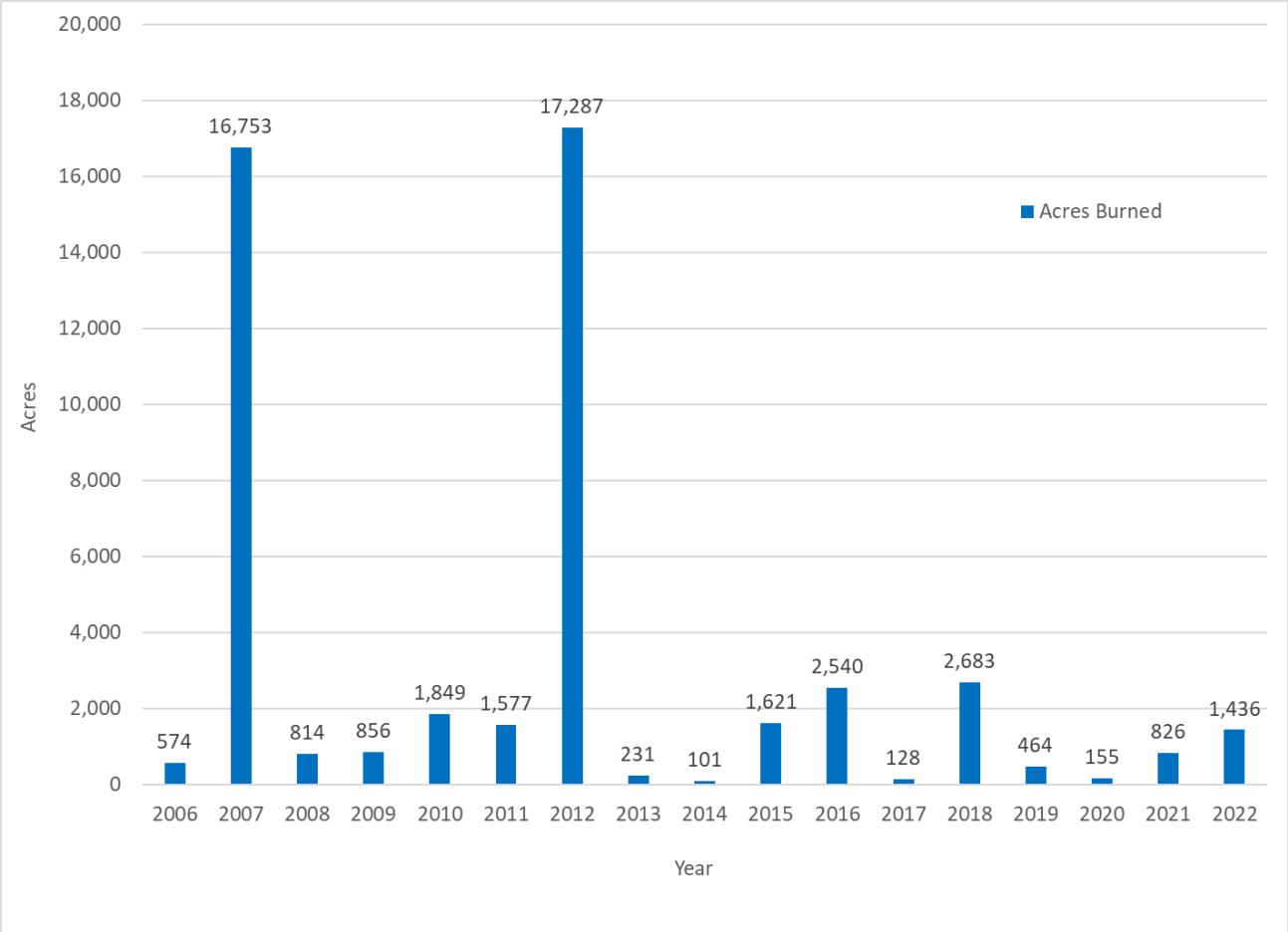


Figure 1. Acres of state forest land burned by wildfire 2006 to 2022.

Desired future condition, objectives, and management actions

The state forest is managed to limit wildfires to a scale that reflects natural occurrences and ecological function where safety and resource damage concerns allow, in consideration of a changing climate.

Objective 1. Over the planning period, allow low-intensity natural fires that do not threaten resources or public safety to burn to natural boundaries in fire-adapted landscapes.

- Action 1. Develop parameters under which natural fires would be allowed to burn.
- Action 2. Identify cover types and fire-adapted communities that would benefit from natural fire or the restoration of prescribed fire.
- Action 3. Whenever feasible, use minimum-impact fire suppression tactics.
- Action 4. Shift prescribed burn seasons to align with projected seasonal precipitation changes, reducing the risk of unintended wildfire conditions.
- Action 5. In at-risk cover types, use prescribed fire and thinning to reduce surface fuels, increase height to live crown, decrease crown closure, and create a more open forest structure that is expected to be less vulnerable to severe wildfire.

Objective 2. Over the planning period, extinguish human-caused wildfires and fires that threaten resources or public safety.

- Action 1. Identify areas of highest risk for wildfire development.
- Action 2. Maintain adequate resources for the suppression of large wildfires.
- Action 3. Review plans for high-risk dispatch zones annually.

Objective 3. Over the planning period, take actions to reduce the adverse impacts of wildfire.

- Action 1. Maintain the system of fuel breaks.
- Action 2. Work with communities located in fire-prone landscapes to encourage participate in the Community Wildfire Protection Program.

Climate change

All climate change data and information listed here is pulled directly from the open-source Northern Institute of Applied Climate Science (NIACS) Climate Change Impacts tool and adaptation workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium, limited) and agreement (high, moderate, low) described in the Predicted Impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the adaptation approaches. For more information, please go to www.niacs.org.

Predicted climate change impacts related to wildfire

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Northern Michigan soil moisture patterns will change, with drier soil conditions later in the growing season	Medium	Moderate	Summer precipitation is projected to decrease by less than 10% but can increase the risk of wildfire
Climate conditions will increase fire risks in northern Michigan by the end of the century	Medium	Moderate	By the end of the century, most models project an increase in wildfire probability, particularly for boreal forests, temperate coniferous forests, and temperate broadleaf forests

Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

Metrics:

- Area burned annually by forest type

Recreation

Management priority: Motorized recreation trails



Why motorized recreation trails matter

Trails provide a backbone for many types of recreation, connecting people, communities and destinations of interest year-round. Motorized trails (including snowmobile, motorcycle and all-terrain vehicle trails and off-road vehicle routes) provide access to remote areas of the forest for wildlife viewing, hunting and fishing and opportunities to socialize with family and friends. The DNR recognizes the positive impact these activities have on the state's residents, tourism and economy. Continued maintenance and upgrades are needed to solidify Michigan's national recognition as the Trails State.

Current condition and trend

Motorized trails in the state forest are managed by the DNR Parks and Recreation Division, in partnership with the Forest Resources Division and grant sponsors, who maintain the trails through a grant program funded by user fees and administered by the DNR. Between 2016 and 2020, off-road vehicle license sales increased by 30%, and ORV trail permit purchases (which allow ORVs to ride on state trails) increased 37%. After a record year in 2021, there was a slight decline in 2022, but numbers were still up from previous years, and a continued upward trend is anticipated. The increased use has put a strain on trail maintenance resources. Despite a small increase in trail mileage over the last decade, the focus of the program is on providing a sustainable, quality experience over adding mileage.

Conversely, snowmobile permit sales have shown a general decline of 3.6% from 2018 to 2022. There has also been a slight decline in overall mileage, due primarily to the loss of snowmobile trails on private land, which in turn may lead to closures in the state forest.

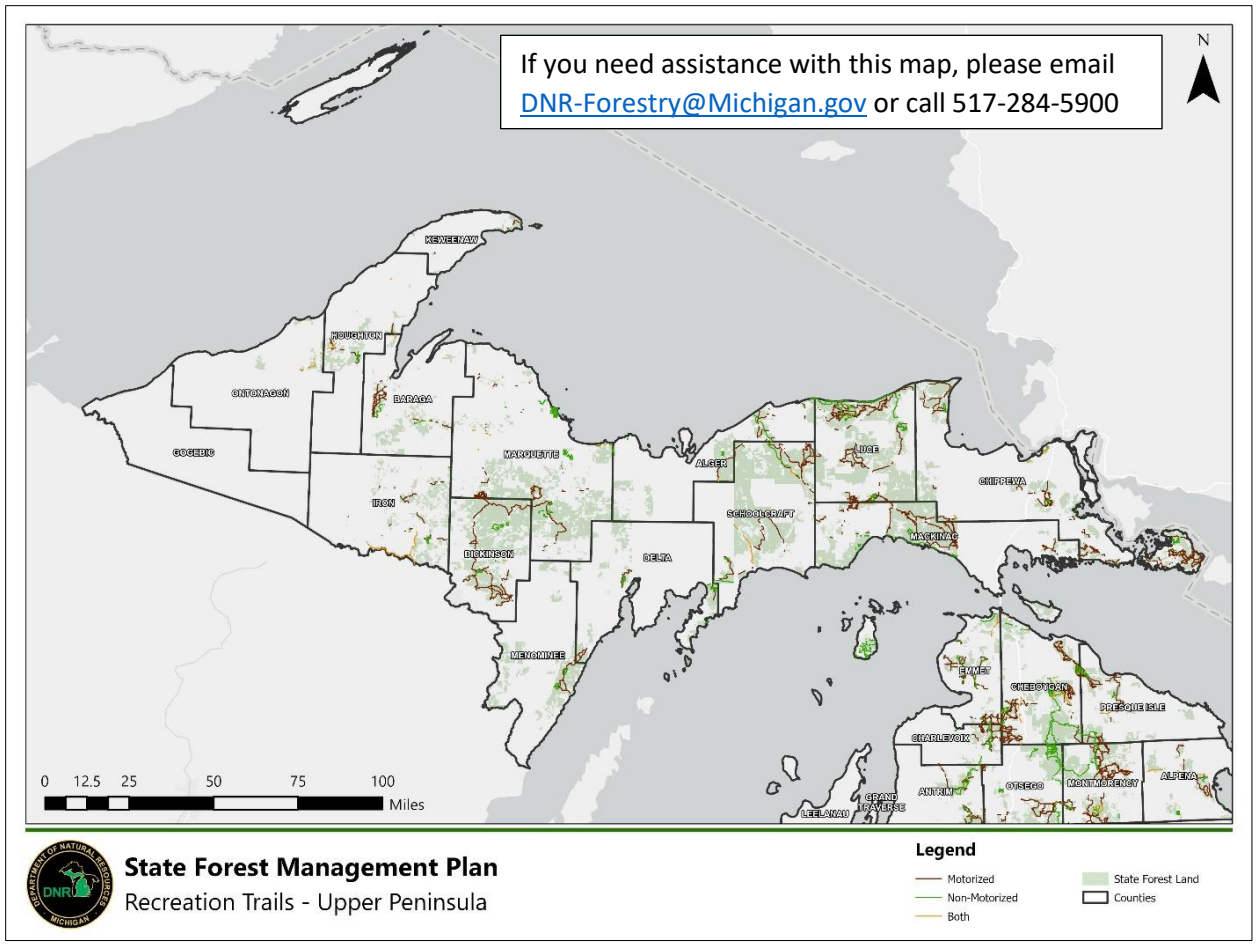


Figure 1. Map showing all trails on state forest land in the Upper Peninsula.

The majority of motorized trails are located in the northern Lower Peninsula (tables 1 and 2, figures 1 and 2). Note that the trail mileage and density indicated by the following tables does not include state forest roads that are open to motorized uses.

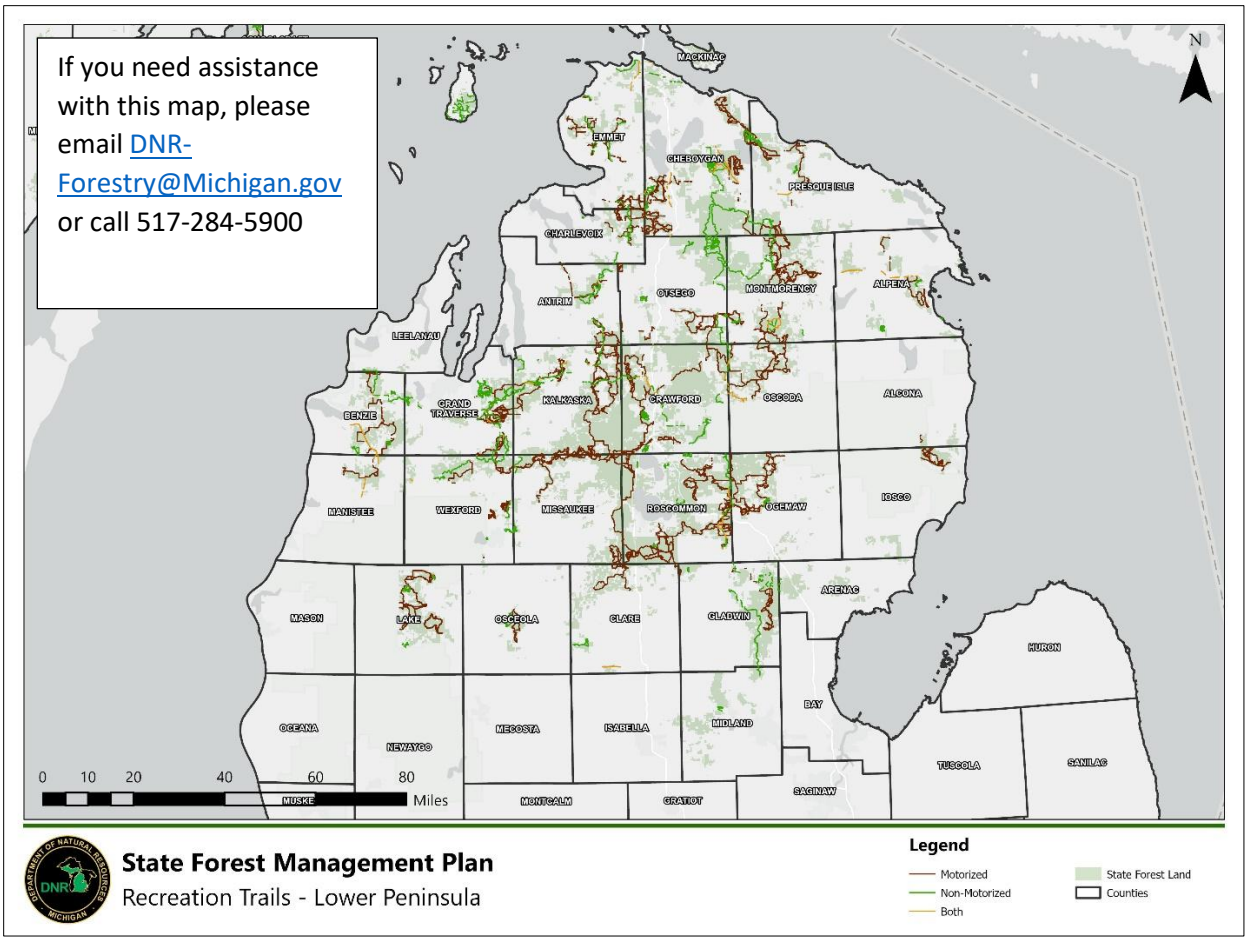


Figure 2. Map showing all trails on state forest land in the northern Lower Peninsula.

Table 1. Number and density of off-road vehicle trail miles by region, 2021 (source: Michigan DNR GIS data).

Region	Sum of ORV (All Types) Trail Miles	Square Miles	Miles of ORV Trails Per Square Mile
NLP	1,805.6	3,218.8	0.56
EUP	517.7	1,687.4	0.31
WUP	251.0	1,399.9	0.18
Total	**2,574.3**	**6,306.1**	**0.41**

Table 2. Number and density of snowmobile trail miles by ecoregion, 2021 (source: Michigan DNR GIS data).

Region	Sum of Snowmobile Trail Miles	Square Miles	Miles of Snowmobile Trails Per Square Mile
NLP	1,099.7	3,218.8	0.34
EUP	471.2	1,687.4	0.28
WUP	272.0	1,399.9	0.19
Total	**1,842.9**	**6,306.1**	**0.29**

Management of motorized recreational trails is guided by the Michigan DNR Trails Plan, 2022-2032, which focuses on sustainable maintenance and development, funding, planning and collaboration, and marketing, promotion and education. While mileage of ORV and snowmobile trails in the state forest will continue to be tracked over time, there is no plan to significantly increase mileage, and any new trails will be carefully considered in relation to forest management objectives, environmental protection, etc. Several studies are proposed in the DNR trails plan that will help inform decision-making, such as a regional gap analysis and improved understanding of trail use patterns.

Desired future condition, objectives and management actions

Desired future condition: The state forest provides diverse, sustainable and safe systems of motorized trails for recreation, visiting points of interest and community connections.

Objective 1. Within 10 years, develop tools and protocols to ensure motorized trails are developed and maintained to provide a quality trail experience and responsible resource management.

- Action 1. Improve understanding of existing trail-use patterns through surveys, trail counters, etc., and use this to inform trail planning, including possible trail system adjustments.
- Action 2. Update management practices based on established resource protection policies and considering potential implications of climate change.
- Action 3. Establish criteria for when a new trail should be developed, considering forest management objectives, land purchase funding source, sustainability, connectivity, demand, etc.
- Action 4. Monitor market trends for motorized recreation vehicles and plan accordingly.
- Action 5. Consider motorized trail connectivity in all potential land transactions.

Objective 2. Routinely provide accurate and easily accessible information regarding motorized trails to both new and existing audiences.

- Action 1. Continue to promote Ride Right and other safety campaigns.
- Action 2. Seek and implement opportunities to provide invasive species prevention and decontamination messaging through campaigns like “PlayCleanGo” and “Dirt Never Hurt But Invasive Species Do.”
- Action 3. Provide up-to-date, interactive, online mapping of motorized trails.
- Action 4. Follow guidance provided in the state trail signage plan (to be completed).

Objective 3. Routinely perform maintenance and operations in accordance with program handbooks to established standards.

- Action 1. Refine coordination between Parks and Recreation and Forest Resources divisions and clubs/grant sponsors.
- Action 2. Enable and execute a coordinated monitoring effort across divisions to identify, document and restore ORV damage to state forest land.
- Action 3. Routinely monitor trails for erosion and reroute/repair as needed.
- Action 4: Evaluate current policies to strengthen ability to prevent trail damage.
- Action 5. Update handbooks annually.
- Action 6: Ensure grant-funded projects are completed in a timely manner.

Objective 4. Routinely engage motorized trail users, communities and local businesses in trail management decisions.

- Action 1. Conduct authentic community engagement to help guide trail development and management and provide education into the rationale behind decision-making processes.
- Action 2. Increase participation in compartment reviews by both staff and stakeholders.
- Action 3. Communicate information regarding timber cuts and treatments that may impact trail use clearly and in a timely way.

Climate change

All climate change data and information listed here is pulled directly from the open-source Northern Institute of Applied Climate Science Climate Change impacts tool and adaptation workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium and limited) and agreement (high, moderate and low) described in the predicted impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the adaptation approaches. For more information, go to NIACS.org.

Predicted impacts relevant to motorized recreation trails

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results From Impacts
Winter precipitation as rain and more melt between snowfall events.	Robust	High	Reduction in season for snowmobiling and potential increase in conflicts with nonsnow use. More freeze-thaw cycles will damage trail infrastructure.
Seasonal variation in soil moisture and altered precipitation may influence the magnitude and duration of flood events.	Not given	Not given	Flooding and increased erosion; reduction in access and higher maintenance costs.

Adaptation approaches

Ensure management actions for motorized trails, such as monitoring trails for erosion and incorporating effective maintenance and reroutes, are resilient to intense precipitation events and erosion. Improving the understanding of existing trail-use patterns will provide a baseline to evaluate changes in use over time, which may be an indirect result of climate change.

Monitoring

The following metrics have been identified for this management priority to track progress toward forest sustainability:

- Number of miles of ORV and snowmobile trails by region.
- Trail miles per square mile every five years by region.
- Funding assigned for motorized trail improvement projects annually.

Management priority: Nonmotorized recreation trails



Why nonmotorized recreation trails matter

Trails provide a backbone for many types of recreation, connecting people, communities and destinations of interest year-round. Nonmotorized trails (including hiking, cross-country skiing, equestrian and mountain biking) provide much-loved recreation and social opportunities, as well as access to remote areas of the forest for wildlife viewing, hunting and fishing. The DNR recognizes the positive impact these activities have on the state's residents, tourism and economy. Continued maintenance and upgrades are needed to solidify Michigan's national recognition as the Trails State.

Current condition and trend

Nonmotorized trails, or pathways, in the state forest are managed by the DNR Parks and Recreation Division in partnership with Forest Resources Division. Some trails/trail systems also have maintenance agreements with volunteer organizations, either for routine maintenance or seasonal grooming of cross-country ski or fat-tire bike trails. Most are natural-surface trails, with some boardwalks and bridges to cross wetlands and watercourses. They include long-distance, linear trails such as the North Country National Scenic Trail and the hiking route of the Iron Belle Trail, looped trail systems, and point-to-point trails. The majority of nonmotorized trails are located in the northern Lower Peninsula. Note that the trail mileage and density indicated by the following tables does not include forest roads that are also open to nonmotorized uses. Many trails have shared use types, so the sum of each use type totals more than the sum of all nonmotorized trails. However, only "designated" uses are recorded, recognizing that other uses may be allowed and secondary to the primary function.

While use of trails in the state forest is hard to track, general recreation trends indicate an increase in trail use in recent years, correlating with the rise of information available on the internet and a greater desire to be outside spurred on by the COVID pandemic.

Table 1. Number and density of designated hiking trail miles by region, 2021 (source: Michigan DNR GIS data).

Region	Sum of Hiking Trail Miles	Square Miles	Miles of Hiking Trails Per Square Mile
NLP	803.9	3,218.8	0.25
EUP	147.2	1,687.4	0.09
WUP	127.3	1399.9	0.09
Total	**1,078.4**	**6,306.1**	**0.17**

Table 2. Number and density of designated biking trail miles by region, 2021 (source: Michigan DNR GIS data).

Region	Sum of Biking Trail Miles	Square Miles	Miles of Biking Trails Per Square Mile
NLP	410.0	3,218.8	0.13
EUP	32.1	1,687.4	0.02
WUP	67.6	1399.9	0.05
Total	**509.7**	**6,306.1**	**0.08**

Table 3. Number and density of designated equestrian trail miles by region, 2021 (source: Michigan DNR GIS data).

Region	Sum of Equestrian Trail Miles	Square Miles	Miles of Equestrian Trails Per Square Mile
NLP	264.6	3,218.8	0.08
EUP	30.5	1,687.4	0.02
WUP	14.2	1399.9	0.01
Total	**309.3**	**6,306.1**	**0.05**

Table 4. Number and density of hunter walking trail miles by region, 2021 (source: Michigan DNR GIS data).*

Region	Sum of Hunter Walking Trail Miles	Square Miles	Miles 0f Hunter Walking Trails Per Square Mile
NLP	144.9	3,218.8	0.05
EUP	37.0	1,687.4	0.02
WUP	41.3	1399.9	0.03
Total	**223.2**	**6,306.1**	**0.04**

**Hunter walking trails are defined as maintained trails within Grouse Enhanced Management Sites.*

Management of nonmotorized recreational trails is guided by the Michigan DNR Trails Plan, 2022-2032, which focuses on sustainable maintenance and development, funding, planning and collaboration, and marketing, promotion and education. While mileage of different types of nonmotorized trails in the state forest will continue to be tracked over time, the emphasis will be on providing a quality trail experience rather than adding trail mileage. Any new trails will be carefully considered in relation to forest management objectives, environmental protection, demand, etc. Several studies are proposed in the DNR trails plan that will help to inform decision making and trail planning, such as the use of surveys, trail counters, etc.

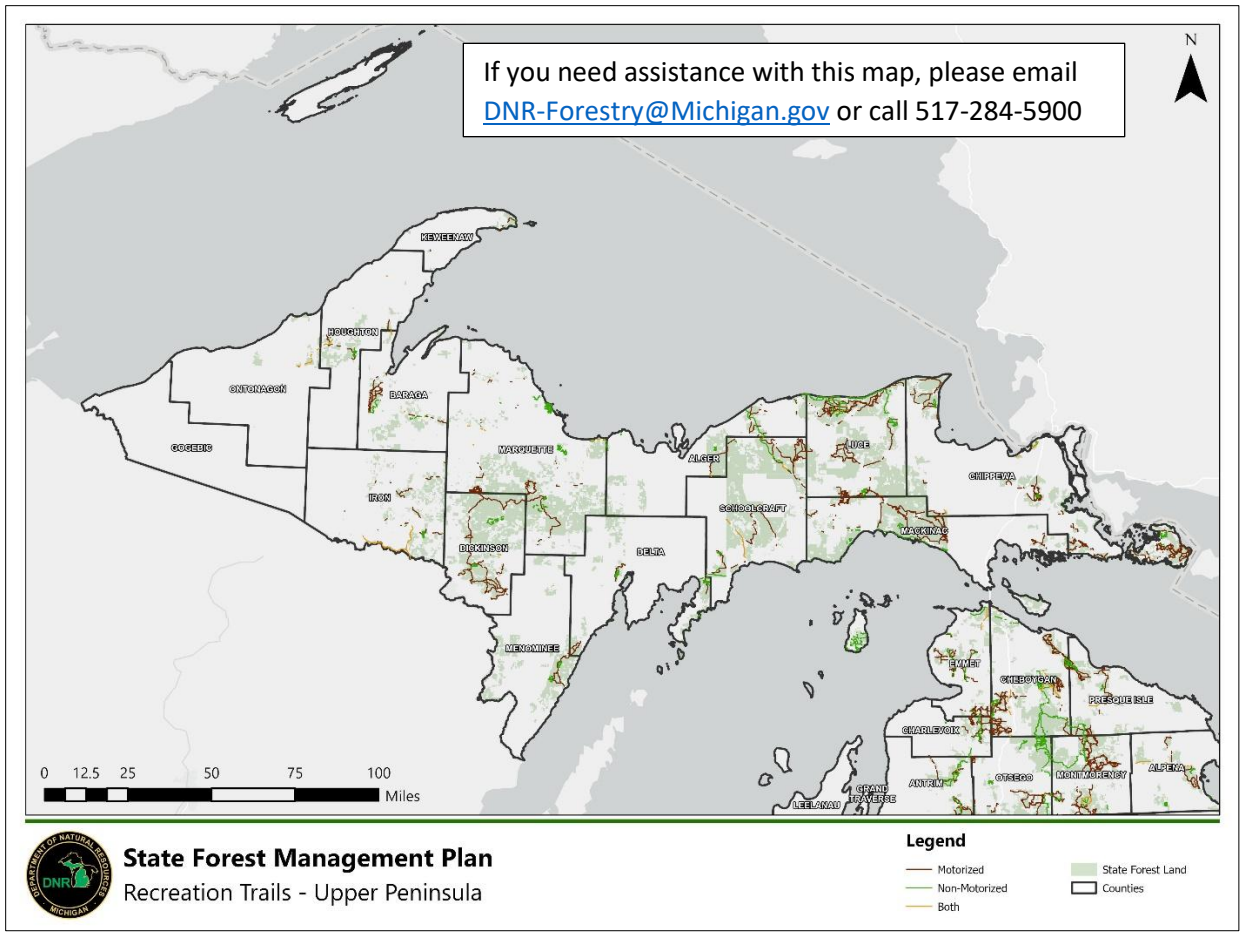


Figure 1. Map showing all trails on state forest land in the Upper Peninsula; nonmotorized trails are shown in green.

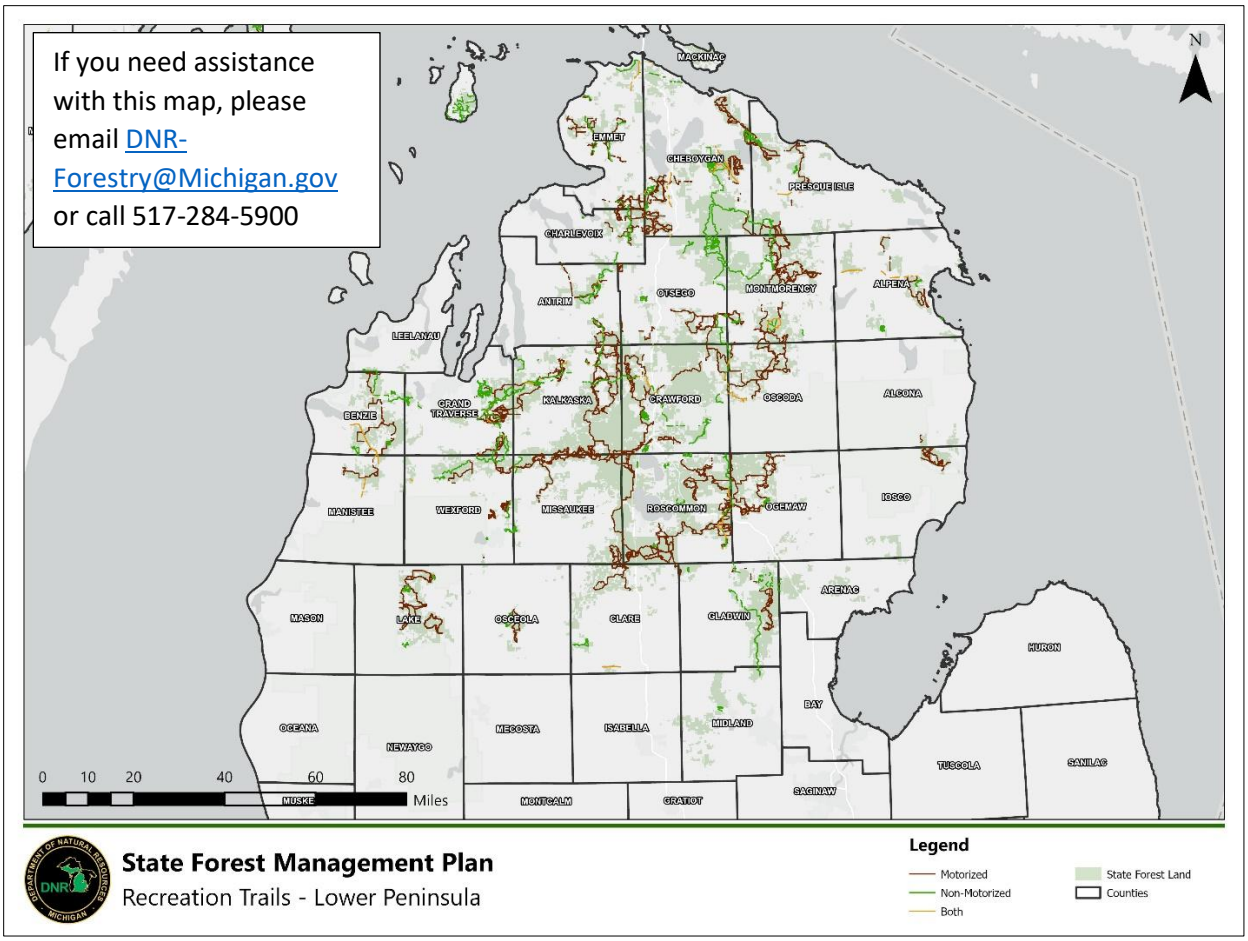


Figure 2. Map showing all trails on state forest land in the northern Lower Peninsula; nonmotorized trails are shown in green.

Desired future condition, objectives and management actions

The state forest provides diverse, sustainable and safe systems of nonmotorized trails for recreation, visiting points of interest and community connections.

Objective 1. Within 10 years, develop tools and protocols to ensure nonmotorized trails are developed and maintained to provide a quality trail experience and responsible resource management.

- Action 1. Improve understanding of existing trail-use patterns through surveys, trail counters, etc., and use this to inform trail planning, including possible trail system adjustments.
- Action 2. Update management practices based on established resource protection policies and considering potential implications of climate change.
- Action 3. Establish criteria for when a new trail should be developed, considering forest management objectives, land purchase funding source, sustainability, connectivity, demand, etc.
- Action 4. Consider nonmotorized trail connectivity in all potential land transactions.

Objective 2. Routinely provide accurate and easily accessible Information regarding nonmotorized trails to both new and existing audiences.

- Action 1. Provide up-to-date, interactive online mapping of nonmotorized trails.
- Action 2. Promote trail safety, etiquette, general use practices and understanding of state forest land management.
- Action 3. Seek and implement opportunities to provide invasive species prevention and decontamination messaging and tools through campaigns like “PlayCleanGo” (e.g., boot brush stations).
- Action 4. Follow guidance provided in the state trail signage plan (to be completed).

Objective 3. Within 10 years, establish and maintain sustainable maintenance practices for nonmotorized trails.

- Action 1. Develop a plan to expand opportunities for volunteer trail maintenance activities.
- Action 2. Develop a nonmotorized trail maintenance and development handbook.
- Action 3. Routinely monitor trails for erosion and reroute/repair as needed.
- Action 4. Prepare and conduct timber harvest prescriptions in a manner that attempts to minimize obstructions and maintain aesthetic values along trails.

Objective 4. Routinely engage nonmotorized trail users, communities and stakeholders in trail management decisions.

- Action 1. Conduct authentic community engagement to help guide trail development and management and provide education into the rationale behind decision-making processes.
- Action 2. Increase participation in compartment reviews by both staff and stakeholders.
- Action 3. Communicate information regarding timber cuts and treatments that may impact trail use clearly and in a timely way.

Climate change

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Predicted impacts relevant to nonmotorized recreation trails

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Increase in temperatures, with more warming in winters.	Robust	High	Heat stress for visitors and pets in summer. Higher use in shoulder seasons, when trails may be wet, resulting in erosion.
Reduced winter snowpack.	Robust	High	Reduction in season for cross-country skiing and snowshoeing.
Seasonal variation in soil moisture and altered precipitation, which may influence the magnitude and duration of flood events.	Not given	Not given	Flooding and increased erosion.

Adaptation approaches

Ensure management actions for nonmotorized trails, such as monitoring trails for erosion and incorporating effective maintenance and reroutes, are resilient to intense precipitation events and erosion. Continuing education on trail condition expectations, including availability of drinking water, potential ground conditions and trail-use best practices, will ensure the comfort and safety of users and protection of resources. Improving the understanding of existing trail-use patterns will provide a baseline to evaluate changes in use over time, which may be an indirect result of climate change.

Monitoring

The following metrics have been identified for this management priority to track progress toward forest sustainability:

- Number of miles of nonmotorized trails by use type and region.
- Trail miles per square mile every five years by region.
- Funding assigned for nonmotorized trail improvement projects annually.

Management priority: Dispersed recreation



Why dispersed recreation matters

The expansive area of state forest land provides general access to all for a variety of low-intensity, low-cost recreation uses that are not confined to a specific place. This is what is referred to by "dispersed recreation." Michigan residents and visitors have been enjoying the dispersed recreation opportunities on almost 4 million acres of state forest for generations. Hunting, fishing, mushrooming, berry picking, fuelwood collection, dispersed camping, wildlife watching, birding, studying plants and other dispersed outdoor recreation pursuits are part of Michigan's heritage and identity. These activities are integral to the quality of life for many, generating lifelong memories, promoting physical and mental health, providing social interactions and food, and promoting knowledge, understanding and stewardship of our natural environment. The DNR also recognizes the positive impact these activities have on the state's tourism industry and economy – hunting contributes almost $9 billion, and fishing contributes more than $2 billion annually (DNR Managed Public Land Strategy, 2021-2027). In addition, funds from hunting and fishing licenses provide vital funding for DNR land acquisition and management programs.

Current condition and trend

The state forest provides over 3.8 million acres for dispersed recreation pursuits across the state (Table 1). Although total state forest land acreage is not expected to change significantly over the next 10 years, ensuring access to large blocks of undeveloped land is a department goal. State land ownership is guided by the DNR Managed Public Land Strategy, 2021-2027, which identifies a strategic approach to land management and acquisitions. Land consolidation efforts are among the highest priorities for DNR acquisitions.

Table 1. State forest acres by year, 2019-2022 (source: Michigan DNR Land Ownership Tracking System).

Mason/Arenac line	Acres in 2019	Acres in 2020	Acres in 2021	Acres in 2022
North	3,565,740	3,574,441	3,571,676	3,574,958
South	288,146	288,202	288,124	287,842
Statewide Total	**3,853,886**	**3,862,643**	**3,859,800**	**3,862,800**

Over the last three years, significant department acquisitions that demonstrate effective land consolidation include:

- Two acquisitions adding over 2,500 acres to the Pigeon River Country State Forest (the largest contiguous block of state forest land).
- The 1,000-acre Upper Au Sable River Tract, almost completely surrounded by the Grayling State Forest Management Unit.
- 955 acres in the Shingleton Management Unit that connect two large blocks of state forest land.

Direct metrics related to dispersed recreation are not tracked, with a few exceptions, due to its very nature; therefore, the acres of state forest land and land consolidation efforts remain the best indirect tracking method. However, some overall trends provide an indication of use levels. Generally, hunting and trapping participation continues to decline across the country, including in Michigan. Coupled with this trend, people are increasingly more interested in wildlife protection and nonconsumptive activities than in more traditional, consumptive ways of engaging with wildlife. Amid a global pandemic in 2020-2021, the country saw increased participation in outdoor recreation, including wildlife-related activities. The Outdoor Foundation reported the largest rise recorded in the outdoor recreation participation rate between 2020 and 2021. It is not yet clear how this will impact outdoor recreation participation in the future.

Desired future condition, objectives and management actions

The state forest provides a consolidated land base for diverse and sustainable dispersed recreation that offers opportunities to connect with nature in different ways.

Objective 1. Within 10 years, increase land consolidation and reduce fragmentation across the state forest, while increasing climate change resiliency.

- Action 1. Prioritize land acquisition efforts on the consolidation of DNR-managed lands to reduce fragmentation.
- Action 2. Avoid fragmentation of large, undeveloped blocks of land by new trails, roads or other activities.

Objective 2. Within five years, comprehensively review and improve how information is shared regarding dispersed use of the state forest, balancing promotion of values and activities to new users with the protection of quiet, low-use areas.

- Action 1. Continue to promote dispersed recreation opportunities with applications such as Mi-Morels, Trout Trails and other education resources.
- Action 2. Develop informative materials on regulations relating to dispersed recreation use.
- Action 3. Elevate the Recreate Responsibly, Leave No Trace and invasive species messages, including to new audiences.

Objective 3. Over the next 10 years, use sound management practices to support a variety of quality dispersed and backcountry experiences in the state forest, while protecting the resources.

- Action 1. Review the dispersed camping registration process and look for ways to make the process more efficient and provide better information on use patterns.
- Action 2. Implement practices and policies to monitor for and protect from overuse and resource damage (e.g., from dispersed camping).
- Action 3. Maintain habitat necessary to support fish and wildlife populations that provide opportunities for diverse recreation.
- Action 4. Consider impacts to dispersed recreation opportunities in the compartment review process.

Climate change

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Predicted impacts relevant to dispersed recreation

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Increase in temperatures, with more warming in winters.	Robust	High	Heat stress for visitors and pets in summer. Higher use in shoulder seasons, when ground conditions may be wet, resulting in erosion. Higher potential for users to seek out water access.
Seasonal variation in soil moisture and altered precipitation, which may influence the magnitude and duration of flood events.	Not given	Not given	Flooding may impact user safety and access. Increased erosion.

Adaptation approaches

Consolidation of state-managed land and reduction of fragmentation increases resiliency of natural communities from climate change impacts. Dispersed recreation, by its nature, is a resilient form of recreation provided there are regulations and protections from overuse in place. Continuing education on responsible recreation and condition expectations, Leave No Trace ethics and techniques to avoid the spread of invasive species will safeguard the comfort and safety of users and help protect the resources. It is likely that use patterns may change in response to a changing climate, which will require monitoring over time. Implementing policies and procedures to monitor for and protect from overuse and resource damage will be important.

Monitoring

The following metrics have been identified for this management priority to track progress toward forest sustainability:

- Acres of state forest.
- Number of inholdings acquired annually.
- Mileage of public/private boundary interface.

Management priority: Areas managed for hunting



Why areas managed for hunting matter

Hunting is a time-honored tradition in Michigan, with the state playing an extensive role during the last 150 years in protection and conservation of game, beginning with the establishment of hunting seasons in the late 1850s. Hunting of wild game, upland birds and waterfowl and trapping/fur harvesting are part of Michigan's heritage and identity. These activities are integral to the quality of life for many, generating lifelong memories, putting food on the table and promoting knowledge, understanding and stewardship of Michigan wildlife and their habitats. The DNR also recognizes the positive impact hunting and trapping have on the state's tourism industry and economy, contributing almost $9 billion annually. In addition, funds from state hunting licenses, and a federal excise tax on firearms, ammunition and archery equipment, provide vital funding for DNR wildlife management programs. Hunter numbers in Michigan (and nationally) are trending downward, with a corresponding projected decline in budgets and workforce.

While the majority of the state forest is open for hunting as dispersed recreation, the DNR Wildlife Division manages designated areas amid the state forest system specifically for wildlife and hunting. This can mean these areas are geographically situated among state forest parcels, are on state forest parcels and/or are included in some state forest administrative processes. These areas all have at least one of three Wildlife Division designations:

State game areas. Largely purchased through state and federal restricted funds pertaining to wildlife management (e.g., State Game Fund, Pittman-Robertson Fund), these lands are areas that focus on habitat management for game (and other) species for the purpose of species population maintenance, hunting and other wildlife-related recreation. Though some of these areas occur within the state forest and Forest Resources Division conducts inventory and assists with management activities, Wildlife Division is the land administrator with primary management responsibility.

State wildlife research areas. These areas were largely purchased through state and federal restricted funds pertaining to wildlife management (e.g., State Game Fund, Pittman-Robertson Fund) and were historically established with the intent to conduct research on various game species in the mid-1900s. This included such efforts as evaluating native wildlife relationships with habitat, reacclimating and reintroducing native species, breeding and releasing non-native species for hunting recreation, and evaluating species growth and development. Most of these establishing research endeavors ended decades ago, and these areas are now primarily managed with a focus on wildlife habitat and wildlife-related recreation. Of the three in the northern Lower and Upper peninsulas, only one is still in the state forest system. Forest Resources Division conducts inventory and assists with management activities in this area, but Wildlife Division is the land administrator with primary management responsibility.

Wildlife management areas. These are areas of the state forest or other ownerships, established in agreement with Forest Resources Division or the landowner, where there is an identified priority for wildlife management. In many cases, these are floodings or other managed wetlands maintained for waterfowl habitat and hunting recreation. This designation also includes lands in the Grouse Enhanced Management Sites, or GEMS program, which are specific areas of the state forest or other ownerships where the management priority is aspen for ruffed grouse and hunter access. In these cases on the state forest, Forest Resources Division is the land administrator, while Wildlife Division has management responsibility. Management responsibility falls to the landowner for areas not on state land.

Current condition and trend

In the northern Lower and Upper peninsulas, there are 64 areas, totaling 184,863 acres, with one of the three Wildlife Division designations in the state forest system. This means these acres are included in state forest planning, modeling and operations and are under forest certification. Of all these areas, Wildlife Division is the land administrator for only the three state game areas (SGAs) and one state wildlife research area (SWRA) in the state forest (Table 1). Wildlife Division retains primary management responsibility for these areas, and habitat management is enacted through co-management with FRD via the compartment review process. All SGAs and SWRAs are subject to rules and regulations that may differ from state forest land. For more information on the management of any of these designated areas, master plans are available online.

Table 1. Wildlife Division SGAs and SWRA in the state forest system.

Area Name and Designation	Region	Included in State Forest Plan and Model	Under Forest Certification	Acres
Backus Creek SGA	NLP	Yes	Yes	4,379
Houghton Lake SWRA	NLP	Yes	Yes	12,131
Hubbard Lake SGA	NLP	Yes	Yes	522
Osceola-Missaukee Grasslands SGA	NLP	Yes	Yes	1,259

All wildlife management areas (WMAs) that Wildlife Division has management responsibility for in the northern Lower and Upper peninsulas occur on state forest land. These areas are managed through co-management with FRD via the compartment review process. They are all included in the state forest management plan and model, are all under forest certification, and are subject to state forest rules and regulations. These generally fall into several categories (Table 2).

Table 2. Area and number of WMAs by type in the state forest system.

Wildlife Management Area Type	NLP Acres (Count)	EUP Acres (Count)	WUP Acres (Count)
GEMS (state land)	23,069 (6)	15,296 (5)	17,416 (4)
Floodings	34,514 (24)	15,805 (6)	6,135 (8)
Other	9,416 (3)	26, 974 (3)	22,326 (2)

Of note, the Backus Creek State Game Area also shares a GEMS designation, thus the 4,379 acres are double-counted across tables 1 and 2. The "Other" category (Table 2) includes:

- NLP: Gladwin Field Trial Area (4,750 acres), Skegemog Lake WMA (3,614), Conners Marsh WMA (1,052).
- EUP: Au Train Basin WMA (6,836 acres), Munuscong WMA (19,292 acres), Portage Marsh WMA (846 acres).
- WUP: Baraga Plains WMA (13,362 acres), Sturgeon River Sloughs WMA (8,964 acres)

The GEMS have been identified and promoted for premier ruffed grouse hunting, with a focus on intensive aspen management and ease of access. Infrastructure includes walking trails for beginners or those with mobility challenges and parking lots with local area information available in established kiosks.

Most of these designations have been static, and there are no plans currently to make any changes, with the exception of the wildlife management areas. The WMAs listed as floodings were originally established by the DNR in the mid-1900s for the purpose of managing waterfowl and furbearer habitat. As such, many of these areas have dam infrastructure between 50 and 100 years old and past the intended project life of the structure. As these undergo administrative review by Wildlife Division, dam rehabilitation (restoration or removal) decisions are made, which is a process outside the scope of this plan. However, removal of dam infrastructure often necessitates removal of the WMA designation, resulting in fewer WMAs now than in the previous decade, and this trend is likely to continue.

Desired future condition, objectives and management actions

A network of areas with targeted habitat management for featured species and hunting recreation is integrated into the state forest to provide diverse and sustainable opportunities for hunting, incorporating climate change adaptation approaches to ensure sustained food and cover resources.

Objective 1. This planning period, manage designated hunting areas in line with featured species management objectives that incorporate climate change adaptations and forest sustainability.

- Action 1. Manage for landscape resiliency through plant species diversity and complexity to ensure sources of food, cover and water are maintained.
- Action 2. Where there are genetic diversity concerns for certain wildlife species, identify designated areas that may be prioritized to increase connectivity for genetic exchange or conservation of trailing- or leading-edge species.
- Action 3. Identify designated areas that may facilitate movement corridors, especially north to south along climate gradients.
- Action 4. Ensure master plans for all eligible properties align with state forest planning frameworks for harvest, forest health, climate change and monitoring, and are implemented through the compartment review process.

Objective 2. Routinely consider climate change adaptations for improving access to areas managed for hunting, incorporating nontraditional and adaptive accessibility approaches for different user groups.

- Action 1. Strategically locate and promote accessible hunting blinds on state game areas as feasible and appropriate.

- Action 2. Assess forest roads, parking areas and trails that provide access to areas for hunting, for how they contribute to habitat fragmentation and for how they are positioned in relation to waterways and the need for culvert size upgrades at crossings in response to likely increases in high-water days and flooding events.
- Action 3. Routinely monitor for forest health issues, resource damage or erosion and take corrective action incorporating climate change adaptations as needed.

Objective 3. Within the planning period, clearly communicate to the public about areas where wildlife management and hunting recreation are the overriding management values.

- Action 1. Routinely record any changes to areas managed for hunting in the Mi-HUNT mapping application.
- Action 2. Ensure website content is accurate, up to date and user-friendly.
- Action 3. Maintain onsite kiosks with information, maps, etc., at GEMS.
- Action 4. Identify nontraditional user groups and tailor communication strategies to better engage their participation.

Climate change

All climate change data and information listed herein is pulled directly from the open-source Northern Institute of Applied Climate Science Climate Change impacts tool and adaptation workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium and limited) and agreement (high, moderate and low) described in the predicted impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the adaptation approaches. For more information, go to NIACS.org.

Predicted impacts relevant to areas managed for hunting

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Increase in temperatures, with more warming in winters.	Robust	High	Changing temperatures could impact animal behavior and hunting success.
Reduction in winter snowpack.	Robust	High	Reduction in snowpack could impact animal behavior and hunter access/success.
Many invasive species, insect pests and pathogens increasing or becoming more damaging.	Limited	High	Increase in pests and disease impacting wildlife populations and habitat, especially locally.

Adaptation approaches

In future climates, variable responses by wildlife will be based on both climate conditions and the variable responses of plants and vegetation communities. Promoting diversity in plants, communities, and age and physical structure will boost landscape resiliency and will help ensure maintenance of food

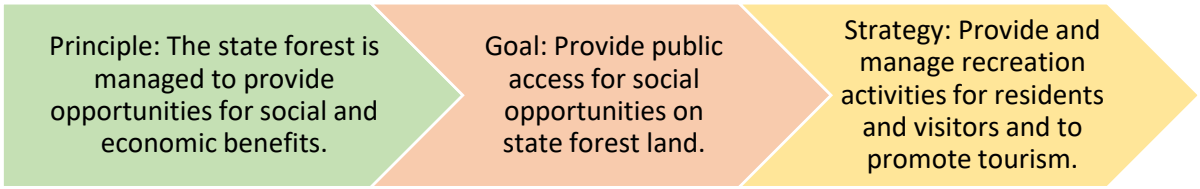
and cover resources for wildlife. Evaluating how designated hunt areas can provide refugia (areas predicted to have relatively stable local climate conditions that act as safe havens), connectivity or movement corridors along climate gradients may be important to help wildlife adapt to a changing environment. Creating and updating master plans for eligible properties, and ongoing management in accordance with those plans, are important to ensure the maintenance of robust habitats with species and structural diversity that are capable of withstanding change. Monitoring for and managing erosion and other disturbances in both the designated areas and access points will become increasingly important. It is likely that use patterns may change in response to a changing climate, which will require monitoring over time and communication to hunters.

Monitoring

The following metrics have been identified for this management priority to track progress toward forest sustainability:

- Number of each area type.
- Acres by area type.

Management priority: State forest campgrounds



Why state forest campgrounds matter

State forest campgrounds fill an important niche in the range of camping opportunities offered on state land. The basic, rustic amenities provided fill a need between the highly developed modern campgrounds in state parks and dispersed camping on state land with no facilities. State forest campgrounds help manage the resource by concentrating use in designated areas. These areas are often located close to bodies of water, trails and other recreation opportunities, allowing people access to and immersion in natural spaces for extended periods. Camping provides important economic benefits to local communities, often in remote areas, and has been contributing to the quality of life for Michigan residents for generations.

Current condition and trend

State forest campgrounds are managed by the Parks and Recreation Division in partnership with the Forest Resources Division (with a few exceptions managed by local townships). PRD started overseeing operational management of state forest campgrounds and trails on state forest land beginning in 2012. After that transition, some campsites that had been previously closed were reopened. Since that time, the number of state forest campgrounds has remained relatively stable, with the majority located in the northern Lower Peninsula (Table 1). The facilities in each campground have also remained largely unchanged, with basic rustic amenities, such as a vault toilet, water supply, fire pit and picnic table. Houghton Lake State Forest Campground is an exception, with modern bathrooms. Seasonal closure dates vary, with some campgrounds open year-round (although the roads may not be plowed in winter, and water may not be available) and others open spring through fall/early winter.

There are 140 state forest campgrounds statewide, providing 2,644 sites (Figure 1 and Table 1). Of those, 13 campgrounds provide group sites (not included in the total number of campsites), 17 are open to equestrians and 29 are open to off-road vehicles for trail access. In addition, there are six rustic cabins located in the Little Presque Isle Recreation Area.

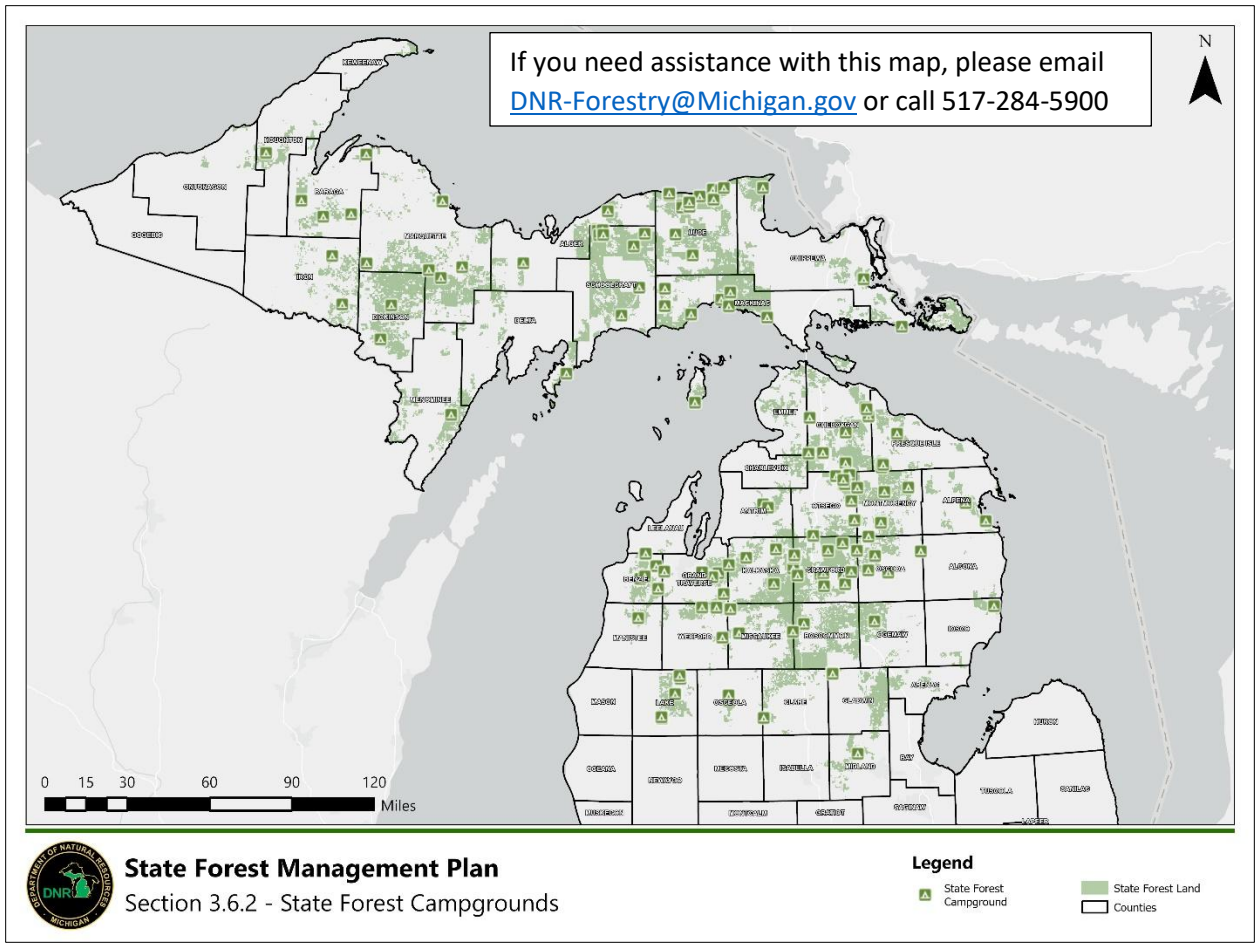


Figure 1. State forest campgrounds across the northern Lower Peninsula and the Upper Peninsula.

Table 1. Existing state forest campground facilities (2022).

Region	# SFCG	# Campsites	# Rustic Cabins	# Group Sites (Incl. Eq.)	# SFCG Open to Equestrians	# SFCG Open to ORV
NLP	90	1,798	0	13	15	22
EUP	34	590	0	0	1	2
WUP	16	256	6	0	1	5
Total	**140**	**2,644**	**6**	**13**	**17**	**29**

Most state forest campgrounds are operated on a first-come, first-served basis, with a limited number of reservations available at select sites. The remote nature of the campgrounds makes reservations difficult, and many users prefer the flexibility a nonreservable system offers. In recent years, use of these campgrounds has generally been trending up, in line with a general increase in outdoor recreation due in part to the COVID-19 pandemic. Between 2018 and 2022, occupancy nights across the state forest system increased by nearly 20% (Table 2). The occupancy nights were particularly high in 2020 and 2021, as people looked to outdoor recreation as relief from the pandemic, with numbers levelling off somewhat in 2022. Note that there was a fee increase from $17 to $20 in 2022.

Table 2. State forest campground occupancy (2018-2022).

	2018	2019	2020	2021	2022
Occupied Nights	73,606	77,190	101,147	110,546	99,747

Management focuses on routine operations and maintenance, with improvements made on an as-needed basis. Parks and Recreation Division completed some internal analysis and planning for state forest campgrounds in 2021. There are no plans to significantly change the number of these campgrounds or campsites available across the system, although some additional equestrian camping opportunities are being investigated in association with user groups.

Desired future condition, objectives and management actions

State forest campgrounds provide a distinctive, well-maintained, sustainable, rustic camping experience, located in a variety of settings that have minimal risk from climate change impacts throughout the state forest.

Objective 1. Within five years, clearly convey to the public information and expectations regarding the state forest campground program.

- Action 1. Update Recreation Search to include accurate description, mapping of amenities and photos of each state forest campground.
- Action 2. Create a mission statement that clearly defines the state forest campground program.
- Action 3. Increase awareness of the state forest campground webpage and expand information to include culture/type of campground, expected conditions, health and safety, etc.

Objective 2. Within five years, implement practices focused on keeping infrastructure safe, clean and functional, considering sustainable siting and design.

- Action 1. Complete an inventory of current infrastructure, including current condition, long-term vulnerabilities, etc., in state forest campgrounds.
- Action 2. Set standards and guidelines for infrastructure updates, such as vault toilets, fire rings, etc.
- Action 3. Review staffing plans and make improvements to better meet needs, considering potential shifts in use patterns due to predicted climate change impacts.
- Action 4. Ensure Americans with Disabilities Act standards are met, where applicable, for all upgrades.

Objective 3. Annually address issues that arise and consider efficiencies in operation for both staff and the public.

- Action 1. Update policies and rules as needed for safe, equitable and sustainable state forest campground use.
- Action 2. Make recommendations regarding technological advances for managing state forest campground registration/reservations.

Objective 4. Annually monitor and address environmental stewardship of state forest campground lands.

- Action 1. Ensure forest inventory and health data is shared between managing divisions to meet needs.
- Action 2. Address erosion and other forest health issues as they arise.

Climate change

All climate change data and information listed herein is pulled directly from the open-source Northern Institute of Applied Climate Science Climate Change impacts tool and adaptation workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium and limited) and agreement (high, moderate and low) described in the predicted impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the adaptation approaches. For more information, go to NIACS.org.

Predicted impacts relevant to state forest campgrounds

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results From Impacts
Increase in temperatures, with more warming in winters.	Robust	High	Heat stress for visitors and pets in summer. Increased use in shoulder seasons likely. Higher potential for users to seek out water access.

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results From Impacts
Intense precipitation events continuing to become more frequent.	Medium	Moderate	Flooding may impact access. Potential safety implications of intense storm events. Increased erosion.
Many invasive species, insect pests and pathogens in northern Michigan forests increasing or becoming more damaging.	Limited	High	Insect pests impacting user comfort. Increased threat to campground trees.

Adaptation approaches

State forest campgrounds provide a rustic experience for visitors. The DNR will continue to educate visitors about expected conditions, including potential for insect pests and necessary actions to protect trees from invasive species and prevent wildfires.

Infrastructure at state forest campgrounds is minimal, but standards and guidelines for infrastructure updates will include design and siting recommendations to minimize risks associated with disturbance events and other potential climate impacts. It is likely that use patterns may change in response to a changing climate, which will require monitoring over time. Staffing plans will take into consideration the potential for increased use in shoulder seasons.

Forest health and erosion monitoring will ensure prompt action as needed to address issues.

Monitoring

The following metrics have been identified for this management priority to track progress toward forest sustainability:

- Number of campgrounds open annually.
- Number of campsites available annually.
- Number of occupancy nights annually.

Land use and access

Management priority: Nonmotorized areas



Why nonmotorized areas matter

State forest land provides for many different levels of access and social activities. Designating areas where motorized recreation is restricted allows for quiet recreation and backcountry experiences, minimizes disturbance to wildlife and protects the environment from overuse or damage. Providing wild, undisturbed areas allows people to immerse themselves in nature and connect with the environment in traditional ways while also presenting a level of challenge and adventure. Nonmotorized areas may also have a specific focus, such as waterfowl management areas or be part of the Grouse Enhanced Management System, some of which also restrict motorized uses.

Current condition and trend

Non-motorized areas are designated through land use orders of the Michigan Department of Natural Resources' director. These may prohibit some or all motorized vehicles off of roads open to motor vehicle use, and in some areas such as the Sand Lakes Quiet Area restrict the launching of motorized boats. In other areas, land use orders specifically prohibit snowmobile use or restrict such use to designation trails. The compartment review process annually evaluates what roads are open or closed to all motor vehicles. Additionally, off-road-vehicle use is prohibited by lack of roads or closure of roads in accordance with Public Act 288, which requires that the DNR inventory and map all state forest roads and designate which roads are open and closed to ORV use.

Nearly 74,000 acres of state forest land has been identified for nonmotorized use (Table 1). Additionally, the use of motorized vehicles isprohibited by law in 6,503 acres of natural areas dedicated under Part 351 Wilderness and Natural Areas, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as discussed in section 3.2 of this plan. Of these areas, the majority are in the northern Lower Peninsula, where the heaviest public use occurs. These areas range from 1,000 acres to more than 20,000 acres in size, providing large tracts of land for quiet recreation.

Other large contiguous areas of the forest may be considered non-motorized due to distance from roads or motorized trails but are not currently designated, measured or tracked as nonmotorized areas. For example, there are 114,914 acres of designated Core Interior Forest Areas, as discussed in section 3.2 of this plan, which are roadless areas greater than 500 acres in size. They are identified as such to benefit wildlife species that require large contiguous forest areas for their habitat. There is no threshold, goal or objective for non-motorized areas at either the state or regional scales other than to continue to provide quiet areas for recreation and environmental protection.

Table 1. Designated Non-motorized Areas on state forest land (Source: Michigan DNR GIS).

Area	Forest Management Unit	Land Use Order	Acres
Northern Lower Peninsula	--	--	--
DeWard Tract	Traverse City, Gaylord, Grayling	4.9	4,441
Green Timber Management Unit	Pigeon River Country	4.34	6,258
Jordan River Valley	Gaylord	4.8	21,304
Kawkawlin Creek Flooding	Gladwin	4.32	2,742
Lame Duck Foot Access Area	Gladwin	4.20	11,376
Sand Lakes Quiet Area	Traverse City	4.25	2,996
Skegemog Lake Wildlife Area	Traverse City	4.24	2,421
LeGrande	Gaylord	4.13	2,401
NLP Subtotal	--	--	**53,939**
Upper Peninsula	--	--	--
Baraga Plains Waterfowl Management Area	Baraga	3.21/9.21	1,900
Little Presque Isle Property	Gwinn	4.30	3,134
Munuscong Wildlife Area	Sault Ste. Marie	4.14/9.21	14,700
UP Subtotal	--	--	**19,734**
Grand Total	--	--	**73,673**

Desired future condition, objectives and management actions

Areas of the state forest are protected and maintained for quiet recreation uses consistent with the resource values.

Objective 1: Throughout the planning period, track and change as necessary the types of protections for non-motorized and roadless areas to maintain and enhance backcountry experiences.

- Action 1. As necessary, field staff and resource divisions recommend updates or draft new land use orders or designations based on public interest and advocacy, or the sensitivity of natural resources to potential disturbance and degradation.

Objective 2: Annually review signage, barriers and other means of restricting access as well as public education on these restrictions to ensure compliance.

- Action 1. Develop and install signage consistent with land use orders.
- Action 2. Regularly inspect, maintain and replace signage and other means of restricting access as needed.

Climate change

All climate change data and information listed herein is pulled directly from the open-source Northern Institute of Applied Climate Science (NIACS) Climate Change Impacts tool and adaptation workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium, limited) and agreement (high, moderate, low) described in the Predicted Impacts table. Planning

strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the Adaptation Approaches. For more information, please go to www.niacs.org.

Predicted impacts relevant to nonmotorized areas

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Winter snowpack will be reduced from 30 to 80% by the end of the century	Robust	High	Higher use of non-motorized areas in late fall and early spring seasons

Adaptation approaches

Monitoring conditions, performing routine maintenance or upgrades, and accurate inventory of trail/stream crossings will increase resilience to climate change impacts.

Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Acreage of designated nonmotorized areas.
- Acreage of other roadless but non-designated nonmotorized areas.

Management priority: State forest roads



Why state forest roads matter

State forest roads are defined as DNR-controlled roads within state forest land, which provide access for management and recreational activities and often link to state, county or township public roads. State forest roads are intended to allow forest access for public use and enjoyment, including hunting, fishing and other recreational opportunities, timber and wildlife management, wildfire protection, law enforcement and emergency services. They also provide public access to private and corporate land where such legal rights are properly established. According to statute and State Land Administrative Rules, a forest road is defined as a "hard-surfaced road, gravel or dirt road, or other route capable of travel by a 2-wheel drive, 4-wheel conventional vehicle designed for road use. Forest Road does not include a street, county road, or highway."

The public uses forest roads as transportation routes to destinations such as a favorite camping, fishing or hunting spots, and as motorized and non-motorized recreation corridors for off-road vehicle, snowmobile, equestrian, biking and hiking use. The network of forest roads allows visitors to explore the 4 million acres of state forest land which would otherwise be largely inaccessible.

It is important to recognize that state forest roads can have a considerable environmental impact. Roads can result in habitat fragmentation, wildlife disturbance, soil compaction and degradation, sediment loading of streams and the introduction of invasive species. Therefore, balancing the desire for access with minimizing negative environmental impacts is important.

Current condition and trend

There are approximately 12,600 miles of state forest roads (Table 1), which are classified as primary or secondary forest roads or as forest access routes where the connectivity and conditions vary accordingly. Forest access routes, while they may be open to use, may not be promoted or maintained for recreational use due to condition.

Of the approximately 12,600 miles of state forest roads, the majority (over 90%) are open to ORV use (*Table 1*). With the passing of PA 288 in 2016, the DNR is required to inventory and map all state forest roads, indicating what is open and closed to ORV use. In 2018, the DNR launched an online map to provide an easy way for the public to actively review forest road status and to submit comments on the management of those roads. Mapping is an ongoing effort, with reviews completed on the ground by DNR staff as well as an in-depth review of public comments. Reasons for closure may include environmental or resource protection, user conflict, or other administrative or management reasons.

Most state forest roads are dirt or natural surface, with 641 miles being gravel or natural surface; only 22 miles are paved. The condition of natural surface roads varies considerably as the DNR has limited funding to conduct routine maintenance and emergency repairs. Major repairs often are associated with

stream crossings, and minor repairs are associated with incidental damage caused by routine use. The Forest Resources Division is in the process of inventorying the location and condition of road stream crossings throughout the entire state forest to help prioritize road maintenance needs. Increased stream flood flows are already occurring due to climate change and will likely cause an increase in the volume of repairs to improperly sized culvert and bridge structures.

Table 1. State forest road by ORV status, 2020-2022 (miles) (Source: Michigan DNR GIS).

ORV status	Length (miles) 2020	Length (miles) 2021	Length (miles) 2022
DNR roads open to ORVs	11,463.7	11,466.0	11,518.3
DNR roads closed to ORVs	565.2	556.2	561.6
Military roads open to ORVs	24.2	24.2	26.6
Military roads closed to ORVs	478.3	475.6	379.0
Military roads seasonally closed to ORVs	--	--	97.4
Seasonal DNR roads seasonal closures to ORVs	10.8	9.9	26.9
Total	**12,542.2**	**12,531.9**	**12,609.8**

Since 2018, only minor changes in the status of state forest roads have occurred, and this is expected to remain relatively stable over time. There is no threshold, goal or objective for the number and extent of state forest roads at either the state or regional scales other than to continue to review status on the ground and to consider public comment. In the future, a more detailed analysis is desired, tracking state forest road status in each region by density (miles per square mile). Any new road plans should carefully consider environmental impact and climate change risks, as well as the benefits of access.

Desired future condition, objectives and management actions

A network of forest roads providing adequate access to the state forest for management, resource protection, and recreation opportunities is classified by a robust inventory of roads and associated attributes, which considers environmental impacts and is guided by a newly developed state forest road plan.

Objective 1. Annually review proposed public access changes on state forest roads.

- Action 1. With public comment, review forest roads open and closed to ORV use in accordance with PA288.
- Action 2: Review internally generated comments and proposed public access changes.

Objective 2. Within five years, co-managing DNR divisions will complete plans and inventories to guide access and maintenance of state forest roads, with consideration of forest health and predicted climate change impacts.

- Action 1. Complete a forest road plan to ensure appropriate, sustainable, motorized and nonmotorized public access, including guidance for maintenance, road density, resource protection, inventory schedule, quality standards and mapping.
- Action 2. Complete a road-stream crossing inventory for state forest roads.

- Action 3. Develop a protocol for maintaining and updating the road-stream crossing inventory.

Objective 3. Annually perform priority maintenance to ensure appropriate, safe access and minimize environmental damage.

- Action 1. Complete highest priority culvert/bridge projects based on inventory and ensure future infrastructure is sized to allow for climate change impacts.
- Action 2. Perform maintenance such as grading, surface drainage and vegetation control on segments of the road system as priorities and funding allow.
- Action 3. Minimize public safety hazards during road maintenance activity via signs, temporary closure, or other means.

Objective 4. Continually ensure information regarding state forest roads is current and available to the public.

- Action 1. Maintain an up-to-date forest road inventory on the DNR website.
- Action 2. Provide information on temporary/emergency forest road closures.
- Action 3. Provide clear expectations for access for all newly acquired property.

Climate change

All climate change data and information listed herein is pulled directly from the open-source Northern Institute of Applied Climate Science (NIACS) Climate Change Impacts tool and adaptation workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium, limited) and agreement (high, moderate, low) described in the Predicted Impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the adaptation approaches. For more information, please go to www.niacs.org.

Predicted impacts relevant to state forest roads

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Winter snowpack will be reduced from 30-80% by the end of the century	Robust	High	Higher use in late fall and early spring seasons
Intense precipitation events will continue to become more frequent	Medium	Moderate	Flooding may impact access and exacerbate erosion

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Seasonal variation in soil moisture and altered precipitation may influence the magnitude and duration of flood events	Not identified	Not identified	Flooding may impact access and exacerbate erosion and damage to stream crossing infrastructure

Adaptation approaches

Forest roads are reviewed annually as part of the compartment review process to determine those that should be open or closed to ORV use. Closures (seasonal or permanent) or reroutes may be needed in the future if it becomes untenable to maintain roads subject to flooding or if environmental damage is increasing. A comprehensive state forest road plan is key to ensuring the system is well planned and supported within the context of predicted climate change impacts. Habitat connectivity will become increasing important, and this will require a careful evaluation of the state forest road network. Maintenance needs also are likely to increase and will be an important part of the plan. Culverts and bridges are particularly vulnerable to flooding events. The road-stream crossing inventory will allow staff to prioritize improvement projects and design them to be more resilient to flooding events, which minimizes erosion potential.

Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Miles of road by type by region, assessed every five years
- Density by type by region, assessed every five years

Management priority: Boating access sites



Why boating access sites matter

Michigan is renowned for its Great Lakes shoreline and thousands of inland lakes, rivers and streams. Motorized boating, paddling and fishing are popular recreation pursuits. They have provided a positive impact on quality of life for Michiganders for generations. They also benefit tourism and the state's wider economy. Michigan has more than 800,000 active watercraft registrations. In addition, non-registered activities such as canoeing, kayaking and paddleboarding have been growing in popularity. Boating is also one of the main ways to reach the state's fisheries, and fishing license fees provide vital revenue for DNR fish management programs. Boating access sites provide known, safe and reliable access points for public enjoyment, law enforcement and resource management. Providing defined boating access points also deters the public from creating other access points that can harm vegetation, soil, and water resources.

Current condition and trend

There are currently 214 boating access sites on state forest land, including motorized access and carry-down sites (Table 1). Of these, three are on the Great Lakes, 133 on inland lakes, and 78 on rivers or streams. Most boating access sites on state forest land are managed by the Parks and Recreation Division, with five sites managed by the Forest Resources Division. There are numerous other informal water access sites that may not be designated by signs, developed or maintained. Boating access sites vary from hard-surface ramps with sufficient water depth to accommodate all trailered watercraft to carry-down launching areas that are only suitable for smaller craft such as kayaks and canoes.

The DNR does not maintain a database of the number of boating access sites over time, so no trend data is available. A field review and verification of DNR's boating access site data is cin progress.

Table 1. Number of boating access sites by type and waterbody per region (Source: DNR GIS BAS types 1 through 4 within state forest compartments)

NLP	Great Lakes	Inland Lakes	River/Stream	Total NLP
Trailered boats (Ramp type 1, 2 and 3)	0	60	11	**71**
Carry down (Ramp type 4)	1	10	36	**47**
Total	**1**	**70**	**47**	**118**

EUP	Great Lakes	Inland Lakes	River/Stream	Total East UP
Trailered boats (Ramp type 1, 2 and 3)	1	15	7	**23**
Carry down (Ramp type 4)	0	5	5	**10**
Total	**1**	**20**	**12**	**33**

WUP	Great Lakes	Inland Lakes	River/Stream	Total West UP
Trailered boats (Ramp type 1, 2 and 3)	1	41	11	**53**
Carry down (Ramp type 4)	0	2	8	**10**
Total	**1**	**43**	**19**	**63**

Desired future condition, objectives and management actions

The state forest has a network of boating access sites managed and maintained to provide public access to the Great Lakes, inland lakes and rivers that are designed to accommodate fluctuating water levels while minimizing soil erosion and impacts on water quality and habitat.

Objective 1. Within three years, complete the inventory of developed and undeveloped boating access sites on state forest land.

- Action 1. Field staff review existing inventory and provide edits and omissions to program managers.
- Action 2. Develop a protocol for maintaining and updating the boating access site inventory.
- Action 3. Make inventory available to the public via a searchable web application, including expected site conditions, closures due to water levels or repairs and other relevant information.

Objective 2. Annually, prioritize capital improvement projects for boating access sites based on established criteria.

- Action 1. Parks and Recreation Division planning staff to complete the waterways “call for projects” for PRD-administered facilities in consultation with FRD staff as needed.
- Action 2. Administer improvement projects, incorporating best management practices, climate change adaptations such as siting and flexible design and Americans with Disabilities Act requirements as needed.

Objective 3. Develop new boating access sites in geographic areas or bodies of water with no or limited access, as opportunities allow.

- Action 1. Develop criteria to prioritize new boating access sites, including recreation value, sustainability and environmental impact.
- Action 2. Evaluate opportunities to acquire land with water access based on established criteria.

Climate change

All climate change data and information listed herein is pulled directly from the open-source Northern Institute of Applied Climate Science (NIACS) Climate Change Impacts tool and adaptation workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium, limited) and agreement (high, moderate, low) described in the Predicted Impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the adaptation approaches. For more information, please go to www.niacs.org.

Predicted impacts relevant to boating access sites

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Increase in temperatures, with more warming in winters	Robust	High	Increase in water related recreation, including boating
Intense precipitation events will continue to become more frequent	Medium	Moderate	Flooding may impact access and exacerbate erosion
Seasonal variation in soil moisture and altered precipitation may influence the magnitude and duration of flood events	Not given	Not given	Flooding may impact access and exacerbate erosion

Adaptation approaches

Updating the boating access site inventory will make it easier to identify issues that need to be addressed and to share information on expected conditions with the public via a searchable web application. This information may include periodic closures due to high or low water levels or unsafe conditions due to flooding. Improvement projects will incorporate resiliency to flooding and flexible design, where possible, to take changing water levels into consideration. They also will incorporate best management practices to minimize erosion. In some circumstances, relocation of infrastructure to less vulnerable locations may need to be considered. As the climate warms, desire for water access is likely to increase, therefore developing new, sustainable boating access sites as opportunities allow will help to relieve pressure on existing sites.

Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Number of boating access site by waterbody by region

Management priority: Boundary maintenance



Why boundary maintenance matters

State forest boundaries define the area in which natural resources are managed by the DNR for the use and enjoyment of the public. There are various ownership boundaries across Michigan, including state forest land, state parks, state game areas, federal lands and private lands. Managing and maintaining state forest boundaries helps ensure mutual respect for both public and private lands. Unresolved trespasses or unknown boundaries can erode public trust and the quality of the natural resources. Surveys help to identify and maintain boundaries in concentrated recreation areas and designated timber sales. They prevent activities on state forest land from encroaching on adjacent private lands and vice versa. Private land trespass onto state land can put the DNR in violation of upholding the purpose for the lands were purchased. This is important where state or federal wildlife funds were used to acquire the land. Maintaining boundaries is critical to resolve issues and help prevent new trespasses.

Current condition and trend

There are approximately 65 new trespass cases recorded each year based on a 10-year average from 2012 to 2021. The DNR has been closing 90 cases per year on average, based on the 10-year average. This indicates that DNR staff have been actively working to resolve outstanding and pending trespass cases (*Table 1*).

Table 1. Number of new trespass cases logged into the trespass tracking system and number of closed trespass cases for fiscal years 2012- 2021 (Source: DNR Trespass Tracking Database).

Fiscal Year	New Trespass Cases	Closed Trespass Cases
FY21	52	77
FY20	64	37
FY19	58	84
FY18	38	71
FY17	47	32
FY16	49	43
FY15	103	61
FY14	79	144
FY13	84	118
FY12	79	233
Total	**653**	**900**
Average	**65.3**	**90**
Median	**61**	**74**

On average over past 10 years, the DNR has closed about 38% more trespass cases than new ones logged. In 2012, the Department enacted a temporary policy (DNR Enforcement Resolution Initiative) that provided a mechanism to resolve a majority of structural and historical encroachments that existed on public land administered by the DNR. This helped reduce the number of pending trespass cases.

DNR field staff continue to find and document new encroachments, but trespass resolution is typically slow. Land survey capacity is a limiting factor when investigating and resolving a potential trespass. The DNR has a robust survey program. However, historically there are far more survey needs than there are resources to accomplish them. Currently there is no data on how many surveys are completed each year or how many miles of line or acres are affected by completed surveys.

If private land in northern Michigan continues to become more fragmented with a higher number of adjacent private landowners, the number of potential property line encroachments also is likely increase.

Desired future condition, objectives and management actions

A state forest with a well maintained and surveyed forest boundary with minimal encroachments that provides clear delineation of areas available for public use and enjoyment.

Objective 1. Continue to resolve trespass cases over the planning period.

- Action 1. Field staff work with the statewide trespass specialist to resolve cases.
- Action 2. Use trespass database to update and track case progress.

Objective 2. Annually update the trespass database with new cases and resolved cases.

- Action 1. Develop a dashboard for easy analysis of the data.

Objective 3. Continually survey any unsurveyed boundary lines.

- Action 1. Track the number of surveyed lines that are complete each year to quantify boundary maintenance.

Climate change

Climate change is unlikely to have an impact on this management priority.

Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Annual number of trespass resolutions
- Annual number of boundary surveys completed

Management priority: Land use permits, leases and easements



Why use permits, leases, and easements matter

State forest land is used for a variety of purposes outside of the general day-to-day activities of the public. The department my grant land use permits and leases under the authority of the Natural Resources and Environmental Protection Act (NREPA), 1994 PA 451, as amended, MCL Section 324.502. Applications are subject to a fee and are vetted through co-management reviews to determine their compatibility with department program goals and resource values. Land use permits can authorize nonexclusive use of state forest land for up to one year.

The majority of permits are important for commercial purposes. One example is a timber sale on private land requiring access across state land. Another is temporary workspace associated with utility construction. Longer-term uses are authorized under surface use leases. Typical examples include communication towers and pipeline substations.

The department may grant easements for public utilities over state lands under authority of the NREPA, MCL Section 324.2129 which include utility lines (such as pipelines or electrical lines), ingress and egress to private property, or to allow a county road commission to construct and maintain a public road. Easements may be granted where they provide necessary and beneficial public services and when conditions can be established to mitigate the impact on the natural environment, and when such uses are not in conflict with the primary use or purpose of the land.

Current condition and trend

Land use applications are typically received by the local forest management unit, then reviewed by all applicable co-managing DNR resource divisions. Permits include parameters or conditions (i.e., timing restrictions, reporting requirements, insurance, etc.). Easement applications are processed through the Real Estate Services Section and reviewed by co-managing DNR resource divisions. The Forest Resources Division monitors hundreds of existing permits, leases, and easements and processes more than 100 new land use-related applications each year. The DNR spatially tracks the progress of each permit and lease application using the Land Use Reviewer and Editor (LURE) application.

Desired future condition, objectives and management actions

Land use permit and lease applications are consistently reviewed and issued where they are determined to be consistent with the mission of the Department and consistent with the Department's and LAD's Management Plans.

Objective 1. Improve capability of, and data available, in land management tools, such as LURE and the Oil and Gas Review Editor (OGRE) over the planning period.

- Action 1. Continue to improve LURE and OGRE capabilities.
- Action 2. Continue to input data into LURE and OGRE by mapping new and existing land uses and work with industry and other state agencies in data sharing.
- Action 3. Train staff to use land management tools.
- Action 4. Develop a use permit and lease dashboard.

Objective 2. By the midpoint of the planning period, develop consistency across the state between management units on review and implementation of land use.

- Action 1. Incorporate LURE into DNR protocols and procedures.
- Action 2. Train staff on review and issuance of use permits, leases, and easements.
- Action 3. Update DNR easement policy and procedure.

Objective 3. Develop long term (archive) storage for land use documents.

- Action 1. Implement Document Manager database.
- Action 2. Transition statewide land use-related documents into database.

Climate change

Climate change is unlikely to have an impact on this management priority.

Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Annual number of issued land use permits
- Annual number of issued surface use leases
- Number of documents transitioned to long-term storage
- Reliable tracking of existing land use permits and leases

Forest products

Management priority: Timber harvest volume



Why timber harvest volume matters

The volume of timber harvested from the state forest is an important measure of the state forest's contribution to growing Michigan's $26.5 billion forest products industry. The state forest annually contributes a sustainable one-fifth of the total volume of timber used by Michigan's industry. Timber harvest volume in terms of tree species and product (sawtimber and pulpwood) and the stumpage prices that the Michigan Department of Natural Resources receives for these products through timber sales contracts generate about $49 million in annual revenue for the DNR. Of this total, about $44 million is annually deposited into the Forest Development Fund, which provides about 65% of the Forest Resources Division's annual operating budget.

Current condition and trend

Timber produced in the state forest is a function of acres prepared for harvest and volume per acre, and timber production is best characterized in terms of total acres prepared and harvested per year (Figure 1). The acres and volume of timber harvested are not directly controlled by the DNR once the timber is contracted and sold to loggers, but harvested acres generally track with a lag from the number of acres prepared. During good market conditions, producers tend to harvest more timber for delivery to mills. Conversely, when markets are poor, producers generally harvest less timber until markets improve. During the period from 2013-2018, the DNR prepared about 60,000 acres of timber per year. This higher level of production is attributed to an increase in salvage harvests in response to tree death caused by the emerald ash borer insect and beech bark disease. Since that period, the number of prepared acres has stabilized at about 50,000 acres per year.

During the period from 2000-2023, harvested volume has been increasing from about 700,000 standard cords in the early 2000s to more than 900,000 cords over the past few years (Figure 2). Over the same timeframe, the number of cords per acre harvested increased from 13.8 to 21.9 cords per acre, which is a function of a state forest that continues to recover and mature from the cutover state of its beginning more than a century ago.

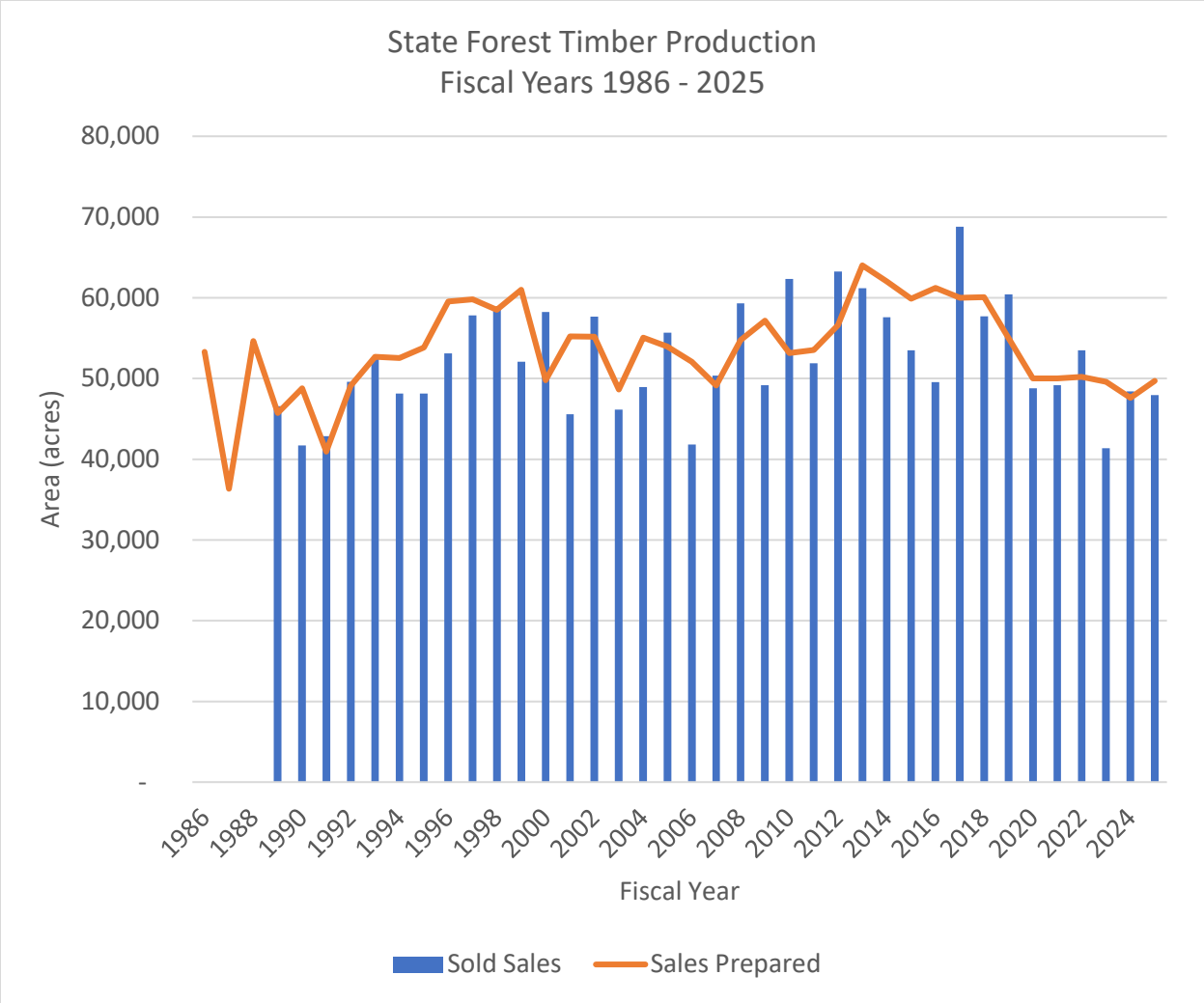


Figure 1. State forest prepared and harvested timber (acres) FY 1986-2023.

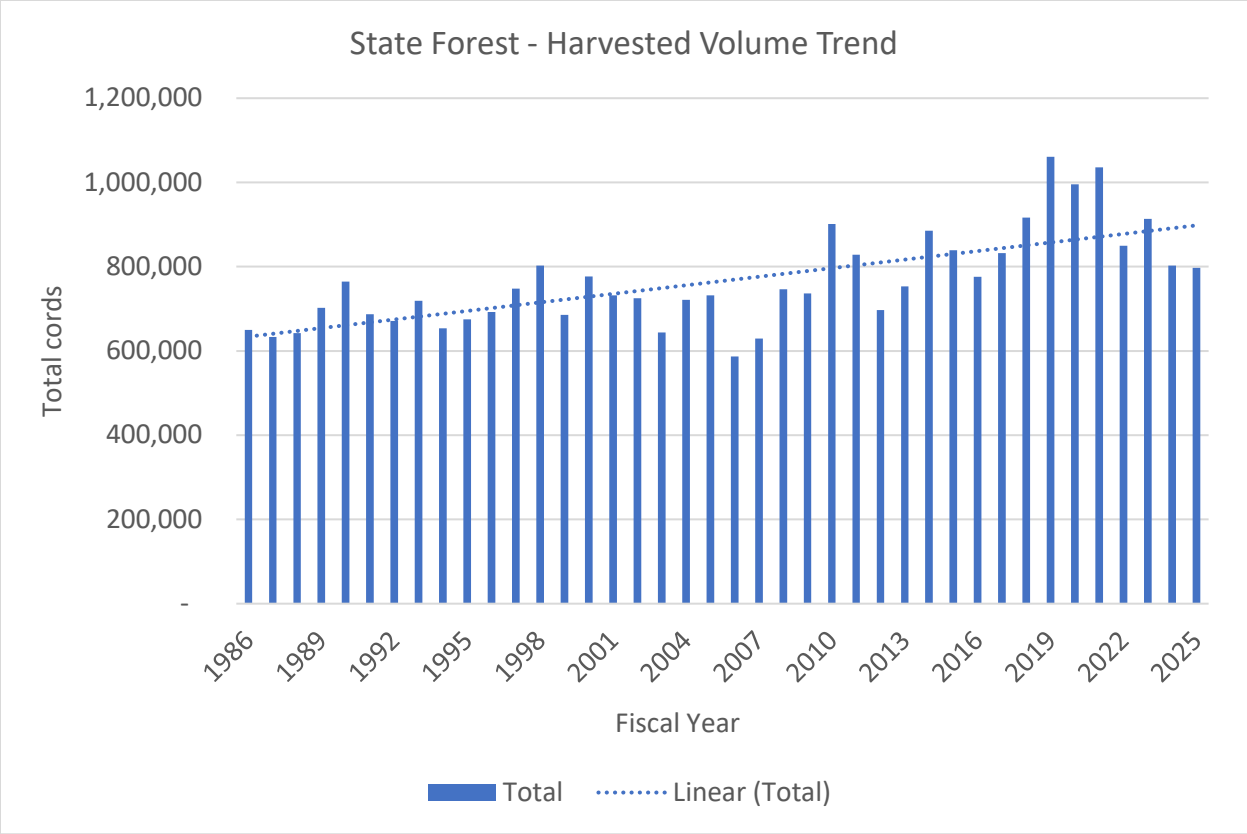


Figure 2. State forest harvested timber (cords) FY1986-2023.

Desired future condition, objectives and management actions

The number of prescribed acres is projected to continue at about 50,000 acres annually over the next decade (Figure 3). The increasing trend in the number of cords produced per acre is expected to eventually flatten, as forest productivity is not limitless. It is projected that harvested volume will stabilize in about 40 years (Period 4 in Figure 3) at about 1 million cords per year following recovery from the adverse impacts of the emerald ash borer, beech bark disease, and the 2025 ice storm damage.

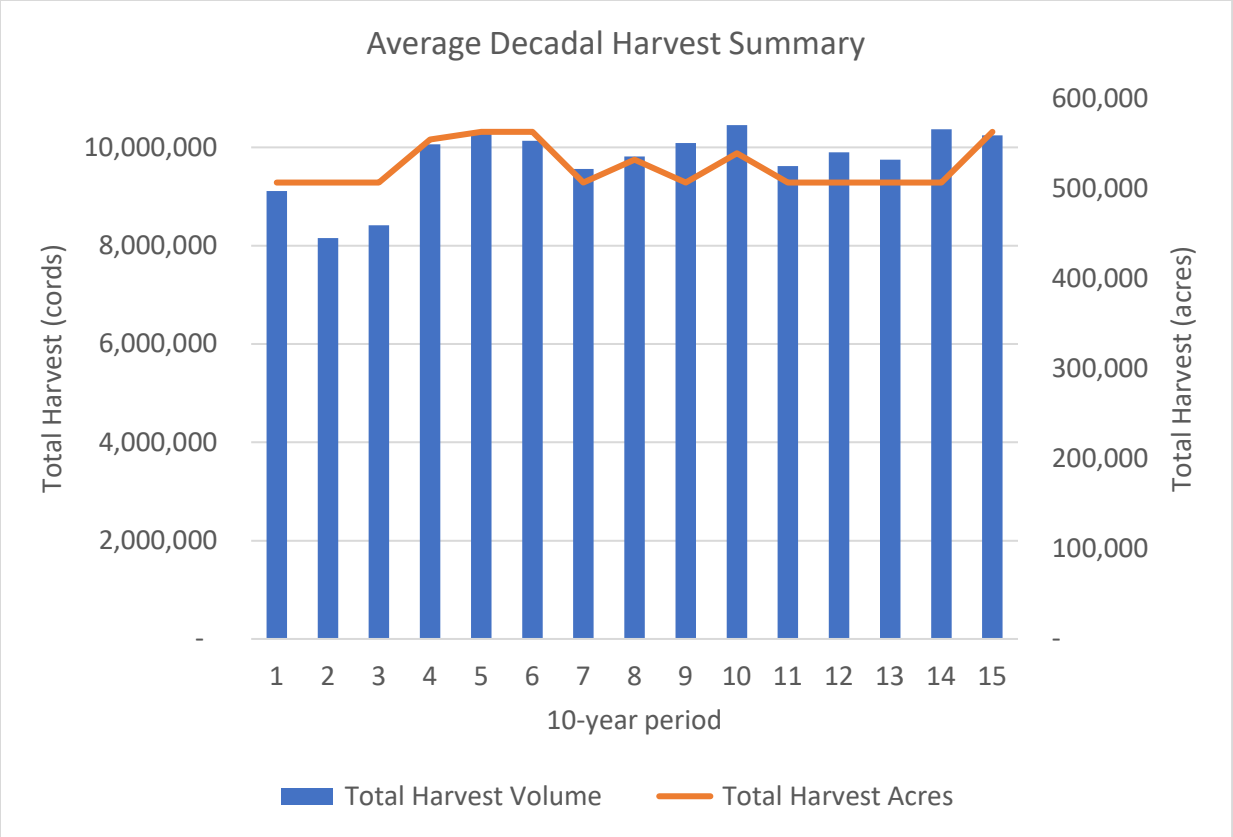


Figure 3. 150-year state forest harvest projection (acres and cords).

Objective 1. The DNR will annually prepare to harvest the number of acres identified by the SFMP implementation model for each year of entry.

- Action 1. Prescribe and implement timber harvest treatments through the annual forest inventory and compartment review process, consistent with management area goals and direction in the SFMP.
- Action 2. Timber harvests and regeneration treatments will facilitate balancing of forest type age and basal area classes, achieve natural and planted forest regeneration after timber harvest, and diversify forest composition with climate-resilient and adapted tree species.

Objective 2. The DNR will annually monitor the health and productivity of the state forest to ensure a sustainable timber harvest volume.

- Action 1. Conduct inventory of forest stands in current year of entry to detect any sign of decline in forest health and productivity related to possible climate-induced stress or native or non-native insects, diseases or invasive plants, especially those that may hinder regeneration after harvest.
- Action 2. Conduct forest health aerial surveys to identity any landscape-level decline in forest health and productivity related to possible climate-induced stress or native or non-native insects and diseases.

Climate change

All climate change data and information listed here is pulled directly from the open-source Northern Institute of Applied Climate Science (NIACS) Climate Change Impacts tool and Adaptation Workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium, limited) and agreement (high, moderate, low) described in the Predicted Impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the Adaptation Approaches. For more information, please go to NIACS.org.

Predicted climate change impacts upon timber harvest volume

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Northern Michigan temperatures will increase between 4°F and 10°F by the end of the century, with more warming during winter	Medium	High	Warmer temperatures will have cascading effects related to snowfall, snowpack, frozen ground, growing season length and seedling germination, all of which may affect the ability to manage some forested landscapes. Warmer conditions may have a positive impact on the growth of some species, while trees species predicted to decline in warmer conditions will suffer negative impacts relative to growth.
Fewer days of frozen ground	Medium	High	There will likely be less access to frozen ground for management activities. Forested lowland stands that cannot be managed will slowly decrease in growth and productivity.
Northern Michigan's growing season will increase by 30 to 70 days by the end of the century	Robust	High	Longer growing seasons could result in greater growth and productivity of trees and other vegetation, if balanced by available water and nutrients.
Northern Michigan soil moisture patterns will change, with drier soil conditions later in the growing season	Medium	Moderate	Droughts are major stressors on forests, and they can make trees more vulnerable to insect outbreaks and other impacts. Drought stress can weaken a tree's defenses to natural pest outbreaks reducing growth and productivity and elevating the risk of stand conversion to a non-forested condition.
Climate conditions will increase fire risks in northern Michigan by the end of the century	Medium	Moderate	Short term conversion of forested stands to non-forested conditions may occur where fire intensity is high enough to replace the stand. This will likely result in a reduction of forest growth.
Northern Michigan's boreal species will face increasing stress from climate change	Medium	High	Boreal and other northern forest communities and species at the southern extent of their natural range in Michigan will experience reduced suitable habitat and biomass. They may be less able to take advantage of longer growing seasons and warmer temperatures than temperate tree species and forest communities, resulting in depressed growth.

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Southern or temperate species in northern Michigan will be favored by climate change	Medium	High	Many temperate species will experience increasing suitable habitat and biomass across the assessment area, and longer growing seasons and warmer temperatures will lead to productivity increases for temperate forest types, resulting in more forest growth.
Northern Michigan's forest productivity will increase by the end of the century	Medium	Moderate	Model projections and other evidence support modest productivity increases for forests across northern Michigan under climate change, although there is uncertainty about the effects of carbon dioxide fertilization. Warmer temperatures are expected to speed nutrient cycling and increase photosynthetic rates for most tree species in the assessment area. Longer growing seasons could also result in greater growth and productivity of trees and other vegetation, if sufficient water and nutrients are available.
Low-diversity systems are at greater risk from climate change	Medium	High	Diverse systems exhibit greater resilience to extreme environmental conditions and greater potential to recover from disturbance than less diverse communities. This relationship makes less diverse communities inherently more susceptible to future changes and stressors, which may result in lower growth capacity in stands effected by stressors.
Tree regeneration and recruitment will change	Medium	High	Seedlings are more vulnerable than mature trees to changes in temperature, moisture, and other seedbed and early growth requirements; they are also expected to be more responsive to favorable conditions.
Many invasive species, insect pests, and pathogens in northern Michigan forests will increase or become more damaging by the end of the century	Limited	High	Warmer temperatures may allow some invasive plant species, insect pests, and pathogens to expand their ranges farther north. Northern Michigan may lose some of the protection offered by a traditionally cold climate and short growing season. Associated mortality can affect short and long-term timber volumes.

Adaptation approaches

Management actions that can mitigate and adapt to the potential impacts of climate change listed in the table include reducing the impact of biological stressors (invasive pests, diseases and herbivory), maintaining and enhancing stand species, genetic and structural diversity, and encouraging native species that are expected to be adapted to future conditions.

Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Annual forest inventory and aerial forest health surveys of the state forest to detect signs of forest health and productivity issues
- Each decade, effectiveness monitoring of continual forest inventory plots within state forest management areas, evaluation of revised growth and yield tables and remodeling and reporting of changes in projected production volumes from the DNR Remsoft Woodstock model
- One- and three-year regeneration surveys for planted stands and regeneration surveys typically during the next compartment inventory cycle for naturally regenerated stands

Management priority: Fuelwood



Why fuelwood matters

Fuelwood permits provide an opportunity for Michigan residents to pay a nominal $20 fee to collect firewood for personal use. A fuelwood permit allows a household to remove up to five standard cords of wood from trees and logging residue that is dead and lying on the ground. This process provides a lower-cost option for firewood and an opportunity to use a product from the state forest.

Current condition and trend

Through 2021, fuelwood permits were issued from local unit offices. Beginning in April 2022, personal use fuelwood permits became available through the DNR's online licensing system, with an optional mail-in permit application process also available. Records of fuelwood permit receipts are readily available, but the annual number of personal use fuelwood permits sold were not compiled in a database until 2022. Based on receipts over the period from 2014-2023, demand for fuelwood permits has declined by 56%. Free permits were provided during part of the year 2020 and for 2021 as part of the response to COVID-19. 1,500 fuelwood permits were sold in 2022, and 1,207 permits were sold in 2023. The amount of firewood that could be collected by permit holders in the impacted area was increased to 10 cords for at least 2 years in response to the ice storm that occurred in the north eastern lower peninsula in the spring of 2025.

Desired future condition, objectives and management actions

State forest fuelwood permits are issued for the benefit of people and the economy of the state without negatively affecting the sustainability of healthy ecosystems or other socioeconomic values.

Objective 1. Monitor the number and value of online and mail-in permits annually.

- Action 1. Use the DNR e-License system to gather data pertaining to online submissions and approvals.
- Action 2. Develop a mail-in permit tracking system.

Objective 2. Examine the risks of invasive species spread with fuelwood collection beginning in October 2024.

- Action 1. Work with invasive species specialist to identify areas that need restrictions or are at a high risk for the spread of invasive species transported by firewood.
- Action 2. Explore opportunities to include invasive species outreach and education efforts as part of the fuelwood permitting process.

Climate change

All climate change data and information listed is pulled directly from the open-source Northern Institute of Applied Climate Science (NIACS) Climate Change Impacts tool and Adaptation Workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium, limited) and agreement (high, moderate, low) described in the Predicted Impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the Adaptation Approaches. For more information, please go to NIACS.org.

Predicted impacts relevant to fuelwood

Predicted Climate Change Impacts	Impact Evidence rating	Impact Agreement rating	Potential Results from Impacts
Invasive species, insect pests, and pathogens will increase or become more damaging by the end of the century	Limited	High	Warmer temperatures may allow some invasive plant species, insect pests, and pathogens to expand their ranges farther north. Northern Michigan may lose some protection offered by a traditionally cold climate and short growing season. Movement of firewood increases the risk of spreading invasive species and disease.

Adaptation approaches

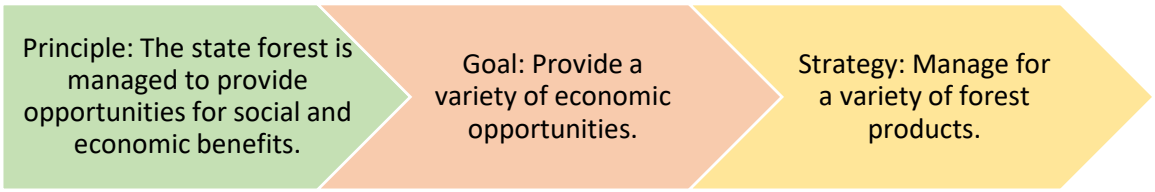
Invasive species, insect pests, and pathogens pose increased risks to the state forest and have the potential to be exacerbated with the movement of fuelwood. Increased efforts to track the number of permits and careful evaluation and consideration of areas with known invasive species occurrences may help reduce associated impacts from climate change.

Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Annual number of fuelwood permits
- Annual value of fuelwood permits

Management priority: Carbon offset credits



Why carbon offset credits matter

Michigan's forests provide natural and sustainable benefits including clean air and water, wildlife habitat, scenic places for recreation, renewable forest products and carbon storage. Carbon storage is achieved when trees absorb carbon dioxide gas from the air. A single mature tree can absorb 48 pounds of carbon annually. The Michigan state forest is a net carbon sink and carbon-offset credits are a means of measuring and monetizing the value of carbon emission reductions in the form of natural forest capital and ecosystem services. Industries that produce carbon emissions may purchase carbon offset credits, investing in forests as carbon sinks and produced durable forest products as carbon storage. Carbon offset credit projects support natural climate solutions on working forest lands. DNR carbon revenues are invested into sustainability, climate change adaptation and mitigation efforts, for example helping to fund a project to identify probable climate-adapted/vulnerable natural communities upon DNR-managed lands.

Current condition and trend

The DNR started the Big Wild Forest Carbon Project in 2020. It is the first carbon project in the nation on public forest lands using the voluntary American Carbon Registry, Improved Forest Management Methodology for Quantifying GHG Removals and Emissions Reductions through Increased Forest Carbon Sequestration on Non-Federal U.S. Forestlands, whereby carbon pools are monitored and verified in live above-ground trees, dead standing trees and durable wood products that are produced from harvested trees. This project is taking place on more than 100,000 acres of the celebrated Pigeon River Country State Forest known as "The Big Wild,". Project development was completed in 2022 with a project term of 40 years.

The success of the Big Wild project led the DNR to begin developing a second forest carbon project in 2022, titled the Wolverine-Copper Country Forest Carbon Project. This project is located on over 120,000 acres in the northern Lower and western Upper peninsulas, including the iconic Jordan River Valley and the remote and rugged tip of the Keweenaw Peninsula. Project development was completed in early 2024 with a 40-year project term.

DTE Energy purchased the first 10 years of carbon offset credits generated from the Big Wild Forest Carbon Project. Carbon offset credits generated from the Wolverine-Copper Country Forest Carbon Project are being marketed for sale by the DNR's carbon project developer.

Desired future condition, objectives and management actions

Management of state forest resources and the sale of carbon credits are intended to be complementary. Commercial timber harvests for forest products and wildlife habitat objectives are specifically compatible with forest carbon projects. Carbon projects do not appreciably affect timber harvest levels

from forests. Changes in forest management to specifically increase carbon sequestration and storage in DNR forest carbon projects are reflected in this management plan through:

- A shift to big tree management of some pine and northern hardwood forest in the Pigeon River Country Forest Management Unit.
- A shift to restoration silviculture (from the adverse impacts of emerald ash borer and beech bark disease) in the Wolverine and Emmet Moraines management areas.
- A cessation of timber management in the Keweenaw Management Area.

Any further changes in management will be driven by revisions to this State Forest Management Plan, which is updated every 10 years and subject to public review prior to approval and implementation.

Objective 1. Manage carbon project areas consistent with the age class, species diversity and harvest goals outlined in the Management Area sections of this plan to ensure forest and durable forest product carbon sequestration rates and storage capacity is undiminished throughout the planning period.

- Action 1. Prescribe and implement timber harvest treatments and achieve natural regeneration and/or planted reforestation objectives through the annual timber and reforestation plans of work.
- Action 2. Annually track and report timber harvest areas and volumes within the carbon project areas for verification of forest and durable forest product carbon sequestration and storage.

Objective 2. Annually monitor carbon project areas for forest pest, pathogen or wind/fire disturbances.

- Action 1. Annually track and report areas impacted by disturbance events for verification of changes in forest carbon sequestration and storage.

Objective 3. Explore expansion of current project areas through property acquisitions and future opportunities for additional carbon projects on other state forest lands throughout the planning period.

- Action 1. Perform afeasibility analysis on prospective areas to determine if a carbon offset project makes sense for the area.
- Action 2. Develop additional carbon offset projects where feasible and dependent upon the state of future compliance and voluntary carbon markets.

Climate change

All climate change data and information listed is pulled directly from the open-source Northern Institute of Applied Climate Science (NIACS) Climate Change Impacts tool and Adaptation Workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium, limited) and agreement (high, moderate, low) described in the Predicted Impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the Adaptation Approaches. For more information, please go to NIACS.org.

Predicted impacts relevant to carbon projects

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Northern Michigan temperatures will increase between 4°F and 10°F by the end of the century, with more warming during winter	Robust	High	Warmer temperatures will have cascading effects related to snowfall, snowpack, frozen ground, growing season length and seedling germination, all of which may affect the ability to manage some forested landscapes. Warmer conditions may have a positive impact on the growth of some species, increasing carbon sequestration rates and storage capacity. Tree species predicted to decline in warmer conditions will suffer negative impacts relative to carbon sequestration and storage.
Drought conditions will occur when increases in snowfall are offset by earlier snowmelt and decreased summer precipitation	Medium	Moderate	Droughts are major stressors on forests, and they can make trees more vulnerable to insect outbreaks and other impacts. Drought stress can weaken a tree's defenses to natural pest outbreaks, elevating the risk of stand mortality and resulting in lower carbon sequestration rates and storage capacity.
Climate conditions will increase fire risks in northern Michigan by the end of the century	Medium	Moderate	Short-term conversion of forested stands to non-forested conditions may occur where fire intensity is high enough to replace the stand and could consume organic material on the surface, reducing the regeneration capacity of the stand. This will likely result in short-term negative impacts on carbon sequestration rates and storage capacity.
Northern Michigan's boreal species will face increasing stress from climate change	Medium	High	Boreal and other northern tree species will experience reduced suitable habitat and biomass across the assessment area and may be less able to take advantage of longer growing seasons and warmer temperatures than temperate tree species and forest communities, resulting in lower carbon sequestration rates and storage capacity.

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Southern or temperate species in northern Michigan will be favored by climate change	Medium	High	Many temperate species will experience increasing suitable habitat and biomass. Longer growing seasons and warmer temperatures will lead to productivity increases for temperate forest types, resulting in higher carbon sequestration rates and storage capacity.
Low-diversity systems are at greater risk from climate change	Medium	High	Diverse systems exhibit greater resilience to extreme environmental conditions and greater potential to recover from disturbance than less diverse communities. This relationship makes less diverse communities inherently more susceptible to changes and stressors, which may result in lower carbon sequestration rates and storage capacity in stands affected by stressors.

Adaptation approaches

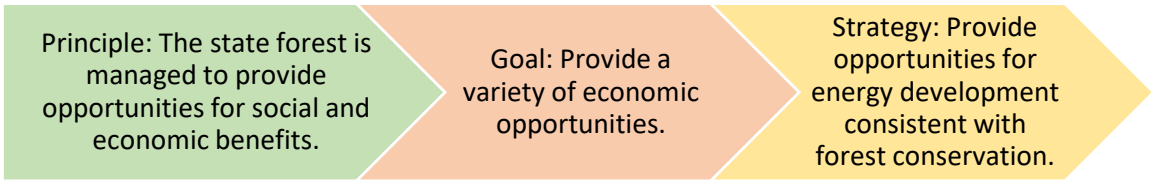
There are many adaptation strategies that can be applied to help Michigan's state forest maintain or improve its capacity to sequester and store carbon, making carbon offset projects possible. While most of these strategies are common management practices, others may be new approaches that need to be specifically applied in response to a changing climate, and may include extending rotation lengths, big tree management, and fuels reduction to decrease fire risk.

Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Annual implementation monitoring of a subset of continuous forest inventory plots and verification of generated offset credits within carbon project areas.
- Five-year effectiveness monitoring of all inventory plots in each carbon project area, remodeling (as necessary) and verification of total offset credits generated by the projects.
- Effectiveness monitoring of carbon project management areas every decade through remodeling and reporting of changes in total forest carbon stocks from the DNR Remsoft Woodstock model.

Management priority: Oil and natural gas



Why oil and natural gas matter

The state forest provides for the development of oil and natural gas resources for the benefit of people and the economy of the state without negatively affecting the sustainability of healthy ecosystems or other socio-economic values. Oil and gas development in the state forest causes adverse fragmentation of forest resources and was a subject of litigation in the 1970s and early 1980s. To mitigate the adverse impacts of oil and gas development, the Michigan Natural Resources Trust Fund was established in 1976 to receive royalty revenues from oil and gas development (and metallic and non-metallic mineral revenues from royalties and leases) where the State of Michigan holds mineral interests. It allocates distributions from the fund to support state and local government projects that increase public outdoor recreation opportunities, including the purchase of additional state forest land. As of December 2023, the fund has paid $1.3 billion to pay for projects in all 83 Michigan counties since its inception in 1976. The trust fund has reached it constitutional cap of $500 million and royalty revenues from oil and gas leases are now deposited into the State Park Endowment Fund, which in part funds the DNR Parks and Recreation Division. Its staff sustainably manages recreational infrastructure on the state forest. The State Park Endowment Fund balance reached $333.7 million in September 2023.

Current condition and trend

The state forest is zoned to provide opportunities for oil, natural gas and mineral development using the following classifications:

- **Non-Leasable** (NL): The NL category prohibits the leasing of a parcel's oil and gas rights. It is used when there are no means to adequately protect surface resources or when deed restrictions prohibit leasing.
- **Leasable Nondevelopment** (LND): Allows for a parcel's oil and gas rights to be leased, but it does not allow the parcel's surface to be used for oil and gas development without separate written permission from the DNR.
- **Leasable Development with Restriction** (LDR): This category allows for a parcel's oil and gas rights to be leased and also allows surface use after all necessary permissions have been obtained. In addition to standard lease provisions, LDR leases contain other specific restrictions (stipulations). Examples of such restrictions include development time restrictions within the Kirtland's Warbler habitat management area.
- **Leasable Development** (LD): The LD category allows for oil and gas rights to be leased and allows surface use after all necessary permissions have been granted. The Lessee must follow all standard lease provisions and obtain all necessary permissions before commencing surface activities.

There are currently 2,872 oil and natural gas leases and 18 natural gas storage leases on 400,651 acres of state forest land (Tables 1 through 3 and Figure 4) located only within the northern Lower Peninsula. There are currently 5,490 oil and gas production and gas storage wells on the state forest, of which 3,363 are still producing (Table 4). Oil and gas leasing activity is volatile and peaked during the October 2010 auction when 273,689 acres of new leases were awarded. The number of new oil and gas leases has been declining (Figure 5) since 2014. As old wells are plugged and abandoned, the oil and gas infrastructure must be properly removed and sites restored to their previous natural condition.

Table 1. Oil and gas leases where DNR's Forest Resources Division is the land administrating division by lease classification (2024 DNR Data).

Type of Lease	Number of Leases
Leasable Development	1,611
Leasable Development with Restrictions	493
Leasable Nondevelopment	768
Total	**2,872**

Table 2. Gas storage leases where FRD is the land administrating division by lease classification (2024 DNR Data).

Type of Lease	Number of Leases
Leasable Development	7
Leasable Development with Restrictions	8
Leasable Nondevelopment	3
Total	**18**

Table 3. Parcel classification for state forest leased for either an oil and gas production or gas storage (acres leased and not actual acres of surface impact; 2024 DNR Data).

Parcel Classification	Unknown Classification*	Development	Development with restrictions	Mixed Classification	Non-Development	Non-Leaseable	Total
Gas Storage	1,347	3,696	6,671	216	7,124	80	**19,135**
Oil and Gas	27,757	82,190	148,127	1,054	113,197	9,190	**381,516**
Total	**29,105**	**85,886**	**154,798**	**1,270**	**120,322**	**9,270**	**400,651**

*Unknown parcel classification represents legacy lease acres held by production that predate the current DNR parcel classification system.

Table 4. Oil and gas well production and gas storage sites on state forest land by field type and by the status of the well (2024 DNR Data).

Field Type	Active	Drilling Complete	Permitted Well	Plugged Back	Plugging Approved	Plugging Complete	Producing	Shut In	Temporarily Abandoned	Well Complete	Total
Gas	130	1	--	4	335	86	2,094	145	121	--	**2,916**
Gas Condensate	--	--	--	--	2	2	--	2	--	--	**6**
Gas Storage	68	--	--	--	6	7	--	--	--	--	**81**
Oil	113	--	--	8	810	40	1,269	45	201	1	**2,487**
Total	**311**	**1**	**0**	**12**	**1,153**	**135**	**3,363**	**192**	**322**	**1**	**5,490**

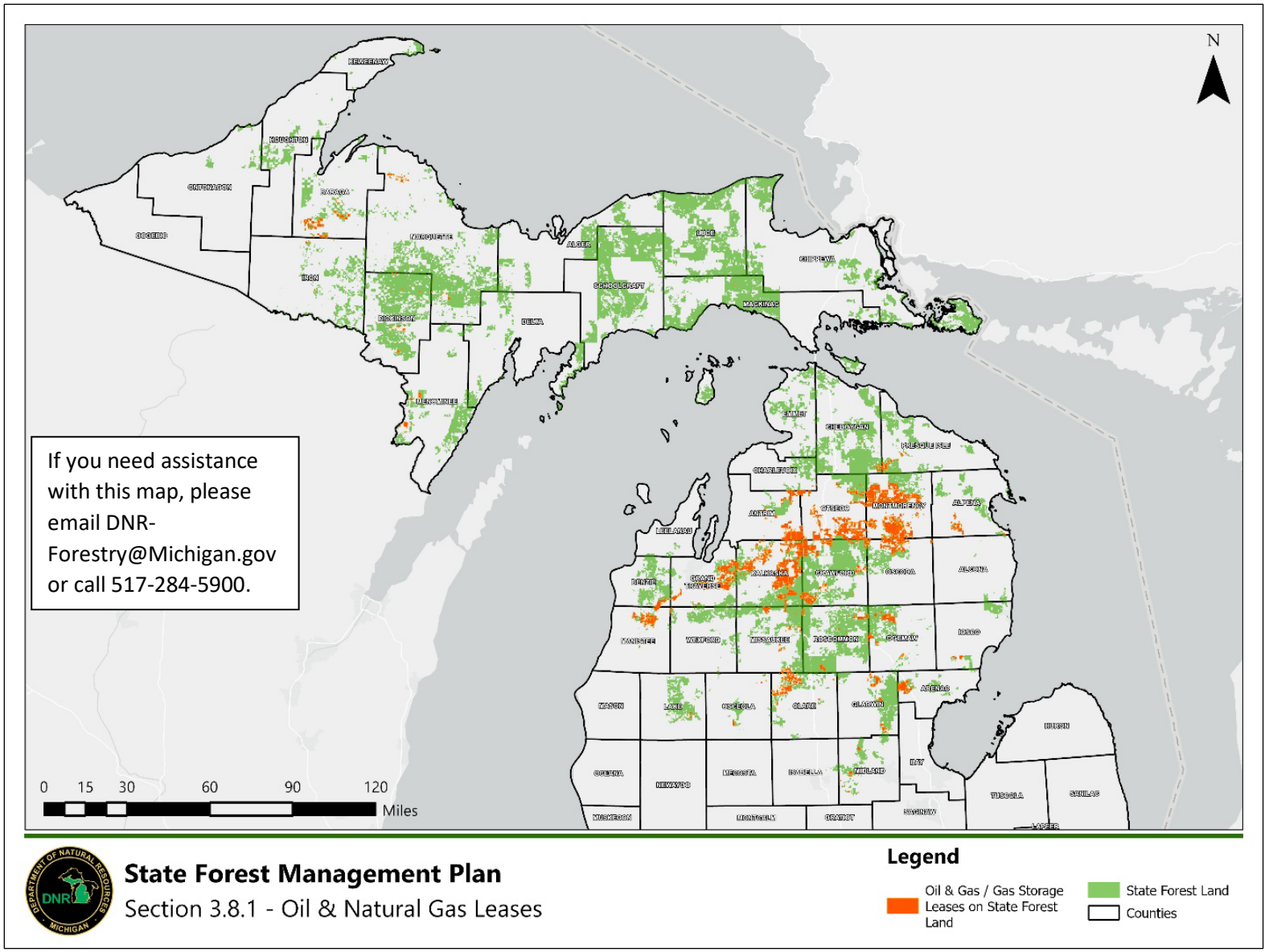


Figure 4. Oil and Gas Leases and Gas Storage Leases on State Forest (2024 DNR Data).

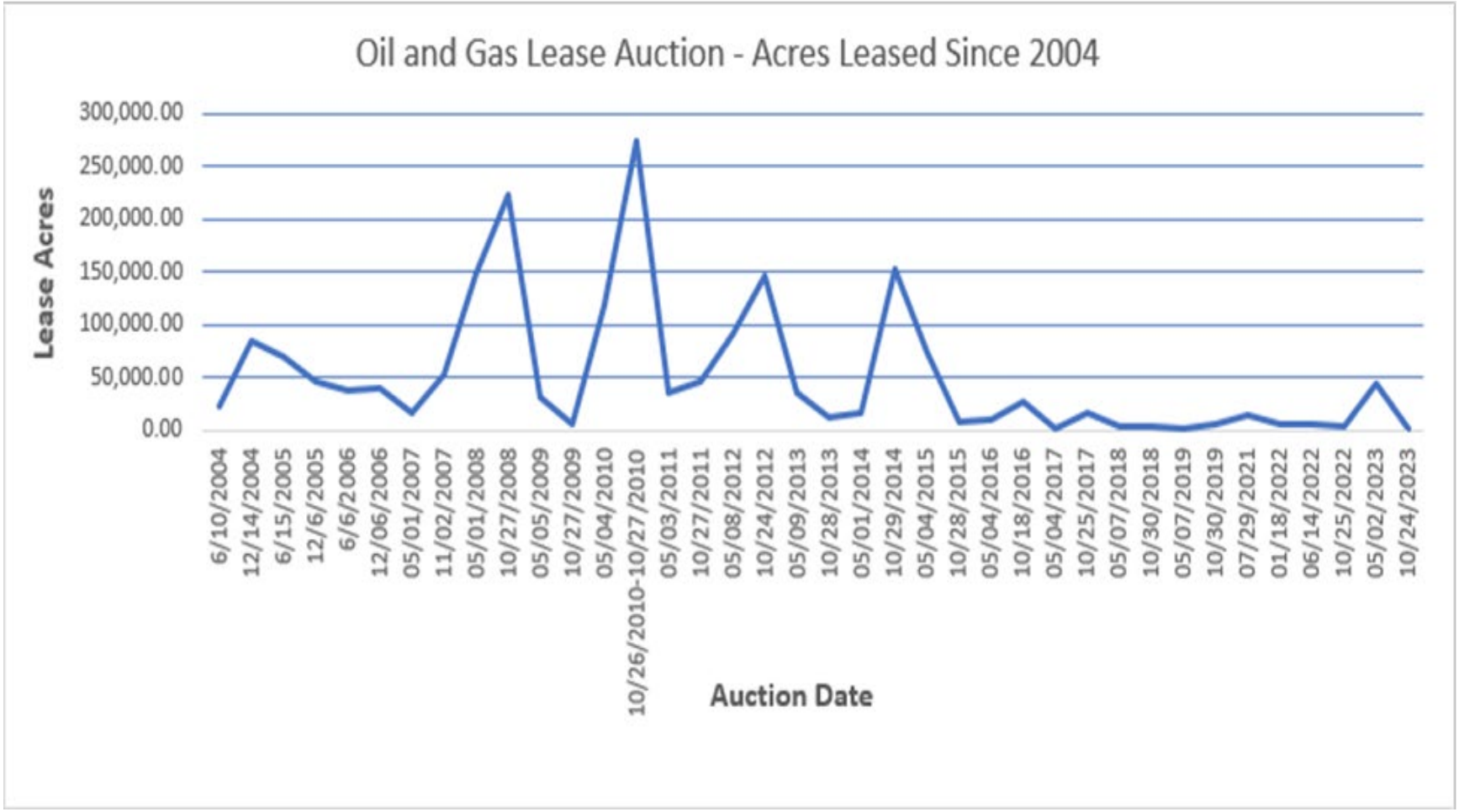


Figure 5. Oil and gas leases from 2004 to 2023 (acres).

Desired future condition, objectives and management actions

The state forest provides for the extraction of oil and gas resources for the benefit of people and the economy of the state without negatively affecting the sustainability of healthy ecosystems or other socioeconomic values.

Objective 1. Improve access to accurate data related to the area of state land used for oil and gas production.

- Action 1. Develop a spatial database to track and report the area of state land developed for oil and gas production and the number of well site permits.
- Action 2. Assess accuracy of current lease and permit holders and ensure that needed reassignments of responsible parties are completed.
- Action 3. Use the Opportunistic Field Survey protocol or another data collection system to allow for more specific spatial data collection regarding oil and gas sites.

Objective 2. Ensure rehabilitation of plugged and abandoned oil and gas well sites.

- Action 1. Direct responsible lease and use permit holders to properly restore well sites in accordance with lease and permit requirements, specifically to restore sites for the provision of timber, wildlife habitat and/or recreation, including remediation of any invasive species.
- Action 2. Provide DNR funding sources for staff or contractors' work to properly restore well sites where there is no responsible party.
- Action 3. Verify restoration work has been completed in accordance with conditions of leases and site permits.

Climate change

All climate change data and information listed here is pulled directly from the open-source Northern Institute of Applied Climate Science (NIACS) Climate Change Impacts tool and Adaptation Workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium, limited) and agreement (high, moderate, low) described in the Predicted Impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the adaptation approaches. For more information, please go to www.niacs.org.

Predicted climate change impacts relevant to oil and natural gas

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Increased fire risks in northern Michigan by 2100	Medium	Moderate	Potential physical damage to oil and gas infrastructure from wildfire in higher fire-risk landscapes.

Adaptation approaches

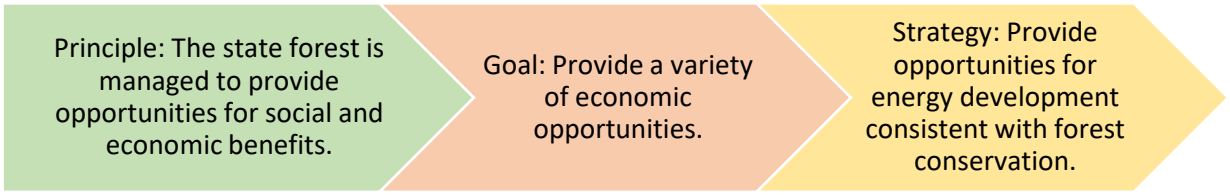
Hazardous fuels reduction is the most prudent adaptation strategy to mitigate potential wildlife risk to oil and gas infrastructure.

Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Annual implementation monitoring of the number of oil and gas leases and number of lease and use permit reassignments.
- Annual implementation monitoring of the number and acres of properly plugged, abandoned and restored oil and gas well sites.
- Effectiveness monitoring of natural vegetation establishment on restored oil and gas well sites.

Management priority: Renewable energy



Why renewable energy matters

The 2022 Michigan Healthy Climate Plan has goals to reduce greenhouse gas emissions 28% below 2005 levels by 2025, 52% below by 2030, and to achieve economy-wide carbon neutrality by 2050. As of 2019, the energy production sector is the single largest source of emissions in Michigan at 58.2 million metric tons of CO2 equivalent each year. Given that the carbon footprint of solar energy is about 20 times less than that of coal-generated electricity, a key strategy of the climate plan is to site solar energy on state-owned lands and properties as quickly as possible. The 2021-2027 DNR Public Land Strategy has a more-specific objective to develop a comprehensive inventory of DNR-managed public lands that are degraded, marginal or contain brownfields or postindustrial sites and market them for potential renewable energy development.

Current condition and trend

The state Renewable Energy and Energy Waste Reduction Act (PA 235 of 2023) requires Michigan electricity providers to achieve a 100% clean energy portfolio by 2040, which provides greater impetus for developing renewable energy on DNR-managed lands. There are currently two executed development leases for utility-scale solar energy development on 433 acres of state forest land. There are also active inquiries from developers for additional renewable energy developments on state forest land that have not yet progressed to the execution of a lease. At present, no small-scale renewable energy developments are associated with office buildings on state forest land.

Desired future condition, objectives and management actions

The state forest provides strategic opportunities for renewable energy projects to support Michigan's goal of providing all power from clean sources by 2040, while minimizing impacts to the sustainability of healthy forested and non-forested ecosystems, wildlife, recreational opportunities or other socio-economic values.

Objective 1. Identify the suitability of state forest land and associated facilities for renewable energy development.

- Action 1. Within one year, DNR renewable energy development teams will complete development of DNR utility-scale renewable energy siting guidance (with preference for non-exclusive use of degraded/brownfield sites) and best management practices for solar and wind energy development.
- Action 2. Quantify and track areas of state forest suitable for utility-scale renewable energy development through 2040, striving to minimize, but likely not totally avoid, impact to forested land.

- Action 3. Assess and prioritize facilities on state forest land for behind-the-meter renewable energy development.

Objective 2. DNR renewable energy development teams pursue development of renewable energy projects on state forest lands through 2040.

- Action 1. Issue requests for proposals for small and utility-scale renewable energy projects, aligned with the siting guidance in Objective 1.
- Action 2. Evaluate and adjudicate industry proposals.
- Action 3. Execute renewable energy development and surface-use leases for new renewable energy projects. Include requirements in development and surface use leases for use of native land cover and monitoring and control of invasive plant species.

Objective 3. Track and quantify the number, size and energy capacity of renewable energy projects located on state forest land through 2040.

- Action 1. Maintain accurate records of utility-scale renewable energy development and surface-use leases in the DNR Landowner Tracking System.
- Action 2. Maintain records of small-scale renewable energy development projects located at office facilities on state forest land.

Climate change

All climate change data and information listed here is pulled directly from the open-source Northern Institute of Applied Climate Science (NIACS) Climate Change Impacts tool and adaptation workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium, limited) and agreement (high, moderate, low) described in the Predicted Impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the adaptation approaches. For more information, please go to www.niacs.org.

Predicted impacts relevant to renewable energy (solar)

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Increased fire risks in northern Michigan by 2100	Medium	Moderate	Potential physical damage to renewable energy infrastructure from wildfire in higher fire-risk landscapes.

Adaptation approaches

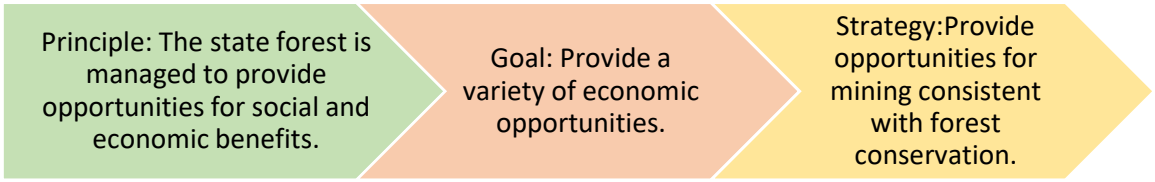
Hazardous fuels reduction is the most prudent adaptation strategy to mitigate potential wildlife risk to renewable energy infrastructure.

Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Implementation monitoring of the number of executed surface-use leases for utility-scale renewable energy development on state forest land.
- Implementation monitoring of the number of small-scale renewable energy development projects located at office facilities on state forest land.
- Effectiveness monitoring of DNR contribution (megawatt capacity) to statewide achievement of 100% public utility renewable energy generation by 2040.

Management priority: Metallic minerals



Why metallic minerals matter

Metallic minerals are necessary for many products that the modern economy and the public demand, such as steel in automotive frames and nickel in automotive batteries. Extraction of these minerals provides a variety of direct and indirect economic benefits to the state of Michigan and local units of government, including royalties to the state, local taxes to county and township governments, and employment associated with the production and processing of metallic minerals and the secondary manufacture of products derived from them.

Current condition and trend

Michigan has a long history of metallic mineral production, including copper, iron, and gold. In 2019, Michigan produced 13.7 million metric tons of copper, 7.8 million metric tons of iron, and 13.5 million metric tons of nickel, valued at more than $873 billion (excluding withheld data for nickel).

All metallic mineral leases on state forest land are in the western Upper Peninsula (*Figure 7*). There are 122 active metallic mineral leases on about 33,299 acres of state forest land (*Tables 5 and 6*), with approximately 7,797 acres currently in the review process.

There has been a significant increase in the demand for metallic minerals. Approximately 70% of the current metallic mineral leases encompassing state forest land have been issued in the last five years. This increase is largely driven by the demand for high-grade battery materials, an indirect effect of climate change. Globally, climate change is driving transitions to renewable sources of electrical power generation and electric vehicles. These transitions necessitate new battery storage technologies, which is (in part) driving increased demand for metallic minerals critical for the manufacture of batteries.

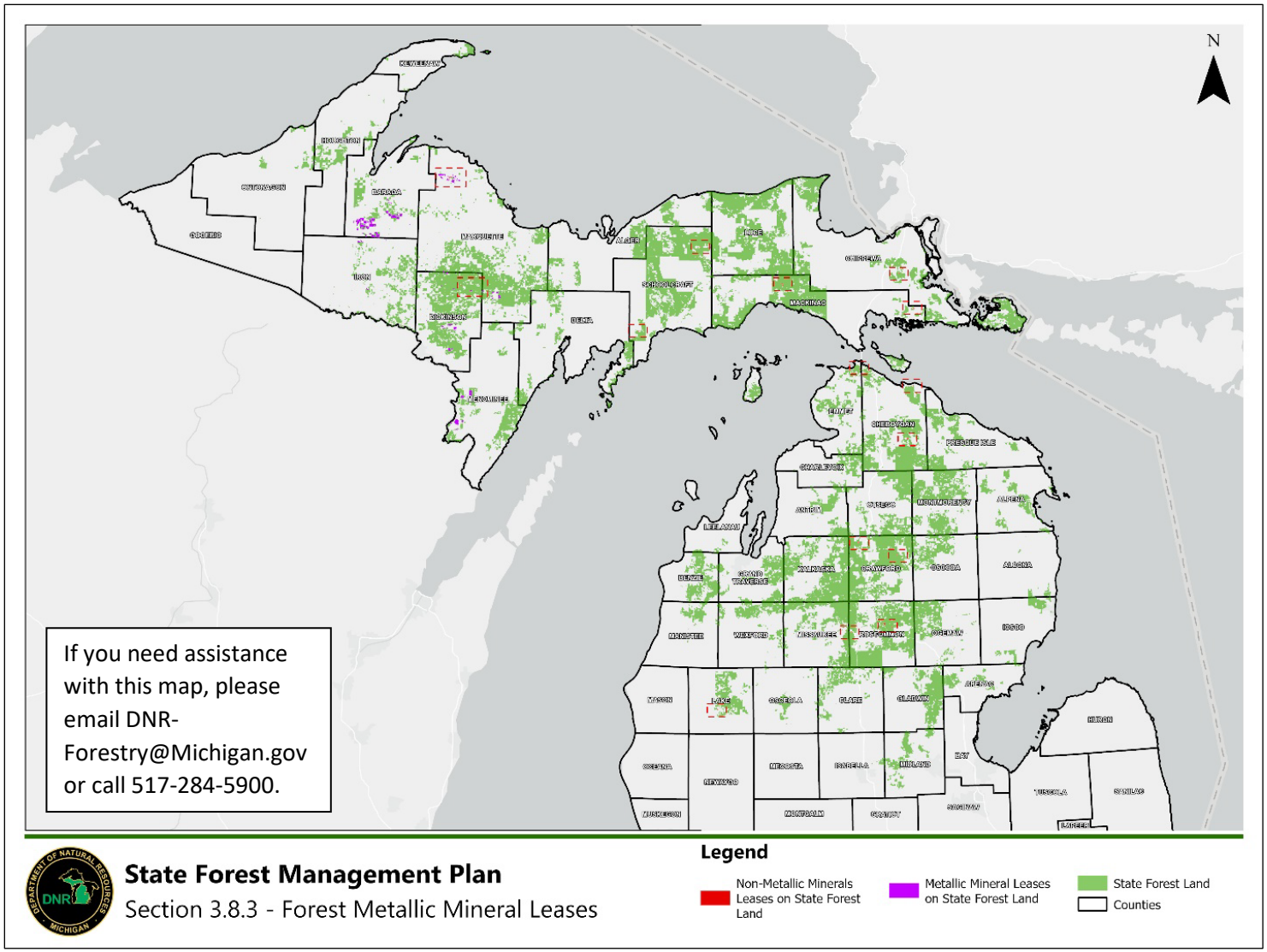


Figure 5. Location of current state forest metallic mineral leases.

Table 5. Number of state forest metallic mineral leases by lease classification and lessee (March 2024 DNR Data).

Lease Category	Robert Mahin	Eagle Mine LLC	Aquila Resources USA, Inc.	Back Forty Joint Venture LLC	Weyerhaeuser Company	Keweenaw Land Association, Limited	Talon Michigan LLC	Total
Leasable Development	--	15	--	--	3	15	2	**35**
Leasable Development with Restrictions	12	3	7	4	6	12	33	**77**
Leasable Non-Development	5	2	2	--	--	--	1	**10**
Total	**17**	**20**	**9**	**4**	**9**	**27**	**36**	**122**

Table 6. Acres of state forest with metallic mineral leases by lease classification and lessee (March 2024 DNR Data).

Lease Category	Robert Mahin	Eagle Mine LLC	Aquila Resources USA, Inc.	Back Forty Joint Venture LLC	Weyer-haeuser Company	Keweenaw Land Association, Limited	Talon Michigan LLC	Total
Leasable Development	630	3,544		160	240	451	120	**5,145**
Leasable Development with Restrictions	4,620	280	1,548	619	1,475	3,684	14,933	**27,159**
Leasable Non-Development	475	80	80				360	**995**
Grand Total	**5,725**	**3,904**	**1,628**	**779**	**1,715**	**4,135**	**15,413**	**33,299**

Desired future condition, objectives and management actions

The state forest provides for the extraction of mineral resources for the benefit of the people and the economy of the state without negatively affecting the sustainability of healthy ecosystems or other socio-economic values.

Objective 1. Leases for extraction of metallic minerals from state forest land are issued when it is determined that adverse impacts to sensitive natural or cultural resources can reasonably be avoided or mitigated.

- Action 1. Prior to lease conveyance, a thorough review of the nominated area is completed by resource specialists for potentially sensitive natural and cultural resources.
- Action 2. Local Tribes are consulted prior to lease conveyance.
- Action 3. Nominated parcels are classified appropriately, considering known (and unknown) information regarding natural and cultural resources.

Objective 2. Improve process for rehabilitation and use of state forest land upon expiration of metallic mineral leases where exploration or mining activities occurred.

- Action 1. Incorporate DNR-approved site restoration plans into development leases.
- Action 2. Prior to lease closure, work with the responsible party to restore formerly leased areas for provision of timber, wildlife habitat and/or recreation, including remediation of any invasive species.
- Action 3. Consider opportunities for alternative uses of formerly leased lands that are not suitable for timber management or wildlife habitat.

Climate change

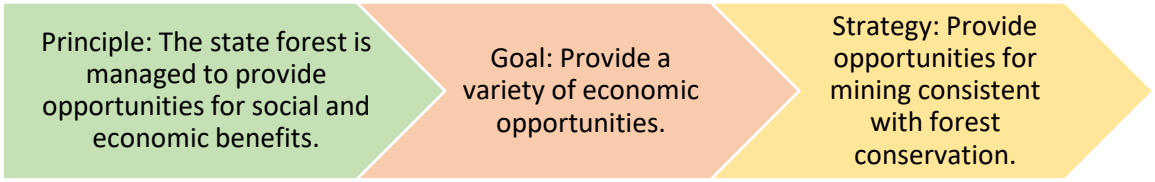
Climate change is unlikely to have an impact on this management priority.

Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Number of state forest metallic mineral leases
- Area of state forest land leased for metallic minerals
- Volume/tonnage of mineral extracted by type

Management priority: Non-metallic minerals



Why non-metallic minerals matter

Although at relatively small scale, sand and gravel extraction provides economic opportunities for DNR work on small road projects and for contractors/cooperators who have been granted leases to extract material from geographically distributed sand and gravel pits located on state forest land. Locally available sand and gravel resources are essential as it is cost prohibitive to transport aggregates for long distances. Other non-metallic minerals such as potash are a valuable commodity essential for Michigan's agricultural and other industries.

Current condition and trend

The are 23 current leases for non-metallic mineral on 1,707 acres of state forest land, which are mostly issued to county road commissions and excavation/construction companies for sand, gravel and clay aggregates (Table 7). Non-metallic mineral development does not always involve a lease. For example, in 2015, the DNR exchanged about 1,000 acres of state forest land in Mackinac County to Graymont (MI) LLC for development of a new limestone quarry. There is potential for a potash mine impacting state forest land near Alpena, but no project has progressed to the stage of development. The number of non-metallic mineral leases are too few in number to provide any discernible trend.

Table 7. Non-Metallic Mineral leases on state forest land by Lessee and Lease Classification (July 2024 DNR Data).

Lessee	Leasable Development	Leasable Development with Restrictions	Acres
Crawford County Road Commission	2	1	171
Darrow Brothers Excavating, Inc.	1		80
Dickinson County Road Commission		3	120
Eagle Mine LLC		1	240
Island Contractors, Inc.		1	15
Mackinac County Road Commission	3	1	422
Michigan Potash Company, LLC		1	40
Ontonagon County Road Commission	1		40
Payne & Dolan, Inc.	1		79
Rieth-Riley Construction Co., Inc.	3		359
Roscommon County Road Commission	1		40
Schoolcraft County Road Commission	2		80
Total	**14**	**8**	**1,687**

Desired future condition, objectives and management actions

The state forest provides for the extraction of non-metallic mineral resources for the benefit of people and the economy of the state without negatively affecting the sustainability of healthy ecosystems or other socio-economic values.

Objective 1. Provide for sand and gravel mining by DNR staff, county road commissions and excavating/construction companies to enable construction and maintenance of road infrastructure for access to the state forest.

- Action 1. Issue surface use leases for non-metallic mineral production where there is no significant adverse impact upon natural resources.
- Action 2. Include a requirement in surface use leases to address monitoring and control of invasive plant species.
- Action 3. Maintain the condition of sand and gravel pits to accommodate altered hydrologic processes and excessive surface runoff associated with increased seasonal intensity of precipitation events.

Objective 2. Ensure rehabilitation of played-out, non-metallic mineral developments.

- Action 1. Incorporate DNR-approved site restoration plans into development leases.
- Action 2. Direct responsible lease and use-permit holders to undertake work to properly restore non-metallic mineral development sites in accordance with lease and permit requirements.
- Action 3. Verify restoration work has been completed in accordance with conditions of leases and site permits.

Climate change

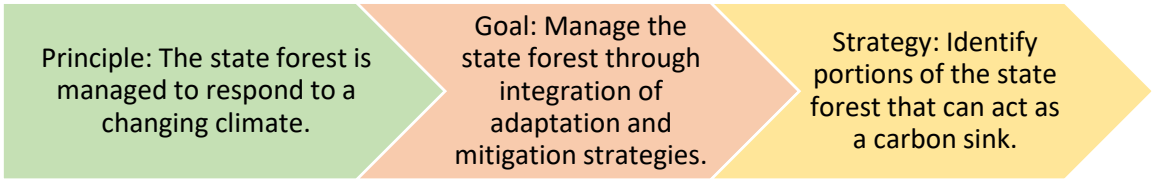
Climate change is unlikely to have an impact on this management priority.

Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Annual implementation monitoring of the number of non-metallic mineral leases and use permits.
- Annual implementation monitoring of the number and acres of properly restored non-metallic mineral sites.
- Effectiveness monitoring of the success of natural vegetation establishment on restored non-metallic mineral sites.

Management priority: Carbon capture utilization and sequestration



Why carbon capture utilization and sequestration matters

The Silurian-Niagaran and Antrim geological formations that underlie parts of the state forest in the northern Lower Peninsula have historically provided an opportunity for oil and gas development and production.

Production naturally declines over time for any hydrocarbon well. For some hydrocarbon reservoirs where primary production has declined but significant volumes of recoverable hydrocarbons remain in the reservoir, carbon dioxide or water can be injected into the reservoir to enable recovery of additional hydrocarbons. This avoids waste and increases revenue to the state. Past practice has often been to flare, or burn, natural gas (CH4) not sold from oil wells, releasing CO2 into the atmosphere. Moreover, Antrim wells produce some CO2 (in increasing amounts over time) in addition to the natural gas. Carbon capture, utilization and storage (CCUS) avoids waste of the CO2 or its release into the atmosphere and allows for secondary recovery operations and/or permanent sequestration.

There is also a growing interest in direct capture of carbon dioxide from power plants generating electricity through gas turbines and injection of the carbon into geological formations for long-term sequestration. This is known as carbon capture and sequestration (CCS). Technology for direct capture of carbon dioxide from the atmosphere and sequestration into geological formations is also an area of growing interest. The Antrim shale formation in Michigan is well-suited for these projects. As oil and gas production in Michigan continues to decline, CCS can make effective use of existing state forest oil and gas infrastructure where well sites are not closed and restored to productive forest use.

Current condition and trend

There are presently 19 wells on state forest lands where carbon dioxide is being injected into geological formations for enhanced oil recovery. There is one proposed project for CCS on state forest land. CCS projects are a new use on state forest lands and there is not sufficient data to show a trend. However, the 2022 Michigan Healthy Climate Plan has a goal to achieve economy-wide carbon neutrality by 2050, and the state Renewable Energy and Energy Waste Reduction Act (PA 235 of 2023) requires Michigan electric providers to achieve a 100% clean energy portfolio by 2040. Along with new federal funding for CCS, these will provide an impetus for more CCS development on state forest land.

Desired future condition, objectives and management actions

Provide opportunities for carbon capture utilization and sequestration at appropriate sites on state forest land.

Objective 1: Lease and permit appropriate sites on the state forest that may be suitable for CCS development.

- Action 1. Conduct comprehensive reviews and adjudicate applications for CCS on state forest land, considering potential public benefit and potential impacts to forest resources and other land uses.

Predicted climate change impacts upon carbon capture utilization and sequestration

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential results from impacts
Climate conditions will increase fire risks in northern Michigan by the end of the century	Medium	Moderate	Potential physical damage to CCUS and CCS infrastructure from to wildfire in higher fire-risk landscapes.

Adaptation approaches

Hazardous fuels reduction is the most prudent adaptation strategy to mitigate potential wildlife risk to CCUS and CCS infrastructure.

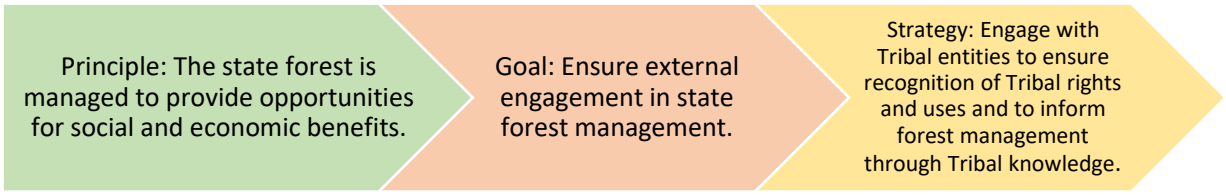
Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Implementation monitoring of the number of CCS projects permitted, leased and developed on state forest land.
- Effectiveness monitoring of metric tons of carbon dioxide that are captured and sequestered in geological formations on the state forest.

Tribal rights and uses

Management priority: Tribal consultation



Why Tribal consultation matters

As the first residents of Michigan, the Anishinaabe, or Odawa, Ojibwe and Potawatomi peoples, have a long history with its land and resources. Over millennia, a wealth of knowledge, both place and culture-based, has been accrued through their interactions with their environments. This knowledge has subsequently been shared among generations through numerous cultural expressions. Historically, this knowledge base has been largely unrecognized and underused by nonTribal government agencies but should play an important part in how Michigan's natural resources are managed going forward.

There are 12 federally recognized Odawa, Ojibwe and Potawatomi Tribes in Michigan. They are: Bay Mills Indian Community, Grand Traverse Bay Band of Ottawa and Chippewa Indians, Hannahville Indian Community, Keweenaw Bay Indian Community, Lac Vieux Desert Band of Lake Superior Chippewa Indians, Little River Band of Ottawa Indians, Little Traverse Bay Bands of Odawa Indians, Match-e-be-nash-she-wish Band of Potawatomi Indians of Michigan (Gun Lake), Nottawaseppi Huron Band of the Potawatomi Indians, Pokagon Band of Potawatomi Indians, Saginaw Chippewa Indian Tribe, and the Sault Ste. Marie Tribe of Chippewa Indians. The State of Michigan recognizes a government-to-government relationship with each. Several statutes, directives and standards guide consultation.

Most recently, the 2019 Executive Directive on State-Tribal Relations (2019-17) required each state agency to identify a Tribal Liaison to provide training on Tribal relations for staff and to establish a process for Tribal consultation. In each agency, that process must ensure the following:

1) Identification of whether an action taken by the state would affect any of the Tribes or Tribal interests;

2) Notification to any affected Tribes on the activity, including necessary information about the activity;

3) Input collected from any affected Tribes for agency consideration;

4) Follow-up with the Tribes consulted on the outcomes of their input in the final decision.

In 2007, an Inland Consent Decree was negotiated between the United States, Michigan Department of Natural Resources and the Bay Mills Indian Community, the Sault Ste. Marie Tribe, and the Grand Traverse Bay, Little River, and Little Traverse Bay Bands for cooperative management within the 1836

treaty area. The 1836 Treaty of Washington was a cession of almost 14 million acres of Odawa and Ojibwe lands in the eastern half of the Upper Peninsula and the northern two-thirds of the Lower Peninsula that reserved hunting, fishing and gathering rights for those Tribes. The 2007 Decree is a legal affirmation of those rights, further defining the extent of those rights and describing cooperative management of natural resources between the Tribes and the State within the treaty area, including some state forest activities.

Forest certification standards from both the Forest Stewardship Council and Sustainable Forest Initiative also guide interactions with affected Tribes on or related to the state forest. Both certifying bodies have standards that require recognition of Indigenous Peoples' rights within or affected by the certified forest area, and the Forest Stewardship Council requires free, prior and informed consent when their legal or customary rights are affected by management actions. As applied, these standards call for engagement with affected Tribes to identify and uphold the customary use and other rights to use and access forest resources and ecosystem services, and special sites of cultural significance on the state forest. How the DNR implements these standards is described in the Forest Certification Work Instructions 9.1 Tribal Relations.

Current condition and trend

Forest Certification Work Instructions for Tribal Relations (9.1) require DNR staff to keep track of meetings, workshops, and "other key interaction" with Tribes related to tactical forest land management activities. These are submitted each fiscal year to the Forest Certification Specialist as documentation towards meeting certification standards. The DNR relies on staff to retain their own records, which should include the date, type of contact, which DNR, Tribe(s) and Tribal staff were involved, the purpose of the contact and any decisions made.

At present, this information is compiled by subject area, which can include individual contact entries or single entries for multiple and routine communications related to projects through committees such as the Wildlife Technical Committee with 1836 treaty tribes and the Michigan Wild Rice Committee. Hence, the reported numbers can include both casual and more structured contacts between DNR and Tribal staff, but do not necessarily represent the total number of all DNR-Tribal interactions for any given year.

Table 1. Number of annual subject area interactions between DNR and Tribal staff.

Year	Number of Subject Area Tribal Interactions
2018	33
2019	27
2020	18
2021	16
2022	15
2023	11

Based on DNR staff data submitted to the Forest Certification Specialist, there looks to be a decline in the number of Tribal interactions between 2018 and 2023 (Table 1). However, that timeframe includes the COVID-19 pandemic and the resulting government shut-down for all non-essential services in 2020,

the DNR work-from-home mandate that lasted until mid-2021 and the general shift to remote work schedules for many staff. There have also been numerous staffing changes in the DNR since 2020, resulting in new employees who may not be as familiar with their respective Tribal contacts and the annual tracking and reporting requirements. There also is likely broad disparity in when and how DNR staff document interactions. Without more standardization in staff documentation of Tribal contacts, not much can be gleaned from this information.

Of note, the information documented and submitted by DNR staff does not necessarily include the nature or quality of the interaction, the specific Tribal input provided, how that input was considered, the final decision or outcome of the interaction, nor whether the Tribe(s) and Tribal staff were notified on the outcomes of their input. Without recording or tracking this data, it won't be possible to assess whether the DNR has met Tribal Consultation requirements as stipulated by Executive Directive 2019-17.

Desired future condition, objectives and management actions

A relationship based on respect and reciprocity developed over time with any of the 12 federally recognized Ojibwe, Odawa, and Potawatomi Tribal communities affected by state forest management; one that adheres to each community's preferences and standards of engagement, and that integrates and protects Tribal rights and the wisdom of Tribal knowledge in the management of the state forest's resources, especially in a changing climate.

Objective 1. This planning period, develop and implement periodic training for DNR staff about Tribal rights, uses and knowledge on the state forest and how that applies to various aspects of forest management, as well as how to respectfully engage with Tribal representatives and programs on those topics.

- Action 1. Reach out to the 12 federally recognized Tribal governments to identify those affected by state forest management, and then respectfully engage in partnership to co-develop DNR staff training on Tribal rights, uses and knowledge as applied to state forest management.
- Action 2. Conduct training every one to three years for all DNR staff associated with state forest management.

Objective 2. Beginning this planning period, promote DNR staff participation in Tribal community events, projects, or initiatives to develop and maintain long-term relationships with each Tribal community and to demonstrate the DNR's commitment to partnership.

- Action 1. Identify ways the DNR can be a reciprocal partner and contribute to different Tribal community events, interests, projects, and initiatives, especially where there is overlap with natural resource management related to the state forest, based on each Tribal community's priorities.
- Action 2. Provide institutional encouragement and support for staff to participate in Tribal community events to build and strengthen relationships and to reciprocate for all the time Tribes invest in state forest projects.

Objective 3. This planning period, improve Tribal consultation practices to increase Tribal participation and impact in state forest management decisions and monitoring, implemented through a set of updated internal procedures.

- Action 1. Engage with Tribes to codevelop and implement a Tribal engagement process to proactively address forest management topics and identify associated performance measures to annually evaluate its effectiveness.
- Action 2. Based on the engagement process codeveloped with Tribes, create a set of supporting internal procedures and communication templates that ensures implementation consistency, clarity on timing and staff roles for each step. Uphold all obligations under the Inland Consent Decree, Executive Directive and forest certification standards.
- Action 3. Develop an interface (e.g., website, database) for staff to document consultations and other key interactions (defined in Work Instructions 9.1) that captures the quality and nature of the interactions, Tribal contributions, outcomes, and follow-ups according to the newly established internal procedures.
- Action 4. Once developed, annually evaluate the Tribal consultation database for procedural compliance at each consultation step, assess outcomes, and use it to generate an annual record of key Tribal interactions and consultations for forest certification.
- Action 5. Annually work with Tribes to review, and improve as needed, annual forest certification reporting on Tribal interactions and consultation.
- Action 6. Update the Forest Certification Work Instructions to reflect Actions 1-5.

Objective 4. Partner with each of the 12 federally recognized Ojibwe, Odawa, and Potawatomi Tribal communities in climate change planning and adaptation responses on the state forest.

- Action 1. Increase awareness of Tribal uses from each Tribal community on public lands for harvest, cultural and recreational pursuits, to increase knowledge of resources and any associated climate-related changes.
- Action 2. Develop partnerships with individual Tribes or through inter-Tribal organizations for landscape-level climate change planning and implementation.
- Action 3. Identify where the DNR and each of the 12 federally recognized Tribes overlap in climate change priorities and work together to determine where to Resist-Accept-Direct.
- Action 4. Integrate cultural priorities from each of the 12 federally recognized Tribes in climate change planning and implementation (such as climate-adapted silvicultural and retention guidance), including culturally important species (such as wiigwass – paper birch) and sites of importance, and well as the maintenance of traditional practices of caretaking for plants.

Climate change

Predicted climate change impacts relevant to tribal consultation

While it will be important to conduct Tribal consultation in relation to forest management and climate change impacts, there are no predicted climate impacts to Tribal consultation itself from climate change.

Adaptation approaches

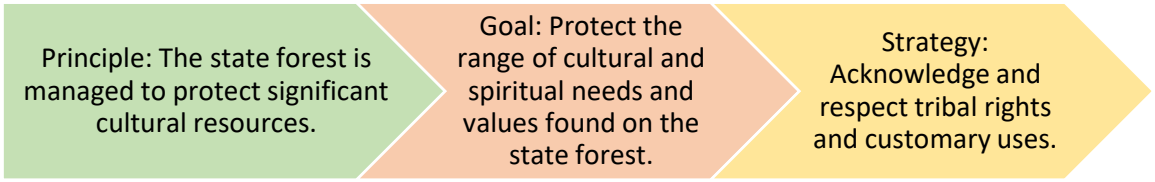
Increasing Tribal consultation and partnerships on resource management issues will be a valuable addition to a climate change response framework. Tribal history and knowledge include an inherent adaptability to resource use and management shaped over millennia of living in Michigan with an ever-changing climate. This kind of cultural and place-based understanding of shifting resource dynamics is invaluable to inform resource management in the future.

Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Annual number of tribal consultations and key interactions
- Annual percent compliance of consultation/key interaction procedural steps
- Percent participation in trainings by state forest staff
- Annual number of active management actions taken to monitor and improve culturally significant species such as habitat, wildlife, fish, reptiles and plants.

Management priority: Culturally significant landscapes and natural resources



Why culturally significant natural and cultural resources matter

Forest landscapes in Michigan have been managed by the Anishinaabek, or Odawa, Ojibwe and Potawatomi people, for millennia through the use of fire and other traditional methods. Cultural and customary use areas include lands that possess and provide significant value for present-day Ojibwe, Odawa and Potawatomi Tribal communities and other ethnic or religious groups, or sites that have been traditionally used by Tribes and/or the public for specific purposes.

There are 12 federally recognized Odawa, Ojibwe and Potawatomi Tribes in Michigan. They are: Bay Mills Indian Community, Grand Traverse Bay Band of Ottawa and Chippewa Indians, Hannahville Indian Community, Keweenaw Bay Indian Community, Lac Vieux Desert Band of Lake Superior Chippewa Indians, Little River Band of Odawa Indians, Little Traverse Bay Bands of Odawa Indians, Match-e-be-nash-she-wish Band of Potawatomi Indians of Michigan (Gun Lake), Nottawaseppi Huron Band of the Potawatomi Indians, Pokagon Band of Potawatomi Indians, Saginaw Chippewa Indian Tribe, and the Sault Ste. Marie Tribe of Chippewa Indians. Each may have customary use areas for making maple syrup, gathering wild fruit and other plant-gathering areas and habitats. Cultural and customary use areas have intrinsic social value. Maintaining, enhancing and preserving these resources for future generations is vitally important to our society.

Current condition and trend

The 2007 Inland Consent Decree negotiated between the United States, Michigan Department of Natural Resources and the Bay Mills Indian Community, the Sault Ste. Marie Tribe, and the Grand Traverse Bay, Little River, and Little Traverse Bay Bands clarified Tribal rights under the 1836 Treaty of Washington. This included the use of state land for gathering activities for the purpose of “personal, medicinal, cultural, or traditional craft use.” When these activities involve a specific area on the state forest, consultation occurs between Tribes and the local forest management unit. In some cases, like for recognition of Tribal sugar bushes, the DNR’s Cultural and Customary Use Special Conservation Area designation will be applied.

This SCA designation can also apply to other areas or features of cultural and historical significance. As of 2026, there are 11 Cultural and Customary Use SCA designations, and those include Tribal sugar bushes, witness trees, historic cabins, and other sites with historic value.

Desired future condition, objectives and management actions

The DNR and Tribal communities cooperate to integrate the wisdom of Tribal knowledge and to protect Tribal culturally significant natural resources in the state forest.

Objective 1. Within five years, identify known areas or landscapes of cultural importance for protection.

- Action 1. Consult with designated Tribal specialists.
- Action 2. Provide appropriate Tribal access to resources.
- Action 3. Protect sensitive Tribal cultural knowledge.
- Action 4. Include significant cultural areas or landscapes in the conservation area network, particularly those area that are vulnerable to adverse impacts from climate change.

Objective 2. Promote and provide access to species of cultural importance in the state forest over the next decade.

- Action 1. Consult with designated Tribal specialists, particularly regarding culturally significant and climate-vulnerable plant and animal species.
- Action 2. Provide appropriate Tribal access to resources.
- Action 3. Protect sensitive Tribal cultural knowledge.
- Action 4. Implement forest management strategies and develop timber sale specifications that consider cultural species of interest and Tribal ecological knowledge and practices.

Climate change

All climate change data and information listed herein is pulled directly from the open-source Northern Institute of Applied Climate Science (NIACS) climate change impacts tool and Adaptation Workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium, limited) and agreement (high, moderate, low) described in the Predicted Impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the Adaptation Approaches. For more information, please go to www.niacs.org

Predicted impacts relevant to culturally significant natural and cultural resources

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results from Impacts
Intense precipitation events will continue to become more frequent	Medium	Moderate	Flooding may affect access to sites and exacerbate erosion, which may adversely impact cultural resources.
Forest composition will change across the landscape	Medium	High	Habitat and biomass of culturally significant tree species (such as black ash and paper birch) will change.

Adaptation approaches

Erosion, especially shoreline erosion, and response efforts can impact cultural and customary use areas and access to those areas. With the expectation that forest composition will change over time, it is important to understand landscapes and species of cultural importance to facilitate appropriate management. As changes occur to hydrological processes, community composition, and species ranges, Tribal knowledge will be essential to inform decision-making, and to maintain and perpetuate cultural sites and traditions on the state forest.

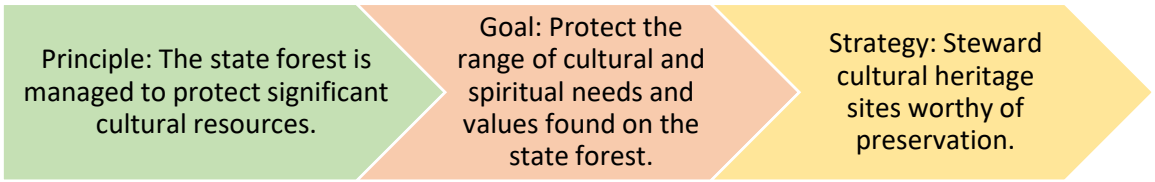
Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Annual number of tribal interactions/consultations
- Number of culturally significant areas or landscapes identified
- Timber sale contracts, burn plans, easement agreements and other specifications used annually to protect cultural resources

Cultural resources

Management priority: Heritage sites



Why heritage sites matter

Heritage sites include archaeological findings, buildings, structures, objects and landscapes, including relevant plants and animals, deemed worthy of preservation for their historic or cultural significance. They honor the legacies of Michigan's people and places. Heritage resources are nonrenewable and contain important information about our shared history and experience.

Current condition and trends

Given the large expanse of state forest land, relatively little is known about what historical and cultural resources of significance may be present. This is due to the small number of formal state forest cultural resources surveys. The known number, location and trends of heritage features in the state forest are confidential data.

Heritage sites have protections under state and federal law, but internal policies, procedures and best practices must be followed to ensure stewardship. The Michigan History Center (part of the Department of Natural Resources) currently has four terrestrial archaeologists and one underwater archaeologist who serve departmentwide. Forest Resources Division needs alone are beyond the capacity of current MHC staff. The ability to fund and contract qualified consultants to help meet desired future conditions, objectives and management actions is essential.

Desired future condition, objectives and management actions

A DNR archaeology program that has the capacity to inventory, protect and monitor the full suite of cultural heritage resources across the state forest.

Objective 1. Within five years, record all known cultural heritage resources into established statewide historic property electronic database.

- Action 1. Incorporate extant data into electronic database.

Objective 2. Throughout the planning period, identify, inventory and evaluate cultural heritage resources on state forest land.

- Action 1. Consult with stakeholders and DNR specialists to identify cultural heritage resources and inform best management practices.
- Action 2. Create research design for forest lands, including predictive modeling to guide resource surveys.

- Action 3. Prioritize and conduct resource surveys.

Objective 3. Throughout the planning period, implement preservation, protection and monitoring of significant cultural heritage resources.

- Action 1. Establish best management practices and review law, policy and procedure for adequate protections, including public interpretation and access as appropriate for individual or categories of resources.
- Action 2. Train staff for resource identification and protection.
- Action 3. Nominate resources for state and federal historic designation as appropriate.
- Action 4. Employ state Freedom of Information Act exemption to protect sensitive archaeological data.

Climate change

All climate change data and information listed herein is pulled directly from the open-source Northern Institute of Applied Climate Science Climate Change impacts tool and adaptation workbooks. Based on three established climate models, there are varying levels of evidence (robust, medium and limited) and agreement (high, moderate and low) described in the predicted impacts table. Planning strategies, approaches and tactics from the workbooks were integrated into the objectives and management actions relevant to each management priority and are summarized in the adaptation approaches. For more information, visit NIACS.org.

Predicted impacts relevant to heritage sites

Predicted Climate Change Impacts	Impact Evidence Rating	Impact Agreement Rating	Potential Results From Impacts
Increased winter precipitation as rain and melting between snowfall events.	Robust	High	More freeze-thaw cycles can expose and/or threaten the integrity of heritage sites.
Seasonal variation in soil moisture and altered precipitation, which may influence the magnitude and duration of flood events.	Not given	Not given	Flooding may impact access and exacerbate erosion of heritage sites.

Adaptation approaches

Erosion, especially shoreline erosion, and response efforts can threaten terrestrial and offshore cultural resources. Having a database of current records and learning more about resources through stakeholder consultation, research and surveys will help to identify those resources that may be most at risk from erosion. Implementing best management practices and training staff will help in both minimizing risks of disturbance and identifying issues that may arise as a result of climate-related events.

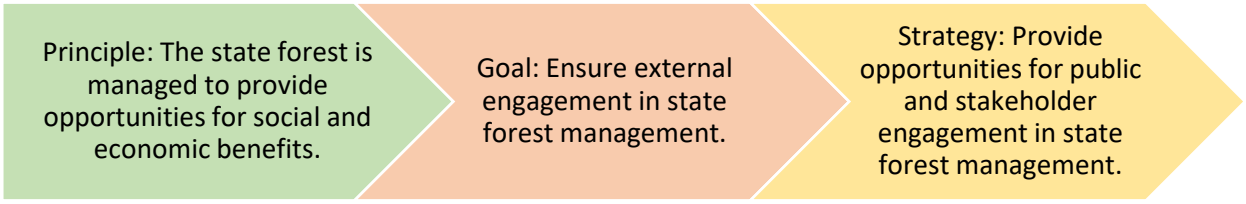
Monitoring

The following metrics have been identified for this management priority to track progress toward forest sustainability:

- Number of known heritage sites or resources by type, significance, location and condition.

Engagement and partnerships

Management priorities: Outreach, engagement, education and partnerships



Why outreach, engagement, education and partnerships matter

The state forest is a public resource that improves many Michigan residents' quality of life by providing clean air and water, habitat for wildlife, places for recreation, and wood products used to make houses, paper, and furniture. Sound management of this resource relies on meaningful public engagement and participation. To facilitate this, it's essential for resource managers to make focused outreach, engagement and education efforts. Outreach aims to provide information about state forest services and programs. Engagement enhances relationships by focusing on inclusion and collaboration. Education promotes lifelong learning to help people understand Michigan's complex, varied and beautiful natural resources and ecosystems. Partnerships play a key role in management of the state forest and in outreach and education efforts. When combined, these factors can help residents, visitors and stakeholders gain a better understanding of the state forest, how it's managed and its many public benefits, and, ultimately, help create a sense of place.

The International Association of Public Participation is an organization committed to promoting public participation based on the central tenet that those "affected by a decision have a right to be involved in the decision-making process." To this end, the organization has developed a framework called the Spectrum of Public Participation to identify the level of public involvement in any engagement process. The five participation levels on the spectrum are: inform, consult, involve, collaborate and empower. These are listed in order of increasing public influence on the outcome. Applying this framework to Michigan Department of Natural Resources outreach, engagement, education and partnership efforts will ensure clarity on the expected level of input for all parties and can be used to effectively structure engagement efforts to help achieve the intended outcomes.

Current condition and trend

Many DNR divisions, programs and initiatives are associated with the state forest in some way. They each have their own public outreach and education efforts, and there is currently no single means of tracking them all.

Here are some examples of outreach, engagement, education and partnership efforts within the Forest Resources Division.

Outreach

Forest Resources Division staff promotes sustainable forest management practices through various outreach efforts that correspond with division programs. For example, the division distributes various newsletters, such as the Forest Utilization and Marketing Newsletter, which is delivered to more than 12,000 inboxes through the DNR's email marketing system. The Forest Stewardship newsletter focuses on private lands, many of which are interwoven with state forest land, promotes sound management practices and reaches more than 20,000 subscribers. When pertinent, news stories are sent to a forest planning group that includes more than 23,000 subscribers. Various program and project reports available on the DNR website provide a wide range of information, such as each division's annual accomplishments, program summaries and highlights. Additionally, partnerships, public work groups, public presentations and volunteer opportunities support ongoing outreach efforts.

Engagement

State forest planning efforts, from 10-year strategic plans to annual timber harvest prescriptions, all go through a public review process to allow for comment and discussion with people interested in this work. Open houses are held annually in each forest management unit as a mechanism to receive input on planned forest management activities. Though public attendance is typically low, there is no internal tracking system to provide data. A webpage, found at Michigan.gov/ForestInput, has been created as another mechanism to share planned management actions and solicit public comment. In its initial year in 2020, the page received 14,510 unique page views, likely driven in large part by the COVID-19 pandemic and associated stay-at-home mandate that increased online activity. In 2021, the site received 4,636 unique views, and by 2022, 1,503 unique views were recorded, continuing the declining trend in public use. This may be due to information now being posted in multiple places and made available through multiple sources.

Education

In 2017, the Forest Resources Division took on a new kind of outreach: a public information campaign focused on providing clear, simple messages about sustainable forestry. The campaign, a first-of-its-kind initiative for the division, continues through fiscal year 2026. The campaign goal is to increase both public understanding and appreciation of sustainable forestry's impact on their lives and to foster an appreciation of the people who care for Michigan's forests. The initial focus of the initiative was on population centers in southern Michigan. Between 2018 and 2019, more than 62 million impressions (the number of times content was displayed on a page, billboard or screen) and over 277,000 engagements (user interactions) were reported.

The campaign was revamped and expanded during 2023, with new commercials and new media placed in markets during key periods in spring and fall. The new campaign has met or exceeded industry benchmarks for audience engagement. All advertising is based on surveys of audience knowledge and needs. For the past two years, the campaign also has been expanded to two northern Michigan markets, Traverse City and Marquette, at the request of some industry members of the DNR's Timber and Forest Product Advisory Council. industry.

In Michigan, Project Learning Tree is an award-winning international environmental education program designed for teachers and other educators, parents and community leaders working with youth from

preschool through grade 12. Run by Forest Resources Division staff, the program provides educators with tools, training and resources to bring the environment into their classrooms and their students into the environment. Materials are distributed, along with professional development, through in-person workshops or online courses. In 2025 alone, the program held 15 workshops reaching 207 educators and more than 66,000 children.

Additionally, the Nature Awaits program has been introduced at state parks to provide fourth grade field trips introducing kids to the importance of the natural environment as well as forests and their many uses. More than 53,000 students, teachers and chaperones have experienced a state park through the program since it launched in the spring of 2024.

In September 2025 and April 2026, the DNR held open houses in Lansing for Michigan legislators and legislative staff. Each division staffed tables and offered information to keep legislative staff and elected officials up to date on DNR activities and plans, including a variety of state forest efforts planned in the coming years. The response was generally good, with legislative staffers saying they appreciated the opportunity to learn more about DNR activities.

Partnerships

Partnerships are critical to state forest management, as they increase the DNR's ability to accomplish objectives that may be outside the department's scope or beyond staff capacity. Some significant partnerships include: Partnership for Ecosystem Research and Management with faculty at Michigan State University to conduct research that informs resource management decisions; the Michigan Cooperative Tree Improvement Program with Michigan State University; cooperative invasive species management areas to treat invasive species on the state forest; agreements with recreational groups to maintain snowmobile and other trail systems; and the Great Lakes Forest Fire Compact. A number of stakeholder groups and nongovernmental organizations also partner with the DNR on featured species habitat projects and monitoring on the state forest.

Desired future condition, objectives and management actions

Outreach, engagement, education and partnerships occur regularly to highlight the state forest, its management and the connection to public values.

Objective 1. Annually increase knowledge of the state forest and forest management among Michigan's residents, with emphasis on underserved residents.

- Action 1. Continue the sustainable forestry public information campaign with social media, press releases and emails releases to targeted audiences.
- Action 2. Focus on possible funding sources to continue the public information paid advertising campaign in population centers across the southern Lower Peninsula and selected northern Michigan communities.
- Action 3. Continue to improve and grow email subscriber lists for newsletters such as the Forest Utilization and Marketing newsletter, the Forest Stewardship newsletter, the Urban and Community Forestry newsletter and other publications for targeted audiences that appropriately communicate the benefits of state forests.
- Action 4. Continue enhancing and developing public information campaigns for Michigan's residents.

- Action 5. Train formal and informal educators in the Project Learning Tree curriculum.
- Action 6. Begin developing a strategy to communicate effects of climate change, incorporating best practices for climate-exacerbated risk communication.

Objective 2. Throughout the planning period, increase use and awareness of state forests for a diversity of recreational activities, including both traditional pursuits like hunting and fishing and nontraditional activities.

- Action 1. Prioritize efforts to engage with nontraditional state forest recreationists and/or underserved communities.
- Action 2. Continue to enhance and update to the High Conservation Value Areas story map.
- Action 3. Further develop the DNR foraging web page, encouraging visiting the forest for berries, nuts and mushrooms.
- Action 4. Coordinate efforts with the DNR Parks and Recreation Division to promote increased use of the Michigan trails network and state forest campgrounds.

Objective 3. Provide opportunities for the public and stakeholders to engage on a regular basis throughout the planning period.

- Action 1. Explore opportunities for public meetings, information and listening sessions using the International Association of Public Participation scale for defining the level of participation required. Develop a process for tracking attendance, input and satisfaction.
- Action 2. Enhance public participation by creating easy-to-use tools that show how planning efforts are connected and implemented, who to contact and how the public can get involved in the planning process.
- Action 3. Improve public participation in forest planning by continuing the MiState Forest Viewer, providing virtual or live/interactive Q&A options, developing presentations explaining proposed forest treatments and increasing efforts to communicate with adjacent landowners.
- Action 4. Develop a process to track input and provide feedback to stakeholders on how their comments were addressed and/or implemented.
- Action 5. Continually make connections between public values and the benefits of forest management activities.

Objective 4. Maintain current and foster new partnerships to increase the DNR's capacity to conduct research, management, monitoring, and outreach and engagement.

- Action 1. Continue ongoing research endeavors with Michigan State University's Partnership for Ecosystem Research and Management staff and with other universities.
- Action 2. Look for opportunities to develop new partnerships to address gaps in management.
- Action 3. Increase volunteer and community science opportunities through programs such as Adopt-A-Forest.

Climate change

Predicted climate change impacts relevant to outreach, engagement, education and partnerships

There are no anticipated climate impacts to outreach, engagement, education or partnerships.

Adaptation approaches

It is likely that outreach, engagement, education and partnerships around climate change impacts and adaptation and/or mitigation responses on the state forest will increase.

Monitoring

The following metrics have been identified for this management priority to track progress towards forest sustainability:

- Annual number of public outreach efforts, measured by the International Association for Public Participation (IAP2) spectrum.
- Annual number of public engagement efforts measured by IAP2 spectrum level.
- Annual number of education efforts by IAP2 spectrum level.
- Annual number of outreach, engagement and education efforts through partnerships.
- Annual number of partnership projects conducted on the state forest.

Ecoregion

Northern Lower Peninsula

State Forest Area:
2,036,486 acres

Location:
28 counties in the Northern Lower Peninsula

Population Centers:
Traverse City, Alpena, Mt. Pleasant, Petoskey, Gaylord and Cadillac

Landcover:
Forested: 1,766,447 acres
Nonforested: 270,038 acres

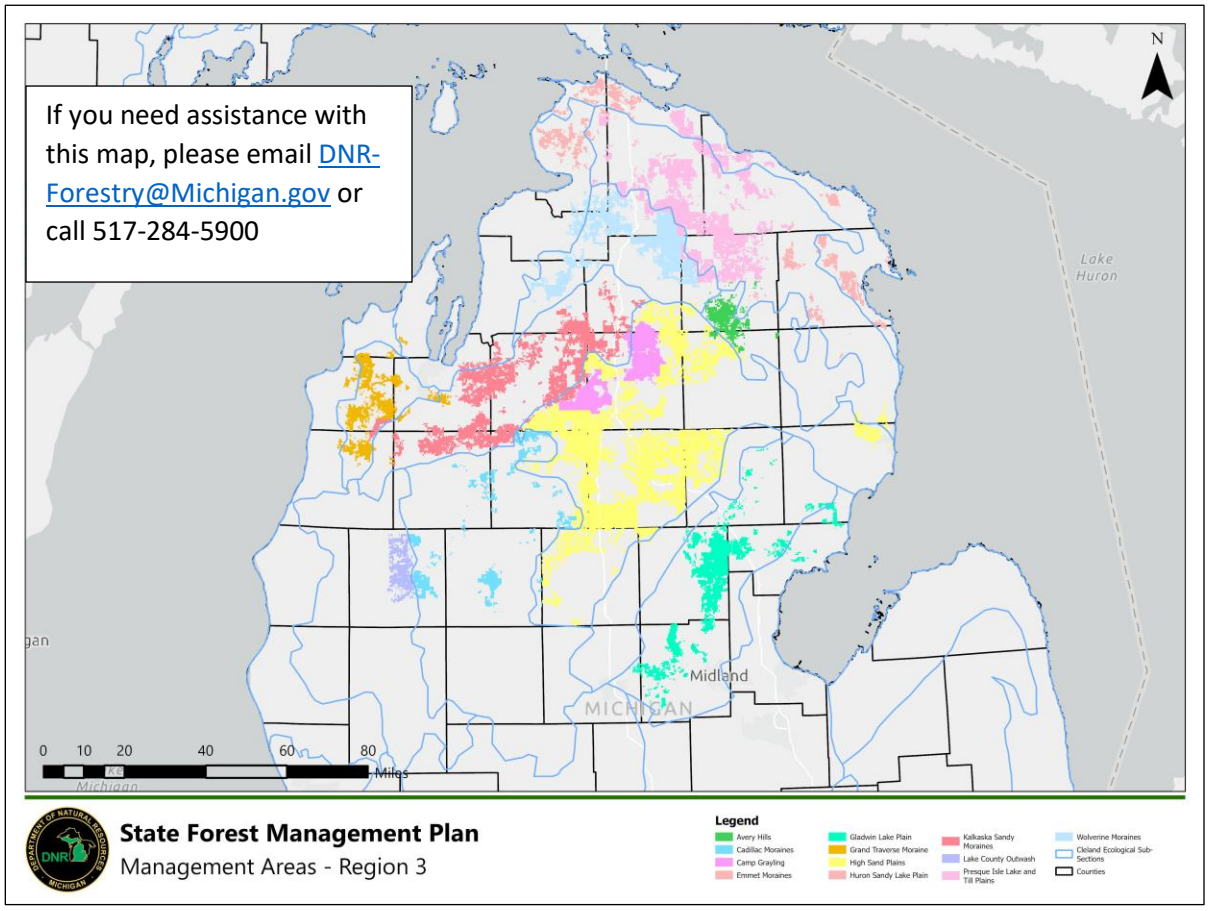


Figure 1. Northern Lower Peninsula Ecoregion.

Forested landscape

Current and projected future condition

The Northern Lower Peninsula Ecoregion is comprised of 87% forested cover types and 13% nonforested cover types (Table 1). Of the forested cover types, the upland is 70% of the total area and lowland landscape is only 17%. The largest contributors to upland cover types are aspen and northern hardwood. Lowland deciduous and lowland conifer make up 8% of the total landscape position. Lowland shrub is the most common nonforested cover type in the ecoregion representing 5% of the landscape.

Table 1. Current landscape context and distribution of cover types.

Land Type	Landscape Position	Forest Type	Cover Type	Acres	Acres by Category		
Forested (≥25% CC)	Upland	Deciduous	Aspen	477,069	932,444	1,425,996	1,766,447
			Northern Hardwood	198,396			
			Black Red Hybrid Oak	54,880			
			Northern Red Oak	47,599			
			Oak Mix	38,167			
			Mixed Upland Deciduous	116,334			
		Mixed	Upland Mixed Forest	63,384	63,384		
		Coniferous	Planted Red Pine	141,545	430,168		
			Planted Jack Pine	100,867			
			Planted White Pine	6,907			
			Planted Mixed Pine	12,455			
			Natural Red Pine	22,675			
			Natural Jack Pine	65,184			
			Natural White Pine	22,107			
			Natural Mixed Pines	44,458			
			Upland Spruce/Fir	3,572			
			Upland Conifers	9,273			
			Hemlock	1,125			
	Lowland	Deciduous	Lowland Aspen/Balsam Poplar	44,928	131,576	340,452	
			Lowland Deciduous	86,648			
		Mixed	Lowland Mixed Forest	28,039	28,039		
		Coniferous	Cedar	74,169	180,837		
			Lowland Conifers	84,947			
			Lowland Spruce/Fir	12,555			
			Tamarack	9,166			
Nonforested (<25% CC)	Upland		Herbaceous Openland	37,818	104,946		270,038
			Upland Shrub	34,825			
			Low Density Trees	16,201			

Land Type	Landscape Position	Forest Type	Cover Type	Acres	Acres by Category	
			Bare/Sparsely Vegetated	3,745		
			Cropland	1,443		
			Urban	10,914		
	Lowland		Lowland Shrub	95,600	165,092	
			Marsh	31,563		
			Bog	10,023		
			Treed Bog	7,420		
			Water	20,486		
					Grand Total:	2,036,486

There are 1,425,518 acres (70% of the total ecoregion and 80% of the forested area) that can be managed toward desired future conditions via commercial timber harvest in the Northern Lower Peninsula Ecoregion (Table 2). Of the total area, over 23% is in the aspen cover type, 7% in planted red pine, and 10% in northern hardwood. The remaining 33 cover types represent less than 6% each of the ecoregion. Acres unavailable for management are categorized by site condition (Table 3).

Table 2. Current cover type composition by management availability.

Forested Cover Type	Available Acres	Available Percent	Unavailable Acres	Unavailable Percent	Total Acres	Total Percent
Aspen	459,176	26.0%	17,894	1.0%	**477,069**	**27.0%**
Northern Hardwood	184,463	10.4%	13,933	0.8%	**198,396**	**11.2%**
Planted Red Pine	137,366	7.8%	4,179	0.2%	**141,545**	**8.0%**
Mixed Upland Deciduous	107,390	6.1%	8,944	0.5%	**116,334**	**6.6%**
Planted Jack Pine	100,141	5.7%	726	0.0%	**100,867**	**5.7%**
Lowland Deciduous	23,281	1.3%	63,368	3.6%	**86,648**	**4.9%**
Lowland Conifers	11,888	0.7%	73,059	4.1%	**84,947**	**4.8%**
Cedar	8,094	0.5%	66,076	3.7%	**74,169**	**4.2%**
Natural Jack Pine	60,819	3.4%	4,365	0.2%	**65,184**	**3.7%**
Upland Mixed Forest	57,288	3.2%	6,096	0.3%	**63,384**	**3.6%**
Black Red Hybrid Oak	50,593	2.9%	4,287	0.2%	**54,880**	**3.1%**
Northern Red Oak	42,889	2.4%	4,698	0.3%	**47,587**	**2.7%**
Lowland Aspen Balsam Poplar	28,394	1.6%	16,534	0.9%	**44,928**	**2.5%**
Natural Mixed Pines	39,739	2.2%	4,719	0.3%	**44,458**	**2.5%**
Oak Mix	35,405	2.0%	2,762	0.2%	**38,167**	**2.2%**
Lowland Mixed Forest	8,900	0.5%	19,140	1.1%	**28,039**	**1.6%**
Natural Red Pine	20,170	1.1%	2,505	0.1%	**22,675**	**1.3%**
Natural White Pine	19,204	1.1%	2,903	0.2%	**22,107**	**1.3%**
Lowland Spruce Fir	2,203	0.1%	10,352	0.6%	**12,555**	**0.7%**

Forested Cover Type	Available Acres	Available Percent	Unavailable Acres	Unavailable Percent	Total Acres	Total Percent
Planted Mixed Pine	11,600	0.7%	855	0.0%	**12,455**	**0.7%**
Upland Conifers	6,335	0.4%	2,938	0.2%	**9,273**	**0.5%**
Tamarack	685	0.0%	8,481	0.5%	**9,166**	**0.5%**
Planted White Pine	6,546	0.4%	361	0.0%	**6,907**	**0.4%**
Upland Spruce Fir	2,606	0.1%	965	0.1%	**3,572**	**0.2%**
Hemlock	347	0.0%	778	0.0%	**1,125**	**0.1%**
Total	**1,425,518**	**80.7%**	**340,918**	**19.3%**	**1,766,435**	**100.0%**

Table 3. Site conditions (reason area in unavailable for commercial harvest) for unavailable acres.

Site Condition	Acres	Percent of Unavailable Area
Too Wet	194,685	57.1%
Conservation Values	29,590	8.7%
Best Management Practices	24,205	7.1%
Military Lease/Easement	14,865	4.4%
Blocked by Obstacle	12,896	3.8%
Federal/State/Local Law	11,049	3.2%
Too Steep	8,616	2.5%
Other Influence Zones	6,671	2.0%
Denied Access	6,144	1.8%
Recreation/Scenic	6,031	1.8%
Long-Term Retention	5,975	1.8%
Cannot Regenerate	5,895	1.7%
Other Department/Division Processes	3,585	1.1%
Species of Special Concern or Threatened and Endangered	3,580	1.1%
Rare Landforms	1,836	0.5%
Non-Military Lease/Easement	1,823	0.5%
Wildlife Concerns	921	0.3%
Unproductive	867	0.3%
Deer Wintering Area	532	0.2%
Blocked by Railroad	525	0.2%
Non-DNR Agency Concerns	218	0.1%
Natural/Quiet/Wilderness Area	176	0.1%
Neighbor/Interest Group	165	0.0%
Historical/Archaeological	68	0.0%
Total Unavailable	**340,918**	**100%**

Projected 10-year cover type management actions

Each cover type in the Northern Lower Peninsula Ecoregion has a unique age class and basal area class goals that describe the long-term desired future conditions. The calculated harvest levels that are needed during the first 10-year planning period are summarized in Table 4. These harvest levels are necessary to begin achieving long-term planning goals. This will help establish a desirable amount of regeneration for the even-aged cover types over the 10-year period or help to achieve desired basal area distribution among uneven-aged cover types like northern hardwoods.

Table 4. Ten-year planning period harvest goals (acres) by cover type and silvicultural regime.

Cover Type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Total
Northern Hardwood	1,766	65,148	--	4,336	343	**71,594**
Aspen	65,212	--	--	--	--	**65,212**
Planted Red Pine	11,230	--	43,773	--	--	**55,003**
Mixed Upland Deciduous	13,881	1,645	--	--	1,087	**16,613**
Natural Jack Pine	10,950	--	--	--	--	**10,950**
Black Red Hybrid Oak	8,006	--	619	--	353	**8,978**
Lowland Deciduous	1,193	485	-	173	6,274	**8,124**
Northern Red Oak	6,484	--	310	591	82	**7,467**
Planted Jack Pine	6,981	--	--	--	--	**6,981**
Lowland Aspen/Balsam Poplar	5,632	--	--	--	--	**5,632**
Natural Mixed Pines	--	--	2,529	--	2,510	**5,039**
Upland Mixed Forest	4,438	--	--	--	--	**4,438**
Oak Mix	3,799	--	409	--	81	**4,288**
Planted White Pine	481	--	3,025	--	--	**3,506**
Natural White Pine	--	--	1,722	--	1,662	**3,384**
Lowland Conifers	1,919	--	--	--	--	**1,919**
Planted Mixed Pine	1,150	--	497	--	--	**1,647**
Upland Spruce/Fir	1,453	--	--	--	--	**1,453**
Natural Red Pine	--	--	582	--	610	**1,192**
Lowland Mixed Forest	970	--	--	--	--	**970**
Upland Conifers	896	--	--	--	64	**960**
Lowland Spruce/Fir	446	--	--	--	--	**446**
Hemlock	--	326	--	--	--	**326**
Cedar	74	--	--	25	--	**100**
Tamarack	44	--	--	--	--	**44**
Total	**147,006**	**67,604**	**53,465**	**5,125**	**13,066**	**286,266**

There are a few cover type transitions projected for the Northern Lower Peninsula Ecoregion (Table 5). The managed area of each cover type is projected to remain fairly stable as treatment regimes will not significantly change the amount of area in each cover type except for aspen and northern red oak. The largest decrease forecasted is in the northern red oak cover type where approximately 10.7% or 5,110 acres will convert to other cover types such as upland mixed forest through forest management and regeneration activities. The largest increase occurs on the aspen cover type where 6,335 acres are projected to convert into this cover type increasing by 1.3%, mostly from the oak cover types.

Table 5. Projected 10-year cover type acres resulting from cover type transitions.

Cover Type	Current Acreage	Projected Acreage at End of 10-Year Planning Period	Projected 10-Year Change in Acreage
Aspen	477,069	483,404	6,335
Northern Hardwood	198,396	199,257	861
Planted Red Pine	141,545	142,359	814
Mixed Upland Deciduous	116,334	116,609	275
Planted Jack Pine	100,867	100,515	-351
Lowland Deciduous	86,648	86,742	94
Lowland Conifers	84,947	84,241	-706
Cedar	74,169	74,169	0
Natural Jack Pine	65,184	64,990	-194
Upland Mixed Forest	63,384	67,045	3,661
Black Red Hybrid Oak	54,880	51,418	-3,461
Northern Red Oak	47,599	42,489	-5,110
Lowland Aspen/Balsam Poplar	44,928	44,958	30
Natural Mixed Pines	44,458	45,214	756
Oak Mix	38,167	37,786	-381
Lowland Mixed Forest	28,039	28,840	801
Natural Red Pine	22,675	22,782	108
Natural White Pine	22,107	22,396	288
Lowland Spruce/Fir	12,555	12,336	-220
Planted Mixed Pine	12,455	11,305	-1,150
Upland Conifers	9,273	8,638	-635
Tamarack	9,166	9,166	0
Planted White Pine	6,907	6,427	-481
Upland Spruce/Fir	3,572	2,236	-1,335
Hemlock	1,125	1,125	0
Lowland Shrub	95,600	95,600	0
Herbaceous Openland	37,818	37,818	0
Upland Shrub	34,825	34,825	0
Marsh	31,563	31,563	0
Water	20,486	20,486	0
Low Density Trees	16,201	16,201	0
Urban	10,914	10,914	0
Bog	10,023	10,023	0
Treed Bog	7,420	7,420	0
Bare/Sparsely Vegetated	3,745	3,745	0
Cropland	1,443	1,443	0
Total	**2,036,486**	**2,036,486**	**0**

NLP management areas

Avery Hills

State Forest Area: 43,770 acres	Location: Northeastern Lower Peninsula	Population Centers: Atlanta Lewiston
Subsection: Avery Hills	Landforms: Steep moraine ridges, outwash channels and plains	Landcover: Forested: 41,002 acres Nonforested: 2,769 acres

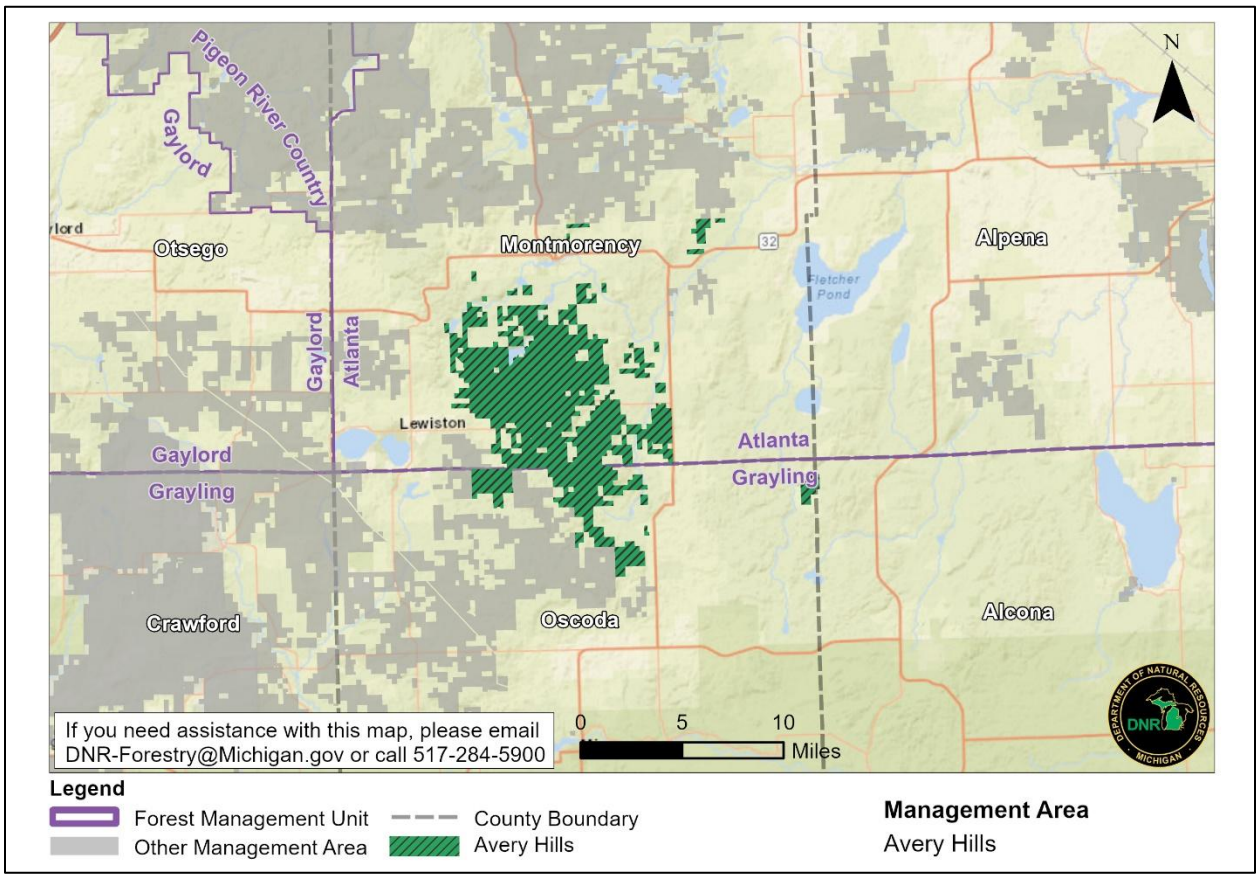


Figure 1. Avery Hills Management Area.

Forested landscape

Current and projected future condition

The Avery Hills Management Area consists mostly of shade-intolerant species throughout all the age groups (Figure 2). Available upland and unavailable lowland contain the majority of shade tolerant acres, primarily in the mature age category.

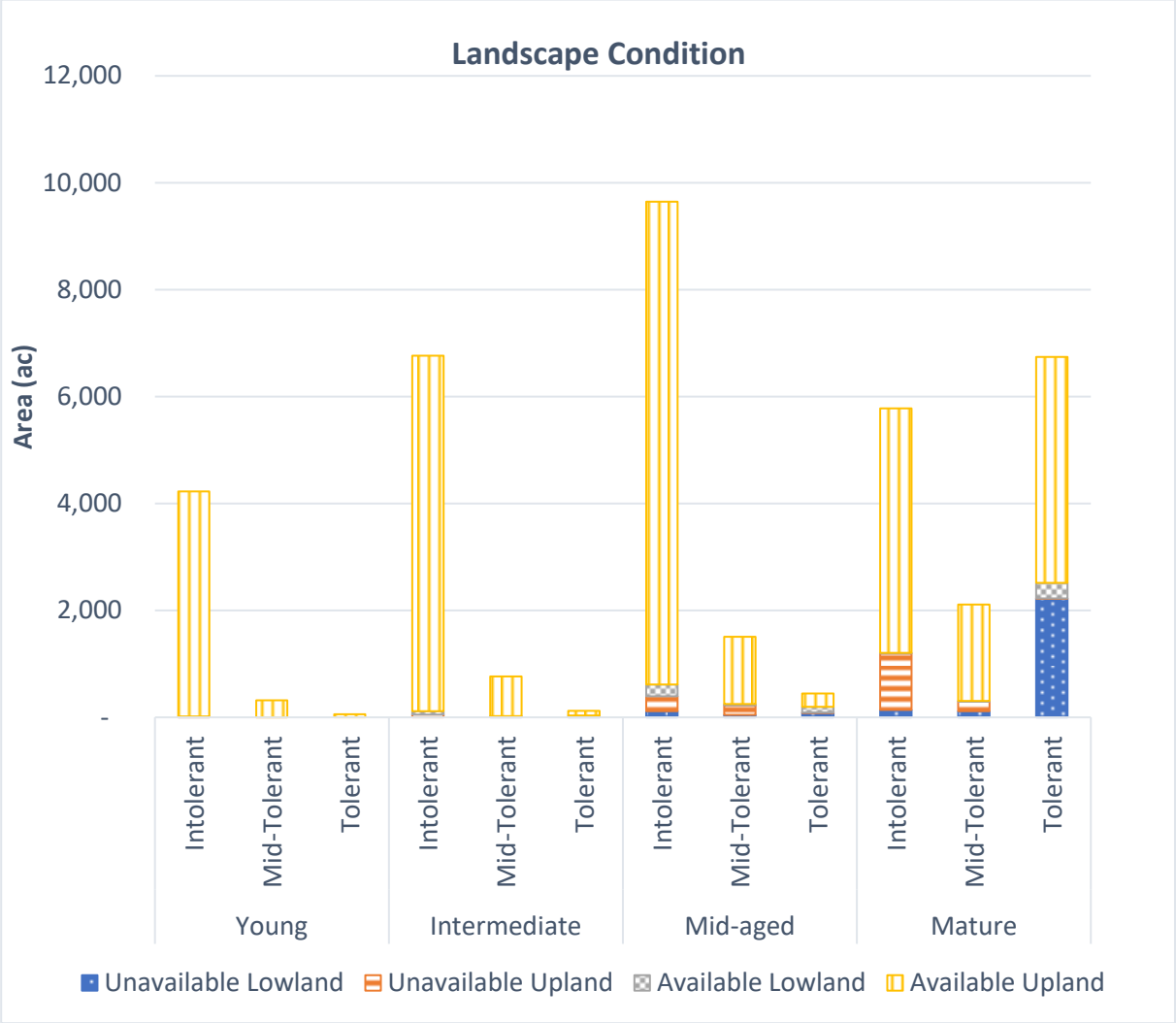


Figure 2. Forest diversity matrix showing the current distribution of forested acres across management availability, age category, landscape position and shade tolerance.

The mature shade-tolerant areas of the management area should be maintained at the current distribution of age categories. The areas of contiguous hardwood in large patches should be maintained as well through treatments that do not reduce the canopy closure beyond a typical selection harvest regime. A more even distribution of the shade intolerant area across the age categories is desirable in the Avery Hills Management Area, and this can be achieved by accomplishing individual cover type age class goals over the next several decades.

Landscape habitat conditions refine the management area landscape into featured species habitat context. Current and projected acres for the metrics identified in the Management Priorities (Section 3 Statewide/Regional) establish a baseline and future condition based on management over the planning period (Table 1).

Table 1. Current acres for landscape habitat conditions.

Landscape Habitat Condition	Monitoring Metric	Current Acres
Young Forest	Acres of 0-19 stands in Aspen and Jack Pine	4,223
Mature Forest	Acres of 80+ year stands across cover types	14,633
Mature Forest	Acres of 120+ year stands across cover types	438
Mesic Conifer Cover types	Acres of mesic conifer cover types	424
Mesic Conifers in other Cover types	Average canopy occupancy	14%
Mast – Oak Cover types	Acres of Oak cover types	4,677
Mast Tree Species in other Cover types	Acres of Total Canopy Occupancy of Mast Tree Acres (Trace-100%)	27,365
Big Trees	Total Canopy Stand Occupancy of Species in Sawlog or Greater Size Class	26,124
Nonforested Openings	Acres of Total Herbaceous Openland, Upland Shrub and Cropland	1,356
Landscape Forest Matrix	Percent Deciduous Forest	83%
Landscape Forest Matrix	Percent Coniferous Forest	15%

The Avery Hills Management Area has the following special analysis units (SAUs). These SAUs have specific cover type goals, typically associated with wildlife habitat management. For any SAUs that overlap with this management area, SAU cover type goals take priority as the SFMP model strives to meet the cover type goals across the area, ensuring they are met. Please see Section 5 for a detailed description of the management direction and harvest goals for each of these SAUs.

- Grouse Enhanced Management Site (GEMS) – Greasy Creek

The Avery Hills Management Area is comprised of 94% forested cover types and 6% nonforested cover types. Of the forested cover types, 86% are in the upland landscape position. The largest contributors to upland cover types are aspen, northern hardwoods and northern red oak. Cedar and lowland conifer make up 77% of the lowland landscape position. Herbaceous openland is the most common nonforested cover types in the management area representing 2% of the landscape (Table 2).

Table 2. Current landscape context and distribution of cover types.

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
Forested	Upland	Deciduous	Aspen	20,297	33,504	37,468	41,002
			Northern Hardwood	4,504			
			Black Red Hybrid Oak	371			
			Northern Red Oak	4,019			
			Oak Mix	753			
			Mixed Upland Deciduous	3,560			
		Mixed	Upland Mixed Forest	701	701		
		Coniferous	Planted Red Pine	1,135	3,263		
			Planted Jack Pine	564			
			Planted White Pine	0			
			Planted Mixed Pine	182			
			Natural Red Pine	208			
			Natural Jack Pine	750			
			Natural White Pine	44			
			Natural Mixed Pines	214			
			Upland Spruce/Fir	96			
			Upland Conifers	70			
			Hemlock	0			
	Lowland	Deciduous	Lowland Aspen/Balsam Poplar	353	469	3,534	
			Lowland Deciduous	117			
		Mixed	Lowland Mixed Forest	125	125		
		Coniferous	Cedar	1,907	2,940		
			Lowland Conifers	831			
			Lowland Spruce/Fir	88			
			Tamarack	114			
Nonforested	Upland	N/A	Herbaceous Openland	1,032	N/A	1,870	2,769
			Upland Shrub	324			
			Low Density Trees	114			
			Bare/Sparsely Vegetated	41			
			Cropland	0			
			Urban	359			
	Lowland	N/A	Lowland Shrub	236	N/A	899	
			Marsh	274			
			Bog	25			
			Treed Bog	68			
			Water	296			
						Grand Total:	**43,770**

There are 36,494 acres (89% of the forested area) that can be managed toward desired future conditions via commercial timber harvest in the Avery Hills Management Area (Table 3). Of that, over 48% is in the aspen cover type, 11% in the northern hardwoods cover type, 8% in the northern red oak, and 8% in the mixed upland deciduous. The remaining 19 cover types represent less than 3% each of the forested and available land in the management area.

Table 3. Current cover type composition by management availability.

AVERY HILLS						
Forested Cover Type	Available Acres	Available %	Unavailable Acres	Unavailable %	Total Acres	Total %
Aspen	19,830	48.3%	472	1.1%	20,302	49.5%
Black Red Hybrid Oak	323	0.8%	49	0.1%	372	0.9%
Cedar	251	0.6%	1,658	4.0%	1,909	4.7%
Hemlock	0	0.0%	0	0.0%	0	0.0%
Lowland Aspen/Balsam Poplar	254	0.6%	99	0.2%	353	0.9%
Lowland Conifers	176	0.4%	656	1.6%	832	2.0%
Lowland Deciduous	31	0.1%	86	0.2%	117	0.3%
Lowland Mixed Forest	34	0.1%	91	0.2%	125	0.3%
Lowland Spruce/Fir	36	0.1%	52	0.1%	88	0.2%
Mixed Upland Deciduous	3,442	8.4%	118	0.3%	3,560	8.7%
Natural Jack Pine	750	1.8%	0	0.0%	750	1.8%
Natural Mixed Pines	187	0.5%	27	0.1%	214	0.5%
Natural Red Pine	195	0.5%	14	0.0%	209	0.5%
Natural White Pine	43	0.1%	1	0.0%	44	0.1%
Northern Hardwood	4,487	10.9%	18	0.0%	4,505	11.0%
Northern Red Oak	3,282	8.0%	738	1.8%	4,019	9.8%
Oak Mix	705	1.7%	47	0.1%	753	1.8%
Planted Jack Pine	564	1.4%	0	0.0%	564	1.4%
Planted Mixed Pine	182	0.4%	0	0.0%	182	0.4%
Planted Red Pine	1,059	2.6%	77	0.2%	1,136	2.8%
Tamarack	2	0.0%	112	0.3%	114	0.3%
Upland Conifers	24	0.1%	46	0.1%	70	0.2%
Upland Mixed Forest	575	1.4%	128	0.3%	703	1.7%
Upland Spruce/Fir	61	0.1%	36	0.1%	96	0.2%
Grand Total	**36,494**	**89.0%**	**4,522**	**11.0%**	**41,016**	**100.0%**

Table 4. Site conditions for unavailable acres.

Site Condition (Reason area is unavailable for commercial harvest)	Area (ac)	% of Unavailable Area
Too Wet	1,646	36.4%
BMPs	1,020	22.6%
Too Steep	669	14.8%
Long-Term Retention	308	6.8%
Conservation Values	190	4.2%
Other Dept./Div. Processes	168	3.7%
Cannot Regenerate	164	3.6%
Recreation/Scenic	158	3.5%
Blocked by Obstacle	88	1.9%
Other Influence Zones	83	1.8%
Denied Access	15	0.3%
Species of special concern or T&E	10	0.2%
Non-Military Lease/Easement	4	0.1%
Total Unavailable	**4,522**	**100.0%**

Projected 10-year cover type management actions

Each cover type in the Avery Hills Management Area has a unique age class and basal area class goals that describe the long-term desired future conditions. The calculated harvest levels that are needed during the first 10-year planning period are summarized in Table 5. These harvest levels are necessary to begin achieving long-term planning goals. This will help establish a desirable amount of regeneration for the even-aged cover types over the 10-year period or help to achieve desired basal area distribution among cover types like northern hardwoods. Implementing these silvicultural regimes will yield an estimated 85,624 cords, the planned harvest volume for the decade (Table 6).

Table 5. Ten-year planning period harvest goals (acres) by cover type and silvicultural regime.

Silvicultural Regimes								
Cover Type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Salvage Clearcut	Salvage Thinning	Grand Total
Aspen	1,636	-	-	-	-	697	-	2,333
Northern Hardwood	-	-	-	-	-	405	1,441	1,846
Northern Red Oak	469	-	-	25	20	-	232	746
Mixed Upland Deciduous	463	71	-	-	-	-	-	534
Planted Red Pine	-	-	171	-	-	40	39	250
Natural Jack Pine	-	-	-	-	-	197	-	197
Planted Jack Pine	-	-	-	-	-	96	-	96
Upland Mixed Forest	93	-	-	-	-	-	-	93
Oak Mix	-	-	-	-	-	88	-	88
Upland Spruce/Fir	57	-	-	-	-	-	-	57
Lowland Aspen/Balsam Poplar	52	-	-	-	-	-	-	52
Lowland Conifers	23	-	-	-	-	-	-	23
Lowland Spruce/Fir	10	-	-	-	-	-	-	10
Natural Red Pine	-	-	10	-	-	-	-	10
Natural Mixed Pines	-	-	3	-	2	-	-	4
Upland Conifers	-	-	-	-	-	-	-	-
Planted White Pine	-	-	-	-	-	-	-	-
Natural White Pine	-	-	-	-	-	-	-	-
Black Red Hybrid Oak	-	-	-	-	-	-	-	-
Tamarack	-	-	-	-	-	-	-	-
Cedar	-	-	-	-	-	-	-	-
Lowland Deciduous	-	-	-	-	-	-	-	-
Planted Mixed Pine	-	-	-	-	-	-	-	-
Hemlock	-	-	-	-	-	-	-	-
Lowland Mixed Forest	-	-	-	-	-	-	-	-
Totals	**2,804**	**71**	**184**	**25**	**22**	**1,523**	**1,712**	**6,340**

Table 6. Projected 10-year harvest volume by product and species.

10-Year Estimated Harvest Volume Projection Avery Hills Management Area Product	Species	Volume Planned*	Volume Prepared**
Pulpwood (cords)	Mixed Aspen	22,033	20,711
	Mixed Hardwood	21,520	20,228
	Jack Pine	4,488	4,219
	Mixed Spruce	4,207	3,955
	Mixed Oak	4,175	3,925
	Mixed Softwood	2,445	2,299
	Red Pine	2,192	2,060
	White Pine	1,332	1,252
	Pulpwood Total	**62,391**	**58,648**
Sawtimber (MBF)	Red Oak	6,003	5,643
	Mixed Aspen	4,487	4,218
	White Pine	2,139	2,011
	Red Pine	1,909	1,795
	Red Maple	654	615
	White Oak	577	542
	Sugar Maple	433	407
	Mixed Oak	72	68
	Basswood	28	26
	Sawtimber Total	**16,302**	**15,324**
	Total Sawtimber Harvest Volume in Cords	**85,624**	**80,486**
	Grand Total Harvest Volume in Cords	**148,015**	**139,134**
* Volume estimates based on 100% of the projected harvests for the 10 year planning period. ** Volume estimates based on 94% of the projected harvests for the 10 year planning period accounting for reduction in acres and associated volume once sales are prepared for bid.			

There are few cover type transitions projected for the Avery Hills Management Area (

Table 7). The managed area of each cover type is projected to remain stable as treatment regimes will not significantly change the amount of area in each cover type. The largest decrease forecasted is in the northern red oak cover type where 314 acres will likely convert to aspen or other cover types through forest management and regeneration activities. The largest increase occurs in the aspen type where 276 acres are projected to convert into this cover type.

Table 7. Projected 10-year cover type acres resulting from cover type transitions.

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Aspen	20,297	20,573	276
Northern Hardwood	4,504	4,504	0
Northern Red Oak	4,019	3,705	-314
Mixed Upland Deciduous	3,560	3,575	15
Cedar	1,907	1,907	0
Planted Red Pine	1,135	1,249	114
Lowland Conifers	831	823	-8
Natural Jack Pine	750	750	0
Upland Mixed Forest	701	652	-49
Black Red Hybrid Oak	371	371	0
Lowland Aspen/Balsam Poplar	353	350	-2
Natural Mixed Pines	214	214	0
Natural Red Pine	208	208	0
Planted Mixed Pine	182	182	0
Lowland Mixed Forest	125	137	12
Lowland Deciduous	117	119	2
Tamarack	114	114	0
Upland Spruce/Fir	96	44	-52
Lowland Spruce/Fir	88	84	-4
Upland Conifers	70	70	0
Natural White Pine	44	44	0
Oak Mix	753	762	9
Planted Jack Pine	564	564	0
Herbaceous Openland	1,032	1,032	0
Urban	359	359	0
Upland Shrub	324	324	0
Marsh	274	274	0
Lowland Shrub	236	236	0
Low Density Trees	114	114	0
Treed Bog	68	68	0
Bare/Sparsely Vegetated	41	41	0
Bog	25	25	0
Water	296	296	0
Total:	**43,770**	**43,770**	**0**

Featured species current and projected habitat acres

There are seven featured species in this management area that span various cover types, age classes, and stand level conditions. Current and projected total habitat acres by species across the decade provide a baseline and show the result of long-term management actions (Table 8). As noted in the Featured Species Management Priority (Section 3), it is recommended that these featured species habitat acres be viewed as acres of potential habitat, representing a condition on the landscape where the more nuanced aspects of each species' habitat requirements are likely to be found or managed for. As described in the introduction, the modeling effort was limited by several factors including the simplification of habitat attributes into MiFI variables. Therefore, when referring to habitat acres what is being referred to is potential habitat acres.

Some species show a loss in habitat over the next century. As mentioned in the Featured Species Management Priority (Section 3), the current condition for many cover types is a surplus of acres in the 0-9 age class from the compensatory management approach applied in the previous decade. The model eventually evens out the age classes at a lower, sustainable level over time, usually by 50 years. For any species with northern hardwoods as a priority cover type, there is a perceived drop in acres between 40 and 60 years; this is due to the basal area dropping below 81 but because it only drops into the upper 70s, it is not expected to translate to any real habitat loss on the ground. Two of these species, black bear and wild turkey, were not included in the State Forest Management Plan model but are included here to inform management decisions over the decade.

Table 8. Featured species current and projected total habitat acres (i.e., potential habitat).

Featured Species	Priority Cover Types	Total Habitat Acres Current	10-year Projected Habitat Acres	50-year Projected Habitat Acres	100-year Projected Habitat Acres
Black Bear	Generalist/mast	--	--	--	--
Black-Throated Blue Warbler	Northern hardwoods, mixed upland deciduous	4,276	4,745	2,163	4,565
Marten	Northern hardwoods, mixed upland deciduous, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, lowland mixed forest, lowland conifers, hemlock, cedar	11,111	11,508	9,177	10,907
Ruffed Grouse	Aspen	8,740	7,930	6,290	6,543
Snowshoe Hare	Aspen, cedar, hemlock, lowland aspen, lowland conifers, lowland mixed forest, lowland spruce/fir, mixed upland deciduous, natural jack pine, natural mixed pines, planted jack pine, upland spruce/fir	10,529	10,113	7,650	7,968
Wild Turkey	Nonforested openings	1,032	--	--	--
Wood Thrush	Northern hardwoods, northern red oak, mixed upland deciduous, lowland deciduous	7,687	8,132	5,374	7,542
Wood Turtle	Nonforested openings	--	--	--	--

Cover type composition and associated featured species

Aspen

Current condition

The aspen cover type is currently distributed well across most of the age classes. There are larger spikes in the 0-9 and 10-19 age classes and a large deficit in the 20-29 age class. The larger 0-9 age class spike is in part due to the compensatory approach used to help balance age classes in the last 10 years. Meaning, larger amounts of acres were put into the 0-9 age class to compensate for the lack of acres in the 20-29 age class (Figure 3). The past management regime has been primarily clearcut for this cover type. This current planning period will continue to smooth out the distribution of the aspen in this management area.

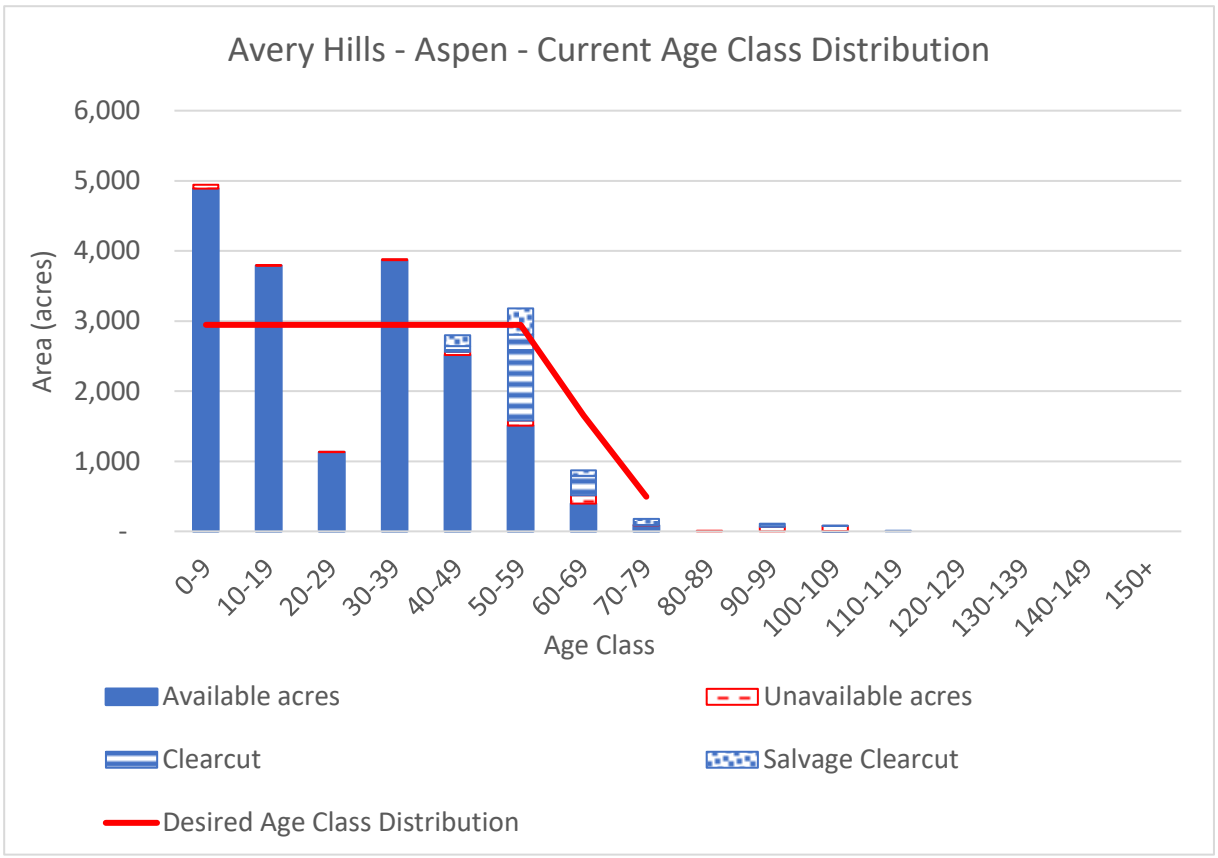


Figure 3. Current age class distribution, the desired age class distribution, and the projected harvests in the aspen cover type over the 10-year planning period.

Current conditions are a result of consistent commercial harvests and regeneration efforts on available aspen acres during the previous planning periods. A portion of this cover type meets the habitat requirements for ruffed grouse and snowshoe hare (Table 9).

Table 9. Featured species with aspen as a priority habitat cover type, habitat variables and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Aspen	Aspen Habitat Acres - Available	Aspen Habitat Acres - Unavailable
Ruffed Grouse	Age Category: 0-19 Size Class: Sapling	8,686	54
Snowshoe Hare	Age Category: 0-19 Size Class: Sapling	8,686	54

Desired future condition

The projected long-term cover type trend for aspen is stable in the Avery Hills Management Area. There are a few transitions into this cover type from other cover types forecasted in this management area increasing the aspen cover type acreage by approximately 276 acres in the first 10-year planning period, then continuing this trend in the following planning periods.

The long-term goal for this cover type is balanced age classes between 0 and 60-years-old for all available aspen stands in this management area. Maintaining lower acreage in the 60-69- and 70-79-year-old age classes continues to be desirable from a habitat standpoint and to ensure the aspen cover type is distributed within the desired age classes.

The end of the planning period will result in the establishment of the desired amount of regeneration in the upcoming 0-9 age class. Progress toward the long-term age class distribution of aspen will take several decades in the management area (Figure 4).

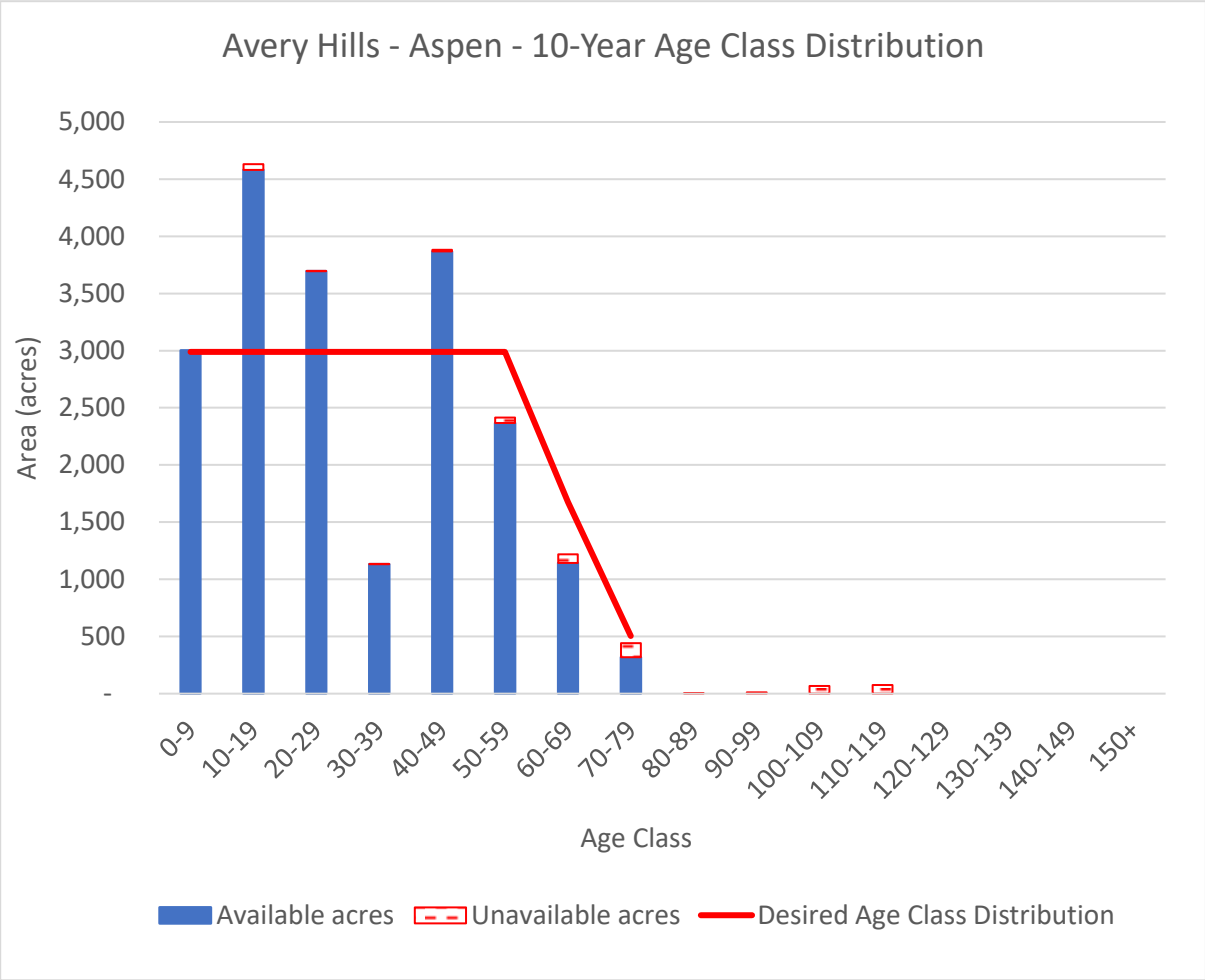


Figure 4. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of aspen acres has nearly reached the desired future condition (Figure 5).

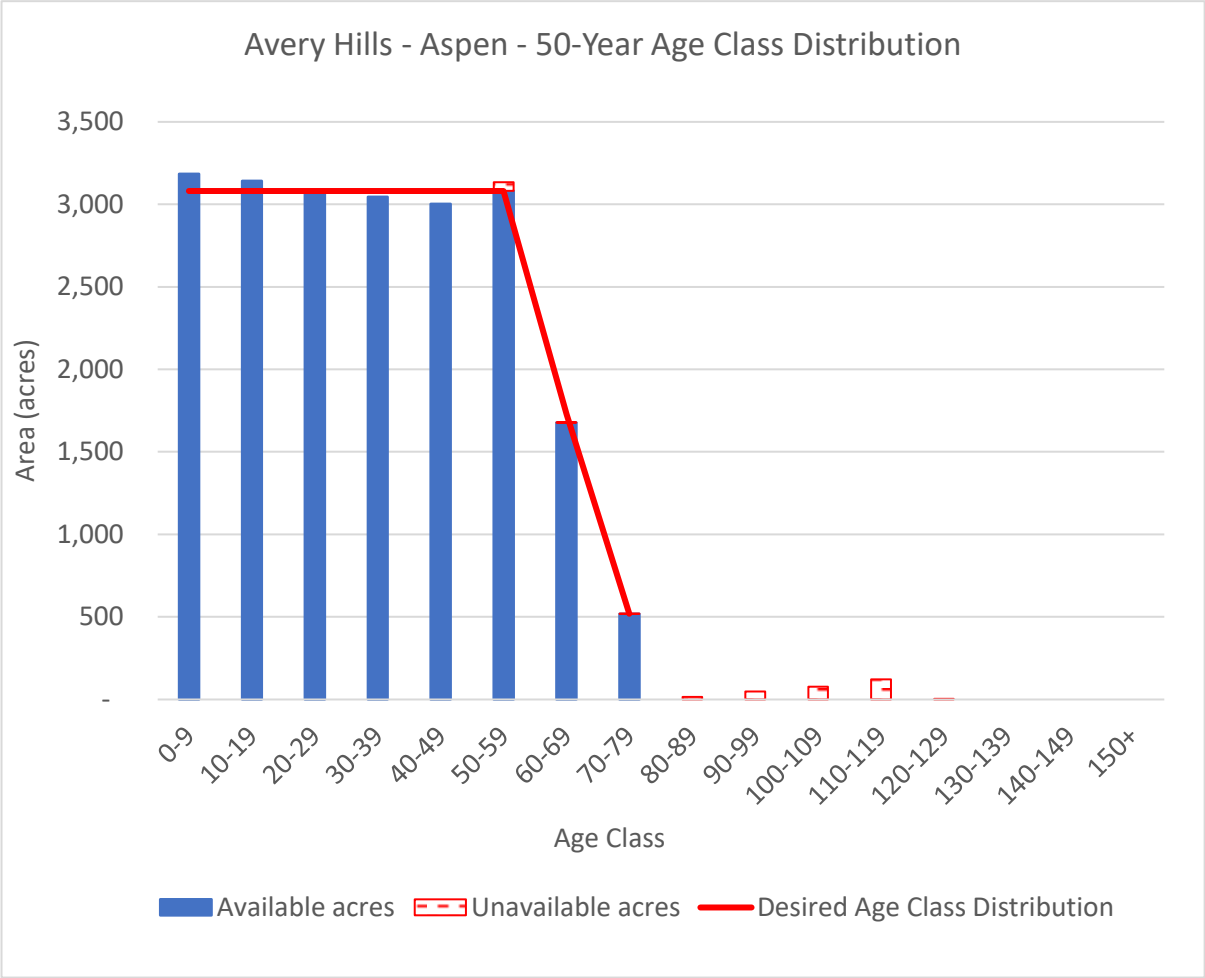


Figure 5. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 6) will concentrate the manageable acres of aspen in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest (Figure 7).

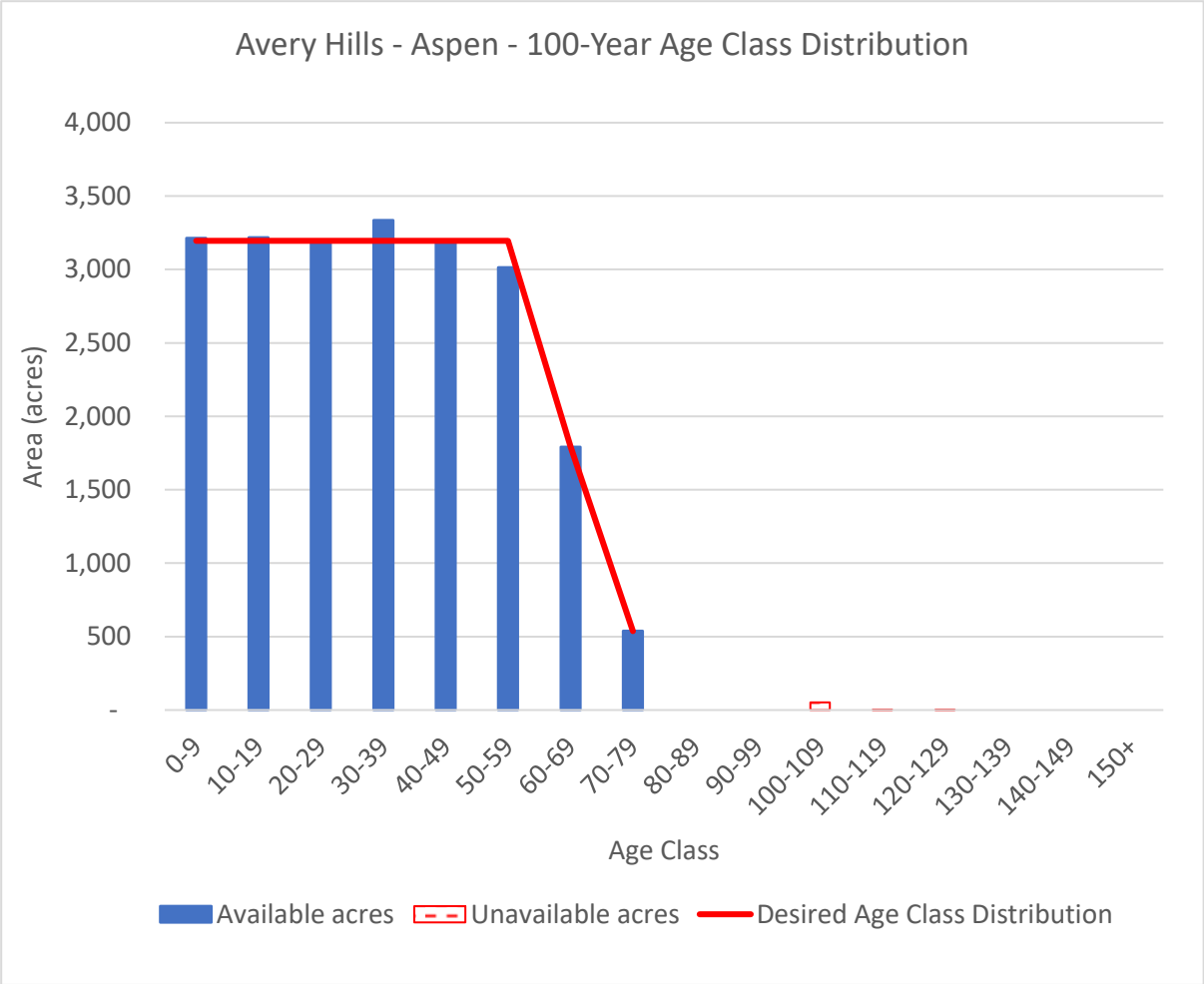


Figure 6. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

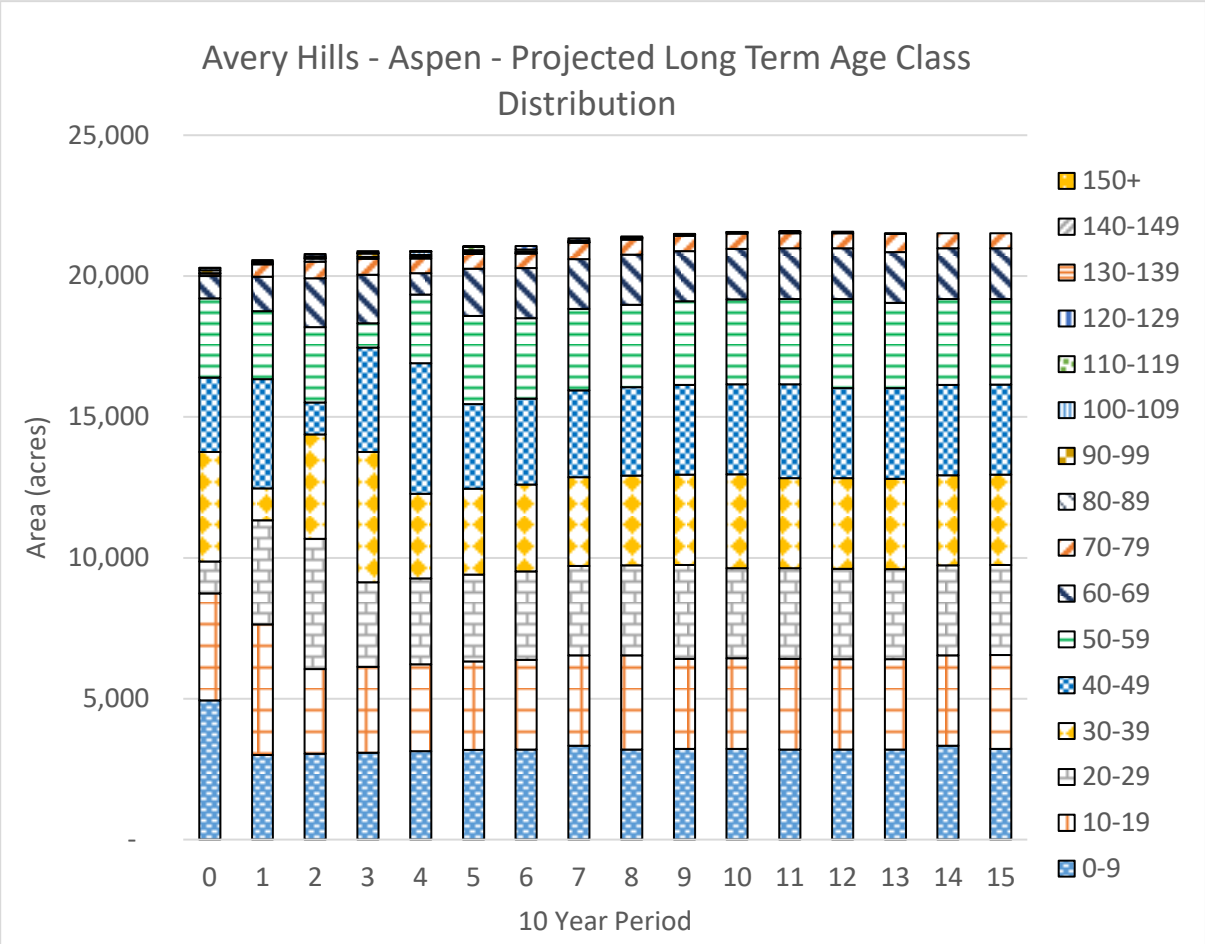


Figure 7. Projected age class distribution for all acres of aspen over the next 150 years.

Management actions

There are 2,333 acres of projected clearcut harvest in the aspen cover type during this planning period. There are an additional 409 acres that the model expects will regenerate due to 2025 ice storm damage. These acres, plus the 276 acres that will transition from other cover types total 3,018 acres, slightly over the desired establishment of 2,947 acres per decade.

Northern hardwoods

Current condition

Most of the northern hardwood cover type is currently between a stand age of 90 and 119 years old in the Avery Hills Management Area (Figure 8). The past management regime has been primarily single-tree selection which allows for stand age to continue to increase over time. Group selection harvests were used in less amounts over the last planning period.

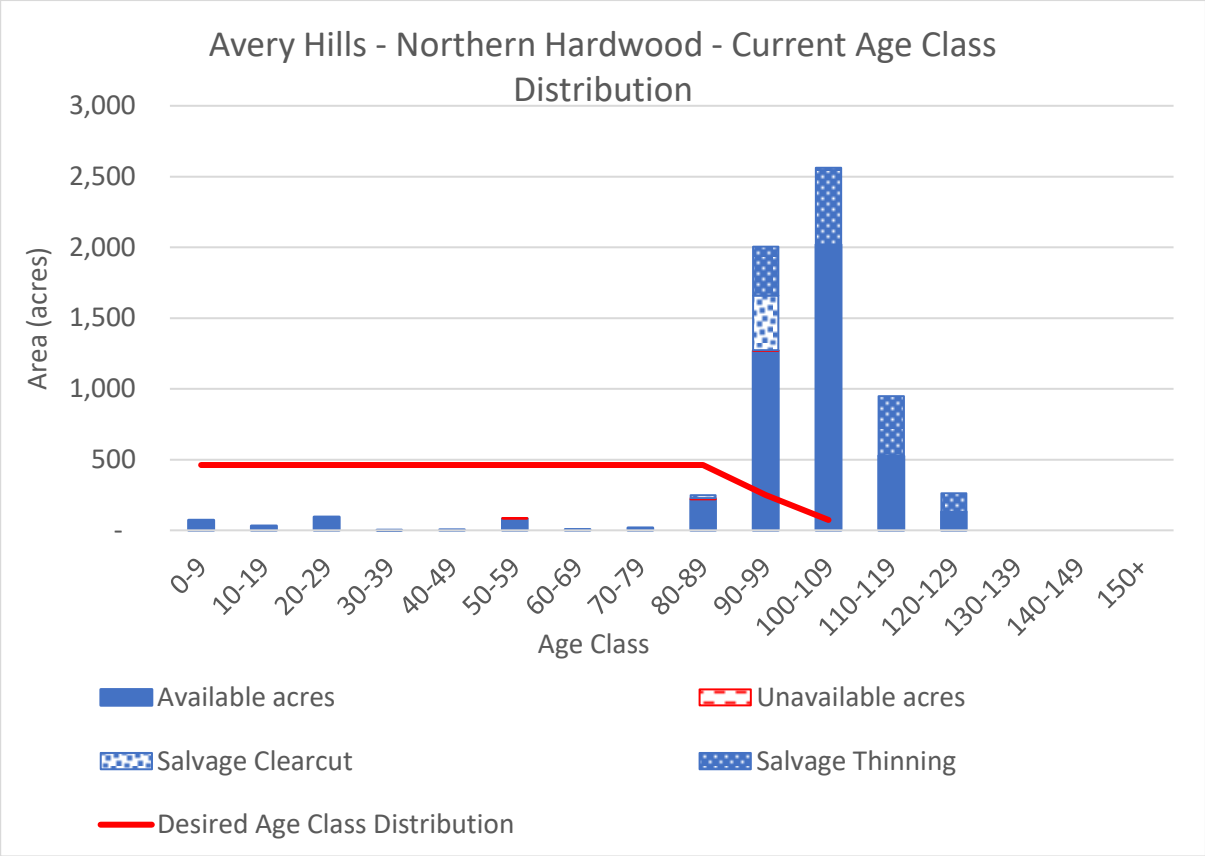


Figure 8. Current age class distribution and projected harvests in the northern hardwood cover type.

The area of northern hardwood is well distributed in the ideal basal area classes for optimal growing conditions in the Avery Hills Management Area (Figure 9). Current conditions are a result of a regulated selection harvest regime that has been in place in this management area. Ash and beech salvage efforts have aided in maintaining this 81-110 basal area condition.

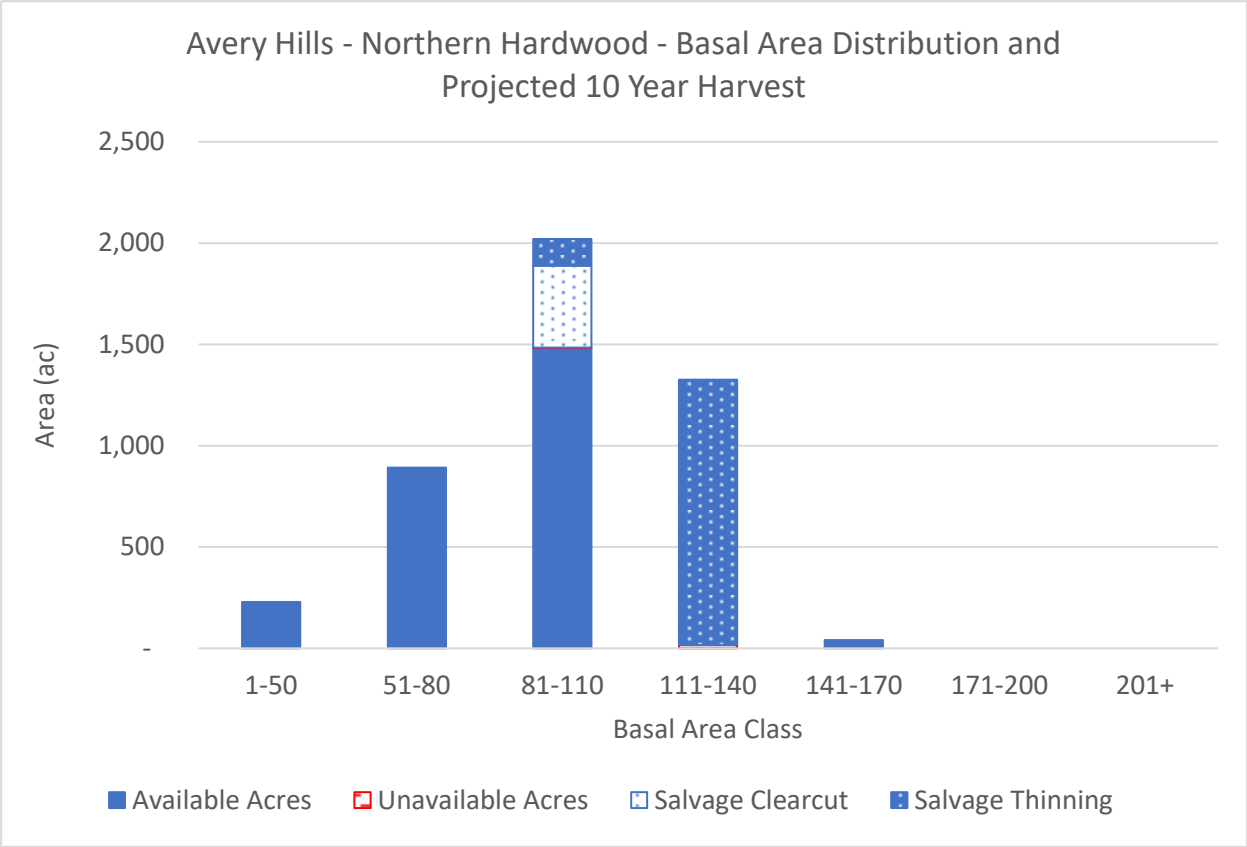


Figure 9. Current basal area distribution of the northern hardwood cover type as well as the projected harvests from each basal area class.

Selection harvest and thinning are the primary silvicultural treatment projected during this 10-year planning period with clearcutting opportunities present in order to salvage damaged trees from the 2025 ice storm and to utilize even-aged management silvicultural regimes to increase stem density, species composition, and regeneration within the northern hardwood areas. A portion of this cover type meets the habitat requirements for black-throated blue warbler and marten (Table 10).

Table 10. Featured species with northern hardwoods as a priority habitat cover type, habitat variables and current acres (e.g., potential habitat).

Featured Species	Featured Species Habitat – Northern Hardwood	Northern Hardwood Habitat Acres – Available	Northern Hardwood Habitat Acres – Unavailable
Black-Throated Blue Warbler	Age Category: 80+ Size Category: Sawlog Basal Area: 81+	3,306	16
Marten	Age Category: 40+ Size Category: Pole, Sawlog Basal Area: 81+	3,367	18

Desired future condition

The projected cover type trend for northern hardwood is slightly decreasing in the Avery Hills Management Area over the next 60 years followed by slight increases over the next 90 years (Figure 10). There are no projected transitions into this cover type from other cover types forecasted in this management area over the next 10 years and no projected transitions from northern hardwoods to other cover types during the same period.

The desired basal area distribution is a bell-shaped curve where a significant majority of the area is kept in the 81-110 basal area class with recently harvested stands occupying the 51-80 class and stands that are ready for harvest occupy the 111-140 basal area class.

Regeneration and recruitment continue to be a focus in the northern hardwood cover type across this management area. The long-term sustainability of this cover type in an uneven-aged silvicultural regime is dependent on the successful establishment of northern hardwood species as well as the recruitment of those seedlings and saplings into the pole and saw log classes. The Avery Hills Management Area will take several decades to reach the desired future condition.

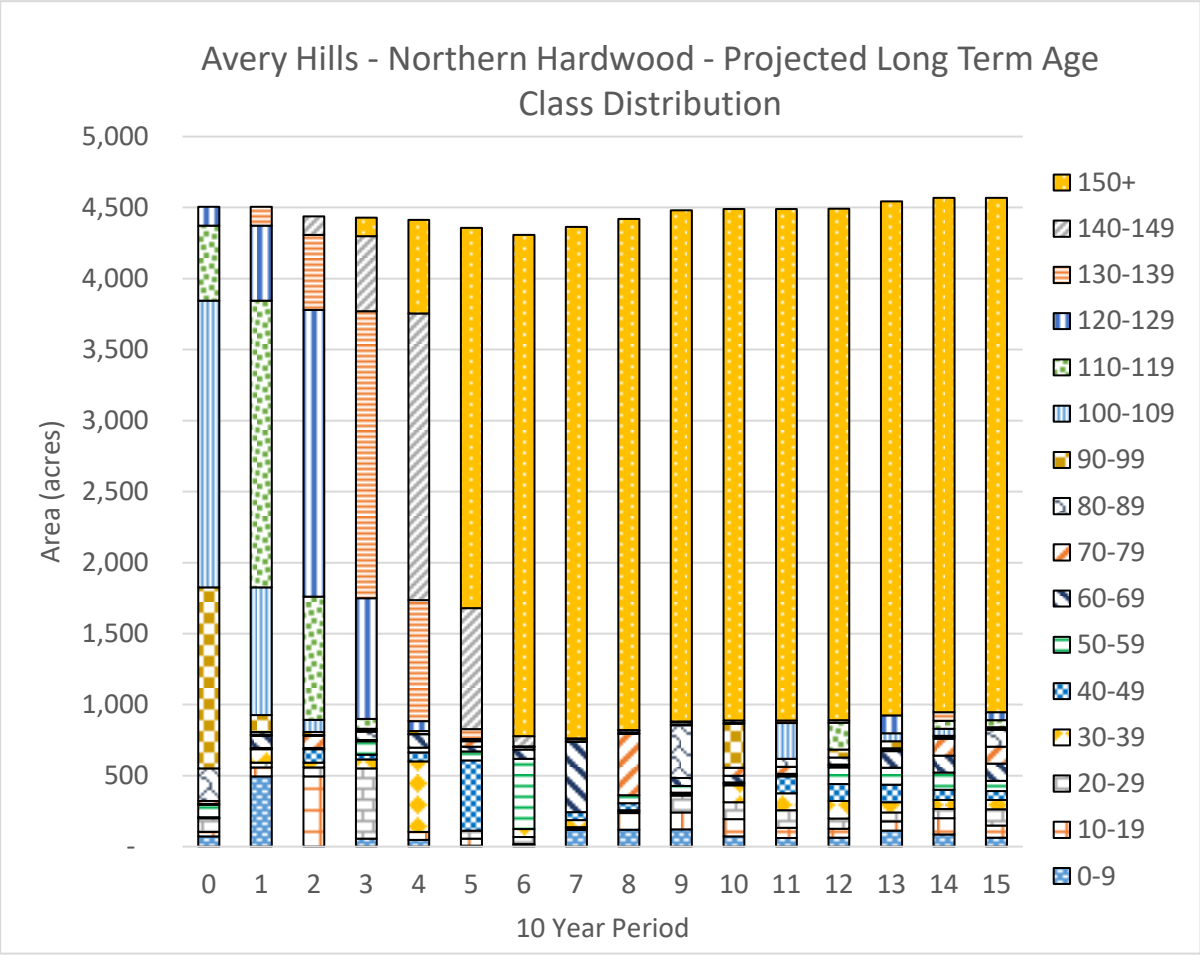


Figure 10. Projected age class distribution for all acres of northern hardwood over the next 150 years.

Management actions

The desired forest conditions and associated featured species habitat will be maintained and achieved through continued application of the projected single tree selection harvest regime on 1,441 acres and clearcut on 405 acres throughout the first 10-year planning period (Table 3). Multiple silvicultural regimes should have continued consideration as emerging research results become available. Emphasis on larger canopy gaps should be used to encourage diverse regeneration of northern hardwood species while maintaining an overall long-term mature forest closed canopy landscape condition.

Northern red oak

Current condition

Most of the northern red oak cover type is currently in the 100-109 age class in the Avery Hills Management Area (Figure 11). The past management regime has been a mix of single tree selection, group selection and some clearcutting. These stands were generally fire originated about 100-plus years ago. Regeneration of these stands through traditional management has been very difficult and has resulted in some stand conversions. The stands that have remained in northern red oak through selection harvesting continue to age. The northern red oak cover type in the Avery Hills Management Area is of medium quality but seems to hold strong in older age classes compared to oak that declines at much younger ages in other areas.

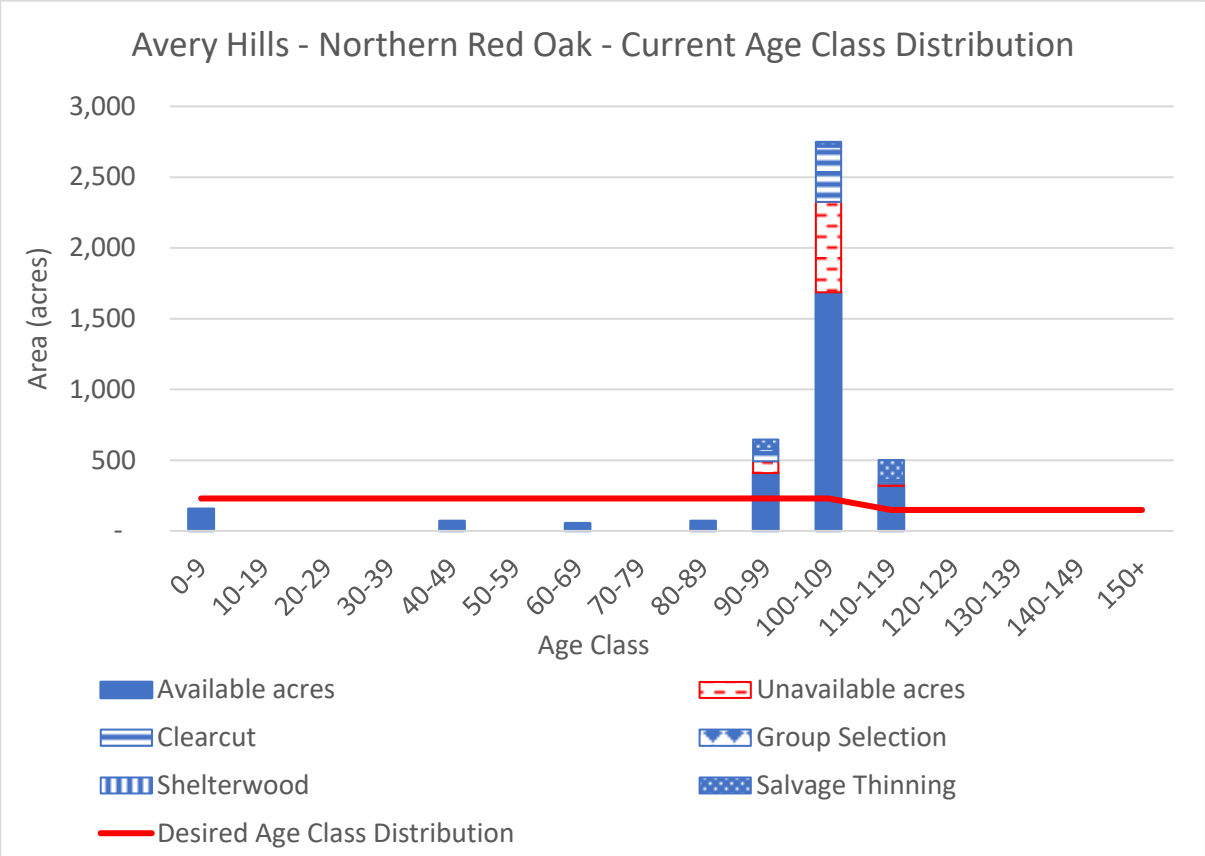


Figure 11. Current age class distribution and projected harvests in the northern red oak cover type.

The area of northern red oak is well distributed in the ideal basal area classes for optimal growing conditions in the Avery Hills Management Area (Figure 12). Current conditions are a result of past shelterwood and selection harvests maintaining the basal area in a bell-shaped curve across the basal area classes.

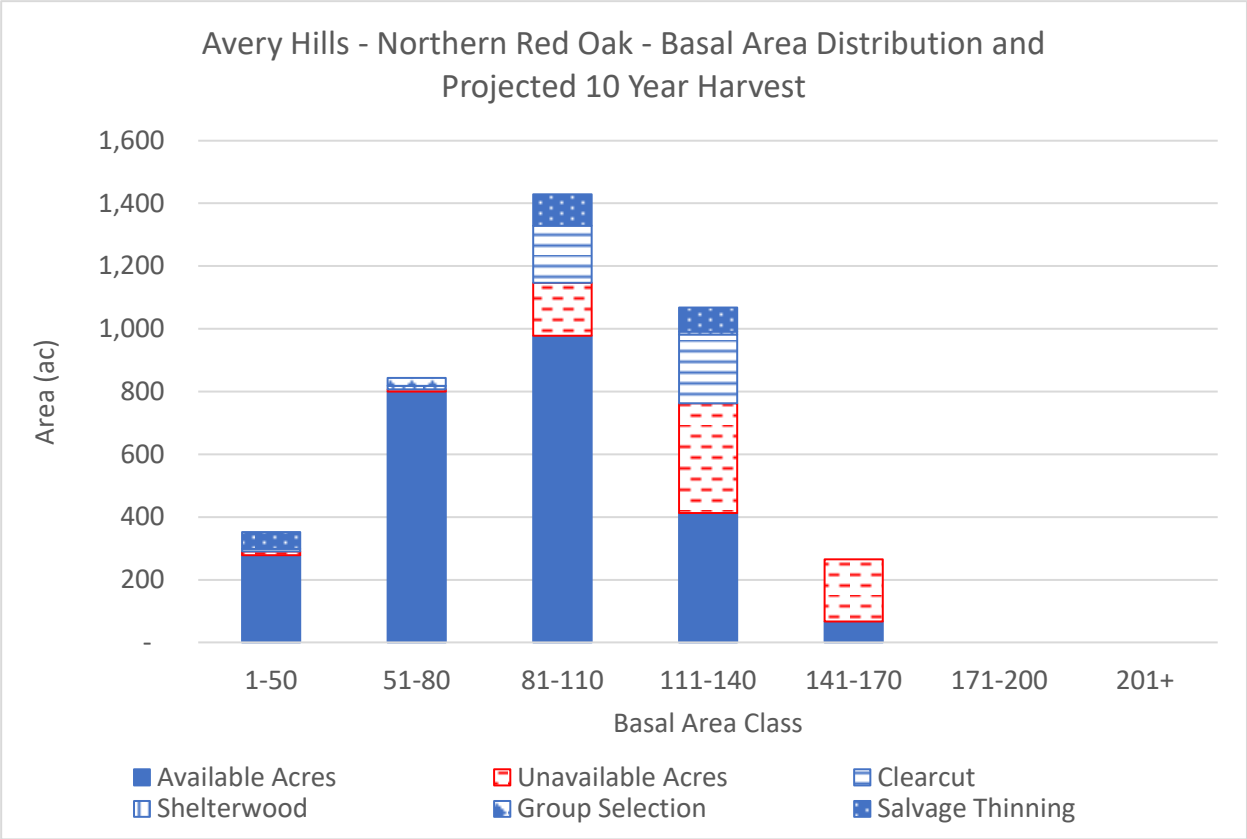


Figure 12. Current basal area distribution of the northern red oak cover type as well as the projected harvests from each basal area class.

Clearcut harvest and thinning are the primary silvicultural treatments projected during this 10-year planning period. These silvicultural regimes will help to maintain optimal growing basal areas while providing some regeneration opportunities. Some of these stands will be converted to other cover types over time throughout this planning period and future periods. These conversions are primarily due to regeneration difficulties and lack of stand replacing fires pushing them into more of the mixed cover types. A portion of this cover type meets the habitat requirements for marten and wood thrush (Table 11).

Table 11. Featured species with northern red oak as a selected habitat cover type, habitat variables and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Northern Red Oak	Northern Red Oak Habitat Acres – Available	Northern Red Oak Habitat Acres - Unavailable
Marten	Age Category: 40+ Size Category: Pole, Sawlog Basal Area: 81+	2,208	718
Wood Thrush	Age Category: 40+ Size Category: Sawlog Basal Area: 81+	2,208	718

Desired future condition

The projected long-term cover type trend for northern red oak is decreasing in the Avery Hills Management Area (Figure 13). There are no transitions into this cover type from other cover types forecasted in this management area over the next planning period. There are about 314 acres that will be transitioning to other cover types during the planning period.

The desired basal-area distribution is a bell-shaped curve where a significant majority of the area is kept in the 81-110 basal-area class with recently harvested stands occupying the 51-80 class and stands ready for harvest occupy the 111-140 basal-area class. The age class trend will continue to get older while regenerating some of the stands where possible will help add acres to the 0-9 age class. The northern red oak in this management area can sustain longer into older age classes before significant decline takes place.

Regeneration and recruitment continue to be a focus in the northern red oak cover type across this management area. The long-term sustainability of the northern red oak will be more as a component of the mixed upland deciduous cover type as some acres will transition out of the northern red oak cover type and into the mixed upland deciduous through clearcutting. The percentage of northern red oak seedlings that recruit are expected to be less than the current cover type but will still be a significant component in these stands. Thinning, shelterwood and groups selection will continue to be used as silvicultural methods to maintain basal area and provide habitat into older age classes. The Avery hills Management Area will take several decades to achieve this future condition.

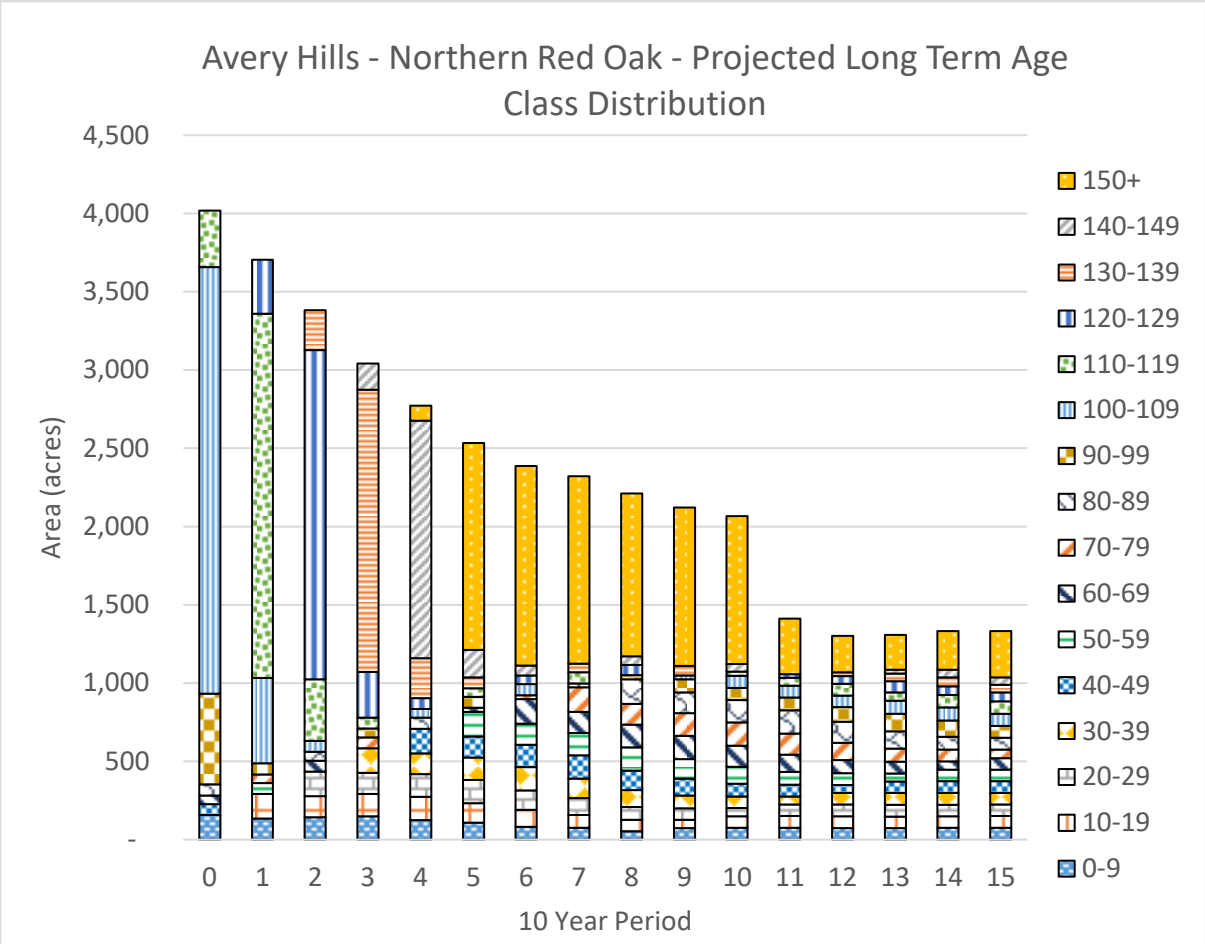


Figure 13. Projected age class distribution for all acres of northern red oak over the next 150 years.

Management actions

The desired forest conditions and associated featured species habitat will be maintained and achieved through continued application of an array of different silvicultural treatments including 469 acres of clearcut, 25 acres of group selection, 20 acres of shelterwood, and about 232 acres of ice storm salvage treatments throughout the first 10-year planning period (Table 5).

Mixed upland deciduous

Current condition

The mixed upland deciduous cover type is currently distributed well across most of the age classes (Figure 14). There is a larger spike in the 0-9 class and deficits in the rest of the age classes until the 90-109 ages where there is a spike in acreage in these older two groups. The larger 0-9 spike is partially due to the conversion of many oak stands over the last 10-year planning period. Many of the more purely oak stands regenerate to a more mixed stands with an oak component. The past management regime has been primarily clearcut for this cover type. This current planning period will continue to smooth out the distribution of the mixed upland deciduous in this management area.

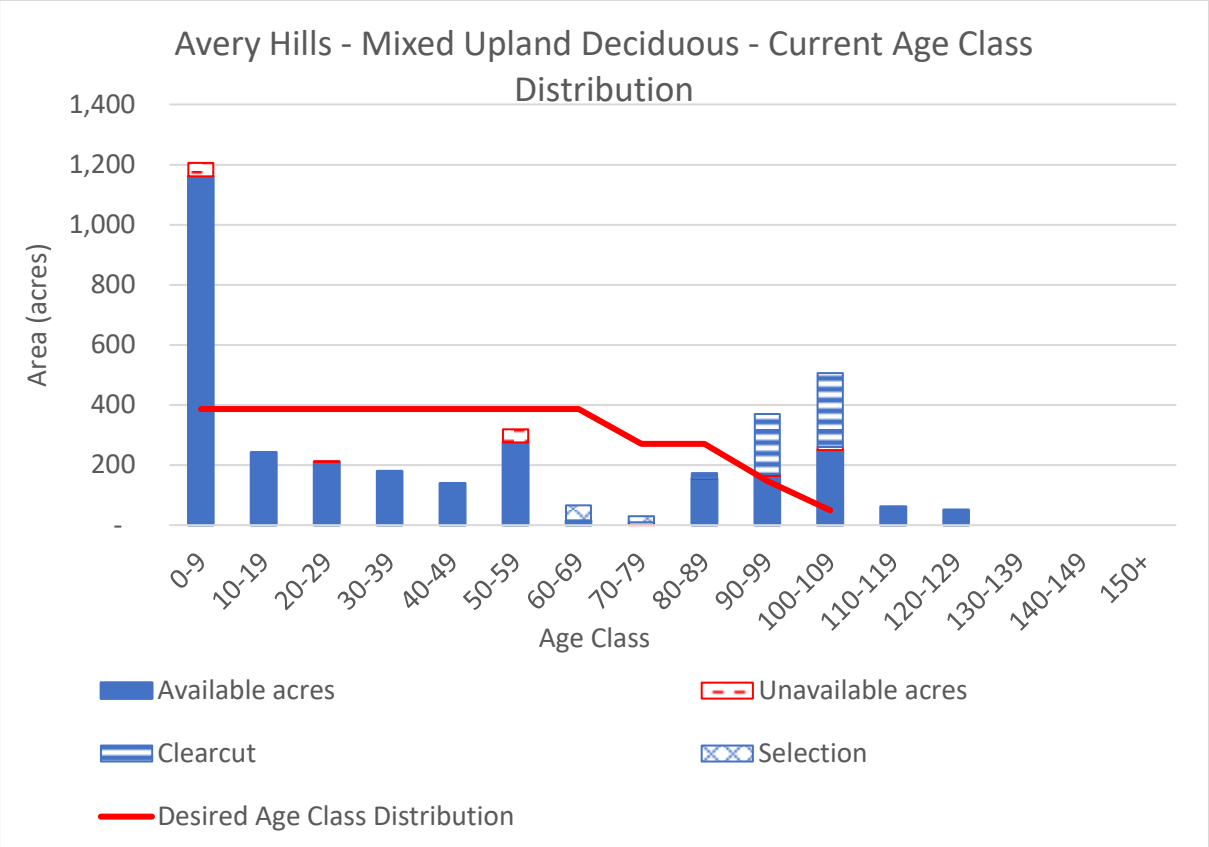


Figure 14. Current age class distribution, the desired age class distribution, and the projected harvests in the mixed upland deciduous cover type over the 10-year planning period.

Current conditions are a result of consistent conversions or reclassification of oak stands into the mixed cover type. Commercial harvests and regeneration efforts on available mixed upland deciduous acres have also contributed to large number of acres in the 0-9 year-old age class over the last planning period.

Table 12. Featured species with mixed upland deciduous as a priority habitat cover type, habitat variables and current acres (e.g., potential habitat).

Featured Species	Featured Species Habitat – Mixed Upland Deciduous	Mixed Upland Deciduous Habitat Acres – Available	Mixed Upland Deciduous Habitat Acres – Unavailable
Snowshoe Hare	Age Category: 0-19 Size Category: Sapling	1,404	44
Black-Throated Blue Warbler	Age Category: 80+ Size Category: Sawlog Basal Area: 81+	947	7
Marten	Age Category: 40+ Size Category: Pole, Sawlog Basal Area: 81+	1,267	31
Wood Thrush	Age Category: 40+ Size Category: Sawlog Basal Area: 81+	1,267	31

Desired future condition

The projected long-term cover type trend for mixed upland deciduous is gradually increasing then stabling off in later planning periods in the Avery Hills Management Area. There are a few transitions into this cover type from other cover types forecasted in this management area increasing the mixed upland deciduous cover type acreage by approximately 15 acres in the first 10-year planning period, then continuing this trend in the following planning periods.

The long-term goal for this cover type is balanced age classes between 0 and 60-years-old for all available mixed upland deciduous stands in this management area. Then maintaining lower acreage in the 70- to 79 and 80- to 89-year-old age classes before tapering off throughout the classes maintaining lesser amount out until the 110-119-year-old age class. This continues to be desirable from a habitat standpoint and to ensure the mixed upland deciduous cover type is distributed within the desired age classes.

The end of the planning period will result in the establishment of slightly higher amounts of the desired amount of regeneration in the upcoming 0-9 age class. Progress toward the long-term age class distribution of the mixed upland deciduous cover type will take several decades in the management area (Figure 15).

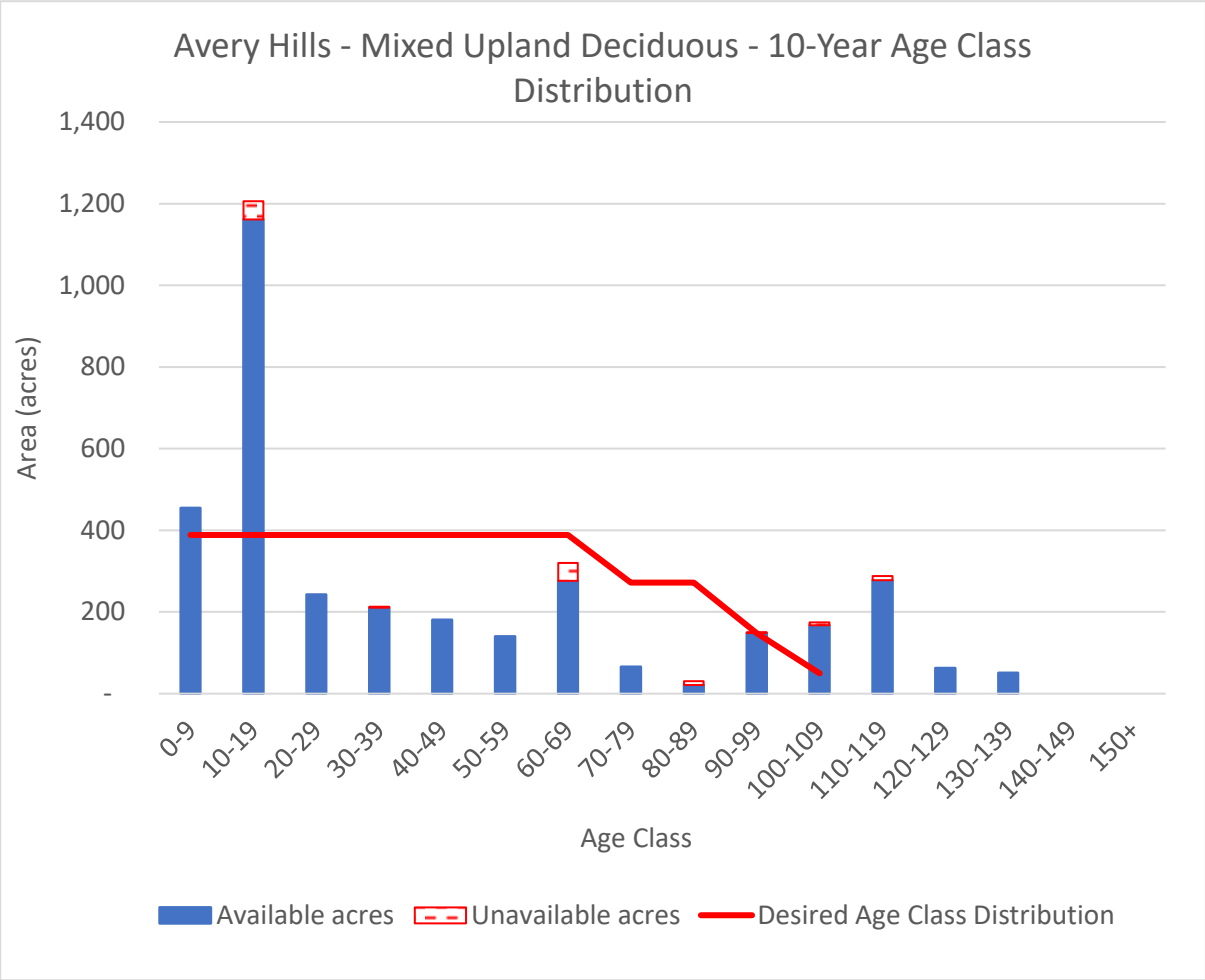


Figure 15. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of mixed-upland deciduous acres progressing toward the desired future condition (Figure 16).

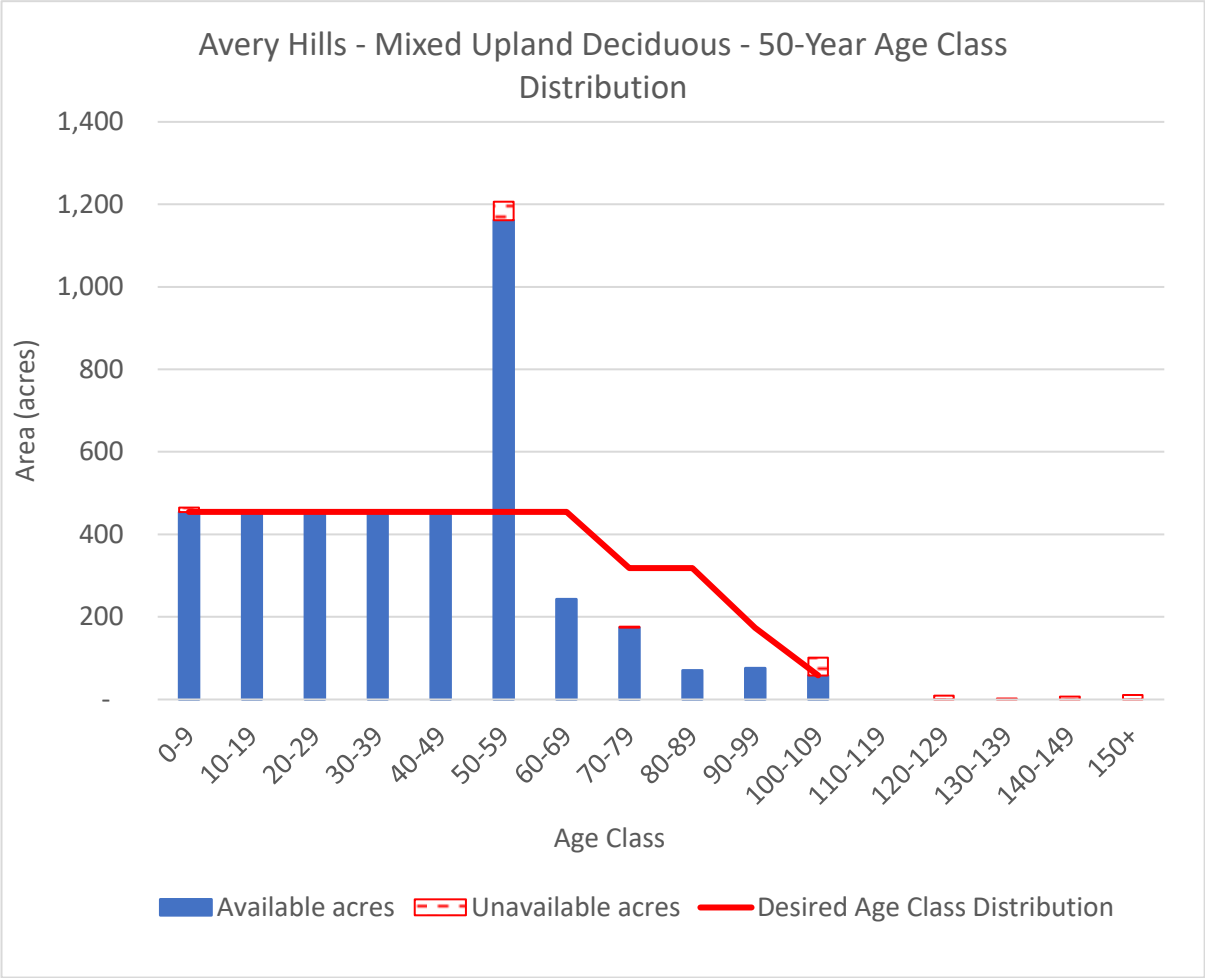


Figure 16. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 17) will concentrate the manageable acres of mixed-upland deciduous in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest (Figure 18).

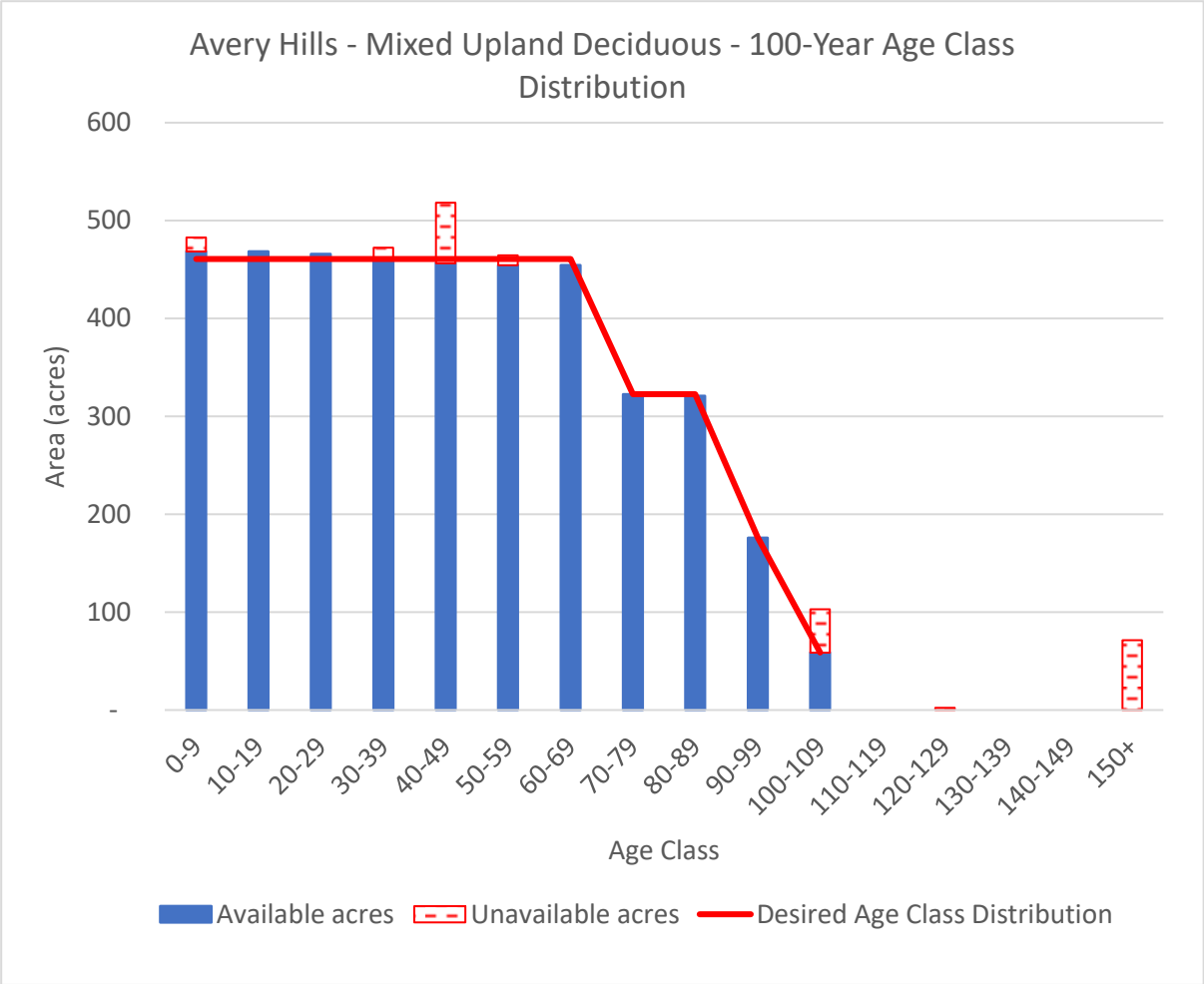


Figure 17. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

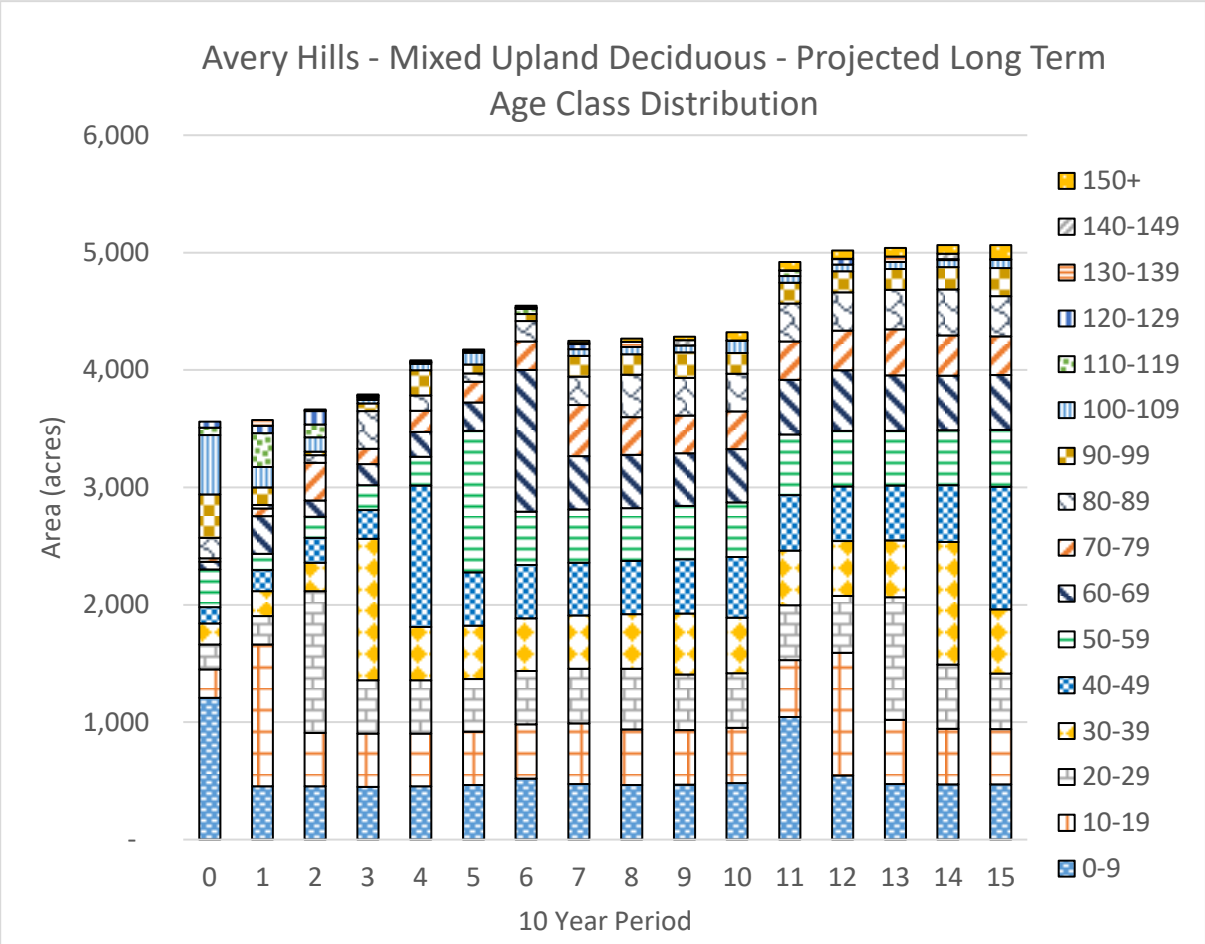


Figure 18. Projected age class distribution for all acres of mixed-upland deciduous over the next 150 years in the Avery Hills Management Area.

Management actions

There are 463 acres of projected clearcut harvest, and 71 acres projected for selection harvest in the mixed-upland deciduous cover type during this planning period. This target is slightly higher than the desirable amount of acreage going into the 0-9 year-old age class in part due to stand sizes and spatial allocation of the acreage across available stands. With the addition of the 15 acres transitioning into this cover type, this will be slightly higher than the target for the planning period resulting in the gradual increase of acreage across this cover type.

Conservation area network

High conservation value areas

There are up to nine different high conservation value area (HCVA) types that can be found in each management area (Table 14; see Biodiversity in Section 3 for more information).

Table 13. High conservation value areas within the management area.

High Conservation Value Area Type and Name	Acres
GEMS	**1,078**
Greasy Creek	1,078
Grand Total	**1,078**

Ecological reference areas

Ecological reference areas are a type of HCVA and are higher-quality examples of functioning ecosystems that are primarily influenced by natural ecological processes.

Table 14. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 15. Ecological reference areas (ERAs) within the management area.

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	Number of Occurrences
Existing ERA	**Dry-mesic Northern Forest**	D	G4	S3	1
Existing ERA	**Rich Conifer Swamp**	B			1
Existing ERA	**Rich Conifer Swamp**	BC	G4	S3	1
Grand Total					**3**

Special conservation areas

Reviewable special conservation areas (SCAs; Table 16) refers to those area types that may be reviewed or updated through the compartment review process as needed. Static SCAs (Table 17) refers to those area types that generally do not change or require updating (see Biodiversity in Section 3 for more information).

Table 16. Reviewable special conservation areas within the Avery Hills Management Area.

Reviewable Special Conservation Area Type and Name	Acres
Habitat Area or Habitat Corridor	**98**
Sage Lake ERA	98
Mineral Resource Area	**16**
Montmorency County Road Commission	4
Pit # 129- Greasy Creek Gravel Pit	1
Pit # 14- Greasy Creek	11
Spring, Wetlands or Riparian Areas	**2**
Spring Seep	1
Vernal Pond Cedar Seep	1
Grand Total	**116**

Table 17. Static special conservation areas within the Avery Hills Management Area.

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Designated Trout and Cold Water Stream Buffer		**828**
		425
Barger Creek		10
Crooked Creek		43
Fuller Creek		37
Gilchrist Creek		37
Greasy Creek		20
Hunt Creek		107
Miller Creek		14
Nugent Creek		13
Sage Creek		66
Sheridan Creek		14
Stanniger Creek		7
Thunder Bay River		35
Designated Trout and Coldwater Streams	**31.0**	
	15.7	
Barger Creek	0.4	
Crooked Creek	1.6	
Fuller Creek	1.4	
Gilchrist Creek	1.4	
Greasy Creek	0.7	
Hunt Creek	4.1	
Miller Creek	0.5	
Nugent Creek	0.5	
Sage Creek	2.4	
Sheridan Creek	0.5	
Stanniger Creek	0.2	
Thunder Bay River	1.6	
Important Bird Areas		**1,668**
Pigeon Country moraines		1,668
Research Areas		**2,693**
Hunt Creek Fish Research Station		2,693
Wood Turtle Stream 100 ft Buffer		**7**
Thunder Bay River		7
Wood Turtle Stream 660 ft Buffer		**43**
Thunder Bay River		43
Grand Total	**31.0**	**5,238**

Rare species

Rare species occurrences are compiled from the Michigan Natural Features Inventory Biotics database (Table 18, Table 20 and Table 21) and do not necessarily include all rare species found in this management area due to biases in survey effort and verifiable observation reporting over time.

Table 18. Rare animal and plant species conservation status key.

Status	Status
E = endangered	LE = listed endangered
T = threatened	LT = listed threatened
SC = special concern	PDL = proposed for delisting

Table 19. Rare animal occurrence within the Avery Hills Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Alasmidonta viridis	Slippershell	T		1
Animal	Appalachia arcana	Secretive locust	SC		2
Animal	Appalachina sayanus	Spike-lip crater	SC		3
Animal	Bombus terricola	Yellow banded bumble bee	SC		1
Animal	Buteo lineatus	Red-shouldered hawk	SC		2
Animal	Emydoidea blandingii	Blanding's turtle	SC		2
Animal	Gavia immer	Common loon	T		4
Animal	Glyptemys insculpta	Wood turtle	T		2
Animal	Haliaeetus leucocephalus	Bald eagle	SC		4
Animal	Hesperia metea	Cobweb skipper	SC		1
Animal	Lasmigona compressa	Creek heelsplitter	SC		2
Animal	Lithobates palustris	Pickerel frog	SC		1
Animal	Opheodrys vernalis	Smooth green snake	SC		1
Animal	Pyrgus centaureae wyandot	Grizzled skipper	T		1
Animal	Setophaga discolor	Prairie warbler	SC		1
Animal	Setophaga kirtlandii	Kirtland's warbler	E		1
Total	-	-	-	-	**29**

Table 20. Rare plant occurrence within the Avery Hills Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Plant	Agoseris glauca	Prairie or pale agoseris	T		1
Plant	Amerorchis rotundifolia	Small round-leaved orchis	E		1
Plant	Cirsium hillii	Hill's thistle	SC		1
Plant	Cypripedium arietinum	Ram's head lady's-slipper	SC		2
Plant	Festuca altaica	Rough fescue	SC		1
Plant	Gymnocarpium robertianum	Limestone oak fern	T		1
Plant	Prunus umbellata	Alleghany or Sloe plum	SC		1
Total	-	-	-	-	**8**

Table 21. Other rare occurrence within Avery Hills Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Other	-	Great blue heron rookery			1
Total	-	-	-	-	**1**

Non-ERA Natural Communities

Natural communities that are identified with an element occurrence in the MNFI Biotics database, but have not been given an additional ecological reference area designation, are recognized and managed accordingly (Table 22).

Table 22. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 23. Non-ecological reference area natural communities within Avery Hills Management Area.

Community Type	Element Occurrence Rank	State Rank	Global Rank	Number of Occurrences
Dry-mesic Northern Forest	D	S3	G4	1
Rich Conifer Swamp	B	S3	G4	1
Rich Conifer Swamp	BC	S3	G4	1
Total	-	-	-	**3**

Forest health

Forest health concerns, both native and non-native, can have impacts on stand conditions and management decisions. The following insects (Table 24) and diseases (Table 25) could have an impact on management during the planning period and may need to be monitored and/or addressed.

Table 24. Defoliating insects of concern in the Avery Hills Management Area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Spongy moth	Lymantria dispar	Non-native	Yes
Forest tent caterpillar	Malacosoma disstria	Native	Yes
Large aspen tortrix	Choristoneura conflictana	Native	Yes
Spruce budworm	Choristoneura fumiferana	Native	
Jack pine budworm	Choristoneura pinus	Native	

Watch for and retain lingering ash with potential resistance to emerald ash borer.

Table 25. Maladies of concern in the Avery Hills management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Canker (stem infections)	Various	Various	Yes
Armillaria root rot	Armillaria spp.	Native	
Oak decline	Various	Various	Yes

Watch for and report symptoms of oak wilt and follow guidance in the oak wilt management guidance for state land.

Aquatic resources

Riparian habitat

A total of 24 miles of streams and rivers are found in the management area (Table 26). Streams/rivers classified as cold types comprise approximately 96% of the riverine mileage.

Table 26. Classification type and length of streams/rivers found within the management area.

Type	Length (miles)
Cold Stream	18
Cold Small River	0
Cold Transitional Stream	5
Cold Transitional Small River	0
Cold Transitional Large River	0
Warm Transitional Stream	1
Warm Transitional Small River	0
Warm Transitional Large River	0
Warm Stream	0
Warm Small River	0
Warm Large River	0

Lacustrine habitat

A total of nine lakes and ponds of at least 1 surface acre are found in the management area (Table 27).

Table 27. Size and number of lakes and ponds located within the management area.

Lake Size Class (acres)	Number
1-99	6
100-499	3
500+	0

Wetlands

A total of 3,484 acres of wetlands are found in the management area (Table 28). Forested wetlands comprise approximately 93% of wetland types found in the management area.

Table 28. Area of emergent, forested and riverine wetland types found within the management area.

Wetland Type	Area (acres)
Emergent	217
Forested	3,227
Riverine	40

Vernal pools and seeps

A total of 1,050 acres of stands containing vernal pools have been inventoried in the management area while 1,011 acres of stands with seeps have been identified.

Riparian vegetation cover

Aspen is the predominant cover type present in a 100-meter riparian zone located next to streams/rivers in the management area (Table 29).

Table 29. Largest vegetative cover types (i.e., top 10) and area located in a 100-meter buffer of streams/rivers within the management area.

Cover Type	Area (acres)
Aspen	1,052
Cedar	885
Lowland Conifers	327
Marsh	185
Northern Red Oak	149
Northern Hardwood	141
Mixed Upland Deciduous	112
Lowland Shrub	100
Natural Jack Pine	96
Planted Red Pine	74

Watershed vegetation cover

The management area includes portions of important watersheds of the Thunder Bay River and East Branch Big Creek (Table 30). Aspen is a major cover type of the state forest in each watershed.

Table 30. Largest vegetative cover types (i.e., top five) and area of the Thunder Bay River watershed located within the management area.

Cover Type	Area (acres)
Aspen	19,013
Northern Red Oak	4,741
Northern Hardwood	4,413
Mixed Upland Deciduous	2,903
Cedar	1,910

Table 31. Largest vegetative cover types (i.e., top five) and area of the East Branch Big Creek watershed located within the management area.

Cover Type	Area (acres)
Aspen	651
Planted Jack Pine	513
Planted Mixed Pine	147
Mixed Upland Deciduous	123
Planted Red Pine	90

Recreation

Avery Hills Management Area has good public access for management and public recreation with a system of county and forest access roads. The area is accessible from the communities of Atlanta, Fairview, Lewiston and Mio. Recreation facilities found here include several snowmobile trails, off-road vehicle trails, including 2.8 miles of the Mio Trail; the Atlanta to Hunt Creek Motorcycle Michigan Cross Country Cycle Trail; the Hunt Creek Motorcycle Trail; and the Big Oaks Equestrian Trail.

There are two state forest campgrounds (rustic) within the management area, both on Avery Lake with Big Oaks designated for equestrian camping.

Table 32. Designated recreation trails by type.

Recreation Category	Recreation Type	# of Miles
Motorized Recreation Trails	ORV (all types) Snowmobile	35 26
Nonmotorized Recreation Trails	Hiking Equestrian Biking Hunter Walking Trails	0 15.6 0 1.3
Total		**77.8**

Note: Trail use types may overlap.

Table 33. State forest campgrounds.

Name	# of sites	# of Equestrian Sites	ORV Access
Avery Lake State Forest Campground	15	-	-
Big Oaks Equestrian State Forest Campground	-	24	X

The Greasy Creek Grouse Enhanced Management Area is on the east side of the management area, accessed off M-33. The roads within this area are currently open to vehicles as the site is currently used for oil and gas extraction. In addition, hunter access trails provide access to the grouse habitat.

Table 34. Areas managed for hunting.

Type	Name	# of Acres
Grouse Enhanced Management Area	Greasy Creek	1,077.7

Boating access sites provide access to several inland lakes including the Sage Lake Flooding.

Table 35. Boating access sites.

Name	Waterbody
Avery Lake State Forest Campground	Avery Lake
Lake Fifteen State Forest Campground	Lake Fifteen

Name	Waterbody
McCormick Lake	McCormick Lake
Sage Lake Flooding	Sage Lake Flooding

Bois Blanc Island

State Forest Area: 10,882 acres	Location: Northeastern Lower Peninsula Eastern Upper Peninsula	Population Centers: Mackinaw City Cheboygan St. Ignace
Subsection: Valders Red Till and Sandy Lake Plain/St. Ignace Lake Plain	Landforms: Lacustrine sand Exposed Limestone bedrock	Landcover: Forested: 10,236 acres Nonforested: 646 acres

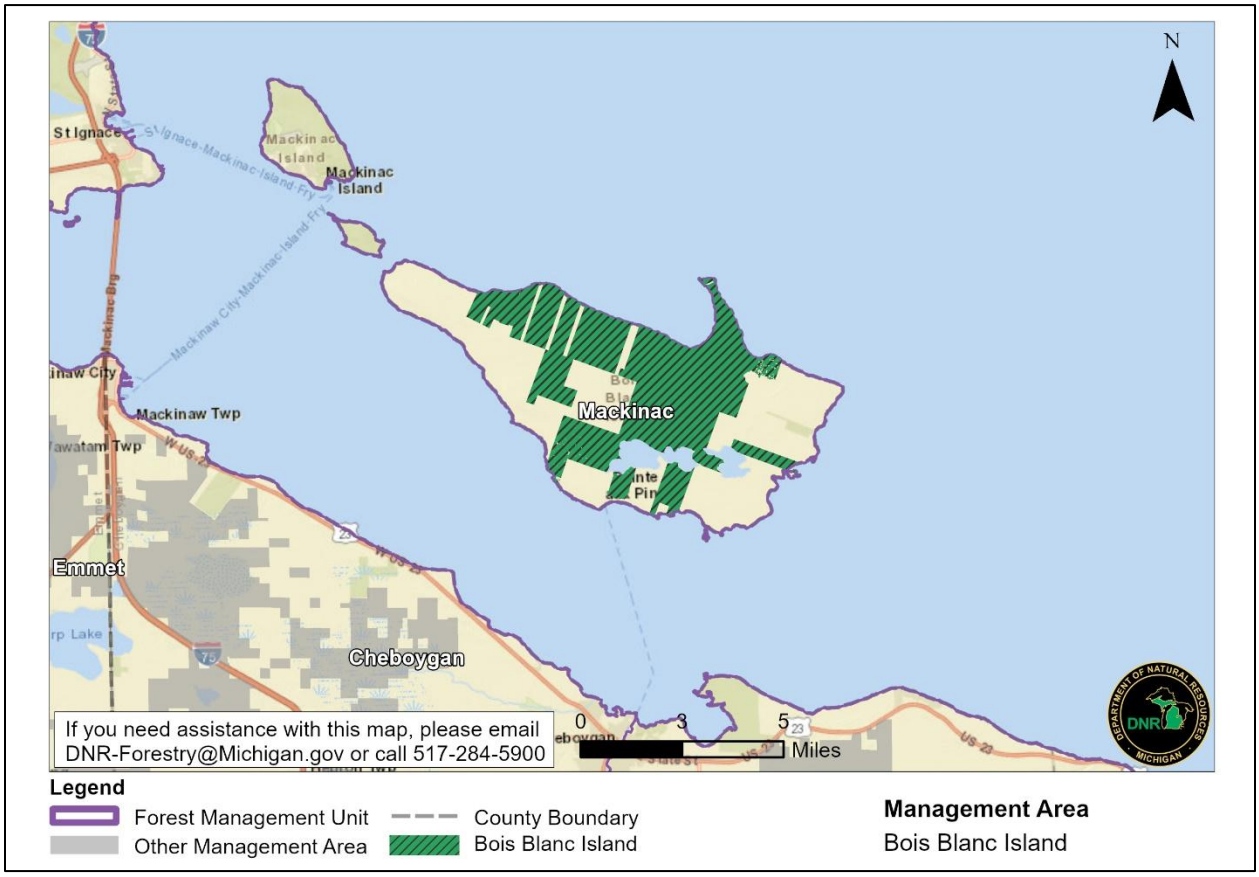


Figure 1. Bois Blanc Island Management Area.

Forested landscape

Current and projected future condition

The Bois Blanc Island Management Area has primarily shade-tolerant tree species mostly in the mature age category (Figure 2). Harvesting has been limited in the past due to difficulties associated with an island as well as cultural and historical protection.

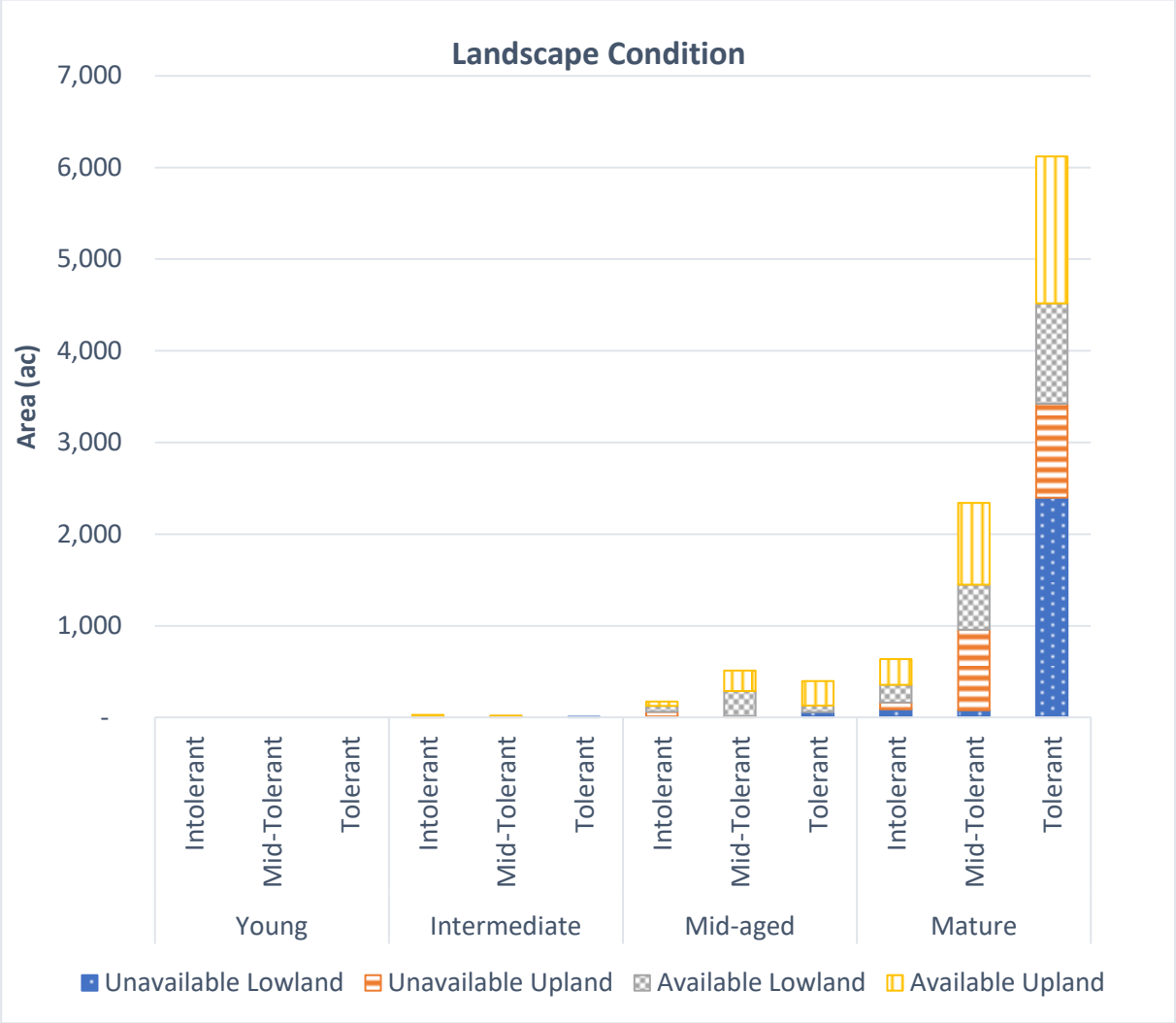


Figure 2. Forest diversity matrix showing the current distribution of forested acres across management availability, age category, landscape position and shade tolerance.

Landscape habitat conditions refine the management area landscape into featured species habitat context. Current and projected acres for the metrics identified in the Management Priorities (Section 3 Statewide/Regional) establish a baseline and future condition based on management over the planning period (Table 1).

Table 1. Current acres for landscape habitat conditions.

Landscape Habitat Condition	Monitoring Metric	Current Acres
Young Forest	Acres of 0-19 stands in Aspen and Jack Pine	0
Mature Forest	Acres of 80+ year stands across cover types	9,099
Mature Forest	Acres of 120+ year stands across cover types	1,328
Mesic Conifer Cover Types	Acres of mesic conifer cover types	209
Mesic Conifers in other Cover Types	Average canopy occupancy	16%
Mast – Oak Cover Types	Acres of oak cover types	10,449
Mast Tree Species in other Cover Types	Acres of total canopy occupancy of mast tree acres (trace-100%)	52,414
Big Trees	Total canopy stand occupancy of species in sawlog or greater size class	7,464
Nonforested Openings	Acres of total herbaceous openland, upland shrub, and cropland	47
Landscape Forest Matrix	Percent deciduous forest	53%
Landscape Forest Matrix	Percent coniferous forest	38%

The Bois Blanc Island management area has the following special analysis units (SAUs). These SAUs have specific cover type goals, typically associated with wildlife habitat management. For any SAUs that overlap with this management area, SAU cover type goals take priority as the SFMP model strives to meet the cover type goals across the area, ensuring they are met. Please see Section 5 for a detailed description of the management direction and harvest goals for each of these SAUs.

The Bois Blanc Island management area is comprised of 94% forested cover types and 6% nonforested cover types (

Table 2). Of the forested cover types, 53% are upland and 47% are lowland. The largest contributors to upland cover types are northern hardwoods and mixed upland deciduous. Cedar and lowland conifer are the largest contributors to lowland cover types. Lowland shrub is the most common nonforested cover type in the management area representing only 2% of the landscape.

Table 2. Current landscape context and distribution of cover types.

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
Forested	Upland	Deciduous	Aspen	392	4,529	5,384	10,236
			Northern Hardwood	2,869			
			Black Red Hybrid Oak	0			
			Northern Red Oak	10			
			Oak Mix	9			
			Mixed Upland Deciduous	1,249			
		Mixed	Upland Mixed Forest	646	646		
		Coniferous	Planted Red Pine	0	209		
			Planted Jack Pine	0			
			Planted White Pine	0			
			Planted Mixed Pine	0			
			Natural Red Pine	0			
			Natural Jack Pine	0			
			Natural White Pine	0			
			Natural Mixed Pines	0			
			Upland Spruce/Fir	63			
			Upland Conifers	126			
			Hemlock	21			
	Lowland	Deciduous	Lowland Aspen/Balsam Poplar	319	876	4,852	
			Lowland Deciduous	557			
		Mixed	Lowland Mixed Forest	294	294		
		Coniferous	Cedar	2,642	3,682		
			Lowland Conifers	992			
			Lowland Spruce/Fir	48			
			Tamarack	0			
Nonforested	Upland	N/A	Herbaceous Openland	41	N/A	86	646
			Upland Shrub	6			
			Low Density Trees	2			
			Bare/Sparsely Vegetated	17			
			Cropland	0			
			Urban	21			
	Lowland	N/A	Lowland Shrub	189	N/A	560	
			Marsh	103			
			Bog	62			
			Treed Bog	103			
			Water	103			
						Grand Total:	**10,882**

Bois Blanc Island is currently under a series of archeological surveys to determine cultural and historical significance of many of the forested stands. This, in addition to the difficulties with managing the forest through commercial timber sales on the island, access issues, and other influences, the vast majority of the forested stands are unavailable for commercial harvesting (Table 3). Acres unavailable for management are categorized by site conditions (Table 4).

Table 3. Current cover type composition by management availability.

BOIS BLANC ISLAND Forested Cover Type	Available Acres	Available %	Unavailable Acres	Unavailable %	Total Acres	Total %
Aspen			392	3.8%	392	3.8%
Cedar			2,642	25.8%	2,642	25.8%
Hemlock			21	0.2%	21	0.2%
Lowland Aspen/Balsam Poplar			319	3.1%	319	3.1%
Lowland Conifers			992	9.7%	992	9.7%
Lowland Deciduous			557	5.4%	557	5.4%
Lowland Mixed Forest			294	2.9%	294	2.9%
Lowland Spruce/Fir			48	0.5%	48	0.5%
Mixed Upland Deciduous			1,249	12.2%	1,249	12.2%
Northern Hardwood			2,869	28.0%	2,869	28.0%
Northern Red Oak			10	0.1%	10	0.1%
Oak Mix			9	0.1%	9	0.1%
Upland Conifers			126	1.2%	126	1.2%
Upland Mixed Forest			646	6.3%	646	6.3%
Upland Spruce/Fir			63	0.6%	63	0.6%
Grand Total			**10,237**	**100.0%**	**10,237**	**100.0%**

Table 4. Site conditions for unavailable acres.

Site Condition (Reason Area is Unavailable for Commercial Harvest)	Area (ac)	% of Unavailable Area
Blocked by Obstacle	5,862	57.3%
Federal/State/Local Law	1,902	18.6%
Too Wet	850	8.3%
Species of special concern or T&E	629	6.1%
Rare Landforms	305	3.0%
Cannot Regenerate	252	2.5%
Natural/Quiet/Wilderness Area	198	1.9%
Conservation Values	95	0.9%
Unproductive	58	0.6%
Other Influence Zones	51	0.5%
Best Management Practices	24	0.2%
Deer Wintering Area	11	0.1%
Total Unavailable	**10,236**	**100%**

Projected 10-year cover type management actions

No management actions are planned for the Bois Blanc Management Area. As a result, there are very few cover type transitions projected (Table 5). The managed area of each cover type is projected to remain stable with the absence of commercial harvesting. Some natural transitions will occur over time as aspen stands grow older and die out, other hardwood species will grow into these stands increasing the northern hardwoods and upland conifer stands over time.

Table 5. Projected 10-year cover type acres resulting from cover type transitions.

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Northern Hardwood	2,869	2,907	38
Cedar	2,642	2,642	0
Mixed Upland Deciduous	1,249	1,249	0
Lowland Conifers	992	992	0
Upland Mixed Forest	646	646	0
Lowland Deciduous	557	557	0
Aspen	392	341	-51
Lowland Aspen/Balsam Poplar	319	319	0
Lowland Mixed Forest	294	294	0
Upland Conifers	126	131	5
Upland Spruce/Fir	63	63	0
Lowland Spruce/Fir	48	48	0
Hemlock	21	21	0
Northern Red Oak	10	10	0
Oak Mix	9	9	0
Black Red Hybrid Oak	0	8	8
Lowland Shrub	189	189	0
Treed Bog	103	103	0
Marsh	103	103	0
Bog	62	62	0
Herbaceous Openland	41	41	0
Urban	21	21	0
Bare/Sparsely Vegetated	17	17	0
Upland Shrub	6	6	0
Low Density Trees	2	2	0
Water	103	103	0
Total:	**10,882**	**10,882**	**0**

Featured species current and projected habitat acres

There are no featured species assigned for the Bois Blanc Management Area, and thus there are no current or projected habitat acres.

Cover type composition and associated featured species

Age class and basal area distribution by cover type is not provided, and there are no associated featured species.

Management actions

There are no projected harvests on Bois Blanc Island in the next 10-year planning cycle. This is due to large areas that are protected for historical and cultural significance in addition to the logistical problems associated with a commercial harvest on the island.

Conservation area network

High conservation value areas

There are up to nine different high conservation value areas (HCVA) types that can be found in each management area (Table 6; see Biodiversity in Section 3 for more information).

Table 6. High conservation value areas within Bois Blanc Island Management Area.

High Conservation Value Area Type and Name	Acres
Coastal Environmental Areas	**2**
	2
Eastern Massasauga Managed Land	**3,271**
	3,271
Forest Habitat Core Interior	**1,936**
	1,936
Natural Areas Legally Dedicated	**264**
	264
Grand Total	**5,473**

Ecological reference areas

Ecological reference areas (ERAs) are a type of HCVA and are higher quality examples of functioning ecosystems that are primarily influenced by natural ecological processes.

Table 7. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 8. Ecological reference areas within the management area.

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	Number of Occurrences
Existing ERA	Boreal Forest	AB		S3	2
Existing ERA	Coastal Fen	C	G1G2	S2	1
Existing ERA	Limestone Cobble Shore	B		S3	1
Existing ERA	Limestone Cobble Shore	B	G2G3	S3	1
Existing ERA	Mesic Northern Forest	AB		S3	2
Existing ERA	Northern Wet Meadow	AB	G4G5	S4	1
Existing ERA	Rich Conifer Swamp	AB		S3	2
Existing ERA	Wooded Dune and Swale Complex	C	G3	S3	1
Grand Total					**11**

Special conservation areas

Reviewable special conservation areas (SCAs; Table 9) refers to those SCA types that may be reviewed or updated through the compartment review process as needed. Static SCAs (Table 10) refers to those SCA types that generally do not change or require updating (see Biodiversity in Section 3 for more information).

Table 9. Reviewable special conservation areas within Bois Blanc Island Management Area.

Reviewable Special Conservation Area Type and Name	Acres
Concentrated Recreational Area	**92**
Continuation of North Shore cover type	92
Cultural or Customary Area	**17**
Bois Blanc Sugar Bush	17
Mineral Resource Area	**13**
Island Contractors Inc.	7
Mackinac County Road Commission	6
Spring, Wetlands, or Riparian Areas	**824**
Wooded Dune and Swale Complex	824
Grand Total	**946**

Table 10. Static special conservation areas within Bois Blanc Island Management Area.

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Great Lakes Islands		**10,881**
Bois Blanc Island		10,881
Non-dedicated Natural Areas		**2**
Natural Area Bois Blanc Island		2
Grand Total		**10,883**

Rare species

Rare species occurrences are compiled from the Michigan Natural Features Inventory Biotics database (Table 11 and Table 13) and do not necessarily include all rare species found in this management area due to biases in survey effort and verifiable observation reporting over time.

Table 11. Rare animal and plant species conservation status key.

Status	Status
E = endangered	LE = listed endangered
T = threatened	LT = listed threatened
SC = special concern	PDL = proposed for delisting

Table 12. Rare animal occurrence within Bois Blanc Island Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Buteo lineatus	Red-shouldered hawk	SC		3
Animal	Cistothorus palustris	Marsh wren	SC		1
Animal	Gavia immer	Common loon	T		3
Animal	Haliaeetus leucocephalus	Bald eagle	SC		4
Animal	Opheodrys vernalis	Smooth green snake	SC		1
Animal	Pandion haliaetus	Osprey	SC		2
Animal	Sistrurus catenatus	Eastern massasauga	T	LT	1
Animal	Somatochlora hineana	Hine's emerald dragonfly	E	LE	3
Animal	Sterna forsteri	Forster's tern	T		1
Total	-	-	-	-	**19**

Table 13. Rare plant occurrence within Bois Blanc Island Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Plant	Adlumia fungosa	Climbing fumitory	T		1
Plant	Arnoglossum plantagineum	Prairie Indian-plantain	SC		2
Plant	Barbarea orthoceras	Northern winter cress	SC		1
Plant	Calypso bulbosa	Calypso or fairy-slipper	T		2
Plant	Cirsium pitcheri	Pitcher's thistle	T	LT	2
Plant	Crataegus douglasii	Douglas's hawthorn	SC		1
Plant	Cypripedium arietinum	Ram's head lady's-slipper	SC		1
Plant	Gymnocarpium robertianum	Limestone oak fern	T		2
Plant	Iris lacustris	Dwarf lake iris	T	LT	3
Plant	Pinguicula vulgaris	Butterwort	SC		3
Plant	Solidago houghtonii	Houghton's goldenrod	T	LT	1
Plant	Tanacetum bipinnatum ssp. huronense	Lake Huron tansy	SC		1
Total	-	-	-	-	**20**

Non-ecological reference area natural communities

Natural communities that are identified with an element occurrence in the MNFI Biotics database, but that have not been given an additional ecological reference area (ERA) designation, are recognized and managed accordingly. There are no non-ERA natural communities in this management area at the present time.

Forest Health

Forest health concerns, both native and non-native, can have impacts on stand conditions and management decisions. The following insects (Table 14) and diseases (Table 15) could have an impact on management during the planning period and may need to be monitored and/or addressed.

Table 14. Defoliating insects of concern in the Bois Blanc Island Management Area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Spongy moth	Lymantria dispar	Non-native	
Forest tent caterpillar	Malacosoma disstria	Native	
Spruce budworm	Choristoneura fumiferana	Native	

Watch for and retain lingering ash with potential resistance to emerald ash borer. Monitor the limited hemlock resource, hemlock woolly adelgid is not known to occur near this management area, however climate moderated areas near Lake Huron may be at greater risk.

Table 15. Maladies of concern in the Bois Blanc Island Management Area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Canker (stem infections)	Various	Various	Yes
Armillaria root rot	Armillaria spp.	Native	

Report surviving mature beech trees that may be resistant to beech bark disease. Watch for symptoms of beech leaf disease.

Aquatic Resources

Riparian Habitat

Only small intermittent stream/rivers are found in the management area on the island.

Lacustrine Habitat

A total of five lakes and ponds of at least one surface acre are found in the management area (Table 16).

Table 16. Size and number of lakes and ponds located within the management area.

Lake Size Class (acres)	Number
1-99	2
100-499	3
500+	0

Wetlands

A total of 3,277 acres of wetlands are found in the management area (Table 17). Forested wetlands comprise approximately 94% of wetland types found in the management area.

Table 17. Area of emergent, forested and riverine wetland types found within the management area.

Wetland Type	Acres
Emergent	148
Forested	3,089
Riverine	40

Vernal pools and seeps

A total of 121 acres of vernal pools and seeps have been inventoried in the management area while no areas of seeps have been identified.

Riparian vegetation cover

Cedar is the predominant cover type present in a 100-meter riparian zone located next to streams/rivers in the management area (Table 18).

Table 18. Largest vegetative cover types (i.e., top 10) and area located in a 100-meter buffer of streams/rivers within the management area.

Cover Type	Acres
Cedar	397
Lowland Conifers	77
Lowland Shrub	49
Treed Bog	40
Upland Conifers	35
Bog	25
Marsh	24
Northern Hardwood	24
Upland Mixed Forest	23
Mixed Upland Deciduous	19

Watershed vegetation cover

The management area includes small watersheds with short portions streams/rivers that all drain to Lake Huron (Table 19). Northern hardwood, cedar and mixed upland deciduous are major cover types on the island.

Table 19. Largest vegetative cover types (i.e., top five) and area of the Michigamme River watershed located within the management area.

Cover Type	Acres
Northern Hardwood	2,871
Cedar	2,643
Mixed Upland Deciduous	1,250
Lowland Conifers	993
Upland Mixed Forest	646

Recreation

The Bois Blanc Island Management Area has limited access for management and public recreation. There are three dedicated natural areas in this management area, providing opportunities for wildlife viewing, bird watching and wildflower viewing, as well as hunting and fishing. There are no designated trails, state forest campgrounds or boating access sites on state forest land on the island.

Cadillac Moraines

State Forest Area: 78,295 acres	Location: Wexford, Missaukee, Lake and Osceola counties	Population Centers: Cadillac, Lake City, Reed City and Evart
Subsection: Interlobate End and Ground Moraines	Landforms: Moraine ridges, outwash channels and plains	Landcover: Forested: 73,424 acres Nonforested: 4,872 acres

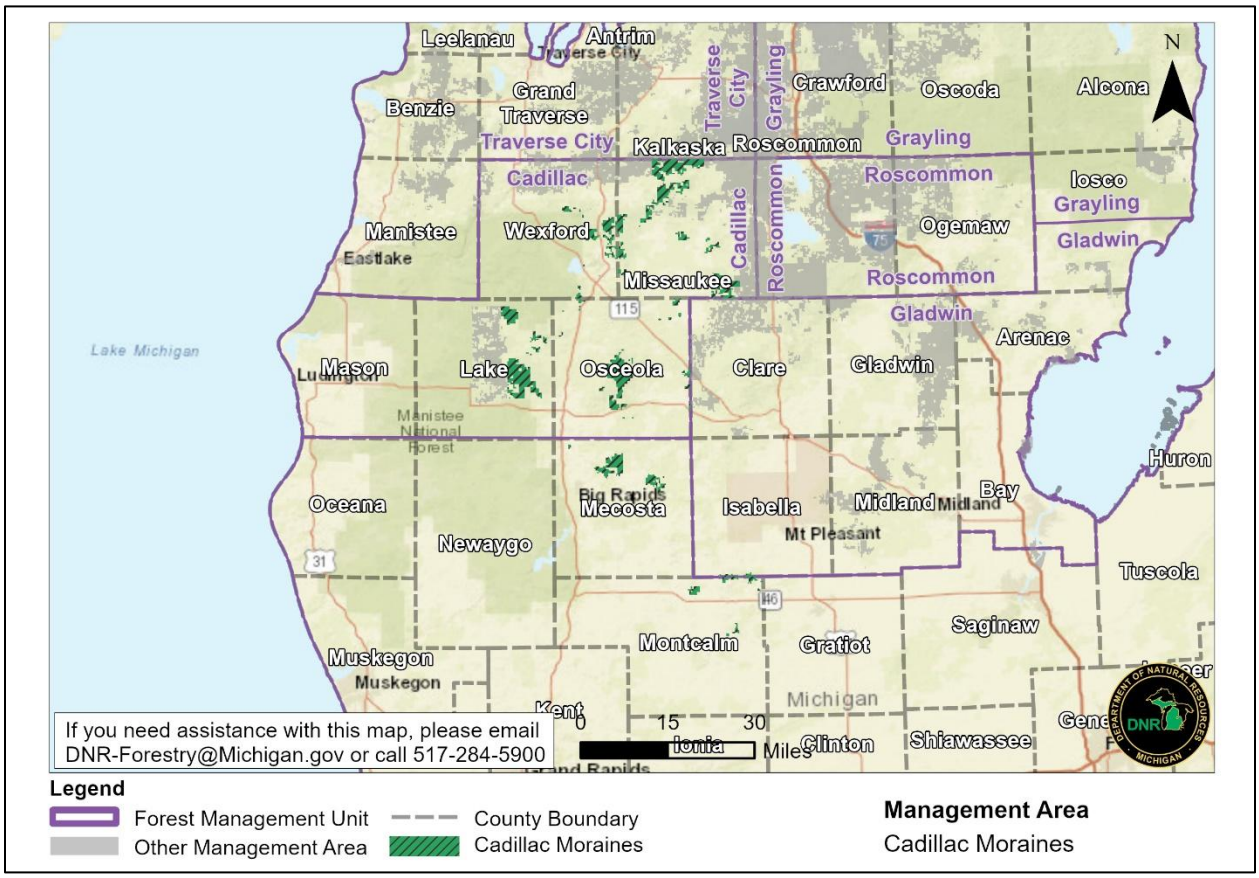


Figure 1. Cadillac Moraines Management Area.

Forested landscape

Current and projected future condition

The Cadillac Moraines Management Area includes a variety of shade tolerance levels, most of which are available uplands (Figure 2). The majority of tolerant cover types occur on available uplands located in the mid-aged and mature categories. Mid-tolerant cover types mostly occur on available uplands in the mid-aged category while the intolerant cover types have the highest amount in the intermediate category.

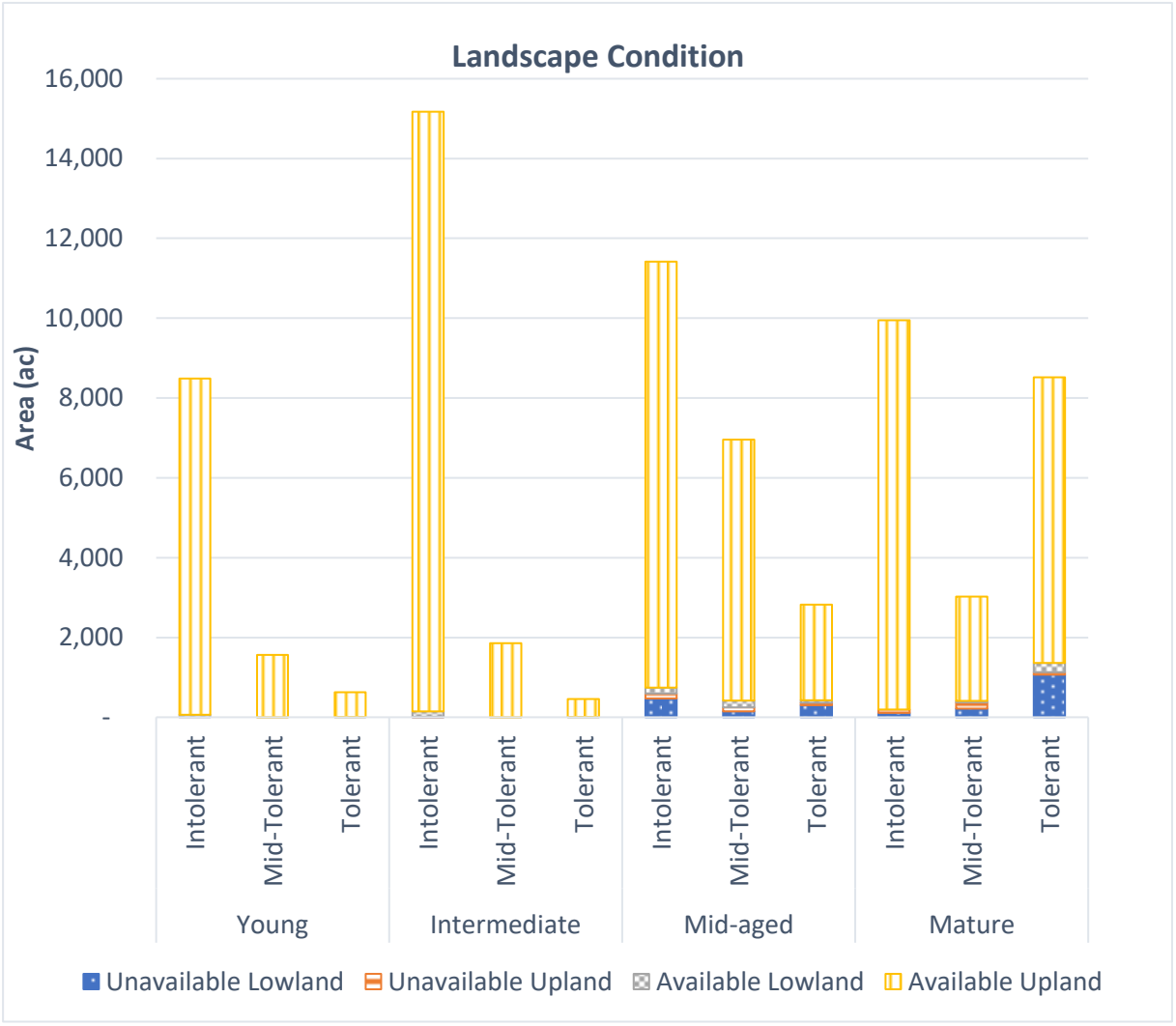


Figure 2. Forest diversity matrix showing the current distribution of forested acres across management availability, age category, landscape position and shade tolerance.

A more-even distribution of the shade intolerant area across the age categories is desirable in the Cadillac Moraines Management Area and this can be achieved by accomplishing individual cover type age class goals over the next several decades.

Landscape habitat conditions refine the management area landscape into featured species habitat context. Current and projected acres for the metrics identified in the Management Priorities (Section 3 Statewide/Regional) establish a baseline and future condition based on management over the planning period (Table 1).

Table 1. Current acres for landscape habitat conditions.

Landscape Habitat Condition	Monitoring Metric	Current Acres
Young Forest	Acres of 0-19 stands in Aspen and Jack Pine	8,324
Mature Forest	Acres of 80+ year stands across cover types	21,488
Mature Forest	Acres of 120+ year stands across cover types	297
Mesic Conifer Cover Types	Acres of mesic conifer cover types	1,898
Mesic Conifers in Other Cover Types	Average canopy occupancy	18%
Mast – Oak Cover Types	Acres of oak cover types	10,449
Mast Tree Species in other Cover Types	Acres of total canopy occupancy of mast tree acres (trace-100%)	52,414
Big Trees	Acres of total canopy stand occupancy of species in sawlog or greater size class	35,507
Nonforested Openings	Acres of total herbaceous openland, upland shrub and cropland	1,494
Landscape Forest Matrix	Percent deciduous forest	81%
Landscape Forest Matrix	Percent coniferous forest	16%

The Cadillac Moraines Management Area has the following special analysis units (SAUs). These SAUs have specific cover type goals, typically associated with wildlife habitat management. For any SAUs that overlap with this management area, SAU cover type goals take priority as the SFMP model strives to meet the cover type goals across the area, ensuring they are met. See Section 5 for a detailed description of the management direction and harvest goals for each of these SAUs.

- Grouse Enhanced Management Site (GEMS) – Mark Knee Memorial

The Cadillac Moraines Management Area is comprised of 94% forested cover types and 6% nonforested cover types (

Table 2). Of the forested cover types, the upland landscape position makes up 90% of the total landscape while the lowland is at only 4%. The largest contributors to upland cover types are aspen, northern hardwoods, mixed upland deciduous, planted red pine and northern red oak. Lowland conifer

makes up about 39% of the lowland forested landscape position. Lowland shrub is the most common nonforested cover type in the management area representing 2% of the total landscape.

Table 2. Current landscape context and distribution of cover types.

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
Forested	Upland	Deciduous	Aspen	33,264	58,807	70,198	73,424
			Northern Hardwood	8,931			
			Black Red Hybrid Oak	2,999			
			Northern Red Oak	5,569			
			Oak Mix	2,336			
			Mixed Upland Deciduous	5,707			
		Mixed	Upland Mixed Forest	1,795	1,795		
		Coniferous	Planted Red Pine	5,604	9,596		
			Planted Jack Pine	271			
			Planted White Pine	915			
			Planted Mixed Pine	395			
			Natural Red Pine	216			
			Natural Jack Pine	299			
			Natural White Pine	766			
			Natural Mixed Pines	525			
			Upland Spruce/Fir	453			
			Upland Conifers	133			
			Hemlock	21			
	Lowland	Deciduous	Lowland Aspen/Balsam Poplar	515	904	3,226	
			Lowland Deciduous	389			
		Mixed	Lowland Mixed Forest	278	278		
		Coniferous	Cedar	425	2,044		
			Lowland Conifers	1,264			
			Lowland Spruce/Fir	243			
			Tamarack	111			
Nonforested	Upland	N/A	Herbaceous Openland	1,151	N/A	1,971	4,872
			Upland Shrub	253			
			Low Density Trees	214			
			Bare/Sparsely Vegetated	22			
			Cropland	43			
			Urban	289			
	Lowland	N/A	Lowland Shrub	1,222	N/A	2,901	
			Marsh	771			
			Bog	204			
			Treed Bog	62			
			Water	642			

	Grand Total:	**78,295**

There are 70,493 acres (90% of the total management area and 96% of the forested area) that can be managed toward desired future conditions via commercial timber harvest in the Cadillac Moraines Management Area (Table 3). Of that, over 42% is in the aspen cover type, 11% in northern hardwood, 7% in mixed upland deciduous and 7% in northern red oak. The remaining 20 cover types represent less than 5% each of the forested and available land in the management area. Acres unavailable for management are categorized by site condition (Table 4).

Table 3. Current cover type composition by management availability.

Cadillac Moraines Forested Cover Type	Available Acres	Available %	Unavailable Acres	Unavailable %	Total Acres	Total %
Aspen	33,116	45.1%	148	0.2%	33,264	45.3%
Northern Hardwood	8,819	12.0%	112	0.2%	8,931	12.2%
Mixed Upland Deciduous	5,561	7.6%	146	0.2%	5,707	7.8%
Planted Red Pine	5,596	7.6%	8	0.0%	5,604	7.6%
Northern Red Oak	5,517	7.5%	52	0.1%	5,569	7.6%
Black Red Hybrid Oak	2,981	4.1%	19	0.0%	2,999	4.1%
Oak Mix	2,336	3.2%	0	0.0%	2,336	3.2%
Upland Mixed Forest	1,735	2.4%	59	0.1%	1,795	2.4%
Lowland Conifers	286	0.4%	978	1.3%	1,264	1.7%
Planted White Pine	915	1.2%	0	0.0%	915	1.2%
Natural White Pine	763	1.0%	3	0.0%	766	1.0%
Natural Mixed Pines	522	0.7%	3	0.0%	525	0.7%
Lowland Aspen	260	0.4%	255	0.3%	515	0.7%
Upland Spruce Fir	453	0.6%	0	0.0%	453	0.6%
Cedar	34	0.0%	392	0.5%	425	0.6%
Planted Mixed Pine	395	0.5%	0	0.0%	395	0.5%
Lowland Deciduous	191	0.3%	199	0.3%	389	0.5%
Natural Jack Pine	293	0.4%	6	0.0%	299	0.4%
Lowland Mixed Forest	110	0.1%	168	0.2%	278	0.4%
Planted Jack Pine	270	0.4%	1	0.0%	271	0.4%
Lowland Spruce Fir	24	0.0%	220	0.3%	243	0.3%
Natural Red Pine	200	0.3%	16	0.0%	216	0.3%
Upland Conifers	110	0.1%	23	0.0%	133	0.2%
Tamarack	0	0.0%	111	0.2%	111	0.2%
Hemlock	8	0.0%	12	0.0%	21	0.0%
Total	**70,493**	**96.0%**	**2,930**	**4.0%**	**73,424**	**100%**

Table 4. Site conditions for unavailable acres.

Site Condition (Reason Area is Unavailable for Commercial Harvest)	Acres	% of Unavailable Area
Too Wet	1,700	58.0%
Best Management Practices	407	13.9%
Too Steep	186	6.3%
Long-Term Retention	123	4.2%
Recreation/Scenic	119	4.1%
Conservation Values	68	2.3%
Deer Wintering Area	64	2.2%
Blocked by Obstacle	63	2.1%
Denied Access	61	2.1%
Wildlife Concerns	59	2.0%
Other Dept./Division Processes	44	1.5%
Cannot Regenerate	20	0.7%
Other Influence Zones	16	0.6%
Total Unavailable	**2,930**	**100%**

Projected 10-year cover type management actions

Each cover type in the Cadillac Moraines Management Area has a unique age class and basal area class goals that describe the long-term desired future conditions. The harvest levels that are needed in the first planning period to begin achieving those long-term goals are summarized below (Table 5). These harvests will help establish a desirable amount of regeneration for the even-aged cover types over the 10-year period or help to achieve desired basal area distribution among uneven-aged cover types like northern hardwoods. Implementing these silvicultural regimes will yield 275,294 cords, the planned harvest volume for the decade (Table 6).

Table 5. Ten-year planning period harvest goals (acres) by cover type and silvicultural regime.

Silvicultural Regimes								
Cover Type	**Clearcut**	**Selection**	**Thinning**	**Group Selection**	**Shelterwood**	**Salvage Clearcut**	**Salvage Thinning**	**Grand Total**
Aspen	4,673	-	-	-	-	-	-	4,673
Northern Hardwood	34	2,185	-	613	-	-	-	2,832
Planted Red Pine	185	-	2,587	-	-	-	-	2,772
Northern Red Oak	468	-	-	313	-	-	-	780
Mixed Upland Deciduous	529	92	-	-	7	-	-	628
Upland Mixed Forest	471	-	-	-	-	-	-	471
Upland Spruce/Fir	421	-	-	-	-	-	-	421
Planted White Pine	1	-	376	-	-	-	-	377
Black Red Hybrid Oak	365	-	-	-	-	-	-	365
Oak Mix	212	-	-	-	-	-	-	212
Natural White Pine	-	-	85	-	51	-	-	136
Upland Conifers	76	-	-	-	19	-	-	95
Lowland Aspen/Balsam Poplar	90	-	-	-	-	-	-	90
Lowland Conifers	42	-	-	-	-	-	-	42
Natural Jack Pine	39	-	-	-	-	-	-	39
Planted Mixed Pine	3	-	11	-	-	-	-	14
Hemlock	-	8	-	-	-	-	-	8
Natural Red Pine	-	-	7	-	-	-	-	7
Planted Jack Pine	2	-	-	-	-	-	-	2
Totals	**7,610**	**2,285**	**3,066**	**925**	**77**	**-**	**-**	**13,963**

Table 6. Projected 10-year harvest volume by species.

10-Year Estimated Harvest Volume Projection Cadillac Moraines Management Area Product	Species	Volume Planned*	Volume Prepared**
Pulpwood (cords)	Mixed Aspen	44,882	42,189
	Mixed Hardwood	32,879	30,906
	Red Pine	22,797	21,429
	Mixed Spruce	12,646	11,887
	White Pine	6,166	5,796
	Mixed Oak	5,845	5,494
	Mixed Softwood	5,234	4,920
	Jack Pine	3,144	2,956
	Pulpwood Total	**133,594**	**125,578**
Sawtimber (MBF)	Red Pine	20,945	19,688
	Mixed Aspen	12,358	11,617
	Red Oak	9,120	8,573
	Sugar Maple	8,378	7,876
	Red Maple	5,518	5,187
	White Pine	4,845	4,554
	Mixed Oak	1,742	1,638
	White Oak	1,676	1,576
	Basswood	782	735
	Sawtimber Total	**65,365**	**61,443**
	Total Sawtimber Harvest Volume in Cords	**141,700**	**133,198**
	Grand Total Harvest Volume in Cords	**275,294**	**258,776**
* Volume estimates based on 100% of the projected harvests for the 10 year planning period. ** Volume estimates based on 94% of the projected harvests for the 10-year planning period accounting for reduction in acres and associated volume once sales are prepared for bid.			

There are very few cover type transitions projected for the Cadillac Moraines Management Area. The managed area of each cover type is projected to remain stable as treatment regimes will not significantly change the amount of area in each cover type. The largest decrease forecasted is in the

northern red oak, 386 acres and upland spruce/fir, 378 acres, will convert to other cover types through forest management and regeneration activities. The largest increase occurs in the aspen acreage, where 454 total acres are projected to convert into this cover type.

Table 7. Projected 10-year cover type acres resulting from cover type transitions.

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Aspen	33,264	33,718	454
Northern Hardwood	8,931	8,972	41
Mixed Upland Deciduous	5,707	5,806	99
Planted Red Pine	5,604	5,853	249
Northern Red Oak	5,569	5,183	-386
Black Red Hybrid Oak	2,999	2,857	-142
Oak Mix	2,336	2,500	163
Upland Mixed Forest	1,795	1,762	-33
Lowland Conifers	1,264	1,240	-24
Planted White Pine	915	914	-1
Natural White Pine	766	767	1
Natural Mixed Pines	525	540	15
Lowland Aspen/Balsam Poplar	515	514	-1
Upland Spruce/Fir	453	74	-378
Cedar	425	425	0
Planted Mixed Pine	395	392	-3
Lowland Deciduous	389	394	5
Natural Jack Pine	299	307	8
Lowland Mixed Forest	278	301	23
Planted Jack Pine	271	248	-22
Lowland Spruce/Fir	243	241	-2
Natural Red Pine	216	216	0
Upland Conifers	133	68	-65
Tamarack	111	111	0
Hemlock	21	21	0
Lowland Shrub	1,222	1,222	0
Herbaceous Openland	1,151	1,151	0
Marsh	771	771	0
Water	642	642	0
Urban	289	289	0
Upland Shrub	253	253	0

Low Density Trees	214	214	0
Bog	204	204	0
Treed Bog	62	62	0
Cropland	43	43	0
Bare/Sparsely Vegetated	22	22	0
Total:	**78,295**	**78,295**	**0**

Featured species current and projected habitat acres

There are nine featured species in this management area that span various cover types, age classes and stand level conditions. Current and projected total habitat acres by species across the decade provide a baseline and show the result of long-term management actions (Table 8). As noted in the Featured Species Management Priority (Section 3), it is recommended that these featured species habitat acres be viewed as acres of potential habitat, representing a condition on the landscape where the more nuanced aspects of each species' habitat requirements are likely to be managed for or found. As described in the introduction, the modeling effort was limited by several factors including the simplification of habitat attributes into MiFI variables. Therefore, when referring to habitat acres what is being referred to is potential habitat acres.

Some species show a loss in habitat over the next century. As mentioned in the Featured Species Management Priority (Section 3), the current condition for many cover types is a surplus of acres in the 0-9 age class from the compensatory management approach applied in the previous decade. The model eventually evens out the age classes at a lower, sustainable level over time, usually by 50 years. For any species with northern hardwoods as a priority cover type, there is a perceived drop in acres between 40 and 60 years; this is due to the basal area dropping below 81 but because it only drops into the upper 70s, it is not expected to translate to any real habitat loss on the ground. Three of these species, black bear, wild turkey and black-backed woodpecker, were not included in the State Forest Management Plan model but are included here to inform management decisions over the decade.

Table 8. Featured species current and projected total habitat acres (i.e., potential habitat).

Featured Species	Priority Cover Types	Current Habitat Acres	10-year Projected Habitat Acres	50-year Projected Habitat Acres	100-year Projected Habitat Acres
American Woodcock	Aspen, lowland aspen, lowland deciduous	11,020	11,772	10,717	10,656
Black Bear	Mast	--	--	--	--
Black-Backed Woodpecker	Natural disturbance	--	--	--	--
Black-Throated Blue Warbler	Northern hardwoods, mixed upland deciduous	7,803	8,569	4,210	9,372
Golden-Winged Warbler	Aspen, black-red hybrid oak, northern red oak, oak mix, tamarack	12,499	13,602	11,048	11,214
Marten	Northern hardwoods, mixed upland deciduous, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, lowland mixed forest, lowland conifers, hemlock, cedar	18,497	18,356	17,888	22,177
Ruffed Grouse	Aspen	10,932	11,606	10,443	10,525
Snowshoe Hare	Aspen, cedar, hemlock, lowland aspen, lowland conifers, lowland mixed forest, lowland spruce/fir, mixed upland deciduous, natural jack pine, natural mixed pines, planted jack pine, upland spruce/fir	12,695	13,338	11,891	12,101
Wild Turkey	Openings	1,194	--	--	--
Wood Turtle	Nonforested Openings	--	--	--	--

Cover type composition and associated featured species

Aspen

Current condition

Most of the aspen cover type is currently between stand ages of 0 and 39 years old in the Cadillac Moraines Management Area (Figure 3). The age class distribution is currently somewhat balanced, except for a spike in the 30-39 age class. There is a deficit in the 50-59 age class which will lead to a deficit in the 50- to 59 and 60- to 69-year age class for the next planning period.

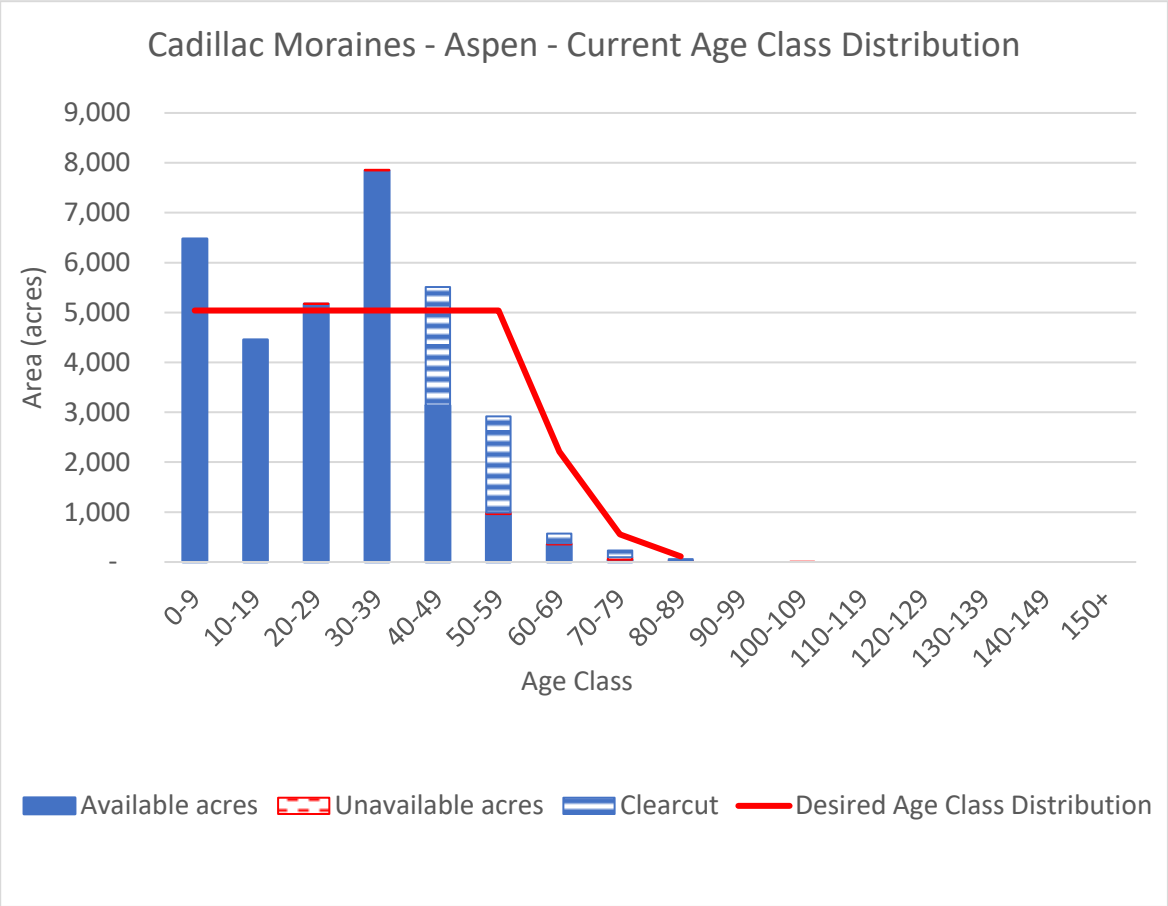


Figure 3. Current age class distribution, the desired age class distribution, and the projected harvests in the aspen cover type over the 10-year planning period.

Current conditions are a result of consistent commercial harvests and regeneration efforts on available aspen acres during the previous two planning periods. A portion of this cover type meets the habitat requirements for American woodcock, golden-winged warbler, ruffed grouse and snowshoe hare (Table 9).

Table 9. Featured species with aspen as a priority habitat cover type, habitat variables and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Aspen	Aspen Habitat Acres - Available	Aspen Habitat Acres - Unavailable
American Woodcock	Age Category: 0-19 Size Class: Sapling	10,932	0
Golden-Winged Warbler	Age Category: 0-19 Size Class: Sapling	10,932	0
Ruffed Grouse	Age Category: 0-19 Size Class: Sapling	10,932	0
Snowshoe Hare	Age Category: 0-19 Size Class: Sapling	10,932	0

Desired Future Condition

The projected long-term cover type trend for aspen is increasing in the Cadillac Moraines Management Area. Much of the aspen area falls within the available category and will have other cover types transition into this. There will be an increase of about 1% in this cover type. Habitat elements in this cover type will be preserved due to the abundance of availability.

The long-term goal for this cover type is balanced age classes between 0 and 50 years old with a tail to 80 years old for all available aspen stands in this management area. Maintaining lower acreage in old age classes continues to be desirable to ensure the aspen in the stand stays vigorous allowing for best regeneration results.

The end of the planning period will result in the establishment of a desirable number of 5,133 acres in the 0-9 age class (Figure 4). Progress toward the long-term desired age class distribution of aspen will take a few decades of even-aged management in this management area.

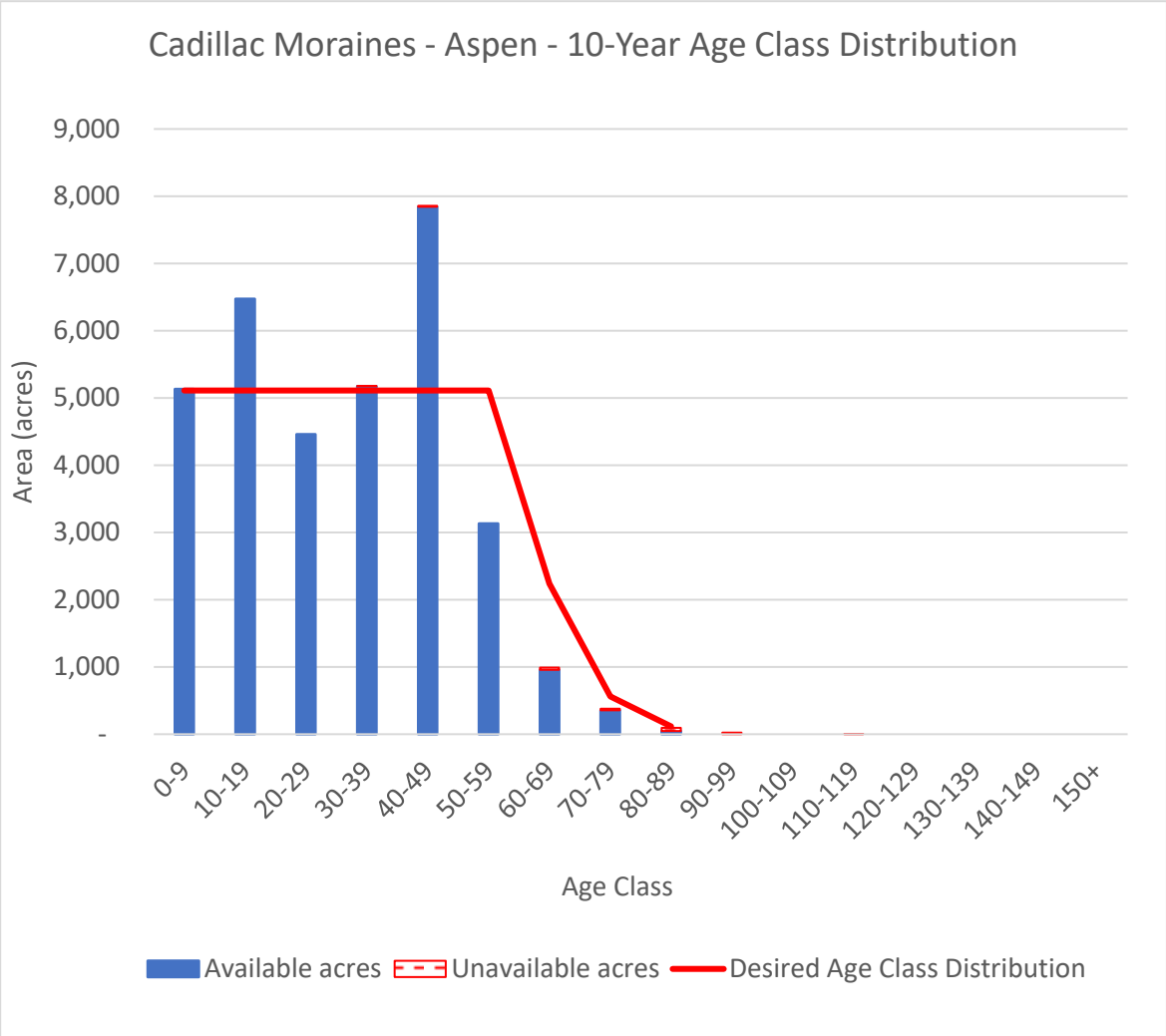


Figure 4. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution of aspen has reached the desired future condition for available acres (Figure 5). There is an increase in acres in the older age classes, beyond the desired age of 60 years old, due to the tail built into this management area.

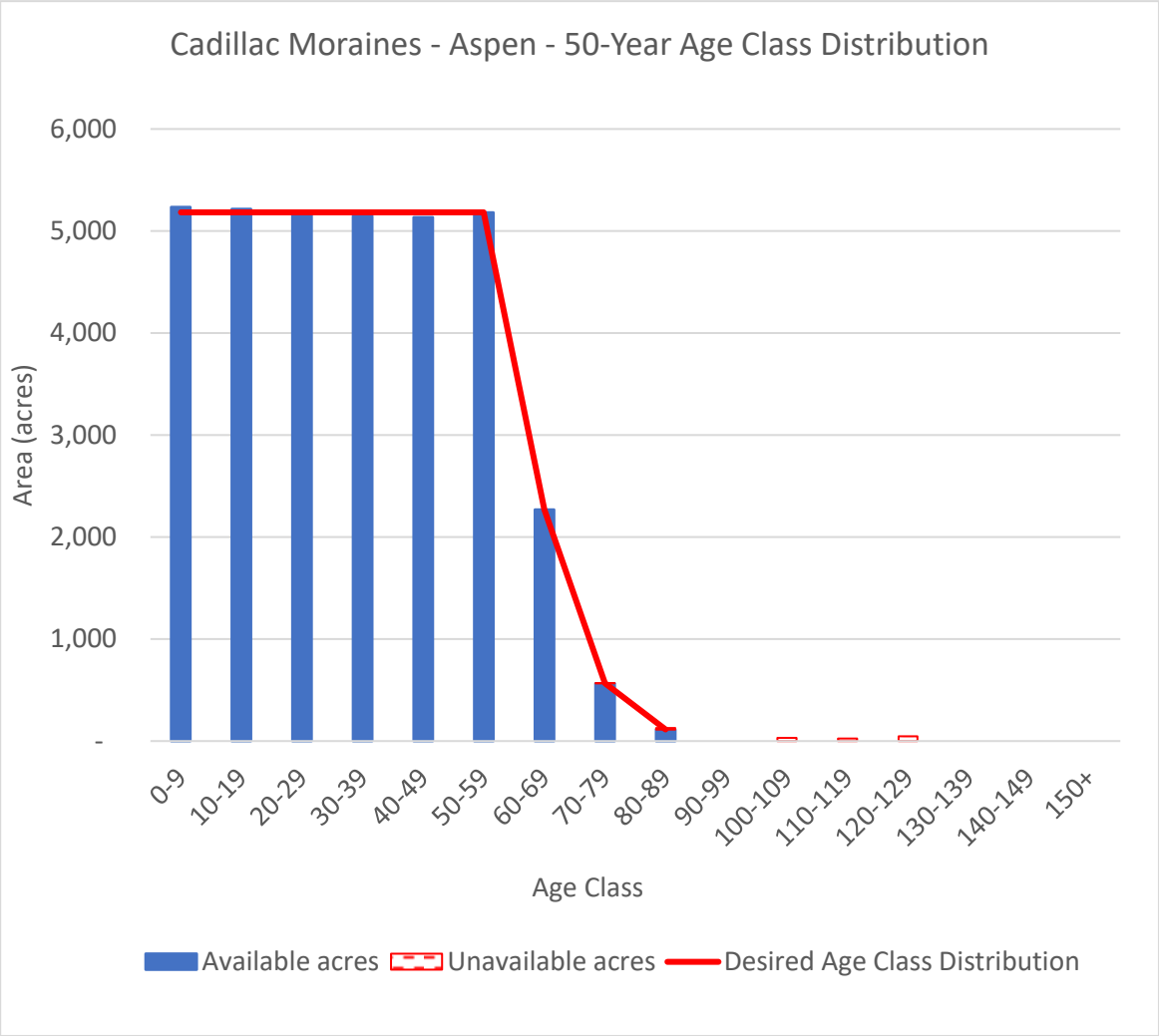


Figure 5. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 6) will concentrate the manageable acres of aspen in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest (Figure 7).

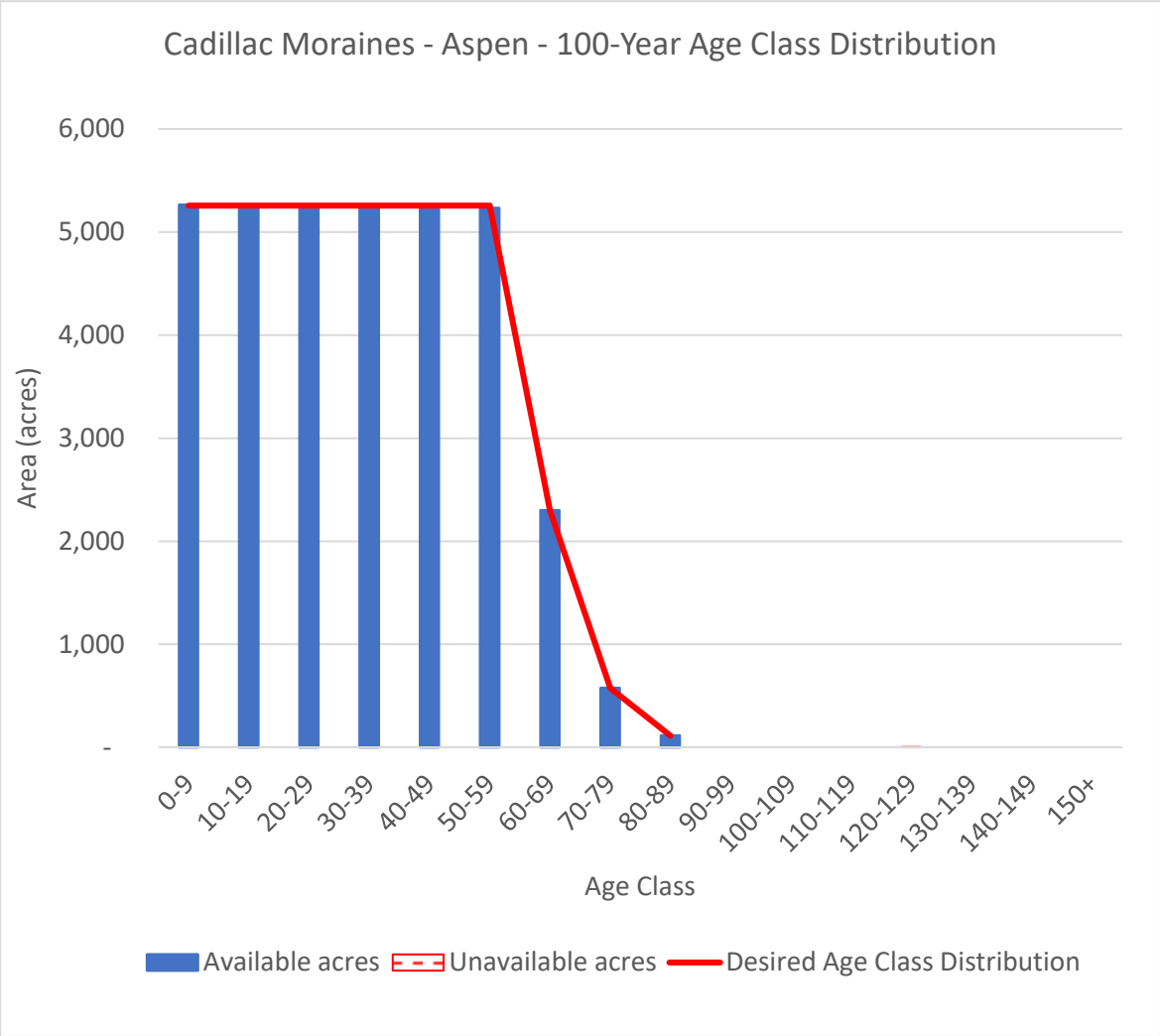


Figure 6. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

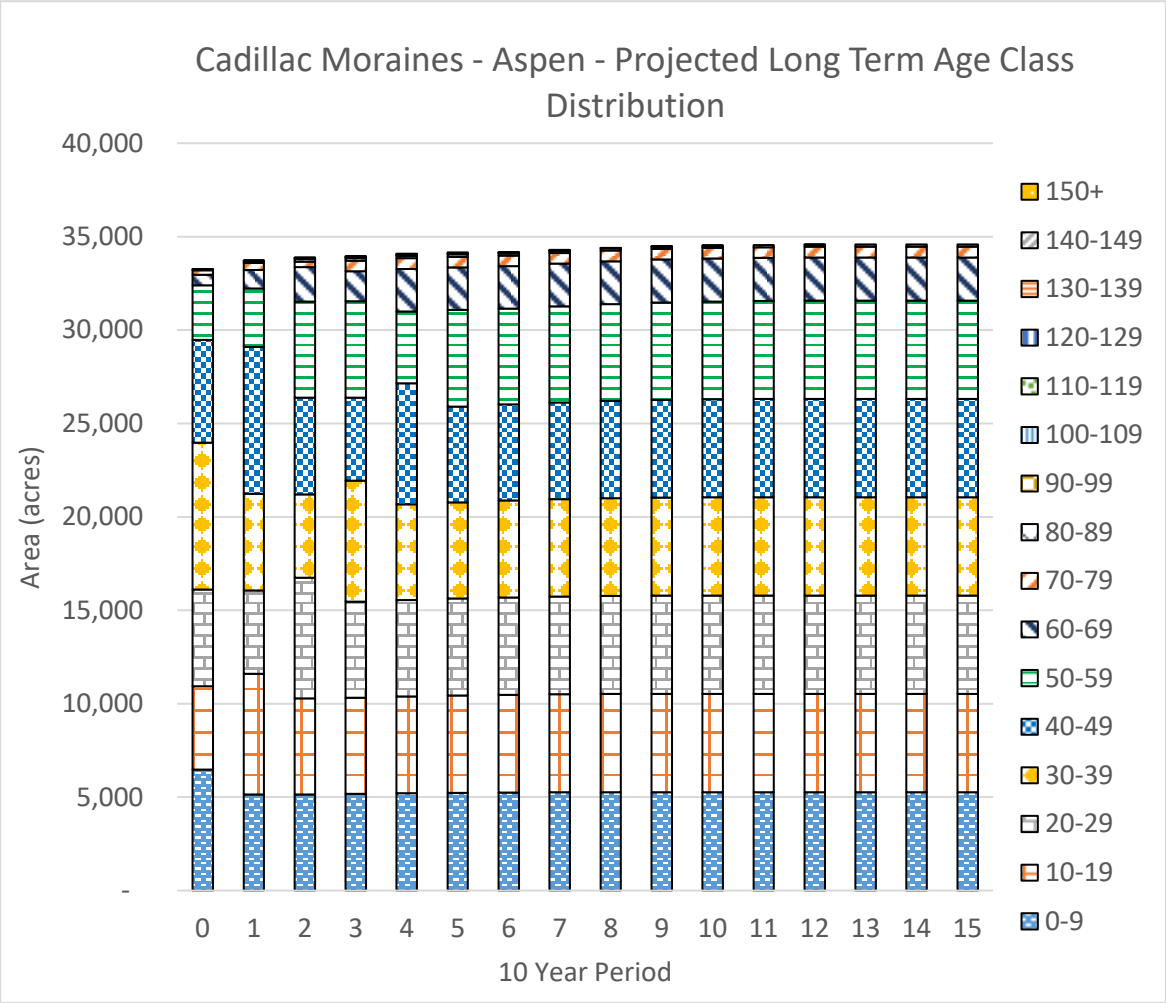


Figure 7. Projected age class distribution for all acres of aspen over the next 150 years in the Cadillac Moraines Management Area.

Management actions

There are 4,673 acres of projected clearcut harvest in the aspen cover type during the planning period. This falls slightly short of the desired establishment of 5,133 acres of aspen per decade because of the current unbalanced age class condition in the 30-39 age class. There are projected to be 454 acres converting into this cover type by the end of the planning period totaling 5,127 acres in the 0-9 age class.

Northern hardwoods

Current condition

Most of the northern hardwood cover type is currently between a stand age of 90 and 99 years old in the Cadillac Moraines Management Area (Figure 8). The past management regime has been primarily single tree selection which allows for stand age to continue to increase over time. Some stands are beginning to achieve an uneven-aged condition where a featured stand age becomes less evident, but the dominant age of these stands will likely increase past 150 years old prior to a younger age cohort becoming the prominent component of these stands.

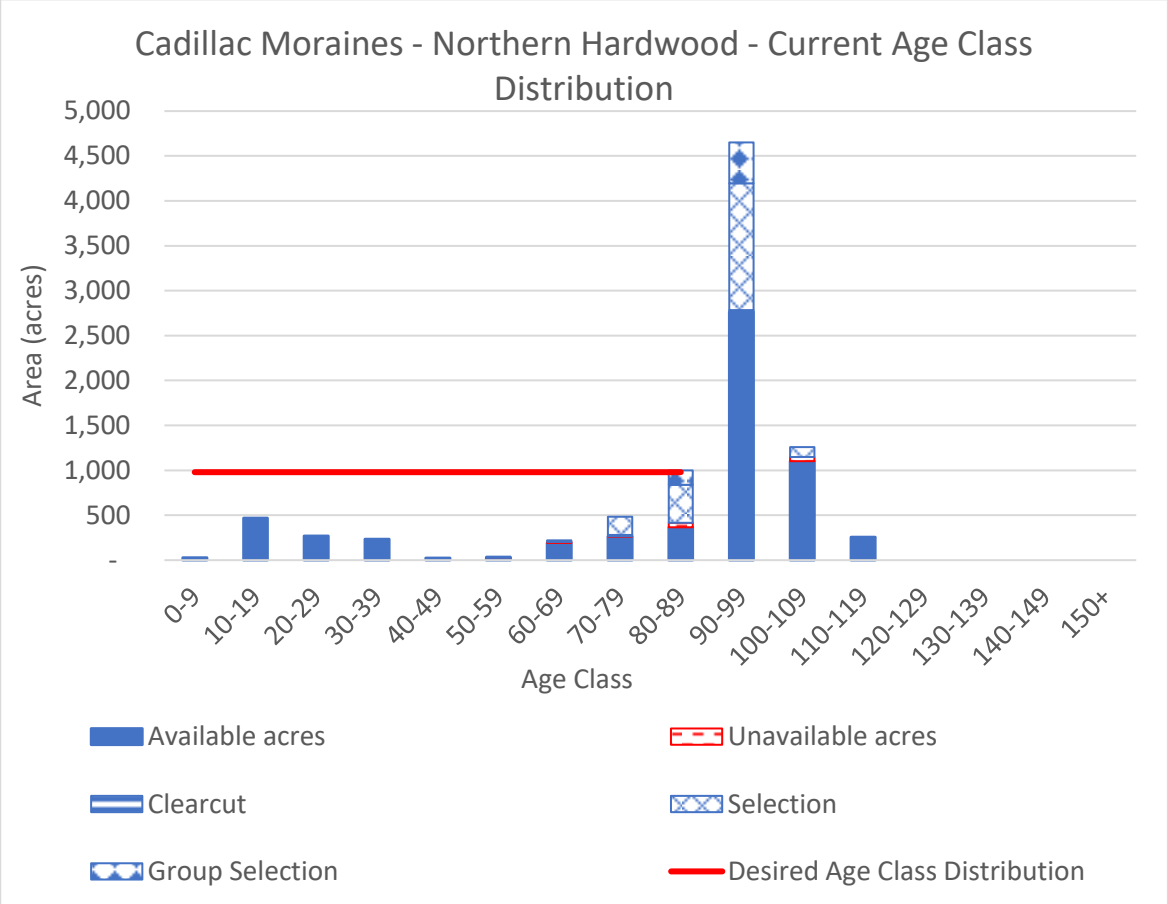


Figure 8. Current age class distribution and projected harvests in the northern hardwood cover type.

Northern hardwood acres are generally well positioned in the ideal basal area classes for optimal growing conditions, with most of the acres falling in the 80-140 basal area class, in the Cadillac Moraines Management Area (Figure 9). Current conditions are a result of beech and ash salvage efforts in the previous planning period and a regulated selection harvest regime that has been in place in this management area for decades.

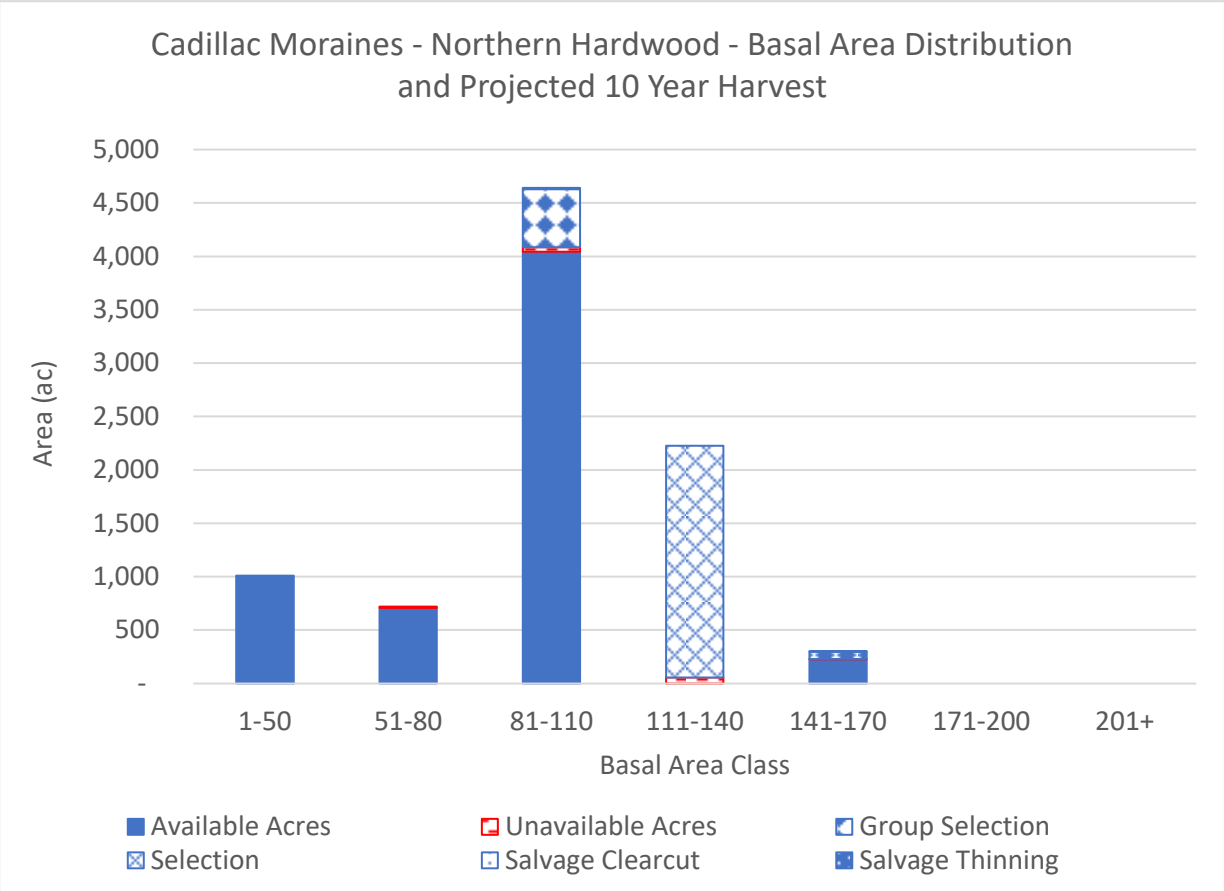


Figure 9. Current basal area distribution of the northern hardwood cover type as well as the projected harvests from each basal area class.

There are very few acres of unavailable northern hardwoods in the Cadillac Moraines Management Area. Opportunities to utilize a proportion of a stand to include in gaps will vary based on the age and condition of a stand, but the guidance for a typical log-sized hardwood stand will be 10-20% of the area, with the remaining 80-90% subject to thinning or no harvesting. Small group selection is the primary silvicultural treatment projected during this 10-year planning period. A portion of this cover type meets the habitat requirements for black-throated blue warbler and marten (Table 10).

Table 10. Featured species with northern hardwoods as a priority habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Northern Hardwood	Northern Hardwood Habitat Acres - Available	Northern Hardwood Habitat Acres - Unavailable
Black-Throated Blue warbler	Age Category: 80+ Size Category: Sawlog Basal Area: 81+	6,465	92
Marten	Age Category: 40+ Size Category: Pole, Sawlog Basal Area: 81+	7,101	102

Desired future condition

The projected long-term cover type trend for northern hardwood is stable in the Cadillac Moraines Management Area (Figure 10). There are almost no transitions into this cover type or out from northern hardwoods to other cover types with only a 0.4% increase.

The desired basal area distribution is a bell-shaped curve where a significant majority of the area is kept in the 81-110 basal area class with recently harvested stands occupying the 51-80 class and stands that are ready for harvest occupy the 111-140 basal area class.

Regeneration and recruitment continue to be a focus in the northern hardwood cover type across this management area. The long-term sustainability of this cover type in an uneven-aged silvicultural regime is dependent on the successful establishment of northern hardwood species as well as the recruitment of those seedlings and saplings into the pole and saw log classes. The Cadillac Moraines Management Area will take several decades to reach the desired future condition.

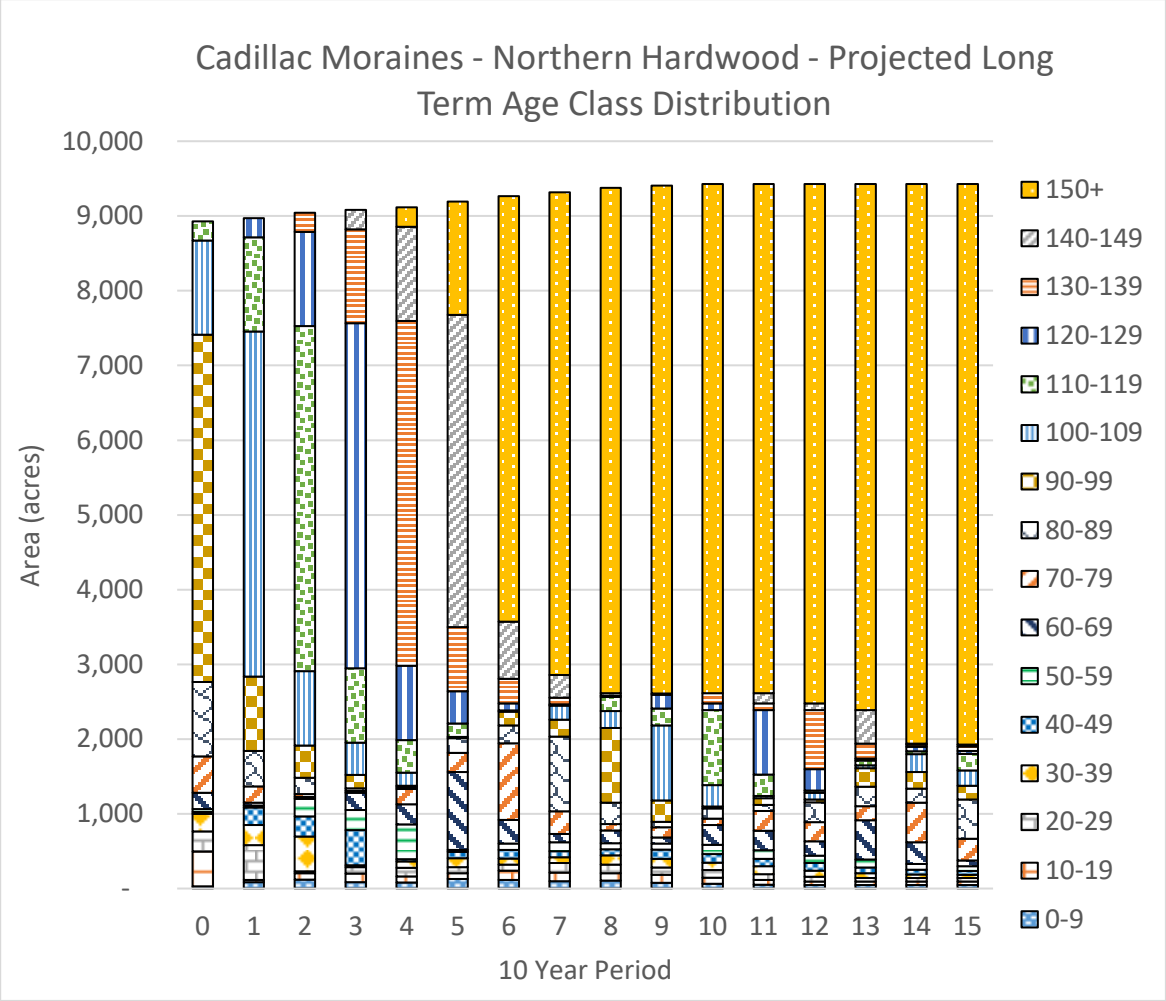


Figure 10. Projected age class distribution for all acres of northern hardwood over the next 150 years.

Management actions

The desired forest conditions and associated featured species habitat will be maintained and achieved through continued application of the projected harvest regimes. It includes 2,185 acres of selection, 613 acres of group selection, and 34 acres of clearcut harvest methods (Table 7). Multiple silvicultural regimes should have continued consideration as emerging research results become available. Emphasis on canopy gaps should be used to encourage diverse regeneration of northern hardwood species while maintaining an overall long-term mature forest closed canopy landscape condition.

Mixed upland deciduous

Current condition

The Cadillac Moraines Management Area has a surplus of acres in the 20- to 29-year-old age class mostly with 90- to 109-year-old age classes contributing to the rest of the surplus (Figure 11). The age class distribution is just over the balanced distribution of 641 acres in the 0- to 19-year-old age classes.

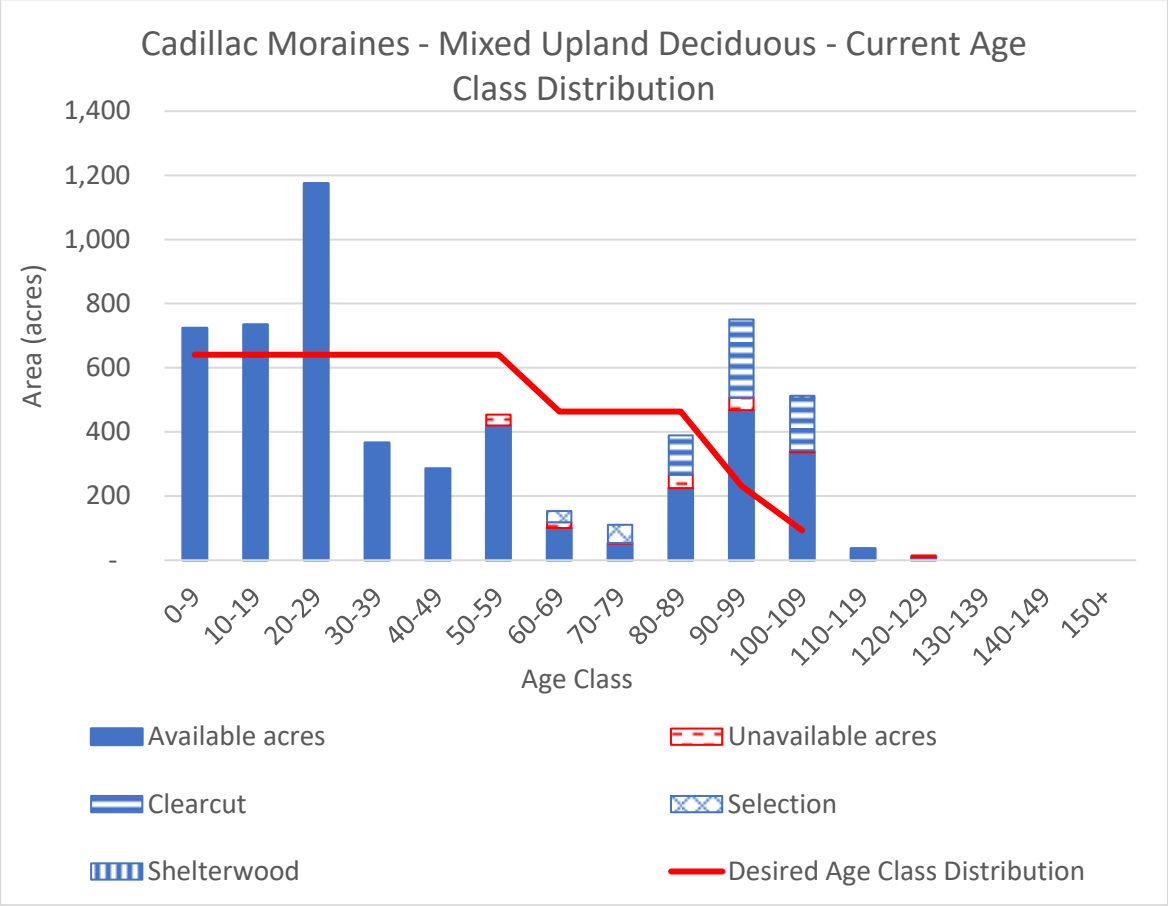


Figure 11. Current age class distribution, the desired age class distribution, and the projected harvests in the mixed upland deciduous cover type over the 10-year planning period.

A portion of this cover type meets the habitat requirements for black-throated blue warbler and marten (Table 11).

Table 11. Featured species with mixed upland deciduous as a priority habitat cover type, habitat variables and current acres (e.g., potential habitat).

Featured Species	Featured Species Habitat – Mixed Upland Deciduous	Mixed Upland Deciduous Habitat Acres - Available	Mixed Upland Deciduous Habitat Acres - Unavailable
Black-Throated Blue Warbler	Age Category: 80+ Size Category: Sawlog Basal Area: 81+	1,159	87
Marten	Age Category: 40+ Size Category: Pole, Sawlog Basal Area: 81+	1,741	140

Desired future condition

The projected long-term cover type trend for mixed upland deciduous is increasing by 1% in the Cadillac Moraines Management Area. There are a few transitions in and out of this cover type during this planning period.

The long-term goal for this cover type is an age class distribution with a rotation age of 50 years with a drop of approximately 28% in acres for the individual age class until the 80-year-old age class and tail off to the 100-year-old age class.

The end of the planning period will result in the establishment of approximately 724 acres of mixed upland deciduous to the 0- to 9-year-old age class in the available acres (Figure 12). This is just above the 641 acres of desired acres. Progress toward the long-term desired age class distribution of mixed upland deciduous will take many decades to achieve the desired balanced age class condition.

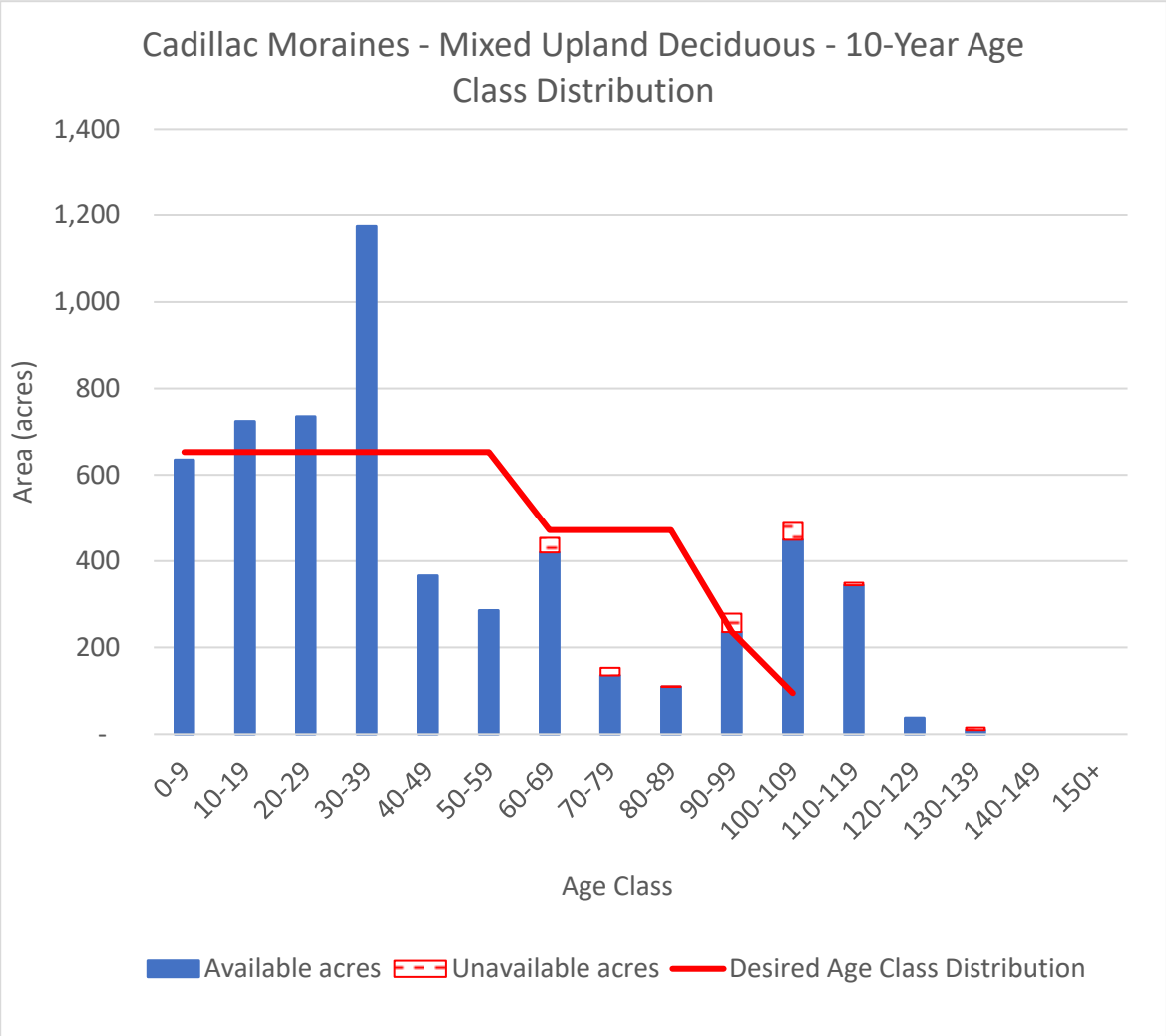


Figure 12. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution of mixed upland deciduous is beginning to reach the desired future condition for available acres (Figure 13). The number of acres in the older age classes, 110 years and older, continues to increase due to unavailable landscape conditions.

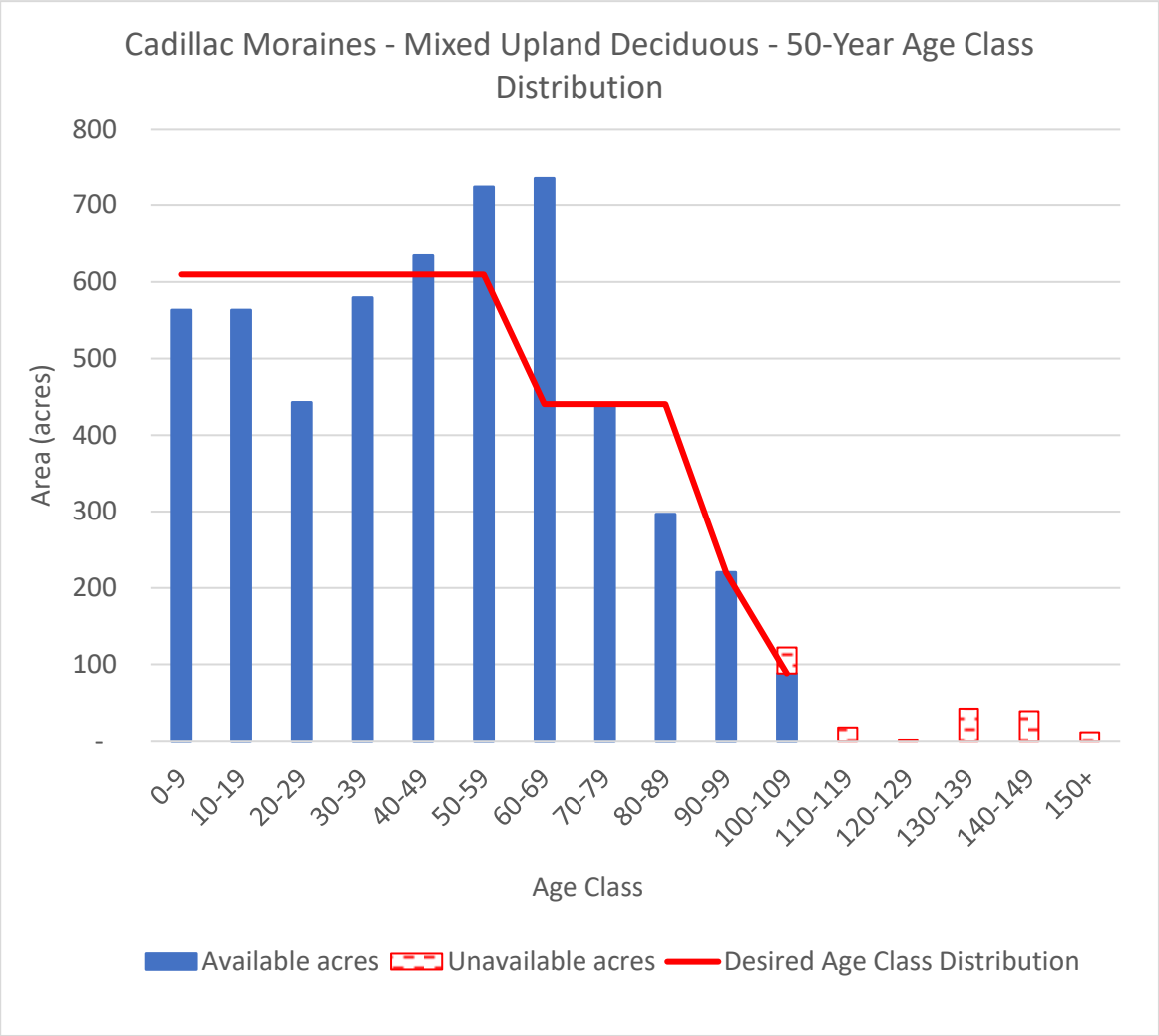


Figure 13. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 14) will concentrate on the manageable acres of mixed upland deciduous cover type in productive growing conditions while providing an even flow of forest products and a wide variety of wildlife habitat conditions across the landscape in young, mid-aged, and mature forest (Figure 15). Only the 60- to 69-year-old age class is over the desirable amount of 417 acres in the age class.

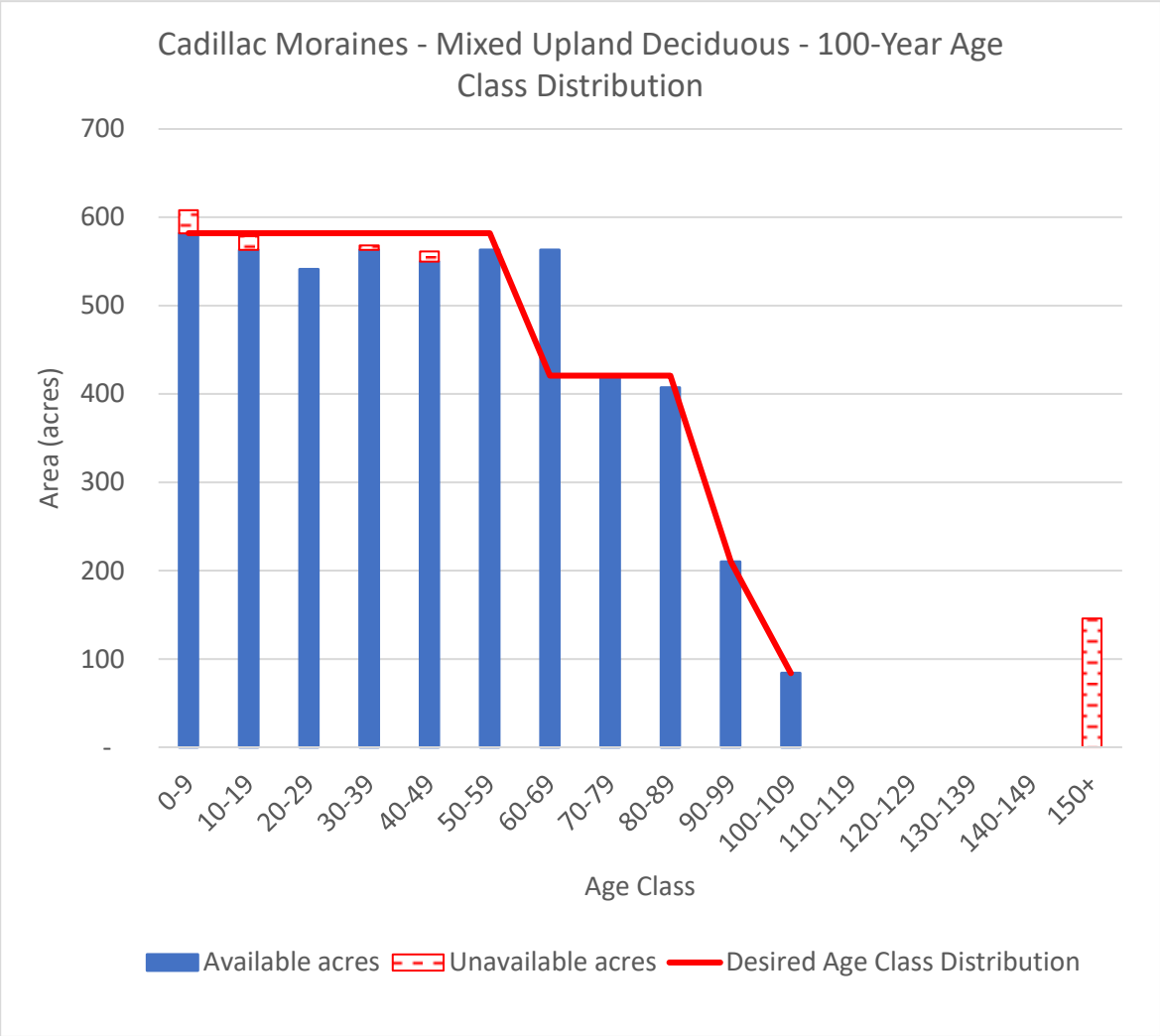


Figure 14. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

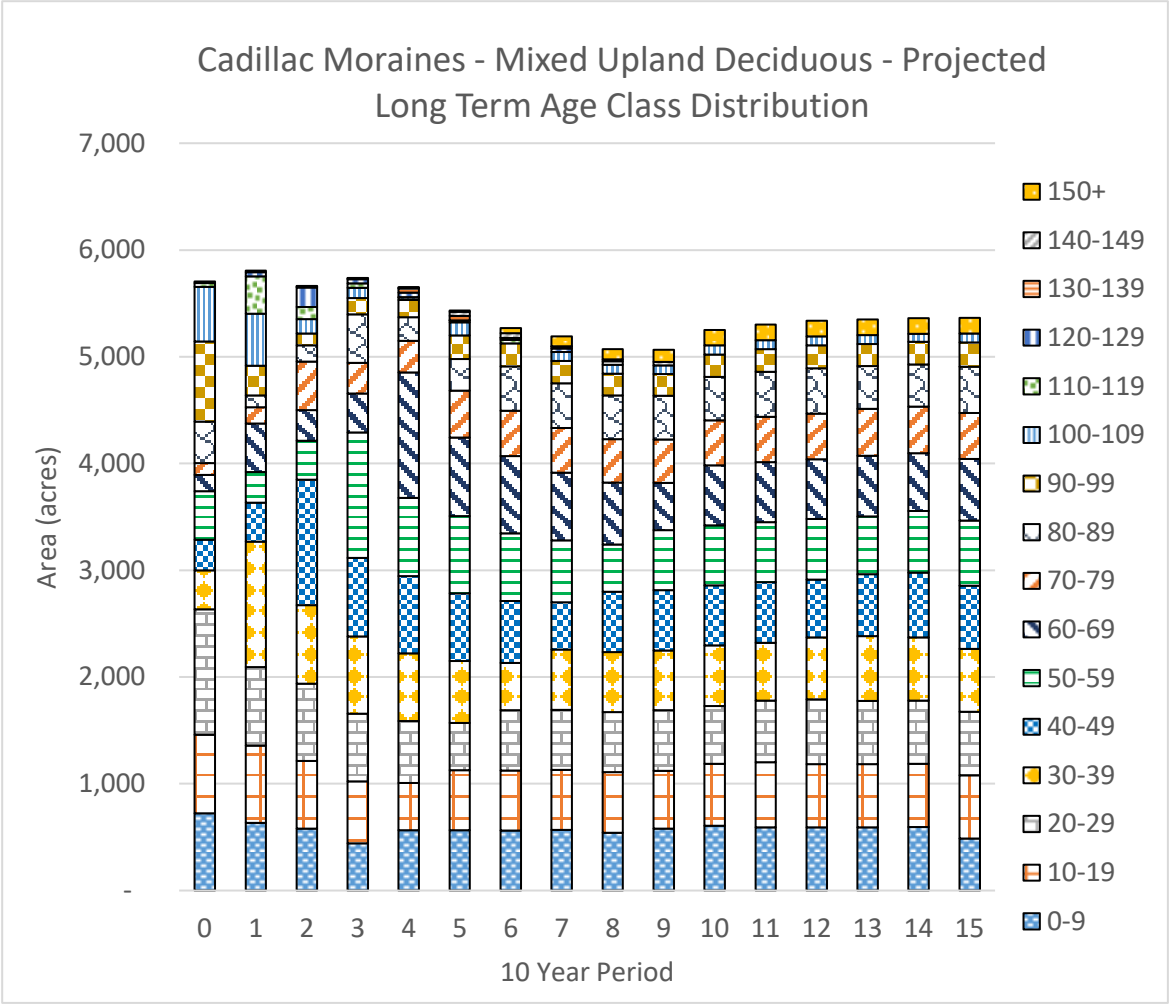


Figure 15. Projected age class distribution for all acres of mixed upland deciduous over the next 150 years.

Management Actions

There are 529 acres of projected clearcut harvest in the mixed upland deciduous cover type during the planning period. There are also predicted to be 99 acres to be converted into this cover type. This is just under the desired establishment of 641 acres of mixed upland deciduous per decade.

Planted red pine

Current Condition

The Cadillac Moraines management area has a surplus of acres in the 0- to 9-year age class and 60- to 69-year-old age class that was created due to the harvesting of the large number of mature and over-mature acres on the landscape and most being planted within the same decade (Figure 16). The age class distribution is currently very unbalanced across almost all the age class categories. Additionally, a deficit of available acres occurs in almost all age classes.

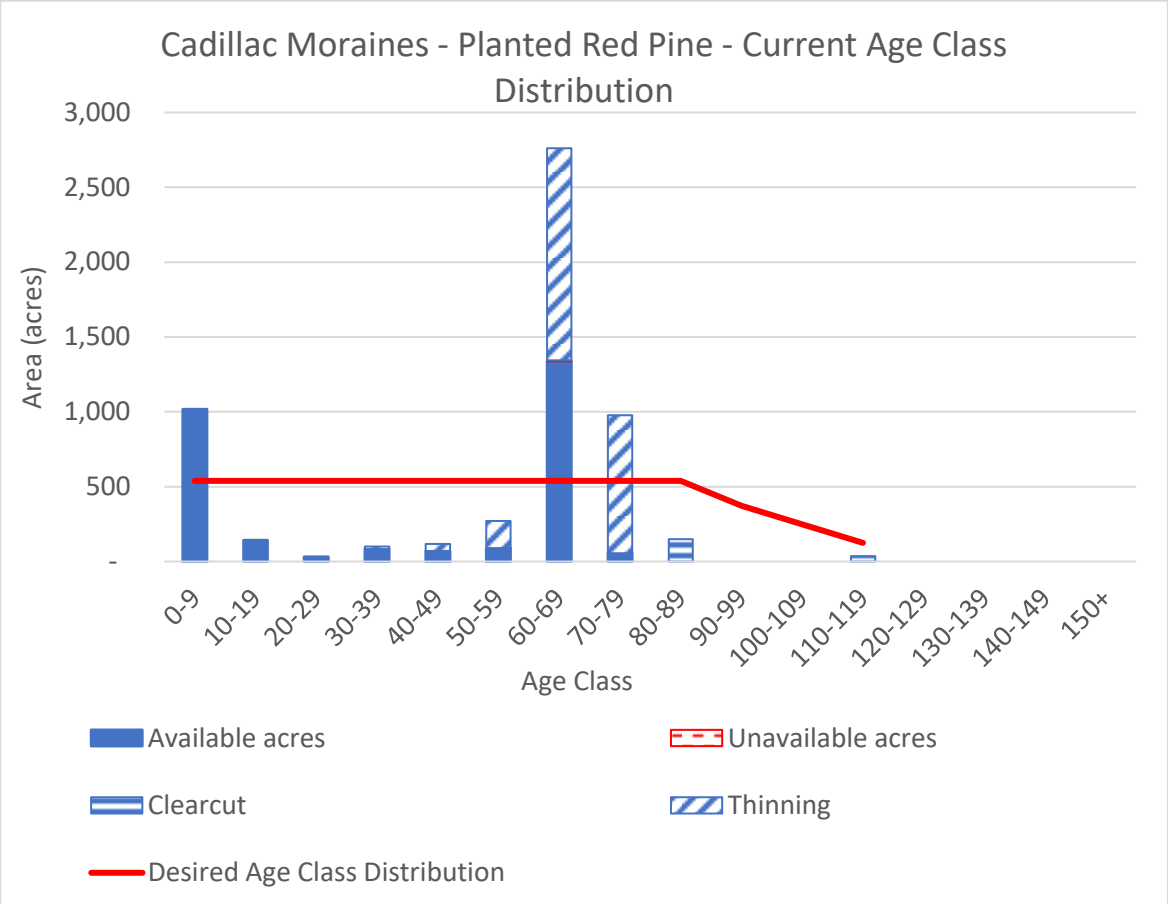


Figure 16. Current age class distribution, the desired age class distribution, and the projected harvests in the planted red pine cover type over the 10-year planning period.

Desired Future Condition

The projected long-term cover type trend for planted red pine is fairly stable in the Cadillac Moraines Management Area. There are a few transitions in and out of this cover type during this planning period with only a 4% growth.

The long-term goal for this cover type is balanced age classes between 0 and 80-years-old for all available planted red pine acres and then decreasing number of acres in until the max tail of 110-years-old is reached.

The end of the planning period will result in the establishment of approximately 423 acres of planted red pine from the available acres (Figure 17). In addition, another 66 acres are projected to transition into this cover type. Progress toward the long-term desired age class distribution of 562 of planted red pine in each age class from 0 to 80-year-old age class will take many decades to achieve the desired balanced age class condition.

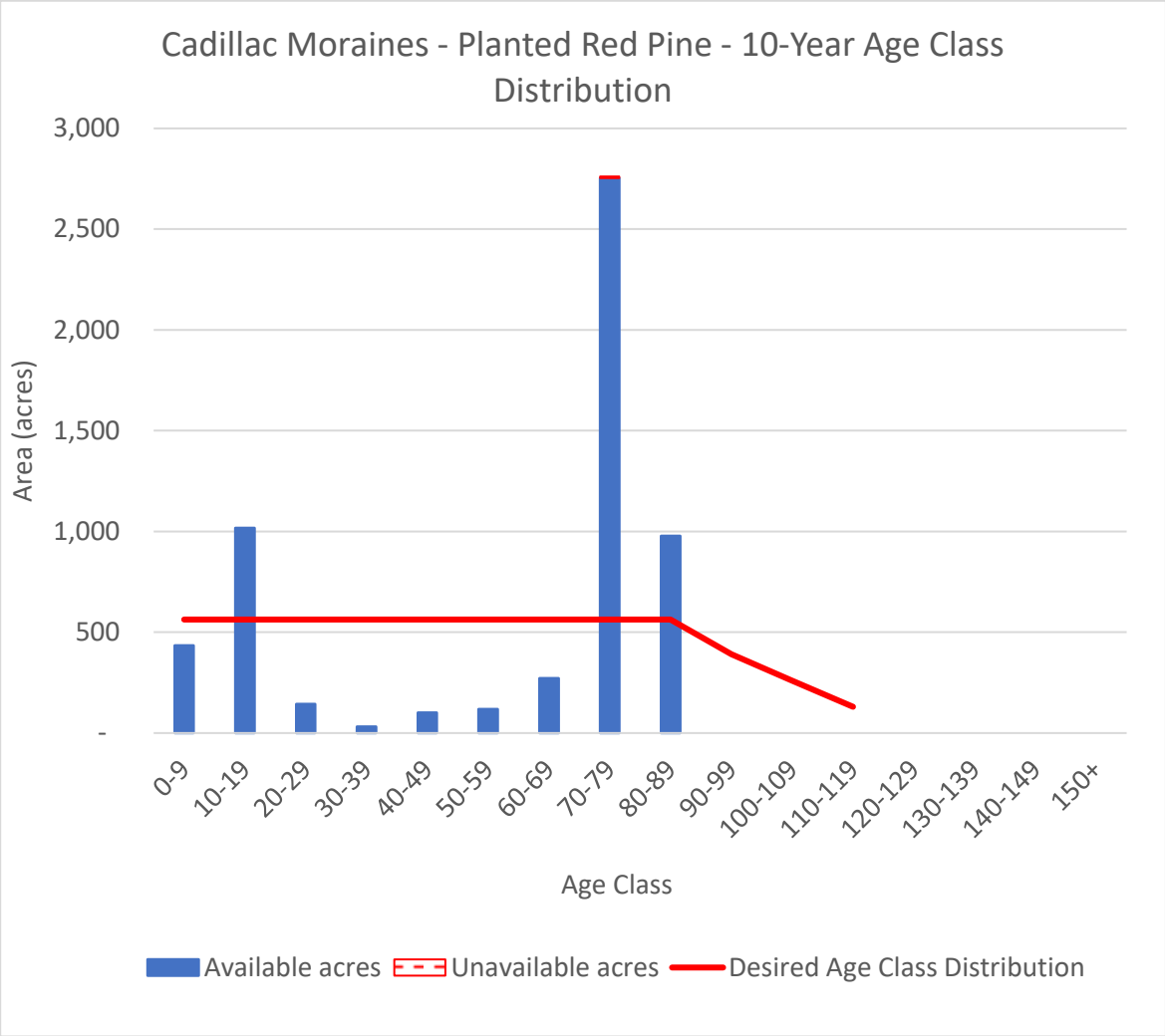


Figure 17. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution of planted red pine is beginning to reach the desired future condition for available acres in the age classes between 0 and 40-year-old age (Figure 18). The number of acres in the older age classes, 120 years and older, continues to increase as the spike in the 110- to 119-year-old age class continues to get harvested over time.

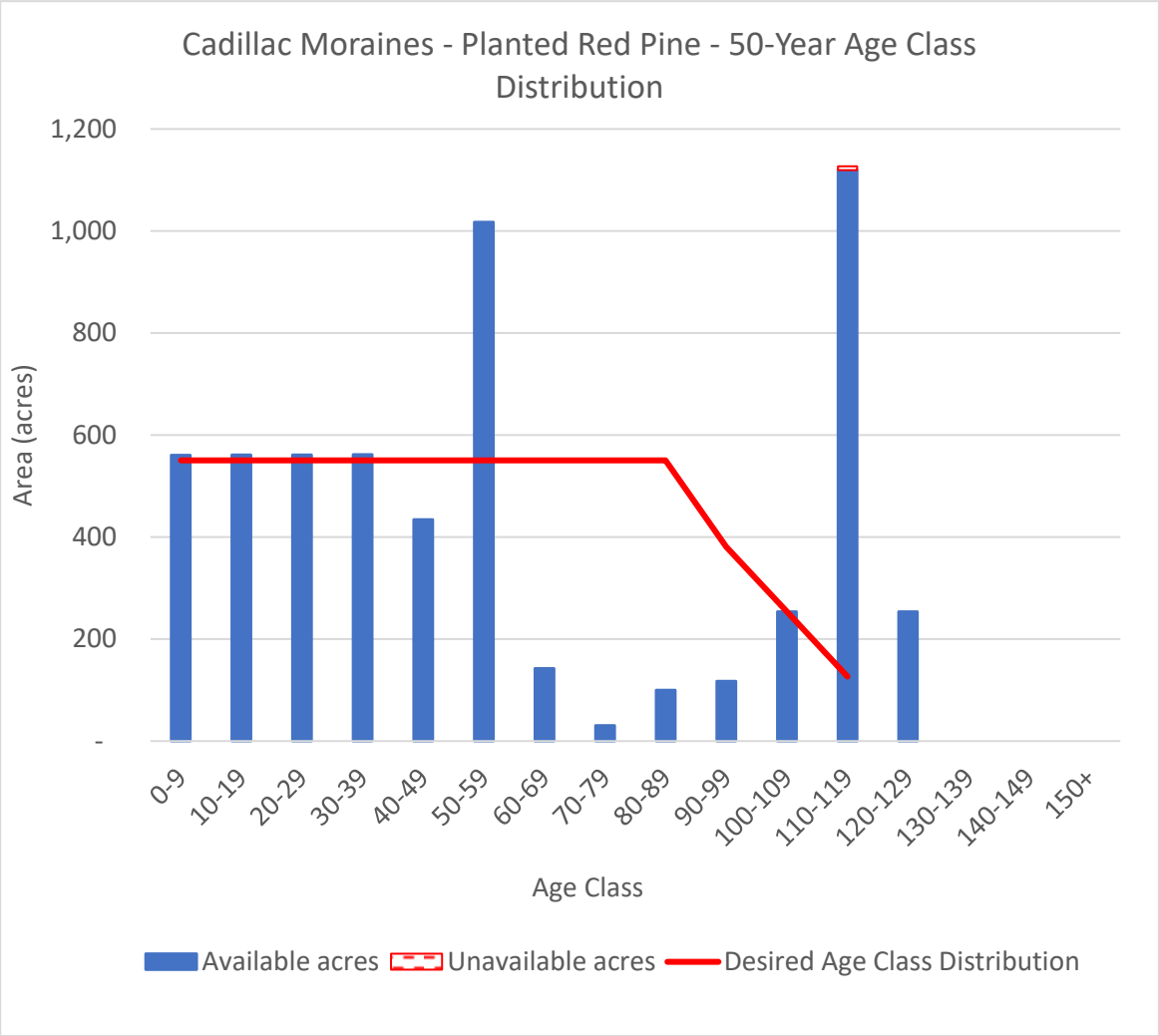


Figure 18. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 19) will concentrate on the manageable acres of planted red pine cover type in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged, and mature forest (Figure 20).

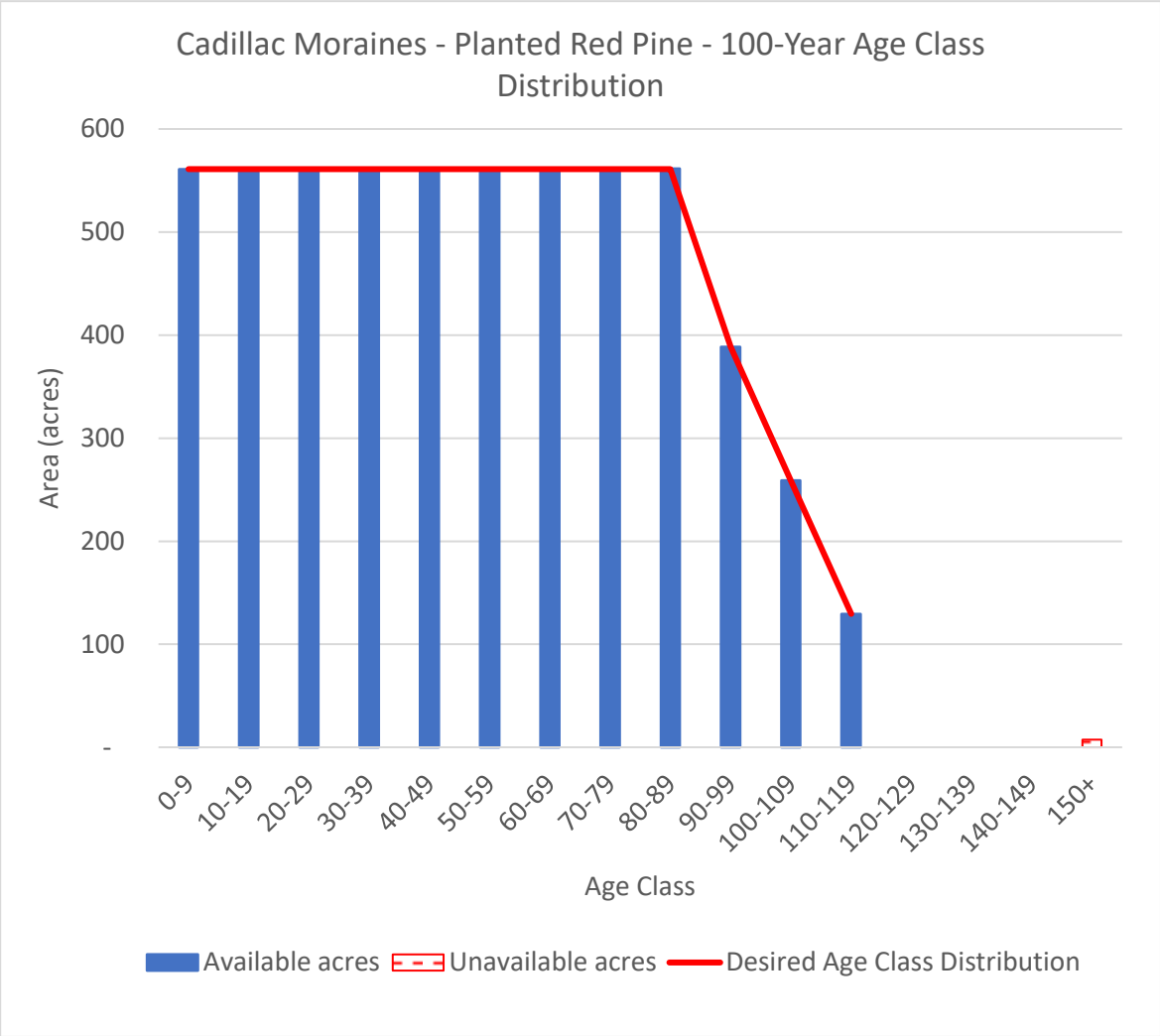


Figure 19. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

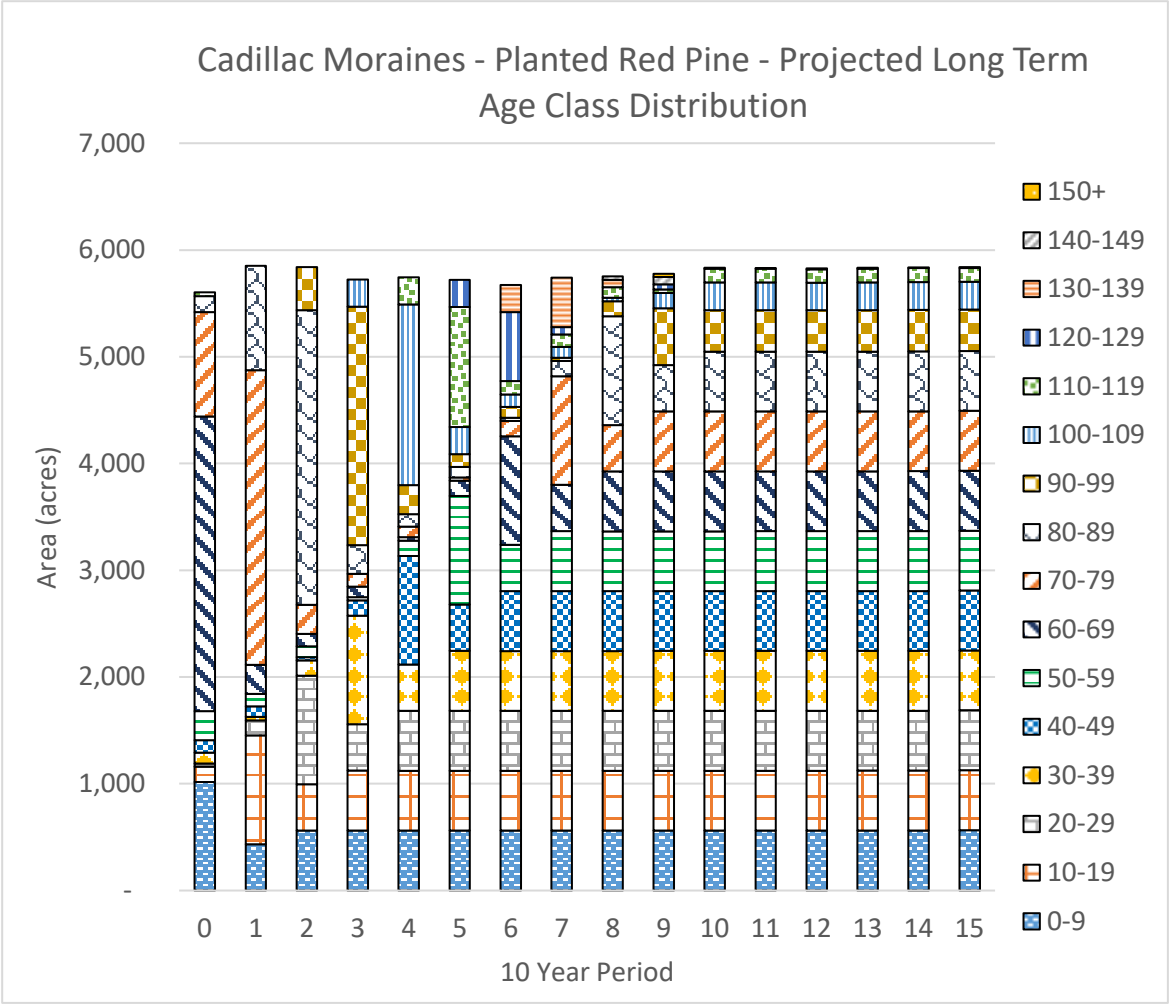


Figure 20. Projected age class distribution for all acres of northern hardwood over the next 150 years.

Management actions

There are 185 acres of projected clearcut harvest in the planted red pine cover type during the planning period. An additional 238 acres are projected to transition into this cover type as well. This is below the desired establishment of 562 acres of planted red pine per decade because of the current unbalanced age class condition and the number of acres in the same 10-year age class spike.

Northern red oak

Current condition

Most of the northern red oak cover type is currently in the 90- to 119-year-old age classes (Figure 21). The past management regime has been primarily single-tree selection which allows for stand age to continue to increase over time. Some stands are beginning to achieve an uneven-aged condition where a featured stand age becomes less evident, but the dominant age of these stands will likely increase past 150 years old prior to a younger age cohort becoming the prominent component of these stands.

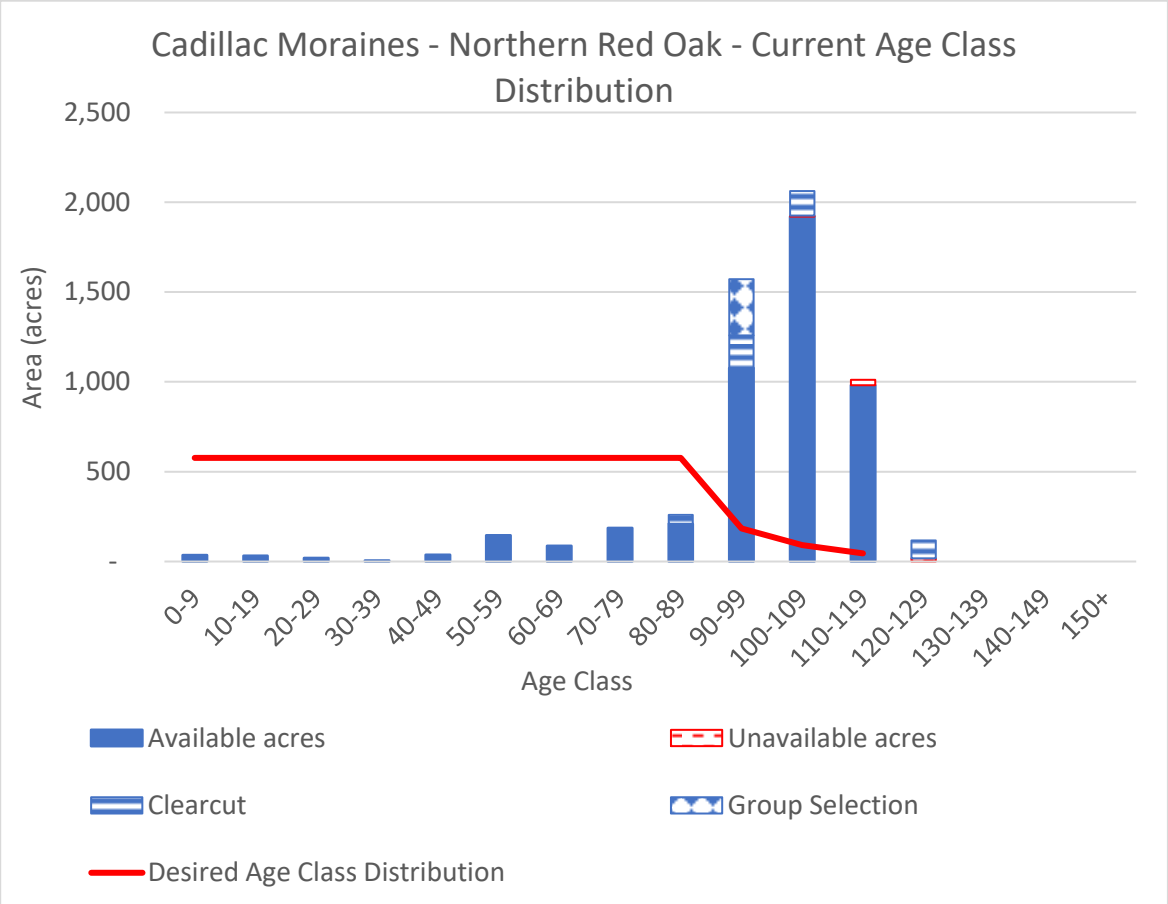


Figure 21. Current age class distribution, the desired age class distribution, and the projected harvests in the northern red oak cover type over the 10-year planning period.

Current conditions are a result of consistent commercial harvests efforts on available northern red oak acres during the previous planning periods. Much of the northern red oak acres are distributed across the 81-110, and 111-140 basal area classes, but there are also quite a few in the 1-50 basal area class (Figure 22). A portion of this cover type meets the habitat requirements for marten (Table 50).

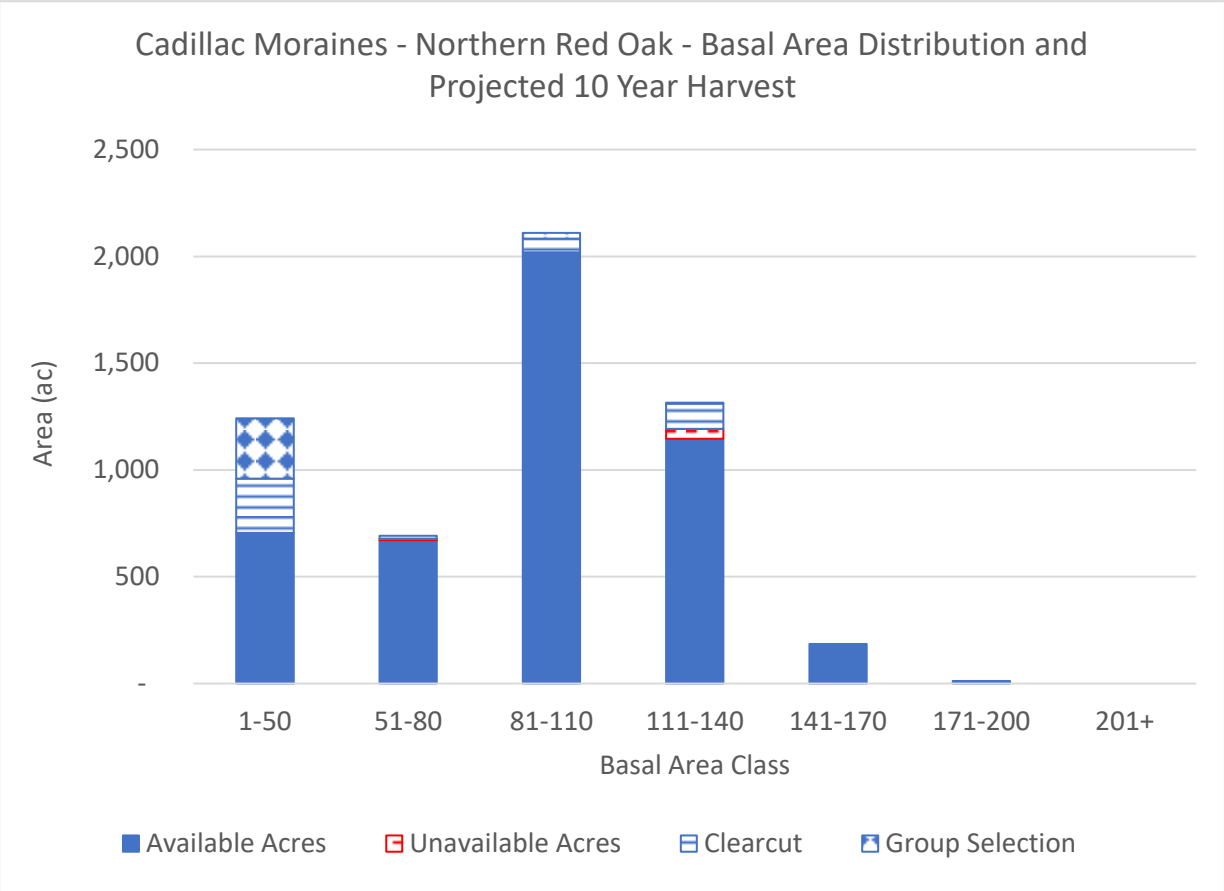


Figure 22. Current basal area distribution of the northern red oak cover type as well as the projected harvests from each basal area class.

Table 12. Featured species with northern red oak as a priority habitat cover type, habitat variables and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Northern Red Oak	Northern Red Oak Habitat Acres - Available	Northern Red Oak Habitat Acres - Unavailable
Marten	Age Category: 40+ Size Category: Pole, Sawlog Basal Area: 81+	3,774	46

Desired future condition

There are very few acres of unavailable northern red oak in the Cadillac Moraines Management Area. Clearcut is the primary silvicultural treatment projected during this 10-year planning period to increase stem density, species composition and regeneration of younger stands within the northern red oak areas.

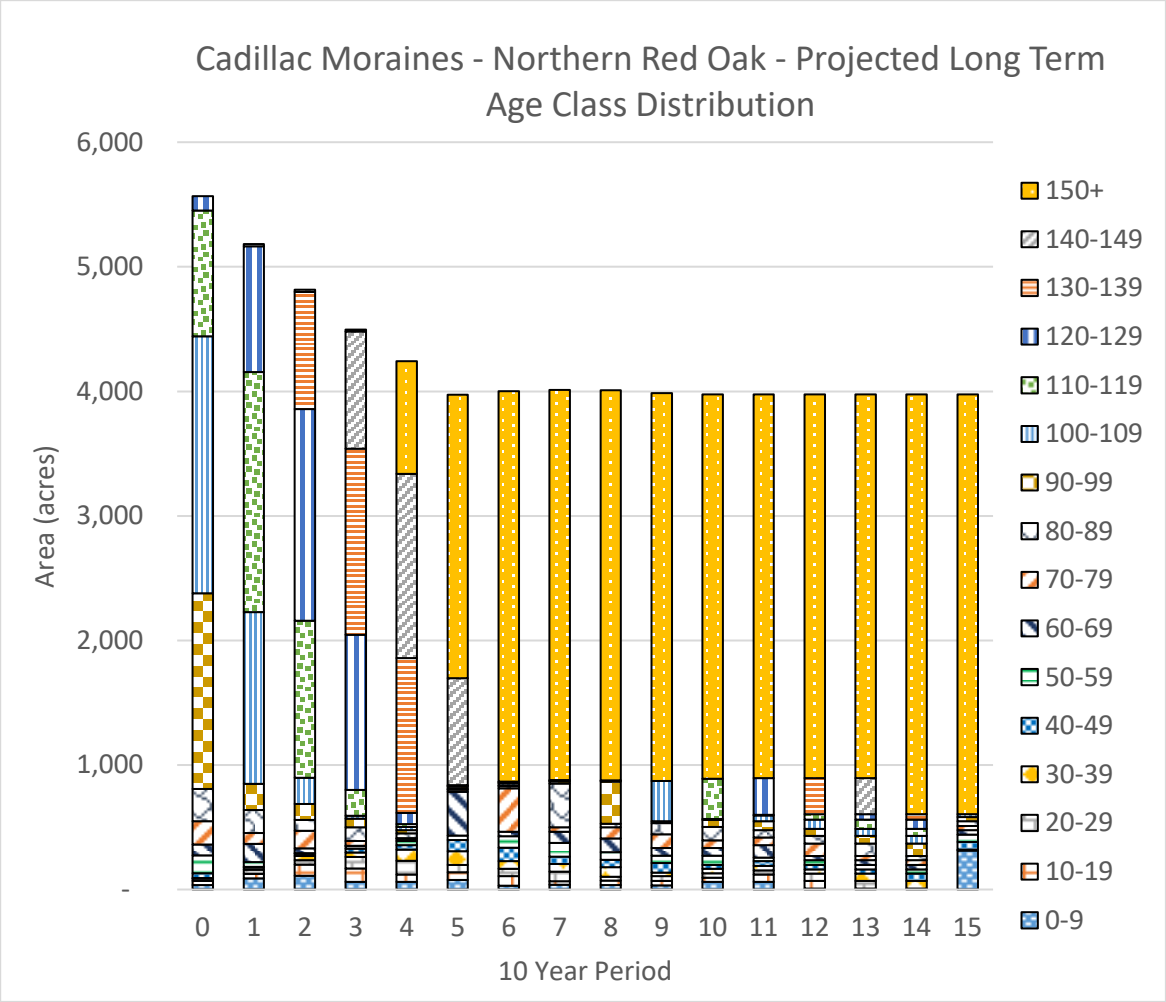


Figure 23. Projected age class distribution for all acres of northern red oak over the next 150 years.

Management actions

There are 948 acres of projected clearcut harvest, 122 acres of thinning and 42 acres of projected shelterwood in the northern red oak cover type during this planning period. Some of this cover type will be converting into others such as oak mix.

Conservation area network

High conservation value areas

There are up to nine different high conservation value area (HCVA) types that can be found in each management area (Table 13; see Biodiversity in Section 3 for more information).

Table 13. High value conservation areas within Cadillac Moraines Management Area.

High Conservation Value Area Type and Name	Acres
Eastern Massasauga Managed Land	**0**
-	0
Natural Rivers Vegetative Buffer	**293**
-	293
Natural Rivers Zoning District	**702**
-	702
GEMS	**4,024**
Mark Knee Memorial GEMS	4,024
Grand Total	**5,019**

Ecological reference areas

Ecological reference areas are a type of HCVA and are higher quality examples of functioning ecosystems that are primarily influenced by natural ecological processes.

Table 14. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 15. Ecological reference areas (ERA) within the management area.

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	Number of Occurrences
Existing ERA	Northern Wet Meadow	C	G4G5	S4	2
Existing ERA	Rich Conifer Swamp	BC	G4	S3	1
Existing ERA	Submergent Marsh	AB	GU	S4	1
Grand Total	-	-	-	-	**4**

Special conservation areas

Reviewable special conservation areas (SCAs; Table 16) refers to those SCA types that may be reviewed or updated through the compartment review process as needed. Static SCAs (Table 17) refers to those SCA types that generally do not change or require updating (see Biodiversity in Section 3 for more information).

Table 16. Reviewable special conservation areas within Cadillac Moraines Management Area.

Reviewable Special Conservation Area Type and Name	Acres
Concentrated Recreational Area	**22**
Dyer Lake Campground	7
Long Lake (Missaukee) Campground	13
Tin Cup Spring Motorcycle Trail and Route	1
Grand Total	**21**

Table 17. Static special conservation areas within Cadillac Moraines Management Area.

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Common Natural Heritage Element Occurrences	**-**	**68**
Poor Conifer Swamp	-	68
Designated Trout and Cold Water Stream Buffer	**-**	**895**
--	-	488
Coe Creek	-	17
East Branch Pine River	-	7
Filer Creek	-	9
Ham Creek	-	9
Hopkins Creek	-	14
Manton Creek	-	6
Middle Branch River	-	35
North Branch Pine River	-	7
Pine River	-	202
Sanborn Creek	-	76
Silver Creek	-	9
Twin Creek	-	15
Designated Trout and Coldwater Streams	**33.3**	**-**
--	17.8	-
Coe Creek	0.7	-
East Branch Pine River	0.3	-
Filer Creek	0.3	-
Ham Creek	0.4	-
Hopkins Creek	0.7	-
Manton Creek	0.2	-
Middle Branch River	1.2	-
North Branch Pine River	0.3	-
Pine River	7.4	-
Sanborn Creek	3.1	-
Silver Creek	0.3	-
Twin Creek	0.5	-
Mussel Stream Group 2 - State threatened or endangered	**0.0**	**-**
Cunnerson Creek-Clam River	0.0	-
Wild and Scenic Rivers	**0.7**	**-**
Pine Wild and Scenic River	0.7	-
Wood Turtle Stream 100ft Buffer	**-**	**73**
Pine River	-	73
Wood Turtle Stream 660ft Buffer	**-**	**370**
Pine River	-	370
Grand Total	**34.0**	**1,406**

Rare species

Rare species occurrences are compiled from the Michigan Natural Features Inventory Biotics database (Table 18, Table 20) and do not necessarily include all rare species found in this management area due to biases in survey effort and verifiable observation reporting over time.

Table 18. Rare animal and plant species conservation status key.

Status	Status
E = endangered	LE = listed endangered
T = threatened	LT = listed threatened
SC = special concern	PDL = proposed for delisting

Table 19. Rare animal occurrence within Cadillac Moraines Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Alasmidonta viridis	Slippershell	T	-	2
Animal	Asio flammeus	Short-eared owl	E	-	1
Animal	Bombus borealis	Northern amber bumble bee	SC	-	1
Animal	Buteo lineatus	Red-shouldered hawk	SC	-	1
Animal	Centronyx henslowii	Henslow's sparrow	E	-	1
Animal	Emydoidea blandingii	Blanding's turtle	SC	-	1
Animal	Gavia immer	Common loon	T	-	4
Animal	Glyptemys insculpta	Wood turtle	T	-	3
Animal	Haliaeetus leucocephalus	Bald eagle	SC	-	5
Animal	Lanius ludovicianus migrans	Migrant loggerhead shrike	E	-	1
Animal	Lasmigona compressa	Creek heelsplitter	SC	-	1
Animal	Notropis dorsalis	Bigmouth shiner	T	-	1
Animal	Planogyra asteriscus	Eastern flat-whorl	SC	-	1
Animal	Setophaga kirtlandii	Kirtland's warbler	E	-	1
Animal	Spiza americana	Dickcissel	SC	-	1
Animal	Terrapene carolina carolina	Eastern box turtle	T	-	2
Animal	Thamnophis butleri	Butler's garter snake	SC	-	1
Total	-	-	-	-	**28**

Table 20. Rare plant occurrence within Cadillac Moraines Management Area.

	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Plant	Juncus vaseyi	Vasey's rush	T	-	1
Total	-	-	-	-	**1**

Non-ecological reference area natural communities

Natural communities that are identified with an element occurrence in the Michigan Natural Features Inventory Biotics database, but that have not been given an additional ecological reference area designation, are recognized and managed accordingly (Table 21).

Table 21. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 22. Non-ecological reference area natural communities within Cadillac Moraines Management Area.

Community Type	Element Occurrence Rank	State Rank	Global Rank	Number of Occurrences
Poor Conifer Swamp	B	S4	G4	1
Grand Total	**-**	**-**	**-**	**1**

Forest health

Forest health concerns, both native and non-native, can have impacts on stand conditions and management decisions. The following insects (Table 23) and diseases (Table 24) could have an impact on management during the planning period and may need to be monitored and/or addressed.

Table 23. Defoliating insects of concern in the Cadillac Moraines management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Spongy moth	Lymantria dispar	Non-native	Yes
Forest tent caterpillar	Malacosoma disstria	Native	Yes
Large aspen tortrix	Choristoneura conflictana	Native	Yes
Hemlock wooly adelgid	Adelges tsugae	Non-native	Yes

Watch for and retain lingering ash with potential resistance to emerald ash borer.

Table 24. Maladies of concern in the Cadillac Moraines Management Area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Canker (stem infections)	Various	Various	Yes
Armillaria root rot	Armillaria spp.	Native	Yes
Oak decline	Various	Various	Yes

Monitor planted red pine for pockets of mortality that may suggest Heterobasidion root disease and follow guidance in areas near disease-positive stands. Report surviving mature beech trees that may be resistant to beech bark disease. Watch for symptoms of beech leaf disease.

Aquatic resources

Riparian habitat

Approximately 32 miles of streams and rivers are found in the management area (Table 25). Streams/rivers classified as cold types comprise approximately 69% of the riverine mileage.

Table 25. Classification type and length of streams/rivers found within the management area.

Type	Length (miles)
Cold Stream	15
Cold Small River	7
Cold Transitional Stream	<1
Cold Transitional Small River	<1
Cold Transitional Large River	0
Warm Transitional Stream	8
Warm Transitional Small River	2
Warm Transitional Large River	0
Warm Stream	0
Warm Small River	0
Warm Large River	0

Lacustrine habitat

A total of 15 lakes and ponds of at least one surface acre are found in the management area (Table 26).

Table 26. Size and number of lakes and ponds located within the management area.

Lake Size Class (acres)	Number
1-99	14
100-499	1
500+	0

Wetlands

A total of 5,627 acres of wetlands are found in the management area (Table 27). Forested wetlands comprise approximately 89% of wetland types found in the management area.

Table 27. Area of emergent, forested, and riverine wetland types found within the management area.

Wetland Type	Acres
Emergent	511
Forested	4,993
Riverine	123

Vernal pools and seeps

A total of 92 acres of vernal pools and seeps have been inventoried in the management area while 244 acres of seeps have been identified.

Riparian vegetation cover

Aspen is the predominant cover type present in a 100-meter riparian zone located next to streams/rivers in the management area (Table 28).

Table 28. Largest vegetative cover types (i.e., top 10) and area located in a 100-meter buffer of streams/rivers within the management area.

Cover Type	Acres
Aspen	1,672
Northern Hardwood	679
Planted Red Pine	437
Mixed Upland Deciduous	389
Lowland Shrub	365
Northern Red Oak	288
Marsh	249
Lowland Conifers	235

Cover Type	Acres
Herbaceous Openland	223
Lowland Aspen/Balsam Poplar	196

Watershed vegetation cover

The management area includes portions of important watersheds of the Manistee and Pere Marquette rivers (Table 29 & Table 30). Aspen and hardwoods are major cover types of the state forest in each watershed.

Table 29. Largest vegetative cover types (i.e., top five) and area of the Manistee River watershed located within the management area.

Cover Type	Acres)
Aspen	8,756
Northern Hardwood	5,637
Planted Red Pine	1,684
Black-Red Hybrid Oak	1,223
Northern Red Oak	1,138

Table 30. Largest vegetative cover types (i.e., top five) and area of the Pere Marquette River watershed located within the management area.

Cover Type	Acres
Aspen	4,586
Black-Red Hybrid Oak	1,932
Mixed Upland Deciduous	1,166
Northern Red Oak	859
Northern Hardwood	494

Recreation

The Cadillac Moraines Management Area consists of several smaller, non-contiguous blocks of land. Nonetheless, it has good access to recreation opportunities with a well-developed road/trail system.

Off-road vehicle trails in this management area are extensive and include the Lincoln Hills ORV/snowmobiling route/motorcycle trail; the North Missaukee ORV route; the Michigan Cross Country Cycle Trail; and the Tin Cup, Evart and Long Lake motorcycle/ORV trails. Nonmotorized trails include the Cadillac Pathway and Silver Creek Pathway open to hiking and biking; and 4.9 miles of the Shore-to-Shore equestrian trail.

There are six state forest campgrounds (rustic) within the management area, all of which provide water access. Additional recreation opportunities are provided by nearby Mitchell State Park and the Manistee National Forest.

Table 31. Designated recreation trails by type.

Recreation Category	Recreation Type	# of Miles
Motorized Recreation Trails	ORV (all types)	140.8
Motorized Recreation Trails	Snowmobile	34.2
Nonmotorized Recreation Trails	Hiking	19.9
Nonmotorized Recreation Trails	Equestrian	4.9
Nonmotorized Recreation Trails	Biking	15.1
Nonmotorized Recreation Trails	Hunter Access Trails	10.4
Total	-	**225.2**

Note: Trail-use types may overlap.

Table 32. State forest campgrounds.

State Forest Campground	# of sites	ORV Access
Long Lake (Wexford)	12	X
Silver Creek	26	-
Sunrise Lake	17	-
Goose Lake	30	-
Long Lake (Missaukee)	11	-
Lincoln Bridge	9	-

The Mark Knee Memorial Grouse Enhanced Management Site provides excellent habitat for bird hunting, with over ten miles of hunter access trails.

The Pine River is popular for water recreation with multiple access points. Other boating access sites provide access to the Middle Branch River, Silver Creek and inland lakes.

The Cadillac Moraines Management Area is also popular for dispersed recreation such as hunting and mushroom picking.

Table 33. Areas managed for hunting.

Type	Name	Acres
Grouse Enhanced Management Site	Mark Knee Memorial	4,020.9

Table 34. Boating access sites.

Boating Access Site	Waterbody
Coe Creek	Pine River
Edgetts Bridge	Pine River
Goose Lake State Forest Campground	Goose Lake
Graver Road Pine River	Pine River
Lincoln Bridge State Forest Campground	Pine River
Long Lake State Forest Campground	Long Lake
Marion Ponds	Middle Branch River
Middle Branch	Middle Branch River
Pine River	Pine River
Silver Creek State Forest Campground	Silver Creek
Sunrise Lake State Forest Campground	Sunrise Lake

Camp Grayling

State Forest Area:	Location:	Population Centers:
105,874 acres	Kalkaska, Crawford and southern Otsego counties	Grayling

Subsection:	Landforms:	Landcover:
Grayling Outwash Plain, Kirtland's Warbler High Sand Plains	Ice-contact formed end-moraine ridges and outwash areas	Forested: 83,574 acres Nonforested: 22,300 acres

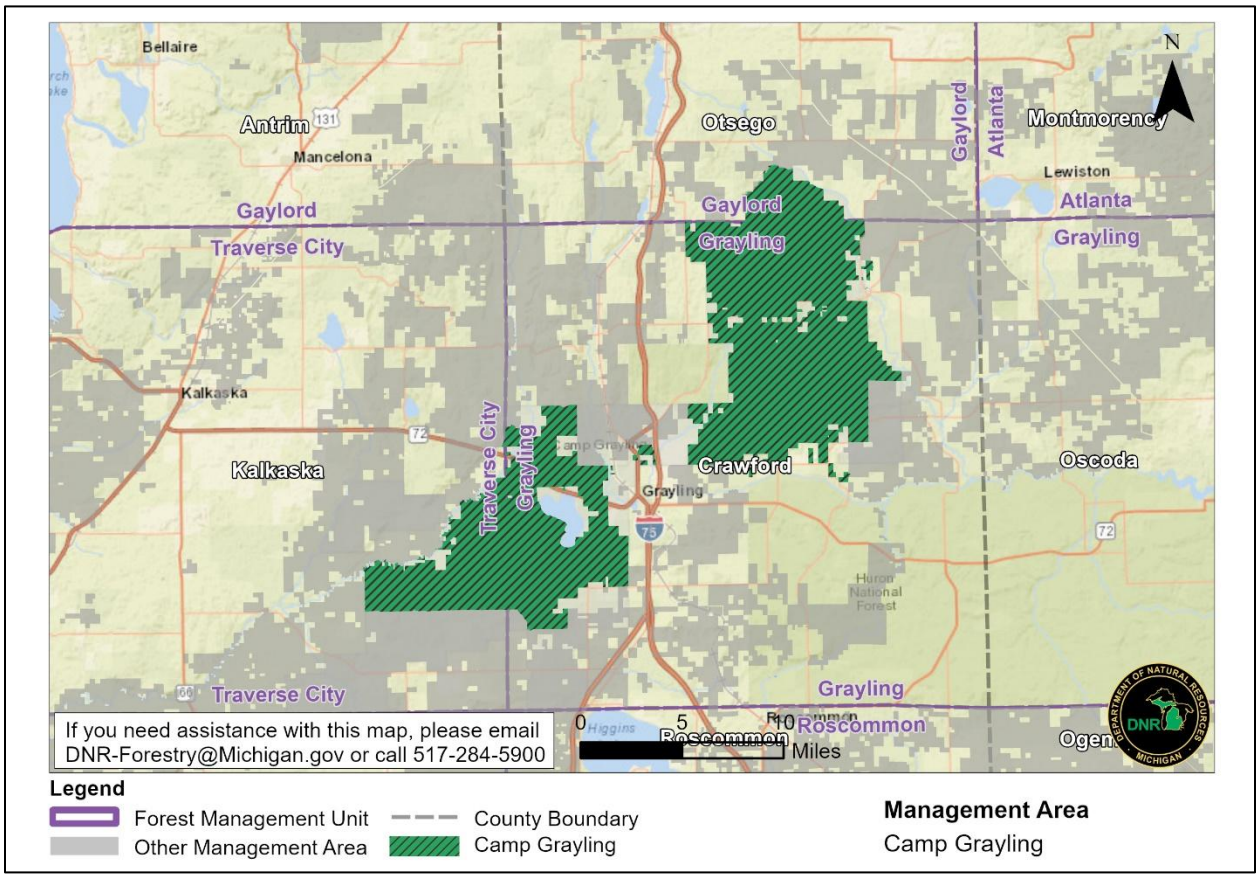


Figure 1. Camp Grayling Management Area.

Forested landscape

Current and projected future condition

The Camp Grayling Management Area includes mostly shade-intolerant species across the four different age categories (Figure 2). The tolerant cover types occur on available uplands in the mature age category. Mid-tolerant cover types occur almost equally on available uplands in the mid-aged and mature age categories while the majority of the intolerant cover types occur in the intermediate category.

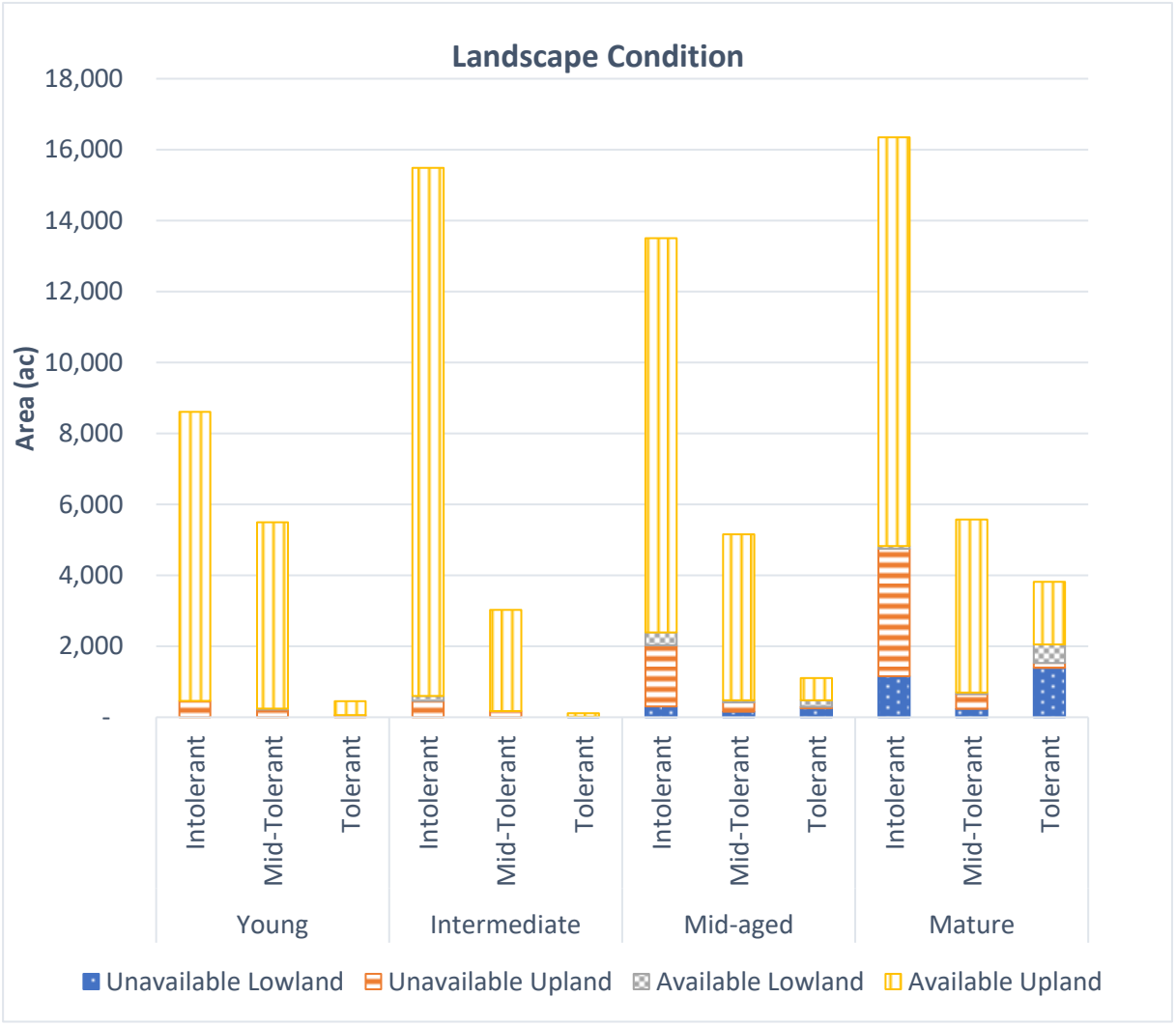


Figure 2. Forest diversity matrix showing the current distribution of forested acres across management availability, age category, landscape position and shade tolerance.

Landscape habitat conditions refine the management area landscape into featured species habitat context. Current and projected acres for the metrics identified in the Management Priorities (Section 3 Statewide/Regional) establish a baseline and future condition based on management over the planning period (Table 1).

Table 1. Current acres for landscape habitat conditions.

Landscape Habitat Condition	Monitoring Metric	Current Acres
Young Forest	Acres of 0-19 stands in Aspen and Jack Pine	6,717
Mature Forest	Acres of 80+ year stands across cover types	25,504
Mature Forest	Acres of 120+ year stands across cover types	908
Mesic Conifer Cover types	Acres of mesic conifer cover types	2,273
Mesic Conifers in other Cover types	Average canopy occupancy	18%
Mast – Oak Cover types	Acres of Oak cover types	15,066
Mast Tree Species in other Cover types	Acres of Total Canopy Occupancy of Mast Tree Acres (Trace-100%)	50,143
Big Trees	Acres of Total Canopy Stand Occupancy of Species in Sawlog or Greater Size Class	30,909
Nonforested Openings	Acres of Total Herbaceous Openland, Upland Shrub, and Cropland	13,849
Landscape Forest Matrix	Percent Deciduous Forest	65%
Landscape Forest Matrix	Percent Coniferous Forest	30%

The Camp Grayling Management Area has the following special analysis units (SAUs). These SAUs have specific cover type goals, typically associated with wildlife habitat management. For any SAUs that overlap with this management area, SAU cover type goals take priority as the SFMP model strives to meet the cover type goals across the area, ensuring they are met. See Section 5 for a detailed description of the management direction and harvest goals for each of these SAUs.

- Kirtland's warbler – Special analysis unit

The Camp Grayling Management Area is comprised of 79% forested cover types and 21% nonforested cover types (Table 2). Within the forested cover types, the upland landscape position makes up 74% of the total landscape and lowland landscape makes up only 5% of the total landscape. The largest contributors to upland cover types are aspen, mixed upland deciduous and natural jack pine. Lowland conifer and lowland spruce/fir take up 50% of the lowland forested landscape position. Upland shrub is the most common nonforested cover type in the management area representing 9% of the landscape.

Table 2. Current landscape context and distribution of cover types.

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
Forested	Upland	Deciduous	Aspen	21,261	53,718	78,466	83,574
			Northern Hardwood	2,190			
			Black Red Hybrid Oak	7,356			
			Northern Red Oak	5,048			
			Oak Mix	5,341			
			Mixed Upland Deciduous	12,522			
		Mixed	Upland Mixed Forest	3,758	3,758		
		Coniferous	Planted Red Pine	4,093	20,990		
			Planted Jack Pine	3,241			
			Planted White Pine	38			
			Planted Mixed Pine	265			
			Natural Red Pine	800			
			Natural Jack Pine	10,281			
			Natural White Pine	293			
			Natural Mixed Pines	1,791			
			Upland Spruce/Fir	7			
			Upland Conifers	99			
			Hemlock	82			
	Lowland	Deciduous	Lowland Aspen/Balsam Poplar	553	783	5,108	
			Lowland Deciduous	231			
		Mixed	Lowland Mixed Forest	359	359		
		Coniferous	Cedar	754	3,966		
			Lowland Conifers	1,759			
			Lowland Spruce/Fir	818			
			Tamarack	635			
Nonforested	Upland	N/A	Herbaceous Openland	4,329	N/A	19,730	22,300
			Upland Shrub	9,520			
			Low Density Trees	3,265			
			Bare/Sparsely Vegetated	554			
			Cropland	0			
			Urban	2,062			
	Lowland	N/A	Lowland Shrub	1,629	N/A	2,571	
			Marsh	100			
			Bog	208			
			Treed Bog	224			
			Water	410			
						Grand Total:	**105,874**

There are 75,544 acres (87% of the forested area) that can be managed toward desired future conditions via commercial timber harvest in the Camp Grayling Management Area (Table 3). Of that, over 24% is in the aspen cover type, 14% in mixed upland deciduous, and 11% in natural jack pine. The remaining 22 cover types represent less than 7% each of the forested and available land in the management area. Acres unavailable for management are categorized by site condition (Table 4).

Table 3. Current cover type composition by management availability.

CAMP GRAYLING Forested Cover Type	Available Acres	Available %	Unavailable Acres	Unavailable %	Total Acres	Total %
Aspen	20,833	24.1%	859	1.0%	21,692	25.1%
Black Red Hybrid Oak	5,355	6.2%	2,003	2.3%	7,358	8.5%
Cedar	309	0.4%	445	0.5%	754	0.9%
Hemlock	0	0.0%	82	0.1%	82	0.1%
Lowland Aspen/Balsam Poplar	371	0.4%	182	0.2%	553	0.6%
Lowland Conifers	533	0.6%	1,240	1.4%	1,773	2.0%
Lowland Deciduous	62	0.1%	168	0.2%	231	0.3%
Lowland Mixed Forest	124	0.1%	235	0.3%	359	0.4%
Lowland Spruce/Fir	241	0.3%	691	0.8%	931	1.1%
Mixed Upland Deciduous	12,145	14.0%	545	0.6%	12,690	14.7%
Natural Jack Pine	9,830	11.4%	1,268	1.5%	11,098	12.8%
Natural Mixed Pines	1,427	1.6%	374	0.4%	1,800	2.1%
Natural Red Pine	774	0.9%	71	0.1%	845	1.0%
Natural White Pine	218	0.3%	76	0.1%	294	0.3%
Northern Hardwood	2,106	2.4%	84	0.1%	2,190	2.5%
Northern Red Oak	3,918	4.5%	1,149	1.3%	5,067	5.9%
Oak Mix	4,792	5.5%	556	0.6%	5,348	6.2%
Planted Jack Pine	4,231	4.9%	116	0.1%	4,348	5.0%
Planted Mixed Pine	301	0.3%	0	0.0%	301	0.3%
Planted Red Pine	4,161	4.8%	69	0.1%	4,230	4.9%
Planted White Pine	38	0.0%	0	0.0%	38	0.0%
Tamarack	25	0.0%	648	0.7%	673	0.8%
Upland Conifers	86	0.1%	13	0.0%	99	0.1%
Upland Mixed Forest	3,664	4.2%	111	0.1%	3,775	4.4%
Upland Spruce/Fir	0	0.0%	7	0.0%	7	0.0%
Grand Total	**75,544**	**87.3%**	**10,991**	**12.7%**	**86,535**	**100.0%**

Table 4. Site conditions for unavailable acres.

Site Condition (Reason area is unavailable for commercial harvest)	Area (ac)	% of Unavailable Area
Military Lease/Easement	7,506	68.3%
Too Wet	1,606	14.6%
Conservation Values	472	4.3%
Species of special concern or T&E	299	2.7%
BMPs	250	2.3%
Long-Term Retention	213	1.9%
Federal/State/Local Law	151	1.4%
Recreational/Scenic	142	1.3%
Too Steep	112	1.0%
Non-DNR agency concerns	86	0.8%
Wildlife Concerns	43	0.4%
Other Influence Zones	36	0.3%
Cannot Regenerate	28	0.3%
Other Dept./Div. Processes	21	0.2%
Blocked by Obstacle	17	0.2%
Denied Access	8	0.1%
Rare Landforms	2	0.0%
Total Unavailable	**10,991**	**100.0%**

Projected 10-year cover type management actions

Each cover type in the Camp Grayling Management Area has a unique age class and basal area class goals that describe the long-term desired future conditions. The calculated harvest levels that are needed during the first 10-year planning period are summarized in (Table 3). These harvest levels are necessary to begin achieving long-term planning goals. This will help establish a desirable amount of regeneration for the even-aged cover types over the 10-year period or help to achieve desired basal area distribution among uneven-aged cover types like mixed upland deciduous. Implementing these silvicultural regimes will yield 199,571 cords, the planned harvest volume for the decade (Table 4).

Table 5. Ten-year planning period harvest goals (acres) by cover type and silvicultural regime.

Silvicultural Regimes								
Cover Type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Salvage Clearcut	Salvage Thinning	Grand Total
Aspen	2,511	-	-	-	-	589	-	3,100
Natural Jack Pine	1,495	-	-	-	-	531	-	2,026
Planted Red Pine	424	-	1,068	-	-	47	40	1,579
Mixed Upland Deciduous	1,334	128	-	-	19	-	-	1,481
Oak Mix	522	-	53	-	-	-	-	574
Northern Red Oak	572	-	-	-	-	-	-	572
Northern Hardwood	-	-	-	-	-	-	528	528
Planted Jack Pine	120	-	-	-	-	99	-	219
Natural Mixed Pines	-	-	74	-	44	-	-	118
Lowland Aspen/Balsam Poplar	59	-	-	-	-	-	-	59
Natural White Pine	-	-	29	-	28	-	-	57
Lowland Conifers	40	-	-	-	-	-	-	40
Natural Red Pine	-	-	10	-	4	-	-	14
Planted Mixed Pine	14	-	-	-	-	-	-	14
Upland Conifers	14	-	-	-	-	-	-	14
Lowland Mixed Forest	7	-	-	-	-	-	-	7
Totals	**7,112**	**128**	**1,234**	**-**	**96**	**1,266**	**568**	**10,402**

Table 6. Projected 10-year harvest volume by product and species.

10-Year Estimated Harvest Volume Projection Camp Grayling Management Area			
Product	**Species**	**Volume Planned***	**Volume Prepared****
Pulpwood (cords)	Mixed Aspen	25,214	23,701
	Jack Pine	23,813	22,384
	Mixed Hardwood	22,147	20,818
	Red Pine	7,786	7,319
	Mixed Oak	7,136	6,708
	Mixed Spruce	4,961	4,664
	Mixed Softwood	3,175	2,984
	White Pine	2,197	2,065
	Pulpwood Total	**96,429**	**90,643**
Sawtimber (MBF)	Red Pine	12,629	11,872
	Red Oak	9,903	9,309
	Mixed Aspen	5,557	5,224
	White Pine	3,139	2,950
	Red Maple	2,405	2,261
	White Oak	1,321	1,242
	Sugar Maple	830	780
	Mixed Oak	552	519
	Basswood	96	90
	Sawtimber Total	**36,433**	**34,247**
	Total Sawtimber Harvest Volume in Cords	**93,667**	**88,047**
	Grand Total Harvest Volume in Cords	**190,096**	**178,690**

* Volume estimates based on 100% of the projected harvests for the 10-year planning period.

** Volume estimates based on 94% of the projected harvests for the 10-year planning period accounting for reduction in acres and associated volume once sales are prepared for bid.

There are a few cover type transitions projected for the Camp Grayling Management Area (Table 7). The managed area of cover types are projected to remain fairly stable as treatment regimes will not change the amount of area in each cover type by a significant amount. The largest decrease forecasted is in the northern red oak where 402 acres will convert to other cover types through forest management,

military activities and regeneration activities. The largest increase occurs on the aspen forest type where 427 acres are projected to convert into this cover type.

Table 7. Projected 10-year cover type acres resulting from cover type transitions.

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Aspen	21,261	21,688	427
Mixed Upland Deciduous	12,522	12,319	-203
Natural Jack Pine	10,281	9,976	-305
Black Red Hybrid Oak	7,356	7,356	0
Oak Mix	5,341	5,458	117
Northern Red Oak	5,048	4,647	-402
Planted Red Pine	4,093	4,257	165
Upland Mixed Forest	3,758	3,982	224
Planted Jack Pine	3,241	3,207	-34
Northern Hardwood	2,190	2,221	31
Natural Mixed Pines	1,791	1,794	3
Lowland Conifers	1,759	1,745	-13
Lowland Spruce/Fir	818	802	-16
Natural Red Pine	800	800	0
Cedar	754	754	0
Tamarack	635	635	0
Lowland Aspen/Balsam Poplar	553	551	-1
Lowland Mixed Forest	359	387	28
Natural White Pine	293	293	0
Planted Mixed Pine	265	251	-14
Lowland Deciduous	231	233	3
Upland Conifers	99	91	-8
Hemlock	82	82	0
Planted White Pine	38	38	0
Upland Spruce/Fir	7	7	0
Upland Shrub	9,520	9,520	0
Herbaceous Openland	4,329	4,329	0
Low Density Trees	3,265	3,265	0
Lowland Shrub	1,629	1,629	0
Bare/Sparsely Vegetated	554	554	0
Water	410	410	0
Treed Bog	224	224	0
Bog	208	208	0
Marsh	100	100	0
Urban	2,062	2,062	0
Total:	**105,874**	**105,874**	**0**

Featured species current and projected habitat acres

There are nine featured species in this management area that span various cover types, age classes and stand level conditions. Current and projected total habitat acres by species across the decade provide a baseline and show the result of long-term management actions (Table 8). As noted in the Featured Species Management Priority (Section 3), it is recommended that these featured species habitat acres be viewed as acres of potential habitat, representing a condition on the landscape where the more nuanced aspects of each species' habitat requirements are likely to be managed for or found. As described in the introduction, the modeling effort was limited by several factors including the simplification of habitat attributes into MiFI variables. Therefore, when referring to habitat acres what is being referred to is potential habitat acres.

Some species show a loss in habitat over the next century. As mentioned in the Featured Species Management Priority (Section 3), the current condition for many cover types is a surplus of acres in the 0-9 age class from the compensatory management approach applied in the previous decade. The model eventually evens out the age classes at a lower, sustainable level over time, usually by 50 years. For any species with northern hardwoods as a priority cover type, there is a perceived drop in acres between 40-60 years; this is due to the basal area dropping below 81 but because it only drops into the upper 70s, it is not expected to translate to any real habitat loss on the ground. Two of these species were not included in the State Forest Management Plan model, black bear and wild turkey, but are included here to inform management decisions over the decade. Kirtland's warbler habitat is described in the Kirtland's Warbler Special Analysis Unit (Section 5).

Table 8. Featured species current and projected total habitat acres (e.g., potential habitat).

Featured Species	Priority Cover types	Total Habitat Acres Current	Total Habitat Acres 10-year	50-year Projected Habitat Acres	100-year Projected Habitat Acres
American Woodcock	Aspen, lowland aspen, lowland deciduous	6,852	7,215	8,085	8,549
Black Bear	Mast	--	--	--	--
Golden-Winged Warbler	Aspen, black-red hybrid oak, northern red oak, oak mix, tamarack	10,533	11,007	8,865	9,699
Kirtland's Warbler	Jack pine	--	--	--	--
Marten	Northern hardwoods, mixed upland deciduous, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, lowland mixed forest, lowland conifers, hemlock, cedar	13,250	13,347	19,617	17,842
Ruffed Grouse	Aspen	6,639	6,931	7,968	8,384

Featured Species	Priority Cover types	Total Habitat Acres Current	Total Habitat Acres 10-year	50-year Projected Habitat Acres	100-year Projected Habitat Acres
Snowshoe Hare	Aspen, cedar, hemlock, lowland aspen, lowland conifers, lowland mixed forest, lowland spruce/fir, mixed upland deciduous, natural jack pine, natural mixed pines, planted jack pine, upland spruce/fir	19,035	16,811	14,283	14,965
Wild Turkey	Nonforested openings	--	--	--	--
Wood Thrush	Northern hardwoods, northern red oak, mixed upland deciduous, lowland deciduous	7,091	6,929	9,144	9,743

Cover type composition and associated featured species

Aspen

Current condition

The largest age class of the aspen cover type is currently between stand ages of 30 and 39 years old in the Camp Grayling Management Area (Figure 3). The age class distribution is currently fairly close to being balanced. There is a deficit in the 50-59 but that should not lead to a deficit in the 0- to 9-year age class for the next planning period. A small number of unavailable acres that extend beyond the desired maximum age class distribution.

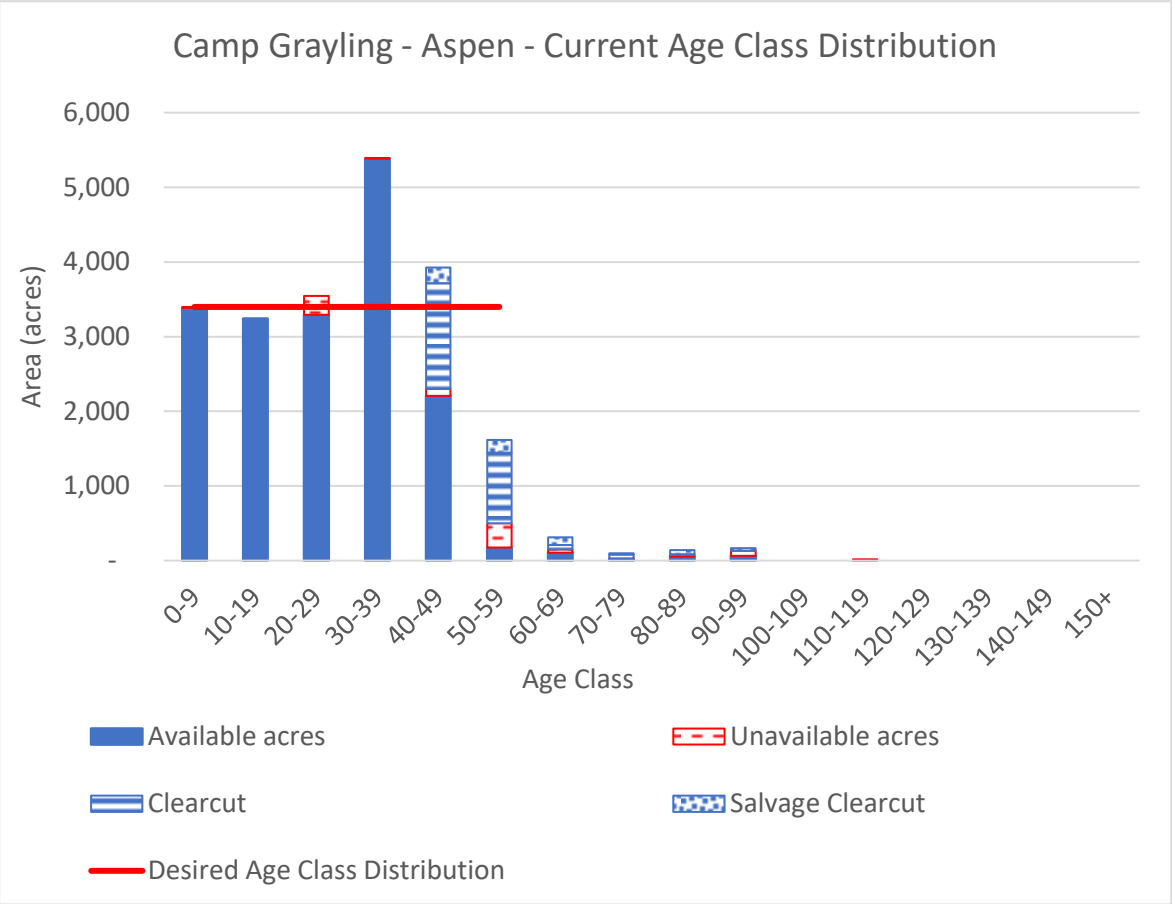


Figure 3. Current age class distribution and projected harvests in aspen cover type.

Current conditions are a result of consistent commercial harvests and regeneration efforts on available aspen acres during the previous two planning periods. A portion of this cover type meets the habitat requirements for American woodcock, golden-winged warbler, ruffed grouse and snowshoe hare (Table 9).

Table 9. Featured species with aspen as a priority habitat cover type, habitat variables and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Aspen	Aspen Habitat Acres – Available	Aspen Habitat Acres - Unavailable
American Woodcock	Age Category: 0-19 Size Class: Sapling	6,631	8
Ruffed Grouse	Age Category: 0-19 Size Class: Sapling	6,631	8
Golden-Winged Warbler	Age Category: 0-19 Size Class: Sapling	6,631	8
Snowshoe Hare	Age Category: 0-19 Size Class: Sapling	6,631	8

Desired future condition

The projected long-term cover type trend for aspen is increasing in the Camp Grayling Management Area. Much of the aspen area falls under the available category and will have other cover types transition into it. Habitat elements in this cover type will be preserved due to the abundance of this cover type.

The long-term goal for this cover type is balanced age classes between 0 and 59 years old for all available aspen stands in this management area. Maintaining lower acreage in old age classes continues to be desirable to maintain vigor in the stand promoting regeneration abilities.

The end of the planning period will result in the establishment of 3,389 acres in the 0-9 age class which is very close to the 3,400 acres desired (Figure 4). Progress toward the long-term desired age class distribution of aspen will take a couple decades of even-aged management in this management area.

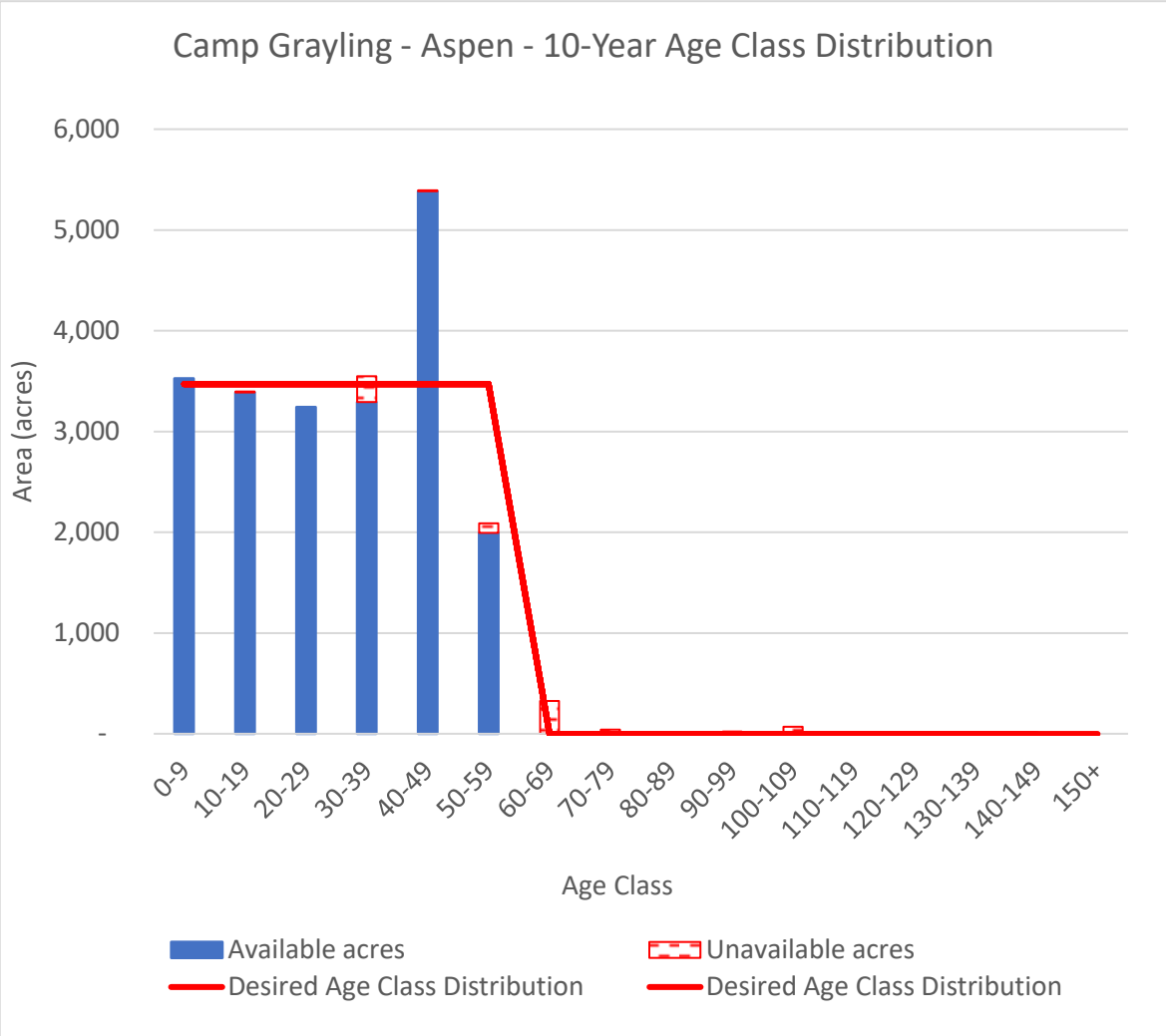


Figure 4. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution of aspen has about reached the desired future condition for available acres (Figure 5). There is an increase in acres in the older age classes, beyond the desired age of 50 years old, due to the unavailable acres in this management area.

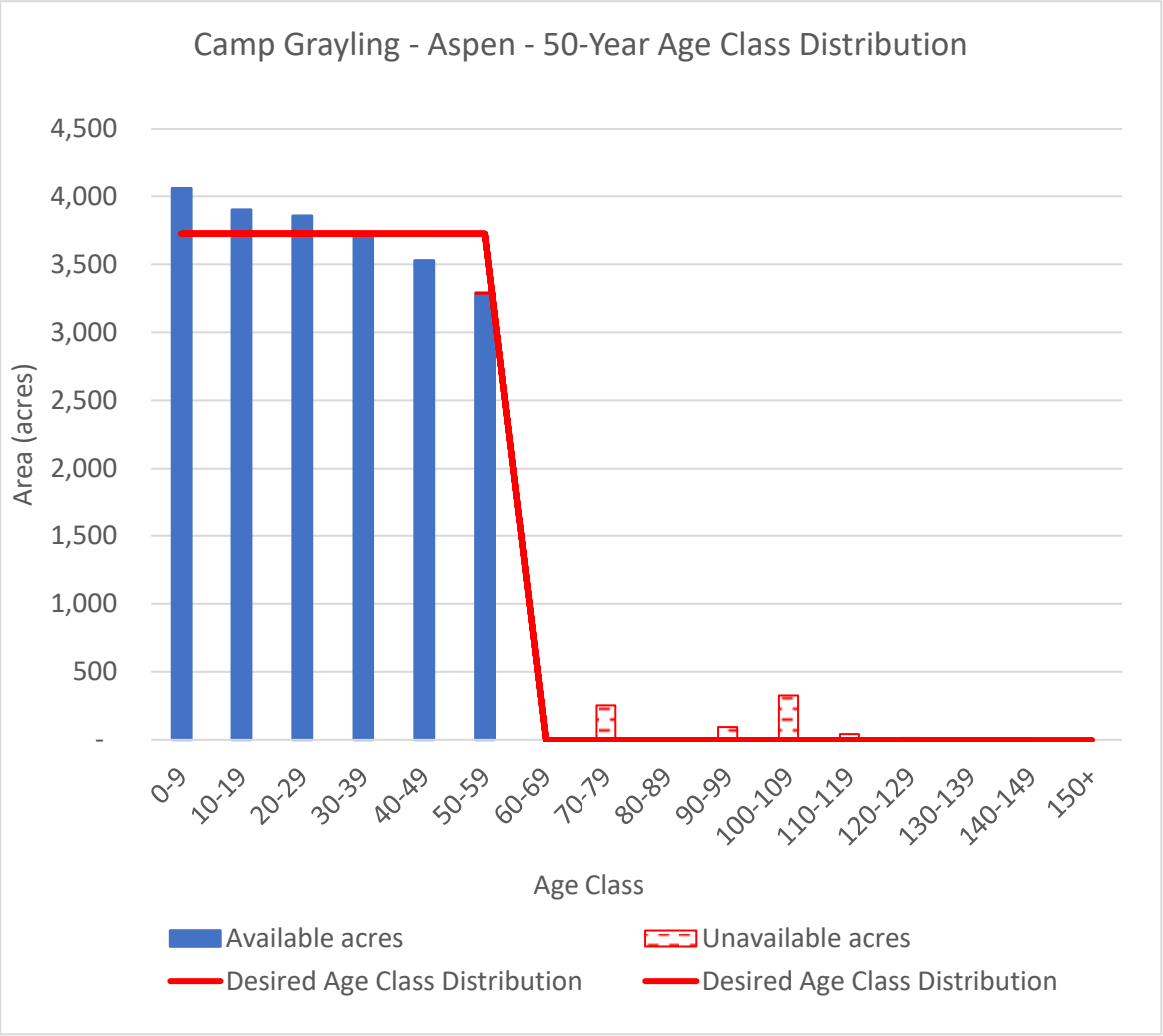


Figure 5. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 6) will concentrate the manageable acres of aspen in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest (Figure 7).

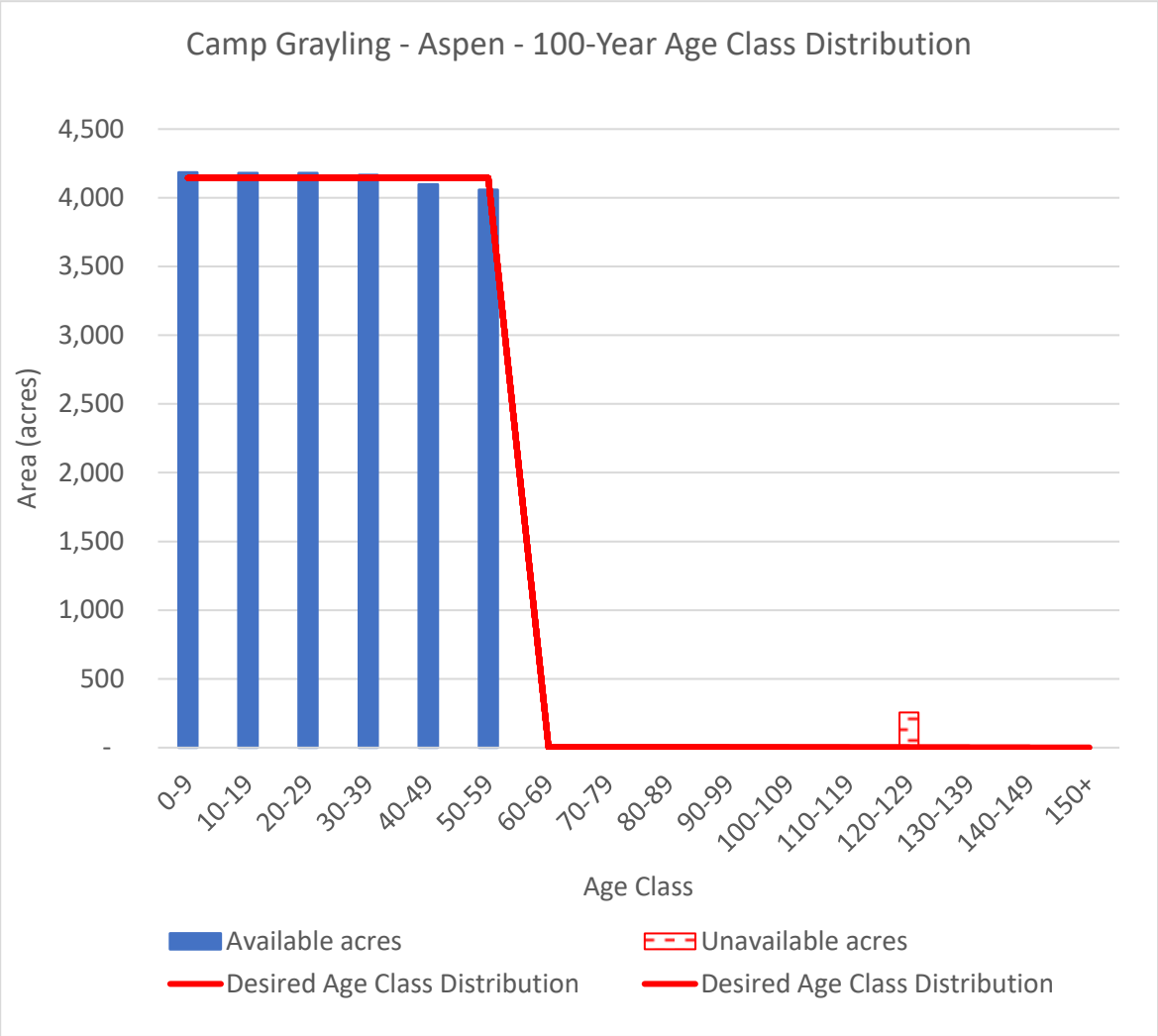


Figure 6. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

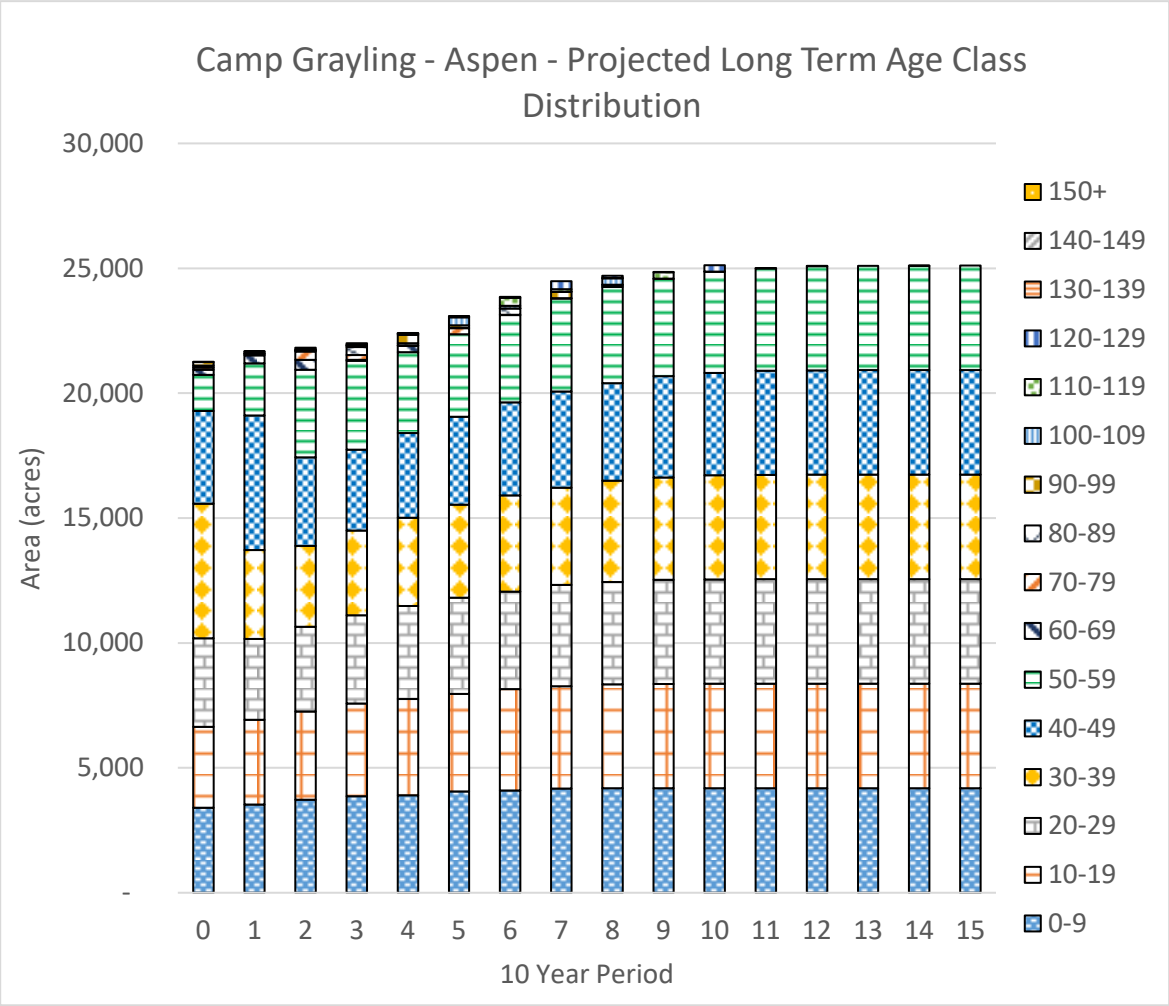


Figure 7. Projected age class distribution for all acres of aspen over the next 150 years in the Camp Grayling Management Area.

Management actions

There are 2,511 acres of projected clearcut harvest and 589 acres of ice storm salvage clearcut harvest in the aspen cover type during the planning period. This along with the 427 acres transitioning into this cover type will fall slightly higher than the desired establishment of 3,400 acres of aspen per decade.

Mixed upland deciduous

Current condition

The Camp Grayling Management Area in mixed upland deciduous has a surplus of acres in the 0-19-year age classes that was created due to the harvesting of the large number of mature and over-mature acres on the landscape (Figure 8). The age class distribution is currently unbalanced across almost all the age class categories. Additionally, a deficit of available acres occurs in almost all age classes 20 years up to 89 years old. A portion of this cover type meets the habitat requirements for black-throated blue warbler and marten (Table 10).

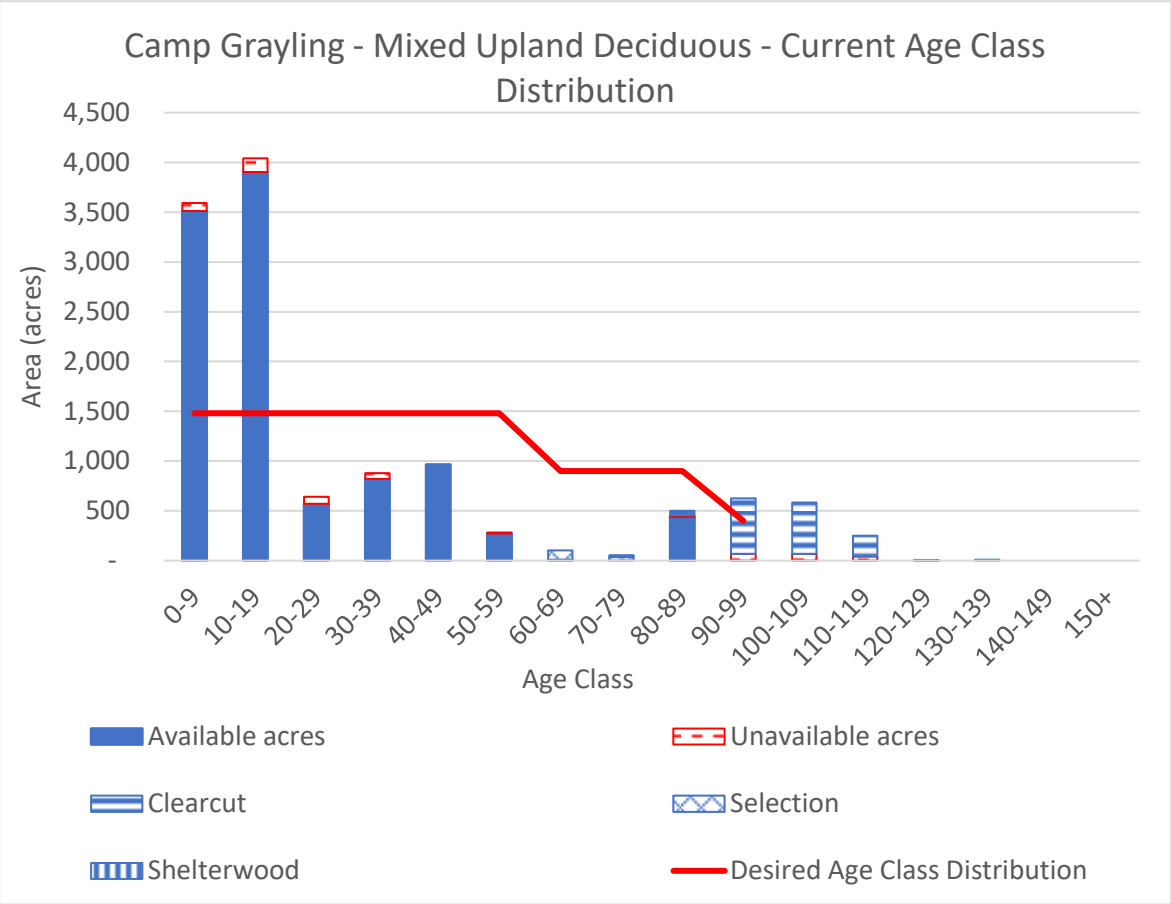


Figure 8. Current age class distribution, the desired age class distribution, and the projected harvests in the mixed upland deciduous cover type over the 10-year planning period.

Table 10. Featured species with mixed upland deciduous as a priority habitat cover type, habitat variables and current acres (e.g., potential habitat).

Featured Species	Featured Species Habitat – Mixed Upland Deciduous	Mixed Upland Deciduous Habitat Acres - Available	Mixed Upland Deciduous Habitat Acres - Unavailable
Snowshoe Hare	Age Category: 0-19 Size Category: Sapling	7,417	218
Marten	Age Category: 40+ Size Category: Pole, Sawlog Basal Area: 81+	2,004	161
Wood Thrush	Age Category: 40+ Size Category: Sawlog Basal Area: 81+	2,004	161

Desired future condition

The projected long-term cover type trend for mixed upland deciduous is fairly unstable in the Camp Grayling Management Area. There are a few transitions in and out of this cover type during this planning period.

The long-term goal for this cover type is balanced age classes between 0 and 50 years old for all available mixed upland deciduous acres and then decreasing number of acres in until 80 years old followed by the max tail of 90 years old is reached.

The end of the planning period will result in the establishment of approximately 1,141 acres of mixed upland deciduous from the available acres (Figure 9). Progress toward the long-term desired age class distribution of mixed upland deciduous will take many decades to achieve the desired balanced age class condition.

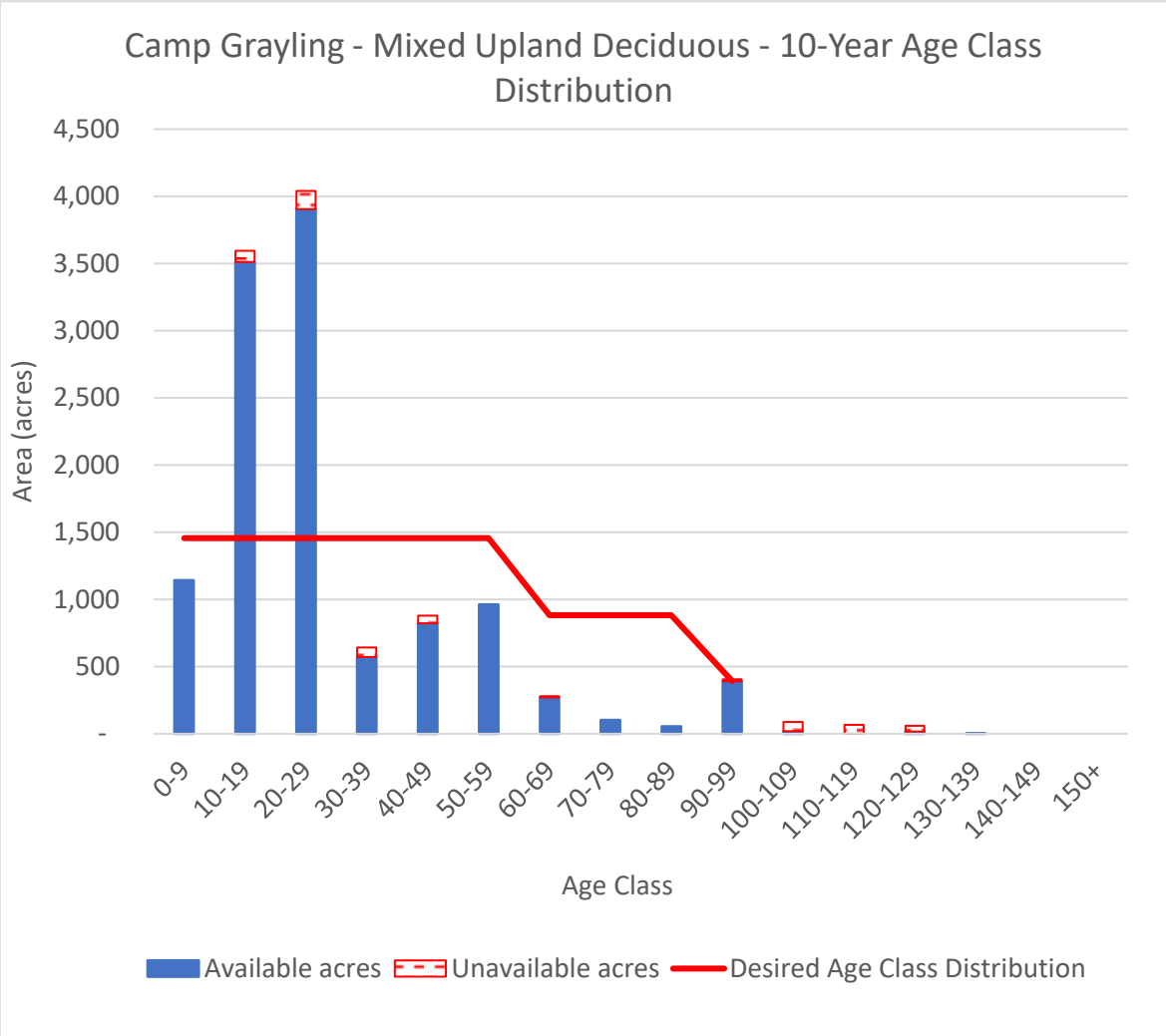


Figure 9. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution of mixed upland deciduous is beginning to reach the desired future condition for available acres in the age classes (Figure 10). The number of acres in the age classes of 50-69 years old are still high due to previous management activities.

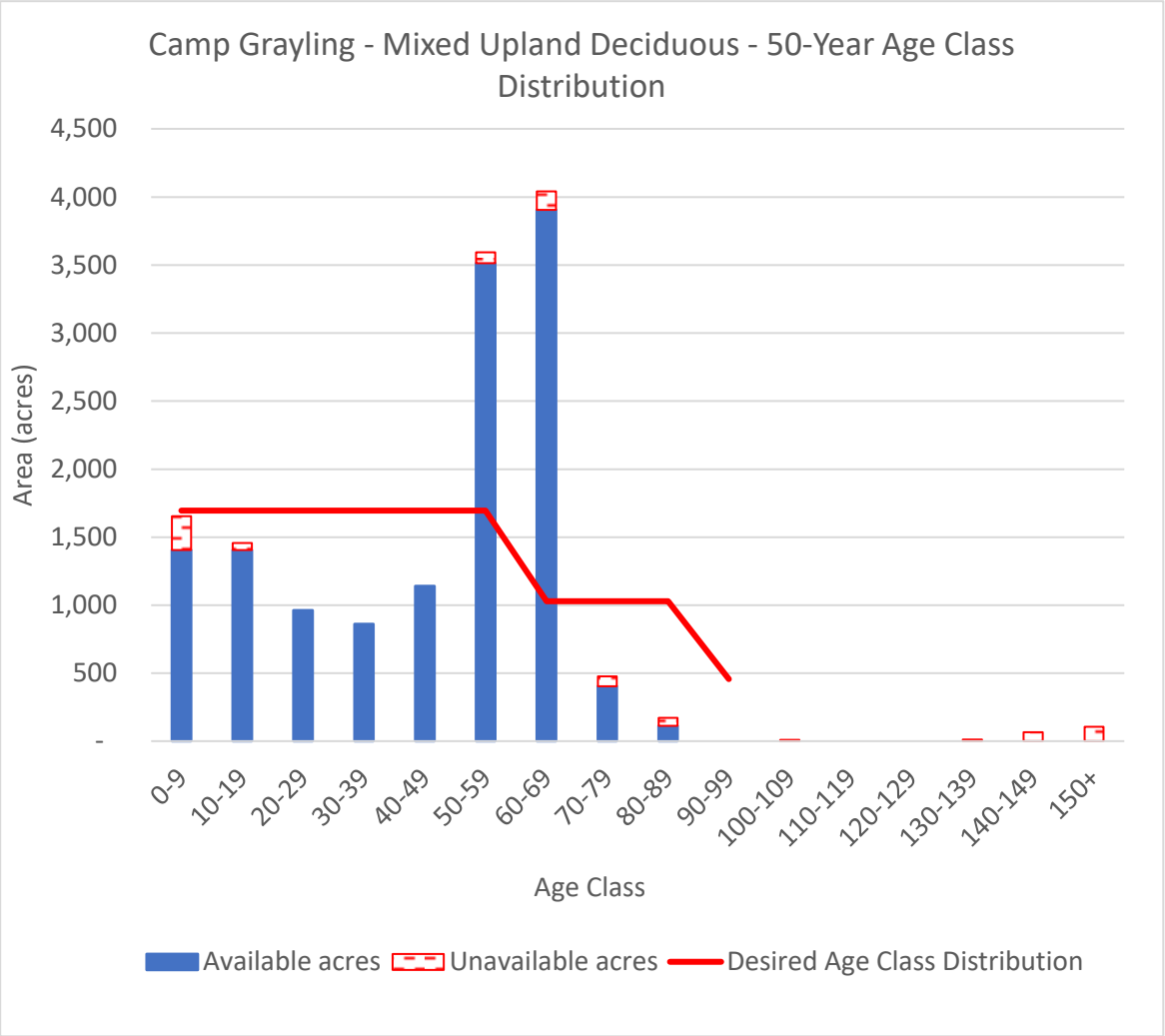


Figure 10. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 11) will concentrate on the manageable acres of mixed upland deciduous cover type in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest (Figure 12).

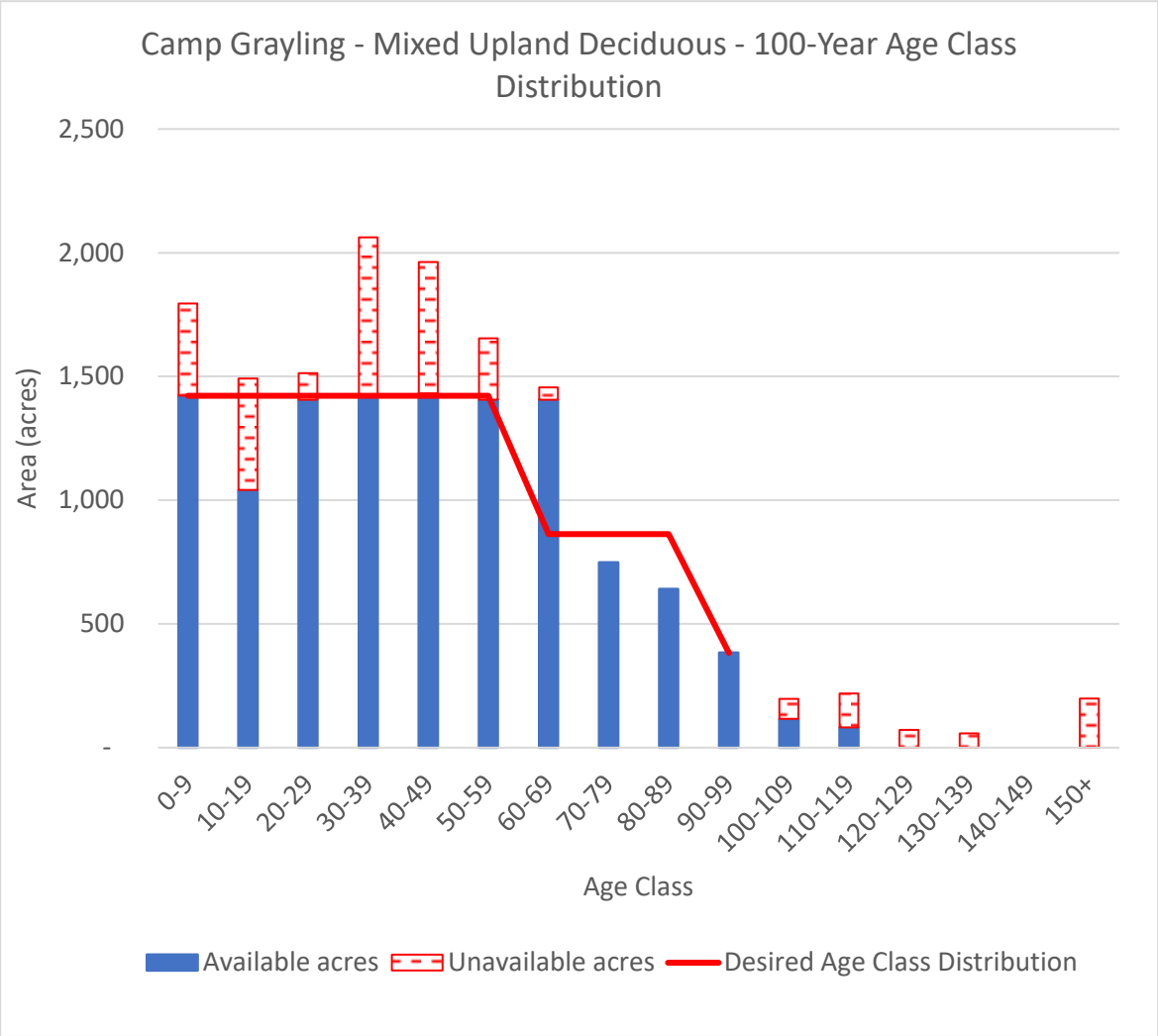


Figure 11. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

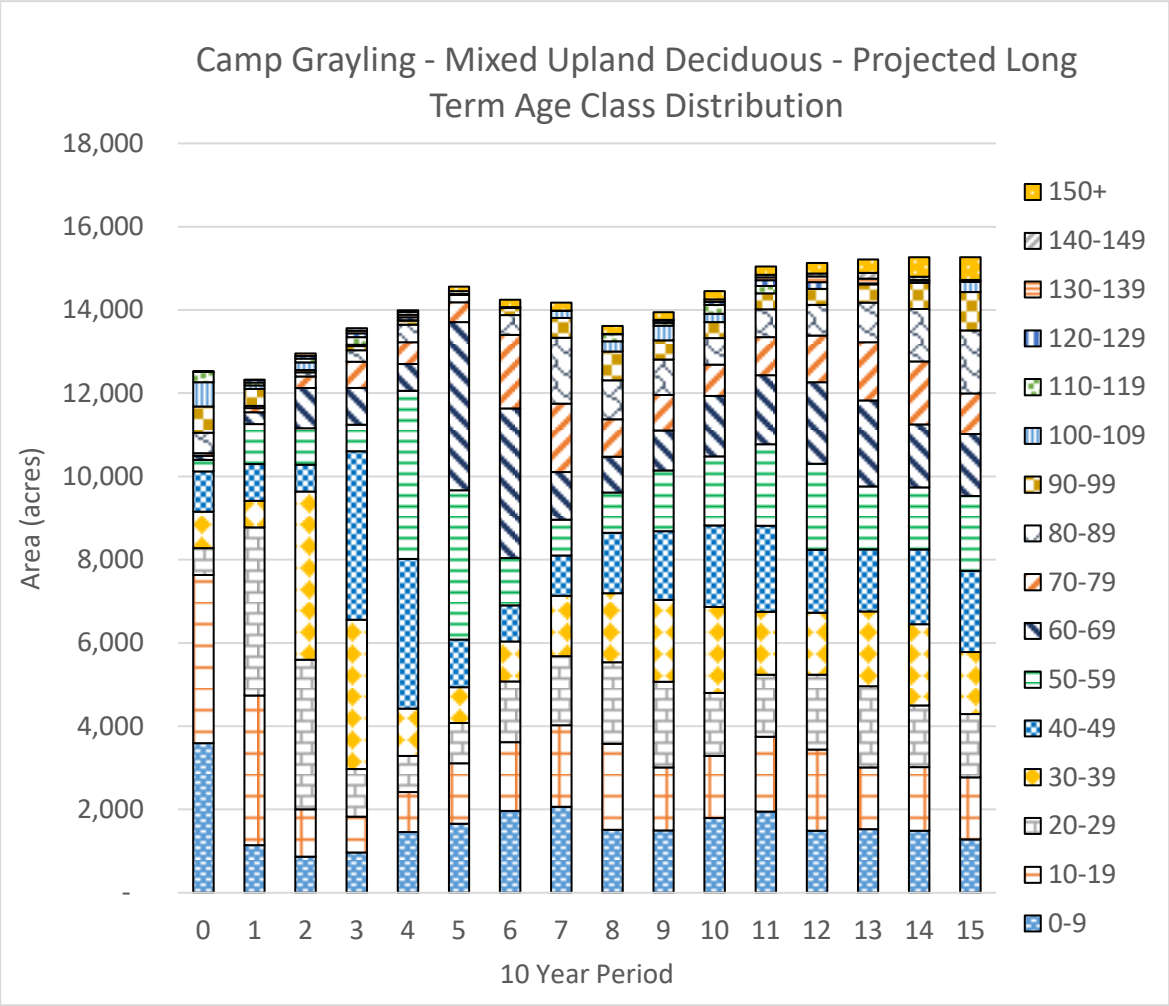


Figure 12. Projected age class distribution for all acres of mixed upland deciduous over the next 150 years.

Management actions

There are 1,334 acres of projected clearcut harvest in the mixed upland deciduous cover type during the planning period. There are also 203 acres projected to transition out of this cover type resulting in 1,131 acres regenerating in this cover type. This is below the desired establishment of 1,455 acres of mixed upland deciduous per decade because of the current unbalanced age class condition and the high amount of acres already below the age of 19.

Natural jack pine

Current condition

Most of the natural jack pine cover type is currently in three main age classes (Figure 13). They are 0-9, 30-39, and 50-59-year-old age classes. The past management regime has been primarily clearcut for this cover type. The 10-29 age classes have a deficit as well as 40-49-year-old age class.

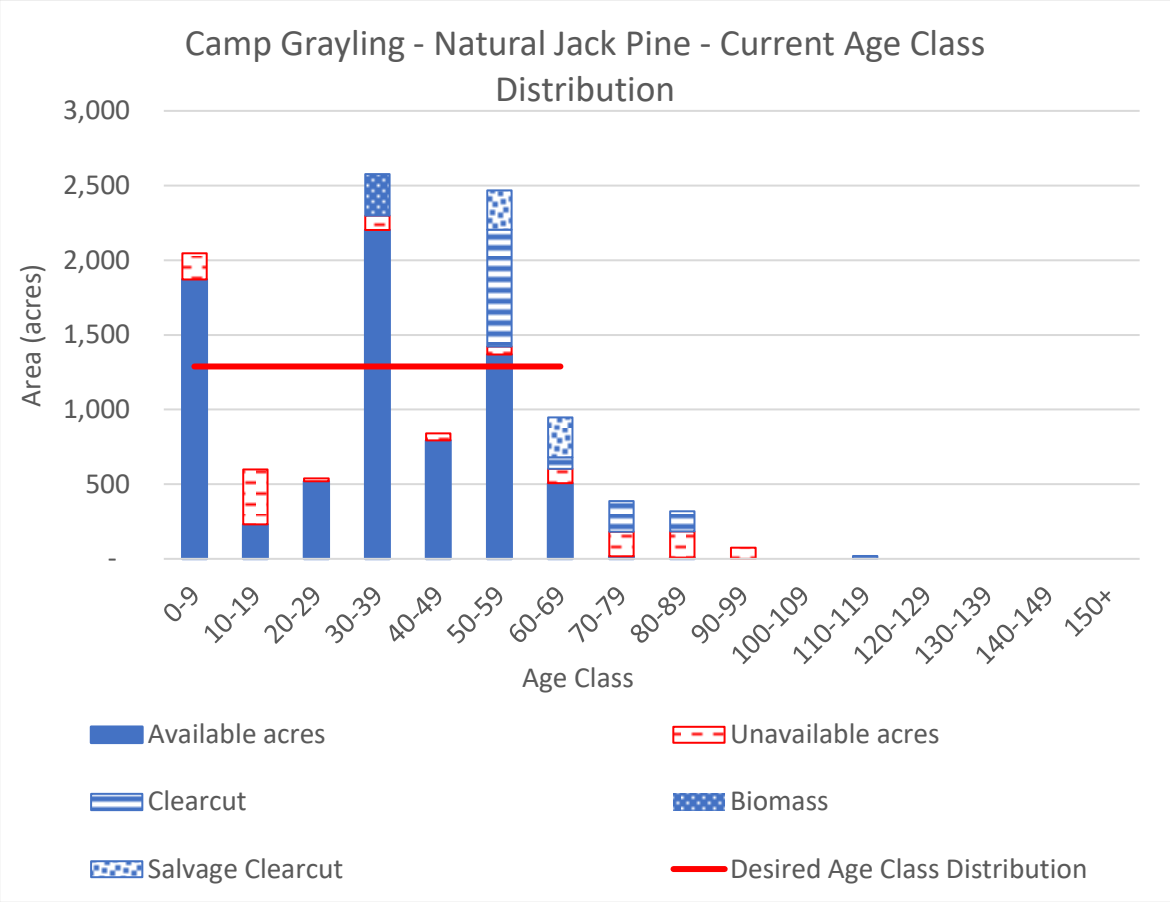


Figure 13. Current age class distribution, the desired age class distribution, and the projected harvests in the natural jack pine cover type over the 10-year planning period.

Current conditions are a result of consistent commercial harvests and regeneration efforts on available natural jack pine acres during the previous planning period. A portion of this cover type meets the habitat requirements for Kirtland's warbler (Section 5) and snowshoe hare (Table 11). No data is provided for Kirtland's warbler, because the jack pine acres in this management area that have relevance are those within designated essential habitat. Because essential habitat was represented as a whole in the SAU, and the SAU provides unit-level management actions, it is best to refer to Section 5 for more information.

Table 11. Featured species with natural jack pine as a priority habitat cover type, habitat variables and current acres (e.g., potential habitat).

Featured Species	Featured Species Habitat – Natural Jack Pine	Natural Jack Pine Habitat Acres - Available	Natural Jack Pine Habitat Acres - Unavailable
Snowshoe Hare	Age Category: 0-19 Size Category: Sapling	2,102	543
Kirtland's Warbler	Age Category: 0-19 Size Category: Sapling, Pole	NA	NA

Desired future condition

The projected long-term cover type trend for natural jack pine is decreasing in the Camp Grayling Management Area. There are few transitions from the natural jack pine into other cover types forecasted in this management area.

The long-term goal for this cover type is balanced age classes between 0 and 60 years old for all available natural jack pine stands in this management area. Maintaining lower acreage in old age classes continues to be desirable to lessen the prevalence and severity of jack pine budworm outbreaks and to reduce the threat of damaging wildfire.

The end of the planning period will result in the establishment of a desirable number of acres in the 0-9 age class (Figure 14). Progress toward the long-term desired age class distribution of natural jack pine will take many decades of even-aged management in this management area.

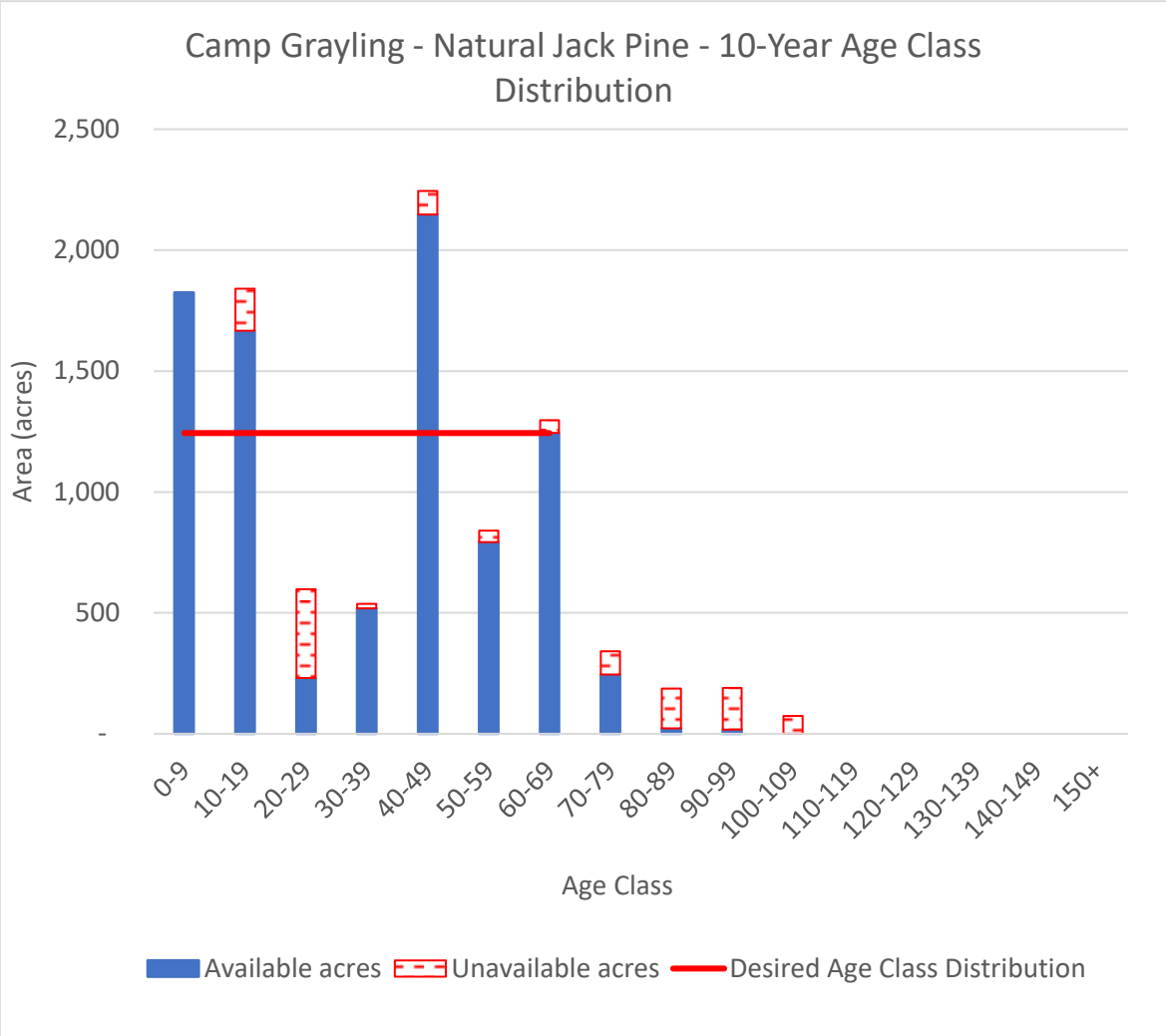


Figure 14. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of natural jack pine acres nearly reaching the desired future condition with only two age classes deviating from the target proportions (Figure 15). As is often the case, an unbalanced condition in the first planning period can often result in the need to carry some acres above the target rotation age to achieve the desired age class goals.

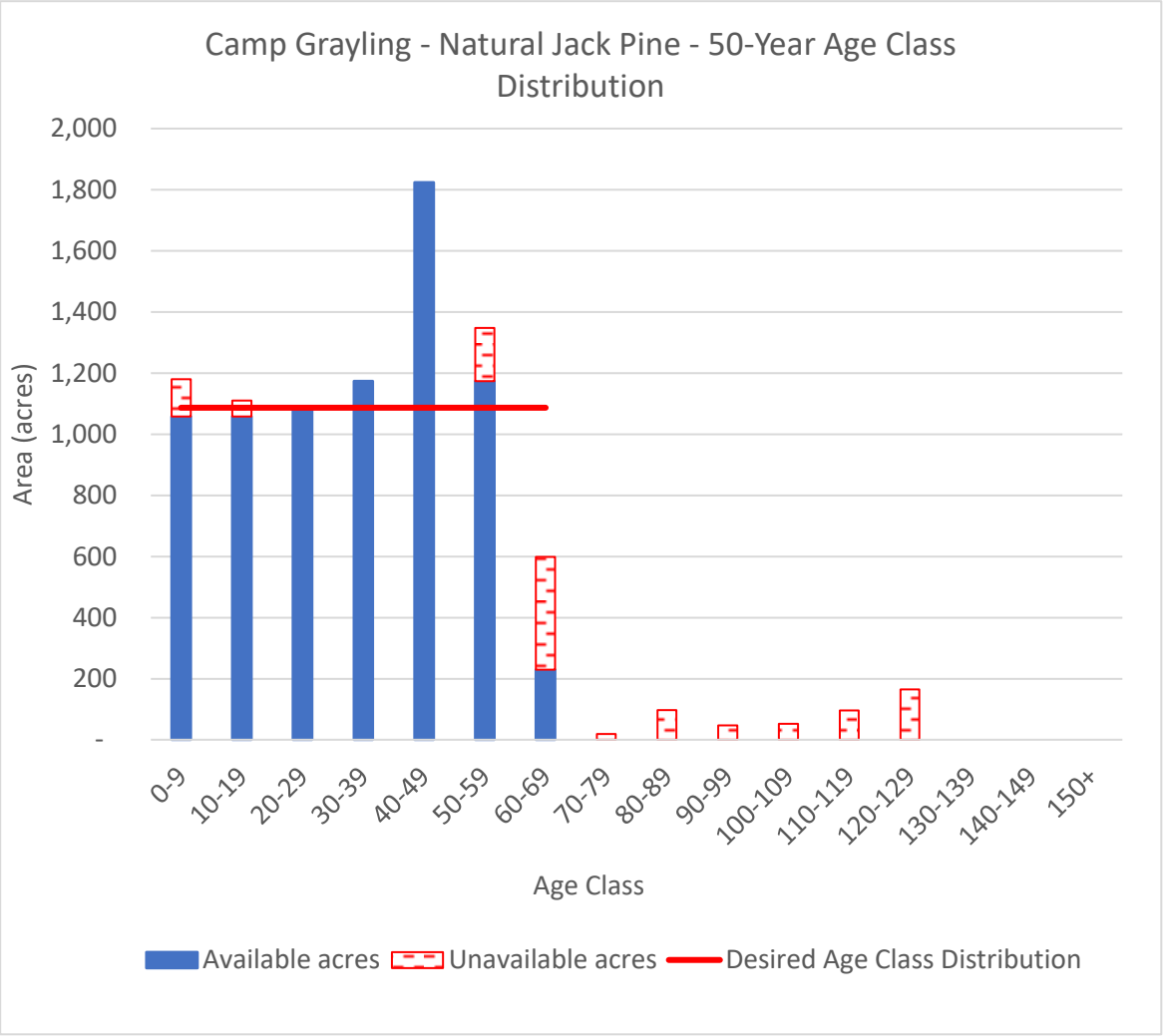


Figure 15. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 16) will concentrate the manageable acres of natural jack pine in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest (Figure 17).

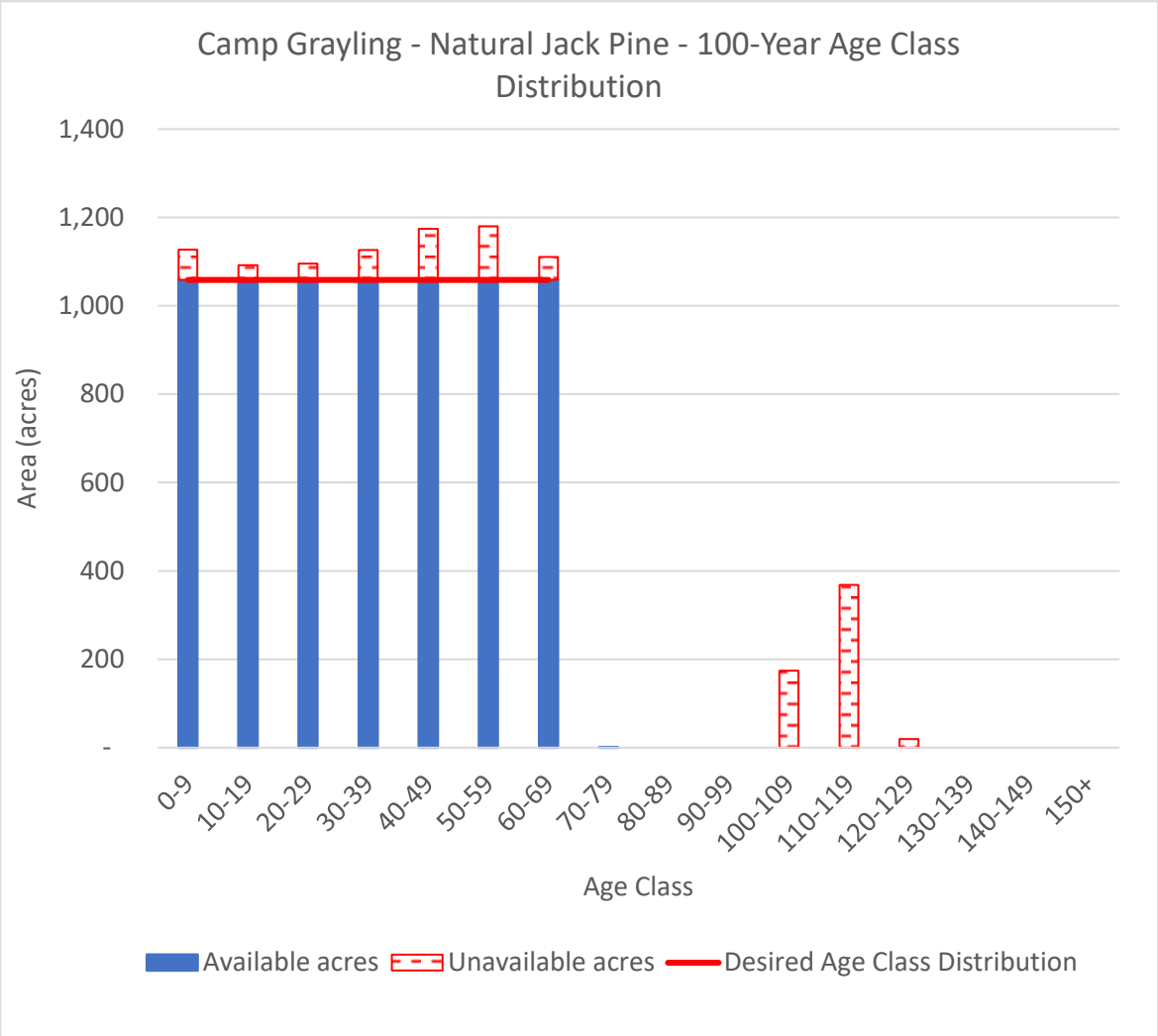


Figure 16. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

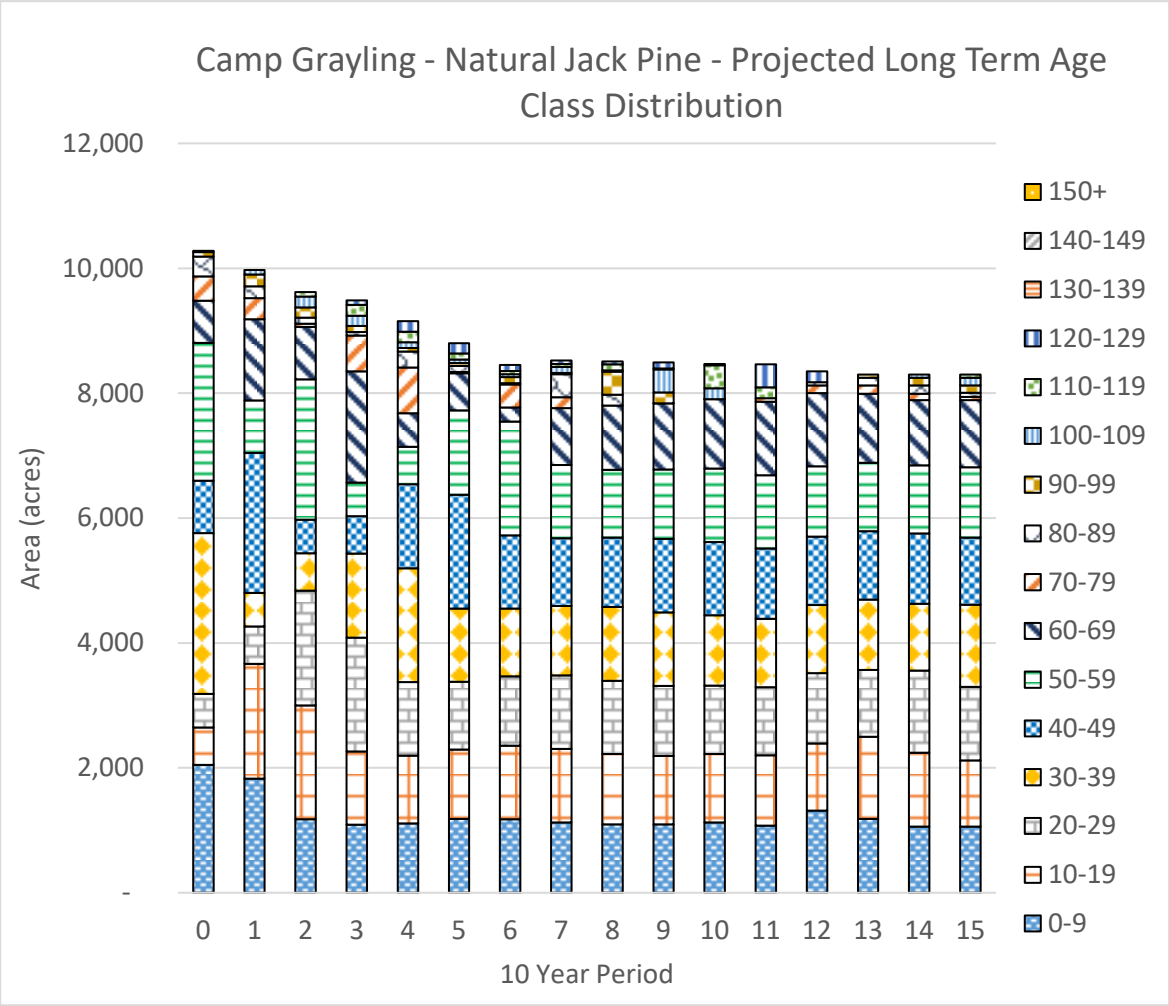


Figure 17. Projected age class distribution for all acres of natural jack pine over the next 150 years.

Management Actions

There are 1,495 acres of projected clearcut harvest and 531 acres of ice storm salvage clearcut harvest in the natural jack pine cover type during this planning period. There are approximately 440 acres of jack pine projected to regenerate due to severe ice storm damage and about 305 acres that will transition into other cover types. This results in a total of approximately 1,833 acres of regeneration in this period. This falls above the desired establishment of 1,288 acres per decade because of the current unbalanced conditions in the 10-19 and the 20-29-year-old age classes.

Conservation area network

High conservation value areas

There are up to eight different high conservation value areas (HCVA) types that can be found in each management area (**Error! Reference source not found.**; see Biodiversity in Section 3 for more information).

Table 12. High conservation value areas within Camp Grayling Management Area.

High Conservation Value Area Type and Name	Acres
Eastern Massasauga Managed Land	**4,337**
--	4,337
Kirtland's Warbler Habitat	**1,486**
Down River	485
Lovells	1
Manistee	972
Sharon	24
Staley Lk	4
Natural Rivers Vegetative Buffer	**553**
--	553
Natural Rivers Zoning District	**1,890**
--	1,890
Grand Total	**8,267**

Ecological reference areas

Ecological reference areas (ERAs) are a type of HCVA and are higher quality examples of functioning ecosystems that are primarily influenced by natural ecological processes.

Table 13. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 14. Ecological reference areas within the management area.

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	Number of Occurrences
Existing ERA	Intermittent Wetland	B	-	-	1
Existing ERA	Intermittent Wetland	B	G2	S3	1
Existing ERA	Northern Shrub Thicket	A	G4	S5	1
Existing ERA	Poor Fen	B	G3	S3	2
Existing ERA	Rich Conifer Swamp	B	G4	S3	1
Existing ERA	Wet-mesic Sand Prairie	BC	-	-	1
Proposed ERA	Dry Northern Forest	CD	G3?	S3	2
Proposed ERA	Intermittent Wetland	B	G2	S3	1
Proposed ERA	Intermittent Wetland	C	G2	S3	1
Proposed ERA	Northern Fen	C	G3	S3	1
Proposed ERA	Pine Barrens	BC	G3	S2	2
Proposed ERA	Pine Barrens	C	G3	S2	3
Proposed ERA	Poor Fen	-	G3	S3	2
Grand Total	-	-	-	-	**17**

Special conservation areas

Reviewable special conservation areas (SCAs; Table 15) refers to those SCA types that may be reviewed or updated through the compartment review process as needed. Static SCAs (Table 16) refers to those SCA types that generally do not change or require updating (see Biodiversity in Section 3 for more information).

Table 15. Reviewable special conservation areas within Camp Grayling Management Area.

Reviewable Special Conservation Area Type and Name	Acres
Concentrated Recreational Area	**105**
Jones Lake Campground	32
Manistee River Bridge Campground	49
Shupac Lake Campground	24
Habitat Area or Habitat Corridor	**907**
Block 3BCamp Grayling Pine Barrens Management Area	311
Stand 1 Camp Grayling Pine Barrens Management	8
Stand 10 sm Camp Grayling Pine Barrens Management	4
Stand 11 sm Camp Grayling Pine Barrens Management	12
Stand 12 Camp Grayling Pine Barrens Management	58
Stand 13 Camp Grayling Pine Barrens Management	36
Stand 14 Camp Grayling Pine Parrens Management	10
Stand 2 Camp Grayling Pine Barrens Management	4
Stand 3 Camp Grayling Pine Barrens Management	10
Stand 4 Camp Grayling Pine Barrens Management	16
Stand 5 Camp Grayling Pine Barrens Management	32
Stand 6 Camp Grayling Pine Barrens Management	8
Stand 7 Camp Grayling Pine Barrens Management	151
Stand 8 Camp Grayling Pine Barrens Management	18
Stand 9 Camp Grayling Pine Barrens Management	110
Unspecified	117
Mineral Resource Area	**44**
Crawford County Road Commission	7
DMVA	23
MPRC Pit	13
Grand Total	**1,055**

Table 16. Static special conservation areas within Camp Grayling Management Area.

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Common Natural Heritage Element Occurrences	**-**	**103**
Bog	-	42
Northern Shrub Thicket	-	53
Poor Conifer Swamp	-	9
Designated Trout and Coldwater Stream Buffer	**-**	**746**
--	-	278
Au Sable River	-	15
Barker Creek	-	13
Clear Creek	-	13
East Branch Au Sable River	-	167
Manistee River	-	56
North Branch Au Sable River	-	55
Portage Creek	-	150
Designated Trout and Coldwater Streams	**27.1**	**-**
<Null>	10.3	-
Au Sable River	0.2	-
Barker Creek	0.5	-
Clear Creek	0.5	-
East Branch Au Sable River	6.3	-
Manistee River	1.7	-
North Branch Au Sable River	2.0	-
Portage Creek	5.8	-
Important Bird Areas	**-**	**3,060**
Kirtland's Warbler Management Units & Guide's Rest	-	3,060
Military Lease Land	**-**	**95,855**
Board Purchases	-	12,633
Deeded to Board	-	17,484
Federal Land	-	146
Hanson Grant	-	14,024
Long Term Lease	-	51,569
Military Research Areas	**-**	**101,221**
Camp Grayling	-	101,221
Mussel Stream Group 2 - State threatened or endangered	**0.6**	**-**
East Branch Au Sable River	0.6	-
Wood Turtle Stream 660ft Buffer	**-**	**1**
North Branch Au Sable River	-	1
Grand Total	**27.7**	**200,987**

Rare species

Rare species occurrences are compiled from the Michigan Natural Features Inventory Biotics database (Table 17 and Table 19) and do not necessarily include all rare species found in this management area due to biases in survey effort and verifiable observation reporting over time.

Table 17. Rare animal and plant species conservation status key.

Status	Status
E = endangered	LE = listed endangered
T = threatened	LT = listed threatened
SC = special concern	PDL = proposed for delisting

Table 18. Rare animal occurrence within Camp Grayling Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Accipiter gentilis	Northern goshawk	T	-	1
Animal	Alasmidonta viridis	Slippershell	T	-	2
Animal	Ammodramus savannarum	Grasshopper sparrow	SC	-	1
Animal	Antrostomus vociferus	Eastern whip-poor-will	T	-	4
Animal	Appalachia arcana	Secretive locust	SC	-	11
Animal	Atrytonopsis hianna	Dusted skipper	SC	-	11
Animal	Bartramia longicauda	Upland sandpiper	T	-	3
Animal	Bombus terricola	Yellow banded bumble bee	SC	-	1
Animal	Brychius hungerfordi	Hungerford's crawling water beetle	E	LE	4
Animal	Buteo lineatus	Red-shouldered hawk	SC	-	3
Animal	Chordeiles minor	Common nighthawk	SC	-	6
Animal	Clemmys guttata	Spotted turtle	T	-	1
Animal	Eacles imperialis pini	Pine imperial moth	SC	-	1
Animal	Emydoidea blandingii	Blanding's turtle	SC	-	3
Animal	Gavia immer	Common loon	T	-	6
Animal	Glyptemys insculpta	Wood turtle	T	-	2
Animal	Haliaeetus leucocephalus	Bald eagle	SC	-	5
Animal	Hesperia metea	Cobweb skipper	SC	-	1

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Hylocichla mustelina	Wood thrush	SC	-	1
Animal	Lasmigona compressa	Creek heelsplitter	SC	-	2
Animal	Lasmigona costata	Flutedshell	SC	-	1
Animal	Lithobates palustris	Pickerel frog	SC	-	1
Animal	Melanerpes erythrocephalus	Red-headed woodpecker	SC	-	3
Animal	Microtus pinetorum	Woodland vole	SC	-	1
Animal	Myotis lucifugus	Little brown bat	T	-	1
Animal	Necturus maculosus	Mudpuppy	SC	-	1
Animal	Opheodrys vernalis	Smooth green snake	SC	-	5
Animal	Physella magnalacustris	Great Lakes physa	SC	-	1
Animal	Setophaga kirtlandii	Kirtland's warbler	E	-	5
Animal	Sistrurus catenatus	Eastern massasauga	T	LT	6
Animal	Sturnella magna	Eastern meadowlark	SC	-	3
Animal	Vermivora chrysoptera	Golden-winged warbler	T	-	5
Total	-	-	-	-	102

Table 19. Rare plant occurrence within Camp Grayling Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Plant	Agoseris glauca	Prairie or pale agoseris	T	-	1
Plant	Calypso bulbosa	Calypso or fairy-slipper	T	-	1
Plant	Cirsium hillii	Hill's thistle	SC	-	14
Plant	Corispermum pallasii	Pallas' bugseed	SC	-	2
Plant	Dalibarda repens	False violet	T	-	1
Plant	Festuca altaica	Rough fescue	SC	-	7
Plant	Juncus vaseyi	Vasey's rush	T	-	1
Plant	Piptatherum canadense	Canada rice grass	T	-	1
Plant	Potentilla canadensis	Canada cinquefoil	SC	-	1
Plant	Prunus umbellata	Alleghany or Sloe plum	SC	-	5

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Plant	Solidago vossii	Voss's goldenrod	E	LT	3
Plant	Sporobolus heterolepis	Prairie dropseed	SC	-	2
Plant	Stellaria crassifolia	Fleshy stitchwort	E	-	1
Plant	Trichophorum clintonii	Clinton's bulrush	SC	-	1
Plant	Viola novae-angliae	New England violet	T	-	2
Grand Total	-	-	-	-	**43**

Non-ecological reference area natural communities

Natural communities that are identified with an element occurrence in the MNFI Biotics database, but that have not been given an additional ecological reference area designation, are recognized and managed accordingly (Table 20).

Table 20. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 21. Non-ecological reference area natural communities within Camp Grayling Management Area.

Community Type	Element Occurrence Rank	State Rank	Global Rank	Number of Occurrences
Bog	B	S4	G3G5	1
Northern Shrub Thicket	BC	S5	G4	2
Northern Wet Meadow	-	S4	G4G5	2
Poor Conifer Swamp	BC	S4	G4	2
Grand Total	-	-	-	**7**

Forest health

Forest health concerns, both native and non-native, can have impacts on stand conditions and management decisions. The following insects (Table 22) and diseases (Table 23) could have an impact on management during the planning period and may need to be monitored and/or addressed.

Table 22. Defoliating insects of concern in the Camp Grayling management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Spongy moth	Lymantria dispar	Non-native	Yes
Forest tent caterpillar	Malacosoma disstria	Native	Yes
Large aspen tortrix	Choristoneura conflictana	Native	-
Jack pine budworm	Choristoneura pinus	Native	-

Watch for lingering ash with potential resistance to emerald ash borer. Monitor young jack and red pine for redheaded pine sawfly damage.

Table 23. Maladies of concern in the Camp Grayling management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Canker (stem infections)	Various	Various	Yes
Armillaria root rot	Armillaria spp.	Native	-
Oak decline	Various	Various	Yes

Monitor oak for symptoms of oak wilt and follow state land oak wilt guidance. Monitor planted red pine for Heterobasidion root disease and follow disease guidance. Report surviving mature beech trees that may be resistant to beech bark disease. Watch for symptoms of beech leaf disease.

Aquatic resources

Riparian habitat

Approximately 31 miles of streams and rivers are found in the management area (Table 24). Streams/rivers classified as cold types comprise approximately 90% of the riverine mileage.

Table 24. Classification type and length of streams/rivers found within the management area.

Type	Length (miles)
Cold Stream	18
Cold Small River	3
Cold Transitional Stream	5
Cold Transitional Small River	2
Cold Transitional Large River	0
Warm Transitional Stream	3
Warm Transitional Small River	0

Type	Length (miles)
Warm Transitional Large River	0
Warm Stream	0
Warm Small River	<1
Warm Large River	0

Lacustrine habitat

A total of 14 lakes and ponds of at least one surface acre are found in the management area (Table 25).

Table 25. Size and number of lakes and ponds located within the management area.

Lake Size Class (acres)	Number
1-99	11
100-499	2
500+	1

Wetlands

A total of 7,721 acres of wetlands are found in the management area (Table 26). Forested wetlands comprise approximately 93% of wetland types found in the management area.

Table 26. Area of emergent, forested and riverine wetland types found within the management area.

Wetland Type	Acres
Emergent	443
Forested	7,168
Riverine	110

Vernal pools and seeps

A total of 65 acres of vernal pools and seeps have been inventoried in the management area while 20 acres of seeps have been identified.

Riparian vegetation cover

Lowland shrub, aspen and lowland conifers are predominant cover types present in a 100-meter riparian zone located next to streams/rivers in the management area (Table 27).

Table 27. Largest vegetative cover types (i.e., top 10) and area located in a 100-meter buffer of streams/rivers within the management area.

Cover Type	Acres
Lowland Shrub	823
Aspen	519

Cover Type	Acres
Lowland Conifers	406
Natural Jack Pine	276
Mixed Upland Deciduous	248
Planted Red Pine	234
Natural Mixed Pines	222
Lowland Aspen/Balsam Poplar	166
Upland Shrub	164
Northern Red Oak	105

Watershed vegetation cover

The management area includes portions of important watersheds of the Manistee and Au Sable rivers (Table 28 & Table 29). Aspen, red pine, jack pine and red oak are major cover types of the state forest in each watershed.

Table 28. Largest vegetative cover types (i.e., top five) and area of the Manistee River watershed located within the management area.

Cover Type	Acres
Natural Jack Pine	5,455
Northern Red Oak	3,268
Mixed Upland Deciduous	2,943
Planted Jack Pine	2,794
Aspen	2,096

Table 29. Largest vegetative cover types (i.e., top five) and area of the Au Sable River watershed located within the management area.

Cover Type	Area (acres)
Aspen	14,268
Mixed Upland Deciduous	6,733
Upland Shrub	5,500
Black-Red Hybrid Oak	5,418
Natural Jack Pine	4,846

Recreation

The Camp Grayling Management Area is the Michigan National Guard training grounds with some areas used for military exercise, therefore access to recreation varies.

Motorized trails in this management area include parts of the Frederick Route and Trail and the West Higgins Route and Trail and several snowmobile trails running both north-south and east-west.

Nonmotorized trails are limited and include the Grayling Area Community Pathway open to hiking and biking, and a short section of the Shore-to-Shore equestrian trail. The 3,500-acre Hanson Hills Recreation Area, administered by the Grayling Recreation Authority, offers intensive all-season, nonmotorized recreation opportunities on land leased from the Michigan Department of Military and Veterans Affairs.

There are five state forest campgrounds (rustic) within the management area, all of which provide water access. Additional recreation opportunities are provided by the adjacent Hartwick Pines State Park.

Table 30. Designated recreation trails by type.

Recreation Category	Recreation Type	# of Miles
Motorized Recreation Trails	Off-Road Vehicles (all types)	15.1
Motorized Recreation Trails	Snowmobile	29.7
Nonmotorized Recreation Trails	Hiking	1.4
Nonmotorized Recreation Trails	Equestrian	0.1
Nonmotorized Recreation Trails	Biking	0.3
Nonmotorized Recreation Trails	Hunter Access Trails	10.4
Total	-	**46.3**

Note: Trail-use types may overlap.

Table 31. State forest campgrounds.

State Forest Campground	# of sites	Off-Road Vehicle Access
CCC Bridge	31	Yes
Manistee River Bridge	23	-
Lake Margrethe	37	-
Jones Lake	42	-
Shupac Lake	30	-

There are no areas managed specifically for hunting in this management area.

The Manistee River runs along the northwest boundary of the Camp Grayling Management Area and is popular for fishing and paddling with three boating access sites within the management area. Other boating access sites provide access to small inland lakes and the larger Lake Margrethe.

Portions of the Camp Grayling Management Area are popular destinations for hunting, hiking, mushroom hunting, etc. for the nearby community of Grayling.

Table 32. Boating access sites.

Name	Waterbody
Burnt Cabin	Manistee River
CCC Bridge State Forest Campground	Manistee River
Guthrie Lake	Guthrie Lake
Hole in the Fence	Manistee River
Jones Lake State Forest Campground	Jones Lake State Forest Campground
K.P. Lake	K.P. Lake
Lake Margrethe State Forest Campground	Lake Margrethe State Forest Campground
Section One Lake	Section One Lake
Shupac Lake State Forest Campground	Shupac Lake State Forest Campground

Emmet Moraines

State Forest Area: 29,586 acres	Location: Northeastern Lower Peninsula	Population Centers: Petoskey Harbor Springs Pellston
Subsection: Emmet Moraines	Landforms: Steep sandy ridges Ground moraines	Landcover: Forested: 26,942 acres Nonforested: 2,644 acres

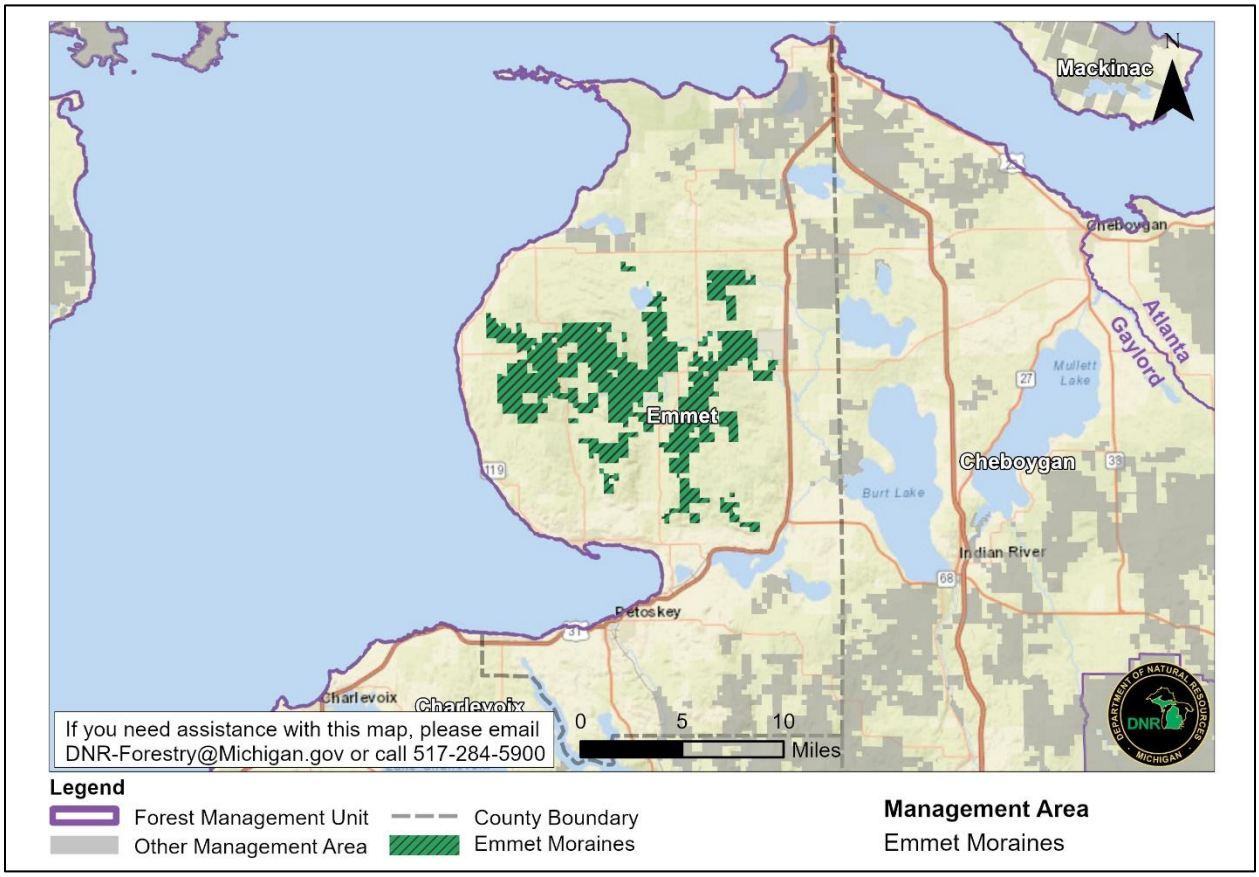


Figure 1. Emmet Moraines Management Area.

Forested landscape

Current and projected future condition

The Emmet Moraines Management Area includes a variety of shade-tolerance levels with the most tolerant occurring mostly in the mature age category. The mid-tolerant category occurs mostly in the mature age. The intolerance occurs mostly in the young and mid-age categories (Figure 2).

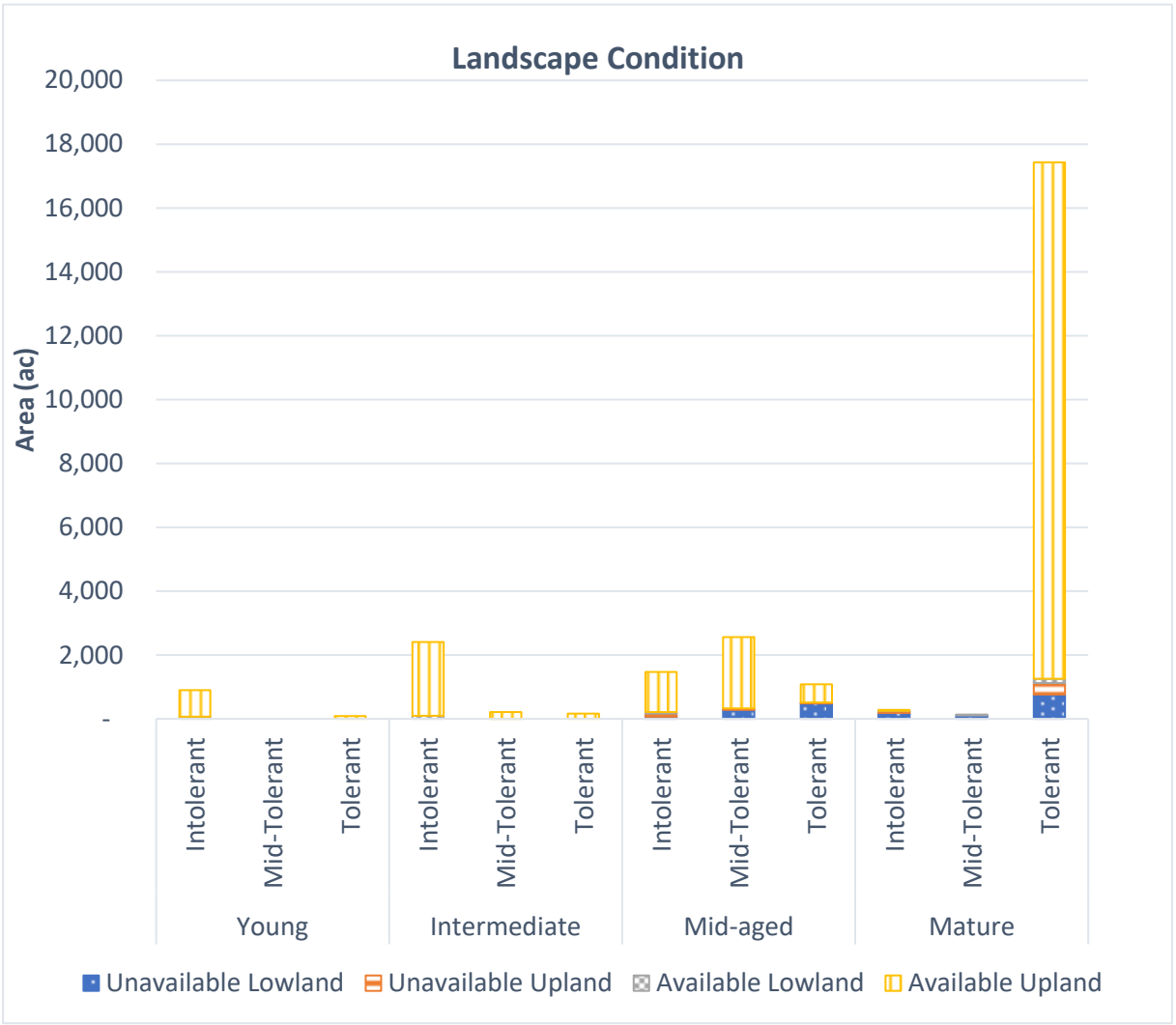


Figure 2. Forest diversity matrix showing the current distribution of forested acres across management availability, age category, landscape position and shade tolerance.

Landscape habitat conditions refine the management area landscape into featured species habitat context. Current and projected acres for the metrics identified in the Management Priorities (Section 3 Statewide/Regional) establish a baseline and future condition based on management over the planning period (Table 1).

Table 1. Current acres for landscape habitat conditions.

Landscape Habitat Condition	Monitoring Metric	Current Acres
Young Forest	Acres of 0-19 stands in Aspen and Jack Pine	902
Mature Forest	Acres of 80+ year stands across cover types	17,845
Mature Forest	Acres of 120+ year stands across cover types	97
Mesic Conifer Cover types	Acres of mesic conifer cover types	73
Mesic Conifers in other Cover types	Average canopy occupancy	4%
Mast – Oak Cover types	Acres of oak cover types	22
Mast Tree Species in other Cover types	Acres of total canopy occupancy of mast tree acres (trace-100%)	18,181
Big Trees	Acres of total canopy stand occupancy of species in sawlog or greater size class	17,688
Nonforested Openings	Acres of total herbaceous openland, upland shrub and cropland	650
Landscape Forest Matrix	Percent deciduous forest	84%
Landscape Forest Matrix	Percent coniferous forest	15%

The Emmet Moraines Management Area is comprised of 91% forested cover types and 9% nonforested cover types (Table 2). Of the forested cover types, 83% are in the upland landscape position. The largest contributors to upland cover types are northern hardwoods, aspen and planted red pine. Lowland conifer and cedar take up 60% of the lowland landscape position. Lowland shrub is the most common nonforested cover type in the management area representing 6% of the landscape.

Table 2. Current landscape context and distribution of cover types.

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
Forested	Upland	Deciduous	Aspen	4,540	22,097	24,636	26,942
			Northern Hardwood	17,441			
			Black Red Hybrid Oak	0			
			Northern Red Oak	22			
			Oak Mix	0			
			Mixed Upland Deciduous	95			
		Mixed	Upland Mixed Forest	7	7		
		Coniferous	Planted Red Pine	2,426	2,533		
			Planted Jack Pine	0			
			Planted White Pine	11			
			Planted Mixed Pine	0			
			Natural Red Pine	23			
			Natural Jack Pine	0			
			Natural White Pine	0			
			Natural Mixed Pines	3			
			Upland Spruce/Fir	70			
			Upland Conifers	0			
			Hemlock	0			
	Lowland	Deciduous	Lowland Aspen/Balsam Poplar	344	633	2,305	
			Lowland Deciduous	289			
		Mixed	Lowland Mixed Forest	137	137		
		Coniferous	Cedar	486	1,535		
			Lowland Conifers	896			
			Lowland Spruce/Fir	48			
			Tamarack	105			
Nonforested	Upland	N/A	Herbaceous Openland	280	N/A	829	2,644
			Upland Shrub	370			
			Low Density Trees	87			
			Bare/Sparsely Vegetated	5			
			Cropland	0			
			Urban	88			
	Lowland	N/A	Lowland Shrub	1,781	N/A	1,815	
			Marsh	18			
			Bog	0			
			Treed Bog	9			
			Water	8			
						Grand Total:	**29,586**

There are 24,441 acres (83% of the total management area and 91% of the forested area) that can be managed toward desired future conditions via commercial timber harvest in the Emmet Moraines Management Area (Table 3). Of that, over 63% is in the hardwood cover type, 17% in the aspen cover type, and 9% in planted red pine. The remaining 15 cover types represent less than 1% each of the forested and available land in the management area. Acres unavailable for management are categorized by site condition (Table 4).

Table 3. Current cover type composition by management availability.

EMMET MORAINES Forested Cover Type	Available Acres	Available %	Unavailable Acres	Unavailable %	Total Acres	Total %
Aspen	4,458	16.5%	81	0.3%	4,540	16.8%
Cedar	129	0.5%	357	1.3%	486	1.8%
Lowland Aspen/Balsam Poplar	227	0.8%	117	0.4%	344	1.3%
Lowland Conifers	0	0.0%	896	3.3%	896	3.3%
Lowland Deciduous	2	0.0%	288	1.1%	289	1.1%
Lowland Mixed Forest	31	0.1%	106	0.4%	137	0.5%
Lowland Spruce/Fir	0	0.0%	48	0.2%	48	0.2%
Mixed Upland Deciduous	95	0.4%	0	0.0%	95	0.4%
Natural Mixed Pines	3	0.0%	0	0.0%	3	0.0%
Natural Red Pine	23	0.1%	0	0.0%	23	0.1%
Northern Hardwood	17,060	63.3%	381	1.4%	17,441	64.7%
Northern Red Oak	0	0.0%	22	0.1%	22	0.1%
Planted Red Pine	2,365	8.8%	61	0.2%	2,426	9.0%
Planted White Pine	11	0.0%	0	0.0%	11	0.0%
Tamarack	9	0.0%	96	0.4%	105	0.4%
Upland Mixed Forest	7	0.0%	0	0.0%	7	0.0%
Upland Spruce/Fir	22	0.1%	48	0.2%	70	0.3%
Grand Total	**24,441**	**90.7%**	**2,501**	**9.3%**	**26,942**	**100%**

Table 4. Site conditions for unavailable acres.

Site Condition (Reason area is unavailable for commercial harvest)	Area (ac)	% of Unavailable Area
Too Wet	1,872	74.9%
Too Steep	236	9.4%
BMPs	182	7.3%
Other Dept./Div. Processes	78	3.1%
Conservation Values	72	2.9%
Long-Term Retention	57	2.3%
Neighbor / Interest Group	2	0.1%
Denied Access	2	0.1%
Total Unavailable	**2,501**	**100.0%**

Projected 10-year cover type management actions

Each cover type in the Emmet Moraine Management Area has a unique age class and basal area class goals that describe the long-term desired future conditions. The harvest levels that are needed in the first planning period to begin achieving those long-term goals are summarized below (Table 5). These harvests will help establish a desirable amount of regeneration for the even-aged cover types over the 10-year period or help to achieve desired basal area distribution among uneven-aged cover types like northern hardwoods. Implementing these silvicultural regimes will yield 154,484 cords, the planned harvest volume for the decade (Table 6).

Table 5. Ten-year planning period harvest goals (acres) by cover type and silvicultural regime.

Silvicultural Regimes								
Cover Type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Salvage Clearcut	Salvage Thinning	Grand Total
Northern Hardwood	-	516	-	331	-	140	1,653	2,639
Planted Red Pine	-	-	658	-	-	672	497	1,827
Aspen	271	-	-	-	-	217	-	488
Lowland Aspen/Balsam Poplar	37	-	-	-	-	-	-	37
Planted White Pine	-	-	11	-	-	-	-	11
Totals	**307**	**516**	**669**	**331**	**-**	**1,029**	**2,150**	**5,001**

Table 6. Projected 10-year harvest volume by species.

10-Year Estimated Harvest Volume Projection Emmet Moraines Management Area			
Product	**Species**	**Volume Planned***	**Volume Prepared****
Pulpwood (cords)	Mixed Hardwood	20,390	19,166
	Red Pine	13,993	13,154
	Mixed Aspen	6,291	5,914
	Mixed Softwood	5,688	5,347
	Mixed Spruce	1,323	1,243
	Mixed Oak	467	439
	White Pine	423	398
	Jack Pine	408	383
	Pulpwood Total	**48,983**	**46,044**
Sawtimber (MBF)	Sugar Maple	6,992	6,572
	Red Pine	3,231	3,037
	Red Maple	1,496	1,406
	Basswood	1,244	1,169
	Red Oak	618	581
	Mixed Aspen	485	456
	White Pine	124	116
	Mixed Oak	70	65
	White Oak	3	3
	Sawtimber Total	**14,261**	**13,406**
	Total Sawtimber Harvest Volume in Cords	**105,501**	**99,171**
	Grand Total Harvest Volume in Cords	**154,484**	**145,215**

* Volume estimates based on 100% of the projected harvests for the 10-year planning period.

** Volume estimates based on 94% of the projected harvests for the 10-year planning period accounting for reduction in acres and associated volume once sales are prepared for bid.

There are very few cover type transitions projected for the Emmet Moraines management area (Table 7). The managed area of each cover type is projected to remain fairly stable as treatment regimes will not significantly change the amount of area in each cover type. The largest decrease forecasted is in the aspen cover type where only 14 acres will convert to other cover types through forest management and

regeneration activities. The largest increase occurs in the northern hardwoods type where only 14 acres are projected to convert into this cover type.

Table 7. Projected 10-year cover type acres resulting from cover type transitions.

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Northern Hardwood	17,441	17,455	14
Aspen	4,540	4,525	-14
Planted Red Pine	2,426	2,426	0
Lowland Conifers	896	896	0
Cedar	486	486	0
Lowland Aspen/Balsam Poplar	344	342	-2
Lowland Deciduous	289	291	2
Lowland Mixed Forest	137	137	0
Tamarack	105	105	0
Mixed Upland Deciduous	95	95	0
Upland Spruce/Fir	70	70	0
Lowland Spruce/Fir	48	48	0
Natural Red Pine	23	23	0
Northern Red Oak	22	22	0
Planted White Pine	11	11	0
Upland Mixed Forest	7	7	0
Natural Mixed Pines	3	3	0
Lowland Shrub	1,781	1,781	0
Upland Shrub	370	370	0
Herbaceous Openland	280	280	0
Urban	88	88	0
Low Density Trees	87	87	0
Marsh	18	18	0
Treed Bog	9	9	0
Bare/Sparsely Vegetated	5	5	0
Water	8	8	0
Total:	**29,586**	**29,586**	**0**

Featured species current and projected habitat acres

There are six featured species in this management area that span various cover types, age classes and stand level conditions. Current and projected total habitat acres by species across the decade provide a baseline and show the result of long-term management actions (Table 8). As noted in the Featured Species Management Priority (Section 3), it is recommended that these featured species habitat acres be viewed as acres of potential habitat, representing a condition on the landscape where the more

nuanced aspects of each species' habitat requirements are likely to be found or managed for. As described in the introduction, the modeling effort was limited by several factors including the simplification of habitat attributes into MiFI variables. Therefore, when referring to habitat acres what is being referred to is potential habitat acres.

Some species show a loss in habitat over the next century. As mentioned in the Featured Species Management Priority (Section 3), the current condition for many cover types is a surplus of acres in the 0-9 age class from the compensatory management approach applied in the previous decade. The model eventually evens out the age classes at a lower, sustainable level over time, usually by 50 years. For any species with northern hardwoods as a priority cover type, there is a perceived drop in acres between 40 and 60 years; this is due to the basal area dropping below 81 but because it only drops into the upper 70s, it is not expected to translate to any real habitat loss on the ground.

Table 8. Featured species current and projected total habitat acres (e.g., potential habitat).

Featured Species	Priority Cover types	Total Habitat Acres Current	Total Habitat Acres 10-year	50-year Projected Habitat Acres	100-year Projected Habitat Acres
Black-Throated Blue Warbler	Northern hardwoods, mixed upland deciduous	13,384	16,302	7,415	16,835
Cerulean Warbler	Northern hardwoods, mixed upland deciduous, lowland deciduous	16,498	16,845	16,373	17,125
Golden-Winged Warbler	Aspen, black-red hybrid oak, northern red oak, oak mix, tamarack	1,297	1,596	1,132	1,134
Marten	Northern hardwoods, mixed upland deciduous, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, lowland mixed forest, lowland conifers, hemlock, cedar	14,658	17,761	9,736	18,950
Ruffed Grouse	Aspen	1,297	1,595	1,130	1,129
Snowshoe Hare	Aspen, cedar, hemlock, lowland aspen, lowland conifers, lowland mixed forest, lowland spruce/fir, mixed upland deciduous, natural jack pine, natural mixed pines, planted jack pine, upland spruce/fir	1,479	1,813	1,202	1,220
Wood Turtle	Nonforested Openings	--	--	--	--

Cover type composition and associated featured species

Northern hardwoods

Current condition

Most of the northern hardwood cover type is currently between a stand age of 90 and 109 years old in the Emmet Moraines Management Area (Figure 3). The past management regime has been primarily single tree selection which allows for stand age to continue to increase over time. Group selection harvesting was used in less amounts over the last planning period.

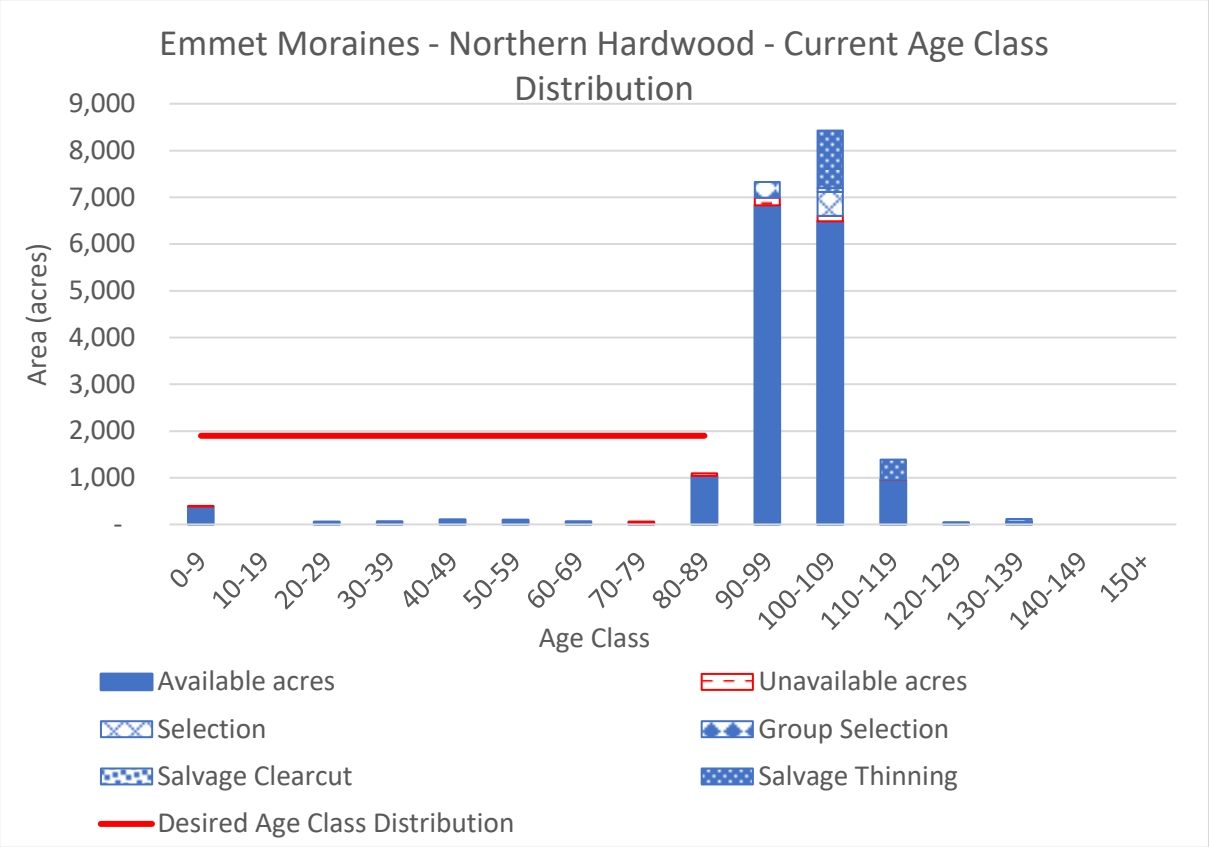


Figure 3. Current age class distribution and projected harvests in the northern hardwood cover type.

The area of northern hardwood is well distributed in the ideal basal area classes for optimal growing conditions in the Emmet Moraines Management Area (Figure 4). Current conditions are a result of ash and beech salvage efforts in the previous planning period and a regulated selection harvest regime that has been in place in this management area for decades.

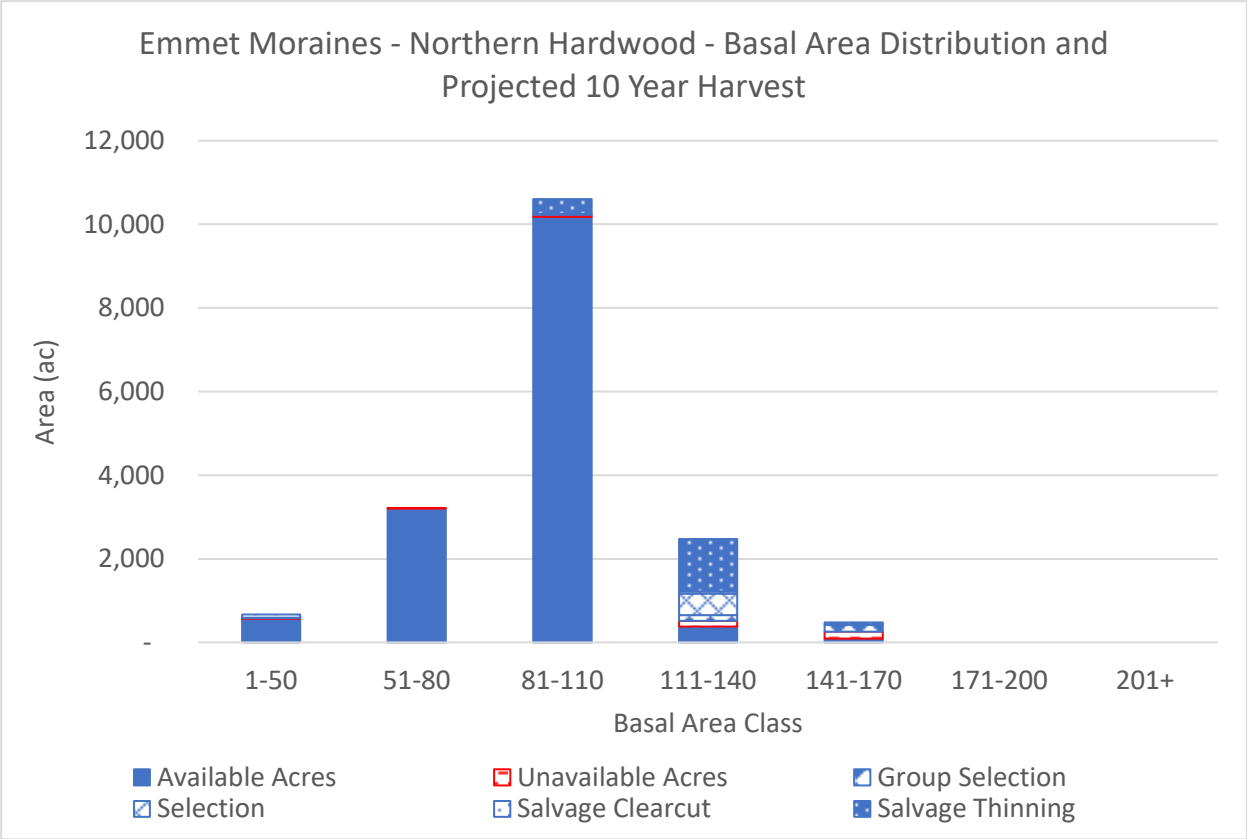


Figure 4. Current basal area distribution of the northern hardwood cover type as well as the projected harvests from each basal area class.

There are 381 acres of unavailable northern hardwoods in the Emmet Moraines Management Area. Selection is the primary silvicultural treatment projected during this 10-year planning period but there may be opportunities to utilize even-aged management silvicultural regimes to increase stem density, species composition, and regeneration within the northern hardwood areas. A portion of this cover type meets the habitat requirements for cerulean warbler, black-throated blue warbler and marten (Table 9).

Table 9. Featured species with northern hardwoods as a priority habitat cover type, habitat variables and current acres (e.g., potential habitat).

Featured Species	Featured Species Habitat – Northern Hardwood	Northern Hardwood Habitat Acres - Available	Northern Hardwood Habitat Acres - Unavailable
Cerulean Warbler	Age Category: 80+ Size Category: Sawlog Basal Area: 81+	16,150	348
Black-Throated Blue Warbler	Age Category: 80+ Size Category: Sawlog Basal Area: 81+	13,046	338
Marten	Age Category: 40+	13,115	357

Featured Species	Featured Species Habitat – Northern Hardwood	Northern Hardwood Habitat Acres - Available	Northern Hardwood Habitat Acres - Unavailable
	Size Category: Pole, Sawlog Basal Area: 81+		

Desired future condition

The projected long-term cover type trend for northern hardwood is pretty stable with slight increases in the first few planning periods in the Emmet Moraines Management Area (Figure 5). There are few transitions into this cover type from other cover types forecasted in this management area and equally few transitions from northern hardwoods to other cover types.

The desired basal area distribution is a bell-shaped curve where a significant majority of the area is kept in the 81-110 basal area class with recently harvested stands occupying the 51-80 class and stands that are ready for harvest occupy the 111-140 basal area class. Diameter distributions of the northern hardwood stands should follow the appropriate Q-curve relative to stand age and condition.

An uneven-aged condition is the long-term goal for most northern hardwood stands in this management area. An uneven-aged condition is achieved when there is no single discernable age cohort that is more prevalent than others across the stand area as canopy gaps fill in with regenerating seedlings, saplings, poles, and eventually remaining stems become sawlog sized over time.

Regeneration and recruitment continue to be a focus in the northern hardwood cover type across this management area. The long-term sustainability of this cover type in an uneven-aged silvicultural regime is dependent on the successful establishment of northern hardwood species as well as the recruitment of those seedlings and saplings into the pole and saw log classes. The Emmet Moraines Management Area will take several decades to reach the desired future condition because of the impacts from beech bark disease and the emerald ash borer. The amount of American beech and ash that once occupied much of the northern hardwood stands have resulted in lower-than-normal residual basal area and decreased stocking levels across much of the northeastern Lower Peninsula. To add to these lower basal areas, the 2025 ice storm damage has also reduced the basal area on some stands.

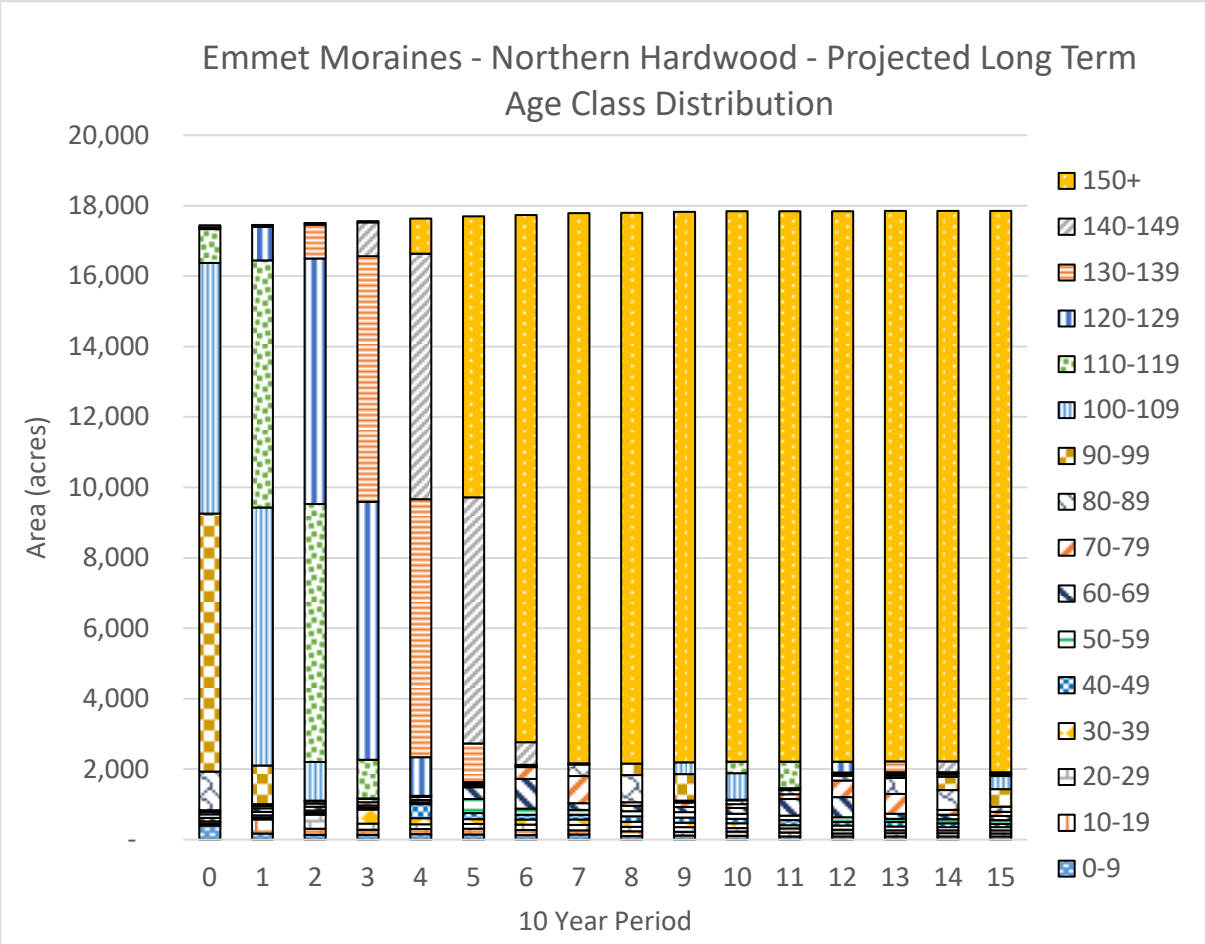


Figure 5. Projected age class distribution for all acres of northern hardwood over the next 150 years.

Management actions

The desired forest conditions and associated featured species habitat will be maintained and achieved through continued application of the projected single tree selection harvest regime on 516 acres, group selection on 331 acres as well as ice storm salvage thinning on 1,653 acres and salvage clearcuts on 140 acres throughout the first 10-year planning period. Multiple silvicultural regimes should have continued consideration as emerging research results become available. Emphasis on larger canopy gaps should be used to encourage diverse regeneration of northern hardwood species while maintaining an overall long-term mature forest closed canopy landscape condition.

Aspen

Current condition

Most of the aspen cover type is currently in the 0-9-year-old age class and the 20-49-year-old age classes. (Figure 6). The past management regime has been primarily clearcut for this cover type. The 10-19 age class has a deficit. The 0–9-year-old class is much higher due to past management using the compensatory approach where the management regimes intentionally harvest more to create a short-term spike in the 0-9 age class in order to compensate for the shortages in the 10-19-year-old age class. This current planning period will continue to smooth out the distribution of the aspen in this management area.

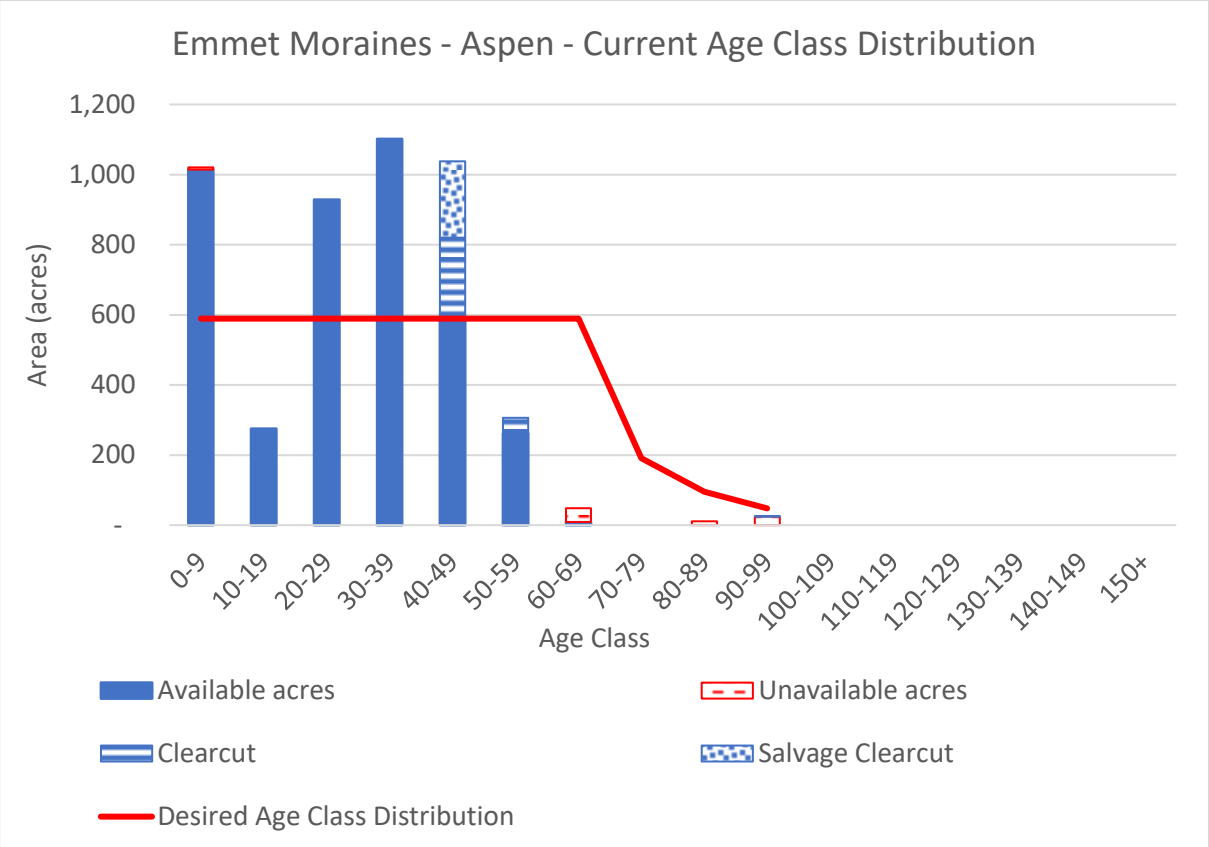


Figure 6. Current age class distribution, the desired age class distribution, and the projected harvests in the aspen cover type over the 10-year planning period.

Current conditions are a result of consistent commercial harvests and regeneration efforts on available aspen acres during the previous planning periods. A portion of this cover type meets the habitat requirements for golden-winged warbler, ruffed grouse and snowshoe hare (Table 10).

Table 10. Featured species with aspen as a selected habitat cover type, habitat variables and current acres (e.g., potential habitat).

Featured Species	Featured Species Habitat – Aspen	Aspen Habitat Acres - Available	Aspen Habitat Acres - Unavailable
Golden-Winged Warbler	Age Category: 0-19 Size Class: Sapling	1,290	7
Ruffed Grouse	Age Category: 0-19 Size Class: Sapling	1,290	7
Snowshoe Hare	Age Category: 0-19 Size Class: Sapling	1,290	7

Desired future condition

The projected long-term cover type trend for aspen is stable in the Emmet Moraines Management Area. There are a few transitions into or out of this cover type from or to other cover types forecasted in this management area decreasing the aspen cover type acreage by approximately only 14 acres in the first 10-year planning period.

The long-term goal for this cover type is balanced age classes between 0 and 70 years old for all available aspen stands in this management area. Maintaining some lower acreage in old age classes continues to be desirable to ensure the aspen cover type is distributed within the desired age classes.

The end of the planning period will result in the establishment of the desired amount of regeneration in in the upcoming 0-9 age class (Figure 7). Progress toward the long-term age class distribution of aspen will take several decades in the management area.

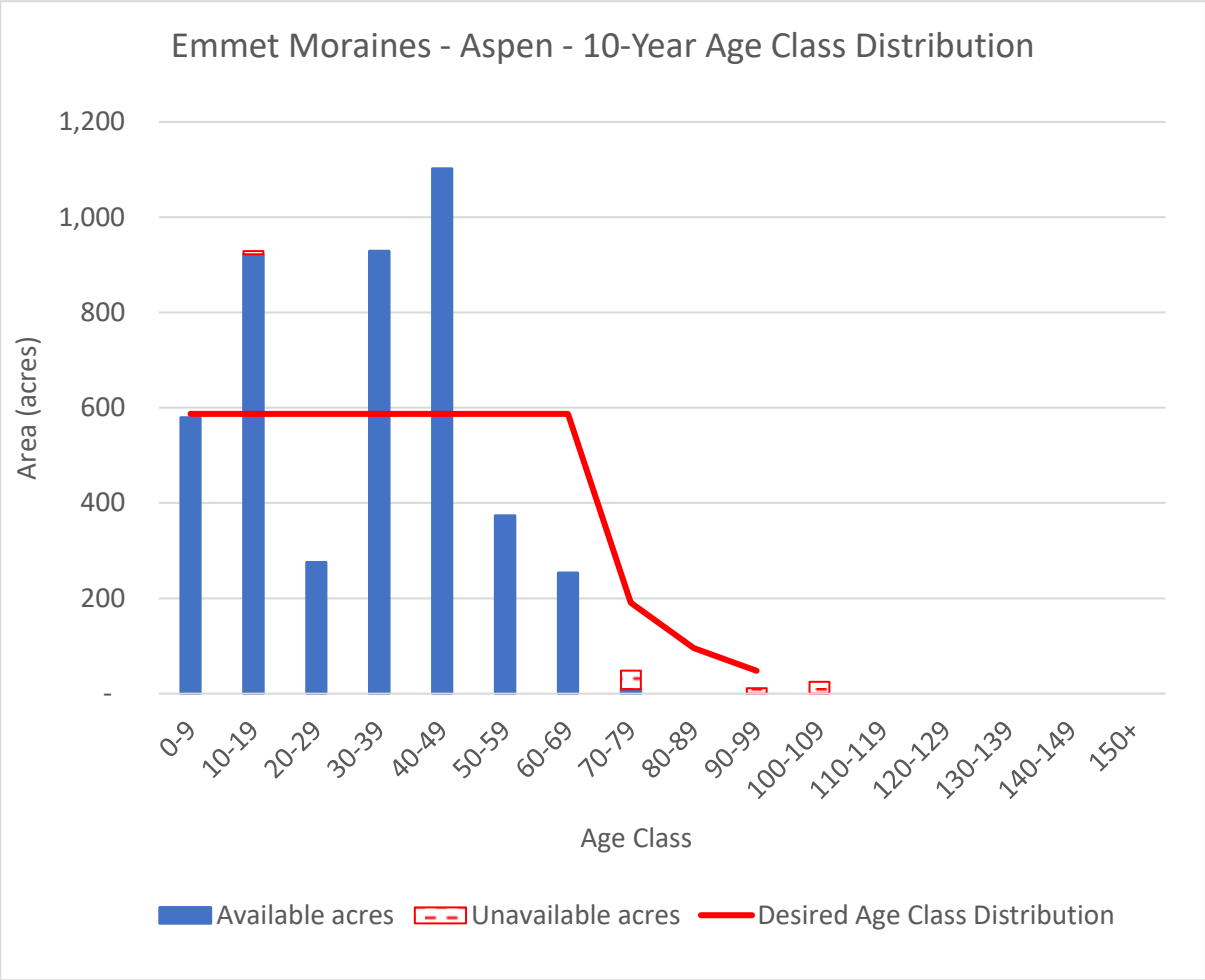


Figure 7. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of aspen acres is beginning to reach the desired future condition (Figure 8).

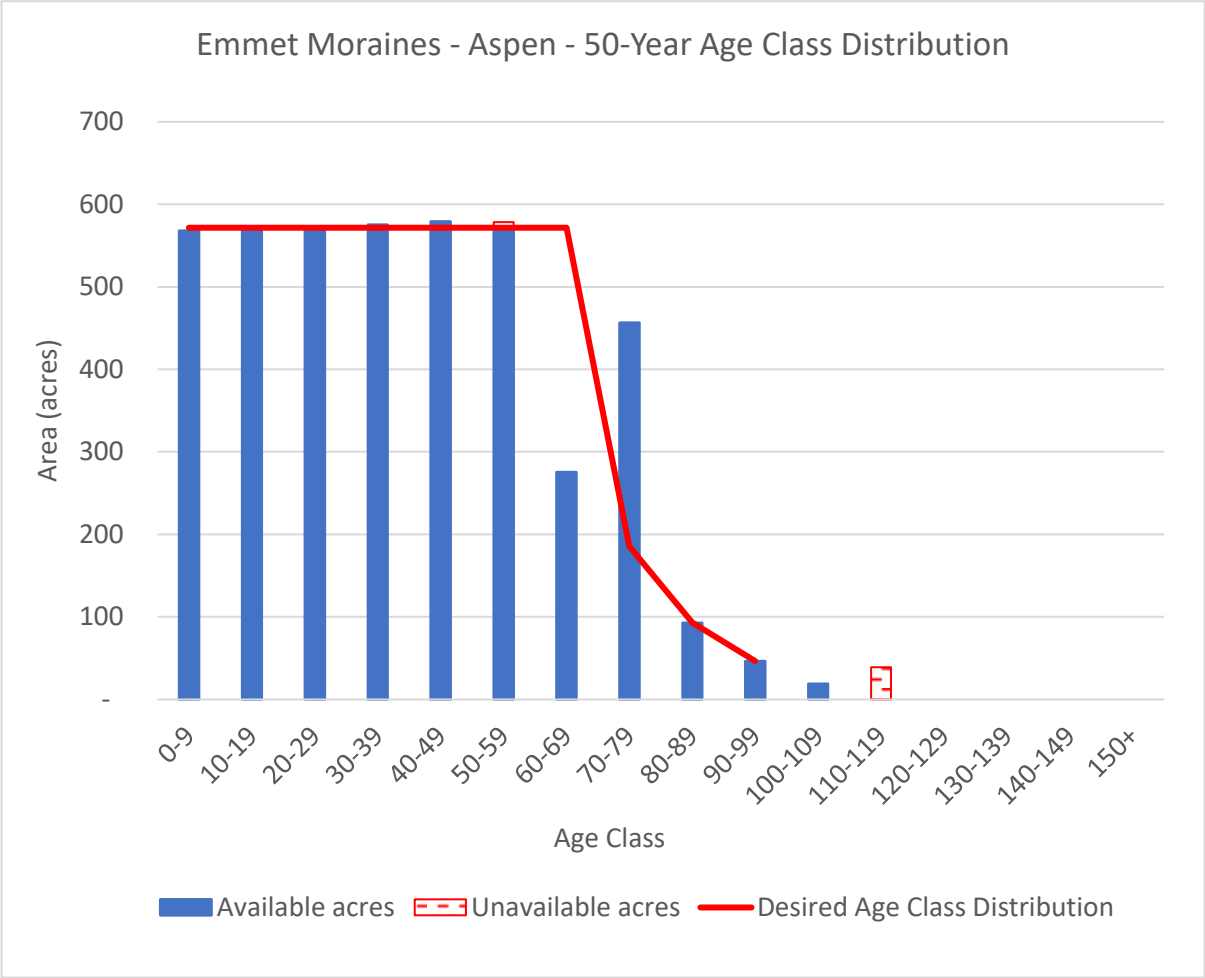


Figure 8. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 9) will concentrate the manageable acres of aspen in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest (Figure 10).

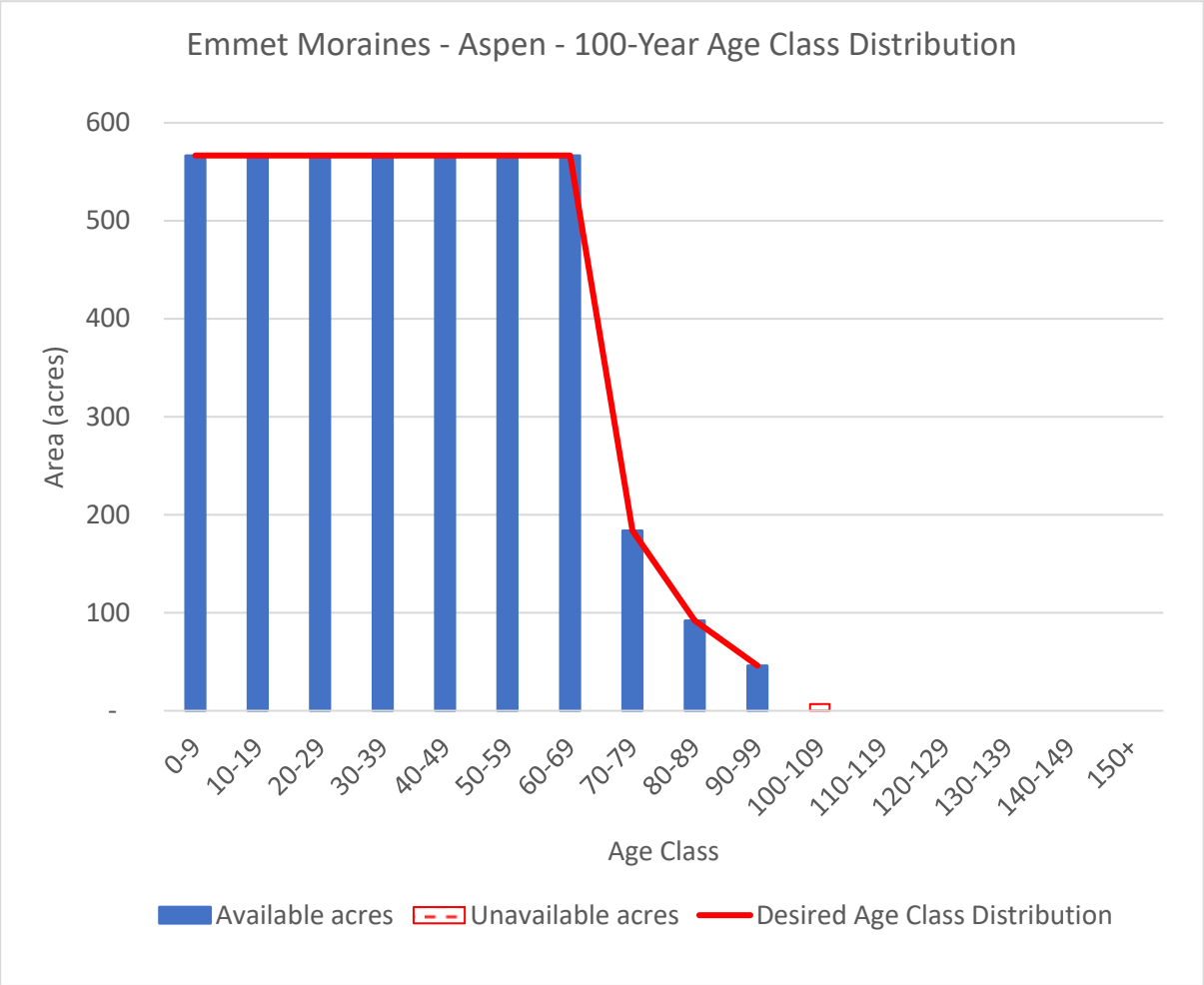


Figure 9. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

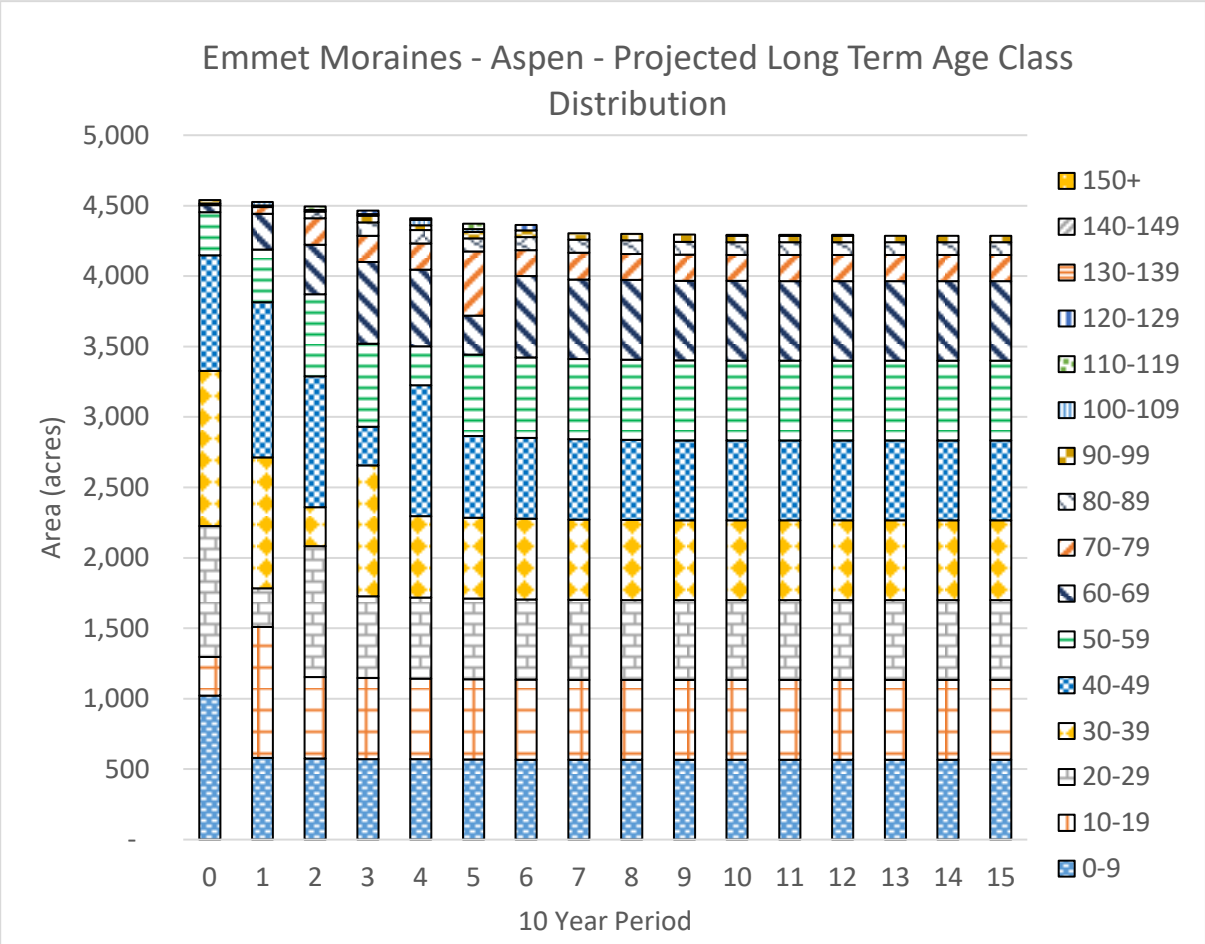


Figure 10. Projected age class distribution for all acres of aspen over the next 150 years in the Emmet Moraines Management Area.

Management actions

There are 271 acres of projected clearcut harvest plus another 217 acres of clearcut salvage due to ice storm damage in the aspen cover type during this planning period. This plus another 92 acres forecasted to naturally regenerate due to ice storm damage and minus the 14 acres projected to transition to another cover type will be slightly under the desired regeneration establishment of 587 acres per decade.

Planted red pine

Current condition

Most of the planted red pine cover type is currently between stand ages of 0-9 years old and 60- to 79-year-old age classes in the Emmet Moraines Management Area (Figure 11). The age class distribution is currently unbalanced. There is a deficit in all six age classes from 10 to 59 years old. The 0-9 age class will only compensate for some of those deficits.

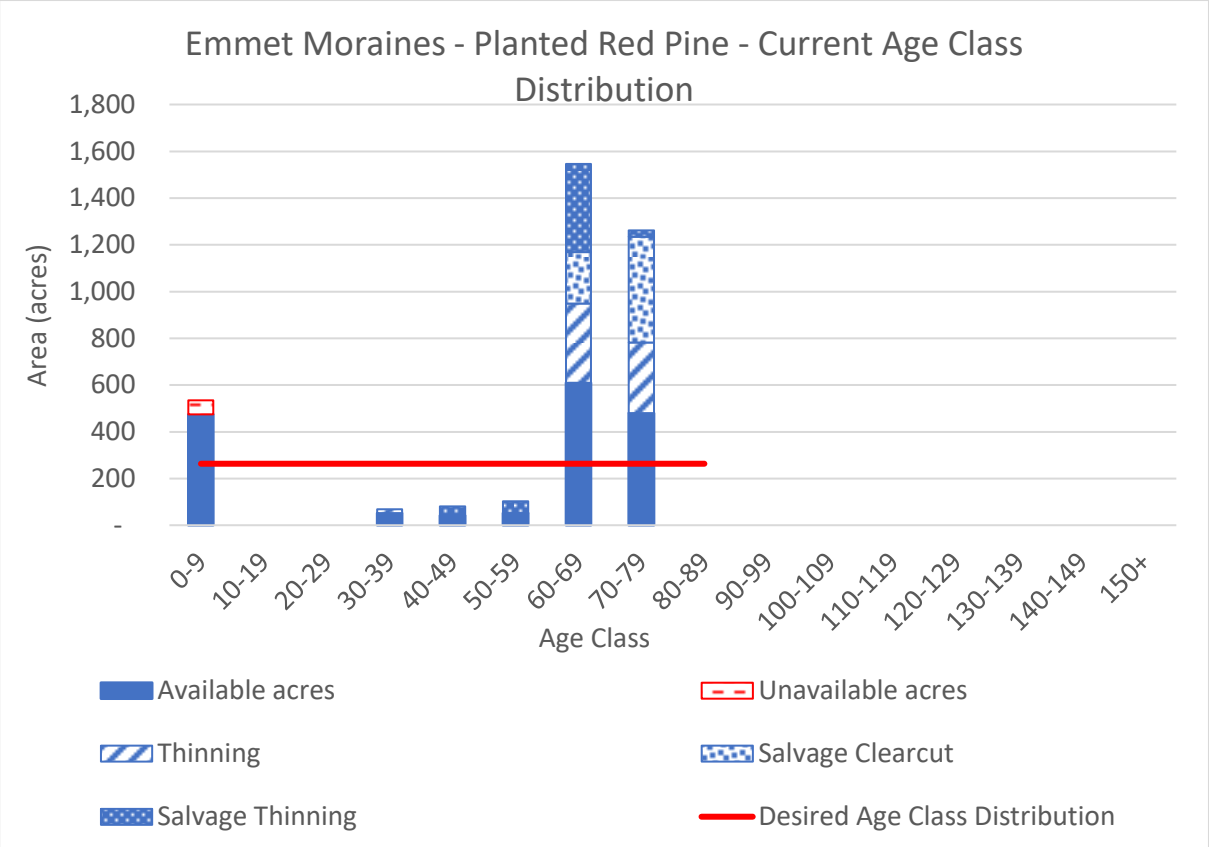


Figure 11. Current age class distribution and projected harvests in planted red pine cover type.

Desired future condition

The projected long-term cover type trend for planted red pine is decreasing in the Emmet Moraines Management Area. The long-term goal for this cover type is balanced age classes between 0 and 90 years old age classes for all available red pine stands in this management area.

The end of the planning period will result in the establishment of 672 acres being established in the 0-9 age class (Figure 12). These 672 acres are forecasted due to ice storm salvage clearcuts. The ice storm salvage will add another spike in the 0-9 age class. Reaching desired age class distribution will take longer due the storm damage and salvage efforts. The active presences of Heterobasidion root disease in many of the red pine stands in the management area may limit which stands can be replanted.

Progress toward the long-term desired age class distribution of red pine will take many decades of even-aged management in this management area.

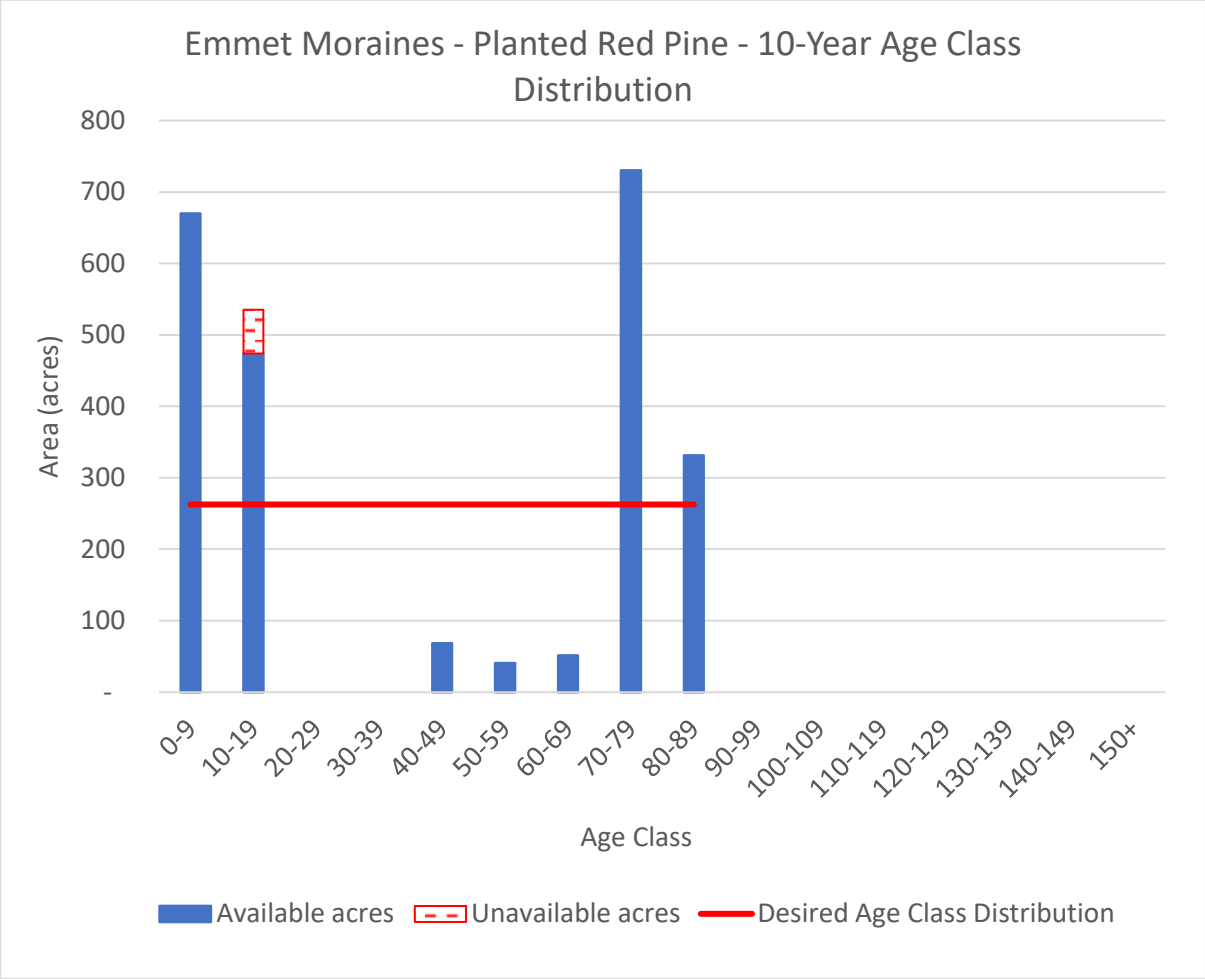


Figure 12. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution of planted red pine is beginning to reach the desired future condition for available acres (Figure 13). As is often the case, unbalanced age classes may result in the need to leave some acres in older age classes to achieve the desired age class distribution in future planning periods.

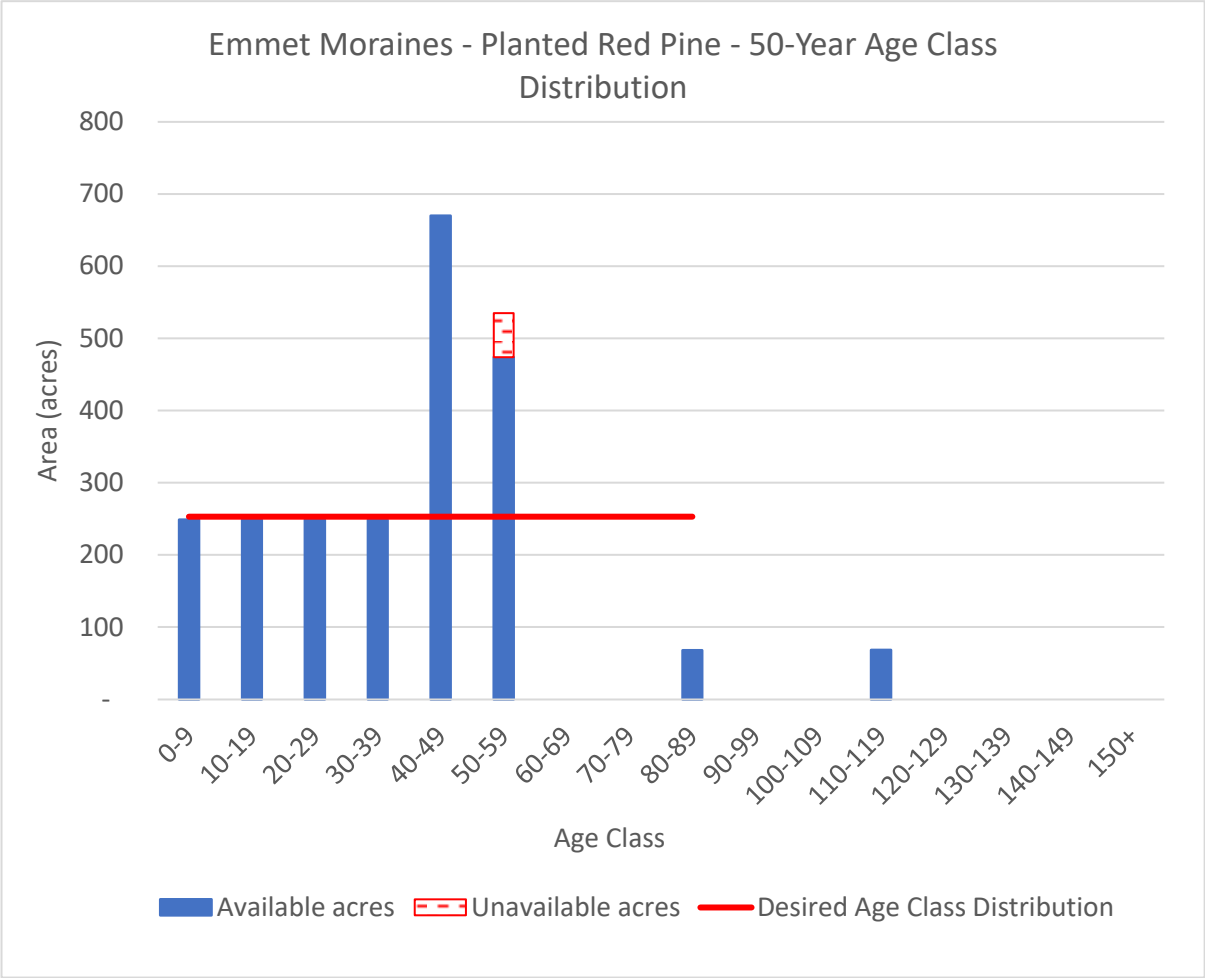


Figure 13. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 14) will concentrate the manageable acres of red pine in productive growing conditions while providing an even flow of forest products. This may take several more decades beyond 100 years to achieve the desired age class distribution.

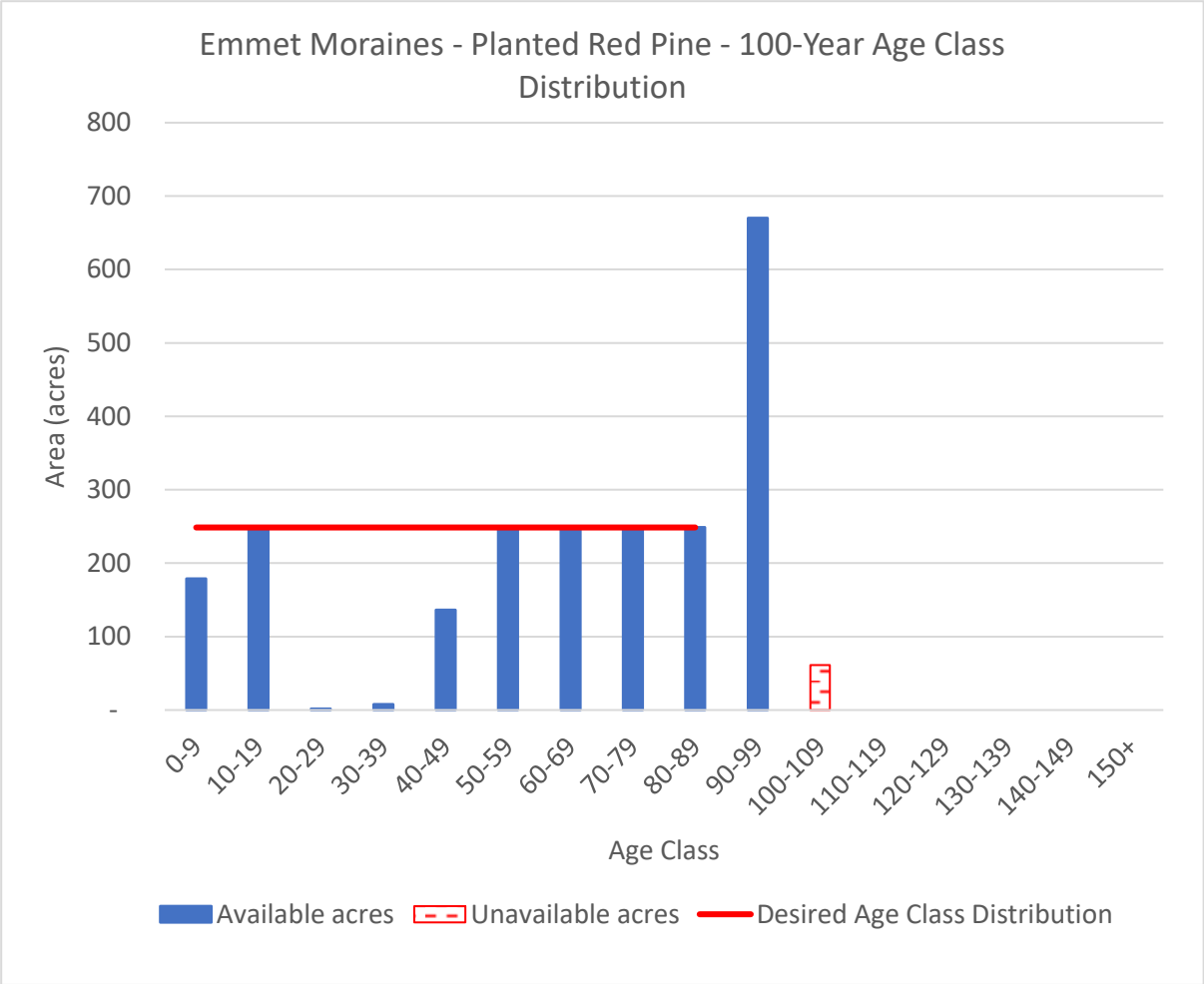


Figure 14. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

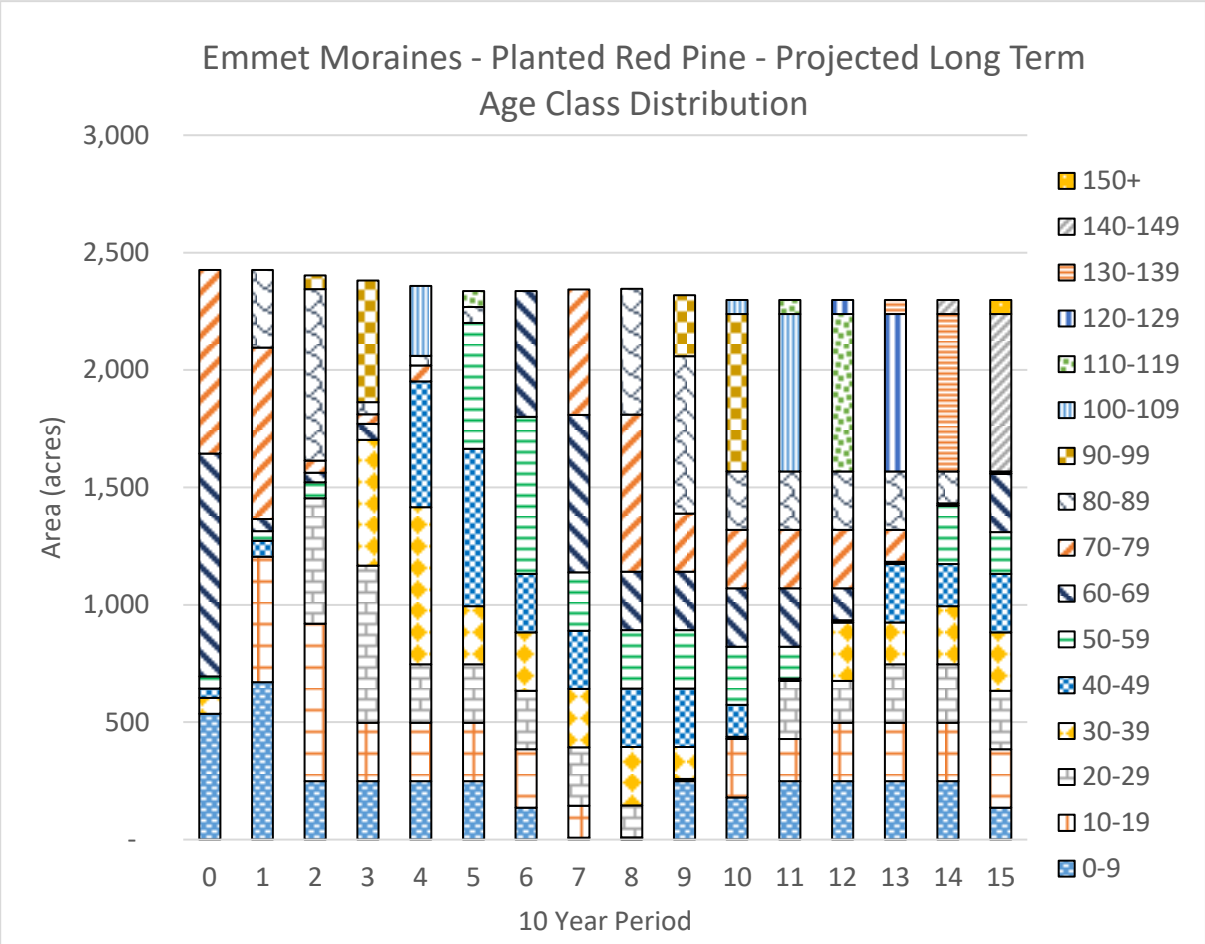


Figure 15. Projected age class distribution for all acres of planted red pine over the next 150 years in the Emmet Moraines Management Area.

Management actions

There are 658 acres of projected thinning harvests in the planted red pine cover type during the planning period. This will allow some acres to be held in older age classes and provide opportunities to help balance the age classes in future planning periods. However, there are 672 acres of projected salvage clearcut and another 497 acres of salvage thinning due to the impacts of the 2025 ice storm. These salvage operations in this cover type will result in a much longer time to reach the desired age class distribution.

Conservation area network

High conservation value areas

There are up to nine different high conservation value area (HCVA) types that can be found in each management area (see Biodiversity in Section 3 for more information). There are no current HCVAs in this management area at this time.

Ecological reference areas

ecological reference areas (ERAs) are a type of HCVA and are higher quality examples of functioning ecosystems that are primarily influenced by natural ecological processes.

Table 11. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 12. Ecological reference areas within the management area.

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	Number of Occurrences
Existing ERA	Mesic Northern Forest	D		S3	1
Existing ERA	Mesic Northern Forest	X	G4	S3	2
Grand Total					**3**

Special conservation areas

Reviewable special conservation areas (SCAs; Table 13) refers to those SCA types that may be reviewed or updated through the compartment review process as needed. Static SCAs (Table 12) refers to those SCA types that generally do not change or require updating (see Biodiversity in Section 3 for more information).

Table 13. Reviewable special conservation areas within Emmet Moraines Management Area.

Reviewable Special Conservation Area Type and Name	Acres
Habitat Area or Habitat Corridor	**79**
52101001	79
Grand Total	**79**

Table 14. Static special conservation areas within Emmet Moraines Management Area.

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Designated Trout and Cold Water Stream Buffer		**273**
		175
Cold Creek		7
McPhee Creek		9
West Branch Maple River		83
Designated Trout and Coldwater Streams	**10.1**	
	6.4	
Cold Creek	0.3	
McPhee Creek	0.4	
West Branch Maple River	3.1	
Wood Turtle Stream 100ft Buffer		**83**
West Branch Maple River		83
Wood Turtle Stream 660ft Buffer		**482**
West Branch Maple River		482
Grand Total	**10.1**	**839**

Rare Species

Rare species occurrences are compiled from the Michigan Natural Features Inventory Biotics database (Table 15 and Table 17) and do not necessarily include all rare species found in this management area due to biases in survey effort and verifiable observation reporting over time.

Table 15. Rare animal and plant species conservation status key.

Status	Status
E = endangered	LE = listed endangered
T = threatened	LT = listed threatened
SC = special concern	PDL = proposed for delisting

Table 16. Rare animal occurrence within Emmet Moraines Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Buteo lineatus	Red-shouldered hawk	SC		10
Animal	Eacles imperialis pini	Pine imperial moth	SC		1
Animal	Erora laeta	Early hairstreak	SC		1
Animal	Haliaeetus leucocephalus	Bald eagle	SC		3
Animal	Myotis lucifugus	Little brown bat	T		1

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Necturus maculosus	Mudpuppy	SC		1
Animal	Opheodrys vernalis	Smooth green snake	SC		1
Animal	Pandion haliaetus	Osprey	SC		1
Animal	Sistrurus catenatus	Eastern massasauga	T	LT	1
Animal	Stenelmis douglasensis	Douglas stenelmis riffle beetle	SC		1
Grand Total	-	-	-	-	**21**

Table 17. Rare plant occurrence within Emmet Moraines Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Plant	Amerorchis rotundifolia	Small round-leaved orchis	E		1
Plant	Beckmannia syzigachne	Slough grass	T		1
Plant	Drosera anglica	English sundew	SC		1
Plant	Stachys pilosa	Hairy hedge-nettle	SC		1
Plant	Woodsia obtusa	Blunt-lobed woodsia	T		1
Total	-	-	-	-	**5**

Non-ecological reference area natural communities

Natural communities that are identified with an element occurrence in the MNFI Biotics database, but that have not been given an additional ecological reference area (ERA) designation, are recognized and managed accordingly. There are no non-ERA element occurrences in this management area at this time.

Forest health

Forest health concerns, both native and non-native, can have impacts on stand conditions and management decisions. The following insects (Table 18) and diseases (Table 19) could have an impact on management during the planning period and may need to be monitored and/or addressed.

Table 18. Defoliating insects of concern in the Emmet Moraines Management Area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Spongy moth	Lymantria dispar	Non-native	Yes
Forest tent caterpillar	Malacosoma disstria	Native	Yes
Large aspen tortrix	Choristoneura conflictana	Native	Yes

Watch for lingering ash with potential resistance to emerald ash borer. Monitor young red pine for redheaded pine sawfly damage.

Table 19. Maladies of concern in the Emmet Moraines Management Area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Canker (stem infections)	Various	Various	Yes
Armillaria root rot	Armillaria spp.	Native	

Monitor planted red pine for Heterobasidion root disease and follow guidance. Report surviving mature beech trees that may be resistant to beech bark disease. Watch for symptoms of beech leaf disease.

Aquatic resources

Riparian habitat

A total of 15 miles of streams and rivers are found in the management area (Table 20). Streams/rivers classified as cold types comprise approximately 73% of the riverine mileage.

Table 20. Classification type and length of streams/rivers found within the management area.

Type	Length (miles)
Cold Stream	1
Cold Small River	3
Cold Transitional Stream	0
Cold Transitional Small River	0
Cold Transitional Large River	0
Warm Transitional Stream	10
Warm Transitional Small River	0
Warm Transitional Large River	0
Warm Stream	1
Warm Small River	0
Warm Large River	0

Lacustrine habitat

A total of one lake of at least 1 surface acre are found in the management area (Table 21).

Table 21. Size and number of lakes and ponds located within the management area.

Lake Size Class (acres)	Number
1-99	0
100-499	0
500+	1

Wetlands

A total of 4,653 acres of wetlands are found in the management area (Table 22). Forested wetlands comprise approximately 97% of wetland types found in the management area.

Table 22. Area of emergent, forested and riverine wetland types found within the management area.

Wetland Type	Acres
Emergent	41
Forested	4,492
Riverine	120

Vernal pools and seeps

A total of 8 acres of vernal pools and seeps have been inventoried in the management area, and 506 acres of seeps have been identified.

Riparian vegetation cover

Northern hardwood is the predominant cover type present in a 100-meter riparian zone located next to streams/rivers in the management area (Table 23).

Table 23. Largest vegetative cover types (i.e., top 10) and area located in a 100-meter buffer of streams/rivers within the management area.

Cover Type	Acres
Northern Hardwood	2,579
Lowland Shrub	615
Aspen	452
Planted Red Pine	282
Cedar	105
Lowland Conifers	97
Lowland Aspen/Balsam Poplar	53
Herbaceous Openland	52
Upland Shrub	50
Upland Spruce/Fir	37

Watershed vegetation cover

The management area includes portions of watersheds of the Maple and Crooked rivers (Table 24 and Table 25). Northern hardwood and aspen are major cover types of the state forest in each watershed.

Table 24. Largest vegetative cover types (i.e., top five) and area of the Maple River watershed located within the management area.

Cover Type	Acres
Northern Hardwood	12,178
Aspen	3,236
Planted Red Pine	1,906
Lowland Shrub	1,782
Lowland Conifers	897

Table 25. Largest vegetative cover types (i.e., top five) and area of the Crooked River watershed located within the management area.

Cover Type	Acres
Northern Hardwood	1,909
Aspen	867
Planted Red Pine	236
Herbaceous Openland	48
Upland Shrub	41

Recreation

Access for management and/or recreation is good throughout the Emmett Moraines Management Area, as there is very little lowland and a well-developed road/trail system.

Taking advantage of the undulating terrain and abundant snow, many miles of snowmobile trail cross the management area. The southern part of the Indian Gardens ORV Route, a 37-mile route using a combination of paved and gravel roads and two tracks, is in the west of the area. In addition, the North Country Trail and hiking route of the Iron Belle Trail bisects the entire management area from northwest to southeast.

There are no state forest campgrounds in this management area. However, DNR recreation facilities nearby include Wilderness State Park to the north and Petoskey State Park to the south.

Table 26. Designated recreation trails by type.

Recreation Category	Recreation Type	# of Miles
Motorized Recreation Trails	ORV (all types)	15.3
	Snowmobile	46.5
Nonmotorized Recreation Trails	Hiking	14.7
	Equestrian	0
	Biking	0
	Hunter Access Trails	0
Total		**76.5**

Note: Trail-use types may overlap.

There are no areas designated for hunting or boating access sites within the Emmett Moraines Management Area.

Gladwin Lake Plain

State Forest Area: 167,208 acres	Location: Gladwin, Iosco, Midland, Arenac, eastern Isabella and southeast Ogemaw counties	Population Centers: Midland, Mt. Pleasant, Gladwin and Standish
Subsection: Gladwin Silty Lake Plain, Saginaw Clay Lake and Till Plain	Landforms: Lake plain flat clay plains with broad sand channels	Landcover: Forested: 132,072 acres Nonforested: 35,135 acres

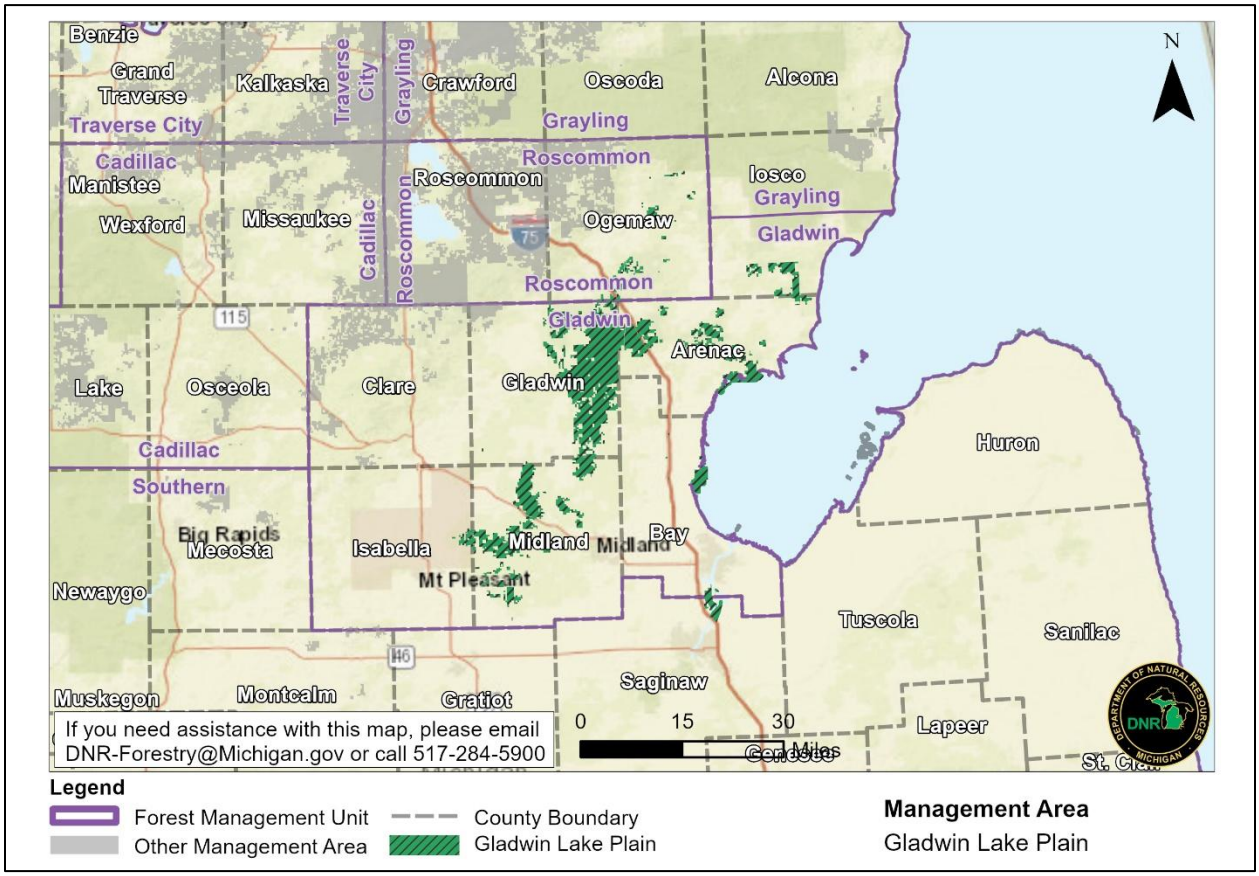


Figure 1. Gladwin Lake Plain Management Area.

Forested landscape

Current and projected future condition

The Gladwin Lake Plain management area includes a variety of shade-tolerance levels with the largest category in the intermediate and mid-aged age categories (Figure 2). The mid-tolerant unavailable lowlands make up half of the total acres in the mature age category. Intolerant cover types mostly occur on available upland in the intermediate age categories while the young and mid-aged are almost equal.

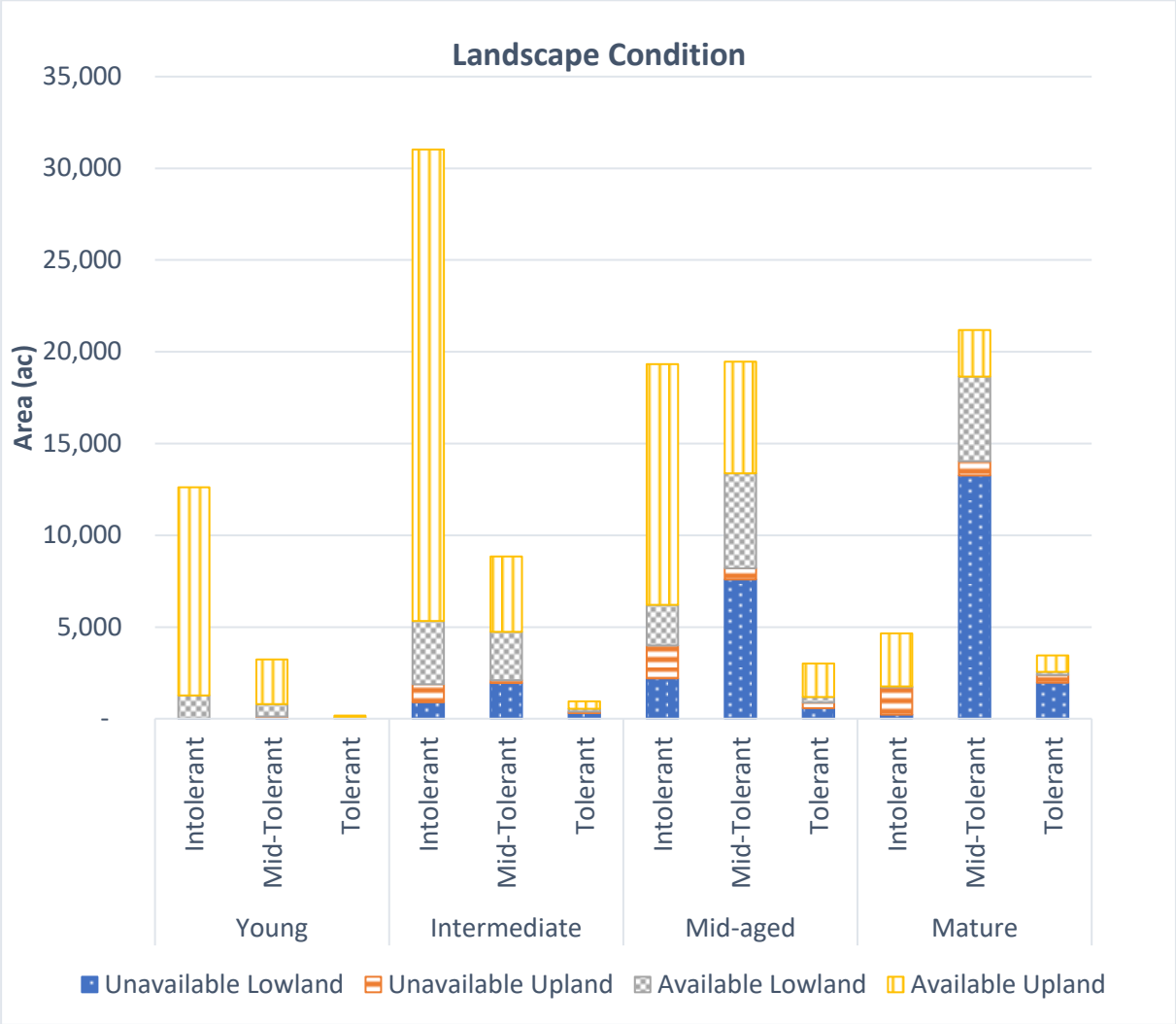


Figure 2. Forest diversity matrix showing the current distribution of forested acres across management availability, age category, landscape position and shade tolerance.

Landscape habitat conditions refine the management area landscape into featured species habitat context. Current and projected acres for the metrics identified in the Management Priorities (Section 3 Statewide/Regional) establish a baseline and future condition based on management over the planning period (Table 1).

Table 1. Current acres for landscape habitat conditions.

Landscape Habitat Condition	Monitoring Metric	Current Acres
Young Forest	Acres of 0-19 stands in Aspen and Jack Pine	10,542
Mature Forest	Acres of 80+ year stands across cover types	29,304
Mature Forest	Acres of 120+ year stands across cover types	1,031
Mesic Conifer Cover types	Acres of mesic conifer cover types	4,617
Mesic Conifers in other Cover types	Average canopy occupancy	31%
Mast – Oak Cover types	Acres of oak cover types	9,014
Mast Tree Species in other Cover types	Acres of total canopy occupancy of mast tree acres (trace-100%)	82,099
Big Trees	Acres of total canopy stand occupancy of species in sawlog or greater size class	41,713
Nonforested Openings	Acres of total herbaceous openland, upland shrub, and cropland	2,007
Landscape Forest Matrix	Percent deciduous forest	84%
Landscape Forest Matrix	Percent coniferous forest	12%

The Gladwin Lake Plain Management Area has the following special analysis units (SAUs). These SAUs have specific cover type goals, typically associated with wildlife habitat management. For any SAUs that overlap with this management area, SAU cover type goals take priority as the SFMP model strives to meet the cover type goals across the area, ensuring they are met. Please see Section 5 for a detailed description of the management direction and harvest goals for each of these SAUs.

- Grouse Enhanced Management Site (GEMS) - Lame Duck Foot Access Area

The Gladwin Lake Plain Management Area is comprised of 79% forested cover types and 21% nonforested cover types (

Table 2). Of the forested cover types, the upland has 19% more area than the lowland landscape. The largest contributors to upland cover types are aspen and mixed upland deciduous. Lowland deciduous and lowland aspen/balsam poplar take up 26% of the total landscape position. Lowland shrub is the most common nonforested cover type in the management area representing 12% of the landscape.

Table 2. Current landscape context and distribution of cover types.

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
Forested	Upland	Deciduous	Aspen	45,001	66,660	81,672	132,072
			Northern Hardwood	1,465			
			Black Red Hybrid Oak	7,133			
			Northern Red Oak	579			
			Oak Mix	2,337			
			Mixed Upland Deciduous	10,144			
		Mixed	Upland Mixed Forest	2,967	2,967		
		Coniferous	Planted Red Pine	2,360	12,046		
			Planted Jack Pine	1,268			
			Planted White Pine	2			
			Planted Mixed Pine	266			
			Natural Red Pine	551			
			Natural Jack Pine	2,983			
			Natural White Pine	2,326			
			Natural Mixed Pines	1,430			
			Upland Spruce/Fir	90			
			Upland Conifers	751			
			Hemlock	20			
	Lowland	Deciduous	Lowland Aspen/Balsam Poplar	10,001	44,075	50,400	
			Lowland Deciduous	34,074			
		Mixed	Lowland Mixed Forest	2,198	2,198		
		Coniferous	Cedar	851	4,128		
			Lowland Conifers	2,692			
			Lowland Spruce/Fir	75			
			Tamarack	510			
Nonforested	Upland	N/A	Herbaceous Openland	1,197	N/A	3,594	35,135
			Upland Shrub	703			
			Low Density Trees	1,081			
			Bare/Sparsely Vegetated	103			
			Cropland	107			
			Urban	402			
			Lowland Shrub	20,463			

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
	Lowland	N/A	Marsh	5,388	N/A	31,542	
			Bog	2,087			
			Treed Bog	1,181			
			Water	2,424			
						Grand Total:	167,208

There are 96,124 acres (57.5% of the total management area and 72.8% of the forested area) that can be managed toward desired future conditions via commercial timber harvest in the Gladwin Lake Plain Management Area (Table 3). Of that, over 31.8% is in the aspen cover type, 9.7% in lowland deciduous, and 6.9% in mixed upland deciduous. The remaining 22 cover types represent less than 5.5% each of the forested and available land in the management area. Acres unavailable for management are categorized by site condition (Table 4).

Table 3. Current cover type composition by management availability.

GLADWIN LAKE PLAIN Forested Cover Type	Available Acres	Available %	Unavailable Acres	Unavailable %	Total Acres	Total %
Aspen	41,998	31.8%	3,003	2.3%	45,001	34.1%
Lowland Deciduous	12,749	9.7%	21,329	16.1%	34,078	25.8%
Mixed Upland Deciduous	9,143	6.9%	1,002	0.8%	10,144	7.7%
Lowland Aspen/Balsam Poplar	7,190	5.4%	2,812	2.1%	10,002	7.6%
Black Red Hybrid Oak	6,651	5.0%	483	0.4%	7,133	5.4%
Upland Mixed Forest	2,575	1.9%	392	0.3%	2,967	2.2%
Natural Jack Pine	2,574	1.9%	409	0.3%	2,983	2.3%
Planted Red Pine	2,326	1.8%	34	0.0%	2,360	1.8%
Oak Mix	2,158	1.6%	180	0.1%	2,337	1.8%
Natural White Pine	1,822	1.4%	505	0.4%	2,327	1.8%
Planted Jack Pine	1,260	1.0%	8	0.0%	1,268	1.0%
Natural Mixed Pines	1,232	0.9%	198	0.1%	1,430	1.1%
Northern Hardwood	1,143	0.9%	323	0.2%	1,465	1.1%
Lowland Conifers	677	0.5%	2,015	1.5%	2,692	2.0%
Upland Conifers	675	0.5%	75	0.1%	751	0.6%
Lowland Mixed Forest	604	0.5%	1,594	1.2%	2,198	1.7%
Natural Red Pine	523	0.4%	28	0.0%	551	0.4%
Northern Red Oak	400	0.3%	178	0.1%	579	0.4%
Planted Mixed Pine	266	0.2%	0	0.0%	266	0.2%
Tamarack	85	0.1%	425	0.3%	510	0.4%
Cedar	24	0.0%	827	0.6%	851	0.6%
Hemlock	20	0.0%	0	0.0%	20	0.0%
Upland Spruce/Fir	18	0.0%	72	0.1%	90	0.1%
Lowland Spruce/Fir	11	0.0%	64	0.0%	75	0.1%
Planted White Pine	2	0.0%	0	0.0%	2	0.0%
Grand Total	**96,126**	**72.8%**	**35,952**	**27.2%**	**132,078**	**100%**

Table 4. Site conditions for unavailable acres.

Site Condition (Reason area is unavailable for commercial harvest)	Area (ac)	% of Unavailable Area
Too Wet	26,741	74.4%
Denied Access	2,982	8.3%
Blocked by Obstacle	2,703	7.5%
Best Management Practices	834	2.3%
Conservation Values	826	2.3%
Recreation/Scenic	614	1.7%
Long-Term Retention	456	1.3%
Cannot Regenerate	185	0.5%
Federal/State/Local Law	151	0.4%
Too Steep	136	0.4%
Wildlife Concerns	122	0.3%
Other Influence Zones	62	0.2%
Unproductive	46	0.1%
Blocked by Railroad	30	0.1%
Non-DNR agency concerns	18	0.1%
Non-Military Lease/Easement	17	0.0%
Neighbor / Interest Group	13	0.0%
Other Dept./Div. Processes	10	0.0%
Total Unavailable	**35,949**	**100%**

Projected 10-year cover type management actions

Each cover type in the Gladwin Lake Plain Management Area has unique age class and basal area class goals that describe the long-term desired future conditions. The calculated harvest levels that are needed during the first 10-year planning period are summarized in Table 5. These harvest levels are necessary to begin achieving long-term planning goals. This will help establish a desirable amount of regeneration for the even-aged cover types over the 10-year period or help to achieve desired basal area distribution among uneven-aged cover types like northern hardwoods. Implementing these silvicultural regimes will yield 250,024 cords, the planned harvest volume for the decade (Table 6).

Table 5. Ten-year planning period harvest goals (acres) by cover type and silvicultural regime.

Silvicultural Regimes								
Cover Type	**Clearcut**	**Selection**	**Thinning**	**Group Selection**	**Shelterwood**	**Salvage Clearcut**	**Salvage Thinning**	**Grand Total**
Aspen	6,943	-	-	-	-	-	-	6,943
Lowland Deciduous	910	254	-	168	1,579	-	-	2,911
Mixed Upland Deciduous	939	-	-	-	680	-	-	1,619
Lowland Aspen/Balsam Poplar	1,385	-	-	-	-	-	-	1,385
Black Red Hybrid Oak	835	-	-	-	147	-	-	982
Planted Red Pine	-	-	570	-	-	-	-	570
Upland Mixed Forest	371	-	-	-	-	-	-	371
Upland Conifers	318	-	-	-	6	-	-	324
Natural Jack Pine	224	-	-	-	-	-	-	224
Natural White Pine	-	-	110	-	91	-	-	201
Lowland Conifers	143	-	-	-	-	-	-	143
Natural Mixed Pines	-	-	62	-	70	-	-	131
Northern Hardwood	12	97	-	-	4	-	-	113
Oak Mix	73	-	5	-	-	-	-	78
Natural Red Pine	-	-	25	-	15	-	-	40
Northern Red Oak	37	-	-	-	-	-	-	37
Lowland Mixed Forest	23	-	-	-	-	-	-	23
Planted Jack Pine	14	-	-	-	-	-	-	14
Tamarack	3	-	-	-	-	-	-	3
Totals	**12,230**	**351**	**771**	**168**	**2,592**	**-**	**-**	**16,112**

Table 6. Projected 10-year harvest volume by species.

10-Year Estimated Harvest Volume Projection Gladwin Lake Plain Management Area Product	Species	Volume Planned*	Volume Prepared**
Pulpwood (cords)	Mixed Aspen	67,766	63,700
	Mixed Hardwood	47,401	44,557
	Mixed Spruce	15,454	14,527
	Mixed Softwood	12,706	11,944
	Mixed Oak	6,106	5,740
	Jack Pine	6,041	5,678
	Red Pine	5,034	4,732
	White Pine	4,144	3,895
	Pulpwood Total	**164,652**	**154,773**
Sawtimber (MBF)	Mixed Aspen	12,460	11,712
	Red Maple	6,960	6,542
	Red Pine	5,574	5,240
	White Pine	4,504	4,233
	Red Oak	4,151	3,902
	White Oak	2,468	2,320
	Mixed Oak	2,010	1,889
	Sugar Maple	1,571	1,476
	Basswood	357	335
	Sawtimber Total	**40,054**	**37,651**
	Total Sawtimber Harvest Volume in Cords	**85,372**	**80,250**
	Grand Total Harvest Volume in Cords	**250,024**	**235,023**

* Volume estimates based on 100% of the projected harvests for the 10-year planning period.

** Volume estimates based on 94% of the projected harvests for the 10-year planning period accounting for reduction in acres and associated volume once sales are prepared for bid.

There are a few cover type transitions projected for the Gladwin Lake Plain Management Area (Table 7). The managed area of each cover type is projected to remain fairly stable as treatment regimes will not significantly change the amount of area in each cover type except for black red hybrid oak. The largest decrease forecasted is in the black red hybrid oak cover type where approximately 4% or 307 acres will

convert to other cover types such as mixed upland deciduous through forest management and regeneration activities. The largest increase occurs on the mixed upland deciduous cover type where 196 acres are projected to convert into this cover type increasing by 1.9%, mostly from the black red hybrid oak.

Table 7. Projected 10-year cover type acres resulting from cover type transitions.

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Aspen	45,001	45,164	163
Lowland Deciduous	34,074	34,102	28
Mixed Upland Deciduous	10,144	10,340	196
Lowland Aspen/Balsam Poplar	10,001	9,977	-24
Black Red Hybrid Oak	7,133	6,826	-307
Natural Jack Pine	2,983	2,895	-88
Upland Mixed Forest	2,967	3,024	58
Lowland Conifers	2,692	2,626	-66
Planted Red Pine	2,360	2,497	137
Oak Mix	2,337	2,339	2
Natural White Pine	2,326	2,326	0
Lowland Mixed Forest	2,198	2,261	63
Northern Hardwood	1,465	1,459	-6
Natural Mixed Pines	1,430	1,434	4
Planted Jack Pine	1,268	1,275	7
Cedar	851	851	0
Upland Conifers	751	605	-146
Northern Red Oak	579	558	-20
Natural Red Pine	551	551	0
Tamarack	510	510	0
Planted Mixed Pine	266	266	0
Upland Spruce/Fir	90	90	0
Lowland Spruce/Fir	75	74	-1
Hemlock	20	20	0
Planted White Pine	2	2	0
Lowland Shrub	20,463	20,463	0
Marsh	5,388	5,388	0
Water	2,424	2,424	0
Bog	2,087	2,087	0
Herbaceous Openland	1,197	1,197	0

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Treed Bog	1,181	1,181	0
Low Density Trees	1,081	1,081	0
Upland Shrub	703	703	0
Urban	402	402	0
Cropland	107	107	0
Bare/Sparsely Vegetated	103	103	0
Total:	**167,208**	**167,208**	**0**

Featured species current and projected habitat acres

There are nine featured species in this management area that span various cover types, age classes and stand level conditions. Current and projected total habitat acres by species across the decade provide a baseline and show the result of long-term management actions (Table 8). As noted in the Featured Species Management Priority (Section 3), it is recommended that these featured species habitat acres be viewed as acres of potential habitat, representing a condition on the landscape where the more nuanced aspects of each species' habitat requirements are likely to be managed for or found. As described in the introduction, the modeling effort was limited by several factors including the simplification of habitat attributes into MiFI variables. Therefore, when referring to habitat acres what is being referred to is potential habitat acres.

Some species show a loss in habitat over the next century. As mentioned in the Featured Species Management Priority (Section 3), the current condition for many cover types is a surplus of acres in the 0-9 age class from the compensatory management approach applied in the previous decade. The model eventually evens out the age classes at a lower, sustainable level over time, usually by 50 years. For any species with northern hardwoods as a priority cover type, there is a perceived drop in acres between 40 and 60 years; this is due to the basal area dropping below 81 but because it only drops into the upper 70s, it is not expected to translate to any real habitat loss on the ground. Three of these species were not included in the State Forest Management Plan model, black bear, wild turkey and black-backed woodpecker, but are included here to inform management decisions over the decade.

Table 8. Featured species current and projected total habitat acres (e.g., potential habitat).

Featured Species	Priority Cover Types	Total Habitat Acres Current	Total Habitat Acres 10-year	50-year Projected Habitat Acres	100-year Projected Habitat Acres
American Woodcock	Aspen, lowland aspen, lowland deciduous	16,904	20,190	18,871	20,145
Black Bear	Mast	91,113	--	--	--

Featured Species	Priority Cover Types	Total Habitat Acres Current	Total Habitat Acres 10-year	50-year Projected Habitat Acres	100-year Projected Habitat Acres
Black-Backed Woodpecker	Natural Disturbance	--	--	--	--
Cerulean Warbler	Northern hardwoods, mixed upland deciduous	18,579	21,789	29,795	30,070
Golden-Winged Warbler	Aspen, black-red hybrid oak, northern red oak, oak mix, tamarack	14,652	16,612	14,549	15,015
Ruffed Grouse	Aspen	13,796	16,000	14,402	14,666
Snowshoe Hare	Aspen, cedar, hemlock, lowland aspen, lowland conifers, lowland mixed forest, lowland spruce/fir, mixed upland deciduous, natural jack pine, natural mixed pines, planted jack pine, upland spruce/fir	19,382	21,921	20,340	20,842
Wild Turkey	Nonforested Openings	1,304	--	--	--
Wood Thrush	Northern hardwoods, northern red oak, mixed upland deciduous, lowland deciduous	19,775	28,155	34,410	38,763
Wood Turtle	Nonforested Openings	--	--	--	--

Cover type composition and associated featured species

Aspen

Current condition

Most of the aspen cover type is currently between stand age 30 and 39 in the Gladwin Lake Plain Management Area (Figure 3). The age class distribution is currently unbalanced, especially in the 30- to 39-year-old age classes where the bulk of acres occur. There is a deficit in the 10-19 and the 50-59 age classes, which will lead to a deficit in the 20- to 29-year age class for the next planning period. A small number of acres that extend beyond the desired maximum age class distribution due to being unavailable.

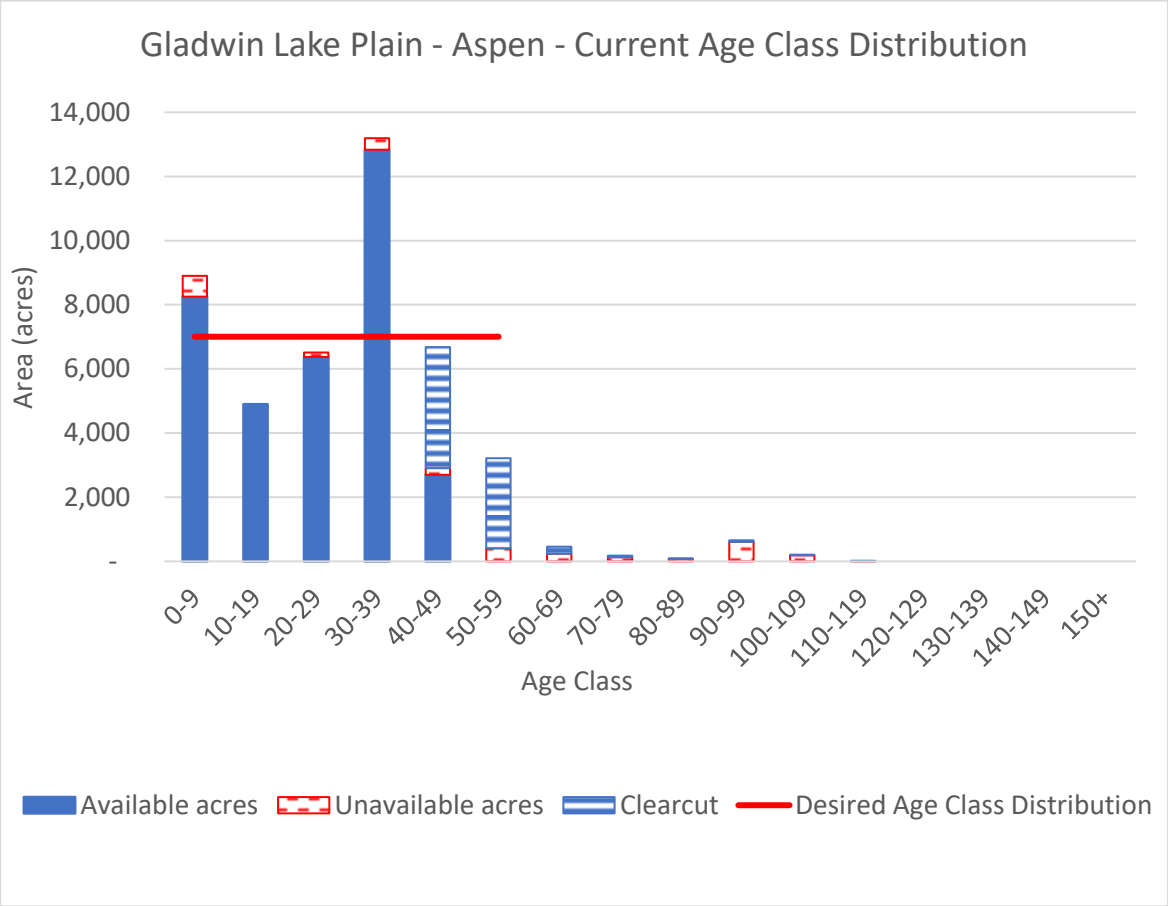


Figure 3. Current age class distribution and projected harvests in the aspen cover type.

Current conditions are a result of harvests and regeneration efforts on available aspen acres during the previous initiative of the Deer Range Improvement Program. A portion of this cover type meets the habitat requirements for American woodcock, golden-winged warbler, ruffed grouse and snowshoe hare (Table 9).

Table 9. Featured species with aspen as a priority habitat cover type, habitat variables and current acres (e.g., potential habitat).

Featured Species	Featured Species Habitat – Aspen	Aspen Habitat Acres - Available	Aspen Habitat Acres - Unavailable
American Woodcock	Age Category: 0-19 Size Class: Sapling	13,152	645
Golden-Winged Warbler	Age Category: 0-19 Size Class: Sapling	13,152	645
Ruffed Grouse	Age Category: 0-19 Size Class: Sapling	13,152	645
Snowshoe Hare	Age Category: 0-19 Size Class: Sapling	13,152	645

Desired future condition

The projected long-term cover type trend for aspen is increasing by less than .01% in the Gladwin Lake Plain Management Area. Much of the aspen area falls within the available category and will remain in this cover type. Habitat elements in this cover type will be preserved due to the abundance.

The long-term goal for the aspen cover type is balanced age classes between 0 and 50 years old for all available stands in this management area. Maintaining lower acreage in old age classes continues to be desirable to maintain stand vigor for regeneration and wildlife habitat.

The end of the planning period will result in the establishment of a 7,104 which is only 104 acres more than the desirable number of acres in the 0-9 age class (Figure 4). Progress toward the long-term desired age class distribution of aspen will take a few decades of even-aged management.

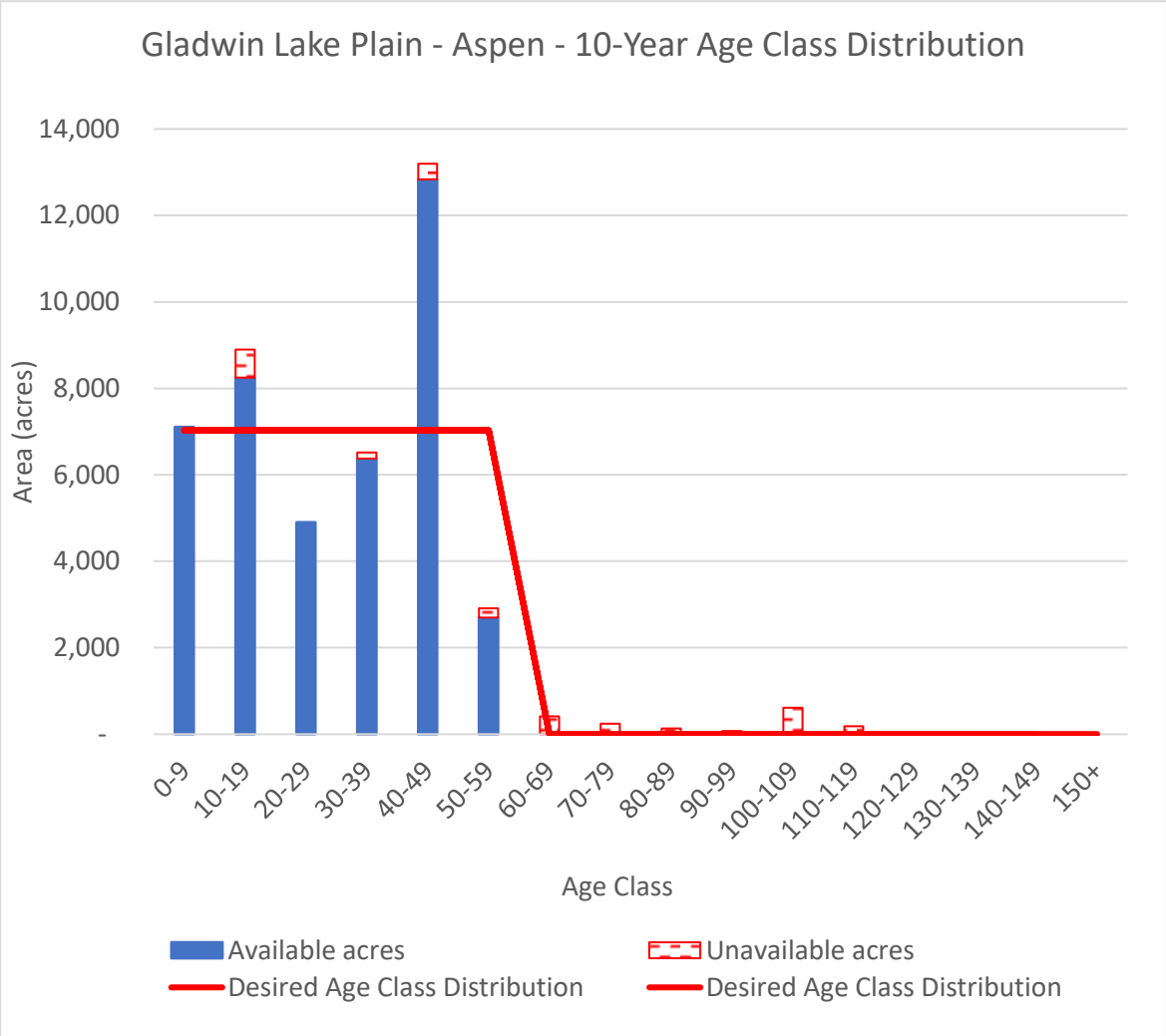


Figure 4. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution of aspen has about reached the desired future condition for available acres (Figure 5). There is an increase in acres in the older age classes, beyond the desired age of 50 years old, due to the unavailable acres likely due to access issues in this management area.

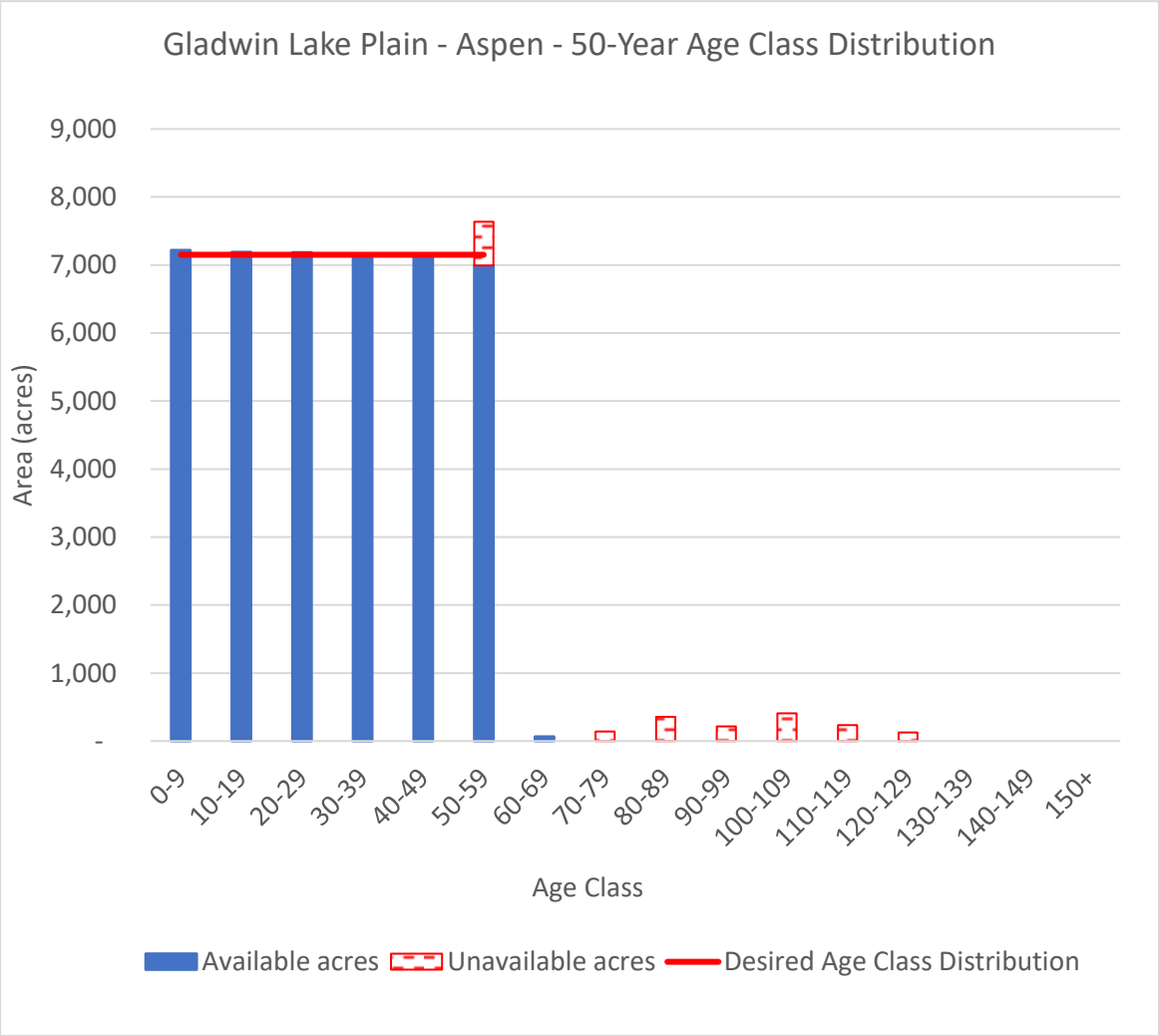


Figure 5. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 6) will concentrate the manageable acres of aspen in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest (Figure 7).

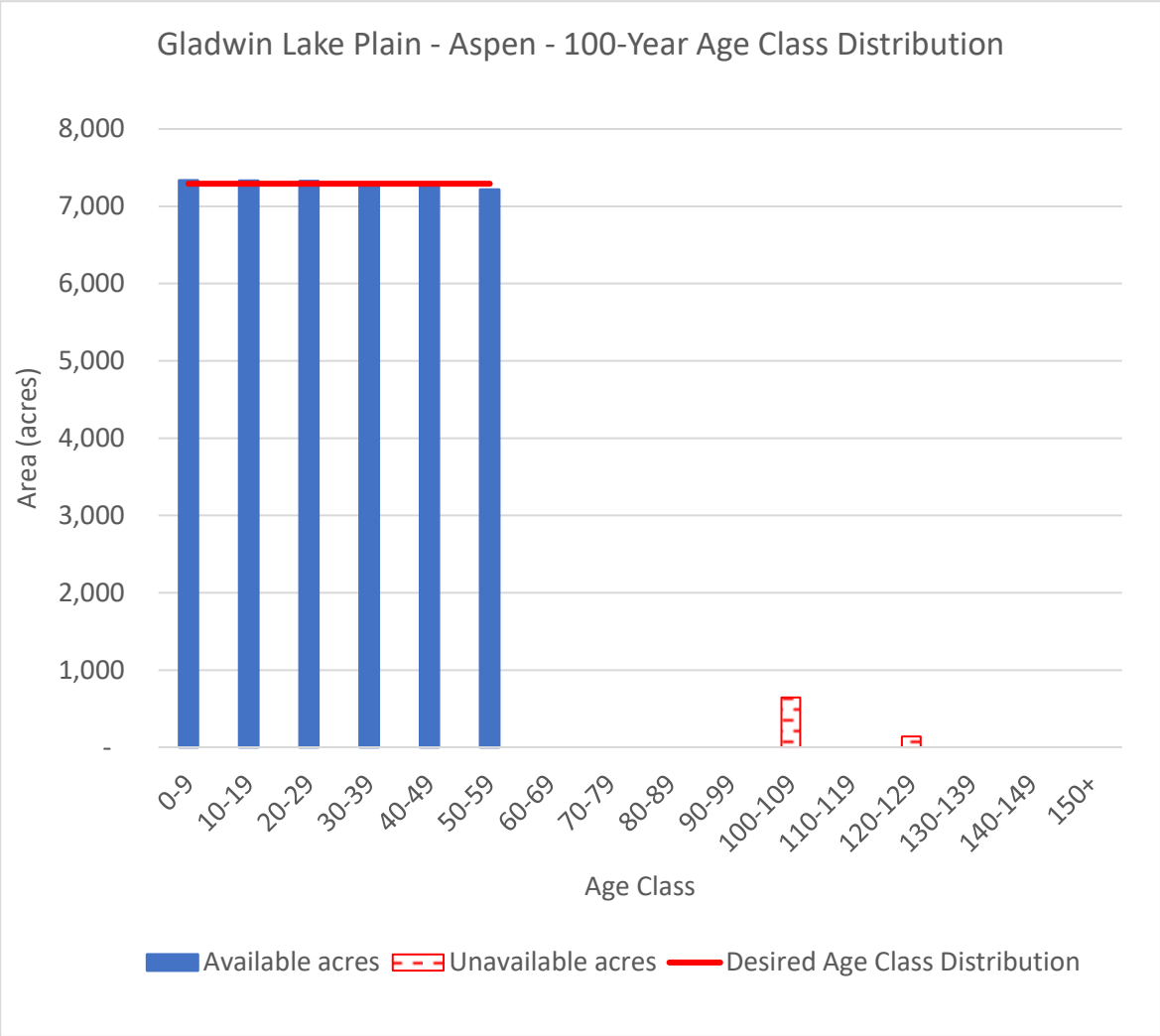


Figure 6. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

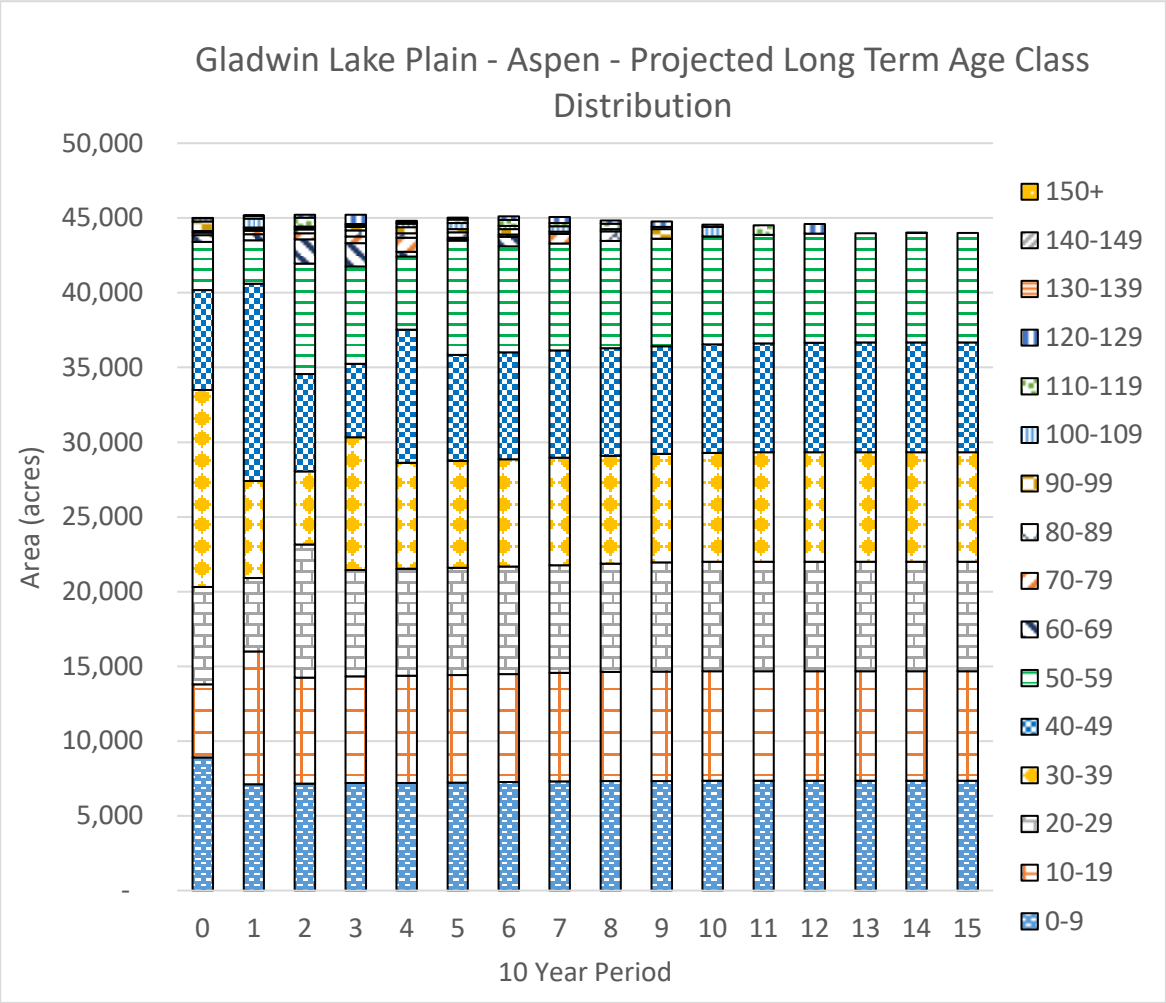


Figure 7. Projected age class distribution for all acres of aspen over the next 150 years.

Management actions

There are 6,943 acres of projected clearcut harvest in the aspen cover type during the planning period. This falls very close to the desired establishment of 7,000 acres of aspen per decade.

Lowland deciduous

Current condition

The Gladwin Lake Plain Management Area has a shortage of acres in the lowland deciduous 0- to 29-year age class that was created due to the unavailability of these acres on the landscape (Figure 8). The age class distribution is currently unbalanced across almost all the age class categories. The available landscape position of which many of these acres occur contributes to the number of acres extending beyond the desired maximum age class tail of 80 years old. Lowland deciduous and lowland aspen/balsam poplar will sometimes transition into each other's cover types post-harvest. A portion of this cover type meets the habitat requirements for American woodcock, cerulean warbler and wood thrush (Table 117).

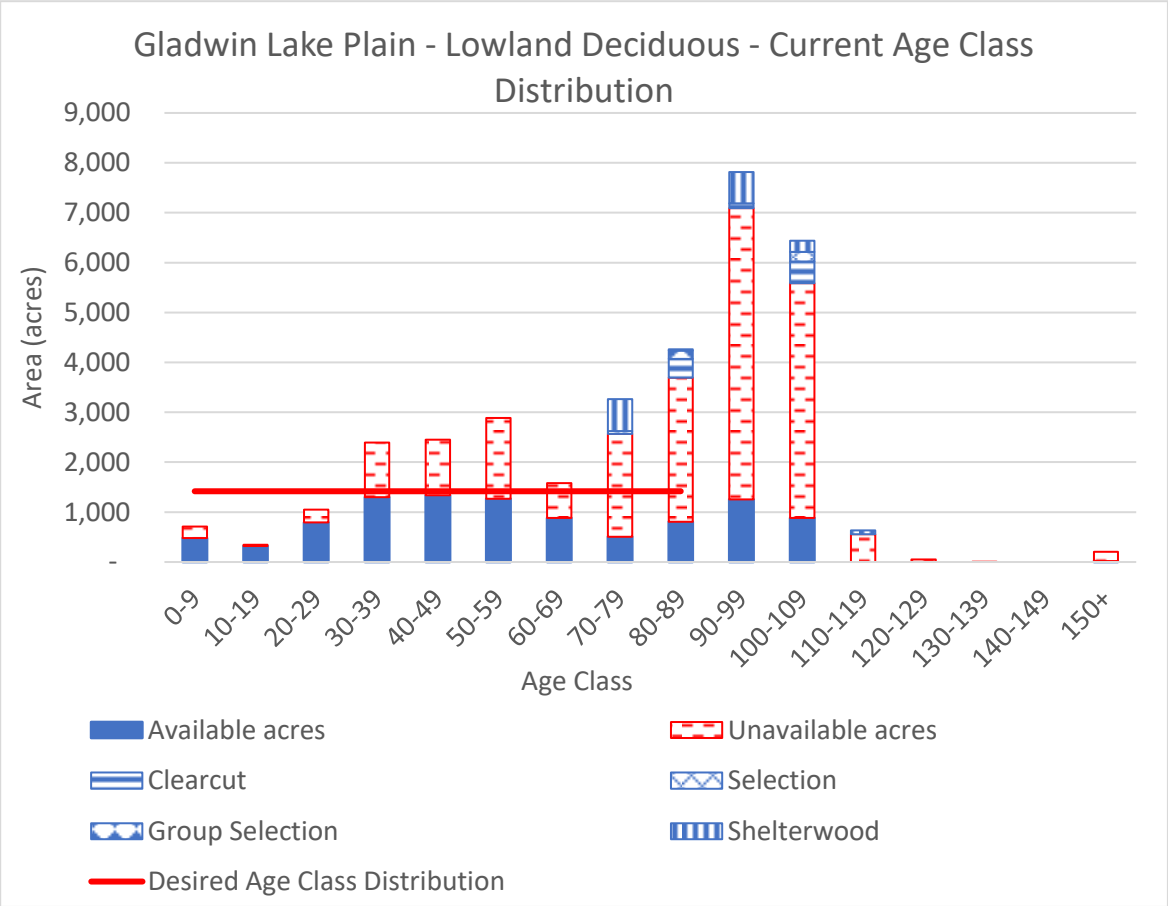


Figure 8. Current age class distribution, the desired age class distribution and the projected harvests in the lowland deciduous cover type over the 10-year planning period.

Table 10. Featured species with lowland deciduous as a selected habitat cover type habitat variables and current acres (e.g., potential habitat).

Featured Species	Featured Species Habitat – Lowland Deciduous	Lowland Deciduous Habitat Acres-Available	Lowland Deciduous Habitat Acres-Unavailable
American Woodcock	Age Category: 0-19 Size Category: Sapling	796	258
Cerulean Warbler	Age Category: 80+ Size Category: Sawlog Basal Area: 81+	4,081	11,997
Wood Thrush	Age Category: 40+ Size Category: Sawlog Basal Area: 81+	4,609	11,330

Desired future condition

The projected long-term cover type trend for lowland deciduous is stable in the Gladwin Lake Plain Management Area. There are a few transitions in and out of this cover type during this planning period due to unavailability.

The long-term goal for this cover type is balanced age classes between 0 and 80 years old for all available lowland deciduous acres.

The end of the planning period will result in the establishment of approximately 939 acres of lowland deciduous from the available acres. Progress toward the long-term desired age class distribution of lowland deciduous will take many decades to achieve the desired balanced age class condition (Figure 9).

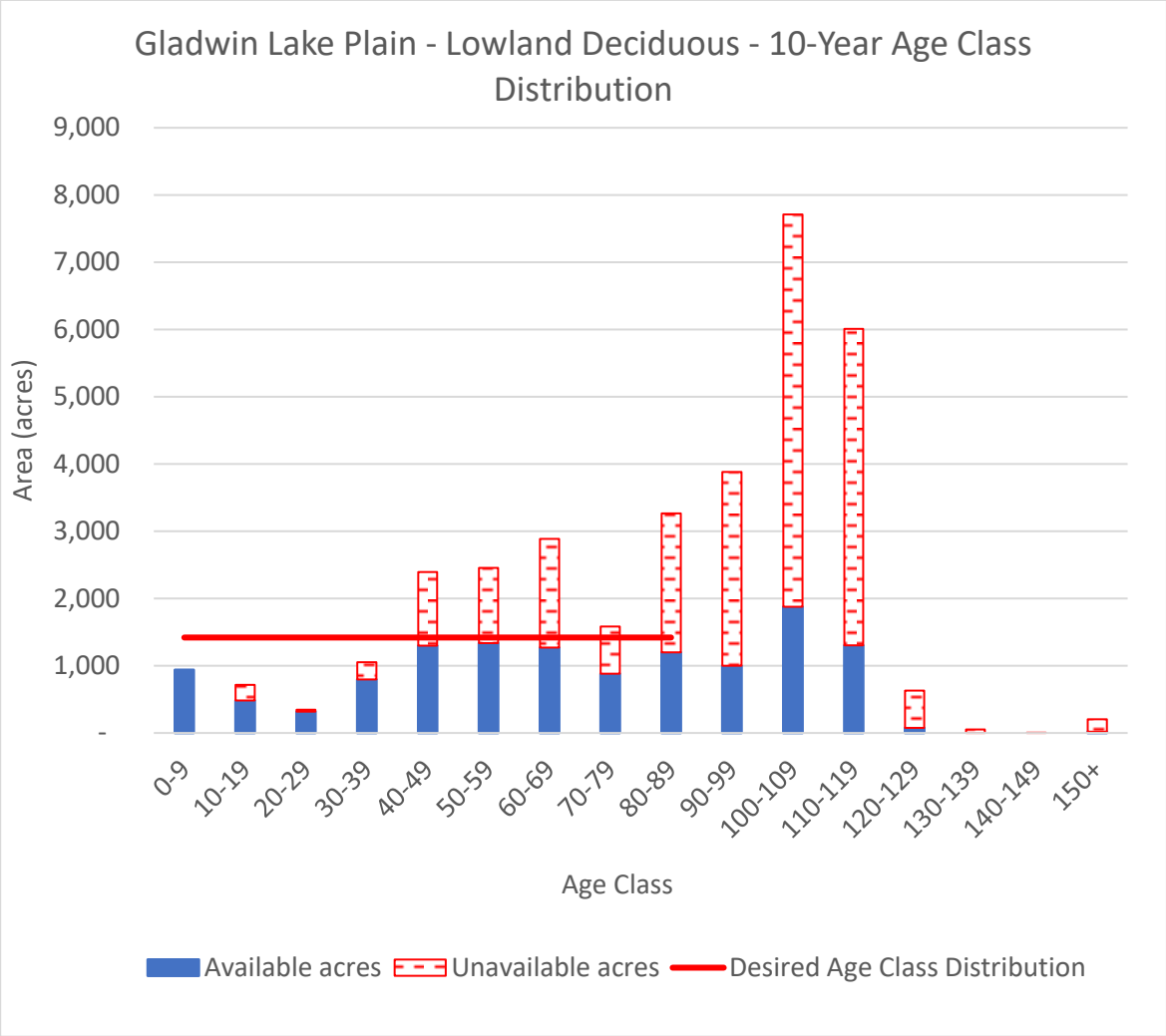


Figure 9. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution of lowland deciduous is beginning to reach the desired future condition for available acres in the age classes between 0 and 80 years old (Figure 10). The number of

acres in the older age classes, 120 years and older, continues to increase as the unavailable acres continue to move to the older age classes.

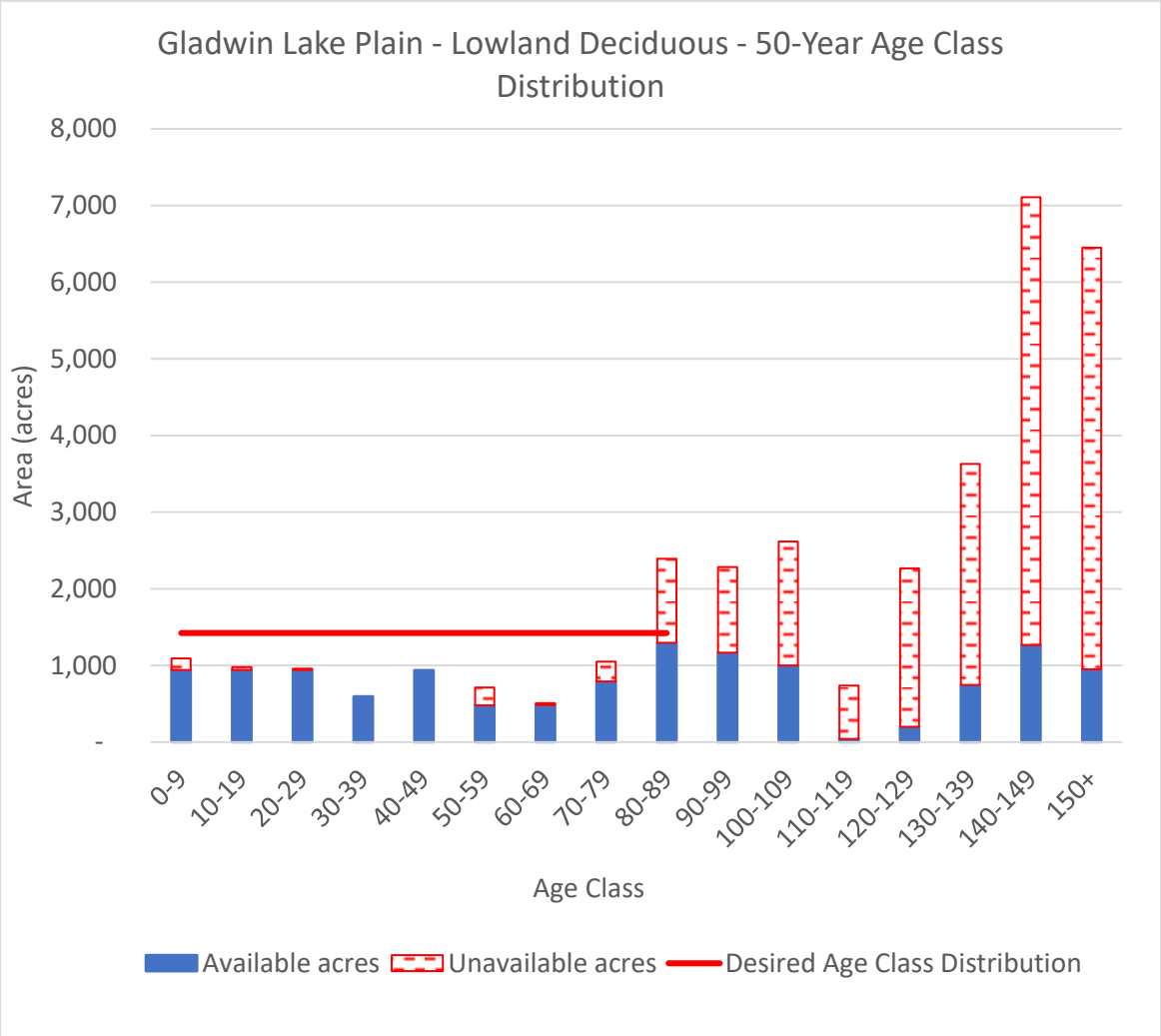


Figure 10. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 11) will concentrate on the manageable acres of lowland deciduous cover type in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest (Figure 12).

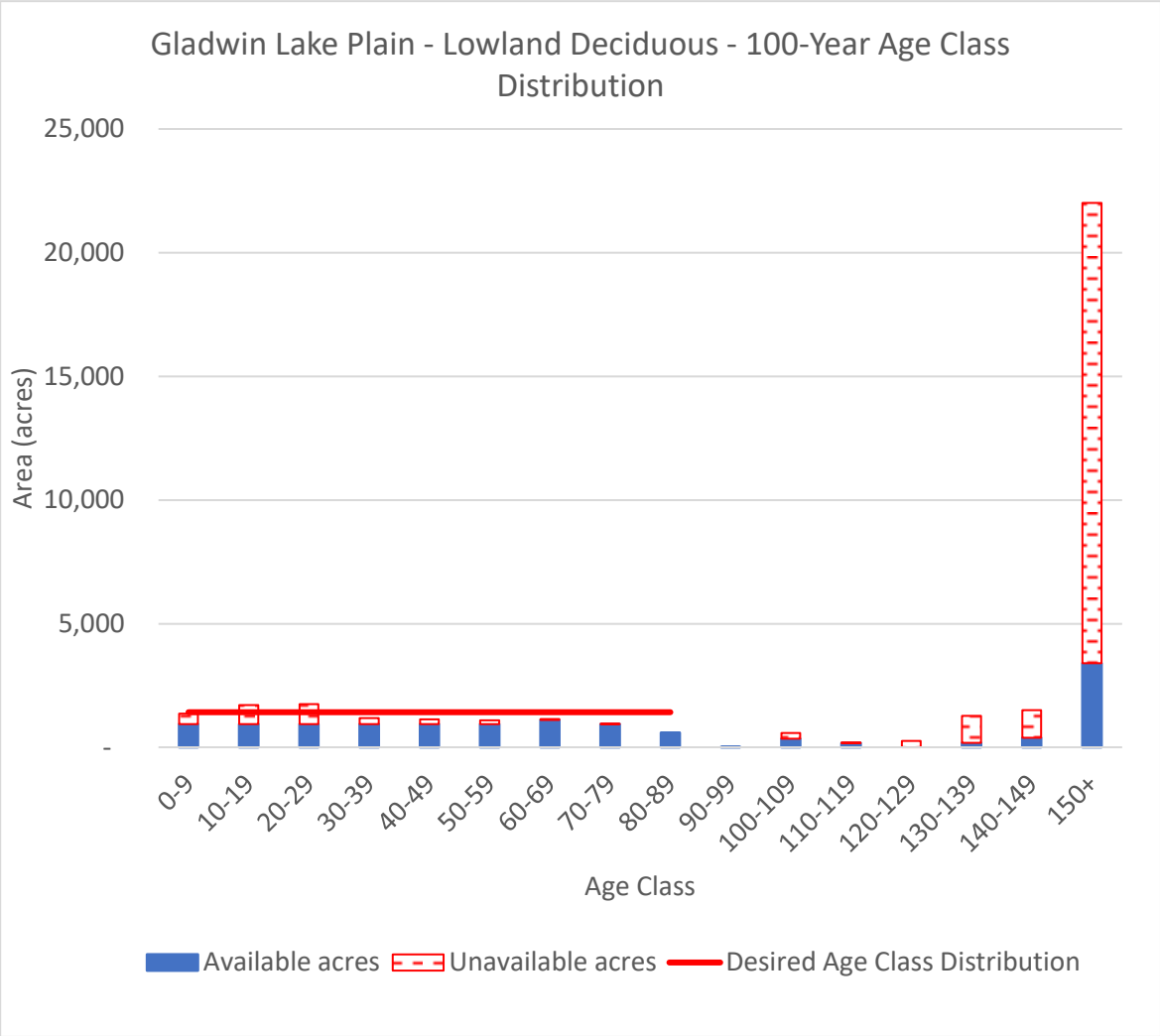


Figure 11. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

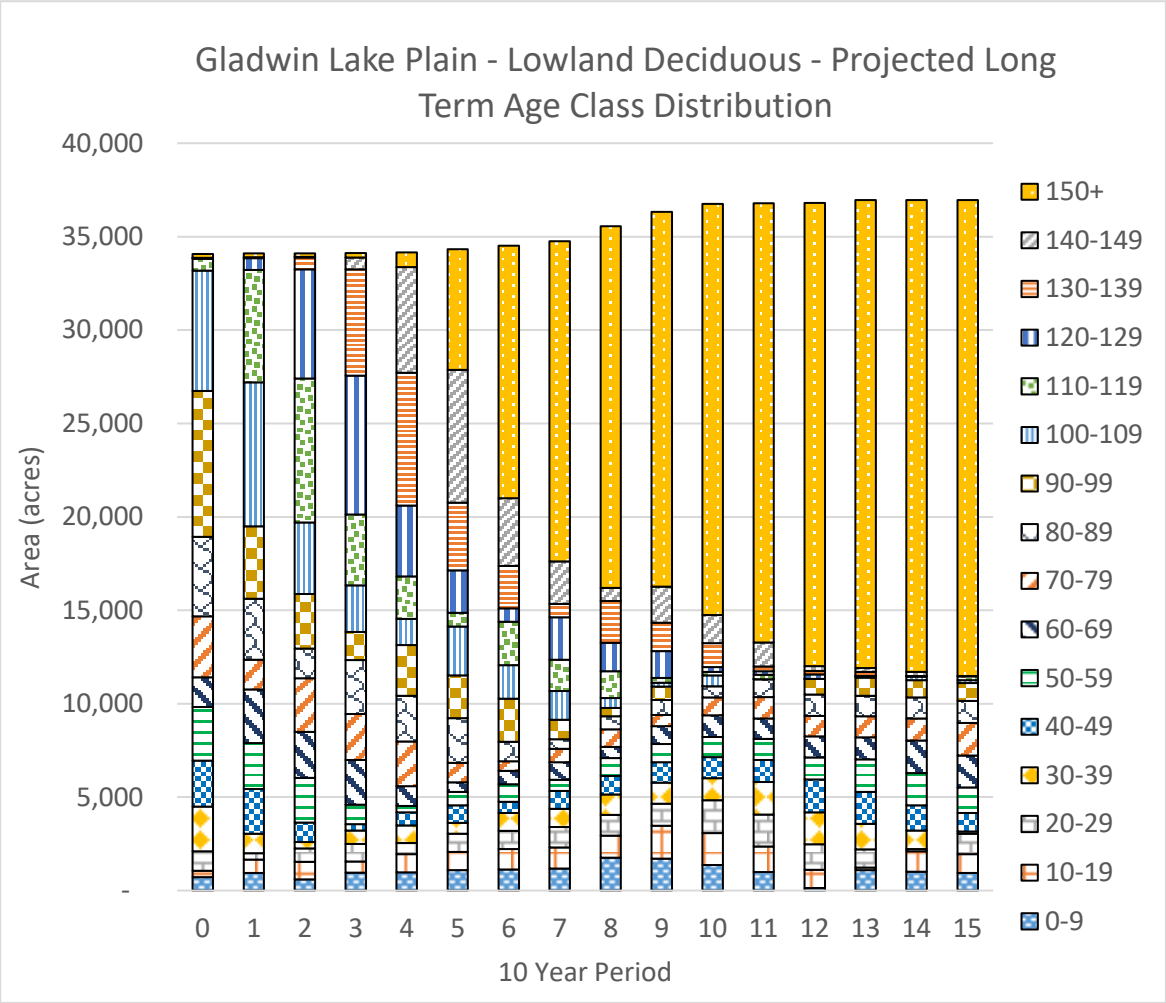


Figure 12. Projected age class distribution for all acres of northern hardwood over the next 150 years.

Management actions

There are 910 acres of projected clearcut harvest in the lowland deciduous cover type during the planning period. This is below the desired establishment of 1,420 acres of lowland deciduous per decade because of the current unbalanced age class condition and the number of acres in the unavailable category.

Mixed upland deciduous

Current condition

The Gladwin Lake Plain Management Area has a surplus of acres in the 30- to 39-year-old age class with some of the surplus in the 90- to 109-year-old age class (

Figure 13). The age class distribution is currently approaching a balanced distribution in the 20- to 29-year-old age class. A portion of this cover type meets the habitat requirements for cerulean warbler, wood thrush and snowshoe hare (Table 11).

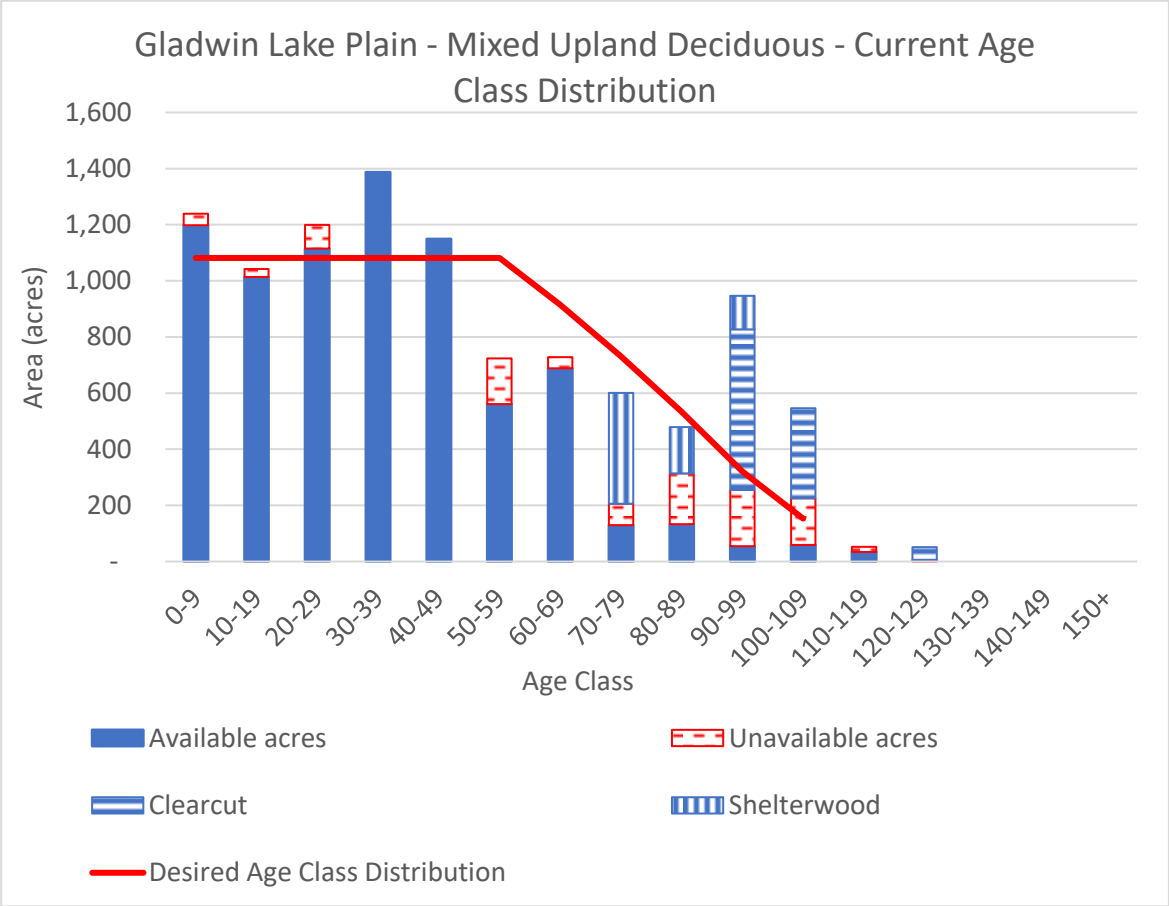


Figure 13. Current age class distribution, the desired age class distribution, and the projected harvests in the mixed upland deciduous cover type over the 10-year planning period.

Table 11. Featured species with mixed upland deciduous as a priority habitat cover type, habitat variables and current acres (e.g., potential habitat).

Featured Species	Featured Species Habitat – Mixed Upland Deciduous	Mixed Upland Deciduous Habitat Acres - Available	Mixed Upland Deciduous Habitat Acres - Unavailable
Snowshoe Hare	Age Category: 0-19 Size Category: Sapling	2,212	69
Cerulean Warbler	Age Category: 80+ Size Category: Sawlog Basal Area: 81+	1,191	564
Wood Thrush	Age Category: 40+ Size Category: Sawlog Basal Area: 81+	2,130	598

Desired Future Condition

The end of the planning period will result in the establishment of approximately 1,198 acres of mixed upland deciduous to the 0- to 9-year-old age class in the available acres which is just above the desired 1,082 acres (Figure 14). Progress toward the long-term desired age class distribution of mixed upland deciduous will take many decades to achieve the desired balanced age class condition.

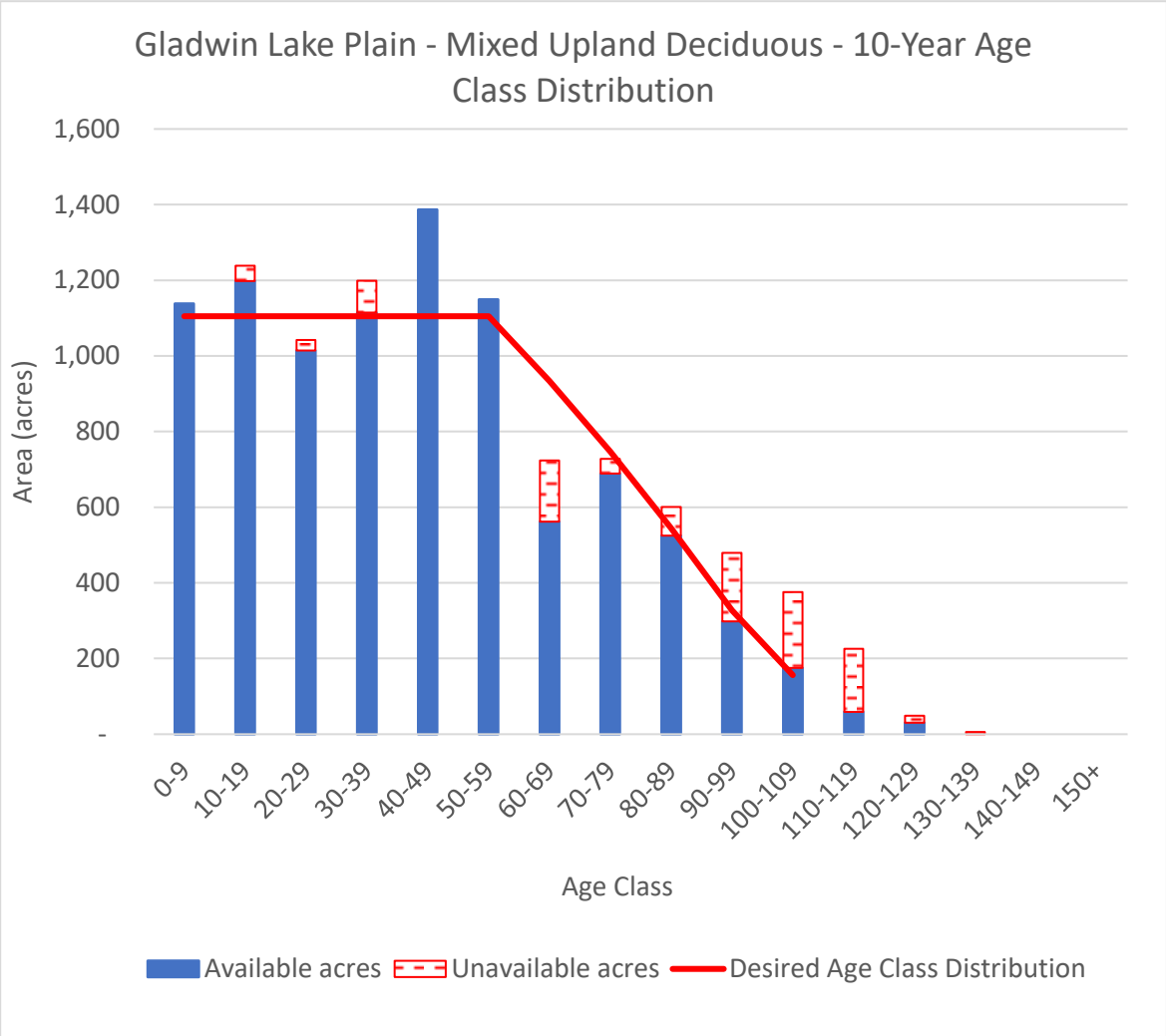


Figure 14. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution of mixed upland deciduous is nearly at the desired future condition for available acres (Figure 15). The number of acres in the older age classes, 110 years and older, continues to increase due to unavailability.

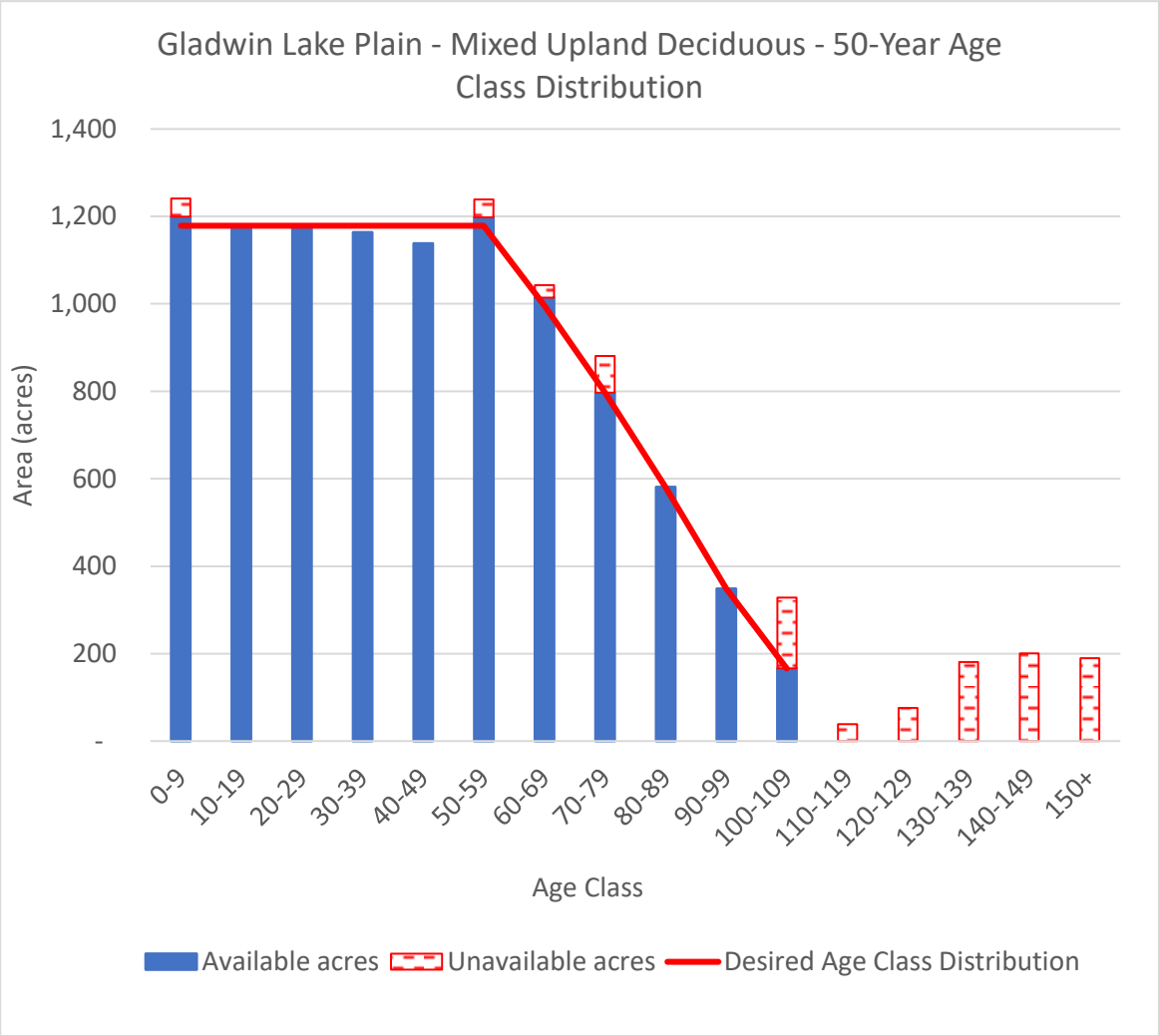


Figure 15. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 16) will concentrate on the manageable acres of mixed upland deciduous cover type in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest (Figure 17).

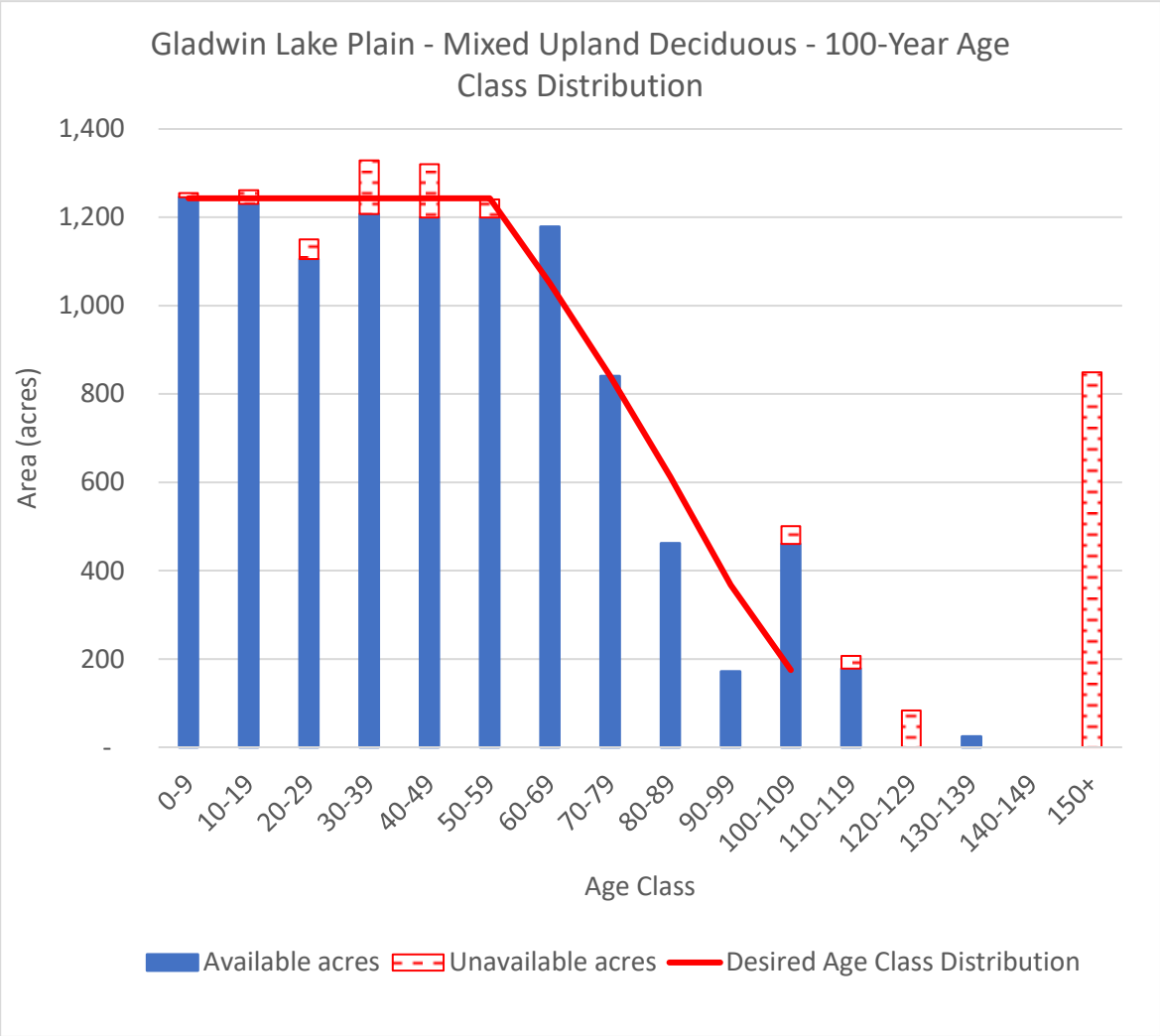


Figure 16. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

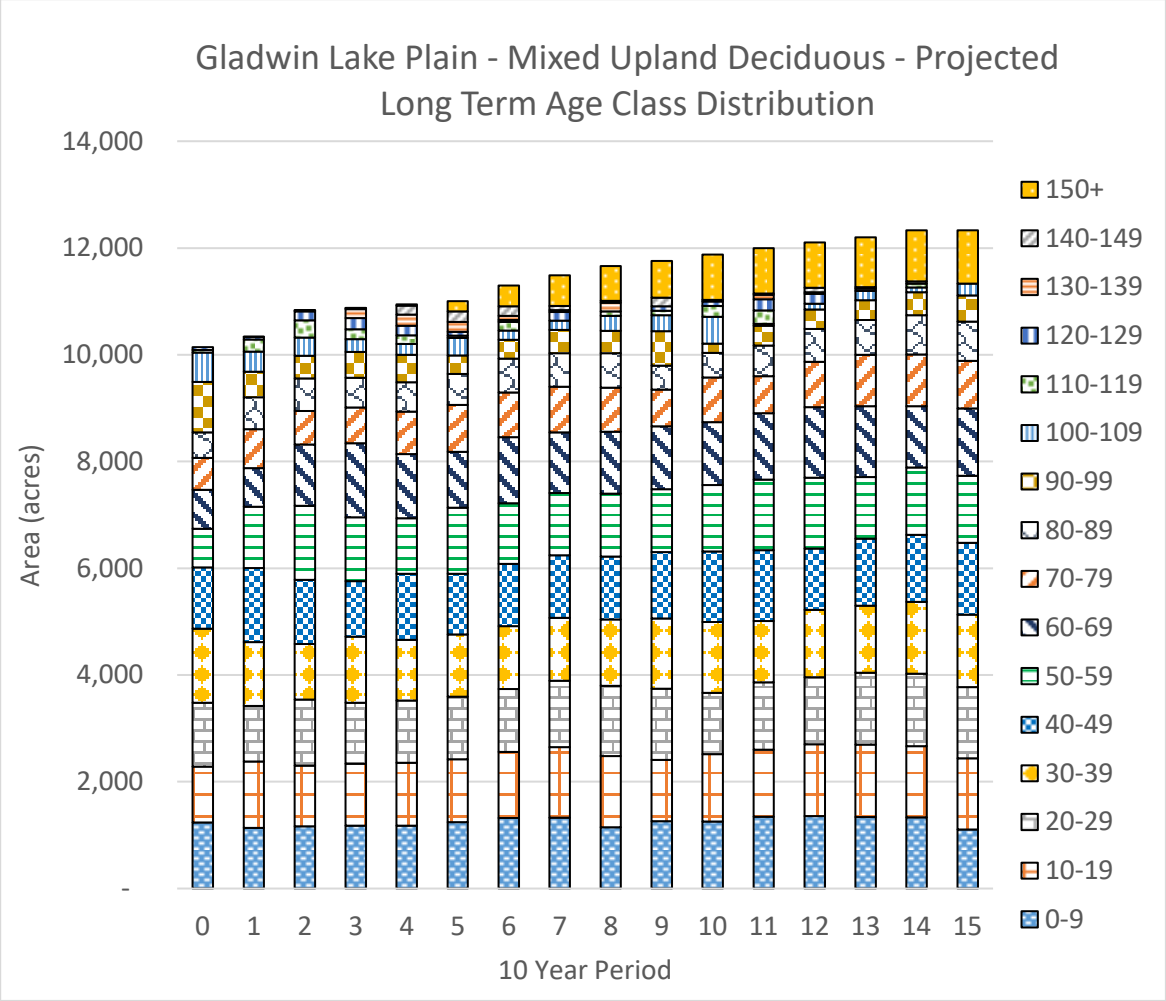


Figure 17. Projected age class distribution for all acres of mixed upland deciduous over the next 150 years.

Management actions

There are 939 acres of projected clearcut harvest and 680 acres of shelterwood in the mixed upland deciduous cover type during the planning period. There are also predicted to be 196 acres to be converted into this cover type. This is close to the desired establishment of 1,082 acres of mixed upland deciduous per decade.

Lowland aspen/balsam poplar

Current condition

The Gladwin Lake Plain Management Area has well balanced acres in the 0- to 9-year age class that was created due to the harvesting of mature and over-mature acres on the landscape during the last planning period (

Figure 18). The age class distribution is currently unbalanced across almost all the age class categories besides the 0- to 9-year age class. The surplus of acres in the 30- to 39-year-old age class is from the previous initiative of the Deer Range Improvement Program. Lowland deciduous and lowland aspen/balsam poplar will sometimes transition into each other's cover types post-harvest. The unavailable landscape position on which many of these acres occur contributes to the number of acres extending beyond the desired maximum age class tail of 50 years old.

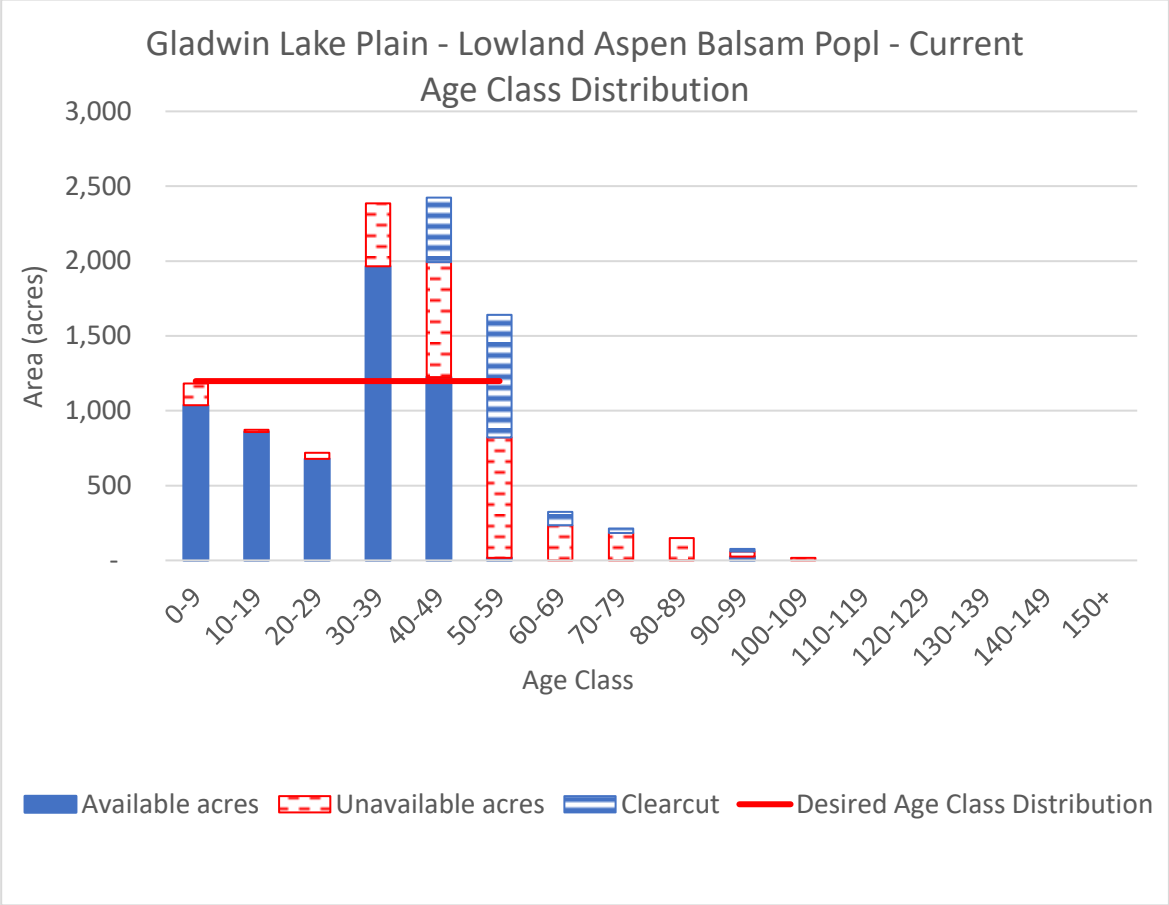


Figure 18. Current age class distribution, the desired age class distribution, and the projected harvests in the aspen cover type over the 10-year planning period.

Table 12. Featured species with lowland aspen/balsam poplar as a priority habitat cover type, habitat variables and current acres (e.g., potential habitat).

Featured Species	Featured Species Habitat – Lowland Aspen/Balsam Poplar	Lowland Aspen/Balsam Poplar Habitat Acres - Available	Lowland Aspen/Balsam Poplar Habitat Acres - Unavailable
American Woodcock	Age Category: 0-19 Size Category: Sapling	1,895	159
Snowshoe Hare	Age Category: 0-19 Size Category: Sapling	1,895	159

Desired future condition

The projected long-term cover type trend for lowland aspen/balsam poplar is stable in the Gladwin Lake Plain Management Area. There are very few transitions in and out of this cover type during this planning period with only a projected 24-acre decrease.

The long-term goal for this cover type is balanced age classes between 0 and 50 years old for all available lowland aspen/balsam poplar acres.

The end of the planning period will result in the establishment of approximately 1,352 acres of lowland aspen/balsam poplar from the available acres (Figure 19). Progress toward the long-term desired age class distribution of lowland conifers will take many decades to achieve the desired balanced age class condition.

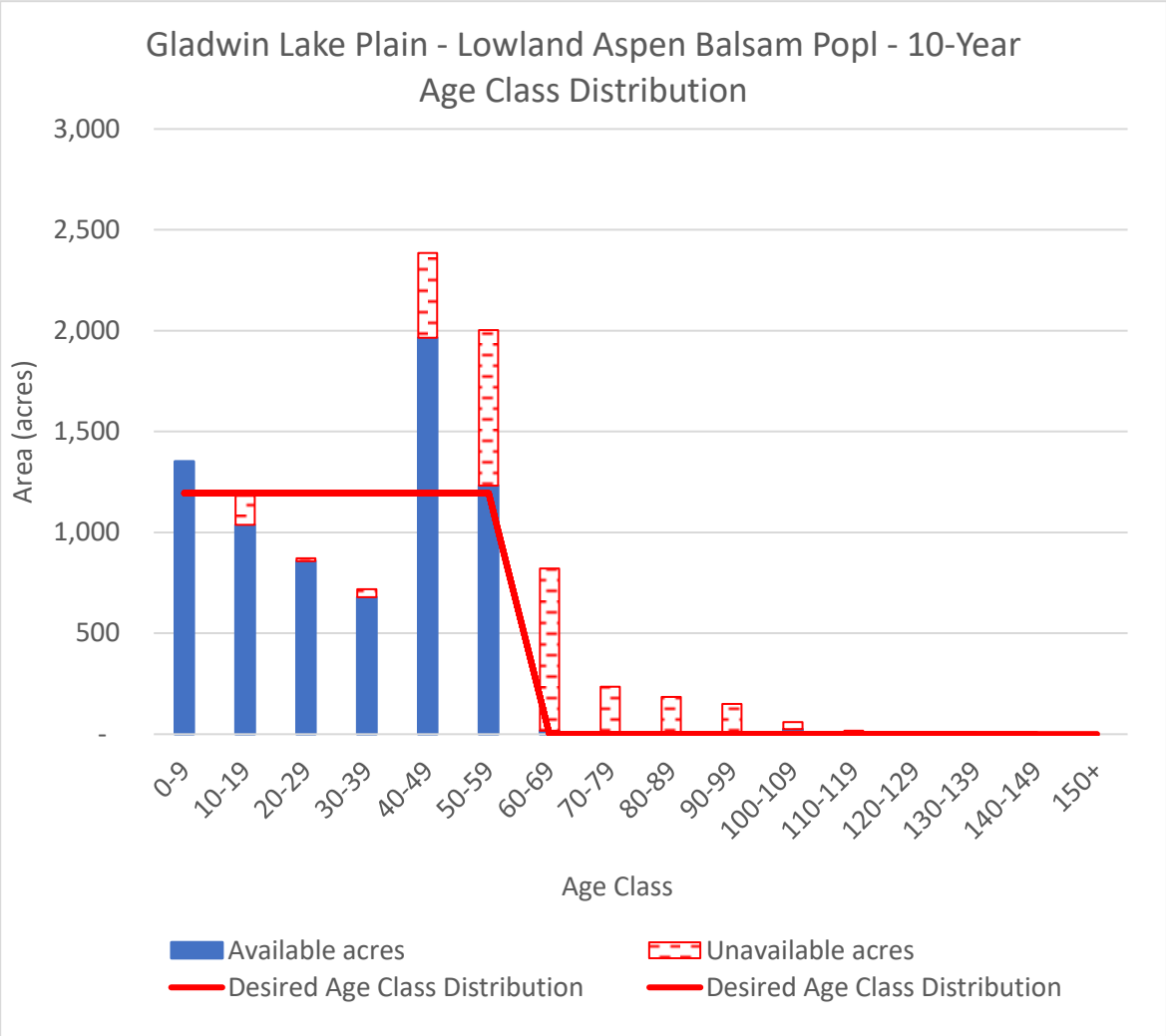


Figure 19. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution of lowland aspen/balsam poplar is nearing the desired future condition for available acres in the age classes (Figure 20). The number of acres in the older age classes, 80 years and older, continues to increase as the unavailable acres continue to move to the older age classes.

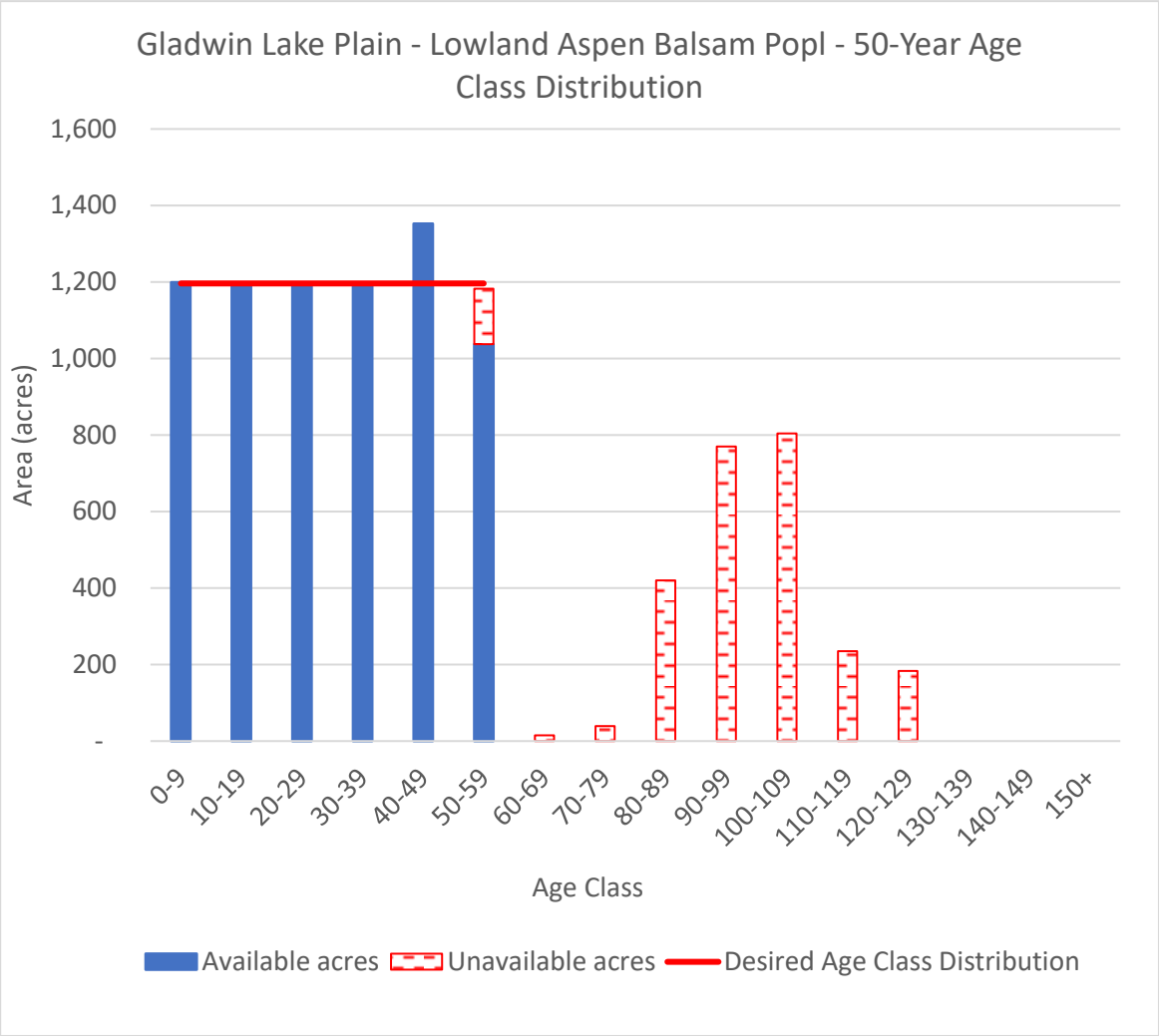


Figure 20. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 21) will concentrate on the manageable acres of lowland aspen/balsam poplar cover type in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged, and mature forest (Figure 22) The older age classes will most likely be converting into the lowland deciduous cover type as the lowland aspen age out.

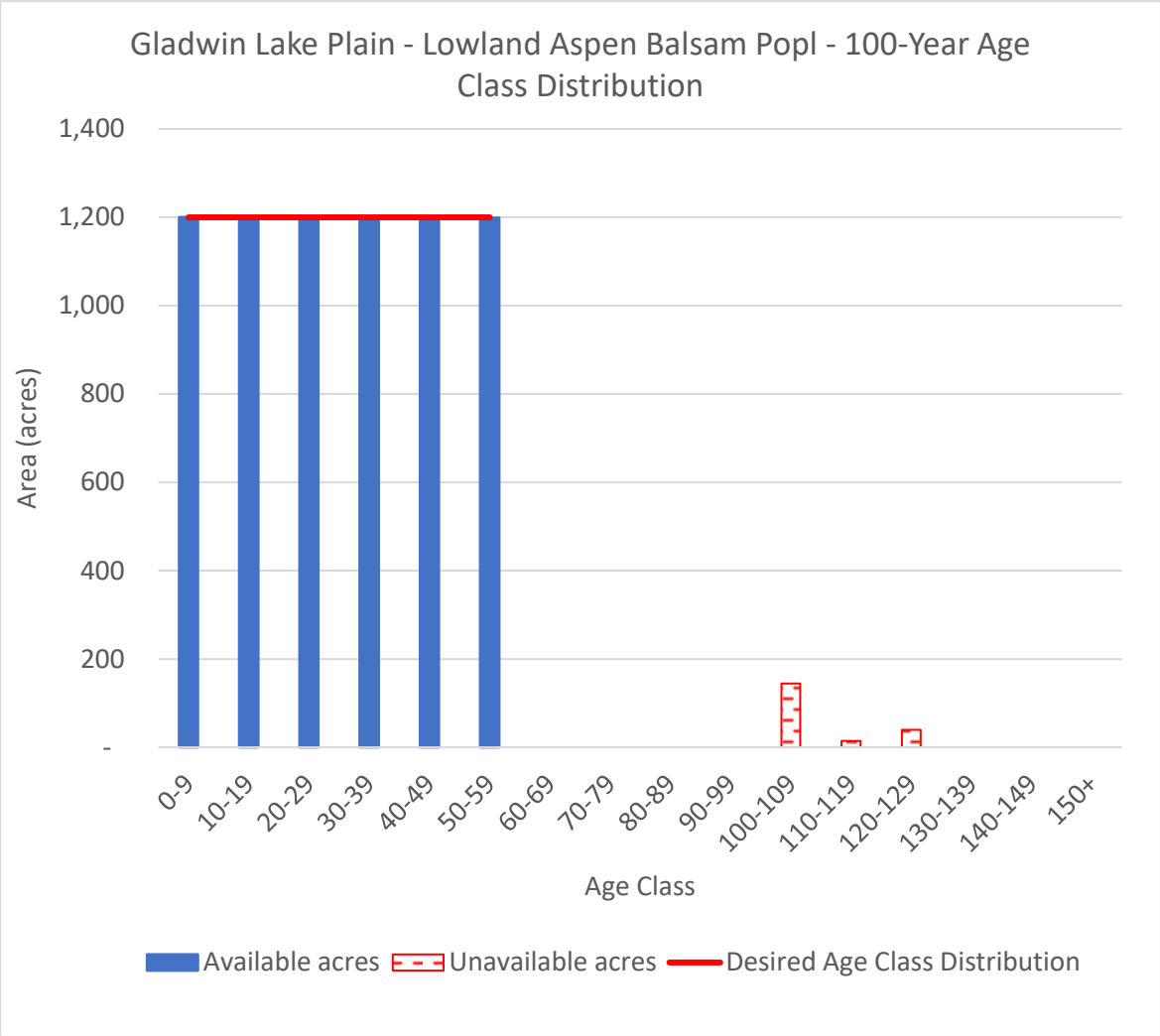


Figure 21. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

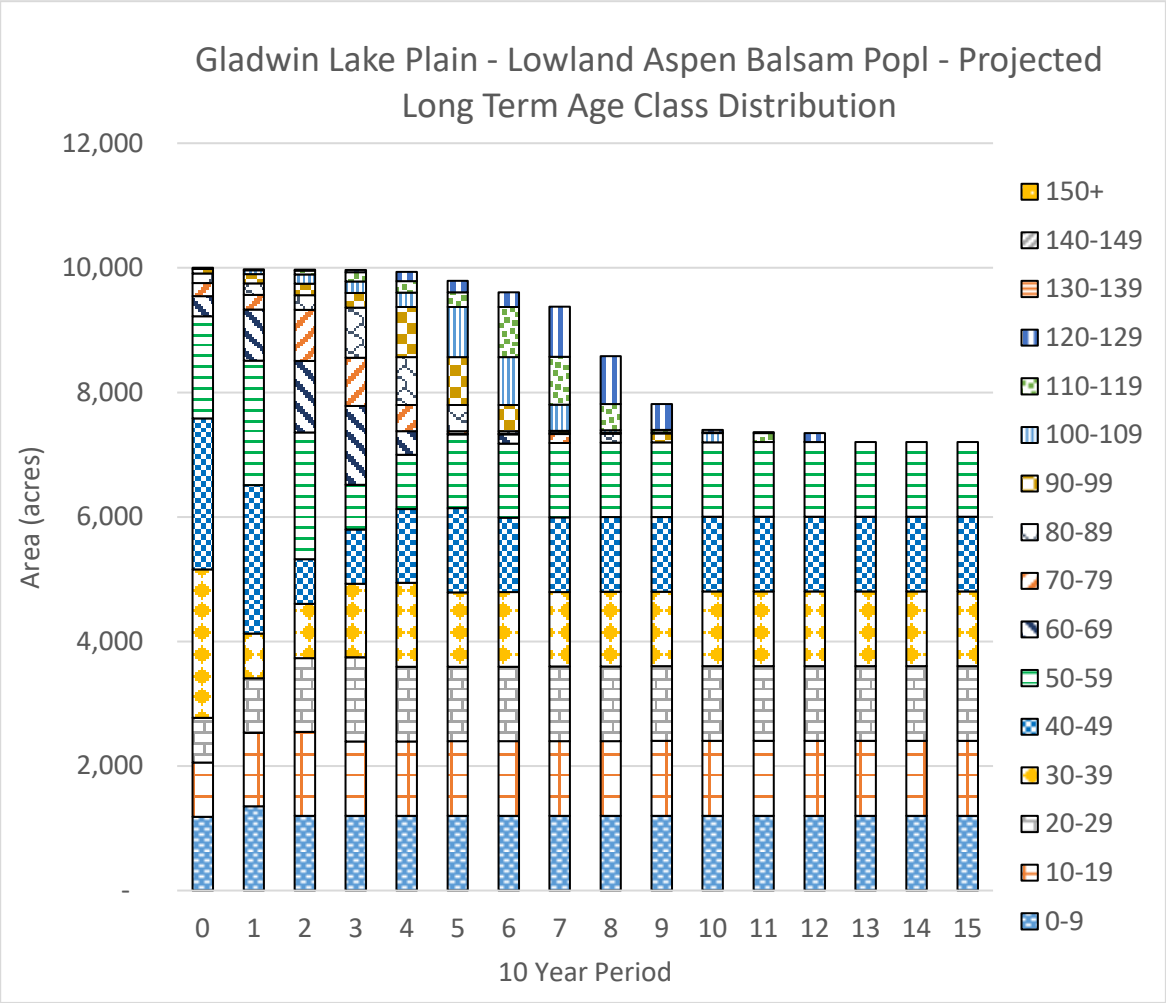


Figure 22. Projected age class distribution for all acres of lowland aspen/balsam poplar over the next 150 years.

Management actions

There are 1,385 acres of projected clearcut harvest in the lowland aspen/balsam poplar cover type during the planning period. This is just above the desired establishment of 1,194 acres of lowland aspen/balsam poplar per decade because of the current unbalanced age class condition in the older age classes of 50-plus.

Conservation area network

High conservation value areas

There are up to nine different HCVA types that can be found in each management area (Table 13; see Biodiversity in Section 3 for more information).

Table 13. High conservation value areas (HCVAs) within Gladwin Lake Plain Management Area.

High Conservation Value Area Type and Name	Acres
Dedicated Management Area's	**12,974**
--	12,974
Eastern Massasauga Managed Land	**2,589**
--	2,589
Natural Rivers Vegetative Buffer	**315**
--	315
Natural Rivers Zoning District	**879**
--	879
State Wildlife Management Areas	**7,909**
Bentley Marsh Flooding SWMA	1,474
Molasses Impoundments 4 Flooding SWMA Un	1,801
Molasses Impoundments 5 Flooding SWMA Un	1,481
Molasses River Flooding No.1 SWMA	1,642
Molasses River Flooding No.2 SWMA	1,510
GEMS	**11,335**
Lame Duck Foot Access Area	11,335
Grand Total	**36,000**

Ecological reference areas

Ecological reference areas (ERAs) are a type of HCVA and are higher-quality examples of functioning ecosystems that are primarily influenced by natural ecological processes.

Table 14. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 15. Ecological reference areas within the management area.

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	Number of Occurrences
Existing ERA	Floodplain Forest	BC	G3?	S3	1
Existing ERA	Rich Conifer Swamp	C	-	-	1
Grand Total	**-**	**-**	**-**	**-**	**2**

Special conservation areas

Reviewable special conservation areas (SCAs; Table 16) refers to those SCA types that may be reviewed or updated through the compartment review process as needed. Static SCAs (Table 17) refers to those SCA types that generally do not change or require updating (see Biodiversity in Section 3 for more information).

Table 16. Reviewable special conservation areas within Gladwin Lake Plain Management Area.

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Designated Trout and Cold Water Stream Buffer		**526**
--		333
Bear Creek		13
Big Creek		21
Cursten Creek		18
Harwood Creek		2
Hettinger Creek		21
Klacking Creek		20
Mayhue Creek		4
Parmalee Creek		17
Prior Creek		21
Rifle River		44
Spring Creek		12
Designated Trout and Coldwater Streams	**19.1**	
--	12.0	-
Bear Creek	0.5	-
Big Creek	0.8	-
Cursten Creek	0.7	-
Harwood Creek	0.1	-
Hettinger Creek	0.8	-
Klacking Creek	0.7	-
Mayhue Creek	0.2	-
Parmalee Creek	0.6	-

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Prior Creek	0.8	-
Rifle River	1.6	-
Spring Creek	0.4	-
Important Bird Areas	**-**	**143,020**
Gladwin Lake Plain	-	143,020
Mussel Stream Group 1 - State special concern	**6.6**	**-**
Dice Drain-Chippewa River	3.8	-
Molasses River	2.8	-
Mussel Stream Group 2 - State threatened or endangered	**2.1**	**-**
Bluff Creek	0.1	-
East Branch Tittabawassee River	0.5	-
Klacking Creek-Rifle River	1.1	-
Molasses River	0.4	-
Mussel Stream Group 3 - Federally threatened or endangered	**2.0**	**-**
Black Creek-Tittabawassee River	0.1	-
East Branch Tittabawassee River	0.3	-
Middle Branch Tittabawassee River	1.6	-
Wood Turtle Stream 100ft Buffer		**212**
Au Gres River	-	13
Chippewa River	-	60
Johnson Creek	-	8
Middle Branch Tittabawassee River	-	35
Mud Creek	-	17
Rifle River	-	8
Salt Creek	-	53
Salt River	-	18
Wood Turtle Stream 660ft Buffer	**-**	**1,293**
--	-	34
Au Gres River	-	109
Chippewa River	-	335
Johnson Creek	-	37
Middle Branch Tittabawassee River	-	236
Mud Creek	-	115
Rifle River	-	50
Salt Creek	-	279
Salt River	-	99
Grand Total	**29.8**	**145,051**

Table 17. Static special conservation areas within Gladwin Lake Plain Management Area.

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Designated Trout and Cold Water Stream Buffer	**-**	**526**
<Null>	-	333
Bear Creek	-	13
Big Creek	-	21
Cursten Creek	-	18
Harwood Creek	-	2
Hettinger Creek	-	21
Klacking Creek	-	20
Mayhue Creek	-	4
Parmalee Creek	-	17
Prior Creek	-	21
Rifle River	-	44
Spring Creek	-	12
Designated Trout and Coldwater Streams	**19.1**	**-**
<Null>	12.0	-
Bear Creek	0.5	-
Big Creek	0.8	-
Cursten Creek	0.7	-
Harwood Creek	0.1	-
Hettinger Creek	0.8	-
Klacking Creek	0.7	-
Mayhue Creek	0.2	-
Parmalee Creek	0.6	-
Prior Creek	0.8	-
Rifle River	1.6	-
Spring Creek	0.4	-
Important Bird Areas	**-**	**143,020**
Gladwin Lake Plain	-	143,020
Mussel Stream Group 1 - State special concern	**6.6**	**-**
Dice Drain-Chippewa River	3.8	-
Molasses River	2.8	-
Mussel Stream Group 2 - State threatened or endangered	**2.1**	**-**
Bluff Creek	0.1	-
East Branch Tittabawassee River	0.5	-
Klacking Creek-Rifle River	1.1	-
Molasses River	0.4	-

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Mussel Stream Group 3 - Federally threatened or endangered	**2.0**	**-**
Black Creek-Tittabawassee River	0.1	-
East Branch Tittabawassee River	0.3	-
Middle Branch Tittabawassee River	1.6	-
Wood Turtle Stream 100ft Buffer	**-**	**212**
Au Gres River	-	13
Chippewa River	-	60
Johnson Creek	-	8
Middle Branch Tittabawassee River	-	35
Mud Creek	-	17
Rifle River	-	8
Salt Creek	-	53
Salt River	-	18
Wood Turtle Stream 660ft Buffer	**-**	**1,293**
--	-	34
Au Gres River	-	109
Chippewa River	-	335
Johnson Creek	-	37
Middle Branch Tittabawassee River	-	236
Mud Creek	-	115
Rifle River	-	50
Salt Creek	-	279
Salt River	-	99
Grand Total	**29.8**	**145,051**

Rare species

Rare species occurrences are compiled from the Michigan Natural Features Inventory Biotics database (Table 18, Table 20 and Table 21) and do not necessarily include all rare species found in this management area due to biases in survey effort and verifiable observation reporting over time.

Table 18. Rare animal and plant species conservation status key.

Status	Status
E = endangered	LE = listed endangered
T = threatened	LT = listed threatened
SC = special concern	PDL = proposed for delisting

Table 19. Rare animal occurrence within Gladwin Lake Plain Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Accipiter gentilis	Northern goshawk	T	-	1
Animal	Alasmidonta viridis	Slippershell	T	-	3
Animal	Bombus affinis	Rusty-patched bumble bee	E	LE	1
Animal	Bombus pensylvanicus	American bumble bee	E	-	1
Animal	Buteo lineatus	Red-shouldered hawk	SC	-	4
Animal	Cambarus robustus	Big water crayfish	SC	-	3
Animal	Chlidonias niger	Black tern	T	-	1
Animal	Emydoidea blandingii	Blanding's turtle	SC	-	6
Animal	Gavia immer	Common loon	T	-	2
Animal	Glaucomys sabrinus	Northern flying squirrel	SC	-	1
Animal	Glyptemys insculpta	Wood turtle	T	-	9
Animal	Haliaeetus leucocephalus	Bald eagle	SC	-	14
Animal	Lasmigona compressa	Creek heelsplitter	SC	-	1
Animal	Lasmigona costata	Flutedshell	SC	-	1
Animal	Lithobates palustris	Pickerel frog	SC	-	1
Animal	Merolonche dolli	Doll's merolonche	SC	-	2
Animal	Moxostoma duquesnei	Black redhorse	SC	-	1
Animal	Myotis lucifugus	Little brown bat	T	-	1
Animal	Necturus maculosus	Mudpuppy	SC	-	6
Animal	Opheodrys vernalis	Smooth green snake	SC	-	1
Animal	Percina copelandi	Channel darter	E	-	4
Animal	Sistrurus catenatus	Eastern massasauga	T	LT	1
Animal	Venustaconcha ellipsiformis	Ellipse	SC	-	2
Total	-	-	-	-	**67**

Table 20. Rare plant occurrence within Gladwin Lake Plain Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Plant	Aristida longespica	Three-awned grass	SC	-	1
Plant	Carex haydenii	Hayden's sedge	X	-	1
Plant	Carex seorsa	Sedge	T	-	1
Plant	Cypripedium arietinum	Ram's head lady's-slipper	SC	-	1
Plant	Juncus dichotomus	Forked rush	SC	-	1
Plant	Lithospermum latifolium	Broad-leaved puccoon	SC	-	2
Plant	Lycopus virginicus	Virginia water-horehound	SC	-	1
Total	-	-	-	-	**8**

Table 21. Other rare occurrences within Gladwin Lake Plain Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Other	-	Great blue heron rookery	-	-	4
Total	-	-	-	-	**4**

Non-ecological reference area natural communities

Natural communities that are identified with an element occurrence in the MNFI Biotics database, but that have not been given an additional ecological reference area (ERA) designation, are recognized and managed accordingly (Table 22).

Table 22. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 23. Non-ecological reference area natural communities within Gladwin Lake Plain Management Area.

Community Type	Element Occurrence Rank	State Rank	Global Rank	Number of Occurrences
Floodplain Forest	BC	S3	G3?	1
Rich Conifer Swamp	C	S3	G4	1
Total	-	-	-	**2**

Forest health

Forest health concerns, both native and non-native, can have impacts on stand conditions and management decisions. The following insects (Table 24) and diseases (Table 25) could have an impact on management during the planning period and may need to be monitored and/or addressed.

Table 24. Defoliating insects of concern in the Gladwin Lake Plain management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Spongy moth	Lymantria dispar	Non-native	Yes
Forest tent caterpillar	Malacosoma disstria	Native	Yes
Jack pine budworm	Choristoneura pinus	Native	-

Watch for lingering ash with potential resistance to emerald ash borer. Monitor young jack and red pine for redheaded pine sawfly damage.

Table 25. Maladies of concern in the Gladwin Lake Plain management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Canker (stem infections)	Various	Various	Yes
Armillaria root rot	Armillaria spp.	Native	-
Oak decline	Various	Various	Yes

Monitor oak for symptoms of oak wilt and follow state land oak wilt guidance. Monitor planted red pine for Heterobasidion root disease and follow disease guidance. Report surviving mature beech trees that may be resistant to beech bark disease. Watch for symptoms of beech leaf disease.

Aquatic resources

Riparian habitat

A total of 181 miles of streams and rivers are found in the management area (Table 26). Streams/rivers classified as warm types comprise approximately 96% of the riverine mileage.

Table 26. Classification type and length of streams/rivers found within the management area.

Type	Length (miles)
Cold Stream	2
Cold Small River	0
Cold Transitional Stream	5
Cold Transitional Small River	0
Cold Transitional Large River	0
Warm Transitional Stream	70
Warm Transitional Small River	7
Warm Transitional Large River	6
Warm Stream	85
Warm Small River	3
Warm Large River	3

Lacustrine habitat

A total of 32 lakes and ponds of at least 1 surface acre are found in the management area (Table 27).

Table 27. Size and number of lakes and ponds located within the management area.

Lake Size Class (acres)	Number
1-99	26
100-499	4
500+	2

Wetlands

A total of 75,103 acres of wetlands are found in the management area (Table 28). Forested wetlands comprise approximately 94% of wetland types found in the management area.

Table 28. Area of emergent, forested and riverine wetland types found within the management area.

Wetland Type	Acres
Emergent	4,230
Forested	70,618
Riverine	255

Vernal pools and seeps

A total of 874 acres of vernal pools and seeps have been inventoried in the management area and 333 acres of seeps have been identified.

Riparian vegetation cover

Aspen and lowland deciduous are the predominant cover types present in a 100-meter riparian zone located next to streams/rivers in the management area (Table 29).

Table 29. Largest vegetative cover types (i.e., top 10) and area located in a 100-meter buffer of streams/rivers within the management area.

Cover Type	Acres
Aspen	5,649
Lowland Deciduous	5,128
Lowland Shrub	3,705
Marsh	1,741
Mixed Upland Deciduous	1,457
Lowland Aspen/Balsam Poplar	1,313
Black-Red Hybrid Oak	808
Lowland Conifers	603
Northern Hardwood	380
Natural White Pine	377

Watershed vegetation cover

The management area includes portions of important watersheds of the Maple Crooked rivers (Table 30 & Table 31). Aspen and lowland deciduous are major cover types of the state forest in each watershed.

Table 30. Largest vegetative cover types (i.e., top five) and area of the Maple River watershed located within the management area.

Cover Type	Acres
Aspen	8,131
Lowland Deciduous	7,881
Lowland Shrub	2,502
Mixed Upland Deciduous	2,295
Lowland Aspen/Balsam Fir	1,795

Table 31. Largest vegetative cover types (i.e., top five) and area of the Crooked River watershed located within the management area.

Cover type	Acres
Aspen	34,110
Lowland Deciduous	23,815
Lowland Shrub	15,644
Lowland Aspen/Balsam Fir	7,442
Mixed Upland Deciduous	7,104

Recreation

Access in the Gladwin Lake Plain Management Area is primarily by dirt road, two-tracks and the Gladwin Trail. Seasonal flooding due to a high-water table may limit access in some areas. This management area is near the communities of Midland, Mount Pleasant and Gladwin and accessible from the population centers of southern Michigan. The high level of use results in some illegal ORV activities and trash dumping.

Off-road vehicle trails in this management area are extensive and include the Gladwin Route and Trail, M-30 North Gladwin MCCCT and the M-30 to St. Helen #3 MCCCT. Nonmotorized trails include 32.7 miles of the Midland to Mackinaw Boy Scout trail (hiking) and the Pine Haven Pathway which is designated for bike and hike use.

There is one state forest campground (rustic) within the management area, with access to Black Creek.

Table 32. Designated Recreation Trails by type

Recreation Category	Recreation Type	# of Miles
Motorized Recreation Trails	ORV (all types)	35.2
	Snowmobile	0
Nonmotorized Recreation Trails	Hiking	41.3
	Equestrian	0
	Biking	8.6
	Hunter Access Trails	15.2
-	-	**100.3**

Note: Trail-use types may overlap.

Table 33. State forest campgrounds.

State Forest Campground	# of sites
Black Creek	23

This area is popular for hunting, with several floodings managed for wildlife. The Lame Duck Foot Access Area is one of the largest Grouse Enhanced Management Site in the state, with several access points and over 15 miles of hunter walking trails providing access to thousands of acres of land managed primarily for bird hunting.

The Rifle River, a designated natural river, flows through the area with three boating access sites on state forest land and additional access in the nearby Rifle River Recreation Area. The river is popular for canoeing and kayaking. It also provides access to Secord Lake/Tittabawassee River and several smaller inland lakes.

Table 34. Areas managed for hunting

Type	Name	# of Acres
State Wildlife Management Area	Bentley Marsh Flooding	1,473.20
--	Molasses Impoundments 4 Flooding	1,800.20
--	Molasses Impoundments 5 Flooding	1,480.40
--	Molasses River Flooding No.1	1,641.80
--	Molasses River Flooding No.1	1,508.90
--	Kawkawlin Creek Flooding	2,933.00
Grouse Enhanced Management Site	Lame Duck Foot Access Area	11,323.60
Total	**Six locations**	**22,161.10**

Table 35. Boating access sites.

Name	Waterbody
Bass Lake	Bass Lake
Big & Little Williams Lake	Big & Little Williams Lake
Bougner Lake	Bougner Lake
Henderson Lake	Henderson Lake
Kenneth Road Rifle River	Rifle River
Klacking Creek	Rifle River
Moffatt Bridge	Rifle River
Sandford Lake	Sandford Lake
Secord Lake - East	Secord Lake (Tittabawassee River)
Secord Lake - North	Secord Lake (Tittabawassee River)

Grand Traverse Moraine

State Forest Area: 95,850 acres	Location: Benzie, Grand Traverse, Leelanau and Manistee counties	Population Centers: Traverse City, Copemish, Benzonia, Frankfort, Kingsley and Honor
Subsection: Grand Traverse Ground Moraine, Manistee Sandy Outwash Plain and Kalskaska Sandy Moraines	Landforms: High outwash plain, Moraine ridges, Lake plain	Landcover: Forested: 84,186 acres Nonforested: 11,664 acres

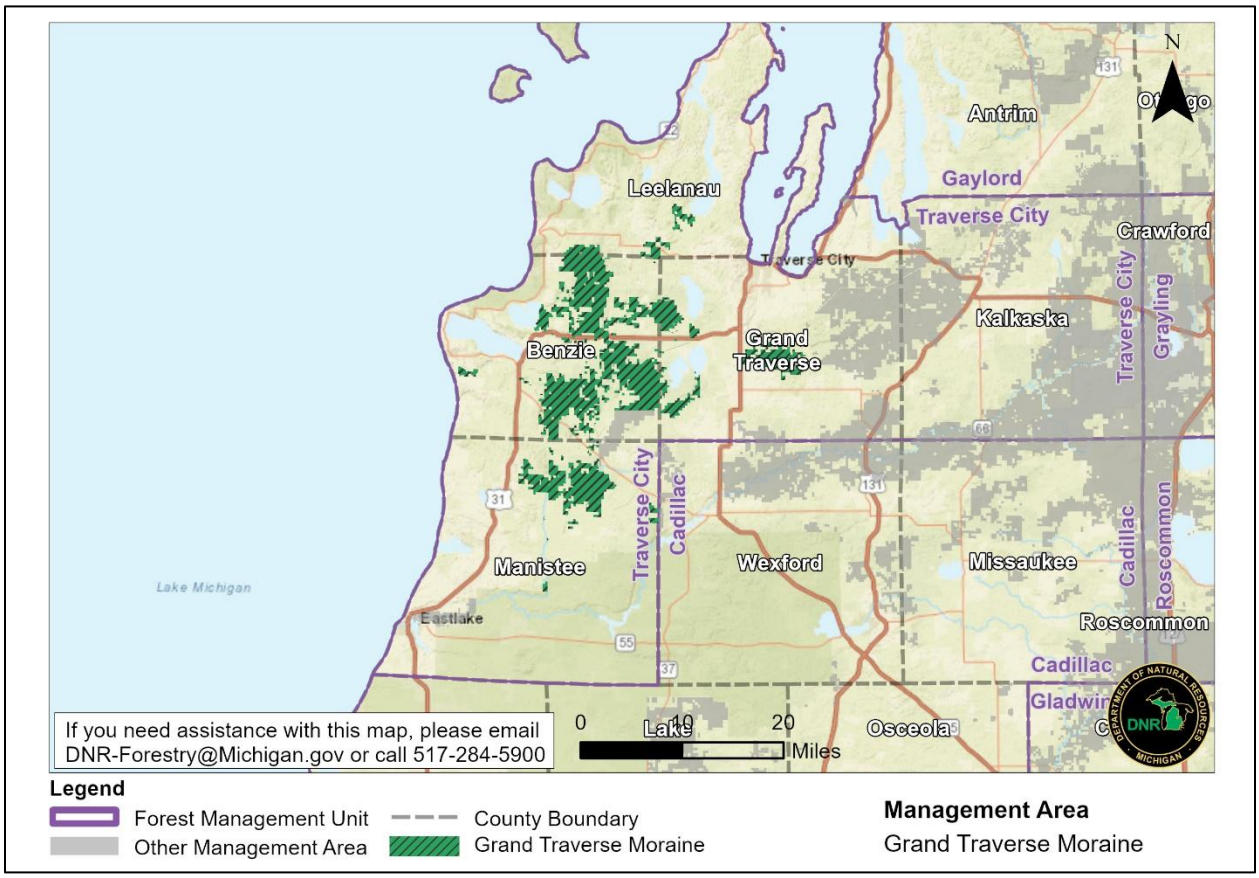


Figure 1. Grand Traverse Moraine Management Area.

Forested landscape

Current and projected future condition

The Grand Traverse Moraine Management Area is dominated by aspen, northern hardwood, planted red pine and lowland deciduous cover types that are largely upland and available. The Forest Diversity Matrix (Figure 2) provides a coarse representation of how forested acres are distributed across the landscape. Shade intolerant available upland cover types are relatively evenly distributed across the young, intermediate and mid-aged categories. The unavailable lowland acres are more prevalent in the mature age category. Mid-tolerant are mostly located in the mid-aged and mature age categories.

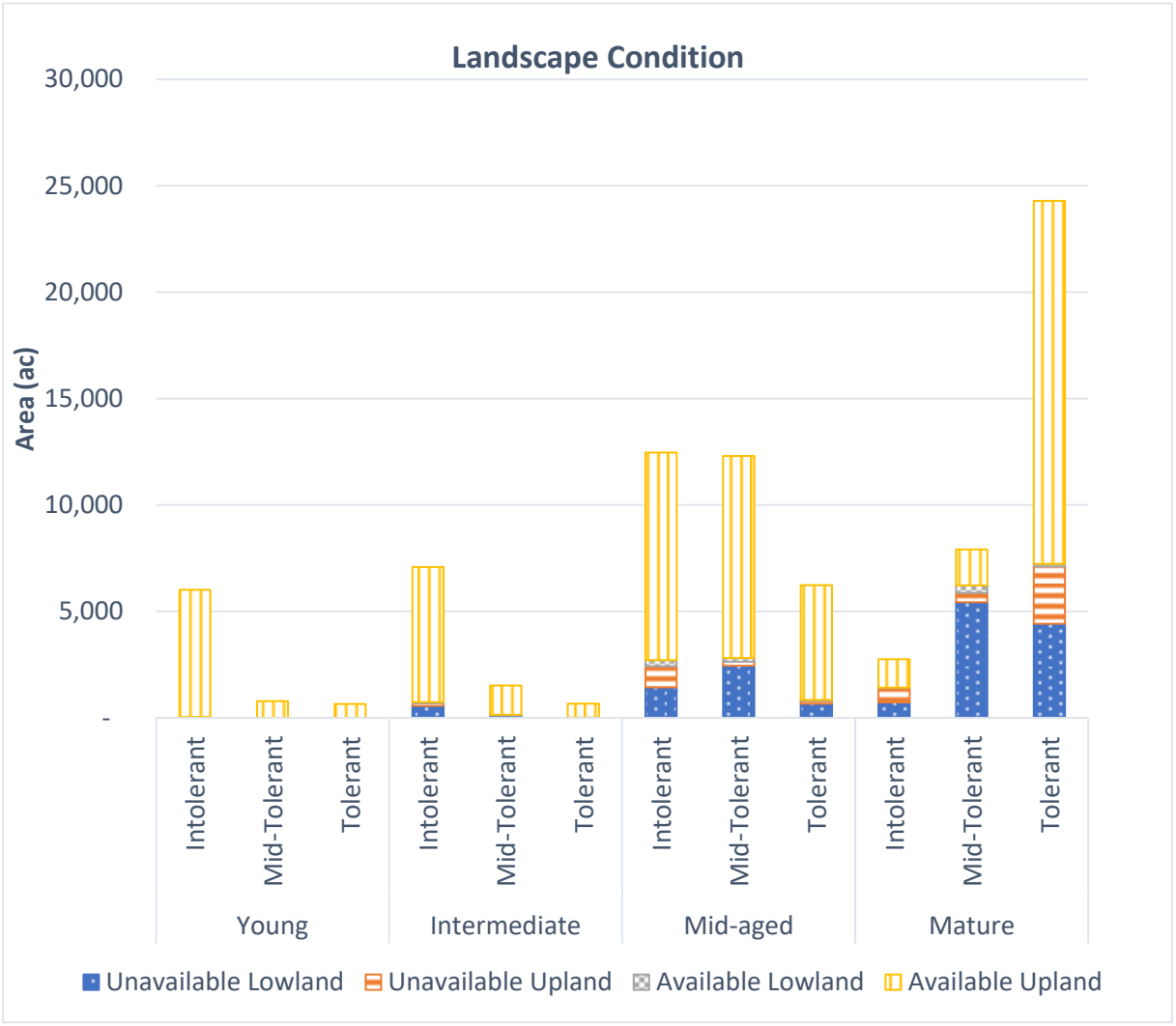


Figure 2. Forest diversity matrix showing the current distribution of forested acres across management availability, age category, landscape position and shade tolerance.

Landscape habitat conditions refine the management area landscape into featured species habitat context. Current and projected acres for the metrics identified in the Management Priorities (Section 3 Statewide/Regional) establish a baseline and future condition based on management over the planning period (Table 1).

Table 1. Current acres for landscape habitat conditions.

Landscape Habitat Condition	Monitoring Metric	Current Acres
Young Forest	Acres of 0-19 stands in Aspen and Jack Pine	6,009
Mature Forest	Acres of 80+ year stands across cover types	34,966
Mature Forest	Acres of 120+ year stands across cover types	962
Mesic Conifer Cover types	Acres of mesic conifer cover types	2,387
Mesic Conifers in other Cover types	Average canopy occupancy	14%
Mast – Oak Cover types	Acres of oak cover types	1,579
Mast Tree Species in other Cover types	Acres of total canopy occupancy of mast tree acres (trace-100%)	56,362
Big Trees	Acres of total canopy stand occupancy of species in sawlog or greater size class	50,724
Nonforested Openings	Acres of total herbaceous openland, upland shrub, and cropland	3,409
Landscape Forest Matrix	Percent deciduous forest	71%
Landscape Forest Matrix	Percent coniferous forest	24%

The Grand Traverse Moraine Management Area has the following special analysis units (SAUs). These SAUs have specific cover type goals, typically associated with wildlife habitat management. For any SAUs that overlap with this management area, SAU cover type goals take priority as the SFMP model strives to meet the cover type goals across the area, ensuring they are met. See Section 5 for a detailed description of the management direction and harvest goals for each of these SAUs.

- Grouse Enhanced Management Site (GEMS) – Little Betsie

The Grand Traverse Moraine Management Area is dominated by forested cover types with 88% of the area covered in forested stands (

Table 2). The upland deciduous portion of that is 53% of the management area and comprised mostly of northern hardwood and aspen. Low density trees and herbaceous openland are the most common nonforested cover type in this management area representing 4% of the landscape.

Table 2. Current landscape context and distribution of cover types.

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
Forested	Upland	Deciduous	Aspen	24,648	50,470	67,228	84,186
			Northern Hardwood	22,040			
			Black Red Hybrid Oak	167			
			Northern Red Oak	1,138			
			Oak Mix	274			
			Mixed Upland Deciduous	2,204			
		Mixed	Upland Mixed Forest	2,207	2,207		
		Coniferous	Planted Red Pine	8,708	14,551		
			Planted Jack Pine	340			
			Planted White Pine	1,771			
			Planted Mixed Pine	530			
			Natural Red Pine	118			
			Natural Jack Pine	696			
			Natural White Pine	1,581			
			Natural Mixed Pines	372			
			Upland Spruce/Fir	326			
			Upland Conifers	93			
			Hemlock	15			
	Lowland	Deciduous	Lowland Aspen/Balsam Poplar	2,398	9,244	16,958	
			Lowland Deciduous	6,847			
		Mixed	Lowland Mixed Forest	1,705	1,705		
		Coniferous	Cedar	3,182	6,009		
			Lowland Conifers	2,092			
			Lowland Spruce/Fir	17			
			Tamarack	718			
Nonforested	Upland	N/A	Herbaceous Openland	2,354	N/A	6,588	11,664
			Upland Shrub	965			
			Low Density Trees	2,334			
			Bare/Sparsely Vegetated	300			
			Cropland	90			
			Urban	545			
			Lowland Shrub	1,585			
			Marsh	1,790			

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
Nonforested	Lowland	N/A	Bog	286	N/A	5,076	11,664
			Treed Bog	124			
			Water	1,291			
						Grand Total:	95,850

There are 63,059 acres (65.7% of the total management area and 74.9% of the forested area) that can be managed toward desired future conditions via commercial timber harvest in the Grand Traverse Moraine Management Area (Table 3). Of that, almost 28% is in the aspen cover type, 23.2% in northern hardwood, and 10.2% in planted red pine. The remaining 22 cover types represent less than 3% each of the forested and available land in the management area. Acres unavailable for management are categorized by site condition (Table 4).

Table 3. Current cover type composition by management availability.

Forested Cover Type	Available Acres	Available %	Unavailable Acres	Unavailable %	Total Acres	Total %
Aspen	23,315	27.7%	1,333	1.6%	24,648	29.3%
Northern Hardwood	19,546	23.2%	2,494	3.0%	22,040	26.2%
Planted Red Pine	8,602	10.2%	106	0.1%	8,708	10.3%
Lowland Deciduous	491	0.6%	6,356	7.6%	6,847	8.1%
Cedar	43	0.1%	3,139	3.7%	3,182	3.8%
Lowland Aspen Balsam Poplar	362	0.4%	2,035	2.4%	2,398	2.8%
Upland Mixed Forest	2,035	2.4%	172	0.2%	2,207	2.6%
Mixed Upland Deciduous	1,995	2.4%	209	0.2%	2,204	2.6%
Lowland Conifers	127	0.2%	1,965	2.3%	2,092	2.5%
Planted White Pine	1,738	2.1%	33	0.0%	1,771	2.1%
Lowland Mixed Forest	72	0.1%	1,633	1.9%	1,705	2.0%
Natural White Pine	1,288	1.5%	293	0.3%	1,581	1.9%
Northern Red Oak	728	0.9%	410	0.5%	1,138	1.4%
Tamarack	18	0.0%	700	0.8%	718	0.9%
Natural Jack Pine	691	0.8%	5	0.0%	696	0.8%
Planted Mixed Pine	516	0.6%	13	0.0%	530	0.6%
Natural Mixed Pines	371	0.4%	2	0.0%	372	0.4%
Planted Jack Pine	310	0.4%	30	0.0%	340	0.4%
Upland Spruce Fir	244	0.3%	82	0.1%	326	0.4%
Oak Mix	243	0.3%	31	0.0%	274	0.3%
Black Red Hybrid Oak	153	0.2%	14	0.0%	167	0.2%
Natural Red Pine	112	0.1%	7	0.0%	118	0.1%
Upland Conifers	61	0.1%	32	0.0%	93	0.1%
Lowland Spruce Fir	0	0.0%	17	0.0%	17	0.0%
Hemlock	0	0.0%	15	0.0%	15	0.0%
Total	**63,059**	**74.9%**	**21,126**	**25.1%**	**84,186**	**100.0%**

Table 4. Site conditions for unavailable acres.

Site Condition (Reason Area is Unavailable for Commercial Harvest)	Acres	% of Unavailable Area
Too Wet	12,761	60.4%
Conservation Values	2,905	13.8%
Too Steep	1,522	7.2%
Recreation/Scenic	790	3.7%
Best Management Practices	738	3.5%
Other Influence Zones	585	2.8%
Long-Term Retention	429	2.0%
Blocked by Obstacle	393	1.9%
Other Dept./Div. Processes	243	1.2%
Species of special concern or T&E	162	0.8%
Denied Access	158	0.7%
Wildlife Concerns	154	0.7%
Deer Wintering Area	92	0.4%
Cannot Regenerate	84	0.4%
Federal/State/Local Law	83	0.4%
Non-DNR agency concerns	21	0.1%
Rare Landforms	3	0.0%
Non-Military Lease/Easement	1	0.0%
Total Unavailable	**21,126**	**100%**

Projected 10-year cover type management actions

Each cover type in the Grand Traverse Moraine Management Area has a unique age class and basal area class goals that describe the long-term desired future conditions. The harvest levels that are needed in the first planning period to begin achieving those long-term goals are summarized below (Table 5). These harvests will help establish a desirable amount of regeneration for the even-aged cover types over the 10-year period or help to achieve desired basal area distribution among uneven-aged cover types like northern hardwoods. Implementing these silvicultural regimes will yield 326,734 cords, the planned harvest volume for the decade (Table 6).

Table 5. Ten-year planning period harvest goals (acres) by cover type and silvicultural regime.

Silvicultural Regimes								
Cover Type	**Clearcut**	**Selection**	**Thinning**	**Group Selection**	**Shelterwood**	**Salvage Clearcut**	**Salvage Thinning**	**Grand Total**
Northern Hardwood	157	5,494	-	294	151	-	-	6,097
Planted Red Pine	245	-	3,873	-	-	-	-	4,118
Aspen	2,813	-	-	-	-	-	-	2,813
Mixed Upland Deciduous	1,032	255	-	-	-	-	-	1,287
Planted White Pine	-	-	878	-	-	-	-	878
Upland Mixed Forest	825	-	-	-	-	-	-	825
Natural White Pine	-	-	111	-	120	-	-	231
Upland Spruce/Fir	206	-	-	-	-	-	-	206
Northern Red Oak	146	-	-	-	-	-	-	146
Planted Mixed Pine	13	-	116	-	-	-	-	129
Black Red Hybrid Oak	129	-	-	-	-	-	-	129
Lowland Aspen/Balsam Poplar	86	-	-	-	-	-	-	86
Planted Jack Pine	71	-	-	-	-	-	-	71
Lowland Deciduous	47	3	-	-	-	-	-	50
Upland Conifers	37	-	-	-	3	-	-	40
Natural Jack Pine	26	-	-	-	-	-	-	26
Lowland Conifers	25	-	-	-	-	-	-	25
Natural Mixed Pines	-	-	10	-	10	-	-	20
Oak Mix	-	-	8	-	-	-	-	8
Lowland Mixed Forest	7	-	-	-	-	-	-	7
Totals	**5,865**	**5,752**	**4,995**	**294**	**285**	**-**	**-**	**17,190**

Table 6. Projected 10-year harvest volume by species.

10-Year Estimated Harvest Volume Projection Grand Traverse Moraine Management Area			
Product	**Species**	**Volume Planned***	**Volume Prepared** ***
Pulpwood (cords)	Mixed Hardwood	47,614	44,757
	Red Pine	32,576	30,621
	Mixed Aspen	25,411	23,886
	Mixed Softwood	11,980	11,261
	Mixed Spruce	10,842	10,191
	White Pine	10,659	10,019
	Mixed Oak	3,626	3,408
	Jack Pine	2,073	1,949
	Pulpwood Total	**144,779**	**136,092**
Sawtimber (MBF)	Red Pine	31,327	29,448
	Sugar Maple	17,777	16,711
	Mixed Aspen	10,781	10,134
	White Pine	8,701	8,179
	Red Maple	6,348	5,967
	Red Oak	4,748	4,463
	Basswood	2,545	2,392
	Mixed Oak	1,047	984
	White Oak	1,007	947
	Sawtimber Total	**84,282**	**79,225**
	Total Sawtimber Harvest Volume in Cords	**181,955**	**171,038**
	Grand Total Harvest Volume in Cords	**326,734**	**307,130**
* Volume estimates based on 100% of the projected harvests for the 10-year planning period. ** Volume estimates based on 94% of the projected harvests for the 10-year planning period accounting for reduction in acres and associated volume once sales are prepared for bid.			

There are a few cover type transitions projected in the Grand Traverse Moraine Management Area (Table 7). The managed area of each cover type is projected to remain relatively stable as treatment regimes will not change the amount of area in each cover type more than 3% except for upland mixed forest, mixed upland deciduous, northern red oak, planted jack pine upland spruce/fir, oak mix, black

red hybrid oak, and upland conifers. Many of the species listed above is due to being smaller in number of total acres in those cover types inflating the percentage change. The largest acreage decrease forecasted is in the mixed upland deciduous cover type where 414 acres are forecasted to convert to other cover types through forest management activities. The largest increase in acres is the aspen cover type where 526 acres are expected to convert into it, increasing by 2%.

Table 7. Projected 10-year cover type acres resulting from cover type transitions.

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Aspen	24,648	25,174	526
Northern Hardwood	22,040	22,189	149
Planted Red Pine	8,708	8,961	253
Lowland Deciduous	6,847	6,848	1
Cedar	3,182	3,182	0
Lowland Aspen/Balsam Poplar	2,398	2,399	2
Upland Mixed Forest	2,207	1,880	-327
Mixed Upland Deciduous	2,204	1,790	-414
Lowland Conifers	2,092	2,080	-12
Planted White Pine	1,771	1,771	0
Lowland Mixed Forest	1,705	1,714	9
Natural White Pine	1,581	1,581	0
Northern Red Oak	1,138	1,042	-96
Tamarack	718	718	0
Natural Jack Pine	696	698	2
Planted Mixed Pine	530	516	-13
Natural Mixed Pines	372	376	4
Planted Jack Pine	340	321	-19
Upland Spruce/Fir	326	141	-185
Oak Mix	274	448	174
Black Red Hybrid Oak	167	140	-27
Natural Red Pine	118	118	0
Upland Conifers	93	66	-27
Lowland Spruce/Fir	17	17	0
Hemlock	15	15	0
Herbaceous Openland	2,354	2,354	0
Low Density Trees	2,334	2,334	0
Marsh	1,790	1,790	0
Lowland Shrub	1,585	1,585	0

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Water	1,291	1,291	0
Upland Shrub	965	965	0
Urban	545	545	0
Bare/Sparsely Vegetated	300	300	0
Bog	286	286	0
Treed Bog	124	124	0
Cropland	90	90	0
Total:	**95,850**	**95,850**	**0**

Featured species current and projected habitat acres

There are eight featured species in this management area that span various cover types, age classes, and stand level conditions. Current and projected total habitat acres by species across the decade provide a baseline and show the result of long-term management actions (Table 8). As noted in the Featured Species Management Priority (Section 3), it is recommended that these featured species habitat acres be viewed as acres of potential habitat, representing a condition on the landscape where the more nuanced aspects of each species' habitat requirements are likely to be found or managed for. As described in the introduction, the modeling effort was limited by several factors including the simplification of habitat attributes into MiFI variables. Therefore, when referring to habitat acres what is being referred to is potential habitat acres.

Some species show a loss in habitat over the next century. As mentioned in the Featured Species Management Priority (Section 3), the current condition for many cover types is a surplus of acres in the 0-9 age class from the compensatory management approach applied in the previous decade. The model eventually evens out the age classes at a lower, sustainable level over time, usually by 50 years. For any species with northern hardwoods as a priority cover type, there is a perceived drop in acres between 40 and 60 years; this is due to the basal area dropping below 81 but because it only drops into the upper 70s, it is not expected to translate to any real habitat loss on the ground. Three of these species were not included in the State Forest Management Plan model but are included here to inform management decisions over the decade.

Table 8. Featured species current and projected total habitat acres (e.g., potential habitat).

Featured Species	Priority Cover Types	Total Habitat Acres Current	Total Habitat Acres 10-year	50-year Projected Habitat Acres	100-year Projected Habitat Acres
Black Bear	Mast	57,941	--	--	--

Featured Species	Priority Cover Types	Total Habitat Acres Current	Total Habitat Acres 10-year	50-year Projected Habitat Acres	100-year Projected Habitat Acres
Black-Backed Woodpecker	Natural disturbance	--	--	--	--
Black-Throated Blue Warbler	Northern hardwoods, mixed upland deciduous	16,388	18,365	10,687	21,219
Golden-Winged Warbler	Aspen, black-red hybrid oak, northern red oak, oak mix, tamarack	11,628	11,484	6,728	6,785
Marten	Northern hardwoods, mixed upland deciduous, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, lowland mixed forest, lowland conifers, hemlock, cedar	27,208	29,624	23,560	33,623
Ruffed Grouse	Aspen	11,550	11,201	6,661	6,663
Snowshoe Hare	Aspen, cedar, hemlock, lowland aspen, lowland conifers, lowland mixed forest, lowland spruce/fir, mixed upland deciduous, natural jack pine, natural mixed pines, planted jack pine, upland spruce/fir	12,530	12,670	7,613	7,912
Wild Turkey	Nonforested openings	2,444	--	--	--
Wood Thrush	Northern hardwoods, northern red oak, mixed upland deciduous, lowland deciduous	24,551	27,067	20,561	31,288
Wood Turtle	Nonforested openings	--	--	--	--

Cover type composition and associated featured species

Aspen

Current condition

The current age class distribution is quite unbalanced with a deficit of acres in ages 20-29, 40-year-old-age classes to 70-year-old age classes (Figure 3). The younger age class of 0-9 has a surplus of 4,264

acres. To balance the age class will take multiple planning periods with a surplus of acres in the 0-9 age class.

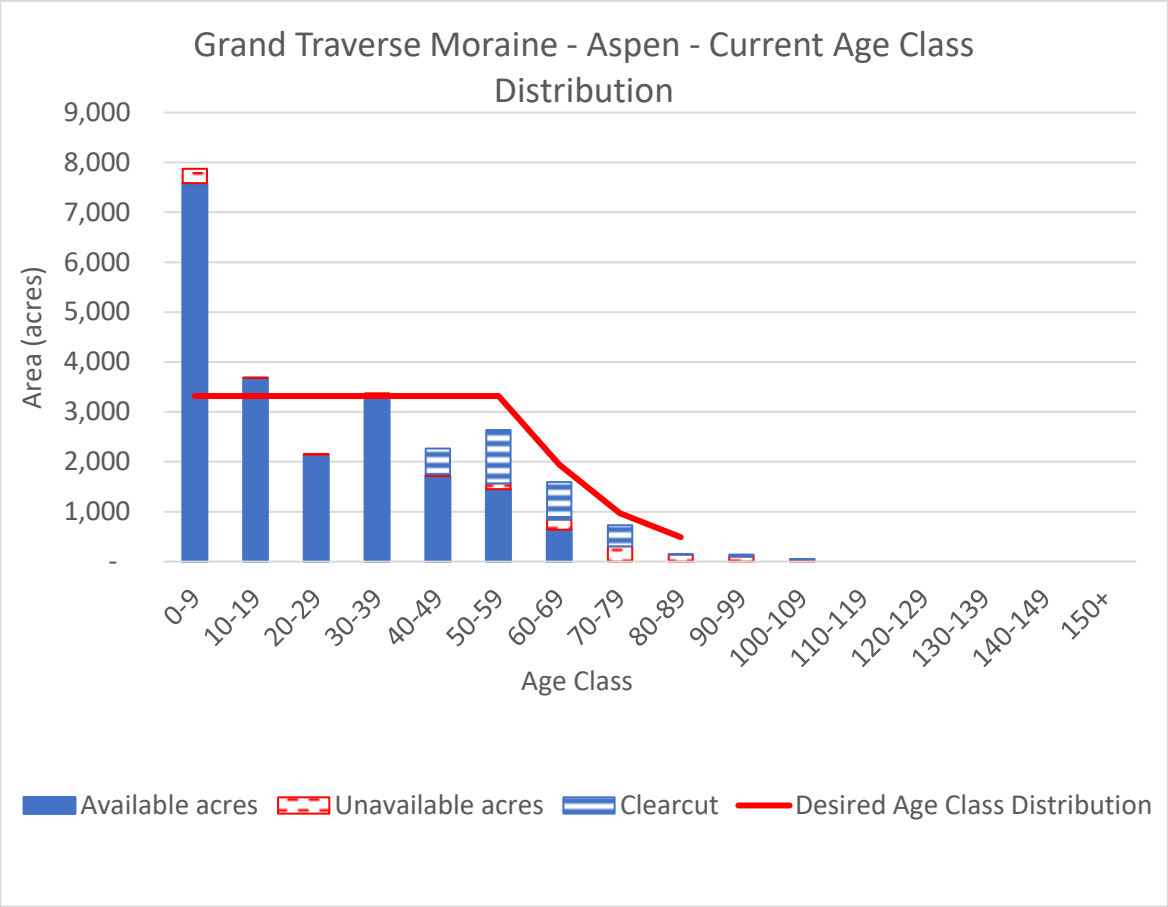


Figure 3. Current age class distribution, the desired age class distribution, and the projected harvests in the aspen cover type over the 10-year planning period.

Current conditions are a result of consistent commercial harvests and regeneration efforts on available aspen acres during the previous two planning periods. A portion of this cover type meets the habitat requirements for golden-winged warbler, ruffed grouse and snowshoe hare (Table 9).

Table 9. Featured species with aspen as a priority habitat cover type, habitat variables and current acres (i.e., potential habitat)..

Featured Species	Featured Species Habitat – Aspen	Aspen Habitat Acres - Available	Aspen Habitat Acres - Unavailable
Golden-Winged Warbler	Age Category: 0-19 Size Class: Sapling	11,261	289
Ruffed Grouse	Age Category: 0-19 Size Class: Sapling	11,261	289
Snowshoe Hare	Age Category: 0-19 Size Class: Sapling	11,261	289

Desired future condition

The projected long-term cover type trend for aspen is stable in the Grand Traverse Moraine Management Area with only a 2% increase. There are a few transitions into this cover type from other cover types forecasted in this management area and fewer transitions from aspen to other cover types.

The long-term goal for this cover type is balanced age classes between 0 and 50-years-old with a tail extending to 80- to 89-year-old age class for all available aspen stands in this management area. Maintaining lower acreage in old age classes continues to be desirable to keep vigor in these stands promoting probability of regeneration levels to be higher.

The end of the planning period will result in the establishment of 3,330 acres in the upcoming 0-9 age class. Progress toward the long-term desired age class distribution of aspen will take many decades in this management area (Figure 4).

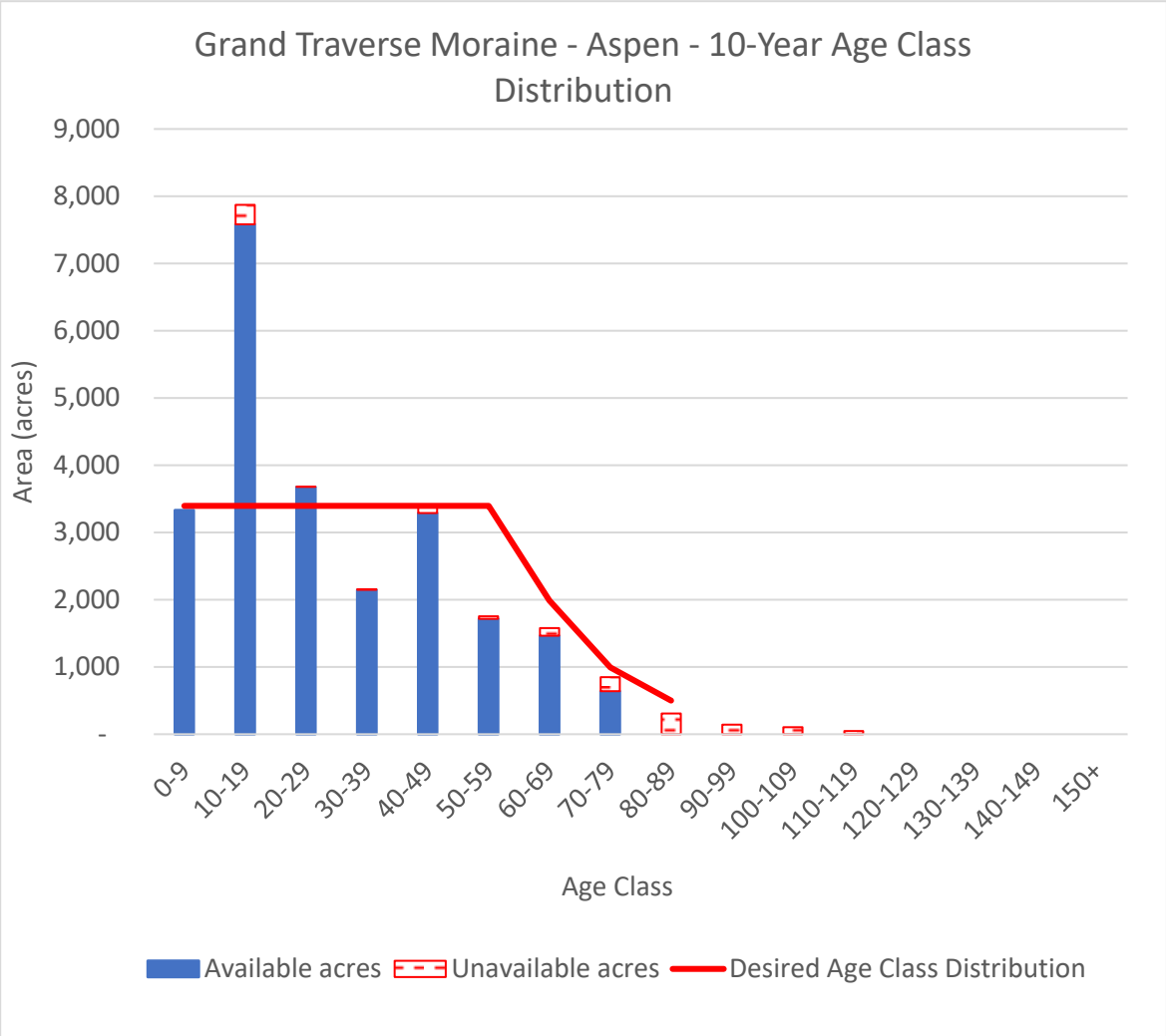


Figure 4. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of aspen acres nearly reaching the desired future condition with only the older age classes with unavailable acres and the 50- to 59-year-old age class deviating from the target proportions (Figure 5). As is often the case, an extremely unbalanced condition in the first planning period can often result in the need to carry some acres slightly longer above the desired age class distribution as seen in Figure 4.

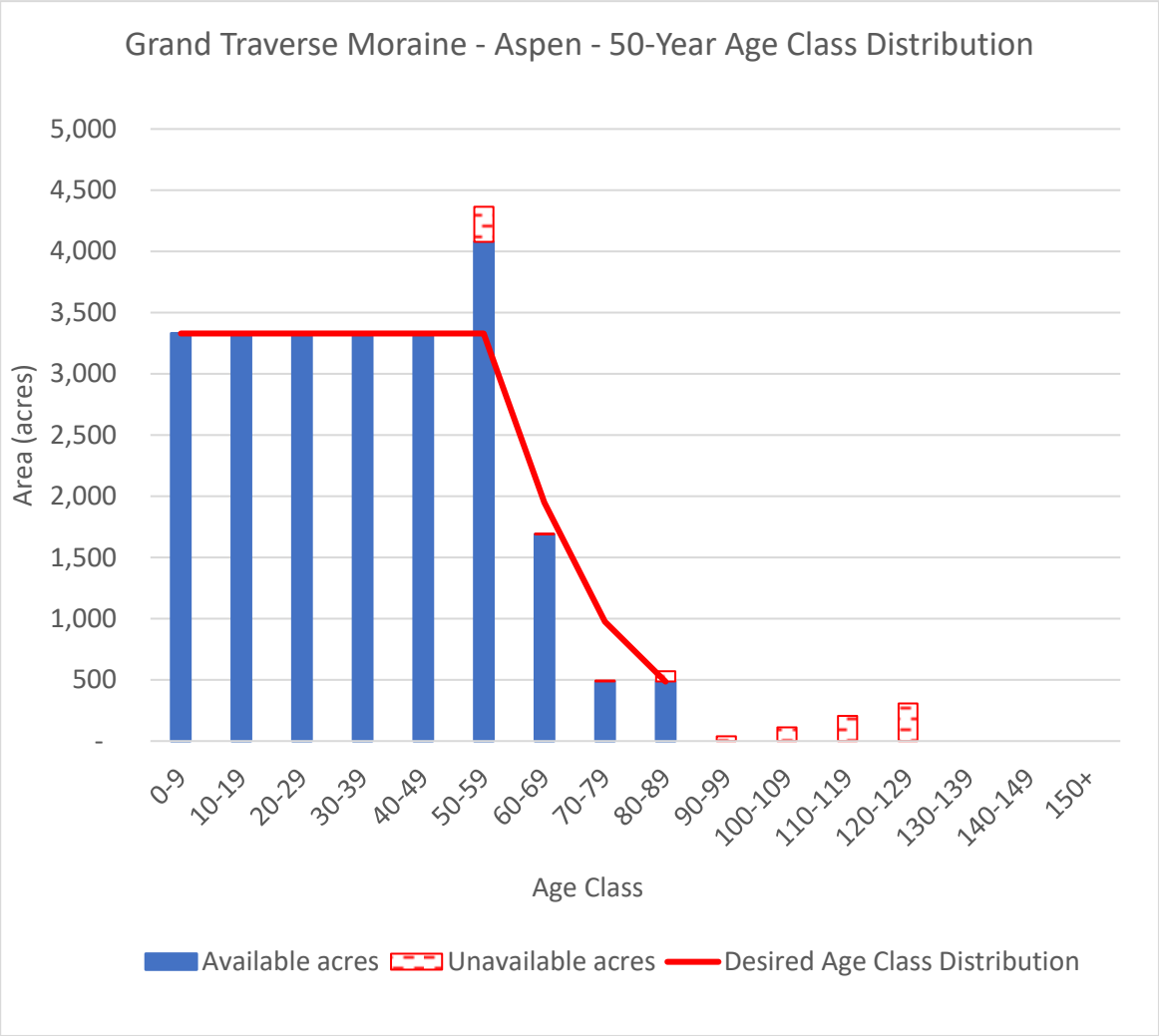


Figure 5. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 6) will concentrate the manageable acres of aspen in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest (Figure 7).

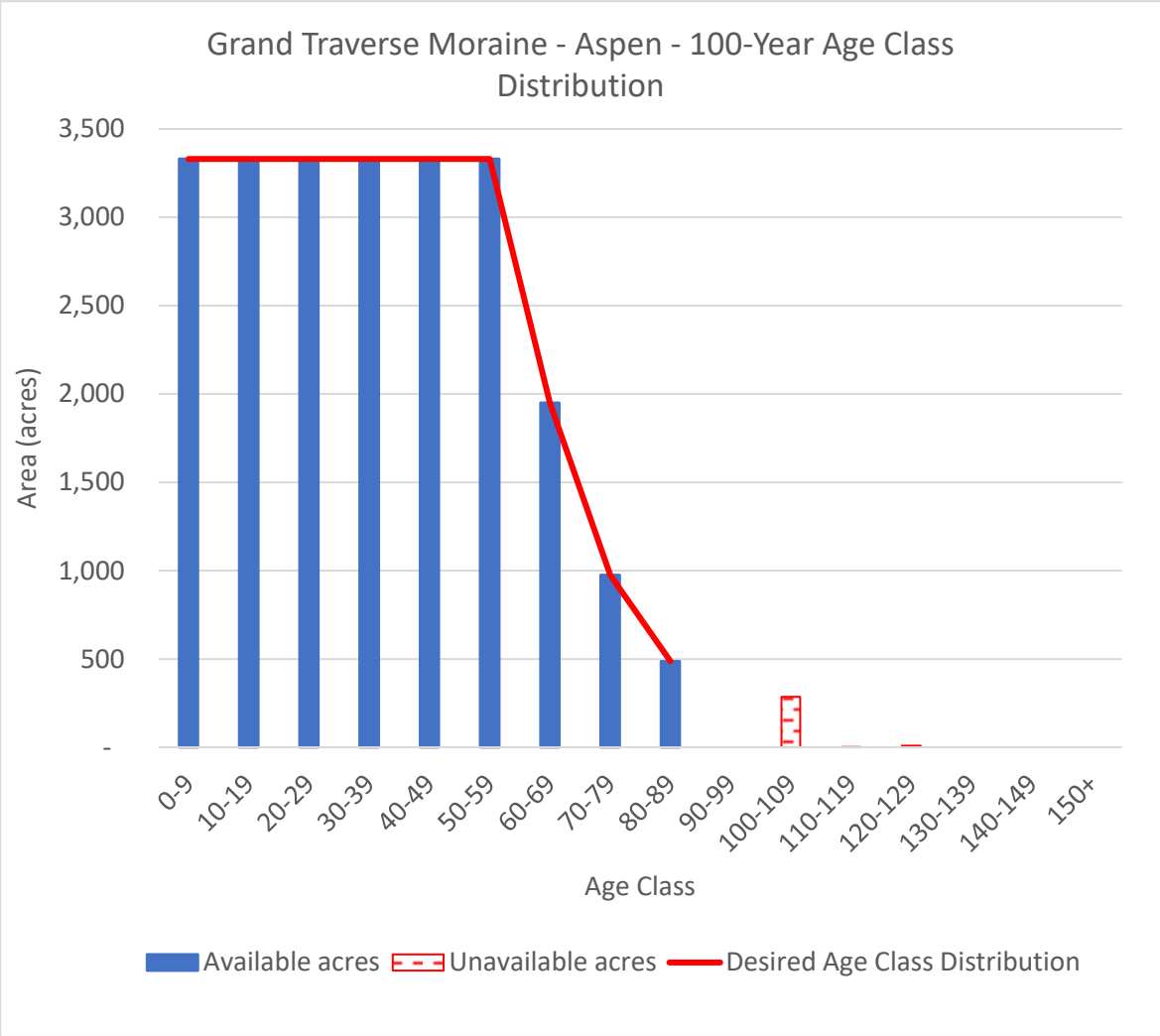


Figure 6. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

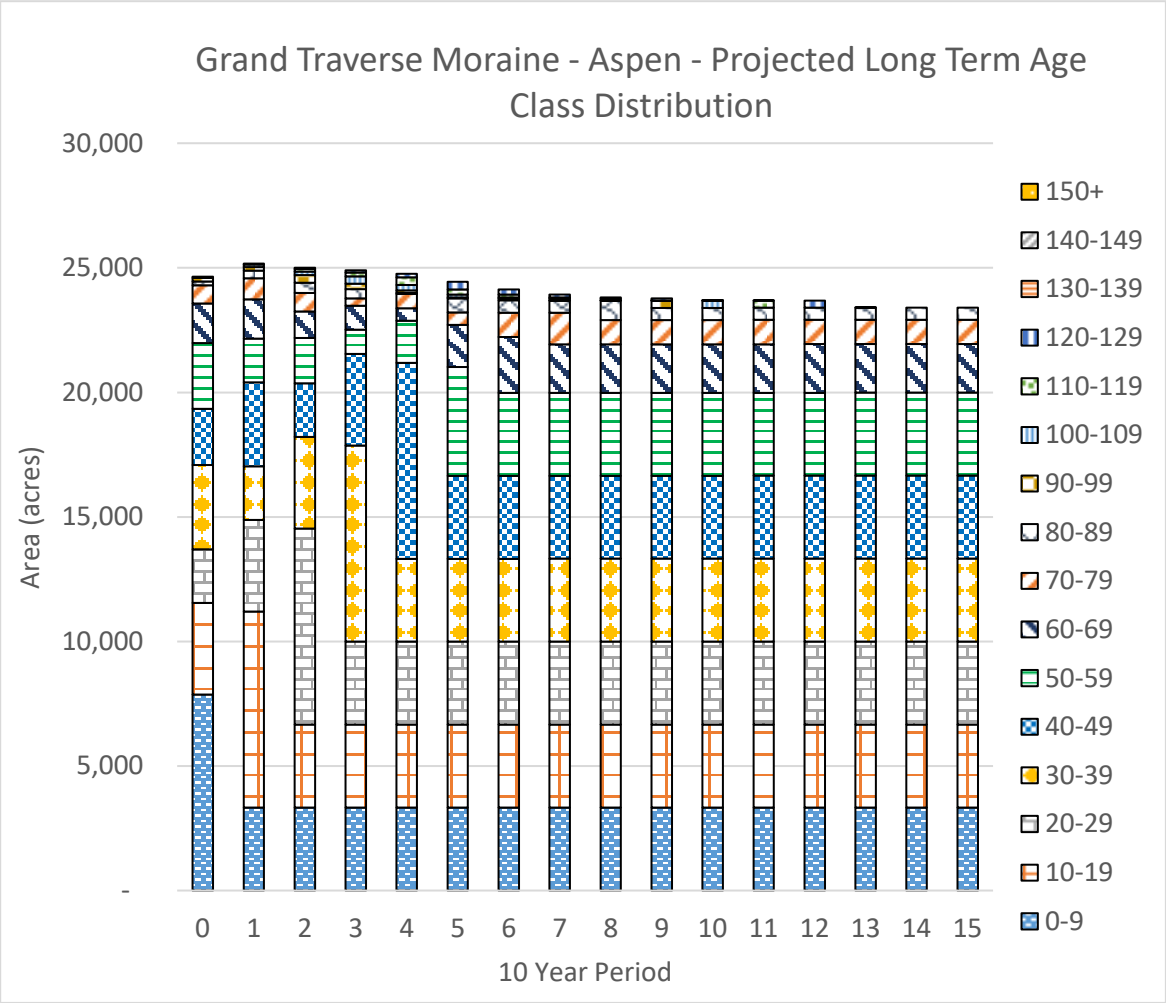


Figure 7. Projected age class distribution for all acres of aspen over the next 150 years.

Management actions

There are 2,813 acres of projected clearcut harvest in the aspen cover type and an additional 526 acres that will be converting into aspen from other cover types. These total to an expected 3,339 acres of regeneration in the aspen cover type over the next 10 years. This falls very close the desired establishment of 3,394 acres per decade.

Northern hardwoods

Current condition

Most of the northern hardwood cover type is currently between a stand age of 90 and 119 years old in the Grand Traverse Moraine Management Area (Figure 8). The past management regime has been primarily single tree selection which allows for stand age to continue to increase over time. Some stands are beginning to achieve an uneven-aged condition where a featured stand age becomes less evident, but the dominant age of these stands will likely increase past 150 years old prior to a younger age cohort becoming the prominent component of these stands.

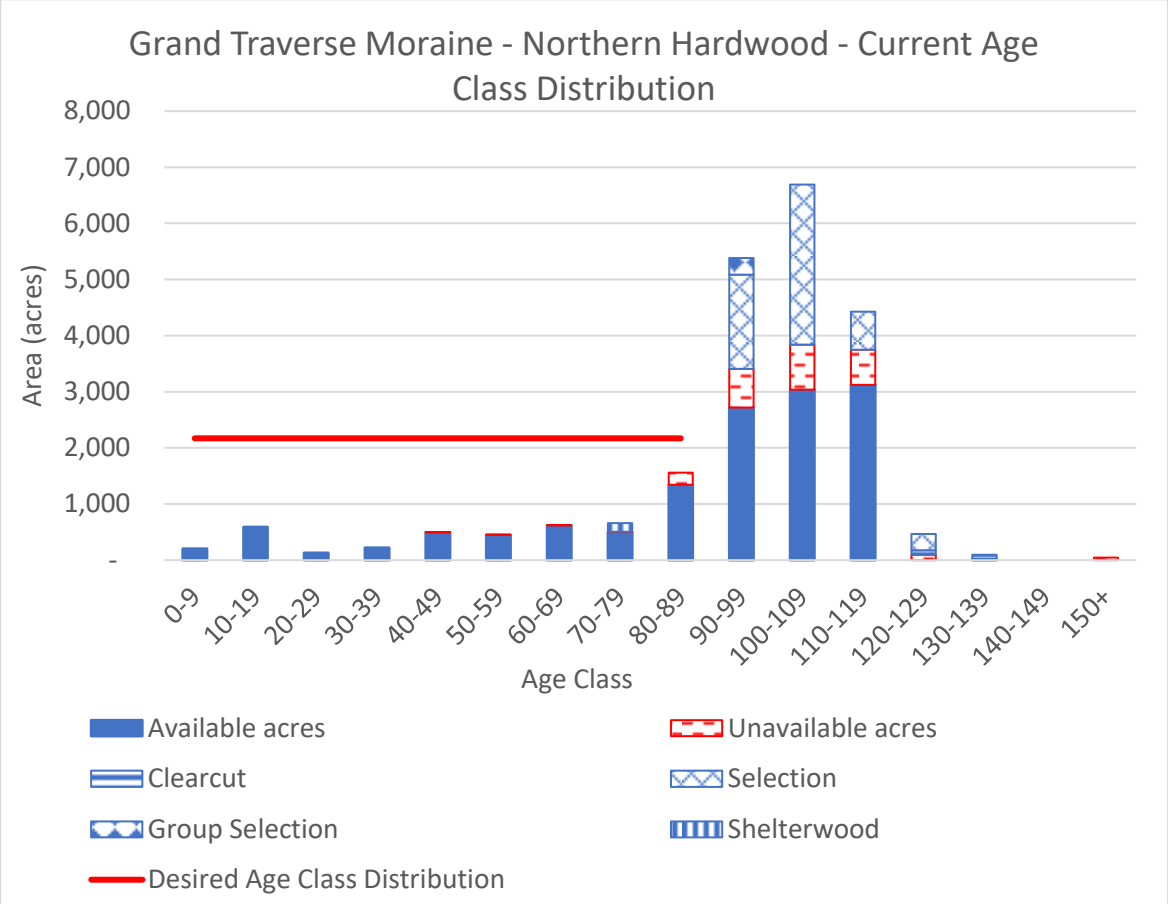


Figure 8. Current age class distribution and projected harvests in the northern hardwood cover type.

The area of northern hardwood is well distributed in the ideal basal area classes for optimal growing conditions in the Grand Traverse Moraine Management Area (Figure 9). Current conditions are a result of a selection harvest regime that has been in place in this management area for decades.

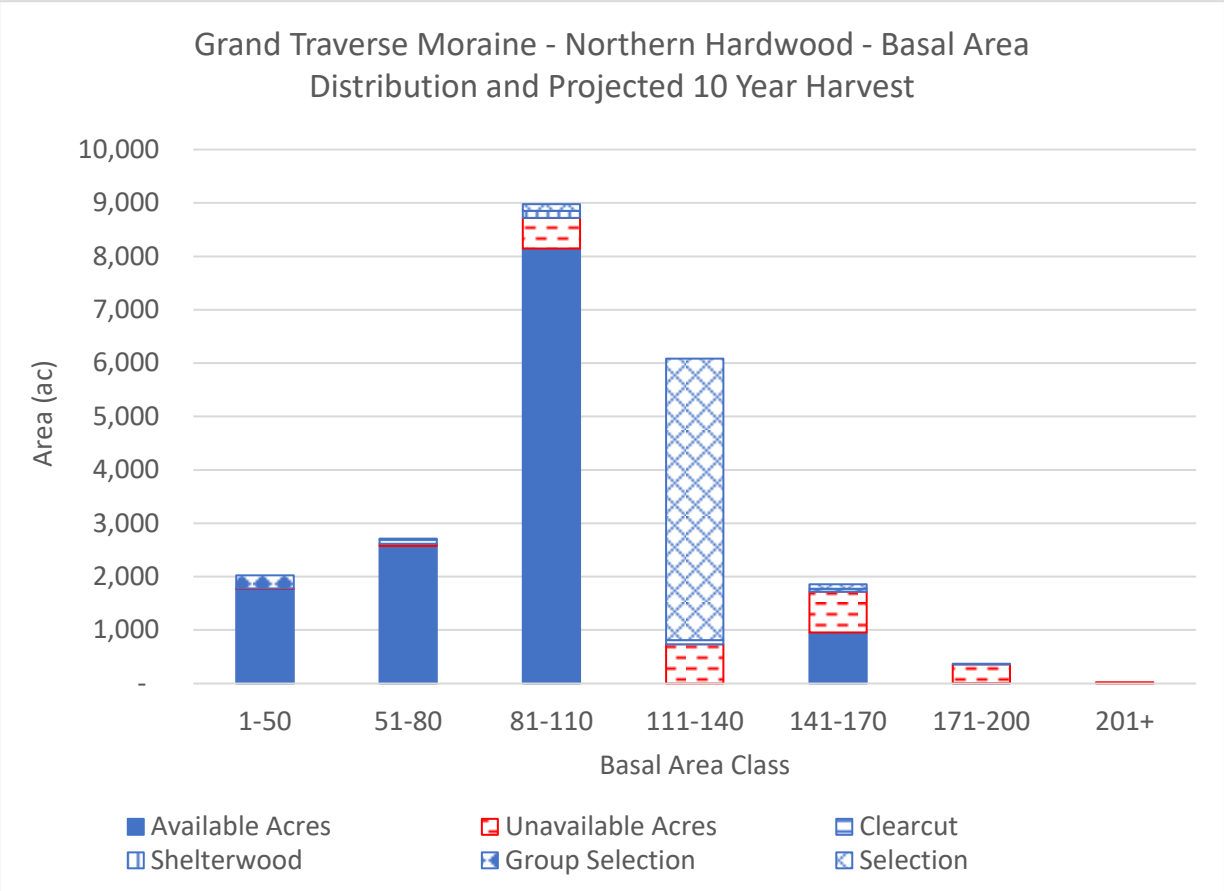


Figure 9. Current basal area distribution of the northern hardwood cover type as well as the projected harvests from each basal area class.

Only 3% of the acres in northern hardwoods in the Grand Traverse Moraine Management Area are unavailable for commercial harvest. Opportunities to utilize a proportion of a stand to include in gaps will vary based on the age and condition of a stand, but the guidance for a typical log-sized hardwood stand will be 10-20% of the area, with the remaining 80-90% subject to thinning or no harvesting. Small group selection is the primary silvicultural treatment projected during this 10-year planning period. A portion of this cover type meets the habitat requirements for black-throated blue warbler and marten (Table 10).

Table 10. Featured species with northern hardwoods as a priority habitat cover type, habitat variables and current acres (e.g., potential habitat).

Featured Species	Featured Species Habitat – Northern Hardwood	Northern Hardwood Habitat Acres - Available	Northern Hardwood Habitat Acres - Unavailable
Black-Throated Blue Warbler	Age Category: 80+ Size Category: Sawlog Basal Area: 81+	13,423	2,437
Marten	Age Category: 40+ Size Category: Pole, Sawlog Basal Area: 81+	14,778	2,447

Desired future condition

The projected long-term cover type trend for northern hardwood is stable in the Grand Traverse Moraine Management Area (Table 7). There are only about 149 projected acres transitioning into this cover type from other cover types forecasted in this management area.

The desired basal area distribution is a bell-shaped curve where a significant majority of the area is kept in the 81-110 basal area class with recently harvested stands occupying the 51-80 class and stands that are ready for harvest occupy the 111-140 basal area class.

Regeneration and recruitment continue to be a focus in the northern hardwood cover type across this management area. The long-term sustainability of this cover type in an uneven-aged silvicultural regime is dependent on the successful establishment of northern hardwood species as well as the recruitment of those seedlings and saplings into the pole and saw log classes. The Grand Traverse Moraine Management Area will take several decades to reach the desired future condition.

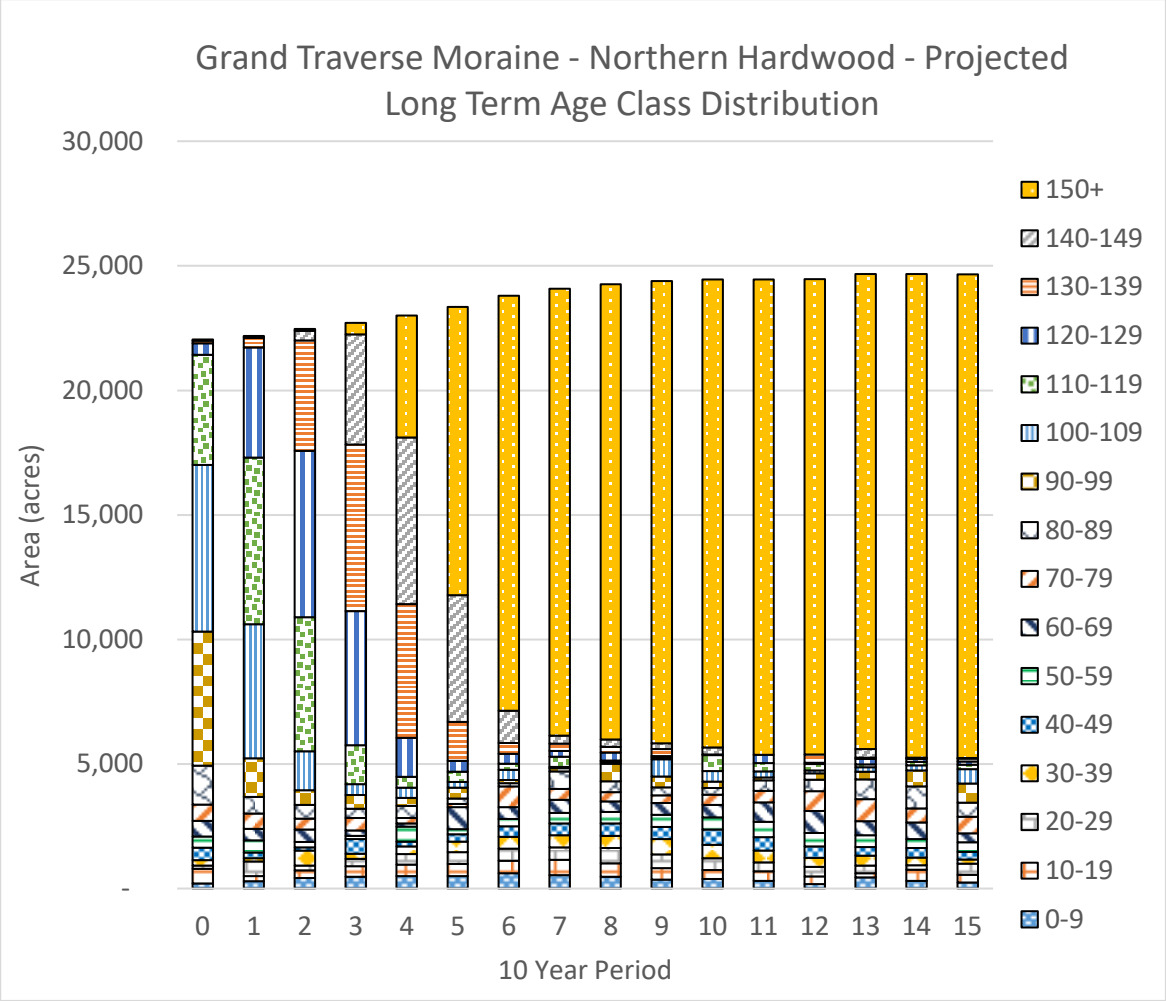


Figure 10. Projected age class distribution for all acres of northern hardwood over the next 150 years.

Management actions

The desired forest conditions and associated featured species habitat will be maintained and achieved through continued application of the projected harvest regimes. It includes 5,494 acres of selection, 294 acres of group selection, 151 acres of shelterwood and 157 acres of clearcut harvest methods (Table 3). Canopy gaps should be used to encourage diverse regeneration of northern hardwood species while maintaining an overall long-term mature forest closed canopy landscape condition.

Planted red pine

Current condition

The largest amount of the planted red pine cover type is currently between a stand age of 60 and 79 years old in the Grand Traverse Moraine Management Area (Figure 11). Nearly all the acres are available for commercial management; only 0.1% of the cover type is considered unavailable (Table 3). The past management regime has been primarily thinning every 10 to 20 years to achieve an approximate residual basal area of 120 square feet. The age class distribution in this cover type is in a very unbalanced condition.

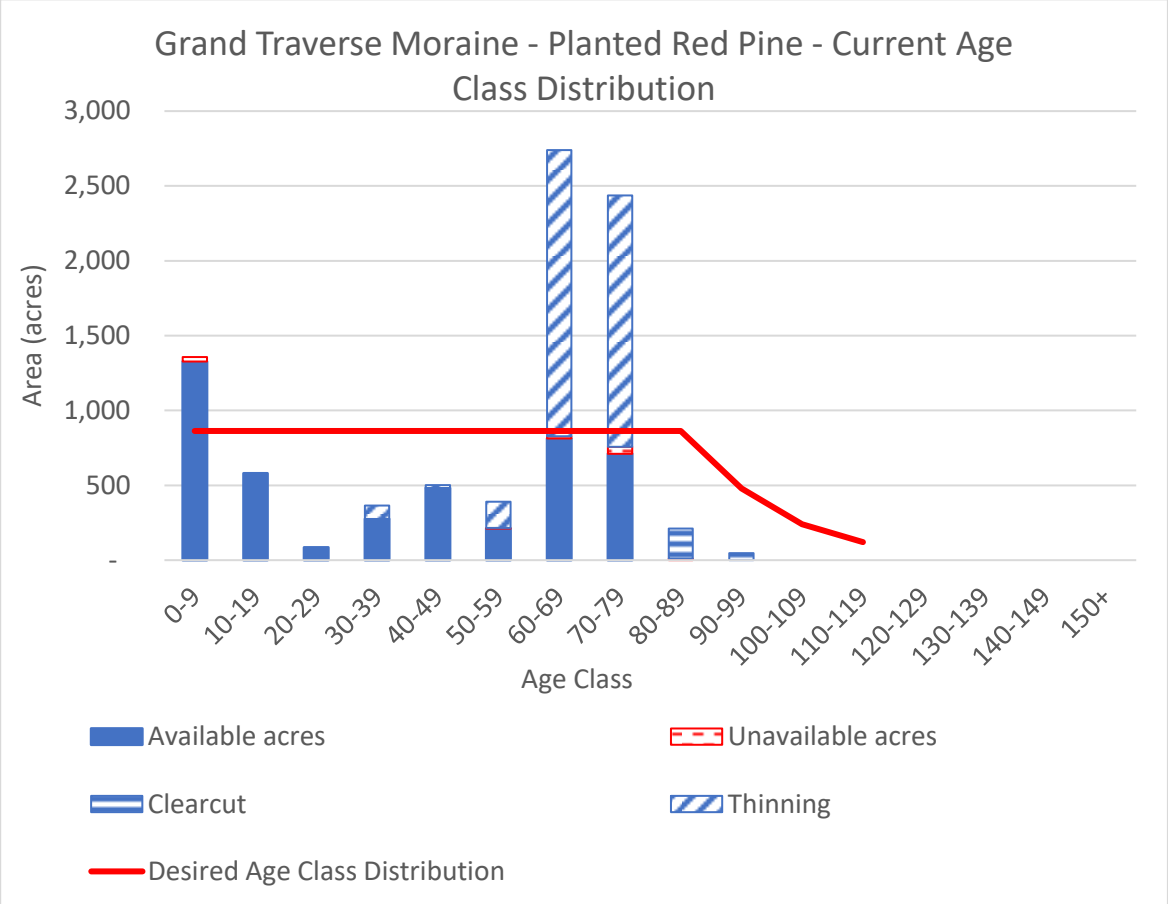


Figure 11. Current age class distribution and projected harvests in the red pine cover type.

Current conditions are a result of plantations established during the 1930s by the Civilian Conservation Corps, most of which reached maturity during the previous two planning periods. Additionally, there have been consistent commercial harvests and regeneration efforts on available planted red pine acres during the previous planning period.

Desired future condition

The projected long-term cover type trend for planted red pine is stable in the Grand Traverse Moraine Management Area with only a 2.9% increase in acres. There are very few transitions into this cover type

from other cover types forecasted in this management area and fewer transitions from planted red pine to other cover types.

The long-term goal for this cover type is balanced age classes between 0 and 80 years old with a tail out to 110 years old for all available planted red pine stands in this management area. Maintaining lower acreage in old age classes continues to be desirable to lessen the prevalence and severity of diseases and to reduce the threat of damaging wildfire.

The end of the planning period will result in the establishment of about 498 acres of regeneration in the upcoming 0-9 age class given the amount of merchantable and available acres in the older age classes (Figure 12). Progress toward the long-term age class distribution of planted red pine will take many decades in the management area.

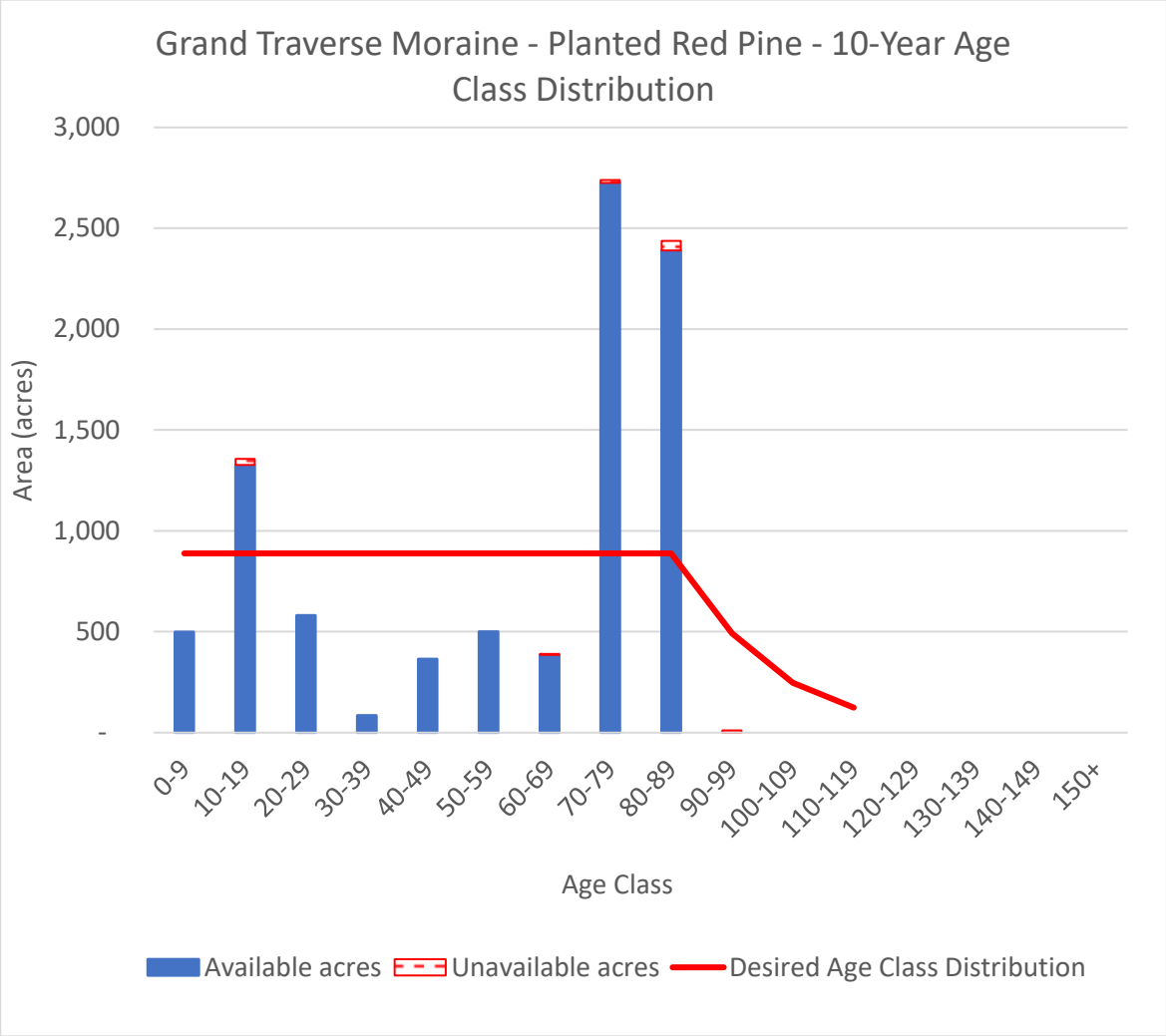


Figure 12. Short-term future age class distribution of the planted red pine cover type after planned harvests have taken place.

The mid-term age class distribution of planted red pine is beginning to reach the desired future condition for available acres (Figure 13) but still has a deficit in the 40- to 49-year-old and 60- to 89-year-

old age class. There is an increase in acres in the older age classes, beyond the desired age of 80 years old, due to the number of acres already at 70 years old in this management area. As is often the case, unbalanced age classes may result in the need to leave some acres in older age classes to achieve the desired age class distribution in future planning periods.

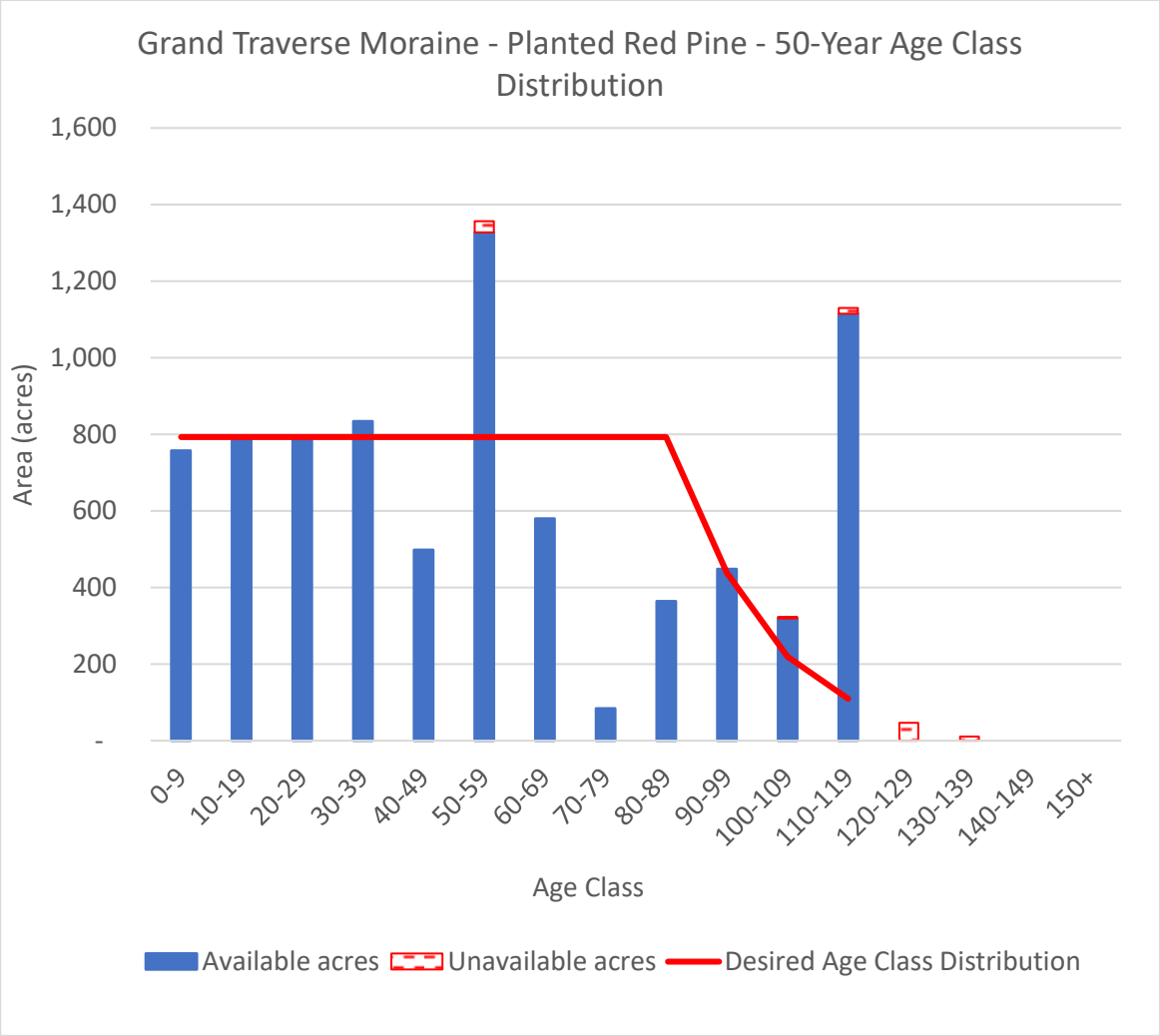


Figure 13. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution of 888 acres (Figure 14) will concentrate the manageable acres of planted red pine in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest.

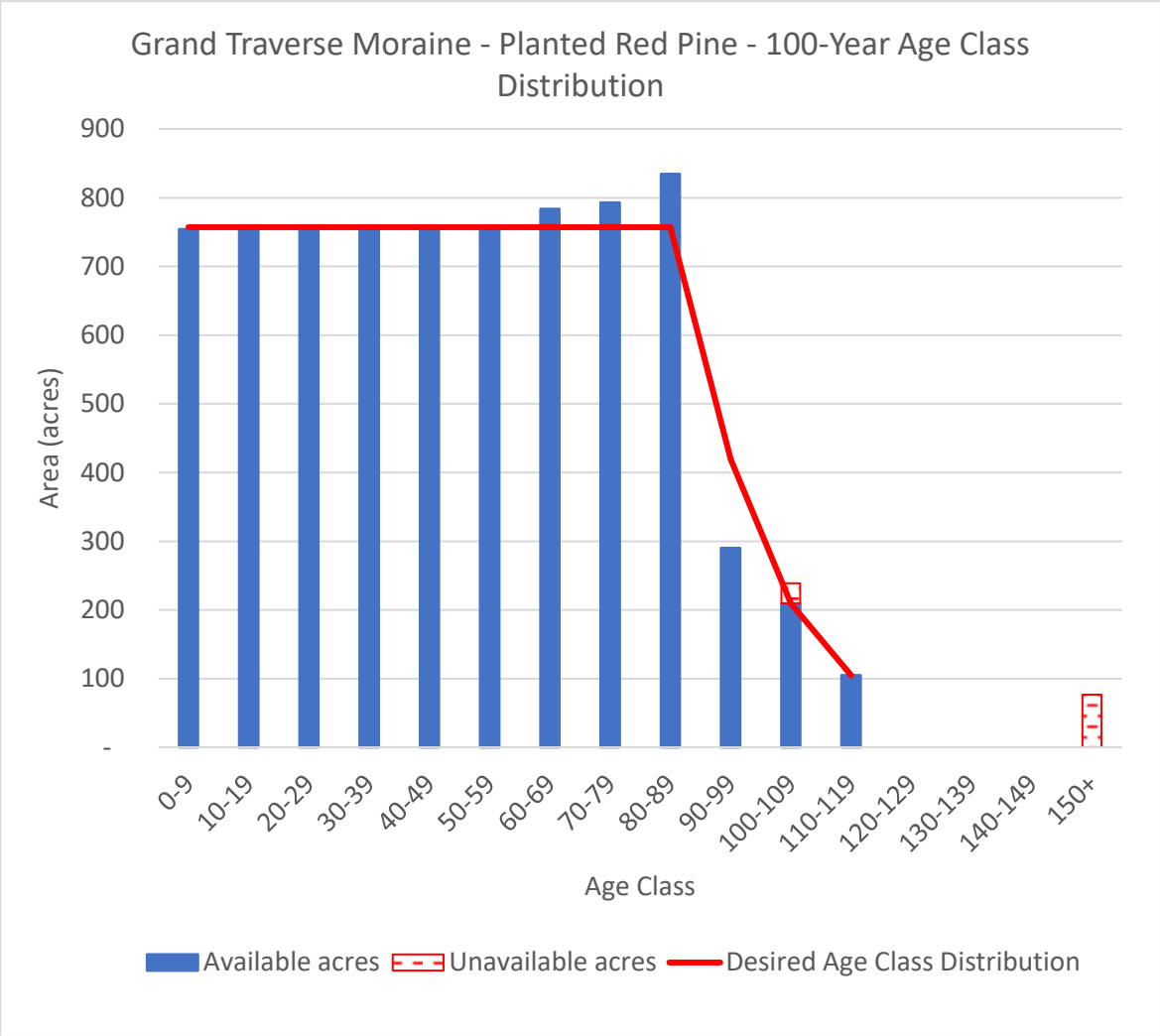


Figure 14. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

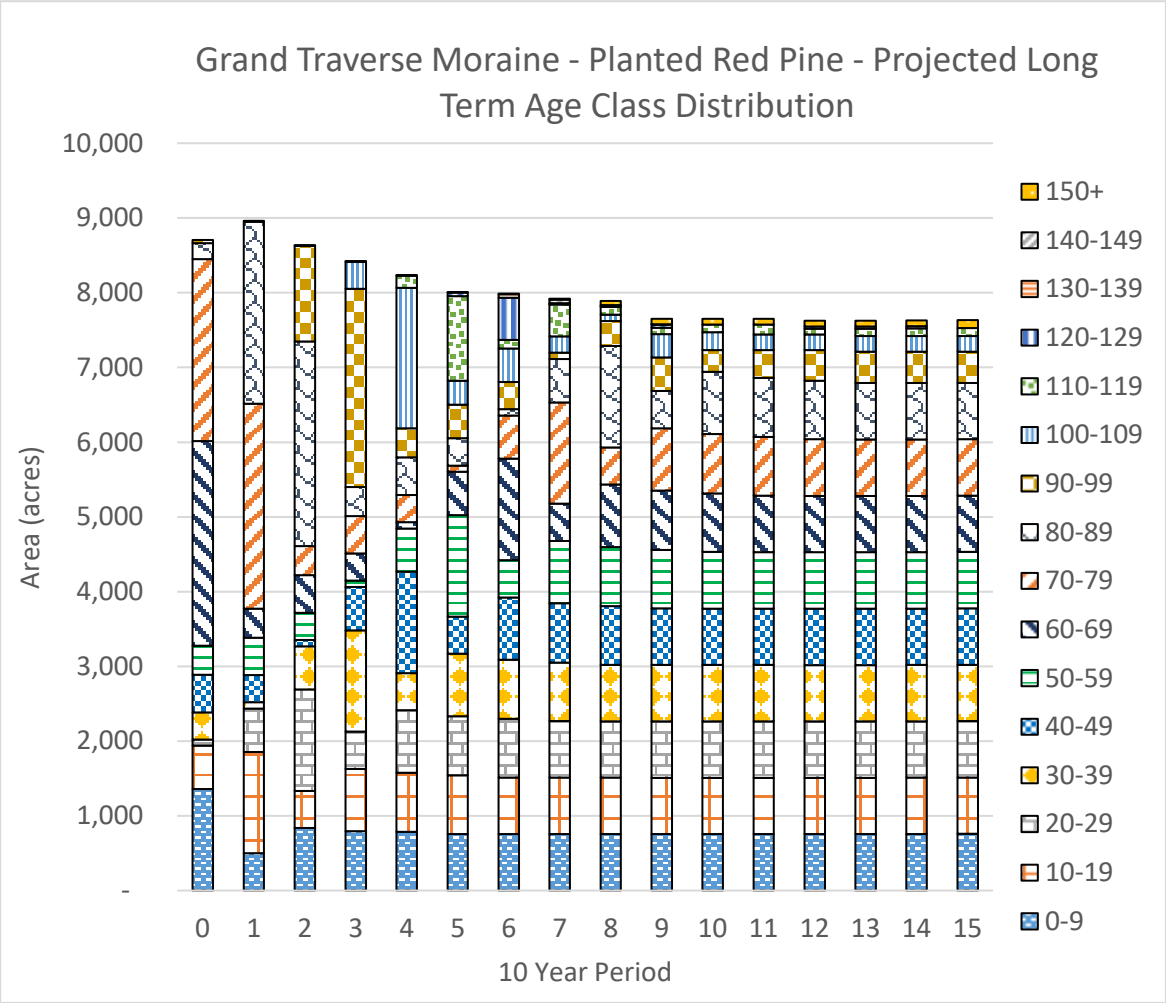


Figure 15. Projected age class distribution for all acres of planted red pine over the next 150 years.

Management actions

There are 245 acres of projected clearcut harvest in the planted red pine cover type during this planning period and 253 acres converting into the planted red pine cover type. This is well below the desired establishment of 889 acres per decade because of the current unbalanced condition residing in mostly three different age classes. In addition to clearcut acres, there are 3,873 acres projected for thinning in this cover type.

Lowland deciduous

Current condition

The largest amount of the lowland deciduous cover type is currently between a stand age of 70 and 119 years old in the Grand Traverse Moraine management area (Figure 16). Due to much of the cover type being unavailable there are not many acres outside of this age group giving it almost a bell-shaped curve.

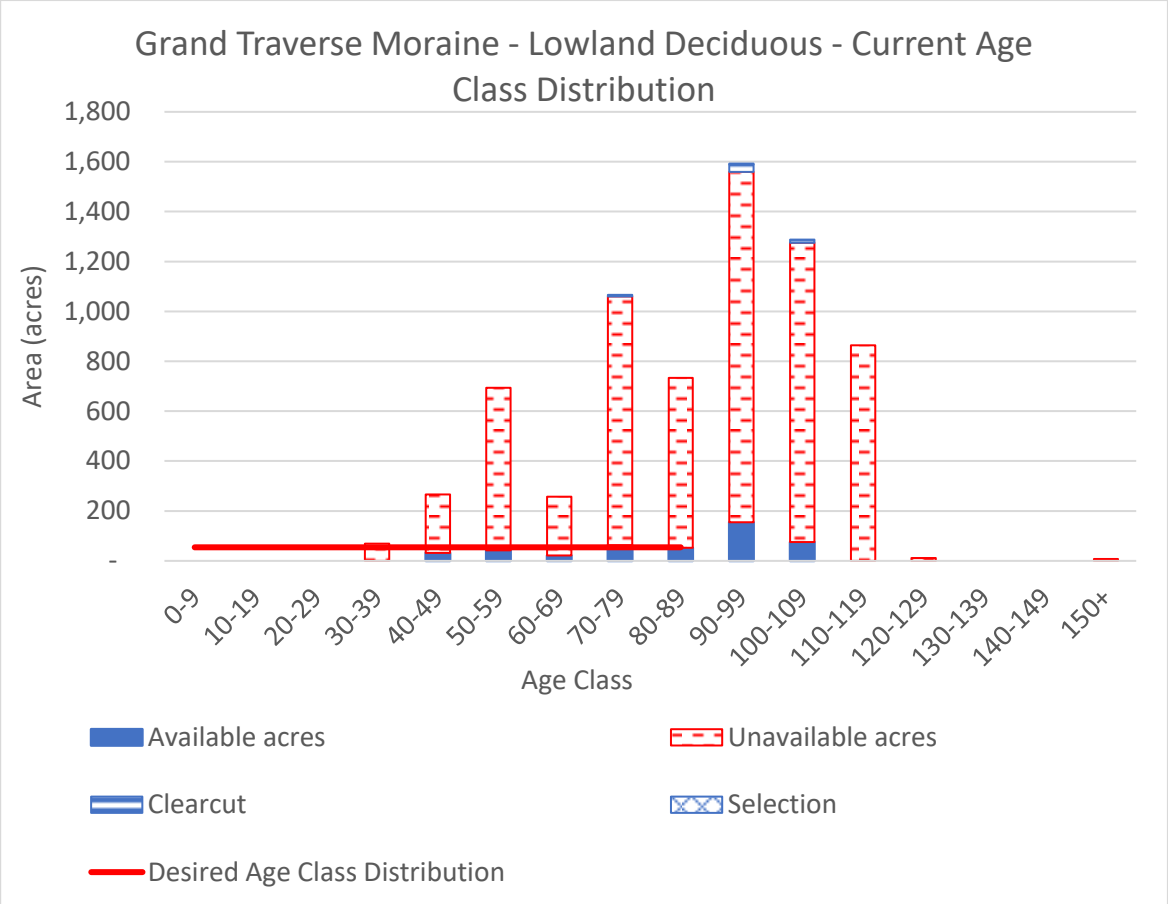


Figure 16. Current age class distribution and projected harvests in the lowland deciduous cover type.

Current conditions are a result of the lowland deciduous being largely unavailable for harvesting. With that, the majority of the lowland deciduous is distributed in the 80-140 basal area classes (Figure 17). The majority of this is not available due to landscape conditions being too wet. A portion of this cover type meets the habitat requirements for wood thrush (Table 144).

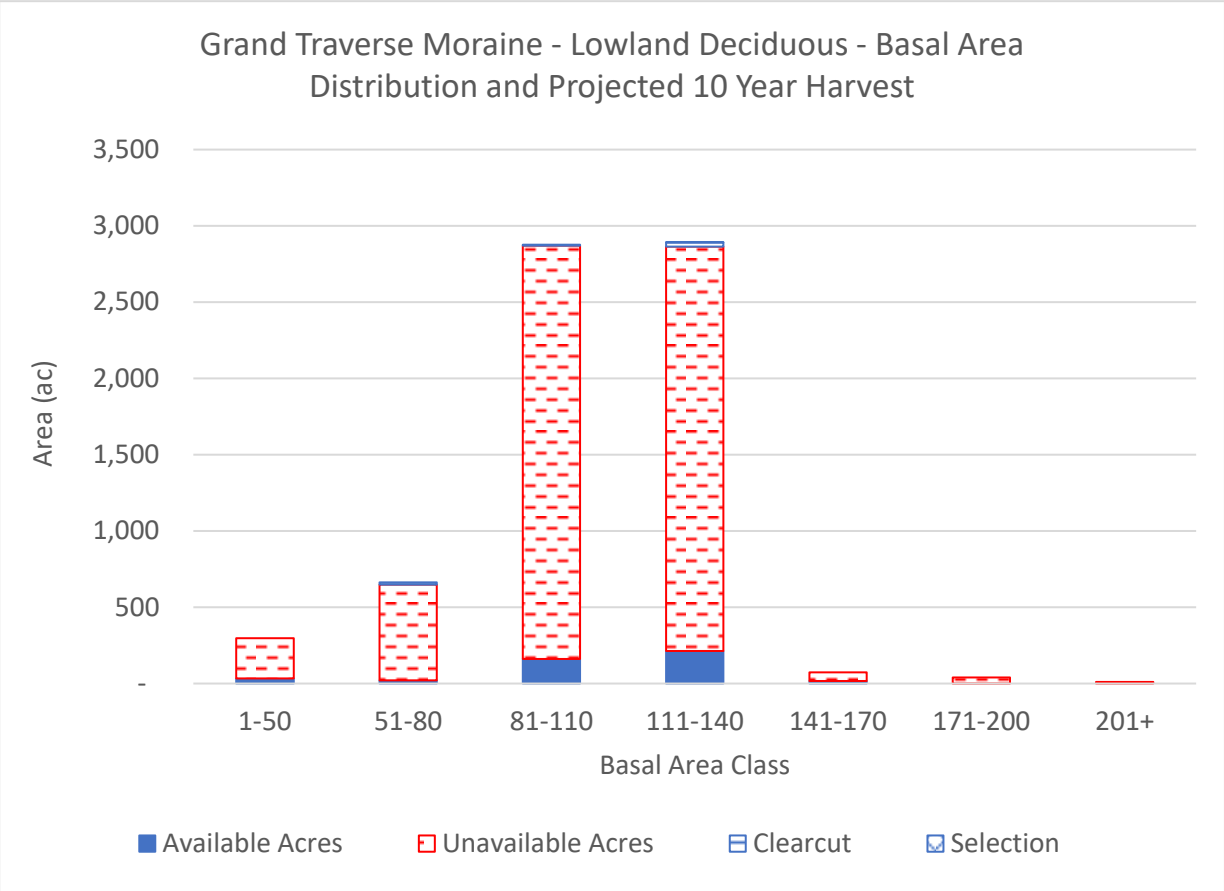


Figure 17. Current basal area distribution of the northern hardwood cover type as well as the projected harvests from each basal area class.

Table 11. Featured species with lowland deciduous as a selected habitat cover type, habitat variables and current acres (e.g., potential habitat).

Featured Species	Featured Species Habitat – Lowland Deciduous	Lowland Deciduous Habitat Acres - Available	Lowland Deciduous Habitat Acres - Unavailable
Wood Thrush	Age Category: 40+ Size Category: Sawlog Basal Area: 81+	392	5,007

Desired future condition

The projected long-term cover type trend for lowland deciduous is stable in the Grand Traverse Moraine Management Area. There are no transitions into this cover type from other cover types forecasted in this management area and no transitions from lowland deciduous to other cover types due to being mostly unavailable for harvesting.

The long-term goal for this cover type is to maintain this cover type on the landscape. Due to much of it being unavailable for harvest this cover type will continue to age and eventually make it to the older age classes of 150-plus (Figure 18).

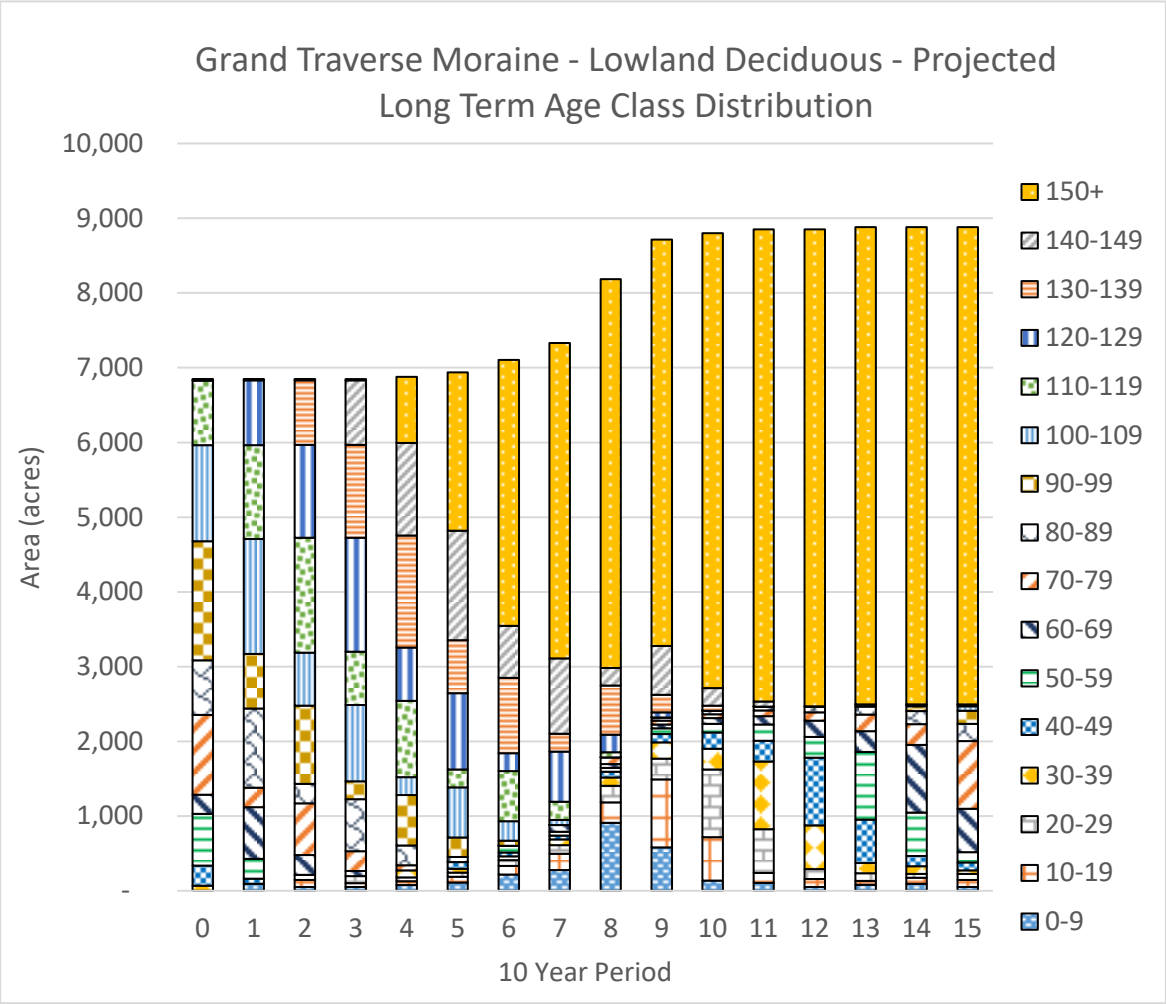


Figure 18. Projected age class distribution for all acres of planted red pine over the next 150 years.

Management actions

The desired forest conditions and associated featured species habitat will be maintained and achieved through continued application of the projected restart harvest regime on 491 available acres (Table 3). This will be approximately 47 acres per decade (Table 5).

Conservation area network

High conservation value areas

There are up to nine different high conservation value area (HCVA) types that can be found in each management area (Table 12; see Biodiversity in Section 3 for more information).

Table 12. High conservation value areas within the Grand Traverse Moraine Management Area.

High Conservation Value Area Type and Name	Acres
Forest Habitat Core Interior	**3,316**
--	3,316
GEM	**1,484**
Little Betsie	1,484
Natural Rivers Vegetative Buffer	**384**
--	384
Natural Rivers Zoning District	**1,497**
--	1,497
State Wildlife Management Areas	**1,101**
Grass Lake Flooding SWMA	469
Lake DuBonnet / Mud Lake Flooding SWMA	632
GEMS	**1,484**
Little Betsie	1,484
Grand Total	**9,267**

Ecological reference areas

Ecological reference areas are a type of HCVA and are higher quality examples of functioning ecosystems that are primarily influenced by natural ecological processes.

Table 13. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 14. Ecological reference areas within the management area.

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	Number of Occurrences
Existing ERA	Bog	AB	G3G5	S4	1

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	Number of Occurrences
Existing ERA	Bog	B	G3G5	S4	1
Existing ERA	Hardwood-Conifer Swamp	BC	G4	S3	1
Existing ERA	Northern Fen	AB	G3	S3	2
Existing ERA	Northern Fen	B	G3	S3	2
Existing ERA	Northern Hardwood Swamp	C	G4	S3?	1
Existing ERA	Rich Conifer Swamp	B	G4	S3	1
Existing ERA	Rich Conifer Swamp	BC	G4	S3	1
Grand Total	-	-	-	-	**10**

Special conservation areas

Reviewable special conservation areas (SCAs; Table 15) refers to those SCA types that may be reviewed or updated through the compartment review process as needed. Static SCAs (Table 16) refers to those SCA types that generally do not change or require updating (see Biodiversity in Section 3 for more information).

Table 15. Reviewable special conservation areas within the Grand Traverse Moraine Management Area.

Reviewable Special Conservation Area Type and Name	Acres
Concentrated Recreational Area	**33**
Unspecified	33
Habitat Area or Habitat Corridor	**8,700**
61004041	762
Deadstream Swamp	1,342
Little Betsie GEMS	4,135
Solon Swamp	1,516
Unspecified	800
Walters Loop	144
Possible Type 1 or Type 2 Old Growth	**180**
--	180
Spring, Wetlands, or Riparian Areas	**1,905**
61015024	240
Unspecified	606
Grand Total	**9,758**

Table 16. Static special conservation areas within the Grand Traverse Moraine Management Area.

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Designated Trout and Cold Water Stream Buffer	**-**	**2,001**

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
--	-	515
Bear Creek	-	209
Beaver Creek	-	16
Betsie River	-	122
Boardman River	-	35
Brundage Creek	-	73
Carter Creek	-	19
Cedar Run	-	31
Collison Creek	-	17
Dair Creek	-	116
Dutchman Creek	-	38
First Creek	-	3
Greens Creek	-	32
Jaxon Creek	-	85
Kinney Creek	-	66
Lemon Creek	-	123
Mason Creek	-	19
North Branch Platte River	-	37
Pickerel Creek	-	41
Platte River	-	204
Second Creek	-	66
Stanley Creek	-	14
Swainston Creek	-	17
Third Creek	-	66
Victoria Creek	-	38
Designated Trout and Coldwater Streams	**74.8**	**-**
--	19.6	-
Bear Creek	8.1	-
Beaver Creek	0.6	-
Betsie River	4.4	-
Boardman River	1.3	-
Brundage Creek	2.7	-
Carter Creek	0.7	-
Cedar Run	1.2	-
Collison Creek	0.6	-
Dair Creek	4.3	-
Dutchman Creek	1.4	-
First Creek	0.1	-
Greens Creek	1.2	-
Jaxon Creek	3.1	-

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Kinney Creek	2.4	-
Lemon Creek	4.5	-
Mason Creek	0.7	-
North Branch Platte River	1.6	-
Pickerel Creek	1.5	-
Platte River	7.4	-
Second Creek	2.4	-
Stanley Creek	0.5	-
Swainston Creek	0.6	-
Third Creek	2.4	-
Victoria Creek	1.5	-
Important Bird Areas	**-**	**77,575**
Grand Traverse Bay basin (Albert Ecoregion Vii.5.2)	-	1,424
Manistee National Forest Red-shouldered Hawk IBA	-	76,151
Mussel Stream Group 2 - State threatened or endangered	**3.2**	**-**
Collison Creek-Platte River	3.2	-
Wild and Scenic Rivers	**1.2**	**-**
Bear Creek Wild and Scenic River	1.2	-
Wood Turtle Stream 100ft Buffer	**-**	**597**
Bear Creek	-	92
Betsie River	-	230
Boardman River	-	14
Platte River	-	195
Third Creek	-	66
Wood Turtle Stream 660ft Buffer	**-**	**3,541**
Bear Creek	-	576
Betsie River	-	1,167
Boardman River	-	88
Platte River	-	1,285
Third Creek	-	424
Grand Total	**79.1**	**83,714**

Rare species

Rare species occurrences are compiled from the Michigan Natural Features Inventory Biotics database (Table 18, Table 18, Table 20) and do not necessarily include all rare species found in this management area due to biases in survey effort and verifiable observation reporting over time.

Table 17. *Rare animal and plant species conservation status key.*

Status	Status
E = endangered	LE = listed endangered
T = threatened	LT = listed threatened
SC = special concern	PDL = proposed for delisting

Table 18. Rare animal occurrence within the Grand Traverse Moraine Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Accipiter gentilis	Northern goshawk	T	-	1
Animal	Alasmidonta viridis	Slippershell	T	-	1
Animal	Bombus borealis	Northern amber bumble bee	SC	-	1
Animal	Bombus terricola	Yellow banded bumble bee	SC	-	1
Animal	Buteo lineatus	Red-shouldered hawk	SC	-	25
Animal	Coregonus artedi	Lake herring or Cisco	T	-	4
Animal	Cygnus buccinator	Trumpeter swan	SC	-	1
Animal	Emydoidea blandingii	Blanding's turtle	SC	-	1
Animal	Gavia immer	Common loon	T	-	9
Animal	Glyptemys insculpta	Wood turtle	T	-	7
Animal	Haliaeetus leucocephalus	Bald eagle	SC	-	11
Animal	Lasmigona compressa	Creek heelsplitter	SC	-	1
Animal	Lasmigona costata	Flutedshell	SC	-	1
Animal	Lithobates palustris	Pickerel frog	SC	-	1
Animal	Necturus maculosus	Mudpuppy	SC	-	2
Animal	Notropis anogenus	Pugnose shiner	E	-	1
Animal	Pandion haliaetus	Osprey	SC	-	3
Animal	Sagittunio nasutus	Eastern pondmussel	E	-	1
Animal	Sistrurus catenatus	Eastern massasauga	T	LT	1
Animal	Terrapene carolina carolina	Eastern box turtle	T	-	1
Animal	Utterbackia imbecillis	Paper pondshell	SC	-	1
Animal	Vermivora chrysoptera	Golden-winged warbler	T	-	2
Total	-	-	-	-	**77**

Table 19. Rare plant occurrence within the Grand Traverse Moraine Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Plant	Panax quinquefolius	Ginseng	T	-	2
Total	**-**	**-**	**-**	**-**	**2**

Table 20. Other rare occurrence within the Grand Traverse Moraine Management Area.

Non-ecological reference area natural communities

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Other	**-**	Great blue heron rookery	-	-	2
Total	**-**	**-**	**-**	**-**	**2**

Natural communities that are identified with an element occurrence in the MNFI Biotics database, but that have not been given an additional ecological reference area (ERA) designation, are recognized and managed accordingly (Table 21).

Table 21. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 22. Non-ecological reference area natural communities within the Grand Traverse Moraine Management Area.

Community Type	Element Occurrence Rank	State Rank	Global Rank	Number of Occurrences
Rich Conifer Swamp	CD	S3	-	2
Grand Total	**-**	**-**	**-**	**2**

Forest health

Forest health concerns, both native and non-native, can have impacts on stand conditions and management decisions. The following insects (Table 23) and diseases (Table 24) could have an impact on management during the planning period and may need to be monitored and/or addressed.

Table 23. Defoliating insects of concern in the Grand Traverse Moraine Management Area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Spongy moth	Lymantria dispar	Non-native	Yes
Forest tent caterpillar	Malacosoma disstria	Native	Yes
Hemlock wooly adelgid	Adelges tsugae	Non-native	-

Watch for and retain lingering ash with potential resistance to emerald ash borer. Monitor hemlock for hemlock wooly adelgid infestations.

Table 24. Maladies of concern in the Grand Traverse Moraine Management Area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Canker (stem infections)	Various	Various	Yes
Armillaria root rot	Armillaria spp.	Native	-
Oak decline	Various	Various	Yes
Heterobasidon root disease	Heterobasidion irregulare	Native	-
Beech bark disease	Cryptococcus fagisuga	Non-native	Yes

Monitor oak for signs of oak wilt and follow statewide guidance. Monitor planted red pine for Heterobasidion root disease and follow the guidance. Monitor and report any surviving beech for possible beech bark disease resistance. Watch for symptoms of beech leaf disease.

Aquatic resources

Riparian habitat

A total of 88 miles of streams and rivers are found in the management area (Table 25). Streams/rivers classified as cold types comprise approximately 70% of the riverine mileage.

Table 25. Classification type and length of streams/rivers found within the management area.

Type	Length (miles)
Cold Stream	40
Cold Small River	10
Cold Transitional Stream	6
Cold Transitional Small River	6
Cold Transitional Large River	0
Warm Transitional Stream	17

Type	Length (miles)
Warm Transitional Small River	9
Warm Transitional Large River	0
Warm Stream	0
Warm Small River	0
Warm Large River	0

Lacustrine habitat

A total of 28 lakes and ponds of at least 1 surface acre are found in the management area (Table 26).

Table 26. Size and number of lakes and ponds located within the management area.

Lake Size Class (acres)	Number
1-99	18
100-499	4
500+	6

Wetlands

A total of 20,186 acres of wetlands are found in the management area (Table 27). Forested wetlands comprise approximately 95% of wetland types found in the management area.

Table 27. Area of emergent, forested and riverine wetland types found within the management area.

Wetland Type	Acres
Emergent	812
Forested	19,221
Riverine	153

Vernal pools and seeps

A total of 706 acres of vernal pools and seeps have been inventoried in the management area, and 2,918 acres of seeps have been identified.

Riparian vegetation cover

Aspen and lowland deciduous are the predominant cover types present in a 100-meter riparian zone located next to streams/rivers in the management area (Table 28).

Table 28. Largest vegetative cover types (i.e., top 10) and area located in a 100-meter buffer of streams/rivers within the management area.

Cover Type	Acres
Aspen	1,816

Cover Type	Acres
Lowland Deciduous	1,421
Northern Hardwood	947
Marsh	920
Lowland Shrub	890
Lowland Conifers	768
Cedar	755
Lowland Mixed Forest	544
Tamarack	239
Upland Mixed Forest	223

Watershed vegetation cover

The management area includes portions of important watersheds of the Platte and Betsie rivers (Table 29 & Table 30). Aspen is a major cover type of the state forest in each watershed.

Table 29. Largest vegetative cover types (i.e., top five) and area of the Platte River watershed located within the management area.

Cover Type	Acres
Northern Hardwood	13,488
Aspen	9,782
Planted Red Pine	3,224
Mixed Upland Deciduous	1,537
Upland Mixed Forest	1,286

Table 30. Largest vegetative cover types (i.e., top five) and area of the Betsie River watershed located within the management area.

Cover Type	Acres
Aspen	7,643
Northern Hardwood	6,313
Planted Red Pine	2,948
Lowland Deciduous	1,749
Cedar	1,326

Recreation

Access in the Grand Traverse Moraines Management Area for public recreation and management is generally good and there is a well-developed road/trail system. This management area is southwest of Traverse City and east of Frankfort and sees high levels of public recreation use.

An extensive network of snowmobile trails traverses this management area. Nonmotorized trails include nearly 10 miles of the Betsie Valley State Trail, which stretches 22 miles from Frankfort to Mesick along

the former Ann Arbor Railroad. Hiking trails include the Betsie River Pathway (7.9 miles), Lake Ann Trail (5.4 miles) and the Lost Lake Pathway (6.4 miles). The Shore-to-Shore equestrian trail, which is also open to hiking, passes through the north of the management area.

There are nine state forest campgrounds (rustic) within the management area, all providing access to water. Grass Lake and Healy Lake state forest campgrounds are under township management. The two trail camps provide equestrian camping opportunities for those riding the Shore-to-Shore trail and are maintained with the help of the Michigan Trail Riders Association.

Table 31. Designated recreation trails by type

Recreation Category	Recreation Type	# of Miles
Motorized Recreation Trails	Off-Road Vehicle (All Types)	0
Motorized Recreation Trails	Snowmobile	81.6
Nonmotorized Recreation Trails	Hiking	55.1
Nonmotorized Recreation Trails	Equestrian	25.5
Nonmotorized Recreation Trails	Biking	29.7
Nonmotorized Recreation Trails	Hunter Access Trails	0.8
Total	-	**192.7**

Note: Trail-use types may overlap.

Table 32. State forest campgrounds.

Name	# of sites	Eq.	ORV Access
Lake Dubonnet Trail Camp	-	200 (group)	-
Grass Lake State Forest Campground	15		-
Garey Lake Trail Camp	-	200 (group)	-
Lake Ann State Forest Campground	30	-	Yes
Lake Dubonnet State Forest Campground	50	-	Yes
Garey Lake State Forest Campground	12	-	Yes
Platte River State Forest Campground	26	-	Yes
Veterans Memorial State Forest Campground	24	-	-
Healy Lake State Forest Campground	24	-	-

Grass Lake Flooding State Wildlife Management Area is in eastern Benzie County, adjacent to Grass Lake State Forest Campground. The Little Betsie Grouse Enhanced Management Site, 1 mile east of Thompsonville, covers over 4,000 in Benzie County with approximately half in the Grand Traverse Moraine Management Area. It provides high quality habitat for grouse and woodcock with access via hunter walking trails.

Boating access sites provide access to the Boardman, Betsie and Platte rivers, Bear Creek and numerous inland lakes. The Betsie and Boardman rivers are designated natural rivers and are popular for fishing and paddling.

Dispersed recreation such as camping, hunting and mushrooming are also popular in the management area.

Table 33. Areas managed for hunting.

Type	Name	# of Acres
State Wildlife Management Area	Grass Lake Flooding	468.4
Grouse Enhanced Management Site	Little Betsie	1,483.3
Total	-	**1,951.7**

Table 34. Boating access sites.

Name	Waterbody
Bass Lake North	Bass Lake
Bass Lake South	Bass Lake
Bear Creek	Bear Creek
Cedar Hedge Lake	Cedar Hedge Lake
Ellis Lake	Ellis Lake
Garey Lake State Forest Campground	Garey Lake
Grass Lake State Forest Campground	Grass Lake
Green Lake	Green Lake
Hayes Bridge	Platte River
Homestead Dam	Betsie River
Homestead Pond	Homestead Pond
Lake Dubonnet State Forest Campground	Lake Dubonnet
Platte River State Forest Campground	Platte River
Potter Bridge	Bear Creek
River Road	Boardman River
State Road - Bear Creek	Bear Creek
Turtle Lake	Turtle Lake
US 31	Betsie River
Veterans Memorial Park	Platte River

High Sand Plains

State Forest Area:	Location:	Population Centers:
633,253 acres	Northcentral Lower Penninsula	Gaylord, Grayling, Roscommon, Harrison, Houghton Lake and West Branch

Subsection:	Landforms:	Landcover:
Kirtland's Warbler High Sand Plains, Alcona Gravelly Ice Contact and Clare Moraines	Outwash channels and plains, ice-contact sands and ridges and sandy outwash plains	Forested: 540,468 acres Nonforested: 92,785 acres

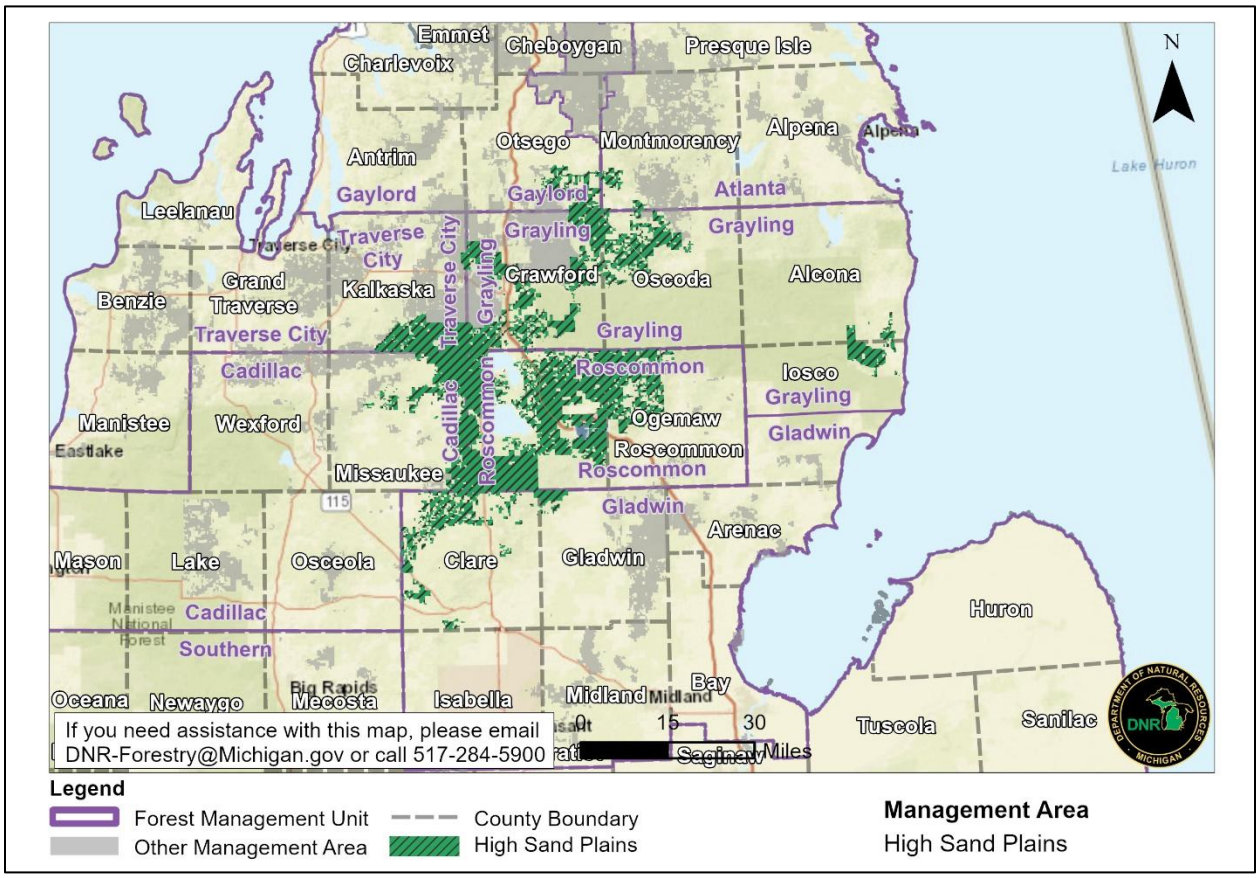


Figure 1. High Sand Plains Management Area.

Forested landscape

Current and projected future condition

The High Sand Plains Management Area includes a variety of shade tolerance levels spread out among the age categories (Figure 2). The majority of tolerant cover types occur on unavailable lowlands in the mature age category. Mid-tolerant cover types mostly occur on available uplands in the mid-aged and mature categories while most intolerant cover types occur in the intermediate, mid-aged, and young categories on available uplands.

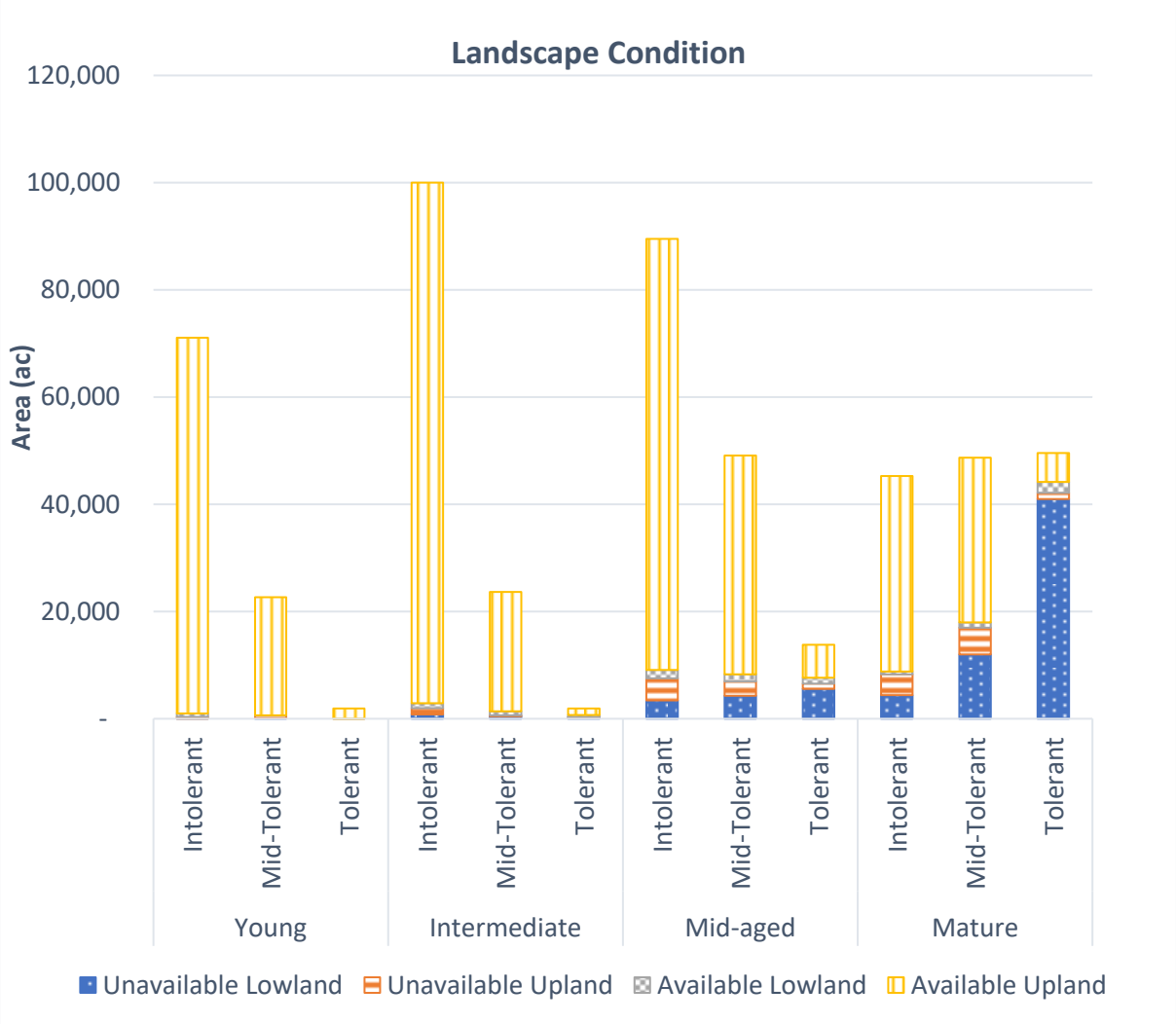


Figure 2. Forest diversity matrix showing the current distribution of forested acres across management availability, age category, landscape position and shade tolerance.

Landscape habitat conditions refine the management area landscape into featured species habitat context. Current and projected acres for the metrics identified in the Management Priorities (Section 3 Statewide/Regional) establish a baseline and future condition based on management over the planning period (Table 1).

Table 1. Current acres for landscape habitat conditions.

Landscape Habitat Condition	Monitoring Metric	Current Acres
Young Forest	Acres of 0-19 stands in Aspen and Jack Pine	64,311
Mature Forest	Acres of 80+ year stands across cover types	143,327
Mature Forest	Acres of 120+ year stands across cover types	11,171
Mesic Conifer Cover Types	Acres of mesic conifer cover types	27,281
Mesic Conifers in other Cover Types	Average canopy occupancy	36%
Mast – Oak Cover Types	Acres of oak cover types	50,593
Mast Tree Species in other Cover Types	Acres of total canopy occupancy of mast tree acres (trace-100%)	312,763
Big Trees	Acres of total canopy stand occupancy of species in sawlog or greater size class	193,374
Nonforested Openings	Acres of total herbaceous openland, upland shrub, and cropland	20,902
Landscape Forest Matrix	Percent deciduous forest	49%
Landscape Forest Matrix	Percent coniferous forest	46%

The High Sand Plains Management Area has the following special analysis units (SAUs). These SAUs have specific cover type goals, typically associated with wildlife habitat management. For any SAUs that overlap with this management area, SAU cover type goals take priority as the SFMP model strives to meet the cover type goals across the area, ensuring they are met. See Section 5 for a detailed description of the management direction and harvest goals for each of these SAUs.

- Grouse Enhanced Management Site (GEMS) – Backus Creek
- Kirtland's warbler – Special analysis unit

The High Sand Plains Management Area is comprised of 85% forested cover types and 15% nonforested cover types (Table 2). Of the forested cover types, 72% are in the upland and only 13% are in the lowland of the total landscape positions. The largest contributors to upland cover types are aspen, natural jack pine and mixed upland deciduous. Lowland conifer, cedar and lowland spruce/fir take up 61% of the total lowland forested landscape position. Lowland shrub is the most common nonforested cover type in the management area representing 6% of the landscape.

Table 2. Current landscape context and distribution of cover types.

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
Forested	Upland	Deciduous	Aspen	142,234	247,253	456,920	540,468
			Northern Hardwood	8,217			
			Black Red Hybrid Oak	22,703			
			Northern Red Oak	15,560			
			Oak Mix	16,577			
			Mixed Upland Deciduous	41,963			
		Mixed	Upland Mixed Forest	20,042	20,042		
		Coniferous	Planted Red Pine	38,889	189,624		
			Planted Jack Pine	74,931			
			Planted White Pine	1,114			
			Planted Mixed Pine	5,312			
			Natural Red Pine	8,696			
			Natural Jack Pine	33,406			
			Natural White Pine	6,994			
			Natural Mixed Pines	16,012			
			Upland Spruce/Fir	768			
			Upland Conifers	3,137			
			Hemlock	367			
	Lowland	Deciduous	Lowland Aspen/Balsam Poplar	5,076	19,059	83,548	
			Lowland Deciduous	13,983			
		Mixed	Lowland Mixed Forest	6,263	6,263		
		Coniferous	Cedar	23,801	58,226		
			Lowland Conifers	27,081			
			Lowland Spruce/Fir	5,606			
			Tamarack	1,738			
Nonforested	Upland	N/A	Herbaceous Openland	11,779	N/A	28,913	92,785
			Upland Shrub	9,039			
			Low Density Trees	3,560			
			Bare/Sparsely Vegetated	1,070			
			Cropland	84			
			Urban	3,380			
	Lowland	N/A	Lowland Shrub	34,938	N/A	63,872	
			Marsh	12,919			
			Bog	4,665			
			Treed Bog	4,077			
			Water	7,272			
						Grand Total:	**633,253**

There are 445,012 acres (70.3% of the total management area and 82.8% of the forested area) that can be managed toward desired future conditions via commercial timber harvest in the High Sand Plains Management Area (Table 3). Of that, 25.5% is in the aspen cover type; 13.7% in planted jack pine; 7.4% in mixed upland deciduous; 7.1% in planted red pine; and 5.7% in natural jack pine. The remaining 20 cover types represent less than 4% each of the forested and available land in the management area. Acres unavailable for management are categorized by site condition (Table 4).

Table 3. Current cover type composition by management availability.

HIGH SAND PLAINS Forested Cover Type	Available Acres	Available %	Unavailable Acres	Unavailable %	Total Acres	Total %
Aspen	137,240	25.5%	4,579	0.9%	141,819	26.4%
Black Red Hybrid Oak	21,962	4.1%	745	0.1%	22,708	4.2%
Cedar	932	0.2%	22,870	4.3%	23,802	4.4%
Hemlock	136	0.0%	232	0.0%	367	0.1%
Lowland Aspen/Balsam Poplar	2,540	0.5%	2,537	0.5%	5,078	0.9%
Lowland Conifers	3,045	0.6%	24,024	4.5%	27,069	5.0%
Lowland Deciduous	1,891	0.4%	12,094	2.2%	13,985	2.6%
Lowland Mixed Forest	1,281	0.2%	4,982	0.9%	6,263	1.2%
Lowland Spruce/Fir	877	0.2%	4,616	0.9%	5,493	1.0%
Mixed Upland Deciduous	39,938	7.4%	1,861	0.3%	41,799	7.8%
Natural Jack Pine	30,749	5.7%	1,847	0.3%	32,596	6.1%
Natural Mixed Pines	14,273	2.7%	1,732	0.3%	16,005	3.0%
Natural Red Pine	7,471	1.4%	1,185	0.2%	8,656	1.6%
Natural White Pine	5,870	1.1%	1,125	0.2%	6,995	1.3%
Northern Hardwood	7,450	1.4%	769	0.1%	8,218	1.5%
Northern Red Oak	15,018	2.8%	523	0.1%	15,541	2.9%
Oak Mix	15,449	2.9%	1,123	0.2%	16,572	3.1%
Planted Jack Pine	73,391	13.7%	436	0.1%	73,827	13.7%
Planted Mixed Pine	5,115	1.0%	163	0.0%	5,277	1.0%
Planted Red Pine	38,259	7.1%	498	0.1%	38,758	7.2%
Planted White Pine	1,097	0.2%	18	0.0%	1,115	0.2%
Tamarack	180	0.0%	1,522	0.3%	1,701	0.3%
Upland Conifers	2,139	0.4%	1,000	0.2%	3,138	0.6%
Upland Mixed Forest	18,258	3.4%	1,755	0.3%	20,013	3.7%
Upland Spruce/Fir	454	0.1%	314	0.1%	768	0.1%
Grand Total	**445,012**	**82.8%**	**92,548**	**17.2%**	**537,560**	**100.0%**

Table 4. Site conditions for unavailable acres.

Site Condition (Reason area is unavailable for commercial harvest)	Area (ac)	% of Unavailable Area
Too Wet	58,417	63.1%
Blocked by Obstacle	5,374	5.8%
BMPs	4,803	5.2%
Federal/State/Local Law	4,068	4.4%
Other Influence Zones	3,789	4.1%
Conservation Values	3,650	3.9%
Cannot Regenerate	2,558	2.8%
Denied Access	1,773	1.9%
Long-Term Retention	1,712	1.8%
Recreational/Scenic	1,224	1.3%
Too Steep	1,125	1.2%
Species of special concern or T&E	1,049	1.1%
Other Dept./Div. Processes	1,039	1.1%
Rare Landforms	493	0.5%
Blocked by Railroad	391	0.4%
Deer Wintering Area	340	0.4%
Unproductive	338	0.4%
Wildlife Concerns	139	0.1%
Military Lease/Easement	104	0.1%
Non-Military Lease/Easement	65	0.1%
Historical/Archaeological	53	0.1%
Neighbor / Interest Group	44	0.0%
Total Unavailable	**92,548**	**100.0%**

Projected 10-year cover type management actions

Each cover type in the High Sand Plains Management Area has a unique age class and basal-area-class goals that describe the long-term desired future conditions. The calculated harvest levels that are needed during the first 10-year planning period are summarized in Table 5. These harvest levels are necessary to begin achieving long-term planning goals. This will help establish a desirable amount of regeneration for the even-aged cover types over the 10-year period or help to achieve desired basal area distribution among uneven-aged cover types like northern hardwoods. Implementing these silvicultural regimes will yield 1,472,940 cords, the planned harvest volume for the decade (Table 6).

Table 5. Ten-year planning period harvest goals (acres) by cover type and silvicultural regime.

Silvicultural Regimes								
Cover Type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Salvage Clearcut	Salvage Thinning	Grand Total
Aspen	18,914	-	-	-	-	2,653	-	21,567
Planted Red Pine	1,285	-	11,451	-	-	1,460	1,710	15,905
Natural Jack Pine	5,055	-	-	-	-	940	-	5,994
Planted Jack Pine	3,935	-	-	-	-	1,946	-	5,881
Northern Red Oak	4,309	-	343	177	88	-	-	4,918
Black Red Hybrid Oak	4,201	-	509	-	106	33	-	4,849
Oak Mix	2,691	-	201	-	48	-	-	2,940
Mixed Upland Deciduous	2,188	129	-	-	166	144	-	2,627
Natural Mixed Pines	-	-	777	-	1,158	-	390	2,324
Northern Hardwood	-	1,023	-	74	-	368	117	1,583
Natural White Pine	-	-	362	-	774	-	412	1,548
Natural Red Pine	-	-	310	-	334	-	14	659
Planted White Pine	442	-	212	-	-	-	-	654
Upland Conifers	451	-	-	-	113	-	-	564
Lowland Aspen/Balsam Poplar	407	-	-	-	-	-	-	407
Lowland Conifers	402	-	-	-	-	-	-	402
Planted Mixed Pine	-	-	393	-	-	-	-	393
Lowland Deciduous	332	24	-	-	10	-	-	366
Lowland Mixed Forest	307	-	-	-	-	-	-	307
Lowland Spruce/Fir	208	-	-	-	-	-	-	208
Upland Mixed Forest	-	-	-	-	-	110	-	110
Hemlock	-	87	-	-	-	-	-	87
Tamarack	18	-	-	-	-	-	-	18
Totals	**45,144**	**1,263**	**14,557**	**252**	**2,797**	**7,654**	**2,643**	**74,310**

Table 6. Projected 10-year harvest volume by species.

10-Year Estimated Harvest Volume Projection High Sand Plains Management Area Product	Species	Volume Planned*	Volume Prepared**
Pulpwood (cords)	Mixed Aspen	202,321	190,182
	Mixed Hardwood	130,373	122,550
	Red Pine	103,600	97,384
	Jack Pine	90,802	85,354
	Mixed Oak	51,851	48,740
	Mixed Spruce	33,685	31,664
	White Pine	25,878	24,326
	Mixed Softwood	18,208	17,116
	Pulpwood Total	**656,718**	**617,315**
Sawtimber (MBF)	Red Pine	99,733	93,749
	Red Oak	67,297	63,259
	Mixed Aspen	50,947	47,890
	White Pine	37,633	35,375
	White Oak	20,438	19,211
	Mixed Oak	17,000	15,980
	Red Maple	14,440	13,574
	Sugar Maple	4,864	4,572
	Basswood	437	411
	Sawtimber Total	**312,788**	**294,020**
	Total Sawtimber Harvest Volume in Cords	**816,222**	**767,248**
	Grand Total Harvest Volume in Cords	**1,472,940**	**1,384,564**
* Volume estimates based on 100% of the projected harvests for the 10-year planning period. ** Volume estimates based on 94% of the projected harvests for the 10-year planning period accounting for reduction in acres and associated volume once sales are prepared for bid.			

There are a few cover type transitions projected for the High Sand Plains Management Area (Table 7). The managed area of each cover type is projected to remain fairly stable with only a few exceptions as treatment regimes generally will not significantly change the amount of area in each cover type. The largest decrease forecasted is in the northern red oak cover type where 3,276 acres will convert to other cover types such as mixed upland deciduous and upland mixed forest through forest management and

regeneration activities. The largest increase occurs on the mixed upland deciduous forest cover type where 2,803 acres are projected to convert into this cover type.

Table 7. Projected 10-year cover type acres resulting from cover type transitions.

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Aspen	142,234	143,532	1,297
Mixed Upland Deciduous	41,963	44,766	2,803
Planted Red Pine	38,889	39,699	810
Lowland Conifers	27,081	26,981	-100
Cedar	23,801	23,801	0
Black Red Hybrid Oak	22,703	20,729	-1,974
Upland Mixed Forest	20,042	21,962	1,920
Lowland Deciduous	13,983	14,005	22
Lowland Mixed Forest	6,263	6,428	165
Lowland Spruce/Fir	5,606	5,499	-107
Planted Mixed Pine	5,312	5,312	0
Lowland Aspen/Balsam Poplar	5,076	5,097	21
Upland Conifers	3,137	2,730	-407
Tamarack	1,738	1,738	0
Planted White Pine	1,114	672	-442
Hemlock	367	367	0
Lowland Shrub	34,938	34,938	0
Natural Jack Pine	33,406	33,645	239
Natural Mixed Pines	16,012	16,177	166
Natural Red Pine	8,696	8,696	0
Natural White Pine	6,994	7,259	265
Northern Hardwood	8,217	8,331	115
Northern Red Oak	15,560	12,283	-3,276
Oak Mix	16,577	15,246	-1,331
Planted Jack Pine	74,931	74,746	-185
Marsh	12,919	12,919	0
Herbaceous Openland	11,779	11,779	0
Upland Shrub	9,039	9,039	0
Water	7,272	7,272	0
Bog	4,665	4,665	0
Treed Bog	4,077	4,077	0
Low Density Trees	3,560	3,560	0
Bare/Sparsely Vegetated	1,070	1,070	0
Upland Spruce/Fir	768	768	0
Urban	3,380	3,380	0
Cropland	84	84	0
Total:	**633,253**	**633,253**	**0**

Featured species current and projected habitat acres

There are 11 featured species in this management area that span various cover types, age classes and stand level conditions. Current and projected total habitat acres by species across the decade provide a baseline and show the result of long-term management actions (Table 8). As noted in the Featured Species Management Priority (Section 3), it is recommended that these featured species habitat acres be viewed as acres of potential habitat, representing a condition on the landscape where the more nuanced aspects of each species' habitat requirements are likely to be found or managed for. As described in the introduction, the modeling effort was limited by several factors including the simplification of habitat attributes into MiFI variables. Therefore, when referring to habitat acres what is being referred to is potential habitat acres.

Some species show a loss in habitat over the next century. As mentioned in the Featured Species Management Priority (Section 3), the current condition for many cover types is a surplus of acres in the 0-9 age class from the compensatory management approach applied in the previous decade. The model eventually evens out the age classes at a lower, sustainable level over time, usually by 50 years. For any species with northern hardwoods as a priority cover type, there is a perceived drop in acres between 40 and 60 years; this is due to the basal area dropping below 81 but because it only drops into the upper 70s, it is not expected to translate to any real habitat loss on the ground. Three of these species were not included in the State Forest Management Plan model, black bear, wild turkey and black-backed woodpecker, but are included here to inform management decisions over the decade. Kirtland's warbler habitat is described in the Kirtland's warbler special analysis unit (Section 5).

Table 8. Featured species current and projected total habitat acres (e.g., potential habitat).

Featured Species	Priority Cover Types	Total Habitat Acres Current	Total Habitat Acres 10-year	50-year Projected Habitat Acres	100-year Projected Habitat Acres
American Woodcock	Aspen, lowland aspen, lowland deciduous	44,656	48,661	50,812	51,634
Black Bear	Mast	363,356	---	--	--
Black-Backed Woodpecker	Natural disturbance	--	--	--	--
Blackburnian Warbler	Northern hardwoods, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, hemlock	20,060	26,029	33,788	45,372
Golden-Winged Warbler	Aspen, black-red hybrid oak, northern red oak, oak mix, tamarack	51,848	55,823	51,614	52,344
Kirtland's Warbler	Jack pine	--	--	--	--

Featured Species	Priority Cover Types	Total Habitat Acres Current	Total Habitat Acres 10-year	50-year Projected Habitat Acres	100-year Projected Habitat Acres
Marten	Northern hardwoods, mixed upland deciduous, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, lowland mixed forest, lowland conifers, hemlock, cedar	102,861	104,849	116,591	118,885
Ruffed Grouse	Aspen	43,339	46,953	49,287	49,929
Snowshoe Hare	Aspen, cedar, hemlock, lowland aspen, lowland conifers, lowland mixed forest, lowland spruce/fir, mixed upland deciduous, natural jack pine, natural mixed pines, planted jack pine, upland spruce/fir	92,653	96,547	93,470	93,870
Wild Turkey	Nonforested openings	11,863	--	--	--
Wood Thrush	Northern hardwoods, northern red oak, mixed upland deciduous, lowland deciduous	32,847	34,383	38,956	41,809
Wood Turtle	Nonforested openings	--	--	--	--

Cover type composition and associated featured species

Aspen

Current condition

Most of the aspen cover type is currently evenly distributed. The 30- to 39-year-old age class has the largest spike in acres. (Figure 3). The past management regime has been primarily clearcut for this cover type. With this cover type being fairly evenly distributed out the age of 50 and tail to the age of 80, it should not take very long to achieve a balanced age class distribution.

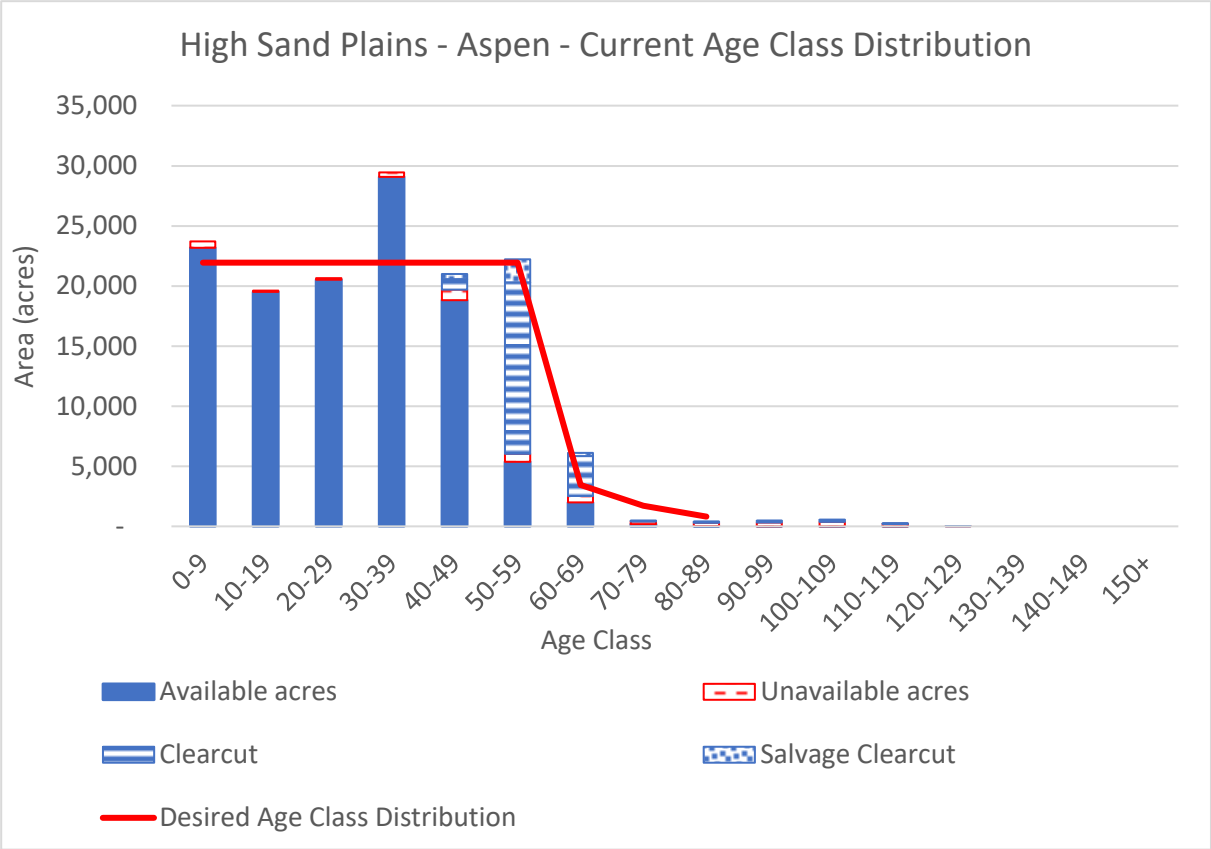


Figure 3. Current age class distribution, the desired age class distribution, and the projected harvests in the aspen cover type over the 10-year planning period.

Current conditions are a result of consistent commercial harvests and regeneration efforts on available aspen acres during the previous planning periods as well as previous initiative of the Deer Range Improvement Program. A portion of this cover type meets the habitat requirements for American woodcock, golden-winged warbler, ruffed grouse and snowshoe hare (Table 9).

Table 9. Featured species with aspen as a priority habitat cover type, habitat variables and current acres (e.g., potential habitat).

Featured Species	Featured Species Habitat – Aspen	Aspen Habitat Acres - Available	Aspen Habitat Acres - Unavailable
American Woodcock	Age Category: 0-19 Size Class: Sapling	42,708	631
Golden-Winged Warbler	Age Category: 0-19 Size Class: Sapling	42,708	631
Ruffed Grouse	Age Category: 0-19 Size Class: Sapling	42,708	631
Snowshoe Hare	Age Category: 0-19 Size Class: Sapling	42,708	631

Desired future condition

The projected long-term cover type trend for aspen is fairly stable in the High Sand Plains Management Area with only a 0.9% increase in acres from other cover types forecasted in this management area.

The long-term goal for this cover type is balanced age classes between 0 and 50 years old and a tail out to 80 years old for all available aspen stands in this management area. Maintaining lower acreage in old age classes continues to be desirable to ensure the aspen cover type is distributed within the desired age classes.

The end of the planning period will result in the establishment of 23,203 acres which is just above desired amount of regeneration in in the upcoming 0-9 age class (Figure 4). Given the distribution of available acres progress toward the long-term age class distribution of aspen will only take a couple decades in the management area.

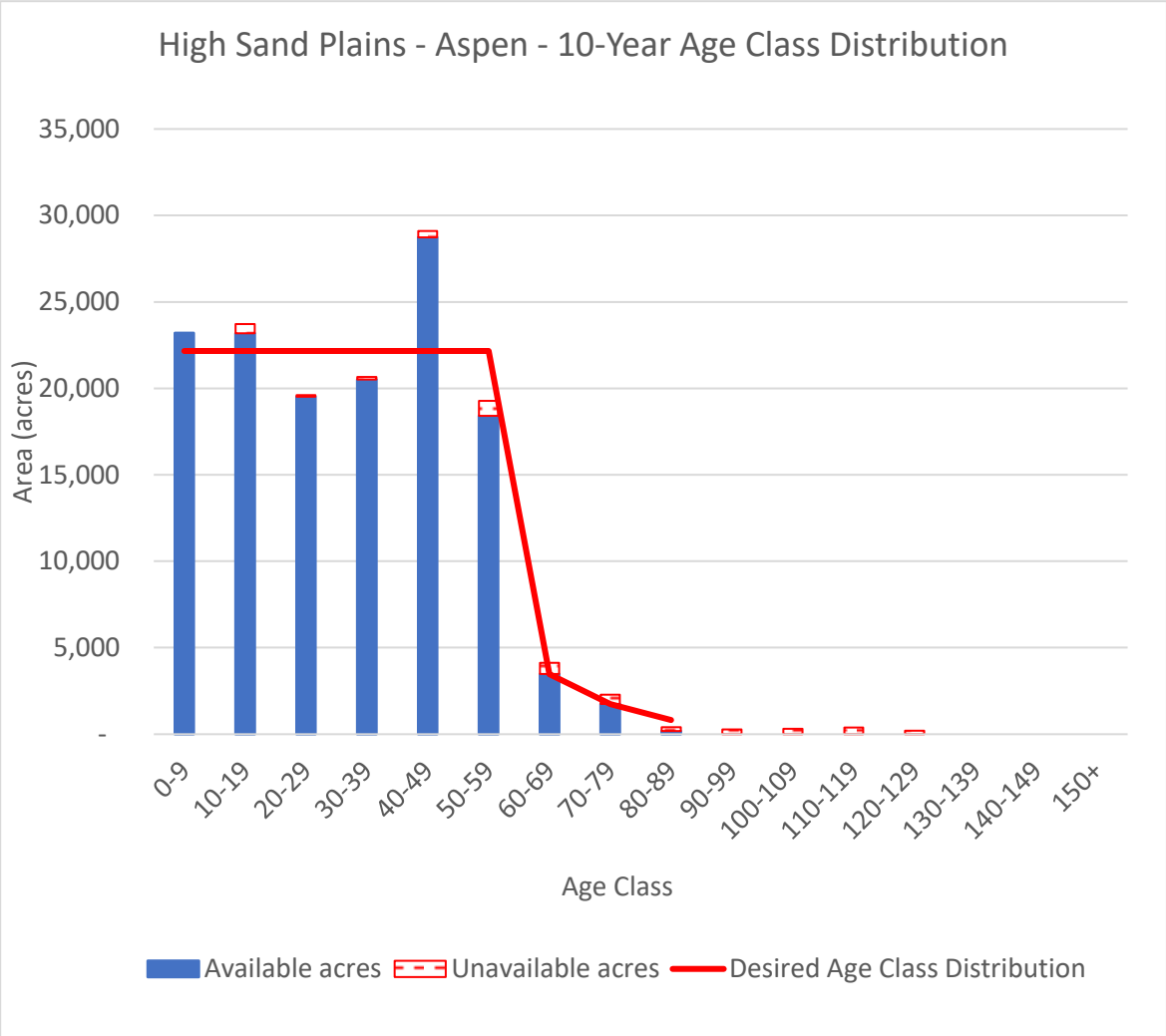


Figure 4. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of aspen acres has essentially reached the desired future condition (Figure 5). As is often the case, an unbalanced condition in the first planning period can result in the need to work at it for multiple decades until the deficit or surplus in an age class has reached the max tail age.

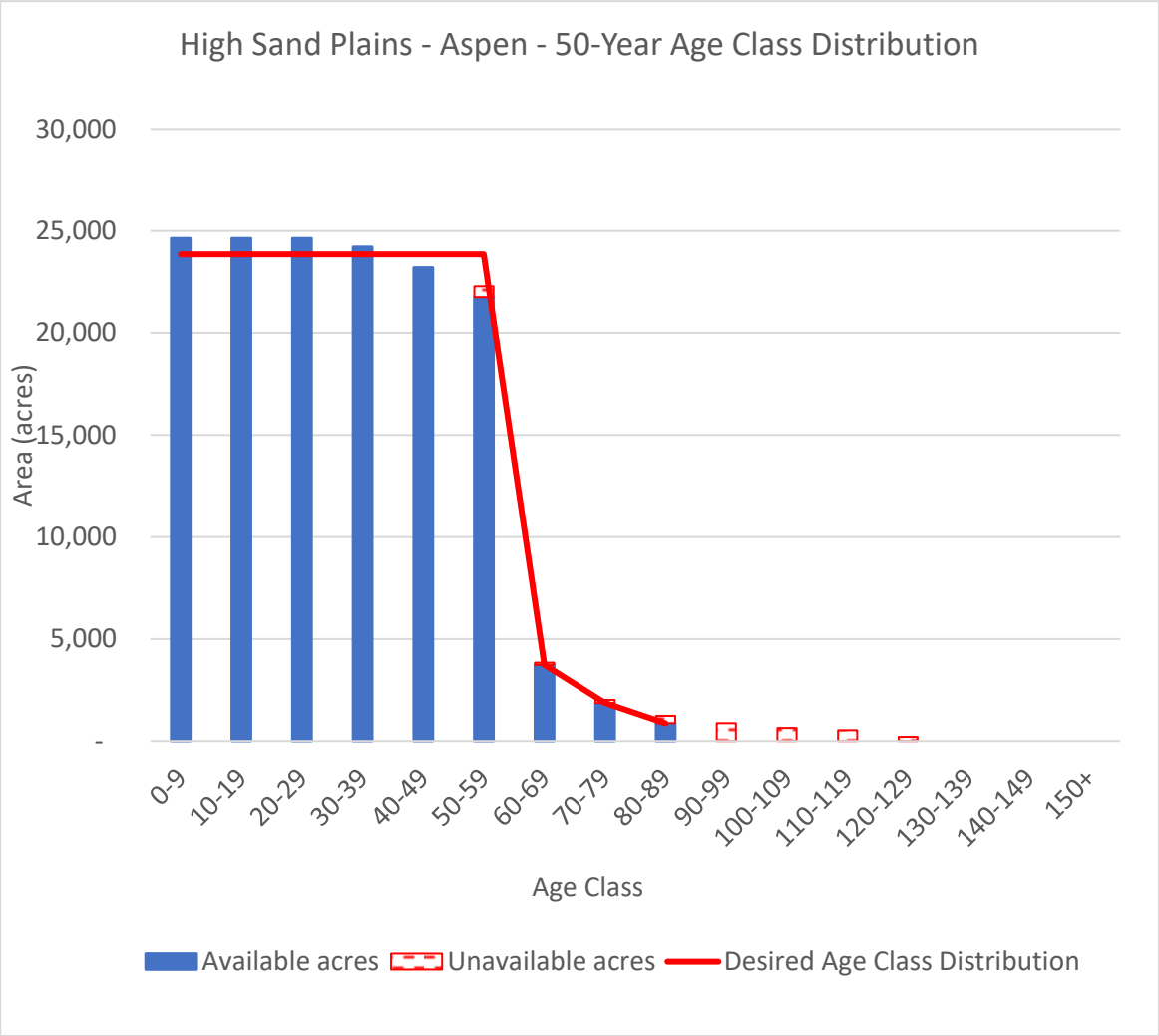


Figure 5. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 6) will concentrate the manageable acres of aspen in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest (Figure 7).

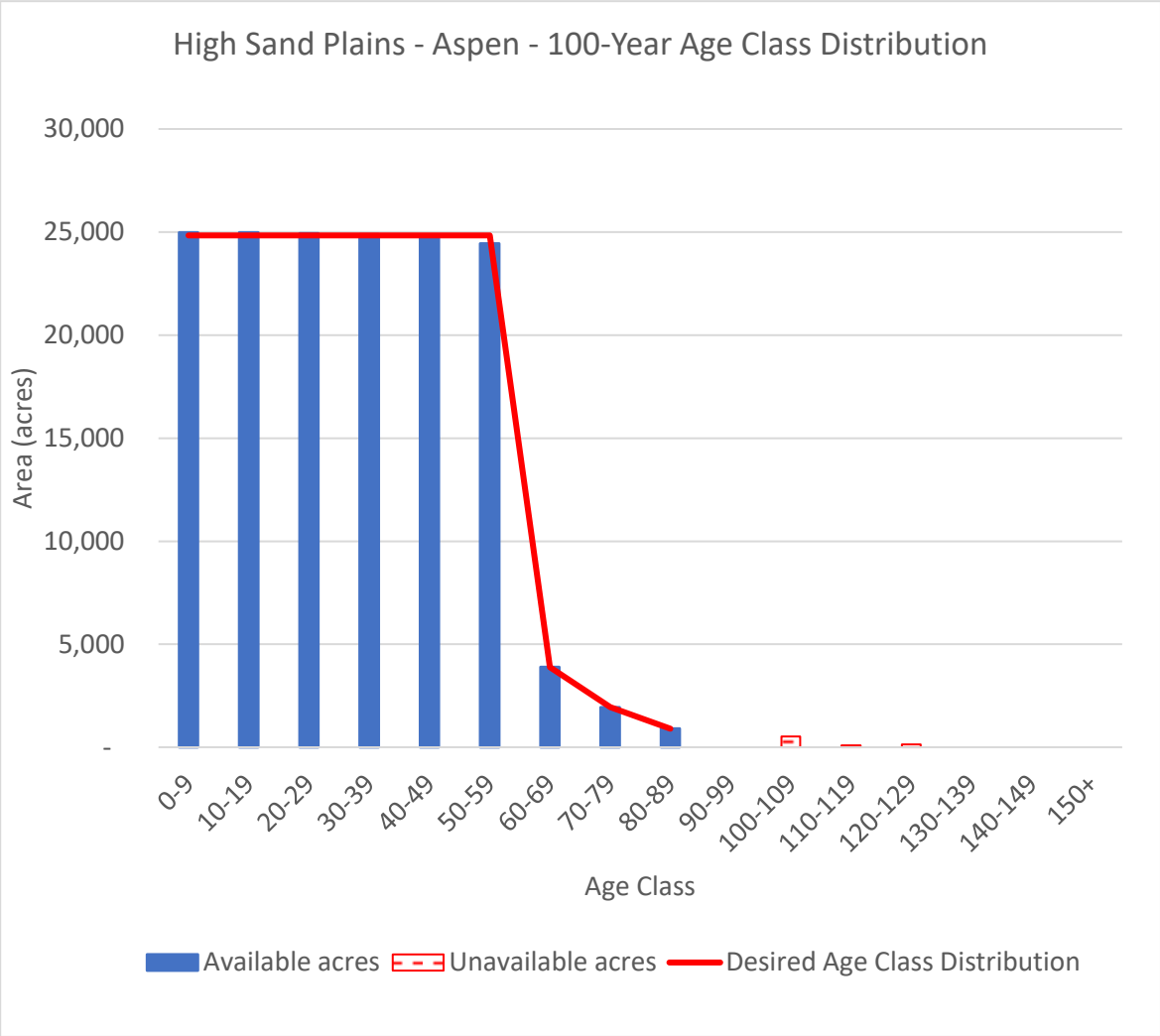


Figure 6. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

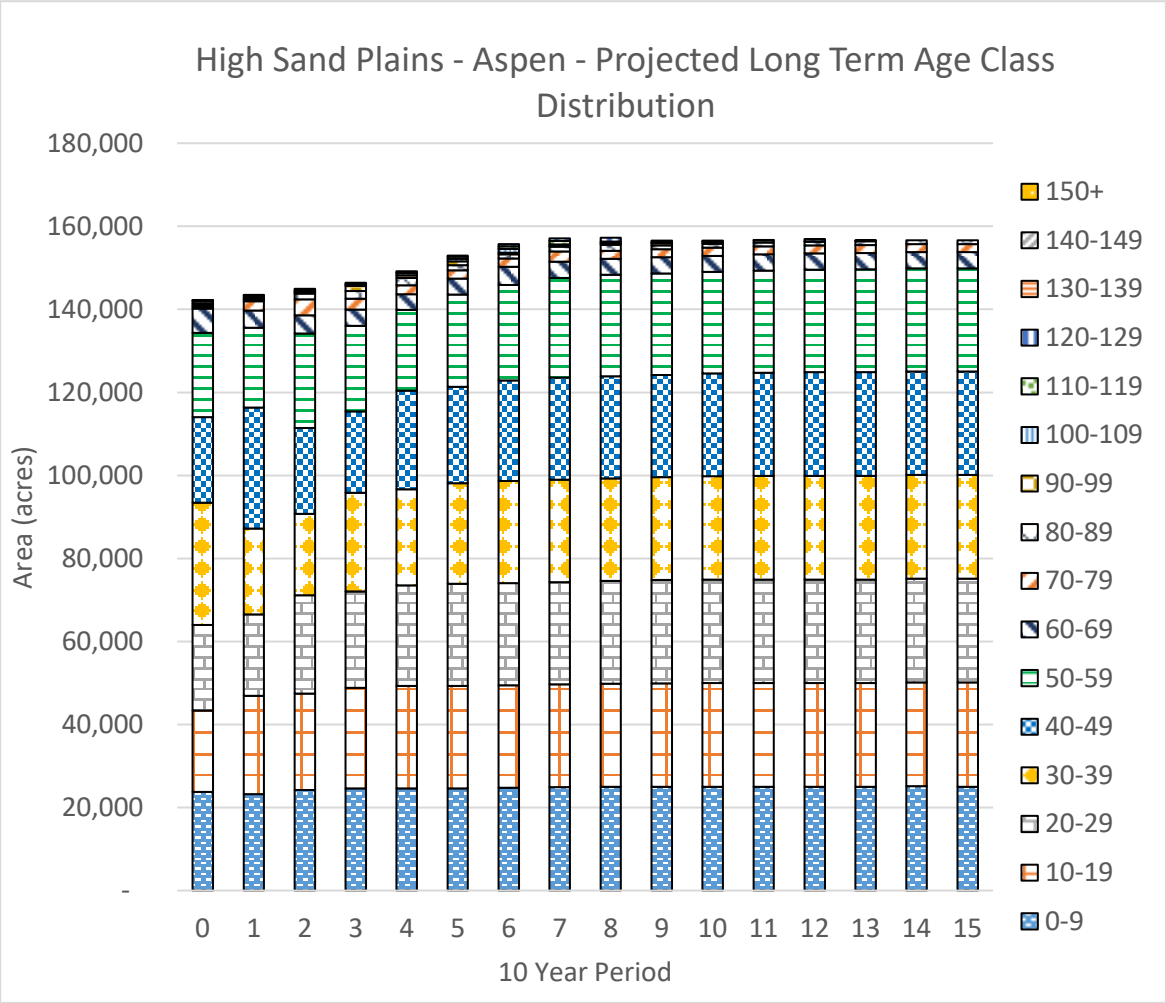


Figure 7. Projected age class distribution for all acres of aspen over the next 150 years.

Management actions

There are 18,914 acres of projected clearcut harvest and 2,653 acres of salvage clearcut from the 2025 ice storm damage in the aspen cover type during this planning period. There are an additional 338 acres forecasted to regenerate naturally from severe ice storm damage that are not salvage harvested. There are also 1,297 acres projected to transition into this cover type over the planning period. This totals 23,202 acres that will regenerate into the 0-9 age class and is slightly higher than the desired establishment of 21,950 acres per decade. This is due in part to the 1,297 acres from other cover types transitioning into aspen.

Planted jack pine

Current condition

Most of the planted jack pine cover type is currently in the 20- to 39-year-old age classes and nearly all of the acres are available for commercial management; less than 1% of the cover type is considered unavailable (Figure 8). The past management regime has been primarily clearcut. Planted jack pine was managed on a 60-year rotation to provide pulpwood products and occasional sawlogs with the objective of balancing the age class distribution and managing jack pine on suitable sites. Jack pine also provides habitat for many wildlife species. The age class distribution in this cover type is in an unbalanced condition.

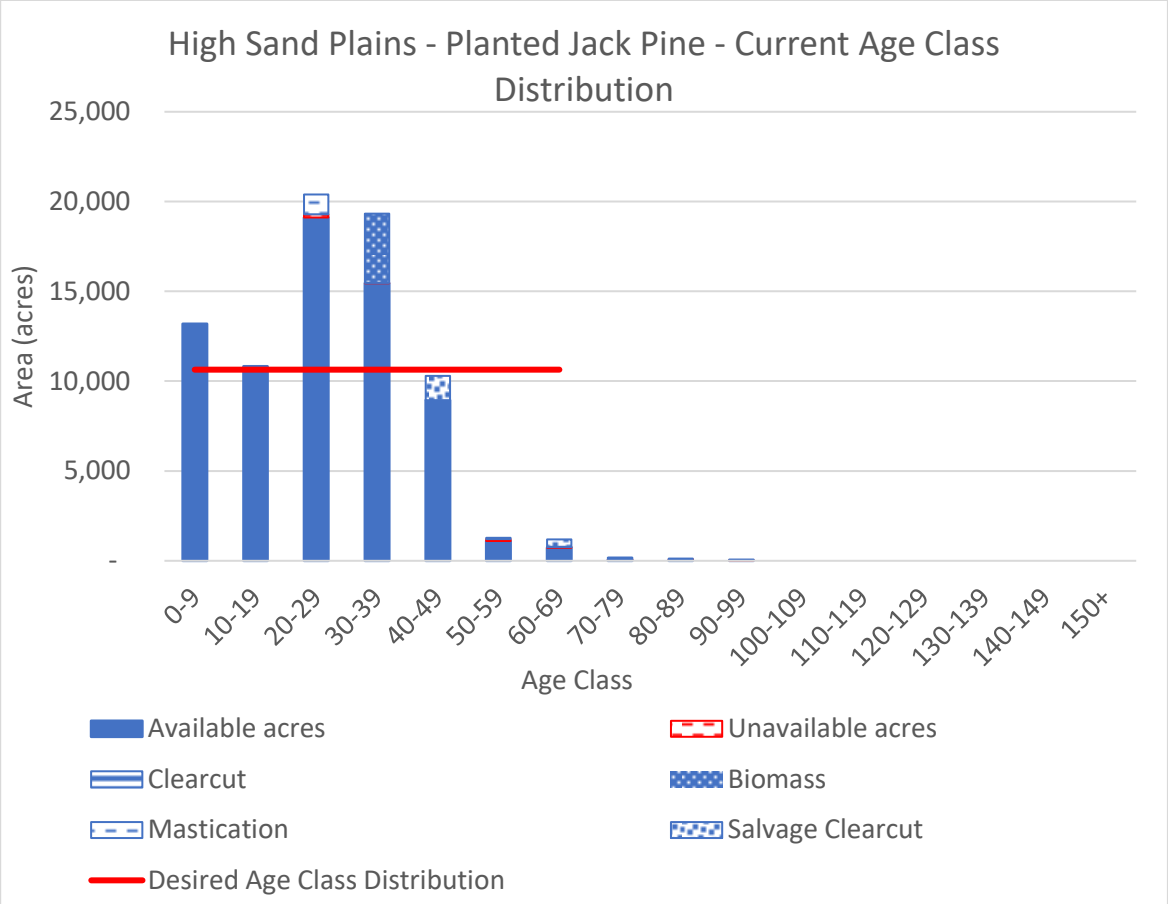


Figure 8. Current age class distribution, the desired age class distribution, and the projected harvests in the planted jack pine cover type over the 10-year planning period.

Current conditions are a result of plantations established during the same few decades. Additionally, there have been consistent commercial harvests and regeneration efforts on available jack pine acres planted during the previous planning periods. A portion of this cover type meets the habitat requirements for Kirtland's warbler (Section 5) and snowshoe hare (Table 10). No data is provided for Kirtland's warbler, because the jack pine acres in this management area that have relevance are those within designated essential habitat. Because essential habitat was represented in the SAU, and the SAU provides unit-level management actions, it is best to refer to Section 5 for more information.

Table 10. Featured species with planted jack pine as a selected habitat cover type, habitat variables and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Planted Jack Pine	Planted Jack Pine Habitat Acres - Available	Planted Jack Pine Habitat Acres - Unavailable
Snowshoe Hare	Age Category: 0-19 Size Category: Sapling	24,009	0
Kirtland's Warbler	Age Category: 0-19 Size Category: Sapling, Pole	NA	NA

Desired future condition

The projected long-term cover type trend for planted jack pine is stable in the High Sand Plains Management Area. There are a few transitions from planted jack pine to other cover types such as natural jack pine with only a 0.2% decrease in cover type acreage.

The long-term goal for this cover type is balanced age classes between 0 and 60-years-old for all available planted jack pine stands in this management area. Maintaining lower acreage in old age classes continues to be desirable to lessen the prevalence and severity of diseases and to reduce the threat of damaging wildfire.

The end of the planning period will result in the establishment of 8,426 acres in the upcoming 0-9 age class (Figure 9). Progress toward the long-term age class distribution of planted jack pine will take many decades in the management area due to its unbalanced distribution.

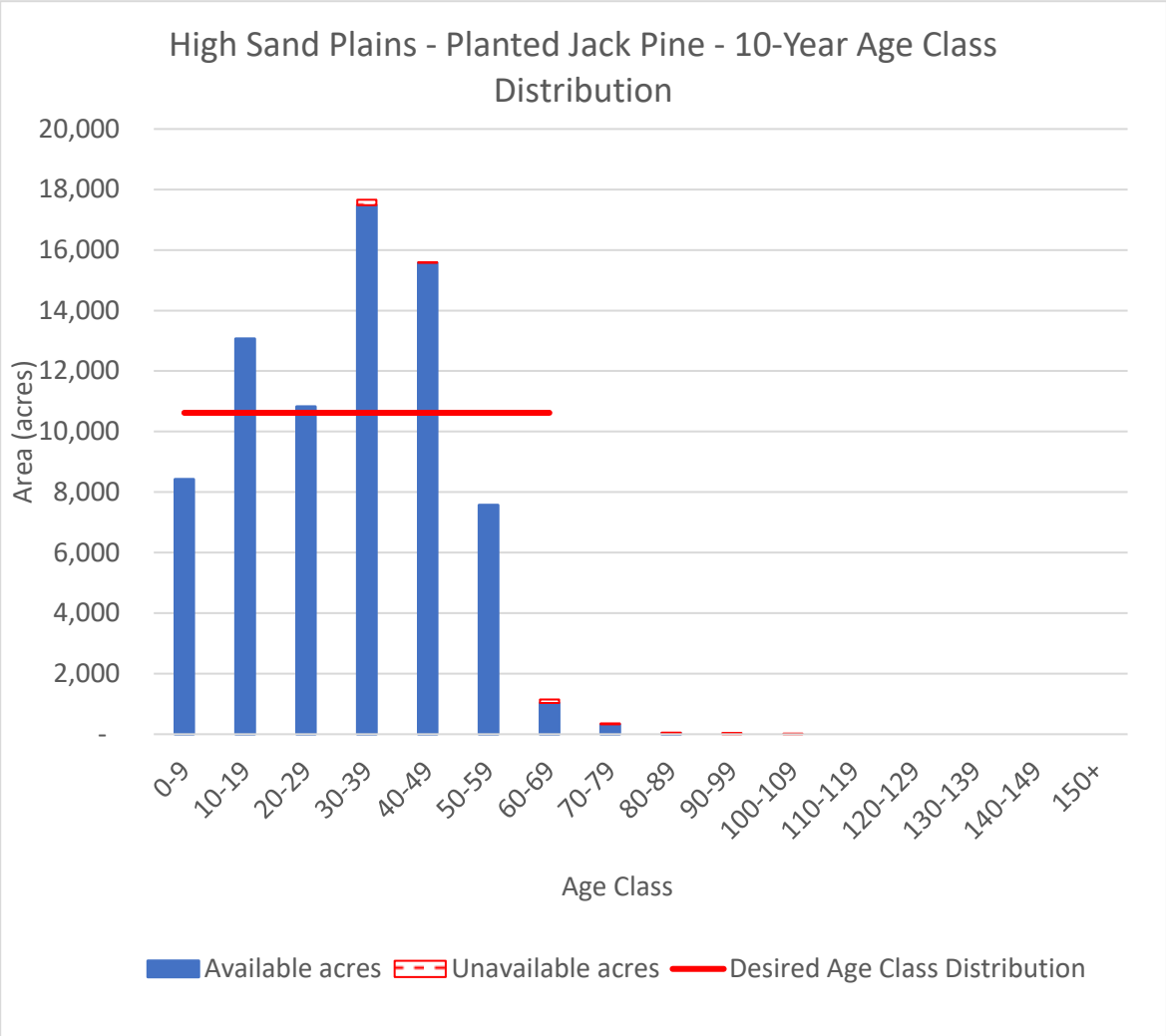


Figure 9. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of planted jack pine still working toward the balanced desired future condition (Figure 10). With this case, an extremely unbalanced condition in the first planning period can often result in taking more time to achieve the desired age class goals.

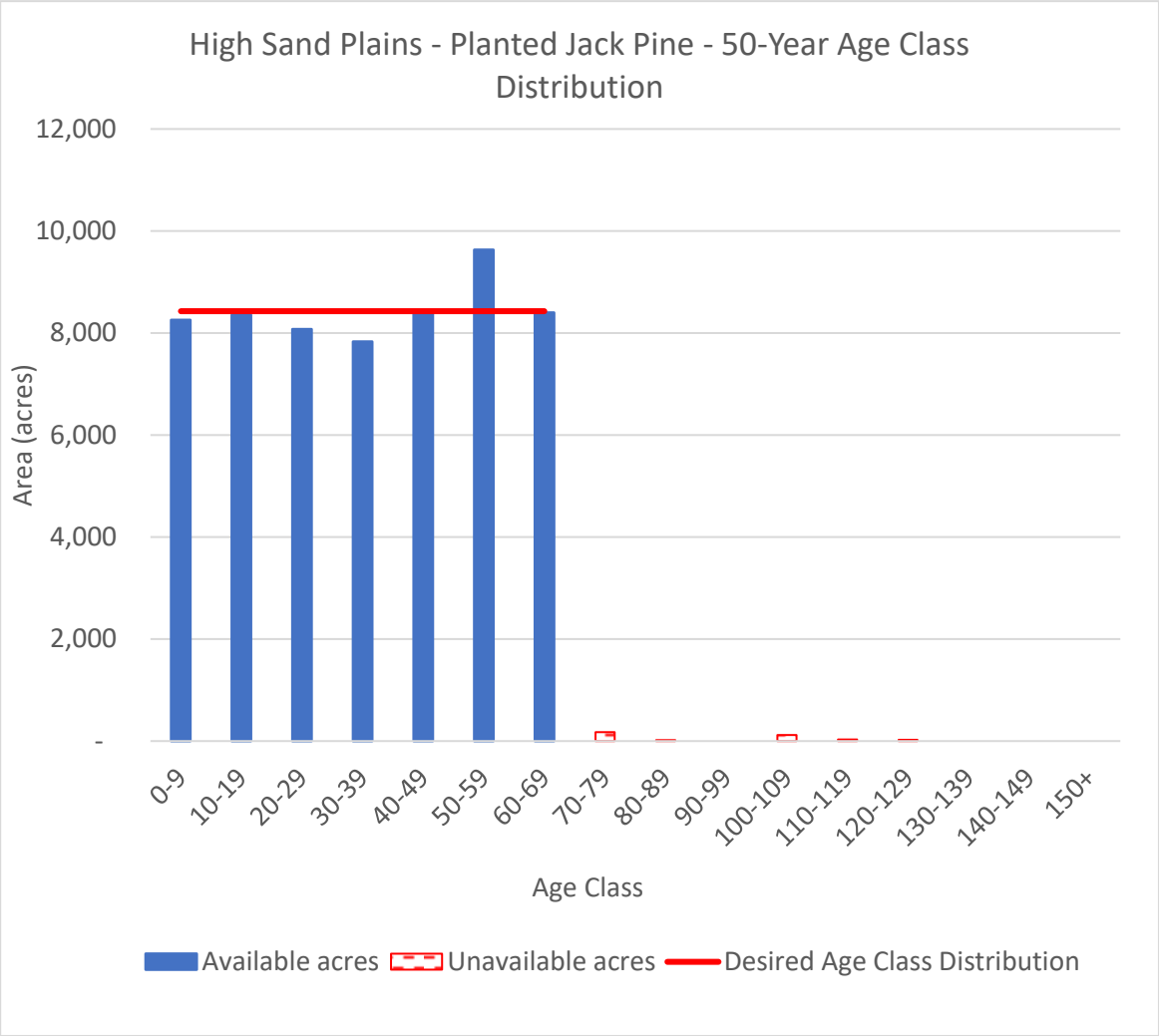


Figure 10. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 11) will concentrate the manageable acres of planted in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest (Figure 12).

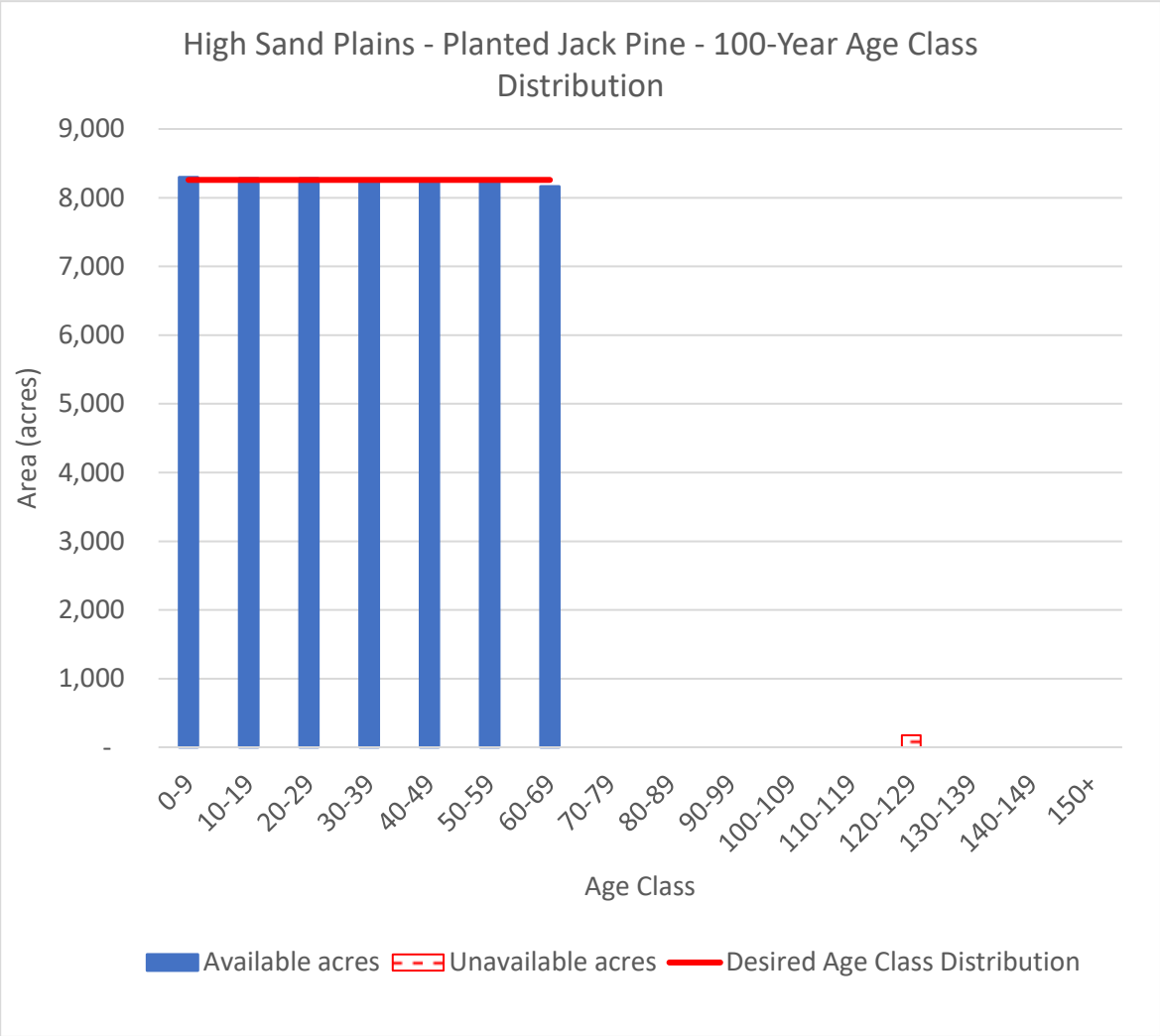


Figure 11. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

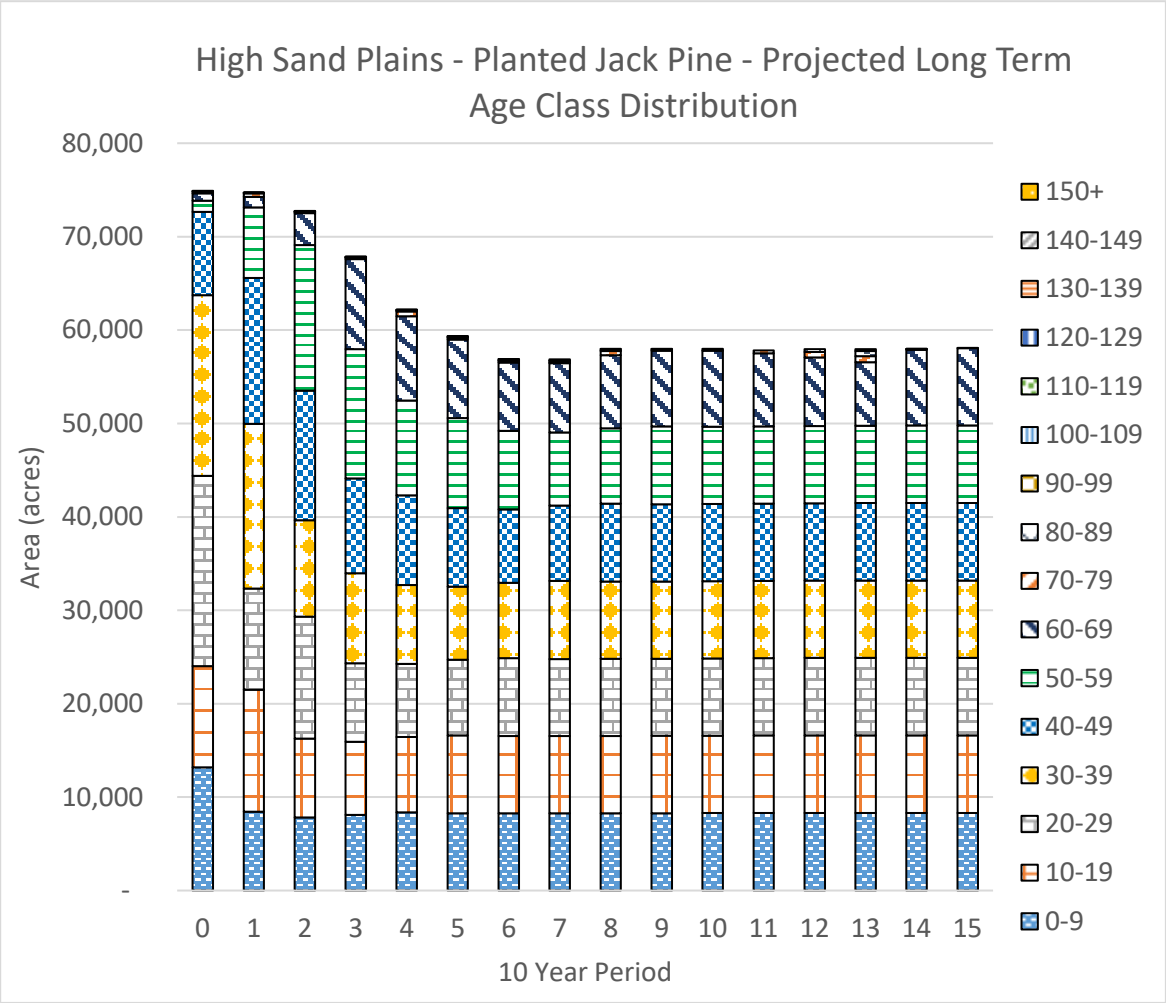


Figure 12. Projected age class distribution for all acres of planted jack pine over the next 150 years.

Management actions

There are 3,935 acres of projected clearcut and 1,946 acres of salvage clearcut harvest along with 1,327 acres of mastication treatments and 1,436 acres of stands that have severe damage from the ice storm that will be planted in the jack pine cover type during this planning period. Approximately 180 acres are forecasted to transition into other cover types resulting in the 8,643 acres in the 0-9 age class. This is well below the desired establishment of 10,616 acres per decade because of the current unbalanced condition.

Mixed upland deciduous

Current condition

The age class distribution of mixed upland deciduous is currently unbalanced in this management area (Figure 13). There are deficits in several of the age class categories from 40 to 79 years old. With that, several acres are beyond the tail of the age class distribution of 80 years old and older.

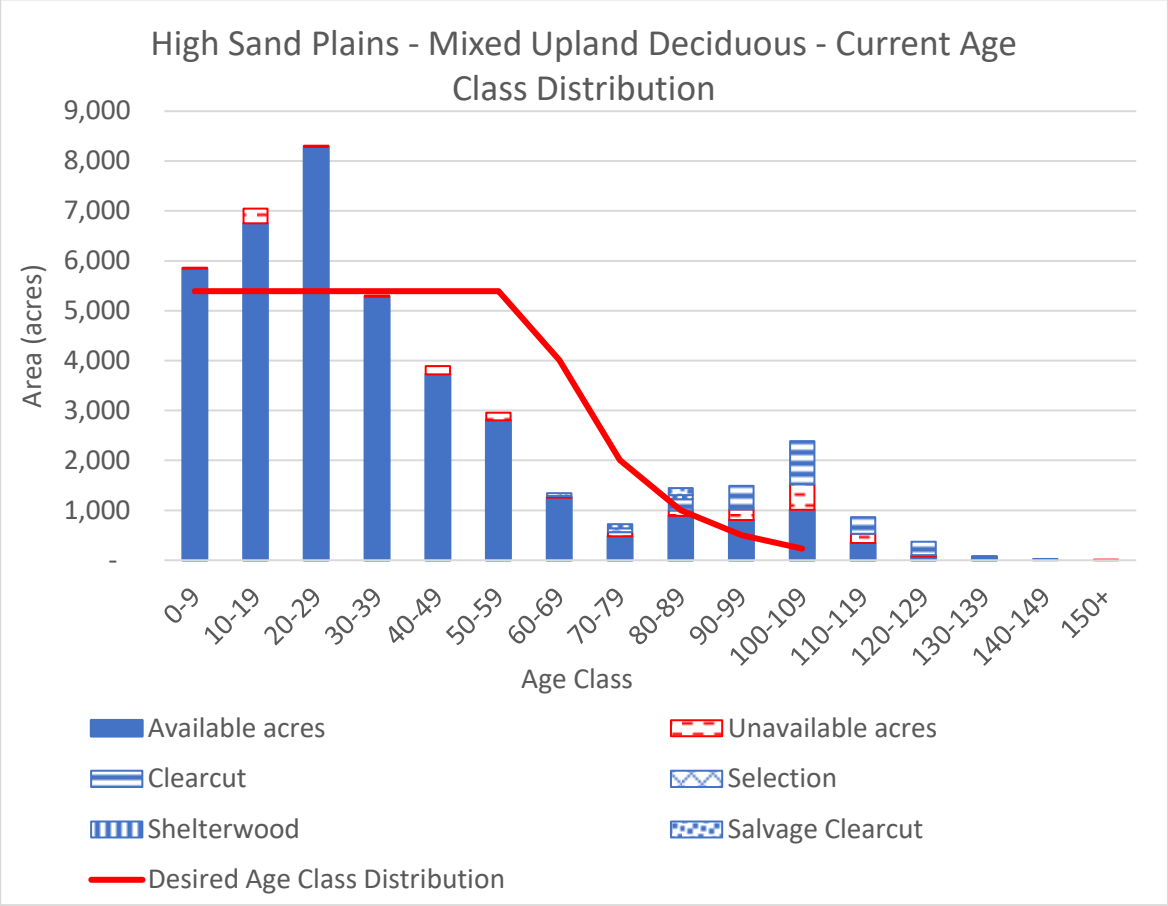


Figure 13. Current age class distribution and projected harvests in the mixed upland deciduous cover type.

Current conditions are a result of successful commercial harvests and natural regeneration efforts that have been in place in this management area for decades. A portion of this cover type meets the habitat requirements for snowshoe hare, marten and wood thrush (Table 11).

Table 11. Featured species with mixed upland deciduous as a priority habitat cover type, habitat variables and current acres (e.g., potential habitat).

Featured Species	Featured Species Habitat – Mixed Upland Deciduous	Mixed Upland Deciduous Habitat Acres - Available	Mixed Upland Deciduous Habitat Acres - Unavailable
Snowshoe Hare	Age Category: 0-19	12,595	315

Featured Species	Featured Species Habitat – Mixed Upland Deciduous	Mixed Upland Deciduous Habitat Acres - Available	Mixed Upland Deciduous Habitat Acres - Unavailable
	Size Category: Sapling		
Marten	Age Category: 40+ Size Category: Pole, Sawlog Basal Area: 81+	8,694	1,236
Wood Thrush	Age Category: 40+ Size Category: Sawlog Basal Area: 81+	8,694	1,236

Desired future condition

The projected long-term cover type trend for mixed upland deciduous is fairly stable in the High Sand Plains Management Area. There are projected transitions into this cover type from other cover types forecasted with an increase of 3.8% in acres. There are very few transitions out of mixed upland deciduous.

The long-term goal for this cover type is balanced age classes between 0 and 50 years old and a max tail age of 100 years old for all available mixed upland deciduous stands in this management area.

The end of the planning period will result in the establishment of 5,133 acres of regeneration in the upcoming 0-9 age class given the amount of merchantable and available acres in the older age classes (Figure 14). Progress toward the long-term age class distribution of mixed upland deciduous will take many decades in the management area.

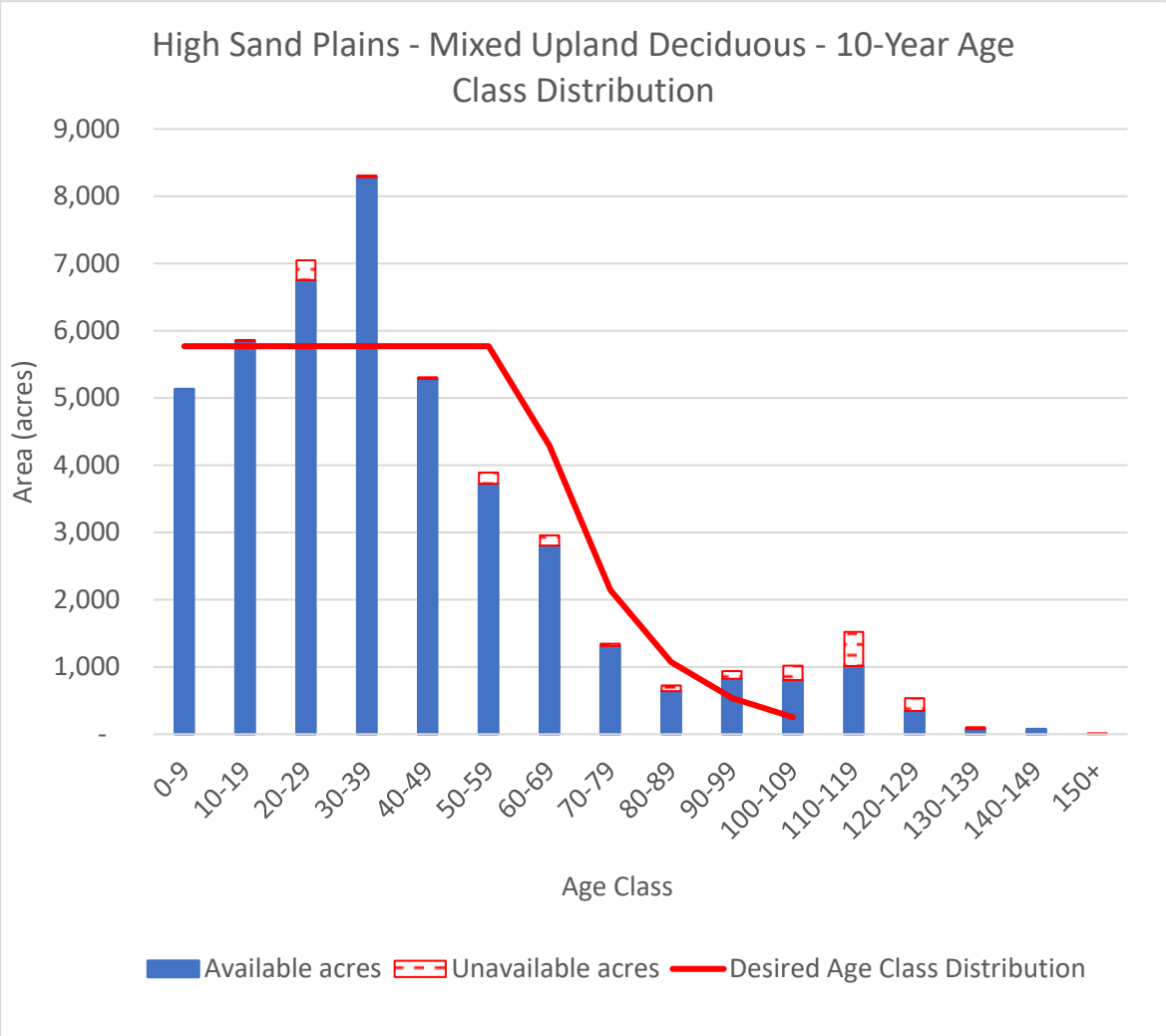


Figure 14. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of mixed upland deciduous acres begins to reach the desired future condition especially in the younger age classes (Figure 15). There continues to show a deficit in the 10- to 49-year-old age classes due to the unbalanced condition during the first planning period. As is often the case, an extremely unbalanced condition in the first planning period can result in the need to carry some acres slightly longer into older age classes in future years in order to meet the desired distribution and achieve age class goals as seen in Figure 14 in age class 60-69.

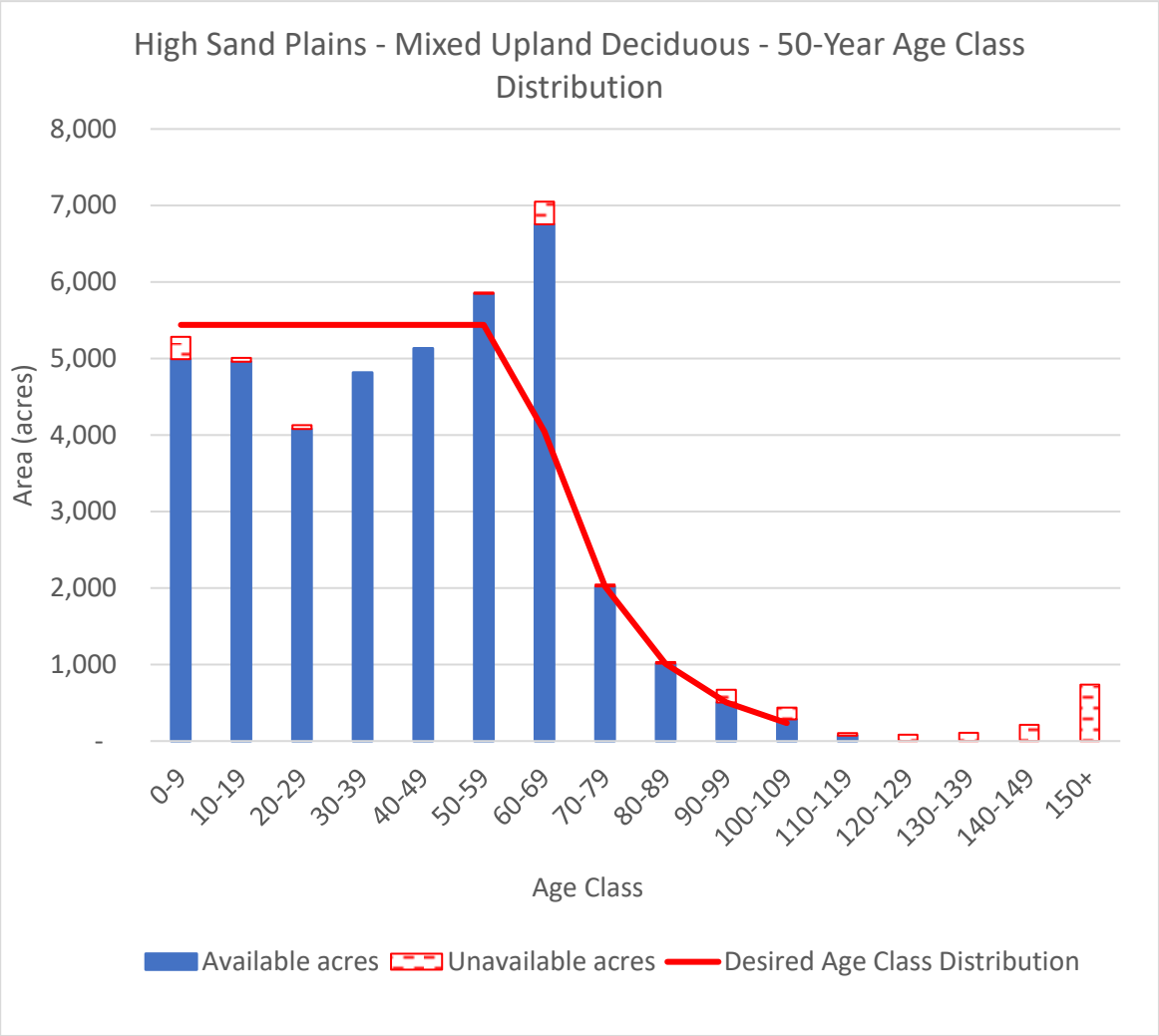


Figure 15. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 16) will concentrate the manageable acres of mixed upland deciduous in productive growing conditions while providing an even flow of forest products and a wide variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest (Figure 17).



Figure 16. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

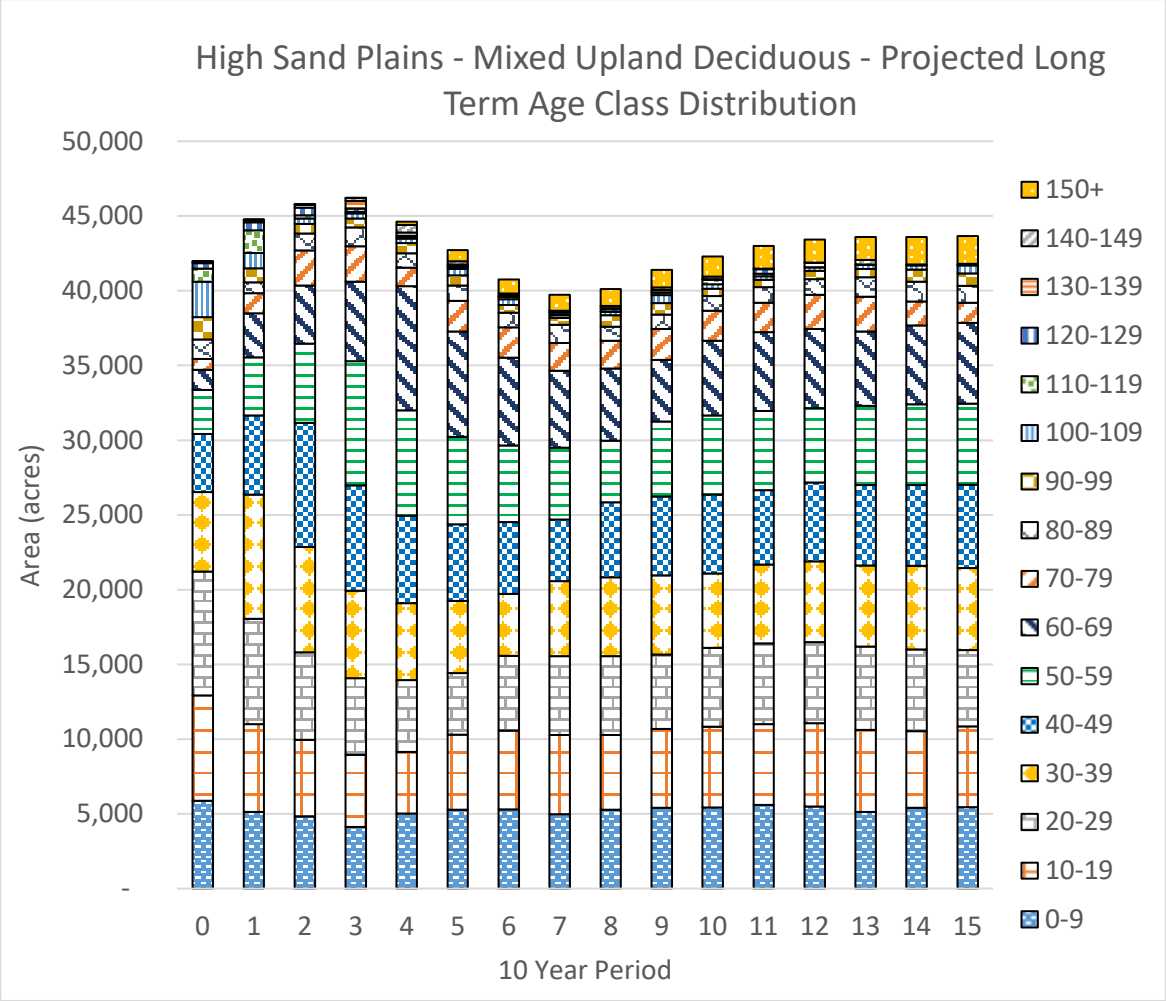


Figure 17. Projected age class distribution for all acres of mixed upland deciduous over the next 150 years.

Management actions

The desired forest conditions and associated featured species habitat will be maintained and achieved through continued application of the projected clearcut harvest regime on 2,188 acres, salvage clearcut on 144 acres, an additional 129 acres in selection, and 166 acres of shelterwood harvest regime. There are also approximately 2,803 acres forecasted to transition into this cover type over this planning period. These actions will encourage a healthy and productive forested mix in the mixed upland deciduous cover type.

Planted red pine

Current condition

Most of the planted red pine cover type is currently in the 0- to 9-year-old age class and nearly all the acres are available for commercial management; only 1% of the cover type is considered unavailable (Figure 18). The past management regime has been primarily thinning every 10 to 20 years to achieve an approximate residual basal area of 120 square feet. The age class distribution in this cover type is in a very unbalanced condition.

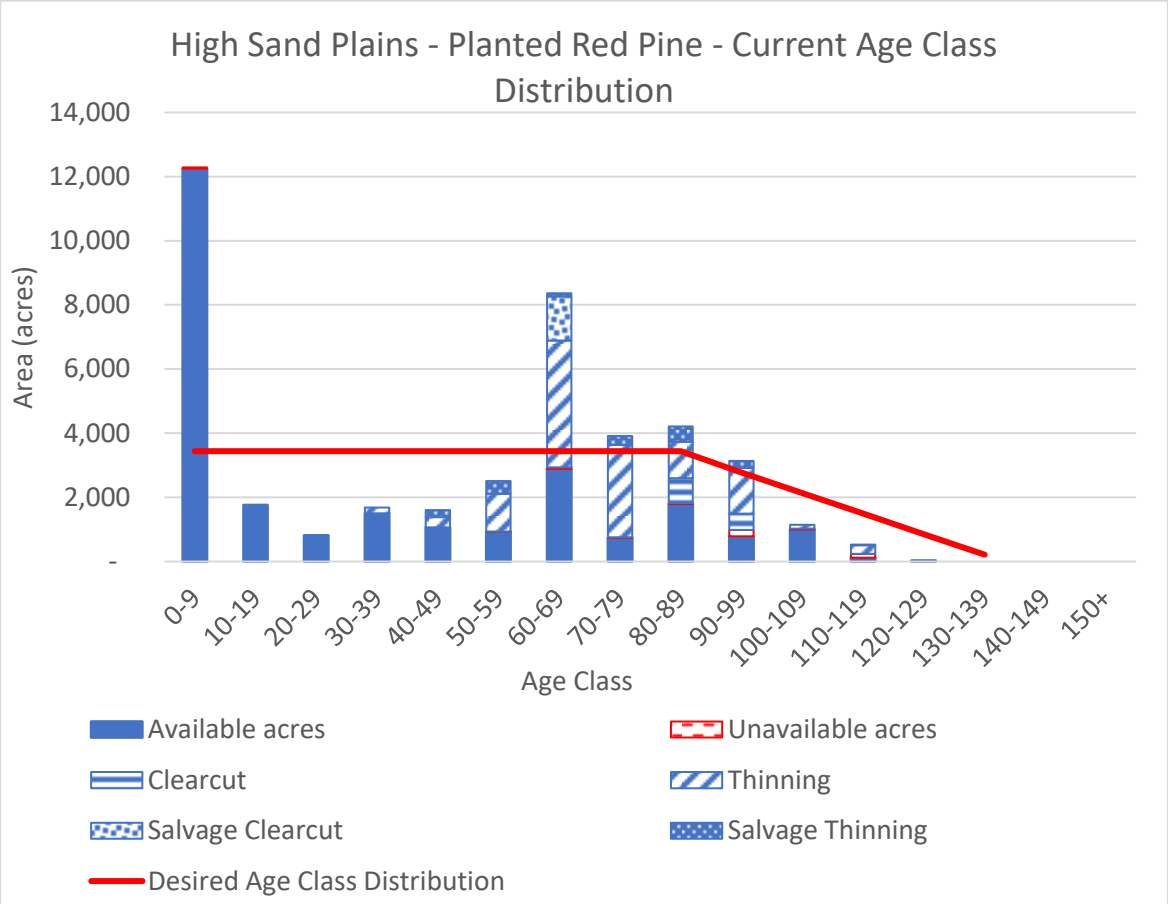


Figure 18. Current age class distribution, the desired age class distribution, and the projected harvests in the planted red pine cover type over the 10-year planning period.

Current conditions are a result of plantations established during the 1930s by the Civilian Conservation Corps, most of which reached maturity during the previous two planning periods. Additionally, there have been consistent commercial harvests regeneration efforts on available planted red pine acres during the previous planning period.

Desired future condition

The projected long-term cover type trend for planted red pine is increasing in the High Sand Plains Management Area. There are a few transitions into this cover type from other cover types forecasted in this management area with an increase of about 2.1%.

The long-term goal for this cover type is balanced age classes between 0 and 80 years old with a tail out to 130 years old for all available planted red pine stands in this management area. Maintaining lower acreage in old age classes continues to be desirable to lessen the prevalence and severity of diseases and to reduce the threat of damaging wildfire.

The end of the planning period will result in the establishment of 3,555 acres in the upcoming 0-9 age class which is just over the desired 3,509 acres (Figure 19). Progress toward the long-term age class distribution of planted red pine will take many decades in the management area.

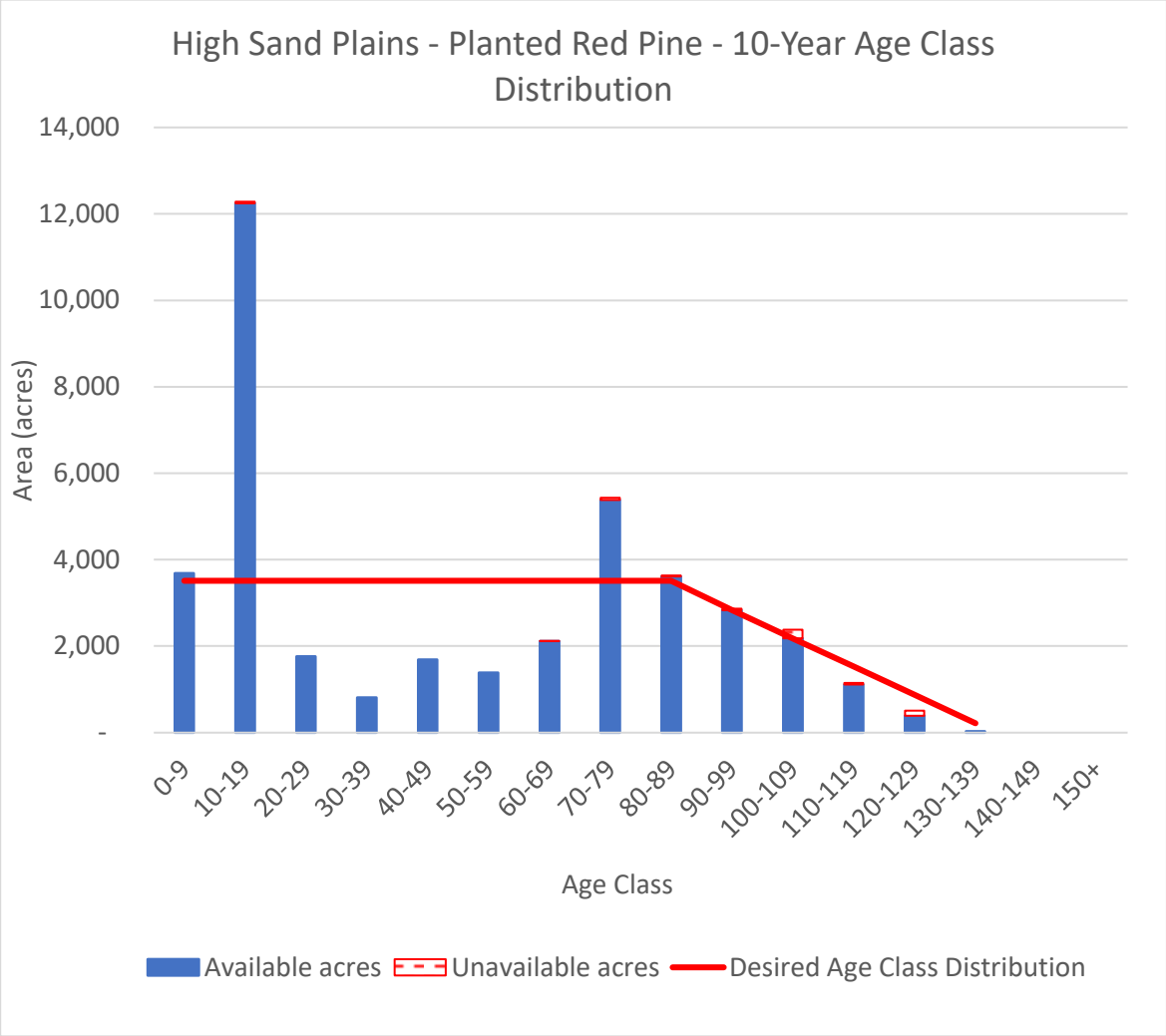


Figure 19. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of planted red pine beginning to improve with a few age classes nearing the desired future condition (Figure 20). As is often the case, extremely un-

balanced conditions in the first planning period can often result in the need to carry some acres higher in certain age classes to achieve the desired age class goals.

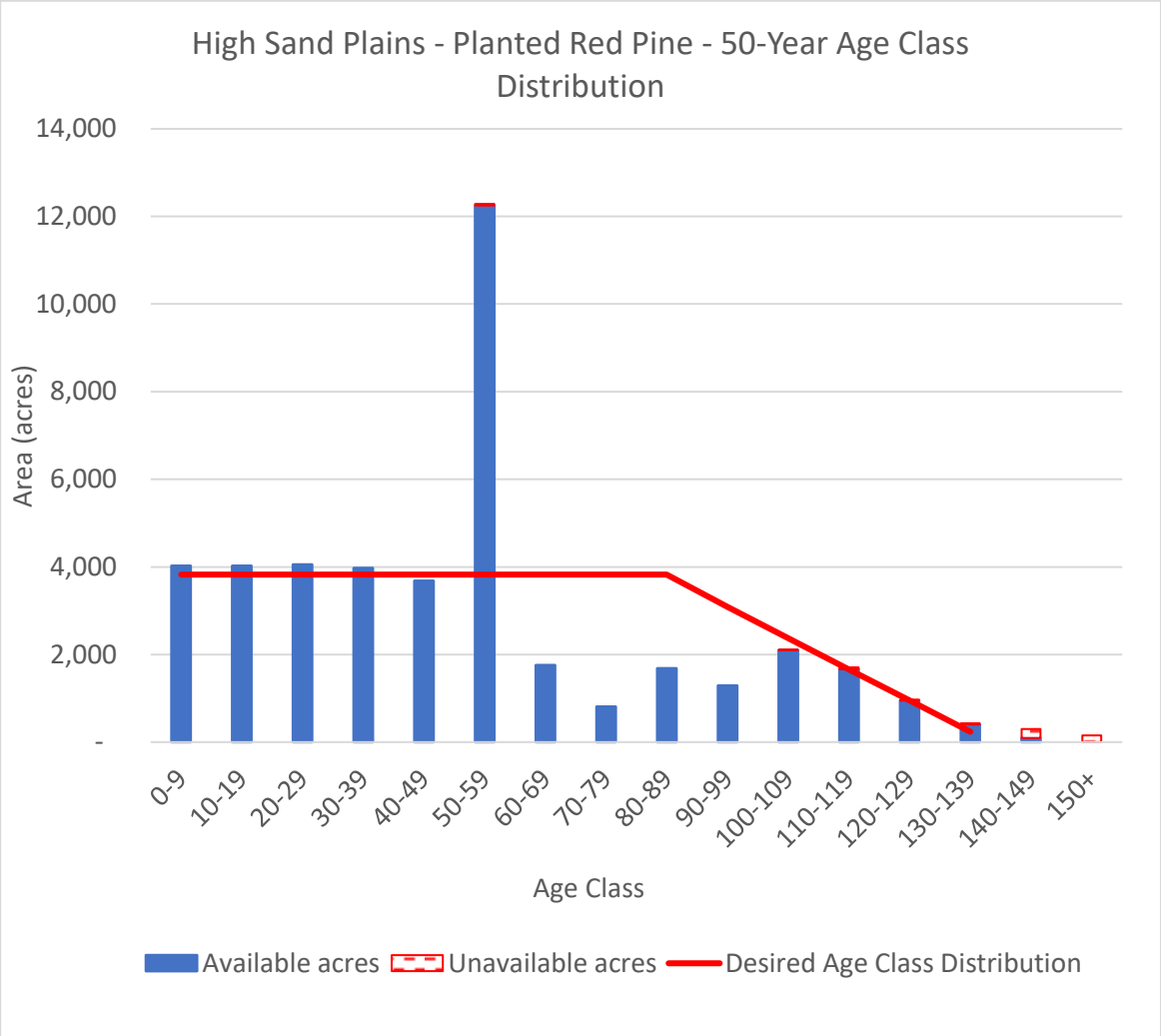


Figure 20. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 21) will concentrate the manageable acres of planted in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest (Figure 22).

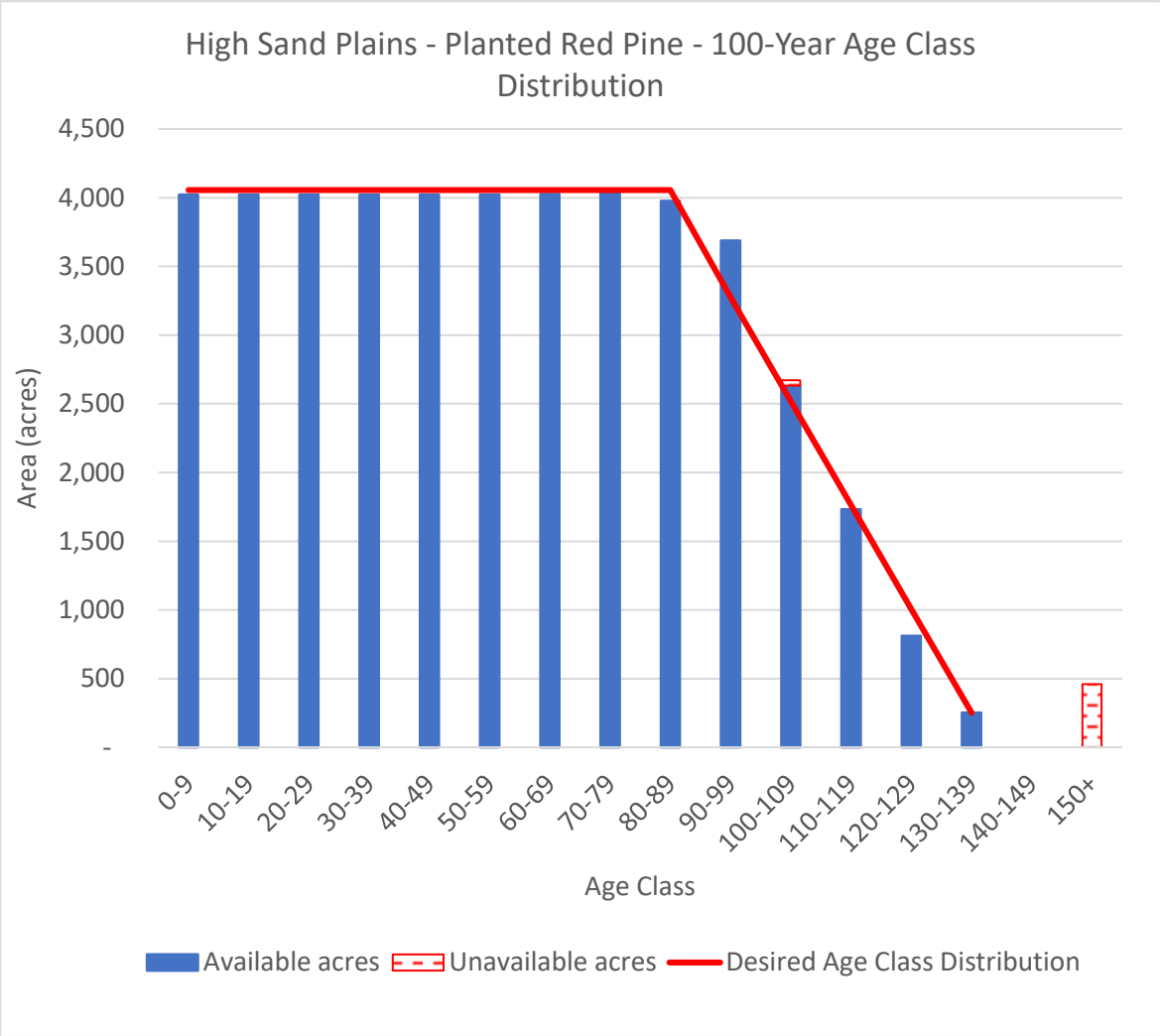


Figure 21. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

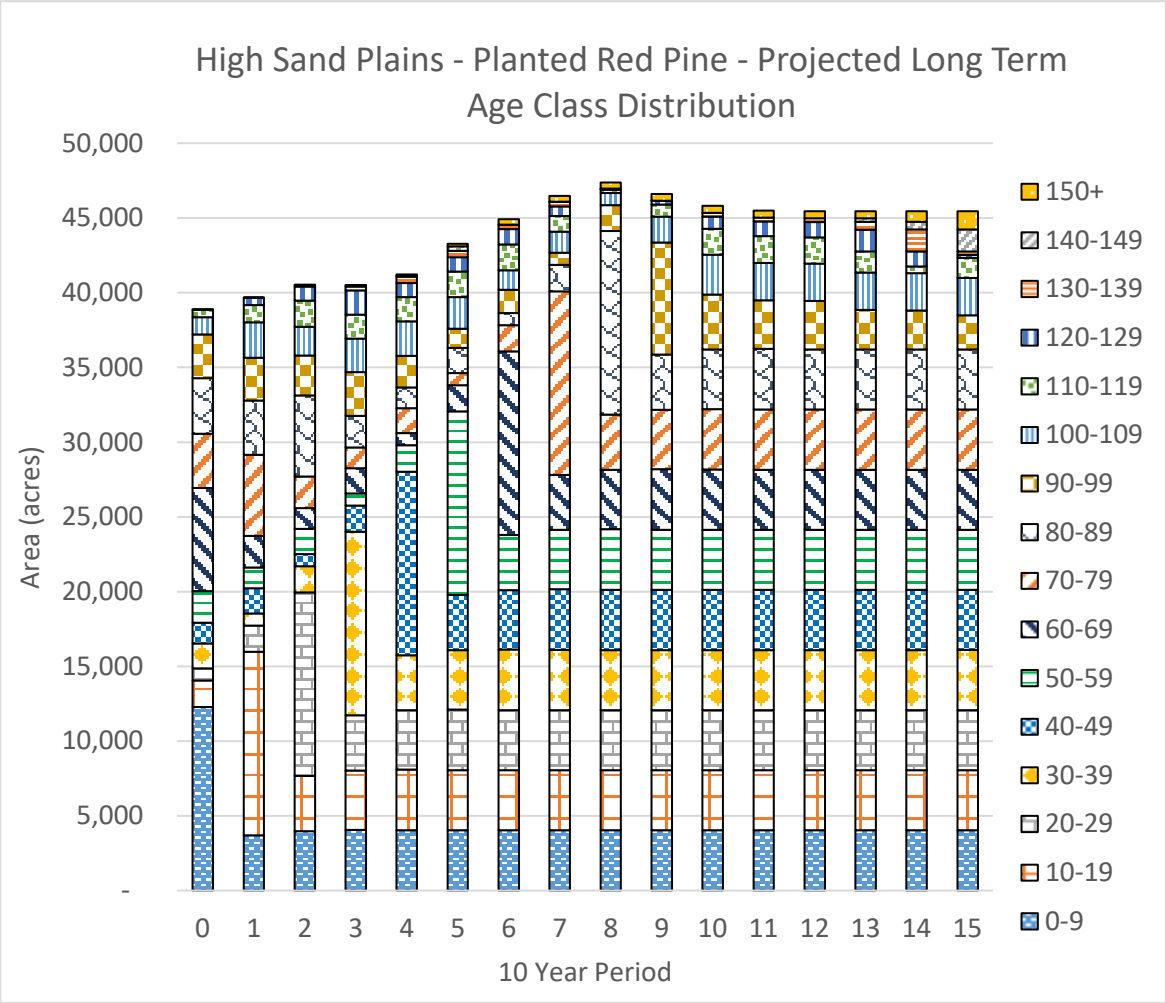


Figure 22. Projected age class distribution for all acres of planted red pine over the next 150 years.

Management actions

There are 1,285 acres of projected clearcut harvest and 1,460 salvage clearcut in the planted red pine cover type during this planning period. There are also 810 acres forecasted to transition into planted red pine. This is close to the desired establishment of 3,509 acres per decade. In addition to clearcut acres, there are 11,451 acres projected for thinning and 1,710 acres of salvage thinning in this cover type.

Natural jack pine

Current condition

Most of the natural jack pine cover type is currently between stand ages of 0 and 9 years old and 30 and 49 years old in the High Sand Plains Management Area (Figure 23). The age class distribution is currently unbalanced, especially in the 10- to 29-year-old age classes where the bulk of deficit acres occur. There is also a smaller deficit in the 60- to 69-year-old age class. A small number of acres that extend beyond the desired maximum age class distribution due to unavailability.

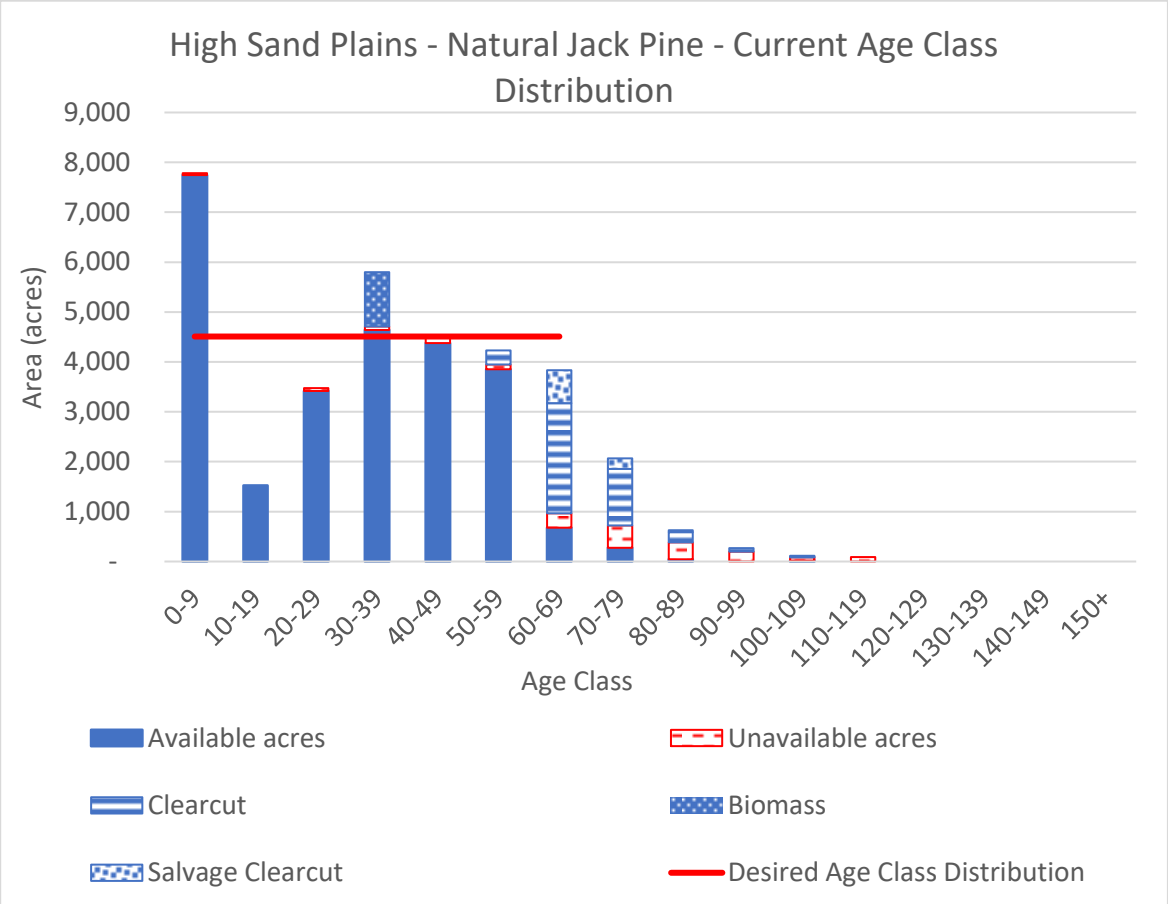


Figure 23. Current age class distribution and projected harvests in natural jack pine cover type.

Current conditions are a result of inconsistent commercial harvests and regeneration efforts on available natural jack pine acres during the previous two planning periods. A portion of this cover type meets the habitat requirements for Kirtland's warbler (Section 5) and snowshoe hare (Table 12). No data is provided for Kirtland's warbler, because the jack pine acres in this management area that have relevance are those within designated essential habitat. Because essential habitat was represented in the SAU, and the SAU provides unit-level management actions, it is best to refer to Section 5 for more information.

Table 12. Featured species with natural jack pine as a selected habitat cover type, habitat variables and current acres (e.g., potential habitat).

Featured Species	Featured Species Habitat – Natural Jack Pine	Natural Jack Pine Habitat Acres - Available	Natural Jack Pine Habitat Acres - Unavailable
Snowshoe Hare	Age Category: 0-19 Size Category: Sapling	9,264	43
Kirtland's Warbler	Age Category: 0-19 Size Category: Sapling, Pole	NA	NA

Desired future condition

The projected long-term cover type trend for natural jack pine is increasing in the High Sand Plains Management Area. Much of the increase in acres will be coming from the planted jack pine.

The long-term goal for this cover type is balanced age classes between 0 and 60 years old for all available jack pine stands in this management area. Maintaining lower acreage in old age classes continues to be desirable to lessen the prevalence and severity of jack pine budworm outbreaks and to reduce the threat of damaging wildfire.

The end of the planning period will result in the establishment of 6,734 acres which is slightly more than desirable number of acres in the 0-9 age class due to the surplus of acres in the older age classes (Figure 24). Progress toward the long-term desired age class distribution of jack pine will take many decades of even-aged management in this management area.

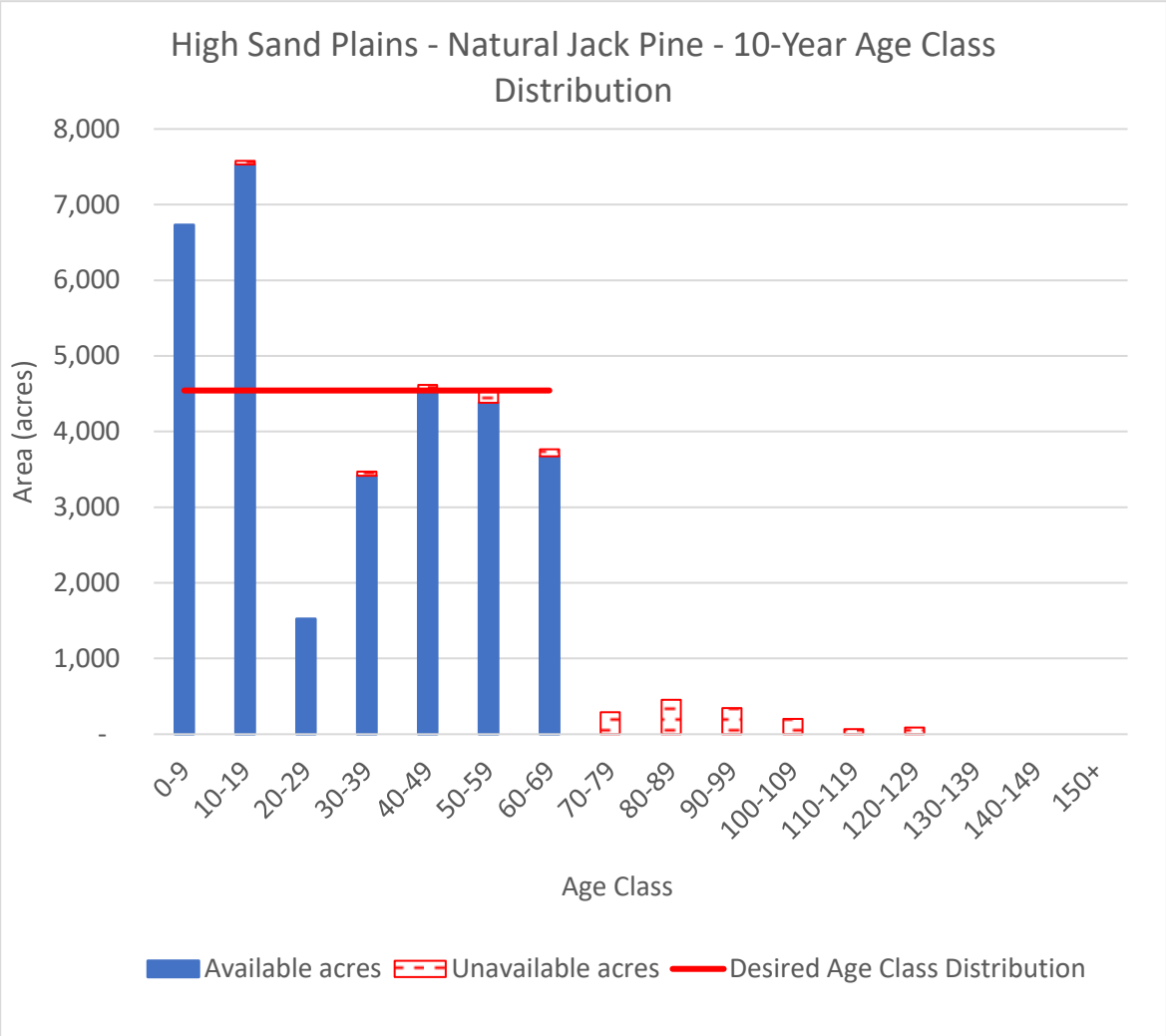


Figure 24. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution of jack pine is beginning to reach the desired future condition for available acres (Figure 25). There is an increase in acres in the older age classes, beyond the desired age of 60, due to the unbalanced nature of this cover type in this management area. As is often the case, unbalanced age classes may result in the need to leave some acres in older age classes to achieve the desired age class distribution in future planning periods.

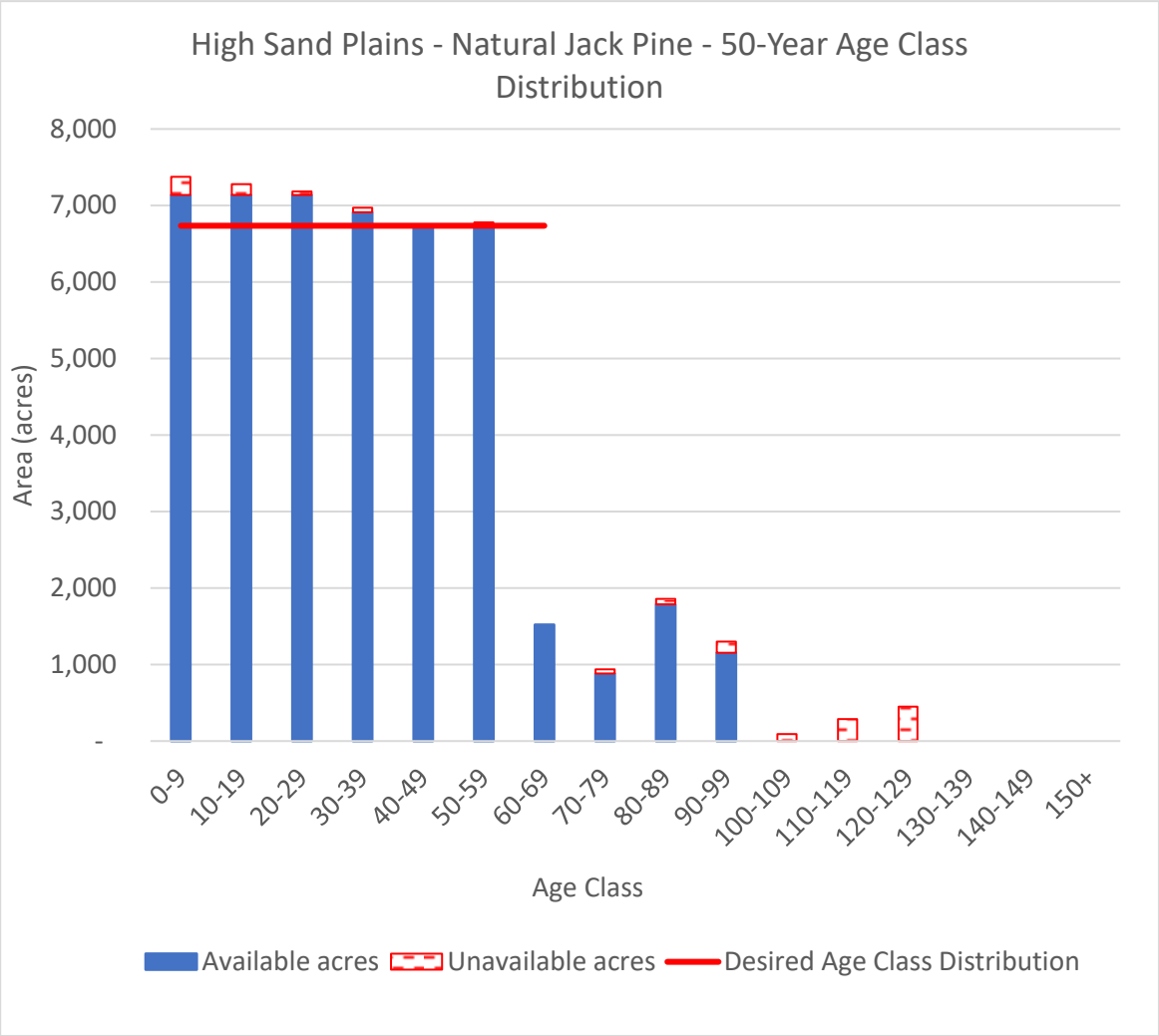


Figure 25. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 26) will concentrate the manageable acres of natural jack pine in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged, and mature forest (Figure 27).

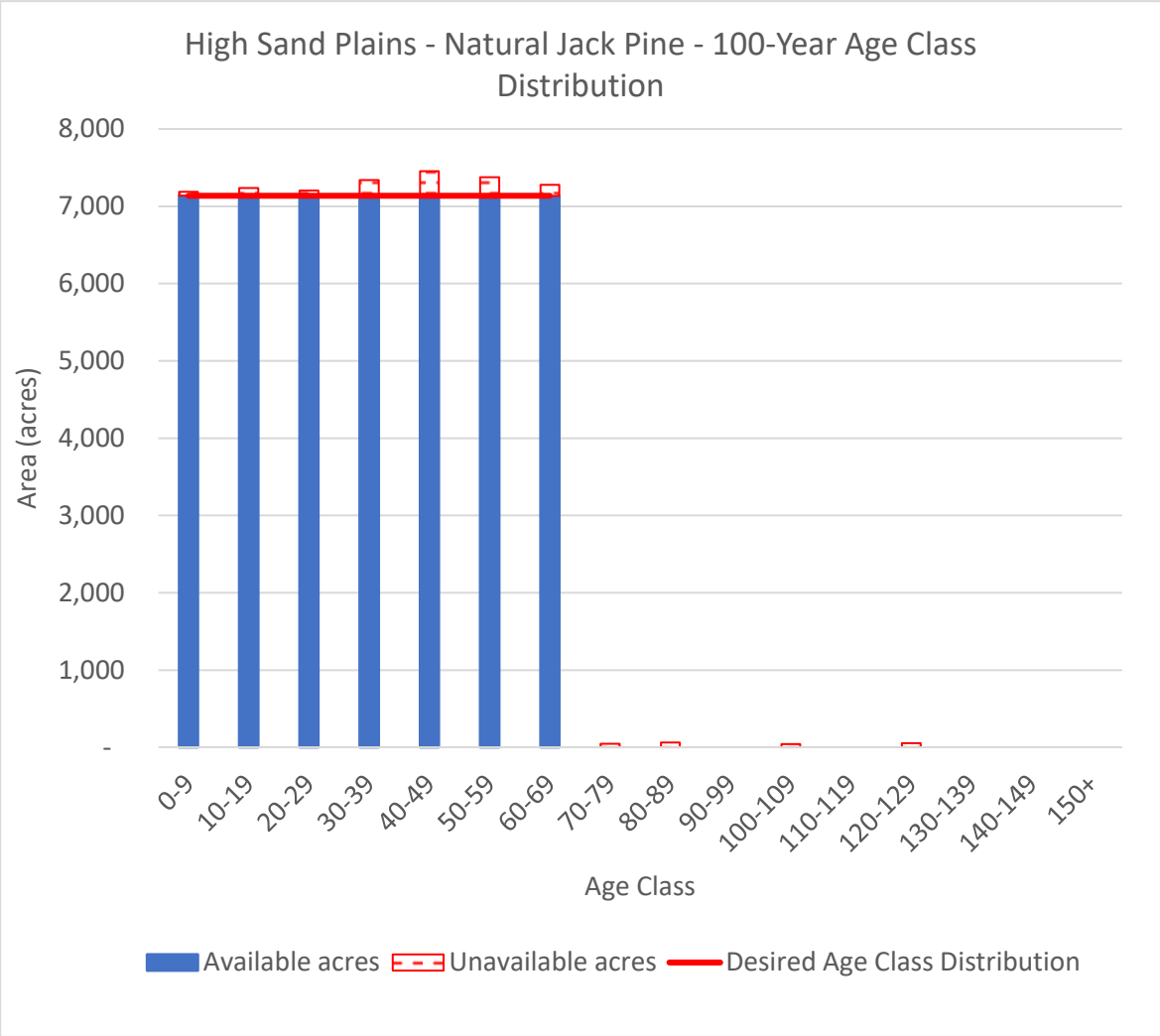


Figure 26. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

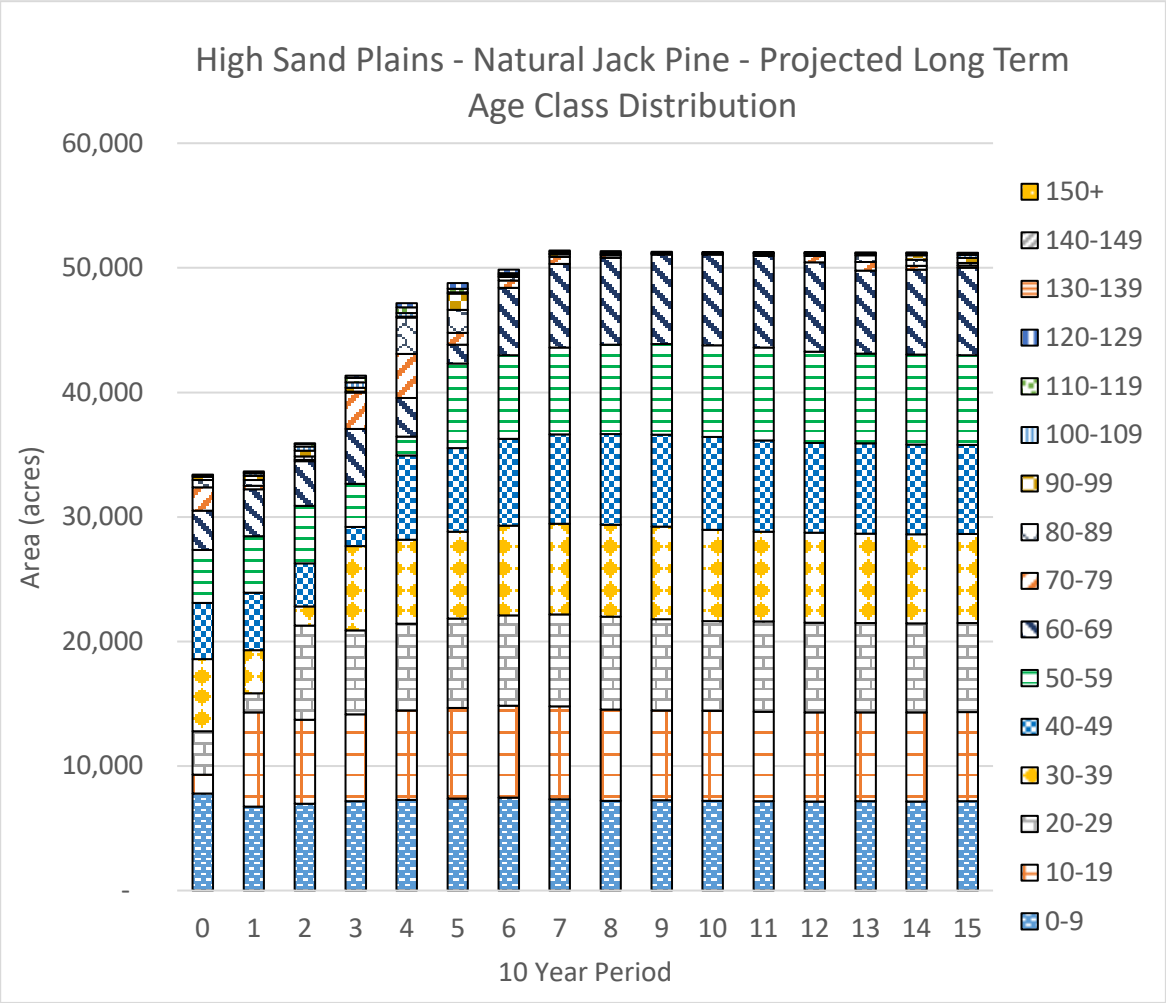


Figure 27. Projected age class distribution for all acres of natural jack pine over the next 150 years.

Management actions

There are 5,055 acres of projected clearcut harvest plus 940 acres of salvage clearcut in the natural jack pine cover type during the planning period. This, plus an additional 207 acres expected to regenerate due to severe ice storm damage and 239 acres transitioning into this cover type, falls above the desired establishment of 4,543 acres of natural jack pine per decade because of the current unbalanced age class condition.

Lowland conifers

Current condition

The High Sand Plains Management Area has a surplus of acres above the max tail of 80- to 89-year-old age class that was created due to unavailability of those acres on the landscape (Figure 28). The age class distribution is currently unbalanced across almost all the age class categories. Additionally, a deficit of available acres occurs in 10- to 59-year-old age classes. The landscape position of which many of these acres occur contributes to the number of acres extending beyond the desired maximum age class tail of 80 years old. A portion of this cover type meets the habitat requirements for snowshoe hare and marten (Table 13).

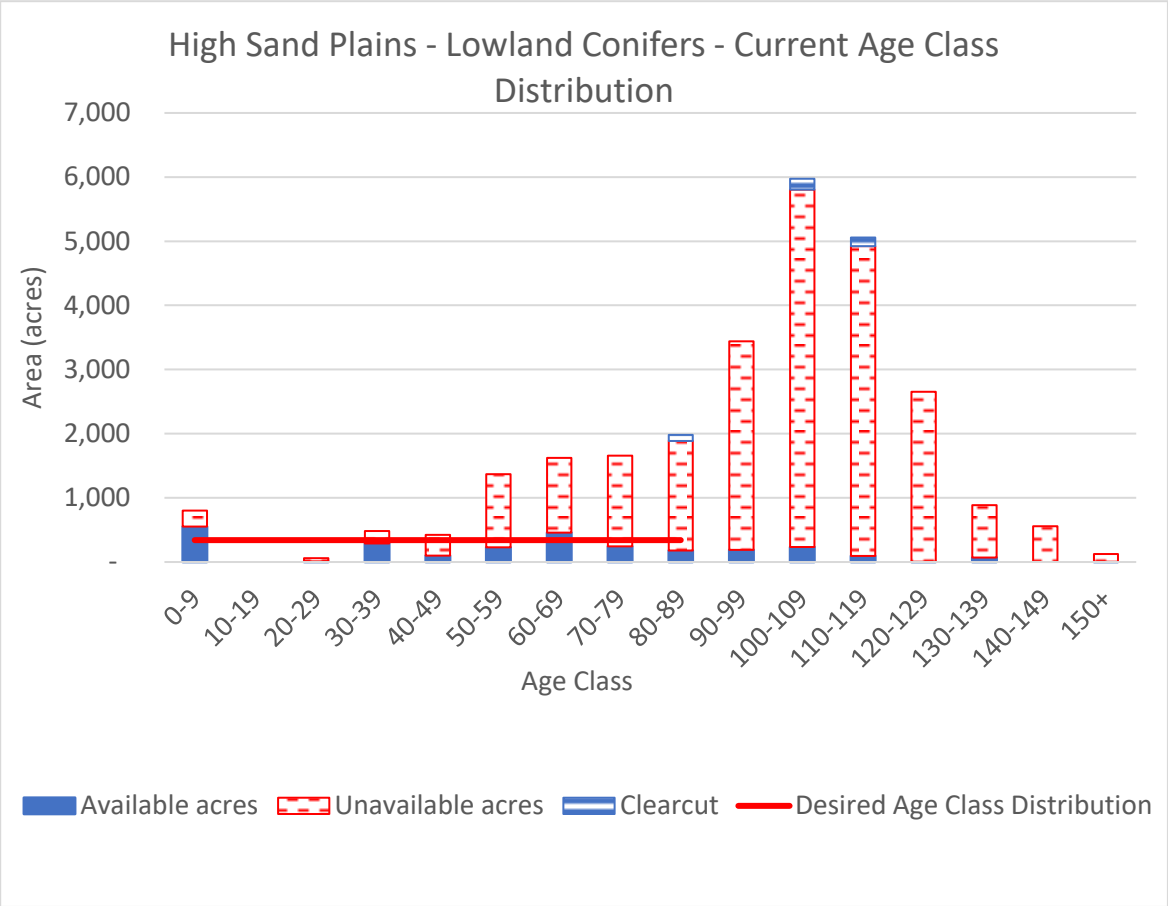


Figure 28. Current age class distribution, the desired age class distribution, and the projected harvests in the lowland conifer cover type over the 10-year planning period.

Table 13. Featured species with lowland conifers as a priority habitat cover type, habitat variables and current acres (e.g., potential habitat).

Featured Species	Featured Species Habitat – Lowland Conifers	Lowland Conifers Habitat Acres - Available	Lowland Conifers Habitat Acres - Unavailable
Snowshoe Hare	Age Category: 0-19 Size Category: Sapling	550	252
Marten	Age Category: 40+ Size Category: Pole, Sawlog Basal Area: 81+	1,185	16,793

Desired future condition

The projected long-term cover type trend for lowland conifers is fairly stable in the High Sand Plains Management Area with less than a 0.4% decrease in acres. There are a few transitions in and out of this cover type during this planning period.

The long-term goal for this cover type is balanced age classes between 0 and 80 years old for all available lowland conifer acres. Much of the cover type will grow into the older age classes due to being unavailable for commercial harvest.

The end of the planning period will result in the establishment of approximately 302 acres of lowland conifers from the available acres (Figure 29). Progress toward the long-term desired age class distribution of lowland conifers will take many decades to achieve the desired balanced age class condition.

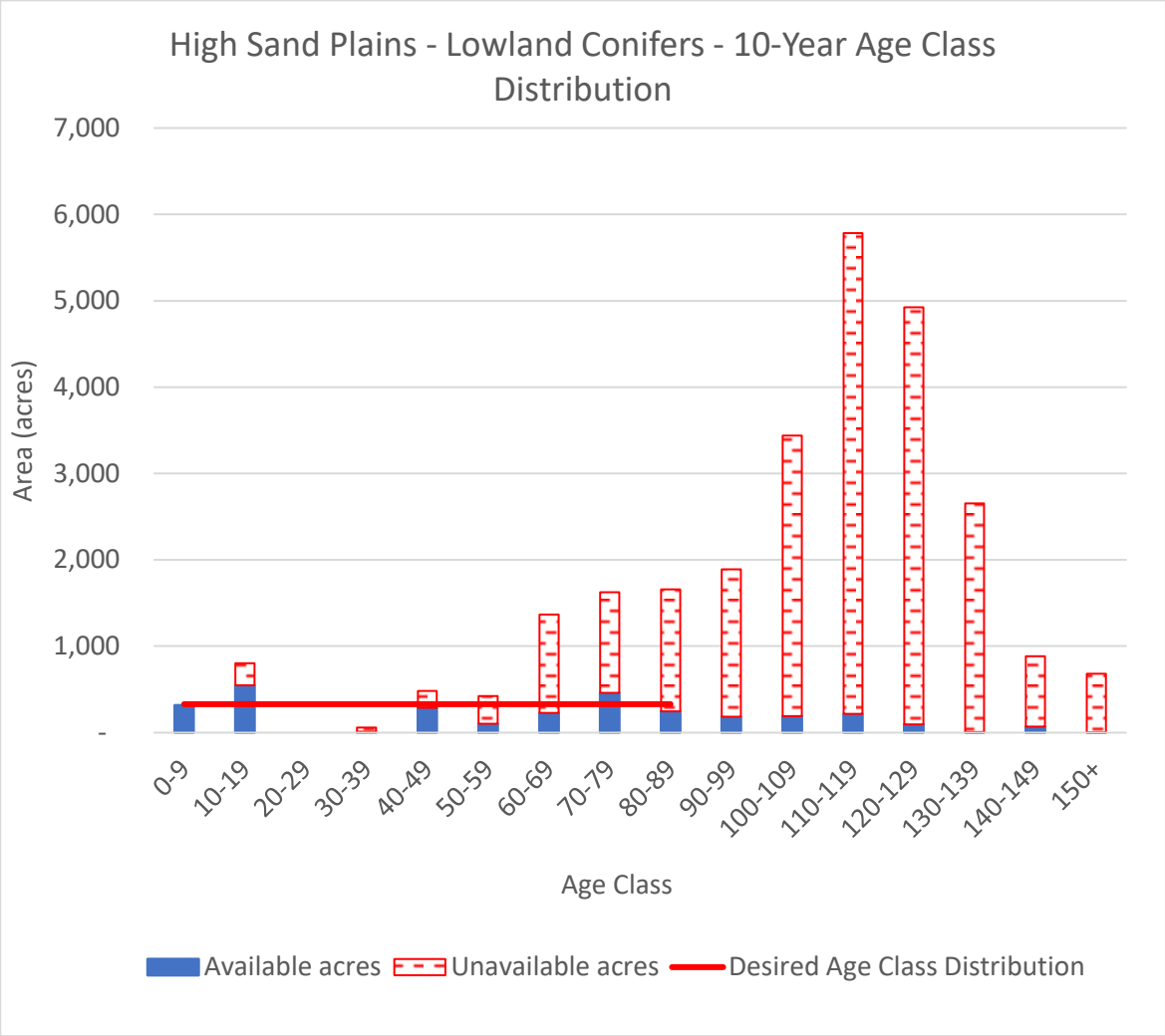


Figure 29. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution of lowland conifers is beginning to reach the desired future condition for available acres in the age classes between 0 and 40-year-old age classes and between the 80 and 89-year age classes (Figure 30). The number of acres in the older age classes, 90 years and older, continues to increase as the unavailable acres continue to move to the older age classes.

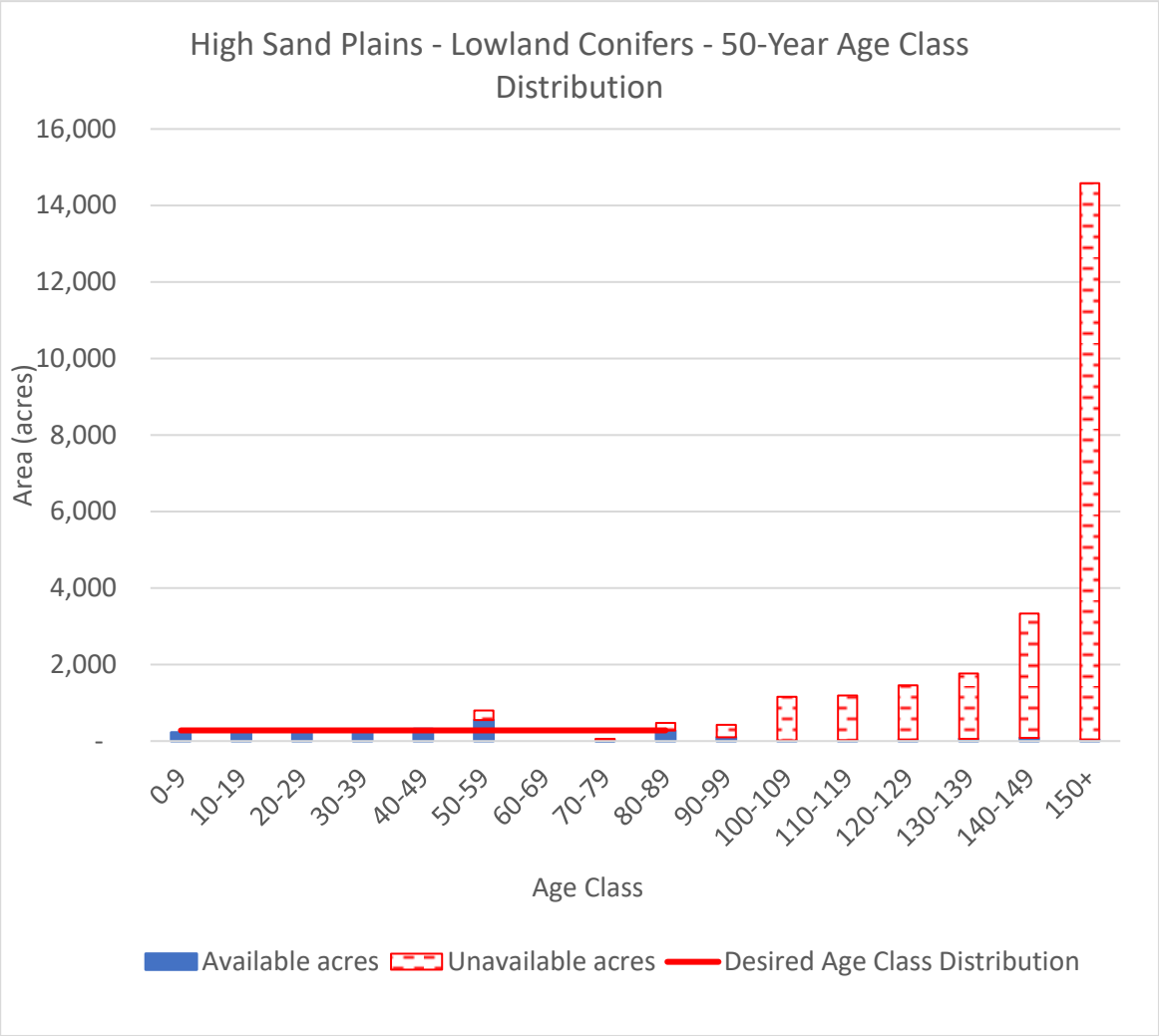


Figure 30. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 31) will concentrate on the manageable acres of lowland conifer cover type in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest (Figure 32).



Figure 31. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

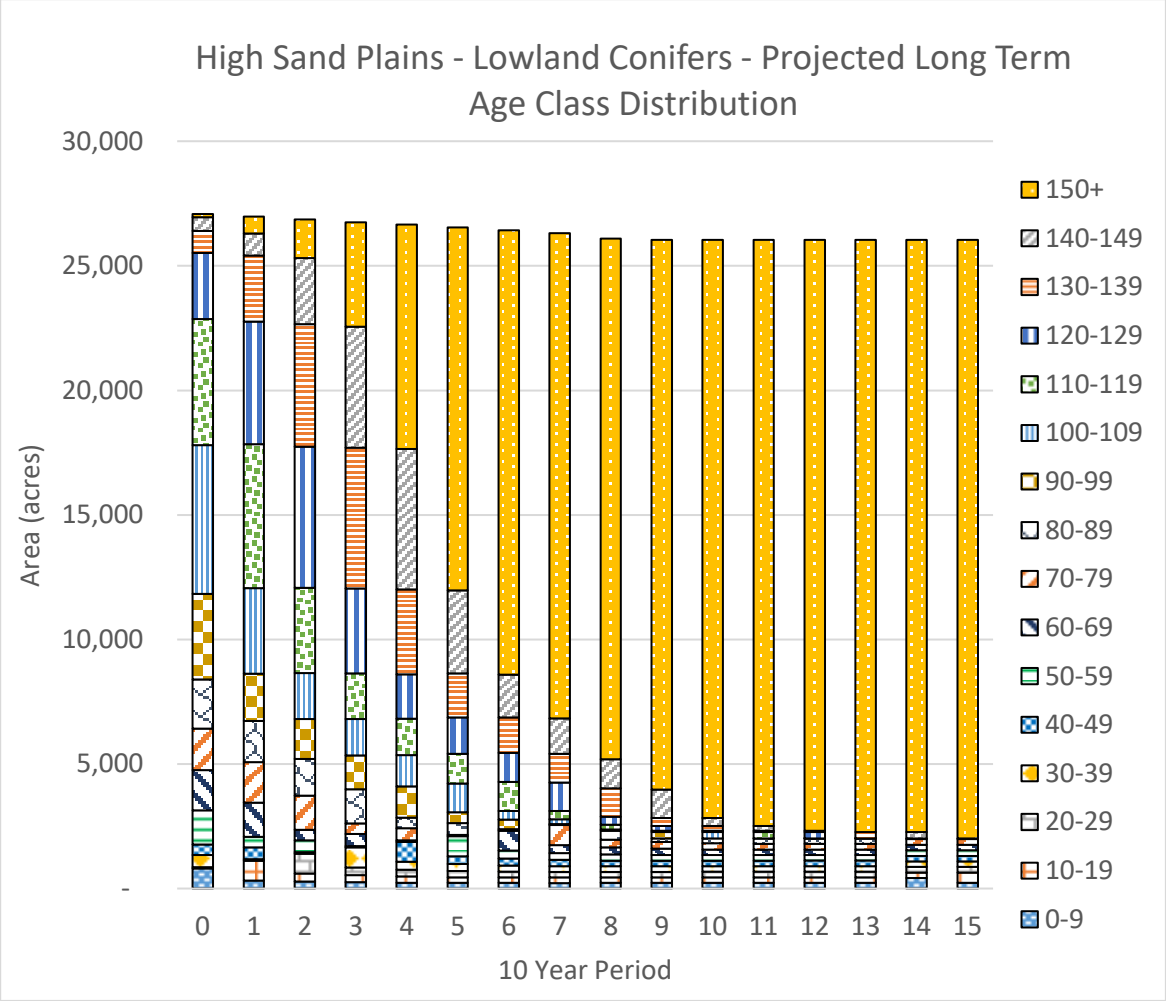


Figure 32. Projected age class distribution for all acres of lowland conifers over the next 150 years.

Management actions

There are 402 acres of projected clearcut harvest in the lowland conifer cover type during the planning period. 100 acres are projected to transition into other cover types resulting in about 302 acres of regeneration which is very close to the desired establishment of 328 acres of lowland conifer per decade.

Conservation area network

High conservation value areas

There are up to nine different high conservation value area (HCVA) types that can be found in each management area (Table 14; see Biodiversity in Section 3 for more information).

Table 14. High conservation value areas within the High Sand Plains Management Area.

High Conservation Value Area Type and Name	Acres
Dedicated Management Area's	**7,554**

High Conservation Value Area Type and Name	Acres
--	7,554
Eastern Massasauga Managed Land	**11,588**
--	11,588
Forest Habitat Core Interior	**1,292**
--	1,292
Kirtland's Warbler Habitat	**76,959**
Big Creek	2,594
Crapo Lk	4,259
Damon	17,533
Down River	3,457
Fletcher	4,176
Leota	6,736
Lovells	7,426
Manistee	2,555
Monument	701
Muskrat	4,850
N Branch	645
Ogemaw	6,142
Pere Chene	4,024
Sharon	5,018
St Helen	3,519
Staley Lk	3,323
Natural Area's Legally Dedicated	**159**
(blank)	159
Natural Rivers Vegetative Buffer	**2,866**
(blank)	2,866
Natural Rivers Zoning District	**9,316**
(blank)	9,316
State Wildlife Management Areas	**11,877**
Backus Lake Flooding SWMA	1,658
Bear Creek Flooding SWMA	986
Beaver Lake Flooding SWMA	475
Cannon Creek 1 and 2 Floodings SWMA	475
Connors Marsh Flooding SWMA	1,057
Denton Creek Flooding SWMA	805
Houghton Lake Flats (North and South) Fl	857
Old Fur Farm Flooding SWMA	1,975
Reedsburg Damn Flooding SWMA	1,024
Robinson Creek Flooding SWMA	2,566
State Wildlife Research Areas	**13,802**
Houghton Lake SWRA	10,986
Pere Marquette SF	2,816

High Conservation Value Area Type and Name	Acres
Verified Type 1 and Type 2 Old Growth	**374**
Type 1 Old Growth	282
Type 2 Old Growth	92
GEMS	**4,329**
Backus Creek	4,329
Grand Total	**140,116**

Ecological reference areas

Ecological reference areas (ERAs) are a type of HCVA and are higher quality examples of functioning ecosystems that are primarily influenced by natural ecological processes.

Table 15. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 16. Ecological reference areas within the management area.

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	Number of Occurrences
Existing ERA	Bog	B	G3G5	S4	1
Existing ERA	Bog	BC	G3G5	S4	1
Existing ERA	Bog	C	<Null>	<Null>	1
Existing ERA	Cirsium hillii	E	G3	S3	1
Existing ERA	Dry Northern Forest	BC	-	-	1
Existing ERA	Dry Northern Forest	C	<Null>	<Null>	1
Existing ERA	Dry Northern Forest	D	G3?	S3	1
Existing ERA	Dry-mesic Northern Forest	BC	-	-	3
Existing ERA	Dry-mesic Northern Forest	BC	<Null>	<Null>	1
Existing ERA	Dry-mesic Northern Forest	BC	<Null>	S3	1
Existing ERA	Dry-mesic Northern Forest	C	<Null>	<Null>	2

Existing ERA	Floodplain Forest	B	G3?	S3	1
Existing ERA	Floodplain Forest	BC	G3?	S3	2
Existing ERA	Intermittent Wetland	B	G2	S3	1
Existing ERA	Mesic Northern Forest	BC	G4	S3	2
Existing ERA	Mesic Northern Forest	CD	G4	S3	1
Existing ERA	Muskeg	AB	<Null>	S3	1
Existing ERA	Northern Fen	B	G3	S3	1
Existing ERA	Northern Fen	BC	G3	S3	1
Existing ERA	Northern Shrub Thicket	A	G4	S5	1
Existing ERA	Northern Shrub Thicket	B	G4	S5	1
Existing ERA	Northern Shrub Thicket	BC	G4	S5	2
Existing ERA	Northern Wet Meadow	B	-	-	1
Existing ERA	Northern Wet Meadow	BC	G4G5	S4	1
Existing ERA	Oak-Pine Barrens	C	G3	S2	1
Existing ERA	Pine Barrens	B	-	-	1
Existing ERA	Pine Barrens	BC	G3	S2	1
Existing ERA	Pine Barrens	C	-	-	1
Existing ERA	Pine Barrens	C	G3	S2	1
Existing ERA	Pine Barrens	CD	<Null>	<Null>	1
Existing ERA	Pine Barrens	D	G3	S2	4
Existing ERA	Poor Conifer Swamp	B	-	-	1
Existing ERA	Poor Fen	AB	<Null>	S3	3
Existing ERA	Poor Fen	B	G3	S3	1
Existing ERA	Rich Conifer Swamp	BC	G4	S3	1
Existing ERA	Rich Conifer Swamp	C	<Null>	<Null>	2
Existing ERA	Rich Conifer Swamp	C	G4	S3	4
Proposed ERA	Dry Northern Forest	C	G3?	S3	-
Proposed ERA	Intermittent Wetland	C	G2	S3	1
Proposed ERA	Northern Fen	B	G3	S3	1
Proposed ERA	Pine Barrens	AB	G3	S2	1
Proposed ERA	Pine Barrens	BC	G3	S2	3
Proposed ERA	Pine Barrens	C	G3	S2	2
Proposed ERA	Pine Barrens	CD	G3	S2	1
Proposed ERA	Pine Barrens	C?	G3	S2	1
Proposed ERA	Pine Barrens	D?	G3	S2	1
Grand Total	**-**	**-**	**-**	**-**	**63**

Special Conservation Areas

Reviewable special conservation areas (SCAs; Table 17) refers to those SCA types that may be reviewed or updated through the compartment review process as needed. Static SCAs (Table 18) refers to those

SCA types that generally do not change or require updating (see Biodiversity in Section 3 for more information).

Table 17. Reviewable special conservation areas within the High Sand Plains Management Area.

Reviewable Special Conservation Area Type and Name	Acres
Concentrated Recreational Area	**2,129**
Au Sable River Canoe Camp Campground	9
Bear Lake Campground	8
Big Bear Lake Campground	19
Burton's Landing Campground	16
Buttles Road Pathway	1
Canoe Harbor Campground	32
Goose Creek Trail Camp Campground	45
High Banks Overlook	4
Hudson Creek Swamp SCA	1,772
Keystone Landing Campground	28
Parmelee Bridge Campground	14
Rainbow Bend Campground	41
Reedsburg Dam Campground	23
Sheep Pasture Access Site	11
Unspecified	69
Upper Manistee River Campground	34
White Pine Canoe Camp Campground	4
Cultural or Customary Area	**-**
--	-
Habitat Area or Habitat Corridor	**1,749**
71137 Habitat Area	5
Bear Creek Flooding	1,279
C149 Pinery	320
Fletcher Barrens Complex	-
Little Devil Creek Pine	144
Mineral Resource Area	**207**
Crawford County Road Commission	5
Rieth-Riley Construction Co.	175
Roscommon County Road Commission	28
Possible Type 1 or Type 2 Old Growth	**117**
--	117
Spring, Wetlands, or Riparian Areas	**987**
71145013	4
Muskegon River Floodplain	849
Roscommon County Road Commission	28
Wolf and Pup Creek Stream Corridor	106
Visual Management Areas	**328**

Reviewable Special Conservation Area Type and Name	Acres
Lost Twin Lakes Pathway	308
Unspecified	20
Grand Total	**5,623**

Table 18. Static special conservation areas within the High Sand Plains Management Area.

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Common Natural Heritage Element Occurrences	**-**	**1,526**
Bog	-	26
Dry-mesic Northern Forest	-	61
Muskeg	-	43
Northern Shrub Thicket	-	176
Northern Wet Meadow	-	303
Poor Conifer Swamp	-	917
Designated Trout and Cold Water Stream Buffer	**-**	**5,713**
<Null>	-	2,861
Asum Creek	-	15
Au Sable River	-	216
Barker Creek	-	44
Beaver Creek	-	70
Big Cannon Creek	-	229
Big Creek	-	27
Big Devil Creek	-	76
Crane Creek	-	22
Dead Stream	-	16
Douglas Creek	-	17
Duval Creek	-	3
East Branch Big Creek	-	8
East Branch Wolf Creek	-	58
East Creek	-	107
Elm Creek	-	5
Filer Creek	-	8
Giss-I-Was Creek	-	69
Goose Creek	-	50
Hickey Creek	-	1
Hudson Creek	-	132
Klacking Creek	-	35
Little Cannon Creek	-	142
Little Devil Creek	-	5
Manistee River	-	180
Middle Branch Big Creek	-	74
Middle Branch Cedar River	-	7

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Mostellar Creek	-	25
North Branch Au Sable River	-	39
North Branch Cedar River	-	116
North Branch Chippewa River	-	5
Ogemaw Creek	-	16
Overton Creek	-	5
Phelan Creek	-	6
Popple Creek	-	24
Prior Creek	-	26
Pup Creek	-	14
Robinson Creek	-	159
Sauger Creek	-	4
Silver Creek	-	37
Simpson Creek	-	7
Sohn Creek	-	101
South Branch Au Sable River	-	264
South Branch Tobacco River	-	59
Thayer Creek	-	98
Townline Creek	-	20
West Branch Big Creek	-	78
West Branch Muskegon River	-	84
Whisky Creek	-	49
Designated Trout and Coldwater Streams	**211.1**	**-**
<Null>	105.0	-
Asum Creek	0.5	-
Au Sable River	7.3	-
Barker Creek	1.6	-
Beaver Creek	2.6	-
Big Cannon Creek	8.4	-
Big Creek	1.1	-
Big Devil Creek	2.8	-
Crane Creek	0.8	-
Dead Stream	0.6	-
Douglas Creek	0.7	-
Duval Creek	0.1	-
East Branch Big Creek	0.3	-
East Branch Wolf Creek	2.2	-
East Creek	4.0	-
Elm Creek	0.2	-
Filer Creek	0.4	-
Giss-I-Was Creek	2.5	-
Goose Creek	1.9	-

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Hickey Creek	0.1	-
Hudson Creek	5.1	-
Klacking Creek	1.3	-
Little Cannon Creek	5.5	-
Little Devil Creek	0.2	-
Manistee River	6.6	-
Middle Branch Big Creek	2.7	-
Middle Branch Cedar River	0.3	-
Mostellar Creek	0.9	-
North Branch Au Sable River	1.5	-
North Branch Cedar River	4.2	-
North Branch Chippewa River	0.2	-
Ogemaw Creek	0.6	-
Overton Creek	0.2	-
Phelan Creek	0.3	-
Popple Creek	0.9	-
Prior Creek	1.0	-
Pup Creek	0.5	-
Robinson Creek	6.0	-
Sauger Creek	0.1	-
Silver Creek	1.5	-
Simpson Creek	0.2	-
Sohn Creek	4.0	-
South Branch Au Sable River	9.9	-
South Branch Tobacco River	2.2	-
Thayer Creek	3.6	-
Townline Creek	0.7	-
West Branch Big Creek	3.0	-
West Branch Muskegon River	3.2	-
Whisky Creek	1.8	-
Important Bird Areas	**-**	**138,395**
Kirtland's Warbler Management Units & Guide's Rest	-	126,470
Lower Au Sable River and Iosco Co. Northern Goshawk IBA	-	11,408
Pigeon Country moraines	-	517
Military Lease Land	**-**	**5,590**
Board Purchases	-	201
Deeded to Board	-	693
Federal Land	-	95
Long Term Lease	-	4,601
Military Research Areas	**-**	**39,746**

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Camp Grayling	-	33,937
Hunt Creek Fish Research Station	-	0
Roscommon Forest Fire Experiment Station	-	5,809
Mussel Stream Group 1 - State special concern	**6.8**	**-**
Backus Creek	5.1	-
Cranberry Creek-Muskegon River	0.1	-
Dead Stream Flooding-Muskegon River	1.1	-
Dishwash Creek-Muskegon River	0.6	-
Mussel Stream Group 2 - State threatened or endangered	**10.4**	**-**
Backus Creek	3.6	-
Dead Stream Flooding-Muskegon River	2.1	-
Dishwash Creek-Muskegon River	0.8	-
Dyer Lake-Clam River	1.5	-
Middle Branch River	0.1	-
West Branch Clam River	0.5	-
Wolf Creek	1.8	-
Non-dedicated Natural Areas	**-**	**14,607**
Natural Area Crawford Red Pines	-	120
Natural Area Dead Stream Swamp	-	11,547
Natural Area South Branch AuSable River Area	-	300
Natural Area South Branch AuSable River Proposed	-	2,640
Wood Turtle Stream 100ft Buffer	**-**	**572**
Au Sable River	-	71
Bear Creek	-	32
Big Cannon Creek	-	103
Muskegon River	-	273
North Branch Au Sable River	-	12
Pine River	-	2
South Branch Au Sable River	-	26
Wolf Creek	-	53
Wood Turtle Stream 660ft Buffer	**-**	**3,663**
Au Sable River	-	689
Bear Creek	-	190
Big Cannon Creek	-	682
Muskegon River	-	1,479
North Branch Au Sable River	-	79
Pine River	-	35
South Branch Au Sable River	-	197
Wolf Creek	-	312
Grand Total	**228.3**	**209,811**

Rare species

Rare species occurrences are compiled from the Michigan Natural Features Inventory Biotics database (*Table* 19, Table 21 and Table 22) and do not necessarily include all rare species found in this management area due to biases in survey effort and verifiable observation reporting over time.

Table 19*. Rare animal and plant species conservation status key.*

Status	Status
E = endangered	LE = listed endangered
T = threatened	LT = listed threatened
SC = special concern	PDL = proposed for delisting

Table 20. Rare animal occurrence within the High Sand Plains Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Accipiter gentilis	Northern goshawk	T	-	3
Animal	Acipenser fulvescens	Lake sturgeon	T	-	1
Animal	Alasmidonta viridis	Slippershell	T	-	5
Animal	Antrostomus vociferus	Eastern whip-poor-will	T	-	1
Animal	Appalachia arcana	Secretive locust	SC	-	29
Animal	Atrytonopsis hianna	Dusted skipper	SC	-	6
Animal	Bombus borealis	Northern amber bumble bee	SC	-	2
Animal	Bombus terricola	Yellow banded bumble bee	SC	-	12
Animal	Botaurus lentiginosus	American bittern	SC	-	1
Animal	Brachionycha borealis	Boreal brachionyncha	SC	-	7
Animal	Brychius hungerfordi	Hungerford's crawling water beetle	E	LE	1
Animal	Buteo lineatus	Red-shouldered hawk	SC	-	5
Animal	Cambarunio iris	Rainbow	SC	-	4
Animal	Cambarus robustus	Big water crayfish	SC	-	2
Animal	Canachites canadensis	Spruce grouse	T	-	1
Animal	Centronyx henslowii	Henslow's sparrow	E	-	1
Animal	Chlidonias niger	Black tern	T	-	2
Animal	Circus hudsonius	Northern harrier	SC	-	1

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Cistothorus palustris	Marsh wren	SC	-	1
Animal	Cistothorus platensis	Sedge wren	SC	-	1
Animal	Clemmys guttata	Spotted turtle	T	-	2
Animal	Coturnicops noveboracensis	Yellow rail	T	-	1
Animal	Cygnus buccinator	Trumpeter swan	SC	-	2
Animal	Emydoidea blandingii	Blanding's turtle	SC	-	14
Animal	Faxonius immunis	Calico crayfish	SC	-	1
Animal	Fontigens nickliniana	Watercress snail	SC	-	1
Animal	Gallinula galeata	Common gallinule	T	-	1
Animal	Gavia immer	Common loon	T	-	11
Animal	Glyptemys insculpta	Wood turtle	T	-	12
Animal	Haliaeetus leucocephalus	Bald eagle	SC	-	38
Animal	Hesperia metea	Cobweb skipper	SC	-	3
Animal	Ixobrychus exilis	Least bittern	T	-	2
Animal	Lasmigona compressa	Creek heelsplitter	SC	-	1
Animal	Lasmigona costata	Flutedshell	SC	-	2
Animal	Ligumia recta	Black sandshell	T	-	2
Animal	Lithobates palustris	Pickerel frog	SC	-	6
Animal	Merolonche dolli	Doll's merolonche	SC	-	4
Animal	Moxostoma carinatum	River redhorse	T	-	1
Animal	Myotis lucifugus	Little brown bat	T	-	2
Animal	Myotis septentrionalis	Northern long-eared bat	T	LE	2
Animal	Necturus maculosus	Mudpuppy	SC	-	4
Animal	Notropis dorsalis	Bigmouth shiner	T	-	2
Animal	Opheodrys vernalis	Smooth green snake	SC	-	12
Animal	Pandion haliaetus	Osprey	SC	-	26
Animal	Papaipema beeriana	Blazing star borer	SC	-	4
Animal	Percina copelandi	Channel darter	E	-	2
Animal	Percina shumardi	River darter	E	-	1
Animal	Physella parkeri	Broadshoulder physa	SC	-	1

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Pisidium idahoense	Giant northern pea clam	SC	-	1
Animal	Pleurobema sintoxia	Round pigtoe	SC	-	1
Animal	Pyrgus centaureae wyandot	Grizzled skipper	T	-	4
Animal	Rallus elegans	King rail	E	-	1
Animal	Sagittunio nasutus	Eastern pondmussel	E	-	1
Animal	Setophaga discolor	Prairie warbler	SC	-	1
Animal	Setophaga kirtlandii	Kirtland's warbler	E	-	9
Animal	Sistrurus catenatus	Eastern massasauga	T	LT	12
Animal	Stagnicola contracta	Deepwater pondsnail	SC	-	1
Animal	Terrapene carolina carolina	Eastern box turtle	T	-	1
Animal	Vermivora chrysoptera	Golden-winged warbler	T	-	3
Grand Total	-	-	-	-	**281**

Table 21. Rare plant occurrence within the High Sand Plains Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Plant	Agoseris glauca	Prairie or pale agoseris	T	-	11
Plant	Calypso bulbosa	Calypso or fairy-slipper	T	-	1
Plant	Cirsium hillii	Hill's thistle	SC	-	55
Plant	Cypripedium arietinum	Ram's head lady's-slipper	SC	-	3
Plant	Dalibarda repens	False violet	T	-	1
Plant	Festuca altaica	Rough fescue	SC	-	32
Plant	Isotria verticillata	Whorled pogonia	T	-	1
Plant	Lycopodiella subappressa	Northern appressed clubmoss	SC	-	1
Plant	Opuntia fragilis	Fragile prickly pear	E	-	1
Plant	Panax quinquefolius	Ginseng	T	-	1
Plant	Potamogeton hillii	Hill's pondweed	T	-	1
Plant	Prunus umbellata	Alleghany or Sloe plum	SC	-	13
Grand Total	-	-	-	-	**121**

Table 22. Other rare occurrence within High Sand Plains Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Other	-	Great blue heron rookery	-	-	12
Total	-	-	-	-	**12**

Non-ecological reference area natural communities

Natural communities that are identified with an element occurrence in the MNFI Biotics database, but that have not been given an additional ecological reference area (ERA) designation, are recognized and managed accordingly (Table 23).

Table 23. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 24. Non-ecological reference area natural communities within the High Sand Plains Management Area.

Community Type	Element Occurrence Rank	State Rank	Global Rank	Number of Occurrences
Bog	B	S4	G3G5	2
Bog	BC	S4	G3G5	1
Bog	C	S4	G3G5	1
Dry Northern Forest	BC	S3	G3?	1
Dry Northern Forest	C	S3	G3?	1
Dry Northern Forest	D	S3	G3?	1
Dry-mesic Northern Forest	BC	S3	G4	3
Dry-mesic Northern Forest	C	S3	G4	2
Floodplain Forest	B	S3	G3?	1
Floodplain Forest	BC	S3	G3?	2

Community Type	Element Occurrence Rank	State Rank	Global Rank	Number of Occurrences
Intermittent Wetland	B	S3	G2	1
Mesic Northern Forest	BC	S3	G4	1
Mesic Northern Forest	CD	S3	G4	1
Muskeg	AB	S3	G4G5	1
Muskeg	BC	S3	G4G5	1
Muskeg	C	S3	G4G5	1
Northern Fen	B	S3	G3	2
Northern Fen	BC	S3	G3	1
Northern Shrub Thicket	AB	S5	G4	1
Northern Shrub Thicket	B	S5	G4	2
Northern Shrub Thicket	BC	S5	G4	3
Northern Wet Meadow	B	S4	G4G5	2
Northern Wet Meadow	BC	S4	G4G5	4
Oak-Pine Barrens	C	S2	G3	1
Pine Barrens	B	S2	G3	2
Pine Barrens	BC	S2	G3	3
Pine Barrens	C	S2	G3	2
Pine Barrens	CD	S2	G3	1
Pine Barrens	D	S2	G3	4
Poor Conifer Swamp	AB	S4	G4	1
Poor Conifer Swamp	B	S4	G4	2
Poor Conifer Swamp	BC	S4	G4	1
Poor Fen	AB	S3	G3	1
Poor Fen	B	S3	G3	1
Rich Conifer Swamp	BC	S3	G4	1
Rich Conifer Swamp	C	S3	G4	6
Total	**-**	**-**	**-**	**62**

Forest health

Forest health concerns, both native and non-native, can have impacts on stand conditions and management decisions. The following insects (Table 25) and diseases (Table 26) could have an impact on management during the planning period and may need to be monitored and/or addressed.

Table 25. Defoliating insects of concern in the High Sand Plains management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Spongy moth	Lymantria dispar	Non-native	Yes
Forest tent caterpillar	Malacosoma disstria	Native	Yes
Jack pine budworm	Choristoneura pinus	Native	Yes

Watch for lingering ash with potential resistance to emerald ash borer. Monitor young jack and red pine for redheaded pine sawfly damage.

Table 26. Maladies of concern in the High Sand Plains management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Canker (stem infections)	Various	Various	Yes
Armillaria root rot	Armillaria spp.	Native	Yes
Oak decline	Various	Various	Yes

Monitor oak for symptoms of oak wilt and follow state land oak wilt guidance. Monitor planted red pine for Heterobasidion root disease and follow guidance. In areas where beech has been lost due to beech bark disease report surviving mature beech trees that may be resistant to the disease. Watch for symptoms of beech leaf disease.

Aquatic resources

Riparian habitat

A total of 413 miles of streams and rivers are found in the management area (Table 27). Streams/rivers classified as warm types comprise approximately 67% of the riverine mileage.

Table 27. Classification type and length of streams/rivers found within the management area.

Type	Length (miles)
Cold Stream	53
Cold Small River	11
Cold Transitional Stream	56
Cold Transitional Small River	2
Cold Transitional Large River	15
Warm Transitional Stream	184
Warm Transitional Small River	7
Warm Transitional Large River	43
Warm Stream	27
Warm Small River	13
Warm Large River	2

Lacustrine habitat

A total of 68 lakes and ponds of at least 1 surface acre are found in the management area (Table 28).

Table 28. Size and number of lakes and ponds located within the management area.

Lake Size Class (acres)	Number
1-99	52

Lake Size Class (acres)	Number
100-499	13
500+	3

Wetlands

A total of 142,017 acres of wetlands are found in the management area (Table 29). Forested wetlands comprise approximately 92% of wetland types found in the management area.

Table 29. Area of emergent, forested and riverine wetland types found within the management area.

Wetland Type	Acres
Emergent	10,129
Forested	130,534
Riverine	1,354

Vernal pools and seeps

A total of 2,791 acres of vernal pools and seeps have been inventoried in the management area, and 1,194 acres of seeps have been identified.

Riparian vegetation cover

Lowland shrub is the predominant cover type present in a 100-meter riparian zone located next to streams/rivers in the management area (Table 30).

Table 30. Largest vegetative cover types (i.e., top 10) and area located in a 100-meter buffer of streams/rivers within the management area.

Cover type	Acres
Lowland Shrub	11,274
Aspen	6,465
Marsh	5,818
Lowland Deciduous	5,209
Lowland Conifers	3,495
Cedar	2,994
Mixed Upland Deciduous	2,088
Natural Mixed Pines	1,529
Upland Mixed Forest	1,245
Natural Jack Pine	1,217

Watershed vegetation cover

The management area includes portions of important watersheds of the Au Sable and Muskegon rivers (Table 31 & Table 32). Aspen is a major cover type of the state forest in each watershed.

Table 31. Largest vegetative cover types (i.e., top 5) and area of the Au Sable River watershed located within the management area.

Cover Type	Acres
Aspen	63,077
Planted Jack Pine	57,593
Natural Jack Pine	23,994
Planted Red Pine	21,546
Mixed Upland Deciduous	20,379

Table 32. Largest vegetative cover types (i.e., top five) and area of the Muskegon River watershed located within the management area.

Cover Type	Acres
Aspen	47,273
Lowland Shrub	20,602
Cedar	12,483
Planted Red Pine	10,547
Lowland Deciduous	10,289

Recreation

Access for management and public recreation is good within the expansive High Sand Plains Management Area, with a well-developed road and trail system. However, there are some areas of limited accessibility due to lowland, and use restrictions to protect Kirtland's warbler habitat or lands with former military use.

Recreation opportunities within the management area are diverse, plentiful and well-used, serving the communities of Grayling, Harrison, Houghton Lake, Roscommon, Lake City and West Branch, as well as visitors to this area attracted by its outdoor recreation offerings.

Numerous motorized recreation trails traverse and wind through this management area offering a variety of options for ORV enthusiasts, including ORV Routes, ORV Trails and motorcycle/MCCCT trails. Winter offers numerous snowmobile trail options. The Pere Marquette State Trail (rail trail) passes through the extreme south of the area.

Nonmotorized trails include several long-distance routes. Nearly 50 miles of the Shore-To-Shore equestrian trail and over 29 miles of the Midland to Mackinaw Boy Scout trail pass through the High Sand Plains Management Area. Pathways designated for hiking and biking use include Ogemaw Hills, which is groomed in the winter for cross-country skiing, Tisdale Triangle, Green Pine Lake and the Mason Tract Pathways. The Mason Tract is a special management area along the South Branch of the Au Sable River, preserved for wildlife and quiet recreation. Use is restricted to foot traffic with no dispersed camping. The Gladwin Field Trial Area is located in this management area.

There are 21 state forest campgrounds within the management area, all providing access to water. All are rustic, except for Houghton Lake state forest campground which is considered semi-modern with modern restrooms (but no showers or electric). Several of the state forest campground are canoe camps, providing canoe-in or hike-in sites only. Others are designated for equestrian use on the Shore-to-Shore trail. Ambrose Lake state forest campground was designed specifically with the ORV enthusiast in mind, with large sites and access to the many off-road vehicle trails. House and Trout Lake state forest campgrounds are located within the Gladwin Field Trial Area and are heavily used by field trial participants who come to train their dogs.

Table 33. Designated recreation trails by type.

Recreation Category	Recreation Type	# of Miles
Motorized Recreation Trails	ORV (all types) Snowmobile	660.1 373.2
Nonmotorized Recreation Trails	Hiking Equestrian Biking Hunter Access Trails	144.7 51.1 65.1 11.2
-	-	**1,313.1**

Note: Trail-use types may overlap.

Table 34. State forest campgrounds.

State Forest Campgrounds	# of sites	Eq.	ORV Access
4 Mile Trail Camp	-	Group (200)	-
Ambrose Lake	25	-	X
AuSable River and Canoe Camp	15 (Group)	-	-
Big Bear Lake	30	-	-
Big Bear Pointe	14	-	-
Burton's Landing	12	-	-
Canoe Harbor and Canoe Camp	45	-	-
Goose Creek	30	-	-
Goose Creek Trail Camp		Group (200)	-
Houghton Lake	50	-	-
House Lake	41	-	-
Keystone Landing	18	-	-
Mud Lake	8	-	-
Muskrat Lake	13	-	X
Parmalee Bridge and Canoe Camp	7 (Group)	-	-
Rainbow Bend and Canoe Camp	7	-	-
Reedsburg Dam	47	-	-
Trout Lake	35	-	-
Upper Manistee River and Canoe Camp	30	Group (40)	-
Walsh Road Equestrian and Trail Camp	9	-	-
White Pine Canoe Camp (canoe access only)	5	-	-

There are numerous floodings within High Sand Plains Management Area, managed specifically for wildlife and offering opportunities for wildlife viewing and hunting. The Backus Creek Grouse Enhanced Management Site provides high quality habitat for grouse and woodcock and over 11 miles of hunter walking trails to facilitate access.

High Sand Plains also has many opportunities for water recreation, including paddling and fishing, on the Au Sable, Manistee and the Muskegon rivers, as well as numerous inland lakes.

Dispersed recreation such as camping, hunting, fishing, paddling and mushrooming are popular in the management area. The Kirtland's warbler area is popular with birders, although occupied habitat may be closed to the public during breeding season. The proximity of the Huron National Forest and several state parks and recreation areas adds to the attraction of the area.

Table 35. Areas managed for hunting.

Type	Name	# of Acres
State Wildlife Management Area	Bear Creek Flooding	925
	Denton Creek Flooding	804.7
	Backus Lake Flooding	1,656.40
	Beaver Lake Flooding	475
	Connors Marsh Flooding	1056.1
	Gladwin State Forest	3,350.40
	Pere Marquette State Forest	5,860.50
	Reedsburg Dam Flooding	1,023.50
	Robinson Creek Flooding	2,563.90
	Old Fur Farm Flooding	1,973.30
	Backus Creek State Game Area	3,348.40
	Houghton Lake Flats	872.8
	Houghton Lake State Wildlife Management Area	10,977.40
	Cannon Creek 1 and 2 Flooding State Wildlife Management Area	474.4
	Gladwin State Forest Gladwin Game Refuge Unit	4,711.20
Grouse Enhanced Management Site	Backus Creek	4,325.60

Table 36. Boating access sites

Name	Waterbody
Ambrose Lake State Forest Campground	Ambrose Lake
Au Sable River Canoe Camp	Au Sable River
Big Bear Point State Forest Campground	Big Bear Lake
Bourne Lake	Bourne Lake
Burtons Landing State Forest Campground	Au Sable River

Canoe Harbor State Forest Campground	South Branch Au Sable River
Chase Bridge	South Branch Au Sable River
Connors Flats	Au Sable River
Dead Stream Flooding	Dead Stream Flooding
Emerald Lake	Emerald Lake
Hoister Lake	Hoister Lake
Little Crapo Lake	Little Crapo Lake
Loggers Landing	Manistee River
Muskrat Lake State Forest Campground	Muskrat Lake
Parmalee Bridge State Forest Campground	Au Sable River
Reedsburg Dam State Forest Campground	Dead Stream Flooding
Sand Banks	Manistee River
Sheep Pasture	North Branch Au Sable River
Smith Bridge	South Branch Au Sable River
Steckert Bridge	South Branch Au Sable River
Three Mile Bend	Manistee River
Tin Can	Manistee River
Trout Lake State Forest Campground	Trout Lake
West Sharon Road	Manistee River
White Pine Canoe Camp	Au Sable River

Huron Sandy Lake Plain

State Forest Area: 86,663 acres	Location: Northeastern Lower Peninsula	Population Centers: Mackinaw City, Cheboygan, Rogers City and Alpena
Subsection: Huron Sandy Lake Plain	Landforms: Sandy lake plain Exposed and semi-exposed limestone bedrock Dune and Swale complexes Cobble beaches	Landcover: Forested: 72,767 acres Nonforested: 13,895 acres

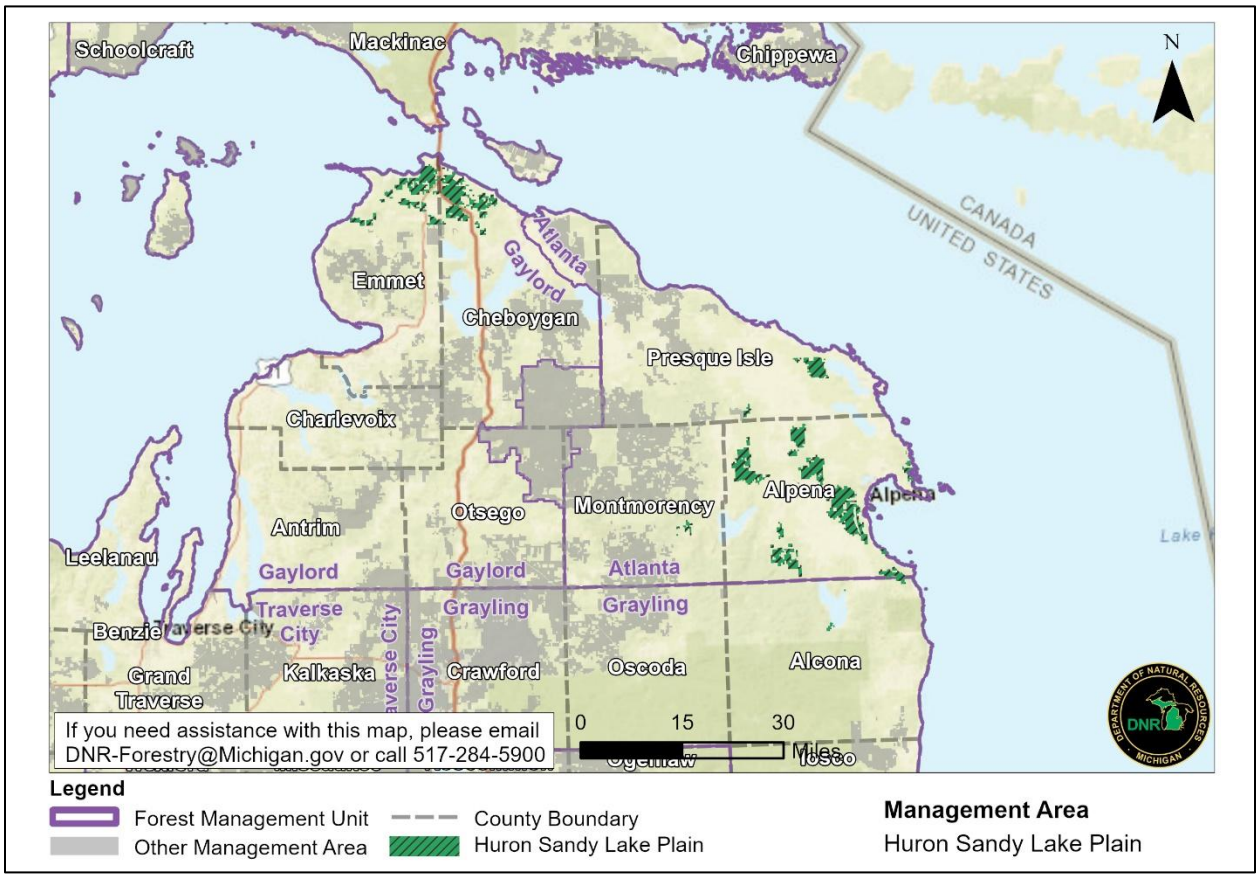


Figure 1. Huron Sandy Lake Plain Management Area.

Forested landscape

Current and projected future condition

The Huron Sandy Lake Plain Management Area includes a variety of shade tolerance levels. The lowland unavailable acres contain the whole range of tolerances and are mostly in the mature and old age groups. The upland available acres contain more intolerant species in the mid-aged and mature categories (Figure 2).

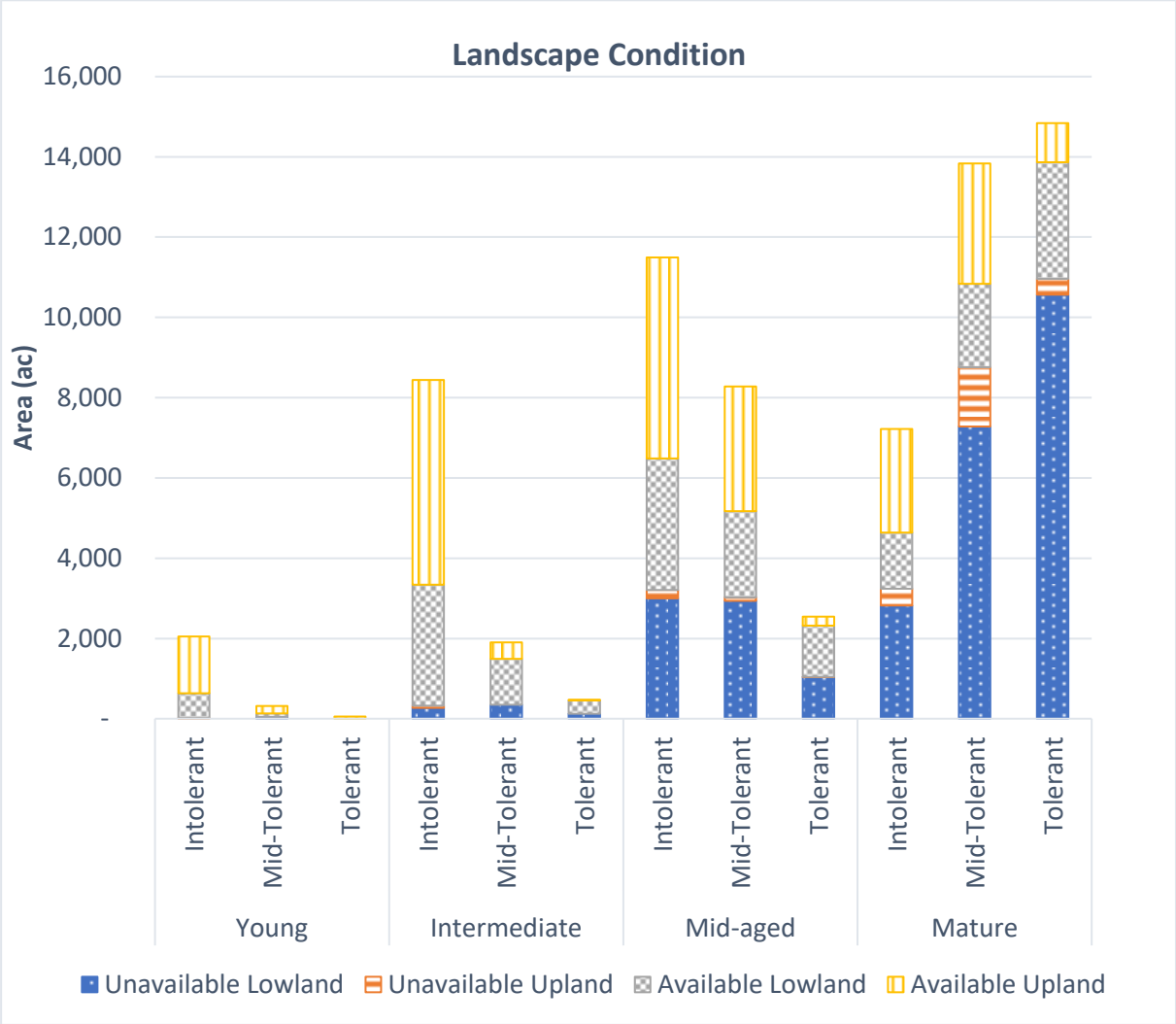


Figure 2. Forest diversity matrix showing the current distribution of forested acres across management availability, age category, landscape position and shade tolerance.

Landscape habitat conditions refine the management area landscape into featured species habitat context. Current and projected acres for the metrics identified in the Management Priorities (Section 3 Statewide/Regional) establish a baseline and future condition based on management over the planning period (Table 1).

Table 1. Current acres for landscape habitat conditions.

Landscape Habitat Condition	Monitoring Metric	Current Acres
Young Forest	Acres of 0-19 stands in Aspen and Jack Pine	2,024
Mature Forest	Acres of 80+ year stands across cover types	35,892
Mature Forest	Acres of 120+ year stands across cover types	4,536
Mesic Conifer Cover types	Acres of mesic conifer cover types	2,124
Mesic Conifers in Other Cover Types	Average canopy occupancy	42%
Mast – Oak Cover types	Acres of oak cover types	1,271
Mast Tree Species in Other Cover Types	Acres of total canopy occupancy of mast tree acres (trace-100%)	13,758
Big Trees	Acres of total canopy stand occupancy of species in sawlog or greater size class	31,874
Nonforested Openings	Acres of total herbaceous openland, upland shrub, and cropland	1,005
Landscape Forest Matrix	Percent deciduous forest	53%
Landscape Forest Matrix	Percent coniferous forest	37%

The Huron Sandy Lake Plain Management Area has the following special analysis units (SAUs). These SAUs have specific cover type goals, typically associated with wildlife habitat management. For any SAUs that overlap with this management area, SAU cover type goals take priority as the SFMP model strives to meet the cover type goals across the area, ensuring they are met. See Section 5 for a detailed description of the management direction and harvest goals for each of these SAUs.

The Huron Sandy Lake Plain Management Area is comprised of 84% forested cover types and 16% nonforested cover types. Of the forested cover types, 35% are upland and 65% are lowland. The largest contributors to upland cover types are aspen and mixed upland deciduous. Lowland deciduous, lowland aspen, cedar and lowland conifer are the largest contributors to lowland cover types. Lowland shrub is the most common nonforested cover type in the management area representing 9% of the landscape (Table 2).

Table 2. Current landscape context and distribution of cover types.

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
			Aspen	12,194			
			Northern Hardwood	1,256			

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
Forested	Upland	Deciduous	Black Red Hybrid Oak	109	17,561	25,743	72,767
			Northern Red Oak	1,076			
			Oak Mix	254			
			Mixed Upland Deciduous	2,673			
		Mixed	Upland Mixed Forest	1,965	1,965		
		Coniferous	Planted Red Pine	1,758	6,217		
			Planted Jack Pine	279			
			Planted White Pine	8			
			Planted Mixed Pine	12			
			Natural Red Pine	1,160			
			Natural Jack Pine	883			
			Natural White Pine	344			
			Natural Mixed Pines	471			
			Upland Spruce/Fir	518			
			Upland Conifers	766			
			Hemlock	18			
	Lowland	Deciduous	Lowland Aspen/Balsam Poplar	9,482	20,751	47,024	
			Lowland Deciduous	11,269			
		Mixed	Lowland Mixed Forest	5,310	5,310		
		Coniferous	Cedar	9,258	20,964		
			Lowland Conifers	6,991			
			Lowland Spruce/Fir	1,227			
			Tamarack	3,488			
Nonforested	Upland	N/A	Herbaceous Openland	598	N/A	1,971	13,895
			Upland Shrub	396			
			Low Density Trees	332			
			Bare/Sparsely Vegetated	203			
			Cropland	11			
			Urban	431			
	Lowland	N/A	Lowland Shrub	7,671	N/A	11,924	
			Marsh	1,665			
			Bog	963			
			Treed Bog	43			
			Water	1,583			
						Grand Total:	86,663

There are 41,691 acres (48% of the total management area and 57% of the forested area) that can be managed toward desired future conditions via commercial timber harvest in the Huron Sandy Lake Plain Management Area (Table 3). Of that, 16% is in the aspen cover type, 10.5% in lowland aspen, and 5.2% in lowland deciduous. The remaining 22 cover types represent less than 4% each of the forested and

available land in the management area. Acres unavailable for management are categorized by site condition (

Table 4).

Table 3. Current cover type composition by management availability.

HURON SANDY LAKE PLAIN						
Forested Cover Type	Available Acres	Available %	Unavailable Acres	Unavailable %	Total Acres	Total %
Aspen	11,620	16.0%	578	0.8%	12,197	16.8%
Black Red Hybrid Oak	104	0.1%	6	0.0%	109	0.2%
Cedar	2,547	3.5%	6,711	9.2%	9,259	12.7%
Hemlock	5	0.0%	12	0.0%	18	0.0%
Lowland Aspen/Balsam Poplar	7,653	10.5%	1,832	2.5%	9,484	13.0%
Lowland Conifers	2,016	2.8%	4,976	6.8%	6,992	9.6%
Lowland Deciduous	3,793	5.2%	7,484	10.3%	11,276	15.5%
Lowland Mixed Forest	2,259	3.1%	3,051	4.2%	5,310	7.3%
Lowland Spruce/Fir	227	0.3%	1,000	1.4%	1,227	1.7%
Mixed Upland Deciduous	2,213	3.0%	463	0.6%	2,676	3.7%
Natural Jack Pine	824	1.1%	59	0.1%	883	1.2%
Natural Mixed Pines	422	0.6%	50	0.1%	472	0.6%
Natural Red Pine	884	1.2%	279	0.4%	1,163	1.6%
Natural White Pine	321	0.4%	23	0.0%	344	0.5%
Northern Hardwood	890	1.2%	366	0.5%	1,256	1.7%
Northern Red Oak	1,035	1.4%	42	0.1%	1,077	1.5%
Oak Mix	236	0.3%	18	0.0%	254	0.3%
Planted Jack Pine	268	0.4%	11	0.0%	279	0.4%
Planted Mixed Pine	7	0.0%	5	0.0%	12	0.0%
Planted Red Pine	1,727	2.4%	31	0.0%	1,758	2.4%
Planted White Pine	8	0.0%	0	0.0%	8	0.0%
Tamarack	87	0.1%	3,401	4.7%	3,488	4.8%
Upland Conifers	591	0.8%	178	0.2%	770	1.1%
Upland Mixed Forest	1,479	2.0%	486	0.7%	1,965	2.7%
Upland Spruce/Fir	476	0.7%	45	0.1%	521	0.7%
Grand Total	**41,691**	**57.3%**	**31,107**	**42.7%**	**72,798**	**100.0%**

Table 4. Site conditions for unavailable acres.

Site Condition (Reason area is unavailable for commercial harvest)	Area (ac)	% of Unavailable Area
Too Wet	24,270	78.0%
Blocked by Obstacle	1,456	4.7%
Conservation Values	1,311	4.2%
BMPs	1,072	3.4%
Federal/State/Local Law	809	2.6%
Cannot Regenerate	550	1.8%
Recreational/Scenic	463	1.5%
Denied Access	279	0.9%
Other Dept./Div. Processes	236	0.8%
Other Influence Zones	218	0.7%
Rare Landforms	137	0.4%
Unproductive	102	0.3%
Long-Term Retention	72	0.2%
Too Steep	70	0.2%
Neighbor / Interest Group	39	0.1%
Species of special concern or T&E	12	0.0%
Wildlife Concerns	11	0.0%
Total Unavailable	**31,107**	**100.0%**

Projected 10-year cover type management actions

Each cover type in the Huron Sandy Lake Plain Management Area has a unique age class and basal area class goals that describe the long-term desired future conditions. The calculated harvest levels that are needed during the first 10-year planning period are summarized in Table 5. These harvest levels are necessary to begin achieving long-term planning goals. It will help establish a desirable amount of regeneration for the even-aged cover types over the 10-year period or help to achieve desired basal area distribution among uneven-aged cover types like northern hardwoods. Implementing these silvicultural regimes will yield 105,438 cords, the planned harvest volume for the decade (Table 6).

Table 5. Ten-year planning period harvest goals (acres) by cover type and silvicultural regime.

Silvicultural Regimes								
Cover Type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Salvage Clearcut	Salvage Thinning	Grand Total
Aspen	1,467	-	-	-	-	13	-	1,479

Silvicultural Regimes								
Cover Type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Salvage Clearcut	Salvage Thinning	Grand Total
Lowland Aspen/Balsam Poplar	1,178	-	-	-	-	-	-	1,178
Planted Red Pine	-	-	-	-	-	-	1,039	1,039
Mixed Upland Deciduous	626	107	-	-	-	-	-	733
Upland Mixed Forest	432	-	-	-	-	6	-	438
Lowland Conifers	371	-	-	-	-	-	-	371
Lowland Deciduous	349	-	-	-	-	-	-	349
Natural Red Pine	-	-	26	-	115	-	114	255
Natural Jack Pine	255	-	-	-	-	-	-	255
Upland Spruce/Fir	242	-	-	-	-	-	-	242
Northern Hardwood	-	-	-	-	-	-	171	171
Lowland Mixed Forest	84	-	-	-	-	-	-	84
Natural Mixed Pines	-	-	23	-	33	-	-	55
Lowland Spruce/Fir	47	-	-	-	-	-	-	47
Upland Conifers	25	-	-	-	7	-	-	31
Natural White Pine	-	-	26	-	-	-	-	26
Tamarack	13	-	-	-	-	-	-	13
Planted Jack Pine	12	-	-	-	-	-	-	12
Planted White Pine	-	-	7	-	-	-	-	7
Hemlock	-	4	-	-	-	-	-	4
Totals	**5,100**	**112**	**81**	**-**	**155**	**19**	**1,324**	**6,790**

Table 6. Projected 10-year harvest volume by species.

10-Year Estimated Harvest Volume Projection Huron Sandy Lake Plain Management Area			
Product	Species	Volume Planned*	Volume Prepared**
Pulpwood (cords)	Mixed Hardwood	18,276	17,180
	Mixed Aspen	17,559	16,505
	Mixed Spruce	9,342	8,782
	Mixed Softwood	9,271	8,715
	Jack Pine	5,180	4,869
	Red Pine	4,965	4,667
	White Pine	1,643	1,545
	Mixed Oak	1,377	1,294
	Pulpwood Total	**67,613**	**63,556**
	Red Pine	3,841	3,610
	Mixed Aspen	3,527	3,315
	White Pine	2,826	2,657

10-Year Estimated Harvest Volume Projection Huron Sandy Lake Plain Management Area			
Product	**Species**	**Volume Planned***	**Volume Prepared****
Sawtimber (MBF)	Red Maple	2,195	2,064
	Red Oak	1,791	1,684
	Sugar Maple	699	657
	White Oak	585	550
	Mixed Oak	152	143
	Basswood	151	142
	Sawtimber Total	**15,767**	**14,821**
	Total Sawtimber Harvest Volume in Cords	**76,701**	**72,099**
	Grand Total Harvest Volume in Cords	**144,314**	**135,655**
* Volume estimates based on 100% of the projected harvests for the 10-year planning period. ** Volume estimates based on 94% of the projected harvests for the 10-year planning period accounting for reduction in acres and associated volume once sales are prepared for bid.			

There are a few cover type transitions projected for the Huron Sandy Lake Plain Management Area (Table 7). The largest increases occur in aspen, lowland mixed forest and planted red pine at 250, 186 and 356 acres respectively. The largest decreases are forecasted in the lowland conifers, mixed upland deciduous, upland mixed forest, and the upland spruce/fir cover types at 166, 247, 109 and 209 acres respectively.

Table 7. Projected 10-year cover type acres resulting from cover type transitions.

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Aspen	12,194	12,443	250
Lowland Deciduous	11,269	11,273	3
Lowland Aspen/Balsam Poplar	9,482	9,478	-3
Cedar	9,258	9,258	0
Lowland Conifers	6,991	6,825	-166
Lowland Mixed Forest	5,310	5,496	186
Tamarack	3,488	3,488	0
Mixed Upland Deciduous	2,673	2,425	-247

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Upland Mixed Forest	1,965	1,856	-109
Planted Red Pine	1,758	2,113	356
Northern Hardwood	1,256	1,256	0
Lowland Spruce/Fir	1,227	1,207	-20
Natural Red Pine	1,160	1,160	0
Northern Red Oak	1,076	1,072	-4
Natural Jack Pine	883	799	-84
Upland Conifers	766	720	-46
Upland Spruce/Fir	518	310	-209
Natural Mixed Pines	471	471	0
Natural White Pine	344	344	0
Planted Jack Pine	279	285	6
Oak Mix	254	348	93
Black Red Hybrid Oak	109	103	-6
Hemlock	18	18	0
Planted Mixed Pine	12	12	0
Planted White Pine	8	8	0
Lowland Shrub	7,671	7,671	0
Marsh	1,665	1,665	0
Water	1,583	1,583	0
Bog	963	963	0
Herbaceous Openland	598	598	0
Urban	431	431	0
Upland Shrub	396	396	0
Low Density Trees	332	332	0
Bare/Sparsely Vegetated	203	203	0
Treed Bog	43	43	0
Cropland	11	11	0
Total:	**86,663**	**86,663**	**0**

Featured species current and projected habitat acres

There are seven featured species in this management area that span various cover types, age classes and stand level conditions. Current and projected total habitat acres by species across the decade provide a baseline and show the result of long-term management actions (Table 8). As noted in the Featured Species Management Priority (Section 3), it is recommended that these featured species habitat acres be viewed as acres of potential habitat, representing a condition on the landscape where the more nuanced aspects of each species' habitat requirements are likely to be found or managed for. As described in the introduction, the modeling effort was limited by several factors including

the simplification of habitat attributes into MiFI variables. Therefore, when referring to habitat acres what is being referred to is potential habitat acres.

Some species show a loss in habitat over the next century. As mentioned in the Featured Species Management Priority (Section 3), the current condition for many cover types is a surplus of acres in the 0-9 age class from the compensatory management approach applied in the previous decade. The model eventually evens out the age classes at a lower, sustainable level over time, usually by 50 years. For any species with northern hardwoods as a priority cover type, there is a perceived drop in acres between 40 and 60 years; this is due to the basal area dropping below 81 but because it only drops into the upper 70s, it is not expected to translate to any real habitat loss on the ground.

Table 8. Featured species current and projected total habitat acres (e.g., potential habitat).

Featured Species	Priority Cover Types	Total Habitat Acres Current	Total Habitat Acres 10-year	50-year Projected Habitat Acres	100-year Projected Habitat Acres
American Woodcock	Aspen, lowland aspen, lowland deciduous	8,394	10,290	6,913	6,976
Cerulean Warbler	Northern hardwoods, mixed upland deciduous	7,449	8,036	9,747	10,252
Golden-Winged Warbler	Aspen, black-red hybrid oak, northern red oak, oak mix, tamarack	4,962	5,896	3,643	3,671
Marten	Northern hardwoods, mixed upland deciduous, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, lowland mixed forest, lowland conifers, hemlock, cedar	21,718	21,942	21,828	22,695
Ruffed Grouse	Aspen	4,900	5,729	3,531	3,555
Snowshoe Hare	Aspen, cedar, hemlock, lowland aspen, lowland conifers, lowland mixed forest, lowland spruce/fir, mixed upland deciduous, natural jack pine, natural mixed pines, planted jack pine, upland spruce/fir	9,593	12,064	7,464	7,569
Wood Thrush	Northern hardwoods, northern red oak, mixed upland deciduous, lowland deciduous	8,954	10,181	11,825	13,574
Wood Turtle	Nonforested openings	--	--	--	--

Cover type composition and associated featured species

Aspen

Current condition

The largest age class of the aspen cover type represented is currently in the 0- to 9-year-old age class (Figure 3). The past management regime has been primarily clearcut for this cover type. The 10- to 19 and 20- to 29 age classes have a deficit of acres. The age class spike in the 0-9 class will compensate for the small deficits in the 10- to 19 and 20- to 29 age classes. This current planning period will continue to smooth out the distribution of the aspen in this management area.

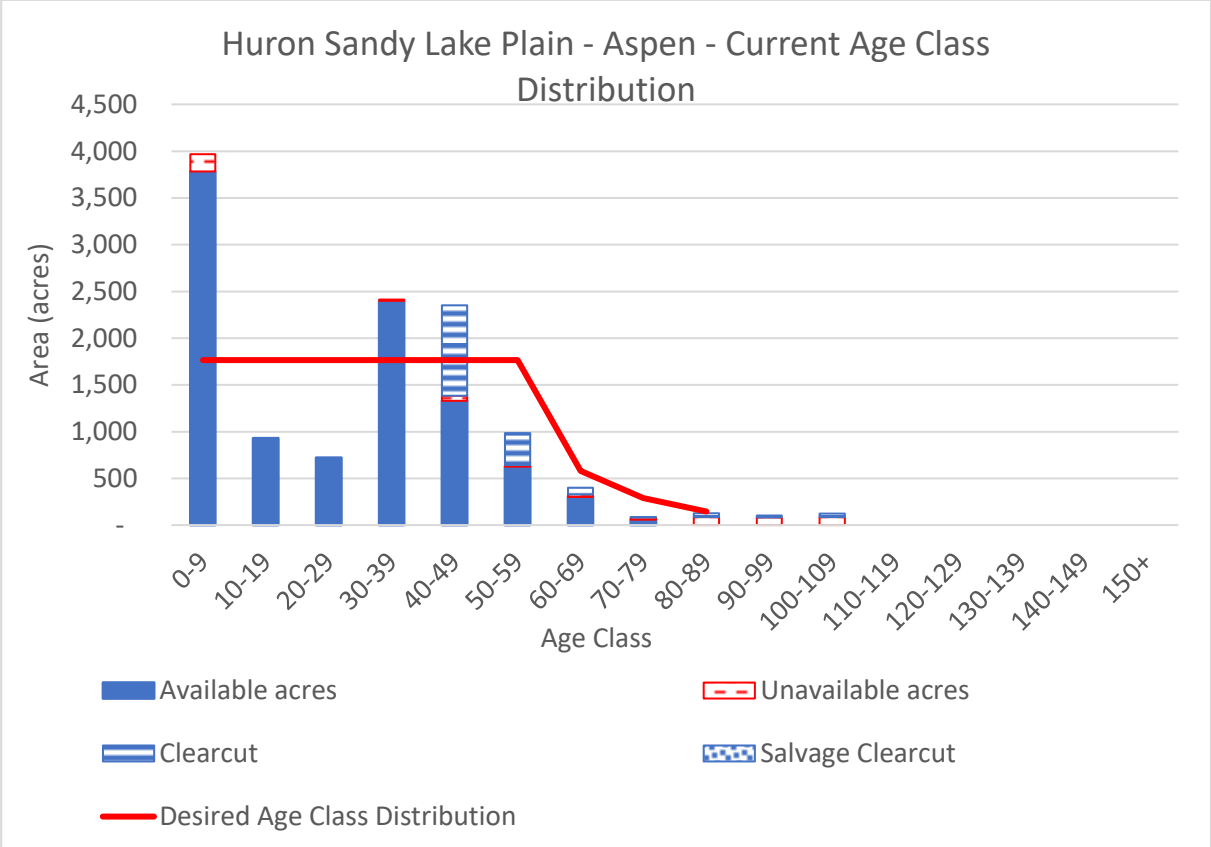


Figure 3. Current age class distribution, the desired age class distribution, and the projected harvests in the aspen cover type over the 10-year planning period.

Current conditions are a result of consistent commercial harvests and regeneration efforts on available aspen acres during the previous planning periods. A portion of this cover type meets the habitat requirements for American woodcock, golden-winged warbler, ruffed grouse and snowshoe hare (Table 9).

Table 9. Featured species with aspen as a priority habitat cover type, habitat variables and current acres (e.g., potential habitat).

Featured Species	Featured Species Habitat – Aspen	Aspen Habitat Acres - Available	Aspen Habitat Acres - Unavailable
American Woodcock	Age Category: 0-19 Size Class: Sapling	42,708	631
Golden-Winged Warbler	Age Category: 0-19 Size Class: Sapling	42,708	631
Ruffed Grouse	Age Category: 0-19 Size Class: Sapling	42,708	631
Snowshoe Hare	Age Category: 0-19 Size Class: Sapling	42,708	631

Desired future condition

The projected long-term cover type trend for aspen is stable in the Huron Sandy Lake Plain Management Area. There are a few transitions into this cover type from other cover types forecasted in this management area increasing the aspen cover type acreage by approximately 250 acres in the first 10-year planning period, then dropping off in the planning periods following.

The long-term goal for this cover type is balanced age classes between 0 and 60 years old and carry a percentage of acres into the older ages classes for all available aspen stands in this management area.

The end of the planning period will result in the establishment of the desired amount of regeneration in in the upcoming 0-9 age class (Figure 4). Progress toward the long-term age class distribution of aspen will take several decades in the management area.

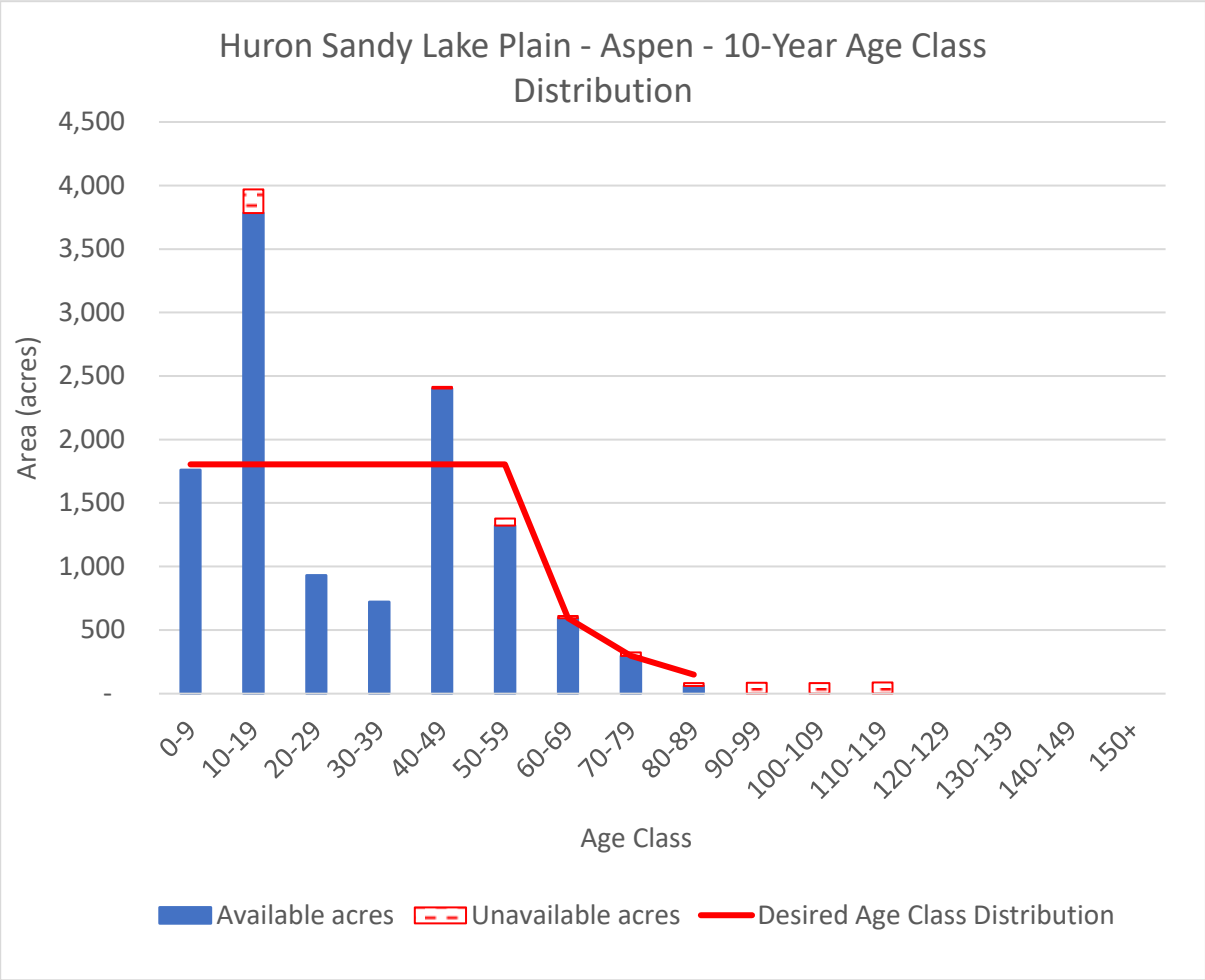


Figure 4. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of aspen acres has reached the desired future condition (Figure 5).

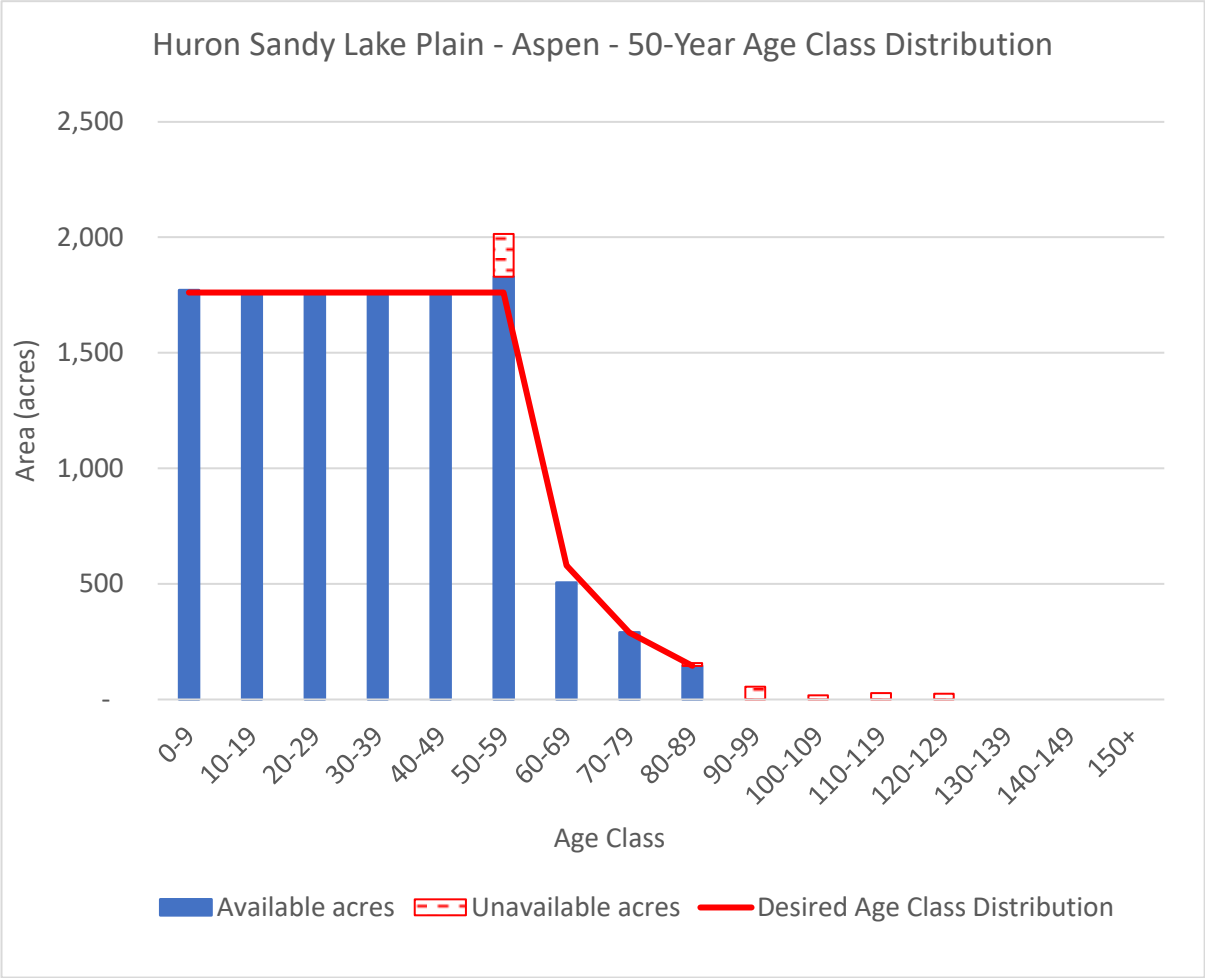


Figure 5. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 6) will concentrate the manageable acres of aspen in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest (Figure 7).

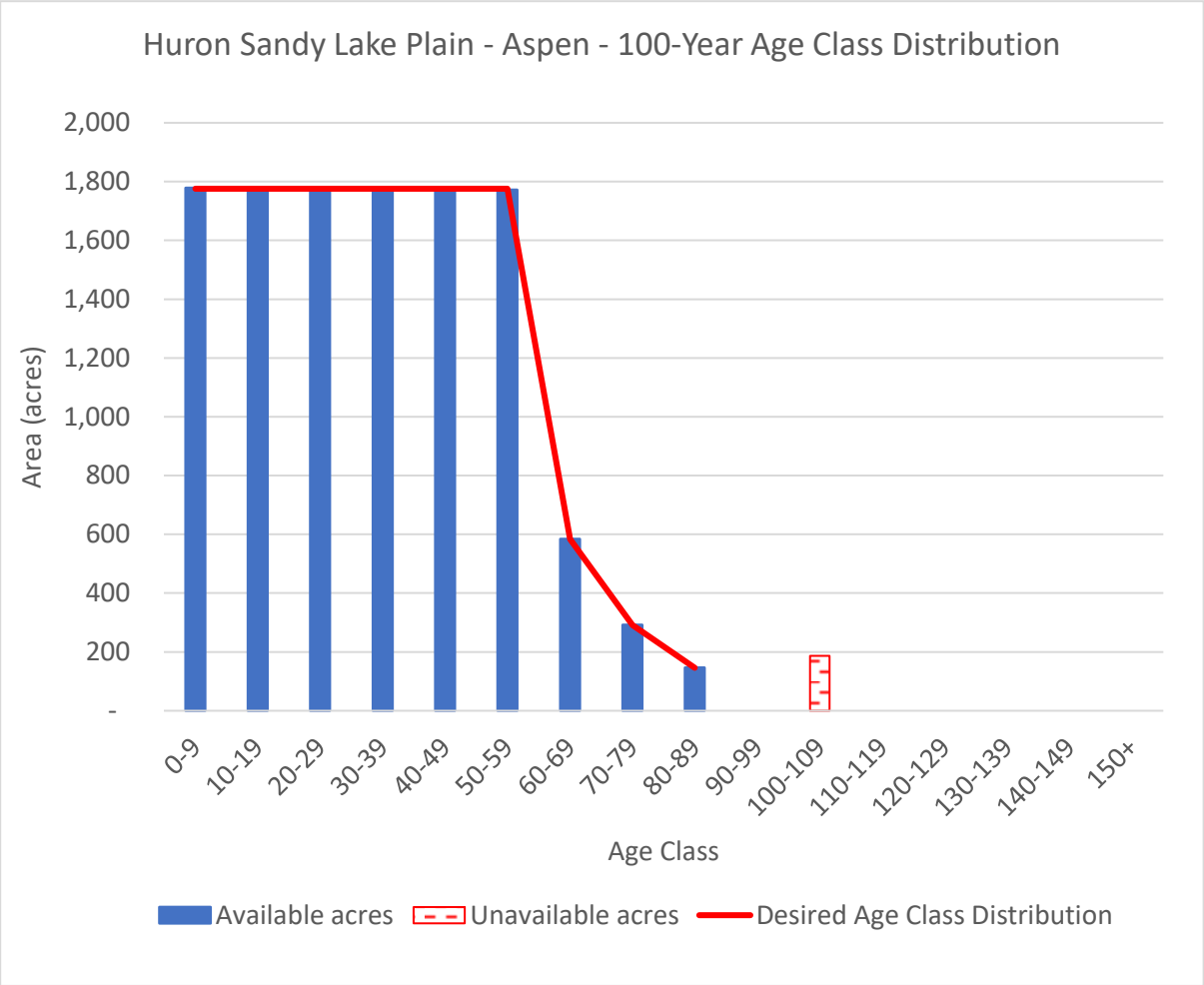


Figure 6. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

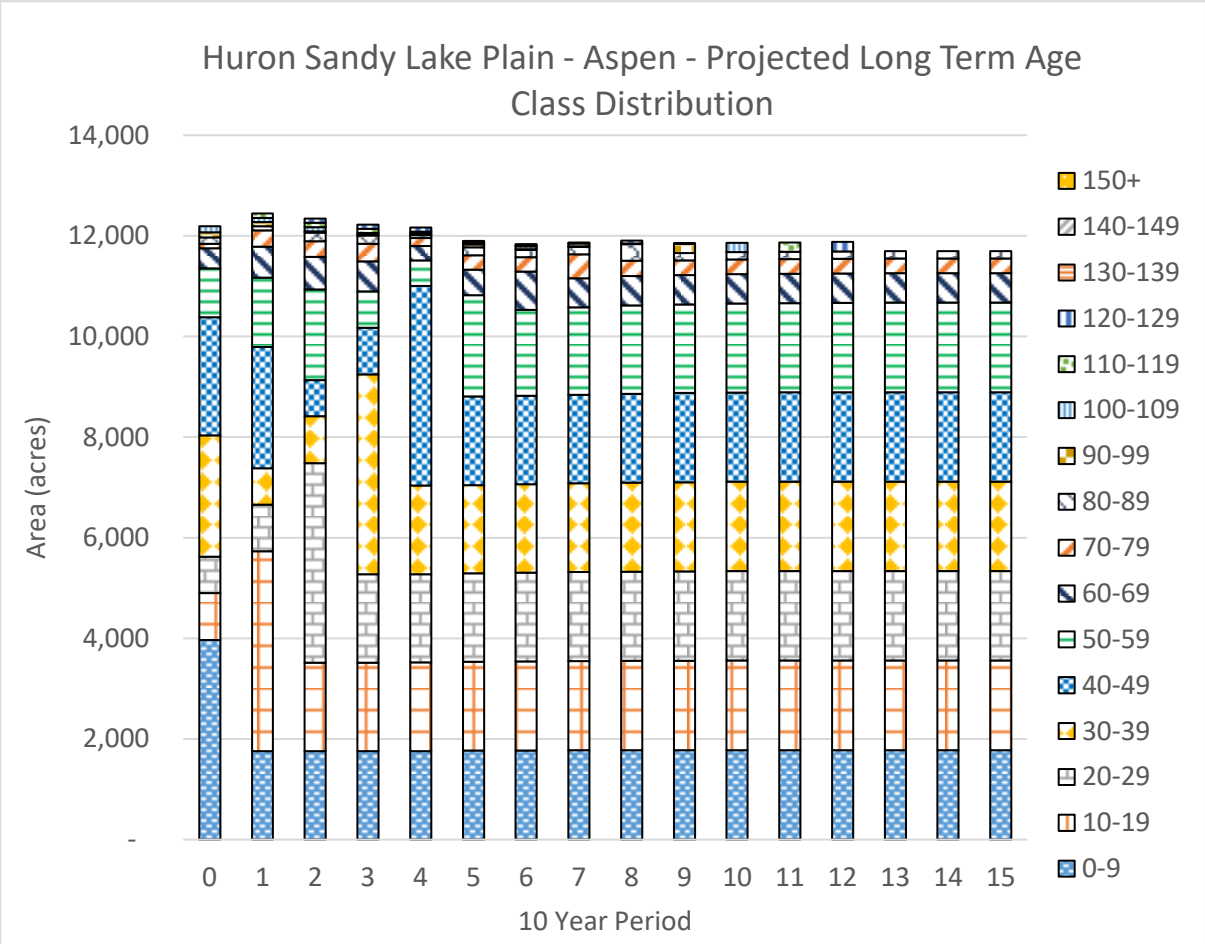


Figure 7. Projected age class distribution for all acres of aspen over the next 150 years.

Management actions

There are 1,467 acres of projected clearcut harvest and 13 acres of salvage clearcut in the aspen cover type during this planning period. This coupled with the 250 acres that are projected to transition into aspen creates the desired number of aspen acres in the 0-9-year-old age class. This amount is just shy of the nearly 1,800-acre distribution line.

Lowland aspen/balsam poplar

Current condition

Similar to the upland aspen, the lowland aspen/balsam poplar cover type has deficits in the 10- to 19 and 20- to 29-year-old age classes and spikes in the 0-9 as well as in the older age classes, 30-59 (Figure 8). The past management regime has been primarily clearcut for this cover type. The 0-9 age class spike will help to compensate for the deficits in the 10-19 and 20-29 classes. This current planning period will continue to smooth out the distribution of the lowland aspen/balsam poplar in this management area.

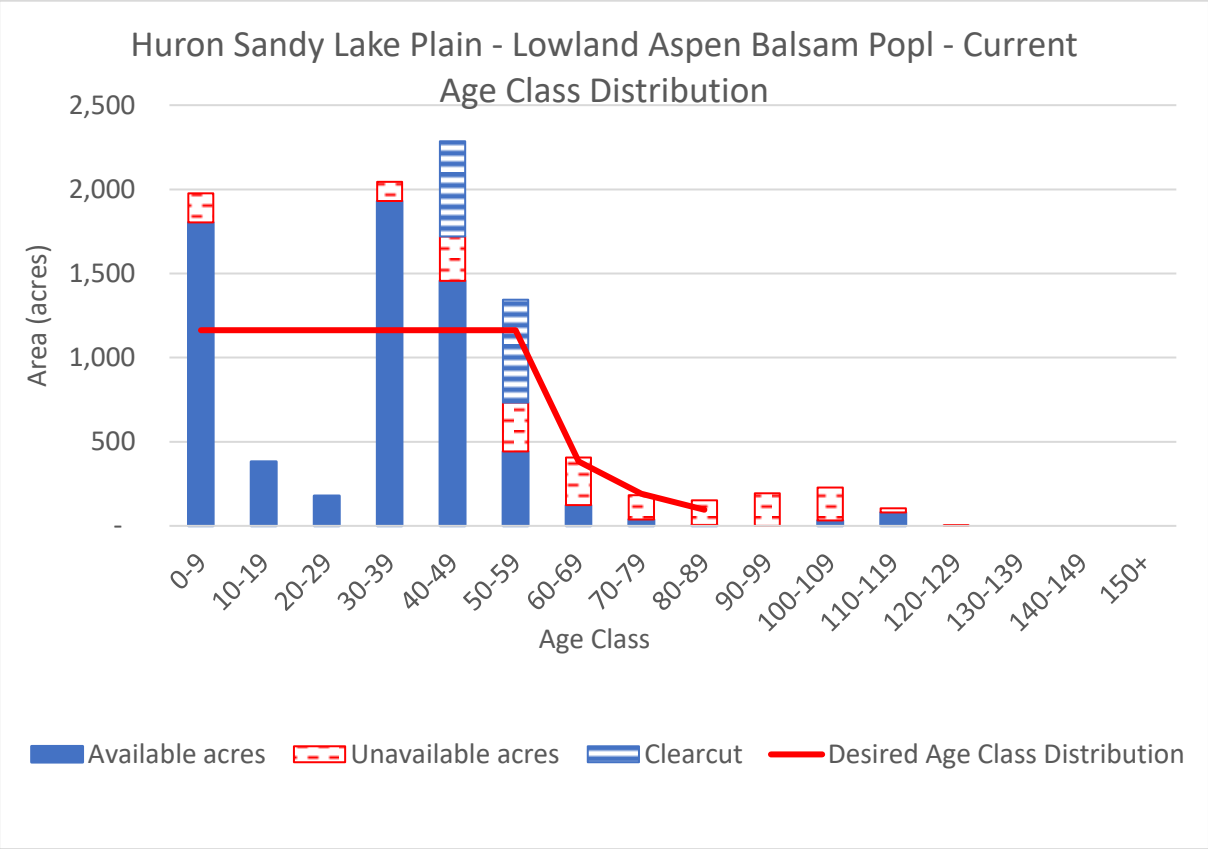


Figure 8. Current age class distribution, the desired age class distribution, and the projected harvests in the lowland aspen/balsam poplar cover type over the 10-year planning period.

Current conditions are a result of consistent commercial harvests and regeneration efforts on available lowland aspen/balsam poplar acres during the previous planning periods. A portion of this cover type meets the habitat requirements for American woodcock and snowshoe hare (Table 10).

Table 10. Featured species with lowland aspen/balsam poplar as a priority habitat cover type, habitat variables and current acres (e.g., potential habitat).

Featured Species	Featured Species Habitat – Lowland Aspen/Balsam Poplar	Lowland Aspen/Balsam Poplar Habitat Acres - Available	Lowland Aspen/Balsam Poplar Habitat Acres - Unavailable
American Woodcock	Age Category: 0-19 Size Category: Sapling	914	65
Snowshoe Hare	Age Category: 0-19 Size Category: Sapling	914	65

Desired future condition

The projected long-term cover type trend for lowland aspen/balsam poplar is stable in the Huron Sandy Lake Plain Management Area. There are very few transitions into or out of this cover type forecasted in this management area.

The long-term goal for this cover type is balanced age classes between 0 and 60 and carry a percentage of acres into the older age classes for all available lowland aspen/balsam poplar stands.

The end of the planning period will result in the establishment of the desired amount of regeneration in the upcoming 0-9 age class (Figure 9). Progress toward the long-term age class distribution of lowland aspen/balsam poplar will take several decades in the management area.

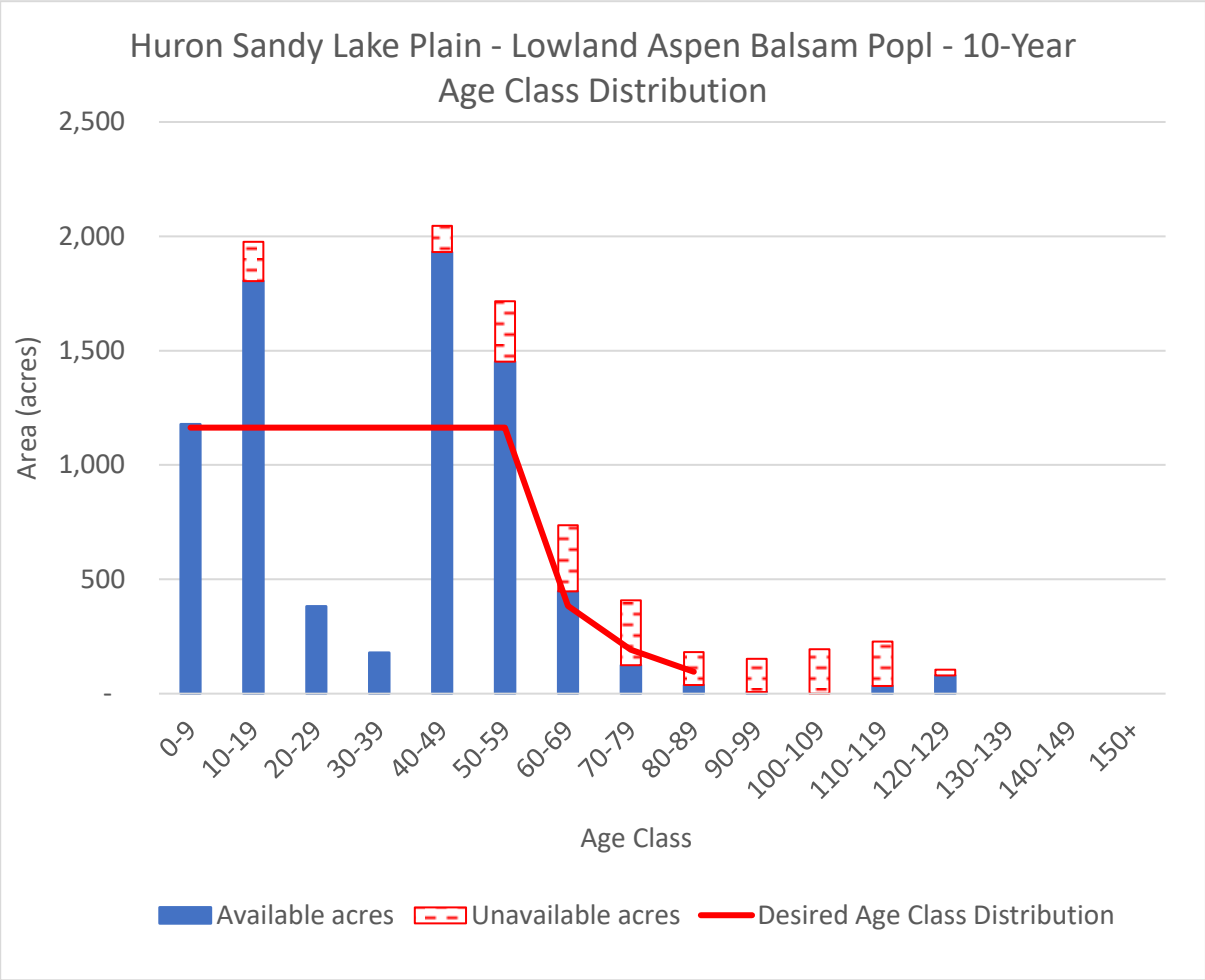


Figure 9. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of lowland aspen/balsam poplar acres has reached the desired future condition (Figure 10).

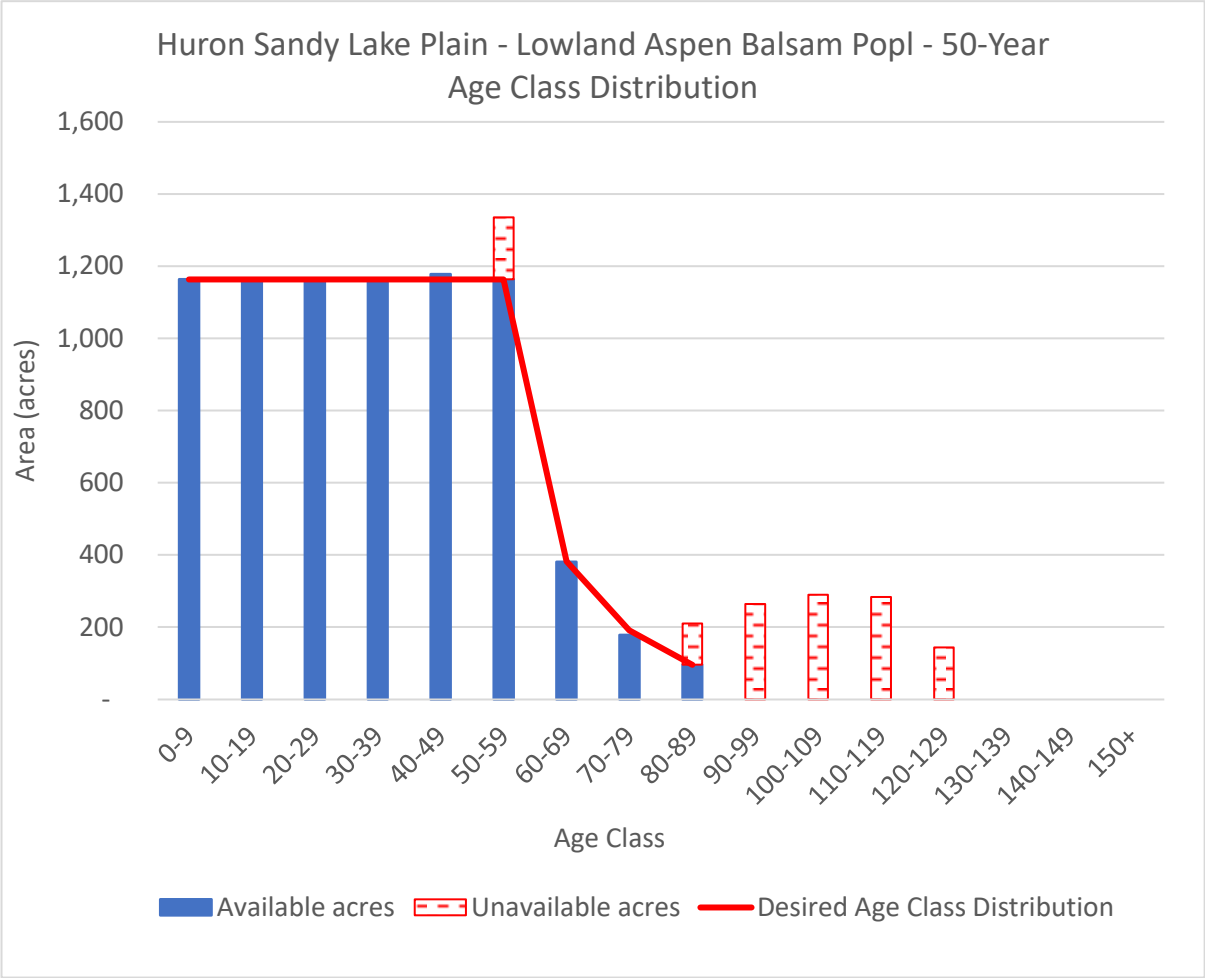


Figure 10. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 11) will concentrate the manageable acres of lowland aspen/balsam poplar in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest (Figure 12).

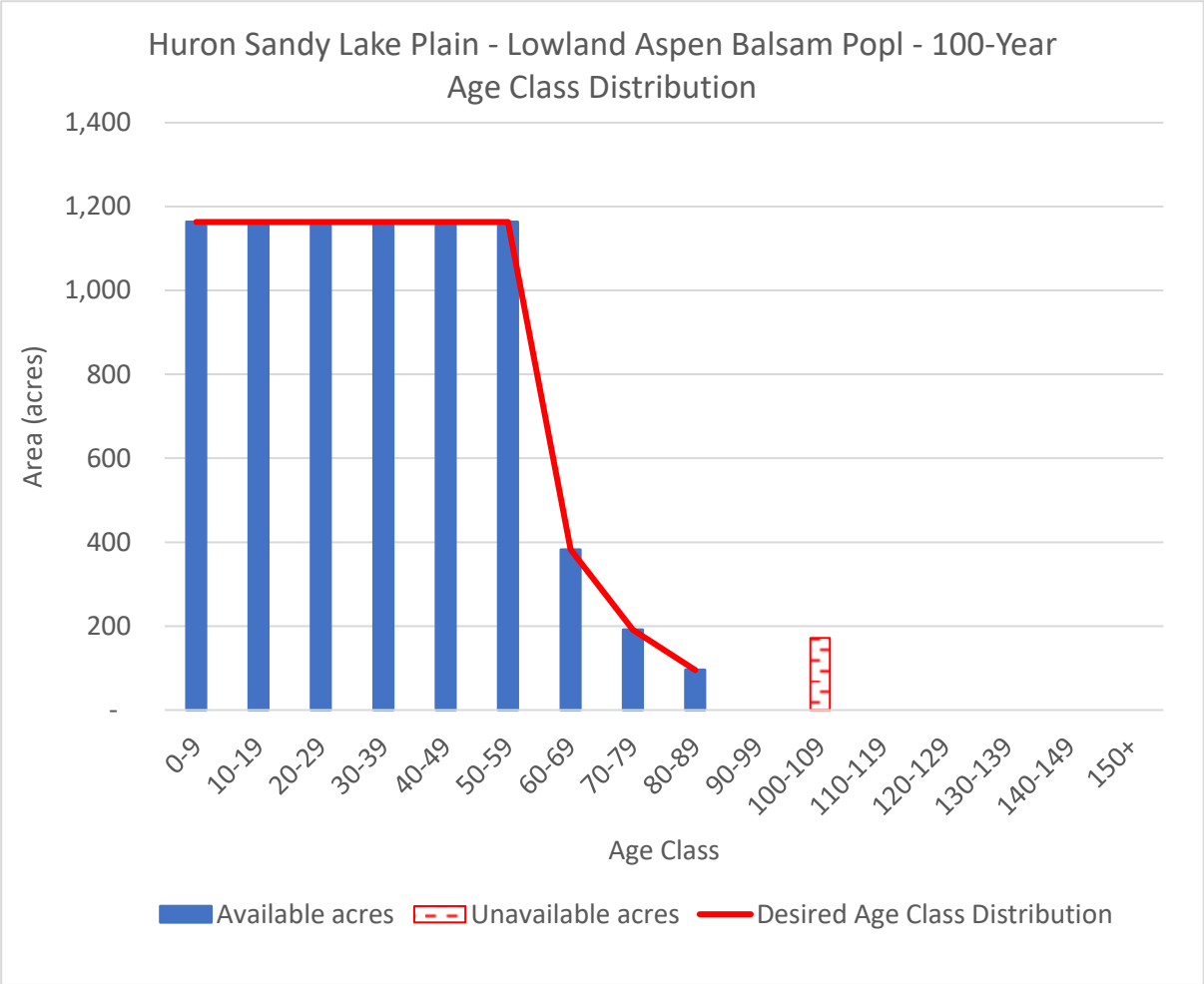


Figure 11. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

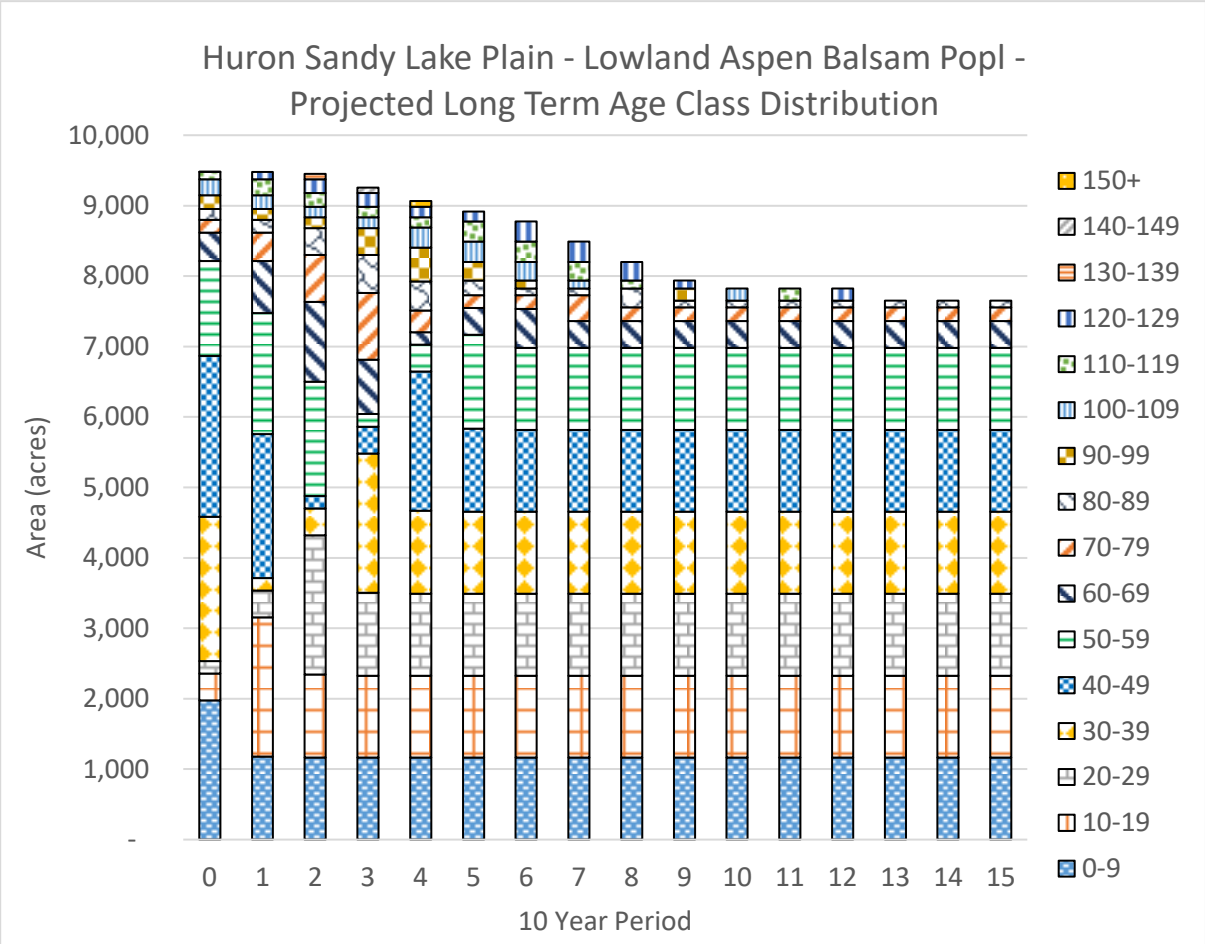


Figure 12. Projected age class distribution for all acres of lowland aspen/balsam poplar over the next 150.

Management actions

There is 1,178 acres of projected clearcut harvest in the lowland aspen/balsam poplar cover type during this planning period. This is very close to the planning period goal of 1,164 desirable acres in the 0-9-year-old age class.

Lowland deciduous

Current condition

The lowland deciduous cover type has a well distributed age class distribution except for large deficits in the 10- to 19 and 20- to 29-year-old age classes (Figure 13). The past management regime has been primarily clearcut for this cover type. The age class spike in the 0-9 age class will help to compensate for the deficits in the 10-19 and 20-29. This current planning period will continue to smooth out the distribution of the lowland deciduous in this management area.

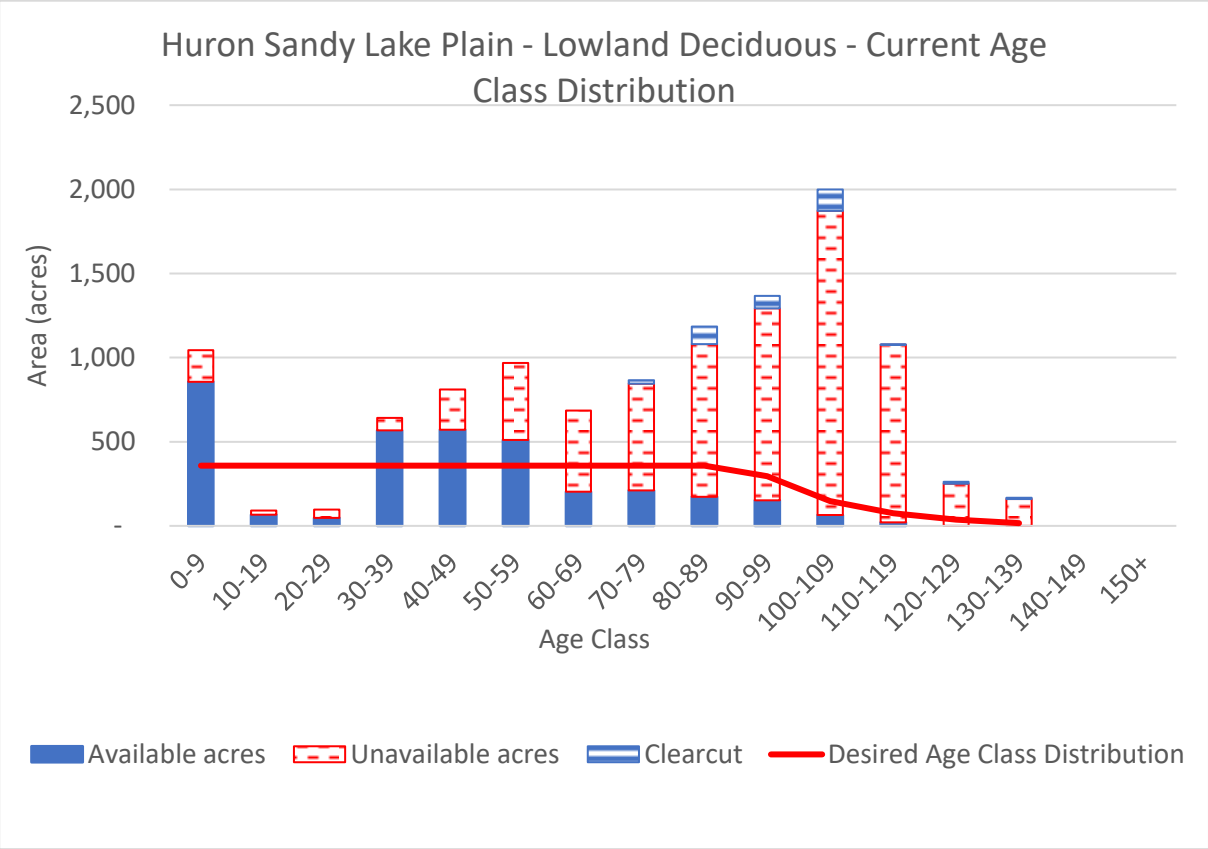


Figure 13. Current age class distribution, the desired age class distribution, and the projected harvests in the lowland deciduous cover type over the 10-year planning period.

Current conditions are a result of consistent commercial harvests and regeneration efforts on available lowland deciduous acres during the previous planning periods. A portion of this cover type meets the habitat requirements for American woodcock, cerulean warbler and wood thrush (Table 11).

Table 11. Featured species with lowland deciduous as a selected habitat cover type, habitat variables and current acres (e.g., potential habitat).

Featured Species	Featured Species Habitat – Lowland Deciduous	Lowland Deciduous Habitat Acres - Available	Lowland Deciduous Habitat Acres - Unavailable
American Woodcock	Age Category: 0-19 Size Category: Sapling	291	47
Cerulean Warbler	Age Category: 80+ Size Category: Sawlog Basal Area: 81+	476	8,253
Wood Thrush	Age Category: 40+ Size Category: Sawlog Basal Area: 81+	596	7,935

Desired future condition

The projected long-term cover type trend for lowland deciduous is steady over the next planning period and increasing in the decades to follow. There are very few transitions into or out of this cover type forecasted in this management area.

The long-term goal for this cover type is balanced age classes between 0 and 90 years old and carry a decreasing percentage of acres into the older age classes out to 140 years old for all available lowland deciduous stands in this management area.

The end of the planning period will result in the establishment of the desired amount of regeneration in the upcoming 0-9 age class (Figure 14). Progress toward the long-term age class distribution of lowland deciduous will take several decades in the management area.

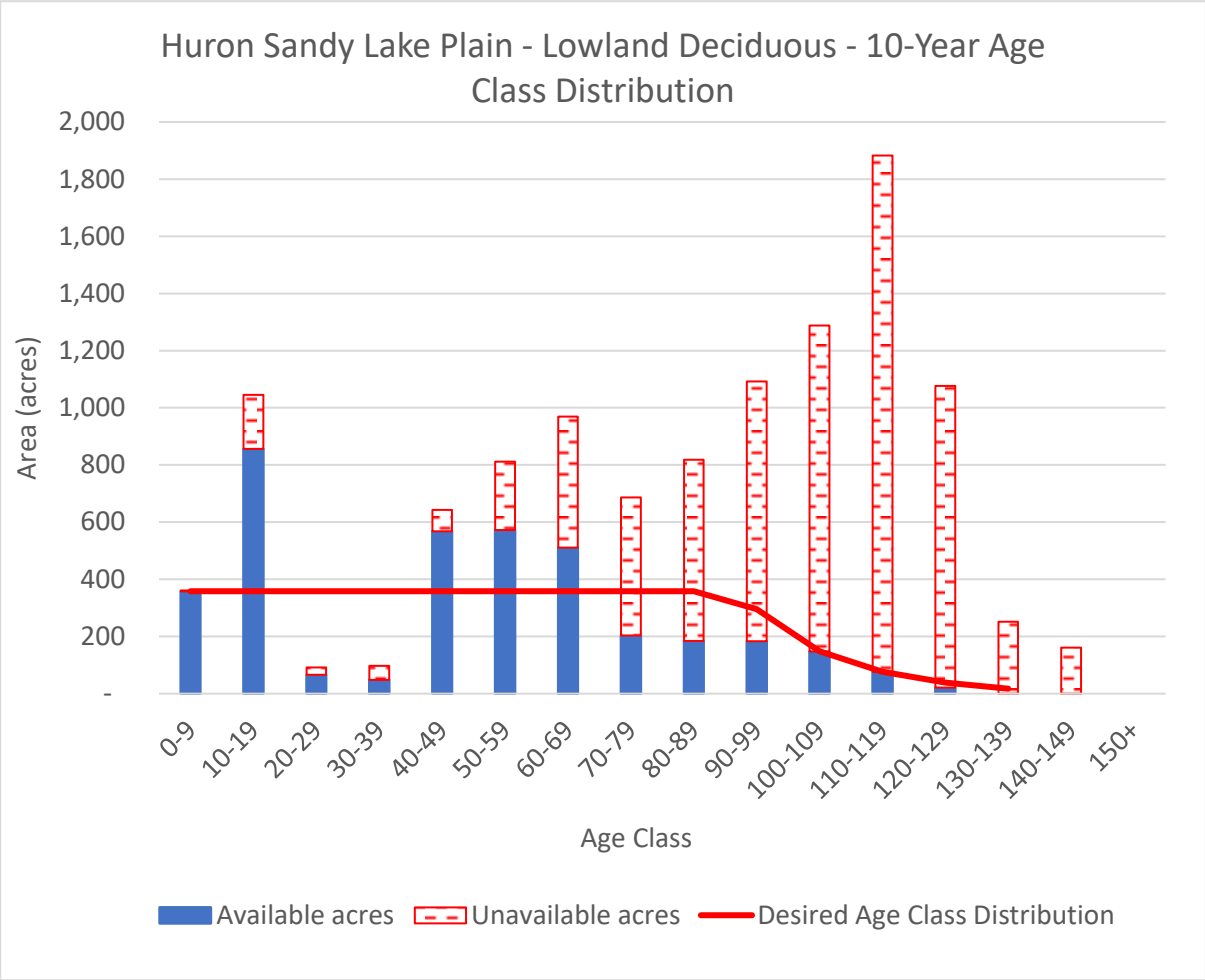


Figure 14. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of lowland deciduous acres has reached the desired future condition (Figure 15).

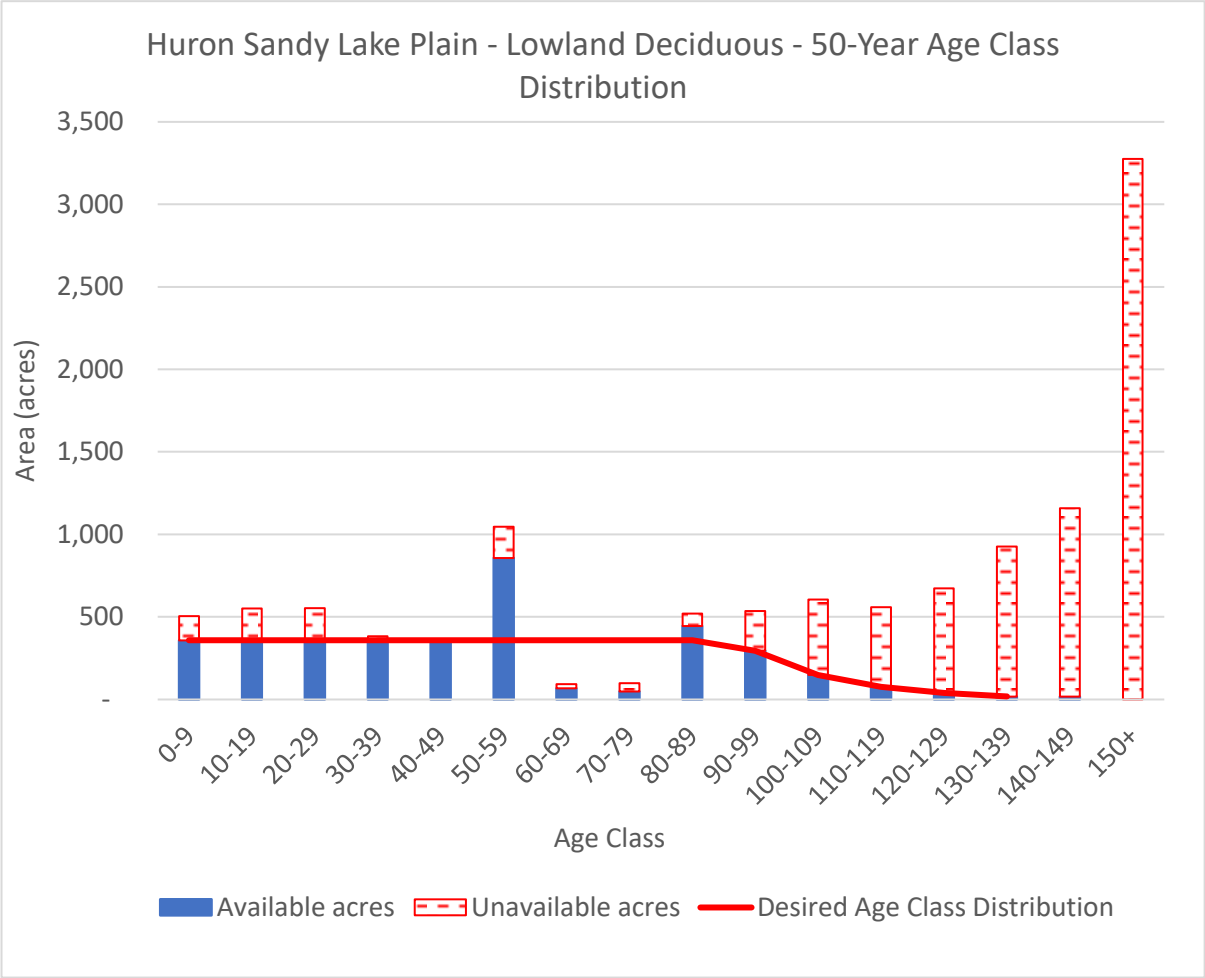


Figure 15. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 16) will concentrate the manageable acres of lowland deciduous in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged, and mature forest (Figure 17).

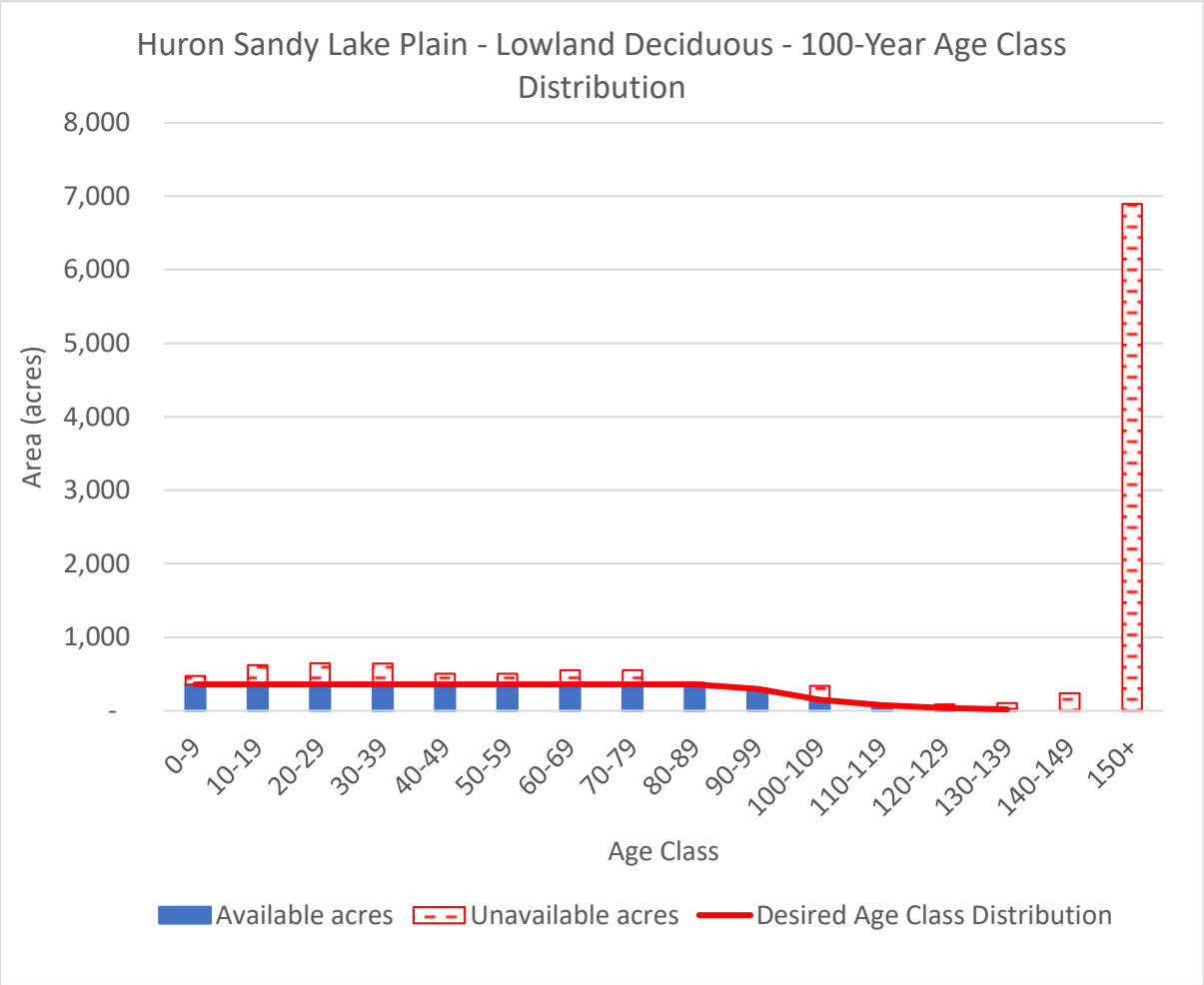

Huron Sandy Lake Plain - Lowland Deciduous - 100-Year Age Class Distribution
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
-
Area (acres)
0-9
10-19
20-29
30-39
40-49
50-59
60-69
70-79
80-89
90-99
100-109
110-119
120-129
130-139
140-149
150+
Age Class
Available acres
Unavailable acres
Desired Age Class Distribution

Figure 16. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

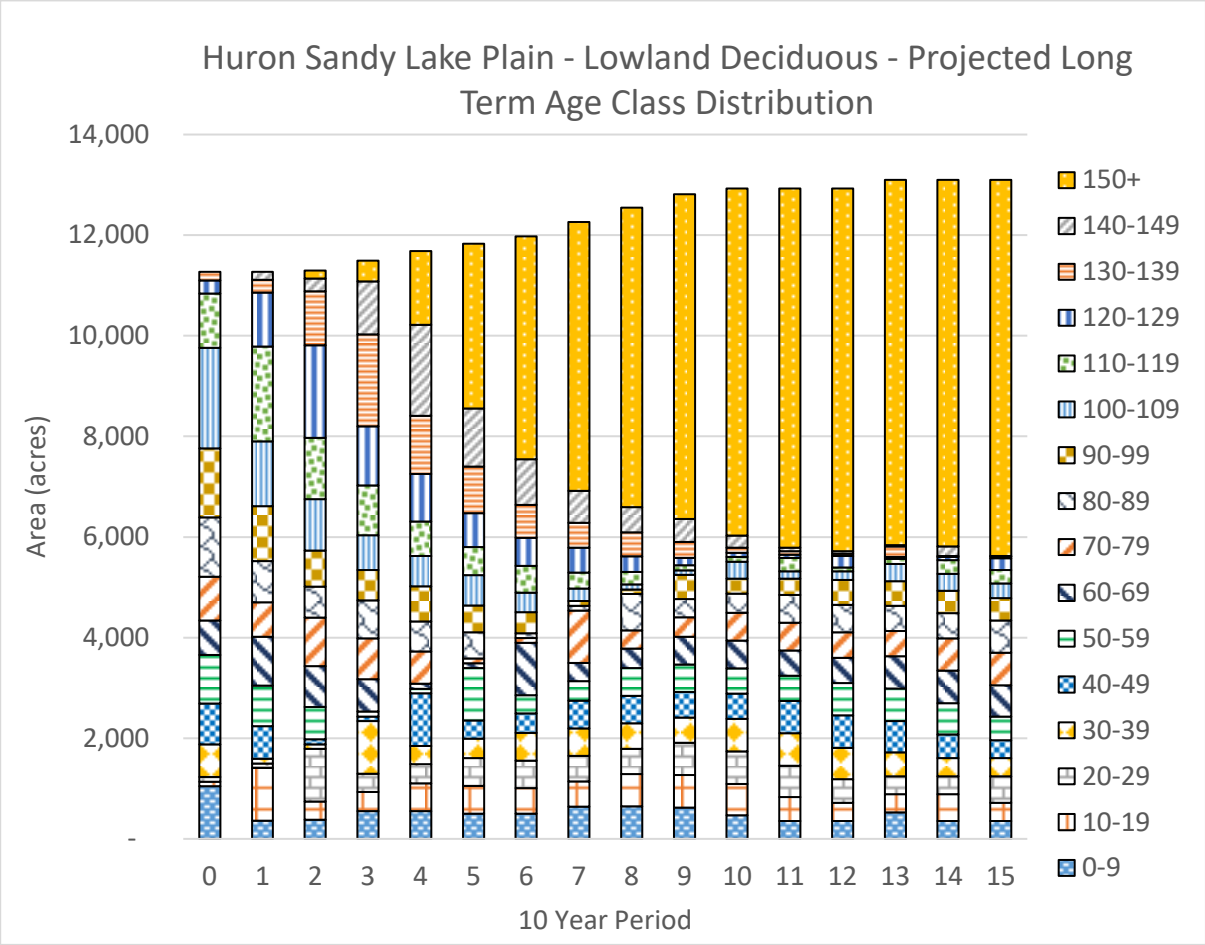


Figure 17. Projected age class distribution for all acres of lowland deciduous over the next 150 years in the Huron Sandy Lake Plain Management Area.

Management actions

There are 349 acres of projected clearcut harvest in the lowland deciduous cover type during this planning period. This is very close to the goal for the desirable number of acres in the 0- to 9-year-old age class.

Conservation area network

High conservation value areas

There are up to nine different high conservation value area (HCVA) types that can be found in each management area (Table 12; see Biodiversity in Section 3 for more information).

Table 12. High conservation value areas within Huron Sandy Lake Plain Management Area.

High Conservation Value Area Type and Name	Acres
Coastal Environmental Areas	**105**
	105
Critical Coastal Habitat (Piping Plover)	**18**
	18
Critical Dunes	**191**
	191
Eastern Massasauga Managed Land	**1,720**
	1,720
Forest Habitat Core Interior	**9**
	9
State Wildlife Management Areas	**7,620**
Dingman Marsh Flooding SWMA	4,580
French Farm Lake Flooding SWMA	2,927
O'Neal Lake Flooding SWMA	112
Grand Total	**9,663**

Ecological reference areas

Ecological reference areas (ERAs) are a type of HCVA and are higher quality examples of functioning ecosystems that are primarily influenced by natural ecological processes.

Table 13. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 14. Ecological reference areas within the management area.

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	Number of Occurrences
Existing ERA	Coastal Fen	AB			2
Existing ERA	Dry Northern Forest	C	G3?	S3	1
Existing ERA	Dry-mesic Northern Forest	BC			1
Existing ERA	Emergent Marsh	BC			1
Existing ERA	Floodplain Forest	C	G3?	S3	1
Existing ERA	Great Lakes Marsh	AB			1
Existing ERA	Great Lakes Marsh	BC	G2	S3	1
Existing ERA	Interdunal Wetland	BC	G2?	S2	1
Existing ERA	Intermittent Wetland	BC	G2	S3	1
Existing ERA	Limestone Bedrock Glade	C	G2G4	S2	1
Existing ERA	Limestone Cliff	B			1
Existing ERA	Northern Fen	B			1
Existing ERA	Northern Fen	B	G3	S3	2
Existing ERA	Poor Fen	C	G3	S3	1
Existing ERA	Rich Conifer Swamp	B			2
Existing ERA	Rich Conifer Swamp	BC	G4	S3	1
Existing ERA	Rich Conifer Swamp	C	G4	S3	1
Existing ERA	Wooded Dune and Swale Complex	B	G3	S3	1
Existing ERA	Wooded Dune and Swale Complex	C	G3	S3	3
Proposed ERA	Patterned Fen	C	GU	S2	1
Grand Total					**25**

Special conservation areas

Reviewable special conservation areas (SCAs; Table 15) refers to those SCA types that may be reviewed or updated through the compartment review process as needed. Static SCAs (Table 16) refers to those SCA types that generally do not change or require updating (see Biodiversity in Section 3 for more information).

Table 15. Reviewable special conservation areas within Huron Sandy Lake Plain Management Area.

Reviewable Special Conservation Area Type and Name	Acres
Concentrated Recreational Area	**454**
Ossineke Campground	35
Unspecified	418
Habitat Area or Habitat Corridor	**652**
52106013	125

52106015	5
52106017	27
Hubbard Lake State Game Area	495
Mineral Resource Area	**76**
H&D Inc.	76
Spring, Wetlands, or Riparian Areas	**87**
H&D Inc.	76
Long Rapids Road Vernal Pool	1
Vernal Pool A	7
Vernal Pool B	3
Grand Total	**1,716**

Table 16. Static special conservation areas within Huron Sandy Lake Plain Management Area.

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Common Natural Heritage Element Occurrences		**26**
Northern Wet Meadow		26
Designated Trout and Cold Water Stream Buffer		**484**
		332
Carp Lake River		117
Gilchrist Creek		5
Weber Creek		19
Widner Creek		11
Designated Trout and Coldwater Streams	**17.5**	
<Null>	12.0	
Carp Lake River	4.3	
Gilchrist Creek	0.2	
Weber Creek	0.7	
Widner Creek	0.4	
Important Bird Areas		**572**
Mackinac Straits Hawk Watch		4
North Point		316
Scarecrow Island		251
Mussel Stream Group 1 - State special concern	**7.7**	
Erskine Creek-North Branch Thunder Bay River	1.6	
Fletcher Pond-Upper South Branch Thunder Bay River	0.5	
Gaffney Creek-Thunder Bay River	2.4	
Jewett Creek-Thunder Bay River	1.3	
Lost Lake-North Branch Thunder Bay River	1.5	
Sunken Lake-North Branch Thunder Bay River	0.5	
Mussel Stream Group 2 - State threatened or endangered	**4.2**	

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Carp Lake River	2.2	
Gaffney Creek-Thunder Bay River	0.9	
King Creek-Lower South Branch Thunder Bay River	0.3	
Sunken Lake-North Branch Thunder Bay River	1.0	
Non-dedicated Natural Areas		**1**
Natural Area Hardwood State Forest Wilderness Area		1
Wood Turtle Stream 100ft Buffer		**36**
Thunder Bay River		27
Upper South Branch Thunder Bay River		9
Wood Turtle Stream 660ft Buffer		**213**
Thunder Bay River		150
Upper South Branch Thunder Bay River		63
Grand Total	**29.5**	**1,332**

Rare species

Rare species occurrences are compiled from the Michigan Natural Features Inventory Biotics database (*Table* 17, Table 19 and Table 20) and do not necessarily include all rare species found in this management area due to biases in survey effort and verifiable observation reporting over time.

Table 17. *Rare animal and plant species conservation status key.*

Status	Status
E = endangered	LE = listed endangered
T = threatened	LT = listed threatened
SC = special concern	PDL = proposed for delisting

Table 18. Rare animal occurrence within Huron Sandy Lake Plain Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Bombus affinis	Rusty-patched bumble bee	E	LE	1
Animal	Bombus borealis	Northern amber bumble bee	SC		6
Animal	Bombus terricola	Yellow banded bumble bee	SC		5
Animal	Buteo lineatus	Red-shouldered hawk	SC		7
Animal	Cambarunio iris	Rainbow	SC		1
Animal	Chlidonias niger	Black tern	T		2
Animal	Cincinnatia cincinnatiensis	Campeloma spire snail	SC		1

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Coregonus artedi	Lake herring or Cisco	T		1
Animal	Dorydiella kansana	Leafhopper	SC		1
Animal	Emydoidea blandingii	Blanding's turtle	SC		3
Animal	Gavia immer	Common loon	T		11
Animal	Haliaeetus leucocephalus	Bald eagle	SC		14
Animal	Lanius ludovicianus migrans	Migrant loggerhead shrike	E		2
Animal	Lasmigona compressa	Creek heelsplitter	SC		1
Animal	Lasmigona costata	Flutedshell	SC		1
Animal	Microtus pinetorum	Woodland vole	SC		1
Animal	Myotis lucifugus	Little brown bat	T		3
Animal	Myotis septentrionalis	Northern long-eared bat	T	LE	1
Animal	Necturus maculosus	Mudpuppy	SC		3
Animal	Notropis anogenus	Pugnose shiner	E		1
Animal	Opheodrys vernalis	Smooth green snake	SC		3
Animal	Pandion haliaetus	Osprey	SC		3
Animal	Pisidium idahoense	Giant northern pea clam	SC		1
Animal	Pygarctia spraguei	Sprague's pygarctia	SC		1
Animal	Pyrgus centaureae wyandot	Grizzled skipper	T		3
Animal	Sagittunio nasutus	Eastern pondmussel	E		1
Animal	Sistrurus catenatus	Eastern massasauga	T	LT	3
Animal	Sphaerium fabale	River fingernail clam	SC		1
Animal	Sterna hirundo	Common tern	T		1
Animal	Thamnophis butleri	Butler's garter snake	SC		1
Animal	Trimerotropis huroniana	Lake Huron locust	T		1
Total	-	-	-	-	**85**

Table 19. Rare plant occurrence within Huron Sandy Lake Plain Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Plant	Astragalus neglectus	Cooper's milk vetch	SC		3
Plant	Calypso bulbosa	Calypso or fairy-slipper	T		1
Plant	Crataegus douglasii	Douglas's hawthorn	SC		1
Plant	Cypripedium arietinum	Ram's head lady's-slipper	SC		8
Plant	Dryopteris filix-mas	Male fern	SC		1
Plant	Eleocharis compressa	Flattened spike rush	T		1
Plant	Graphephorum melicoides	Purple false oats	SC		2
Plant	Iris lacustris	Dwarf lake iris	T	LT	5
Plant	Poa interior	Inland bluegrass	SC		1
Plant	Potamogeton pulcher	Spotted pondweed	T		1
Plant	Pterospora andromedea	Pine-drops	T		3
Plant	Salix pellita	Satiny willow	T		1
Plant	Schoenoplectus torreyi	Torrey's bulrush	SC		2
Plant	Solidago houghtonii	Houghton's goldenrod	T	LT	1
Plant	Stachys pilosa	Hairy hedge-nettle	SC		2
Plant	Tanacetum bipinnatum ssp. huronense	Lake Huron tansy	SC		2
Plant	Thalictrum pubescens	Tall meadowrue	SC		1
Total	-	-	-	-	**36**

Table 20. Other rare occurrence within Huron Sandy Lake Plain Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Other	Great Blue Heron Rookery	Great Blue Heron Rookery			3
Total	-	-	-	-	**3**

Non-ecological reference area natural communities

Natural communities that are identified with an element occurrence in the MNFI Biotics database, but that have not been given an additional ecological reference area (ERA) designation, are recognized and managed accordingly (Table 21).

Table 21. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 22. Non-ecological reference area natural communities within Huron Sandy Lake Plain Management Area.

Community Type	Element Occurrence Rank	State Rank	Global Rank	Number of Occurrences
Northern Wet Meadow	**BC**	S4	G4G5	1
Dry Northern Forest	**D**	S3		2
Grand Total				**3**

Forest health

Forest health concerns, both native and non-native, can have impacts on stand conditions and management decisions. The following insects (Table 23) and diseases (Table 24) could have an impact on management during the planning period and may need to be monitored and/or addressed.

Table 23. Defoliating insects of concern in the Huron Sandy Plains Management Area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Spongy moth	Lymantria dispar	Non-native	Yes
Forest tent caterpillar	Malacosoma disstria	Native	Yes

Watch for and retain lingering ash with potential resistance to emerald ash borer.

Table 24. Maladies of concern in the Huron Sandy Plains Management Area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Canker (stem infections)	Various	Various	Yes
Armillaria root rot	Armillaria spp.	Native	
Oak decline	Various	Various	Yes

Monitor oak for symptoms of oak wilt and follow state land oak wilt guidance. Monitor planted red pine for Heterobasidion root disease and follow disease guidance. Report surviving mature beech trees that may be resistant to beech bark disease. Watch for symptoms of beech leaf disease.

Aquatic resources

Riparian habitat

A total of 59 miles of streams and rivers are found in the management area (Table 25). Streams/rivers classified as warm types comprise approximately 95% of the riverine mileage.

Table 25. Classification type and length of streams/rivers found within the management area.

Type	Length (miles)
Cold Stream	2
Cold Small River	0
Cold Transitional Stream	1
Cold Transitional Small River	0
Cold Transitional Large River	0
Warm Transitional Stream	24
Warm Transitional Small River	4
Warm Transitional Large River	0
Warm Stream	14
Warm small river	7
Warm Large River	7

Lacustrine habitat

A total of 22 lakes and ponds of at least 1 surface acre are found in the management area (Table 26).

Table 26. Size and number of lakes and ponds located within the management area.

Lake Size Class (acres)	Number
1-99	12
100-499	3
500+	7

Wetlands

A total of 55,398 acres of wetlands are found in the management area (Table 27). Forested wetlands comprise approximately 93% of wetland types found in the management area.

Table 27. Area of emergent, forested and riverine wetland types found within the management area.

Wetland Type	Acres
Emergent	3,790
Forested	51,531
Riverine	77

Vernal pools and seeps

A total of 416 acres of vernal pools and seeps have been inventoried in the management area, and 835 acres of seeps have been identified.

Riparian vegetation cover

Lowland deciduous and lowland shrub are the predominant cover types present in a 100-meter riparian zone located next to streams/rivers in the management area (Table 28).

Table 28. Largest vegetative cover types (i.e., top 10) and area located in a 100-meter buffer of streams/rivers within the management area.

Cover Type	Acres
Lowland Deciduous	1,916
Lowland Shrub	1,368
Cedar	870
Aspen	775
Marsh	723
Lowland Aspen/Balsam Poplar	510
Lowland Conifers	489
Lowland Mixed Forest	248
Upland Mixed Forest	237
Bog	231

Watershed vegetation cover

The management area includes portions of important watersheds of the Little Black and Thunder Bay rivers (Table 29 & Table 30). Lowland shrub/aspen/balsam fir are major cover types of the state forest in each watershed.

Table 29. Largest vegetative cover types (i.e., top five) and area of the Little Black River watershed located within the management area.

Cover Type	Acres
Cedar	578
Lowland Shrub	487
Lowland Aspen/Balsam Fir	470
Lowland Conifers	390
Lowland Deciduous	237

Table 30. Largest vegetative cover types (i.e., top five) and area of the Thunder Bay River watershed located within the management area.

Cover Type	Acres
Lowland Deciduous	6,175
Lowland Aspen/Balsam Fir	4,342
Aspen	4,145
Lowland Shrub	3,172
Cedar	2,595

Recreation

Access for public recreation and management in the Huron Sandy Plains Management Area is generally limited due to wetland and adjacent private land, however, there is pressure for recreation access due to the proximity of Mackinaw City, Cheboygan and Alpena.

Motorized trails include the Devils Lake ORV Route near Alpena and the Indian Gardens ORV Route east of Cross Village. A network of snowmobile trails also traverses this management area. Portions of several state trails pass through the Huron Sandy Plain Management Area, including the Hillman-Alpena State Trail, North Central State Trail and Northwestern State Trail. These state trails are open to all nonmotorized uses year-round and snowmobiles seasonally. Other nonmotorized trails include the Chippewa and Norway Ridge pathways (hike/bike), 18.2 miles of the North Country National Scenic Trail/Iron Belle Trail and 4.6 miles of the Shore-to-Shore equestrian trail.

There are two state forest campgrounds (rustic) within the management area, located on Lake Huron and the Thunder Bay River in Alpena County.

Additional recreation facilities in this area are provided by Wilderness, Thompsons Harbor and Negwegon state parks, which are adjacent to state forest land.

Table 31. Designated recreation trails by type.

Recreation Category	Recreation Type	# of Miles
Motorized Recreation Trails	ORV (all types)	11.2

Recreation Category	Recreation Type	# of Miles
	Snowmobile	39.7
Nonmotorized Recreation Trails	Hiking Equestrian Biking Hunter Access Trails	54.3 6.8 31.6 0
Total		**154.8**

Note: Trail-use types may overlap.

Table 32. State forest campgrounds.

State Forest Campgrounds	# of sites
Ossineke	42
Thunder Bay River	10

Areas managed for hunting include Dingman Marsh Flooding, an expansive area of wetland in Cheboygan County, French Farm Lake near the shores of Lake Michigan in Emmett County, and O'Neal Flooding also in Emmett County.

Boating access sites provide access to several inland lakes, Lake Huron and the Thunder Bay River.

Dispersed recreation, such as hunting, is also popular in the management area.

Table 33. Areas managed for hunting.

Type	Name	# of Acres
State Wildlife Management Area	Dingman Marsh Flooding French Farm Lake Flooding O'Neal Lake Flooding	4,578.2 2,925.8 1,236.0
Total		**8,740**

Table 34. Boating access sites.

Name	Waterbody
O'Neal Lake	O'Neal Lake
Paradise Lake	Paradise Lake
Seven Mile Pond-Winyah Lake	Seven Mile Pond-Winyah Lake
Snug Harbor	Lake Huron
South Bay Hubbard Lake	Hubbard Lake
Thunder Bay River State Forest Campground	Thunder Bay River

Kalkaska Sandy Moraines

State Forest Area: 285,254 acres	Location: Otsego, Antrim, Crawford, Kalkaska, Grand Traverse, Wexford and Missaukee Counties	Population Centers: Gaylord, Kalkaska, Rapid City, Traverse City and Fife Lake
Subsection: Kalkaska Sandy Moraines and Wolverine Moraines	Landforms: Sandy ice-disintegration ridges and high outwash plain	Landcover: Forested: 252,893 acres Nonforested: 32,361 acres

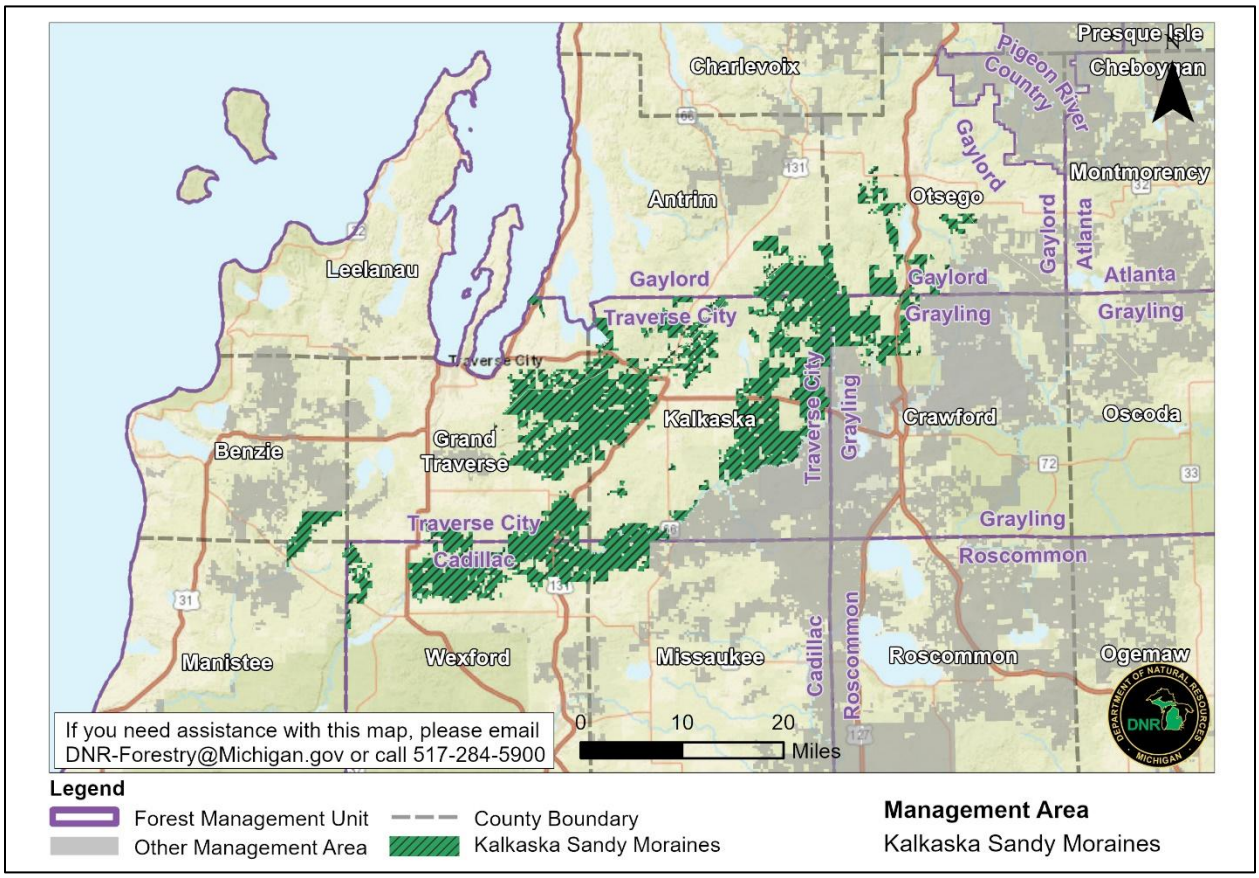


Figure 1. Kalkaska Sandy Moraines Management Area.

Forested landscape

Current and projected condition

The Kalkaska Sandy Moraine Management Area is dominated by aspen, northern hardwood and planted red pine cover types that are largely upland and available (Figure 2). Mid-tolerant available upland cover types are more prevalent in the mid-aged and mature categories, while the unavailable lowland shade tolerant acres are more prevalent in the mature age category.

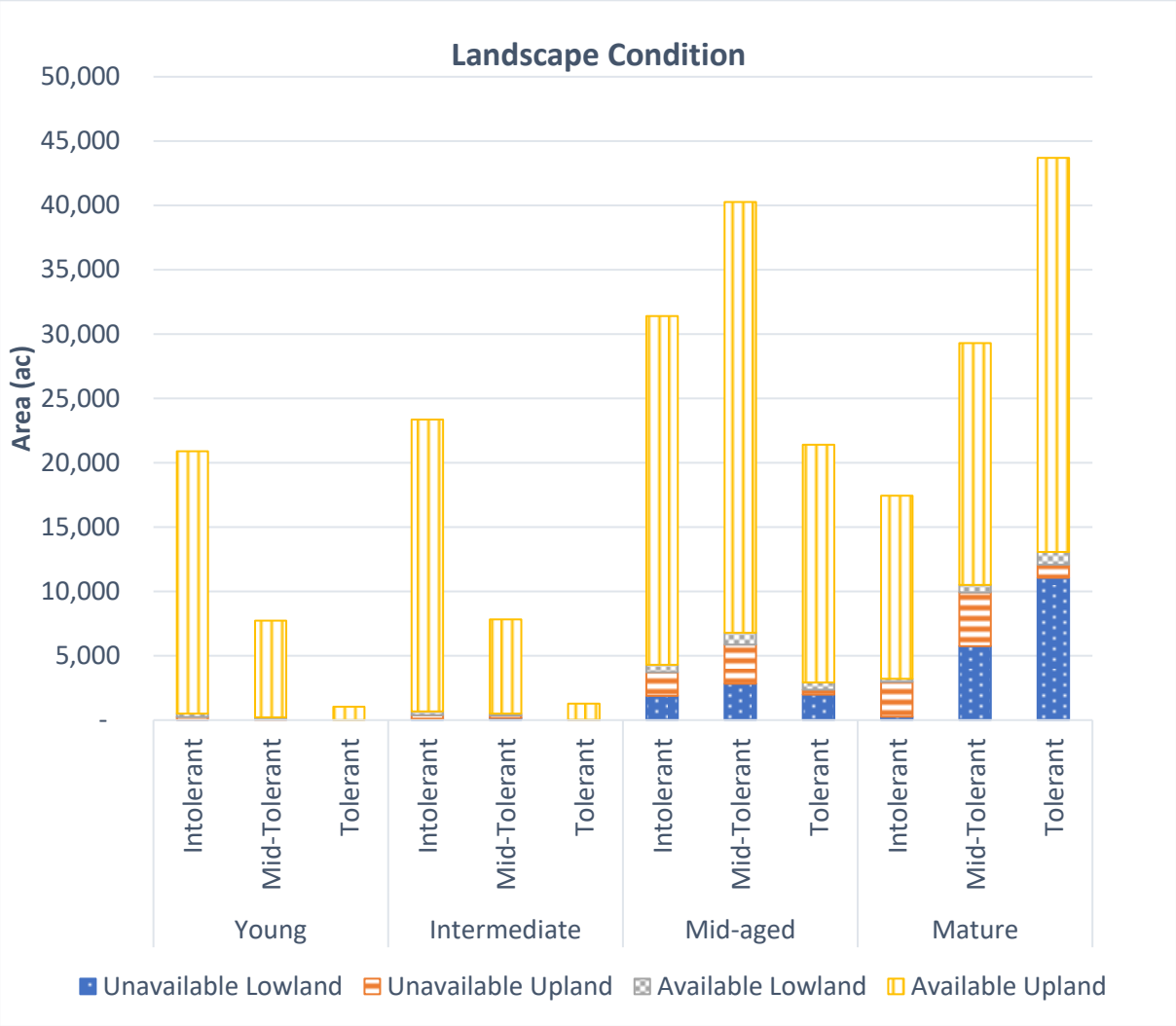


Figure 2. Forest diversity matrix showing the current distribution of forested acres across management availability, age category, landscape position and shade tolerance.

Landscape habitat conditions refine the management area landscape into featured species habitat context. Current and projected acres for the metrics identified in the Management Priorities (Section 3 Statewide/Regional) establish a baseline and future condition based on management over the planning period (Table 1).

Table 1. Current acres for landscape habitat conditions.

Landscape Habitat Condition	Monitoring Metric	Current Acres
Young Forest	Acres of 0-19 stands in Aspen and Jack Pine	20,040
Mature Forest	Acres of 80+ year stands across cover types	90,437
Mature Forest	Acres of 120+ year stands across cover types	4,155
Mesic Conifer Cover Types	Acres of mesic conifer cover types	15,409
Mesic Conifers in other Cover Types	Average canopy occupancy	28%
Mast – Oak Cover types	Acres of oak cover types	17,986
Mast Tree Species in other Cover types	Acres of total canopy occupancy of mast tree acres (trace-100%)	150,307
Big Trees	Acres of total canopy stand occupancy of species in sawlog or greater size class	132,637
Nonforested Openings	Acres of total herbaceous openland, upland shrub, and cropland	14,096
Landscape Forest Matrix	Percent deciduous forest	59%
Landscape Forest Matrix	Percent coniferous forest	35%

The Kalkaska Sandy Moraines Management Area has the following special analysis units (SAUs). These SAUs have specific cover type goals, typically associated with wildlife habitat management. For any SAUs that overlap with this management area, SAU cover type goals take priority as the SFMP model strives to meet the cover type goals across the area, ensuring they are met. See Section 5 for a detailed description of the management direction and harvest goals for each of these SAUs.

- Grouse Enhanced Management Site (GEM) – Little Betsie

The Kalkaska Sandy Moraines Management Area is dominated by forested cover types with 89% of the area covered in forested stands (Table 2). The upland deciduous portion of that is 49% of the management area and comprised mostly of northern hardwood and aspen. Lowland shrub and upland shrub are the most common nonforested cover type in this management area representing 6% of the landscape.

Table 2. Current landscape context and distribution of cover types.

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
Forested	Upland	Deciduous	Aspen	65,434	139,320	223,916	252,893
			Northern Hardwood	43,361			
			Black Red Hybrid Oak	6,687			
			Northern Red Oak	6,927			
			Oak Mix	4,645			
			Mixed Upland Deciduous	12,267			
		Mixed	Upland Mixed Forest	11,932	11,932		
		Coniferous	Planted Red Pine	42,134	72,664		
			Planted Jack Pine	2,443			
			Planted White Pine	2,172			
			Planted Mixed Pine	3,119			
			Natural Red Pine	3,490			
			Natural Jack Pine	3,900			
			Natural White Pine	4,496			
			Natural Mixed Pines	9,348			
			Upland Spruce/Fir	239			
			Upland Conifers	1,265			
			Hemlock	59			
	Lowland	Deciduous	Lowland Aspen/Balsam Poplar	2,884	9,963	28,977	
			Lowland Deciduous	7,079			
		Mixed	Lowland Mixed Forest	3,587	3,587		
		Coniferous	Cedar	3,682	15,427		
			Lowland Conifers	10,925			
			Lowland Spruce/Fir	530			
			Tamarack	290			
Nonforested	Upland	N/A	Herbaceous Openland	5,899	N/A	19,175	32,361
			Upland Shrub	8,133			
			Low Density Trees	3,014			
			Bare/Sparsely Vegetated	514			
			Cropland	64			
			Urban	1,550			
	Lowland	N/A	Lowland Shrub	7,412	N/A	13,186	
			Marsh	2,639			
			Bog	625			
			Treed Bog	269			
			Water	2,241			
						Grand Total:	**285,254**

There are 214,690 acres (75.2% of the total management area and 84.9% of the forested area) that can be managed toward desired future conditions via commercial timber harvest in the Kalkaska Sandy Moraines Management Area (Table 3). Of that, almost 25% is in the aspen cover type, 16.7% in northern hardwood, and 15.7% in planted red pine. The remaining 22 cover types represent less than 5% each of the forested and available land in the management area. Acres unavailable for management are categorized by site condition (Table 4).

Table 3. Current landscape context and cover type composition by management availability.

KALKASKA SANDY MORAINES Forested Cover Type	Available Acres	Available %	Unavailable Acres	Unavailable %	Total Acres	Total %
Aspen	62,966	24.9%	2,476	1.0%	65,442	25.9%
Northern Hardwood	42,312	16.7%	1,052	0.4%	43,364	17.1%
Planted Red Pine	39,596	15.7%	2,544	1.0%	42,140	16.7%
Mixed Upland Deciduous	10,616	4.2%	1,651	0.7%	12,267	4.9%
Upland Mixed Forest	10,609	4.2%	1,323	0.5%	11,932	4.7%
Natural Mixed Pines	8,657	3.4%	691	0.3%	9,349	3.7%
Black Red Hybrid Oak	6,055	2.4%	632	0.2%	6,687	2.6%
Northern Red Oak	6,016	2.4%	911	0.4%	6,927	2.7%
Natural White Pine	4,158	1.6%	339	0.1%	4,497	1.8%
Oak Mix	3,986	1.6%	660	0.3%	4,646	1.8%
Natural Jack Pine	3,705	1.5%	197	0.1%	3,901	1.5%
Natural Red Pine	3,312	1.3%	178	0.1%	3,490	1.4%
Planted Mixed Pine	2,499	1.0%	619	0.2%	3,119	1.2%
Planted Jack Pine	2,393	0.9%	51	0.0%	2,444	1.0%
Planted White Pine	2,159	0.9%	13	0.0%	2,172	0.9%
Lowland Aspen/Balsam Poplar	992	0.4%	1,893	0.7%	2,884	1.1%
Lowland Conifers	964	0.4%	9,961	3.9%	10,925	4.3%
Lowland Deciduous	940	0.4%	6,139	2.4%	7,079	2.8%
Lowland Mixed Forest	935	0.4%	2,653	1.0%	3,588	1.4%
Upland Conifers	679	0.3%	586	0.2%	1,265	0.5%
Cedar	605	0.2%	3,078	1.2%	3,683	1.5%
Lowland Spruce/Fir	241	0.1%	291	0.1%	532	0.2%
Upland Spruce/Fir	196	0.1%	44	0.0%	239	0.1%
Tamarack	90	0.0%	200	0.1%	290	0.1%
Hemlock	27	0.0%	33	0.0%	59	0.0%
Grand Total	**214,707**	**84.9%**	**38,215**	**15.1%**	**252,922**	**100.0%**

Table 4. Site conditions for unavailable acres.

Site Condition (Reason Area is Unavailable for Commercial Harvest)	Area (ac)	% of Unavailable Area
Too Wet	16,372	42.9%
Best Management Practices	7,114	18.6%
Federal/State/Local Law	3,090	8.1%
Conservation Values	2,164	5.7%
Too Steep	1,782	4.7%
Non-Military Lease/Easement	1,699	4.4%
Other Influence Zones	1,558	4.1%
Recreation/Scenic	1,321	3.5%
Blocked by Obstacle	829	2.2%
Long-Term Retention	810	2.1%
Other Department/Division Processes	527	1.4%
Denied Access	525	1.4%
Species of Special Concern or Threatened and Endangered	107	0.3%
Rare Landforms	90	0.2%
Wildlife Concerns	75	0.2%
Deer Wintering Area	42	0.1%
Cannot Regenerate	39	0.1%
Unproductive	33	0.1%
Historical/Archaeological	13	0.0%
Natural/Quiet/Wilderness Area	12	0.0%
Total Unavailable	**38,202**	**100.0%**

Projected 10-year cover type management actions

Each cover type in the Kalkaska Sandy Moraines Management Area has a unique age class and basal-area class goals that describe the long-term desired future conditions. The harvest levels that are needed in the first planning period to begin achieving those long-term goals are summarized below (Table 5). These harvests will help establish a desirable amount of regeneration for the even-aged cover types over the 10-year period or help to achieve desired basal-area distribution among uneven-aged cover types like northern hardwoods. Implementing these silvicultural regimes will yield 1,046,708 cords, the planned harvest volume for the decade (Table 6).

Table 5. Ten-year planning period harvest goals (acres) by cover type and silvicultural regime.

Silvicultural Regimes								
Cover Type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Salvage Clearcut	Salvage Thinning	Grand Total
Planted Red Pine	3,724	-	13,697	-	-	926	1,940	20,286
Northern Hardwood	-	9,712	-	624	-	1,310	1,013	12,660
Aspen	8,389	-	-	-	-	-	-	8,389
Natural Mixed Pines	-	-	762	-	845	-	-	1,607
Planted White Pine	-	-	1,304	-	-	-	-	1,304
Natural White Pine	-	-	516	-	506	-	-	1,022
Mixed Upland Deciduous	796	208	-	-	-	-	-	1,005
Natural Jack Pine	696	-	-	-	-	-	-	696
Upland Spruce/Fir	196	-	-	-	-	-	-	196
Lowland Aspen/Balsam Poplar	170	-	-	-	-	-	-	170
Lowland Deciduous	135	22	-	-	5	-	-	162
Northern Red Oak	121	-	-	7	6	-	-	134
Lowland Mixed Forest	92	-	-	-	-	-	-	92
Lowland Conifers	80	-	-	-	-	-	-	80
Natural Red Pine	-	-	38	-	26	-	-	64
Planted Jack Pine	58	-	-	-	-	-	-	58
Lowland Spruce/Fir	45	-	-	-	-	-	-	45
Upland Mixed Forest	-	-	-	-	-	44	-	44
Planted Mixed Pine	-	-	23	-	-	-	-	23
Black Red Hybrid Oak	9	-	-	-	-	-	-	9
Hemlock	-	4	-	-	-	-	-	4
Tamarack	1	-	-	-	-	-	-	1
Totals	**14,513**	**9,946**	**16,340**	**631**	**1,387**	**2,280**	**2,953**	**48,049**

Table 6. Projected 10-year harvest volume by species.

10-Year Estimated Harvest Volume Projection Kalkaska Sandy Moraines Management Area			
Product	**Species**	**Volume Planned***	**Volume Prepared** ***
Pulpwood (cords)	Red Pine	137,271	129,035
	Mixed Hardwood	117,447	110,400
	Mixed Aspen	88,430	83,124
	White Pine	21,764	20,458
	Mixed Spruce	21,760	20,454
	Mixed Softwood	17,949	16,872
	Jack Pine	13,960	13,122
	Mixed Oak	6,644	6,246
	Pulpwood Total	**425,224**	**399,711**
Sawtimber (MBF)	Red Pine	135,864	127,712
	Sugar Maple	29,360	27,599
	Mixed Aspen	23,129	21,741
	Red Maple	13,849	13,018
	White Pine	9,728	9,144
	Red Oak	6,996	6,576
	Basswood	3,521	3,309
	White Oak	2,234	2,100
	Mixed Oak	1,638	1,540
	Sawtimber Total	**226,320**	**212,740**
	Total Sawtimber Harvest Volume in Cords	**626,442**	**588,856**
	Grand Total Harvest Volume in Cords	**1,051,667**	**988,567**

* Volume estimates based on 100% of the projected harvests for the 10-year planning period.

** Volume estimates based on 94% of the projected harvests for the 10-year planning period accounting for reduction in acres and associated volume once sales are prepared for bid.

There are only a few cover type transitions projected in the Kalkaska Sandy Moraines Management Area (Table 7). The managed area of each cover type is projected to remain relatively stable as treatment regimes will not change the amount of area in each cover type except for upland mixed forest. The

largest decrease forecasted is in the planted red pine cover type where 389 acres are forecasted to convert to other cover types such as upland mixed forest through forest management activities. The largest increase is in upland mixed forest where 605 acres are expected to convert into that cover type increasing by 5.1% in acreage.

Table 7. Projected 10-year cover type acres resulting from cover type transitions.

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Aspen	65,434	65,588	154
Northern Hardwood	43,361	43,733	372
Planted Red Pine	42,134	41,745	-389
Mixed Upland Deciduous	12,267	11,908	-358
Upland Mixed Forest	11,932	12,537	605
Lowland Conifers	10,925	10,869	-56
Natural Mixed Pines	9,348	9,348	0
Lowland Deciduous	7,079	7,089	10
Northern Red Oak	6,927	6,852	-75
Black Red Hybrid Oak	6,687	6,683	-4
Oak Mix	4,645	4,771	125
Natural White Pine	4,496	4,496	0
Natural Jack Pine	3,900	3,633	-267
Cedar	3,682	3,682	0
Lowland Mixed Forest	3,587	3,638	50
Natural Red Pine	3,490	3,490	0
Planted Mixed Pine	3,119	3,119	0
Lowland Aspen/Balsam Poplar	2,884	2,899	15
Planted Jack Pine	2,443	2,455	12
Planted White Pine	2,172	2,172	0
Upland Conifers	1,265	1,265	0
Lowland Spruce/Fir	530	511	-19
Tamarack	290	290	0
Upland Spruce/Fir	239	63	-176
Hemlock	59	59	0
Upland Shrub	8,133	8,133	0
Lowland Shrub	7,412	7,412	0
Herbaceous Openland	5,899	5,899	0
Low Density Trees	3,014	3,014	0
Marsh	2,639	2,639	0

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Water	2,241	2,241	0
Urban	1,550	1,550	0
Bog	625	625	0
Bare/Sparsely Vegetated	514	514	0
Treed Bog	269	269	0
Cropland	64	64	0
Total:	**285,254**	**285,254**	**0**

Featured species current and projected habitat acres

There are 11 featured species in this management area that span various cover types, age classes, and stand level conditions. Current and projected total habitat acres by species across the decade provide a baseline and show the result of long-term management actions (Table 8). As noted in the Featured Species Management Priority (Section 3), it is recommended that these featured species habitat acres be viewed as acres of potential habitat, representing a condition on the landscape where the more nuanced aspects of each species' habitat requirements are likely to be found or managed for. As described in the introduction, the modeling effort was limited by several factors including the simplification of habitat attributes into MiFI variables. Therefore, when referring to habitat acres what is being referred to is potential habitat acres.

Some species show a loss in habitat over the next century. As mentioned in the Featured Species Management Priority (Section 3), the current condition for many cover types is a surplus of acres in the 0-9 age class from the compensatory management approach applied in the previous decade. The model eventually evens out the age classes at a lower, sustainable level over time, usually by 50 years. For any species with northern hardwoods as a priority cover type, there is a perceived drop in acres between 40 and 60 years; this is due to the basal area dropping below 81 but because it only drops into the upper 70s, it is not expected to translate to any real habitat loss on the ground. Three of these species were not included in the State Forest Management Plan model, black bear, wild turkey and black-backed woodpecker, but are included here to inform management decisions over the decade.

Table 8. Featured species current and projected total habitat acres (e.g., potential habitat).

Featured Species	Priority Cover Types	Total Habitat Acres Current	Total Habitat Acres 10-year	50-year Projected Habitat Acres	100-year Projected Habitat Acres
American Woodcock	Aspen, lowland aspen, lowland deciduous	28,076	25,743	22,092	23,449
Black Bear	Mast	168,293	--	--	--

Featured Species	Priority Cover Types	Total Habitat Acres Current	Total Habitat Acres 10-year	50-year Projected Habitat Acres	100-year Projected Habitat Acres
Black-Backed Woodpecker	Natural Disturbance	--	--	--	--
Blackburnian Warbler	Northern hardwoods, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, hemlock	36,523	50,336	37,367	55,532
Black-Throated Blue Warbler	Northern hardwoods, mixed upland deciduous	29,931	37,791	17,092	38,528
Golden-Winged Warbler	Aspen, black-red hybrid oak, northern red oak, oak mix, tamarack	28,908	26,724	22,015	23,369
Marten	Northern hardwoods, mixed upland deciduous, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, lowland mixed forest, lowland conifers, hemlock, cedar	72,600	80,304	70,297	84,866
Ruffed Grouse	Aspen	27,353	24,864	21,469	22,525
Snowshoe Hare	Aspen, cedar, hemlock, lowland aspen, lowland conifers, lowland mixed forest, lowland spruce/fir, mixed upland deciduous, natural jack pine, natural mixed pines, planted jack pine, upland spruce/fir	33,973	30,901	27,220	27,363
Wild Turkey	Nonforested openings	5,963	--	--	--
Wood Thrush	Northern hardwoods, northern red oak, mixed upland deciduous, lowland deciduous	45,767	52,331	35,756	57,545
Wood Turtle	Nonforested openings	--	--	--	--

Cover type composition and associated featured species

Aspen

Current condition

The current age class distribution is not very far from being balanced. There is a deficit of acres in ages 20 to 29, as well as in the 40- to 49-year-old age class (Figure 3). The younger age class of 0-9 has the largest surplus in acres. To balance out the age class distribution it will take multiple planning periods with so many acres already in the 0-9 age class.

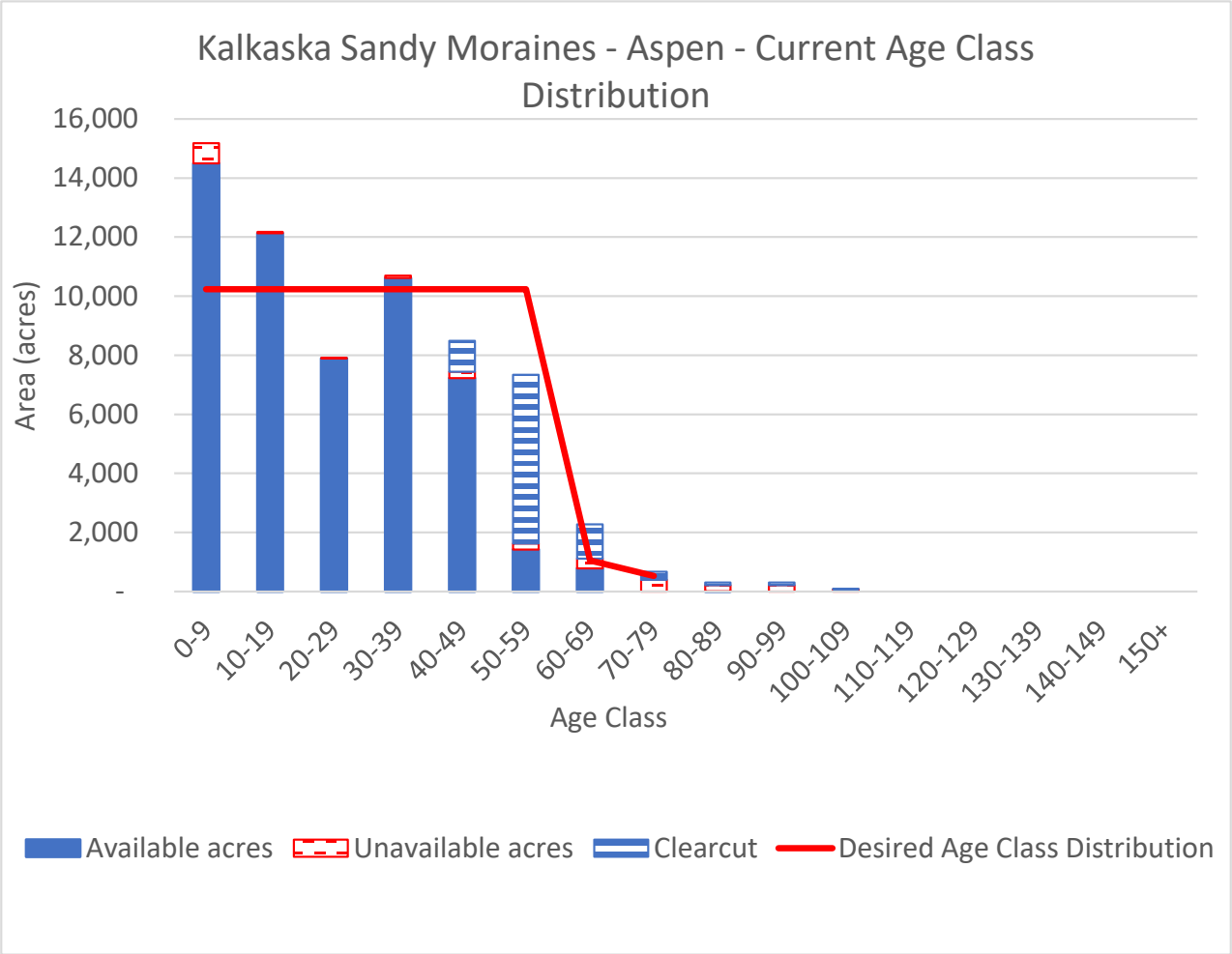


Figure 3. Current age class distribution, the desired age class distribution, and the projected harvests in the aspen cover type over the 10-year planning period.

The current conditions are slightly over our desired age class distribution on harvests and regeneration efforts within available aspen acres during the previous planning periods. A portion of this cover type meets the habitat requirements for American woodcock, golden-winged warbler, ruffed grouse and snowshoe hare (Table 9).

Table 9. Featured species with aspen as a priority habitat cover type, habitat variables and current acres (e.g., potential habitat).

Featured Species	Featured Species Habitat – Aspen	Aspen Habitat Acres - Available	Aspen Habitat Acres - Unavailable
American Woodcock	Age Category: 0-19 Size Class: Sapling	26,621	733
Golden-Winged Warbler	Age Category: 0-19 Size Class: Sapling	26,621	733
Ruffed Grouse	Age Category: 0-19 Size Class: Sapling	26,621	733
Snowshoe Hare	Age Category: 0-19 Size Class: Sapling	26,621	733

Desired future condition

The projected long-term cover type trend for aspen is stable in the Kalkaska Sandy Moraines Management Area with an increase of 0.2% in acres. There are a few transitions into this cover type from other cover types forecasted in this management area and equally few transitions from aspen to other cover types.

The long-term goal for this cover type is balanced age classes between 0 and 50 years old with a tail out to 70 years old for all available aspen stands in this management area. Maintaining lower acreage in old age classes continues to be desirable to keep vigor in these stands promoting a healthier stand fostering regeneration levels to be higher.

The end of the planning period will result in the establishment of 9,676 acres in the upcoming 0-9 age class (Figure 4). It is slightly below the desired age class distribution of 10,256 due to the shortage in the 50- to 59-year-old age class. Progress toward the long-term desired age class distribution of aspen will take many decades in this management area.

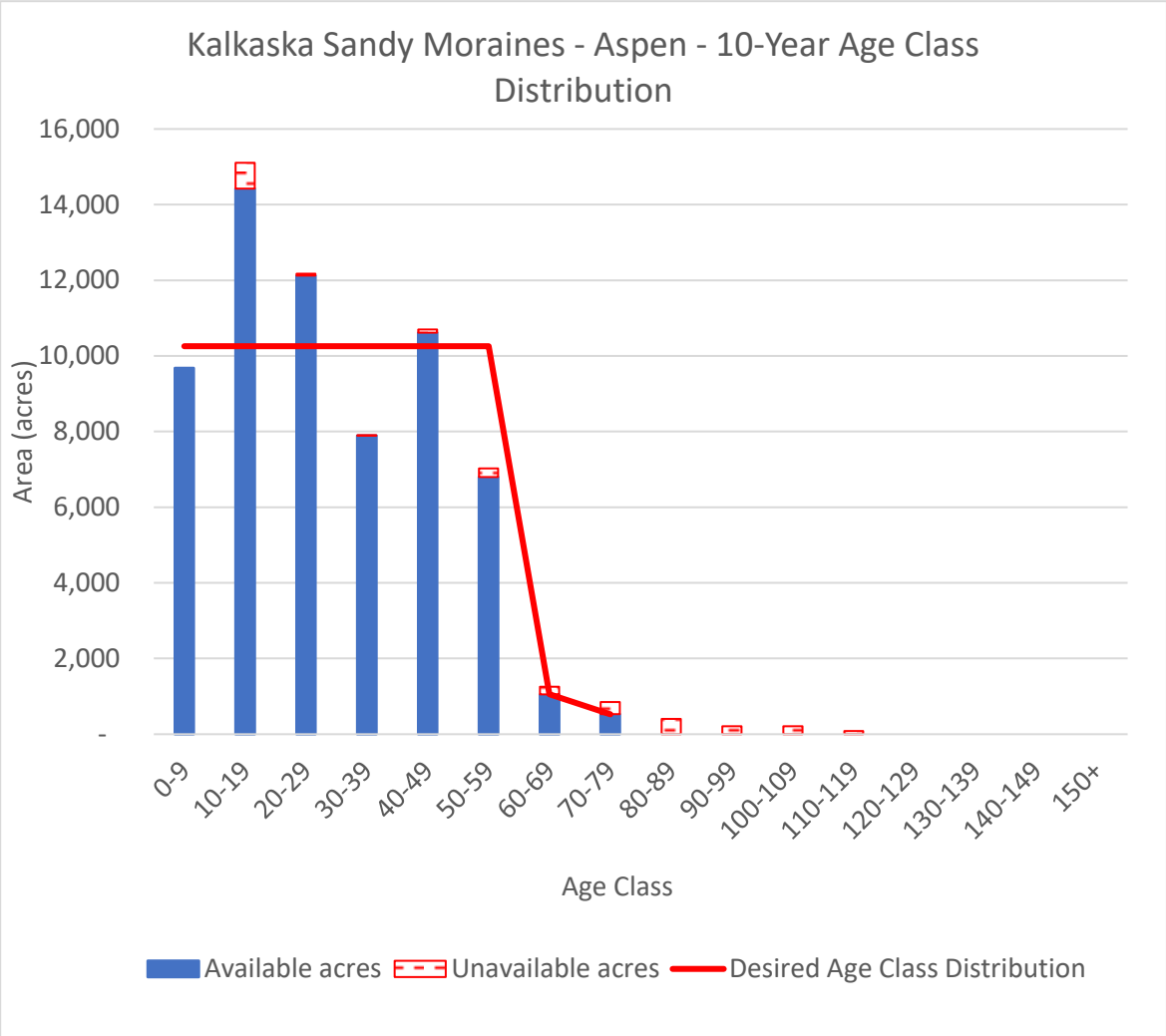


Figure 4. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of aspen acres becoming more even distribution among age classes working toward the desired future condition with only the older age classes with unavailable acres deviating from the target proportions (Figure 5).

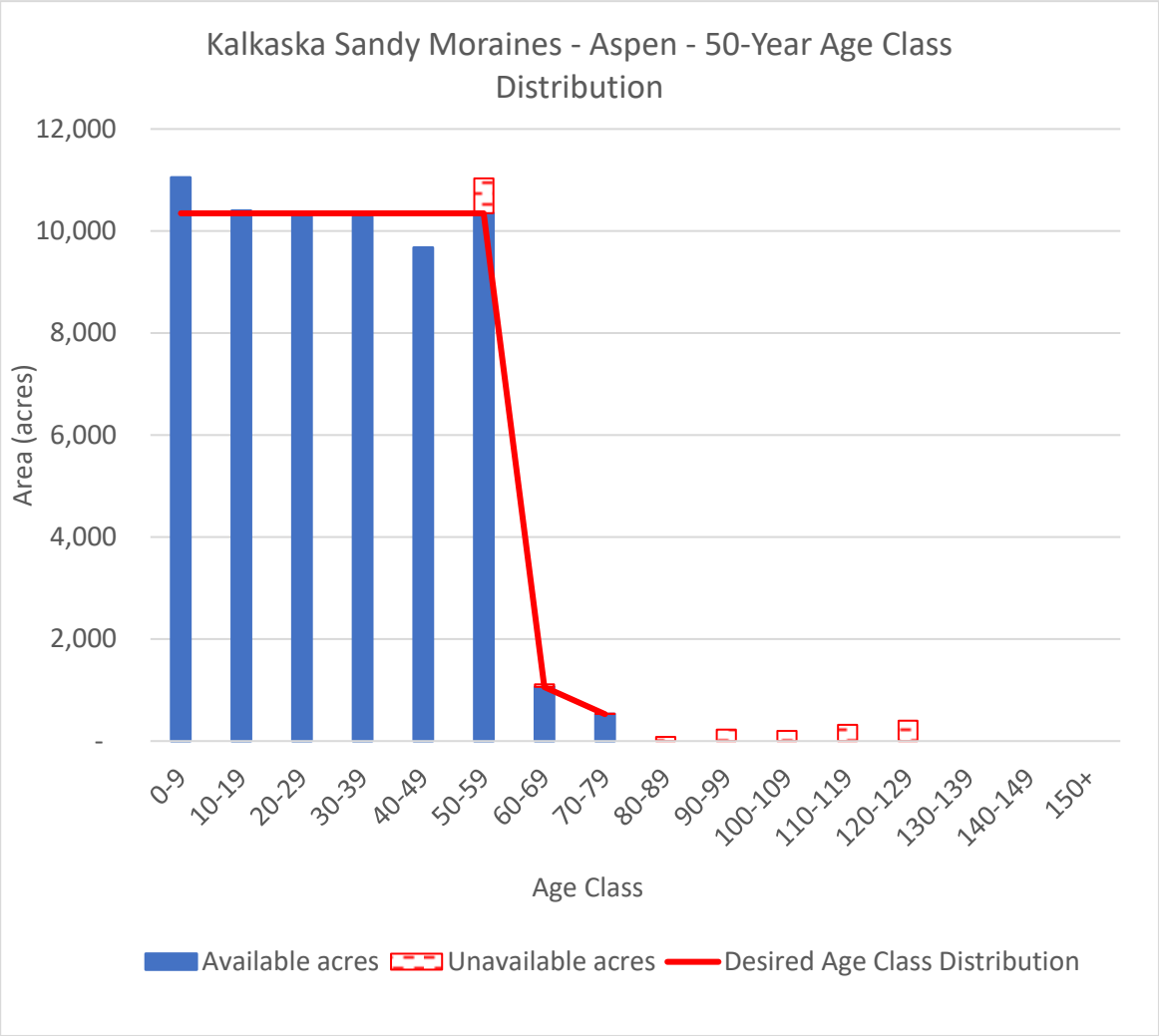


Figure 5. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 6) will concentrate the manageable acres of aspen in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest (Figure 7).

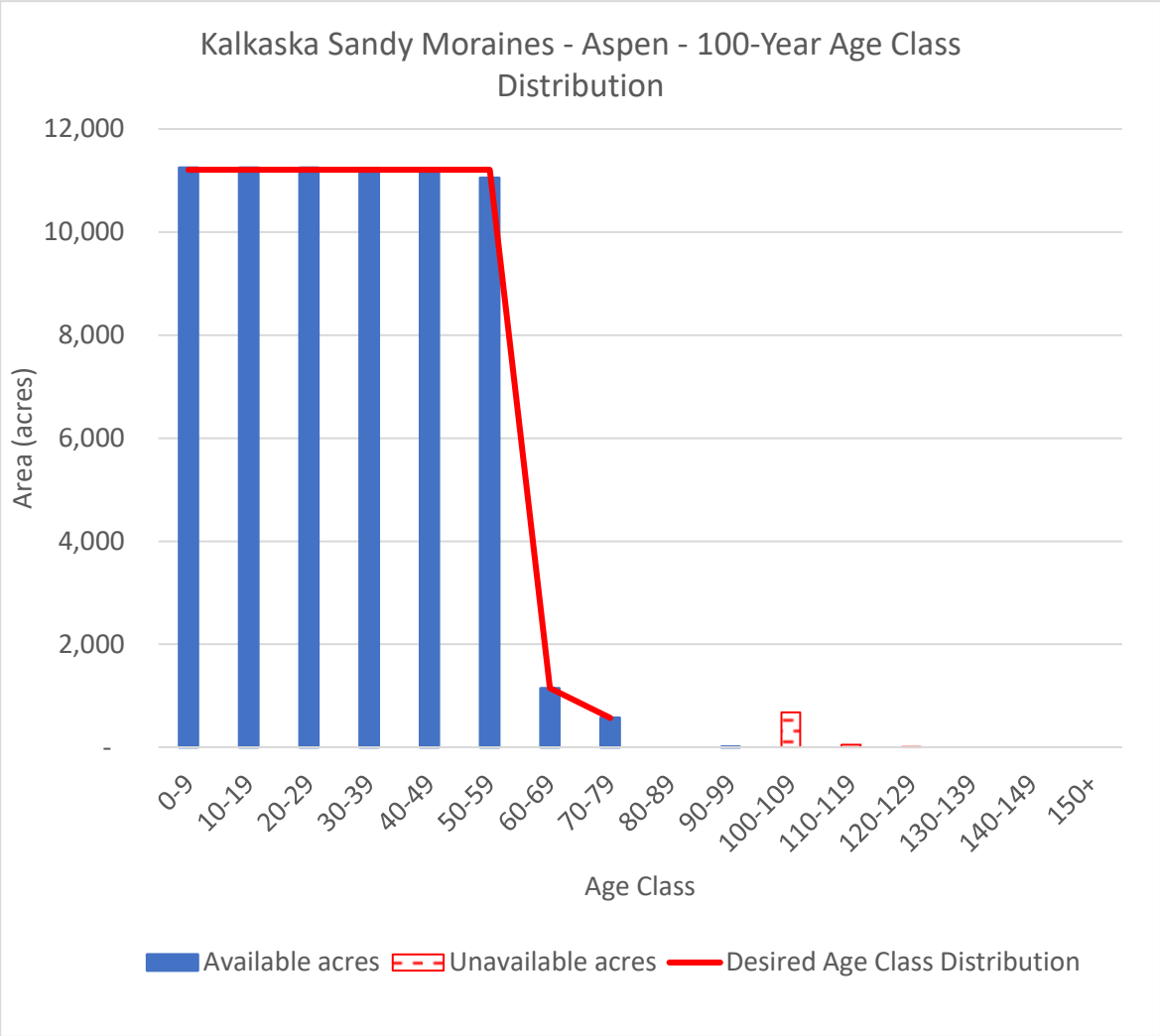


Figure 6. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

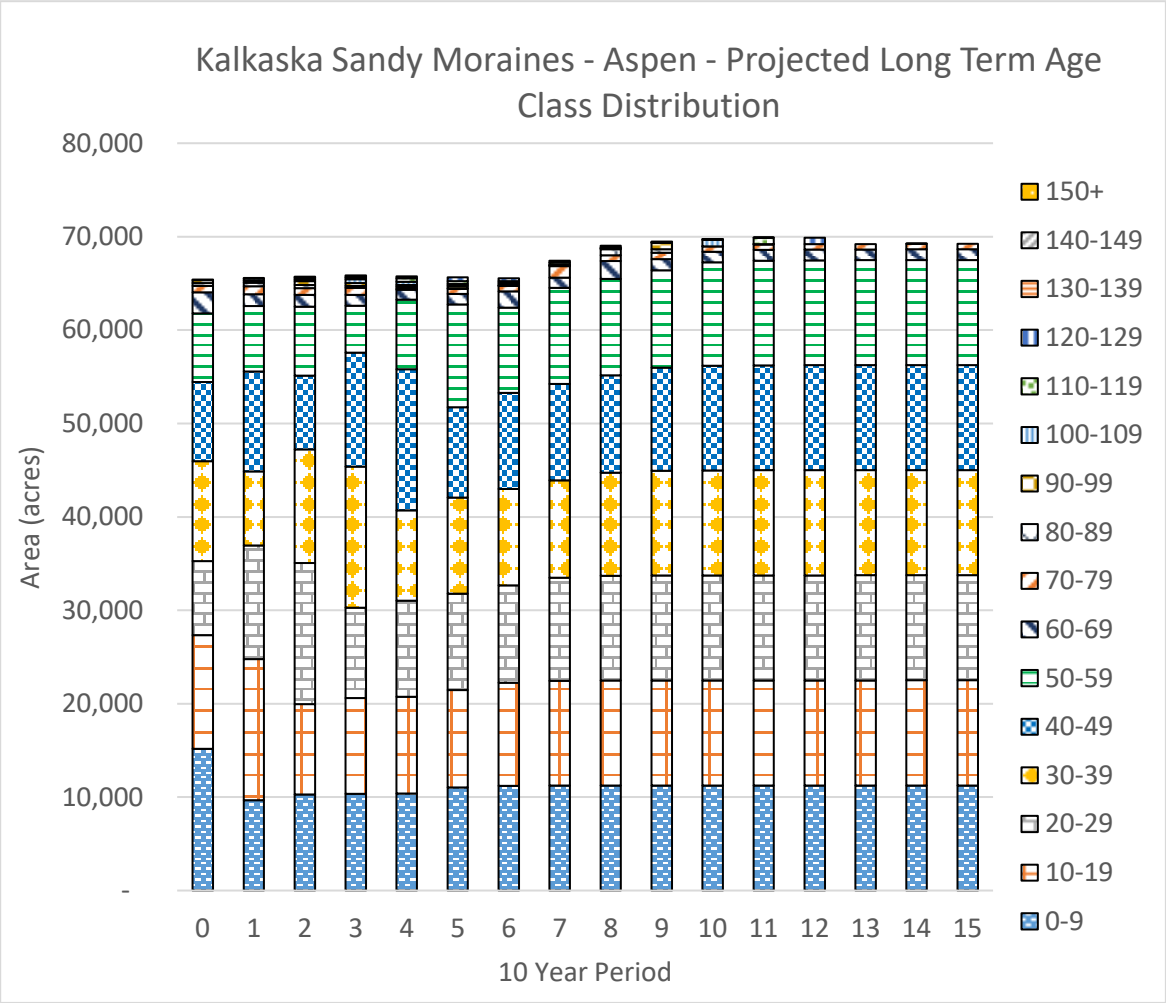


Figure 7. Projected age class distribution for all acres of aspen over the next 150 years.

Management actions

There are 8,389 acres of projected clearcut harvest in the aspen cover type and an additional 154 acres that will be converted to aspen from other cover types. This falls slightly short of the desired establishment of 10,231 acres per decade because of the current unbalanced condition in the 50-59 age class.

Northern hardwoods

Current condition

Most of the northern hardwood cover type is currently between the stand age of 80 and 99 years old in the Kalkaska Sandy Moraines Management Area (Figure 8). The past management regime has been primarily single tree selection which allows for stand ages to continue to increase over time. Some stands are beginning to achieve an uneven-aged condition where a featured stand age becomes less evident, but the dominant age of these stands will likely increase past 150 years old prior to a younger age cohort becoming the prominent component of these stands.

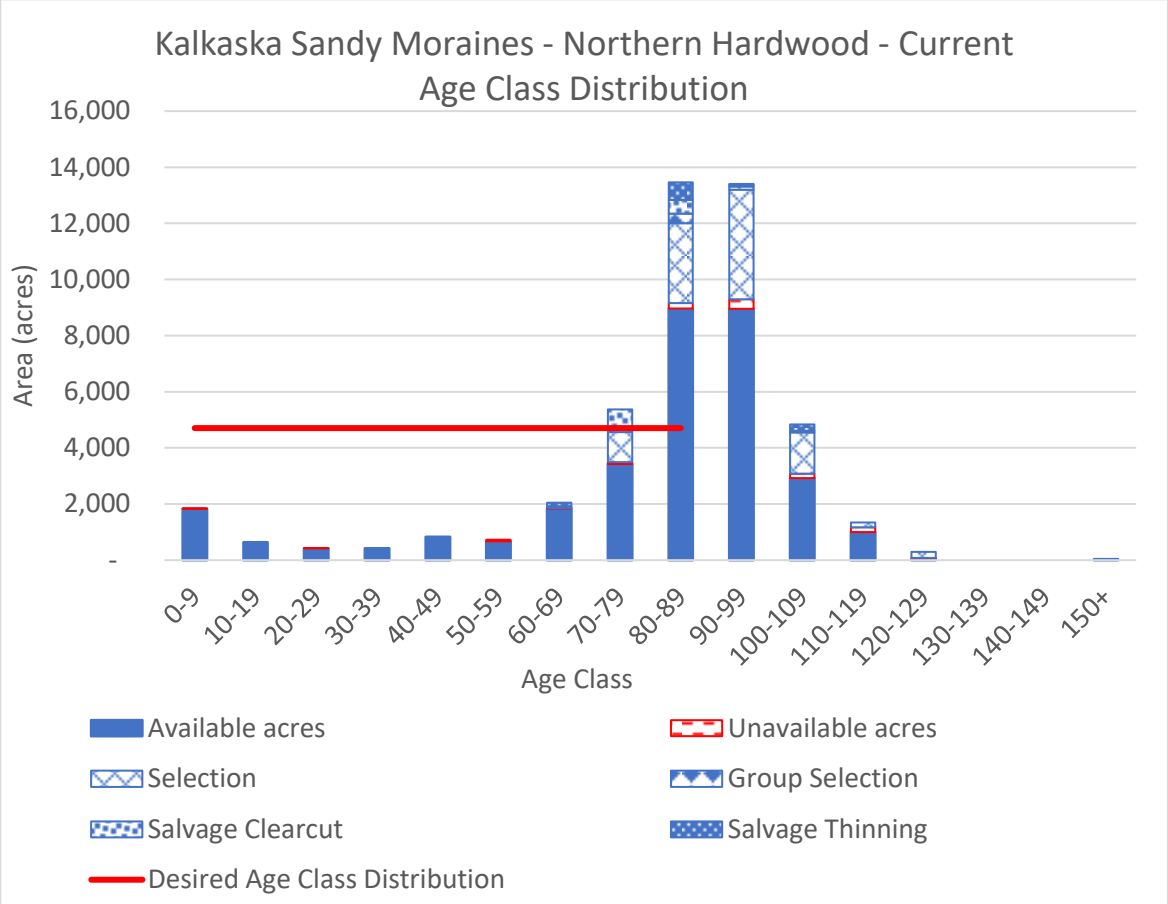


Figure 8. Current age class distribution and projected harvests in the northern hardwood cover type.

The area of northern hardwood is well distributed in the ideal basal area classes for optimal growing conditions in the Kalkaska Sandy Moraines Management Area (Figure 9). Current conditions are a result of a well-regulated selection harvest regime that has been in place in this management area for decades.

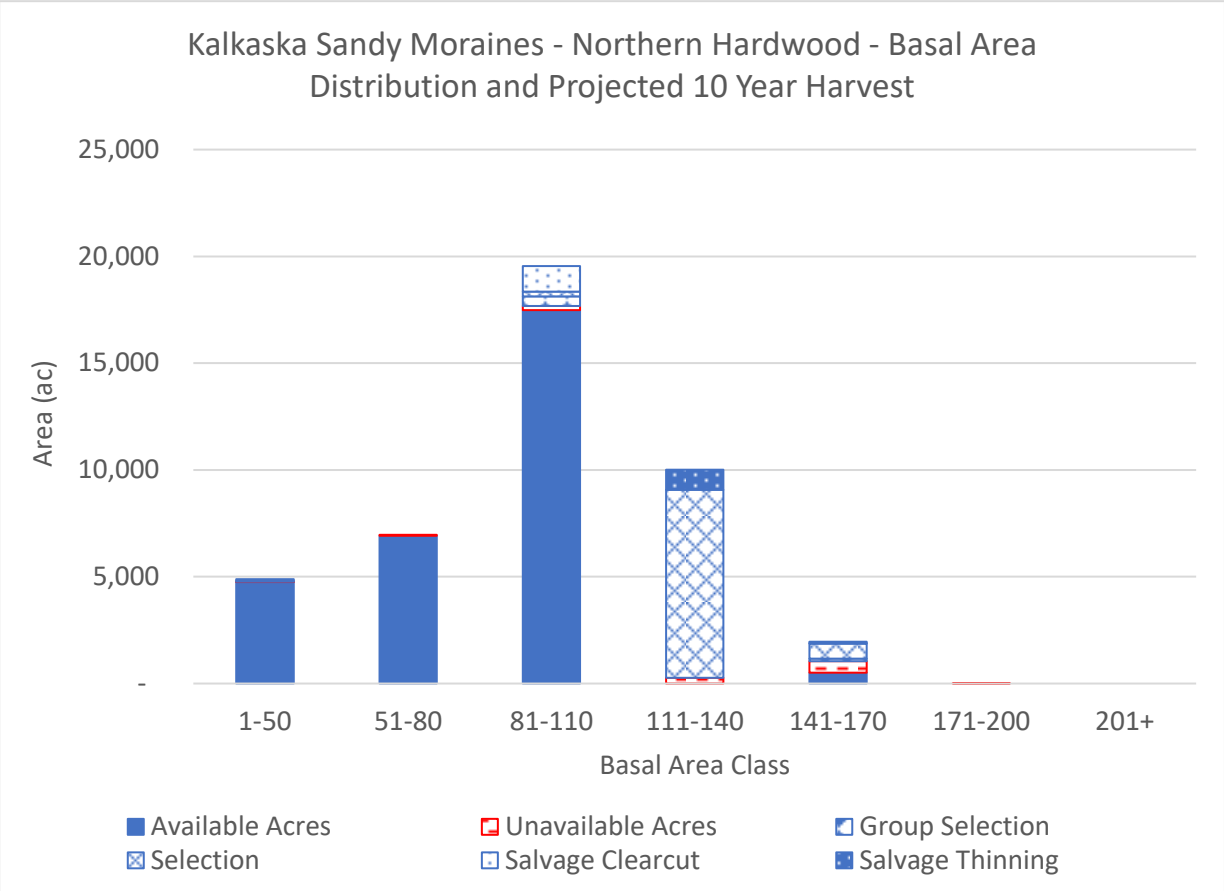


Figure 9. Current basal area distribution of the northern hardwood cover type as well as the projected harvests from each basal area class.

There are very few acres of unavailable northern hardwoods in the Kalkaska Sandy Moraines Management Area. Opportunities to utilize a proportion of a stand to include in gaps will vary based on the age and condition of a stand, but the guidance for a typical log-sized hardwood stand will be 10-20% of the area, with the remaining 80-90% subject to thinning or no harvesting. Small group selection is the primary silvicultural treatment projected during this 10-year planning period. A portion of this cover type meets the habitat requirements for blackburnian warbler, black-throated blue warbler, marten and wood thrush (Table 10).

Table 10. Featured species with northern hardwoods as a selected habitat cover type, habitat variables and current acres (e.g., potential habitat).

Featured Species	Featured Species Habitat – Northern Hardwood	Northern Hardwood Habitat Acres- Available	Northern Hardwood Habitat Acres- Unavailable
Blackburnian Warbler	Age Category: 80+ Size Category: Pole, Sawlog Basal Area: 81+	25,010	839
Black-Throated Blue Warbler	Age Category: 80+ Size Category: Sawlog Basal Area: 81+	25,010	839
Marten	Age Category: 40+ Size Category: Pole, Sawlog Basal Area: 81+	30,524	984
Wood Thrush	Age Category: 40+ Size Category: Sawlog Basal Area: 81+	30,524	984

Desired future condition

The projected long-term cover type trend for northern hardwood is stable in the Kalkaska Sandy Moraines management area with only a 0.6% increase in acres (Figure 10). The desired basal area distribution is a bell-shaped curve where a significant majority of the area is kept in the 81-110 basal-area class with recently harvested stands occupying the 51-80 class and stands that are ready for harvest occupy the 111-140 basal-area class. Diameter distributions of the northern hardwood stands should follow the appropriate Q-curve relative to stand age and condition.

An uneven-aged condition is the long-term goal for all northern hardwood stands in this management area. An uneven-aged condition is achieved when there is no single discernable age cohort that is more prevalent than others across the stand area as canopy gaps fill in with regenerating seedlings, saplings, poles, and eventually remaining stems become sawlog sized over time.

Regeneration and recruitment continue to be a focus in the northern hardwood cover type across this management area. The long-term sustainability of this cover type in an uneven-aged silvicultural regime is dependent on the successful establishment of northern hardwood species as well as the recruitment of those seedlings and saplings into the pole and sawlog classes.

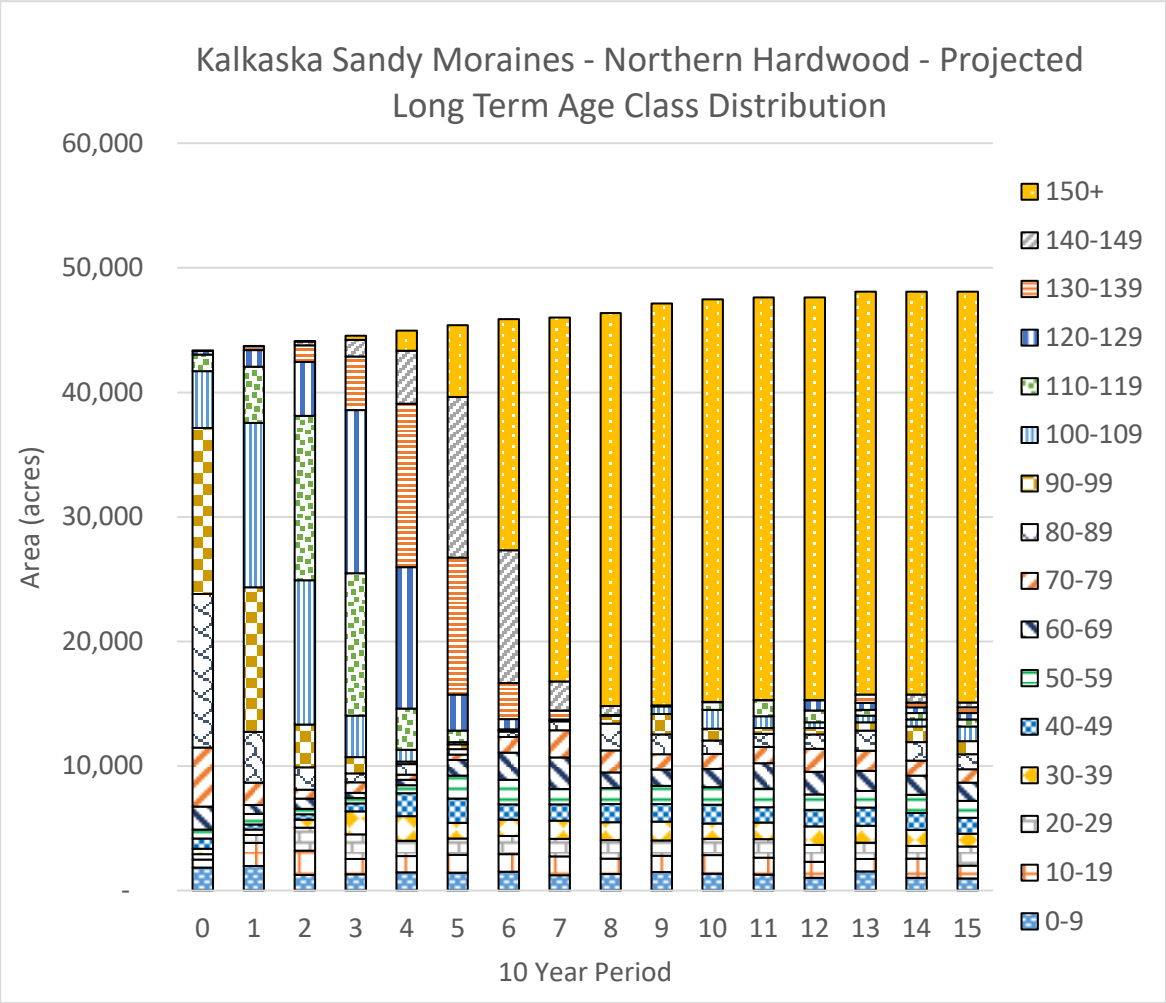


Figure 10. Projected age class distribution for all acres of northern hardwood over the next 150 years.

Management actions

The desired forest conditions and associated featured species habitat will be maintained and achieved through continued application of the projected selection harvest regime on 9,712 acres, group selection on 624 acres, 1,310 acres of salvage clearcut, and 1,013 acres of salvage thinning. Canopy gaps should be used to encourage diverse regeneration of northern hardwood species while maintaining an overall long-term mature forest closed canopy landscape condition.

Planted red pine

Current condition

The largest amount of the red pine cover type is currently between a stand age of 0 and 9 years old and 60- to 69-year-old age class in the Kalkaska Sandy Moraines Management Area (Figure 11). Due to much of the pine being past the desired age class distribution of 80 years old much of it was restarted and replanted causing a major spike in the 0-9 age class.

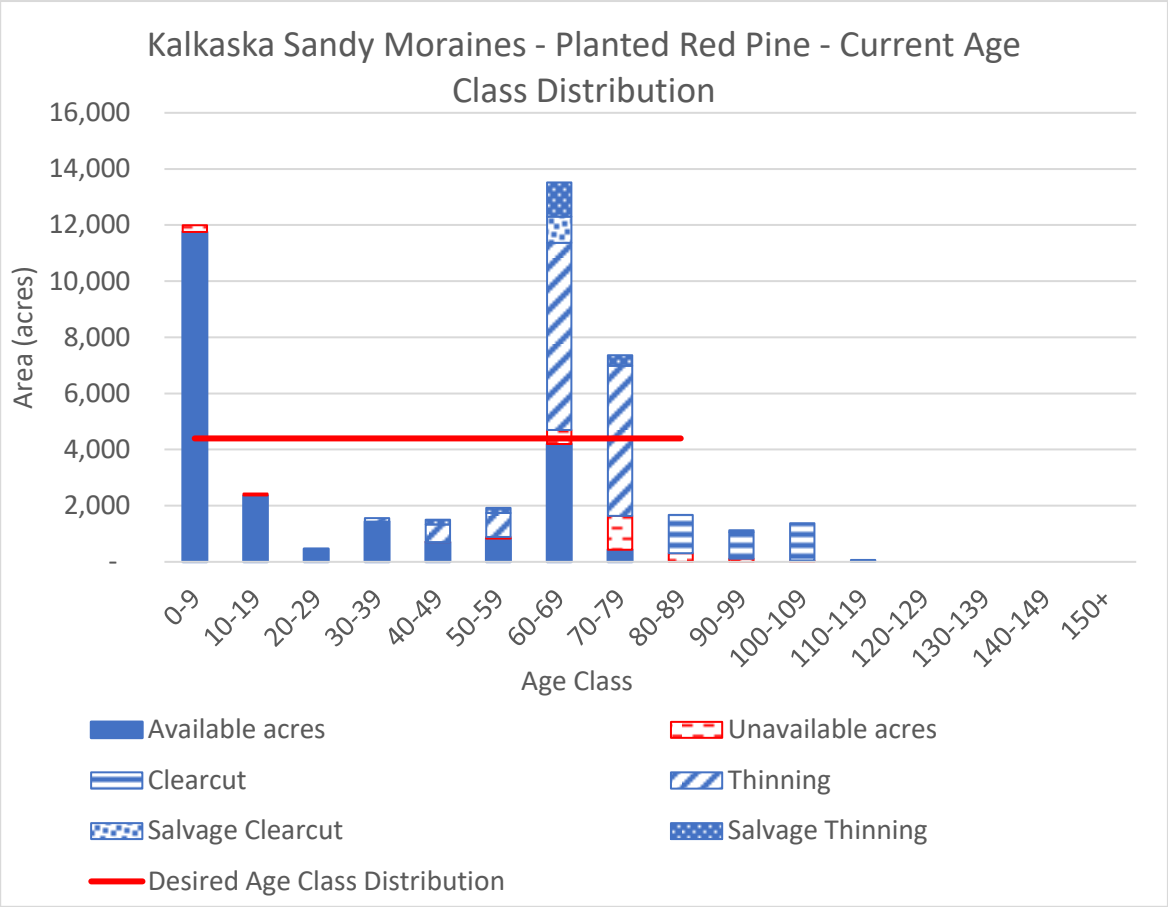


Figure 11. Current age class distribution and projected harvests in the planted red pine cover type.

Current conditions are a result of plantations established during the 1930s and 1940s by the Civilian Conservation Corps, most of which reached maturity during the previous two planning periods. There have been consistent commercial harvests and regeneration efforts on available planted red pine acres during the previous planning periods.

Desired future condition

The projected long-term cover type trend for red pine is stable in the Kalkaska Sandy Moraines Management Area. There are a few transitions out of this cover type into other cover types forecasted in this management area decreasing by 0.9%.

The long-term goal for this cover type is balanced age classes between 0 and 80 years old for all available planted red pine stands in this management area. Maintaining lower acreage in old age classes continues to be desirable to lessen the prevalence and severity of diseases and to reduce the threat of damaging wildfire.

The end of the planning period will result in the establishment of 4,261 acres of regeneration in the upcoming 0-9 age class given the amount of merchantable and available acres in the older age classes (Figure 12). This is slightly below the desired distribution of 4,356 acres. Progress toward the long-term age class distribution of planted red pine will take many decades in the management area.

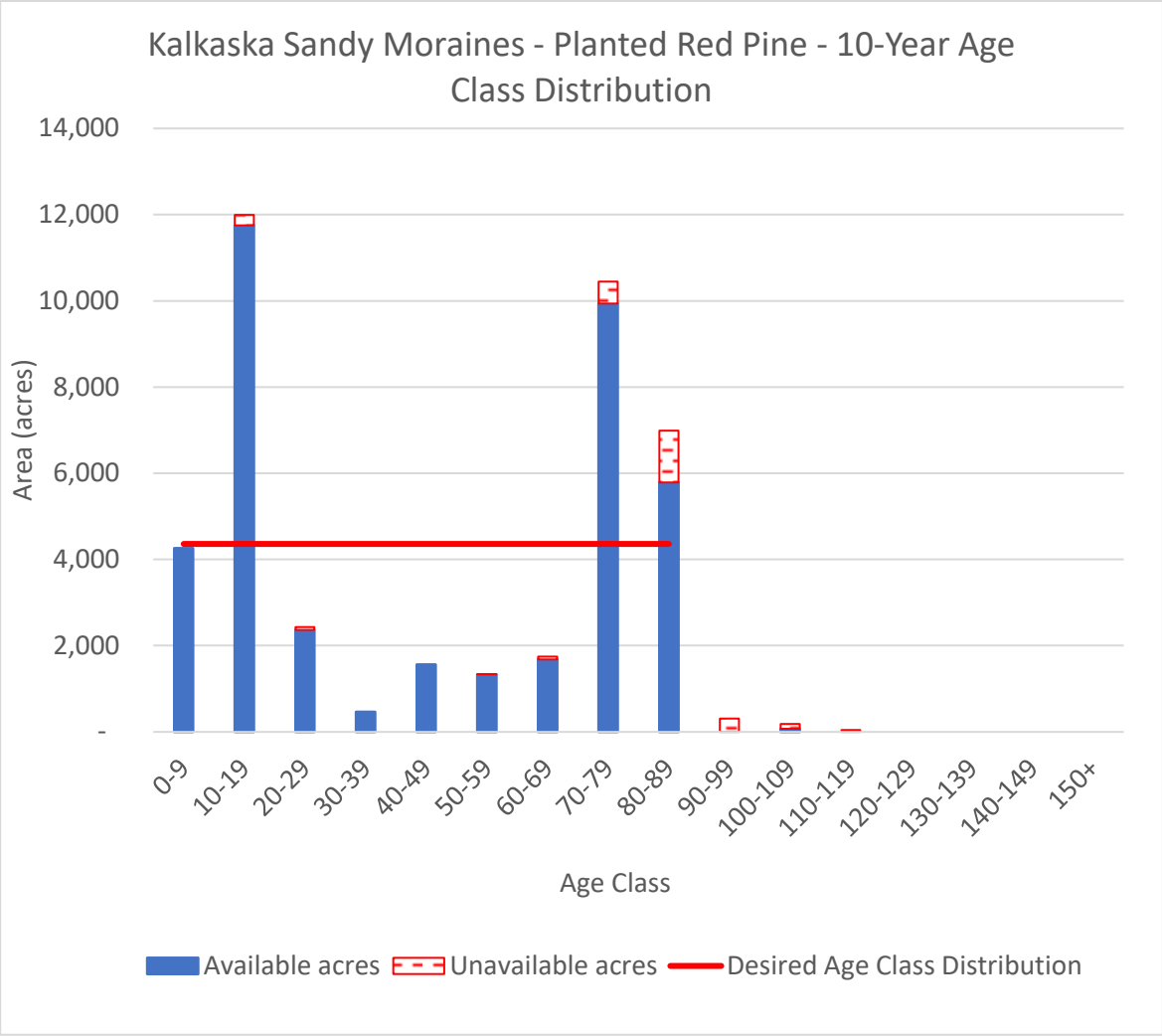


Figure 12. Short-term future age class distribution of the red pine cover type as well as the projected harvests from each age class.

The mid-term age class distribution of planted red pine is beginning to reach the desired future condition for available acres (Figure 13). There is an increase in acres in the older age classes, beyond the desired age of 80 years old, due to the number of unavailable acres in this management area. As is often the case, unbalanced age classes may result in the need to leave some acres in older age classes to achieve the desired age class distribution in future planning periods.

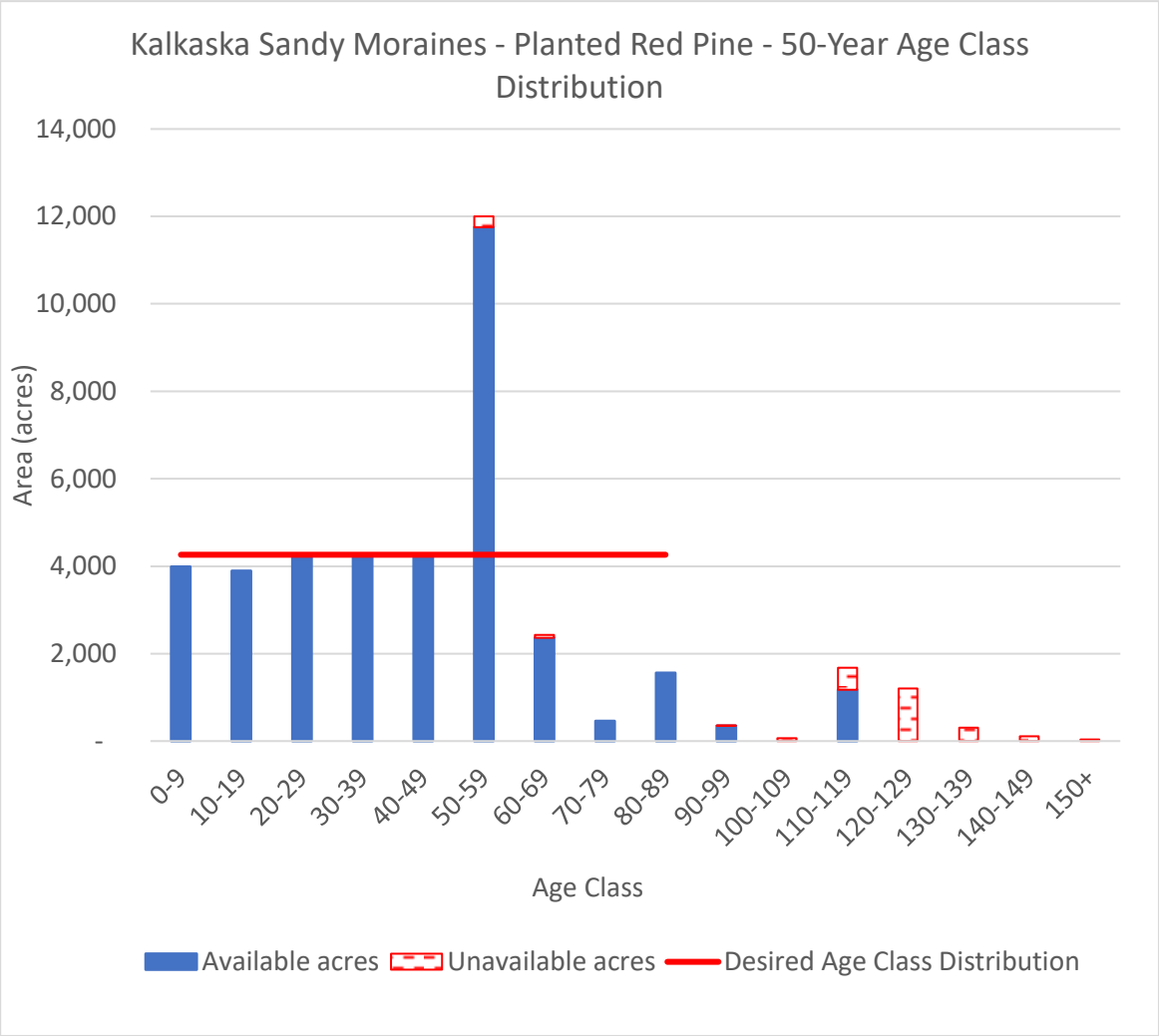


Figure 13. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 14) will concentrate the manageable acres of planted red pine in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest (Figure 15).

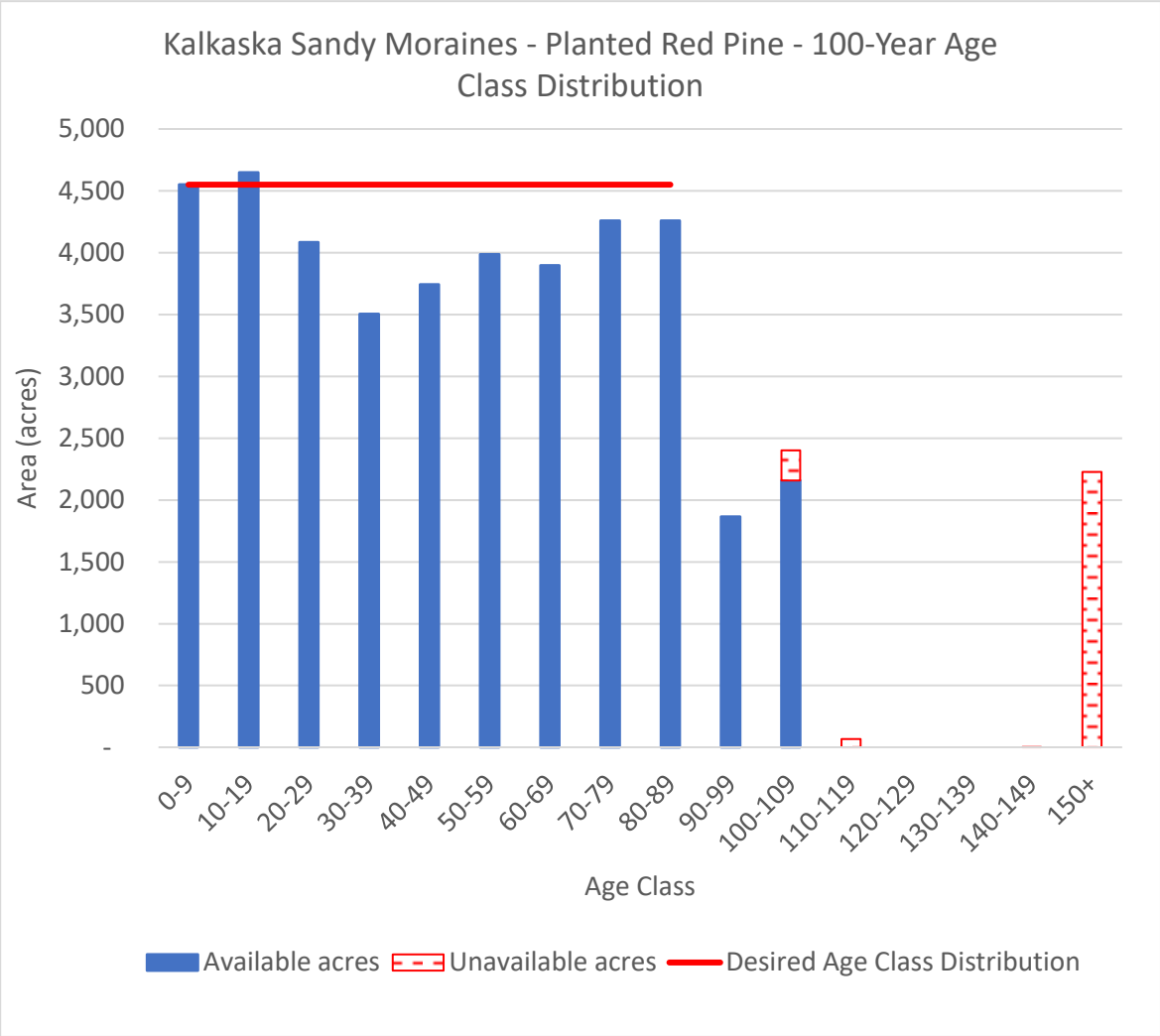


Figure 14. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

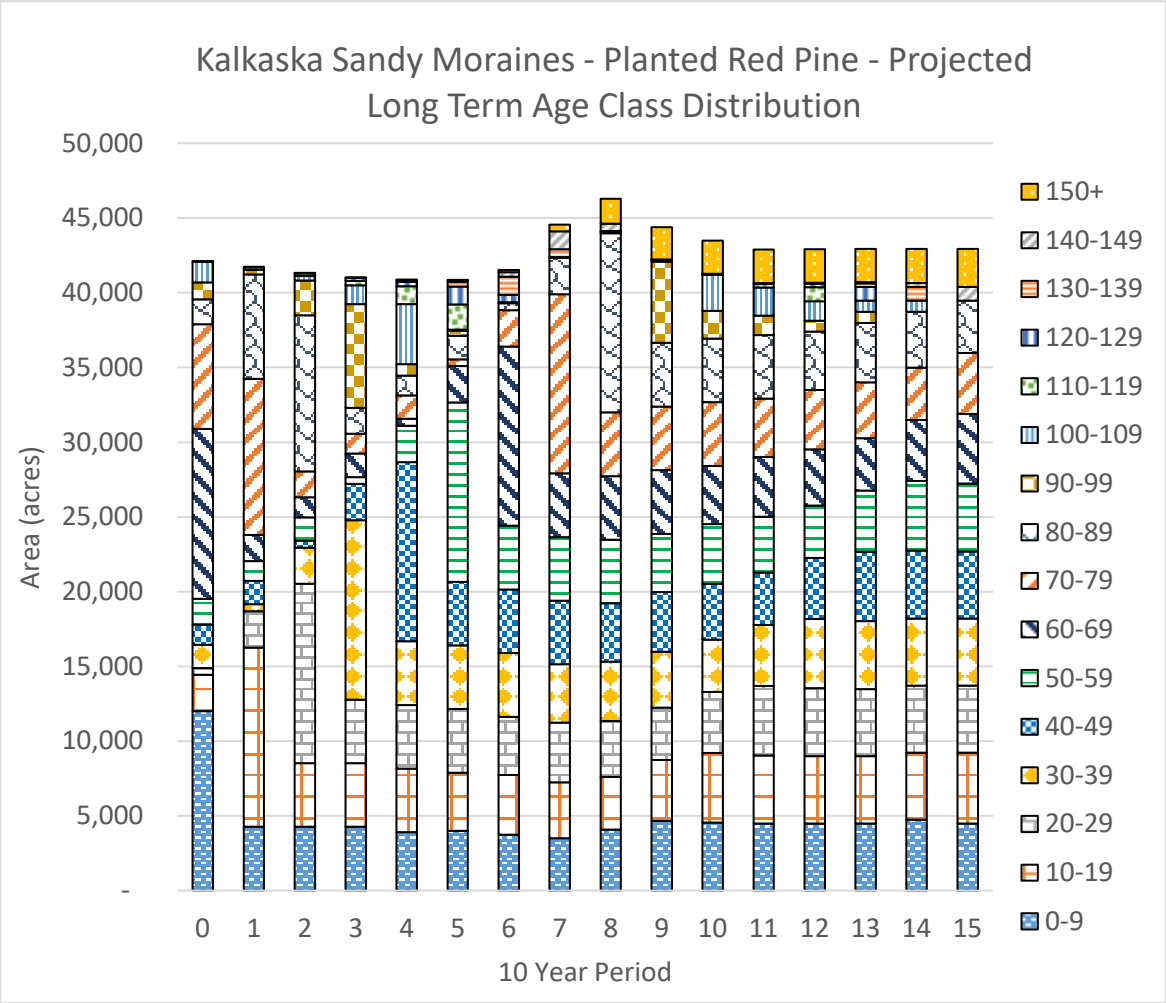


Figure 15. Projected age class distribution for all acres of northern hardwood over the next 150 years.

Management actions

There are 3,724 acres of projected clearcut harvest in the planted red pine cover type during this planning period. This is below the desired establishment of 4,356 acres per decade because of the current unbalanced condition. In addition to clearcut acres, there are 13,697 acres project for thinning in this cover type with additional 1,940 acres of salvage thinning and 926 acres of salvage clearcut.

Conservation area network

High conservation value areas

There are up to nine different high conservation value area (HCVA) types that can be found in each management area (Table 11; see Biodiversity in Section 3 for more information).

Table 11. High conservation value areas within the Kalkaska Sandy Moraines Management Area.

High Conservation Value Area Type and Name	Acres
Dedicated Management Areas	**4,011**

High Conservation Value Area Type and Name	Acres
-	4,011
Eastern Massasauga Managed Land	**2,102**
-	2,102
Forest Habitat Core Interior	**4,951**
-	4,951
GEM	**4,183**
Little Betsie	4,183
Kirtland's Warbler Habitat	**24**
Manistee	24
Natural Rivers Vegetative Buffer	**3,254**
-	3,254
Natural Rivers Zoning District	**10,387**
-	10,387
State Wildlife Management Areas	**2,289**
Goose Creek Flooding SWMA	45
Headquarters Lake Flooding SWMA	293
Skegemog Lake SWA Unit of Pere Marquette	1,951
Verified Type 1 and Type 2 Old Growth	**14**
Type 2 Old Growth	14
GEMS	**2,697**
Little Betsie	2,697
Grand Total	**33,911**

Ecological reference areas

Ecological reference areas (ERAs) are a type of HCVAs and are higher quality examples of functioning ecosystems that are primarily influenced by natural ecological processes.

Table 12. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 13. Ecological reference areas within the management area.

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	Number of Occurrences
Existing ERA	Dry-mesic Northern Forest	BC	G4	S3	1
Existing ERA	Northern Fen	AB	G3	S3	2
Existing ERA	Northern Fen	BC	G3	S3	2
Existing ERA	Northern Wet Meadow	B	G4G5	S4	1
Existing ERA	Oak-Pine Barrens	B	G3	S2	1
Existing ERA	Pine Barrens	BC	G3	S2	1
Existing ERA	Pine Barrens	C	G3	S2	2
Existing ERA	Rich Conifer Swamp	B	-	S3	1
Existing ERA	Rich Conifer Swamp	BC	G4	S3	2
Existing ERA	Rich Conifer Swamp	C	-	S3	1
Existing ERA	Rich Conifer Swamp	C	G4	S3	1
Proposed ERA	Pine Barrens	C	G3	S2	1
Grand Total	-	-	-	-	**16**

Special Conservation Areas

Reviewable special conservation areas (SCAs; Table 14) refers to those SCA types that may be reviewed or updated through the compartment review process as needed. Static SCAs (Table 15) refers to those SCA types that generally do not change or require updating (see Biodiversity in Section 3 for more information).

Table 14. Reviewable special conservation areas within the Kalkaska Sandy Moraines Management Area.

Reviewable Special Conservation Area Type and Name	Acres
Concentrated Recreational Area	**111**
(Closed) Chase Creek SFCG	12
131 Miss Kal Trail Head	4
Campground	4
Chippewa Landing Canoe Livery	33
Guernsey Lake Campground	27
Old US-131 Campground	19
Shooting Range	6
Unspecified	6
Yellowtrees Access Site	1
Cultural or Customary Area	**-**
--	-
Habitat Area or Habitat Corridor	**1,835**
61054126	187
113 corridor red pine SCA	12

Reviewable Special Conservation Area Type and Name	Acres
Fletcher Creek Corridor	14
Flowing well hemlock	57
Flowing well swamp	35
Highbanks Rollaways	233
Hopkins Creek	575
Old red & white pine	20
Rennie Lake Barrens	132
Sigma swamp	291
South Branch Barrens	265
Unspecified	14
Mineral Resource Area	**43**
Crawford County Road Commission	21
Kalkaska County Road Commission	22
Possible Type 1 or Type 2 Old Growth	**45**
--	45
Visual Management Areas	**-**
--	-
Grand Total	**2,034**

Table 15. Static special conservation areas in the Kalkaska Sandy Moraines Management Area.

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Common Natural Heritage Element Occurrences	**-**	**63**
Northern Shrub Thicket	-	24
Northern Wet Meadow	-	39
Designated Trout and Cold Water Stream Buffer	**-**	**7,274**
<Null>	-	2,049
Acme Creek	-	26
Adams Creek	-	28
Anderson Creek	-	72
Apple Creek	-	52
Au Sable River	-	51
Barker Creek	-	11
Battle Creek	-	30
Bissell Creek	-	14
Black Creek	-	5
Blind Creek	-	38
Boardman River	-	77
Bourne Creek	-	18
Bradford Creek	-	42
Buttermilk Creek	-	55

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Common Natural Heritage Element Occurrences	**-**	**63**
Carpenter Creek	-	102
Chase Creek	-	32
Cole Creek	-	12
Collar Creek	-	79
Crofton Creek	-	49
Desmond Creek	-	26
Dutchman Creek	-	69
East Arm Acme Creek	-	27
East Branch Wheeler Creek	-	46
East Creek	-	4
Failing Creek	-	30
Fife Lake Outlet	-	149
Filer Creek	-	75
Fletcher Creek	-	9
Frenchman Creek	-	33
Golden Creek	-	19
Goose Creek	-	92
Ham Creek	-	109
Hauenstein Creek	-	14
Hopkins Creek	-	94
Kolke Creek	-	132
Little Betsie River	-	95
Little Rapid River	-	21
Manistee River	-	1,813
Manton Creek	-	39
Maple Creek	-	16
Morrison Creek	-	65
Morrisy Creek	-	54
Nelson Creek	-	7
North Branch Boardman River	-	280
North Branch Manistee River	-	323
Parker Creek	-	44
Pierson Creek	-	2
Rapid River	-	143
Shannon Creek	-	1
Silver Creek	-	46
Soper Creek	-	62
South Branch Boardman River	-	105
Spring Creek	-	19
Taylor Creek	-	118

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Common Natural Heritage Element Occurrences	**-**	**63**
Twentytwo Creek	-	85
Walton Outlet	-	41
Waterhole Creek	-	14
West Branch Anderson Creek	-	54
Wheeler Creek	-	61
Designated Trout and Coldwater Streams	**272.5**	**-**
<Null>	76.9	-
Acme Creek	0.9	-
Adams Creek	1.0	-
Anderson Creek	2.7	-
Apple Creek	1.9	-
Au Sable River	1.9	-
Barker Creek	0.4	-
Battle Creek	1.1	-
Bissell Creek	0.5	-
Black Creek	0.2	-
Blind Creek	1.4	-
Boardman River	2.9	-
Bourne Creek	0.7	-
Bradford Creek	1.6	-
Buttermilk Creek	2.1	-
Carpenter Creek	3.7	-
Chase Creek	1.2	-
Cole Creek	0.5	-
Collar Creek	2.9	-
Crofton Creek	1.8	-
Desmond Creek	0.9	-
Dutchman Creek	2.5	-
East Arm Acme Creek	1.0	-
East Branch Wheeler Creek	1.7	-
East Creek	0.2	-
Failing Creek	1.1	-
Fife Lake Outlet	5.6	-
Filer Creek	2.9	-
Fletcher Creek	0.4	-
Frenchman Creek	1.3	-
Golden Creek	0.7	-
Goose Creek	3.4	-
Ham Creek	4.1	-
Hauenstein Creek	0.5	-

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Common Natural Heritage Element Occurrences	**-**	**63**
Hopkins Creek	3.4	-
Kolke Creek	4.8	-
Little Betsie River	3.6	-
Little Rapid River	0.7	-
Manistee River	68.2	-
Manton Creek	1.5	-
Maple Creek	0.6	-
Morrison Creek	2.5	-
Morrisy Creek	2.0	-
Nelson Creek	0.3	-
North Branch Boardman River	10.4	-
North Branch Manistee River	12.8	-
Parker Creek	1.7	-
Pierson Creek	0.1	-
Rapid River	5.1	-
Silver Creek	1.8	-
Soper Creek	2.2	-
South Branch Boardman River	3.9	-
Spring Creek	0.7	-
Taylor Creek	4.4	-
Twentytwo Creek	3.1	-
Walton Outlet	1.7	-
Waterhole Creek	0.5	-
West Branch Anderson Creek	2.0	-
Wheeler Creek	2.2	-
Important Bird Areas	**-**	**16,321**
Grand Traverse Bay basin (Albert Ecoregion Vii.5.2)	-	9,614
Kirtland's Warbler Management Units & Guide's Rest	-	86
Manistee National Forest Red-shouldered Hawk IBA	-	6,621
Military Lease Land	**-**	**3**
Board Purchases	-	0
Long Term Lease	-	2
Military Research Areas	**-**	**8,713**
Camp Grayling	-	8,713
Wood Turtle Stream 100ft Buffer	**-**	**1,005**
Boardman River	-	16
Manistee River	-	988
Wood Turtle Stream 660ft Buffer	**-**	**5,872**
Boardman River	-	138
Manistee River	-	5,731

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Common Natural Heritage Element Occurrences	**-**	**63**
Rapid River	-	3
Grand Total	**272.5**	**39,251**

Rare species

Rare species occurrences are compiled from the Michigan Natural Features Inventory Biotics database (Table 16, Table 17 and Table 18) and do not necessarily include all rare species found in this management area due to biases in survey effort and verifiable observation reporting over time.

Table 16. Rare animal occurrence in the Kalkaska Sandy Moraines Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Accipiter gentilis	Northern goshawk	T	-	6
Animal	Acipenser fulvescens	Lake sturgeon	T	-	1
Animal	Appalachina sayanus	Spike-lip crater	SC	-	1
Animal	Atrytonopsis hianna	Dusted skipper	SC	-	3
Animal	Bombus affinis	Rusty-patched bumble bee	E	LE	1
Animal	Bombus borealis	Northern amber bumble bee	SC	-	2
Animal	Bombus terricola	Yellow banded bumble bee	SC	-	5
Animal	Botaurus lentiginosus	American bittern	SC	-	1
Animal	Buteo lineatus	Red-shouldered hawk	SC	-	11
Animal	Clemmys guttata	Spotted turtle	T	-	1
Animal	Coregonus artedi	Lake herring or Cisco	T	-	1
Animal	Eacles imperialis pini	Pine imperial moth	SC	-	1
Animal	Emydoidea blandingii	Blanding's turtle	SC	-	3
Animal	Faxonius immunis	Calico crayfish	SC	-	1
Animal	Gavia immer	Common loon	T	-	18
Animal	Glyptemys insculpta	Wood turtle	T	-	5
Animal	Haliaeetus leucocephalus	Bald eagle	SC	-	12
Animal	Hesperia metea	Cobweb skipper	SC	-	1
Animal	Lasmigona compressa	Creek heelsplitter	SC	-	5

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Lithobates palustris	Pickerel frog	SC	-	6
Animal	Mediappendix protracta	A land snail (no common name)	E	-	1
Animal	Melanerpes erythrocephalus	Red-headed woodpecker	SC	-	1
Animal	Microtus pinetorum	Woodland vole	SC	-	1
Animal	Myotis lucifugus	Little brown bat	T	-	3
Animal	Myotis septentrionalis	Northern long-eared bat	T	LE	1
Animal	Necturus maculosus	Mudpuppy	SC	-	1
Animal	Notropis anogenus	Pugnose shiner	E	-	1
Animal	Opheodrys vernalis	Smooth green snake	SC	-	8
Animal	Pandion haliaetus	Osprey	SC	-	2
Animal	Planogyra asteriscus	Eastern flat-whorl	SC	-	1
Animal	Setophaga kirtlandii	Kirtland's warbler	E	-	2
Animal	Sistrurus catenatus	Eastern massasauga	T	LT	3
Animal	Vermivora chrysoptera	Golden-winged warbler	T	-	1
Grand Total	-	-	-	-	111

Table 17. Rare plant occurrence in the Kalkaska Sandy Moraines Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Plant	Cirsium hillii	Hill's thistle	SC	-	8
Plant	Panax quinquefolius	Ginseng	T	-	2
Plant	Thalictrum pubescens	Tall meadowrue	SC	-	1
Total	-	**-**	**-**	**-**	**11**

Table 18. Other rare occurrence in the Kalkaska Sandy Moraines Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Other	**-**	Great blue heron rookery	-	-	3
Total	**-**	**-**	**-**	**-**	**3**

Non-ecological reference area natural communities

Natural communities that are identified with an element occurrence in the MNFI Biotics database, but that have not been given an additional ecological reference area (ERA) designation, are recognized and managed accordingly (Table 19).

Table 19. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 20. Non-ecological reference area natural communities in the Kalkaska Sandy Moraines Management Area.

Community Type	Element Occurrence Rank	State Rank	Global Rank	Number of Occurrences
Poor Conifer Swamp	**BC**	S4	G4	1
Grand Total	**-**	**-**	**-**	**1**

Forest health

Forest health concerns, both native and non-native, can have impacts on stand conditions and management decisions. The following insects (Table 21) and diseases (Table 22) could have an impact on management during the planning period and may need to be monitored and/or addressed.

Table 21. Defoliating insects of concern in the Kalkaska Sandy Moraines management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Spongy moth	Lymantria dispar	Non-native	Yes
Forest tent caterpillar	Malacosoma disstria	Native	Yes

Watch for lingering ash with potential resistance to emerald ash borer. Monitor young jack and red pine for redheaded pine sawfly damage.

Table 22. Maladies of concern in the Kalkaska Sandy Moraines management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Canker (stem infections)	Various	Various	Yes
Armillaria root rot	Armillaria spp.	Native	-
Oak decline	Various	Various	Yes

Monitor oak for symptoms of oak wilt and follow state land oak wilt guidance. Monitor planted red pine for Heterobasidion root disease and follow disease guidance. In areas where most mature beech has been lost due to beech bard disease, report surviving mature beech trees that may be resistant to it. Watch for symptoms of beech leaf disease.

Aquatic resources

Riparian habitat

Approximately 254 miles of streams and rivers are found in the management area (Table 23). Streams/rivers classified as cold types comprise approximately 97% of the riverine mileage.

Table 23. Classification type and length of streams/rivers found within the management area.

Type	Length (miles)
Cold Stream	131
Cold Small river	35
Cold Transitional Stream	17
Cold Transitional Small River	7
Cold Transitional Large River	58
Warm Transitional Stream	9
Warm Transitional Small River	0
Warm Transitional Large River	<1
Warm Stream	<1
Warm Small River	0
Warm Large River	0

Lacustrine habitat

A total of 59 lakes and ponds of at least 1 surface acre are found in the management area (Table 24).

Table 24. Size and number of lakes and ponds located within the management area.

Lake Size Class (acres)	Number
1-99	52
100-499	5
500+	2

Wetlands

A total of 36,460 acres of wetlands are found in the management area (Table 25). Forested wetlands comprise approximately 91% of wetland types found in the management area.

Table 25. Area of emergent, forested and riverine wetland types found within the management area.

Wetland Type	Acres
Emergent	2,095
Forested	33,264
Riverine	1,101

Vernal pools and seeps

A total of 1,828 acres of vernal pools and seeps have been inventoried in the management area, and 1,764 acres of seeps have been identified.

Riparian vegetation cover

Aspen, lowland shrub and lowland conifers are the predominant cover types present in a 100-meter riparian zone located next to streams/rivers in the management area (Table 26).

Table 26. Largest vegetative cover types (i.e., top 10) and area located in a 100-meter buffer of streams/rivers within the management area.

Cover type	Acres
Aspen	4,938
Lowland Shrub	3,812
Lowland Conifers	3,479
Lowland Deciduous	1,982
Planted Red Pine	1,512
Marsh	1,448
Lowland Mixed Forest	1,442
Cedar	1,367
Northern Hardwood	1,282
Upland Mixed Forest	1,101

Watershed vegetation cover

The management area includes portions of watersheds of the Manistee and Boardman rivers (Table 27 & Table 28). Aspen and pines (i.e., mixed, red) are major cover types of the state forest in each watershed.

Table 27. Largest vegetative cover types (i.e., top five) and area of the Manistee River watershed located within the management area.

Cover Type	Acres
Aspen	41,738
Northern Hardwood	26,684
Planted Red Pine	23,999
Lowland Conifers	7,333
Lowland Shrub	5,519

Table 28. Largest vegetative cover types (i.e., top five) and area of the Boardman River watershed located within the management area.

Cover Type	Acres
Aspen	5,777
Natural Mixed Pines	5,303
Planted Red Pine	4,426
Upland Mixed Forest	3,724
Upland Mixed Deciduous	3,717

Recreation

Access for public recreation and management in the Kalkaska Sandy Moraines Management Area is generally very good with a well-developed road/trail system. This area, between Traverse City, Cadillac and Gaylord, is especially heavily used by residents and visitors due to an abundance of outdoor recreation opportunities.

Numerous off-road vehicle trails, from single track motorcycle trails to full-size ORV trails, traverse the area, including the Grand Traverse Motorcycle Trail, Kalkaska Trail and Route and North Missaukee Route and MCCCT. Being in Michigan's "snowbelt" contributes to the popularity of snowmobiling in the area on the many miles of trails.

Nonmotorized recreation opportunities include over 50 miles of the Shore-to-Shore equestrian trail, which is supported by several trail camps. The North Country National Scenic Trail/Iron Belle Trail also crosses through this management area. The Vasa trail system, maintained under a partnership with TART Trails, offers opportunities for cross-country skiing, hiking and mountain biking close to Traverse City. The Sand Lakes Quiet Area is managed specifically for quiet recreation, with nearly 8 miles of hiking and biking trails. Other nonmotorized trails in the management area include Pine Baron pathway (6.4 miles), Muncie Lakes Pathway (6.4 miles), and the Kalkaska mountain bike trail.

Wetzel Lake day use area is jointly operated by Mancelona Township and Antrim County under a lease agreement with the DNR, providing opportunities for swimming and nonmotorized boating.

There are 13 state forest campgrounds in the Kalkaska Sandy Moraines Management Area, including three equestrian trail camps along the Shore-to-Shore trail and four accessible to ORV use.

Table 29. Designated recreation trails by type.

Recreation Category	Recreation Type	# of Miles
Motorized Recreation Trails	ORV (all types)	313.4
	Snowmobile	172.3
Nonmotorized Recreation Trails	Hiking	188.7
	Equestrian	67.8
	Biking	6.5
	Hunter Access Trails	4.3
Total	-	**800.8**

Note: Trail-use types may overlap.

Table 30. State forest campgrounds.

Name	# of sites	Equestrian	ORV Access
Arbutus Lake State Forest Campground	25	-	-
Baxter Bridge State Forest Campground	25	-	-
Forks State Forest Campground	9	-	-
Guernsey Lake State Forest Campground	35	-	-
Hopkins Creek Equestrian State Forest Campground and Trail Camp		16 (group)	-
Hopkins Creek State Forest Campground	7	-	X
Lake Marjory State Forest Campground	10	-	-
Old US- 131 State Forest Campground	25	-	X
Pickerel Lake (Kalkaska) State Forest Campground	13	-	X
Rapid River Trail Camp		Group (200)	-
Scheck's Place State Forest Campground	30	-	X
Scheck's Place Trail Camp		Group (200)	-
Spring Lake State Forest Campground	30	-	-

There are three areas managed for hunting in this management area, the largest being Skegemog Lake. The state wildlife management area provides access to a variety of habitats. The Little Betsie Grouse Enhanced Management Site provides great habitat for grouse and woodcock with access via hunter walking trails.

Boating access sites are available on many of the larger lakes in the area and provide multiple access points to the Manistee River, a designated Natural River, providing excellent boating and fishing opportunities.

The Kalkaska Sandy Moraines Management Area is also a popular destination for dispersed activities such as hunting, hiking, mushroom hunting, etc.

Table 31. Areas managed for hunting.

Type	Name	# of Acres
State Wildlife Management Area	Goose Creek Flooding	44.8
	Headquarters Lake Flooding	292.8
	Skegemog Lake	1,949.7
GEMS	Little Betsie	2,694.5
Total	-	**4,981.8**

Table 32. Boating access sites.

Name	Waterbody
Big Bradford Lake	Big Bradford Lake
Bluegill Lake	Bluegill Lake
Horseshoe Lake	Horseshoe Lake
Lake Manuka	Lake Manuka
Arbutus Lake #4	Arbutus Lake #4
Baxter Bridge	Manistee River
Chase Creek	Chase Creek/ Manistee River
Cranberry Lake	Cranberry Lake
Forks SFCG	Boardman River
Guernesey Lake State Forest Campground	Guernesey Lake
Harvey River	Manistee River
Hole in the Wall	Manistee River
Indian Lake	Indian Lake
Lucas Road	Manistee River
Old US-131 State Forest Campground	Manistee River
Pickerel Lake State Forest Campground	Pickerel Lake
Rainbow Jim Bridge	Manistee River
Scheck's Place State Forest Campground	Boardman River
Smithville	Manistee River
Spider Lake	Spider Lake
Spring Lake State Forest Campground	Spring Lake
Starvation Lake	Starvation Lake
Yellow Trees Landing	Manistee River

Lake County Outwash

State Forest Area: 38,506 acres	Location: Lake County	Population Centers: Luther and Baldwin
Subsection: Lake County Outwash	Landforms: Beach ridges and depressions Sand spits Transverse sand dunes and Sand bars	Landcover: Forested: 34,752 acres Nonforested: 3,754 acres

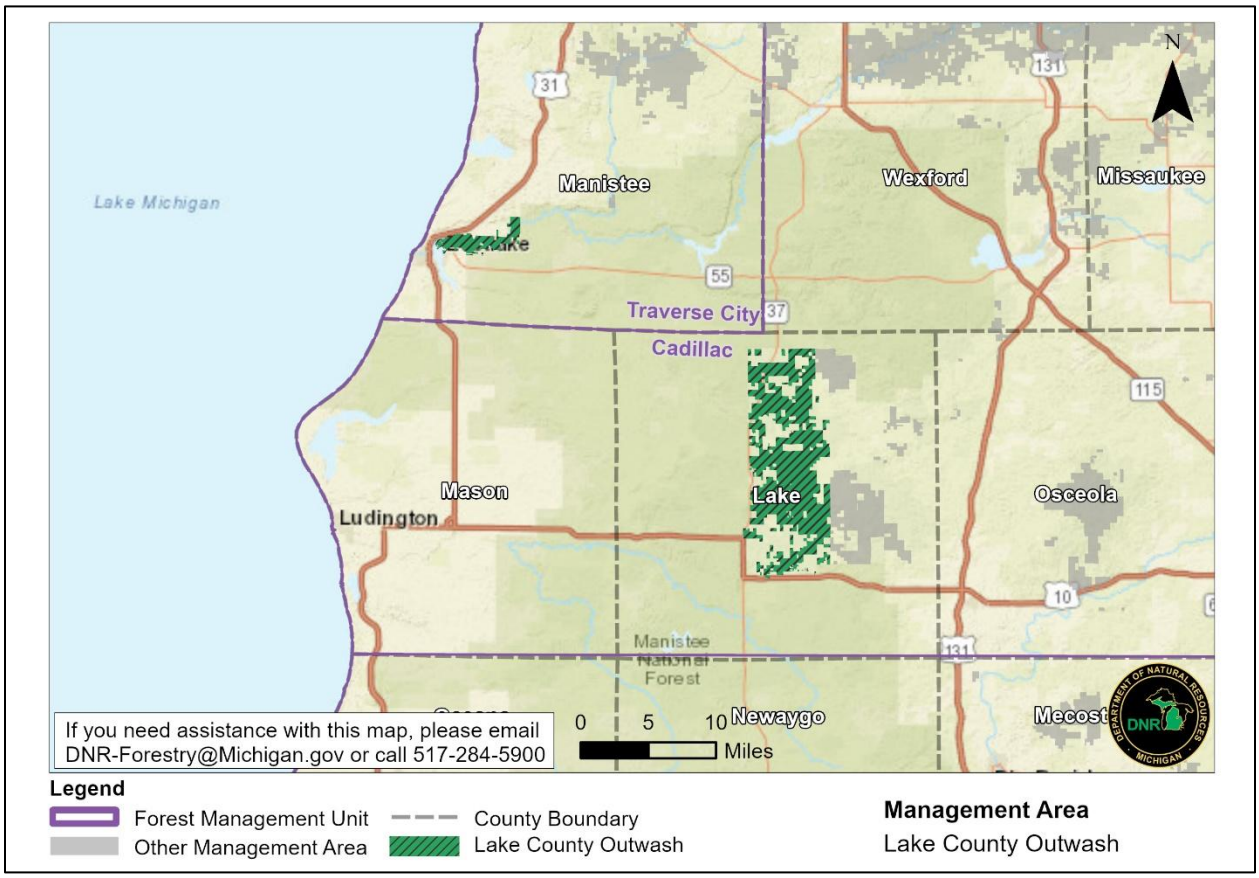


Figure 1. Lake County Outwash Management Area.

Forested landscape

Current and projected future condition

The Lake County Outwash management area includes a variety of shade tolerance levels occurring mostly in the intermediate and older age categories (Figure 2). The majority of tolerant cover types occur on unavailable lowlands in the mature age category. Mid-tolerant cover types mostly occur on available uplands in the intermediate and mid-aged age categories while the majority of the intolerant cover types occur in the intermediate age category on available uplands.

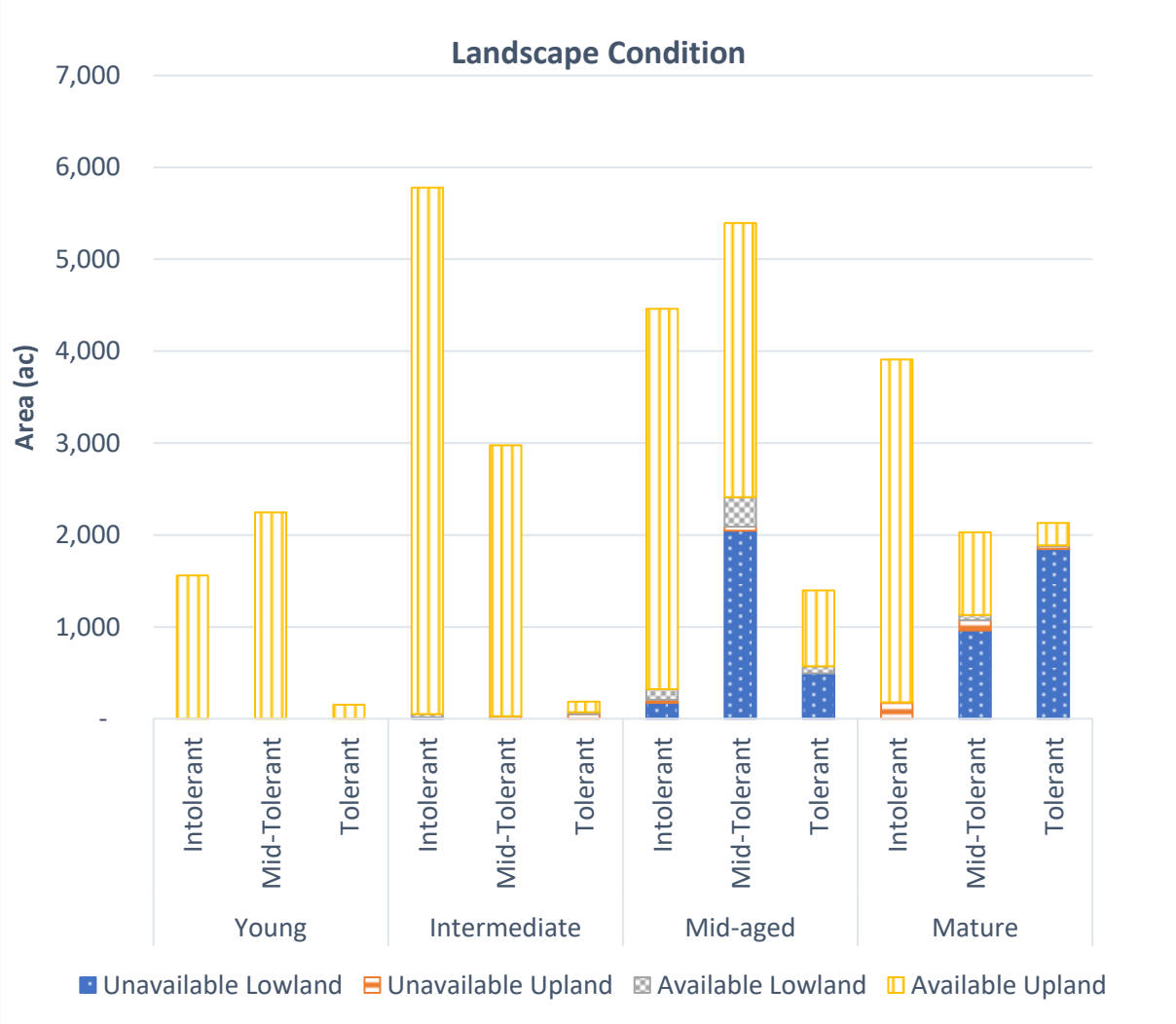


Figure 2. Forest diversity matrix showing the current distribution of forested acres across management availability, age category, landscape position and shade tolerance.

Landscape habitat conditions refine the management area landscape into featured species habitat context. Current and projected acres for the metrics identified in the Management Priorities (Section 3 Statewide/Regional) establish a baseline and future condition based on management over the planning period (Table 1).

Table 1. Current acres for landscape habitat conditions.

Landscape Habitat Condition	Monitoring Metric	Current Acres
Young Forest	Acres of 0-19 stands in aspen and jack pine	1,199
Mature Forest	Acres of 80+ year stands across cover types	8,071
Mature Forest	Acres of 120+ year stands across cover types	591
Mesic Conifer Cover Types	Acres of mesic conifer cover types	3,106
Mesic Conifers in other Cover Types	Average canopy occupancy	27%
Mast – Oak Cover Types	Acres of oak cover types	6,170
Mast Tree Species in Other Cover Types	Acres of total canopy occupancy of mast tree acres (trace-100%)	19,204
Big Trees	Acres of total canopy stand occupancy of species in sawlog or greater size class	12,898
Nonforested Openings	Acres of total herbaceous openland, upland shrub, and cropland	466
Landscape Forest Matrix	Percent deciduous forest	49%
Landscape Forest Matrix	Percent coniferous forest	40%

The Lake County Outwash Management Area has the following special analysis units (SAUs). These SAUs have specific cover type goals, typically associated with wildlife habitat management. For any SAUs that overlap with this management area, SAU cover type goals take priority as the SFMP model strives to meet the cover type goals across the area, ensuring they are met. See Section 5 for a detailed description of the management direction and harvest goals for each of these SAUs.

The Lake County Outwash Management Area is comprised of 90% forested cover types and 10% nonforested cover types (Table 2). Of the forested cover types, there are 74% in the upland and 7% lowland total landscape positions. The largest contributors to upland cover types are black red hybrid oak, aspen and mixed upland deciduous. Lowland deciduous and lowland conifer take up 13% of the total landscape position. Lowland shrub is the most common nonforested cover type in the management area representing 4% of the landscape.

Table 2. Current landscape context and distribution of cover types.

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
Forested	Upland	Deciduous	Aspen	3,921	14,105	28,552	34,752
			Northern Hardwood	257			
			Black Red Hybrid Oak	4,564			
			Northern Red Oak	130			
			Oak Mix	2,210			
			Mixed Upland Deciduous	3,022			
		Mixed	Upland Mixed Forest	2,827	2,827		
		Coniferous	Planted Red Pine	1,803	11,621		
			Planted Jack Pine	2,846			
			Planted White Pine	376			
			Planted Mixed Pine	653			
			Natural Red Pine	3			
			Natural Jack Pine	2,836			
			Natural White Pine	615			
			Natural Mixed Pines	2,442			
			Upland Spruce/Fir	2			
			Upland Conifers	33			
			Hemlock	14			
	Lowland	Deciduous	Lowland Aspen/Balsam Poplar	354	3,040	6,200	
			Lowland Deciduous	2,686			
		Mixed	Lowland Mixed Forest	707	707		
		Coniferous	Cedar	315	2,453		
			Lowland Conifers	2,138			
			Lowland Spruce/Fir	0			
			Tamarack	0			
Nonforested	Upland	N/A	Herbaceous Openland	144	N/A	644	3,754
			Upland Shrub	128			
			Low Density Trees	100			
			Bare/Sparsely Vegetated	8			
			Cropland	194			
			Urban	70			
	Lowland	N/A	Lowland Shrub	1,667	N/A	3,110	
			Marsh	1,046			
			Bog	317			

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
			Treed Bog	13			
			Water	67			
						Grand Total:	38,506

There are 28,736 acres (74.6% of the total management area and 82.7% of the forested area) that can be managed toward desired future conditions via commercial timber harvest in the Lake County Outwash management area (Table 3). Of that, over 12% is in the black red hybrid oak cover type, 10% in aspen, and 8% in mixed upland deciduous. The remaining 15 cover types represent less than 7% each of the forested and available land in the management area. Acres unavailable for management are categorized by site condition (

Table 4).

Table 3. Current cover type composition by management availability.

Forested Cover Type	Available Acres	Available %	Unavailable Acres	Unavailable %	Total Acres	Total %
Black Red Hybrid Oak	4,456	12.8%	109	0.3%	4,564	13.1%
Aspen	3,881	11.2%	40	0.1%	3,921	11.3%
Mixed Upland Deciduous	2,932	8.4%	91	0.3%	3,022	8.7%
Planted Jack Pine	2,845	8.2%	1	0.0%	2,846	8.2%
Natural Jack Pine	2,836	8.2%	0	0.0%	2,836	8.2%
Upland Mixed Forest	2,788	8.0%	39	0.1%	2,827	8.1%
Lowland Deciduous	210	0.6%	2,475	7.1%	2,686	7.7%
Natural Mixed Pines	2,391	6.9%	50	0.1%	2,442	7.0%
Oak Mix	2,138	6.2%	73	0.2%	2,210	6.4%
Lowland Conifers	110	0.3%	2,028	5.8%	2,138	6.2%
Planted Red Pine	1,803	5.2%	0	0.0%	1,803	5.2%
Lowland Mixed Forest	175	0.5%	532	1.5%	707	2.0%
Planted Mixed Pine	649	1.9%	4	0.0%	653	1.9%
Natural White Pine	587	1.7%	29	0.1%	615	1.8%
Planted White Pine	376	1.1%	0	0.0%	376	1.1%
Lowland Aspen Balsam Popl	177	0.5%	177	0.5%	354	1.0%
Cedar	0	0.0%	315	0.9%	315	0.9%
Northern Hardwood	203	0.6%	53	0.2%	257	0.7%
Northern Red Oak	130	0.4%	0	0.0%	130	0.4%
Upland Conifers	33	0.1%	0	0.0%	33	0.1%
Hemlock	14	0.0%	0	0.0%	14	0.0%
Natural Red Pine	3	0.0%	0	0.0%	3	0.0%
Upland Spruce Fir	2	0.0%	0	0.0%	2	0.0%
Grand Total	**28,736**	**82.7%**	**6,016**	**17.3%**	**34,752**	**100.0%**

Table 4. Site conditions for unavailable acres.

Site Condition (Reason Area is Unavailable for Commercial Harvest)	Area (ac)	% of Unavailable Area
Too Wet	5,337	88.7%
Best Management Practices	341	5.7%
Blocked by Obstacle	132	2.2%
Recreation/Scenic	92	1.5%
Cannot Regenerate	36	0.6%
Other Influence Zones	33	0.6%
Too Steep	22	0.4%
Long-Term Retention	19	0.3%
Denied Access	3	0.1%
Total Unavailable	**6,016**	**100.0%**

Projected 10-year cover type management actions

Each cover type in the Lake County Outwash Management Area has a unique age class and basal-area class goals that describe the long-term desired future conditions. The calculated harvest levels that are needed during the first 10-year planning period are summarized in Table 5. These harvest levels are necessary to begin achieving long-term planning goals. This will help establish a desirable amount of regeneration for the even-aged cover types over the 10-year period like black red hybrid oak or help to achieve desired basal area distribution among uneven-aged cover types. Implementing these silvicultural regimes will yield 76,920 cords, the planned harvest volume for the decade (**Error! Reference source not found.**).

Table 5. Ten-year planning period harvest goals (acres) by cover type and silvicultural regime.

Cover type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Grand Total
Black Red Hybrid Oak	948	-	122	-	42	1,112
Aspen	673	-	-	-	-	673
Oak Mix	362	-	124	-	-	486
Planted Jack Pine	441	-	-	-	-	441
Planted Red Pine	-	-	355	-	-	355
Natural Jack Pine	316	-	-	-	-	316
Mixed Upland Deciduous	179	-	-	-	67	246
Planted White Pine	29	-	120	-	-	149
Upland Mixed Forest	141	-	-	-	-	141
Natural White Pine	-	-	50	-	41	92
Lowland Conifers	34	-	-	-	-	34
Lowland Aspen/Balsam Poplar	28	-	-	-	-	28
Upland Conifers	27	-	-	-	-	27
Lowland Deciduous	15	7	-	-	-	21
Hemlock	-	14	-	-	-	14
Natural Mixed Pines	-	-	6	-	-	6
Totals	**3,193**	**20**	**776**	**-**	**151**	**4,139**

Table 6. Projected 10-year harvest volume by species.

10-Year Estimated Harvest Volume Projection **Lake County Outwash Management Area** **Product**	**Species**	**Volume Planned***	**Volume Prepared** ***
Pulpwood (cords)	Jack Pine	17,179	16,148
	Mixed Aspen	6,594	6,199
	Mixed Hardwood	5,580	5,245
	Mixed Oak	5,446	5,119
	Red Pine	3,070	2,886
	White Pine	1,857	1,746
	Mixed Spruce	1,283	1,206
	Mixed Softwood	849	798
	Pulpwood Total	**41,858**	**39,347**
	Mixed Oak	3,461	3,253
	White Oak	3,041	2,858
	Red Pine	2,803	2,635
	Red Oak	2,430	2,284
	Red Maple	1,884	1,771

Sawtimber (MBF)	White Pine	1,698	1,596
	Mixed Aspen	1,417	1,332
	Sugar Maple	81	76
	Basswood	15	14
	Sawtimber Total	**16,830**	**15,820**
	Total Sawtimber Harvest Volume in Cords	**35,062**	**32,958**
	Grand Total Harvest Volume in Cords	**76,920**	**72,305**

* Volume estimates based on 100% of the projected harvests for the 10-year planning period.

** Volume estimates based on 94% of the projected harvests for the 10-year planning period accounting for reduction in acres and associated volume once sales are prepared for bid.

There are a few cover type transitions projected for the Lake County Outwash management area (Table 7). The managed area of the jack pine cover type is projected to change to more natural jack pine instead of planted jack pine. The oak cover types will be transitioning into other oak types or mixed upland deciduous. The largest decrease forecasted is in the planted jack pine cover type where 454 acres will convert to other cover types such as natural jack pine through forest management and regeneration activities. The largest increase occurs on the natural jack pine forest type where 422 acres are projected to convert into this cover type.

Table 7. Projected 10-year cover type acres resulting from cover type transitions.

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Black Red Hybrid Oak	4,564	4,263	-302
Aspen	3,921	3,983	62
Mixed Upland Deciduous	3,022	3,282	260
Planted Jack Pine	2,846	2,392	-454
Natural Jack Pine	2,836	3,258	422
Upland Mixed Forest	2,827	2,954	128
Lowland Deciduous	2,686	2,686	0
Natural Mixed Pines	2,442	2,483	42
Oak Mix	2,210	2,018	-193
Lowland Conifers	2,138	2,122	-16
Planted Red Pine	1,803	1,868	65
Lowland Mixed Forest	707	724	16

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Planted Mixed Pine	653	653	0
Natural White Pine	615	633	18
Planted White Pine	376	347	-29
Lowland Aspen/Balsam Poplar	354	353	0
Cedar	315	315	0
Northern Hardwood	257	257	1
Northern Red Oak	130	124	-6
Upland Conifers	33	20	-13
Hemlock	14	14	0
Natural Red Pine	3	3	0
Upland Spruce/Fir	2	2	0
Lowland Shrub	1,667	1,667	0
Marsh	1,046	1,046	0
Bog	317	317	0
Cropland	194	194	0
Herbaceous Openland	144	144	0
Upland Shrub	128	128	0
Low Density Trees	100	100	0
Urban	70	70	0
Water	67	67	0
Treed Bog	13	13	0
Bare/Sparsely Vegetated	8	8	0
Total:	**38,506**	**38,506**	**0**

Featured species current and projected habitat acres

There are seven featured species in this management area that span various cover types, age classes and stand level conditions. Current and projected total habitat acres by species across the decade provide a baseline and show the result of long-term management actions (Table 8). As noted in the Featured Species Management Priority (Section 3), it is recommended that these featured species habitat acres be viewed as acres of potential habitat, representing a condition on the landscape where the more nuanced aspects of each species' habitat requirements are likely to be found or managed for. As described in the introduction, the modeling effort was limited by several factors including the simplification of habitat attributes into MiFI variables. Therefore, when referring to habitat acres what is being referred to is potential habitat acres.

Some species show a loss in habitat over the next century. As mentioned in the Featured Species Management Priority (Section 3), the current condition for many cover types is a surplus of acres in the 0-9 age class from the compensatory management approach applied in the previous decade. The model eventually evens out the age classes at a lower, sustainable level over time, usually by 50 years. For any species with northern hardwoods as a priority cover type, there is a perceived drop in acres between 40 and 60 years; this is due to the basal area dropping below 81 but because it only drops into the upper 70s, it is not expected to translate to any real habitat loss on the ground. Three of these species were not included in the State Forest Management Plan model, black bear, wild turkey and black-backed woodpecker, but are included here to inform management decisions over the decade.

Table 8. Featured species current and projected total habitat acres (e.g., potential habitat).

Featured Species	Priority Cover Types	Total Habitat Acres Current	Total Habitat Acres 10-year	50-year Projected Habitat Acres	100-year Projected Habitat Acres
American Woodcock	Aspen, lowland aspen, lowland deciduous	937	1,404	1,622	1,843
Black Bear	Mast	25,374	--	--	--
Black-Backed Woodpecker	Natural disturbance	--	--	--	--
Marten	Northern hardwoods, mixed upland deciduous, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, lowland mixed forest, lowland conifers, hemlock, cedar	6,183	6,462	8,355	9,710
Ruffed Grouse	Aspen	756	1,171	1,536	1,731
Snowshoe Hare	Aspen, cedar, hemlock, lowland aspen, lowland conifers, lowland mixed forest, lowland spruce/fir, mixed upland deciduous, natural jack pine, natural mixed pines, planted jack pine, upland spruce/fir	3,288	3,978	4,326	4,404
Wild Turkey	Nonforested openings	338	--	--	--
Wood Turtle	Nonforested openings	--	--	--	--

Cover type composition and associated featured species

Black red hybrid oak

Current condition

Most of the black red hybrid oak cover type is currently between stand ages of 100 and 109 years old in the Lake County Outwash Management Area (Figure 3). The age class distribution is currently unbalanced. In the 0- to 79-year-old age classes where the deficits in acres occur, which will lead to a deficit in the future planning periods. Most of the acres extend beyond the desired maximum age class distribution of 80 years old.

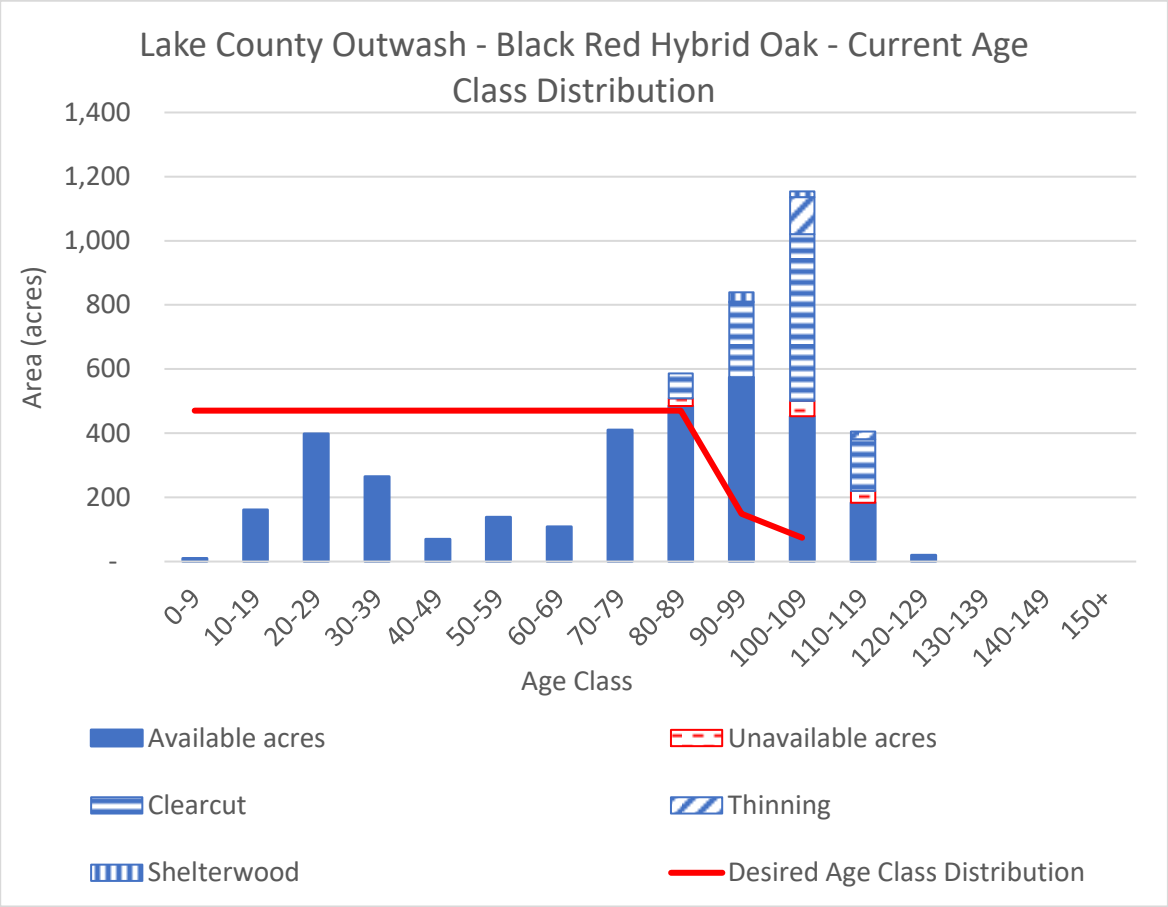


Figure 3. Current age class distribution and projected harvests in black red hybrid oak cover type.

Current conditions are a result of thinning working toward better quality stands. With that, it has now approached a time where there is a lack of regenerating black red hybrid oak in the Lake County Outwash Management Area. A portion of this cover type meets the habitat requirements for golden-winged warbler and marten (Table 9).

Table 9. Featured species with black-red hybrid oak as a selected habitat cover type, habitat variables, and current acres (e.g., potential habitat).

Featured Species	Featured Species Habitat – Black-red Hybrid Oak	Black-red Hybrid Oak Habitat Acres - Available	Black-red Hybrid Oak Habitat Acres - Unavailable
Marten	Age Category: 40+ Size Category: Pole, Sawlog Basal Area: 81+	1,694	87

Desired future condition

The projected long-term cover type trend for black/red hybrid oak is projected to be decreasing by 6.6% in the Lake County Outwash Management Area. Some of the black/red hybrid oak in the area is transitioning into other cover types such as mixed upland deciduous.

The long-term goal for this cover type is balanced age classes between 0 and 80 years old with a tail out to 100 for all available black/red hybrid oak stands in this management area. Maintaining a younger age class helps to keep a more vigorous stand.

The end of the planning period will result in the establishment of 682 acres which is more than desirable number of acres in the 0-9 age class (Figure 4). This is due to the number of acres already beyond the tail of 100 years old. Progress toward the long-term desired age class distribution of black/red hybrid oak will take many decades of even-aged management in this management area.

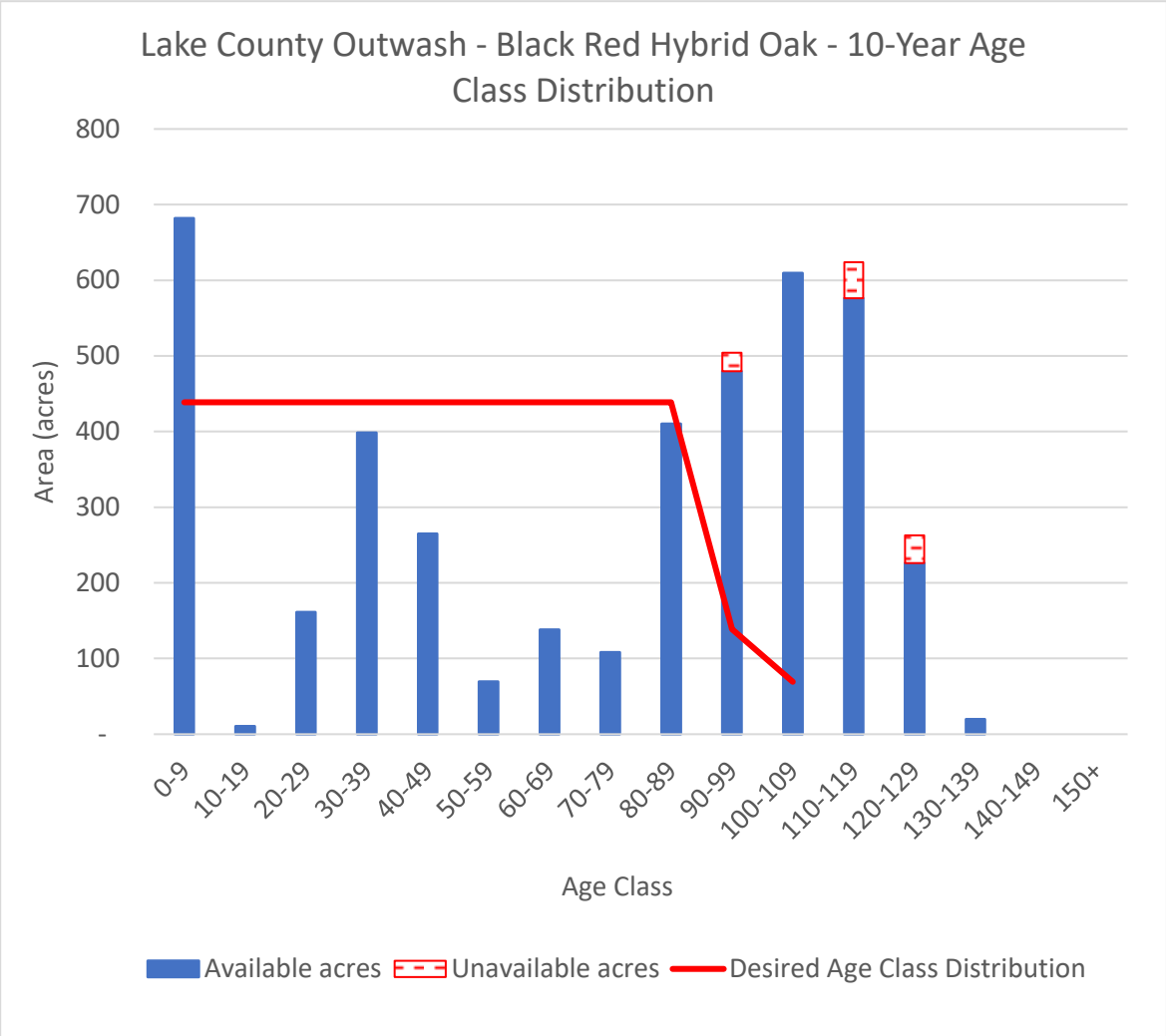


Figure 4. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution of black red hybrid oak is beginning to reach the desired future condition for available acres (Figure 5). There is an increase in acres in the older age classes, beyond the desired age of 80 years old, due to the high number of available acres in this management area already in the older age classes. As is often the case, unbalanced age classes may result in the need to leave some acres in older age classes to achieve the desired age class distribution in future planning periods.

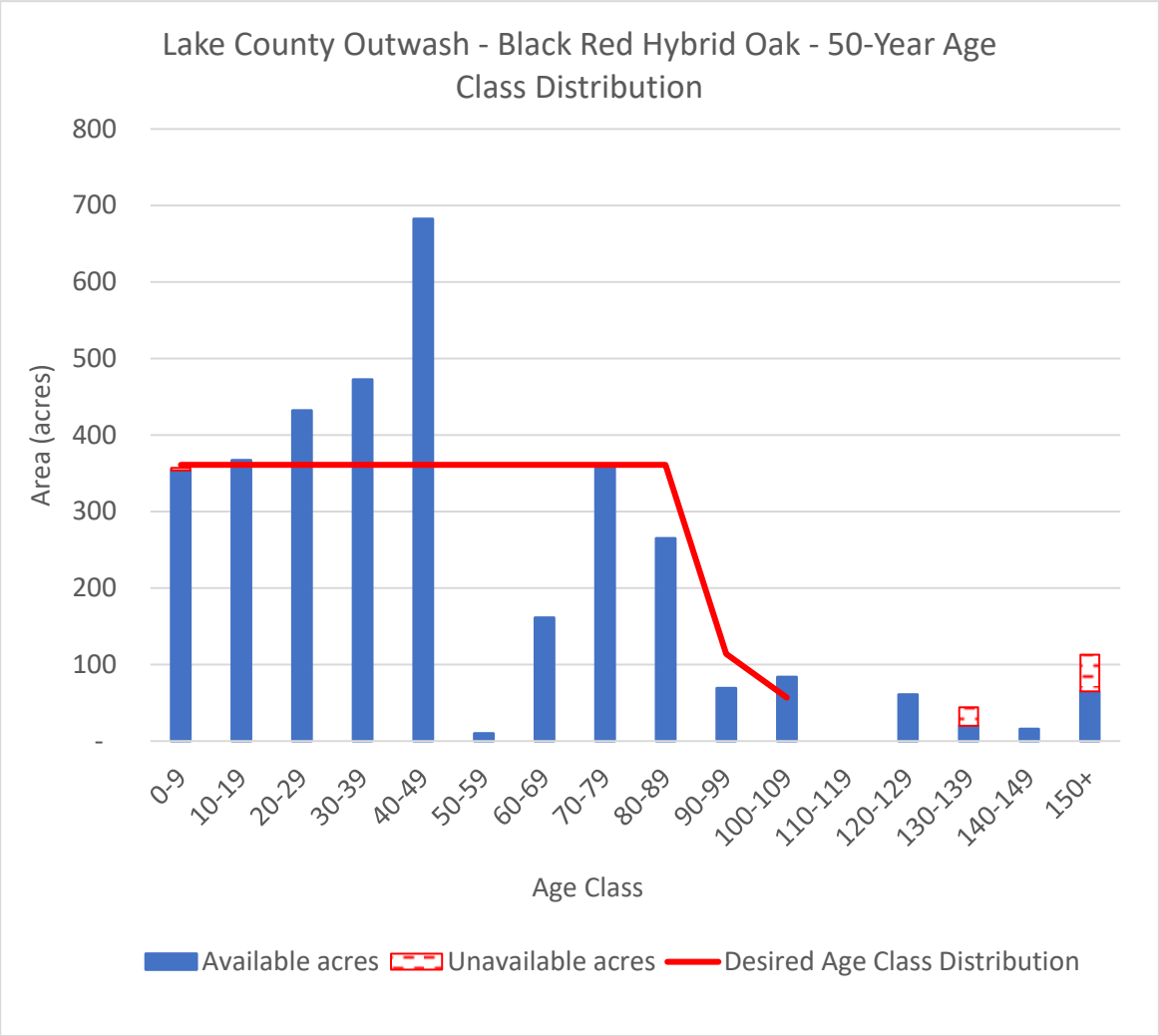


Figure 5. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 6) will concentrate the manageable acres of black red hybrid oak in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest (Figure 7).

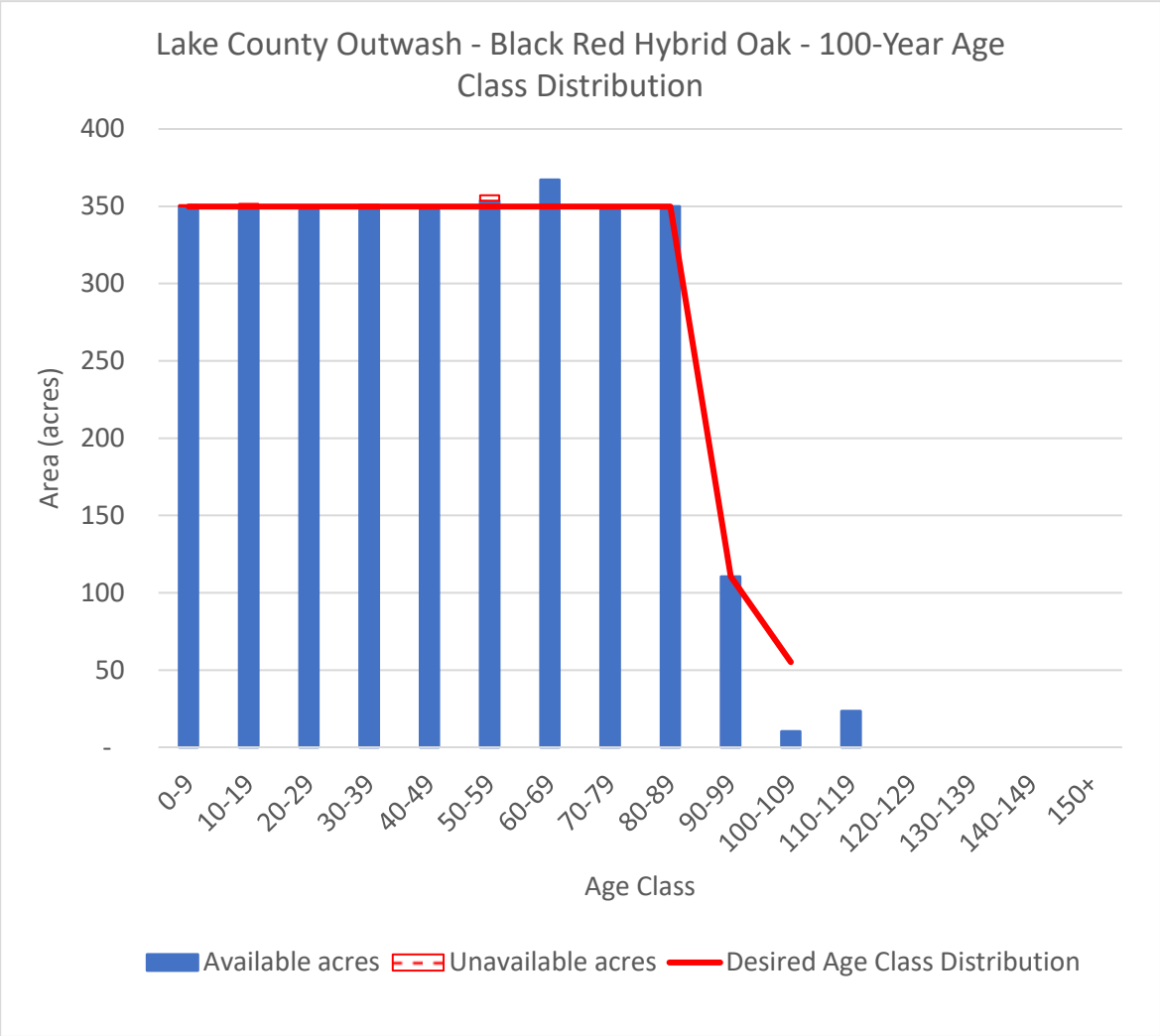


Figure 6. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

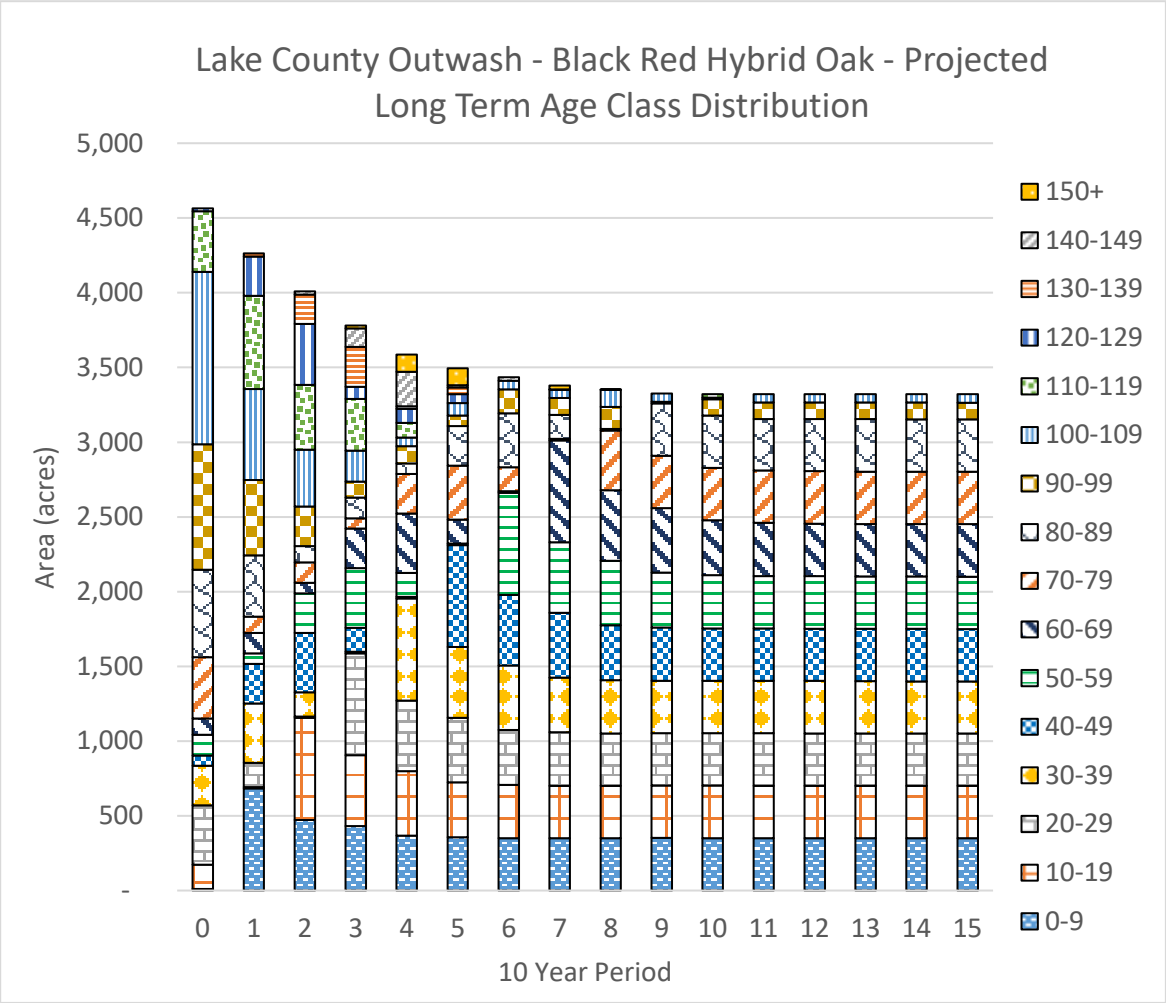


Figure 7. Projected age class distribution for all acres of black/red hybrid oak over the next 150 years.

Management actions

There are 992 acres of projected clearcut harvest in the black/red hybrid oak cover type during the planning period. This ends up above the desired establishment of 438 acres of black/red hybrid oak per decade because of the current unbalanced age class condition and a projected 302 acre decrease in this cover type converting to other cover types such as mixed upland deciduous. There are also an additional 142 acres projected to be thinned and 46 acres of shelterwood harvests.

Aspen

Current condition

The Lake County Outwash Management Area has a surplus of acres in the 30- to 59-year age classes that was created due to harvests and regeneration efforts on available aspen acres during the previous initiative of the Deer Range Improvement Program. (Figure 8). The age class distribution is currently unbalanced across almost all the age class categories. The deficit of available acres occurs in all age classes under 29 years old. A portion of this cover type meets the habitat requirements for ruffed grouse and snowshoe hare (Table 10).

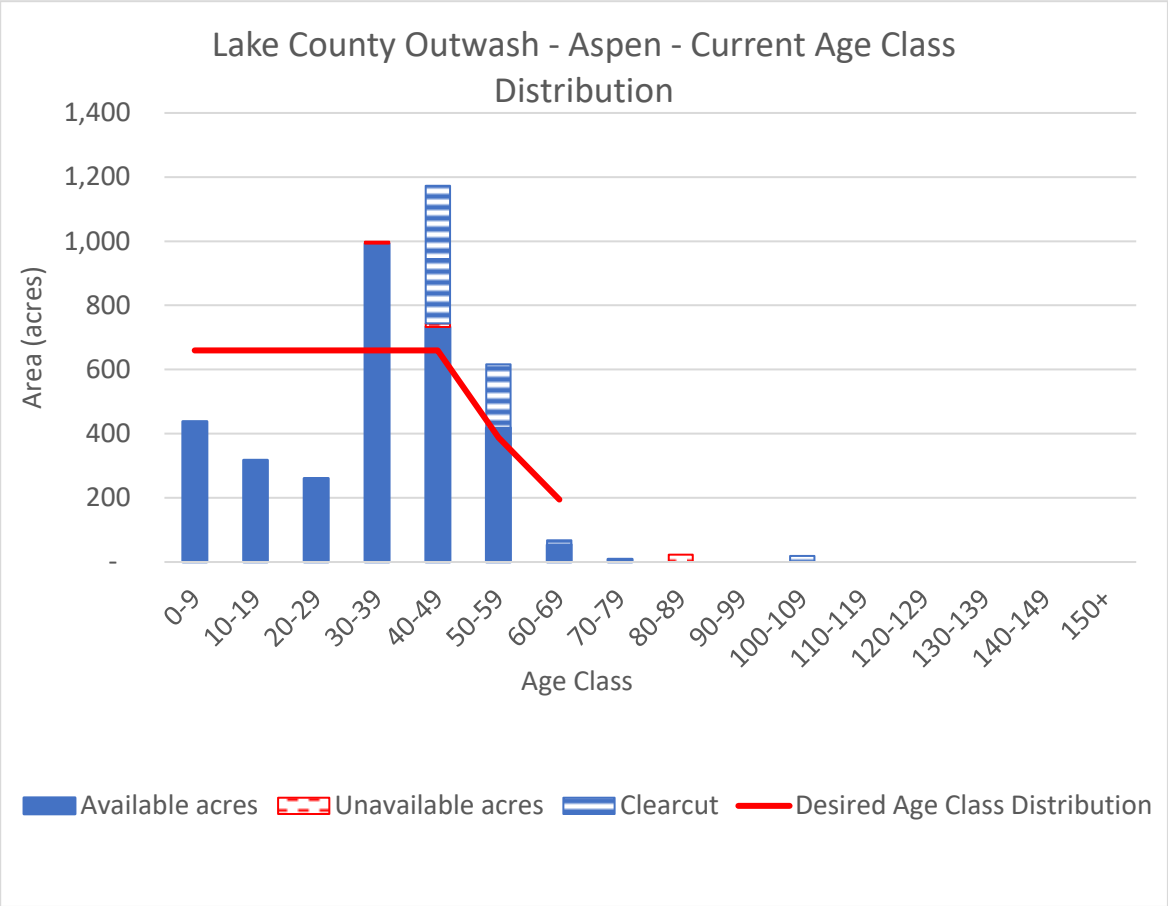


Figure 8. Current age class distribution, the desired age class distribution, and the projected harvests in the aspen cover type over the 10-year planning period.

Table 10. Featured species with aspen as a priority habitat cover type, habitat variables and current acres (e.g., potential habitat).

Featured Species	Featured Species Habitat – Aspen	Aspen Habitat Acres - Available	Aspen Habitat Acres - Unavailable
Ruffed Grouse	Age Category: 0-19 Size Class: Sapling	756	0
Snowshoe Hare	Age Category: 0-19 Size Class: Sapling	756	0

Desired future condition

The projected long-term cover type trend for aspen is fairly stable in the Lake County Outwash Management Area. There is a 1.6% increase for this cover type during this planning period.

The long-term goal for this cover type is balanced age classes between 0 and 40 years old with a decreasing tail out to 60 years old for all available aspen acres.

The end of the planning period will result in the establishment of approximately 734 acres of aspen from the available acres which is 64 acres over the desired age class distribution (Figure 9). Progress toward the long-term desired age class distribution of aspen will take many decades to achieve the desired balanced age class condition due to the current deficit of acres in the 0- to 29-year-old age classes.

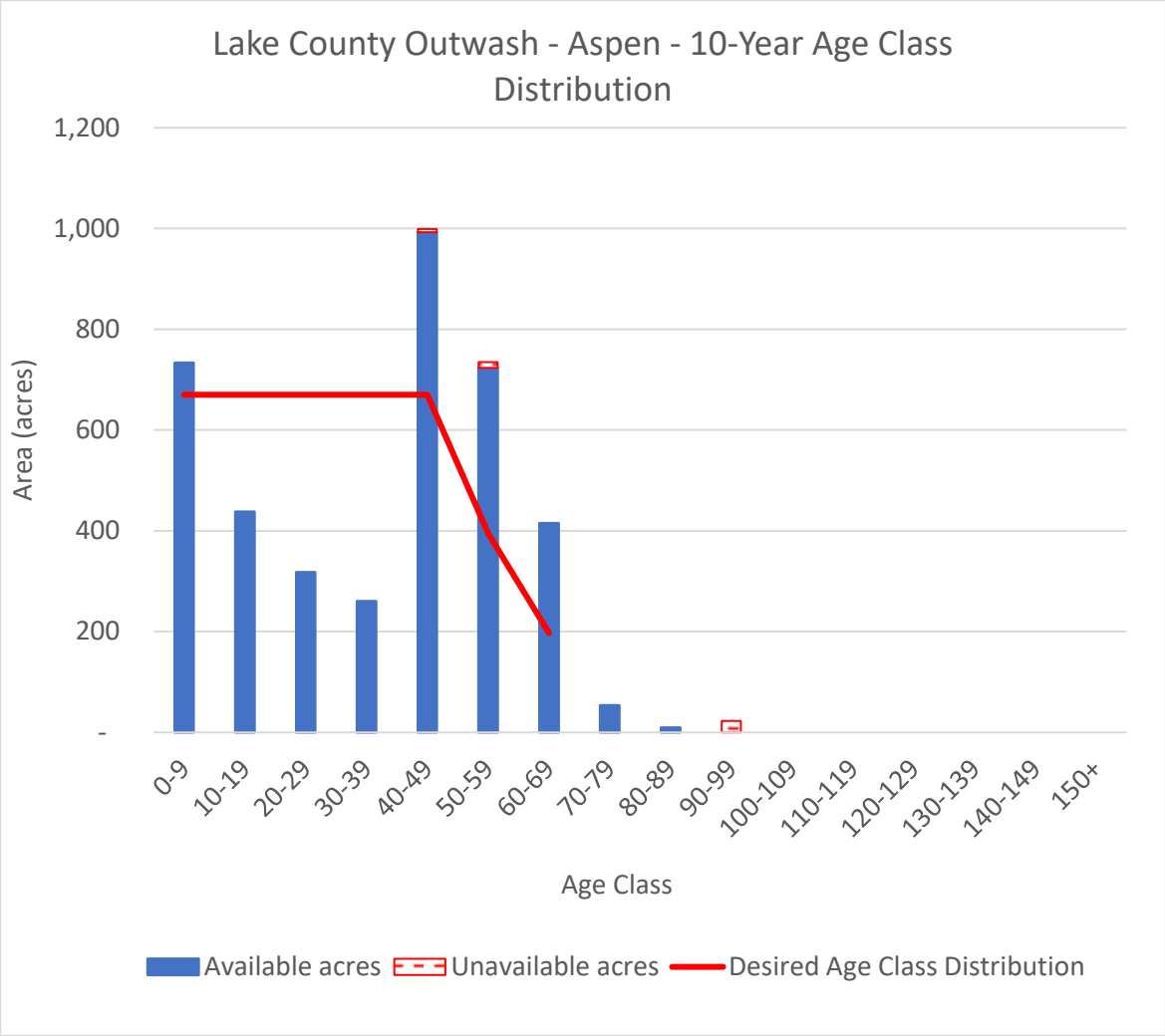


Figure 9. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution of aspen has almost reached the desired future condition for available acres in the age classes between 0- and 40-year-old age classes with a tail out to 60 years old (Figure 10).

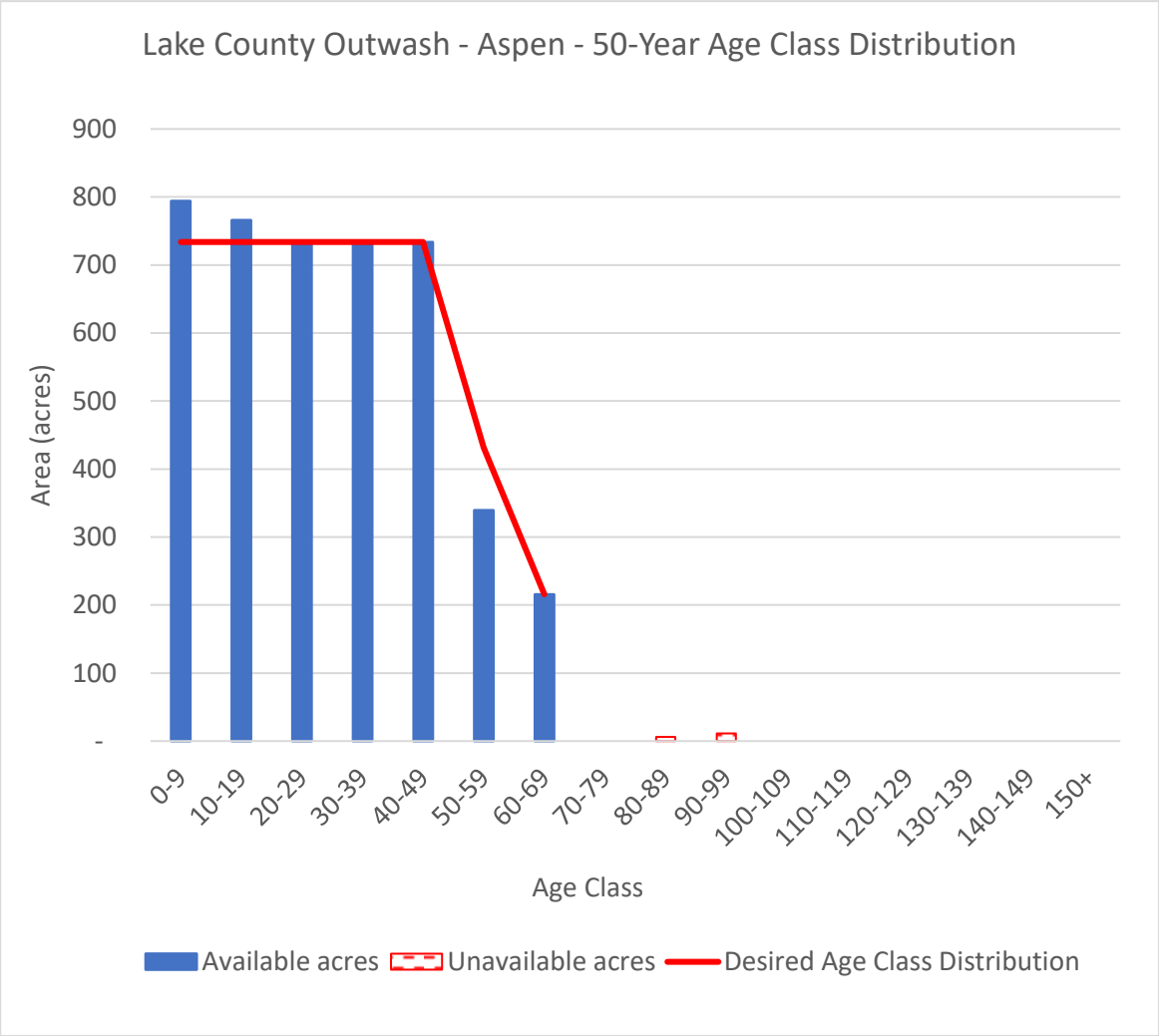


Figure 10. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 11) will concentrate on the manageable acres of aspen cover type in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest (Figure 12).

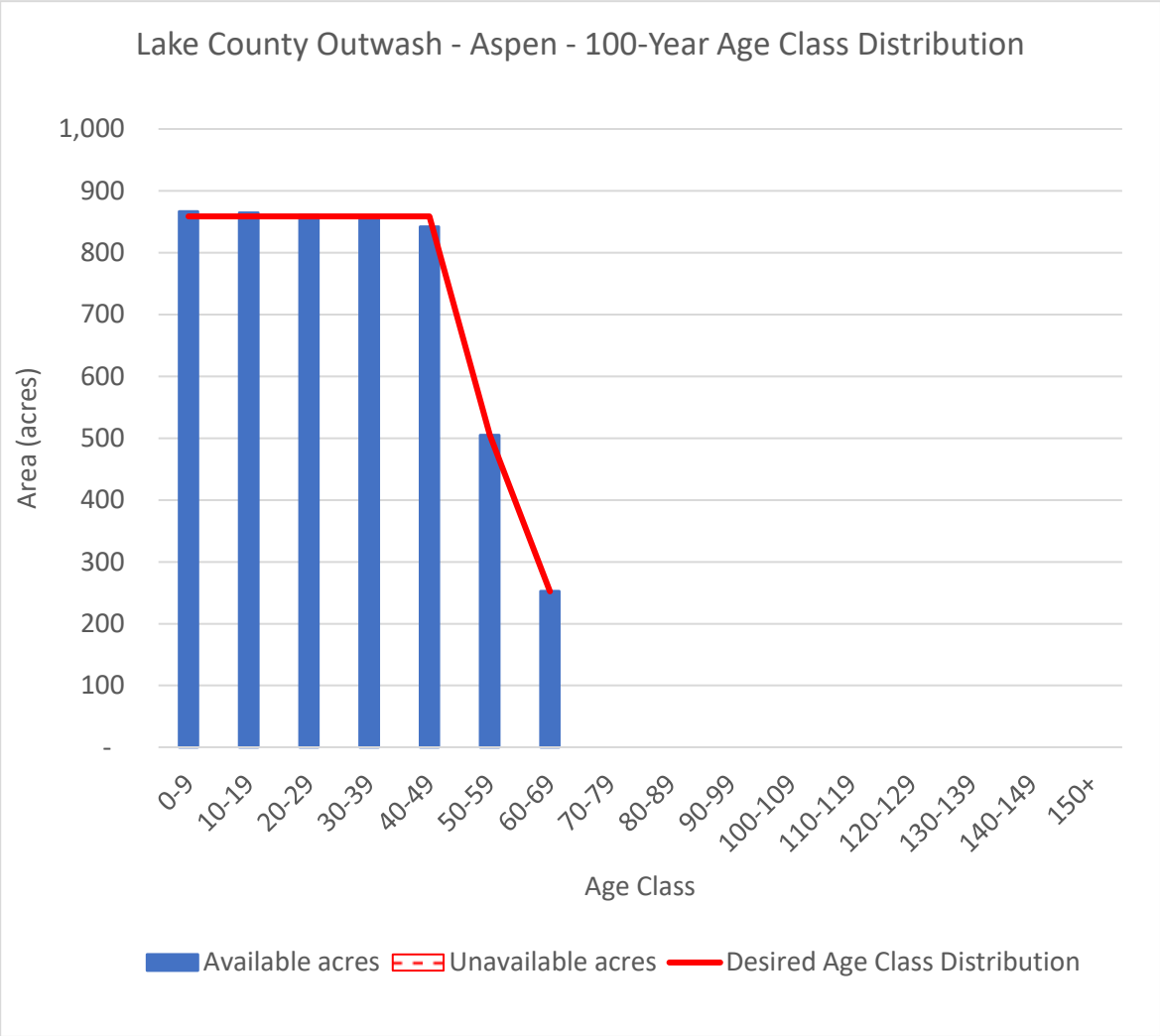


Figure 11. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

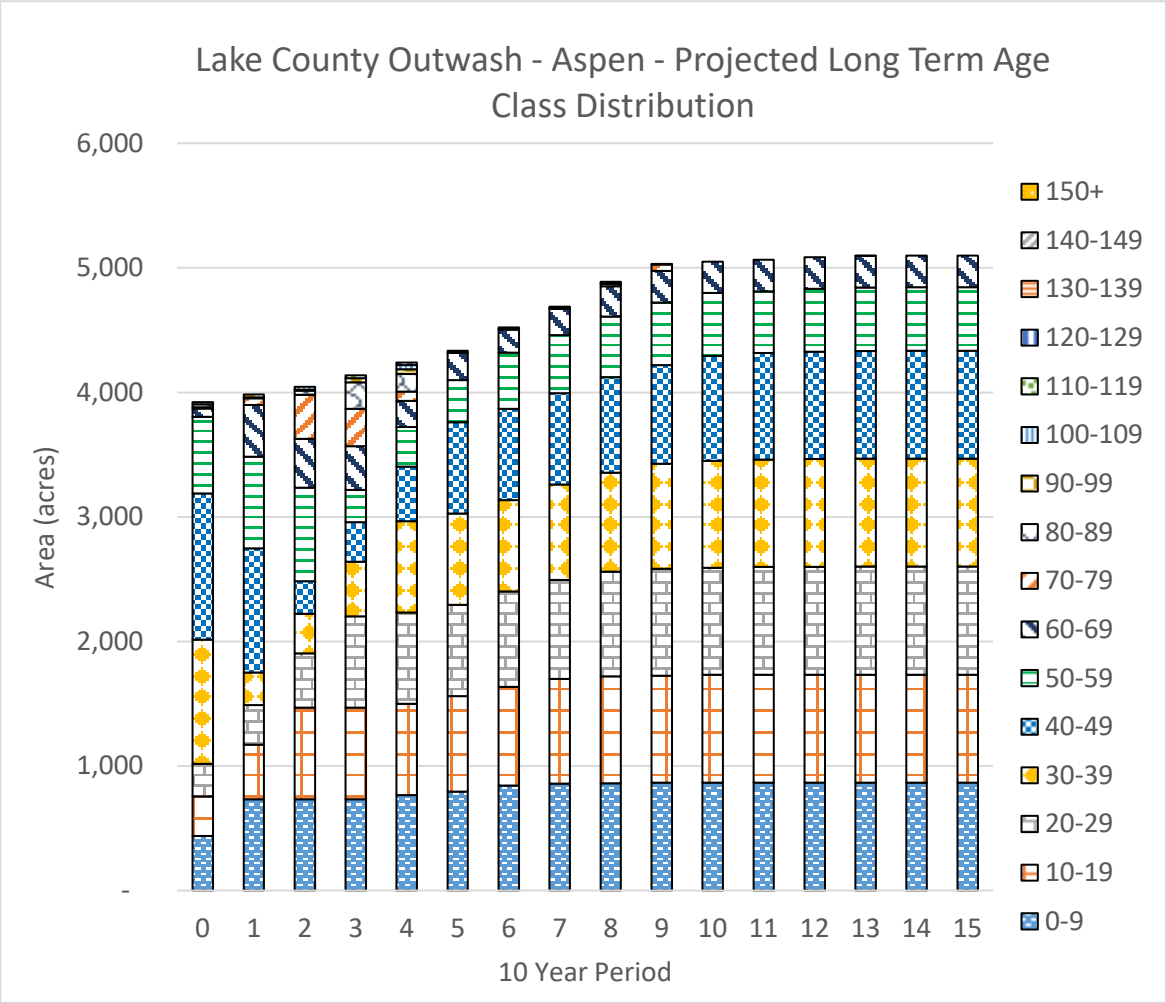


Figure 12. Projected age class distribution for all acres of aspen over the next 150 years.

Management actions

There are 659 acres of projected clearcut harvest, and an additional 62 acres projected to transition into the aspen cover type during the planning period. This is slightly over the desired establishment of 670 acres of aspen per decade.

Mixed upland deciduous

Current condition

Most of the mixed upland deciduous cover type is currently in the 20- to 29-year-old age class. (Figure 13). The past management regime has been primarily clearcut for this cover type. The younger age classes are very close to the desired age class distribution. The spike in the 20- to 29-year-old age class will continue for many decades.

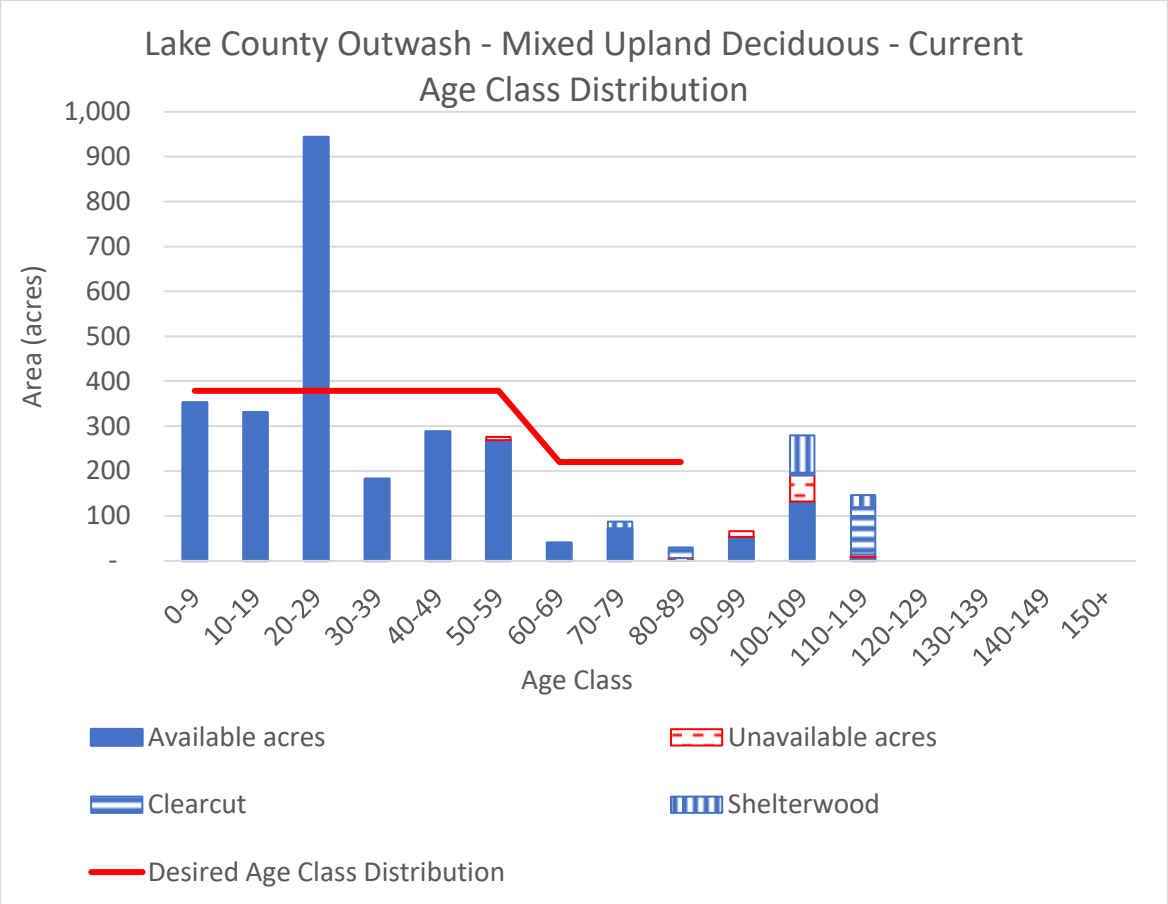


Figure 13. Current age class distribution, the desired age class distribution, and the projected harvests in the mixed upland deciduous cover type over the 10-year planning period.

Current conditions are a result of consistent commercial harvests and regeneration efforts on available aspen acres during the previous two planning periods. A portion of this cover type meets the habitat requirements for snowshoe hare and marten (Table 11).

Table 11. Featured species with mixed upland deciduous as a selected habitat cover type, habitat variables and current acres (e.g., potential habitat).

Featured Species	Featured Species Habitat – Mixed Upland Deciduous	Mixed Upland Deciduous Habitat Acres - Available	Mixed Upland Deciduous Habitat Acres - Unavailable
Snowshoe Hare	Age Category: 0-19 Size Category: Sapling	683	0
Marten	Age Category: 40+ Size Category: Pole, Sawlog Basal Area: 81+	656	83

Desired future condition

The projected long-term cover type trend for mixed upland deciduous is increasing by 8.6% in the Lake County Outwash Management Area. The transitions into this cover type will mostly be from black/red hybrid oak.

The long-term goal for this cover type is balanced age classes between 0 and 50 years old with a tail to 80 years old for all available mixed upland deciduous stands in this management area. Maintaining lower acreage in old age classes continues to be desirable to ensure the mixed upland deciduous cover type is distributed within the desired age classes.

The end of the planning period will result in the establishment of 412 acres which is the desired amount of regeneration in the upcoming 0-9 age class given the amount of available acres (Figure 14). Progress toward the long-term age class distribution of mixed upland deciduous will take many decades in the management area.

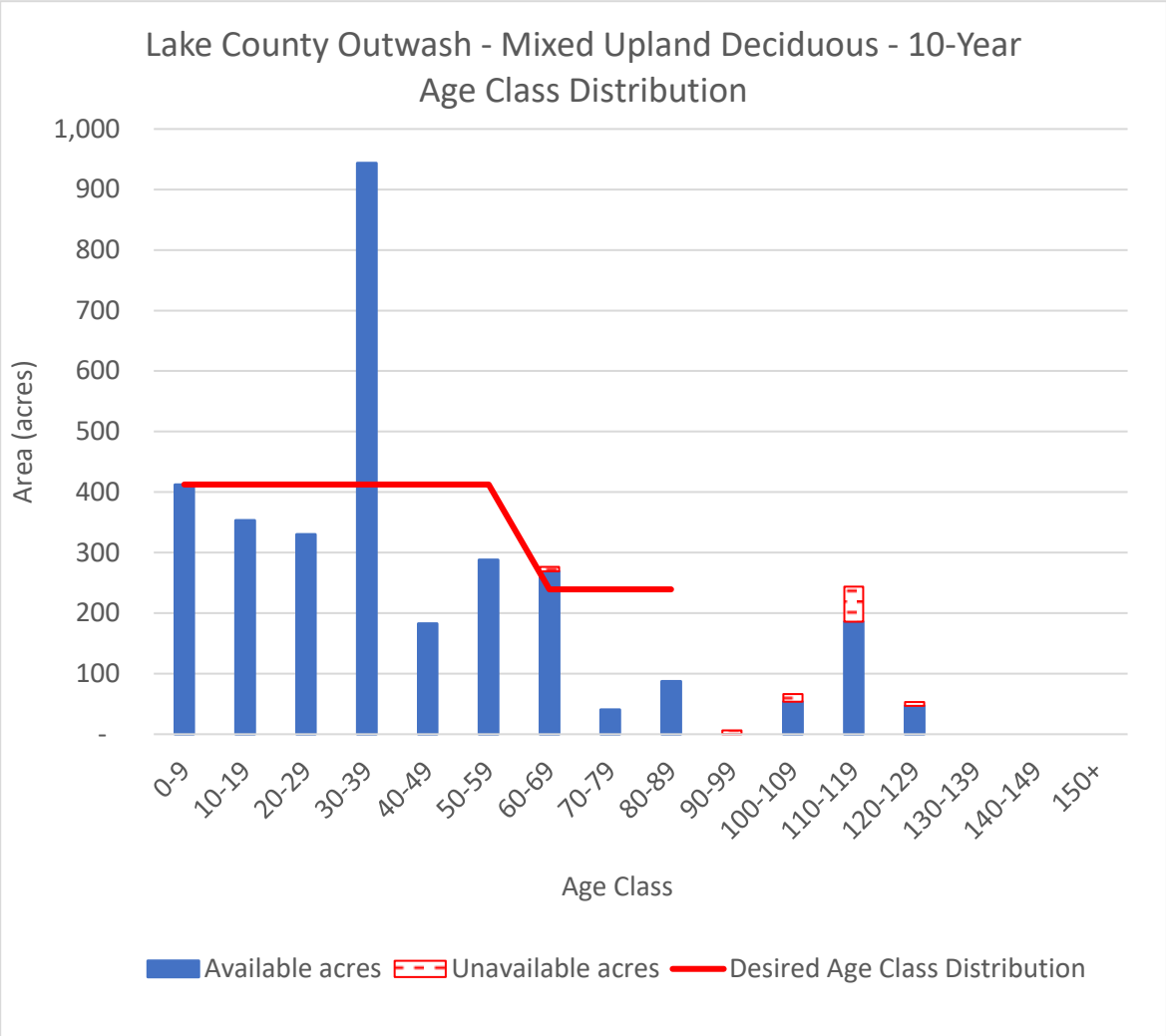


Figure 14. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of mixed upland deciduous acres nearly reaching the desired future condition with only a few age classes deviating from the target proportions (Figure 15). As is often the case, an unbalanced condition in the first planning period can often result in the need to carry some acres slightly longer into older age classes to achieve the desired age class goals.

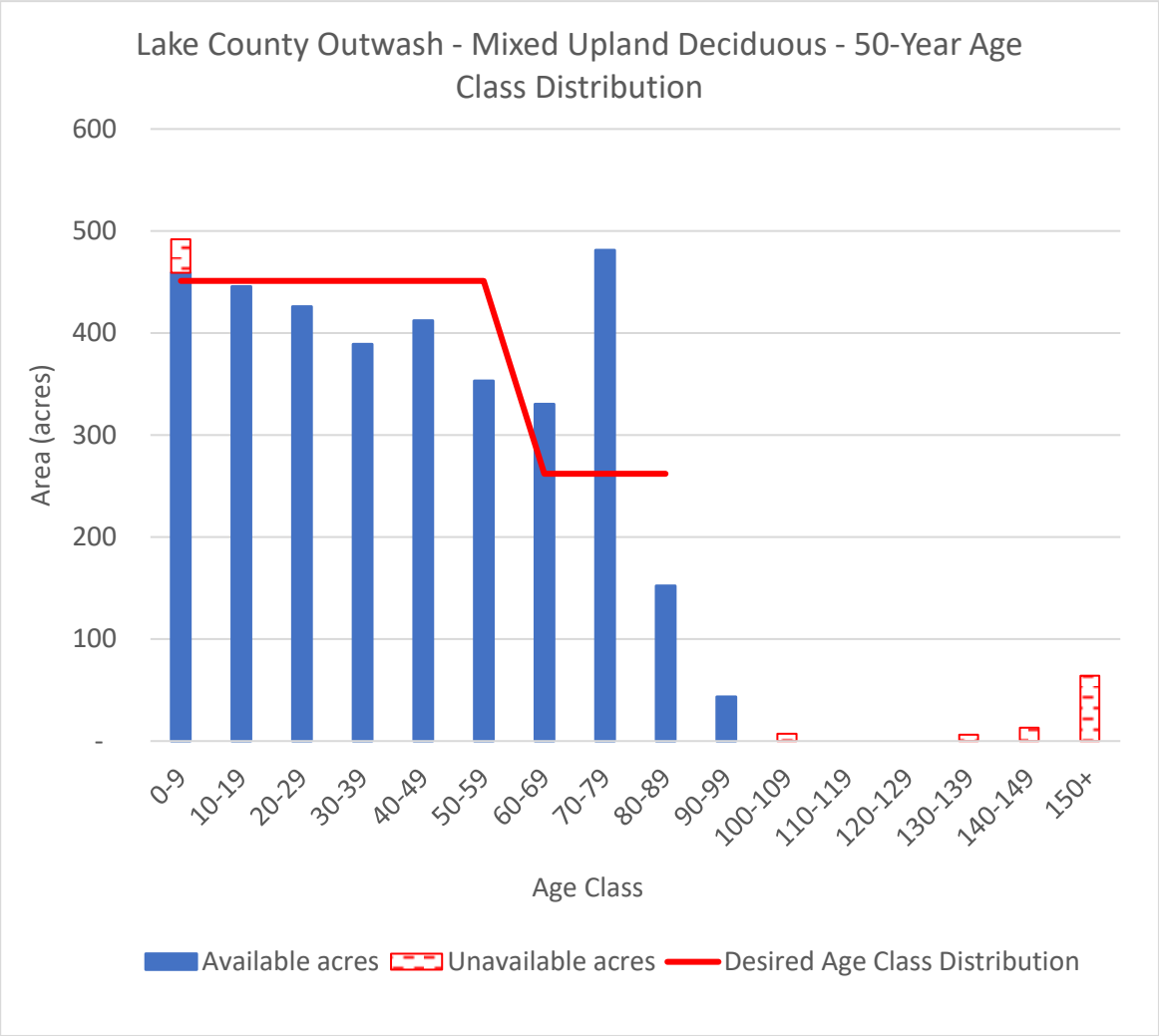


Figure 15. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 16) will concentrate the manageable acres of mixed upland deciduous in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest (Figure 17).

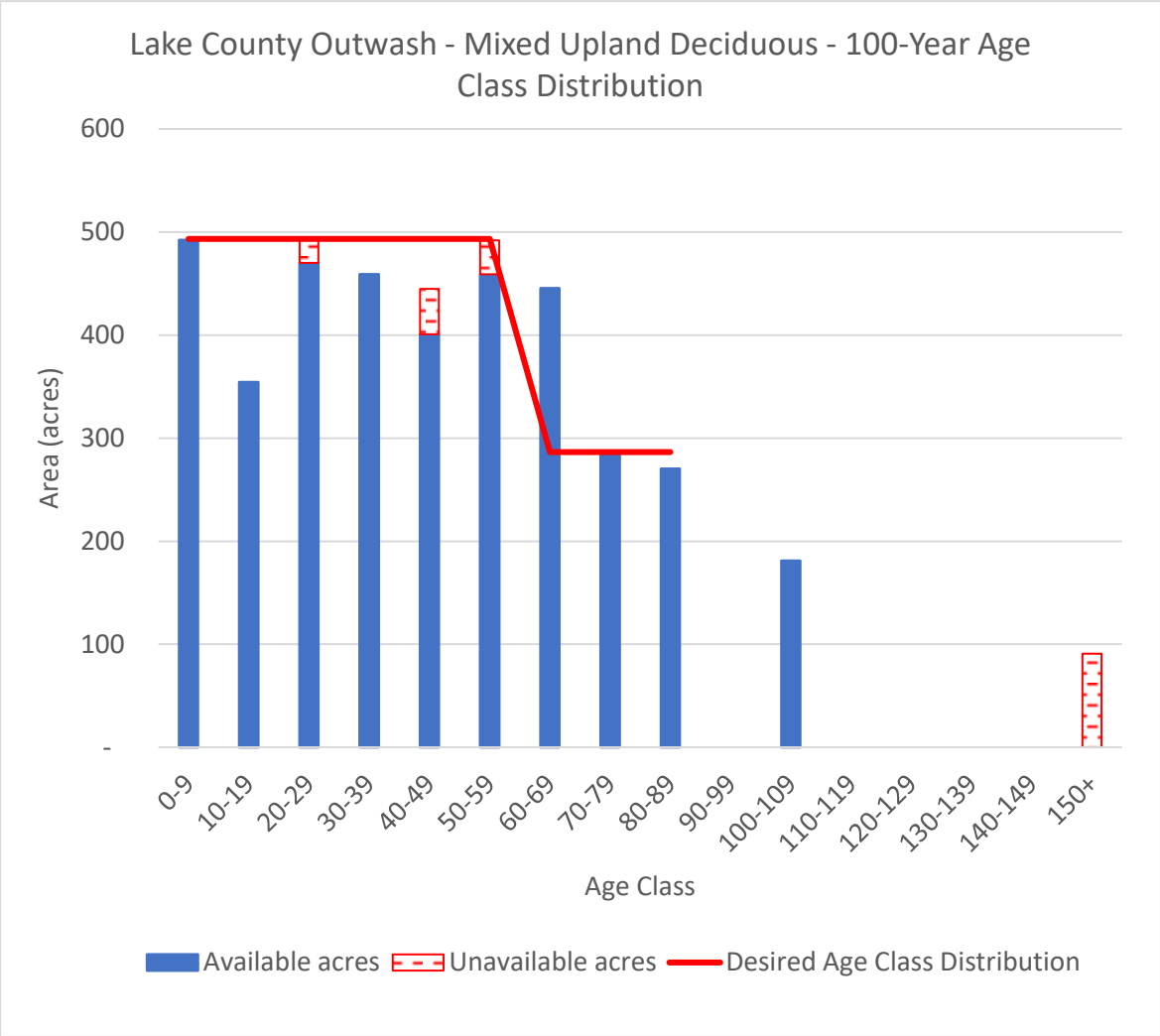


Figure 16. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

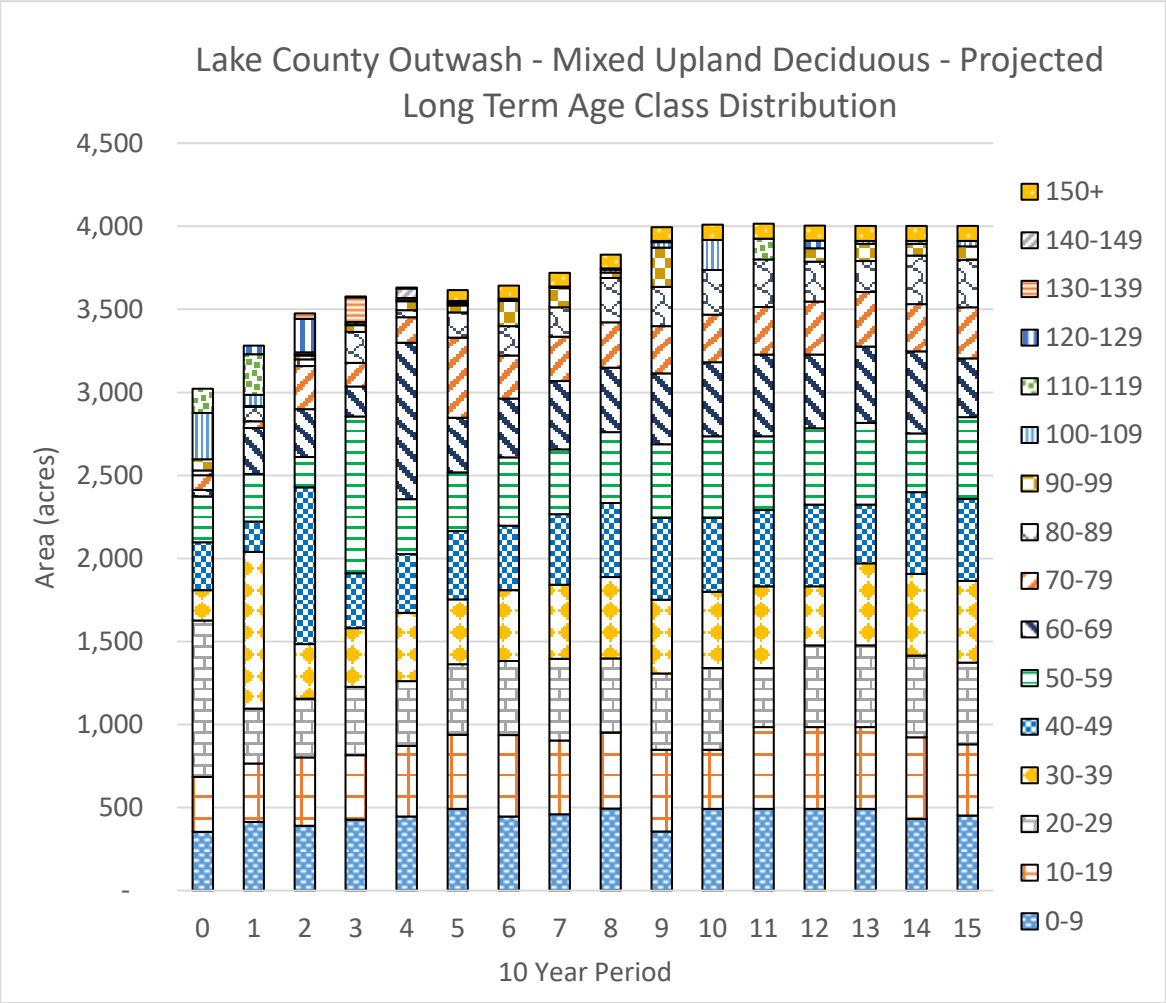


Figure 17. Projected age class distribution for all acres of mixed upland deciduous over the next 150 years.

Management actions

There are 135 acres of projected clearcut harvest and 125 acres of shelterwood in the mixed upland deciduous cover type during this planning period. This falls short of the desired establishment of 412 acres per decade because of the current unbalanced condition and a projected 260 acres converting into mixed upland deciduous from other cover types like black red hybrid oak.

Conservation area network

High conservation value areas

There are up to nine different high conservation value area (HCVA) types that can be found in each management area (Table 12; see Biodiversity in Section 3 for more information).

Table 12. High conservation value areas within the Lake County Outwash Management Area.

High Conservation Value Area Type and Name	Acres
Eastern Massasauga Managed Land	**10,034**
--	10,034
Natural Rivers Vegetative Buffer	**232**
--	232
Natural Rivers Zoning District	**878**
--	878
State Wildlife Management Areas	**38**
Widewaters Flooding SWMA	38
Grand Total	**11,182**

Ecological reference areas

Ecological reference areas (ERAs) are a type of HCVA and are higher quality examples of functioning ecosystems that are primarily influenced by natural ecological processes. There are no existing ERAs in the management unit.

Special conservation areas

Reviewable special conservation areas (SCAs; Table 13) refers to those SCA types that may be reviewed or updated through the compartment review process as needed. Static SCAs (Table 14) refers to those SCA types that generally do not change or require updating (see Biodiversity in Section 3 for more information).

Table 13. Reviewable special conservation areas within the Lake County Outwash Management Area.

Reviewable Special Conservation Area Type and Name	Acres
Concentrated Recreational Area	**50**
Bray Creek Campground	5
Leverentz Lake Campground	17
Leverentz Lake State Forest Campground	28
Little Manistee Motorcycle Trail and Route	1
Grand Total	**50**

Table 14. Static special conservation areas within the Lake County Outwash Management Area.

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Common Natural Heritage Element Occurrences	**-**	**6**
Poor Conifer Swamp	-	6
Designated Trout and Cold Water Stream Buffer	**-**	**869**
	-	422
Baldwin River	-	139
Little Manistee River	-	101
North Branch Cole Creek	-	36
North Branch Twin Creek	-	81
Sanborn Creek	-	10
South Branch Cole Creek	-	30
Syers Creek	-	25
Twin Creek	-	25
Designated Trout and Coldwater Streams	**32.7**	**-**
--	15.9	-
Baldwin River	5.2	-
Little Manistee River	3.8	-
North Branch Cole Creek	1.3	-
North Branch Twin Creek	3.1	-
Sanborn Creek	0.4	-
South Branch Cole Creek	1.1	-
Syers Creek	0.9	-
Twin Creek	0.9	-
Wood Turtle Stream 100ft Buffer	**-**	**26**
Little Manistee River	-	26
Wood Turtle Stream 660ft Buffer	**-**	**172**
Little Manistee River	-	172
Grand Total	**32.7**	**1,074**

Rare species

Rare species occurrences are compiled from the Michigan Natural Features Inventory Biotics database (*Table 15*, Table 17 and Table 18) and do not necessarily include all rare species found in this management area due to biases in survey effort and verifiable observation reporting over time.

Table 15. Rare animal and plant species conservation status key.

Status	Status
E = endangered	LE = listed endangered
T = threatened	LT = listed threatened
SC = special concern	PDL = proposed for delisting

Table 16. Rare animal occurrence in the Lake County Outwash Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Atrytonopsis hianna	Dusted skipper	SC	-	1
Animal	Bombus terricola	Yellow banded bumble bee	SC	-	1
Animal	Erynnis martialis	Mottled duskywing	SC	-	1
Animal	Gavia immer	Common loon	T	-	2
Animal	Glyptemys insculpta	Wood turtle	T	-	2
Animal	Haliaeetus leucocephalus	Bald eagle	SC	-	1
Animal	Hesperia metea	Cobweb skipper	SC	-	1
Animal	Lepyronia gibbosa	Great Plains spittlebug	SC	-	1
Animal	Lithobates palustris	Pickerel frog	SC	-	1
Animal	Sistrurus catenatus	Eastern massasauga	T	LT	3
Total	-	-	-	-	**14**

Table 17. Rare plant occurrence in the Lake County Outwash Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Plant	Cirsium hillii	Hill's thistle	SC	-	3
Plant	Poa paludigena	Bog bluegrass	SC	-	1
Plant	Sisyrinchium strictum	Blue-eyed-grass	T	-	1
Total	-	-	-	-	**5**

Table 18. Other rare occurrence in the Lake County Outwash Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Other	Great Blue Heron Rookery	Great Blue Heron Rookery	-	-	1
Total	-	-	-	-	1

Non-ecological reference area natural communities

Natural communities that are identified with an element occurrence in the MNFI Biotics database, but that have not been given an additional ecological reference area (ERA) designation, are recognized and managed accordingly (Table 19).

Table 19. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 20. Non-ecological reference area natural communities in the Lake County Outwash Management Area.

Community Type	Element Occurrence Rank	State Rank	Global Rank	Number of Occurrences
Dry-mesic Northern Forest	C	S3	-	6
Dry-mesic Northern Forest	-	S3	-	2
Muskeg	-	S3	-	2
Northern Shrub Thicket	BC	S5	G4	1
Northern Wet Meadow	BC	S4	G4G5	2
Poor Conifer Swamp	B	S4	G4	1
Poor Conifer Swamp	C	S4	G4	2
Rich Conifer Swamp	C	S3	-	2
Rich Conifer Swamp	D	S3	-	2
Grand Total	**-**	**-**	**-**	**20**

Forest health

Forest health concerns, both native and non-native, can have impacts on stand conditions and management decisions. The following insects (Table 21) and diseases (Table 22) could have an impact on management during the planning period and may need to be monitored and/or addressed.

Table 21. Defoliating insects of concern in the Lake County Outwash management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Spongy moth	Lymantria dispar	Non-native	Yes
Forest tent caterpillar	Malacosoma disstria	Native	Yes
Jack pine budworm	Choristoneura pinus	Native	Yes

Watch for lingering ash with potential resistance to emerald ash borer. Monitor young jack and red pine for redheaded pine sawfly damage.

Table 22. Maladies of concern in the Lake County Outwash Management Area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Canker (stem infections)	Various	Various	Yes
Armillaria root rot	Armillaria spp.	Native	-
Oak decline	Various	Various	Yes

Monitor oak for symptoms of oak wilt and follow state land oak wilt guidance. Monitor planted red pine for Heterobasidion root disease and follow disease guidance. Watch for symptoms of beech leaf disease.

Aquatic resources

Riparian habitat

A total of 25 miles of streams and rivers are found in the management area (Table 23). Streams/rivers classified as cold types comprise approximately 100% of the riverine mileage.

Table 23. Classification type and length of streams/rivers found within the management area.

Type	Length (miles)
Cold Stream	18
Cold Small River	1
Cold Transitional Stream	6
Cold Transitional Small River	0
Cold Transitional Large River	0
Warm Transitional Stream	0
Warm Transitional Small River	0
Warm Transitional Large River	0
Warm Stream	0
Warm Small River	0
Warm Large River	0

Lacustrine habitat

Three lakes and ponds of at least 1 surface acre are found in the management area (Table 24).

Table 24. Size and number of lakes and ponds located within the management area.

Lake Size Class (acres)	Number
1-99	2

Lake Size Class (acres)	Number
100-499	1
500+	0

Wetlands

A total of 8,218 acres of wetlands are found in the management area (Table 25). Forested wetlands comprise approximately 98% of wetland types found in the management area.

Table 25. Area of emergent, forested and riverine wetland types found within the management area.

Wetland Type	Acres
Emergent	184
Forested	8,017
Riverine	17

Vernal pools and seeps

A total of 17 acres of vernal pools and seeps have been inventoried in the management area while no areas of seeps have been identified.

Riparian vegetation cover

Lowland shrub/deciduous/conifers are the predominant cover types present in a 100-meter riparian zone located next to streams/rivers in the management area (Table 26).

Table 26. Largest vegetative cover types (i.e., top 10) and area located in a 100-meter buffer of streams/rivers within the management area.

Cover Type	Acres
Lowland Shrub	553
Lowland Deciduous	460
Lowland Conifers	374
Marsh	334
Aspen	185
Lowland Mixed Forest	156
Mixed Upland Deciduous	132
Black-Red Hybrid Oak	126
Upland Mixed Forest	99
Oak Mix	75

Watershed vegetation cover

The management area includes portions of important watersheds of the Baldwin River and Little Manistee River (Table 27 & Table 28). Black-red hybrid oak is a major cover type of the state forest in each watershed.

Table 27. Largest vegetative cover types (i.e., top five) and area of the Baldwin River watershed located within the management area.

Cover Type	Acres
Black-Red Hybrid Oak	2,268
Aspen	2,228
Lowland Deciduous	1,660
Lowland Conifers	1,495
Mixed Upland Deciduous	1,436

Table 28. Largest vegetative cover types (i.e., top five) and area of the Little Manistee River watershed located within the management area.

Cover Type	Acres
Black-Red Hybrid Oak	1,552
Natural Jack Pine	1,346
Planted Red Pine	844
Aspen	806
Mixed Upland Deciduous	742

Recreation

Access for public recreation and management in the Lake County Outwash Management Area is very good with a well-developed road/trail system. This area, north of Baldwin, is heavily used by residents and visitors due to an abundance of outdoor recreation opportunities.

Numerous off-road vehicle trails, from single track motorcycle trails to full-size ORV trails, traverse the area, including the Little Manistee Route and Motorcycle Trail; Lincoln Hills Route and Motorcycle Trail; and a portion of the Tin Cup Route and Motorcycle Trail. Many of the ORV Routes are also snowmobile trails in winter and connect to trails in the adjacent national forest.

The Pere Marquette State Trail (rail-trail) runs parallel to U.S.-10, just south of the management area, from Baldwin to Clare. Other nonmotorized trails in the management area include Pine Valley pathway (8.4 miles), and Sheep Ranch Pathway (4 miles), both designated for hiking and biking.

There are three state forest campgrounds in the Lake County Outwash Management Area, all of which are accessible to ORV use with connections to ORV trails. Carrieville State Forest Campground was developed specifically with the ORV enthusiast in mind.

Table 29. Designated recreation trails by type.

Recreation Category	Recreation Type	# of Miles
Motorized Recreation Trails	ORV (all types) Snowmobile	108.4 51.1
Nonmotorized Recreation Trails	Hiking Equestrian Biking Hunter Access Trails	13.4 0 13.4 0
Total	-	**186.2**

Note: Trail-use types may overlap.

Table 30. State Forest Campgrounds.

State Forest Campground Name	# of sites	ORV Access
Bray Creek	9	X
Carrieville	31	X
Leverentz	18	X

Widewaters Flooding is a 38.4-acre site managed for wildlife.

Boating access sites are available on Big Leverentz Lake and the Baldwin River. There are many more sites in in the vicinity of this management area, providing multiple access points to rivers such as the Baldwin, Little Manistee, Pine and Pere Marquette which are popular for fishing and paddling.

Due to the relative proximity of the Lake County Outwash Management Area to more populated areas of southern Michigan, it is popular for dispersed recreation such as hunting and mushrooming. Because the unit is surrounded by the Manistee National Forest, it adds to the attraction of the area for outdoor recreation.

Table 31. Areas managed for hunting.

Type	State Wildlife Management Area Name	# of Acres
State Wildlife Management Area	Little Widewaters Flooding	38.4

Table 32. Boating access sites.

Name	Waterbody
Big Leverentz Lake **Rockey**	Big Leverentz Lake Baldwin River

Presque Isle Lake and Till Plains

State Forest Area: 283,238 acres	Location: Northeastern Lower Peninsula	Population Centers: Cheboygan Indian River and Atlanta
Subsection: Presque Isle Lake and Till Plains	Landforms: Drumlins Steep, sandy end moraines and Sandy glacial lake plains	Landcover: Forested: 251,067 acres Nonforested: 32,171 acres

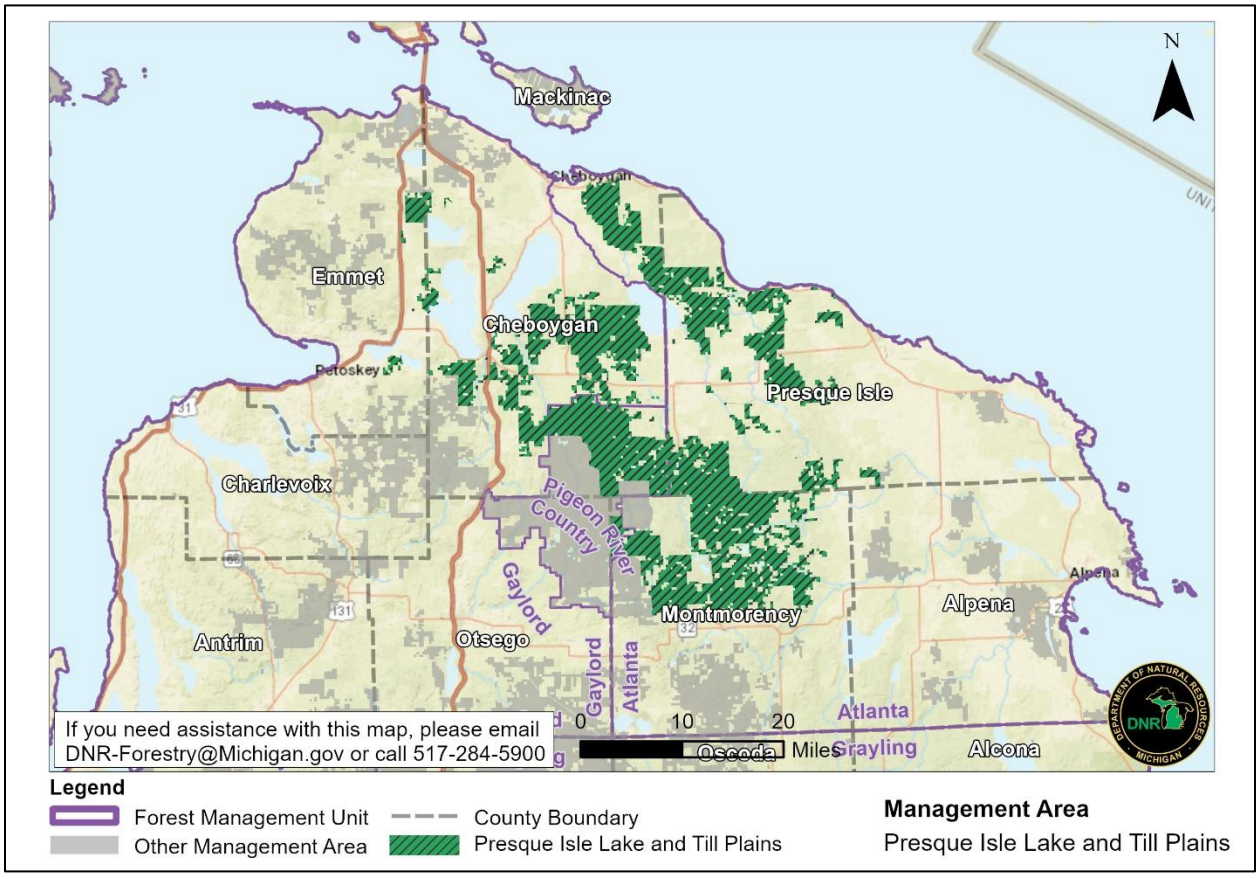


Figure 1. Presque Isle Lake and Till Plains Management Area.

Forested landscape

Current and projected future condition

The Presque Isle Lake and Till Plains Management Area includes a variety of shade tolerance levels occurring mostly in the upland cover types and in the mature age lowland categories (Figure 2). The majority of tolerant cover types occur on unavailable lowlands in the mature age category. Intolerant and mid-tolerant cover types mostly occur on available uplands in all age categories.

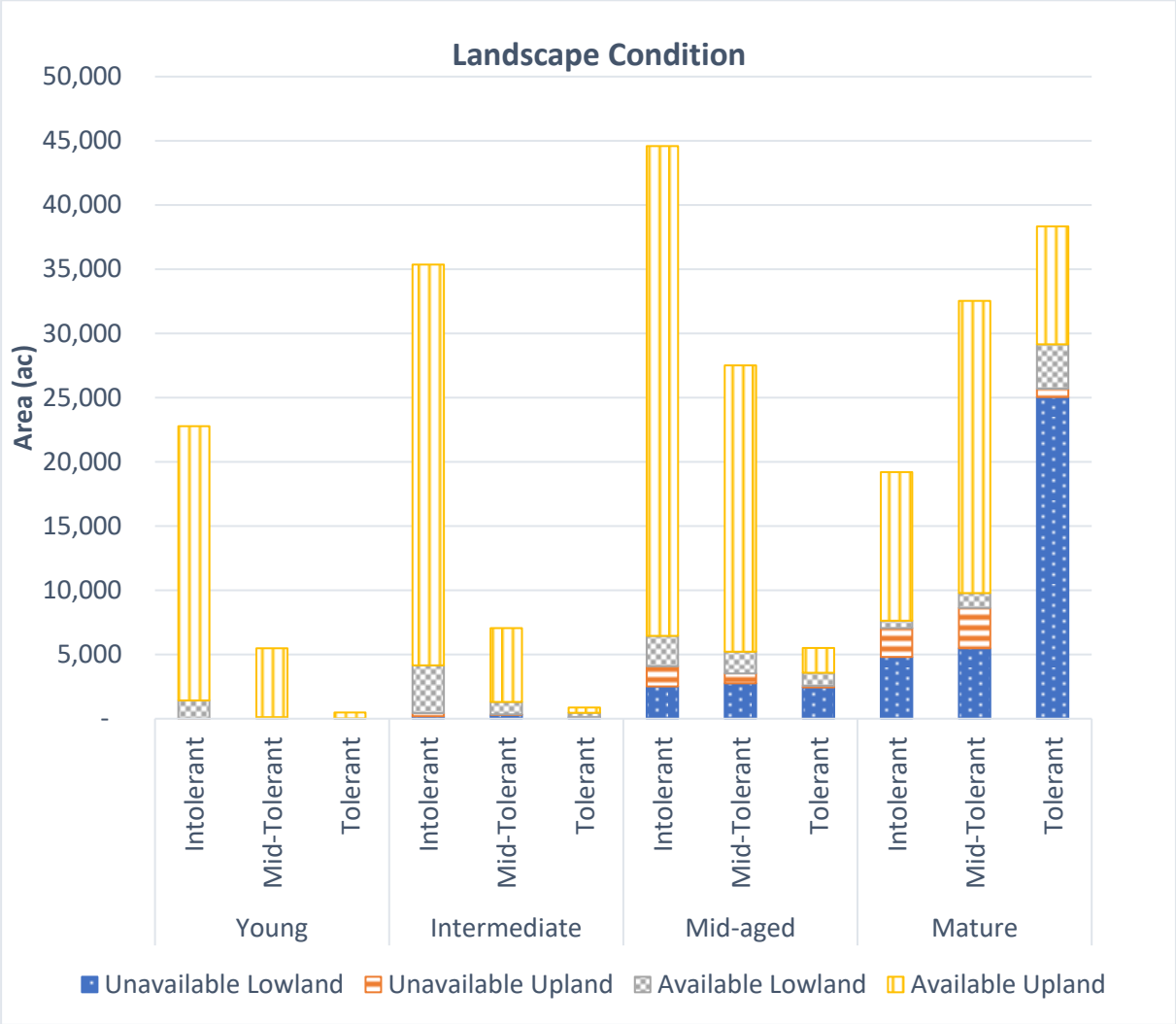


Figure 2. Forest diversity matrix showing the current distribution of forested acres across management availability, age category, landscape position and shade tolerance.

Landscape habitat conditions refine the management area landscape into featured species habitat context. Current and projected acres for the metrics identified in the Management Priorities (Section 3 Statewide/Regional) establish a baseline and future condition based on management over the planning period (Table 1).

Table 1. Current acres for landscape habitat conditions.

Landscape Habitat Condition	Monitoring Metric	Current Acres
Young Forest	Acres of 0-19 stands in Aspen and Jack Pine	21,466
Mature Forest	Acres of 80+ year stands across cover types	86,420
Mature Forest	Acres of 120+ year stands across cover types	7,938
Mesic Conifer Cover types	Acres of mesic conifer cover types	12,328
Mesic Conifers in other Cover types	Average canopy occupancy	41%
Mast – Oak Cover types	Acres of oak cover types	10,915
Mast Tree Species in other Cover types	Acres of total canopy occupancy of mast tree acres (trace-100%)	121,755
Big Trees	Acres of total canopy stand occupancy of species in sawlog or greater size class	129,251
Nonforested Openings	Acres of total herbaceous openland, upland shrub, and cropland	7,128
Landscape Forest Matrix	Percent deciduous forest	52%
Landscape Forest Matrix	Percent coniferous forest	41%

The Presque Isle Lake and Till Plains Management Area has the following special analysis units (SAUs). These SAUs have specific cover type goals, typically associated with wildlife habitat management. For any SAUs that overlap with this management area, SAU cover type goals take priority as the SFMP model strives to meet the cover type goals across the area, ensuring they are met. See Section 5 for a detailed description of the management direction and harvest goals for each of these SAUs.

- Special analysis unit (SAU) – Elk
- Grouse Enhanced Management Site (GEM) – Lee Grande Ranch
- SAU – Kirtland's warbler
- SAU – Pigeon River Country

The Presque Isle Lake and Till Plains Management Area is comprised of 89% forested cover types and 11% nonforested cover types (Table 2). Of the forested cover types, upland landscape is over three times the amount of lowland landscape. The largest contributors to upland cover types are, aspen and planted red pine. Cedar and lowland conifer take up more than 50% of the lowland landscape position. Lowland shrub is the most common nonforested cover type in the management area representing 5% of the landscape.

Table 2. Current landscape context and distribution of cover types.

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
Forested	Upland	Deciduous	Aspen	77,132	112,429	190,104	251,067
			Northern Hardwood	10,119			
			Black Red Hybrid Oak	2,790			
			Northern Red Oak	5,392			
			Oak Mix	3,270			
			Mixed Upland Deciduous	13,727			
		Mixed	Upland Mixed Forest	11,177	11,177		
		Coniferous	Planted Red Pine	24,199	66,498		
			Planted Jack Pine	14,657			
			Planted White Pine	131			
			Planted Mixed Pine	1,295			
			Natural Red Pine	5,943			
			Natural Jack Pine	7,952			
			Natural White Pine	1,979			
			Natural Mixed Pines	7,750			
			Upland Spruce/Fir	623			
			Upland Conifers	1,724			
			Hemlock	244			
	Lowland	Deciduous	Lowland Aspen/Balsam Poplar	10,858	18,885	60,963	
			Lowland Deciduous	8,028			
		Mixed	Lowland Mixed Forest	4,958	4,958		
		Coniferous	Cedar	16,604	37,120		
			Lowland Conifers	15,938			
			Lowland Spruce/Fir	3,382			
			Tamarack	1,195			
Nonforested	Upland	N/A	Herbaceous Openland	4,369	N/A	10,297	32,171
			Upland Shrub	2,258			
			Low Density Trees	1,072			
			Bare/Sparsely Vegetated	770			
			Cropland	501			
			Urban	1,327			
	Lowland	N/A	Lowland Shrub	13,018	N/A	21,874	
			Marsh	3,816			
			Bog	552			
			Treed Bog	1,227			
			Water	3,260			
						Grand Total:	**283,238**

There are 198,505 acres (70% of the total management area and 79% of the forested area) that can be managed toward desired future conditions via commercial timber harvest in the Presque Isle Lake and Till Plains Management Area (Table 3). Of that, over 29.8% is in the aspen cover type, 9.4% in planted red pine, 5.8% in planted jack pine, and 5% in mixed upland deciduous. The remaining 21 cover types represent less than 4% each of the forested and available land in the management area. Acres unavailable for management are categorized by site condition (Table 4).

Table 3. Current cover type composition by management availability.

PRESQUE ISLE LAKE AND TILL PLAIN Forested Cover Type	Available Acres	Available %	Unavailable Acres	Unavailable %	Total Acres	Total %
Aspen	74,844	29.8%	2,300	0.9%	77,144	30.7%
Black Red Hybrid Oak	2,559	1.0%	231	0.1%	2,790	1.1%
Cedar	2,288	0.9%	14,320	5.7%	16,608	6.6%
Hemlock	80	0.0%	164	0.1%	244	0.1%
Lowland Aspen/Balsam Poplar	7,352	2.9%	3,507	1.4%	10,859	4.3%
Lowland Conifers	2,467	1.0%	13,471	5.4%	15,939	6.3%
Lowland Deciduous	2,198	0.9%	5,832	2.3%	8,030	3.2%
Lowland Mixed Forest	2,207	0.9%	2,752	1.1%	4,959	2.0%
Lowland Spruce/Fir	452	0.2%	2,931	1.2%	3,383	1.3%
Mixed Upland Deciduous	12,484	5.0%	1,245	0.5%	13,729	5.5%
Natural Jack Pine	7,386	2.9%	568	0.2%	7,954	3.2%
Natural Mixed Pines	6,814	2.7%	940	0.4%	7,754	3.1%
Natural Red Pine	5,387	2.1%	561	0.2%	5,948	2.4%
Natural White Pine	1,785	0.7%	195	0.1%	1,980	0.8%
Northern Hardwood	9,781	3.9%	340	0.1%	10,121	4.0%
Northern Red Oak	5,012	2.0%	383	0.2%	5,394	2.1%
Oak Mix	3,195	1.3%	75	0.0%	3,270	1.3%
Planted Jack Pine	14,584	5.8%	74	0.0%	14,658	5.8%
Planted Mixed Pine	1,276	0.5%	20	0.0%	1,296	0.5%
Planted Red Pine	23,671	9.4%	539	0.2%	24,210	9.6%
Planted White Pine	122	0.0%	9	0.0%	131	0.1%
Tamarack	166	0.1%	1,030	0.4%	1,195	0.5%
Upland Conifers	1,204	0.5%	521	0.2%	1,725	0.7%
Upland Mixed Forest	10,725	4.3%	456	0.2%	11,181	4.5%
Upland Spruce/Fir	464	0.2%	161	0.1%	625	0.2%
Grand Total	**198,505**	**79.0%**	**52,622**	**21.0%**	**251,127**	**100.0%**

Table 4. Site conditions for unavailable acres.

Site Condition (Reason area is unavailable for commercial harvest)	Area (ac)	% of unavailable Area
Too Wet	32,152	61.1%
Conservation Values	6,111	11.6%
BMPs	4,547	8.6%
Cannot Regenerate	1,633	3.1%
Long-Term Retention	1,603	3.0%
Species of special concern or T&E	1,237	2.4%
Blocked by Obstacle	1,095	2.1%
Rare Landforms	933	1.8%
Other Dept./Div. Processes	905	1.7%
Too Steep	834	1.6%
Recreational/Scenic	727	1.4%
Denied Access	360	0.7%
Unproductive	332	0.6%
Other Influence Zones	64	0.1%
Wildlife Concerns	55	0.1%
Non-Military Lease/Easement	18	0.0%
Neighbor / Interest Group	15	0.0%
Total Unavailable	**52,622**	**100.0%**

Projected 10-year cover type management actions

Each cover type in the Presque Isle Lake and Till Plains Management Area has a unique age class and basal area class goals that describe the long-term desired future conditions. The calculated harvest levels that are needed during the first 10-year planning period are summarized in Table 5. These harvest levels are necessary to begin achieving long-term planning goals. This will help establish a desirable amount of regeneration for the even-aged cover types over the 10-year period or help to achieve desired basal area distribution among uneven-aged cover types like northern hardwoods. Implementing these silvicultural regimes will yield 799,634 cords, the planned harvest volume for the decade (Table 6).

Table 5. Ten-year planning period harvest goals (acres) by cover type and silvicultural regime.

Silvicultural Regimes								
Cover Type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Salvage Clearcut	Salvage Thinning	Grand Total
Planted Red Pine	1,977	-	6,372	-	-	1,298	1,931	11,577
Aspen	8,181	-	-	-	-	410	-	8,592
Upland Mixed Forest	2,154	-	-	-	-	-	-	2,154
Mixed Upland Deciduous	1,765	-	-	-	-	-	-	1,765
Lowland Aspen/Balsam Poplar	1,710	-	-	-	-	-	-	1,710
Northern Hardwood	-	130	-	64	-	350	999	1,544
Northern Red Oak	951	-	-	78	-	-	-	1,029
Natural Mixed Pines	-	-	297	-	452	-	185	933
Planted Jack Pine	-	-	-	-	-	916	-	916
Natural Jack Pine	77	-	-	-	-	668	-	744
Black Red Hybrid Oak	416	-	-	-	34	-	-	451
Lowland Conifers	419	-	-	-	-	-	-	419
Natural White Pine	-	-	192	-	190	-	-	382
Lowland Deciduous	210	46	-	-	31	-	-	287
Planted Mixed Pine	-	-	235	-	-	-	-	235
Natural Red Pine	-	-	57	-	104	-	46	207
Lowland Mixed Forest	186	-	-	-	-	-	-	186
Lowland Spruce/Fir	108	-	-	-	-	-	-	108
Cedar	76	-	-	32	-	-	-	108
Planted White Pine	-	-	86	-	-	-	-	86
Upland Spruce/Fir	78	-	-	-	-	-	-	78
Tamarack	32	-	-	-	-	-	-	32
Hemlock	-	11	-	-	-	-	-	11
Totals	**18,341**	**187**	**7,237**	**173**	**811**	**3,642**	**3,161**	**33,552**

Table 6. Projected 10-year harvest volume by species.

10-Year Estimated Harvest Volume Projection Presque Isle Lake and Till Plains Management Area			
Product	**Species**	**Volume Planned***	**Volume Prepared****
Pulpwood (cords)	Mixed Aspen	83,843	78,813
	Red Pine	71,320	67,041
	Mixed Hardwood	67,317	63,278
	Mixed Spruce	24,304	22,846
	Mixed Softwood	22,822	21,452
	Jack Pine	22,619	21,262
	Mixed Oak	13,515	12,704
	White Pine	9,136	8,588
	Pulpwood Total	**314,876**	**295,984**
Sawtimber (MBF)	Red Pine	82,428	77,482
	Mixed Aspen	26,027	24,466
	Red Oak	18,369	17,267
	White Pine	15,731	14,787
	Red Maple	7,739	7,274
	Sugar Maple	5,542	5,209
	White Oak	5,499	5,169
	Mixed Oak	2,635	2,477
	Basswood	689	647
	Sawtimber Total	**164,659**	**154,780**
	Total Sawtimber Harvest Volume in Cords	**484,758**	**455,673**
	Grand Total Harvest Volume in Cords	**799,634**	**751,656**
* Volume estimates based on 100% of the projected harvests for the 10-year planning period. ** Volume estimates based on 94% of the projected harvests for the 10-year planning period accounting for reduction in acres and associated volume once sales are prepared for bid.			

There are a few cover type transitions projected for the Presque Isle Lake and Till Plains Management Area (Table 7). The largest decreases are 1,016 acres of planted red pine and 735 acres of northern red oak will convert to other cover types like aspen and planted jack pine. The largest increase occurs in the

aspen and planted jack pine cover types where 1,498 acres are projected to convert into aspen and 513 into planted jack pine cover types.

Table 7. Projected 10-year cover type acres resulting from cover type transitions.

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Aspen	77,132	78,630	1,498
Planted Red Pine	24,199	23,183	-1,016
Cedar	16,604	16,604	0
Lowland Conifers	15,938	15,805	-133
Planted Jack Pine	14,657	15,170	513
Mixed Upland Deciduous	13,727	13,610	-117
Upland Mixed Forest	11,177	10,991	-186
Lowland Aspen/Balsam Poplar	10,858	10,882	25
Northern Hardwood	10,119	10,197	78
Lowland Deciduous	8,028	8,026	-1
Natural Jack Pine	7,952	8,026	74
Natural Mixed Pines	7,750	7,867	117
Natural Red Pine	5,943	5,982	39
Northern Red Oak	5,392	4,658	-735
Lowland Mixed Forest	4,958	5,114	156
Lowland Spruce/Fir	3,382	3,336	-46
Oak Mix	3,270	3,282	13
Black Red Hybrid Oak	2,790	2,582	-208
Natural White Pine	1,979	1,979	0
Upland Conifers	1,724	1,724	0
Planted Mixed Pine	1,295	1,295	0
Tamarack	1,195	1,195	0
Upland Spruce/Fir	623	553	-70
Hemlock	244	244	0
Planted White Pine	131	131	0
Lowland Shrub	13,018	13,018	0
Herbaceous Openland	4,369	4,369	0
Marsh	3,816	3,816	0
Water	3,260	3,260	0
Upland Shrub	2,258	2,258	0
Urban	1,327	1,327	0
Treed Bog	1,227	1,227	0
Low Density Trees	1,072	1,072	0
Bare/Sparsely Vegetated	770	770	0
Bog	552	552	0
Cropland	501	501	0
Total:	**283,238**	**283,238**	**0**

Featured species current and projected habitat acres

There are 10 featured species in this management area that span various cover types, age classes and stand level conditions. Current and projected total habitat acres by species across the decade provide a baseline and show the result of long-term management actions (

). As noted in the Featured Species Management Priority (Section 3), it is recommended that these

Featured Species	Priority Cover Types	Total Habitat Acres Current	Total Habitat Acres 10-year	50-year Projected Habitat Acres	100-year Projected Habitat Acres
American Woodcock	Aspen, lowland aspen, lowland deciduous	34,600	36,417	25,991	25,806
Black Bear	Mast	132,670	--	--	--
Black-Backed Woodpecker	Natural disturbance	--	--	--	--
Elk	Aspen	--	--	--	--
Golden-Winged Warbler	Aspen, black-red hybrid oak, northern red oak, oak mix, tamarack	32,994	33,700	22,138	22,834
Kirtland's Warbler	Jack pine	--	--	--	--
Marten	Northern hardwoods, mixed upland deciduous, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, lowland mixed forest, lowland conifers, hemlock, cedar	58,613	59,751	59,703	64,993
Ruffed Grouse	Aspen	31,319	32,194	21,730	22,529
Snowshoe Hare	Aspen, cedar, hemlock, lowland aspen, lowland conifers, lowland mixed forest, lowland spruce/fir, mixed upland deciduous, natural jack pine, natural mixed pines, planted jack pine, upland spruce/fir	47,231	48,389	35,017	35,994
Wild Turkey	Nonforested openings	4,870	--	--	--
Wood Turtle	Nonforested openings	--	--	--	--

featured species habitat acres be viewed as acres of potential habitat, representing a condition on the landscape where the more nuanced aspects of each species' habitat requirements are likely to be found or managed for. As described in the introduction, the modeling effort was limited by several factors

including the simplification of habitat attributes into MiFI variables. Therefore, when referring to habitat acres what is being referred to is potential habitat acres.

Some species show a loss in habitat over the next century. As mentioned in the Featured Species Management Priority (Section 3), the current condition for many cover types is a surplus of acres in the 0-9 age class from the compensatory management approach applied in the previous decade. The model eventually evens out the age classes at a lower, sustainable level over time, usually by 50 years. For any species with northern hardwoods as a priority cover type, there is a perceived drop in acres between 40 and 60 years; this is due to the basal area dropping below 81 but because it only drops into the upper 70s, it is not expected to translate to any real habitat loss on the ground. Three of these species were not included in the State Forest Management Plan model, black bear, wild turkey and black-backed woodpecker, but are included here to inform management decisions over the decade. Kirtland's warbler and elk habitat are described in the special analysis units (Section 5).

Table 8. Featured species current and projected total habitat acres (e.g., potential habitat).

Featured Species	Priority Cover Types	Total Habitat Acres Current	Total Habitat Acres 10-year	50-year Projected Habitat Acres	100-year Projected Habitat Acres
American Woodcock	Aspen, lowland aspen, lowland deciduous	34,600	36,417	25,991	25,806
Black Bear	Mast	132,670	--	--	--
Black-Backed Woodpecker	Natural disturbance	--	--	--	--
Elk	Aspen	--	--	--	--
Golden-Winged Warbler	Aspen, black-red hybrid oak, northern red oak, oak mix, tamarack	32,994	33,700	22,138	22,834
Kirtland's Warbler	Jack pine	--	--	--	--
Marten	Northern hardwoods, mixed upland deciduous, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, lowland mixed forest, lowland conifers, hemlock, cedar	58,613	59,751	59,703	64,993
Ruffed Grouse	Aspen	31,319	32,194	21,730	22,529
Snowshoe Hare	Aspen, cedar, hemlock, lowland aspen, lowland conifers,	47,231	48,389	35,017	35,994

Featured Species	Priority Cover Types	Total Habitat Acres Current	Total Habitat Acres 10-year	50-year Projected Habitat Acres	100-year Projected Habitat Acres
	lowland mixed forest, lowland spruce/fir, mixed upland deciduous, natural jack pine, natural mixed pines, planted jack pine, upland spruce/fir				
Wild Turkey	Nonforested openings	4,870	--	--	--
Wood Turtle	Nonforested openings	--	--	--	--

Cover type composition and associated featured species

Aspen

Current condition

The largest age class of the aspen cover type is currently in the 0- to 9-year-old class (Figure 3). The past management regime has been primarily clearcut for this cover type. The 10-19 and 20-29 age classes have a deficit, and the older age classes are fairly evenly distributed. With the exception of the age class spike in the 0- to 9-year-old class that currently compensates for the small deficits in the 10-19 and 20-29, the aspen age distribution is very uniform. This current planning period will continue to smooth out the distribution of the aspen in this management area.

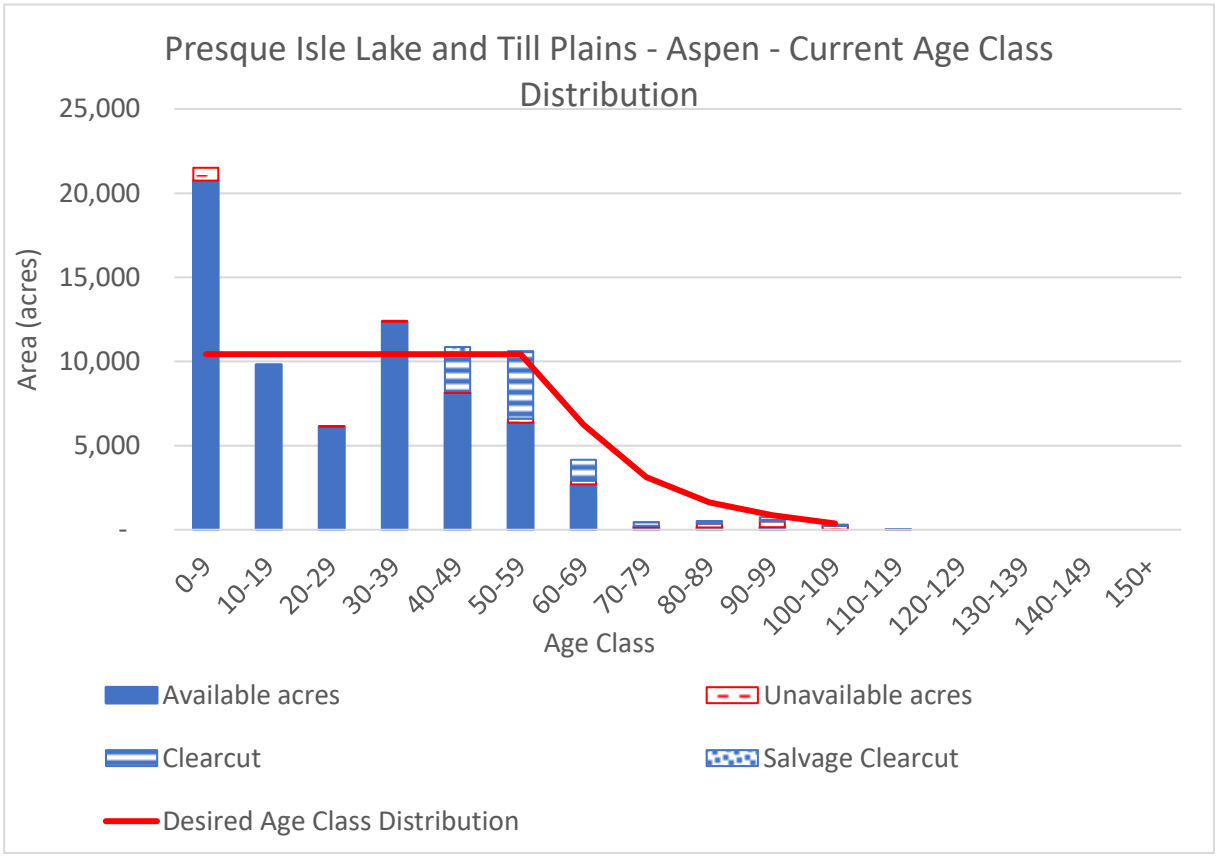


Figure 3. Current age class distribution, the desired age class distribution, and the projected harvests in the aspen cover type over the 10-year planning period.

Current conditions are a result of consistent commercial harvests and regeneration efforts on available aspen acres during the previous planning periods. A portion of this cover type meets the habitat requirements for American woodcock, golden-winged warbler, ruffed grouse and snowshoe hare (Table 9).

Table 9. Featured species with aspen as a priority habitat cover type, habitat variables and current acres (e.g., potential habitat).

Featured Species	Featured Species Habitat – Aspen	Aspen Habitat Acres - Available	Aspen Habitat Acres - Unavailable
Golden-Winged Warbler	Age Category: 0-19 Size Class: Sapling	30,577	742
Ruffed Grouse	Age Category: 0-19 Size Class: Sapling	30,577	742
Snowshoe Hare	Age Category: 0-19 Size Class: Sapling	30,577	742

Desired future condition

The projected long-term cover type trend for aspen is stable in the Presque Isle Lake and Till Plains Management Area. There are a few transitions totaling 1,498 acres into the aspen cover type from other cover types forecasted in the planning period. This will contribute to the 0-9 age class goal in the aspen cover type in the first 10-year planning period.

The long-term goal for this cover type is balanced age classes between 0 and 60 years old for all available aspen stands in this management area. Maintaining lower acreage in old age classes continues to be desirable to ensure the aspen cover type is distributed within the desired age classes.

The end of the planning period will result in the establishment of the desired amount of regeneration in in the upcoming 0-9 age class (Figure 4). Progress toward the long-term age class distribution of aspen will take several decades in the management area.

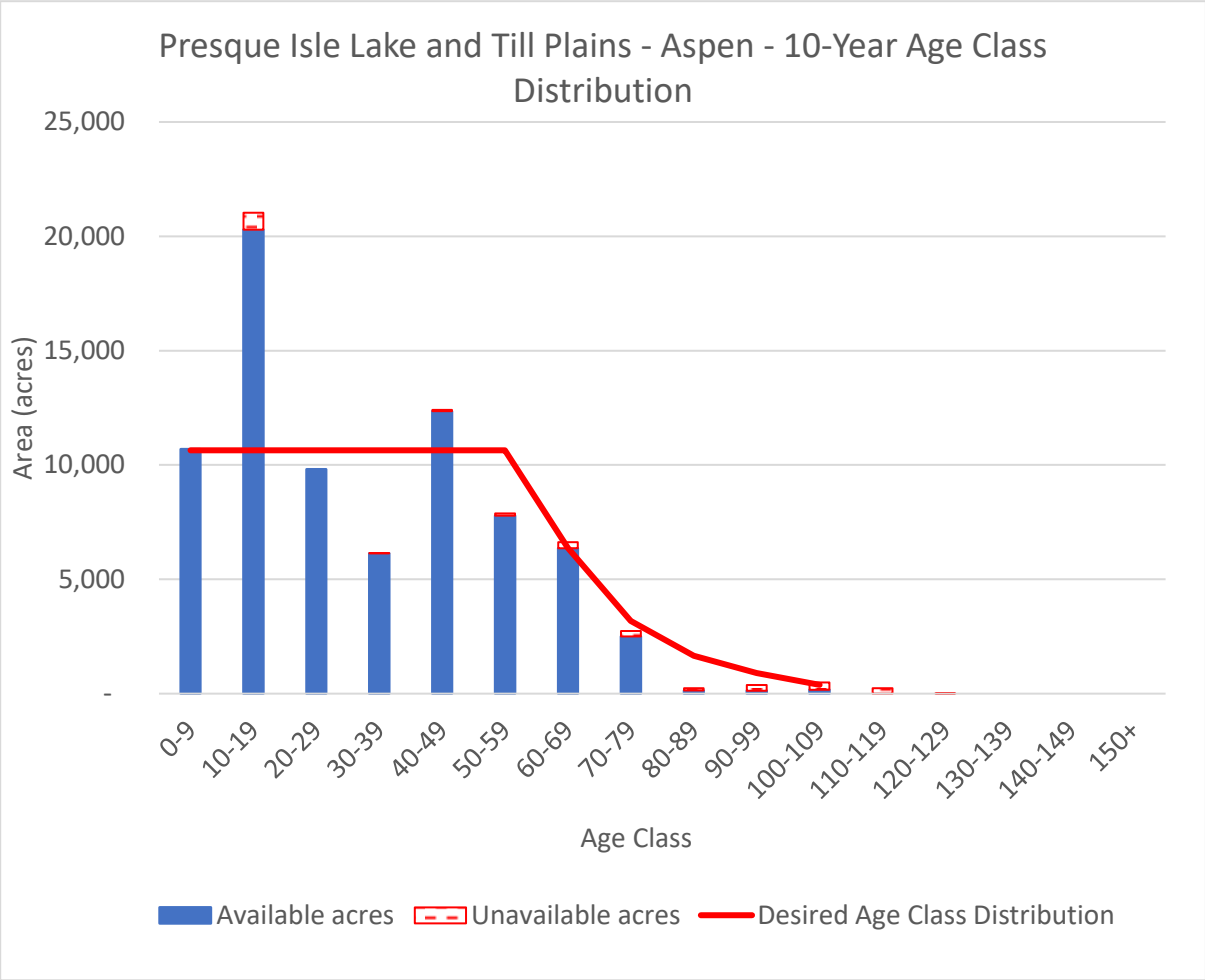


Figure 4. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of aspen acres has reached the desired future condition (Figure 5).

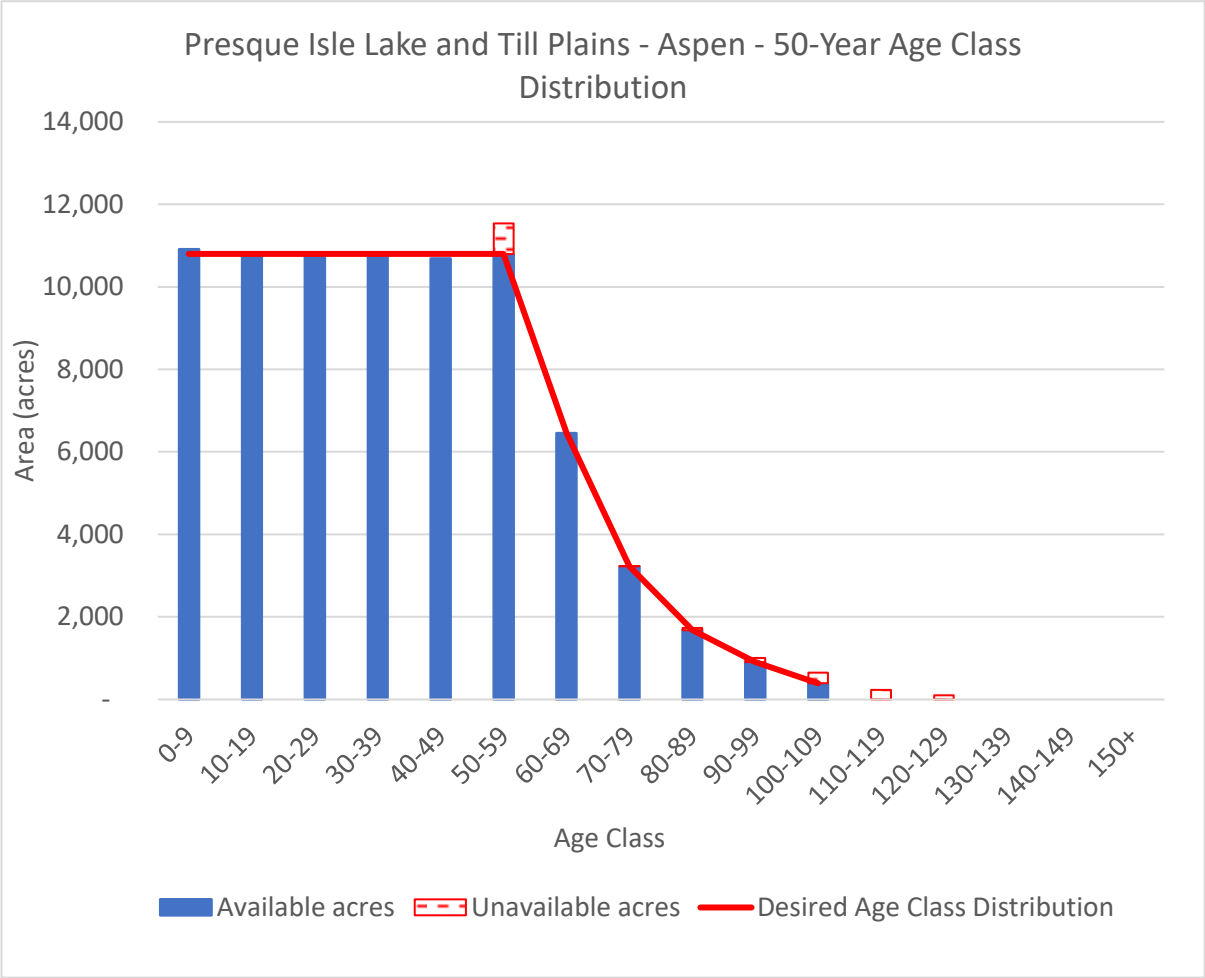


Figure 5. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 6) will concentrate the manageable acres of aspen in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest (Figure 7).

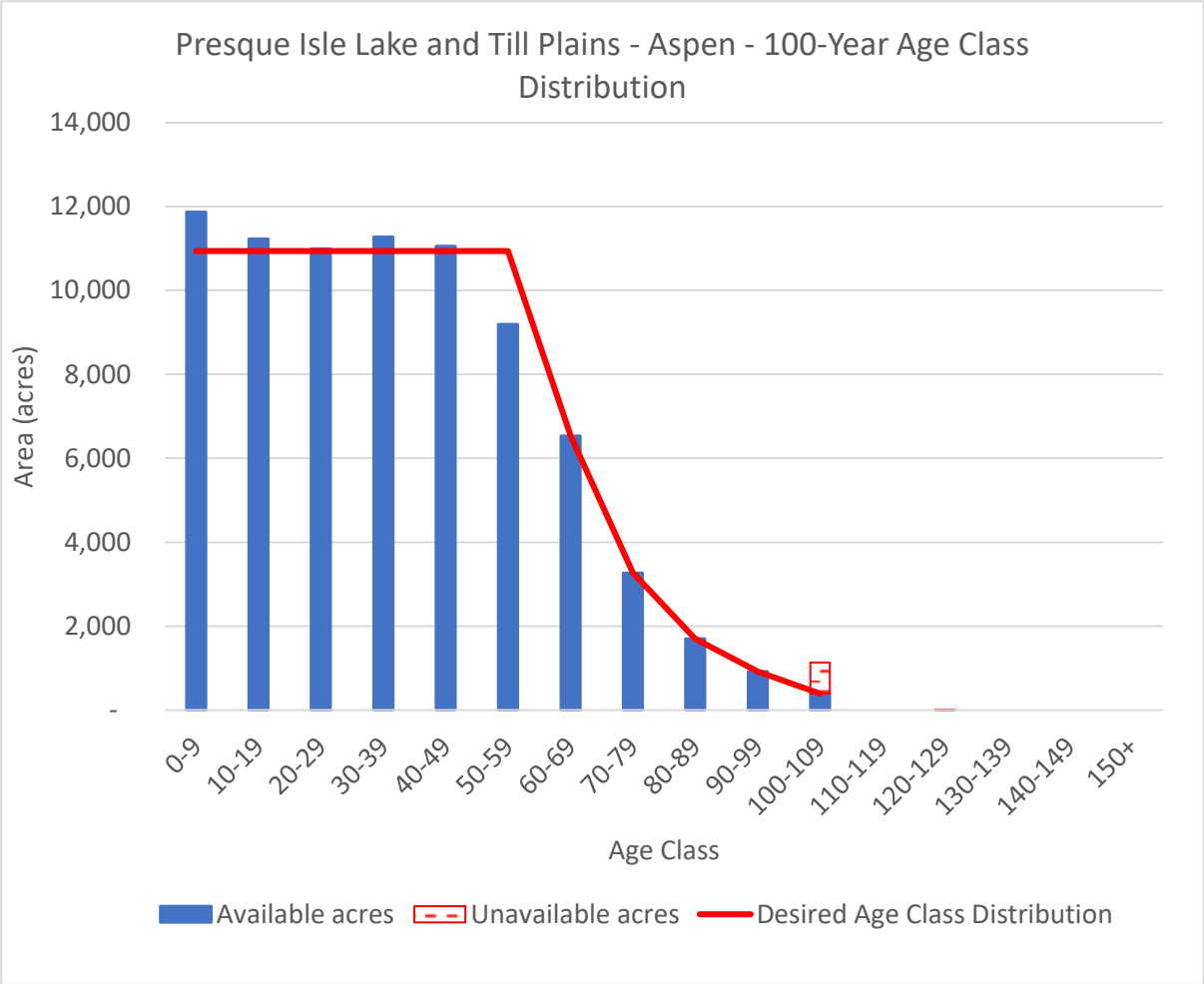


Figure 6. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

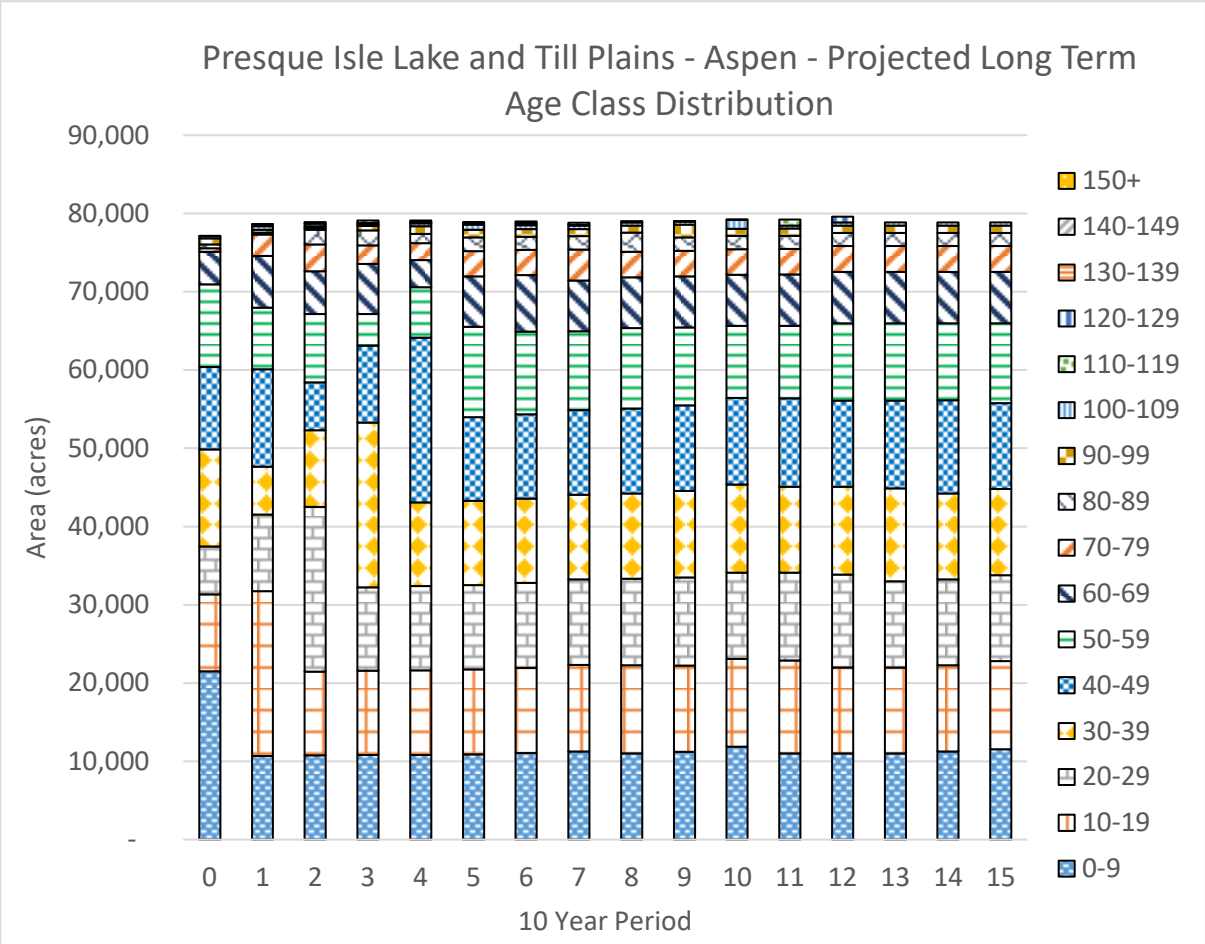


Figure 7. Projected age class distribution for all acres of aspen over the next 150 years.

Management actions

There are 8,181 acres of projected clearcut harvest and 410 acres of salvage clearcut in the aspen cover type during this planning period. This plus the 1,498 acres that are projected to transition into aspen from other cover types and approximately 469 acres that are forecasted to regenerate naturally from severe ice storm damage will be close to the 10-year goal of 10,645 acres of desired establishment of aspen acres in this management area.

Planted red pine

Current condition

Most of the planted red pine cover type is currently in the 0- to 9-year-old age class and the 60- to 100-year-old age classes in the Presque Isle Lake and Till Plains Management Area (Figure 8). The age class distribution is currently unbalanced, especially in the 0-9 years old age classes where the bulk of acres occur. There is a deficit in all the five age classes from 10 to 59 years old, where the 0-9 age class will compensate for some of those deficits. Harvesting older age classes will continue to regenerate the desired amount of planted red pine over the next 10 years.

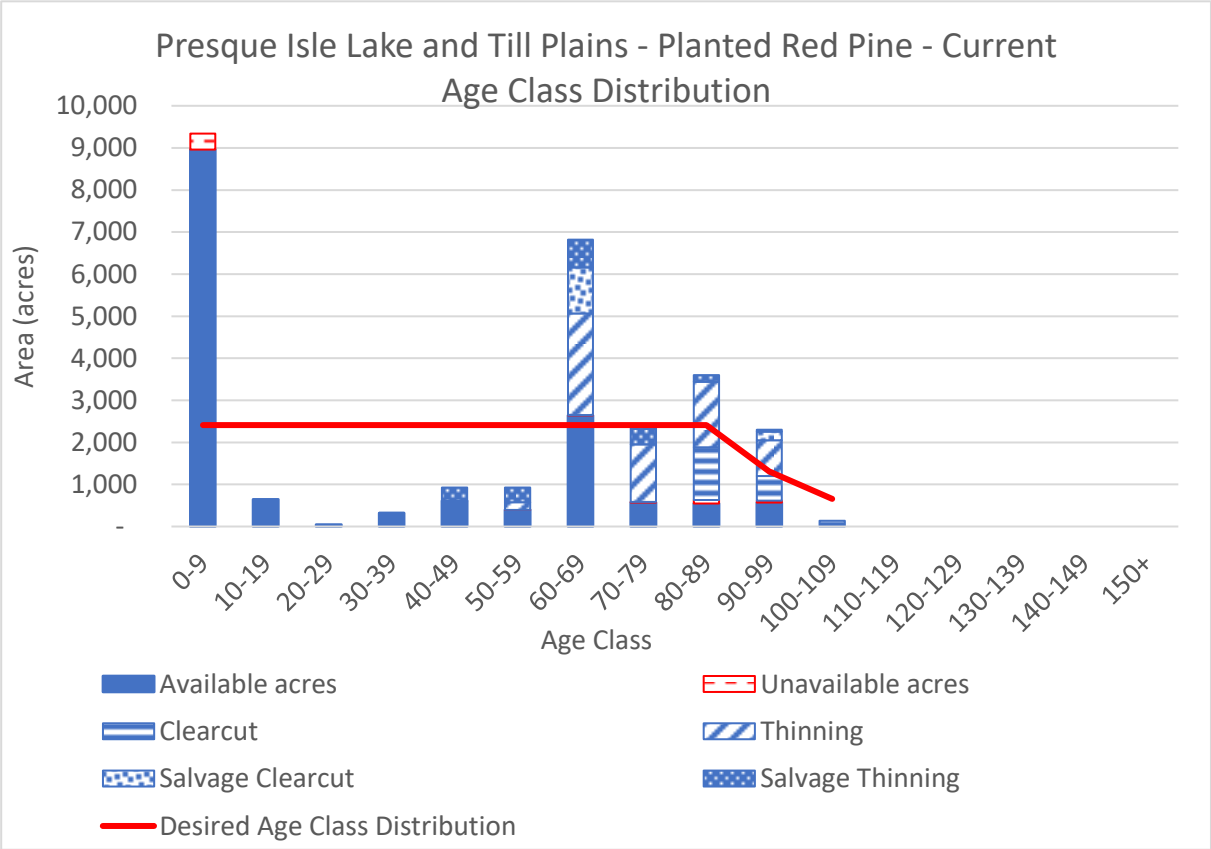


Figure 8. Current age class distribution and projected harvests in planted red pine cover type.

Desired future condition

The projected long-term cover type trend for planted red pine is decreasing initially in the first few periods before increasing to balance back out in the Presque Isle Lake and Till Plains Management Area. The long-term goal for this cover type is balanced age classes between 0 and 90 years old with tailing amounts in the 90- to 109-year-old age classes for all available red pine stands.

The end of the planning period will result in the establishment of a desirable number of acres in the 0-9 age class (Figure 9). Progress toward the long-term desired age class distribution of red pine will take many decades of even-aged management in this management area.

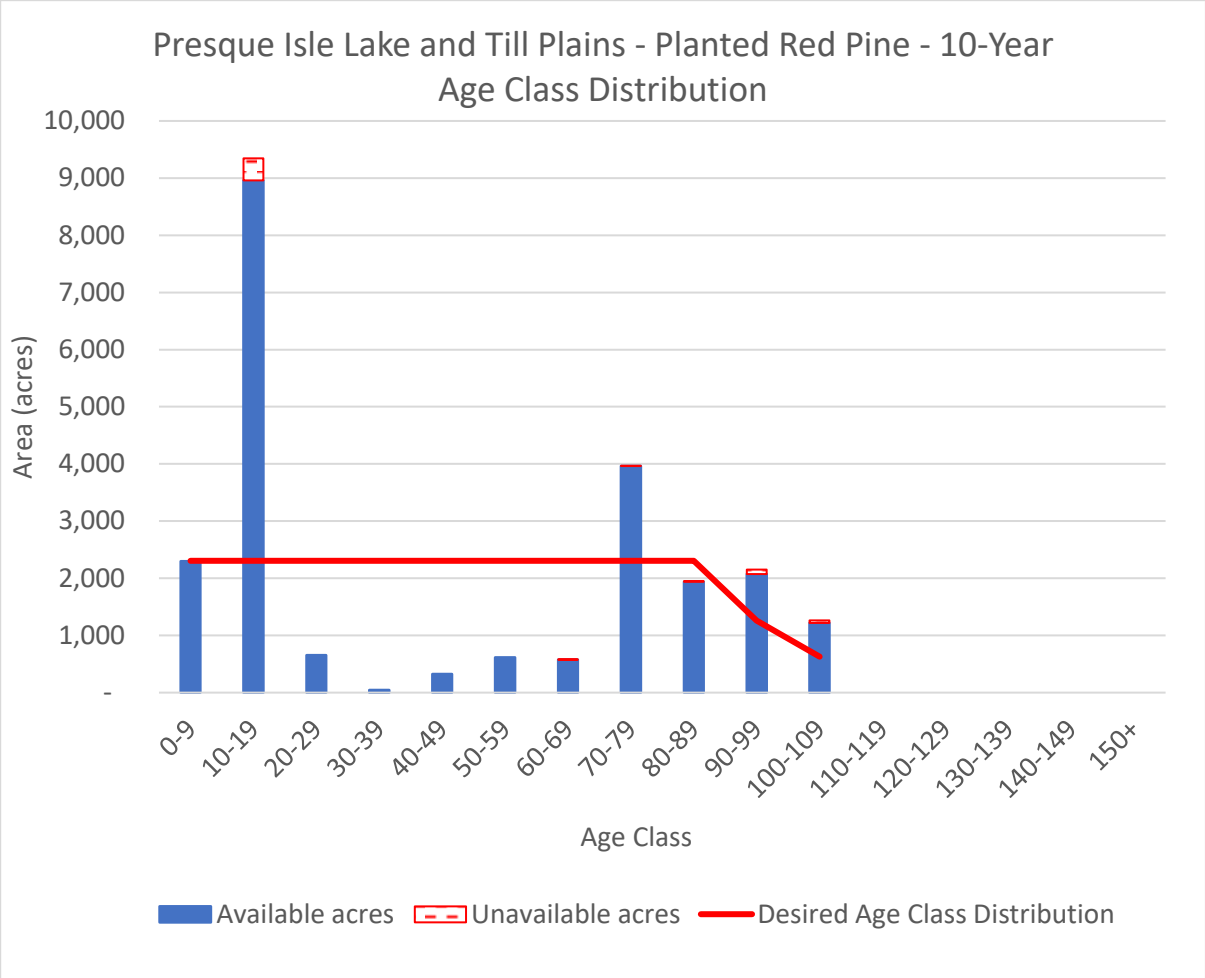


Figure 9. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution of planted red pine is beginning to reach the desired future condition for available acres (Figure 10). As is often the case, unbalanced age classes may result in the need to leave some acres in older age classes to achieve the desired age class distribution in future planning periods.

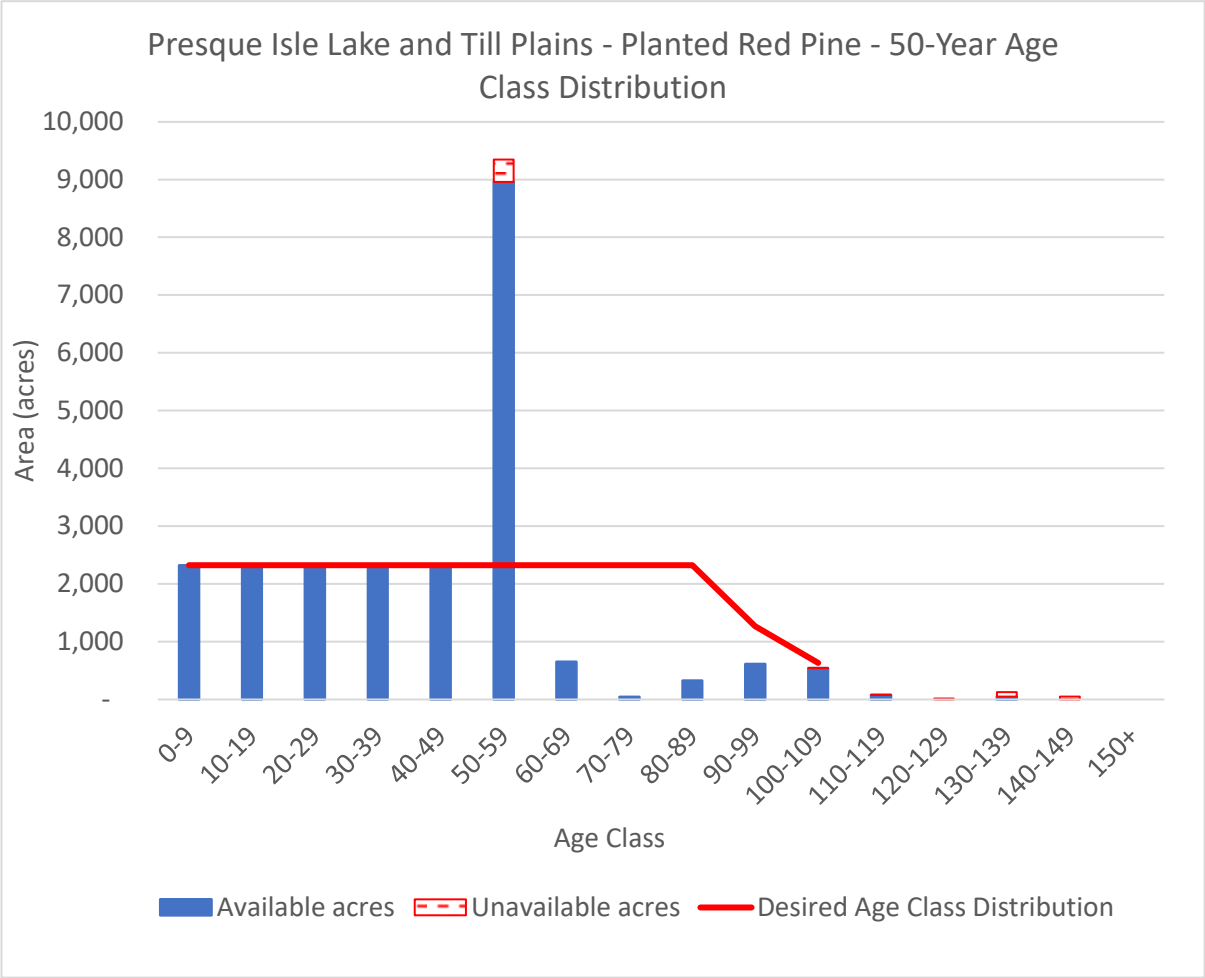


Figure 10. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 11) will concentrate the manageable acres of red pine in productive growing conditions while providing an even flow of forest products (Figure 12).

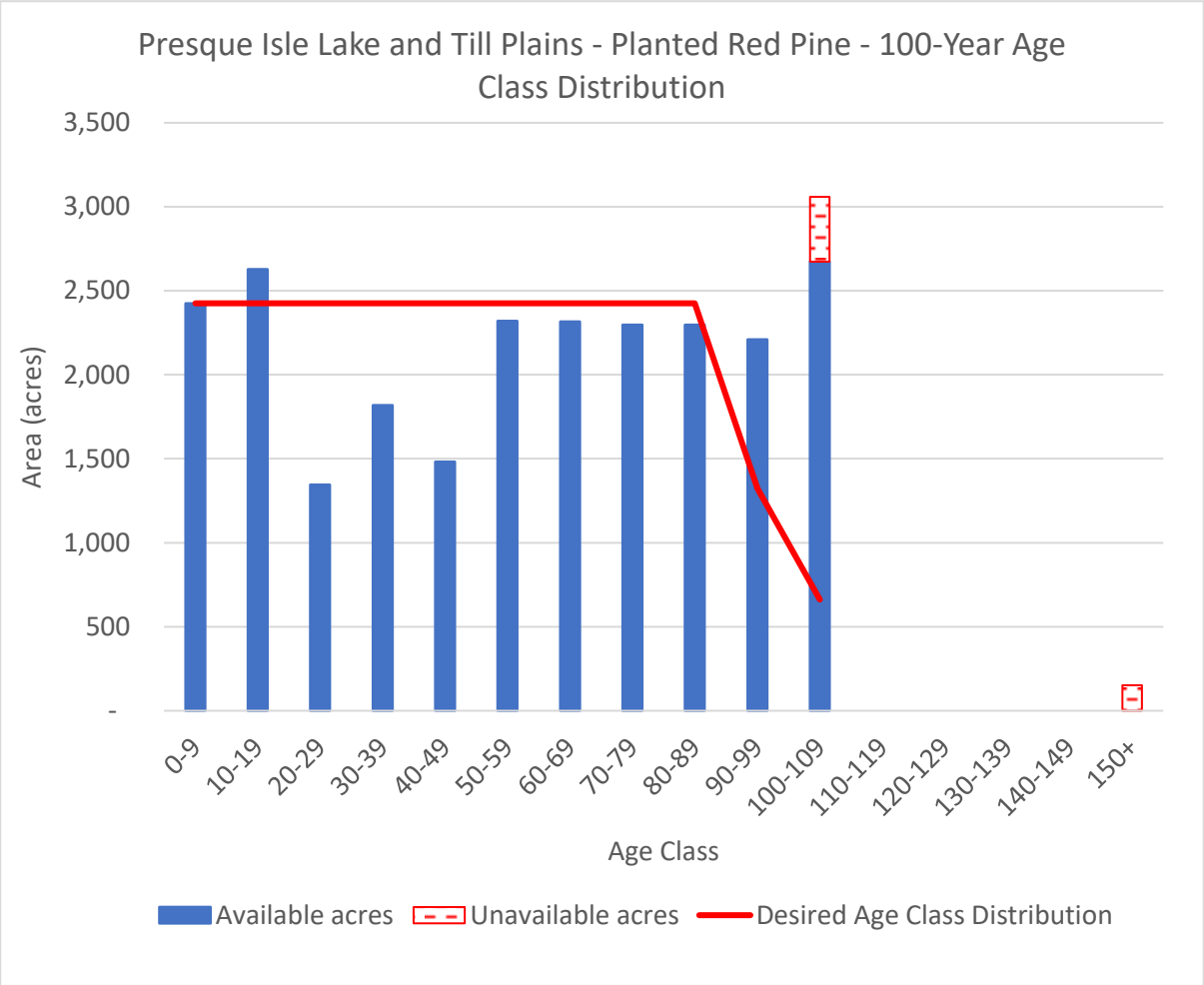


Figure 11. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

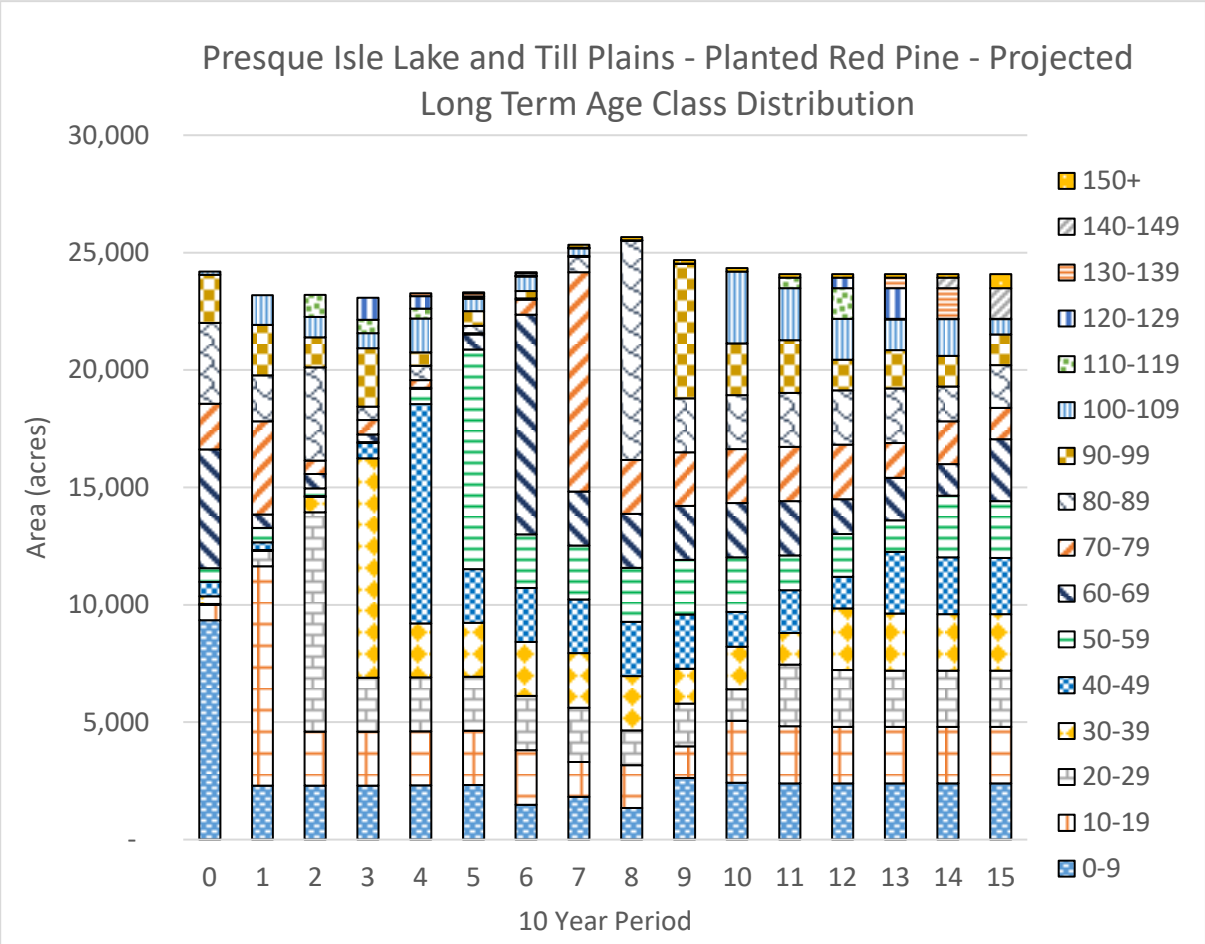


Figure 12. Projected age class distribution for all acres of planted red pine over the next 150 years.

Management actions

There are 1,977 acres of projected clearcut harvest and 1,298 acres of salvage clearcut in the planted red pine cover type during the planning period. There are 1,016 acres forecasted to transition into other cover types resulting in about 2,258 acres of established planted red pine in this 10-year period. This is very close to the desired target of 2,307 acres per decade. There are 6,372 acres of projected thinning harvests and 1,931 acres of salvage thinning in the planted red pine cover type during the planning period. This will allow some acres to be held in older age classes and provide opportunities to balance the age classes in future planning periods.

Cedar

Current condition

The Presque Isle Lake and Till Plains Management Area has a surplus of acres in age classes 90-plus years old, and very few acres in the 0- to 90-year-old age classes (Figure 13). The age class distribution is currently unbalanced across almost all the age class categories. Many of these acres are unavailable and the cedar cover type is extremely challenged in successfully regenerating in this management area. Additionally, a deficit of available acres occurs in almost all age classes. A portion of this cover type meets the habitat requirements for snowshoe hare and marten (Table 10).

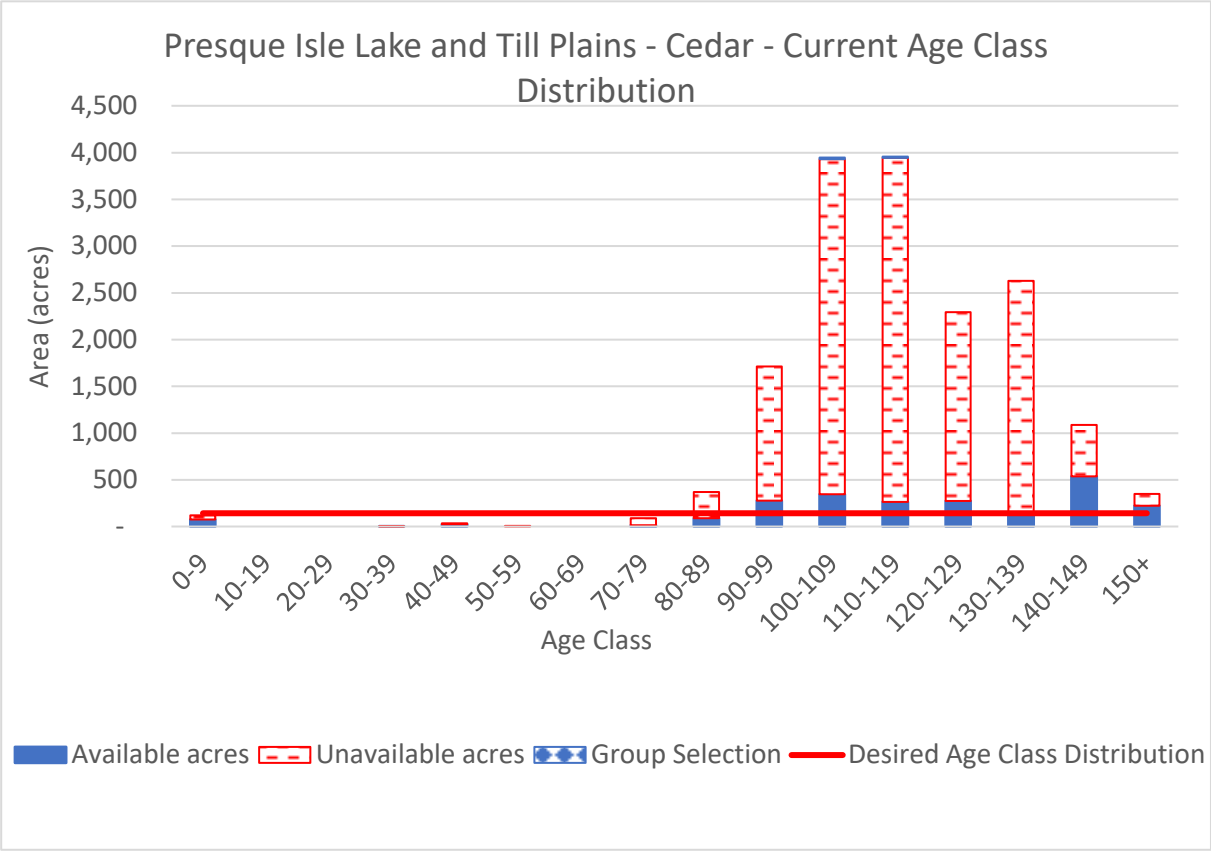


Figure 13. Current age class distribution, the desired age class distribution, and the projected harvests in the aspen cover type over the 10-year planning period.

Table 10. Featured species with cedar as a priority habitat cover type, habitat variables, and current acres (e.g., potential habitat).

Featured Species	Featured Species Habitat – Cedar	Cedar Habitat Acres - Available	Cedar Habitat Acres - Unavailable
Snowshoe Hare	Age Category: 0-19 Size Class: Sapling	75	46
Marten	Age Category: 40+ Size Class: Pole, Sawlog Basal Area: 81+	1,890	13,264

Desired future condition

The projected long-term cover type trend for cedar is fairly stable in the Presque Isle Lake and Till Plains Management Area. There is a low number of available acres for distributing across age classes and most of the cedar acres are unavailable and will continue to grow into an older mature forest.

The long-term goal for this cover type is balanced age classes between 0 and 110 years old for all available cedar acres.

The end of the planning period will result in the establishment of a desirable number of acres in the 0- to 9-year-old age class (Figure 14). Progress toward the long-term desired age class distribution of cedar will take many decades to achieve the desired balanced age class condition.

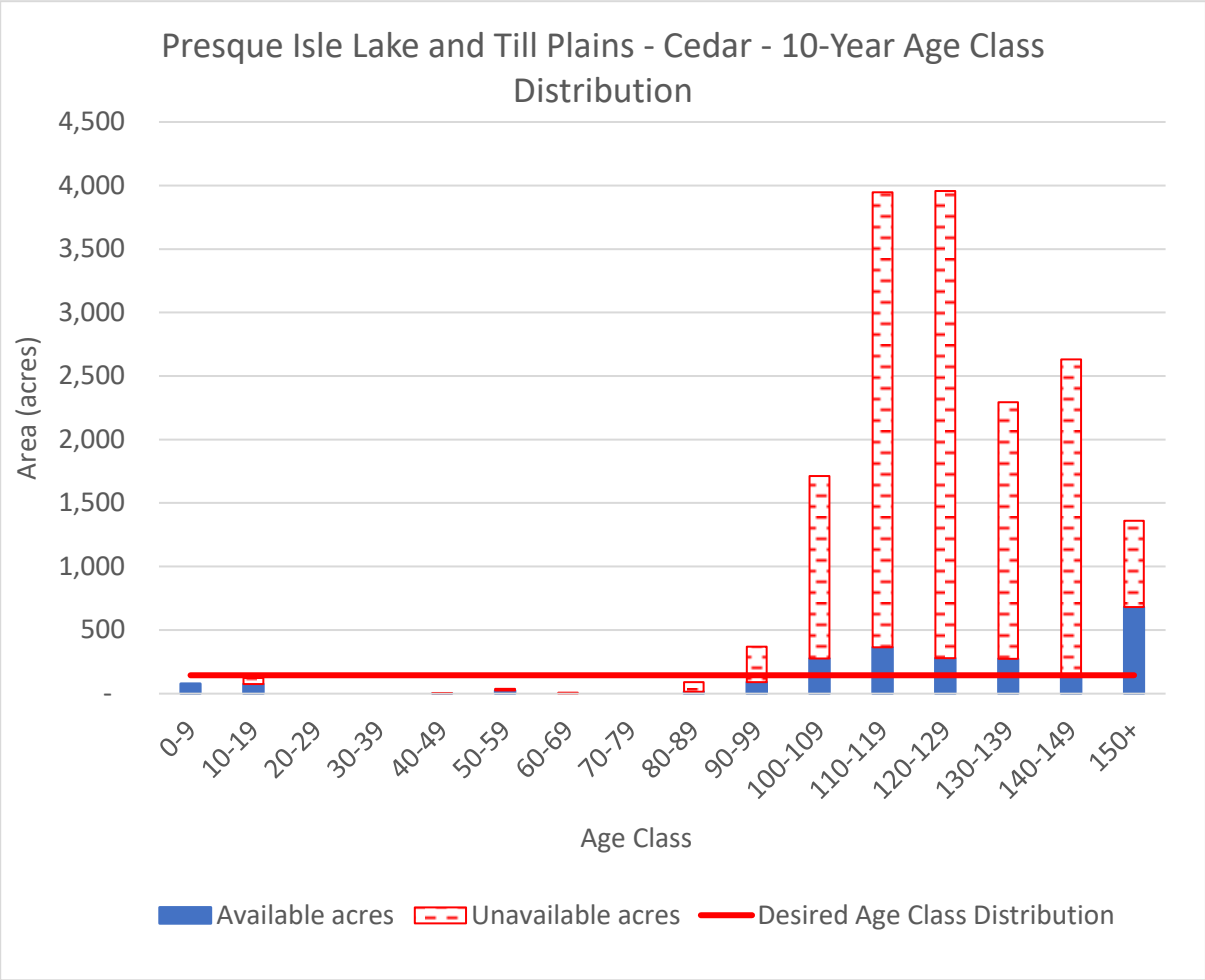


Figure 14. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution of cedar is beginning to reach the desired future condition for available acres in the age classes between 0- and 70-year-old age classes (Figure 15). The number of acres in the older age classes, 150-plus years, continues to increase as the unavailable acres continue to move to those age classes.

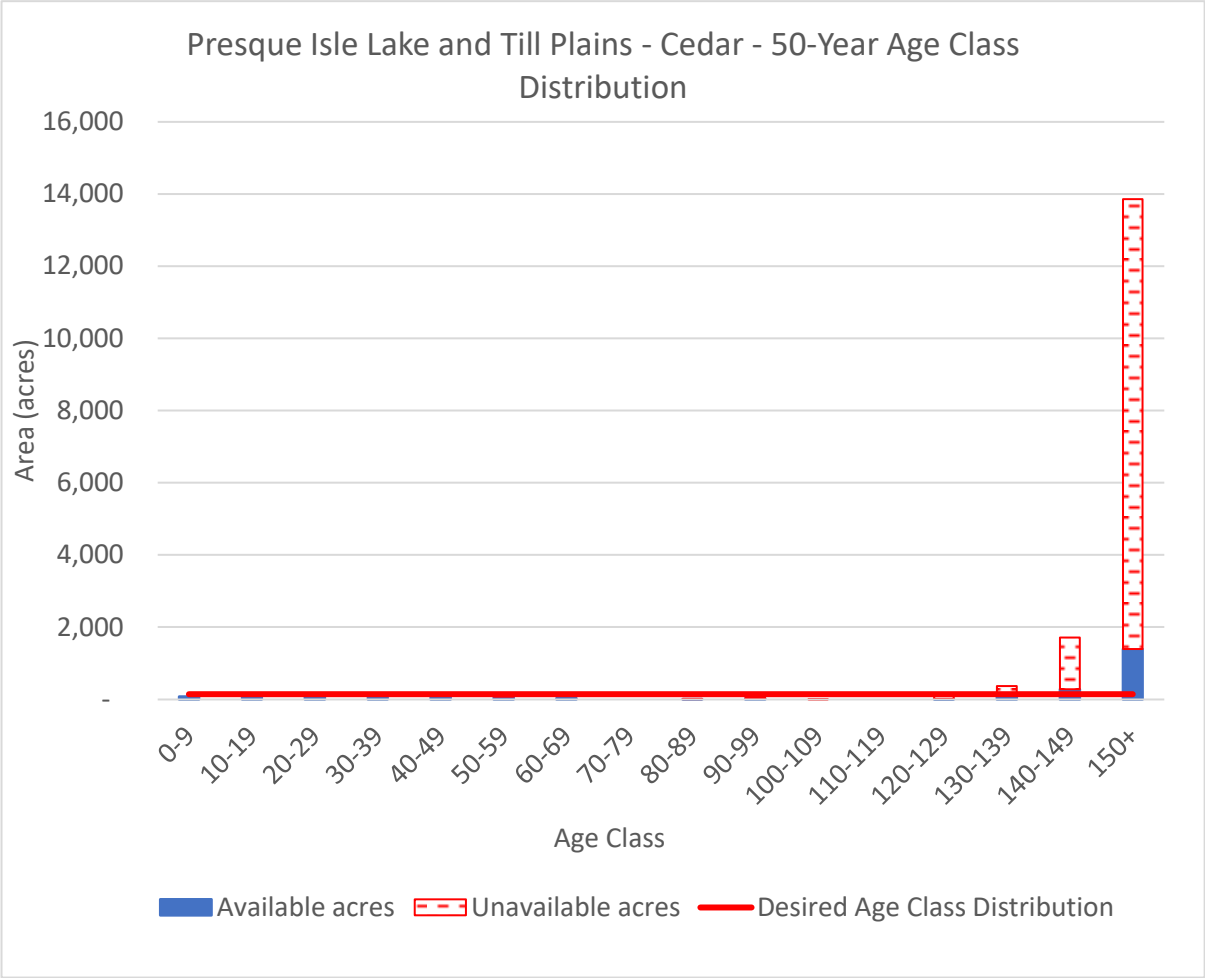


Figure 15. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 16) will concentrate on the manageable acres of cedar cover type in productive growing conditions while providing a variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest (Figure 17).



Figure 16. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

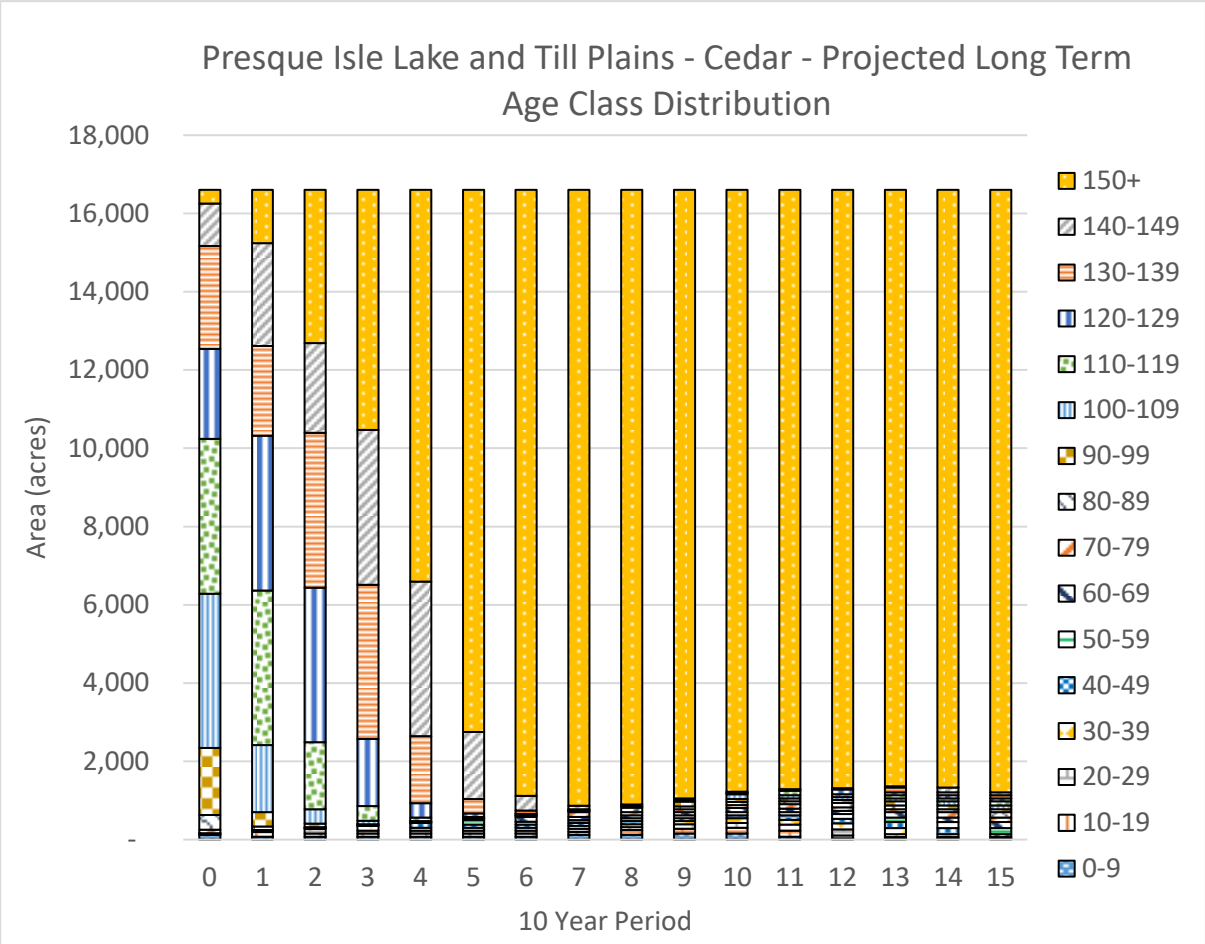


Figure 17. Projected age class distribution for all acres of cedar over the next 150 years.

Management actions

There are 76 acres of projected clearcut/seed tree and 32 acres of group selection harvests in the cedar cover type during the planning period. This is short of the desired establishment of 143 acres of cedar per decade. These slight variances are often due to the available stand sizes.

Lowland conifer

Current condition

The Presque Isle Lake and Till Plains Management Area has relatively well-balanced age classes of the available lowland conifer acres (Figure 18). The exception to this is deficit of acres in the 10- to 29-year-old age classes. Most of the acres in the lowland conifer cover type are unavailable and are in the older 60-plus age classes. A portion of this cover type meets the habitat requirements for snowshoe hare and marten (Table 11).

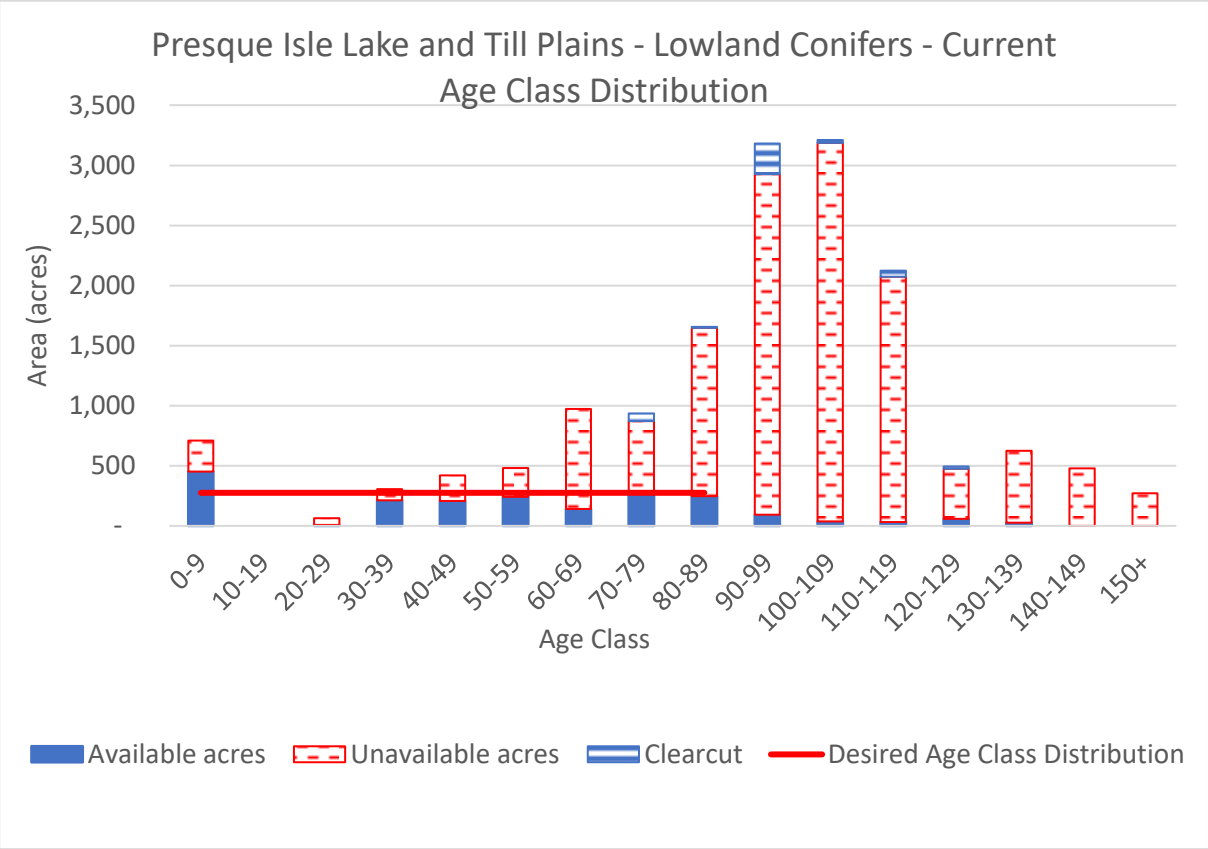


Figure 18. Current age class distribution, the desired age class distribution, and the projected harvests in the lowland conifer cover type over the 10-year planning period.

Table 11. Featured species with lowland conifers as a selected habitat cover type, habitat variables and current acres (e.g., potential habitat).

Featured Species	Featured Species Habitat – Lowland Conifers	Lowland Conifer Habitat Acres - Available	Lowland Conifer Habitat Acres - Unavailable
Snowshoe Hare	Age Category: 0-19 Size Category: Sapling	452	258

Featured Species	Featured Species Habitat – Lowland Conifers	Lowland Conifer Habitat Acres - Available	Lowland Conifer Habitat Acres - Unavailable
Marten	Age Category: 40+ Size Category: Pole, Sawlog Basal Area: 81+	1,055	13,264

Desired future condition

The projected long-term cover type trend for lowland conifers is fairly stable in the Presque Isle Lake and Till Plains Management Area. There are a few transitions out of this cover type during this planning period.

The long-term goal for this cover type is balanced age classes between 0 and 90 years old for all available lowland conifer acres.

The end of the planning period will result in the establishment of a desirable number of acres in the 0-9 age class (Figure 19). Progress toward the long-term desired age class distribution of lowland conifers will take many decades to achieve the desired balanced age class condition.

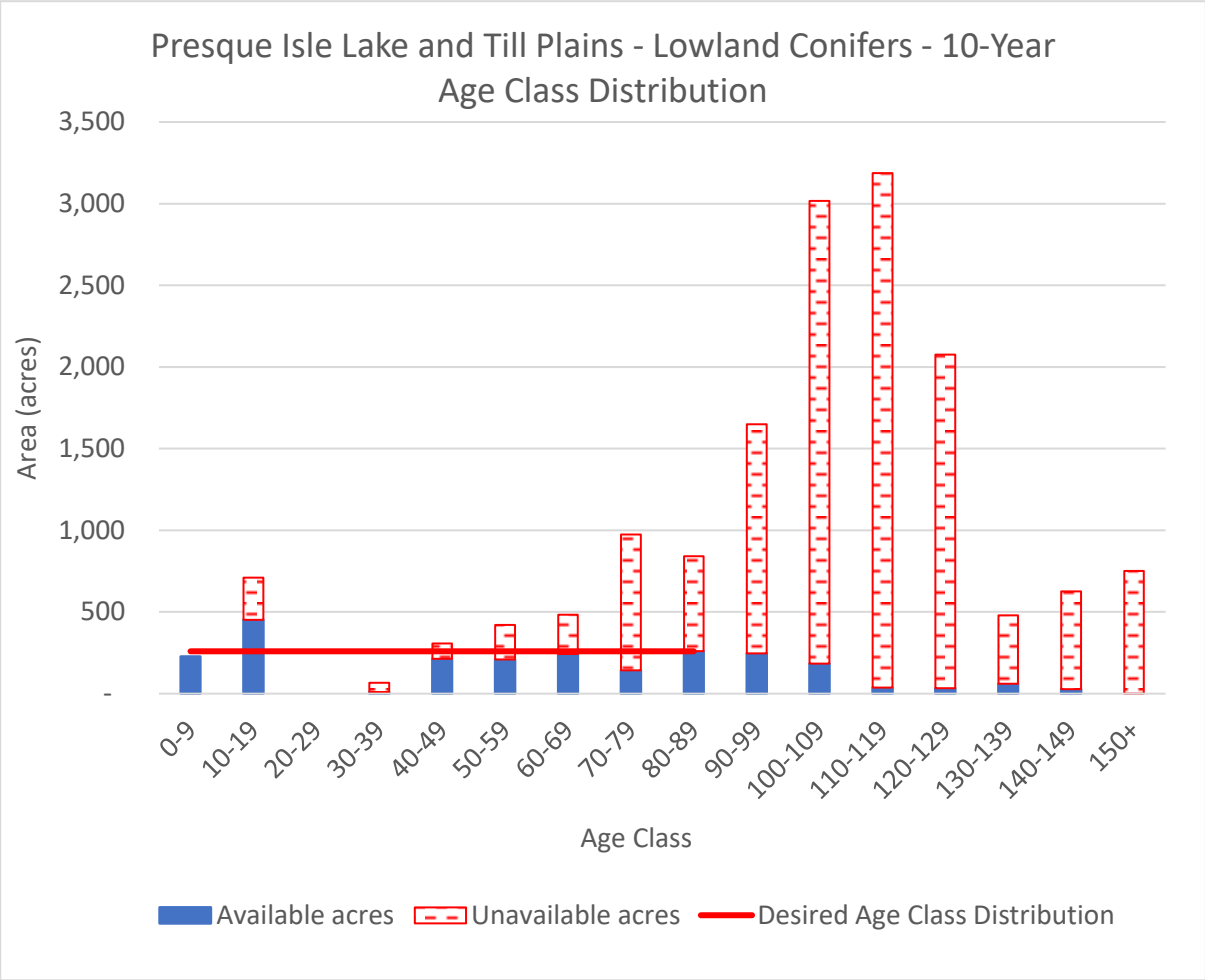


Figure 19. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution of lowland conifers is beginning to reach the desired future condition for available acres in the age classes between 0- and 50-year-old age classes (Figure 20). The number of acres in the older age classes, 120-plus years, continues to increase as the unavailable acres continue to move to the older classes.

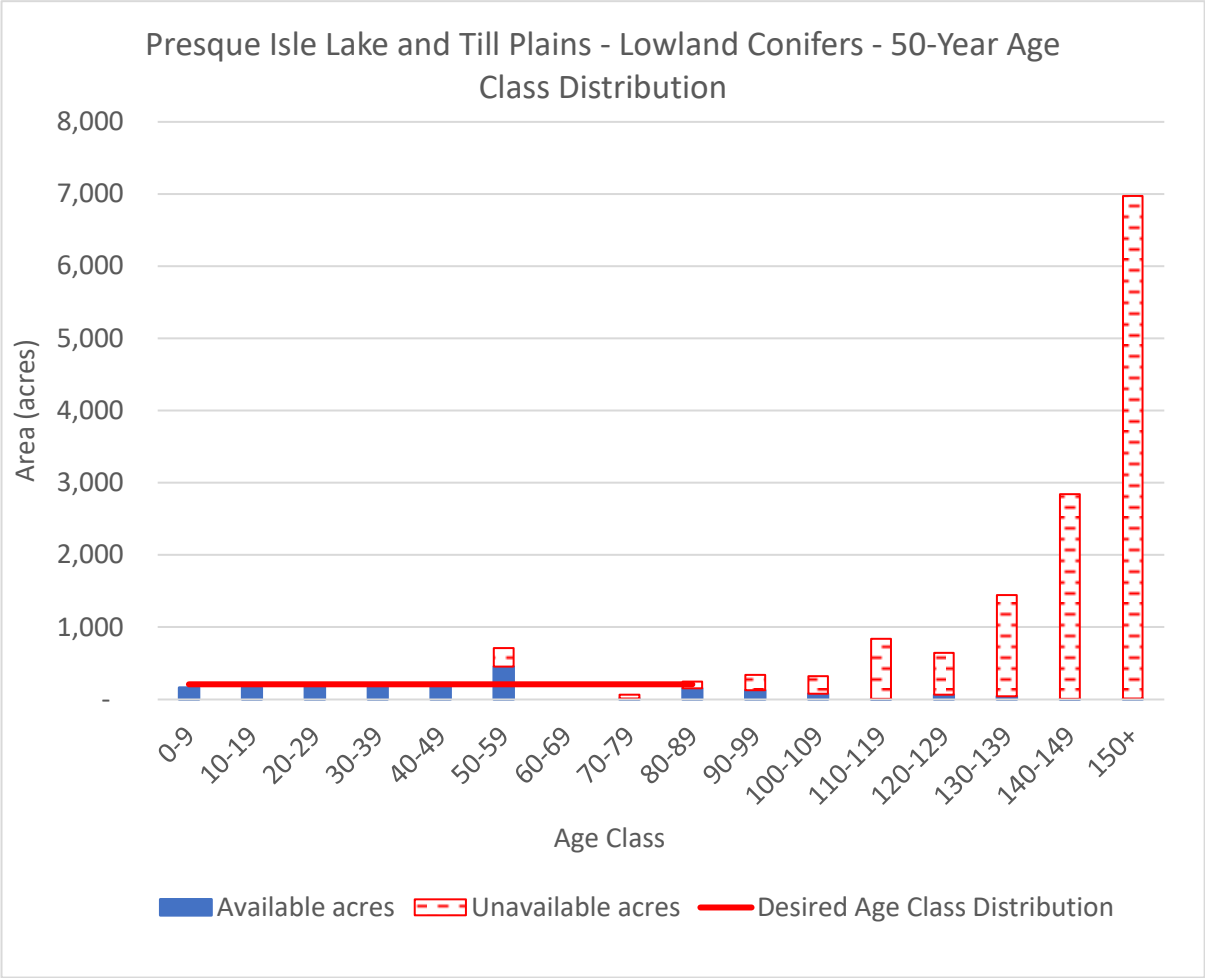


Figure 20. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 21) will concentrate on the manageable acres of lowland conifer cover type in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest (Figure 22).

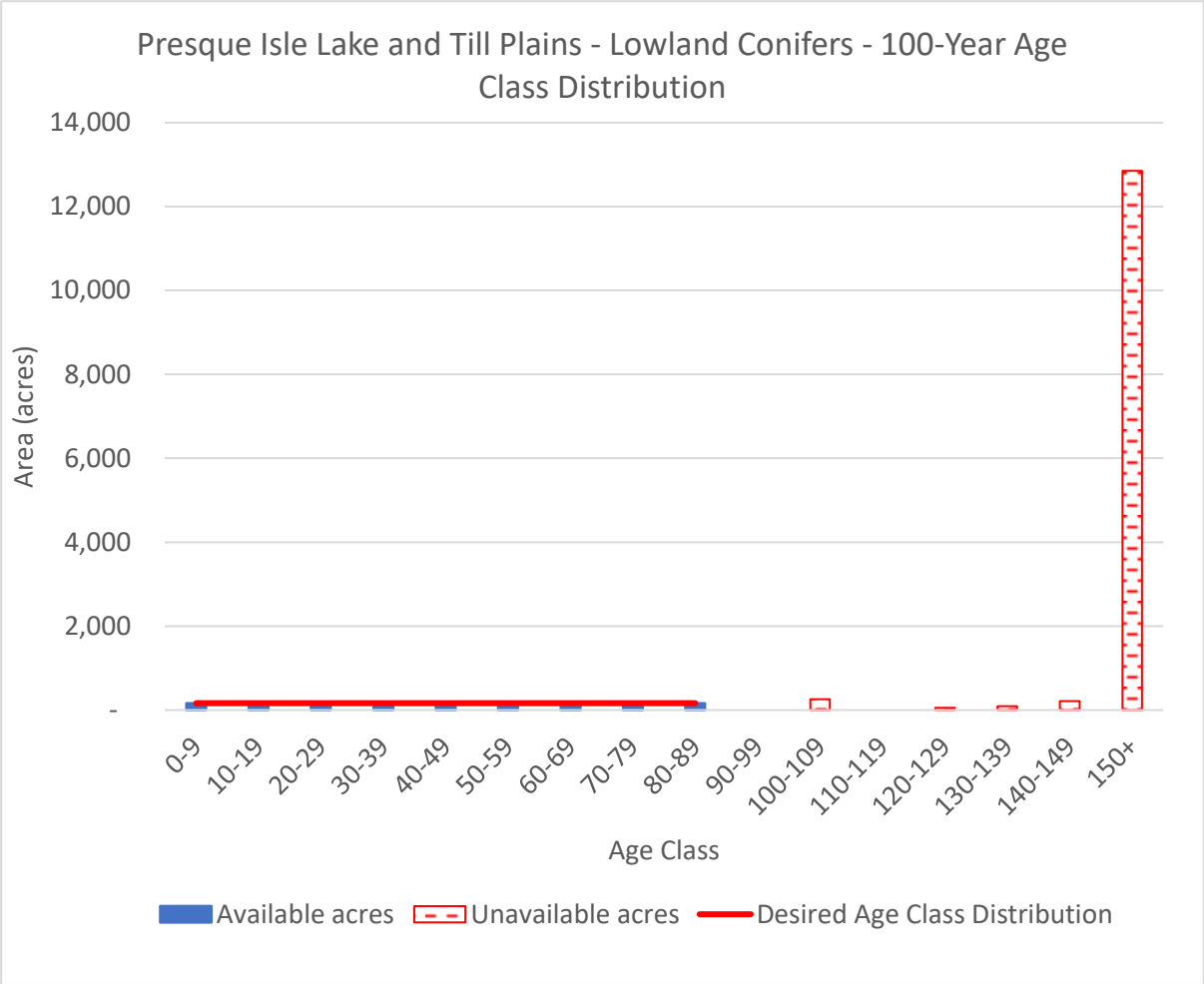


Figure 21. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

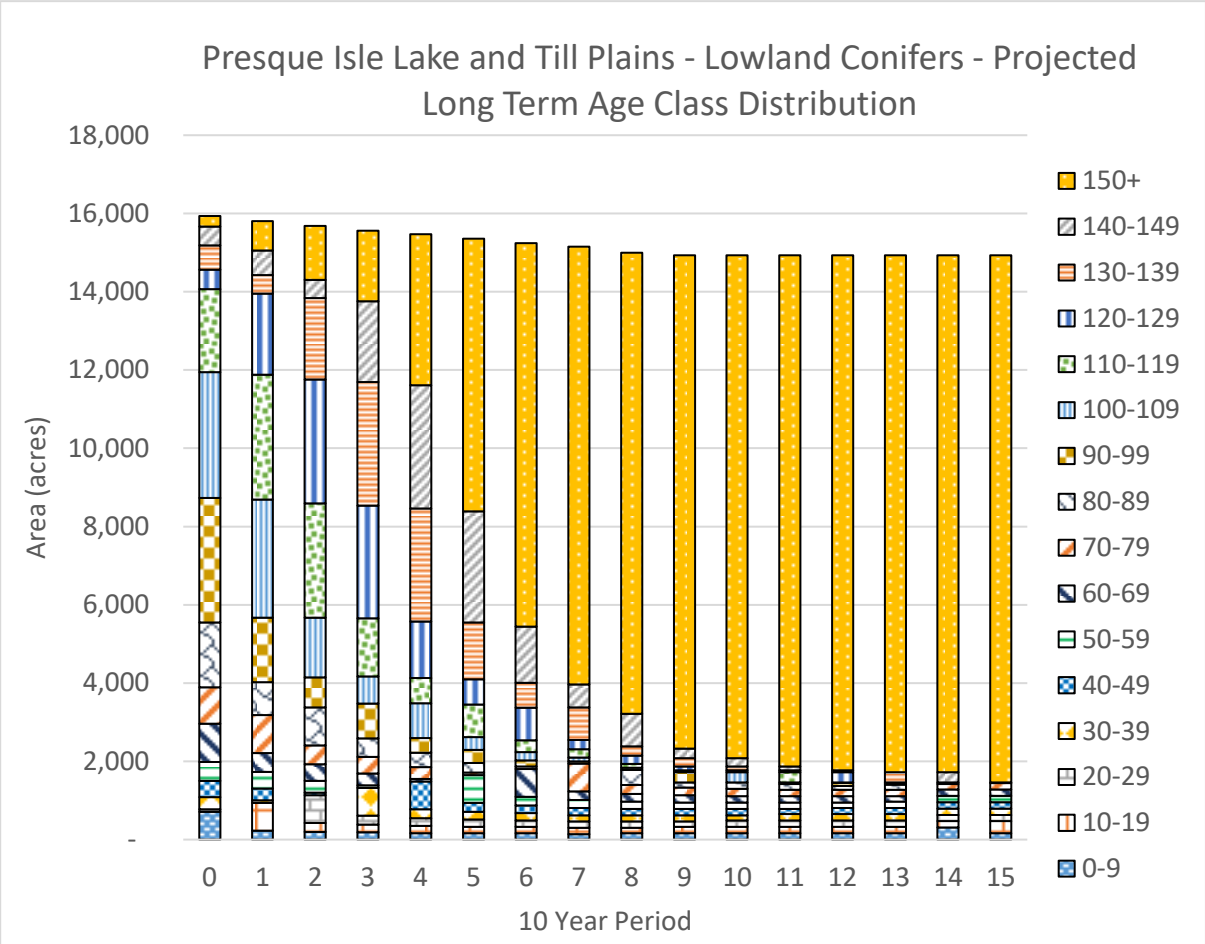


Figure 22. Projected age class distribution for all acres of lowland conifer over the next 150 years.

Management actions

There are 419 acres of projected clearcut harvest in the lowland conifer cover type during the planning period. Of those, 133 acres are projected to transition into other cover types resulting in approximately 286 acres in the 0-9 age class. This is close to the desired establishment of 259 acres of lowland conifer per decade.

Planted jack pine

Current condition

Most of the planted jack pine cover type is currently between stand ages of 0 and 49 years old in the Presque Isle Lake and Till Plains Management Area (Figure 23). The age class distribution is currently unbalanced, especially in the 0- to 49-year-old age classes where the bulk of acres occur. There is a deficit in the 0-9, 50-59 and the 60-69 age classes, which will lead to a deficit in the 0-9-year age class for the next planning period.

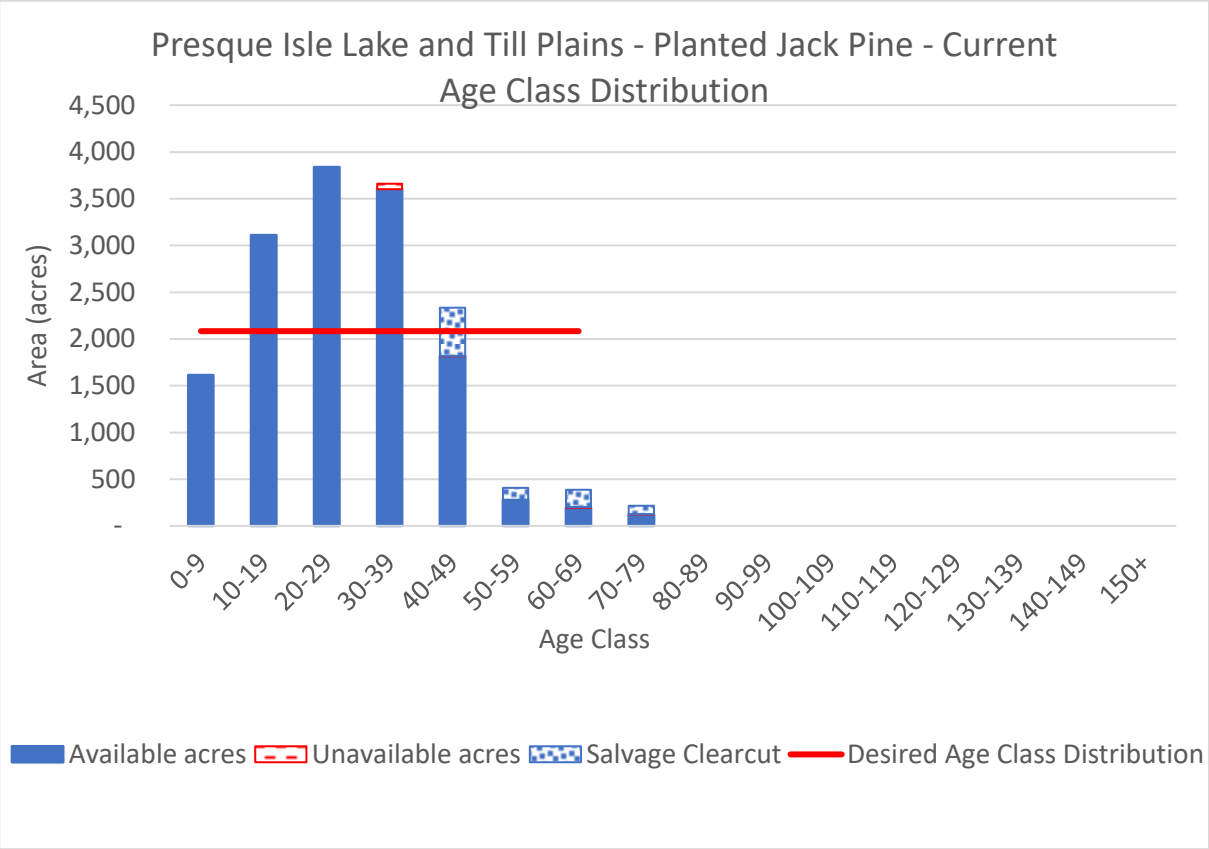


Figure 23. Current age class distribution and projected harvests in planted jack pine cover type.

Current conditions are a result of consistent commercial harvests and regeneration efforts on available jack pine acres during the previous two planning periods. A portion of this cover type meets the habitat requirements for Kirtland's warbler (Section 5) and snowshoe hare (Table 12). No data is provided for Kirtland's warbler, because the jack pine acres in this management area that have relevance are those within designated essential habitat. Because essential habitat was represented as a whole in the SAU, and the SAU provides unit-level management actions, refer to Section 5 for more information.

Table 12. Featured species with planted jack pine as a priority habitat cover type, habitat variables and current acres (e.g., potential habitat).

Featured Species	Featured Species Habitat – Planted Jack Pine	Planted Jack Pine Habitat Acres - Available	Planted Jack Pine Habitat Acres - Unavailable
Snowshoe Hare	Age Category: 0-19 Size Category: Sapling	4,727	0
Kirtland's warbler	Age Category: 0-19 Size Category: Sapling	NA	NA

Desired future condition

The projected long-term cover type trend for planted jack pine is decreasing in the Presque Isle Lake and Till Plains Management Area. Some of these planted jack pine acres will convert to natural jack pine.

The long-term goal for this cover type is balanced age classes between 0 and 70 years old for all available jack pine stands in this management area. Maintaining lower acreage in old age classes continues to be desirable to lessen the prevalence and severity of jack pine budworm outbreaks and to reduce the threat of damaging wildfire.

The end of the planning period will result in the establishment of a slightly less than desirable number of acres in the 0-9 age class (Figure 24). Progress toward the long-term desired age class distribution of jack pine will take many decades of even-aged management in this management area.

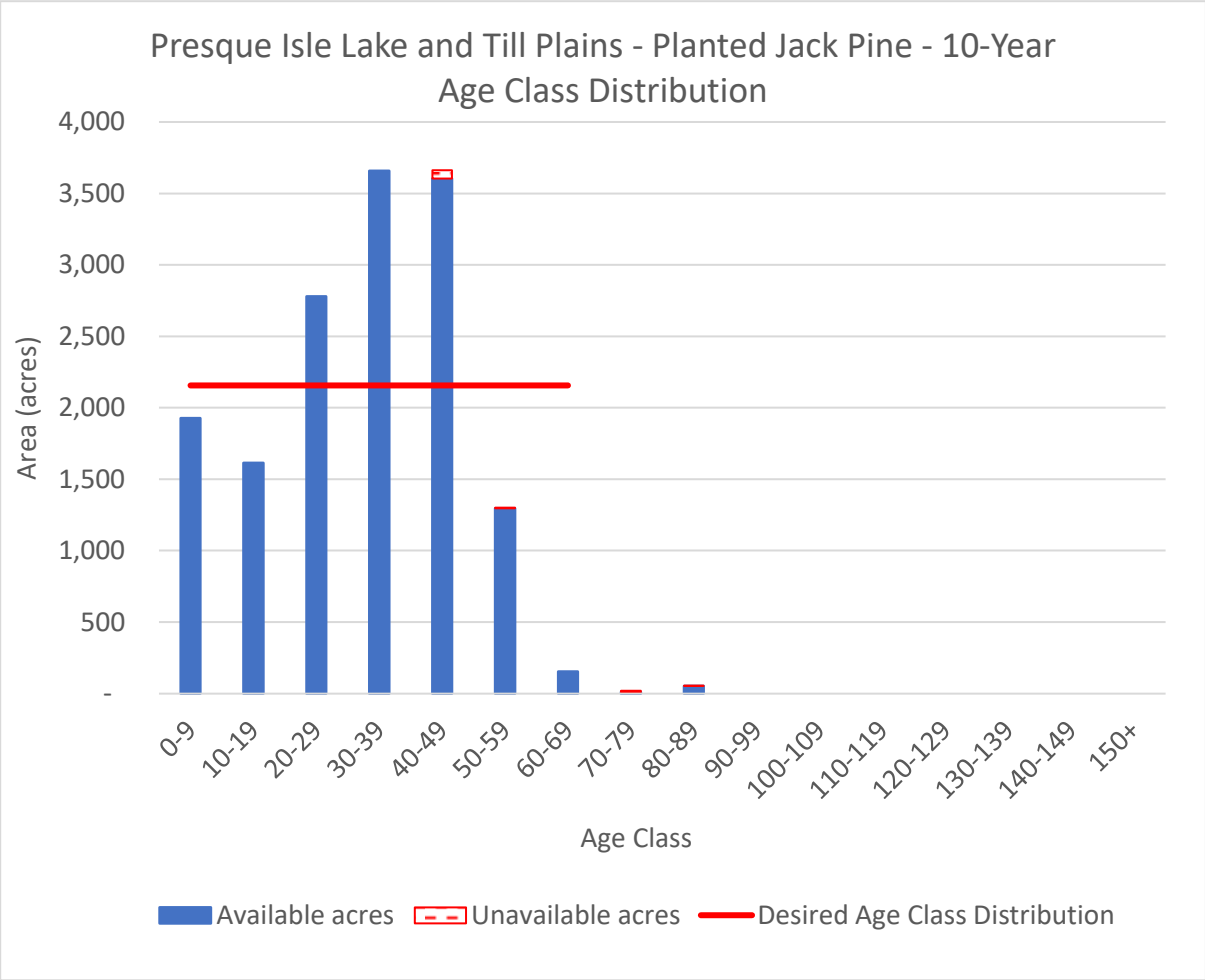


Figure 24. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution of planted jack pine is beginning to reach the desired future condition for available acres (Figure 25).

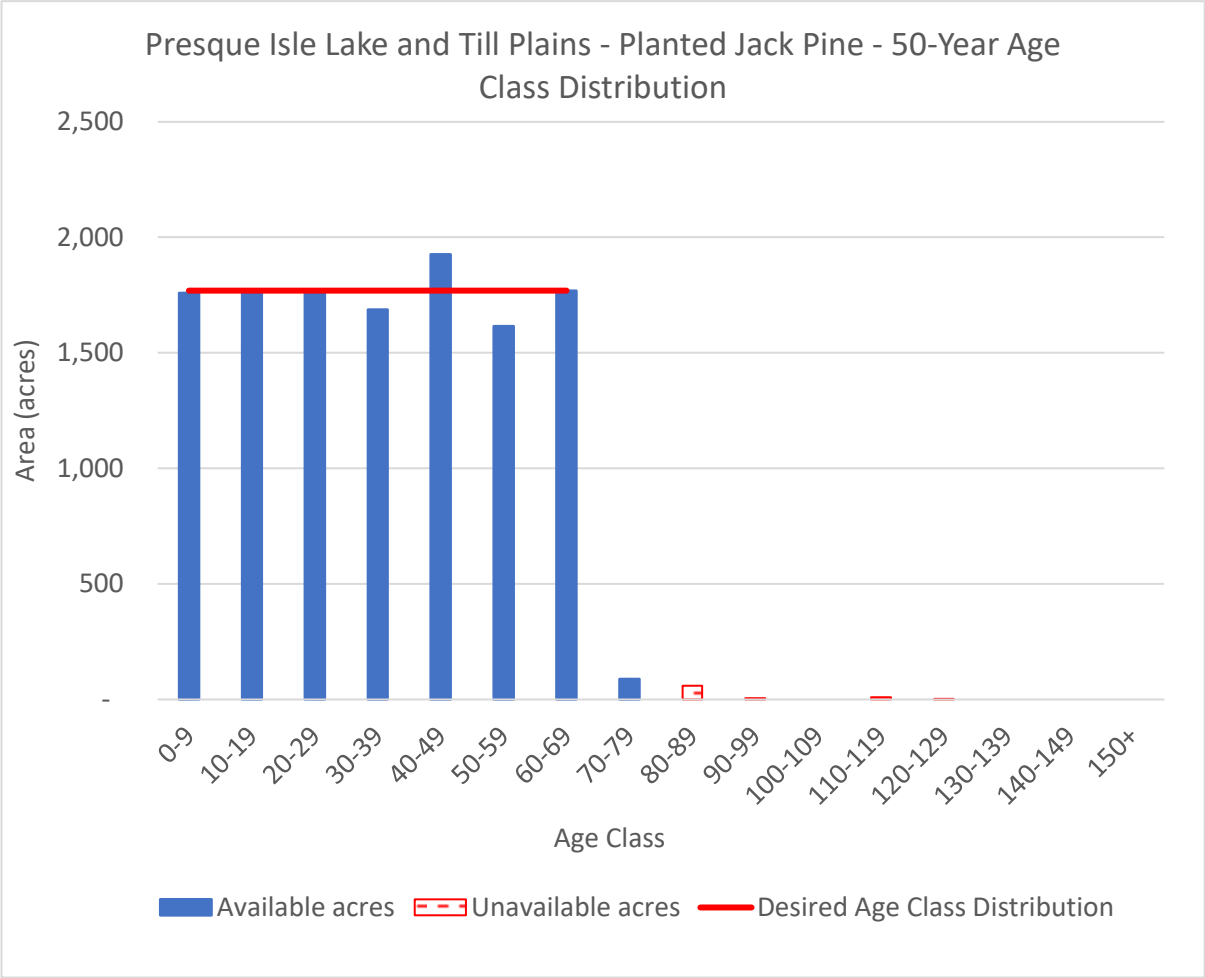


Figure 25. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 26) will concentrate the manageable acres of jack pine in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest (Figure 27).

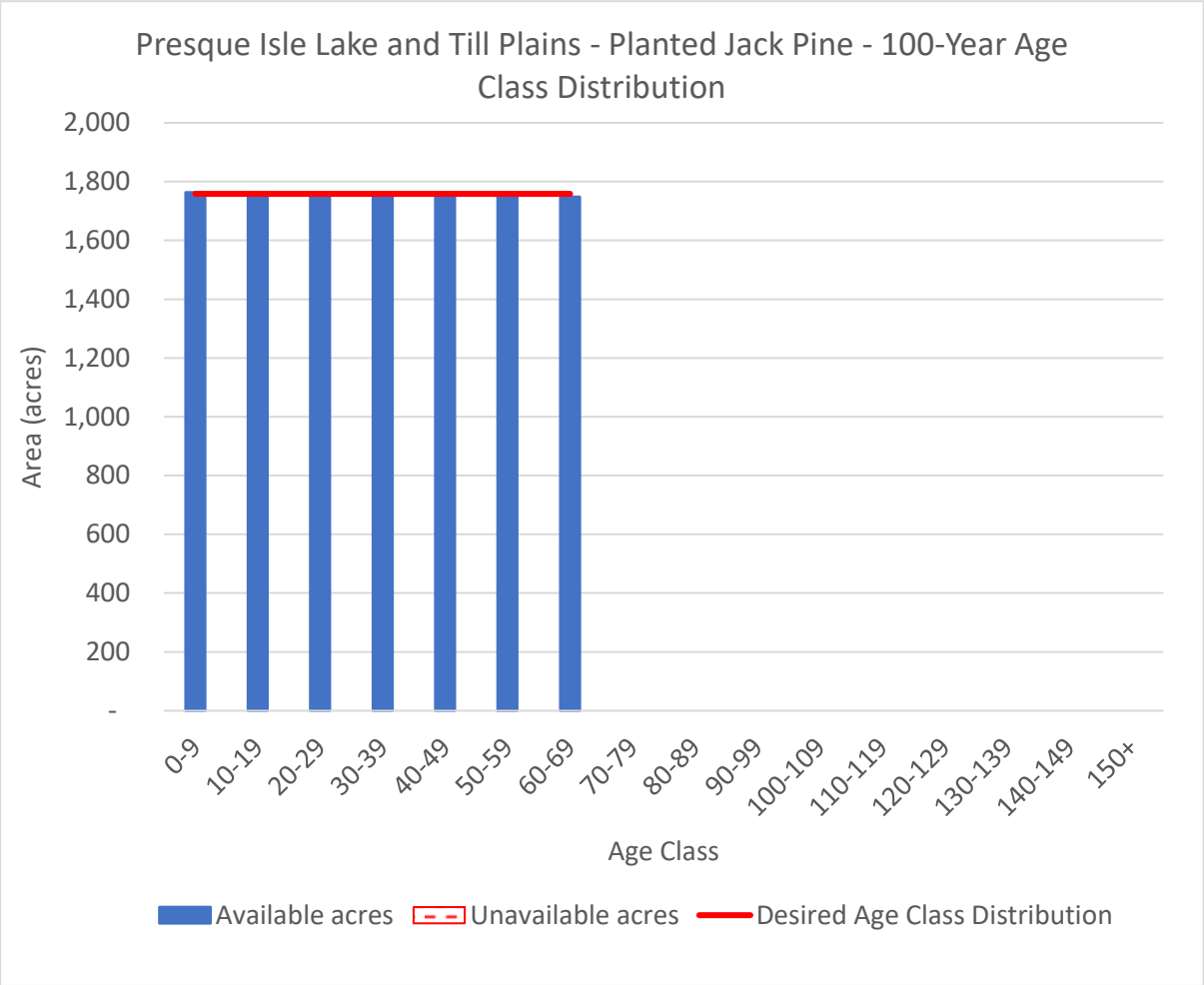


Figure 26. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

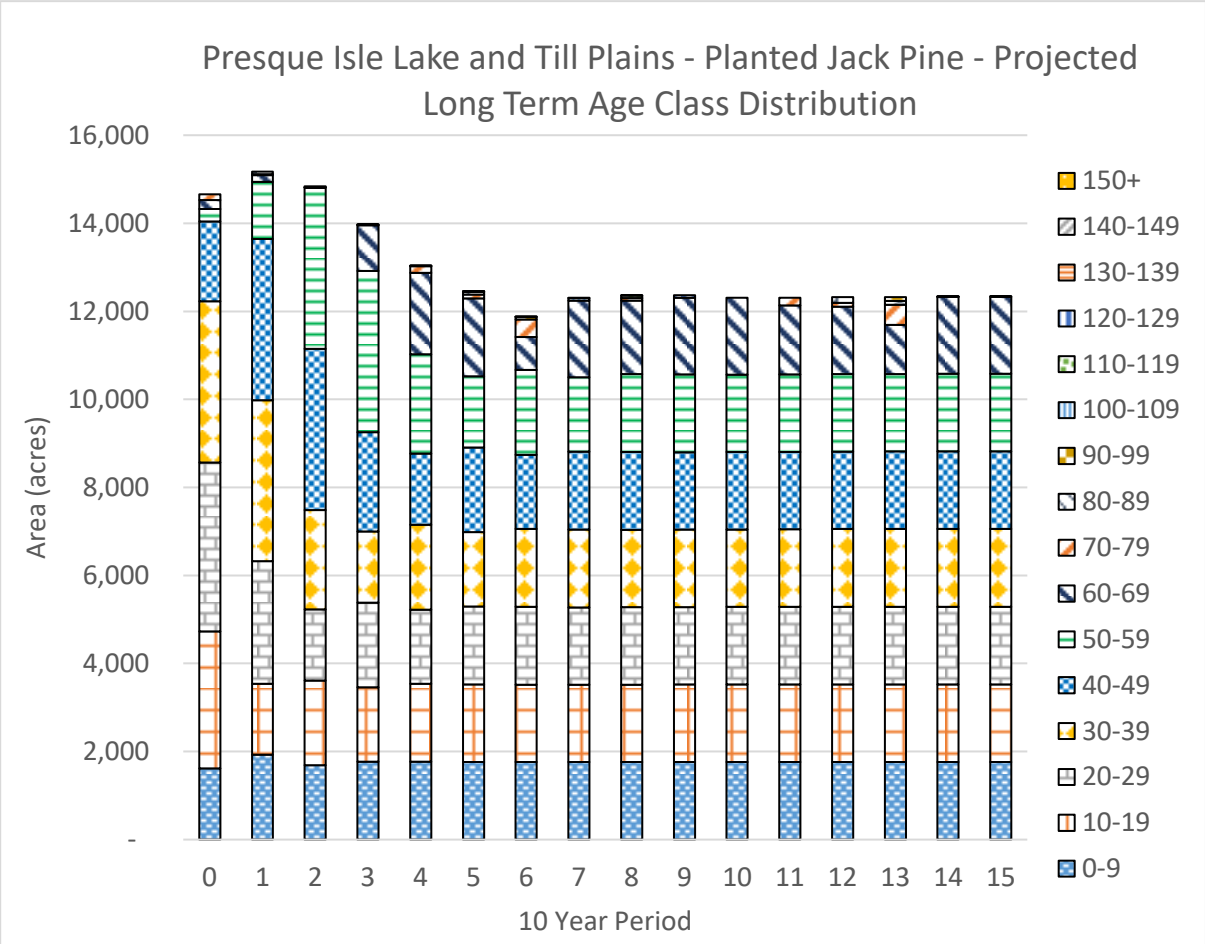


Figure 27. Projected age class distribution for all acres of planted jack pine over the next 150 years.

Management actions

There are 916 acres of projected salvage clearcut harvests in the planted jack pine cover type during the planning period. There are also another 508 acres that are severely damaged from the 2025 ice storm but may not be merchantable for commercial harvests that are projected to be replanted. These acres plus 513 acres of planted jack pine conversions from other cover types is close but still falls short of the desired establishment of 2,157 acres of planted jack pine per decade because of the current unbalanced age class condition and lack of merchantable acres.

Conservation area network

High conservation value areas

There are up to nine different high conservation value area (HCVA) types that can be found in each management area (Table 13; see Biodiversity in Section 3 for more information).

Table 13. High conservation value areas within the Presque Isle Lake and Till Plains Management Area.

High Conservation Value Area Type and Name	Acres
Eastern Massasauga Managed Land	**6,039**
	6,039
Elk Management Area	**86,118**
	86,118
Forest Habitat Core Interior	**3,153**
	3,153
Kirtland's Warbler Habitat	**11,762**
Black Lake	1,796
Brush Crk	1,901
Clear Lake	8,065
Natural Rivers Vegetative Buffer	**322**
	322
Natural Rivers Zoning District	**647**
(	647
State Wildlife Management Areas	**1,970**
Dog Lake Flooding SWMA	812
Stoney Creek Flooding SWMA	1,158
Verified Type 1 and Type 2 Old Growth	**51**
Type 1 Old Growth	20
Type 2 Old Growth	31
GEMS	**2,336**
Lee Grande Ranch	2,336
Grand Total	**112,398**

Ecological reference areas

Ecological reference areas (ERAs) are a type of HCVA and are higher quality examples of functioning ecosystems that are primarily influenced by natural ecological processes.

Table 14. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct

Element Occurrence Rank	State Rank	Global Rank
		?: inexact

Table 15. Ecological reference areas within the management area.

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	Number of Occurrences
Existing ERA	Bog	B	G3G5	S4	4
Existing ERA	Bog	BC			1
Existing ERA	Bog	C	G3G5	S4	1
Existing ERA	Dry Northern Forest	X	G3?	S3	1
Existing ERA	Dry-mesic Northern Forest	BC			3
Existing ERA	Floodplain Forest	BC		S3	1
Existing ERA	Intermittent Wetland	AB			1
Existing ERA	Intermittent Wetland	AB	G2	S3	1
Existing ERA	Intermittent Wetland	B			2
Existing ERA	Muskeg	B	G4G5	S3	2
Existing ERA	Muskeg	BC			4
Existing ERA	Muskeg	BC	G4G5	S3	1
Existing ERA	Northern Shrub Thicket	B	G4	S5	3
Existing ERA	Northern Shrub Thicket	BC		S5	1
Existing ERA	Northern Wet Meadow	B			1
Existing ERA	Pine Barrens	BC	G3	S2	2
Existing ERA	Poor Conifer Swamp	BC			2
Existing ERA	Poor Fen	B	G3	S3	3
Existing ERA	Rich Conifer Swamp	B	G4	S3	2
Existing ERA	Rich Tamarack Swamp	B			1
Existing ERA	Sinkhole	B	G3G5	S2	1
Existing ERA	Wet-mesic Sand Prairie	C	G2G3	S2	1
Existing ERA	Wooded Dune and Swale Complex	C	G3	S3	1
Proposed ERA	Poor Fen	BC	G3	S3	1
Grand Total					**41**

Special conservation areas

Reviewable special conservation areas (SCAs; Table 16) refers to those SCA types that may be reviewed or updated through the compartment review process as needed. Static SCAs (Table 17) refers to those SCA types that generally do not change or require updating (see Biodiversity in Section 3 for more information).

Table 16. Reviewable special conservation areas within the Presque Isle Lake and Till Plains Management Area.

Reviewable Special Conservation Area Type and Name	Acres
Concentrated Recreational Area	**207**
Black Mountain Non-Motorized Pathway	1
NEST	19
Red Pine stand	3
Stoney Creek Camp Sites	8
Unspecified	178
Habitat Area or Habitat Corridor	**368**
54041033	96
Floodplain Forest	241
Large Red Pine Stand	18
Lowland Natural Pine	14
Possible Type 1 or Type 2 Old Growth	**45**
--	45
Spring, Wetlands, or Riparian Areas	**17**
Seep with Spring	2
Unspecified	5
Vernal Pool A	10
Visual Management Areas	**17**
Large pine buffer stand	6
M-68 White Pine	4
Scenic Turn Off	7
Grand Total	**654**

Table 17. Static special conservation areas within the Presque Isle Lake and Till Plains Management Area.

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Common Natural Heritage Element Occurrences		**473**
Northern Shrub Thicket		32
Northern Wet Meadow		72
Poor Conifer Swamp		368
Designated Trout and Cold Water Stream Buffer		**4,175**
		1,897
Adair Creek		21
Berry Creek		100
Black River		44
Brush Creek		137

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Canada Creek		170
Cold Creek		76
Crumley Creek		36
East Branch Black River		199
East Branch Rainy River		27
Elliot Creek		8
Fisher Creek		62
Fox Creek		1
Gokee Creek		22
Grass Creek		36
Hardwood Creek		15
Hartwick Creek		7
Haymeadow Creek		14
Indian Creek		17
Johnson Creek		23
Lewis Branch Adair Creek		75
Little Brush Creek		10
Little McMasters Creek		56
Little Mud Creek		36
Little Ocqueoc River		67
Little Pigeon River		34
Little Sturgeon River		68
Long Lake Creek		8
Maple River		31
McIntosh Creek		31
Middle Branch Little Pigeon River		23
Miller Creek		120
Milligan Creek		16
Minnehaha Creek		9
Mud Creek		36
Mullett Creek		22
North Branch Thunder Bay River		29
Ocqueoc River		100
Packer Creek		52
Pigeon River		23
Rattlesnake Creek		58
Scott Creek		11
Silver Creek		78
Stewart Creek		11
Sturgeon River		11
Sturgis Creek		2

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Tomahawk Creek		105
Twin Lakes Creek		7
Van Hetton Creek		69
Weed Creek		17
West Branch Upper Rainy River		9
West McMasters Creek		34
Wilkes Creek		10
Designated Trout and Coldwater Streams	**152.9**	
<Null>	69.0	
Adair Creek	0.8	
Berry Creek	3.6	
Black River	1.7	
Brush Creek	5.1	
Canada Creek	6.4	
Cold Creek	2.7	
Crumley Creek	1.3	
East Branch Black River	7.5	
East Branch Rainy River	0.9	
Elliot Creek	0.2	
Fisher Creek	2.2	
Gokee Creek	0.8	
Grass Creek	1.4	
Hardwood Creek	0.6	
Hartwick Creek	0.3	
Haymeadow Creek	0.5	
Indian Creek	0.6	
Johnson Creek	0.9	
Lewis Branch Adair Creek	2.7	
Little Brush Creek	0.4	
Little McMasters Creek	2.0	
Little Mud Creek	1.3	
Little Ocqueoc River	2.4	
Little Pigeon River	1.3	
Little Sturgeon River	2.5	
Long Lake Creek	0.3	
Maple River	1.3	
McIntosh Creek	1.1	
Middle Branch Little Pigeon River	0.9	
Miller Creek	4.4	
Milligan Creek	0.5	
Minnehaha Creek	0.3	

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Mud Creek	1.3	
Mullett Creek	0.8	
North Branch Thunder Bay River	1.0	
Ocqueoc River	3.7	
Packer Creek	1.9	
Pigeon River	0.9	
Rattlesnake Creek	2.1	
Scott Creek	0.4	
Silver Creek	2.9	
Stewart Creek	0.4	
Sturgeon River	0.3	
Sturgis Creek	0.1	
Tomahawk Creek	3.8	
Twin Lakes Creek	0.2	
Van Hetton Creek	2.5	
Weed Creek	0.6	
West Branch Upper Rainy River	0.3	
West McMasters Creek	1.2	
Wilkes Creek	0.4	
Important Bird Areas		**86,519**
Kirtland's Warbler Management Units & Guide's Rest		15,578
Pigeon Country moraines		70,941
Mussel Stream Group 1 - State special concern	**6.2**	
Bowen Creek-Black River	6.2	
Mussel Stream Group 2 - State threatened or endangered	**0.0**	
Mullet Lake	0.0	
Natural Beauty Roads	**1.2**	
S Ward Branch Rd	1.2	
Non-dedicated Natural Areas		**947**
Natural Area Dog Lake Wild Area, Pigeon River Coun		659
Natural Area Duck Lake-Mud Lake		236
Natural Area Lake Sixteen		52
Wood Turtle Stream 100ft Buffer		**283**
		11
Black River		68
Grass Creek		32
Indian River		17
Maple River		21

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Ocqueoc River		115
Pigeon River		10
Sturgeon River		8
Wood Turtle Stream 660ft Buffer		**1,876**
		86
Black River		484
Crumley Creek		9
Grass Creek		203
Indian River		110
Maple River		123
Ocqueoc River		688
Pigeon River		111
Sturgeon River		62
Grand Total	**160.3**	**94,273**

Rare species

Rare species occurrences are compiled from the Michigan Natural Features Inventory Biotics database (*Table* 18, Table 20 and Table 21) and do not necessarily include all rare species found in this management area due to biases in survey effort and verifiable observation reporting over time.

Table 18*. Rare animal and plant species conservation status key.*

Status	Status
E = endangered	LE = listed endangered
T = threatened	LT = listed threatened
SC = special concern	PDL = proposed for delisting

Table 19. Rare animal occurrence in the Presque Isle Lake and Till Plains Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Accipiter gentilis	Northern goshawk	T		7
Animal	Acipenser fulvescens	Lake sturgeon	T		4
Animal	Alasmidonta marginata	Elktoe	SC		1
Animal	Alasmidonta viridis	Slippershell	T		1
Animal	Appalachia arcana	Secretive locust	SC		6
Animal	Appalachina sayanus	Spike-lip crater	SC		2

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Atrytonopsis hianna	Dusted skipper	SC		2
Animal	Bombus affinis	Rusty-patched bumble bee	E	LE	1
Animal	Bombus borealis	Northern amber bumble bee	SC		4
Animal	Bombus terricola	Yellow banded bumble bee	SC		3
Animal	Brychius hungerfordi	Hungerford's crawling water beetle	E	LE	3
Animal	Buteo lineatus	Red-shouldered hawk	SC		44
Animal	Cambarus robustus	Big water crayfish	SC		1
Animal	Chlidonias niger	Black tern	T		1
Animal	Cincinnatia cincinnatiensis	Campeloma spire snail	SC		1
Animal	Coregonus artedi	Lake herring or Cisco	T		4
Animal	Elliptio complanata	Eastern elliptio	SC		1
Animal	Emydoidea blandingii	Blanding's turtle	SC		10
Animal	Galba galbana	Boreal fossaria	SC		1
Animal	Gavia immer	Common loon	T		19
Animal	Glaucomys sabrinus	Northern flying squirrel	SC		1
Animal	Glyptemys insculpta	Wood turtle	T		11
Animal	Haliaeetus leucocephalus	Bald eagle	SC		27
Animal	Hypocoena basistriga	Basistriga owlet moth	SC		1
Animal	Lasmigona compressa	Creek heelsplitter	SC		3
Animal	Lasmigona costata	Flutedshell	SC		1
Animal	Lithobates palustris	Pickerel frog	SC		3
Animal	Microtus pinetorum	Woodland vole	SC		1
Animal	Myotis lucifugus	Little brown bat	T		3
Animal	Necturus maculosus	Mudpuppy	SC		3
Animal	Notropis anogenus	Pugnose shiner	E		1
Animal	Opheodrys vernalis	Smooth green snake	SC		6
Animal	Pandion haliaetus	Osprey	SC		7
Animal	Planorbella smithi	An aquatic snail (no common name)	SC		1
Animal	Ptychobranchus fasciolaris	Kidney shell	SC		1

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Sagittunio nasutus	Eastern pondmussel	E		4
Animal	Setophaga discolor	Prairie warbler	SC		1
Animal	Setophaga kirtlandii	Kirtland's warbler	E		2
Animal	Sideridis congermana	German cousin moth	SC		1
Animal	Sistrurus catenatus	Eastern massasauga	T	LT	6
Animal	Stenelmis douglasensis	Douglas stenelmis riffle beetle	SC		1
Animal	Sympistis piffardi	3-striped oncocnemis	SC		2
Animal	Vertigo elatior	Tapered vertigo	SC		1
Total	-	-	-	-	**204**

Table 20. Rare plant occurrence in the Presque Isle Lake and Till Plains Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Plant	Botrychium mormo	Goblin moonwort	E		1
Plant	Callitriche heterophylla	Large water starwort	T		1
Plant	Calypso bulbosa	Calypso or fairy-slipper	T		4
Plant	Cirsium hillii	Hill's thistle	SC		9
Plant	Cypripedium arietinum	Ram's head lady's-slipper	SC		4
Plant	Drosera anglica	English sundew	SC		2
Plant	Eleocharis engelmannii	Engelmann's spike rush	SC		1
Plant	Festuca altaica	Rough fescue	SC		1
Plant	Helianthus hirsutus	Whiskered sunflower	SC		1
Plant	Juncus militaris	Bayonet rush	T		5
Plant	Mimulus michiganensis	Michigan monkey flower	E	LE	2
Plant	Potamogeton hillii	Hill's pondweed	T		1
Plant	Prunus umbellata	Alleghany or Sloe plum	SC		2
Plant	Rorippa aquatica	Lake cress	SC		3
Plant	Stachys pilosa	Hairy hedge-nettle	SC		3
Grand Total	-	-	-	-	40

Table 21. Other rare occurrence in the Presque Isle Lake and Till Plains Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Other	-	Great blue heron rookery			3
Total	-	-	-	-	**3**

Non-ecological reference area natural communities

Natural communities that are identified with an element occurrence in the MNFI Biotics database, but that have not been given an additional ecological reference area (ERA) designation, are recognized and managed accordingly (Table 22).

Table 22. Non-ecological reference area natural communities in the Presque Isle Lake and Till Plains Management Area.

Community Type	Element Occurrence Rank	State Rank	Global Rank	Number of Occurrences
Bog	B	S4	G3G5	2
Bog	BC	S4	G3G5	1
Bog	C	S4	G3G5	1
Dry Northern Forest	X	S3	G3?	1
Dry-mesic Northern Forest	BC	S3	G4	1
Dry-mesic Northern Forest	C	S3	G4	3
Floodplain Forest	BC	S3	G3?	1
Intermittent Wetland	AB	S3	G2	2
Intermittent Wetland	B	S3	G2	2
Muskeg	B	S3	G4G5	2
Muskeg	BC	S3	G4G5	2
Northern Shrub Thicket	B	S5	G4	2
Northern Shrub Thicket	BC	S5	G4	2
Northern Wet Meadow	B	S4	G4G5	1
Northern Wet Meadow	BC	S4	G4G5	2
Pine Barrens	BC	S2	G3	1
Poor Conifer Swamp	B	S4	G4	1
Poor Conifer Swamp	BC	S4	G4	1
Poor Conifer Swamp	C	S4	G4	1
Poor Fen	B	S3	G3	1
Poor Fen	BC	S3	G3	1
Rich Conifer Swamp	B	S3	G4	2
Rich Conifer Swamp	C	S3	G4	1
Rich Conifer Swamp	D	S3	G4	1
Rich Tamarack Swamp	B	S3	G4	1
Sinkhole	B	S2	G3G5	1
Wet-mesic Sand Prairie	C	S2	G2G3	1
Wooded Dune and Swale Complex	C	S3	G3	1
Total	-	-	-	**39**

Forest Health

Forest health concerns, both native and non-native, can have impacts on stand conditions and management decisions. The following insects (Table 23) and diseases (Table 24) could have an impact on management during the planning period and may need to be monitored and/or addressed.

Table 23. Defoliating insects of concern in the Presque Isle Lake and Till Plains management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Spongy moth	Lymantria dispar	Non-native	Yes
Forest tent caterpillar	Malacosoma disstria	Native	Yes
Jack pine budworm	Choristoneura pinus	Native	Yes

Watch for lingering ash with potential resistance to emerald ash borer. Monitor young jack and red pine for redheaded pine sawfly damage.

Table 24. Maladies of concern in the Presque Isle Lake and Till Plains management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Canker (stem infections)	Various	Various	Yes
Armillaria root rot	Armillaria spp.	Native	
Oak decline	Various	Various	Yes

Monitor oak for symptoms of oak wilt and follow state land oak wilt guidance. Monitor planted red pine for Heterobasidion root disease and follow disease guidance. Report surviving mature beech trees that may be resistant to beech bark disease. Watch for symptoms of beech leaf disease.

Aquatic resources

Riparian habitat

A total of 200 miles of streams and rivers are found in the management area (Table 25). Streams/rivers classified as warm types comprise approximately 51% of the riverine mileage.

Table 25. Classification type and length of streams/rivers found within the management area.

Type	Length (miles)
Cold Stream	56
Cold Small River	0
Cold Transitional Stream	35
Cold Transitional Small River	8
Cold Transitional Large River	0
Warm Transitional Stream	60
Warm Transitional Small River	17
Warm Transitional Large River	0
Warm Stream	9
Warm Small River	0
Warm Large River	15

Lacustrine habitat

A total of 76 lakes and ponds of at least 1 surface acre are found in the management area (Table 26).

Table 26. Size and number of lakes and ponds located within the management area.

Lake Size Class (acres)	Number
1-99	58
100-499	11
500+	7

Wetlands

A total of 75,429 acres of wetlands are found in the management area (Table 27). Forested wetlands comprise approximately 97% of wetland types found.

Table 27. Area of emergent, forested and riverine wetland types found within the management area.

Wetland Type	Acres
Emergent	2,157
Forested	73,067
Riverine	205

Vernal pools and seeps

A total of 183 acres of vernal pools and seeps have been inventoried in the management area, and 1,224 acres of seeps have been identified.

Riparian vegetation cover

Lowland shrub and aspen are the predominant cover types present in a 100-meter riparian zone located next to streams/rivers in the management area (Table 28).

Table 28. Largest vegetative cover types (i.e., top 10) and area located in a 100-meter buffer of streams/rivers within the management area.

Cover Type	Acres
Lowland Shrub	5,466
Aspen	4,792
Lowland Conifers	2,419
Cedar	2,215
Marsh	1,664
Lowland Deciduous	1,649
Lowland Aspen/Balsam Poplar	896
Mixed Upland Deciduous	863
Upland Mixed Forest	742
Natural Mixed Pines	697

Watershed vegetation cover

The management area includes portions of important watersheds of the Black and Thunder Bay rivers (Table 29 & Table 30). Aspen is a major cover type of the state forest in each watershed.

Table 29. Largest vegetative cover types (i.e., top five) and area of the Black River watershed located within the management area.

Cover Type	Acres
Aspen	25,084
Planted Jack Pine	6,584
Planted Red Pine	6,572
Cedar	6,087
Lowland Conifers	4,524

Table 30. Largest vegetative cover types (i.e., top 5) and area of the Thunder Bay River watershed located within the management area.

Cover Type	Acres
Aspen	11,415
Planted Red Pine	2,747
Planted Jack Pine	2,556
Mixed Upland Deciduous	2,032
Upland Mixed Forest	1,719

Recreation

Access for public recreation and management in the Presque Isle Lake and Till Plains Management Area is mixed, with access limited in some areas due to wet sites, but other areas well served by a developed road/trail system.

Opportunities for recreation on state forest lands within the management area are abundant, including unique opportunities for elk viewing and backcountry adventures in the Pigeon River Country State Forest special management unit. Motorized recreation options are generally restricted in the Pigeon River Country, but an extensive network of ORV, motorcycle and snowmobile trails can be found east of I-75. The Black Mountain state forest recreation area provides concentrated recreation opportunities for ORV, horseback and bike riding, hiking and cross-country skiing. The 32-mile Black Mountain Pathway is open to all nonmotorized uses. In addition to the trails, there is a 65-acre scramble area for motorcycles and all-terrain vehicles. Other nonmotorized recreation opportunities in the Presque Isle Lake and Till Plains Management Area include 45 miles of the High Country Pathway – an 82-mile looped hiking and biking trail, and the Ocqueoc Falls, Jackson Lake and Sinkhole Pathways. Nearly 18 miles of the Shore-to-Shore equestrian trail passes through the management area, connected to the Stoney Creek equestrian trail and campground. The North Central and Northeastern State Trails (rail trails) also cross the area, providing connections to the wider regional trail system.

There are 13 state forest campgrounds in the Presque Isle Lake and Till Plains Management Area, of which five are accessible to ORV use with connections to ORV trails and two are designated for equestrian use. Additional camping and other recreation opportunities are provided by nearby state parks, including Burt Lake, Cheboygan, Onaway, Aloha and Clear Lake.

Table 31. Designated recreation trails by type.

Recreation Category	Recreation Type	# of Miles
Motorized Recreation Trails	ORV (all types)	286.6
	Snowmobile	139.7
Nonmotorized Recreation Trails	Hiking	128.1
	Equestrian	66.3
	Biking	108.2
	Hunter Access Trails	54.3
Total		**783.3**

Note: Trail-use types may overlap.

Table 32. State forest campgrounds.

Name	# of sites	Equestrian	ORV Access
Black Lake State Forest Campground (Lower)	17		
Black Lake State Forest Campground (Upper)	35		X
Black Lake Trail Camp	8	X (group)	
Ess Lake State Forest Campground	27		X
Jackson Lake State Forest Campground	18		X
Maple Bay State Forest Campground	35		
Ocqueoc Falls State Forest Campground	13		
Shoepac Lake State Forest Campground	25		
Stoney Creek Trail Camp	9	X (group)	
Tomahawk Creek Flooding State Forest Campground	47		X
Tomahawk Lake State Forest Campground	25		X
Town Corner Lake State Forest Campground	12		
Twin Lakes State Forest Campground	11		

There are two state wildlife management areas within the management area and Lee Grande Ranch Grouse Enhanced Management Site, which is managed to provide premier grouse and woodcock hunting opportunities with 8 miles of access trails.

Boating access sites are available on many of the area inland lakes, including the larger Black and Burt lakes.

Opportunities for dispersed recreation on state forest lands within the management area are abundant, including unique opportunities for elk viewing.

Table 33. Areas managed for hunting.

Type	Name	# of Acres
State Wildlife Management Area	Dog lake Flooding Stoney Creek Flooding	811.8 1,157.7
Grouse Enhanced Management Site	Lee Grande Ranch	2,436.2
		4,405.7

Table 34. Boating access site.

Name	Waterbody
Avalon Lake	Avalon Lake
Bear Den Lake	Bear Den Lake
Black Lake State Forest Campground	Black Lake
Cochran Lake	Cochran Lake
De Cheau Lake	De Cheau Lake
Grass Lake	Grass Lake
Jackson Lake State Forest Campground	Jackson Lake
Lake Emma	Lake Emma
Lake Ferdelman	Lake Ferdelman
Lancaster Lake	Lancaster Lake
Little Tomahawk Lake	Little Tomahawk Lake
Long Lake	Long Lake
Maple Bay State Forest Campground	Burt Lake
Munro Lake	Munro Lake
Shoepac Lake State Forest Campground	Shoepac Lake
Tomahawk Creek Flooding East	Tomahawk Creek Flooding
Tomahawk Creek Flooding West	Tomahawk Creek Flooding
Tomahawk Lake State Forest Campground	Tomahawk Lake
Town Corner Lake State Forest Campground	Town Corner Lake

Wolverine Moraines

State Forest Area: 178,107 acres	Location: Northeastern Lower Peninsula	Population Centers: Boyne City Vanderbilt and Gaylord
Subsection: Wolverine Moraines	Landforms: Steep moraine ridges Outwash channels and plains	Landcover: Forested: 163,066 acres Nonforested: 15,041 acres

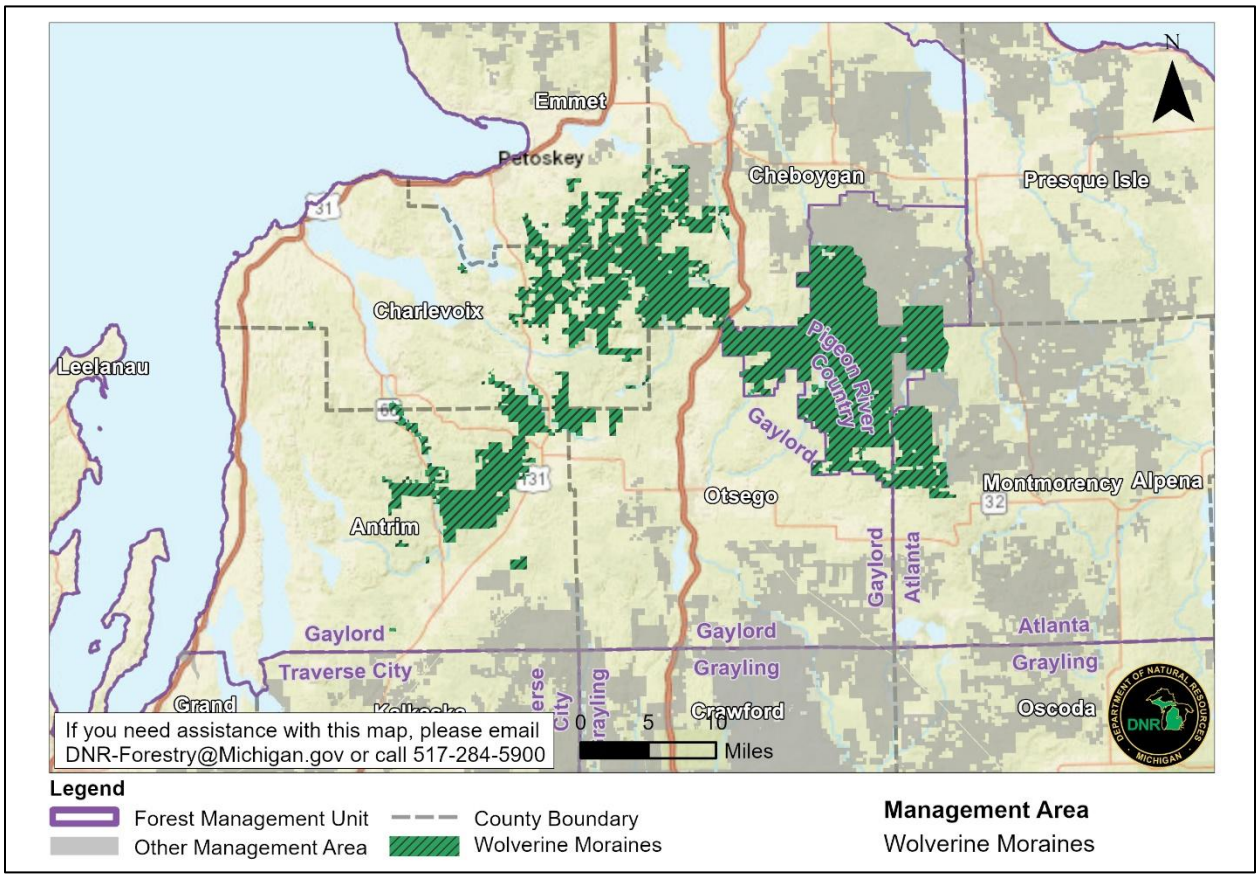


Figure 1. Wolverine Moraines Management Area.

Forested landscape

Current and projected future condition

The Wolverine Moraines Management Area includes a variety of shade tolerance levels with the most tolerant occurring mostly in the mature age category (Figure 2). The intolerant and mid-tolerant categories occur mostly in the young, intermediate and mid-aged categories.

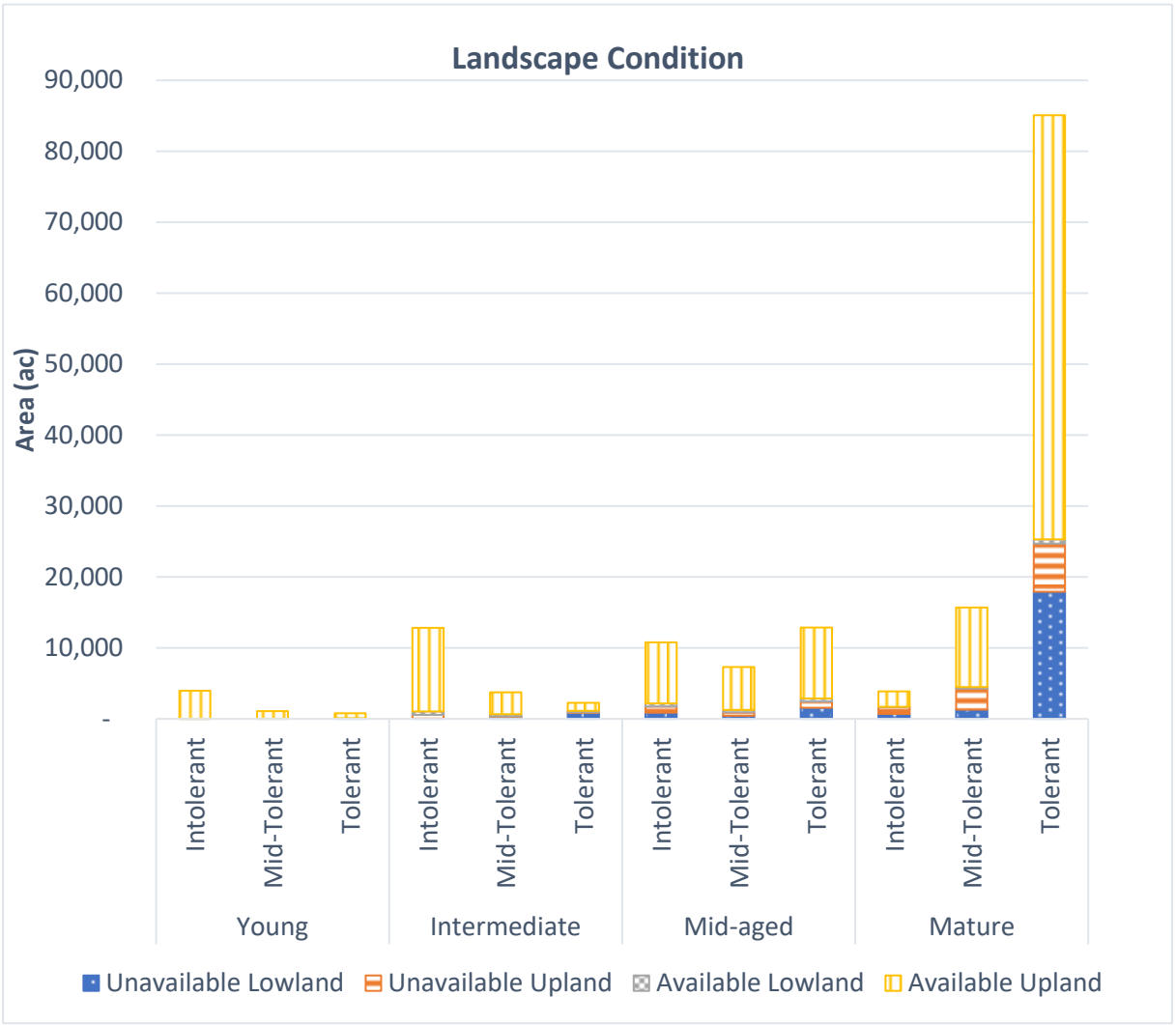


Figure 2. Forest diversity matrix showing the current distribution of forested acres across management availability, age category, landscape position and shade tolerance.

Landscape habitat conditions refine the management area landscape into featured species habitat context. Current and projected acres for the metrics identified in the Management Priorities (Section 3 Statewide/Regional) establish a baseline and future condition based on management over the planning period (Table 1).

Table 1. Current acres for landscape habitat conditions.

Landscape Habitat Condition	Monitoring Metric	Current Acres
Young Forest	Acres of 0-19 stands in Aspen and Jack Pine	21,466
Mature Forest	Acres of 80+ year stands across cover types	89,946
Mature Forest	Acres of 120+ year stands across cover types	8,270
Mesic Conifer Cover types	Acres of mesic conifer cover types	20,760
Mesic Conifers in other Cover types	Average canopy occupancy	27%
Mast – Oak Cover Types	Acres of oak cover types	10,915
Mast Tree Species in other Cover Types	Acres of total canopy occupancy of mast tree acres (trace-100%)	121,755
Big Trees	Acres of total canopy stand occupancy of species in sawlog or greater size class	116,648
Nonforested Openings	Acres of total herbaceous openland, upland shrub, and cropland	7,723
Landscape Forest Matrix	Percent deciduous forest	70%
Landscape Forest Matrix	Percent coniferous forest	26%

The Wolverine Moraines Management Area has the following special analysis units (SAUs). These SAUs have specific cover type goals, typically associated with wildlife habitat management. For any SAUs that overlap with this management area, SAU cover type goals take priority as the SFMP model strives to meet the cover type goals across the area, ensuring they are met. See Section 5 for a detailed description of the management direction and harvest goals for each of these SAUs.

- Special analysis unit – Elk
- Special analysis unit - Pigeon River Country State Forest

The Wolverine Moraines Management Area is comprised of 92% forested cover types and 8% nonforested cover types (Table 2). Of the forested cover types, 83% are in the upland landscape position. The largest contributors to upland cover types are northern hardwoods and aspen. Lowland conifer and cedar take up 79% of the lowland landscape position. Herbaceous openland and lowland shrub are the most common nonforested cover types in the management area representing 3% and 2% of the landscape respectively.

Table 2. Current landscape context and distribution of cover types.

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
Forested	Upland	Deciduous	Aspen	26,753	111,992	135,709	163,066
			Northern Hardwood	75,747			
			Black Red Hybrid Oak	0			
			Northern Red Oak	2,130			
			Oak Mix	160			
			Mixed Upland Deciduous	7,202			
		Mixed	Upland Mixed Forest	3,361	3,361		
		Coniferous	Planted Red Pine	8,437	20,356		
			Planted Jack Pine	29			
			Planted White Pine	370			
			Planted Mixed Pine	426			
			Natural Red Pine	1,467			
			Natural Jack Pine	1,198			
			Natural White Pine	2,670			
			Natural Mixed Pines	4,101			
			Upland Spruce/Fir	317			
			Upland Conifers	1,076			
			Hemlock	266			
	Lowland	Deciduous	Lowland Aspen/Balsam Poplar	1,793	2,894	27,358	
			Lowland Deciduous	1,101			
		Mixed	Lowland Mixed Forest	2,118	2,118		
		Coniferous	Cedar	10,263	22,346		
			Lowland Conifers	11,350			
			Lowland Spruce/Fir	473			
			Tamarack	261			
Nonforested	Upland	N/A	Herbaceous Openland	4,644	N/A	9,278	15,041
			Upland Shrub	2,730			
			Low Density Trees	1,026			
			Bare/Sparsely Vegetated	139			
			Cropland	349			
			Urban	390			
	Lowland	N/A	Lowland Shrub	3,789	N/A	5,763	
			Marsh	1,035			
			Bog	29			
			Treed Bog	19			
			Water	891			
						Grand Total:	**178,107**

There are 125,256 acres (70% of the total management area and 77% of the forested area) that can be managed toward desired future conditions via commercial timber harvest in the Wolverine Moraines Management Area (Table 3). Of that, over 42% is in the hardwood cover type, 15% in the aspen cover type and 5% in planted red pine. The remaining 21 cover types represent less than 4% each of the forested and available land in the management area. Acres unavailable for management are categorized by site condition (Table 4).

Table 3. Current cover type composition by management availability.

WOLVERINE MORAINES						
Forested Cover Type	Available Acres	Available %	Unavailable Acres	Unavailable %	Total Acres	Total %
Aspen	24,810	15.2%	1,949	1.2%	26,759	16.4%
Cedar	172	0.1%	10,092	6.2%	10,263	6.3%
Hemlock	56	0.0%	210	0.1%	266	0.2%
Lowland Aspen/Balsam Poplar	800	0.5%	994	0.6%	1,794	1.1%
Lowland Conifers	1,088	0.7%	10,263	6.3%	11,351	7.0%
Lowland Deciduous	254	0.2%	849	0.5%	1,103	0.7%
Lowland Mixed Forest	777	0.5%	1,343	0.8%	2,120	1.3%
Lowland Spruce/Fir	51	0.0%	422	0.3%	473	0.3%
Mixed Upland Deciduous	5,810	3.6%	1,360	0.8%	7,171	4.4%
Natural Jack Pine	1,187	0.7%	12	0.0%	1,198	0.7%
Natural Mixed Pines	3,447	2.1%	655	0.4%	4,101	2.5%
Natural Red Pine	1,294	0.8%	173	0.1%	1,467	0.9%
Natural White Pine	2,355	1.4%	318	0.2%	2,673	1.6%
Northern Hardwood	68,807	42.2%	6,941	4.3%	75,748	46.5%
Northern Red Oak	1,835	1.1%	295	0.2%	2,130	1.3%
Oak Mix	160	0.1%	0	0.0%	160	0.1%
Planted Jack Pine	29	0.0%	0	0.0%	29	0.0%
Planted Mixed Pine	392	0.2%	34	0.0%	426	0.3%
Planted Red Pine	8,220	5.0%	222	0.1%	8,441	5.2%
Planted White Pine	82	0.1%	288	0.2%	370	0.2%
Tamarack	25	0.0%	237	0.1%	261	0.2%
Upland Conifers	646	0.4%	430	0.3%	1,076	0.7%
Upland Mixed Forest	2,788	1.7%	573	0.4%	3,362	2.1%
Upland Spruce/Fir	172	0.1%	145	0.1%	317	0.2%
Grand Total	**125,256**	**76.8%**	**37,802**	**23.2%**	**163,058**	**100.0%**

Table 4. Site conditions for unavailable acres.

Site Condition (Reason area is unavailable for commercial harvest)	Area (ac)	% of unavailable Area
Too Wet	17,719	46.9%
Conservation Values	9,193	24.3%
BMPs	3,510	9.3%
Too Steep	2,213	5.9%
Federal/State/Local Law	1,234	3.3%
Blocked by Obstacle	1,056	2.8%
Cannot Regenerate	653	1.7%
Other Dept./Div. Processes	451	1.2%
Recreational/Scenic	438	1.2%
Denied Access	329	0.9%
Other Influence Zones	302	0.8%
Wildlife Concerns	274	0.7%
Long-Term Retention	204	0.5%
Blocked by Railroad	132	0.3%
Neighbor / Interest Group	65	0.2%
Non-DNR agency concerns	12	0.0%
Species of special concern or T&E	8	0.0%
Unproductive	7	0.0%
Historical/Archaeological	3	0.0%
Total Unavailable	**37,802**	**100.0%**

Projected 10-year cover type management actions

Each cover type in the Wolverine Moraines Management Area has a unique age class and basal area class goals that describe the long-term desired future conditions. The calculated harvest levels that are needed during the first 10-year planning period are summarized in Table 5. These harvest levels are necessary to begin achieving long-term planning goals. This will help establish a desirable amount of regeneration for the even-aged cover types over the 10-year period or help to achieve desired basal area distribution among uneven-aged cover types like northern hardwoods. Implementing these silvicultural regimes will yield 657,302 cords, the planned harvest volume for the decade (

Silvicultural Regimes								
Cover Type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Salvage Clearcut	Salvage Thinning	Grand Total
Northern Hardwood	-	632	-	591	-	3,161	9,649	14,032
Planted Red Pine	-	-	2,256	-	-	611	1,048	3,915
Aspen	1,900	-	-	-	-	1,116	-	3,016
Mixed Upland Deciduous	1,169	323	-	-	66	105	-	1,663
Northern Red Oak	35	-	-	22	-	290	493	840
Natural Mixed Pines	-	-	116	-	271	-	179	567
Natural White Pine	-	-	113	-	207	-	93	413
Natural Red Pine	-	-	13	-	119	-	138	270
Lowland Conifers	234	-	-	-	-	-	-	234
Upland Mixed Forest	200	-	-	-	-	-	-	200
Lowland Aspen/Balsam Poplar	192	-	-	-	-	-	-	192
Lowland Mixed Forest	155	-	-	-	-	-	-	155
Planted Mixed Pine	-	-	90	-	-	-	-	90
Natural Jack Pine	63	-	-	-	-	-	-	63
Upland Spruce/Fir	58	-	-	-	-	-	-	58
Hemlock	-	33	-	-	-	-	-	33
Planted White Pine	-	-	33	-	-	-	-	33
Lowland Deciduous	32	-	-	-	-	-	-	32
Cedar	8	-	-	-	-	-	-	8
Lowland Spruce/Fir	7	-	-	-	-	-	-	7
Tamarack	1	-	-	-	-	-	-	1
Totals	**4,053**	**987**	**2,620**	**613**	**663**	**5,283**	**11,600**	**25,820**

Table 6).

Table 5. Ten-year planning period harvest goals (acres) by cover type and silvicultural regime.

Silvicultural Regimes								
Cover Type	**Clearcut**	**Selection**	**Thinning**	**Group Selection**	**Shelterwood**	**Salvage Clearcut**	**Salvage Thinning**	**Grand Total**
Northern Hardwood	-	632	-	591	-	3,161	9,649	14,032
Planted Red Pine	-	-	2,256	-	-	611	1,048	3,915
Aspen	1,900	-	-	-	-	1,116	-	3,016
Mixed Upland Deciduous	1,169	323	-	-	66	105	-	1,663
Northern Red Oak	35	-	-	22	-	290	493	840
Natural Mixed Pines	-	-	116	-	271	-	179	567
Natural White Pine	-	-	113	-	207	-	93	413
Natural Red Pine	-	-	13	-	119	-	138	270
Lowland Conifers	234	-	-	-	-	-	-	234
Upland Mixed Forest	200	-	-	-	-	-	-	200
Lowland Aspen/Balsam Poplar	192	-	-	-	-	-	-	192
Lowland Mixed Forest	155	-	-	-	-	-	-	155
Planted Mixed Pine	-	-	90	-	-	-	-	90
Natural Jack Pine	63	-	-	-	-	-	-	63
Upland Spruce/Fir	58	-	-	-	-	-	-	58
Hemlock	-	33	-	-	-	-	-	33
Planted White Pine	-	-	33	-	-	-	-	33
Lowland Deciduous	32	-	-	-	-	-	-	32
Cedar	8	-	-	-	-	-	-	8
Lowland Spruce/Fir	7	-	-	-	-	-	-	7
Tamarack	1	-	-	-	-	-	-	1
Totals	**4,053**	**987**	**2,620**	**613**	**663**	**5,283**	**11,600**	**25,820**

Table 6. Projected 10-year harvest volume by species.

10-Year Estimated Harvest Volume Projection Wolverine Moraines Management Area			
Product	**Species**	**Volume Planned***	**Volume Prepared****
Pulpwood (cords)	Mixed Hardwood	155,172	145,862
	Mixed Softwood	31,719	29,816
	Mixed Aspen	30,539	28,707
	Red Pine	19,958	18,761
	Mixed Spruce	9,382	8,819
	Mixed Oak	5,462	5,135
	White Pine	3,512	3,301
	Jack Pine	1,867	1,755
	Pulpwood Total	**257,612**	**242,155**
Sawtimber (MBF)	Sugar Maple	32,967	30,989
	Red Pine	17,311	16,273
	Red Maple	11,771	11,065
	Mixed Aspen	5,267	4,951
	Red Oak	4,764	4,478
	White Pine	4,343	4,082
	Basswood	3,258	3,063
	White Oak	1,631	1,534
	Mixed Oak	408	384
	Sawtimber Total	**81,722**	**76,819**
	Total Sawtimber Harvest Volume in Cords	**539,558**	**507,185**
	Grand Total Harvest Volume in Cords	**797,170**	**749,340**
* Volume estimates based on 100% of the projected harvests for the 10-year planning period. ** Volume estimates based on 94% of the projected harvests for the 10-year planning period accounting for reduction in acres and associated volume once sales are prepared for bid.			

There are a few cover type transitions projected for the Wolverine Moraines Management Area. The largest decrease forecasted is in the mixed upland deciduous cover type where 610 acres will convert to other cover types through forest management and regeneration activities. The largest increase occurs in the aspen type where 558 acres are projected to convert into this cover type.

Table 7. Projected 10-year cover type acres resulting from cover type transitions.

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Northern Hardwood	75,747	75,747	0
Aspen	26,753	27,311	558
Lowland Conifers	11,350	11,254	-95
Cedar	10,263	10,263	0
Planted Red Pine	8,437	8,462	25
Mixed Upland Deciduous	7,202	6,592	-610
Natural Mixed Pines	4,101	4,101	0
Upland Mixed Forest	3,361	3,509	148
Natural White Pine	2,670	2,670	0
Northern Red Oak	2,130	2,086	-44
Lowland Mixed Forest	2,118	2,199	81
Lowland Aspen/Balsam Poplar	1,793	1,797	4
Natural Red Pine	1,467	1,467	0
Natural Jack Pine	1,198	1,171	-28
Lowland Deciduous	1,101	1,115	14
Upland Conifers	1,076	1,076	0
Lowland Spruce/Fir	473	469	-3
Planted Mixed Pine	426	426	0
Planted White Pine	370	370	0
Upland Spruce/Fir	317	265	-52
Hemlock	266	266	0
Tamarack	261	261	0
Oak Mix	160	160	0
Planted Jack Pine	29	32	3
Herbaceous Openland	4,644	4,644	0
Lowland Shrub	3,789	3,789	0
Upland Shrub	2,730	2,730	0
Marsh	1,035	1,035	0
Low Density Trees	1,026	1,026	0
Water	891	891	0
Urban	390	390	0
Cropland	349	349	0
Bare/Sparsely Vegetated	139	139	0
Bog	29	29	0
Treed Bog	19	19	0
Total:	**178,107**	**178,107**	**0**

Featured species current and projected habitat acres

There are 11 featured species in this management area that span various cover types, age classes and stand level conditions. Current and projected total habitat acres by species across the decade provide a baseline and show the result of long-term management actions (Table 8). As noted in the Featured Species Management Priority (Section 3), it is recommended that these featured species habitat acres be viewed as acres of potential habitat, representing a condition on the landscape where the more nuanced aspects of each species' habitat requirements are likely to be found or managed for. As described in the introduction, the modeling effort was limited by several factors including the simplification of habitat attributes into MiFI variables. Therefore, when referring to habitat acres what is being referred to is potential habitat acres.

Some species show a loss in habitat over the next century. As mentioned in the Featured Species Management Priority (Section 3), the current condition for many cover types is a surplus of acres in the 0-9 age class from the compensatory management approach applied in the previous decade. The model eventually evens out the age classes at a lower, sustainable level over time, usually by 50 years. For any species with northern hardwoods as a priority cover type, there is a perceived drop in acres between 40 and 60 years; this is due to the basal area dropping below 81 but because it only drops into the upper 70s, it is not expected to translate to any real habitat loss on the ground. Three of these species were not included in the State Forest Management Plan model, black bear, wild turkey and black-backed woodpecker, but are included here to inform management decisions over the decade. Elk habitat is described in the elk special analysis unit (Section 5).

Table 8. Featured species current and projected total habitat acres (i.e., potential habitat).

Featured Species	Priority Cover types	Total Habitat Acres Current	Total Habitat Acres 10-year	50-year Projected Habitat Acres	100-year Projected Habitat Acres
Black Bear	Mast	132,670	--	--	--
Black-Backed Woodpecker	Natural disturbance	--	--	--	--
Blackburnian Warbler	Northern hardwoods, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, hemlock	64,126	75,006	44,427	82,827
Black-Throated Blue Warbler	Northern hardwoods, mixed upland deciduous	61,469	70,872	38,326	75,366
Cerulean Warbler	Northern hardwoods, mixed upland deciduous, lowland deciduous	70,435	72,837	72,279	76,308
Elk	Aspen	--	--	--	--

Featured Species	Priority Cover types	Total Habitat Acres Current	Total Habitat Acres 10-year	50-year Projected Habitat Acres	100-year Projected Habitat Acres
Golden-Winged Warbler	Aspen, black-red hybrid oak, northern red oak, oak mix, tamarack	8,642	10,720	8,112	8,424
Marten	Northern hardwoods, mixed upland deciduous, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, lowland mixed forest, lowland conifers, hemlock, cedar	91,385	100,253	76,024	110,700
Ruffed Grouse	Aspen	8,566	10,641	8,103	8,411
Snowshoe Hare	Aspen, cedar, hemlock, lowland aspen, lowland conifers, lowland mixed forest, lowland spruce/fir, mixed upland deciduous, natural jack pine, natural mixed pines, planted jack pine, upland spruce/fir	12,412	16,264	10,417	11,039
Wild Turkey	Nonforested openings	4,993	--	--	--
Wood Turtle	Nonforested openings	--	--	--	--

Cover type composition and associated featured species

Northern hardwoods

Current condition

Most of the northern hardwood cover type is currently between a stand age of 80 and 110 years old in the Wolverine Moraines Management Area (Figure 3). The past management regime has been primarily single tree selection which allows for stand age to continue to increase over time. Group selection and clearcut harvesting were used in less amounts over the last planning period. Some stands are beginning to achieve an uneven-aged condition where a featured stand age becomes less evident, but the dominant age of these stands will likely increase past 150 years old prior to a younger age cohort becoming the prominent component of these stands.

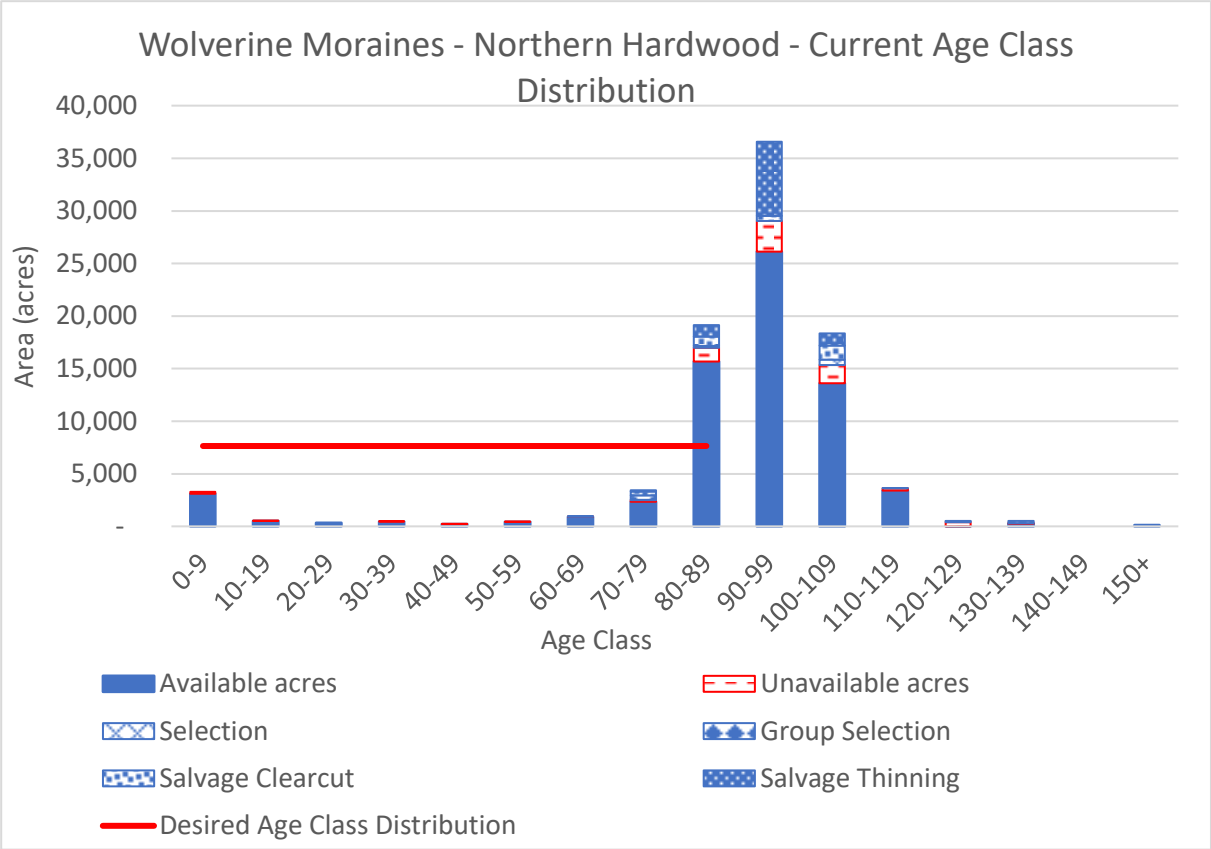


Figure 3. Current age class distribution and projected harvests in the northern hardwood cover type.

The area of northern hardwood is well distributed in the ideal basal area classes for optimal growing conditions in the Wolverine Moraines Management Area (Figure 4). Current conditions are a result of ash and beech salvage efforts in the previous planning period and a regulated selection harvest regime that has been in place in this management area for decades.

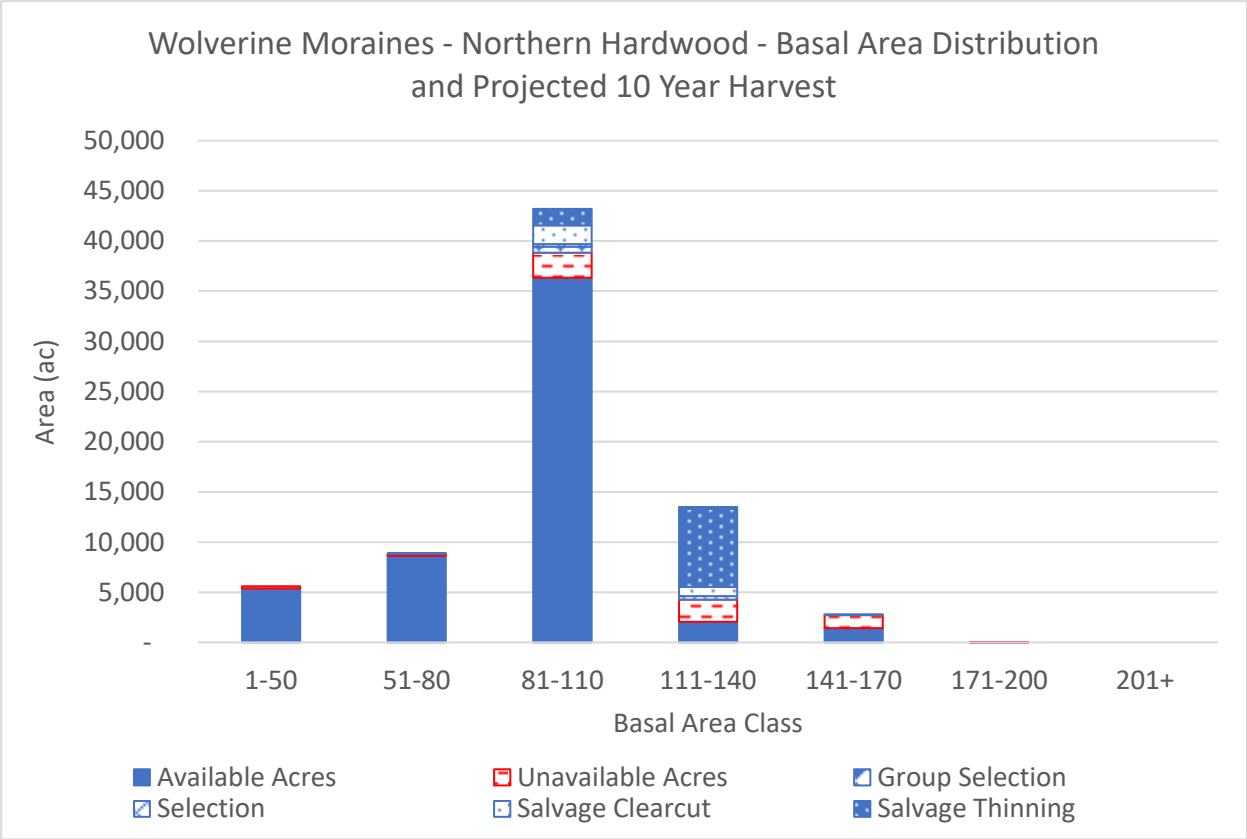


Figure 4. Current basal area distribution of the northern hardwood cover type as well as the projected harvests from each basal area class.

There are 6,941 acres of unavailable northern hardwoods in the Wolverine Moraines Management Area. Selection is the primary silvicultural treatment projected during this 10-year planning period but there may be opportunities to utilize even-aged management silvicultural regimes to increase stem density, species composition and regeneration within the northern hardwood areas. A portion of this cover type meets the habitat requirements for cerulean warbler, black-throated blue warbler and marten (Table 9).

Table 9. Featured species with northern hardwoods as a priority habitat cover type, habitat variables and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Northern Hardwood	Northern Hardwood Habitat Acres - Available	Northern Hardwood Habitat Acres - Unavailable
Cerulean Warbler	Age Category: 80+ Size Category: Sawlog Basal Area: 81+	59,380	6,562
Blackburnian Warbler	Age Category: 80+ Size Category: Pole, Sawlog Basal Area: 81+	51,703	6,332
Black-Throated Blue Warbler	Age Category: 80+ Size Category: Sawlog Basal Area: 81+	51,703	6,332
Marten	Age Category: 40+ Size Category: Pole, Sawlog Basal Area: 81+	54,827	6,492

Desired future condition

The projected long-term cover type trend for northern hardwood is slightly increasing in the Wolverine Moraines Management Area (Figure 5). There are no significant transitions into this cover type from other cover types forecasted in this management area and equally no significant transitions from northern hardwoods to other cover types.

The desired basal area distribution is a bell-shaped curve where a significant majority of the area is kept in the 81-110 basal area class with recently harvested stands occupying the 51-80 class and stands that are ready for harvest occupy the 111-140 basal area class. Diameter distributions of the northern hardwood stands should follow the appropriate Q-curve relative to stand age and condition.

Regeneration and recruitment continue to be a focus in the northern hardwood cover type across this management area. The long-term sustainability of this cover type in an uneven-aged silvicultural regime is dependent on the successful establishment of northern hardwood species as well as the recruitment of those seedlings and saplings into the pole and sawlog classes. The Wolverine Moraines Management Area will take several decades to reach the desired future condition because of the impacts from beech bark disease and the emerald ash borer. The amount of American beech and ash that once occupied much of the northern hardwood stands have resulted in lower-than-normal residual basal area and decreased stocking levels across much of the northeastern Lower Peninsula.

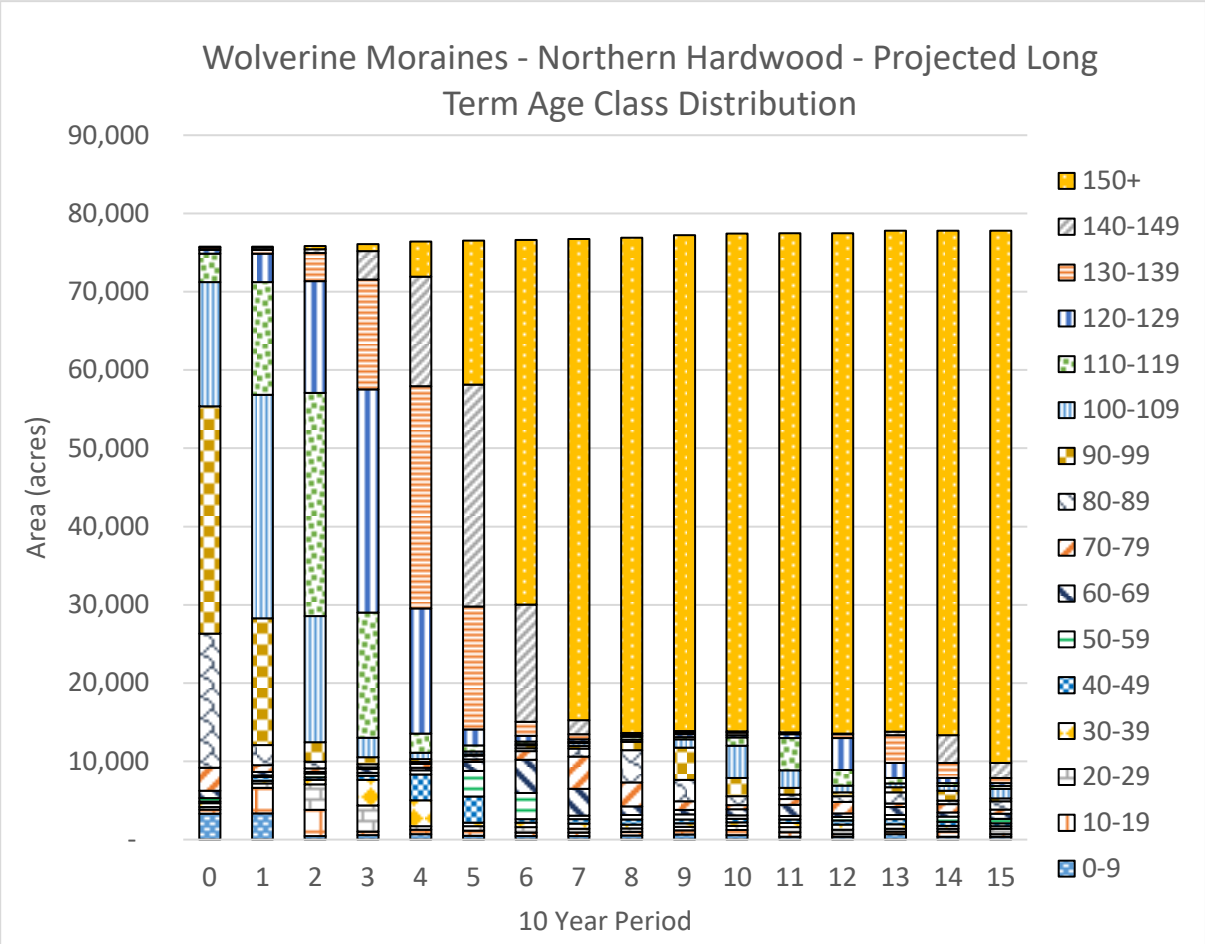


Figure 5. Projected age class distribution for all acres of northern hardwood over the next 150 years.

Management actions

The desired forest conditions and associated featured species habitat will be maintained and achieved through continued application of the projected single tree selection harvest regime on 632 acres, group selection on 591 acres, salvage thinning on 9,649 acres and salvage clearcut on 3,161 acres throughout the first 10-year planning period (Table 5). Multiple silvicultural regimes should have continued consideration as emerging research results become available. Emphasis on larger canopy gaps should be used to encourage diverse regeneration of northern hardwood species while maintaining an overall long-term mature forest closed canopy landscape condition.

Aspen

Current condition

Most of the aspen cover type is currently in the 0-9-year-old age class and the 30-49-year-old age classes. (Figure 6). The past management regime has been primarily clearcut for this cover type. The 10-19 and 20-29 age classes have a deficit. The 0-9-year-old class is much higher due to past management using the compensatory approach where the management regimes intentionally harvest more to create a short term spike in the 0-9 age class in order to compensate for the shortages in both the 10-19-and 20-29-year-old age classes. This current planning period will continue to smooth out the distribution of the aspen in this management area.

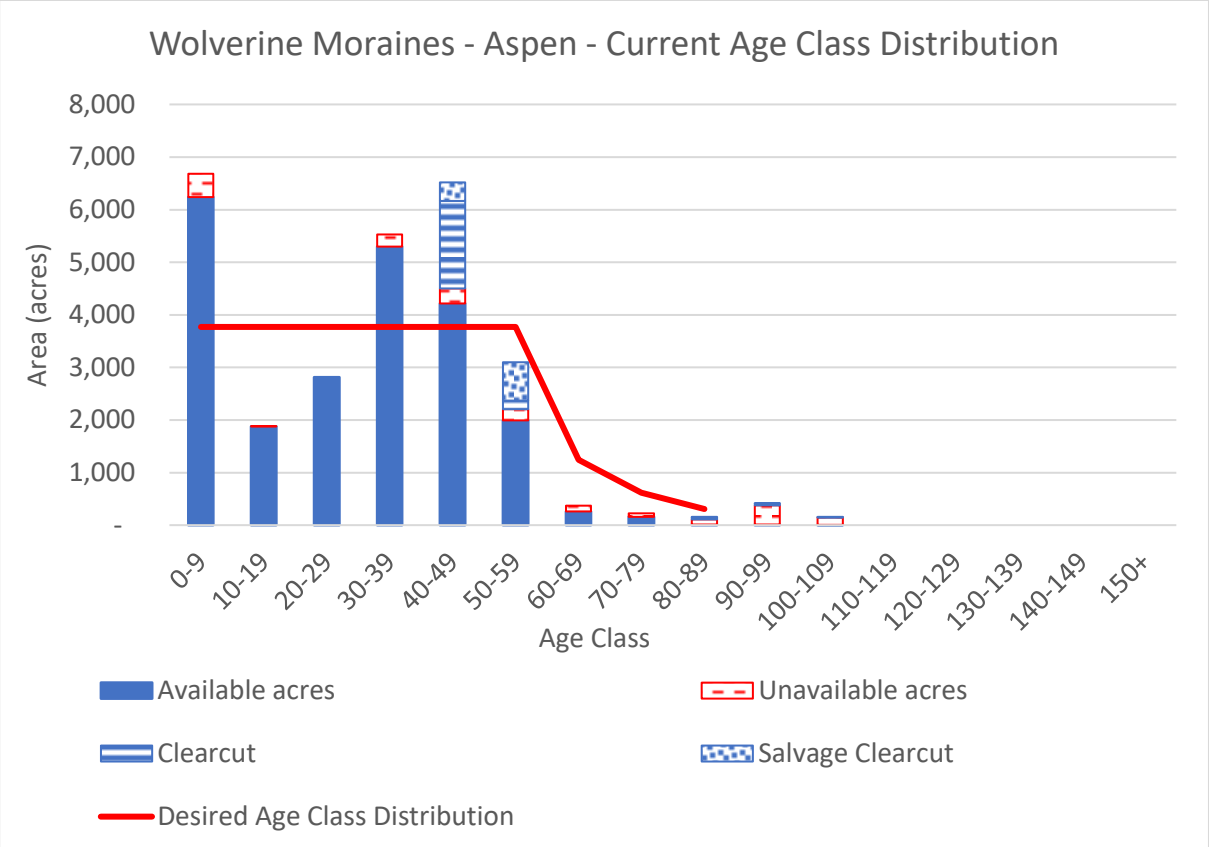


Figure 6. Current age class distribution, the desired age class distribution, and the projected harvests in the aspen cover type over the 10-year planning period.

Current conditions are a result of consistent commercial harvests and regeneration efforts on available aspen acres during the previous planning periods. A portion of this cover type meets the habitat requirements for golden-winged warbler, ruffed grouse and snowshoe hare (Table 10).

Table 10. Featured species with aspen as a priority habitat cover type, habitat variables and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Aspen	Aspen Habitat Acres - Available	Aspen Habitat Acres - Unavailable
Golden-Winged Warbler	Age Category: 0-19 Size Class: Sapling	8,121	446
Ruffed Grouse	Age Category: 0-19 Size Class: Sapling	8,121	446
Snowshoe Hare	Age Category: 0-19 Size Class: Sapling	8,121	446

Desired future condition

The projected long-term cover type trend for aspen is stable in the Wolverine Moraines Management Area. There are a few transitions into this cover type from other cover types forecasted in this management area increasing the aspen cover type acreage by approximately 558 acres in the first 10-year planning period, then leveling out in later planning periods.

The long-term goal for this cover type is balanced age classes between 0 and 60 years old for all available aspen stands in this management area. Maintaining lower acreage in old age classes continues to be desirable to ensure the aspen cover type is distributed within the desired age classes.

The end of the planning period will result in the establishment of the desired amount of regeneration in in the upcoming 0-9 age class (Figure 7). Progress toward the long-term age class distribution of aspen will take several decades in the management area.

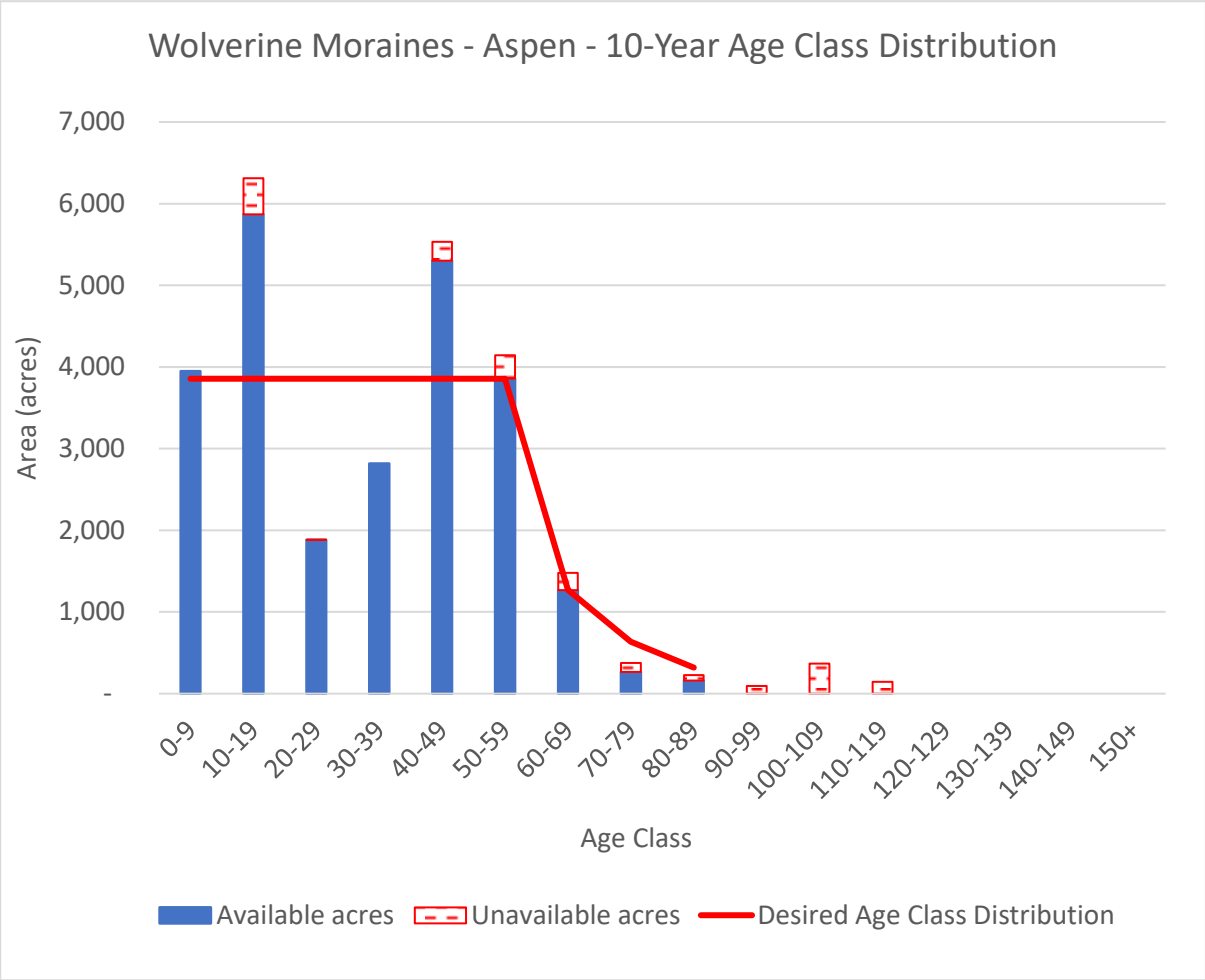


Figure 7. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of aspen acres has reached the desired future condition (Figure 8).

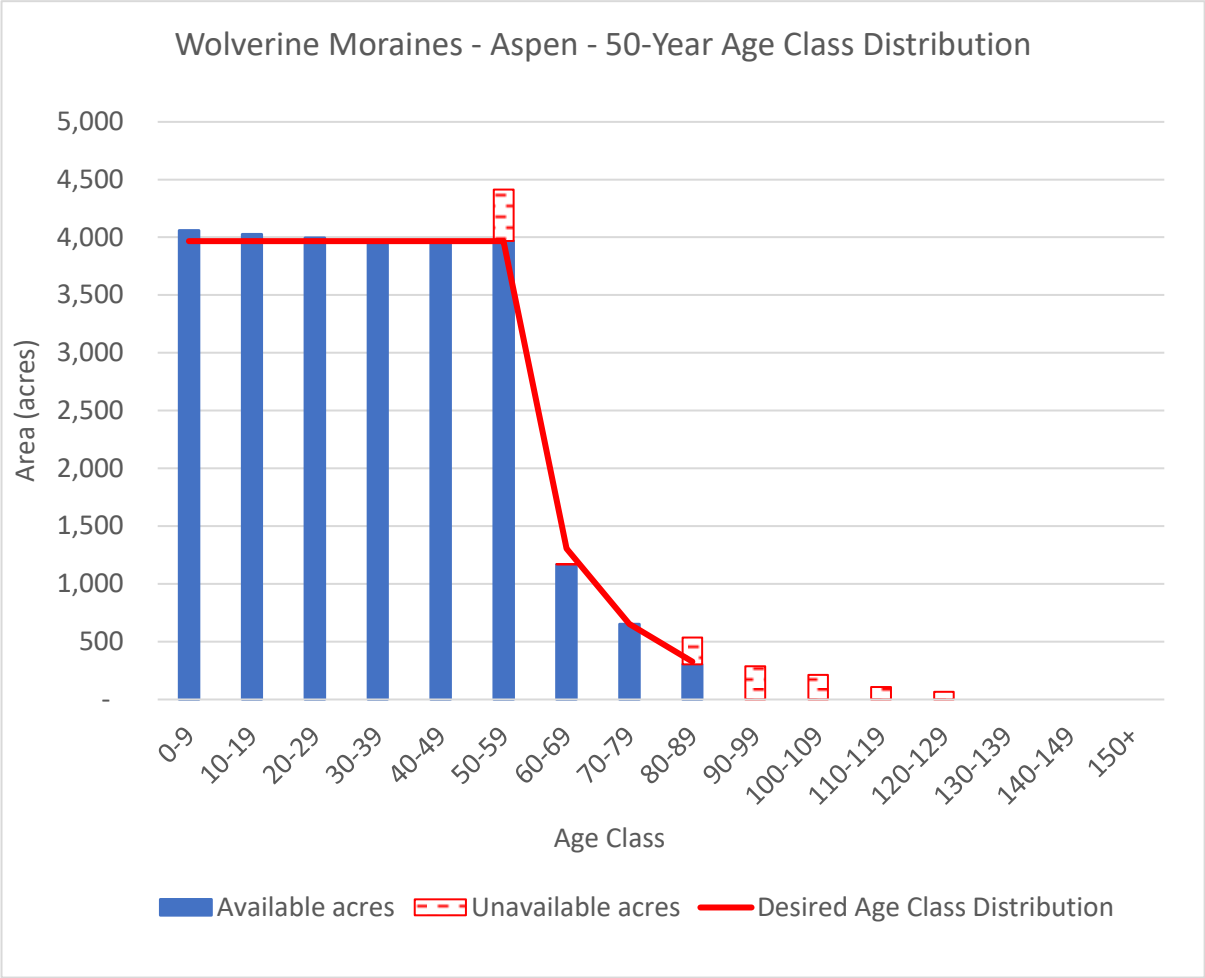


Figure 8. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 9) will concentrate the manageable acres of aspen in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest (Figure 10).

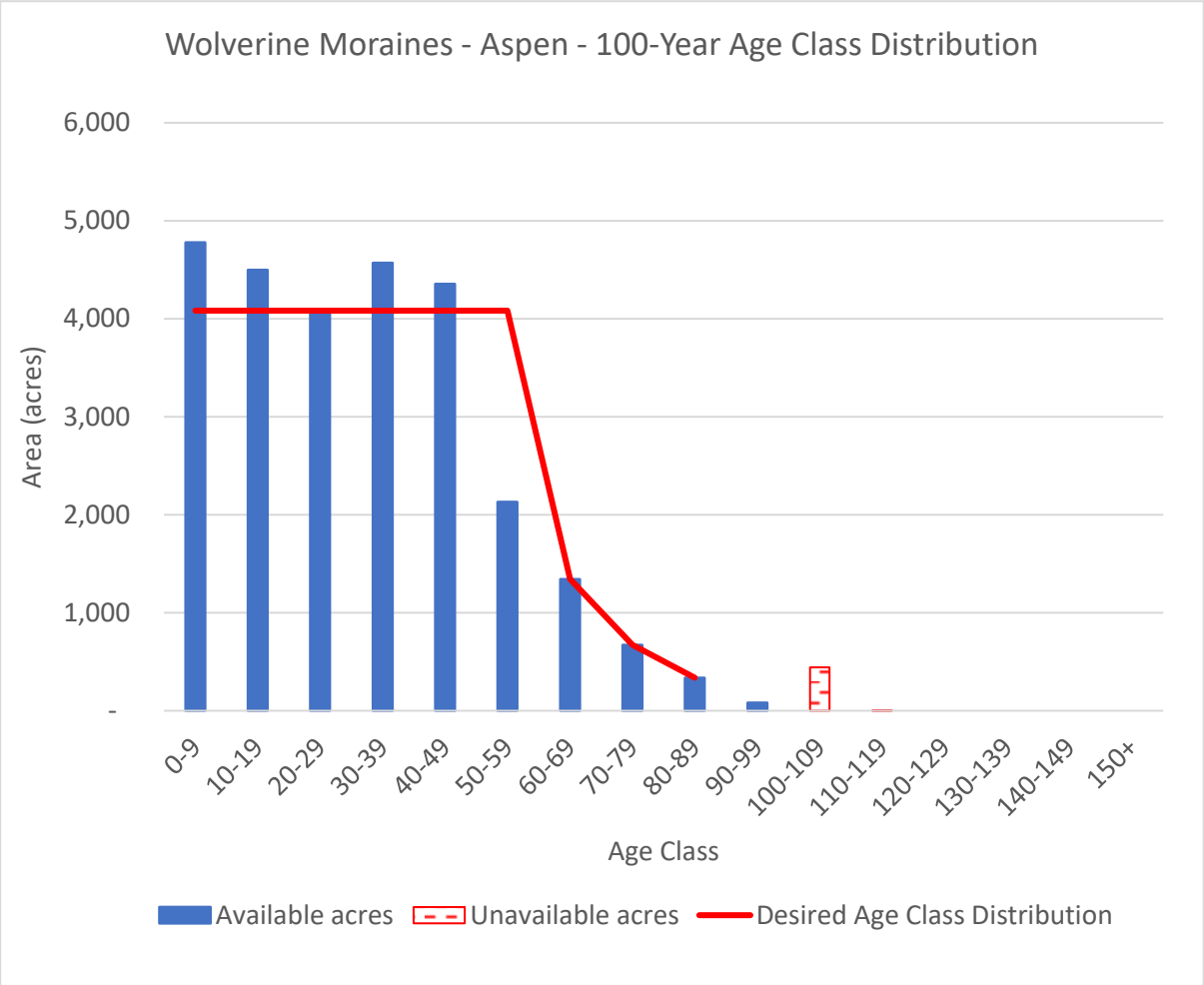


Figure 9. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

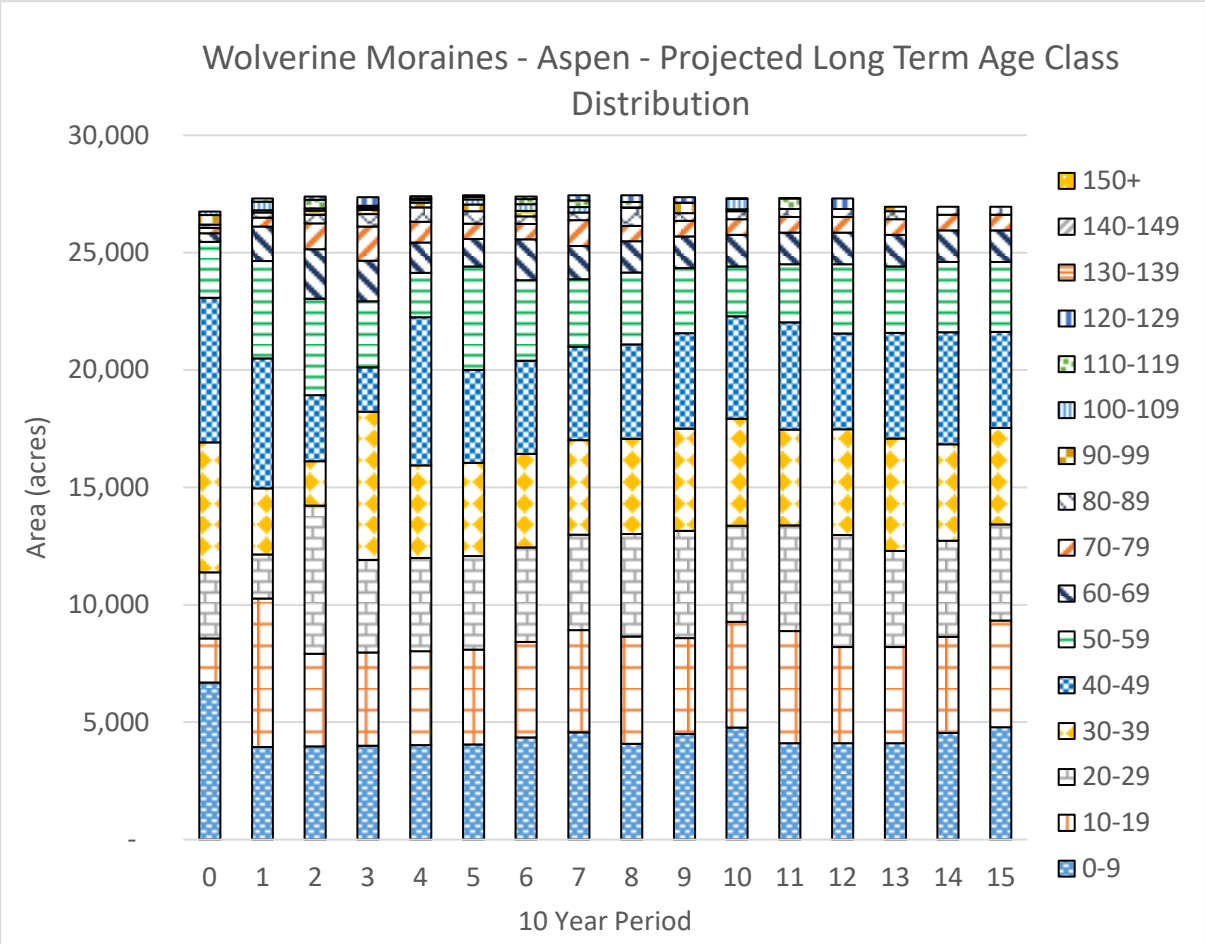


Figure 10. Projected age class distribution for all acres of aspen over the next 150 years.

Management actions

There are 1,900 acres of projected clearcut harvest and 1,116 acres of salvage clearcut in the aspen cover type during this planning period. This plus the 558 acres that will transition from other cover types and approximately 372 acres that are expected to regenerate from severe ice storm damage will be slightly over the desired establishment of 3,857 acres per decade.

Lowland conifer

Current condition

The Wolverine Moraines management area has a very unbalanced age class distribution of the available lowland conifer acres with holes in the 10-19, 20-29, 50-59, and 70-79 age classes (Figure 11). Most of the acres in the lowland conifer cover type are unavailable and are present across most of the age classes. A portion of this cover type meets the habitat requirements for snowshoe hare and marten (Table 11).

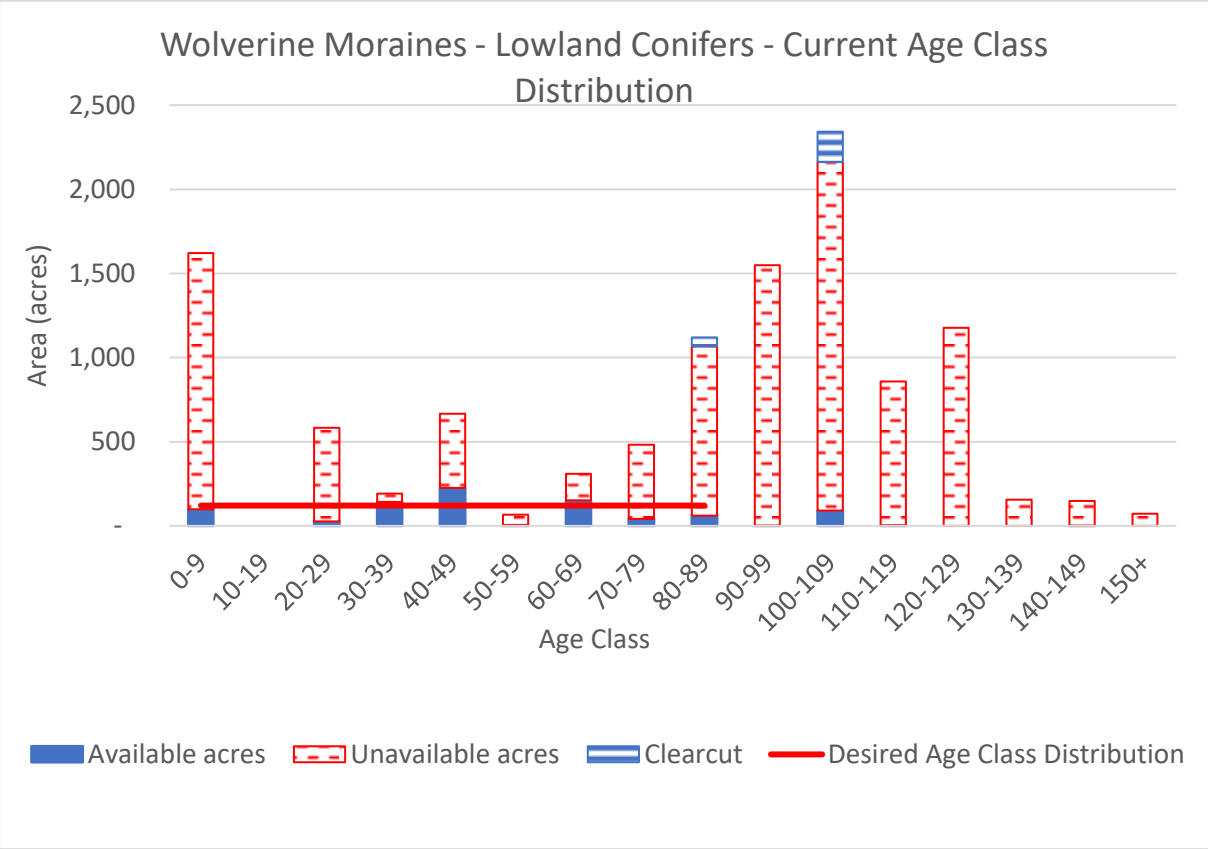


Figure 11. Current age class distribution, the desired age class distribution, and the projected harvests in the lowland conifer cover type over the 10-year planning period.

Table 11. Featured species with lowland conifers as a selected habitat cover type, habitat variables and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Lowland Conifer	Lowland Conifer Habitat Acres - Available	Lowland Conifer Habitat Acres - Unavailable
Snowshoe Hare	Age Category: 80-19 Size Category: Sapling	99	1,523

Featured Species	Featured Species Habitat – Lowland Conifer	Lowland Conifer Habitat Acres - Available	Lowland Conifer Habitat Acres - Unavailable
Marten	Age Category: 40+ Size Category: Pole, Sawlog Basal Area: 81+	566	5,964

Desired future condition

The projected long-term cover type trend for lowland conifers is fairly stable in the Wolverine Moraines Management area. There are a few transitions out of this cover type during this planning period.

The long-term goal for this cover type is balanced age classes between 0 and 90 years old for all available lowland conifer acres.

The end of the planning period will result in the establishment of a desirable number of acres in the 0-9 age class (Figure 12). Progress toward the long-term desired age class distribution of lowland conifers will take many decades to achieve the desired balanced age class condition.

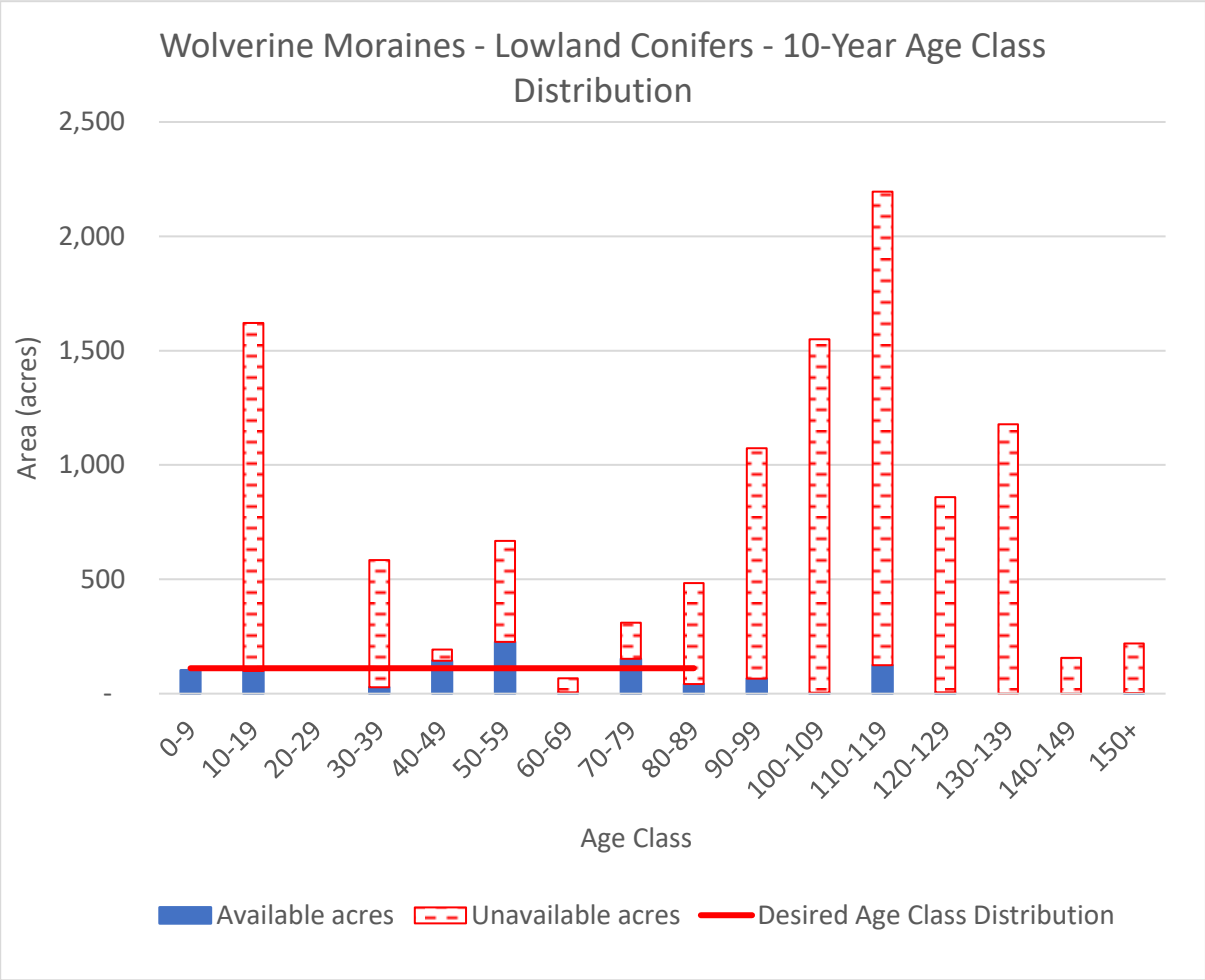


Figure 12. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution of lowland conifers is beginning to reach the desired future condition for available acres in the age classes between 0-and 60-year-old age classes (Figure 13). The number of acres in the older age classes, 120 years and older, continues to increase as the unavailable acres continue to move to the older age classes.

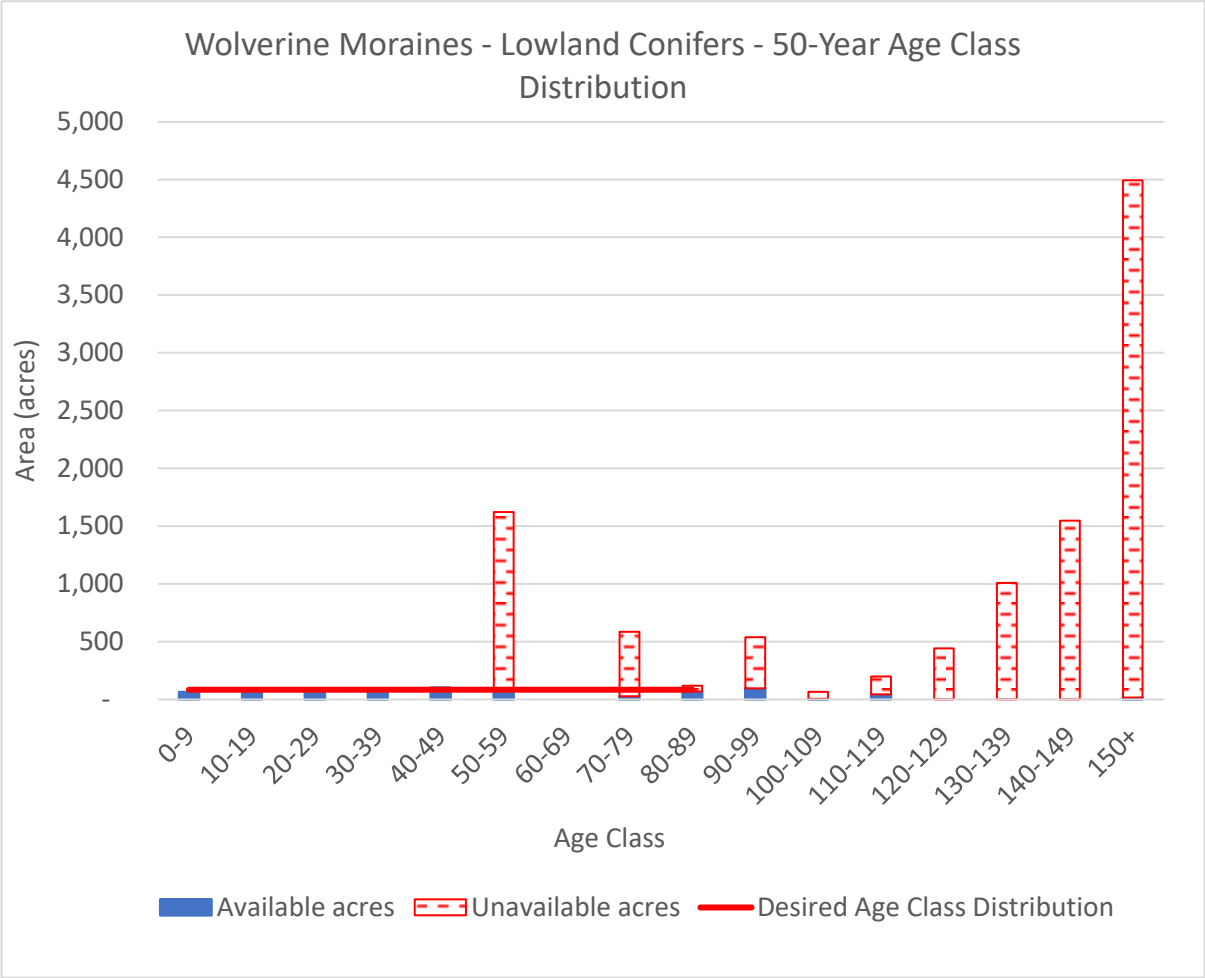


Figure 13. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 14) will concentrate on the manageable acres of lowland conifer cover type in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest (Figure 15).



Figure 14. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

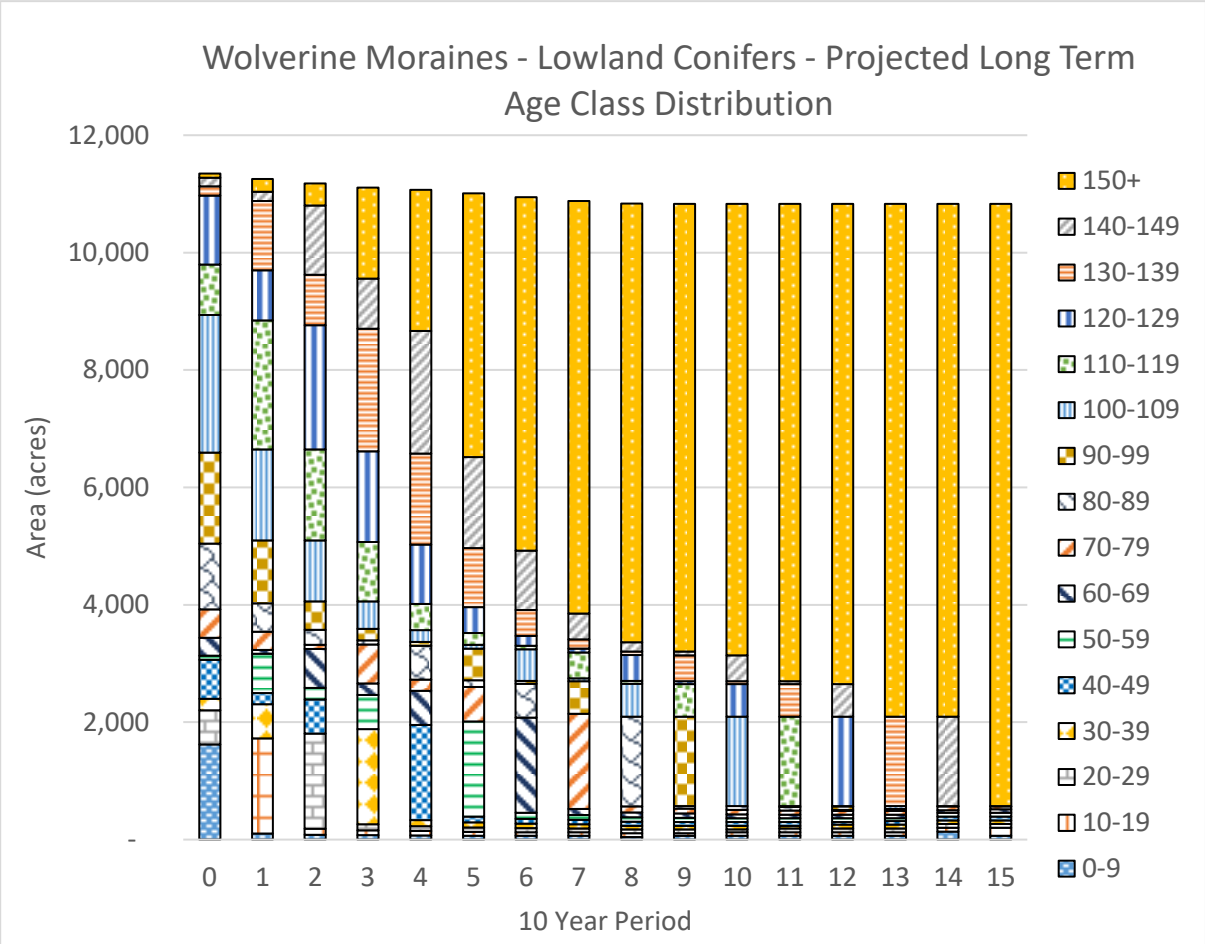


Figure 15. Projected age class distribution for all acres of lowland conifer over the next 150 years.

Management actions

There are 234 acres of projected clearcut harvest in the lowland conifer cover type during the planning period. 95 acres are projected to transition into other cover types. The resulting 139 acres is slightly higher than the desired establishment of 110 acres of lowland conifer per decade because of selected stand sizes.

Planted red pine

Current condition

Most of the planted red pine cover type is currently between stand ages of 0 and 9 years old, 60 and 69 years old, and 90 and 99 years old in the Wolverine Moraines Management Area (Figure 16). The age class distribution is currently unbalanced. There is a deficit in all the seven age classes from 10 to 59 years old and 70 to 89 years old, where the 0-9 age class will compensate for some of those deficits. Harvesting of older age classes will continue to happen to regenerate the desired amount of planted red pine over the next 10 years.

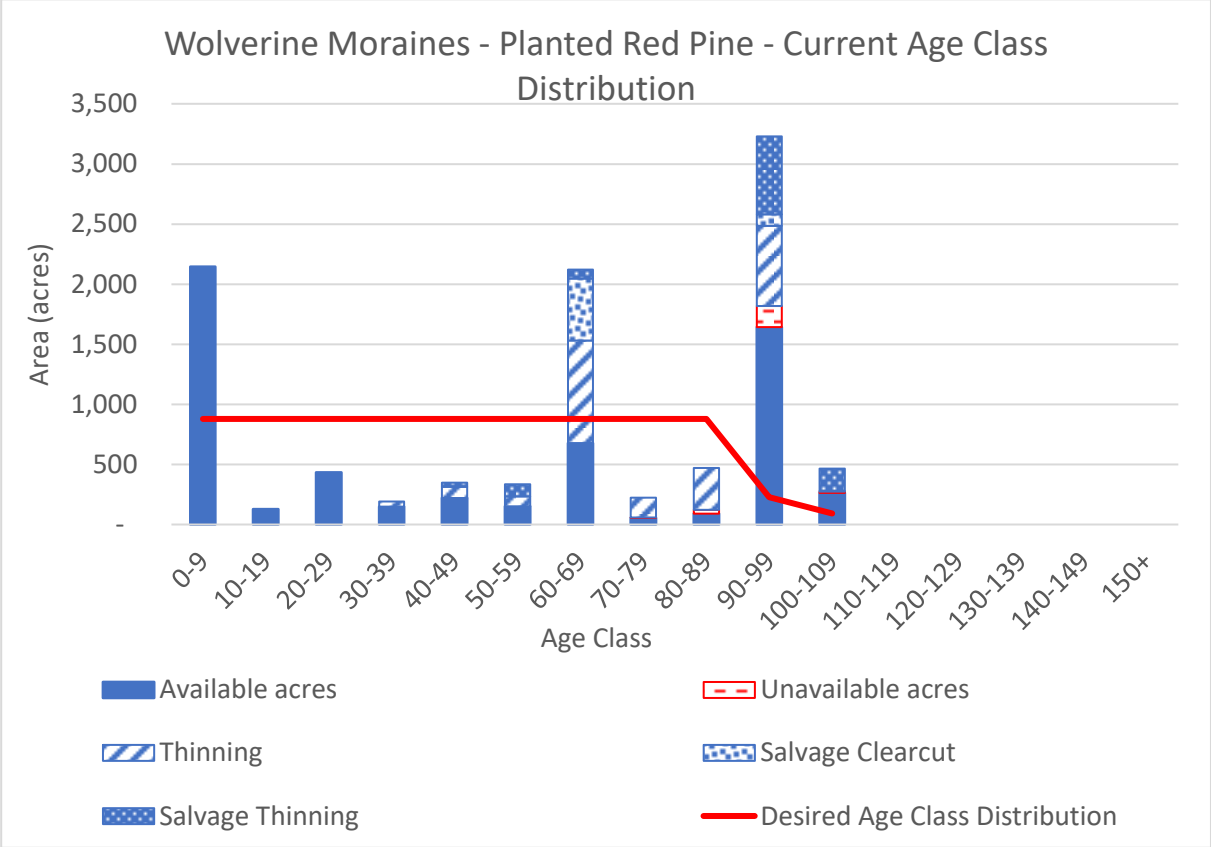


Figure 16. Current age class distribution and projected harvests in planted red pine cover type in the Wolverine Moraines Management Area.

Desired future condition

The projected long-term cover type trend for planted red pine is decreasing in the Wolverine Moraines Management Area. The long-term goal for this cover type is balanced age classes between 0 and 90 years old with a tapering of lesser amounts in the 90-109 age classes for all available red pine stands in this management area.

The end of the planning period will result in the establishment of approximately 655 acres in the 0-9 age class (Figure 17). This is slightly less than the desired age class distribution line due to the need to carry some stands out to older ages to balance the age classes in future planning periods. Progress toward the

long-term desired age class distribution of red pine will take many decades of even-aged management in this management area.

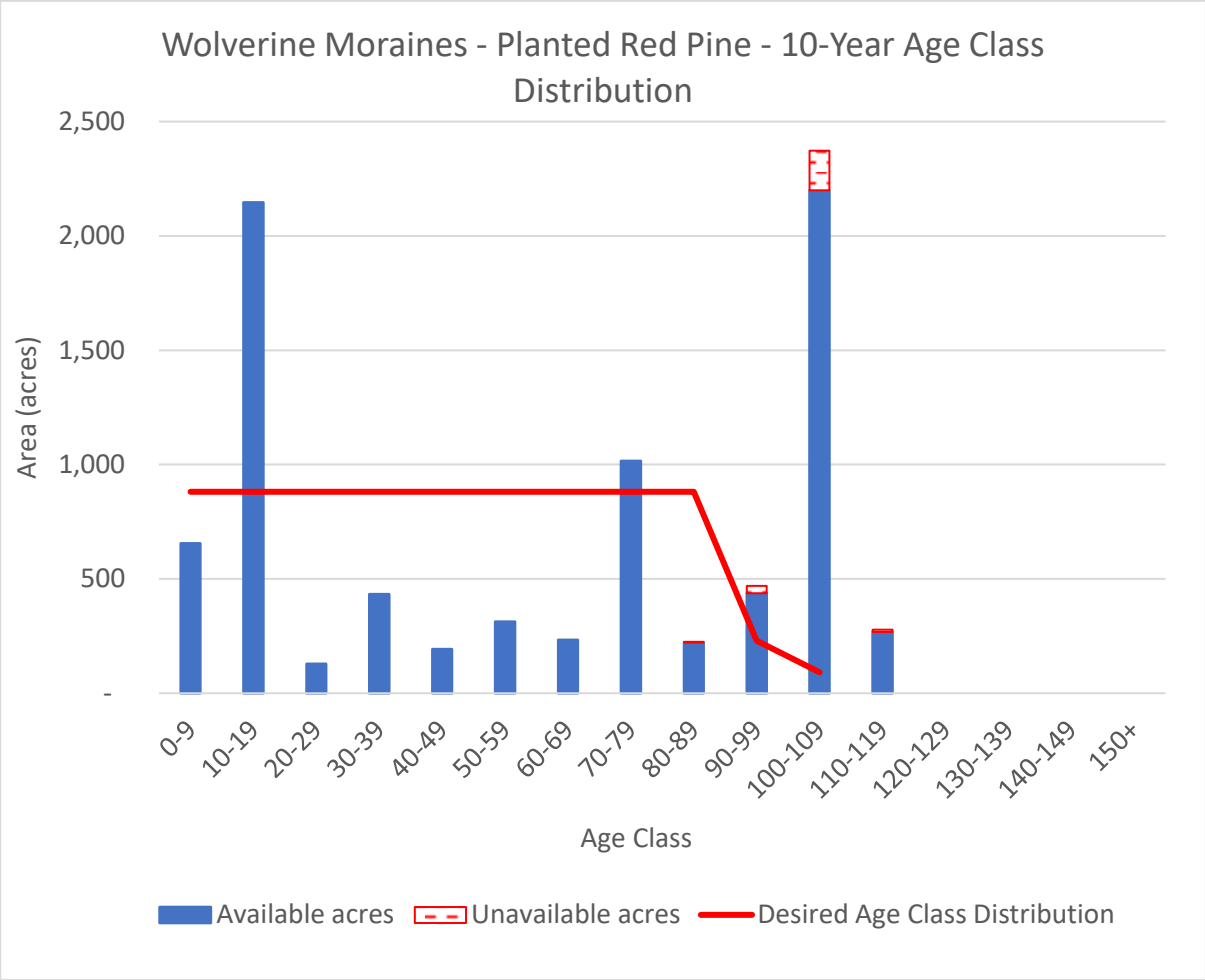


Figure 17. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The mid-term age class distribution of planted red pine shows a continuation of slightly lower acreage in each age class as the model carries some out further into maturity in order to provide enough acreage to continue populating the 0-9 age class (Figure 18). As is often the case, unbalanced age classes may result in the need to leave some acres in older age classes to achieve the desired age class distribution in future planning periods.

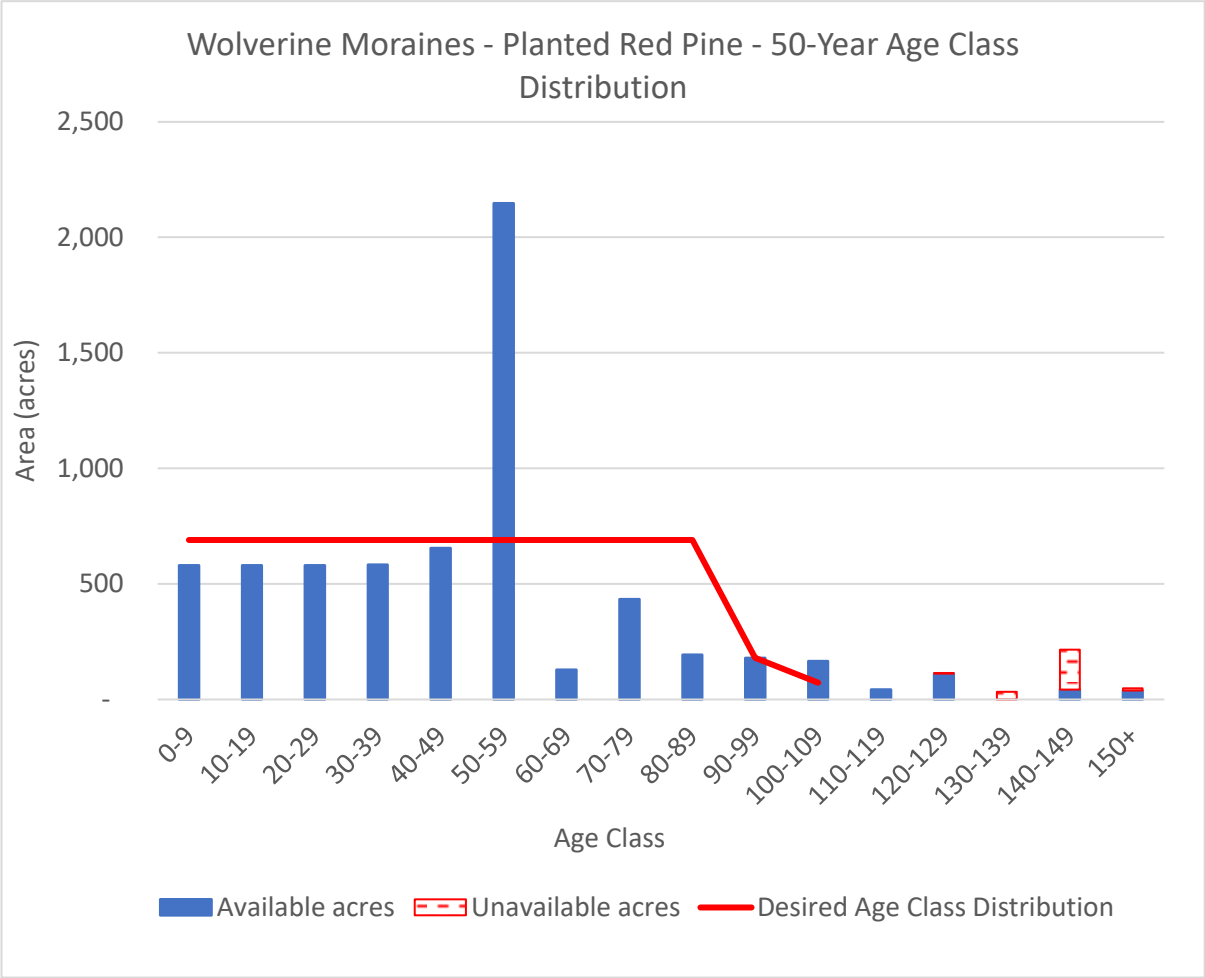


Figure 18. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 19) will concentrate the manageable acres of red pine in productive growing conditions and while providing an even flow of forest products (Figure 20).

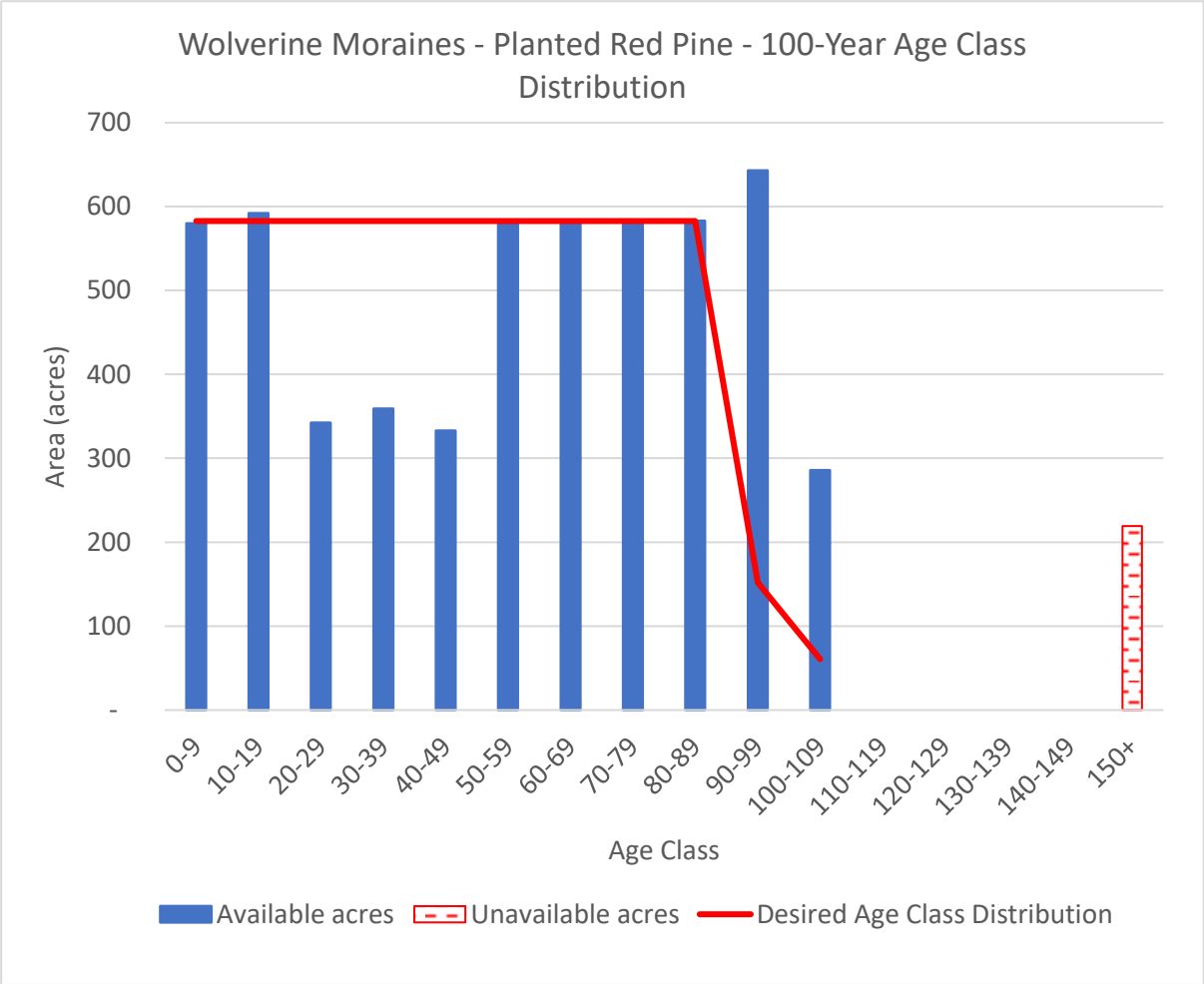


Figure 19. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

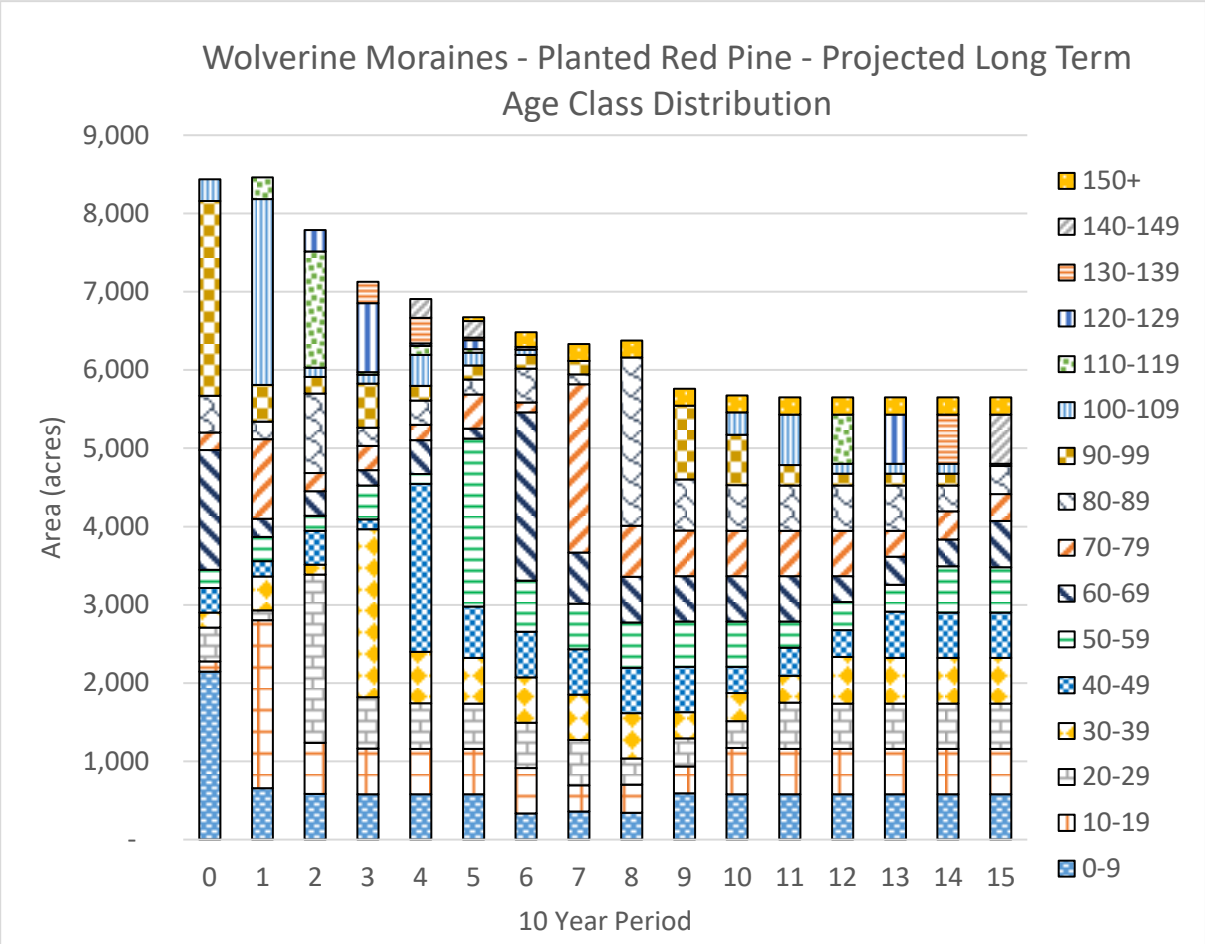


Figure 20. Projected age class distribution for all acres of planted red pine over the next 150 years in the Wolverine Moraines management area.

Management Actions

There are 611 acres of projected salvage clearcut harvest in the planted red pine cover type during the planning period. There are 25 acres that are projected to transition into planted red pine from other cover types resulting in lower acreage than the desired establishment of 880 acres of planted red pine per decade. Because of the current unbalanced age class condition, acreage lower than the desired age class distribution line will be necessary to carry enough merchantable red pine into future planning periods and balance the age classes over time spanning many decades.

There are 2,256 acres of thinning harvests and 1,048 acres of salvage thinning projected in the planted red pine cover type during the planning period. This will allow some acres to be held in older age classes and provide opportunities to balance the age classes in future planning periods.

Conservation area network

High conservation value areas

There are up to eight different high conservation value areas (HCVA) types that can be found in each management area (Table 12; see Biodiversity in Section 3 for more information).

Table 12. High conservation value areas within the Wolverine Moraines Management Area.

High Conservation Value Area Type	Acres
Dedicated Management Areas	27,040
Eastern Massasauga Managed Land	6,410
Forest Habitat Core Interior	9,420
Natural Rivers Vegetative Buffer	1,936
Natural Rivers Zoning District	6,778
Total	**51,584**

Ecological reference areas

Ecological reference areas (ERAs) are a type of HCVA and are higher quality examples of functioning ecosystems that are primarily influenced by natural ecological processes.

Table 13. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 14. Ecological reference areas within the management area.

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	Number of Occurrences
Existing ERA	Bog	BC			1
Existing ERA	Dry-mesic Northern Forest	BC			1
Existing ERA	Mesic Northern Forest	B	G4	S3	1
Existing ERA	Mesic Northern Forest	D			1
Existing ERA	Northern Fen	BC			2
Existing ERA	Northern Fen	BC		S3	1
Existing ERA	Northern Fen	C	G3	S3	1

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	**Number of Occurrences**
Existing ERA	Rich Conifer Swamp	B			1
Existing ERA	Rich Conifer Swamp	B	G4	S3	1
Existing ERA	Rich Conifer Swamp	C			2
Existing ERA	Rich Conifer Swamp	C	G4	S3	1
Proposed ERA	Northern Fen	BC	G3	S3	1
Proposed ERA	Pine Barrens	C	G3	S2	
Proposed ERA	Rich Conifer Swamp	BC	G4	S3	1
Grand Total					**15**

Special conservation areas

Reviewable special conservation areas (SCAs; Table 15) refers to those SCA types that may be reviewed or updated through the compartment review process as needed. Static SCAs (Table 16) refers to those SCA types that generally do not change or require updating (see Biodiversity in Section 3 for more information).

Table 15. Reviewable special conservation areas within the Wolverine Moraines Management Area.

Reviewable Special Conservation Area Type and Name	Acres
Concentrated Recreational Area	**294**
Deadman's Hill Overlook	42
North Country Trail	0
Pigeon Bridge Campground	11
Unspecified	38
Weber Lake Rec Site	202
Cultural or Customary Area	**1**
Witness Tree	1
Habitat Area or Habitat Corridor	**3,132**
52055	782
English oak planting	1
Lovejoy Pines	167
Lovejoy's Pines	628
Meridian Line Pine	69
O'Briens Pond	118
River corridor	55
Sturgeon River Valley SCA	1,311
Unspecified	2
Mineral Resource Area	**3**
Cheboygan County Road Commission	3
Possible Type 1 or Type 2 Old Growth	**215**
--	215

Reviewable Special Conservation Area Type and Name	Acres
Spring, Wetlands, or Riparian Areas	**1,464**
Black River Headwaters SCA	1,315
Pigeon River Corridor	149
Visual Management Areas	**-**
--	-
Grand Total	**5,109**

Table 16. Static special conservation areas within the Wolverine Moraines Management Area.

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Common Natural Heritage Element Occurrences		**103**
Northern Shrub Thicket		41
Northern Wet Meadow		62
Designated Trout and Cold Water Stream Buffer		**6,016**
		2,480
Allen Creek		55
Bartholomew Creek		13
Bennett Creek		10
Berry Creek		26
Black River		437
Blackjack Creek		49
Boyne River		1
Cascade Creek		29
Cedar Creek		9
Cedar River		13
Club Stream		32
Cokirs Creek		4
Collins Creek		38
Cornwall Creek (except Cornwall Impoundment)		111
Cramer Creek		6
East Branch Black River		210
Gimlet Creek		41
Gook Creek		10
Green River		40
Hardwood Creek		77
Hay Marsh Creek		50
Hitchcock Creek		20
Hodge Creek		24
Hog Creek		10
Intermediate River		59

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Jordan River		442
Landslide Creek		48
Licks Creek		13
Lilak Creek		4
Little McMasters Creek		6
Little Pigeon River		37
Marion Creek		13
Marl Creek		71
Martin Creek		6
Mason Creek		3
McIntosh Creek		13
Moyer Creek		31
North Branch Spring Brook		134
Pickerel Creek		25
Pigeon River		370
Saunders Creek		12
Schoolhouse Creek		22
Scott Creek		15
Section Thirteen Creek		32
Severance Creek		16
Six Tile Creek		4
South Branch Boyne River		27
South Branch Spring Brook		118
Spring Brook		34
Stevens Creek		57
Stewart Creek		97
Sturgeon River		254
Todd Creek		7
Tubbs Creek		39
Tutstone Creek		22
Warner Creek		51
Webster Creek		4
West Branch Sturgeon River		128
West McMasters Creek		1
Woolcott Creek		8
Designated Trout and Coldwater Streams	**222.7**	
<Null>	91.0	
Allen Creek	2.1	
Bartholomew Creek	0.5	
Bennett Creek	0.4	

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Berry Creek	1.0	
Black River	16.3	
Blackjack Creek	1.8	
Cascade Creek	1.1	
Cedar Creek	0.3	
Cedar River	0.5	
Club Stream	1.2	
Cokirs Creek	0.2	
Collins Creek	1.4	
Cornwall Creek (except Cornwall Impoundment)	4.1	
Cramer Creek	0.3	
East Branch Black River	7.6	
Gimlet Creek	1.5	
Gook Creek	0.4	
Green River	1.6	
Hardwood Creek	2.8	
Hay Marsh Creek	1.9	
Hitchcock Creek	0.7	
Hodge Creek	0.9	
Hog Creek	0.4	
Intermediate River	2.3	
Jordan River	16.7	
Landslide Creek	1.9	
Licks Creek	0.4	
Lilak Creek	0.2	
Little McMasters Creek	0.2	
Little Pigeon River	1.3	
Marion Creek	0.5	
Marl Creek	2.6	
Martin Creek	0.2	
Mason Creek	0.1	
McIntosh Creek	0.5	
Mill Creek	0.0	
Moyer Creek	1.2	
North Branch Spring Brook	5.0	
Pickerel Creek	0.9	
Pigeon River	13.4	
Saunders Creek	0.5	
Schoolhouse Creek	0.8	
Scott Creek	0.6	

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Section Thirteen Creek	1.1	
Severance Creek	0.6	
Six Tile Creek	0.1	
South Branch Boyne River	1.0	
South Branch Spring Brook	4.5	
Spring Brook	1.3	
Stevens Creek	2.2	
Stewart Creek	3.6	
Sturgeon River	9.5	
Todd Creek	0.3	
Tubbs Creek	1.5	
Tutstone Creek	0.8	
Warner Creek	1.8	
Webster Creek	0.2	
West Branch Sturgeon River	4.7	
Woolcott Creek	0.3	
Important Bird Areas		**113,216**
Grand Traverse Bay basin (Albert Ecoregion Vii.5.2)		31,322
Pigeon Country moraines		81,894
Non-dedicated Natural Areas		**1,908**
Natural Area Grindstone Creek Wild Area, Pigeon Ri		160
Natural Area Jordan River Natural Area		1,569
Natural Area Pine Tract Natural Area, Pigeon Rive		180
Wood Turtle Stream 100ft Buffer		**247**
Black River		45
Pigeon River		131
Sturgeon River		70
Wood Turtle Stream 660ft Buffer		**1,451**
Black River		294
Pigeon River		849
Sturgeon River		308
Grand Total	**222.7**	**122,942**

Rare species

Rare species occurrences are compiled from the Michigan Natural Features Inventory Biotics database (*Table* 17, Table 19 and Table 20) and do not necessarily include all rare species found in this management area due to biases in survey effort and verifiable observation reporting over time.

Table 17. *Rare animal and plant species conservation status key.*

Status	Status
E = endangered	LE = listed endangered
T = threatened	LT = listed threatened
SC = special concern	PDL = proposed for delisting

Table 18. Rare animal occurrence within the Wolverine Moraines Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Accipiter gentilis	Northern goshawk	T		4
Animal	Appalachia arcana	Secretive locust	SC		2
Animal	Appalachina sayanus	Spike-lip crater	SC		1
Animal	Bombus borealis	Northern amber bumble bee	SC		2
Animal	Bombus terricola	Yellow banded bumble bee	SC		3
Animal	Brychius hungerfordi	Hungerford's crawling water beetle	E	LE	1
Animal	Buteo lineatus	Red-shouldered hawk	SC		72
Animal	Coregonus artedi	Lake herring or Cisco	T		1
Animal	Emydoidea blandingii	Blanding's turtle	SC		3
Animal	Gavia immer	Common loon	T		1
Animal	Glyptemys insculpta	Wood turtle	T		1
Animal	Haliaeetus leucocephalus	Bald eagle	SC		8
Animal	Lithobates palustris	Pickerel frog	SC		3
Animal	Microtus pinetorum	Woodland vole	SC		1
Animal	Myotis septentrionalis	Northern long-eared bat	T	LE	1
Animal	Necturus maculosus	Mudpuppy	SC		1
Animal	Opheodrys vernalis	Smooth green snake	SC		4
Animal	Pandion haliaetus	Osprey	SC		2
Animal	Sistrurus catenatus	Eastern massasauga	T	LT	2
Total	-	-	-	-	**113**

Table 19. Rare plant occurrence within the Wolverine Moraines Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Plant	Cirsium hillii	Hill's thistle	SC		5
Plant	Cypripedium arietinum	Ram's head lady's-slipper	SC		1
Plant	Dalibarda repens	False violet	T		1
Plant	Gymnocarpium robertianum	Limestone oak fern	T		3
Plant	Potamogeton hillii	Hill's pondweed	T		1
Plant	Stachys pilosa	Hairy hedge-nettle	SC		1
Plant	Thalictrum pubescens	Tall meadowrue	SC		1
Grand Total	-	-	-	-	**13**

Table 20. Other rare occurrence within the Wolverine Moraines Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Other	-	Great blue heron rookery			1
Total	-	-	-	-	**1**

Non-ecological reference area natural communities

Natural communities that are identified with an element occurrence in the MNFI Biotics database, but that have not been given an additional ecological reference area (ERA) designation, are recognized and managed accordingly (Table 21).

Table 21. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 22. Non-ecological reference area natural communities within the Wolverine Moraines Management Area.

Community Type	Element Occurrence Rank	State Rank	Global Rank	Number of Occurrences
Hardwood-Conifer Swamp	C	S3		2
Mesic Northern Forest	C	S3		2
Northern Shrub Thicket	B	S5	G4	3
Northern Wet Meadow	B	S4	G4G5	3
Northern Wet Meadow	C	S4	G4G5	2
Rich Conifer Swamp	CD	S3		2
Grand Total				**14**

Forest health

Forest health concerns, both native and non-native, can have impacts on stand conditions and management decisions. The following insects (Table 23) and diseases (Table 24) could have an impact on management during the planning period and may need to be monitored and/or addressed.

Table 23. Defoliating insects of concern in the Wolverine Moraines management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Spongy moth	Lymantria dispar	Non-native	Yes
Forest tent caterpillar	Malacosoma disstria	Native	Yes

Watch for lingering ash with potential resistance to emerald ash borer. Monitor young jack and red pine for redheaded pine sawfly damage.

Table 24. Maladies of concern in the Wolverine Moraines management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Canker (stem infections)	Various	Various	Yes
Armillaria root rot	Armillaria spp.	Native	
Oak decline	Various	Various	Yes

Monitor oak for symptoms of oak wilt and follow state land oak wilt guidance. Monitor planted red pine for Heterobasidion root disease and follow disease guidance. Report surviving mature beech trees that may be resistant to beech bark disease. Watch for symptoms of beech leaf disease.

Aquatic resources

Riparian habitat

Approximately 174 miles of streams and rivers are found in the management area (Table 25). Streams/rivers classified as cold types comprise approximately 74% of the riverine mileage.

Table 25. Classification type and length of streams/rivers found within the management area.

Type	Length (miles)
Cold Stream	128
Cold Small River	2
Cold Transitional Stream	21
Cold Transitional Small River	17
Cold Transitional Large River	0
Warm Transitional Stream	<1
Warm Transitional Small River	6
Warm Transitional Large River	0
Warm Stream	0
Warm Small River	0
Warm Large River	0

Lacustrine habitat

A total of 14 lakes and ponds of at least 1 surface acre are found in the management area (Table 26).

Table 26. Size and number of lakes and ponds located within the management area.

Lake Size Class (acres)	Number
1-99	11
100-499	2
500+	1

Wetlands

A total of 31,302 acres of wetlands are found in the management area (Table 27). Forested wetlands comprise approximately 96% of wetland types found in the management area.

Table 27. Area of emergent, forested and riverine wetland types found within the management area.

Wetland Type	Acres
Emergent	1,018
Forested	30,022
Riverine	262

Vernal pools and seeps

A total of 989 acres of vernal pools and seeps have been inventoried in the management area, and 5,306 acres of seeps have been identified.

Riparian vegetation cover

Northern hardwood is the predominant cover type present in a 100-meter riparian zone located next to streams/rivers in the management area (Table 28).

Table 28. Largest vegetative cover types (i.e., top 10) and area located in a 100-meter buffer of streams/rivers within the management area.

Cover Type	Acres
Northern Hardwood	5,139
Lowland Conifers	3,779
Cedar	3,226
Lowland Shrub	2,476
Aspen	2,345
Marsh	730
Lowland Aspen/Balsam Poplar	653
Lowland Mixed Forest	628
Mixed Upland Deciduous	562
Herbaceous Openland	443

Watershed vegetation cover

The management area includes portions of important watersheds of the Black and Boyne rivers (Table 29 and Table 30). Aspen is a major cover type of the state forest in each watershed.

Table 29. Largest vegetative cover types (i.e., top five) and area of the Black River watershed located within the management area.

Cover Type	Acres
Northern Hardwood	9,268
Aspen	6,809
Cedar	5,644
Mixed Upland Deciduous	3,691
Lowland Conifers	2,392

Table 30. Largest vegetative cover types (i.e., top five) and area of the Boyne River watershed located within the management area.

Cover Type	Acres
Northern Hardwood	5,892
Aspen	376
Lowland Conifers	335

Cover Type	Acres
Cedar	291
Herbaceous Openland	126

Recreation

Access for public recreation and management in the Wolverine Moraines Management Area is mixed, constrained in areas by steep slopes or wet areas. The Jordan Valley area is a special management area with a focus on outdoor recreation in a natural setting, while the Pigeon River Country State Forest is focused on wildlife management with limited access in some areas.

Opportunities for recreation on state forest land within the management area are abundant, including unique opportunities for elk viewing and backcountry adventures in the Pigeon River Country special management unit. Motorized recreation options are generally restricted in the Pigeon River Country, but an extensive network of ORV, motorcycle and snowmobile trails can be found east of I-75. Nonmotorized recreation opportunities in the Wolverine Moraines Management Area include nearly 30 miles of the High Country Pathway – an 82-mile looped hiking and biking trail – and the Jordan Valley, Shingle Mill and Wildwood Hills Pathways, among others. Opportunities for equestrians include over 25 miles of the Shore-to-Shore equestrian trail and the 15-mile Pigeon River Equestrian Trail. The North Country National Scenic Trail/Iron Belle Trail and the Northeastern State Trail (rail trail) also cross the area, providing connections to the wider regional trail system.

There are 12 state forest campgrounds in the Wolverine Moraines Management Area, of which three are designated for equestrian individual or group use and one is accessible to ORVs.

Table 31. Designated recreation trails by type.

Recreation Category	Recreation Type	# of Miles
Motorized Recreation Trails	ORV (all types) Snowmobile	128.2 96.9
Nonmotorized Recreation Trails	Hiking Equestrian Biking Hunter Access Trails	137.3 40.0 63.5 0
Total		**466.0**

Note: Trail-use types may overlap.

Table 32. State forest campgrounds.

Name	# of sites	Equestrian	ORV Access
Elk Hill Equestrian River Trail Campground	11	X	
Elk Hill Group Equestrian Campground	-	X (group)	
Graves Crossing State Forest Campground	10		
Haakwood State Forest Campground	18		
Johnson's Crossing Trail Camp	-	X (group)	

Pickerel Lake (Otsego) State Forest Campground	39		
Pigeon Bridge State Forest Campground	10		
Pigeon River State Forest Campground	19		
Pine Grove State Forest Campground	6		
Pinney Bridge State Forest Campground	15		
Round Lake State Forest Campground	10		
Weber Lake State Forest Campground	18		X

There are no areas managed specifically for hunting in this management area, although being in the core of Michigan's elk range provides unique big-game hunting opportunities.

Boating access sites are available on several inland lakes; the Jordan, a designated Natural River; and the Pigeon and Sturgeon rivers provide plentiful opportunities for paddling and fishing.

The management area is close to the communities of Petoskey, Wolverine, Vanderbilt and Boyne City and is a popular recreation destination for both residents and visitors for dispersed recreation such as hunting, fishing, hiking and mushrooming.

Table 33. Boating access sites.

Name	Waterbody
Alba Road	Jordan River
Cedar River 2	Cedar River
Chestonia Bridge	Jordan River
Cornwall Flooding	Cornwall Flooding
Deer Lake	Deer Lake
Elk Hill Equestrian State Forest Campground and Trail Camp	Pigeon River
Green Lake	Green Lake
Haakwood State Forest Campground	Sturgeon River
Henry Lake	Henry Lake
Jordan River	Jordan River
Pickerel Lake State Forest Campground	Pickerel Lake
Rondo	Sturgeon River
Sturgeon River	Sturgeon River
Town Corner Lake State Forest Campground	Town Corner Lake
Trowbridge Road	Sturgeon River
Walloon Lake	Walloon Lake
Webster Bridge	Jordan River

Ecoregion

Eastern Upper Peninsula

State forest area:
1,067,507 acres

Location:
Eastern Upper Peninsula

Population centers:
Manistique, Grand Marais Newberry, Naubinway, Sault Ste. Marie, Hessel, Drummond Township

Land cover:
Forested: 832,058 acres
Nonforested: 235,448 acres

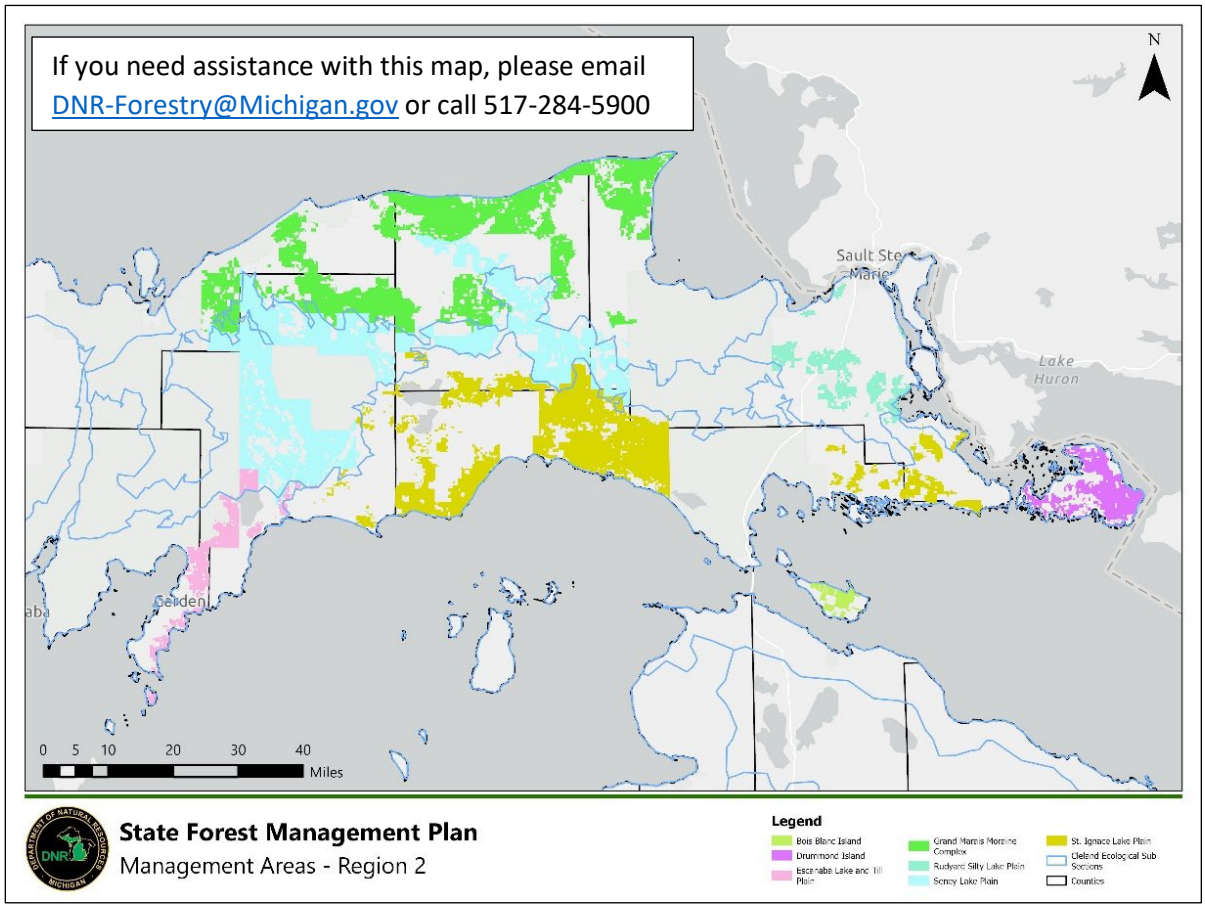


Figure 1. Eastern Upper Peninsula Ecoregion.

Forested landscape

Current and projected future condition

The Eastern Upper Peninsula Ecoregion is comprised of 78% forested cover types and 22% nonforested cover types. Of the forested cover types, 63% are in upland landscape positions and 36% are in lowland landscape positions. The largest contributors to upland cover types are aspen, northern hardwoods and natural jack pine. Cedar has the most acres for cover types in the lowland landscape position. Lowland shrub and herbaceous open land are the most common nonforested cover types in the ecoregion, representing roughly 12% of the landscape (Table 1).

Table 1. Current landscape context and distribution of cover types.

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
Forested	Upland	Deciduous	Aspen	111,967	253,261	527,409	832,058
			Northern hardwood	114,462			
			Black/red hybrid oak	0			
			Northern red oak	1,850			
			Oak mix	1,583			
			Mixed upland deciduous	23,400			
		Mixed	Upland mixed forest	26,848	26,848		
		Coniferous	Planted red pine	46,015	247,299		
			Planted jack pine	22,815			
			Planted white pine	461			
			Planted mixed pine	1,580			
			Natural red pine	24,219			
			Natural jack pine	67,263			
			Natural white pine	19,555			
			Natural mixed pines	26,361			
			Upland spruce/fir	6,639			
			Upland conifers	28,344			
			Hemlock	4,046			
	Lowland	Deciduous	Lowland aspen/balsam poplar	19,707	43,443	304,650	
			Lowland deciduous	23,737			
		Mixed	Lowland mixed forest	19,820	19,820		
		Coniferous	Cedar	114,540	241,387		
			Lowland conifers	72,016			
			Lowland spruce/fir	44,080			
			Tamarack	10,751			
Nonforested	Upland	N/A	Herbaceous open land	20,538	N/A	38,827	235,448
			Upland shrub	8,062			
			Low density trees	4,890			
			Bare/sparsely vegetated	2,156			
			Cropland	91			
			Urban	3,090			
	Lowland	N/A	Lowland shrub	105,368	N/A	196,621	
			Marsh	40,996			
			Bog	5,965			
			Treed bog	27,309			
			Water	16,983			
						Grand Total:	**1,067,507**

There are 614,774 acres (58% of the total management area and 74% of the forested area) that can be managed toward desired future conditions via commercial timber harvest in the Eastern Upper Peninsula ecoregion (Table 2). Of the area available to manage, over 17% is in the aspen cover type, 17% is in the northern hardwood cover type, almost 10% is natural jack pine, over 7% is planted red pine, and nearly 7% is lowland conifers. The remaining cover types represent 4% or less of the forested and available land in the management area.

Table 2. Current cover type composition by management availability.

GRAND MARAIS MORAINE COMPLEX Forested Cover Type	Available Acres	Available %	Unavailable Acres	Unavailable %	Total Acres	Total %
Aspen	106,463	12.8%	5,524	0.7%	111,987	13.5%
Cedar	25,367	3.0%	89,176	10.7%	114,543	13.8%
Hemlock	2,478	0.3%	1,568	0.2%	4,046	0.5%
Lowland aspen/balsam poplar	16,457	2.0%	3,252	0.4%	19,708	2.4%
Lowland conifers	34,065	4.1%	37,960	4.6%	72,025	8.7%
Lowland deciduous	15,146	1.8%	8,593	1.0%	23,739	2.9%
Lowland mixed forest	13,829	1.7%	5,992	0.7%	19,822	2.4%
Lowland spruce/fir	24,345	2.9%	19,750	2.4%	44,095	5.3%
Mixed upland deciduous	19,668	2.4%	3,733	0.4%	23,401	2.8%
Natural jack pine	60,497	7.3%	6,802	0.8%	67,299	8.1%
Natural mixed pines	19,731	2.4%	6,641	0.8%	26,372	3.2%
Natural red pine	20,715	2.5%	3,512	0.4%	24,227	2.9%
Natural white pine	16,573	2.0%	2,987	0.4%	19,560	2.4%
Northern hardwood	106,939	12.9%	7,533	0.9%	114,471	13.8%
Northern red oak	1,768	0.2%	82	0.0%	1,850	0.2%
Oak mix	1,213	0.1%	370	0.0%	1,583	0.2%
Planted jack pine	22,476	2.7%	342	0.0%	22,818	2.7%
Planted mixed pine	1,491	0.2%	88	0.0%	1,580	0.2%
Planted red pine	45,308	5.4%	716	0.1%	46,024	5.5%

GRAND MARAIS MORAINE COMPLEX Forested Cover Type	Available Acres	Available %	Unavailable Acres	Unavailable %	Total Acres	Total %
Planted white pine	461	0.1%	0	0.0%	461	0.1%
Tamarack	3,836	0.5%	6,915	0.8%	10,751	1.3%
Upland conifers	17,901	2.2%	10,448	1.3%	28,349	3.4%
Upland mixed forest	22,738	2.7%	4,114	0.5%	26,852	3.2%
Upland spruce/fir	4,613	0.6%	2,028	0.2%	6,641	0.8%
Grand Total	**604,077**	**72.6%**	**228,127**	**27.4%**	**832,203**	**100.0%**

Table 3. Site conditions for unavailable acres.

Site Condition	Acres	Percent of Unavailable Area
Conservation values	62,427	28.7%
Deer wintering area	52,805	24.3%
Unproductive	20,156	9.3%
Best management practices	17,257	7.9%
Blocked by obstacle	14,409	6.6%
Wildlife concerns	13,839	6.4%
Too wet	13,365	6.2%
Blocked by railroad	5,581	2.6%
Species of special concern or T&E	2,871	1.3%
Federal/state/local law	2,584	1.2%
Non-military lease/easement	2,138	1.0%
Long-term retention	1,668	0.8%
Other DNR/division processes	1,526	0.7%
Too steep	1,283	0.6%
Denied access	1,195	0.6%
Non-DNR agency concerns	1,121	0.5%
Recreational/scenic	1,052	0.5%
Rare landforms	922	0.4%
Total Unavailable	**217,284**	**100.0%**

Projected 10-year cover type management actions

Each cover type in the Eastern Upper Peninsula Ecoregion has unique age class and basal area class goals that describe the long-term desired future conditions. The calculated harvest goals needed during the first 10-year planning period are summarized in Table 4. These harvest goals are necessary to begin achieving long-term planning goals.

Table 4. Ten-year planning period harvest goals (acres) by cover type and silvicultural regime.

Silvicultural Regimes								
Cover Type	**Clearcut**	**Selection**	**Thinning**	**Group Selection**	**Shelterwood**	**Salvage Clearcut**	**Salvage Thinning**	**Grand Total**
Northern hardwood	659	28,729	-	3,756	830	-	-	33,973
Aspen	15,778	-	-	-	-	-	-	15,778
Planted red pine	3,659	-	7,057	-	-	-	-	10,716
Natural jack pine	5,944	-	-	-	-	-	-	5,944
Lowland conifers	5,345	-	-	-	-	-	-	5,345
Upland conifers	4,011	-	-	-	862	-	-	4,872
Planted jack pine	4,415	-	-	-	-	-	-	4,415
Mixed upland deciduous	2,770	261	-	-	298	-	-	3,328
Lowland spruce/fir	3,251	-	-	-	-	-	-	3,251
Lowland aspen/balsam poplar	2,700	-	-	-	-	-	-	2,700
Upland mixed forest	1,985	-	-	-	-	-	-	1,985
Lowland deciduous	1,589	12	-	-	9	-	-	1,609
Natural mixed pines	-	-	804	-	803	-	-	1,607
Natural red pine	-	-	618	-	619	-	-	1,236
Lowland mixed forest	1,232	-	-	-	-	-	-	1,232
Upland spruce/fir	651	-	-	-	-	-	-	651
Totals	**54,449**	**29,120**	**8,810**	**3,856**	**3,715**	**-**	**-**	**99,949**

Cover type projections for the Eastern Upper Peninsula Ecoregion differ from cover type to cover type, mainly driven by treatment regimes within the first planning period. Most cover types remain fairly stable; however, significant transitions are forecasted for a few cover types. The largest forecasted decrease in cover type is planted jack pine, where 13% of the cover type (2,888 acres) is expected to transition to other cover types like natural jack pine (Table 5). Lowland mixed forest is forecasted to increase by 1,796 acres, or about 9%, with conversions from lowland conifers and lowland spruce/fir.

Table 5. Projected 10-year cover type acres resulting from cover type transitions.

Cover Type	Current Acreage	Projected Acreage at End of 10-Year Planning Period	Projected 10-Year Change in Acreage
Cedar	114,540	114,540	0
Northern hardwood	114,462	114,781	319
Aspen	111,967	112,693	726
Lowland conifers	72,016	70,981	-1,035
Natural jack pine	67,263	68,787	1,523
Planted red pine	46,015	46,706	691
Lowland spruce/fir	44,080	43,508	-571
Upland conifers	28,344	27,801	-544
Upland mixed forest	26,848	27,430	582
Natural mixed pines	26,361	26,371	11
Natural red pine	24,219	24,219	0
Lowland deciduous	23,737	23,768	32
Mixed upland deciduous	23,400	23,336	-63
Planted jack pine	22,815	19,928	-2,888
Lowland mixed forest	19,820	21,616	1,796
Lowland aspen/balsam poplar	19,707	19,573	-133
Natural white pine	19,555	19,555	0
Tamarack	10,751	10,700	-51
Upland spruce/fir	6,639	6,303	-336
Hemlock	4,046	4,046	0
Northern red oak	1,850	1,830	-20
Oak mix	1,583	1,583	0
Planted mixed pine	1,580	1,526	-54
Planted white pine	461	461	0
Black/red hybrid oak	0	14	14
Lowland shrub	105,368	105,368	0
Marsh	40,996	40,996	0
Treed bog	27,309	27,309	0
Herbaceous open land	20,538	20,538	0
Water	16,983	16,983	0
Upland shrub	8,062	8,062	0
Bog	5,965	5,965	0
Low-density trees	4,890	4,890	0
Urban	3,090	3,090	0
Bare/sparsely vegetated	2,156	2,156	0

Cropland	91	91	0
Total:	**1,067,507**	**1,067,507**	**0**

EUP management areas

Drummond Island

State forest area: 47,802 acres	Location: Eastern Upper Peninsula	Population centers: Drummond Township
Subsection: St. Ignace Lake Plain	Landforms: Flat lake beds Dune fields Shallow embayments Exposed limestone	Land cover: Forested: 40,438 acres Nonforested: 7,364 acres

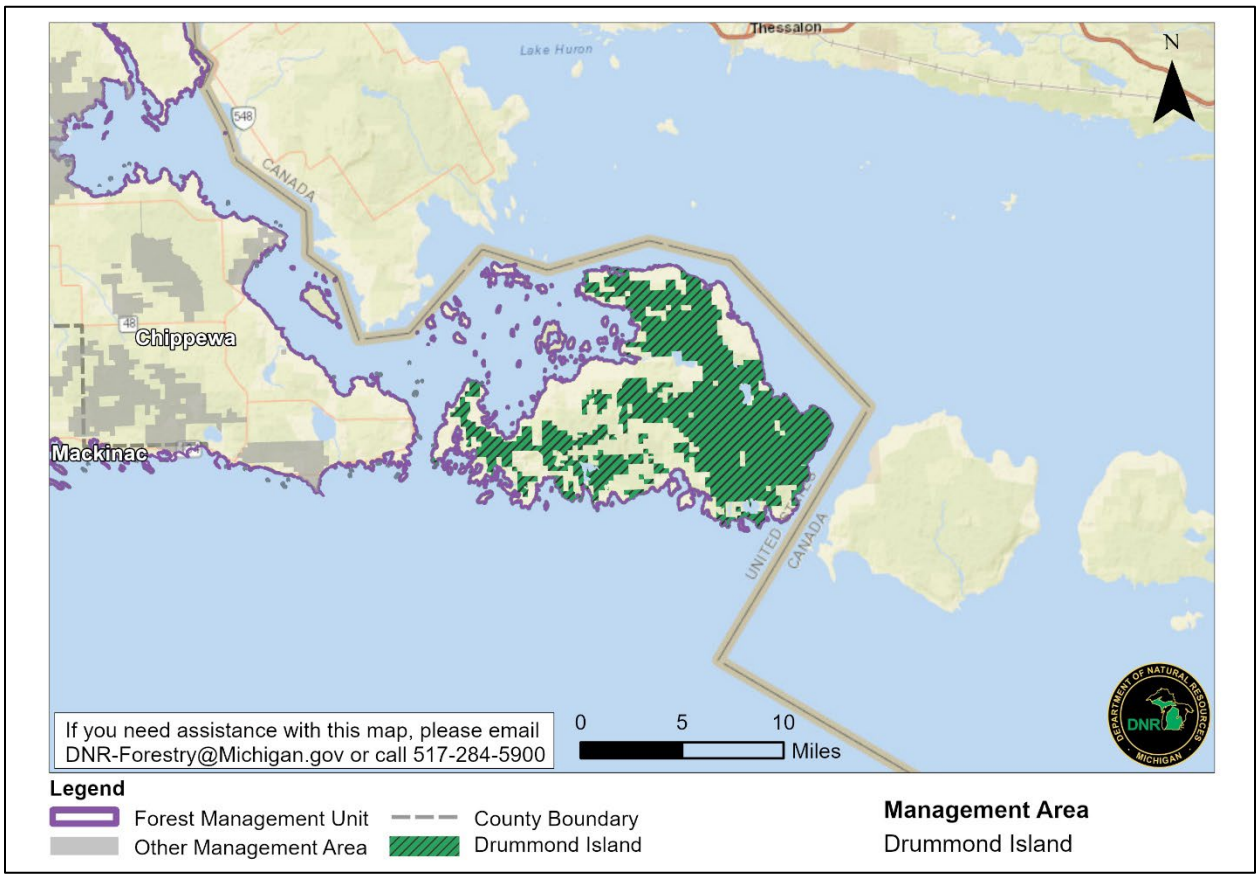


Figure 1. Drummond Island Management Area.

Forested landscape

Current and projected future condition

The Drummond Island Management Area includes a variety of tolerance levels, occurring mostly in the young and old age categories. Tolerant cover types occur on both unavailable lowlands in the old age category. Mid-tolerant cover types mostly occur on available uplands in the mature and old age categories, while most of the intolerant cover types occur in the young category on available uplands.

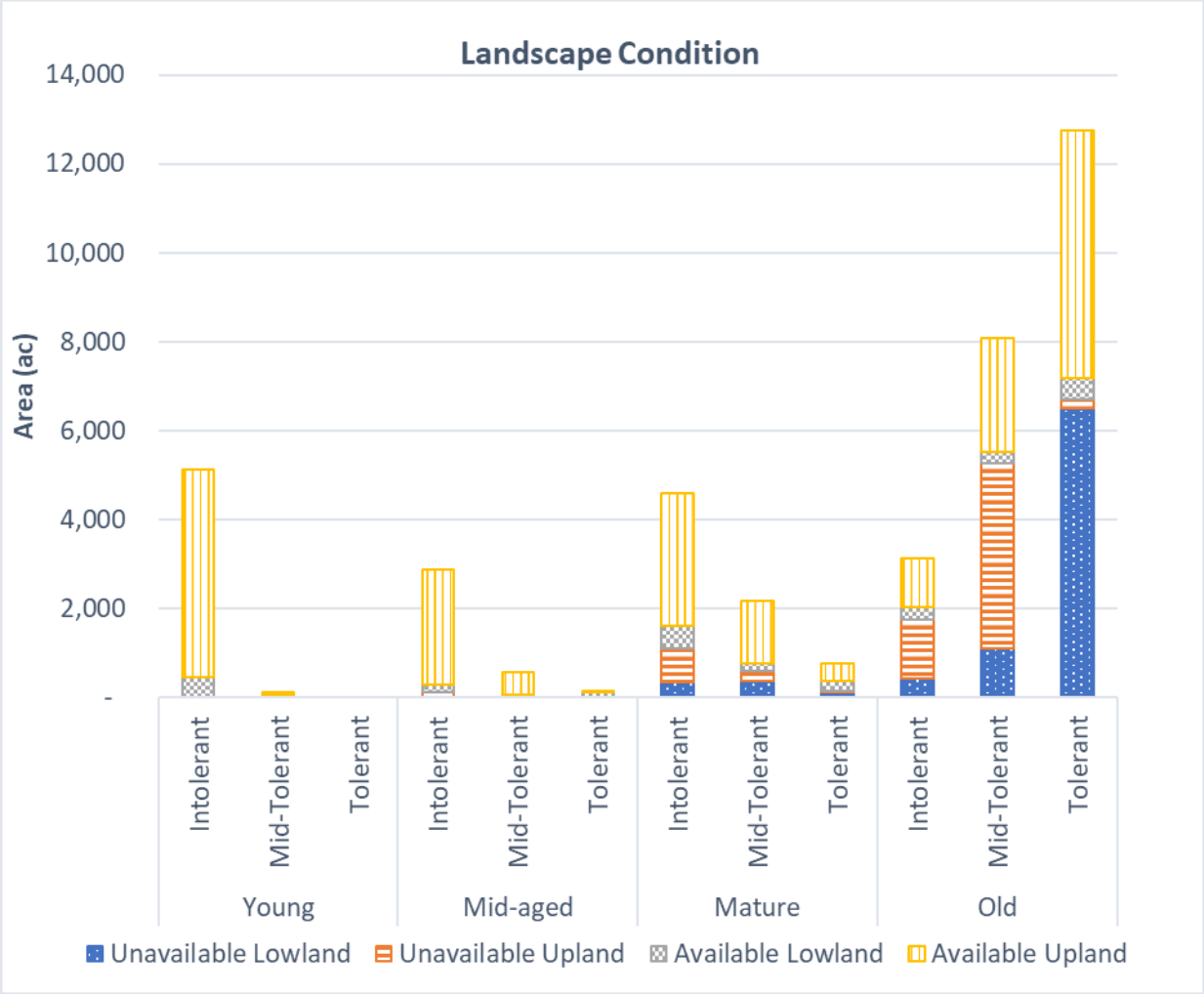


Figure 2. Forest diversity matrix showing the current distribution of forested acres across management availability, age category, landscape position and shade tolerance.

Landscape habitat conditions refine the management area landscape into featured species habitat context. Current and projected acres for the metrics identified in the management priorities (see Section 3) establish a baseline and future condition based on management over the planning period (Table 1).

Table 1. Current acres for landscape habitat conditions.

Landscape Habitat Condition	Monitoring Metric	Current Acres
Young forest	Acres of 0- to 19-year stands in aspen and jack pine	5,248
Mature forest	Acres of 80-plus-year stands across cover types	23,970
Mature forest	Acres of 120-plus-year stands across cover types	5,414
Mesic conifer cover types	Acres of mesic conifer cover types	5,175
Mesic conifers in other cover types	Average canopy occupancy	24%
Mast – oak cover types	Acres of oak cover types	--
Mast tree species in other cover types	Acres of total canopy occupancy of mast tree acres (trace-100%)	8,662
Big trees	Acres of total canopy stand occupancy of species in sawlog or greater size class	22,665
Nonforested openings	Acres of total herbaceous open land, upland shrub and crop land	1,920
Landscape forest matrix	Percent deciduous forest	58%
Landscape forest matrix	Percent coniferous forest	32%

Another important landscape-level habitat in the management area is coastal habitat. The Great Lakes, particularly coastal and nearshore areas, provide globally or continentally important stopover sites for all groups of migratory birds: waterfowl, shorebirds, land birds (defined here as songbirds and raptors), and waterbirds (loons, grebes, cormorants, herons, rails, cranes, gulls and terns) (Ewert, et. Al 2012). The Great Lakes shoreline provides essential stopover habitat for birds to rest, feed and shelter during migration. In addition to migration, the diverse coastal habitats where water and land meet provide unique habitats for breeding birds. Some of these areas are classified by Michigan Audubon as Important Bird Areas. The Great Lakes shoreline is habitat for several rare plant species that are endemic to the Great Lakes.

Forest management and other intrusive activities within a mile of the coastline need to consider the potential impacts to migratory birds and breeding bird habitat.

The Drummond Island Management Area has the following special analysis units (SAUs). These SAUs have specific cover type goals, typically associated with wildlife habitat management. For any SAUs that overlap with this MA, SAU cover type goals take priority as the State Forest Management Plan model strives to meet the cover type goals across the MA, ensuring they are met. Please see Section 5 for a detailed description of the management direction and harvest goals for each of these SAUs.

- Grouse Enhancement Management (GEM) – Drummond

The Drummond Island Management Area is comprised of 85% forested cover types and 15% nonforested cover types. Of the forested cover types, 60% are in an upland landscape position and 25%

are in the lowland landscape positions. The largest contributors to upland cover types are aspen, northern hardwoods and upland conifers. Cedar has the most acres for cover types in the lowland landscape position. Herbaceous open land and marsh are the most common nonforested cover types in the management area, representing 8% of the landscape (Table 2).

Table 2. Current landscape context and distribution of cover types.

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
Forested	Upland	Deciduous	Aspen	13,334	20,592	28,717	40,438
			Northern hardwood	5,931			
			Black/red hybrid oak	0			
			Northern red oak	8			
			Oak mix	0			
			Mixed upland deciduous	1,320			
		Mixed	Upland mixed forest	2,915	2,915		
		Coniferous	Planted red pine	0	5,210		
			Planted jack pine	0			
			Planted white pine	0			
			Planted mixed pine	0			
			Natural red pine	36			
			Natural jack pine	0			
			Natural white pine	76			
			Natural mixed pines	131			
			Upland spruce/fir	458			
			Upland conifers	4,501			
			Hemlock	9			
	Lowland	Deciduous	Lowland aspen/balsam poplar	1,998	2,973	11,721	
			Lowland deciduous	975			
		Mixed	Lowland mixed forest	1,015	1,015		
		Coniferous	Cedar	6,626	7,733		
			Lowland conifers	844			
			Lowland spruce/fir	21			
			Tamarack	243			
Nonforested	Upland	N/A	Herbaceous open land	1,772	N/A	2,280	7,364
			Upland shrub	148			
			Low-density trees	153			
			Bare/sparsely vegetated	112			
			Cropland	0			
			Urban	95			
	Lowland	N/A	Lowland shrub	1,558	N/A	5,084	
			Marsh	1,830			
			Bog	20			
			Treed bog	24			
			Water	1,652			
						Grand Total:	**47,802**

There are 24,689 acres (51% of the total management area and 61% of the forested area) that can be managed toward desired future conditions via commercial timber harvest in the Drummond Island

Management Area (Table 3). Of that, over 27% is in the aspen cover type, 14% is in the northern hardwood cover type and almost 5% is upland mixed forest. The remaining cover types represent less than 4% each of the forested and available land in the management area.

Table 3. Current cover type composition by management availability.

DRUMMOND ISLAND Forested Cover Type	Available Acres	Available %	Unavailable Acres	Unavailable %	Total Acres	Total %
Aspen	11,067	27.4%	2,267	5.6%	13,334	33.0%
Cedar	532	1.3%	6,094	15.1%	6,626	16.4%
Hemlock	9	0.0%	0	0.0%	9	0.0%
Lowland aspen/balsam poplar	1,433	3.5%	565	1.4%	1,998	4.9%
Lowland conifers	291	0.7%	553	1.4%	844	2.1%
Lowland deciduous	236	0.6%	739	1.8%	975	2.4%
Lowland mixed forest	273	0.7%	742	1.8%	1,015	2.5%
Lowland spruce/fir	21	0.1%	0	0.0%	21	0.1%
Mixed upland deciduous	1,257	3.1%	63	0.2%	1,320	3.3%
Natural mixed pines	126	0.3%	5	0.0%	131	0.3%
Natural red pine	0	0.0%	36	0.1%	36	0.1%
Natural white pine	76	0.2%	0	0.0%	76	0.2%
Northern hardwood	5,727	14.2%	204	0.5%	5,931	14.7%
Northern red oak	0	0.0%	8	0.0%	8	0.0%
Tamarack	16	0.0%	227	0.6%	243	0.6%
Upland conifers	1,323	3.3%	3,178	7.9%	4,501	11.1%
Upland mixed forest	1,976	4.9%	939	2.3%	2,915	7.2%
Upland spruce/fir	327	0.8%	131	0.3%	458	1.1%
Grand Total	**24,689**	**61.1%**	**15,749**	**38.9%**	**40,439**	**100.0%**

Desired future condition

There are very few cover type transitions projected for the Drummond Island Management Area. The managed area of each cover type is projected to remain very stable, as treatment regimes will not significantly change the amount of area in each cover type. The largest decrease forecasted is in the upland mixed forest cover type, where 117 acres will convert to other cover types through forest management and regeneration activities. The largest increase occurs in northern hardwoods, where 67 acres are projected to convert into this cover type.

Table 4. Site conditions for unavailable acres.

Site Condition	Acres	Percent of Unavailable Area
Deer wintering area	5,197	33.0%

Site Condition	Acres	Percent of Unavailable Area
Conservation values	4,210	26.7%
Species of special concern or T&E	2,805	17.8%
Wildlife concerns	1,942	12.3%
Too wet	754	4.8%
Recreational/scenic	353	2.2%
BMPs	233	1.5%
Cannot regenerate	108	0.7%
Blocked by obstacle	75	0.5%
Long-term retention	31	0.2%
Unproductive	29	0.2%
Rare landforms	11	0.1%
Other department/division processes	1	0.0%
Total	**15,749**	**100.0%**

Projected 10-year cover type management actions

Each cover type in the Drummond Island Management Area has unique age class and basal area class goals that describe the long-term desired future conditions. The calculated harvest levels that are needed during the first 10-year planning period are summarized in Table 5. These harvest levels are necessary to begin achieving long-term planning goals. Implementing these silvicultural regimes will yield 66,584 cords, the planned harvest volume for the decade (Table 6).

Table 5. Ten-year planning period harvest goals (acres) by cover type and silvicultural regime.

Silvicultural Regimes								
Cover Type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Salvage Clearcut	Salvage Thinning	Grand Total
Northern hardwood	-	1,391	-	-	-	-	-	1,391
Aspen	1,350	-	-	-	-	-	-	1,350
Upland conifers	484	-	-	-	-	-	-	484
Upland mixed forest	176	-	-	-	-	-	-	176
Mixed upland deciduous	139	15	-	-	14	-	-	167
Lowland aspen/balsam poplar	100	-	-	-	-	-	-	100
Lowland deciduous	92	-	-	-	-	-	-	92
Lowland conifers	37	-	-	-	-	-	-	37

Silvicultural Regimes								
Lowland mixed forest	17	-	-	-	-	-	-	17
Lowland spruce/fir	11	-	-	-	-	-	-	11
Natural mixed pines	-	-	-	-	2	-	-	2
Totals	**2,406**	**1,405**	**-**	**-**	**15**	**-**	**-**	**3,826**

Table 6. Projected 10-year harvest volume by product and species.

10-Year Estimated Harvest Volume Projection Drummond Island Management Area			
Product	**Species**	**Volume Planned***	**Volume Prepared****
Pulpwood (cords)	Mixed hardwood	15,176	14,265
	Mixed aspen	9,252	8,697
	Mixed softwood	5,250	4,935
	Mixed spruce	3,724	3,501
	Red pine	957	900
	White pine	731	687
	Mixed oak	623	585
	Jack pine	468	440
	Pulpwood Total	**36,181**	**34,010**
Sawtimber (MBF)	Sugar maple	5,347	5,026
	Mixed aspen	3,448	3,241
	Red pine	3,215	3,022
	Red maple	1,760	1,654
	White pine	1,283	1,206
	Red oak	670	630
	Basswood	655	616
	White oak	105	98
	Mixed oak	75	71
	Sawtimber Total	**16,558**	**15,565**
	Total Sawtimber Harvest Volume in Cords	**34,653**	**32,574**
	Grand Total Harvest Volume in Cords	**70,834**	**66,584**

* Volume estimates based on 100% of the projected harvests for the 10-year planning period.

** Volume estimates based on 94% of the projected harvests for the 10-year planning period accounting for reduction in acres and associated volume once sales are prepared for bid.

These harvests will help establish a desirable amount of regeneration for the even-aged cover types over the 10-year period or help to achieve desired basal area distribution among uneven-aged cover types like northern hardwoods. There are no major projected cover type transitions within the next decade (Table 7).

Table 7. Projected 10-year cover type acres resulting from cover type transitions.

Cover Type	Current Acreage	Projected Acreage at End of 10-Year Planning Period	Projected 10-Year Change in Acreage
Aspen	13,334	13,390	56
Cedar	6,626	6,626	0
Northern hardwood	5,931	5,998	67
Upland conifers	4,501	4,510	9
Upland mixed forest	2,915	2,798	-117
Lowland aspen/balsam poplar	1,998	1,963	-35
Mixed upland deciduous	1,320	1,291	-29
Lowland mixed forest	1,015	1,032	17
Lowland deciduous	975	1,002	27
Lowland conifers	844	836	-8
Upland spruce/fir	458	458	0
Tamarack	243	243	0
Natural mixed pines	131	131	0
Natural white pine	76	76	0
Natural red pine	36	36	0
Lowland spruce/fir	21	19	-2
Hemlock	9	9	0
Northern red oak	8	8	0
Black/red hybrid oak	0	13	13
Marsh	1,830	1,830	0
Herbaceous open land	1,772	1,772	0
Water	1,652	1,652	0
Lowland shrub	1,558	1,558	0
Low-density trees	153	153	0
Upland shrub	148	148	0
Bare/sparsely vegetated	112	112	0
Urban	95	95	0

Cover Type	Current Acreage	Projected Acreage at End of 10-Year Planning Period	Projected 10-Year Change in Acreage
Treed bog	24	24	0
Bog	20	20	0
Total	**47,802**	**47,802**	**0**

Featured species current and projected habitat acres

There are seven featured species in this management area that span various cover types, age classes and stand-level conditions.

As noted in the featured species management priority (Section 3), it is recommended that these featured species habitat acres be viewed as acres of potential habitat, representing a condition on the landscape where the more nuanced aspects of each species' habitat requirements are likely to be found or managed for. As described in the introduction, the modeling effort was limited by several factors including the simplification of habitat attributes into MiFI variables. Therefore, when referring to habitat acres, what is being referred to is potential habitat acres.

Current and projected total habitat acres by species across the decade provide a baseline and show the result of long-term management actions (Table 8). Some species show a loss in habitat over the next century. As mentioned in the featured species management priority (Section 3), the current condition for many cover types is a surplus of acres in the 0-9 age class from the compensatory management approach applied in the previous decade. The model eventually evens out the age classes at a lower, sustainable level over time, usually by 50 years. For any species with northern hardwoods as a priority cover type, there is a perceived drop in acres between 40 and 60 years; this is due to the basal area dropping below 81, but because it only drops into the upper 70s, it is not expected to translate into any real habitat loss on the ground. Three of these species were not included in the State Forest Management Plan model but are included here to inform management decisions over the decade.

Table 8. Featured species current and projected total habitat acres (i.e., potential habitat).

Featured Species	Priority Cover Types	Total Habitat Acres Current	10-Year Projected Habitat Acres	50-Year Projected Habitat Acres	100-Year Projected Habitat Acres
Blackburnian warbler	Northern hardwoods, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, hemlock	8,405	9,590	6,994	11,421
Black-throated blue warbler	Northern hardwoods, mixed upland deciduous	3,973	5,248	2,644	6,757

Featured Species	Priority Cover Types	Total Habitat Acres Current	10-Year Projected Habitat Acres	50-Year Projected Habitat Acres	100-Year Projected Habitat Acres
Ruffed grouse	Aspen	5,594	3,871	3,013	3,058
Snowshoe hare forest	Aspen, cedar, hemlock, lowland aspen, lowland conifers, lowland mixed forest, lowland spruce/fir, mixed upland deciduous, natural jack pine, natural mixed pines, planted jack pine, upland spruce/fir	7,312	5,442	3,727	3,841
White-tailed deer (food)	Food: Northern hardwood, oak mix, aspen, mixed upland deciduous, lowland deciduous, lowland aspen/balsam poplar, lowland mixed forest	27,495	27,495	27,415	27,346
White-tailed deer (shelter)	Shelter: hemlock, cedar, planted red pine, planted white pine, planted mixed pine, natural red pine, natural white pine, natural mixed pines, upland conifers, upland spruce fir, lowland conifers	12,701	12,701	12,783	12,854

Cover type composition and associated featured species

Aspen

Current condition

Most of the aspen cover type is currently in the 0- to 39-year-old age classes. (Figure 3). The past management regime has been primarily clearcut for this cover type. The younger age classes have a surplus of acres, and older age classes have an even larger deficit. Most aspen stands in this management area are very open-grown or are very low site-index. Balancing of age classes has not been the focus, as this management area includes alvar natural communities and other special features.

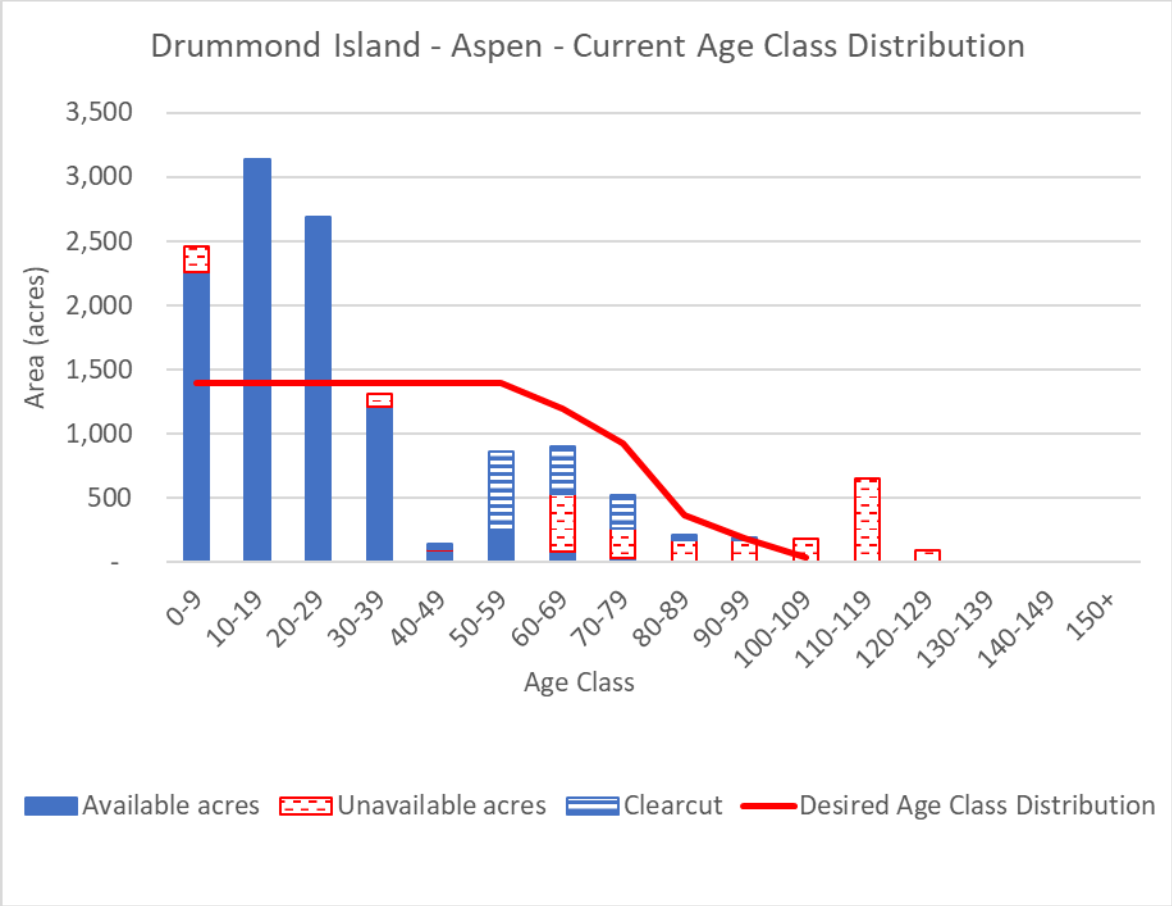


Figure 3. The current age class distribution, the desired age class distribution and the projected harvests in the aspen cover type over the 10-year planning period.

Current conditions are a result of commercial harvests and regeneration efforts on available aspen acres during the previous planning periods. A portion of this cover type meets the habitat requirements for ruffed grouse, snowshoe hare and white-tailed deer.

Table 9. Featured species with aspen as a priority habitat cover type, habitat variables and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Aspen	Aspen Habitat Acres – Available	Aspen Habitat Acres – Unavailable
Ruffed grouse	Age category: 0-19 Size category: sapling Stocking: medium to well	5,389	204
Snowshoe hare	Age category: 0-19 Size category: sapling Stocking: well	7,108	204
White-tailed deer	All ages and size classes	13,334	--

Desired future condition

The projected long-term cover type trend for aspen is stable in the Drummond Island Management Area. There are a few transitions into this cover type from other cover types forecasted in this management area and no transitions from aspen to other cover types.

The long-term goal for this cover type is balanced age classes between 0 and 50 years old, with a gradual tail reaching 100 years, for all available aspen stands in this management area. Maintaining lower acreage in old age classes continues to be desirable to ensure the aspen cover type is distributed within the desired age classes.

The end of the planning period will result in the establishment of 1,411 acres of 0- to 9-year age class. Progress toward the long-term age class distribution of aspen will take many decades in the management area (Figure 4).

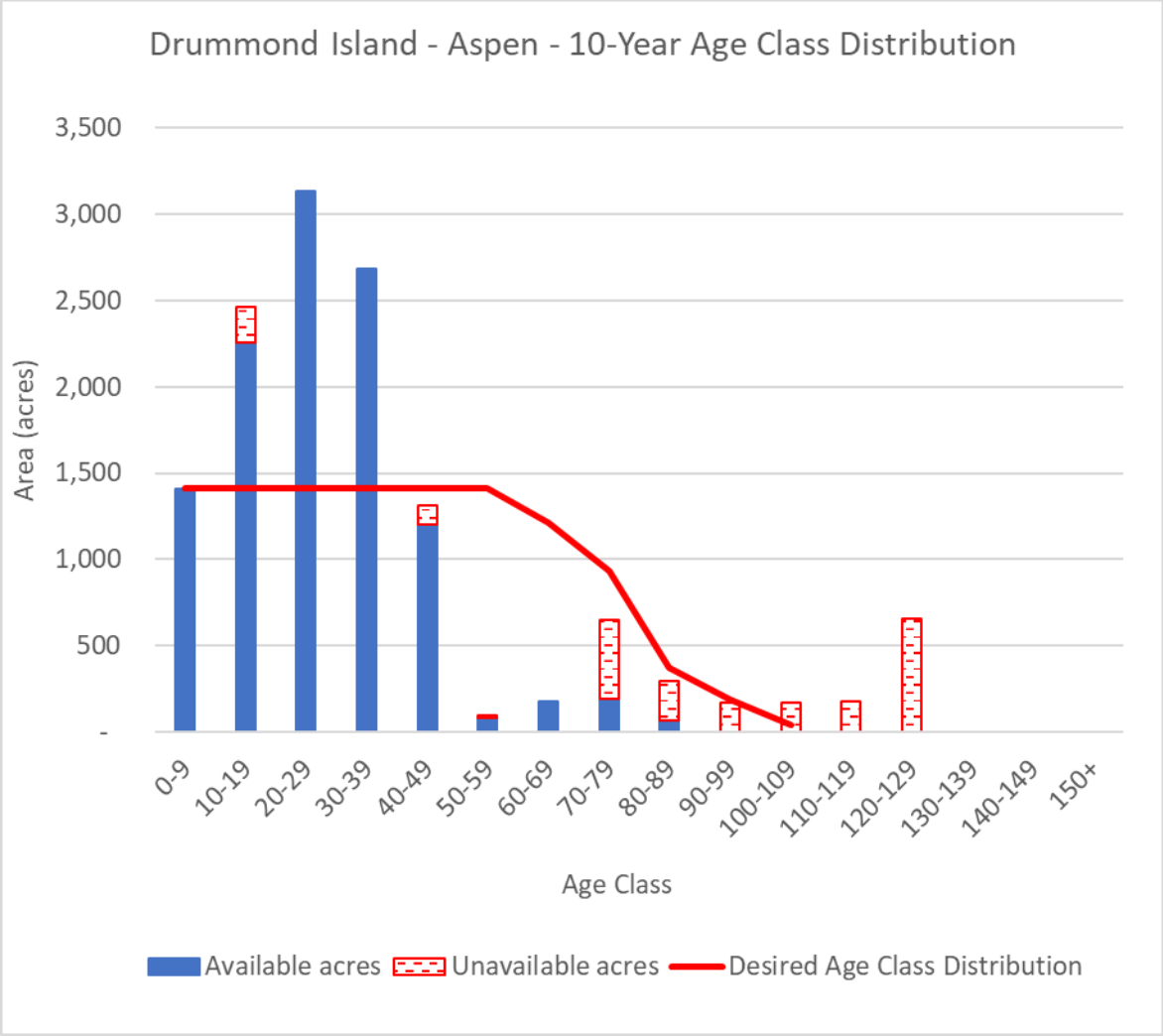


Figure 4. The short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The midterm age class distribution shows the population of aspen acres nearly reaching the desired future condition, with only a few age classes deviating from the target proportions (Figure 5). As is often the case, an extremely unbalanced condition in the first planning period can often result in the need to carry some acres slightly longer into older age classes to achieve the desired age class goals.

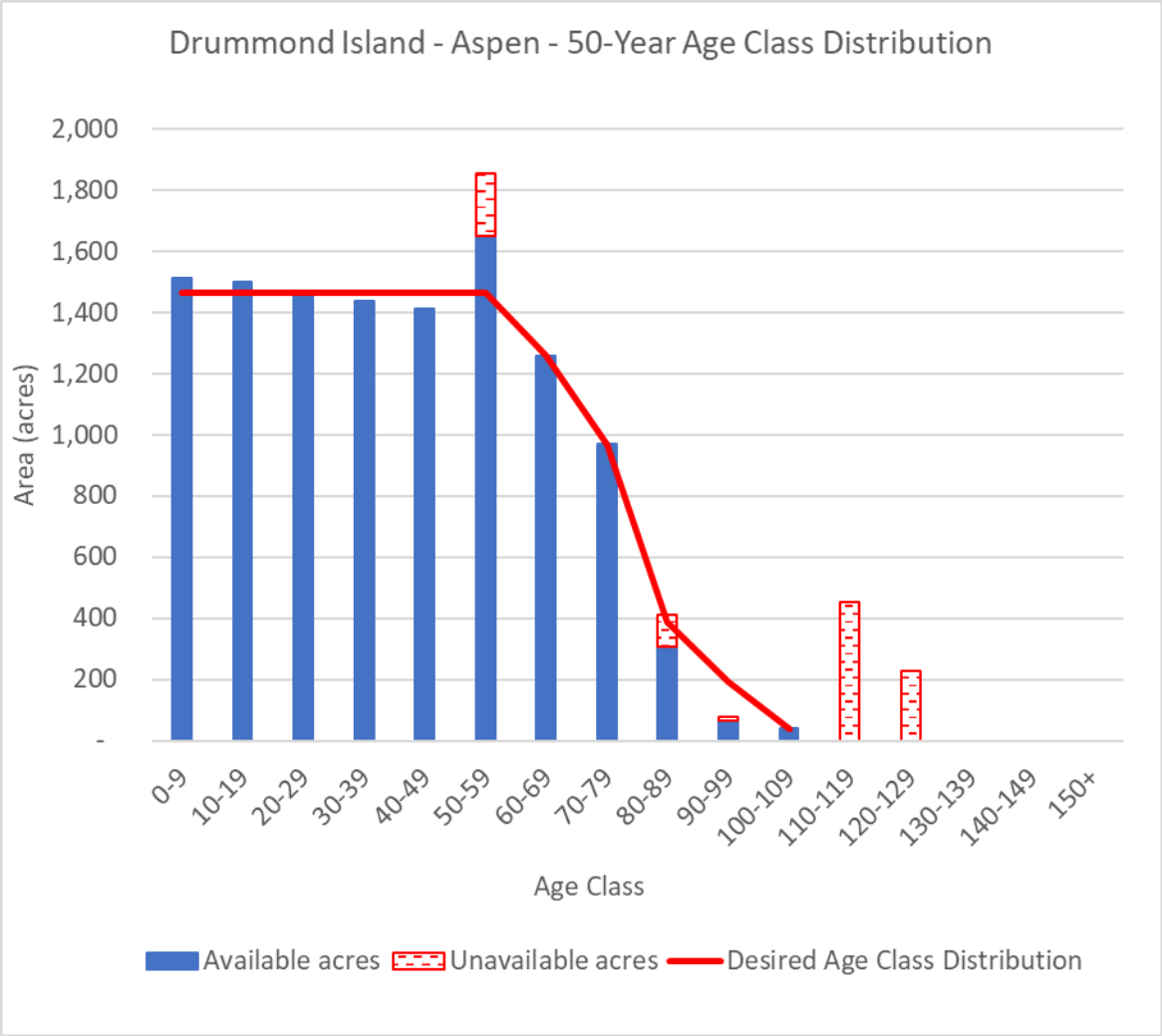


Figure 5. The projected midterm age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 6) will concentrate the manageable acres of aspen in productive growing conditions while providing an even flow of forest products and a wide variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest.

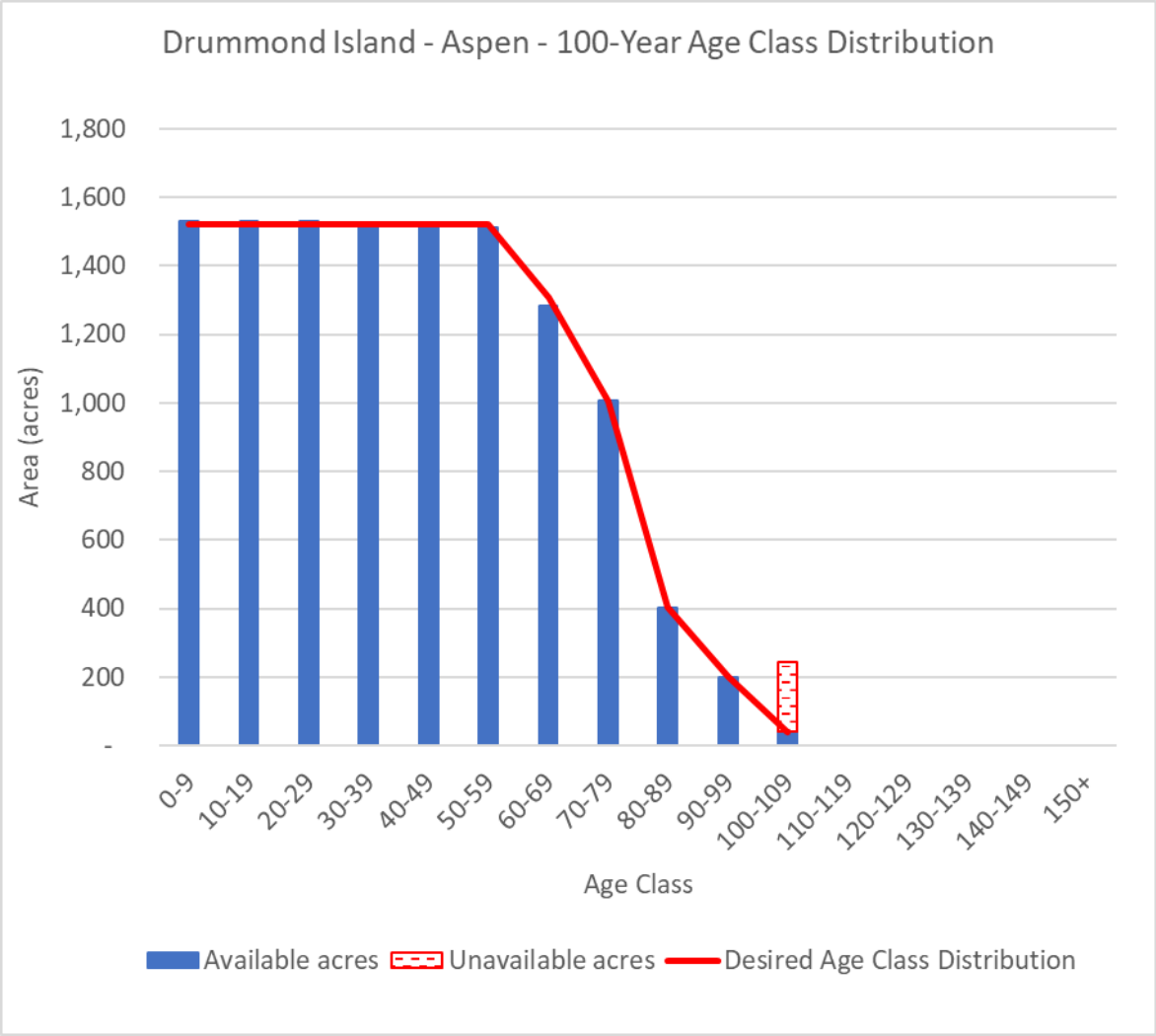


Figure 6. The projected long-term age class distribution at the end of the tenth planning period compared to the long-term desired age class distribution.

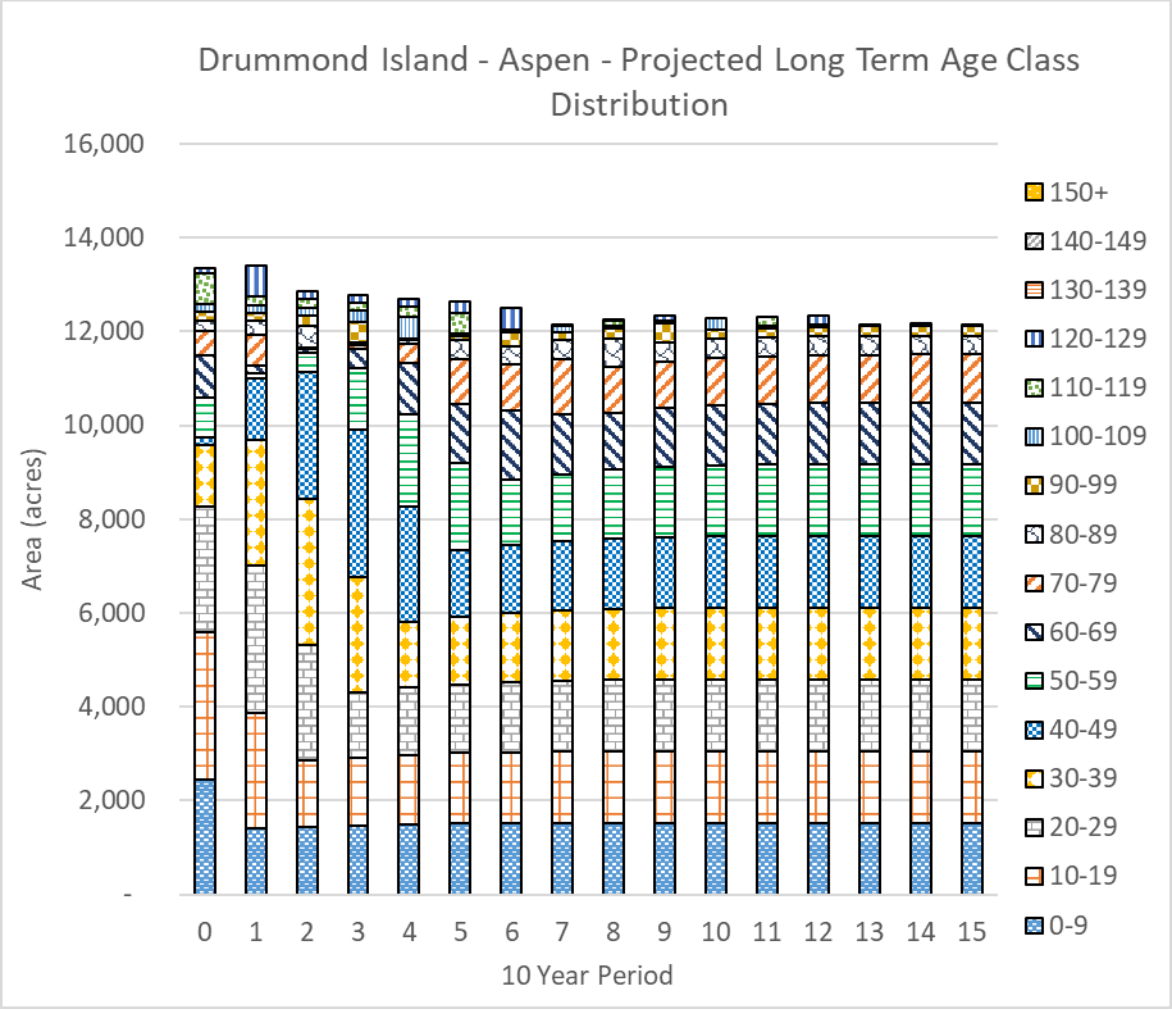


Figure 7. The projected age class distribution for all acres of aspen over the next 150 years.

Management actions

There are 1,330 acres of projected clearcut harvest in the aspen cover type during this planning period, which is just under the desired establishment of 1,393 acres per decade.

Northern hardwoods

Current condition

Most of the northern hardwood cover type is currently between a stand age of 80 and 110 years old in the Drummond Island Management Area (Figure 8). The past management regime has been primarily single tree selection, which allows for stand age to continue to increase over time. Some stands are beginning to achieve an uneven-aged condition, where a featured stand age becomes less evident, but the dominant age of these stands will likely increase beyond 150 years old prior to a younger age cohort becoming the prominent component of these stands.

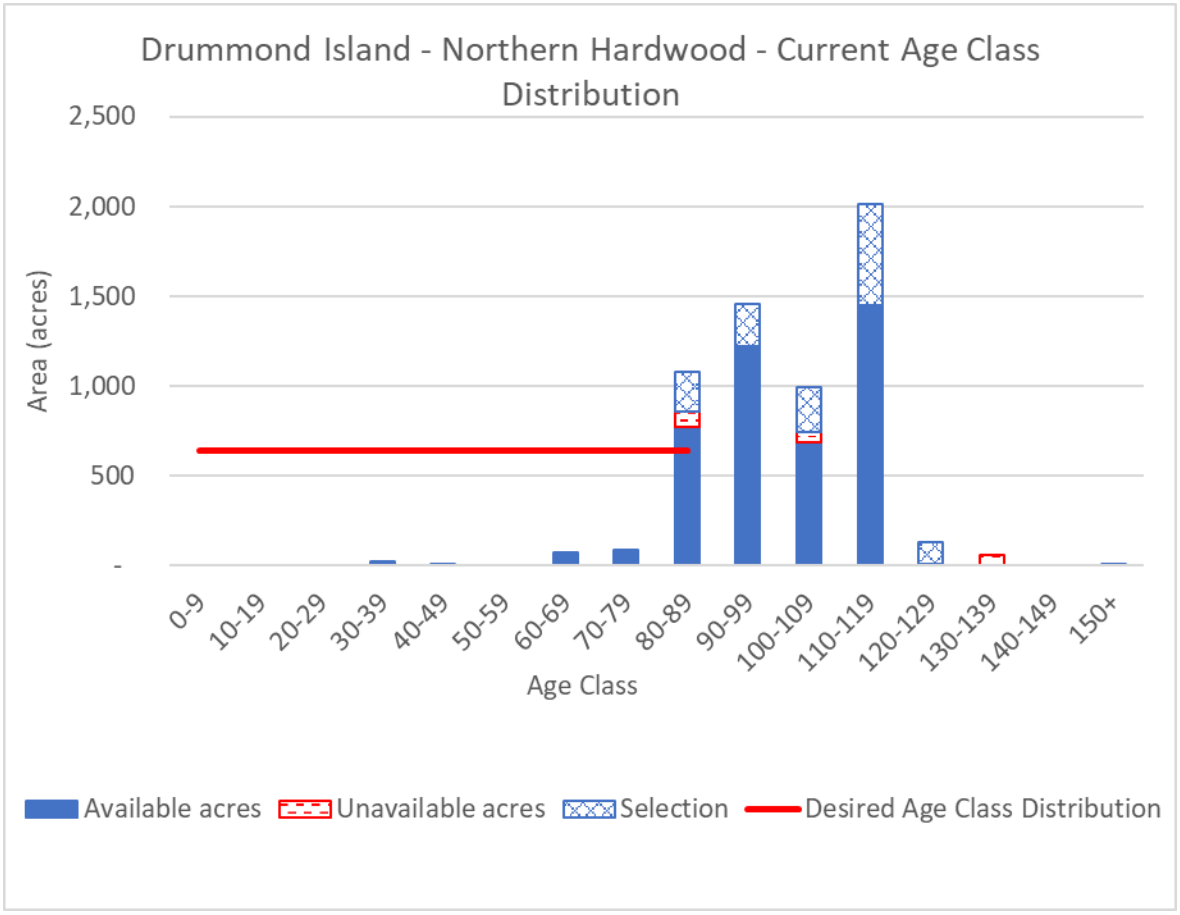


Figure 8. The current age class distribution and desired age class distribution in the northern hardwood cover type in the Drummond Island Management Area.

The area of northern hardwood is well distributed in the ideal basal area classes for optimal growing conditions in the Drummond Island Management Area (Figure 9). Current conditions are a result of beech salvage efforts in the previous planning period and a regulated-selection harvest regime that has been in place in this management area for decades.

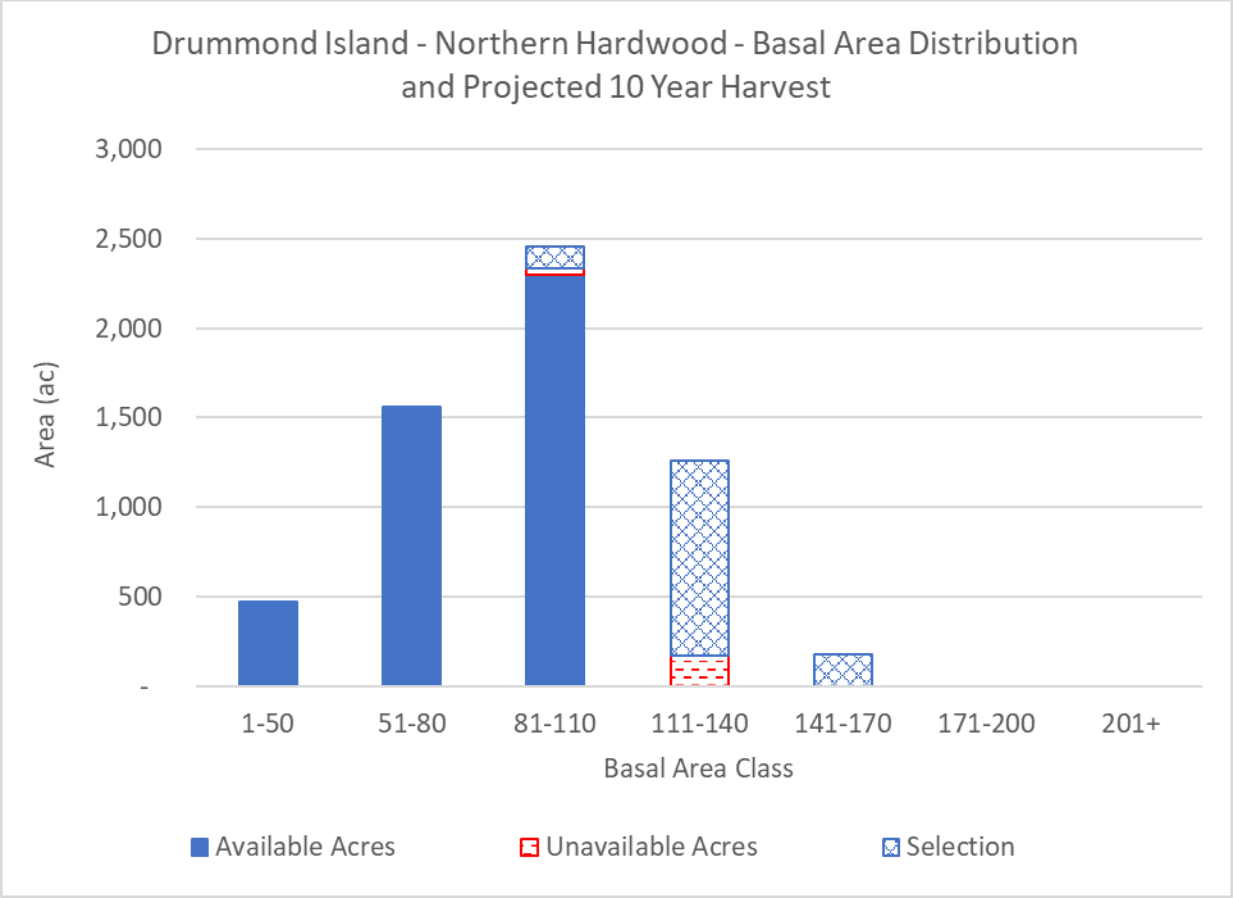


Figure 9. The current basal area distribution of the northern hardwood cover type as well as the projected harvests from each basal area class.

There are very few acres of unavailable northern hardwoods in the Drummond Island Management Area. Selection is the primary silvicultural treatment projected during this 10-year planning period, but there may be opportunities to utilize other harvesting regimes, including even-aged management silvicultural regimes, to increase stem density, species composition and regeneration within the northern hardwood areas. A portion of this cover type meets the habitat requirements for blackburnian warbler, black-throated blue warbler and white-tailed deer.

Table 10. Featured species with northern hardwoods as a priority habitat cover type, habitat variables and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Northern Hardwood	Northern Hardwood Habitat Acres – Available	Northern Hardwood Habitat Acres – Unavailable
Blackburnian warbler	Age category: 80+ Size category: pole, sawlog Basal area: 81+	4,823	3,577
Black-throated blue warbler	Age category: 80+ Size category: sawlog Basal area: 81+	3,762	211
White-tailed deer	All ages and size classes	5,931	--

Desired future condition

The projected long-term cover type trend for northern hardwood is slightly increasing in the Drummond Island Management Area. There are very few transitions into this cover type from other cover types and equally few transitions from northern hardwoods to other cover types forecasted in this management area.

The desired basal area distribution is a bell-shaped curve, where a significant majority of the area is kept in the 81-110 basal area class, with recently harvested stands occupying the 51-80 class and stands that are ready for harvest occupying the 111-140 class. Diameter distributions of the northern hardwood stands should follow the appropriate Q-curve relative to stand age and condition.

An uneven-aged condition is the long-term goal for all northern hardwood stands in this management area, which is achieved when there is no single discernable age cohort that is more prevalent than others across the stand area as canopy gaps fill in with regenerating seedlings, saplings and poles and eventually remaining stems become sawlog-sized over time.

Regeneration and recruitment continue to be a focus in the northern hardwood cover type across this management area. The long-term sustainability of this cover type in an uneven-aged silvicultural regime is dependent on the successful establishment of northern hardwood species as well as the recruitment of those seedlings and saplings into the pole and sawlog classes. Shallow, sensitive soils over bedrock are an issue and influence both growth and harvest. The Drummond Island Management Area will take several decades to reach the desired future condition because of the impacts from beech bark disease. The amount of American beech that once occupied much of the northern hardwood stands has resulted in lower than normal residual basal area and decreased stocking levels across much of the eastern Upper Peninsula.

Although the State Forest Management Plan model shows an increase for featured species potential habitat, it is likely that regeneration issues within this cover type will have an impact on the amount available in the future.

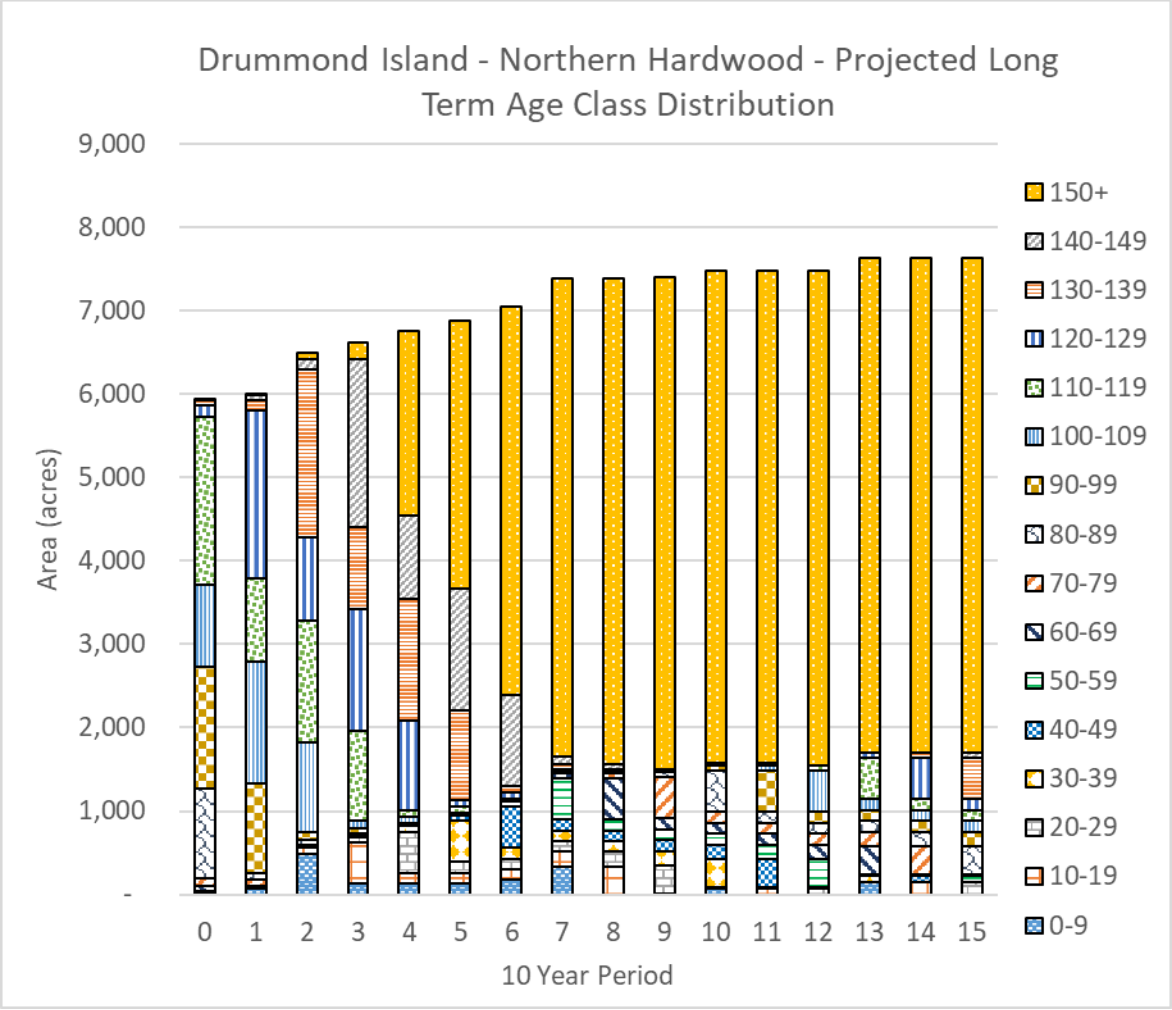


Figure 10. The projected age-class distribution for all acres of northern hardwood over the next 150 years.

Management actions

The desired forest conditions and associated featured species habitat will be maintained and achieved through continued application of the projected selection harvest regime on 1,391 acres (Table 5). Larger canopy gaps should be used to encourage diverse regeneration of northern hardwood species while maintaining an overall long-term mature forest, closed canopy landscape condition, mindful of featured species habitat requirements.

Cedar

Current condition

There are several deer wintering complexes throughout this management area. The majority of this cover type is over 90 years old and unavailable for commercial harvest. The age-class distribution is unbalanced, but regulated harvests are not a priority/focus in this cover type.

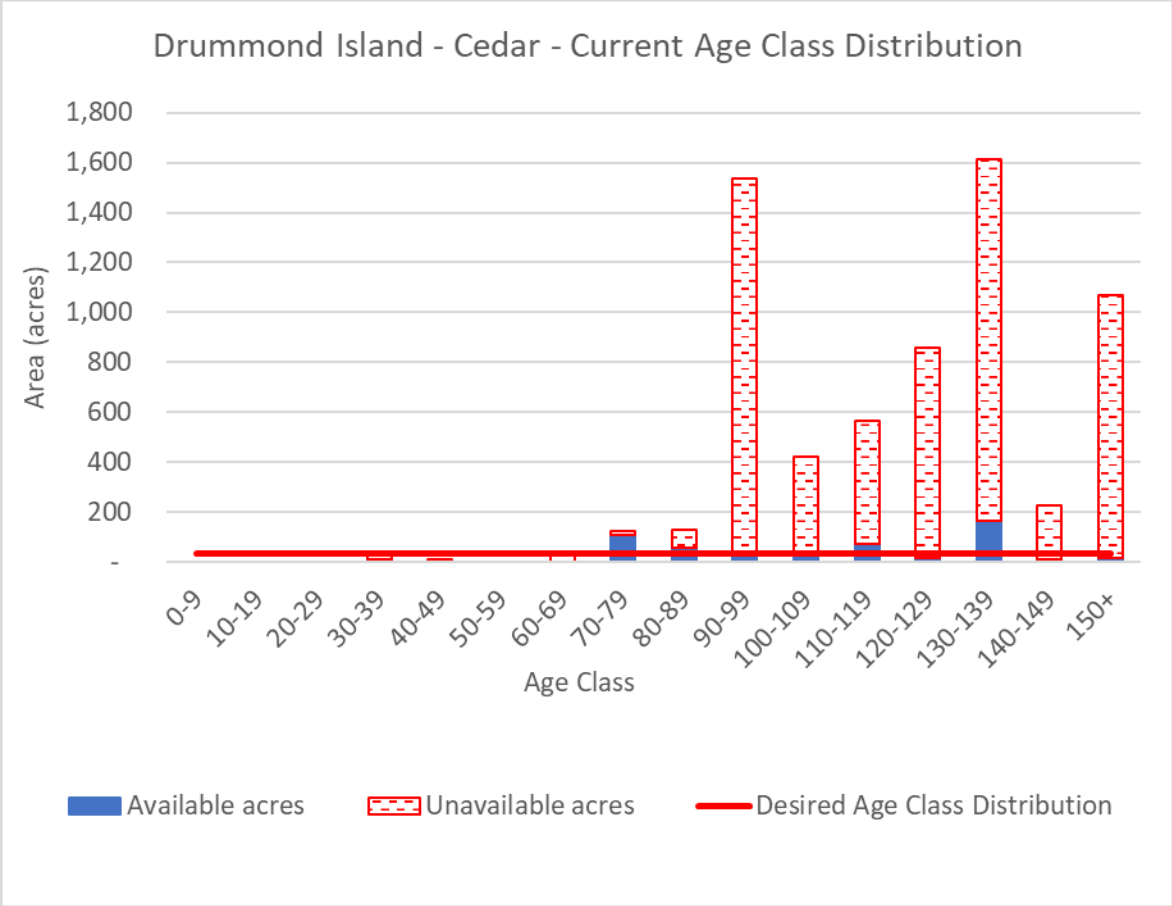


Figure 9. The current age-class distribution and projected harvests in the cedar cover type in the Drummond Island Management Area.

Table 10. Featured species with cedar as a priority habitat cover type, habitat variables and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Cedar	Cedar Habitat Acres – Available	Cedar Habitat Acres – Unavailable
Snowshoe hare	Age category: 0-19 Size category: sapling Stocking: well	0	0
White-tailed deer	All ages and size classes	--	6,626

Desired future condition

The projected long-term cover type trend for cedar is stable in the Drummond Island Management Area. There are very few projected transitions into or out of this cover type from other cover types forecasted.

The long-term goal for this cover type is to manage and maintain wildlife habitat.

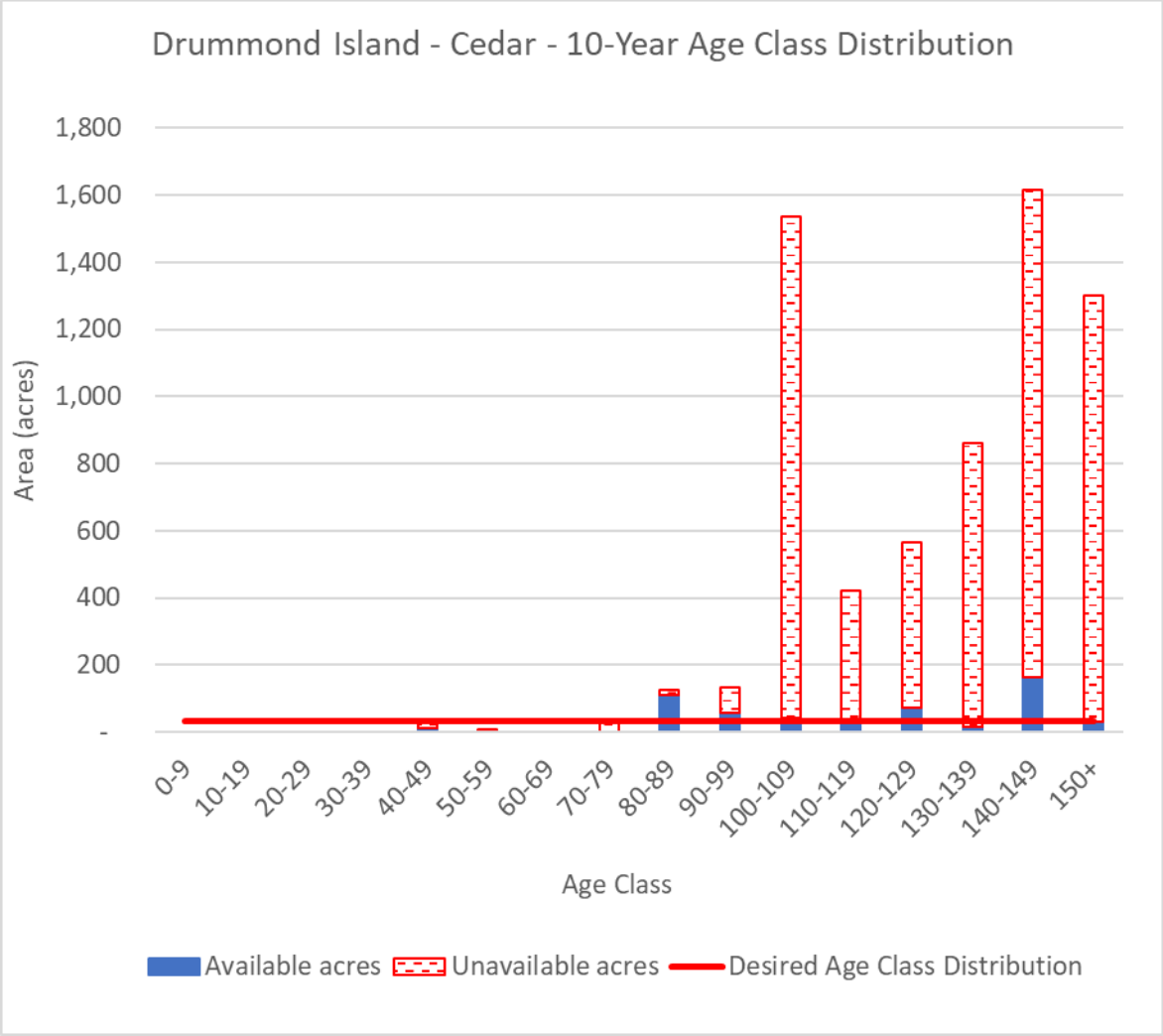


Figure 10. Short-term future age-class distribution at the end of the 10-year planning period compared to the long-term desired age-class distribution.

The midterm age-class distribution shows the population of cedar acres beginning to reach the desired future condition (Figure 11).

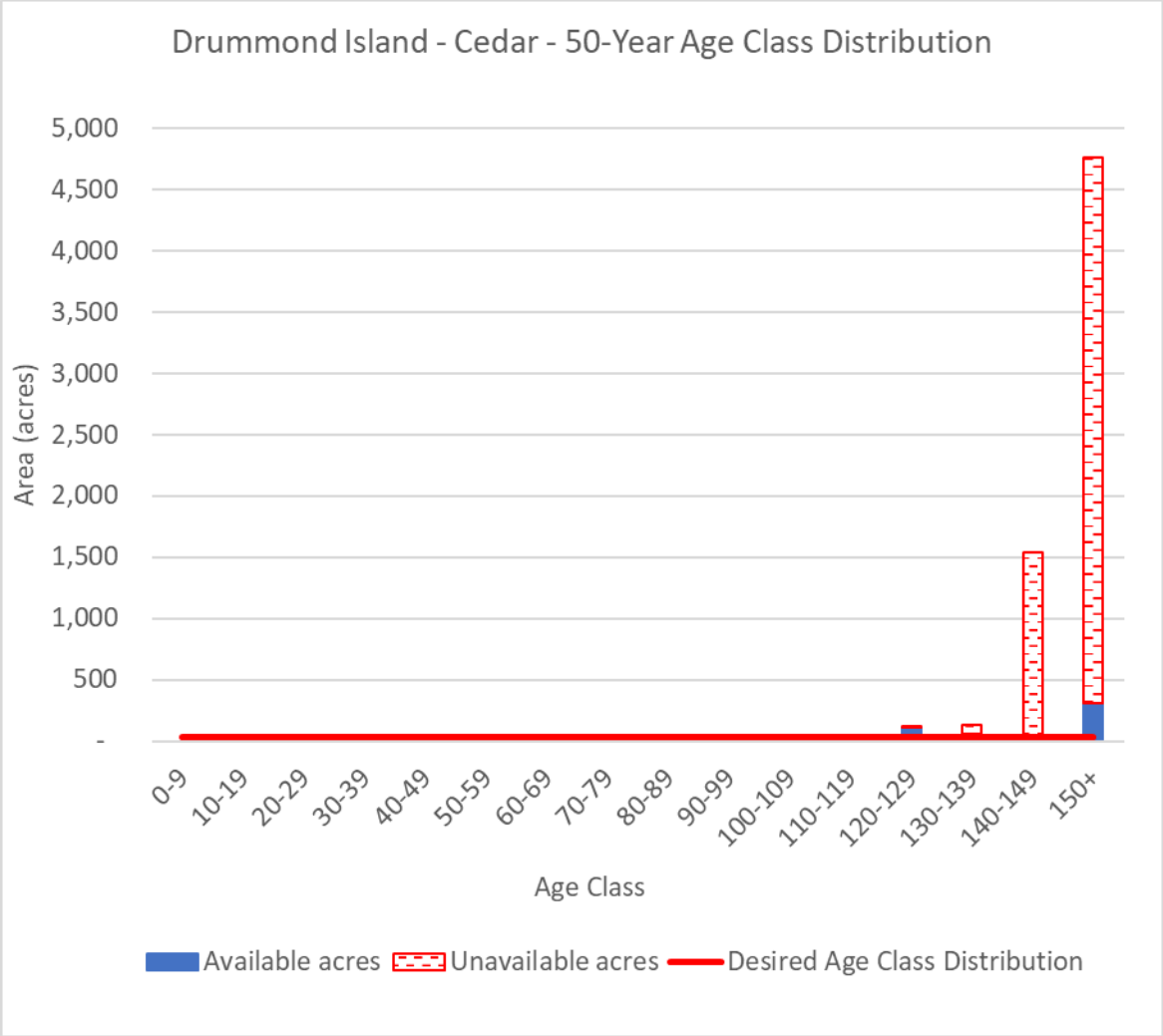


Figure 11. Projected midterm age-class distribution at the end of the fifth planning period compared to the long-term desired age-class distribution.

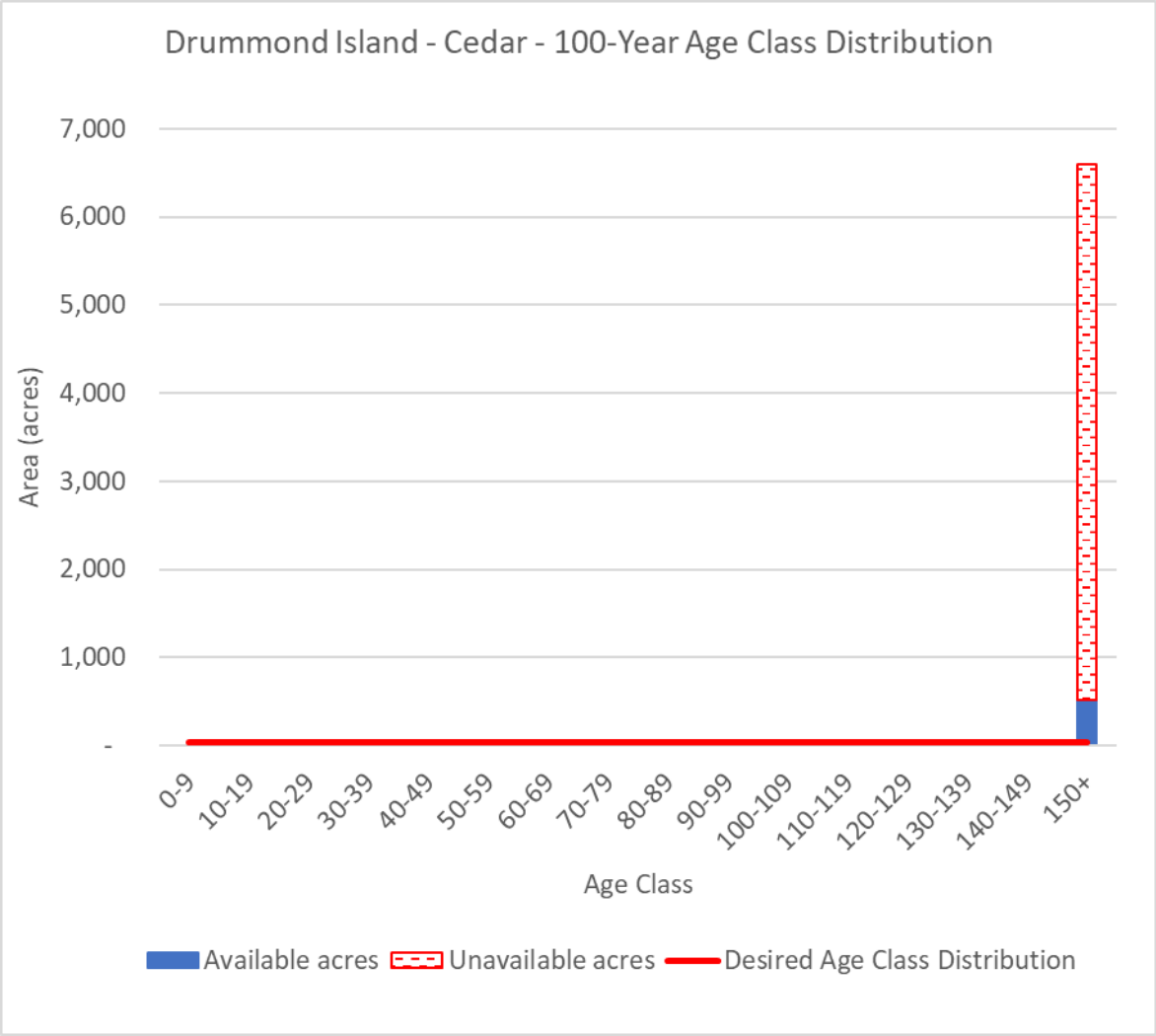


Figure 12. Projected long-term age-class distribution at the end of the 10th planning period compared to the long-term desired age-class distribution.

The long-term achievement of the desired age-class distribution (Figure 12) will concentrate on the management of cedar within the deer wintering complex plans to provide wildlife habitat conditions across the landscape.

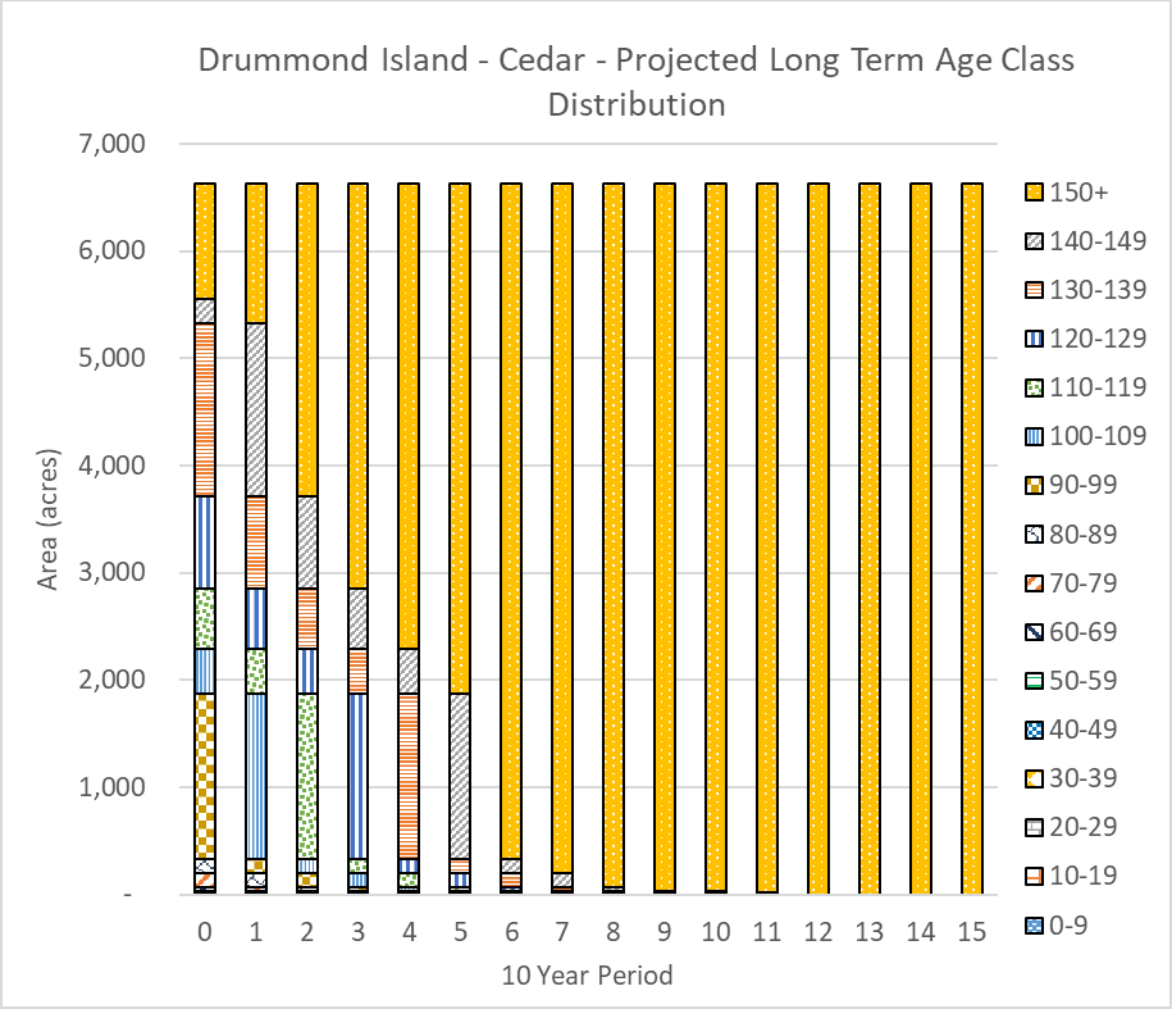


Figure 13. Projected age-class distribution for all acres of cedar over the next 150 years.

Management actions

Maintaining this cover type where it exists on the landscape will be the primary action for this planning period. This cover type provides the best functional shelter habitat related to overwintering deer and deer wintering complexes (see Section 5) and can be a difficult cover type to regenerate through commercial harvest. Continued understanding of how to regenerate the cover type should be considered as emerging research becomes available.

Deer wintering complexes greater than 15,000 acres are modeled as a special analysis unit, or SAU, and information on them can be found in Section 5 of the plan. In deer wintering complexes less than 15,000 acres, harvest of cedar and hemlock is not allowed within those range stands essential for deer survival, and secondary shelter is often protected as well. These areas are guided by the DNR Deer Winter Range Guidelines.

Upland conifer

Current condition

The Drummond Island Management Area has a surplus of acres in the 80 years and older age classes due, in part, to the number of unavailable acres in this cover type (Figure 14). The age-class distribution is currently very unbalanced across almost all the age-class categories. Additionally, a deficit of available acres occurs in all age classes younger than 50 years. The landscape position in which many of these acres occur contributes to the number of acres extending beyond the desired maximum age-class tail of 130 years old.

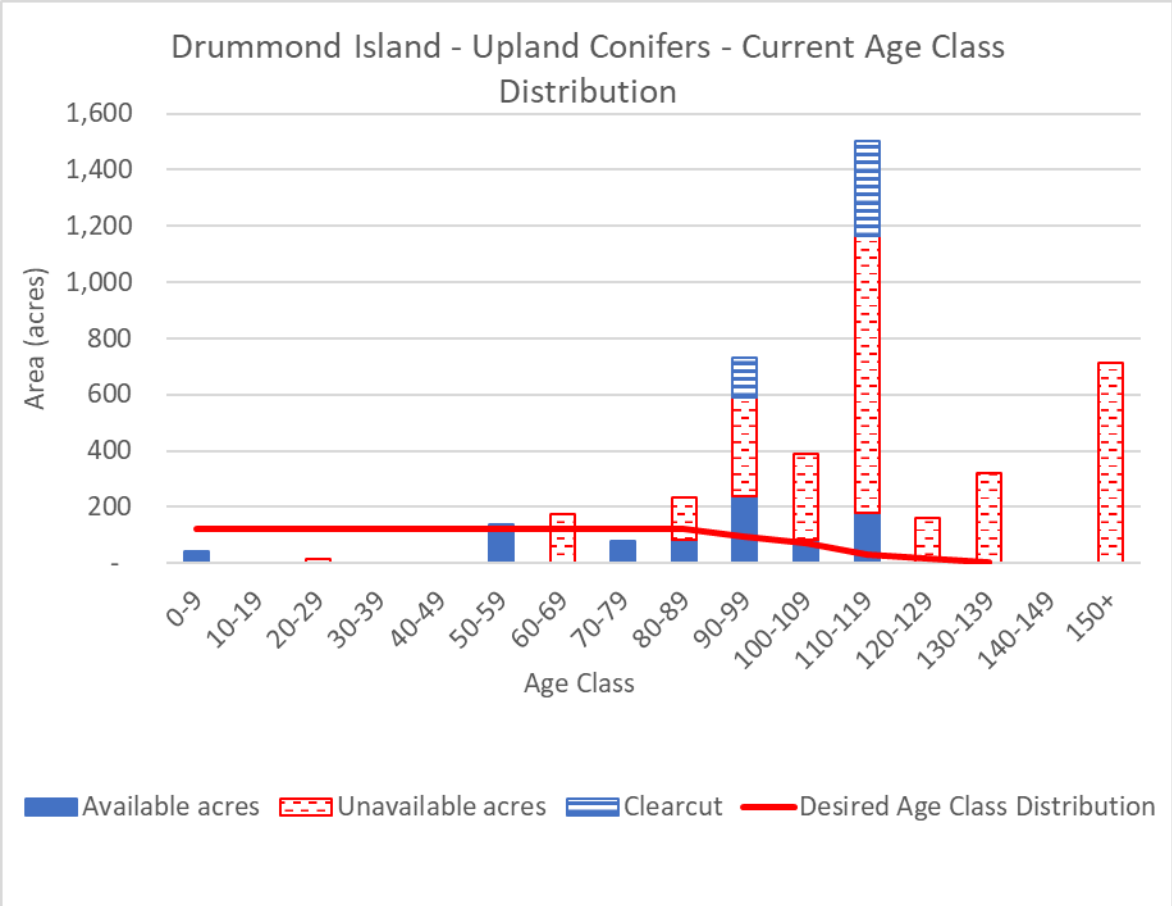


Figure 14. Current age-class distribution, desired age class distribution and projected harvests in the upland conifers cover type over the 10-year planning period.

Table 11. Featured species with upland conifers as a priority habitat cover type, habitat variables and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Upland Conifer	Upland Conifer Habitat Acres – Available	Upland Conifer Habitat Acres – Unavailable
Ruffed grouse	Age category: 0-19 Size category: sapling Stocking: medium to well	5,389	204
Snowshoe hare	Age category: 0-19 Size category: sapling Stocking: well	7,108	204
White-tailed deer	All ages and size classes	4,501	--

Desired future condition

The projected long-term cover type trend for upland conifers is stable in the Drummond Island Management Area. There are a few transitions in and out of this cover type during this planning period.

The long-term goal for this cover type is balanced age classes between 0 and 80 years old for all available upland conifer acres and then decreasing number of acres until the maximum tail of 130 years old is reached.

The end of the planning period will result in the establishment of approximately 440 acres of upland conifers from the available acres (Figure 15). Achieving the long-term desired balanced age-class distribution of lowland conifers will take many decades (Figure 15).



Figure 15. Short-term future age-class distribution at the end of the 10-year planning period compared to the long-term desired age-class distribution.

The midterm age-class distribution of upland conifers is beginning to reach the desired future condition for available acres in the age classes between 0 and 30 years old. The number of acres in the older age classes, 150 years old and older, continues to increase as the unavailable acres move to the older age classes (Figure 16).

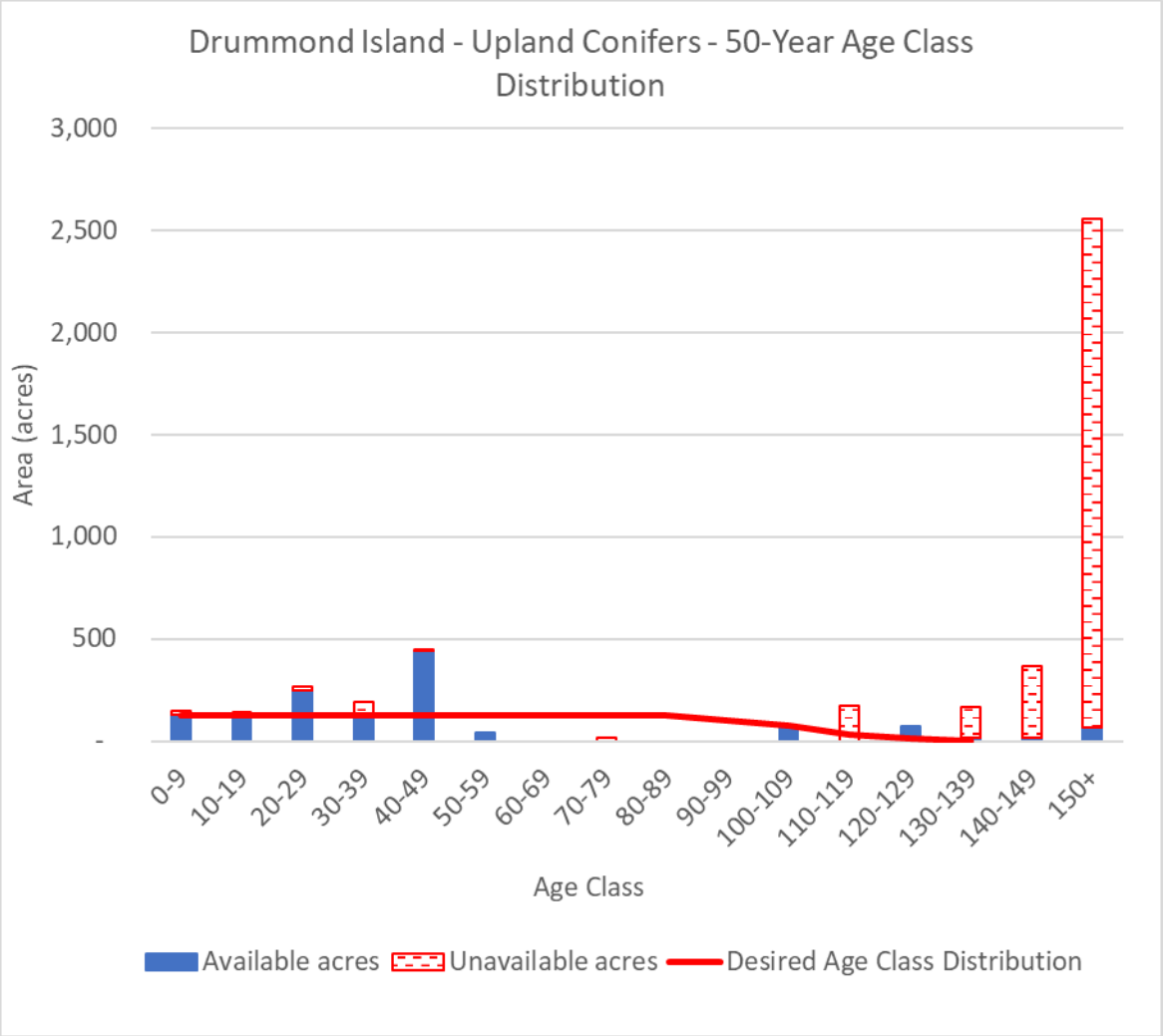


Figure 16. Projected midterm age-class distribution at the end of the fifth planning period compared to the long-term desired age-class distribution.

The long-term achievement of the desired age-class distribution (Figure 17) will concentrate on the manageable acres of upland conifer cover type in productive growing conditions while providing an even flow of forest products and a wide variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest.



Figure 17. Projected long-term age-class distribution at the end of the 10th planning period compared to the long-term desired age-class distribution.

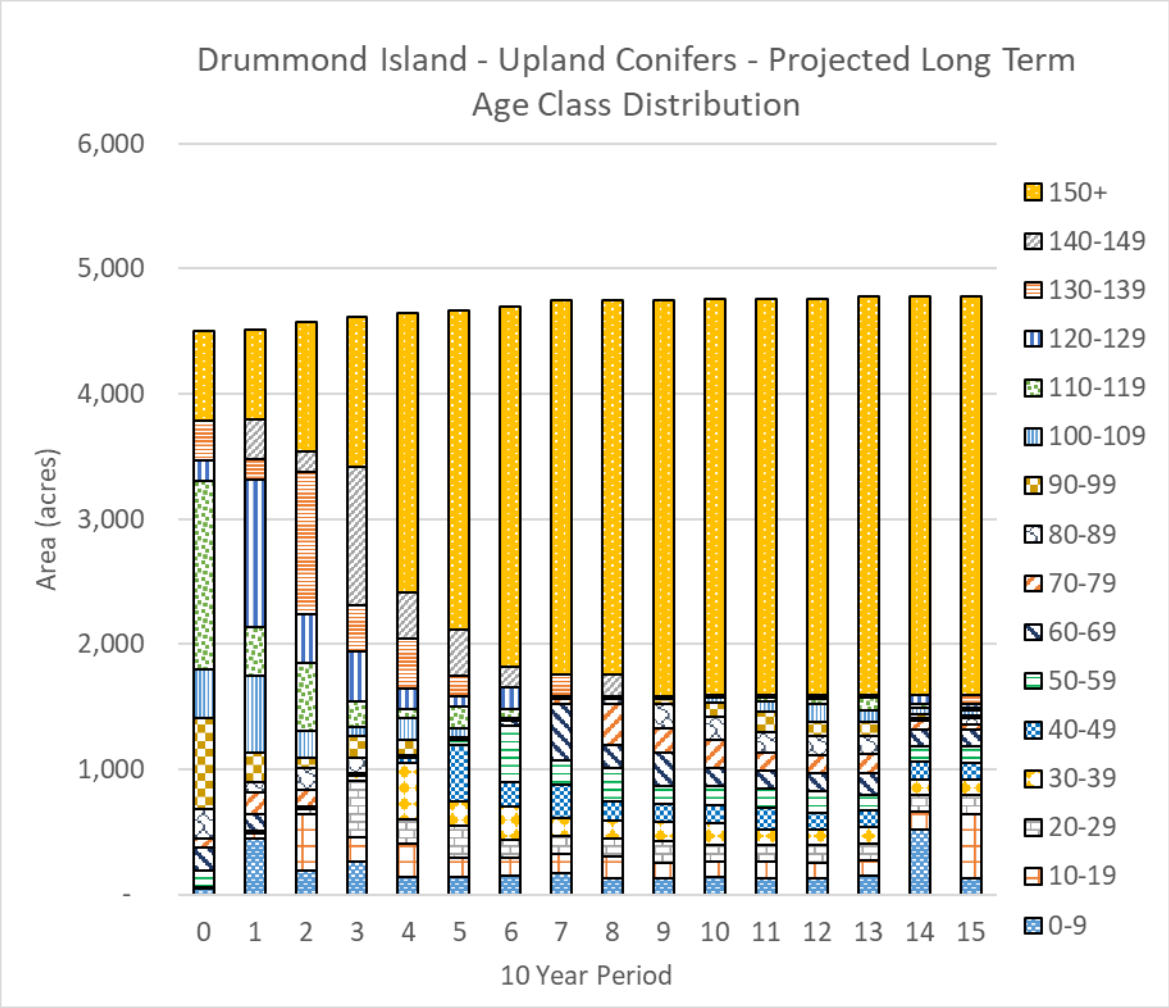


Figure 18. Projected age-class distribution for all acres of upland conifers over the next 150 years.

Management actions

There are 729 acres of clearcut harvest and 201 acres of shelterwood harvest projected in the upland conifer cover type during the planning period. This is above the desired establishment of 123 acres of upland conifer per decade because of the current unbalanced age-class condition and abundance of the cover type currently in older age classes like the 110-119 stand age.

Conservation Area Network

High conservation value areas

There are up to nine different HCVA types that can be found in each management area (Table 12; see Biodiversity in Section 3 for more information).

Table 12. High conservation value areas within the management area.

High Conservation Value Area Type and Name	Acres
Coastal environmental area	**141**
	141
Deer wintering complex	**14,340**
	14,340
Forest habitat core interior	**3,137**
	3,137
Grouse Enhanced Management Site (GEMS)	**2,847**
Drummond	2,847
Grand Total	**20,464**

Ecological reference areas

Ecological reference areas are a type of high conservation value area and are higher-quality examples of functioning ecosystems that are primarily influenced by natural ecological processes.

Table 13. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 14. Ecological reference areas within the management area.

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	Number of Occurrences
Existing ERA	Alvar	A	G2?	S1	2
Existing ERA	Alvar	B	G2?	S1	1
Existing ERA	Boreal forest	B			1
Existing ERA	Boreal forest	B	GU	S3	2
Existing ERA	Boreal forest	C	GU	S3	1
Existing ERA	Dry northern forest	BC	G3?	S3	1

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	Number of Occurrences
Existing ERA	Great Lakes marsh	BC	G2	S3	1
Existing ERA	Great Lakes marsh	C	G2	S3	1
Existing ERA	Limestone bedrock glade	AB	G2G4	S2	1
Existing ERA	Limestone bedrock glade	B			1
Existing ERA	Limestone bedrock glade	B	G2G4	S2	1
Existing ERA	Limestone bedrock glade	C	G2G4	S2	2
Existing ERA	Limestone bedrock lakeshore	A	G3	S2	2
Existing ERA	Limestone bedrock lakeshore	AB			2
Existing ERA	Limestone bedrock lakeshore	AB	G3	S2	1
Existing ERA	Limestone cliff	A	G4G5	S2	1
Existing ERA	Limestone cobble shore	A			1
Existing ERA	Limestone cobble shore	AB	G2G3	S3	2
Existing ERA	Limestone cobble shore	BC	G2G3	S3	1
Existing ERA	Mesic northern forest	BC	G4	S3	1
Existing ERA	Northern fen	C	G3	S3	1
Existing ERA	Northern shrub thicket	AB	G4	S5	2
Existing ERA	Northern wet meadow	AB	G4G5	S4	1
Existing ERA	Sinkhole	AB			1
Proposed ERA	Boreal forest	B	GU	S3	1
Proposed ERA	Limestone bedrock glade	C	G2G4	S2	1
Proposed ERA	Limestone cobble shore	B	G2G3	S3	1
Grand Total					**34**

Special conservation areas

Reviewable special conservation areas (Table 15) are those SCA types that may be reviewed or updated through the compartment review process as needed. Static SCAs (Table 16) are those SCA types that generally do not change or require updating (see Biodiversity in Section 3 for more information).

Table 15. Reviewable special conservation areas within the management area.

Reviewable Special Conservation Area Type and Name	Acres
Habitat area or habitat corridor	**4,997**
Maxton Plains: Alvar and associated natural communities	4,449
Drummond Island Shoreline Integrity Area	549
Mineral resource area	**7**
Chippewa County Road Commission	7

Reviewable Special Conservation Area Type and Name	Acres
Grand Total	**5,004**

Table 16. Static special conservation areas within the management area.

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Designated Trout and Coldwater Stream Buffer		**17**
--		5
Kemp Creek		12
Designated Trout and Coldwater Streams	**0.6**	
--	0.2	
Kemp Creek	0.4	
Great Lakes Islands		**47,705**
Crab Island		4
Drummond Island		47,699
--		2
Important Bird Areas		**25**
Lower St. Mary's River and Potagannissing Bay		25
Nondedicated Natural Areas		**2,080**
Natural Area Maxton Plains - Middle		5
Natural Area Maxton Plains Natural Area -1		752
Natural Area Maxton Plains Natural Area - 2		1,323
Grand Total	**0.6**	**49,826**

Rare species

Rare species occurrences are compiled from the Michigan Natural Features Inventory biotics database (Table 18 and Table 20) and do not necessarily include all rare species found in this management area due to biases in survey effort and verifiable observation reporting over time.

Table 17. Rare animal species conservation status key.

Status	Status
E = endangered	LE = listed endangered
T = threatened	LT = listed threatened
SC = special concern	PDL = proposed for delisting

Table 18. Rare animal species occurrence within the Drummond Island Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Auridius sandaraca	Sanders' golden leafhopper	SC	--	1

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Botaurus lentiginosus	American bittern	SC	--	6
Animal	Canis lupus	Gray wolf	SC	LE	1
Animal	Chlidonias niger	Black tern	T	--	1
Animal	Circus hudsonius	Northern harrier	SC	--	2
Animal	Coturnicops noveboracensis	Yellow rail	T	--	1
Animal	Dichagyris reliqua	The relic	SC	--	2
Animal	Elliptio complanata	Eastern elliptio	SC	--	1
Animal	Euconulus alderi	A land snail (no common name)	T	--	1
Animal	Gavia immer	Common loon	T	--	3
Animal	Haliaeetus leucocephalus	Bald eagle	SC	--	10
Animal	Lasmigona compressa	Creek heelsplitter	SC	--	1
Animal	Mediappendix exilis	Pleistocene catinella	T	--	1
Animal	Myotis lucifugus	Little brown bat	T	--	1
Animal	Opheodrys vernalis	Smooth green snake	SC	--	1
Animal	Pandion haliaetus	Osprey	SC	--	9
Animal	Tympanuchus phasianellus	Sharp-tailed grouse	SC	--	1
Animal	Vallonia gracilicosta albula	A land snail (no common name)	E	--	3
Animal	Vertigo cristata	Crested vertigo	SC	--	1
Animal	Vertigo elatior	Tapered vertigo	SC	--	4
Animal	Vertigo hubrichti	Hubricht's vertigo	E	--	2
Animal	Vertigo nylanderi	Deep-throat vertigo	E	--	1
Animal	Vertigo paradoxa	Mystery vertigo	SC	--	1
Animal	Vertigo pygmaea	Crested vertigo	SC	--	1
Total	--	--	--	--	**56**

Table 19. Rare plant species conservation status key.

Plant Species Status	Plant Species Status
E = endangered	LE = listed endangered
T = threatened	LT = listed threatened
SC = special concern	PDL = proposed for delisting

Table 20. Rare plant species occurrence within the Drummond Island Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Plant	Adlumia fungosa	Climbing fumitory	T	--	1
Plant	Asplenium ruta-muraria	Wall-rue	E	--	1
Plant	Asplenium viride	Green spleenwort	SC	--	2
Plant	Astragalus neglectus	Cooper's milk vetch	SC	--	5
Plant	Calypso bulbosa	Calypso or fairy-slipper	T	--	5
Plant	Carex richardsonii	Richardson's sedge	SC	--	8
Plant	Carex scirpoidea	Bulrush sedge	T	--	4
Plant	Cerastium brachypodum	Shortstalk chickweed	T	--	1
Plant	Cirsium hillii	Hill's thistle	SC	--	16
Plant	Cypripedium arietinum	Ram's head lady's-slipper	SC	--	2
Plant	Eleocharis compressa	Flattened spike rush	T	--	5
Plant	Geum triflorum	Prairie smoke	T	--	1
Plant	Graphephorum melicoides	Purple false oats	SC	--	1
Plant	Gymnocarpium robertianum	Limestone oak fern	T	--	3
Plant	Panicum philadelphicum	Philadelphia panic-grass	E	--	1
Plant	Pellaea atropurpurea	Purple cliff brake	T	--	2
Plant	Platanthera unalascensis	Alaska orchid	SC	--	13
Plant	Poa alpina	Alpine bluegrass	T	--	1
Plant	Poa interior	Inland bluegrass	SC	--	1
Plant	Pterospora andromedea	Pine-drops	T	--	4
Plant	Scutellaria parvula	Small skullcap	T	--	3
Plant	Solidago houghtonii	Houghton's goldenrod	T	LT	2
Plant	Sporobolus heterolepis	Prairie dropseed	SC	--	4
Plant	Trichostema brachiatum	False pennyroyal	T	--	2
Plant	Trisetum spicatum	Downy oat-grass	SC	--	1
Total	--	--	--	--	**89**

Non-ecological reference area natural communities

Natural communities that are identified with an element occurrence in the MNFI Biotics database, but that have not been given an additional ecological reference area designation, are recognized and managed accordingly (Table 22).

Table 21. Non-ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 22. Non-ecological reference areas within the management area.

Community Type	Element Occurrence Rank	State Rank	Global Rank	Number of Occurrences
Mesic northern forest	C	S3	G4	2
Grand Total				**2**

Forest health

Forest health concerns, both native and non-native, can have impacts on stand conditions and management decisions. The following insects (Table 23) and diseases (Table 24) could have an impact on management during the planning period and may need to be monitored and/or addressed.

Table 23. Defoliating insects of concern in the Drummond Island Management Area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Spongy moth	Lymantria dispar dispar	Non-native	Yes
Forest tent caterpillar	Malacosoma disstria	Native	Yes
Large aspen tortrix	Choristoneura conflictana	Native	Yes
Spruce budworm	Choristoneura fumiferana	Native	Yes

Table 24. Maladies of concern in the Drummond management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Canker (stem infections)	Nectria cinnabarina	Native	Yes
Wood decay	various	Mostly native	Yes

Aquatic resources

Riparian habitat

A total of 11 miles of streams and rivers are found in the management area (Table 25). Streams/rivers classified as warm types comprise approximately 100% of the riverine mileage.

Table 25. Classification type and length of streams/rivers found within the management area.

Type	Length (miles)
Cold stream	0
Cold small river	0
Cold transitional stream	0
Cold transitional small river	0
Cold transitional large river	0
Warm transitional stream	11
Warm transitional small river	0
Warm transitional large river	0
Warm stream	0
Warm small river	0
Warm large river	0

Lacustrine habitat

A total of 41 lakes and ponds of at least 1 surface acre are found in the management area (Table 26).

Table 26. Size and number of lakes and ponds located within the management area.

Lake Size Class (acres)	Number
1-99	30
100-499	11
500+	0

Wetlands

A total of 13,532 acres of wetlands are found in the management area (Table 27). Forested wetlands comprise approximately 88% of wetland types found in the management area.

Table 27. Area of emergent, forested and riverine wetland types found within the management area.

Wetland Type	Acres
Emergent	1,628

Wetland Type	Acres
Forested	11,888
Riverine	16

Vernal pools and seeps

A total of 855 acres of vernal pools and seeps have been inventoried in the management area, while 33 acres of seeps have been identified.

Riparian vegetation cover

Cedar, marsh and aspen are the predominant cover types present in a 100-meter riparian zone located next to streams/rivers in the management area (Table 28).

Table 28. Largest vegetative cover types (i.e., top 10) and area located in a 100-meter buffer of streams/rivers within the management area.

Cover type	Acres
Cedar	1,143
Marsh	1,138
Aspen	919
Upland conifers	707
Northern hardwood	487
Lowland shrub	376
Upland mixed forest	241
Lowland mixed forest	158
Lowland aspen/balsam poplar	107
Lowland conifers	84

Watershed vegetation cover

The management area includes small watersheds with short portions of streams/rivers that all drain into Lake Huron. Marsh and cedar are major cover types of the state forest.

Recreation

Drummond Island is accessed primarily via car ferry from DeTour, with air service also available. Most of the island is accessible by roads and trails, except for the Maxton Plains, where access is intentionally limited to protect sensitive habitats. Recreational facilities include a comprehensive system of motorized trails, including off-road vehicle and snowmobile trails (Table 29).

There are no designated nonmotorized trails or state campgrounds on the island, although dispersed recreation is popular, and there are several private resorts providing accommodation for visitors.

Table 29. Designated recreation trails by use type.

Recreation Category	Recreation Type	Number of Miles
Motorized recreation trails	Off-road vehicle (all types) Snowmobile	82.6 45.7
Non-motorized recreation trails	Hiking Equestrian Biking Hunter access trails	0 0 0 12.3
Total		**140.6**

Note: Trail use types may overlap.

The Drummond Grouse Enhanced Management Site on the north side of the island provides a walk-in area managed for grouse, with approximately 12 miles of hunter access trails.

This island is popular for deer, grouse and bear hunting, trapping, fishing, bird-watching, plant study, coastal paddling and motorboating. Protecting rare and unique resources from excessive or unauthorized use and working with partners to ensure recreational activities are compatible with wildlife habitat and resource protection are important.

Table 30. Areas managed for hunting.

Type	Name	Number of Acres
Grouse Enhanced Management Site	Drummond GEMS	2,842.7

Table 31. Boating access sites.

Name	Body of water
Potagannissing Flooding	First Lake

EUP management areas

Escanaba Lake and Till Plain

State forest area: 49,046 acres	Location: Lakeshore of the central Upper Peninsula	Population centers: Manistique Garden
Subsection: Escanaba Lake Plain and Thin Till	Landforms: Beach ridges and swales Flat lake beds Shallow embayments Parabolic dune fields	Land cover: Forested: 40,588 acres Nonforested: 8,459 acres

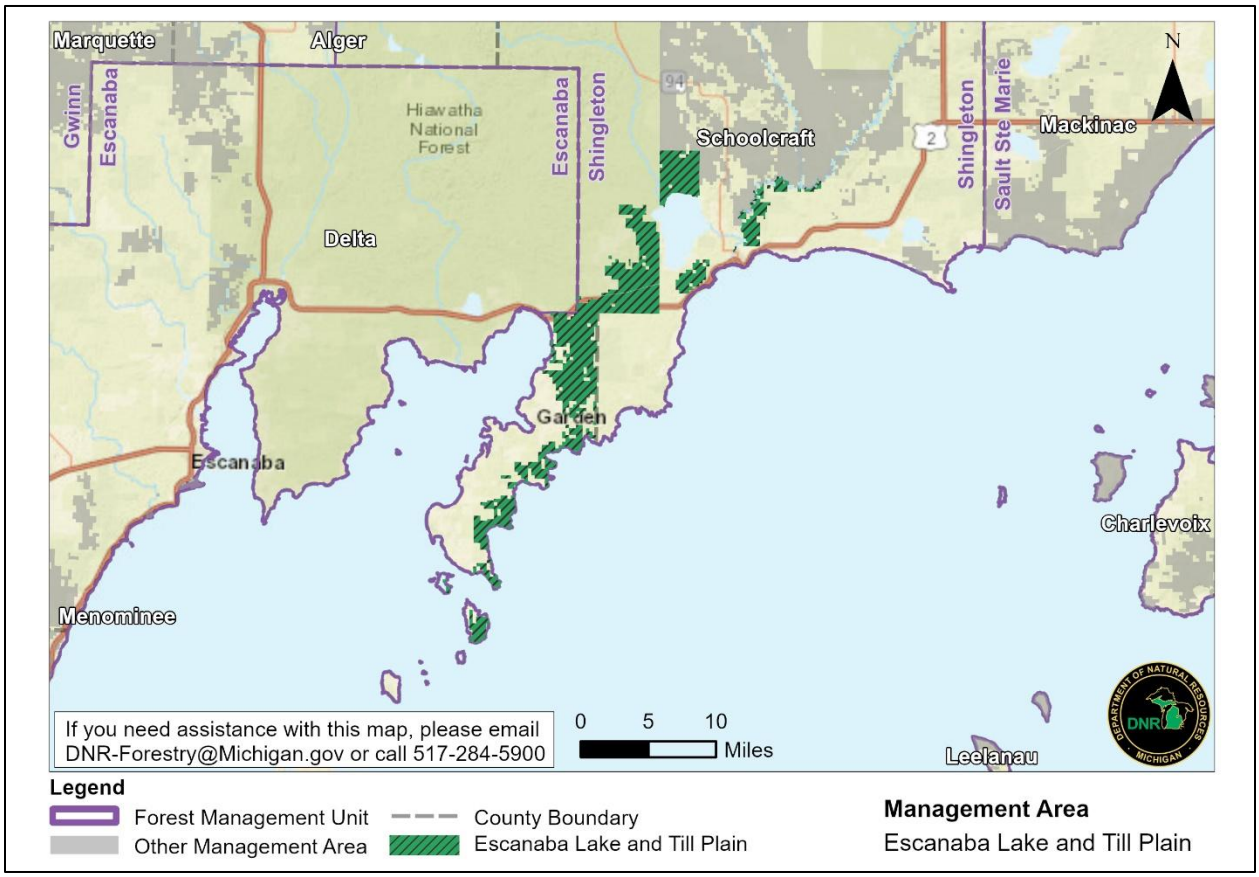


Figure 1. Escanaba Lake and Till Plain Management Area.

Forested landscape

Current and projected future condition

The Escanaba Lake and Till Plain Management Area includes a variety of tolerance levels occurring across all age categories. Most tolerant cover types occur on unavailable lowlands in the old age category. Mid-tolerant cover types mostly occur on available uplands in the mid-aged and mature age categories, while most of the intolerant cover types occur in the young, mid-aged and mature category on available uplands (Figure 2).

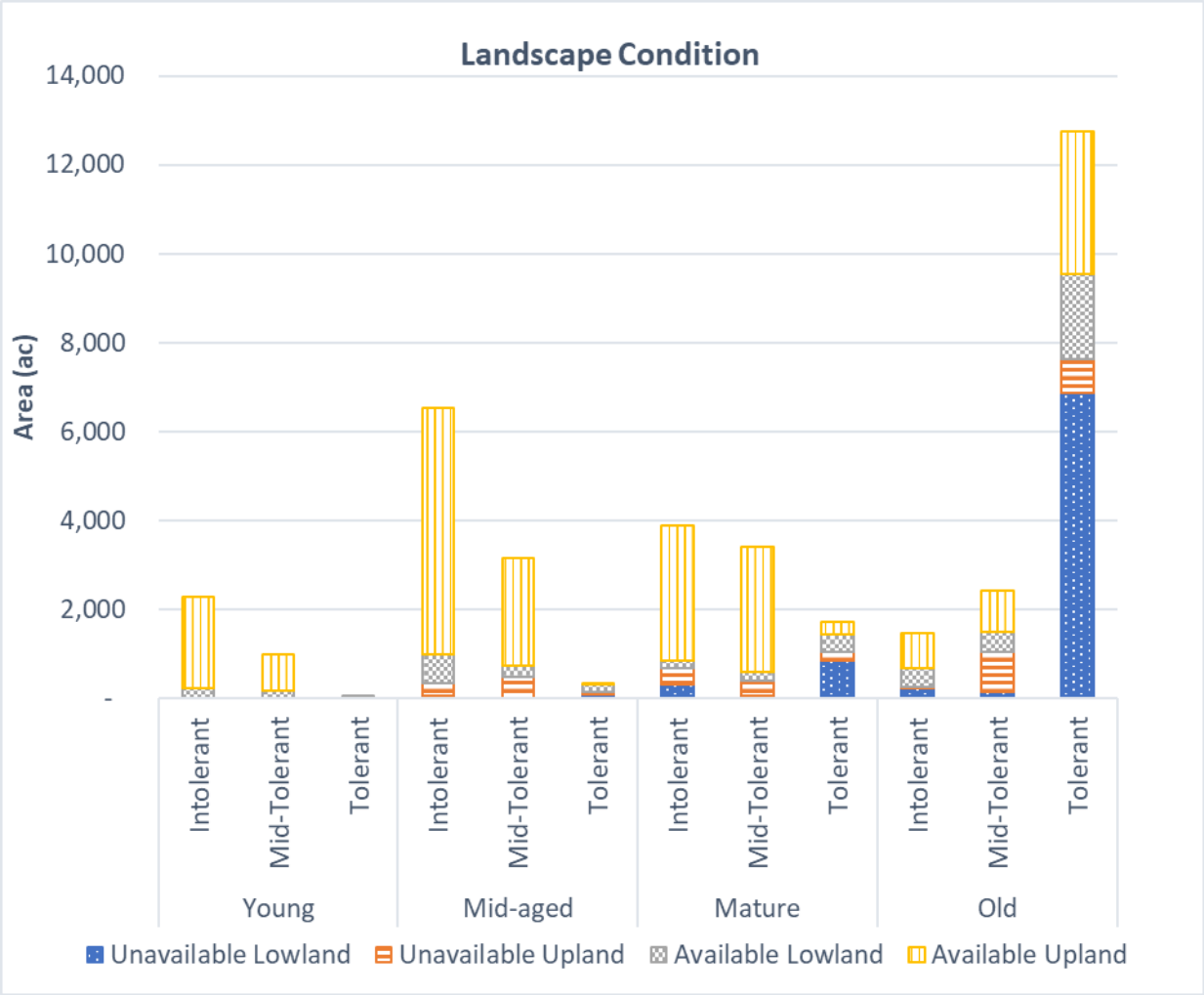


Figure 2. Forest diversity matrix showing the current distribution of forested acres across management availability, age category, landscape position and shade tolerance.

Landscape habitat conditions refine the management area landscape into featured species habitat context. Current and projected acres for the metrics identified in the management priorities (see Section 3) establish a baseline and future condition based on management over the planning period (Table 1).

Table 1. Current acres for landscape habitat conditions.

Landscape Habitat Condition	Monitoring Metric	Current Acres
Young forest	Acres of 0- to 19-year stands in aspen and jack pine	2,023
Mature forest	Acres of 80-plus-year stands across cover types	4,278
Mature forest	Acres of 120-plus-year stands across cover types	484
Mesic conifer cover types	Acres of mesic conifer cover types	5,163
Mesic conifers in other cover types	Average canopy occupancy	35%
Mast – oak cover types	Acres of oak cover types	794
Mast tree species in other cover types	Acres of total canopy occupancy of mast tree acres (trace-100%)	9,635
Big trees	Acres of total canopy stand occupancy of species in sawlog or greater size class	14,206
Nonforested openings	Acres of total herbaceous open land, upland shrub and crop land	1,529
Landscape forest matrix	Percent deciduous forest	41%
Landscape forest matrix	Percent coniferous forest	54%

Another important landscape-level habitat in the management area is coastal habitat. The Great Lakes, particularly coastal and nearshore areas, provide globally or continentally important stopover sites for all groups of migratory birds: waterfowl, shorebirds, land birds (defined here as songbirds and raptors) and waterbirds (loons, grebes, cormorants, herons, rails, cranes, gulls and terns) (Ewert, et al., 2012). The Great Lakes shoreline provides essential stopover habitat for birds to rest, feed and shelter during migration. In addition to migration habitat, the diverse coastal areas where water and land meet provide unique habitats for breeding birds. Some of these areas are classified by Michigan Audubon as important bird areas, or IBAs. The Great Lakes shoreline is habitat for several rare plant species that are endemic to the Great Lakes.

Forest management and other intrusive activities within a mile of the coastline need to consider the potential impacts to migratory birds and breeding bird habitat.

The Escanaba Lake and Till Plain Management area has the following special analysis units. These SAUs have specific cover-type goals, typically associated with wildlife habitat management. For any SAUs that overlap with this management area, SAU cover-type goals take priority. Please see Section 5 for a detailed description of the management direction and harvest goals for each of these SAUs.

- Deer wintering complex – Indian Lake.
- Grouse Enhancement Management Site – Garden Glade.

The Escanaba Lake and Till Plain Management Area is comprised of 83% forested cover types and 17% nonforested cover types. Of the forested cover types, 65% occur in the upland landscape position and 35% occur on lowland landscape positions. The largest contributors to upland cover types are aspen, northern hardwoods and upland conifers. Lowland conifer and cedar cover 21% of the management area. Marsh and lowland shrub are the most common nonforested cover types in the management area, representing 10% of the landscape.

Table 2. Current landscape context and distribution of cover types.

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
Forested	Upland	Deciduous	Aspen	9,439	15,353	26,522	40,588
			Northern hardwood	4,075			
			Black/red hybrid oak	0			
			Northern red oak	539			
			Oak mix	312			
			Mixed upland deciduous	987			
		Mixed	Upland mixed forest	1,081	1,081		
		Coniferous	Planted red pine	2,871	10,089		
			Planted jack pine	340			
			Planted white pine	0			
			Planted mixed pine	185			
			Natural red pine	261			
			Natural jack pine	1,270			
			Natural white pine	173			
			Natural mixed pines	423			
			Upland spruce/fir	968			
			Upland conifers	3,378			
			Hemlock	221			
	Lowland	Deciduous	Lowland aspen/balsam poplar	890	1,367	14,065	
			Lowland deciduous	478			
		Mixed	Lowland mixed forest	924	924		
		Coniferous	Cedar	7,501	11,774		
			Lowland conifers	2,972			
			Lowland spruce/fir	1,047			
			Tamarack	253			
Nonforested	Upland	N/A	Herbaceous open land	1,443	N/A	2,239	8,459
			Upland shrub	86			
			Low density trees	56			
			Bare/sparsely vegetated	350			
			Cropland	0			
			Urban	304			
	Lowland	N/A	Lowland shrub	2,165	N/A	6,220	
			Marsh	2,917			
			Bog	77			
			Treed bog	255			
			Water	806			
						Grand Total:	49,046

There are 28,537 acres (70% of the total management area and 70% of the forested area) that can be managed toward desired future conditions via commercial timber harvest in the Escanaba Lake and Till Plain Management Area. Acres unavailable for management are categorized by site condition. Of those, over 22% are in the aspen cover type, 8% in northern hardwoods and 7% in planted red pine. The remaining cover types represent less than 5% each of the forested and available land in the management area.

Table 3. Current cover type composition by management availability.

ESCANABA LAKE AND TILL PLAIN Forested Cover Type	Available Acres	Available %	Unavailable Acres	Unavailable %	Total Acres	Total %
Aspen	9,182	22.6%	257	0.6%	9,440	23.3%
Cedar	1,394	3.4%	6,107	15.0%	7,501	18.5%
Hemlock	91	0.2%	130	0.3%	221	0.5%
Lowland aspen/balsam poplar	833	2.1%	58	0.1%	891	2.2%
Lowland conifers	1,246	3.1%	1,727	4.3%	2,973	7.3%
Lowland deciduous	344	0.8%	135	0.3%	478	1.2%
Lowland mixed forest	839	2.1%	86	0.2%	924	2.3%
Lowland spruce/fir	695	1.7%	352	0.9%	1,047	2.6%
Mixed upland deciduous	854	2.1%	133	0.3%	987	2.4%
Natural mixed pines	409	1.0%	14	0.0%	423	1.0%
Natural red pine	253	0.6%	7	0.0%	261	0.6%
Natural white pine	154	0.4%	19	0.0%	173	0.4%
Northern hardwood	3,218	7.9%	858	2.1%	4,076	10.0%
Northern red oak	539	1.3%	0	0.0%	539	1.3%
Tamarack	38	0.1%	215	0.5%	253	0.6%
Upland conifers	1,965	4.8%	1,413	3.5%	3,378	8.3%
Upland mixed forest	927	2.3%	153	0.4%	1,081	2.7%
Upland spruce/fir	586	1.4%	383	0.9%	968	2.4%
Grand total	**28,537**	**70.3%**	**12,055**	**29.7%**	**40,592**	**100.0%**

Table 4. Site conditions for unavailable acres.

Site Condition (Reason area is unavailable for commercial harvest)	Area (ac)	% of Unavailable Area
Conservation values	4,135	34.3%
Deer wintering area	3,971	32.9%
Wildlife concerns	1,084	9.0%
Cannot regenerate	811	6.7%

Site Condition (Reason area is unavailable for commercial harvest)	Area (ac)	% of Unavailable Area
BMPs	765	6.3%
Rare landforms	325	2.7%
Too wet	217	1.8%
Blocked by obstacle	216	1.8%
Species of special concern or T&E	203	1.7%
Unproductive	172	1.4%
Long-term retention	36	0.3%
Recreational/scenic	28	0.2%
Nonmilitary lease/easement	24	0.2%
Total unavailable	**12,055**	**100.0%**

Projected 10-year cover type management actions

Each cover type in the Escanaba Lake and Till Plain Management Area has unique age class and basal area class goals that describe the long-term desired future conditions. The calculated harvest levels that are needed during the first 10-year planning period are summarized in Table 5. These harvests will help establish a desirable amount of regeneration for the even-aged cover types over the 10-year period or help to achieve desired basal area distribution among uneven-aged cover types like northern hardwoods. These harvest levels are necessary to begin achieving long-term planning goals. Implementing these silvicultural regimes will yield 78,456 cords, the planned harvest volume for the decade (Table 6).

Table 5. Ten-year planning period harvest goals (acres) by cover type and silvicultural regime.

Silvicultural Regimes								
Cover Type	**Clearcut**	**Selection**	**Thinning**	**Group Selection**	**Shelterwood**	**Salvage Clearcut**	**Salvage Thinning**	**Grand Total**
Aspen	1,634	-	-	-	-	-	-	1,634
Northern hardwood	-	1,076	-	53	-	-	-	1,129
Planted red pine	233	-	559	-	-	-	-	793
Upland conifers	189	-	-	-	12	-	-	202
Lowland conifers	137	-	-	-	-	-	-	137
Lowland mixed forest	129	-	-	-	-	-	-	129
Mixed upland deciduous	103	6	-	-	6	-	-	115
Upland spruce/fir	107	-	-	-	-	-	-	107
Lowland spruce/fir	71	-	-	-	-	-	-	71
Lowland aspen/balsam poplar	56	-	-	-	-	-	-	56
Oak mix	51	-	-	-	-	-	-	51
Totals	**2,747**	**1,082**	**578**	**53**	**34**	**-**	**-**	**4,494**

Table 6. Projected 10-year harvest volume by product and species.

10-Year Estimated Harvest Volume Projection Escanaba Lake and Till Plain Management Area			
Product	**Species**	**Volume Planned***	**Volume Prepared****
Pulpwood (cords)	Mixed aspen	14,796	13,909
	Mixed hardwood	12,710	11,947
	Mixed softwood	6,626	6,228
	Red pine	4,705	4,423
	Mixed spruce	3,669	3,449
	White pine	1,803	1,695
	Mixed oak	644	606
	Jack pine	569	535
	Pulpwood total	**45,524**	**42,793**
Sawtimber (MBF)	Red pine	5,156	4,846
	Sugar maple	3,188	2,997
	White pine	2,777	2,610
	Mixed aspen	2,752	2,587
	Red maple	2,424	2,279
	Red oak	1,188	1,117
	Basswood	356	334
	White oak	155	145
	Mixed oak	46	43
	Sawtimber total	**18,041**	**16,958**
	Total sawtimber harvest volume in cords	**37,940**	**35,663**
	Grand total harvest volume in cords	**83,464**	**78,456**
* Volume estimates based on 100% of the projected harvests for the 10-year planning period. ** Volume estimates based on 94% of the projected harvests for the 10-year planning period accounting for reduction in acres and associated volume once sales are prepared for bid.			

There are very few significant cover-type transitions projected for the Escanaba Lake and Till Plain Management Area (Table 7). The managed area of each cover type is projected to remain stable, as treatment regimes will not significantly change the amount of area in each cover type. The largest decreases forecasted are in the lowland spruce/fir and upland spruce/fir cover types, where 73 and 59

acres, respectively, will convert to other cover types through forest management and regeneration activities. The largest increase occurs in the lowland mixed forest type, where 110 acres are projected to convert into this cover type.

Table 7. Projected 10-year cover type acres resulting from cover type transitions.

Cover Type	Current Acreage	Projected Acreage at End of 10-Year Planning Period	Projected 10-Year Change in Acreage
Aspen	9,439	9,444	5
Cedar	7,501	7,501	0
Northern hardwood	4,075	4,086	11
Upland conifers	3,378	3,381	3
Lowland conifers	2,972	2,969	-3
Planted red pine	2,871	2,856	-16
Upland mixed forest	1,081	1,131	50
Lowland spruce/fir	1,047	1,026	-21
Mixed upland deciduous	987	988	1
Upland spruce/fir	968	914	-54
Lowland mixed forest	924	915	-9
Lowland aspen/balsam poplar	890	902	12
Northern red oak	539	539	0
Lowland deciduous	478	500	22
Planted jack pine	340	340	0
Oak mix	312	312	0
Natural red pine	261	261	0
Natural jack pine	1,270	1,270	0
Natural mixed pines	423	423	0
Tamarack	253	252	-1
Hemlock	221	221	0
Planted mixed pine	185	184	-1
Natural white pine	173	173	0
Marsh	2,917	2,917	0
Lowland shrub	2,165	2,165	0
Herbaceous open land	1,443	1,443	0
Water	806	806	0
Bare/sparsely vegetated	350	350	0
Treed bog	255	255	0
Upland shrub	86	86	0
Bog	77	77	0

Cover Type	Current Acreage	Projected Acreage at End of 10-Year Planning Period	Projected 10-Year Change in Acreage
Low-density trees	56	56	0
Urban	304	304	0
Total:	**49,046**	**49,046**	**0**

Featured species current and projected habitat acres

There are nine featured species in this management area that span various cover types, age classes and stand-level conditions.

As noted in the featured species management priority (Section 3), it is recommended that these featured species habitat acres be viewed as acres of potential habitat, representing a condition on the landscape where the more nuanced aspects of each species' habitat requirements are likely to be found or managed for. As described in the introduction, the modeling effort was limited by several factors including the simplification of habitat attributes into MiFI variables. Therefore, when referring to habitat acres, these are potential habitat acres.

Current and projected total habitat acres by species across the decade provide a baseline and show the result of long-term management actions (Table 8). Some species show a loss in habitat over the next century. As mentioned in the featured species management priority (Section 3), the current condition for many cover types is a surplus of acres in the 0-9 age class from the compensatory management approach applied in the previous decade. The model eventually evens out the age classes at a lower, sustainable level over time, usually by 50 years. For any species with northern hardwoods as a priority cover type, there is a perceived drop in acres between 40 and 60 years; this is due to the basal area dropping below 81, but because it only drops into the upper 70s, it is not expected to translate into any real habitat loss on the ground. Three of these species were not included in the State Forest Management Plan model but are included here to inform management decisions over the decade.

Table 8. Featured species current and projected total habitat acres (i.e., potential habitat).

Featured Species	Priority Cover Types	Total Habitat Acres Current	10-Year Projected Habitat Acres	50-Year Projected Habitat Acres	100-Year Projected Habitat Acres
American woodcock	Aspen, lowland aspen, lowland deciduous	2,325	3,249	3,488	3,543
Black bear	Mast	9,635	--	--	--
Blackburnian warbler	Northern hardwoods, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, hemlock	4,410	5,055	4,331	7,549

Featured Species	Priority Cover Types	Total Habitat Acres Current	10-Year Projected Habitat Acres	50-Year Projected Habitat Acres	100-Year Projected Habitat Acres
Ruffed grouse	Aspen	2,139	3,087	3,102	3,159
Snowshoe hare	Aspen, cedar, hemlock, lowland aspen, lowland conifers, lowland mixed forest, lowland spruce/fir, mixed upland deciduous, natural jack pine, natural mixed pines, planted jack pine, upland spruce/fir	3,991	4,986	4,614	4,876
White-tailed deer (food)	Northern hardwood, oak mix, aspen, mixed upland deciduous, lowland deciduous, lowland aspen/balsam poplar, lowland mixed forest	18,725	18,815	19,387	19,907
White-tailed deer (shelter)	Hemlock, cedar, planted red pine, planted white pine, planted mixed pine, natural red pine, natural white pine, natural mixed pines, upland conifers, upland spruce fir, lowland conifers	20,000	19,911	19,372	18,843
Wild turkey	Nonforested openings	1,443	--	--	--
Wood turtle	Nonforested openings	--	--	--	--

Cover type composition and associated featured species

Aspen

Current condition

Most of the aspen cover type is currently in the 30- to 49-year-old age classes and has a surplus of acres (Figure 3). The past management regime has been primarily clearcut for this cover type. The younger age classes have a slight deficit in the 0- to 9-year age class and a larger deficit in the 10- to 19-year age class. The older age classes are near the desired age class distribution with little variation.

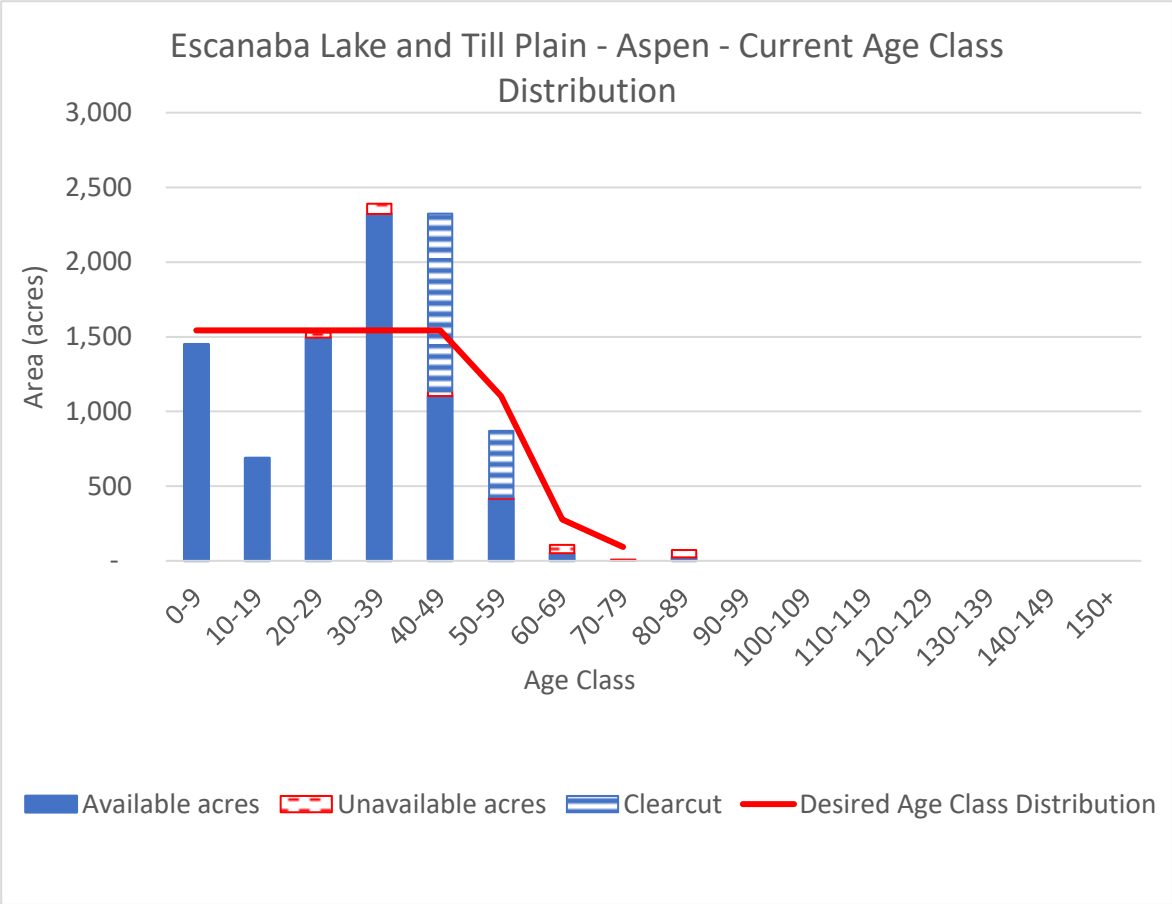


Figure 3. Current age class distribution and projected harvests in the aspen cover type in the Escanaba Lake and Till Plain Management Area.

Current conditions are a result of consistent commercial harvests and regeneration efforts on available aspen acres during the previous planning periods. A portion of this cover type meets the habitat requirements for ruffed grouse, American woodcock and snowshoe hare (Table 9).

Table 9. Featured species with aspen as a priority habitat cover type, habitat variables and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Aspen	Aspen Habitat Acres – Available	Aspen Habitat Acres – Unavailable
Ruffed grouse	Age category: 0-19 Size category: sapling	2,139	0
American woodcock	Age category: 0-19 Size category: sapling	2,139	0
Snowshoe hare	Age category: 0-19 Size category: sapling	2,139	0
White-tailed deer	All ages and size classes	9,439	--

Desired future condition

The projected long-term cover-type trend for aspen is stable in the Escanaba Lake and Till Plain Management Area. There are no transitions into or out of this cover type from other cover types forecasted in this management area.

The long-term goal for this cover type is balanced age classes between 0 and 40 years old for all available aspen stands in this management area. Maintaining lower acreage in old age classes continues to be desirable to ensure the aspen cover type is distributed within the desired age classes.

The end of the planning period will result in the establishment of 1,638 acres in the upcoming 0-9 age class. Progress toward the long-term age class distribution of aspen will take many decades in the management area (Figure 4).

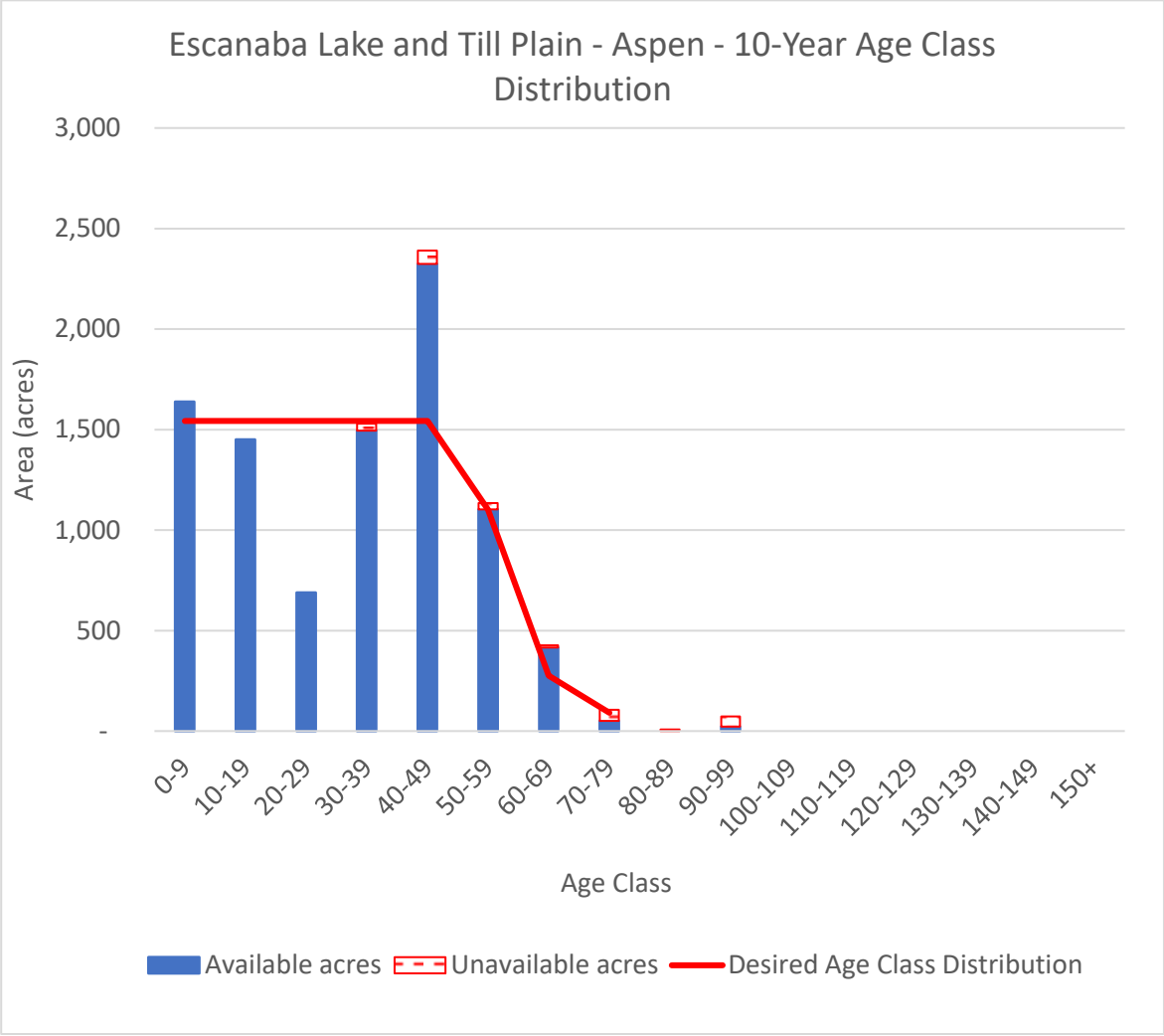


Figure 4. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The midterm age class distribution shows the population of aspen acres nearly reaching the desired future condition, with only a few age classes deviating from the target proportions (Figure 5). As is often the case, an unbalanced condition in the first planning period can often result in the need to carry some acres slightly longer into older age classes to achieve the desired age class goals (Figure 5).

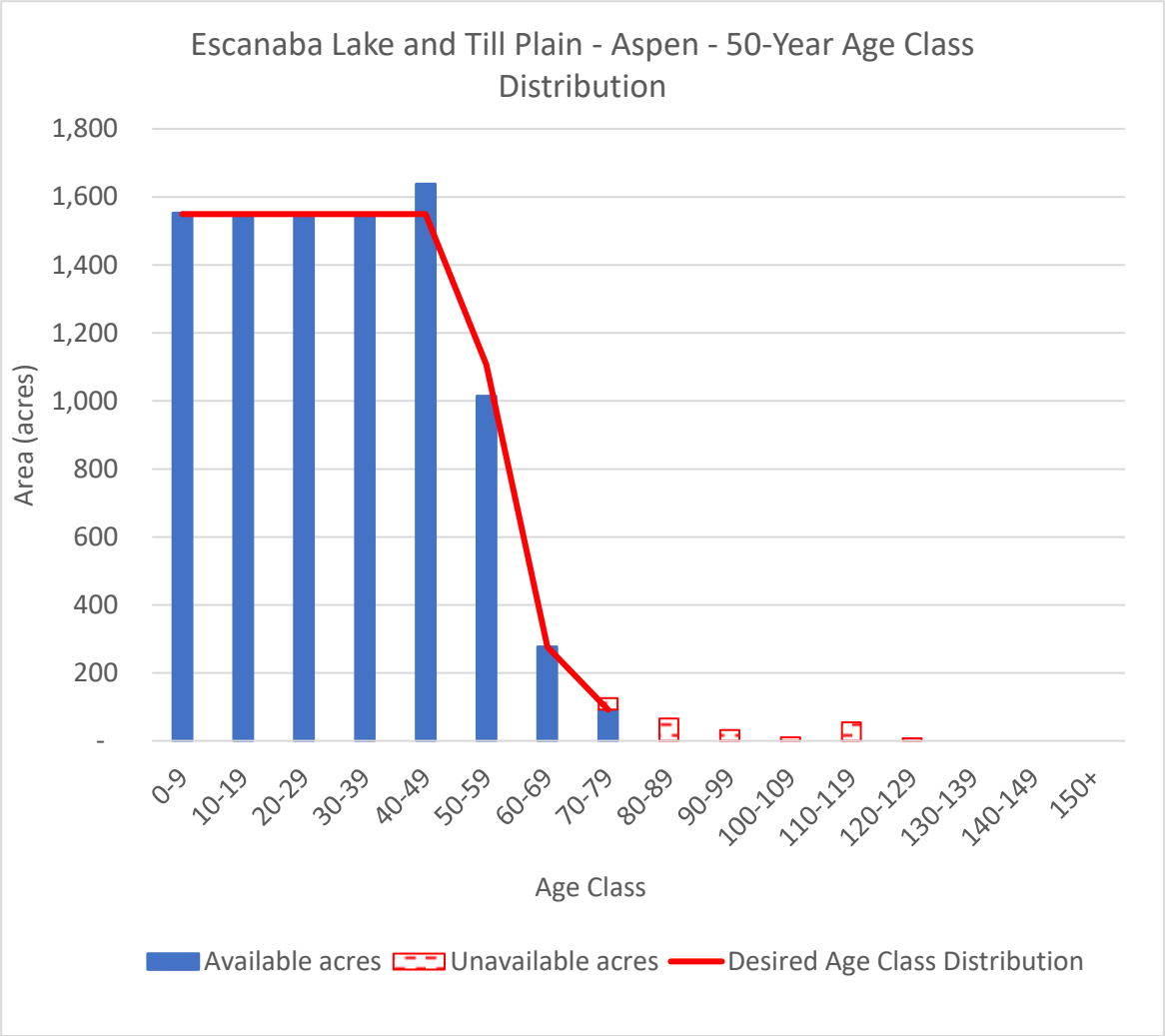


Figure 5. Projected midterm age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 6) will concentrate the manageable acres of aspen in productive growing conditions while providing an even flow of forest products and a wide variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest.

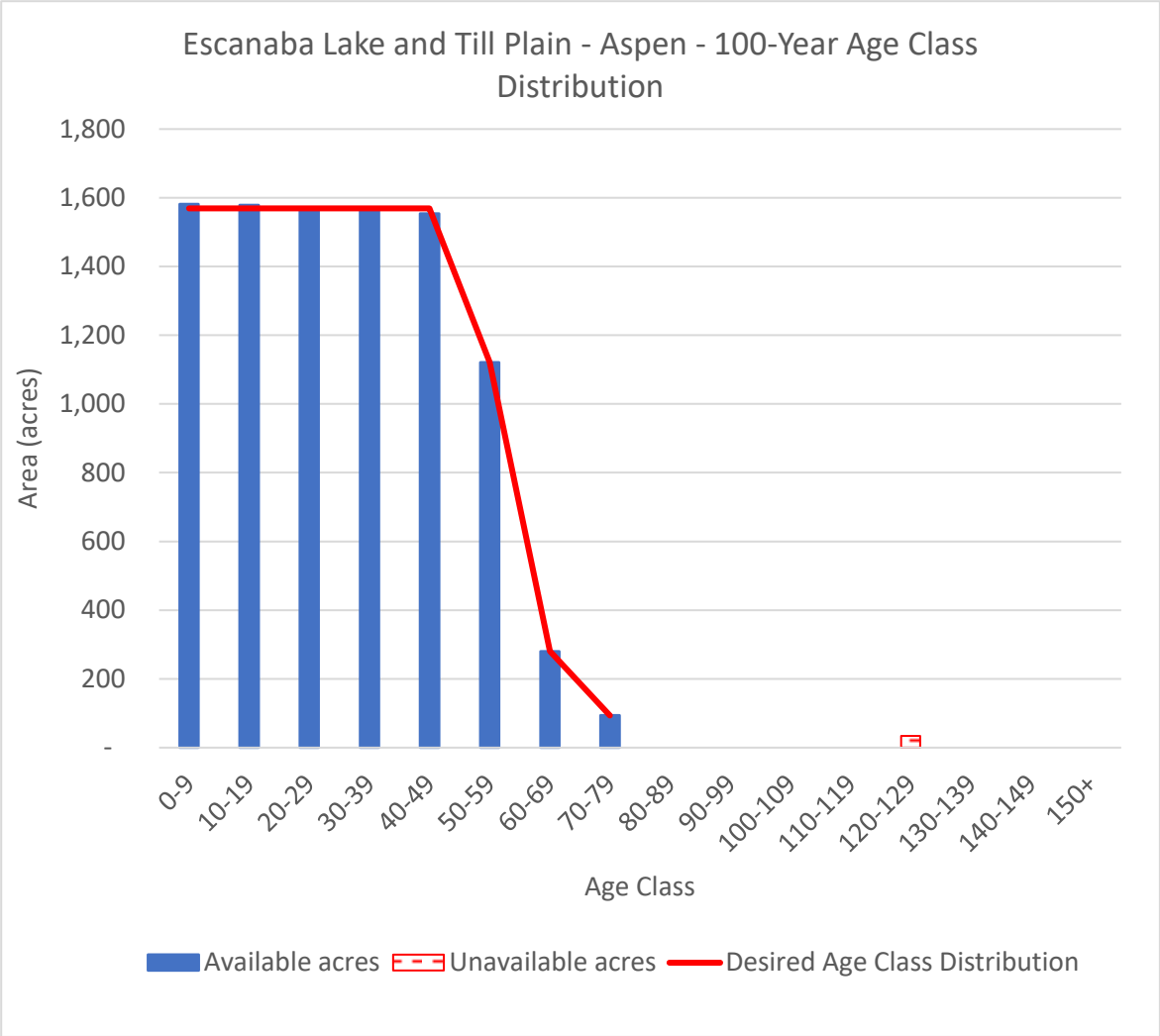


Figure 6. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

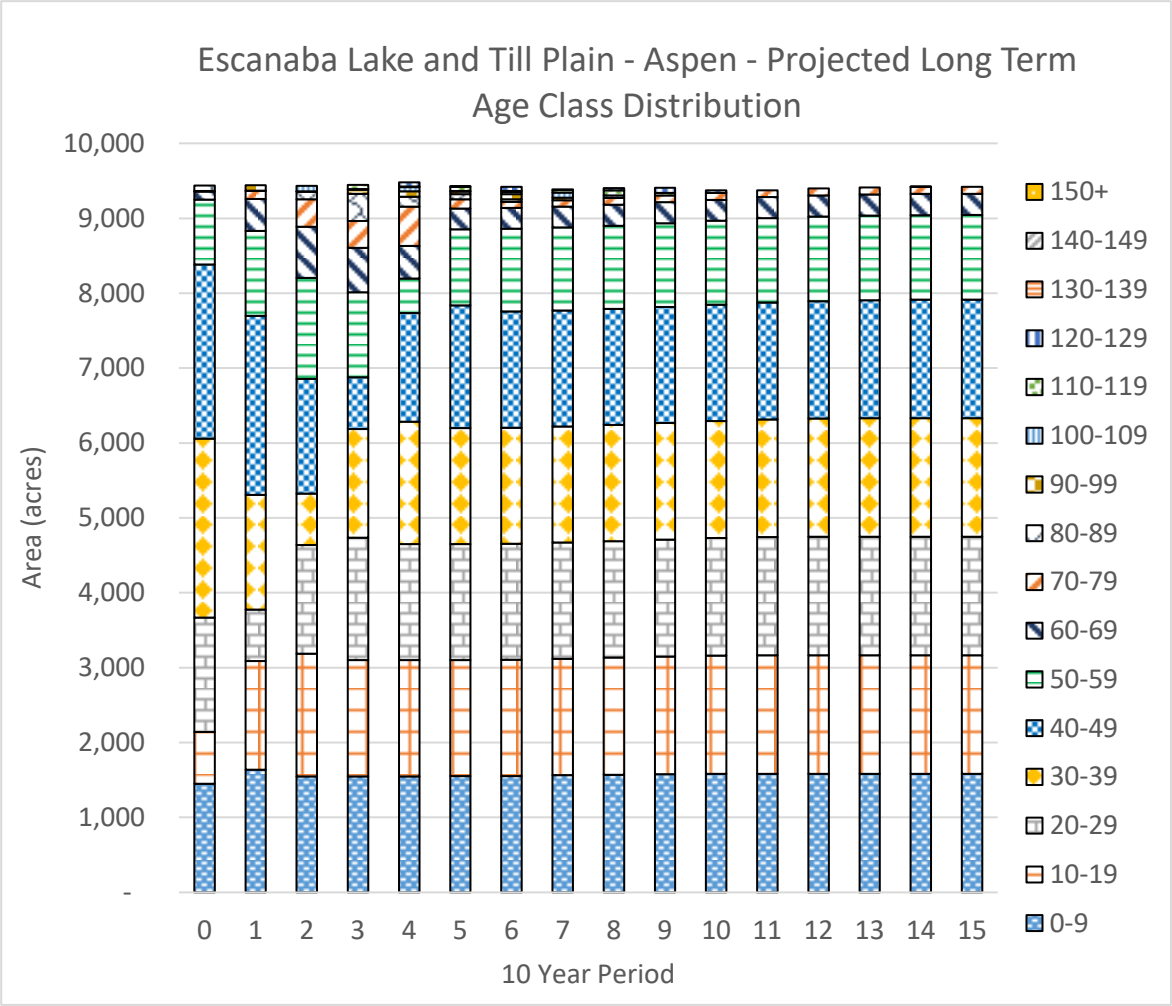


Figure 7. Projected age class distribution for all acres of aspen over the next 150 years.

Management actions

There are 1,636 acres of projected clearcut harvest in the aspen cover type during this planning period. This falls slightly above of the desired establishment of 1,543 acres per decade because of the current unbalanced condition.

Cedar

Current condition

Most of this cover type is over 100 years old and occurs mostly unavailable for commercial harvest (Figure 8). The age class distribution is unbalanced, but regulated harvests are not a priority/focus in this cover type. Limited harvests could occur outside of the deer wintering complexes. A portion of this cover type meets the habitat requirements for white-tailed deer and snowshoe hare.

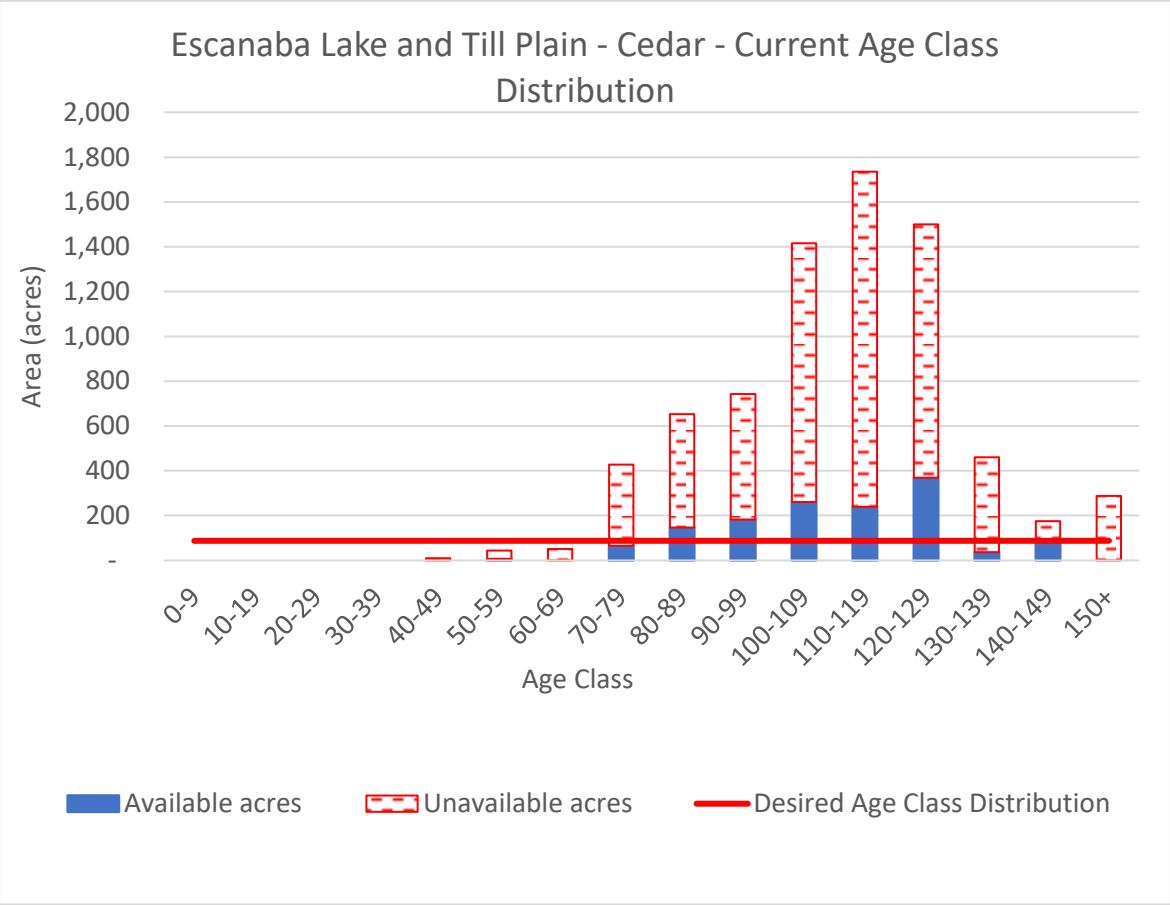


Figure 8. Current age class distribution and unavailable acres in the cedar cover type in the Escanaba Lake and Till Plain Management Area.

Table 10. Featured species with cedar as a selected habitat cover type, habitat variables and current acres (i.e. potential habitat).

Featured Species	Featured Species Habitat – Cedar	Cedar Habitat Acres – Available	Cedar Habitat Acres – Unavailable
Snowshoe hare	Age category: 0-19 Size class: sapling	0	0
White-tailed deer	All ages and size classes	--	7,501

Desired future condition

The projected long-term cover-type trend for cedar is stable in the Escanaba Lake and Till Plain Management Area. There are few projected transitions into or out of this cover type from other cover types forecasted. The long-term goal for this cover type is to manage and maintain wildlife habitat.

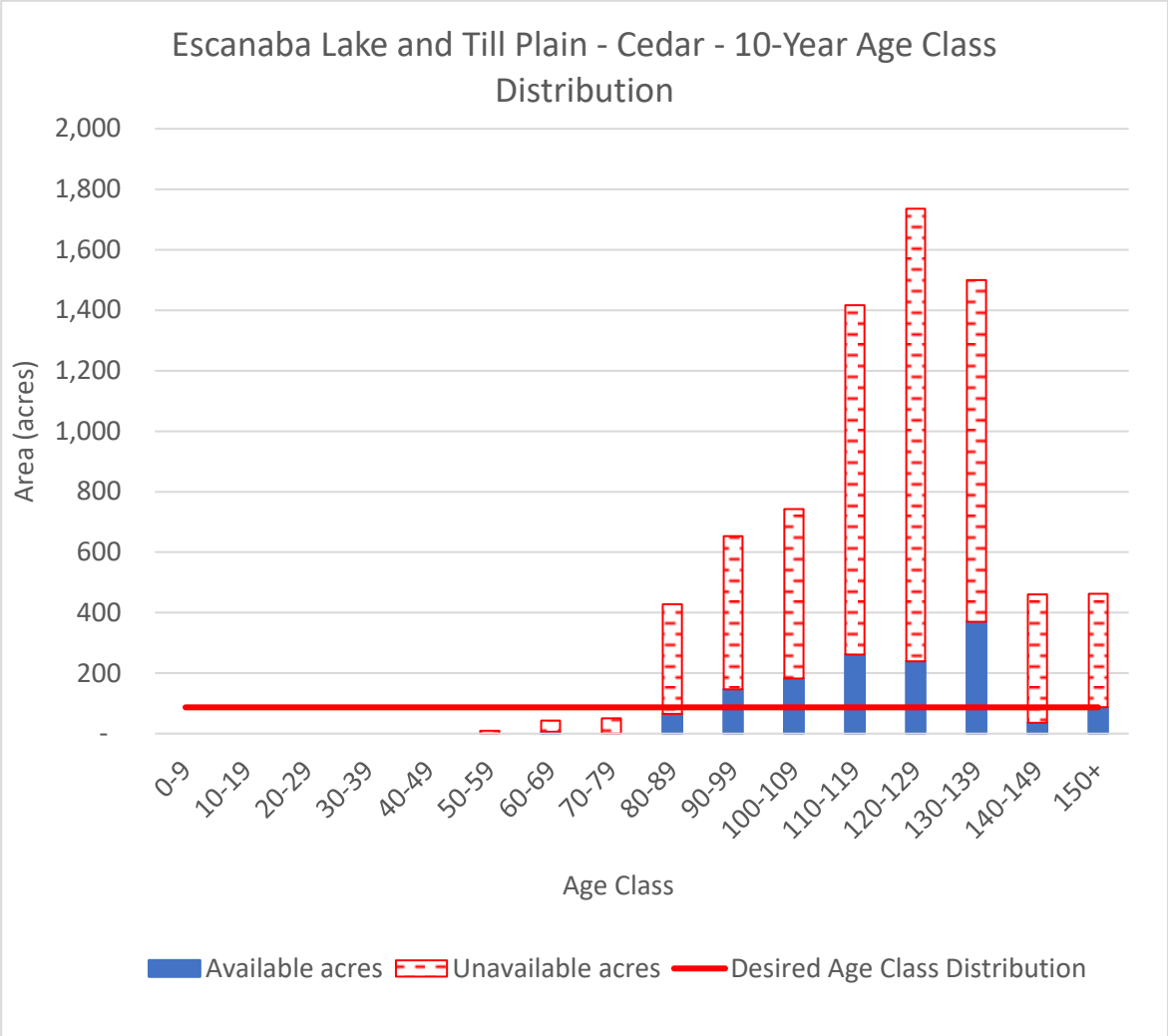


Figure 9. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

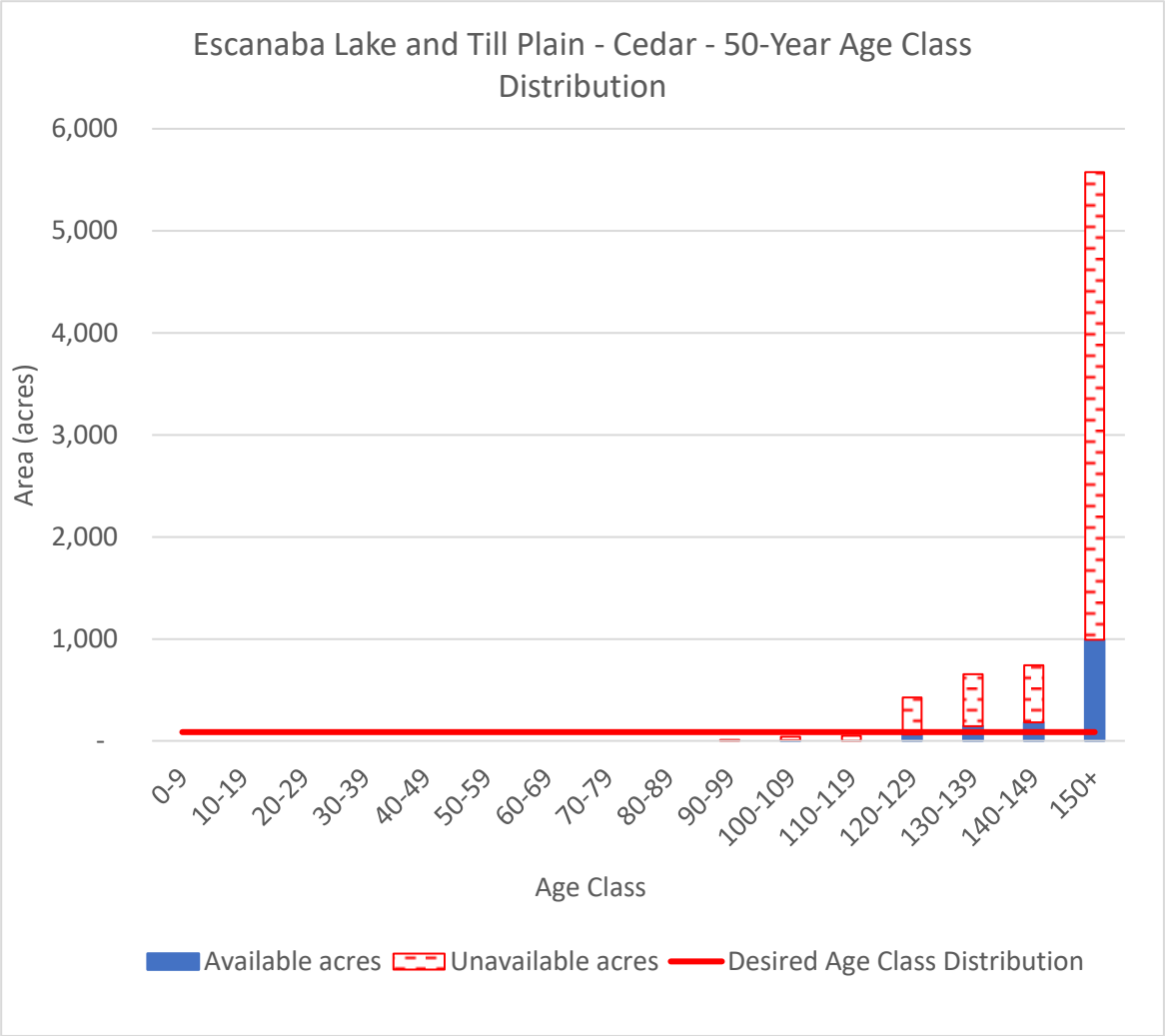


Figure 10. Projected midterm age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The midterm age class distribution shows the population of cedar acres beginning to reach the desired future condition (Figure 10).

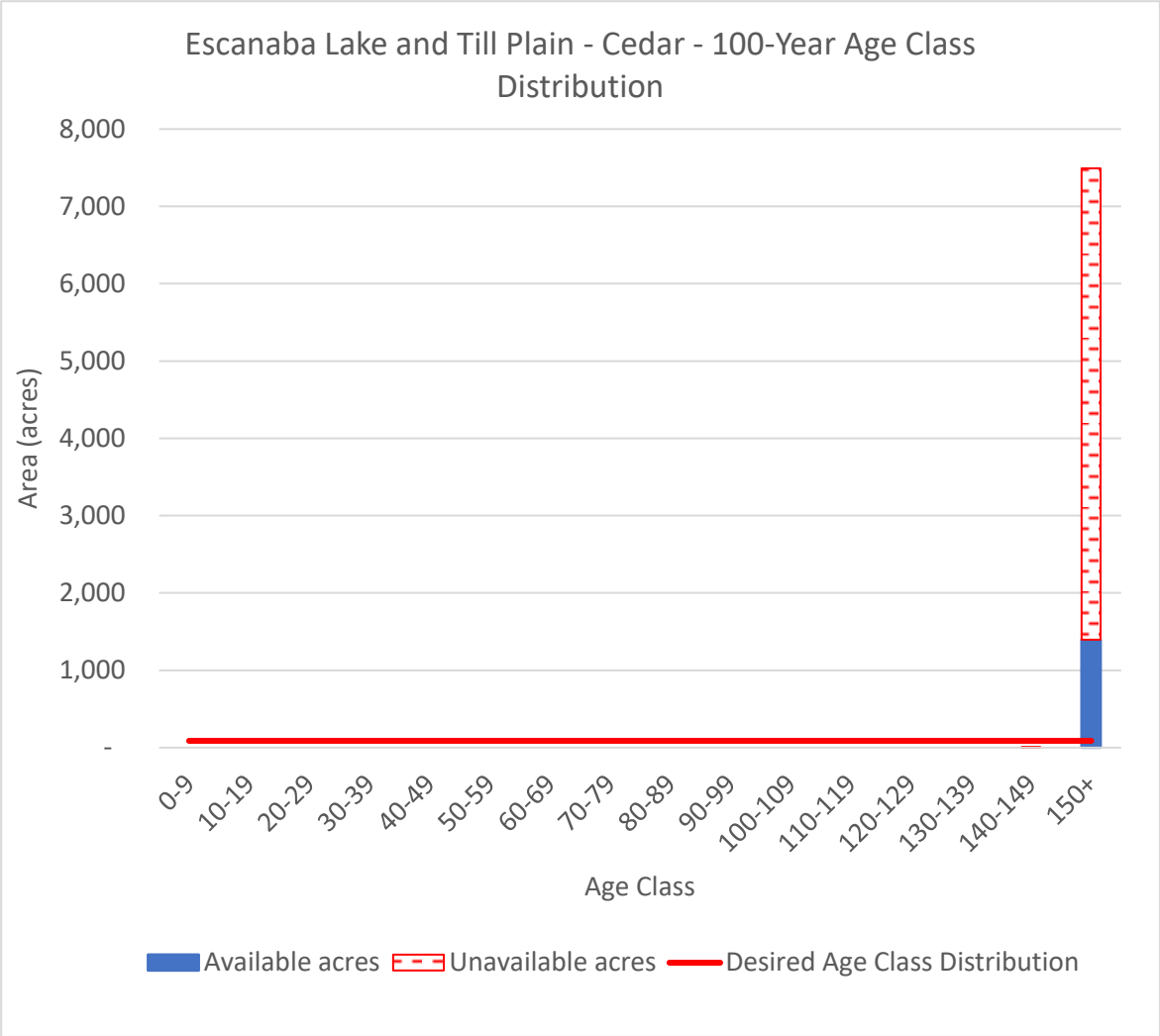


Figure 11. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 11) will concentrate on the management of cedar within the deer wintering complex plans to provide wildlife habitat conditions with mature forest.

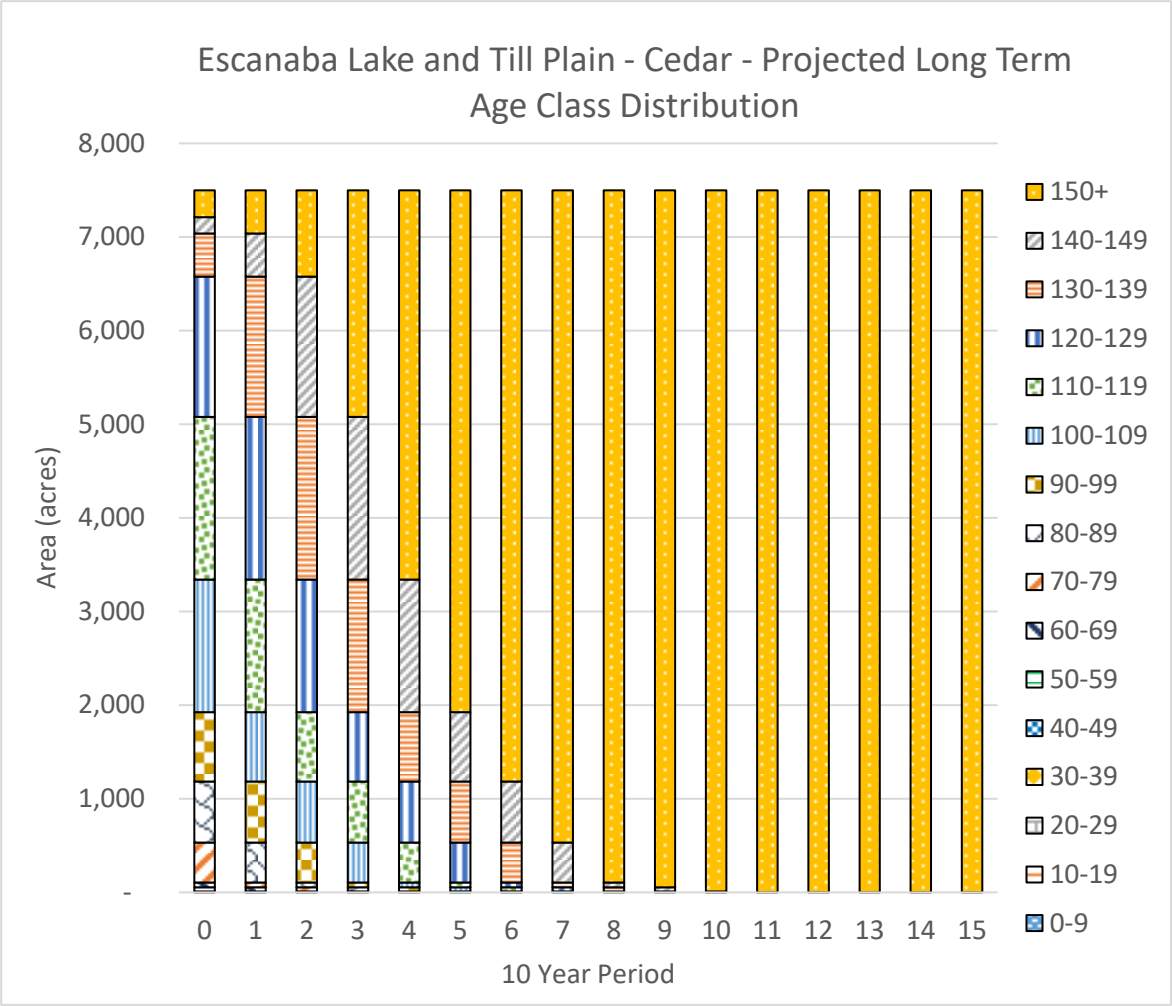


Figure 12. Projected age class distribution for all acres of cedar over the next 150 years.

Management actions

Maintaining this cover type where it exists on the landscape will be the primary action for this planning period. This cover type provides the best functional shelter habitat related to overwintering deer and deer wintering complexes (see Section 5) and can be a difficult cover type to regenerate through commercial harvest. Continued understanding of how to regenerate the cover type should be considered as emerging research becomes available.

Northern hardwoods

Current condition

Most of the northern hardwood cover type is currently between a stand age of 80 and 109 years old in the Escanaba Lake and Till Plain Management Area (Figure 13). The past management regime has been primarily single tree selection, which allows for stand age to continue to increase over time. Some stands are beginning to achieve an uneven-aged condition, where a featured stand age becomes less evident, but the dominant age of these stands will likely increase beyond 150 years old prior to a younger age cohort becoming the prominent component of these stands.

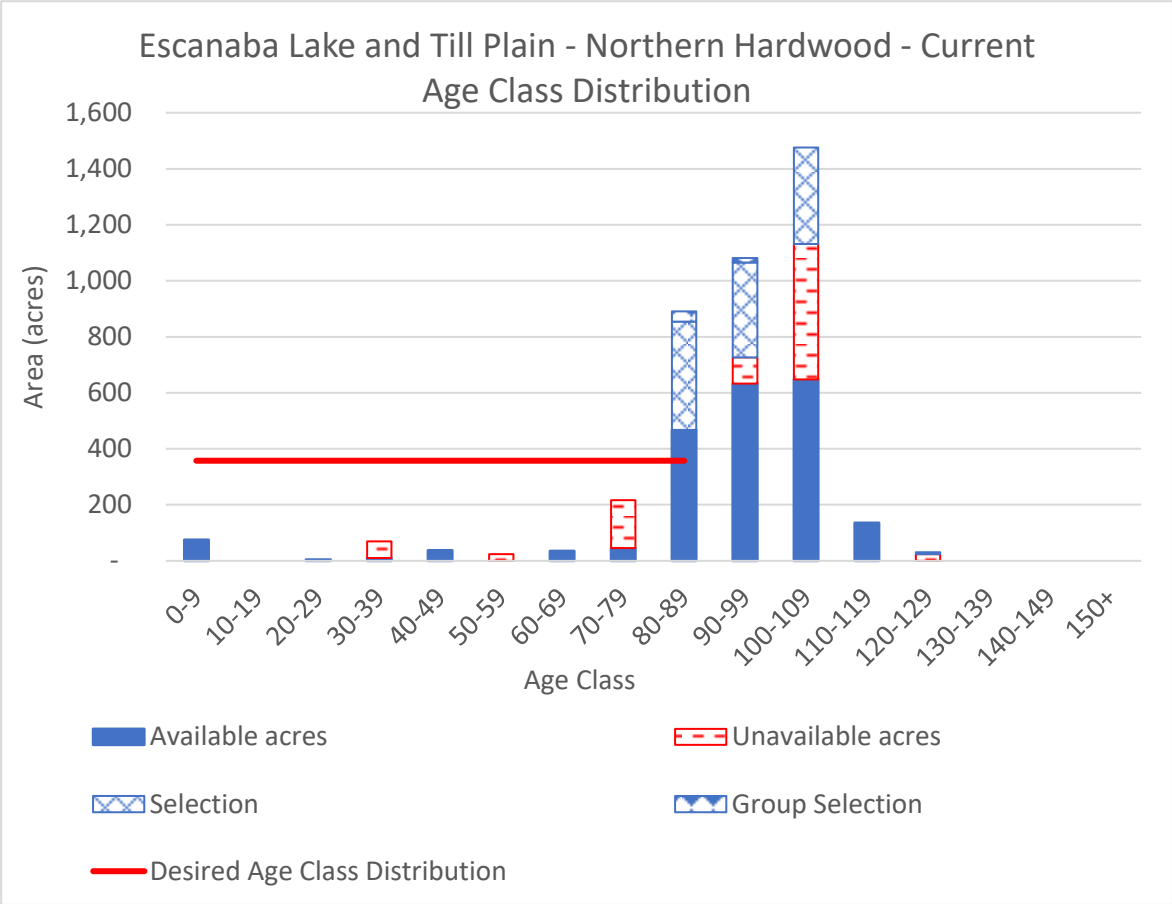


Figure 13. Current age class distribution and projected harvests in the northern hardwood cover type in the Escanaba Lake and Till Plain Management Area.

Stand densities of northern hardwood stands are well distributed in the ideal basal area classes for optimal growing conditions in the Escanaba Lake and Till Plain Management Area (Figure 14). Current conditions are a result of beech salvage efforts in the previous planning period and a regulated selection harvest regime that has been in place in this management area for decades.

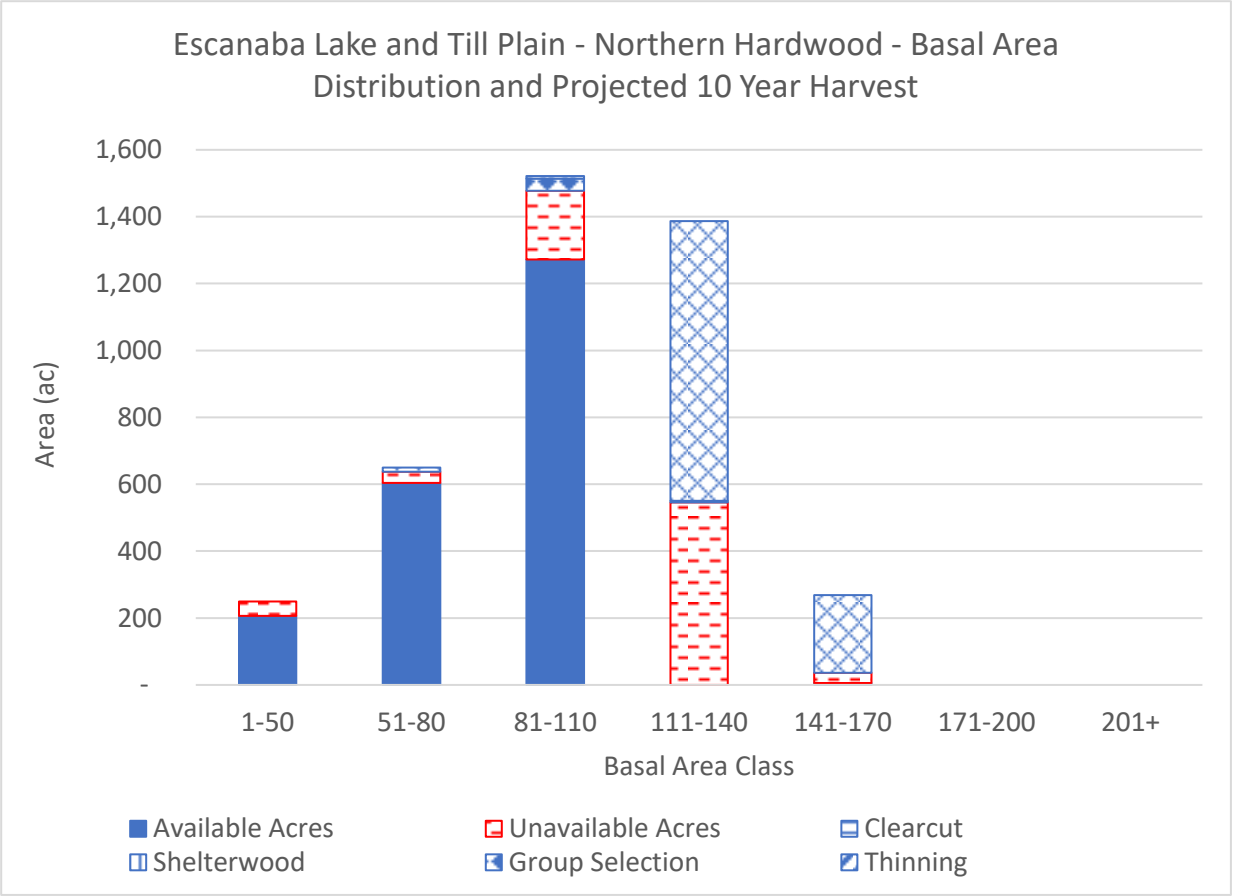


Figure 14. Current basal area distribution of the northern hardwood cover type as well as the projected harvests from each basal area class.

Approximately 80% of northern hardwood stands in the Escanaba Lake and Till Plain Management Area are available for harvest. Selection is the primary silvicultural treatment projected during this 10-year planning period, but there may be opportunities to utilize even-aged management silvicultural regimes to increase stem density, species composition and regeneration within the northern hardwood areas.

Table 11. Featured species with northern hardwoods as a selected habitat cover type, habitat variables and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Northern Hardwood	Northern Hardwood Habitat Acres – Available	Northern Hardwood Habitat Acres – Available
Blackburnian warbler	Age category: 80+ Size category: pole, sawlog Basal area: 81+	2,322	585
White-tailed deer	All sizes and age classes	4,075	--

Desired future condition

The projected long-term cover-type trend for northern hardwood is slightly increasing in the Escanaba Lake and Till Plain Management Area. There are very few transitions into this cover type from other cover types and equally few transitions from northern hardwoods to other cover types forecasted in this management area.

The desired basal area distribution is a bell-shaped curve, where a significant majority of the area is kept in the 81-110 basal area class, with recently harvested stands occupying the 51-80 class and stands that are ready for harvest occupying the 111-140 basal area class. Diameter distributions of the northern hardwood stands should follow the appropriate Q-curve relative to stand age and condition.

An uneven-aged condition is a long-term goal for northern hardwood stands in this management area. An uneven-aged condition is achieved when there is no single discernable age cohort that is more prevalent than others across the stand area, as canopy gaps fill in with regenerating seedlings, saplings and poles, and eventually remaining stems become sawlog-sized over time.

Regeneration and recruitment continue to be a focus in the northern hardwood cover type across this management area. The long-term sustainability of this cover type in an uneven-aged silvicultural regime is dependent on the successful establishment of northern hardwood species as well as the recruitment of those seedlings and saplings into the pole and sawlog classes. The Escanaba Lake and Till Plain Management Area will take several decades to reach the desired future condition because of the impacts from beech bark disease. The amount of American beech that once occupied much of the northern hardwood stands has resulted in lower than normal residual basal area and decreased stocking levels across much of the eastern Upper Peninsula.

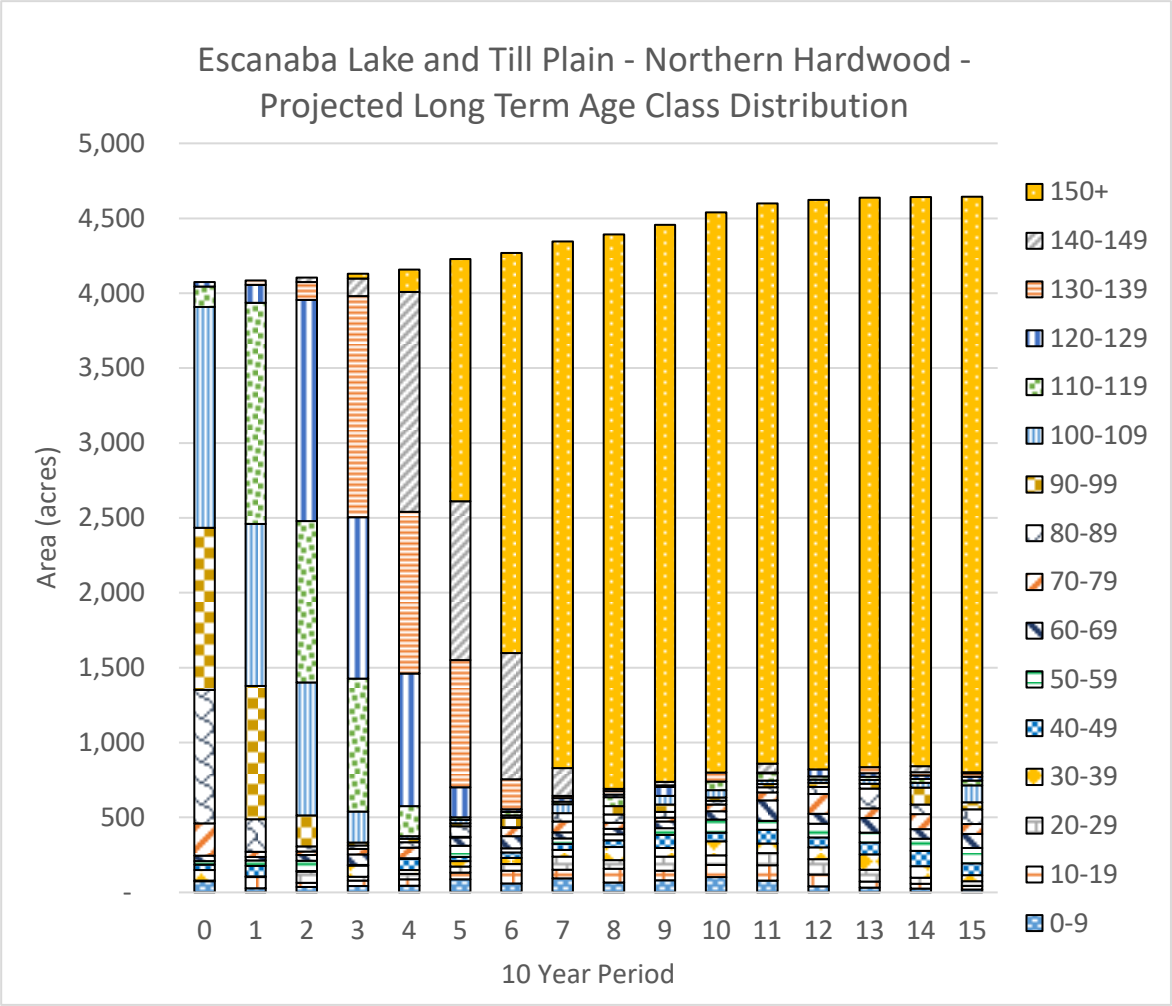


Figure 15. Projected age class distribution for all acres of northern hardwood over the next 150 years.

Management actions

The desired forest conditions and associated featured species habitat will be maintained and achieved through continued application of the projected selection harvest regime on 1,076 acres, as well as 53 acres of the group selection harvest regime (Table 5). Multiple silvicultural regimes should continue to be considered, including group selection, as emerging research results become available. Emphasis should be placed on larger canopy gaps to encourage diverse regeneration of northern hardwood species while maintaining an overall long-term mature forest, closed-canopy landscape condition.

Planted red pine

Current condition

Current age class distributions for the planted red pine cover type are moderately unbalanced, with most of the age classes currently occupying the 0- to 9-year-old age class and the 60- to 79-year-old age classes and all acres are available for commercial management (Figure 16). The past management regime has been primarily thinning every 10 years to achieve an approximate residual basal area of 120 square feet.

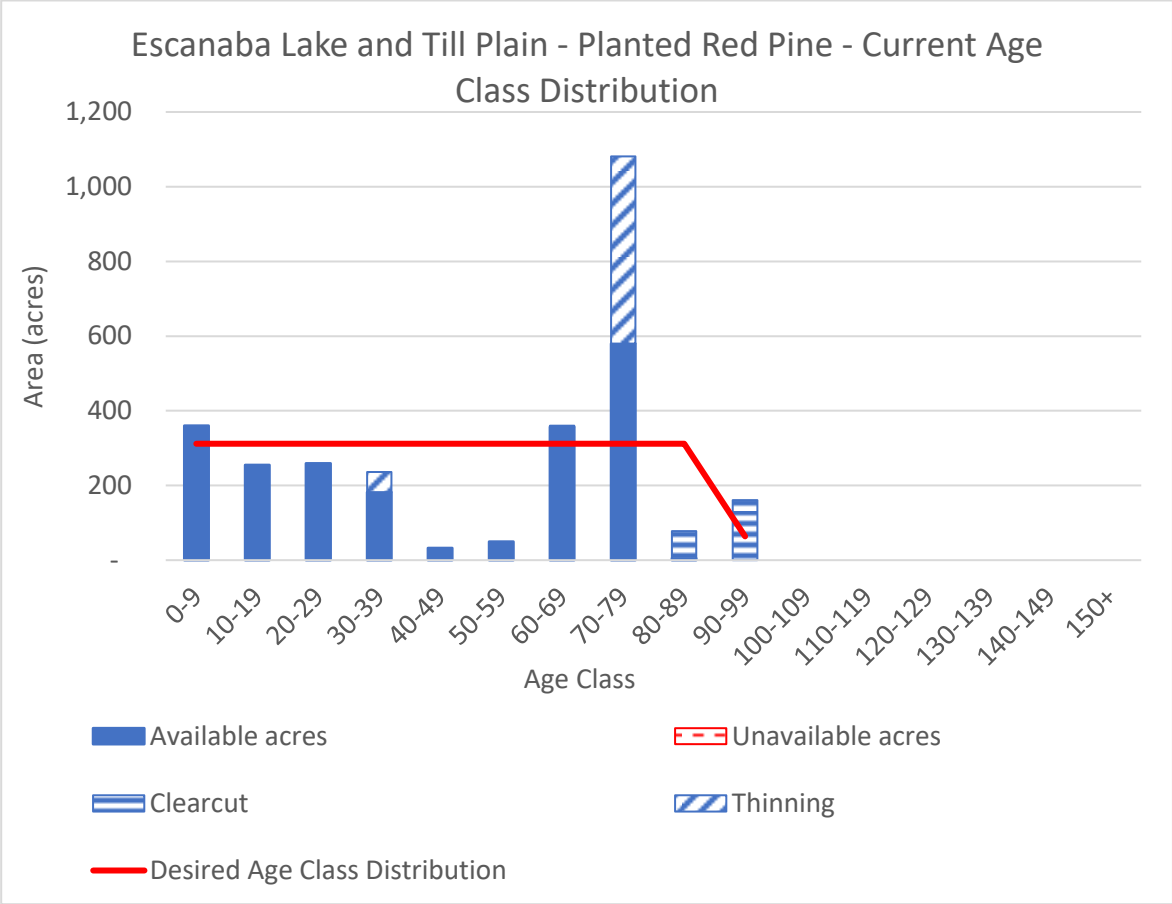


Figure 16. Current age class distribution, desired age class distribution and projected harvests in the planted red pine cover type over the 10-year planning period.

Current conditions are a result of plantations established during the 1930s by the Civilian Conservation Corps and continued planting efforts in later decades, most of which have, during the previous two planning periods, reached – or are now reaching – economic maturity. Additionally, there have been consistent commercial harvests and regeneration efforts on available planted red pine acres during the previous planning periods.

Desired future condition

The projected long-term cover type trend for planted red pine is stable in the Escanaba Lake and Till Plain Management Area. There are very few transitions into this cover type from other cover types, and equally few transitions from planted red pine to other cover types, forecasted in this management area.

The long-term goal for this cover type is balanced age classes between 0 and 80 years old for all available planted red pine stands in this management area. Maintaining lower acreage in old age classes continues to be desirable to lessen the prevalence and severity of diseases and to reduce the threat of damaging wildfire.

The end of the planning period will result in the establishment of 168 acres in the upcoming 0- to 9-year-old age class. Progress toward the long-term age class distribution of planted red pine will take many decades in the management area (Figure 17).

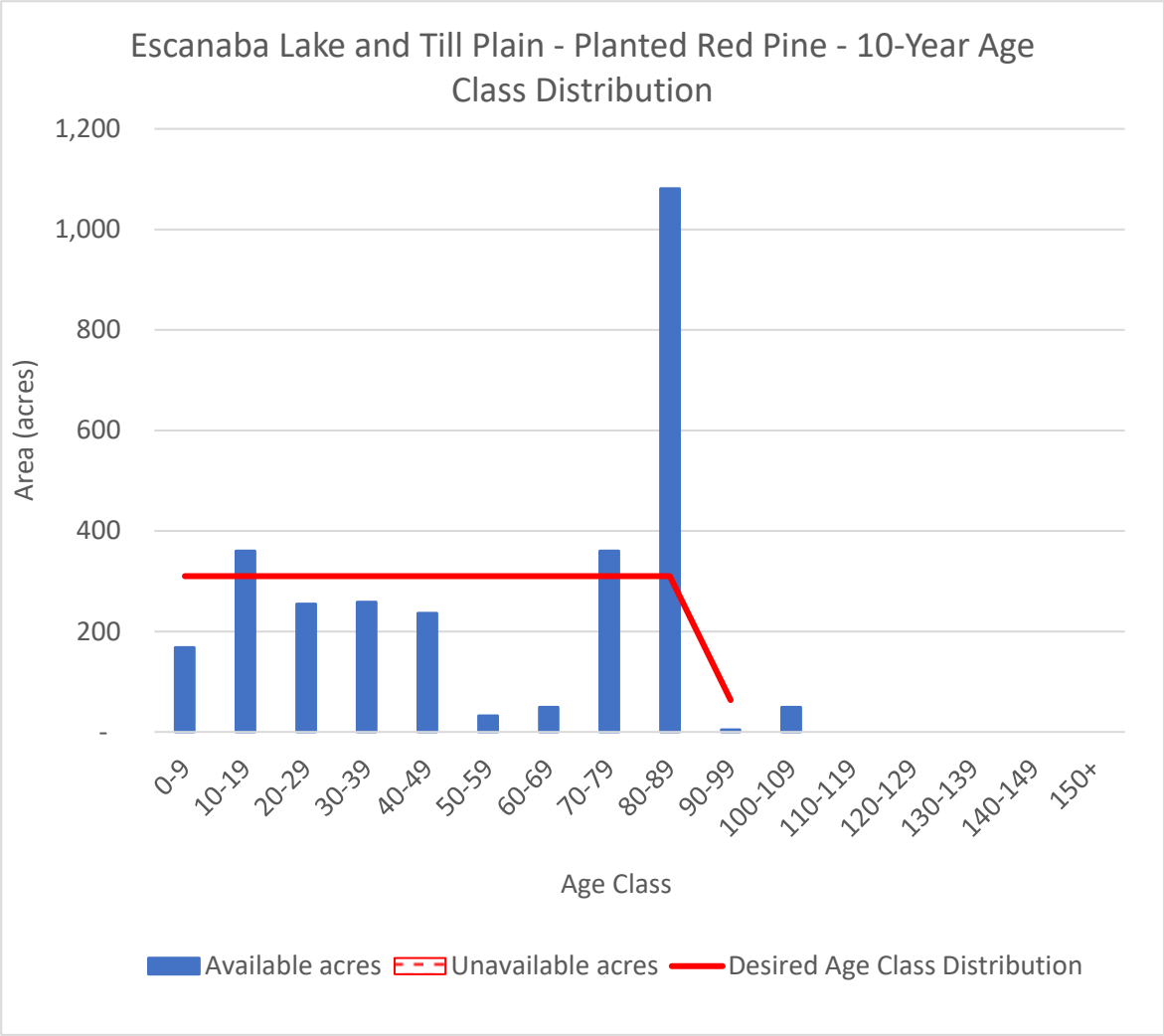


Figure 17. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The midterm age class distribution shows the population of planted red pine beginning to improve, with a few age classes nearing the desired future condition. As is often the case, an unbalanced condition in

the first planning period can often result in the need to carry some acres slightly longer into older age classes to achieve the desired age class goals (Figure 18).

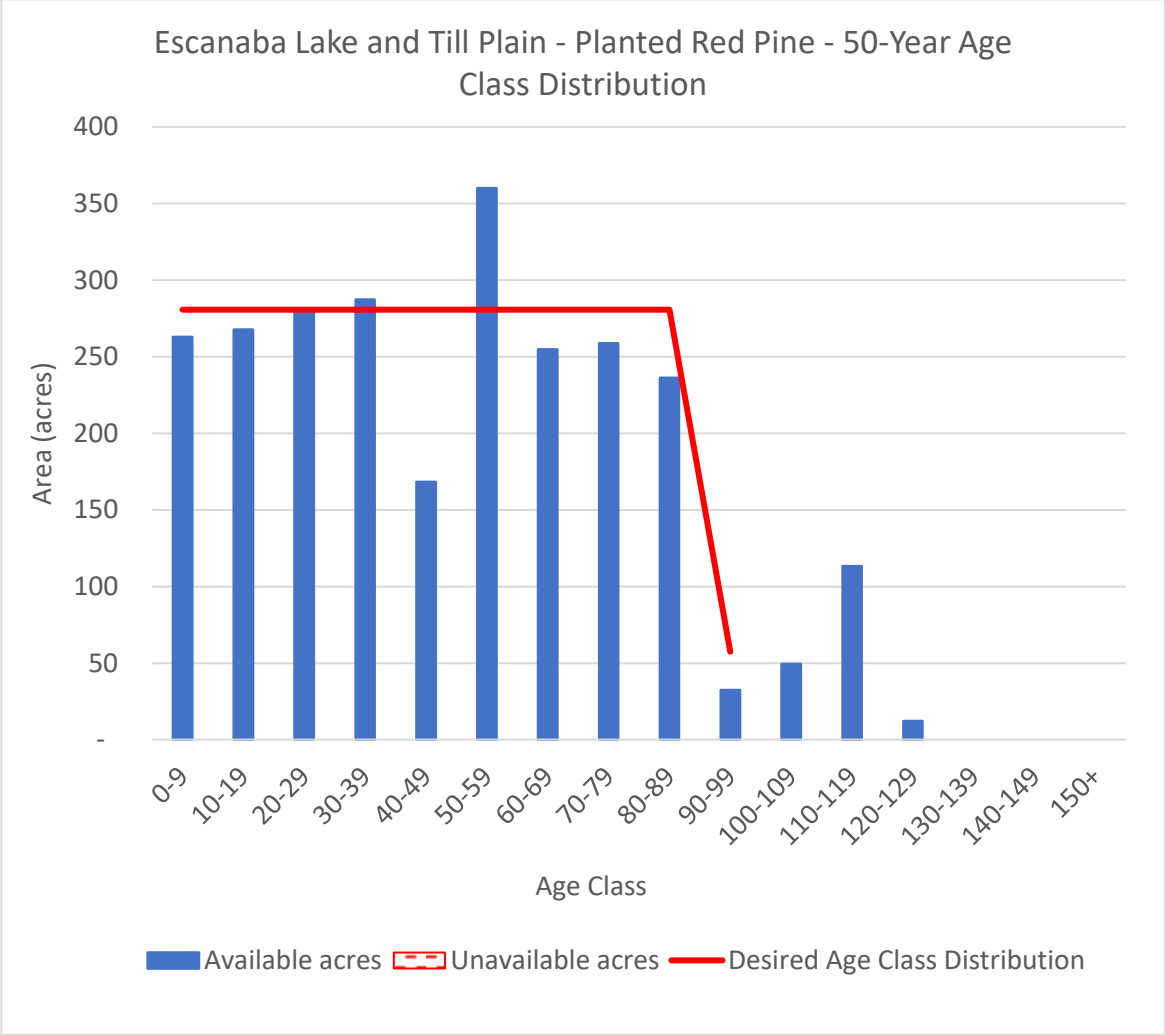


Figure 18. Projected midterm age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 19) will concentrate the manageable acres of planted red pine in productive growing conditions while providing an even flow of forest products and a wide variety of potential wildlife habitat conditions across the landscape in young, mid-aged and mature forest.



Figure 19. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

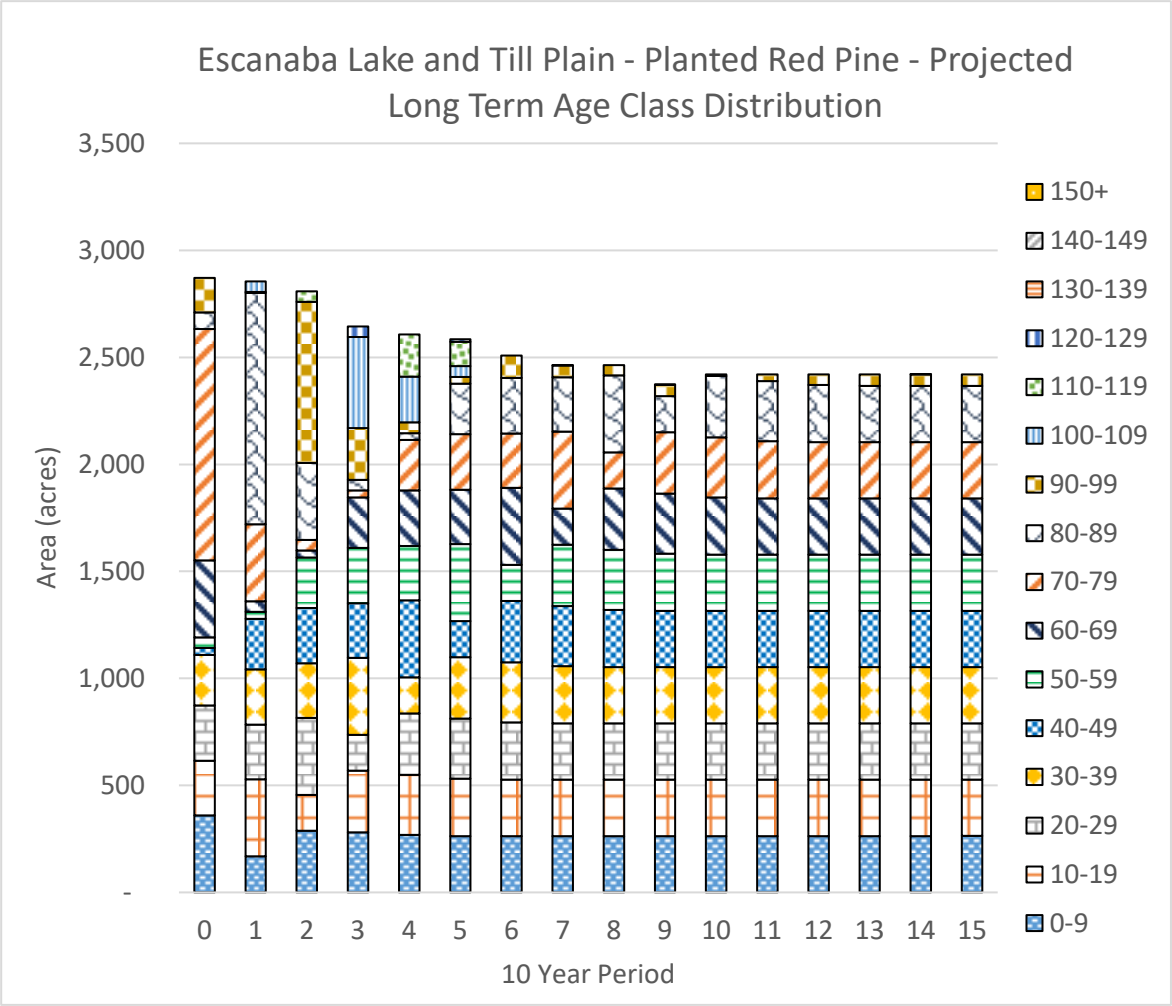


Figure 20. Projected age class distribution for all acres of planted red pine over the next 150 years.

Management actions

There are 233 acres of projected clearcut harvest in the planted red pine cover type during this planning period. This is slightly below the desired establishment of 310 acres per decade because of the current unbalanced condition. In addition to clearcut acres, there are 559 acres projected for thinning in this cover type (Table 5).

Conservation Area Network

High conservation value areas

There are up to nine different HCVA types that can be found in each management area (see Biodiversity in Section 3 for more information).

Table 12. High conservation value areas within the Escanaba Lake and Till Plain Management Area.

High Conservation Value Area Type and Name	Acres
Coastal environmental area	**22**
	22
Deer wintering complex	**16,885**
	16,885
Forest habitat core interior	**1,341**
	1,341
Grouse Enhanced Management Site	**6,304**
Garden Grade	6,304
Grand total	**24,552**

Ecological reference areas

Ecological Reference Areas, a type of HCVA, are higher-quality examples of functioning ecosystems that are primarily influenced by natural ecological processes.

Table 13. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 14. Ecological reference areas within the management area.

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	Number of Occurrences
Existing ERA	Bog	C			1
Existing ERA	Intermittent wetland	AB			1
Existing ERA	Intermittent wetland	C			1

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	Number of Occurrences
Existing ERA	Limestone bedrock glade	AB	G2G4	S2	2
Existing ERA	Limestone bedrock glade	B	G2G4	S2	1
Existing ERA	Limestone bedrock glade	C	G2G4	S2	1
Existing ERA	Limestone bedrock lakeshore	A	G3	S2	1
Existing ERA	Limestone bedrock lakeshore	AB	G3	S2	1
Existing ERA	Limestone bedrock lakeshore	B	G3	S2	1
Existing ERA	Limestone cliff	A	G4G5	S2	1
Existing ERA	Wooded dune and swale complex	AB	G3	S3	1
Existing ERA	Wooded dune and swale complex	B	G3	S3	1
Existing ERA	Wooded dune and swale complex	C	G3	S3	1
Proposed ERA	Boreal forest	BC	GU	S3	3
Proposed ERA	Great Lakes marsh	C	G2	S3	1
Proposed ERA	Limestone bedrock lakeshore	B	G3	S2	2
Proposed ERA	Limestone cobble shore	B	G2G3	S3	1
Proposed ERA	Wooded dune and swale complex	C	G3	S3	2
Grand total					**23**

Special conservation areas

Reviewable special conservation areas (Table 15) are those SCA types that may be reviewed or updated through the compartment review process as needed. Static SCAs (Table 16) are those SCA types that generally do not change or require updating (see Biodiversity in Section 3 for more information).

Table 15. Reviewable special conservation areas within the Escanaba Lake and Till Plain Management Area.

Reviewable Special Conservation Area Type and Name	Acres
Concentrated Recreational Area	**6**
Merwin Campground	6
Merwin Creek Boat Launch	1
Habitat Area or Habitat Corridor	**1,016**
Maxton Plains: Alvar and associated natural communities	1,016
Mineral Resource Area	**26**
Schoolcraft County Road Commission	26
Visual Management Areas	**103**
Rainey Wildlife Viewing Area	103
Grand total	**1,151**

Table 16. Static special conservation areas within the Escanaba Lake and Til Plain Management Area.

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Common Natural Heritage Element Occurrences		**45**
Emergent marsh		1
Northern wet meadow		38
Poor fen		6
Designated Trout and Coldwater Stream Buffer		**165**
Unnamed		131
Spring Creek		23
Thompson Creek		10
Designated Trout and Coldwater Streams	**6.1**	
Unnamed	4.8	
Spring Creek	0.9	
Thompson Creek	0.4	
Great Lakes Islands		**1,462**
Little Summer Island		108
Summer Island		1,354
Nondedicated Natural Areas		**289**
Natural Area Point Detour		289
Wild and Scenic Rivers	**0.8**	
Indian Wild and Scenic River	0.8	
Wood Turtle Stream 100-Foot Buffer		**27**
Manistique River		27
Wood Turtle Stream 660-Foot Buffer		**221**
Manistique River		221
Grand Total	**6.9**	**2,209**

Rare species

Rare species occurrences are compiled from the Michigan Natural Features Inventory biotics database (Table 18 and Table 20) and do not necessarily include all rare species found in this management area due to biases in survey effort and verifiable observation reporting over time.

Table 17. Rare animal species conservation status key.

Species Status	Species Status
E = endangered	LE = listed endangered
T = threatened	LT = listed threatened
SC = special concern	PDL = proposed for delisting

Table 18. Rare animal species occurrence within the Escanaba Lake and Till Plain Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Acipenser fulvescens	Lake sturgeon	T		1
Animal	Ammodramus savannarum	Grasshopper sparrow	SC		1
Animal	Boloria frigga	Frigga fritillary	SC		1
Animal	Bombus borealis	Northern amber bumble bee	SC		1
Animal	Bombus terricola	Yellow banded bumble bee	SC		5
Animal	Canis lupus*	Gray wolf	SC	LE	--
Animal	Cincinnatia cincinnatiensis	Campeloma spire snail	SC		1
Animal	Coregonus artedi	Lake herring or Cisco	T		1
Animal	Falco columbarius	Merlin	SC		1
Animal	Glyptemys insculpta	Wood turtle	T		1
Animal	Haliaeetus leucocephalus	Bald eagle	SC		6
Animal	Mediappendix exilis	Pleistocene catinella	T		1
Animal	Myotis lucifugus	Little brown bat	T		3
Animal	Myotis septentrionalis	Northern long-eared bat	T	LE	1
Animal	Necturus maculosus	Mudpuppy	SC		1
Animal	Pandion haliaetus	Osprey	SC		3
Animal	Planogyra asteriscus	Eastern flat-whorl	SC		1
Animal	Setophaga kirtlandii	Kirtland's warbler	E		1
Animal	Stylurus amnicola	Riverine snaketail	SC		1
Animal	Tympanuchus phasianellus	Sharp-tailed grouse	SC		1
Animal	Vertigo cristata	Crested vertigo	SC		1
Animal	Vertigo elatior	Tapered vertigo	SC		2
Animal	Vertigo hubrichti	Hubricht's vertigo	E		2
Total	-	-	-	-	**37**

**Occurrence information provided by field staff.*

Table 19. Rare plant species conservation status key.

Species Status	Species Status
E = endangered	LE = listed endangered
T = threatened	LT = listed threatened
SC = special concern	PDL = proposed for delisting

Table 20. Rare plant species occurrence within the Escanaba Lake and Till Plain Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Plant	Adlumia fungosa	Climbing fumitory	T		1
Plant	Calypso bulbosa	Calypso or fairy-slipper	T		3
Plant	Carex albolutescens	Sedge	T		1
Plant	Carex richardsonii	Richardson's sedge	SC		1
Plant	Cirsium pitcheri	Pitcher's thistle	T	LT	3
Plant	Cypripedium arietinum	Ram's head lady's-slipper	SC		1
Plant	Drosera anglica	English sundew	SC		1
Plant	Graphephorum melicoides	Purple false oats	SC		1
Plant	Iris lacustris	Dwarf lake iris	T	LT	6
Plant	Minuartia dawsonensis	Rock sandwort	T		1
Plant	Neottia auriculata	Auricled twayblade	SC		1
Plant	Schoenoplectus torreyi	Torrey's bulrush	SC		2
Plant	Stachys pilosa	Hairy hedge-nettle	SC		1
Plant	Tanacetum bipinnatum ssp. huronense	Lake Huron tansy	SC		3
Total	-	-	-	-	**26**

Non-ecological reference area natural communities

Natural communities that are identified with an element occurrence in the MNFI Biotics database, but that have not been given an additional ecological reference area designation, are recognized and managed accordingly (Table 21).

Table 21. Non-ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 22. Non -ecological reference area natural communities within the Escanaba Lake and Till Plain Management Area.

Community Type	Element Occurrence Rank	State Rank	Global Rank	Number of Occurrences
Emergent marsh	AB	S4	GU	1
Northern wet meadow	AB	S4	G4G5	1
Poor fen	B	S3	G3	1
Grand total				**3**

Forest health

Forest health concerns, both native and non-native, can have impacts on stand conditions and management decisions. The following insects (Table 23) and diseases (Table 24) could have an impact on management during the planning period and may need to be monitored and/or addressed.

Table 23. Defoliating insects of concern in the Escanaba Lake and Till Plain Management Area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Spongy moth	Lymantria dispar dispar	Non-native	Yes
Forest tent caterpillar	Malacosoma disstria	Native	Yes
Large aspen tortrix	Choristoneura conflictana	Native	Yes
Spruce budworm	Choristoneura fumiferana	Native	Yes
Hemlock woolly adelgid	Adelges tsugae	Non-native	No

Table 24. Maladies of concern in the Escanaba Lake and Till Plain Management Area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Canker (stem infections)	Nectria cinnabarina	Native	Yes
Heterobasidion root disease	Heterobasidion annosum	Native	No
Oak wilt	Bretziella fagacearum	Non-native	No
Wood decay	Various	Mostly native	Yes

Aquatic resources

Riparian habitat

Approximately 26 miles of streams and rivers are found in the management area (Table 25). Streams/rivers classified as warm types comprise approximately 99% of the riverine mileage.

Table 25. Classification type and length of streams/rivers found within the management area.

Type	Length (miles)
Cold stream	<1
Cold small river	0
Cold transitional stream	0
Cold transitional small river	0

Type	Length (miles)
Cold transitional large river	0
Warm transitional stream	15
Warm transitional small river	1
Warm transitional large river	0
Warm stream	0
Warm small river	<1
Warm large river	10

Lacustrine habitat

A total of 17 lakes and ponds of at least 1 surface acre are found in the management area (Table 26).

Table 26. Size and number of lakes and ponds located within the management area.

Lake Size Class (acres)	Number
1-99	16
100-499	0
500+	1

Wetlands

A total of 19,735 acres of wetlands are found in the management area (Table 27). Forested wetlands comprise approximately 95% of wetland types found in the management area.

Table 27. Area of emergent, forested and riverine wetland types found within the management area.

Wetland Type	Acres
Emergent	757
Forested	18,706
Riverine	272

Vernal pools and seeps

A total of 401 acres of vernal pools and seeps have been inventoried in the management area, while 25 acres of seeps have been identified.

Riparian vegetation cover

Cedar and lowland shrub are the predominant cover types present in a 100-meter riparian zone located next to streams/rivers in the management area (Table 28).

Table 28. Largest vegetative cover types (i.e., top 10) and area located in a 100-meter buffer of streams/rivers within the management area.

Cover Type	Acres
Cedar	950
Lowland shrub	920
Marsh	681
Northern hardwood	677

Cover Type	Acres
Aspen	492
Upland conifers	357
Mixed upland deciduous	295
Bare/sparsely vegetated	280
Lowland conifers	241
Lowland deciduous	137

Watershed vegetation cover

The management area includes portions of important watersheds of the Fishdam River and Little Fishdam River (Table 29 and Table 30). Aspen is a major cover type of the state forest in each watershed.

Table 29. Largest vegetative cover types (i.e., top five) and area for the area of the Fishdam River watershed located within the management area.

Cover Type	Acres
Aspen	1,368
Northern hardwood	537
Planted red pine	404
Upland mixed forest	209
Natural jack pine	120

Table 30. Largest vegetative cover types (i.e., top five) and area for the area of the Little Fishdam River watershed located within the management area.

Cover Type	Acres
Aspen	1,724
Lowland conifer	485
Lowland shrub	471
Cedar	426
Upland conifer	410

Recreation

Access for management and public recreation is generally good in the Escanaba Lake and Till Plain Management Area, with U.S. 2 going through the area and a well-developed two-track/road system. Summer Islands may be accessed by private boat, small plane (airfield on Little Summer) and off-road vehicles or snowmobiles when conditions allow them across the ice. These islands provide for recreational boating, camping, hunting, fishing and waterfowl hunting, although there are no defined recreational facilities.

Several snowmobile trails traverse this management area. The nonmotorized Indian Lake Pathway is located north of Manistique and the Ninga Aki Pathway on the Garden Peninsula. The biking route of the Iron Belle Trail runs through the management area along U.S. 2. Nearby recreation opportunities include the Haywire State Trail (rail-trail), which travels from Marquette to Shingleton and is designated for ORV

and snowmobile use, with all nonmotorized uses also permitted (Table 31). There are two state forest campgrounds within the management area, and dispersed camping is also popular along the lakeshore. Additional recreation opportunities are provided by Indian Lake State Park, which is adjacent to state forest land.

Table 31. Designated recreation trails by use type.

Recreation Category	Recreation Type	Number of Miles
Motorized recreation trails	Off-road vehicle (all types) Snowmobile	0 22.9
Nonmotorized recreation trails	Hiking Equestrian Biking Hunter access trails	7.3 0 0 10
Total		**40.2**

Note: Trail use types may overlap.

Table 32. State forest campgrounds.

Name	Number of sites
Merwin Creek State Forest Campground	10
Portage Bay State Forest Campground	23

The Garden Grade Grouse Enhanced Management Site at the top of the Garden Peninsula includes nearly 7,000 acres of primarily aspen, providing walk-in hunting opportunities for grouse hunters (Table 33).

Opportunities for recreation within the management area include hunting and trapping, fishing, scenic viewing, bird watching and berry picking. U.S. 2 is part of the Lake Michigan Circle Tour that many people travel during the summer and fall months.

Table 33. Areas managed for hunting.

Type	Name	Acres
Grouse Enhanced Management Site	Garden Grade GEMS	6,299

Table 34. Boating access sites.

Name	Body of Water
Merwin Creek State Forest Campground	Merwin Creek

EUP management areas

Grand Marais Moraine Complex

State forest area: 317,037 acres	Location: Lake Superior shoreline and vicinity, central and eastern Upper Peninsula	Population centers: Grand Marais Paradise
Subsection: Grand Marais Glaciofluvial-Moraine Complex	Landforms: Sand dunes, sand spits, shoreline, beach ridges, outwash plains, kettles, alternating swales	Land cover: Forested: 264,156 acres Nonforested: 52,881 acres

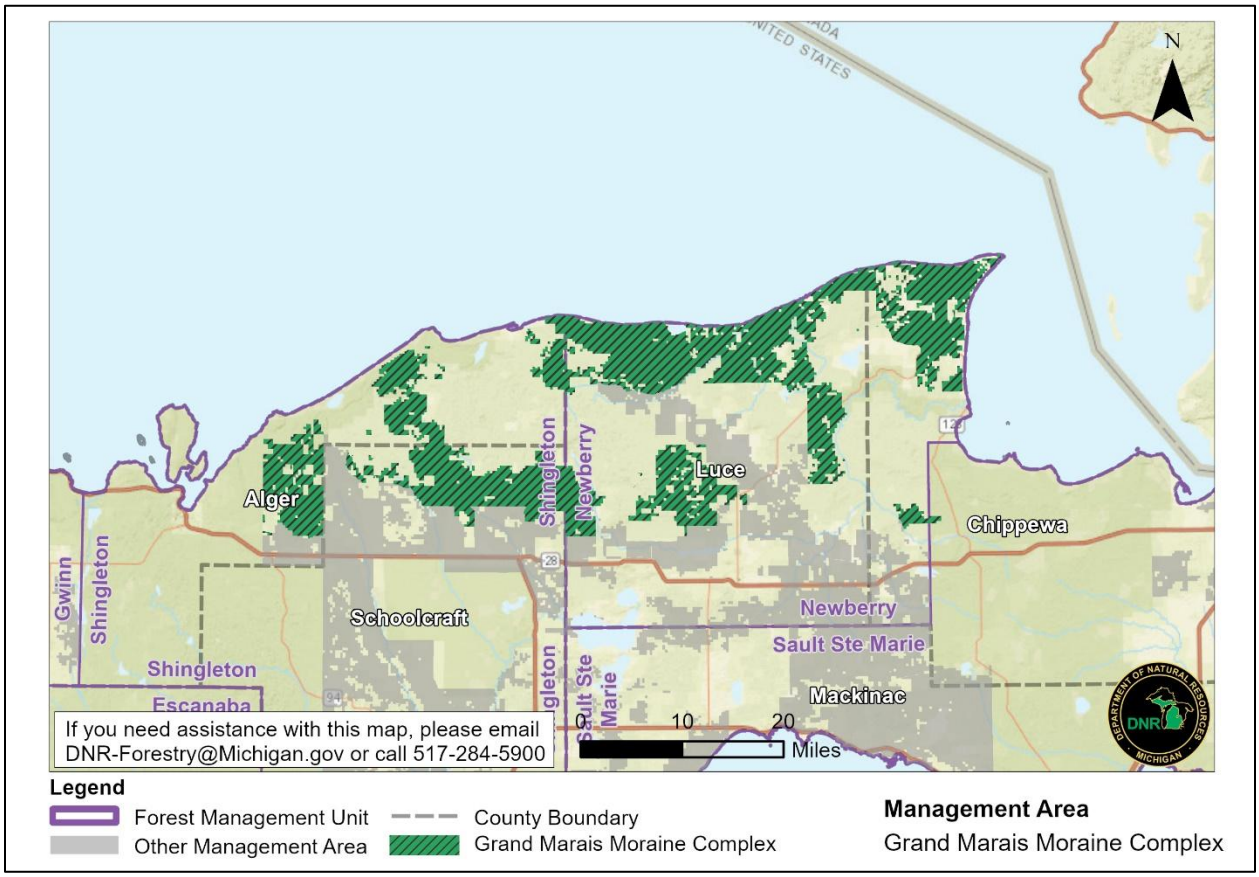


Figure 1. Grand Marais Moraine Complex Management Area.

Forested landscape

Current and projected future conditions

The Grand Marais Moraine Complex Management Area is dominated by available uplands, of which mid-tolerant and intolerant cover types account for most of the area in terms of acres. When all age classes and landscape positions are combined, cover type tolerance levels have a fairly even distribution. Tolerant cover types occur mostly in the old age category, which covers the largest area of all four age categories (Figure 2).

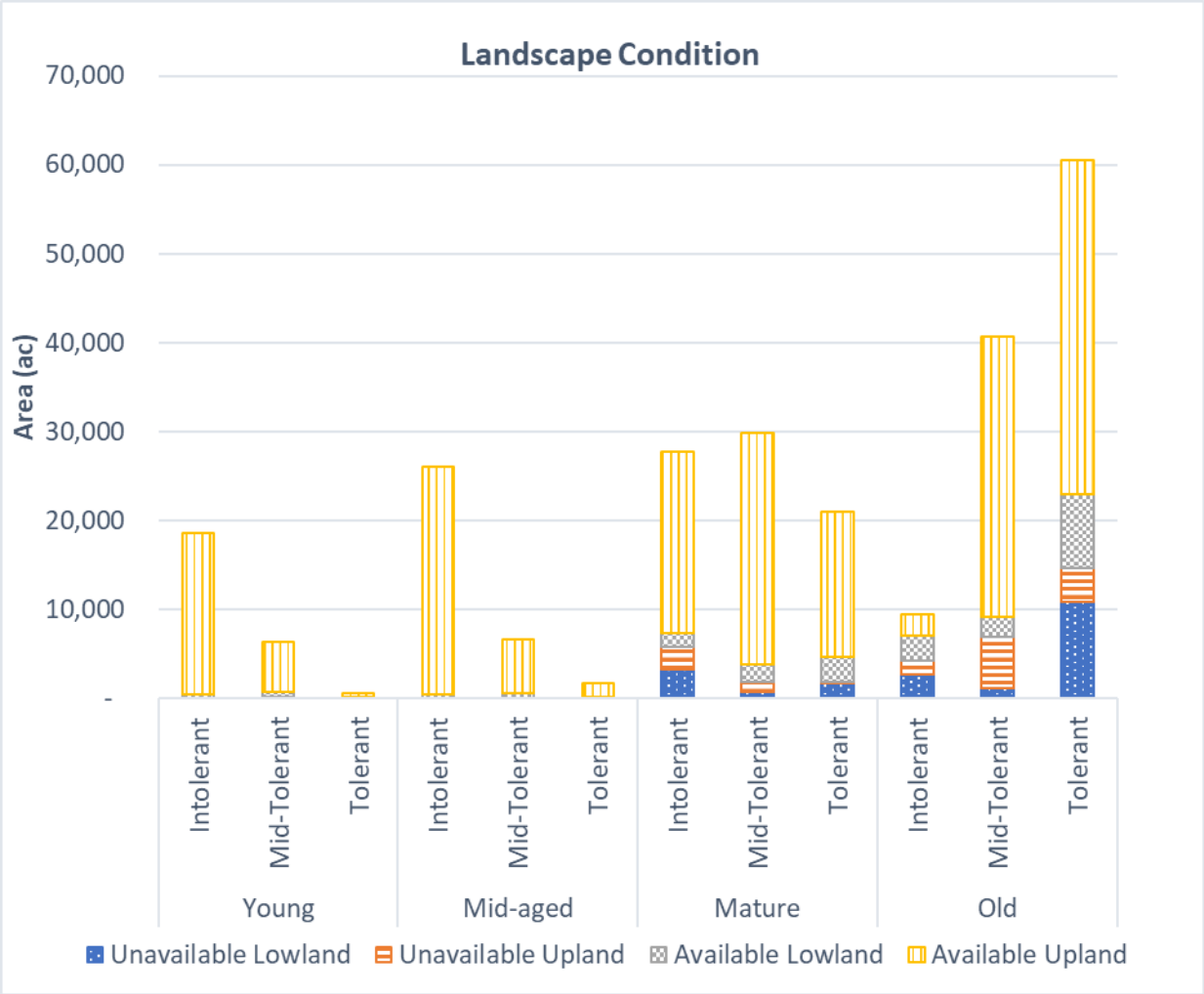


Figure 2. Forest diversity matrix showing the current distribution of forested acres across management availability, age category, landscape position and shade tolerance.

Landscape habitat conditions refine the management area landscape into featured species habitat context. Current and projected acres for the metrics identified in the management priorities (see Section 3) establish a baseline and future condition based on management over the planning period (Table 1).

Table 1. Current and projected acres for landscape habitat conditions.

Landscape Habitat Condition	Monitoring Metric	Current Acres
Young forest	Acres of 0- to 19-year stands in aspen and jack pine	7,758
Mature forest	Acres of 80-plus-year year stands across cover types	110,610
Mature forest	Acres of 120-plus-year stands across cover types	36,127
Mesic conifer cover types	Acres of mesic conifer cover types	39,075
Mesic conifers in other cover types	Average canopy occupancy	49%
Mast – oak cover types	Acres of oak cover types	419
Mast tree species in other cover types	Acres of total canopy occupancy of mast tree acres (trace-100%)	26,329
Big trees	Acres of total canopy stand occupancy of species in sawlog or greater size class	138,062
Nonforested openings	Acres of total herbaceous open land, upland shrub and crop land	14,125
Landscape forest matrix	Percent deciduous forest	30%
Landscape forest matrix	Percent coniferous forest	64%

Other important landscape-level habitat in this management area includes large opening complexes, coastal habitat and natural pine communities.

Large opening complexes

Because opening complexes were not included within the State Forest Management Plan model, it should be noted that there are no future predicted acres for this habitat type. This does not mean that these areas are not intended to be managed. Within the Grand Marais Moraine Complex, there are several areas that are suitable and are maintained as habitat for sharp-tailed grouse and other wildlife species like Kirtland's warbler, upland sandpiper and white-tailed deer, including Kingston Plains, Stanley Lake, Dutch Fred Lake, Danaher Plains, and the Sleeper Lake Fire and Duck Lake Fire areas.

Coastal habitat

The Great Lakes, particularly coastal and nearshore areas, provide globally or continentally important stopover sites for all groups of migratory birds: waterfowl, shorebirds, land birds (defined here as songbirds and raptors) and waterbirds (loons, grebes, cormorants, herons, rails, cranes, gulls and terns) (Ewert, et al., 2012). The Great Lakes shoreline provides essential stopover habitat for birds to rest, feed and shelter during migration. In addition to migration, the diverse coastal habitats where water and land meet provide unique habitats for breeding birds. Some of these areas are classified by Michigan Audubon as important bird areas, including Whitefish Point, where thousands of birds migrate through every spring and fall. Furthermore, the entire shoreline from Whitefish Point to Grand Marais is critical habitat for piping plover. The Great Lakes shoreline is habitat for several rare plant species that are endemic to the Great Lakes.

Forest management and other intrusive activities within a mile of the coastline need to consider the potential impacts to migratory birds and breeding bird habitat.

Natural pine habitat

The Grand Marais Management Area has the largest amount of natural red, natural white and mixed pine (dry northern forest natural community) acres in the Upper Peninsula. These areas generally have a well-developed shrub layer and larger standing and down dead trees, providing habitat for shrub-nesting birds, secondary cavity-nesting species (birds, American marten, northern flying squirrel) and small mammals that provide a food base for predators such as American martens, owls and other forest raptors. Natural red and white pine trees can function as nesting cover for numerous bird species including pine sisken, yellow-rumped warbler, pine warbler, red crossbill and white-winged crossbill. This habitat can be important for winter migrants because of the energetic advantage provided by dense foliage. Young trees, where there are dense branches close to the ground, provide thermal protection and protection from avian predators for many wildlife species, such as ruffed and spruce grouse.

Legacy trees (usually red pine or white pine) in these stands are structurally complex, with large branch systems, thick bark, buttressed roots and cavities creating niche habitats for species such as bats, insect-gleaning birds, and perching and nesting forest raptors, and they provide escape trees for black bears. Larger trees provide a more reliable seed source for species such as red-crossbill, migrant pine grosbeak and red squirrel. Both red and white pine are long-lived and can reach ages of 200-450 years.

Special analysis units

The Grand Marais Morais Moraine Management Area has the following special analysis units. These SAUs have specific cover-type goals, typically associated with wildlife habitat management. For any SAUs that overlap with this management area, SAU cover type goals take priority. See Section 5 for a detailed description of the management direction and harvest goals for each of these SAUs.

- Deer wintering complex – Cusino
- Grouse Enhancement Management Site – Halifax
- Grouse Enhancement Management Site – Melstrand
- Deer wintering complex – McMillan Ten Curves
- Deer wintering complex – Hulbert Hendrie Sage River

The Grand Marais Moraine Complex Management Area is comprised of 83% forested cover types and 17% nonforested cover types. Of the forested cover types, 70% are in the upland landscape position and 13% are in the lowland landscape position. The largest contributors to upland cover types are northern hardwoods, natural jack pine, aspen and planted red pine. The largest cover types in terms of area in the lowland landscape position are lowland conifers, cedar and lowland spruce/fir. Lowland shrub is the most common nonforested cover type in the management area, representing 5% of the landscape (Table 2).

Table 2. Summary table describing the current landscape context and distribution of cover types.

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
Forested	Upland	Deciduous	Aspen	22,309	74,461	220,728	264,156
			Northern hardwood	43,676			
			Black/red hybrid oak	0			
			Northern red oak	364			
			Oak mix	841			
			Mixed upland deciduous	7,271			
		Mixed	Upland mixed forest	11,089	11,089		
		Coniferous	Planted red pine	21,844	135,177		
			Planted jack pine	17,705			
			Planted white pine	263			
			Planted mixed pine	921			
			Natural red pine	16,269			
			Natural jack pine	39,104			
			Natural white pine	13,594			
			Natural mixed pines	14,800			
			Upland spruce/fir	1,315			
			Upland conifers	7,865			
			Hemlock	1,498			
	Lowland	Deciduous	Lowland aspen/balsam poplar	650	4,475	43,428	
			Lowland deciduous	3,825			
		Mixed	Lowland mixed forest	3,919	3,919		
		Coniferous	Cedar	10,967	35,035		
			Lowland conifers	13,669			
			Lowland spruce/fir	9,317			
			Tamarack	1,082			
Nonforested	Upland	N/A	Herbaceous open land	8,905	N/A	19,081	52,881
			Upland shrub	5,133			
			Low-density trees	3,149			
			Bare/sparsely vegetated	811			
			Cropland	87			
			Urban	995			
	Lowland	N/A	Lowland shrub	15,281	N/A	33,800	
			Marsh	4,865			
			Bog	2,836			
			Treed bog	5,106			
			Water	5,713			
						Grand total:	**317,037**

There are 228,302 acres (72% of the total management area and 86% of the forested area) that can be managed toward desired future conditions via commercial timber harvest in the Grand Marais Moraine Complex Management Area (Table 3). Of that, just under 16% is in the northern hardwood cover type, almost 14% is natural jack pine, while aspen and planted red pine cover just over 8% each. The remaining cover types each represent less than 6% each, for a total of 33.8% of the forested and available land in the management area.

Table 3. Current cover type composition by management availability.

GRAND MARAIS MORAINE COMPLEX Forested Cover Type	Available Acres	Available %	Unavailable Acres	Unavailable %	Total Acres	Total %
Aspen	22,027	8.3%	283	0.1%	22,310	8.4%
Cedar	4,598	1.7%	6,369	2.4%	10,967	4.2%
Hemlock	1,081	0.4%	417	0.2%	1,498	0.6%
Lowland aspen/balsam poplar	613	0.2%	38	0.0%	650	0.2%
Lowland conifers	7,247	2.7%	6,422	2.4%	13,669	5.2%
Lowland deciduous	2,696	1.0%	1,129	0.4%	3,825	1.4%
Lowland mixed forest	3,003	1.1%	917	0.3%	3,920	1.5%
Lowland spruce/fir	4,326	1.6%	4,992	1.9%	9,318	3.5%
Mixed upland deciduous	6,290	2.4%	982	0.4%	7,272	2.8%
Natural jack pine	36,450	13.8%	2,656	1.0%	39,106	14.8%
Natural mixed pines	12,961	4.9%	1,839	0.7%	14,800	5.6%
Natural red pine	15,262	5.8%	1,007	0.4%	16,269	6.2%
Natural white pine	12,273	4.6%	1,323	0.5%	13,596	5.1%
Northern hardwood	41,419	15.7%	2,259	0.9%	43,678	16.5%
Northern red oak	296	0.1%	68	0.0%	364	0.1%
Oak mix	598	0.2%	243	0.1%	841	0.3%
Planted jack pine	17,368	6.6%	339	0.1%	17,707	6.7%
Planted mixed pine	846	0.3%	75	0.0%	921	0.3%
Planted red pine	21,568	8.2%	278	0.1%	21,845	8.3%
Planted white pine	263	0.1%	0	0.0%	263	0.1%
Tamarack	212	0.1%	870	0.3%	1,082	0.4%
Upland conifers	6,229	2.4%	1,636	0.6%	7,865	3.0%
Upland mixed forest	9,777	3.7%	1,314	0.5%	11,091	4.2%
Upland spruce/fir	718	0.3%	598	0.2%	1,316	0.5%
Grand total	**228,119**	**86.4%**	**36,054**	**13.6%**	**264,173**	**100.0%**

Table 4. Site conditions for unavailable acres.

Site Condition (Reason area is unavailable for commercial harvest)	Area (ac)	% of Unavailable Area
Conservation values	17,375	48.2%
Best management practices	3,739	10.4%
Unproductive	3,463	9.6%
Deer wintering area	2,594	7.2%
Wildlife concerns	1,665	4.6%
Blocked by obstacle	1,495	4.1%
Federal/state/local law	1,357	3.8%
Too wet	1,086	3.0%
Too steep	740	2.1%
Long-term retention	642	1.8%
Recreational/scenic	498	1.4%
Rare landforms	391	1.1%
Blocked by railroad	350	1.0%
Denied access	214	0.6%
Nonmilitary lease/easement	202	0.6%
Species of special concern or T&E	129	0.4%
Other DNR/division processes	73	0.2%
Other influence zones	43	0.1%
Total unavailable	**36,054**	**100.0%**

Projected 10-year cover type management actions

Each cover type in the Grand Marais Moraine Complex Management Area has unique age class and basal area class goals that describe the long-term desired future conditions. The calculated harvest levels needed during the first 10-year planning period are summarized in Table 5. These harvest levels are necessary to begin achieving long-term planning goals and establish a desirable amount of regeneration for the even-aged cover types over the 10-year period or help to achieve desired basal area distribution among uneven-aged cover types like northern hardwoods. Implementing these silvicultural regimes will yield 653,981 cords, the planned harvest volume for the decade (

Table 6).

Table 5. Ten-year planning period harvest goals (acres) by cover type and silvicultural regime.

Silvicultural Regimes								
Cover Type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Salvage Clearcut	Salvage Thinning	Grand Total
Northern hardwood	225	11,998	-	2,840	600	-	-	15,662
Planted red pine	1,813	-	3,028	-	-	-	-	4,840
Planted jack pine	4,410	-	-	-	-	-	-	4,410
Aspen	3,380	-	-	-	-	-	-	3,380
Natural jack pine	3,016	-	-	-	-	-	-	3,016
Upland conifers	1,562	-	-	-	447	-	-	2,009
Natural mixed pines	-	-	671	-	671	-	-	1,341
Mixed upland deciduous	926	98	-	-	167	-	-	1,192
Natural red pine	-	-	587	-	587	-	-	1,174
Lowland conifers	1,122	-	-	-	-	-	-	1,122
Upland mixed forest	950	-	-	-	-	-	-	950
Lowland spruce/fir	514	-	-	-	-	-	-	514
Natural white pine	-	-	200	-	192	-	-	392
Lowland deciduous	238	-	-	-	2	-	-	240
Lowland mixed forest	218	-	-	-	-	-	-	218
Lowland aspen/balsam poplar	169	-	-	-	-	-	-	169
Hemlock	-	119	-	-	-	-	-	119
Upland spruce/fir	103	-	-	-	-	-	-	103
Tamarack	49	-	-	-	-	-	-	49
Oak mix	43	-	-	-	-	-	-	43

Silvicultural Regimes								
Cover Type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Salvage Clearcut	Salvage Thinning	Grand Total
Planted mixed pine	-	-	17	-	-	-	-	17
Totals	**18,738**	**12,215**	**4,503**	**2,840**	**2,665**	**-**	**-**	**40,961**

Table 6. Projected 10-year harvest volume by species.

10-Year Estimated Harvest Volume Projection Grand Marais Moraine Complex Management Area Product	Species	Volume Planned *	Volume Prepared**
Pulpwood (cords)	Jack pine	128,324	120,624
	Mixed hardwood	106,056	99,693
	Red pine	39,340	36,980
	Mixed softwood	35,486	33,356
	Mixed aspen	27,189	25,557
	Mixed spruce	20,540	19,307
	White pine	9,401	8,837
	Mixed oak	4,793	4,506
	Pulpwood total	**371,128**	**348,860**
Sawtimber (MBF)	Red pine	57,670	54,210
	Sugar maple	41,167	38,697
	White pine	19,006	17,866
	Red maple	18,034	16,952
	Mixed aspen	8,508	7,997
	Red oak	5,619	5,282
	Basswood	4,629	4,351
	Mixed oak	1,029	968
	White oak	1,018	957
	Sawtimber total	**156,681**	**147,280**
	Total sawtimber harvest volume in cords	**324,597**	**305,121**
	Grand total harvest volume in cords	**695,725**	**653,981**

*Volume estimates based on 100% of the projected harvests for the 10-year planning period.

**Volume estimates based on 94% of the projected harvests for the 10-year planning period accounting for reduction in acres and associated volume once sales are prepared for bid.

There are some cover type transitions projected for the Grand Marais Moraine Complex Management Area (*Table 7*). The largest transition is projected for planted jack pine and upland conifers. Planted jack pine is projected to decrease by approximately 3%, and upland conifers are projected to decrease by nearly 7%. A significant amount of the planted jack pine area will transition to natural jack pine or other

cover types like upland mixed forest, whereas a portion of upland conifers is projected to become more diverse and transition to upland mixed cover types or other upland cover types with more deciduous species. Planted red pine is also projected to increase by 2%, whereas natural red pine, white pine and mixed pine are projected to remain stable. Other cover types are projected to remain fairly stable, as treatment regimens will not significantly change the amount of area in each cover type.

Table 7. Projected 10-year cover type acres resulting from cover type transitions.

Cover Type	Current Acreage	Projected Acreage at End of 10-Year Planning Period	Projected 10-Year Change in Acreage
Northern hardwood	43,676	43,768	93
Natural jack pine	39,104	41,586	2,483
Aspen	22,309	22,598	289
Planted red pine	21,844	22,364	520
Planted jack pine	17,705	14,638	-3,066
Natural red pine	16,269	16,269	0
Natural mixed pine	14,800	14,800	0
Lowland conifers	13,669	13,644	-25
Natural white pine	13,594	13,594	0
Upland mixed forest	11,089	11,391	302
Cedar	10,967	10,967	0
Lowland spruce/fir	9,317	9,180	-137
Upland conifers	7,865	7,317	-547
Mixed upland deciduous	7,271	7,253	-19
Lowland mixed forest	3,919	4,106	187
Lowland deciduous	3,825	3,797	-27
Hemlock	1,498	1,498	0
Upland spruce/fir	1,315	1,261	-54
Tamarack	1,082	1,074	-8
Planted mixed pine	921	921	0
Oak mix	841	841	0
Lowland aspen/balsam poplar	650	660	10
Northern red oak	364	364	0
Planted white pine	263	263	0
Black/red hybrid oak	0	0	0
Lowland shrub	15,281	15,281	0
Herbaceous open land	8,905	8,905	0
Water	5,713	5,713	0
Upland shrub	5,133	5,133	0
Treed bog	5,106	5,106	0
Marsh	4,865	4,865	0

Cover Type	Current Acreage	Projected Acreage at End of 10-Year Planning Period	Projected 10-Year Change in Acreage
Low-density trees	3,149	3,149	0
Bog	2,836	2,836	0
Urban	995	995	0
Bare/sparsely vegetated	811	811	0
Cropland	87	87	0
Total:	**317,037**	**317,037**	**0**

Featured species current and projected habitat acres

There are 14 featured species in this management area that span various cover types, age classes and stand-level conditions.

As noted in the featured species management priority (Section 3), it is recommended that these featured species habitat acres be viewed as acres of potential habitat, representing a condition on the landscape where the more nuanced aspects of each species' habitat requirements are likely to be found or managed for. As described in the introduction, the modeling effort was limited by several factors, including the simplification of habitat attributes into MiFI variables. Therefore, when referring to habitat acres, these are potential habitat acres.

Current and projected total habitat acres by species across the decade provide a baseline and show the result of long-term management actions (Table 8). Some species show a loss in habitat over the next century. As mentioned in the featured species management priority (Section 3), the current condition for many cover types is a surplus of acres in the 0-9 age class from the compensatory management approach applied in the previous decade. The model eventually evens out the age classes at a lower, sustainable level over time, usually by 50 years. For any species with northern hardwoods as a priority cover type, there is a perceived drop in acres between 40 and 60 years; this is due to the basal area dropping below 81, but because it only drops into the upper 70s, it is not expected to translate to any real habitat loss on the ground. Three of these species were not included in the State Forest Management Plan model but are included here to inform management decisions over the decade.

Table 8. Featured species current and projected total habitat acres (i.e., potential habitat).

Featured Species	Priority Cover Types	Total Habitat Acres Current	10-Year Projected Habitat Acres	50-Year Projected Habitat Acres	100-Year Projected Habitat Acres
Black bear	Mast	26,329	--	--	--
Black-backed woodpecker	Natural disturbance	--	--	--	--

Featured Species	Priority Cover Types	Total Habitat Acres Current	10-Year Projected Habitat Acres	50-Year Projected Habitat Acres	100-Year Projected Habitat Acres
Blackburnian warbler	Northern hardwoods, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, hemlock	59,201	73,536	64,569	88,985
Black-throated blue warbler	Northern hardwoods, mixed upland deciduous	29,387	39,660	22,623	40,118
Kirtland's warbler	Jack pine (planted and natural)-Danaher/Kingston plains, Duck Lake, Whitefish Point	22,779	21,858	14,684	14,540
Marten U.P.	Northern hardwoods, mixed upland deciduous, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, lowland mixed forest, lowland conifers, hemlock, cedar	78,229	93,957	84,290	109,046
Moose	To be determined	--	--	--	--
Red crossbill	Natural red pine, natural white pine, natural mixed pine, planted red pine	8,087	8,024	11,937	19,943
Ruffed grouse	Aspen	7,239	6,870	7,561	7,838

Featured Species	Priority Cover Types	Total Habitat Acres Current	10-Year Projected Habitat Acres	50-Year Projected Habitat Acres	100-Year Projected Habitat Acres
Sharp-tailed grouse	Nonforested openings	40,410	--	--	--
Snowshoe hare	Aspen, cedar, hemlock, lowland aspen, lowland conifers, lowland mixed forest, lowland spruce/fir, mixed upland deciduous, natural jack pine, natural mixed pines, planted jack pine, upland spruce/fir	39,295	39,492	27,281	27,530
Spruce grouse, mature	Natural jack pine, natural white pine, natural mixed pine, upland conifer, upland spruce/fir, lowland spruce/fir, lowland conifer, tamarack	41,262	40,649	60,612	67,147
Spruce grouse, young	Jack pine (natural and planted)	22,779	21,858	14,683	14,540
Wood turtle	Nonforest openings	--	--	--	--
White-tailed deer (food)	Northern hardwood, oak mix, aspen, mixed upland deciduous, lowland deciduous, lowland aspen/balsam poplar, lowland mixed forest	93,944	94,763	96,375	99,089

Featured Species	Priority Cover Types	Total Habitat Acres Current	10-Year Projected Habitat Acres	50-Year Projected Habitat Acres	100-Year Projected Habitat Acres
White-tailed deer (shelter)*	Hemlock, cedar, planted red pine, planted white pine, planted mixed pine, natural red pine, natural white pine, natural mixed pines, upland conifers, upland spruce fir, lowland conifers	112,321	112,094	113,269	112,395

*Deer wintering complexes greater than 15,000 acres are modeled as a special analysis unit, or SAU, and information on them can be found in Section 5 of the plan. In deer wintering complexes less than 15,000 acres, harvest of cedar and hemlock is not allowed within range stands essential for deer survival, and secondary shelter is often protected as well. These areas are guided by the DNR Deer Winter Range Guidelines.

Cover type composition and associated featured species

Northern hardwoods

Current condition

Most of the northern hardwood cover type is currently between a stand age of 80 and 110 years old in the Grand Marais Moraine Complex Management Area (Figure 3). The past management regime has been primarily single tree selection, which allows for stand age to continue to increase over time. Some stands are beginning to achieve an uneven-aged condition, where a featured stand age becomes less evident, but the dominant age of these stands will likely increase beyond 150 years old prior to a younger age cohort becoming the prominent component of these stands (Figure 3).

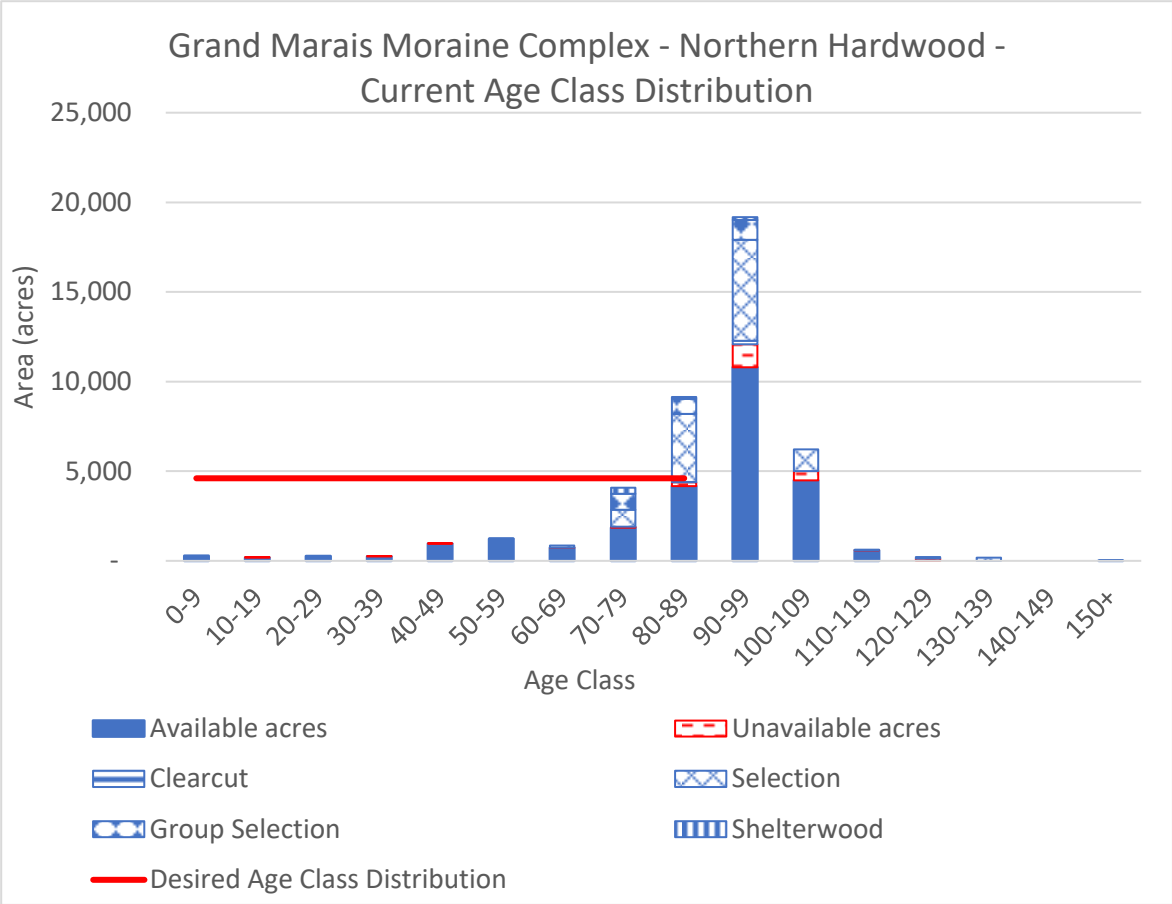


Figure 3. Current age class distribution and projected harvests in the northern hardwood cover type in the Grand Marais Moraine Complex Management Area.

The area of northern hardwood is well distributed in the ideal basal area classes for optimal growing conditions in the Grand Marais Moraine Complex Management Area (Figure 4). Current conditions are a result of beech salvage efforts in the previous planning period and a regular selection harvest regime across this cover type.

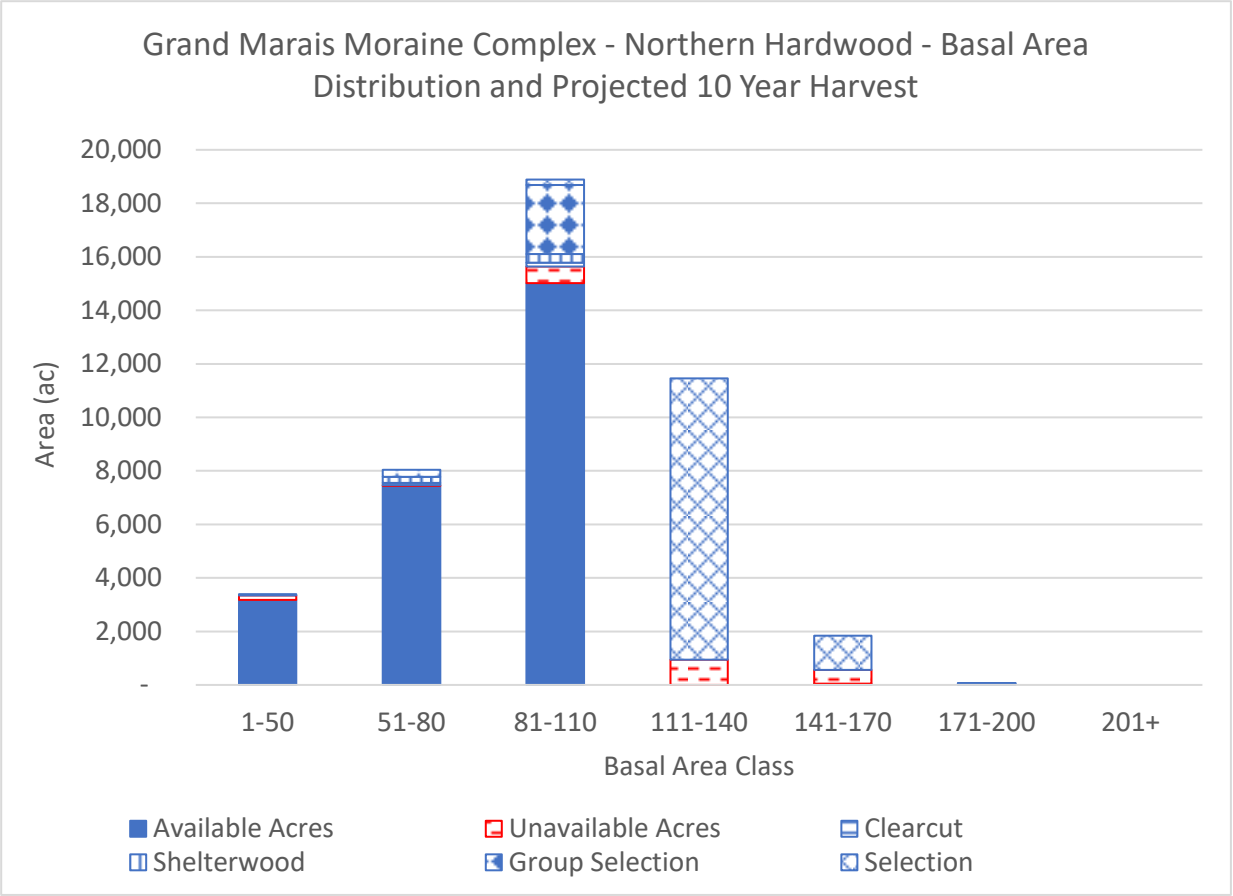


Figure 4. Current basal area distribution of the northern hardwood cover type as well as the projected harvests from each basal area class.

There are very few acres of unavailable northern hardwoods in the Grand Marais Moraine Complex Management Area. Selection is the primary silvicultural treatment projected during this 10-year planning period. There is a smaller amount of group selection prescribed, and there may be opportunities to utilize even-aged management silvicultural regimes to increase stem density, species composition and regeneration within the northern hardwood areas. A portion of this cover type meets the habitat requirements for black-throated blue warbler, blackburnian warbler and marten (Table 9).

Table 9. Featured species with northern hardwoods as a priority habitat cover type, habitat variables and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Northern Hardwood	Northern Hardwood Habitat Acres – Available	Northern Hardwood Habitat Acres – Unavailable
Blackburnian warbler	Age category: 80+ Size category: pole, sawlog Basal area: 81+	25,655	2,022
Black-throated blue warbler	Age category: 80+ Size category: sawlog	25,655	2,022

Featured Species	Featured Species Habitat – Northern Hardwood	Northern Hardwood Habitat Acres – Available	Northern Hardwood Habitat Acres – Unavailable
	Basal area: 81+		
Marten	Age category: 40+ Size category: pole, sawlog Basal area: 81+	25,655	2,022
White-tailed deer	All ages and size classes	43,676	--

Desired future condition

The projected long-term cover type trend for northern hardwood is slightly increasing in the Grand Marais Moraine Complex Management Area. There are few transitions into this cover type from other cover types forecasted and equally few transitions from northern hardwoods to other cover types in this management area.

The desired basal area distribution is a bell-shaped curve, where a significant majority of the area is kept in the 81-110 basal area class, with recently harvested stands occupying the 51-80 class and stands that are ready for harvest occupying the 111-140 basal area class. Diameter distributions of the northern hardwood stands should follow the appropriate Q-curve relative to stand age and condition.

An uneven-aged condition is the long-term goal for all northern hardwood stands in this management area. An uneven-aged condition is achieved when there is no single discernable age cohort that is more prevalent than others across the stand area, as canopy gaps fill in with regenerating seedlings, saplings and poles and eventually remaining stems become sawlog-sized over time.

Regeneration and recruitment continue to be a focus in the northern hardwood cover type across this management area. The long-term sustainability of this cover type in an uneven-aged silvicultural regime is dependent on the successful establishment of northern hardwood species as well as the recruitment of those seedlings and saplings into the pole and sawlog classes. The Grand Marais Moraine Complex Management Area will take several decades to reach the desired future condition because of the impacts from beech bark disease. The amount of American beech that once occupied much of the northern hardwood stands has resulted in lower than normal residual basal area and decreased stocking levels across much of the eastern Upper Peninsula.

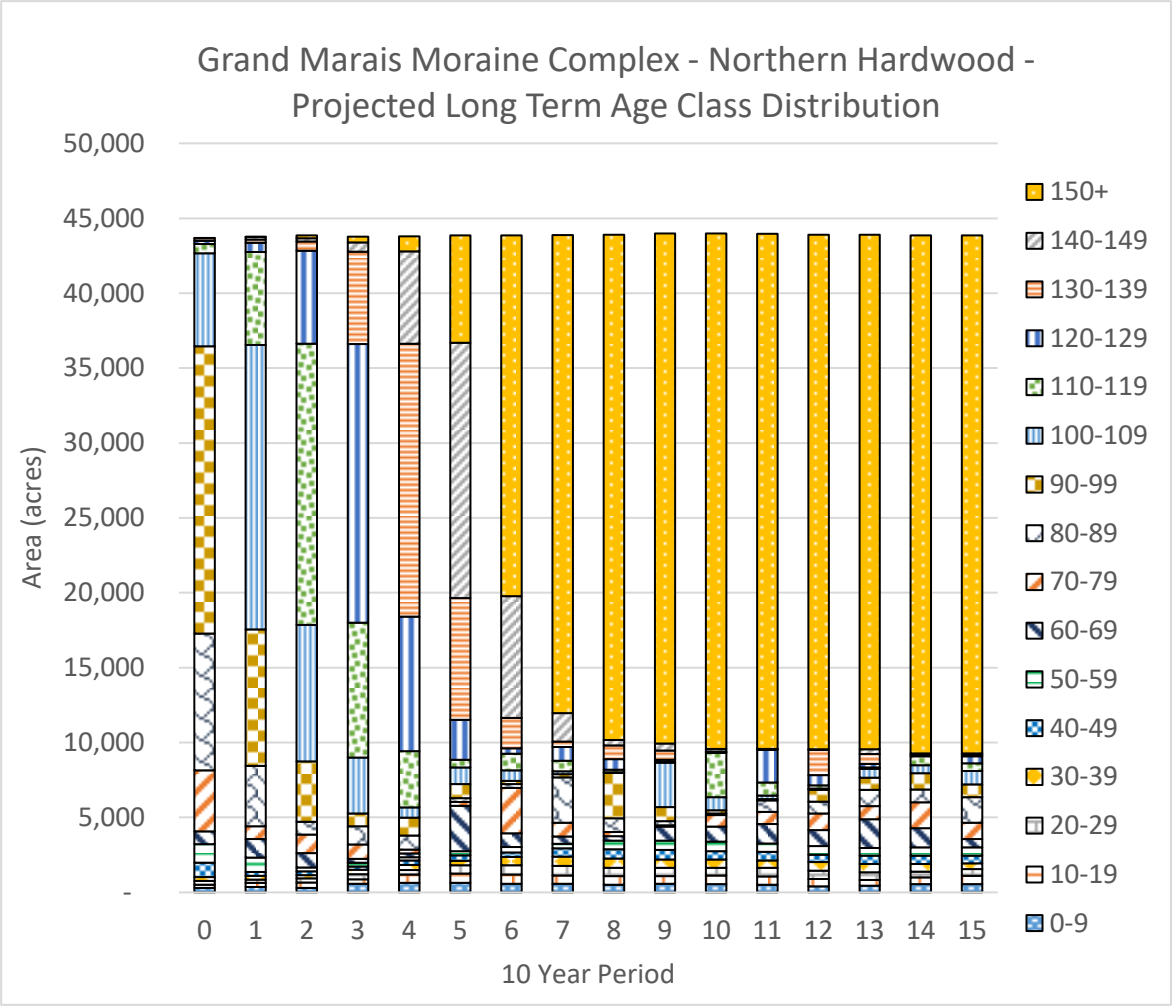


Figure 5. Projected age class distribution for all acres of jack pine over the next 150 years in the Grand Marais Moraine Complex Management Area.

Management actions

The desired forest conditions and associated featured species habitat will be maintained and achieved through continued application of the projected selection harvest regime over 11,998 acres (Table 5). Other silvicultural methodologies for the cover type are projected for this management area, with 2,840 acres of group selection, 600 acres of shelterwood and 225 acres of clearcut management. Multiple silvicultural regimes should continue to be considered as emerging research results become available. Emphasis on larger canopy gaps should be used to encourage diverse regeneration of northern hardwood species while maintaining an overall long-term mature forest, closed-canopy landscape condition.

Natural jack pine

Current condition

Most of the natural jack pine cover type is currently between stand ages of 0 and 49 years old in the Grand Marais Moraine Complex Management Area (Figure 6). The age class distribution is currently

unbalanced, especially in the 0- to 9-year-old age class, where there is an abundance of acres. There is a deficit in the 50-59 and 60-69 age classes, which will lead to a very slight deficit in the 0- to 9-year age class for the next planning period. A small number of acres extend beyond the desired maximum age class distribution, most of which are unavailable for harvest.

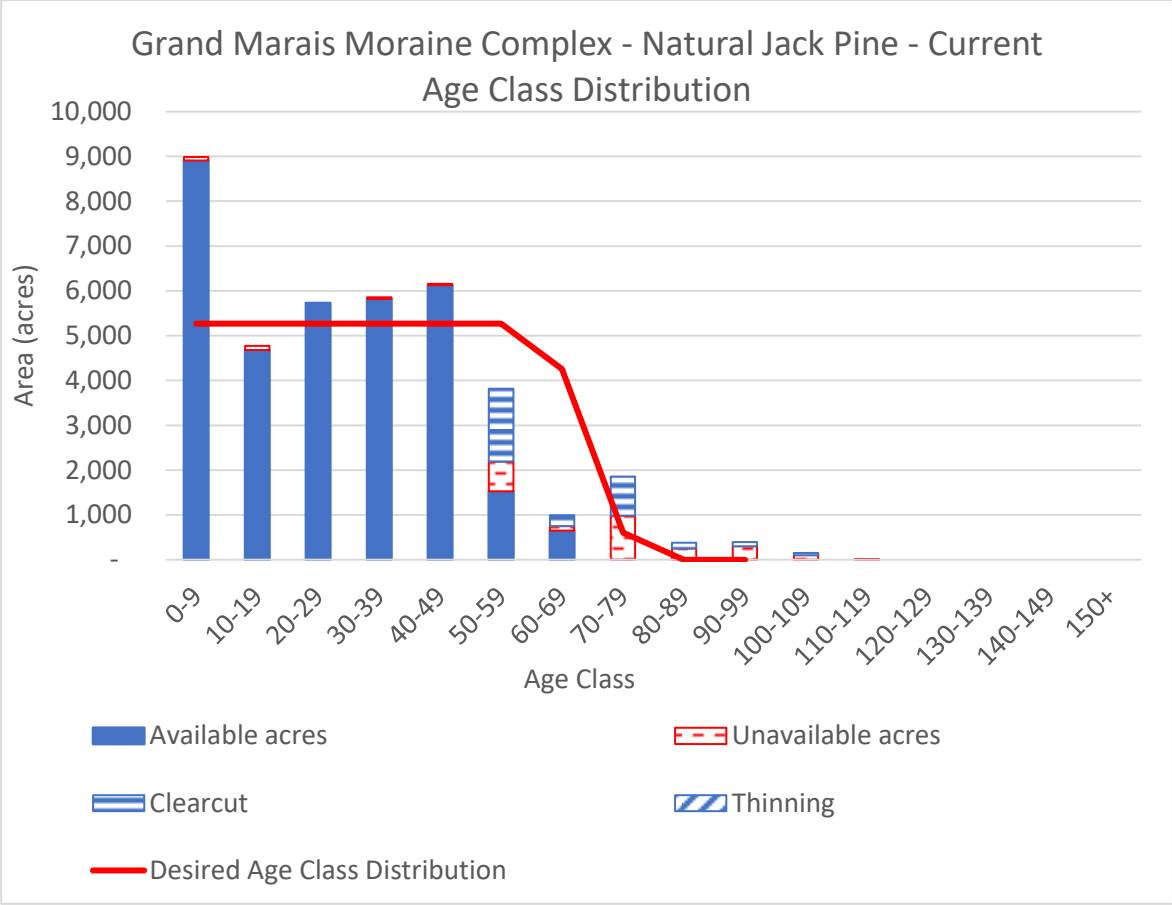


Figure 6. Current age class distribution and projected harvests in natural jack pine cover type in the Grand Marais Moraine Complex Management Area.

Current conditions are a result of consistent commercial harvests and regeneration efforts, an older age class of jack pine occurring on the landscape and thousands of acres that burned during the Duck Lake Fire in 2012. These factors contribute to the surplus of acres in the younger age classes and the balanced condition in the older age classes, where the deviation from the desired age class distribution is less than other cover types in this management area. A portion of this cover type meets the habitat requirements for Kirtland's warbler, snowshoe hare and spruce grouse. Jack pine habitat acres calculated for Kirtland's warbler are those acres found within outwash plains in the Danaher/Kingston plains, Duck Lake and Whitefish Point (

Table 10).

Table 10. Featured species with natural jack pine as a priority habitat cover type, habitat variables and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Jack Pine	Jack Pine Habitat Acres – Available	Jack Pine Habitat Acres – Unavailable
Kirtland's warbler	Age category: 0-19 Size category: sapling	11,057 (includes planted JP)	--
Snowshoe hare	Age category: 0-19 Size category: sapling	13,587	171
Spruce grouse, mature	Age category: 40+ Size category: pole, sawlog	4,775	1,654
Spruce grouse, young	Age category: 0-19	13,587	171

Desired future condition

The projected long-term cover type trend for natural jack pine shows a slight increase in the Grand Marais Moraine Complex Management Area due to transitions from planted jack pine into the natural jack pine cover type, although a stable long-term cover-type condition is desired, with equal transitions into and out of the cover type.

The long-term goal for this cover type is balanced age classes between 0 and 50 years old for all available jack pine stands in this management area. Maintaining lower acreage in old age classes continues to be desirable to lessen the prevalence and severity of jack pine budworm outbreaks and to reduce the threat of damaging wildfire.

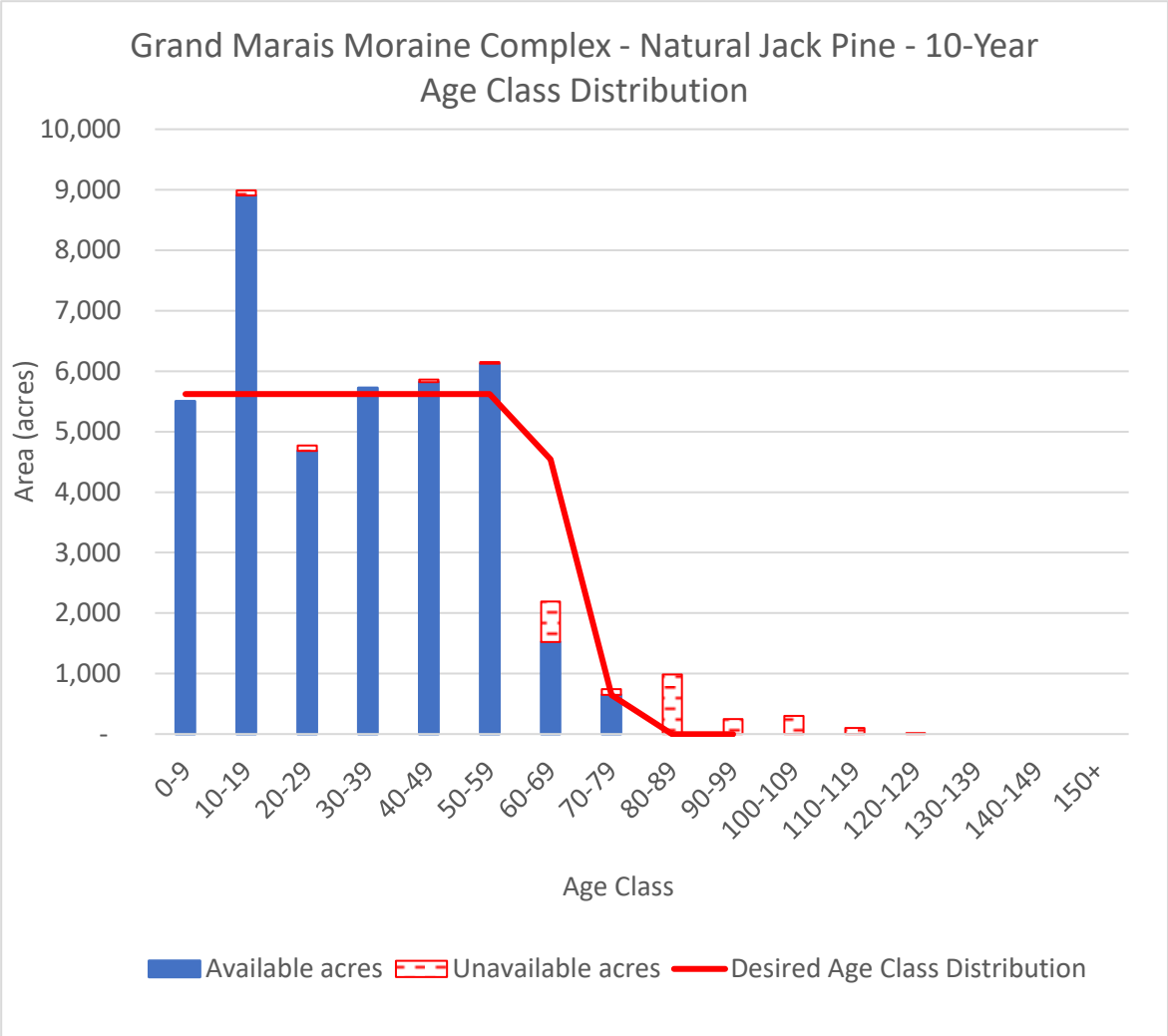


Figure 7. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The end of the planning period will result in the establishment of 5,503 acres of the 0-9 age class of natural jack pine, which is close to the desired age class distribution of 5,623. Progress toward the long-term desired age class distribution will take many decades of even-aged management to fully reach the desired age class distribution in this management area (Figure 8).

The midterm age class distribution of jack pine continues to reach closer to the desired future condition for available acres (Figure 8), carrying forward a notable abundance of 50- to 59-year-old stands from the Duck Lake Fire.

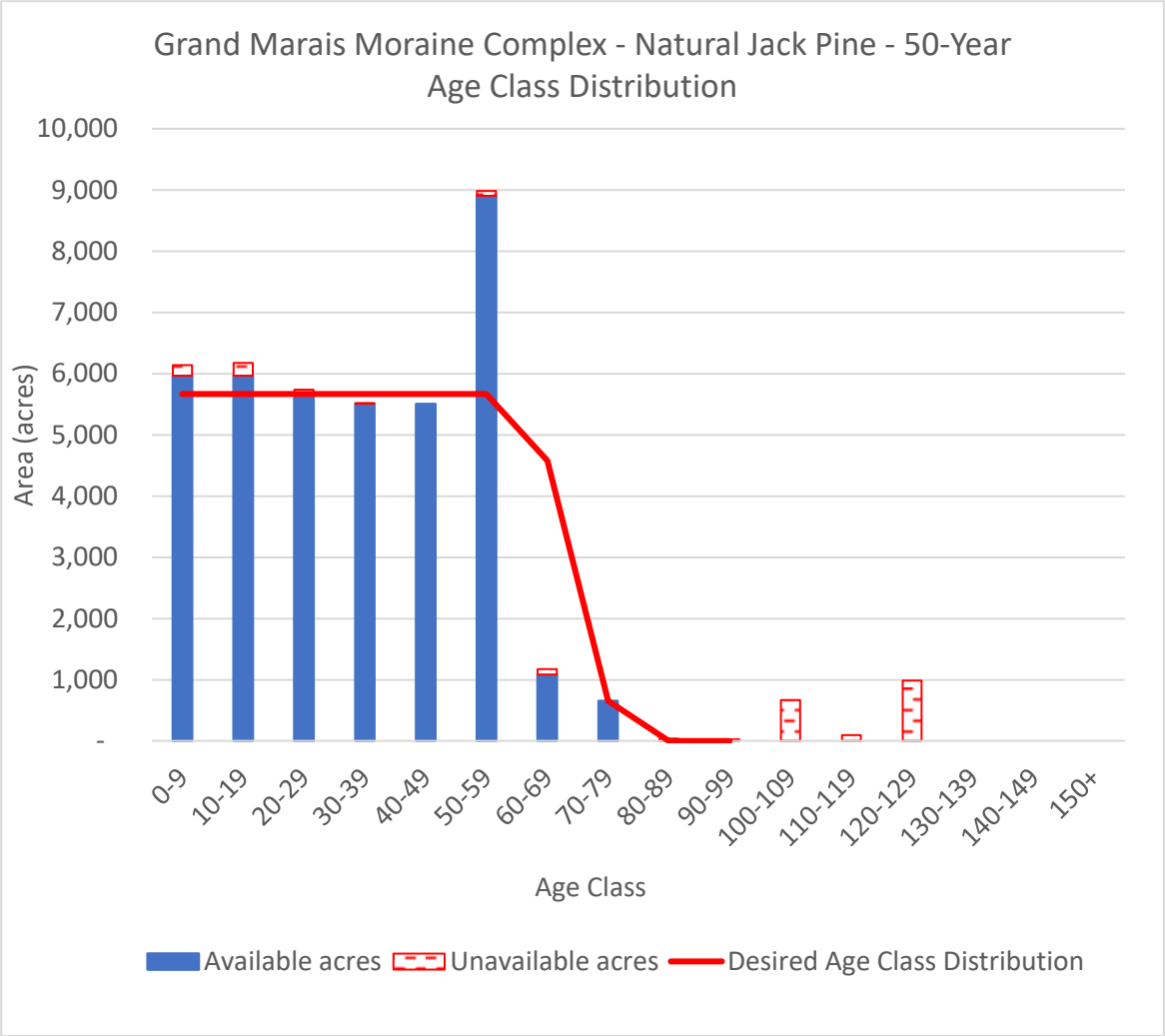


Figure 8. Projected midterm age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 9) will concentrate the manageable acres of jack pine in productive growing conditions while providing an even flow of forest products and a wide variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest. As the future acreage of the cover type is predicted to increase with time, desired age class distribution proportions will also increase.

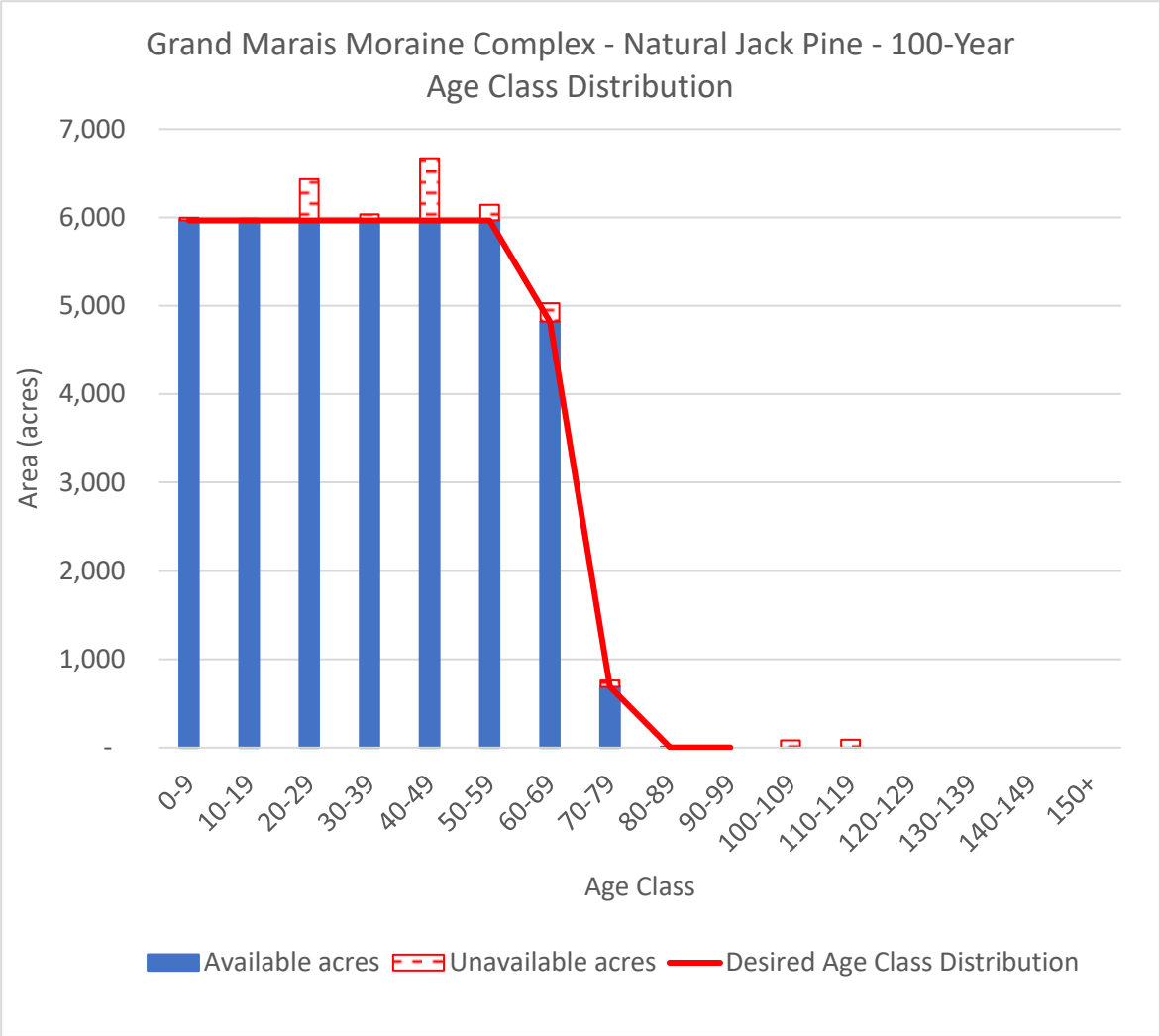


Figure 9. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

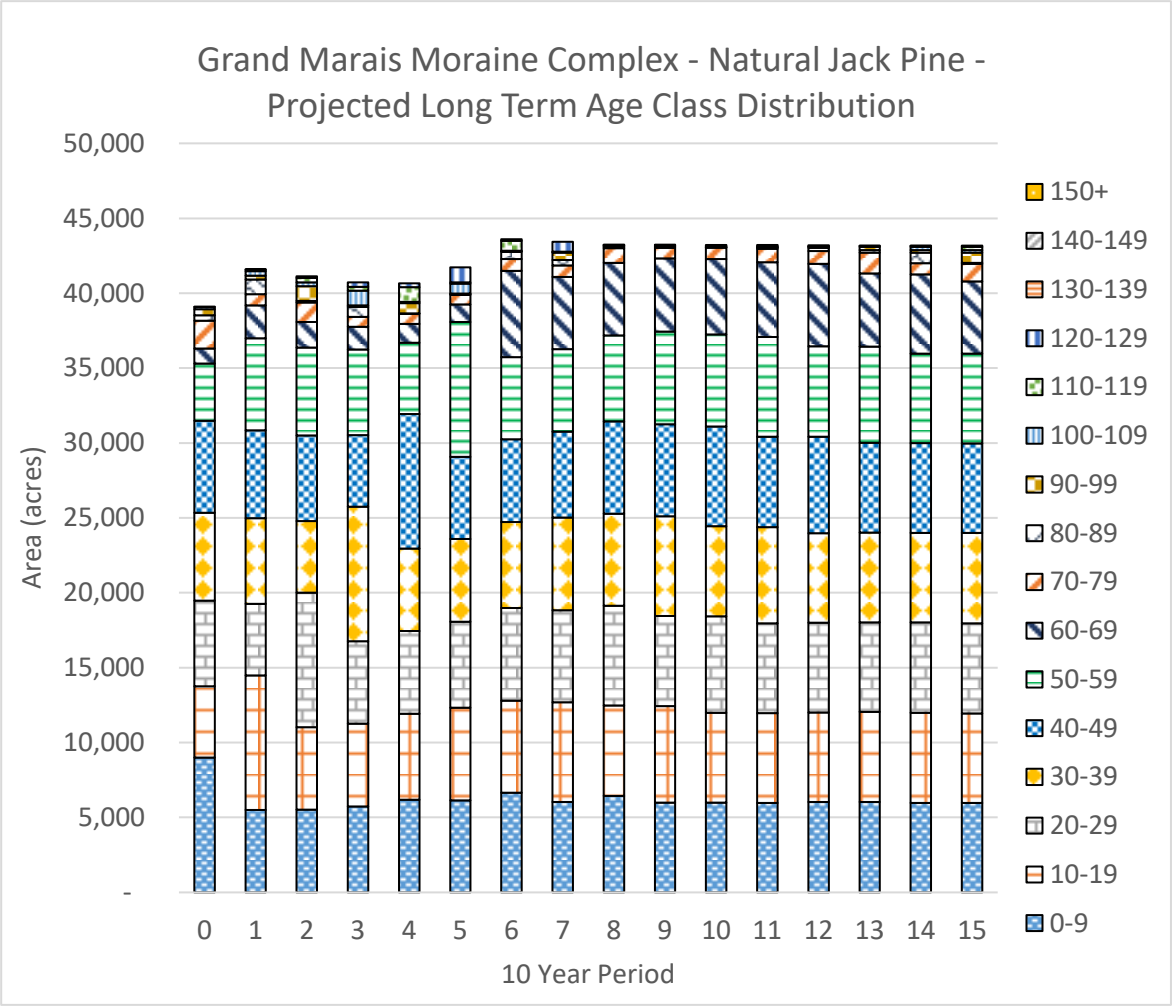


Figure 10. Projected age class distribution for all acres of jack pine over the next 150 years in the Grand Marais Moraine Complex Management Area.

Management actions

There are 3,016 acres of projected clearcut harvest in the natural jack pine cover type during the planning period. A significant proportion of the newly established future stands of this cover type are projected to result from a transition from other cover types, mainly planted jack pine through even-aged management and natural means of regeneration.

Aspen

Current condition

A majority of the aspen cover type is currently between stand ages of 0 and 39 years old in the Grand Marais Moraine Complex Management Area (Figure 11). The age class distribution is currently unbalanced, especially in the 30- to 39-year-old age class, where there is a surplus of acres. There is a deficit in the older age classes and a small number of acres that extend beyond the desired maximum age class distribution.

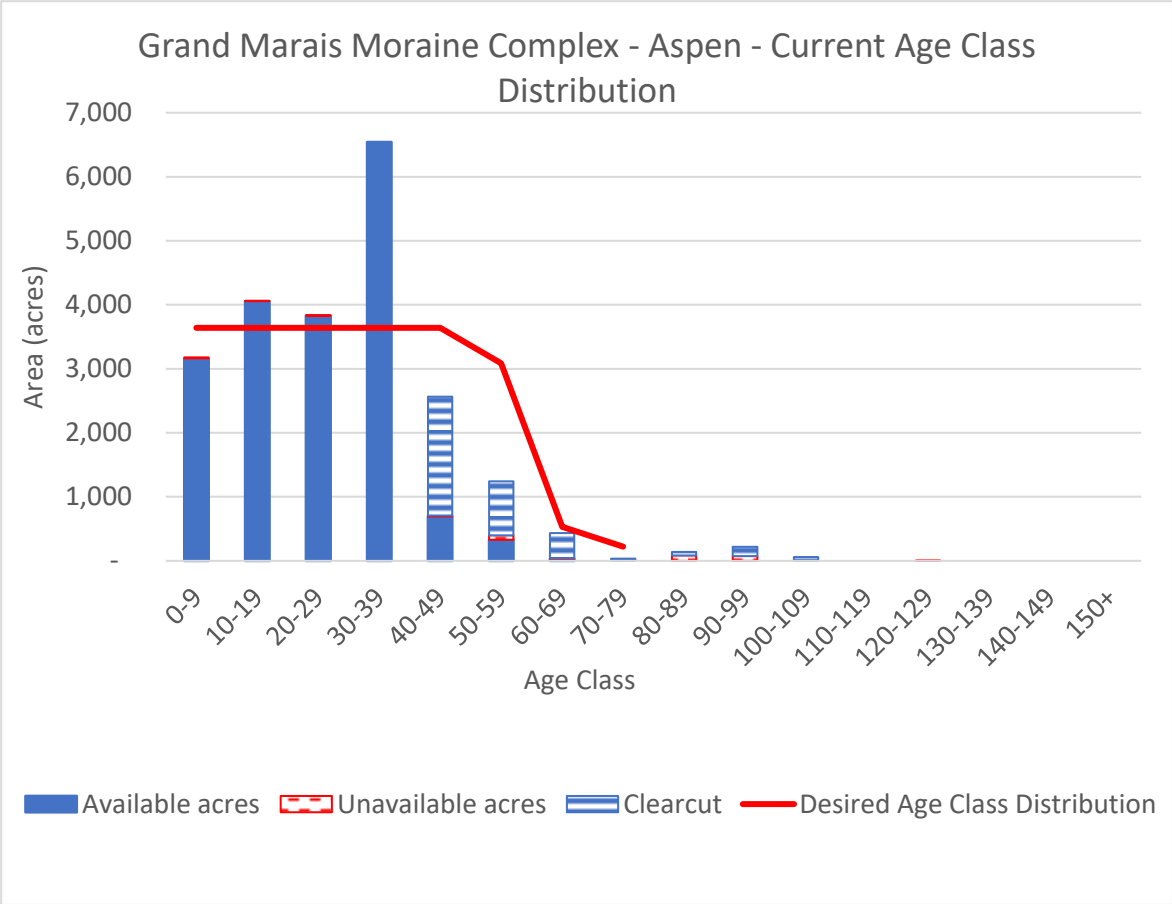


Figure 11. Current age class distribution and projected harvests in aspen cover type in the Grand Marais Moraine Complex Management Area.

Current conditions are a result of consistent commercial harvests and regeneration efforts on aspen acres during previous planning periods. Older age classes of aspen cover types and a higher desired age class distribution within the management area can be attributed to aspen occupying relatively fewer productive sites than in other management areas within the state. A portion of this cover type meets the habitat requirements for ruffed grouse and snowshoe hare (Table 11).

Table 11. Featured species with aspen as a priority habitat cover type, habitat variables and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Aspen	Aspen Habitat Acres – Available	Aspen Habitat Acres – Unavailable
Ruffed grouse	Age category: 0-19 Size category: sapling	7,221	19
Snowshoe hare	Age category: 0-19 Size category: sapling	7,221	19
White-tailed deer	All sizes and age classes	22,309	--

Desired future condition

The projected long-term cover-type trend for aspen is stable in the Grand Marais Moraine Complex Management Area. Much of the aspen area is available for active management, with few transitions into this cover type or out to other cover types. Habitat elements in this cover type will be preserved due to the abundance of adjacent cover types.

The long-term goal for this cover type is balanced age classes between 0 and 40 years old for all available aspen stands and a lower proportion of acreage in the 50-year-old and 60-year-old classes in this management area (Figure 12).

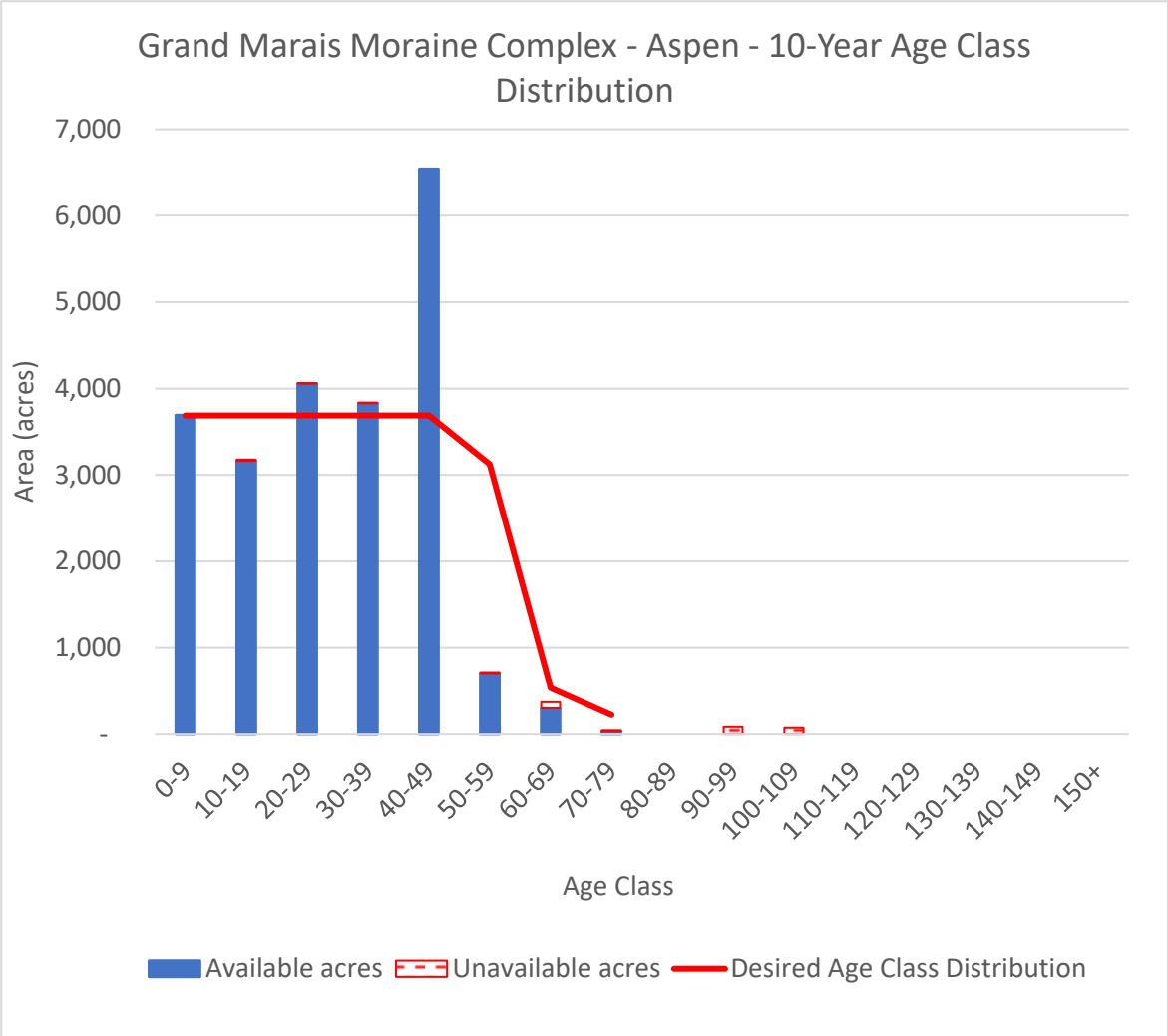


Figure 12. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The end of the planning period will result in the establishment of 3,692 acres of aspen in the 0-9 age class. Progress toward the long-term desired age class distribution of aspen begins to improve, but it will take many decades of even-aged management in this management area to reach the desired age class distribution (Figure 13).

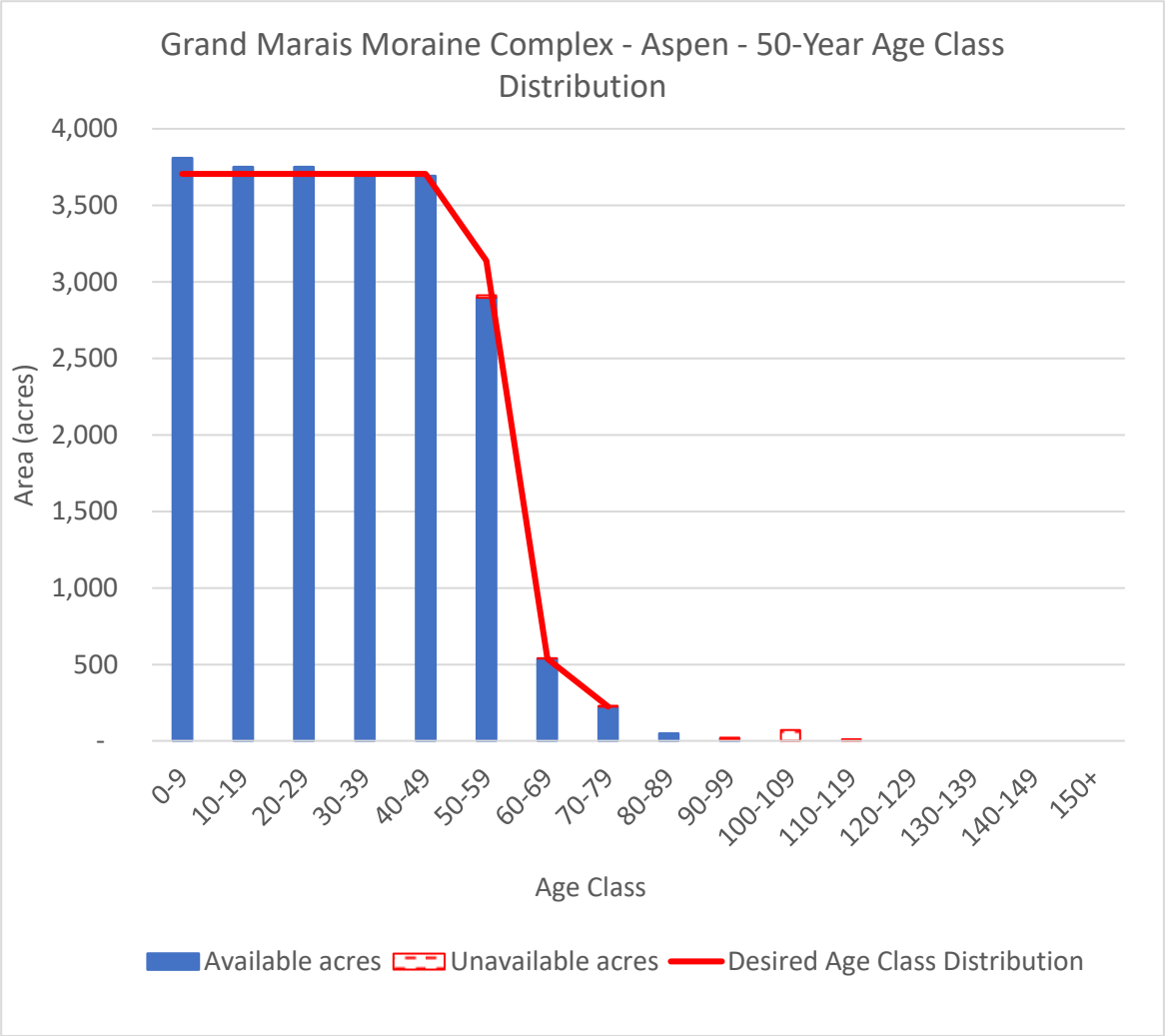


Figure 13. Projected midterm age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The midterm age class distribution of aspen is nearly at the desired future condition, with few age classes significantly deviating from the target proportions for available acres (Figure 13). There is a small number of acres beyond the max tail age of 70 years, most of which is unavailable for harvest or extended to balance the 0-9 age class.

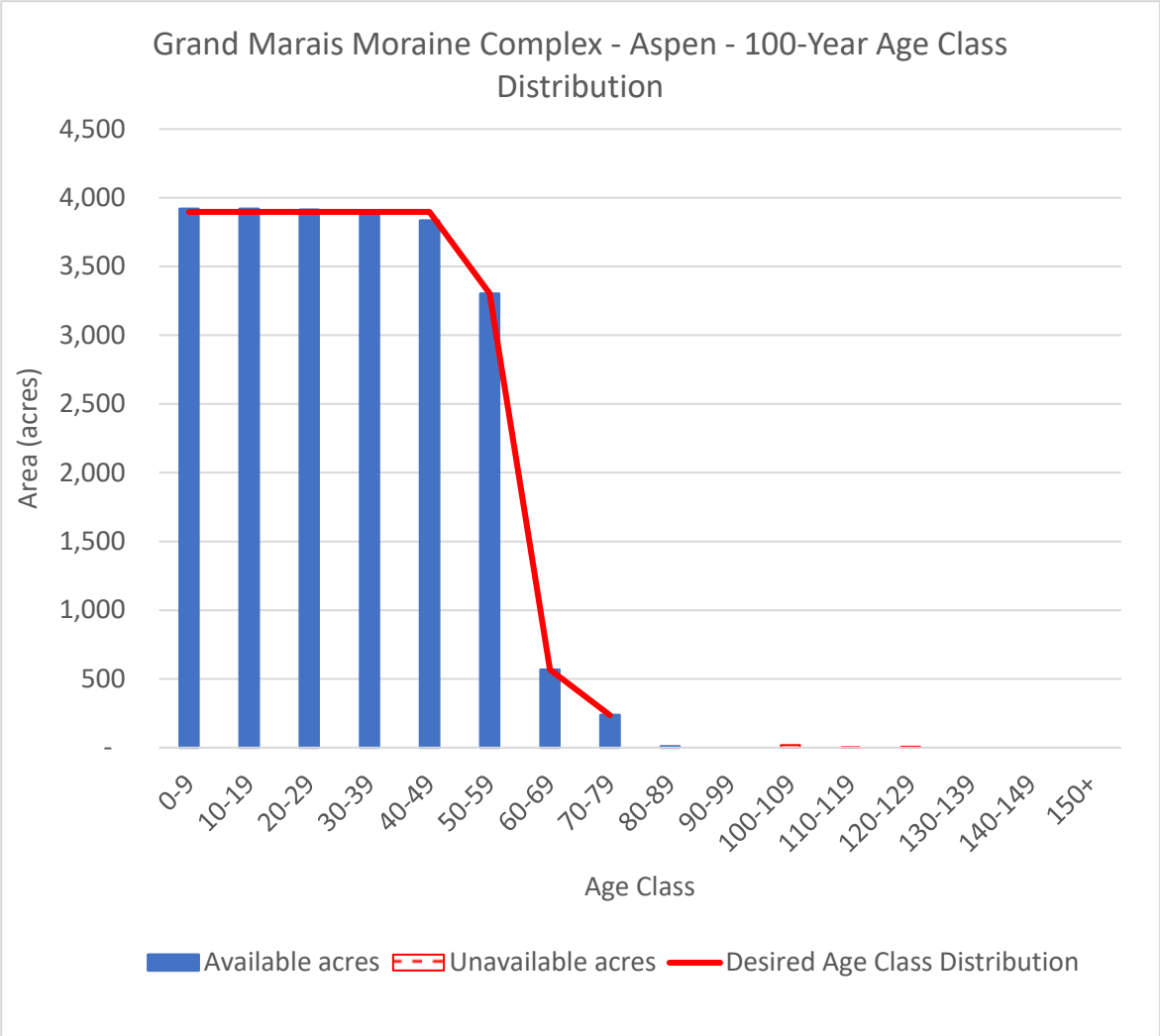


Figure 14. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 15) will concentrate the manageable acres of aspen in productive growing conditions while providing an even flow of forest products and a wide variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest.

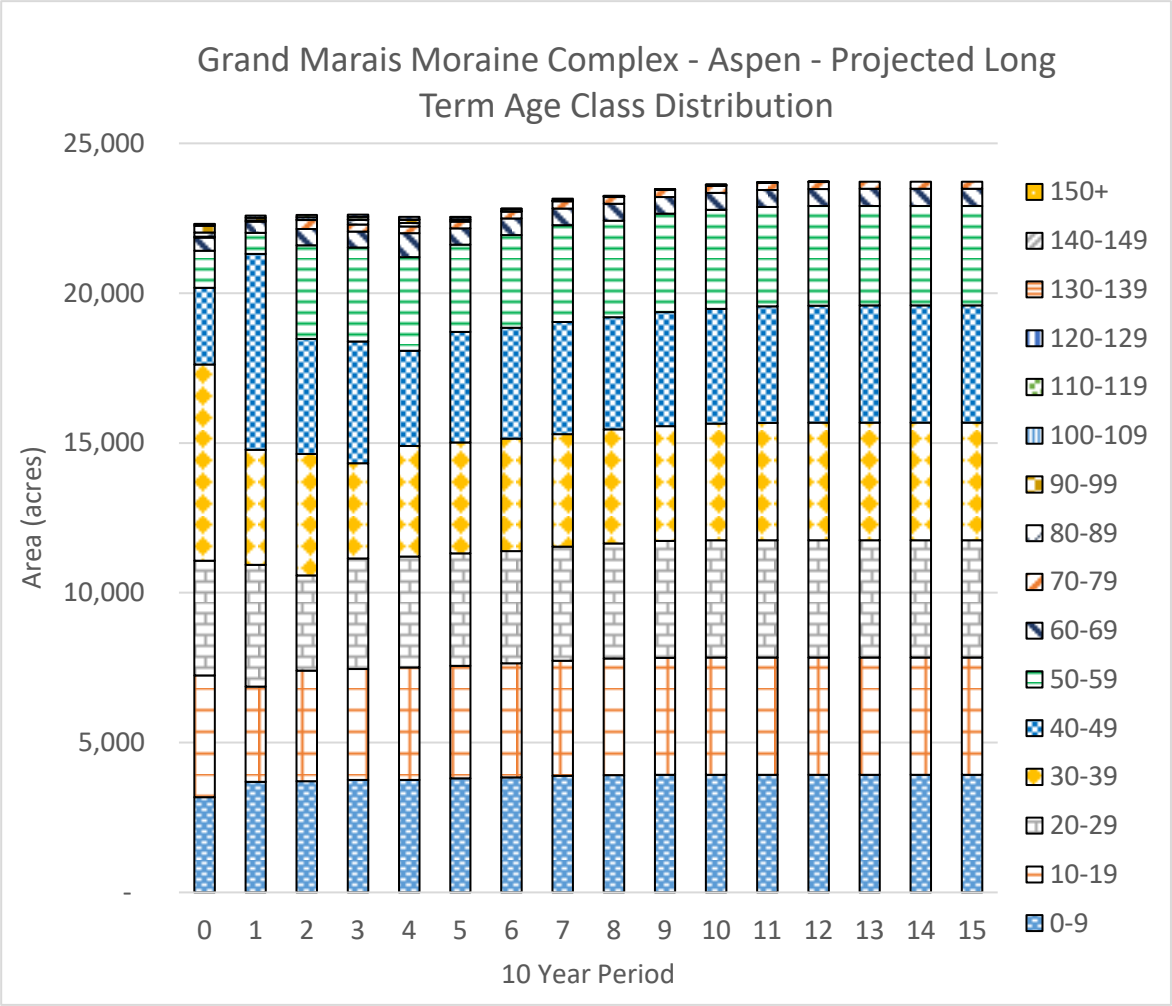


Figure 15. Projected age class distribution for all acres of aspen over the next 150 years in the Grand Marais Moraine Complex Management Area.

Management actions

There are 3,380 acres of projected clearcut harvest in the aspen cover type during the planning period. This falls slightly short of the desired establishment of 3,687 acres of aspen per decade. Transitions to aspen from other cover types accounts for the rest of the desired establishment.

Planted red pine

Current condition

Most of the planted red pine cover type is currently between stand ages of 0-9 years old and 60-69 years old in the Grand Marais Complex Management Area (Figure 16). The age class distribution is currently very unbalanced across all age classes, with the largest deficits between the 30- to 39-year-old and the 40- to 49-year-old age classes.

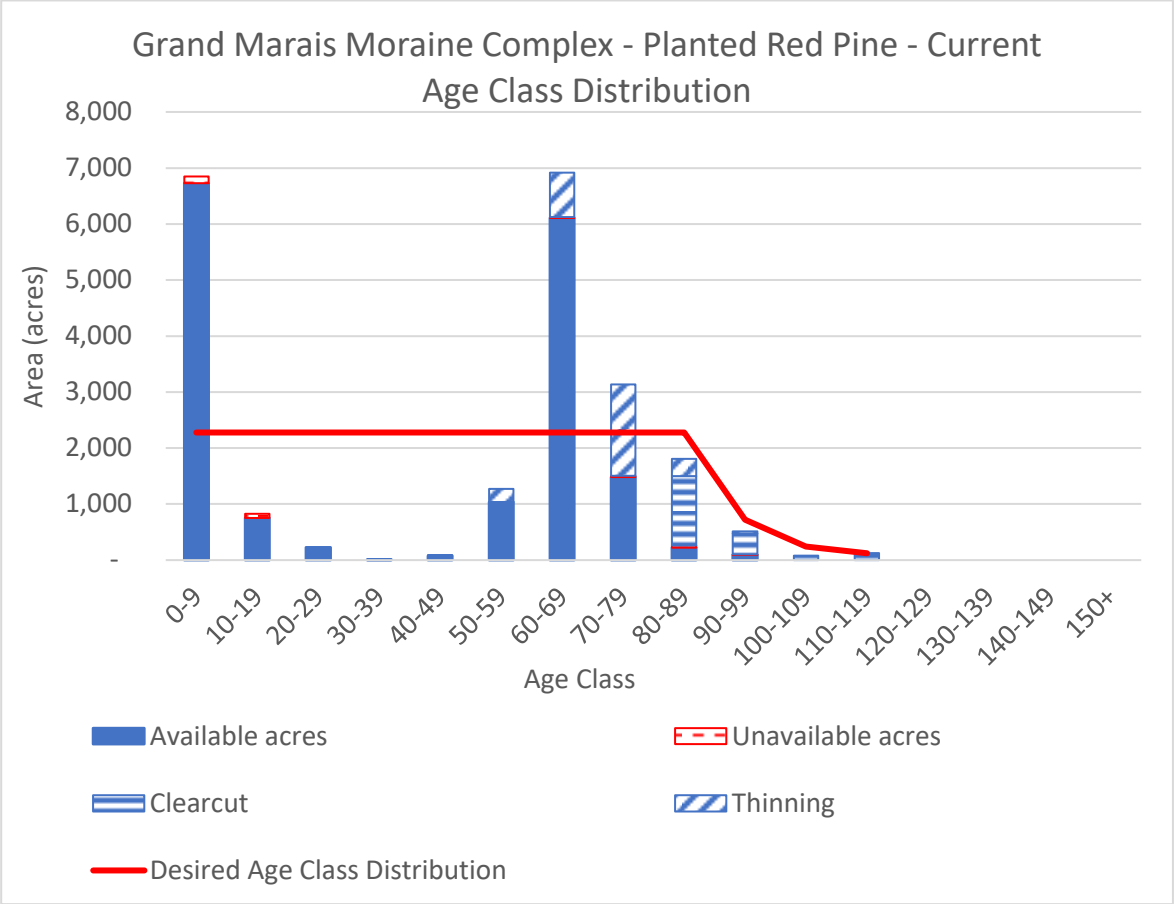


Figure 16. Current age class distribution and projected harvests in planted red pine cover type in the Grand Marais Moraine Complex Management Area.

Current conditions are the result of many acres planted during the 1950s and 60s across the area reaching a harvestable condition and thousands of acres burned in the Duck Lake Fire in 2012, causing an increase in the 0- to 9-year age class. Consistent commercial harvests and regeneration efforts have occurred on available planted red pine acres during the previous two planning periods. Only a small portion of planted red pine acres may be considered as potential habitat for red crossbill due to specific habitat requirements (Table 12).

Table 12. Featured species with planted red pine as a selected habitat cover type, habitat variables and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Planted Red Pine	Planted Red Pine Habitat Acres – Available
Red crossbill	Age category: 80+ Size category: sawlog Stocking: poor, medium Canopy closure: 0-50%	882

Desired future condition

The projected long-term cover type trend for planted red pine is increasing, with eventual stabilization, in the Grand Marais Moraine Complex Management Area. Much of the planted red pine area is available, with very few unavailable acres. There are very few transitions out of the cover type, and some transitions into the cover type, projected. Habitat elements in this cover type will be preserved due to the abundance of adjacent cover types.

The long-term goal for this cover type is balanced age classes between 0 and 80 years old for all available planted pine stands in this management area. Maintaining lower acreage in old age classes continues to be desirable to lessen the prevalence and severity of invasive pest outbreaks and to reduce the threat of damaging wildfire.

The end of the planning period will result in the establishment of the desired number of acres for the 0- to 9-year-old age class. Progress toward the long-term desired age class distribution of planted red pine will take many decades in this management area (Figure 17).

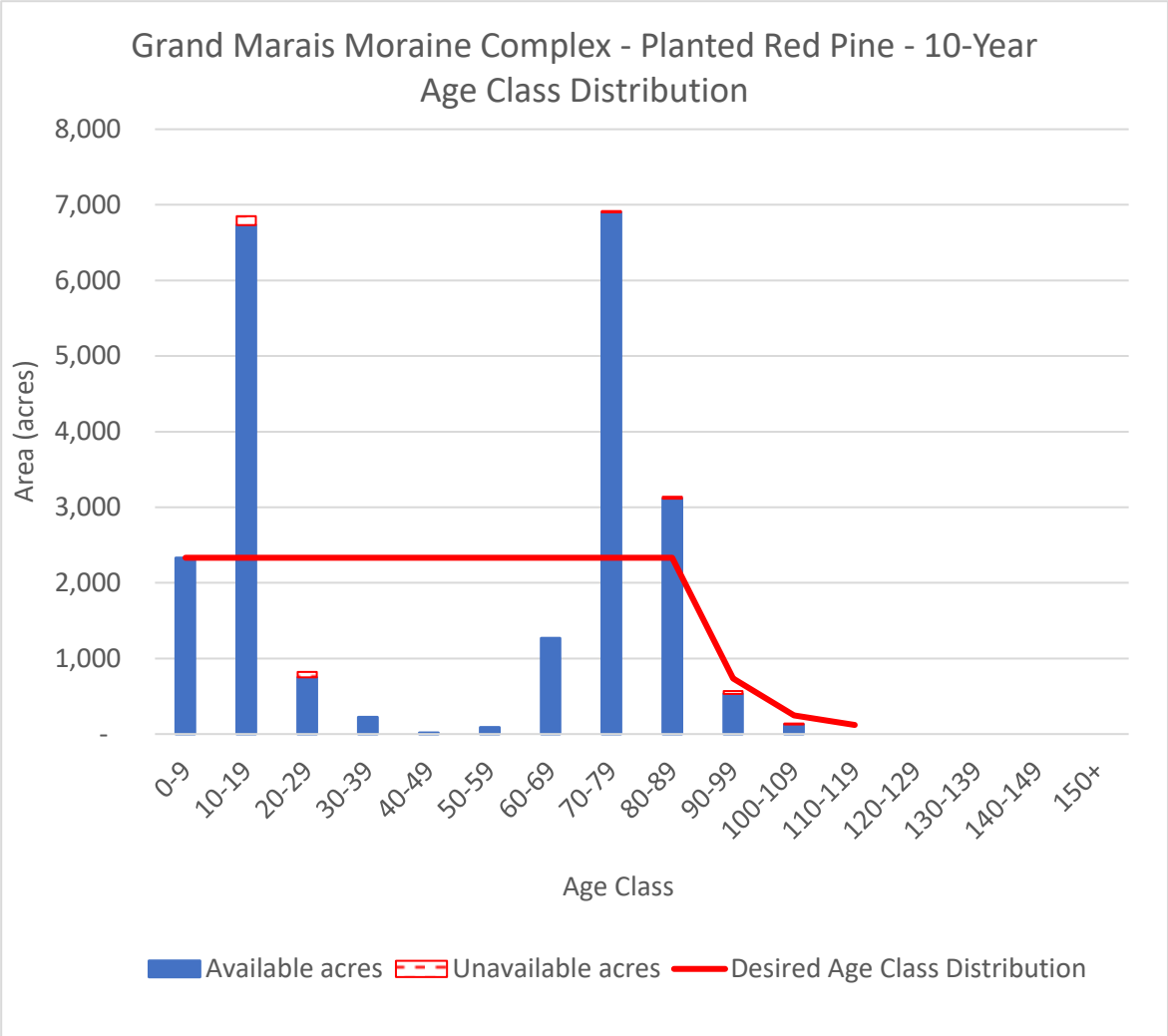


Figure 17. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The midterm age class distribution of planted red pine is beginning to reach the desired future condition for available acres in the 0-49 age classes (Figure 18). There will be an abundance in the 50-59 age class, carrying forward the current 10- to 19-year-old age class. There is also a deficit in the 60- to 90-year-old age classes. Current unbalanced age classes will result in the need to hold a significant number of acres in older age classes in the midterm age period to achieve the desired age class distribution in future planning periods.

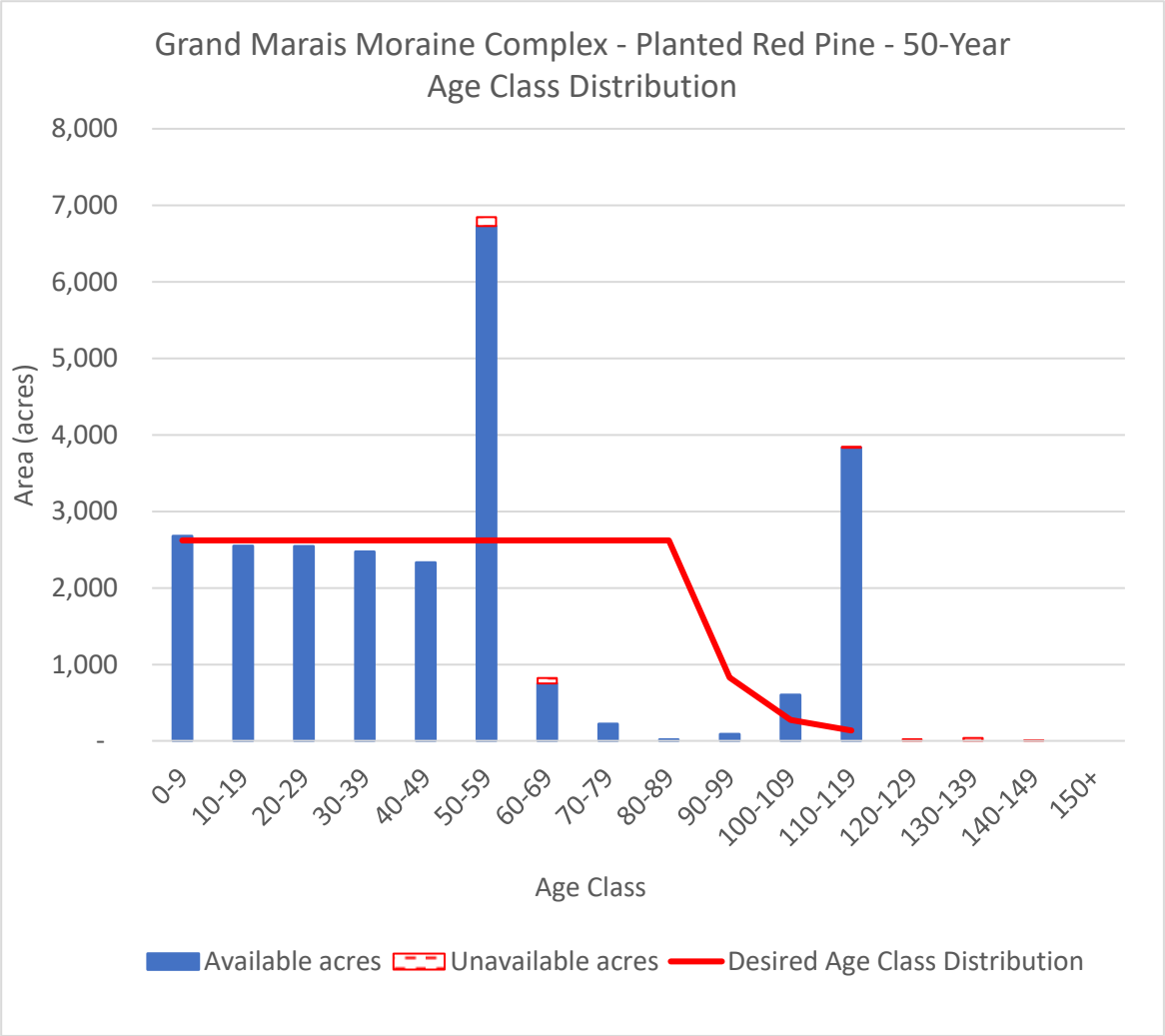


Figure 18. Projected midterm age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 19) will concentrate the manageable acres of planted red pine in productive growing conditions while providing an even flow of forest products and a wide variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest.

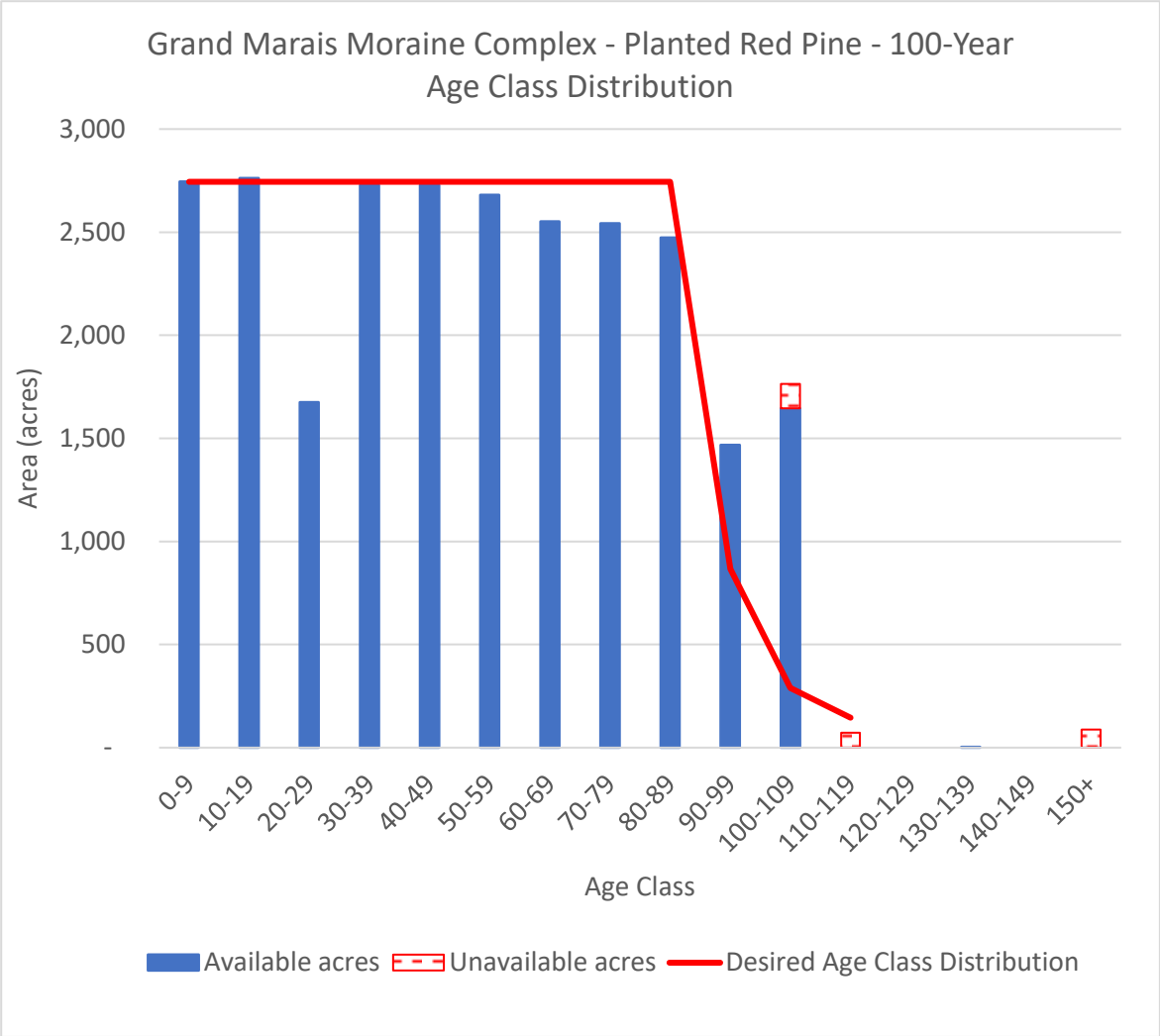


Figure 19. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

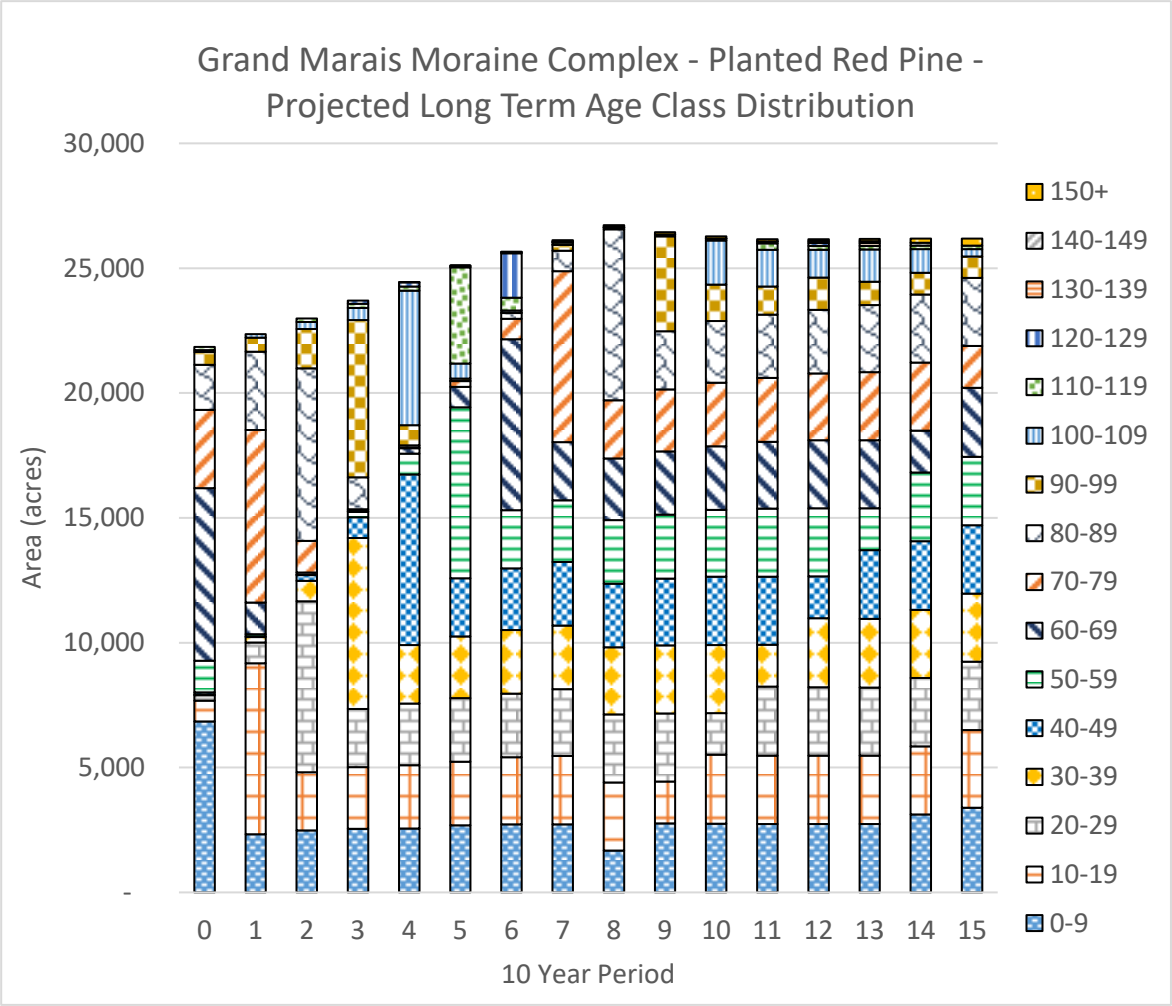


Figure 20. Projected age class distribution for all acres of planted red pine over the next 150 years in the Grand Marais Moraine Complex Management Area.

Management actions

There are 1,813 acres of projected clearcut harvest in the planted red pine cover type and 3,028 acres of thinning projected during the planning period. This falls slightly short of the desired establishment of 2,331 acres of planted pine per decade because of the current unbalanced age class condition, and the projected harvest totals do not include transitions into this cover type.

Planted jack pine

Current condition

Most of the planted jack pine cover type is currently in the 0- to 9-year-old age class. (Figure 21). The past management regime has been primarily clear-cut for this cover type. The younger age classes have a substantial surplus, and the area covered by planted jack pine decreases steadily as the age class increases, except for the 50- to 59-year age class, which has a surplus.

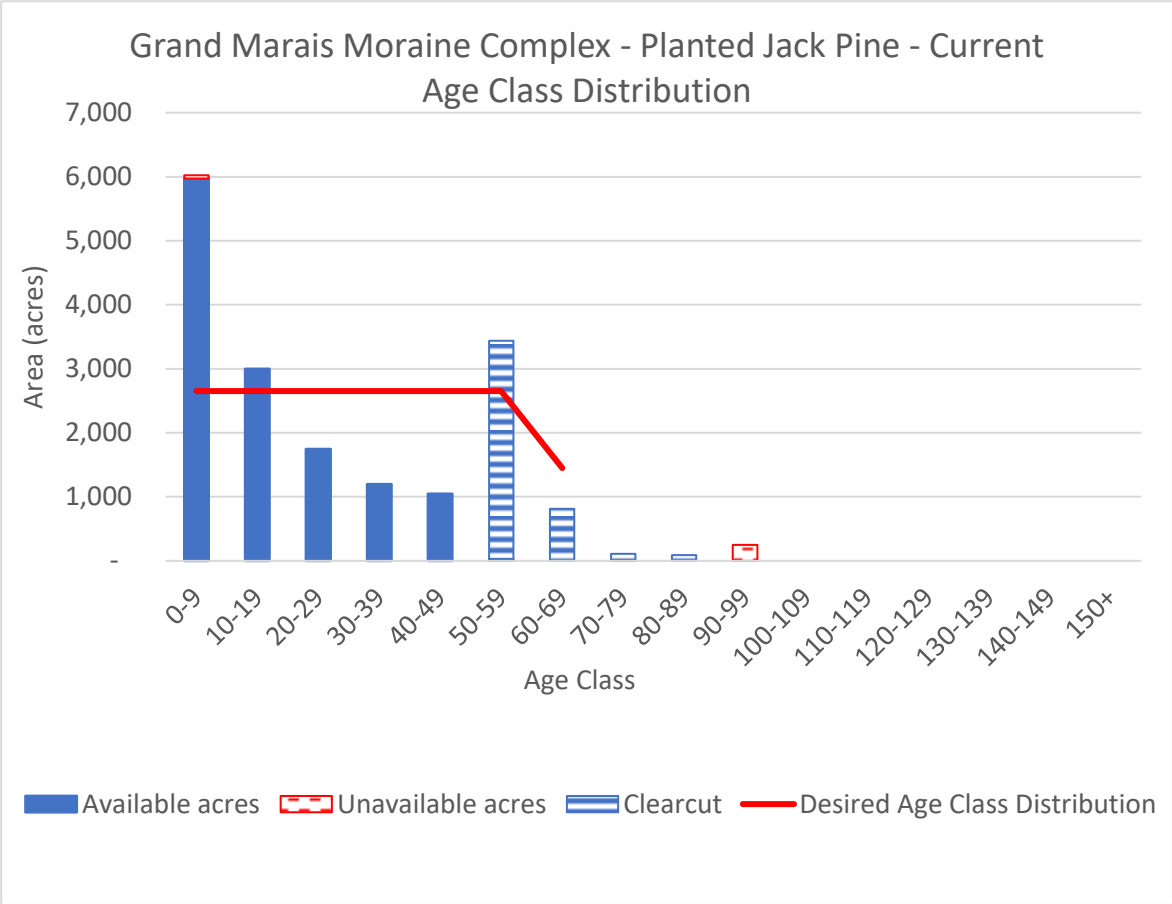


Figure 21. Current age class distribution, desired age class distribution and projected harvests in the planted jack pine cover type over the 10-year planning period.

Current conditions are largely due to the 2012 Duck Lake Fire, which caused substantial damage to the existing jack pine cover type. This prompted the planting of thousands of acres of jack pine to restore the cover type in the affected area. In other areas of the Grand Marais Moraine Complex, consistent commercial harvests and regeneration efforts on available planted jack pine acres have occurred during the previous planning periods. A portion of this cover type meets the habitat requirements for Kirtland's warbler, snowshoe hare and spruce grouse. Jack pine habitat acres calculated for Kirtland's warbler are those acres found within outwash plains in the Danaher/Kingston plains, Duck Lake and Whitefish Point (Table 13).

Table 13. Featured species with planted jack pine as a selected habitat cover type, habitat variables and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Jack Pine	Jack Pine Habitat Acres – Available	Jack Pine Habitat Acres – Unavailable
Kirtland's warbler	Age category: 0-19 Size category: sapling	11,057 (includes natural JP)	--
Snowshoe hare	Age category: 0-19 Size category: sapling	8,970	52

Featured Species	Featured Species Habitat – Jack Pine	Jack Pine Habitat Acres – Available	Jack Pine Habitat Acres – Unavailable
Spruce grouse, young	Age category: 0-19	8,970	52

Desired future condition

The projected long-term cover type trend for planted jack pine is decreasing in the Grand Marais Moraine Complex Management Area as opportunities to naturally regenerate the cover type are utilized. Although there are some transitions into this cover type from other cover types, like natural jack pine when natural regeneration is not successful, transitions out of this cover type are forecasted to outweigh them.

The long-term goal for this cover type is balanced age classes between 0 and 50 years old for all available planted jack pine stands in this management area. Maintaining lower acreage in old age classes continues to be desirable to ensure the planted jack pine cover type is distributed within the desired age classes.

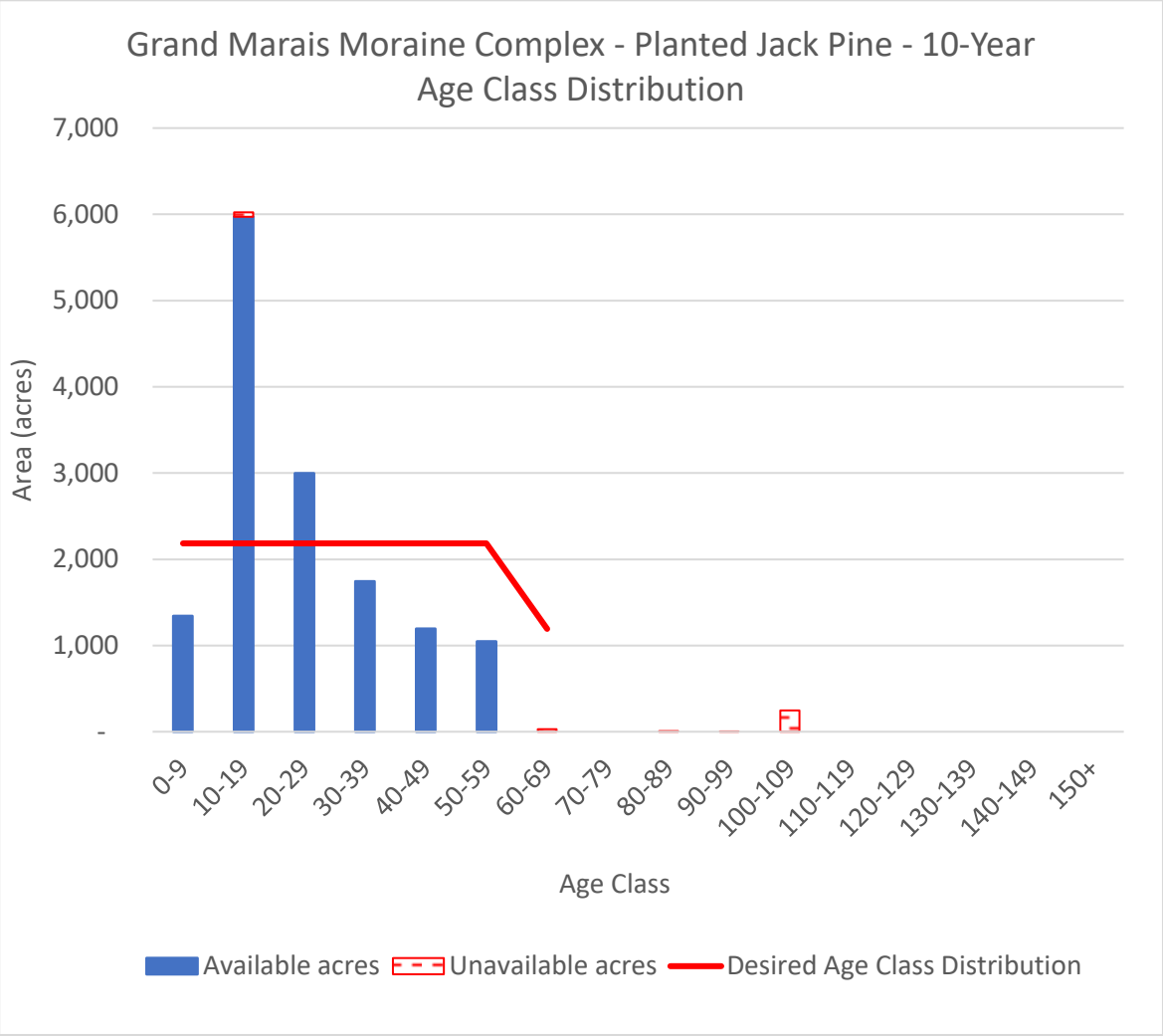


Figure 22. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The end of the planning period will result in the establishment of 1,343 acres, which is below the desired amount. It will take many decades of even-aged management to fully reach the desired long-term age class distribution in this management area (Figure 23).

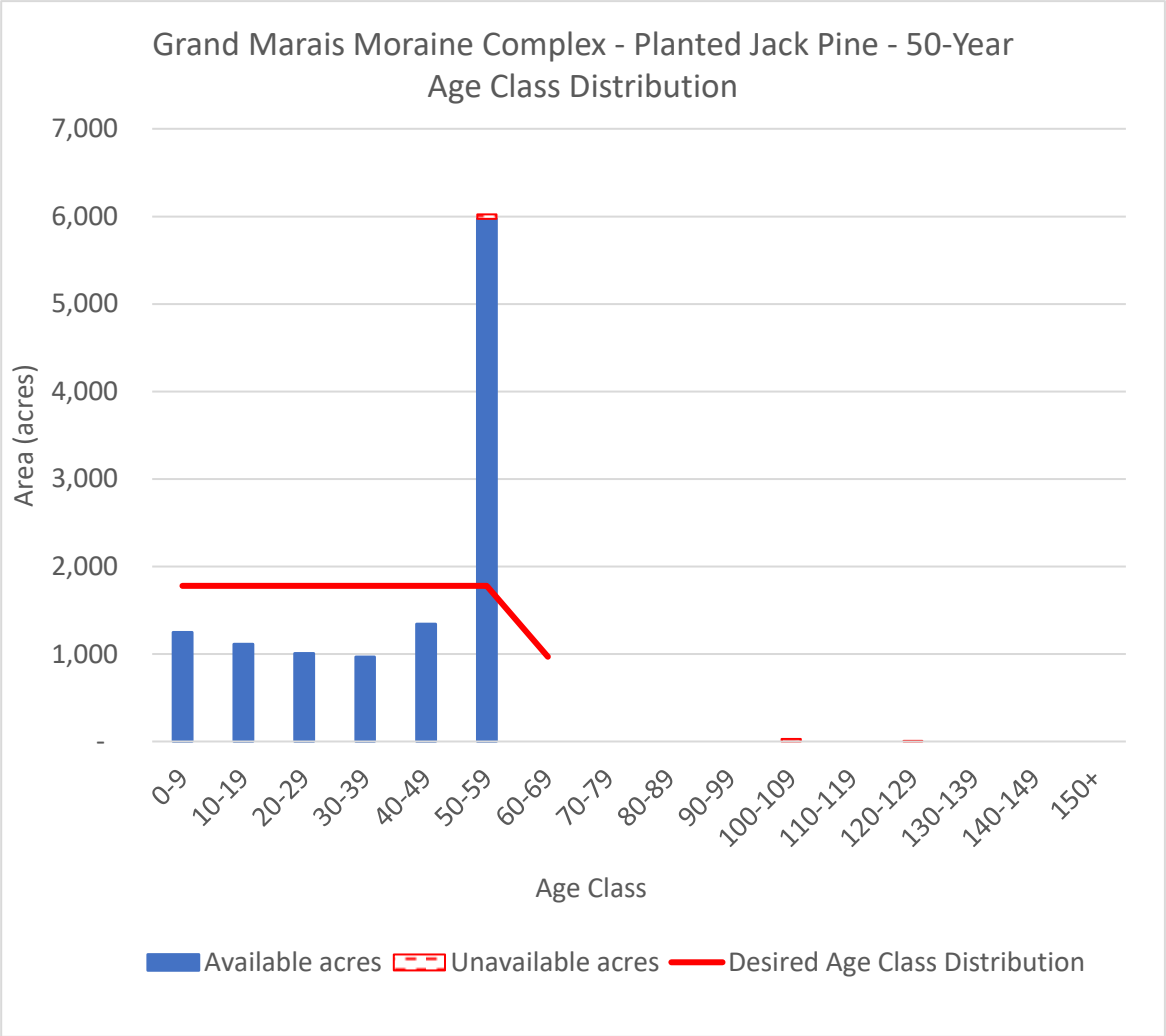


Figure 23. Projected midterm age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The midterm age class distribution shows the population of planted jack pine acres beginning to move toward the desired future condition as fewer acres are established and the surplus of planted jack pine acres reach rotation age (Figure 24).

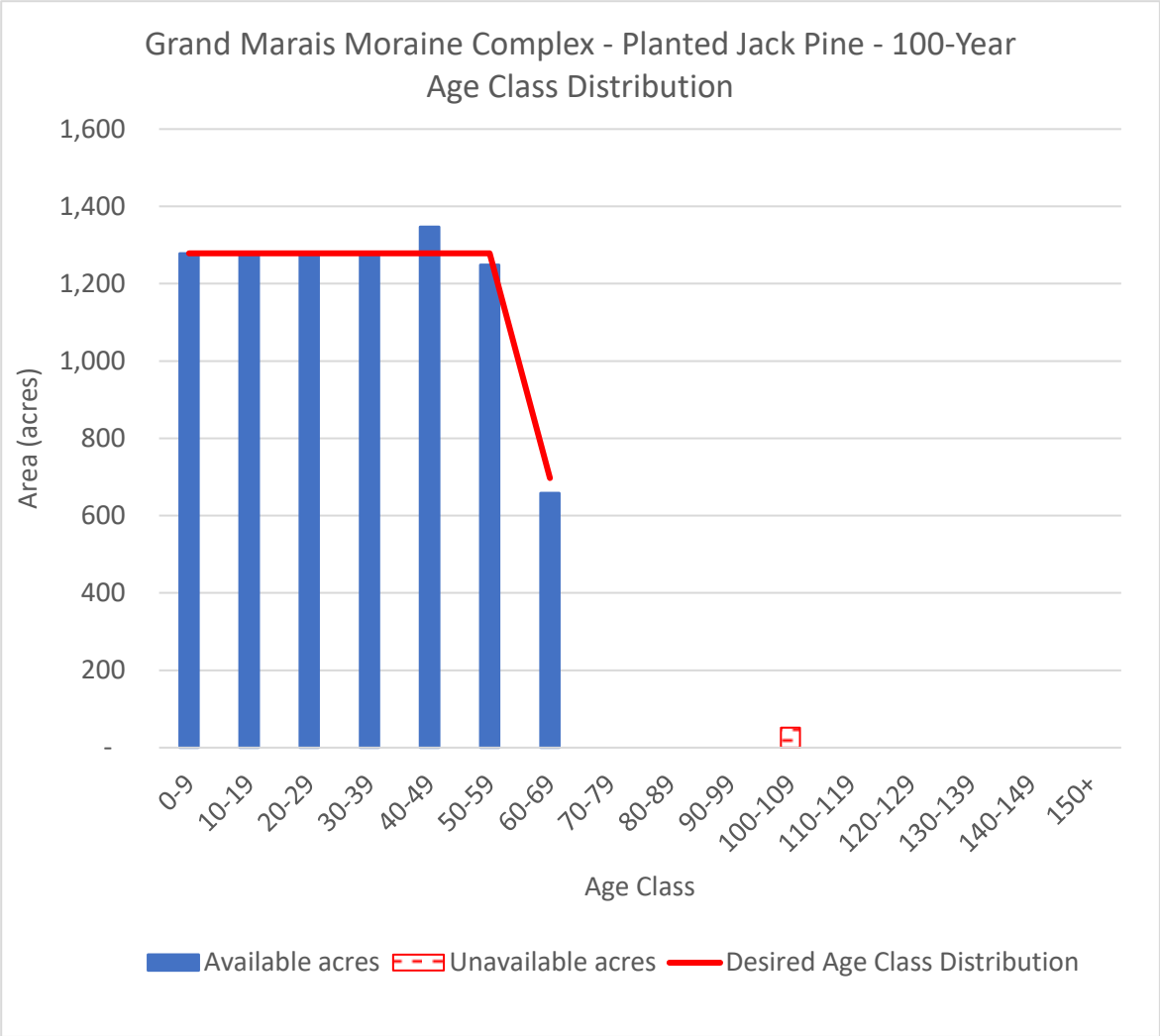


Figure 24. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 25) will concentrate the manageable acres of planted jack pine in productive growing conditions while providing an even flow of forest products and a wide variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest.

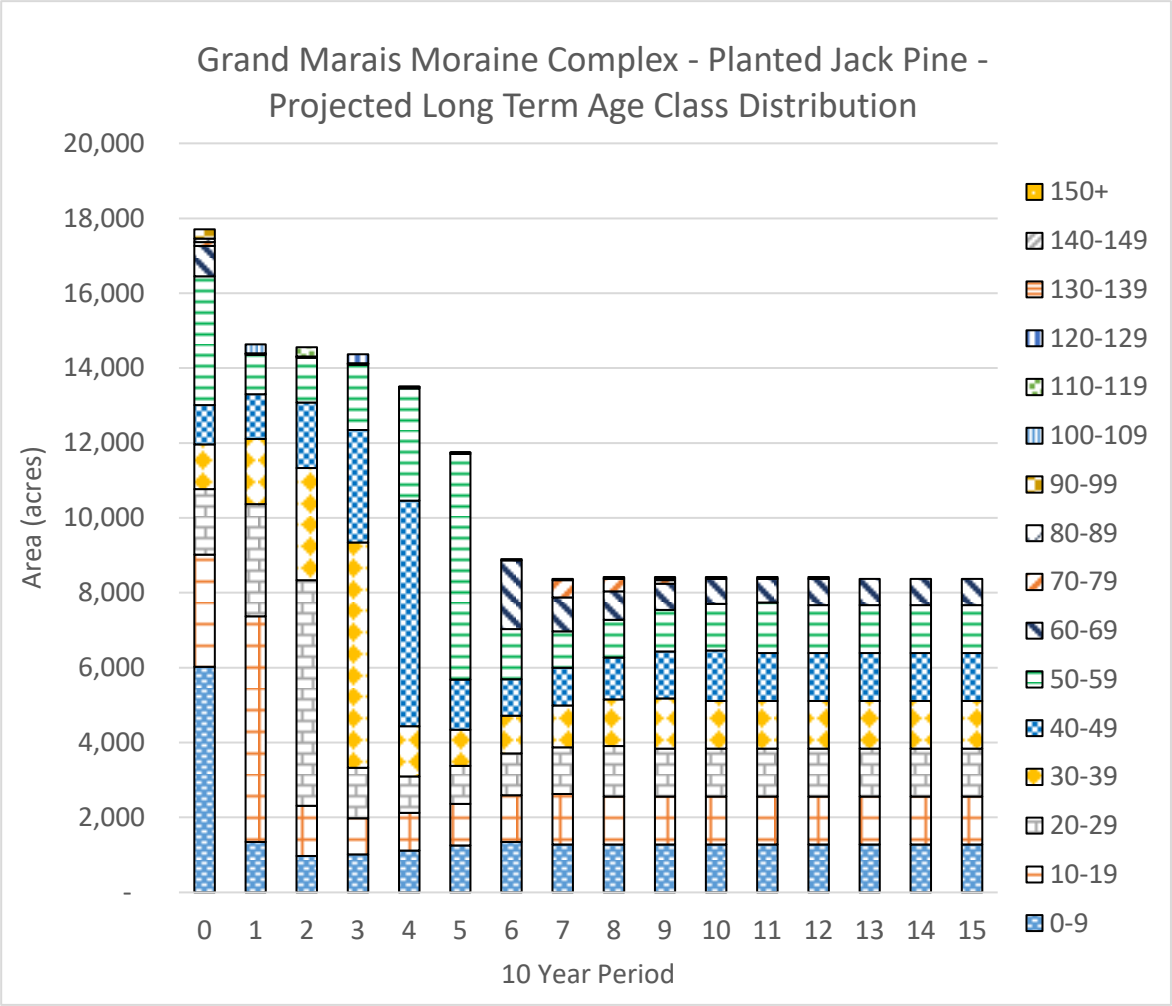


Figure 25. Projected age class distribution for all acres of planted jack pine over the next 150 years in the Grand Marais Moraine Complex Management Area.

Management actions

There are 4,410 acres of projected clearcut harvest in the planted jack pine cover type during this planning period. This is significantly higher than the desired establishment of 2,653 acres per decade because of the current unbalanced condition and transitions to natural jack pine types.

Conservation Area Network

High conservation value areas

There are up to eight different high conservation value area types that can be found in each management area (Table 14; see Biodiversity in Section 3 for more information).

Table 14. High conservation value areas within the management area.

High Conservation Value Area Type and Name	Acres
Critical coastal habitat (piping plover)	**5,250**

High Conservation Value Area Type and Name	Acres
	5,250
Critical dunes	**5,545**
	5,545
Deer wintering complex	**10,834**
	10,834
Forest habitat core interior	**2,849**
	2,849
Natural rivers vegetative buffer	**1,857**
	1,857
Natural rivers zoning district	**4,236**
	4,236
State wildlife management areas	**7,114**
Blind Sucker River Flooding SWMA	4,756
Stanley Lake Flooding SWMA	2,357
State wildlife research areas	**1**
Cusino SWRA	1
Verified Type 1 and Type 2 old growth	**68**
Type 1 old growth	5
Type 2 old growth	62
Grouse Enhanced Management Sites	**3,925**
Halifax	2,705
Melstrand	1,219
Grand total	**41,679**

Ecological reference areas

Ecological reference areas, a type of HCVA, are higher-quality examples of functioning ecosystems that are primarily influenced by natural ecological processes.

Table 15. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 16. Ecological reference areas within the management area

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	Number of Occurrences
Existing ERA	Bog	AB			2
Existing ERA	Bog	B			2
Existing ERA	Bog	B	G3G5	S4	3
Existing ERA	Dry northern forest	B			4
Existing ERA	Dry northern forest	C	G3?	S3	1
Existing ERA	Dry northern forest	D			1
Existing ERA	Dry-mesic northern forest	AB			1
Existing ERA	Dry-mesic northern forest	AB	G4	S3	2
Existing ERA	Dry-mesic northern forest	BC	G4	S3	1
Existing ERA	Emergent marsh	AB	GU	S4	1
Existing ERA	Hardwood-conifer swamp	BC	G4	S3	1
Existing ERA	Interdunal wetland	AB	G2?	S2	2
Existing ERA	Intermittent wetland	A			1
Existing ERA	Intermittent wetland	C	G2	S3	1
Existing ERA	Mesic northern forest	AB	G4	S3	1
Existing ERA	Mesic northern forest	B			2
Existing ERA	Mesic northern forest	C	G4	S3	2
Existing ERA	Muskeg	AB	G4G5	S3	2
Existing ERA	Patterned fen	A	GU	S2	1
Existing ERA	Patterned fen	AB		S2	1
Existing ERA	Patterned fen	B	GU	S2	1
Existing ERA	Patterned fen	C	GU	S2	1
Existing ERA	Poor fen	B		S3	1
Existing ERA	Rich conifer swamp	A	G4	S3	3
Existing ERA	Rich conifer swamp	B	G4	S3	1
Existing ERA	Rich conifer swamp	C	G4	S3	2
Existing ERA	Sand and gravel beach	AB			1
Existing ERA	Sand and gravel beach	AB	G3?	S3	1
Existing ERA	Wooded dune and swale complex	B			1
Proposed ERA	Dry northern forest	B	G3?	S3	2
Proposed ERA	Dry northern forest	C	G3?	S3	4
Proposed ERA	Dry northern forest	CD	G3?	S3	1
Proposed ERA	Open dunes	B	G3	S3	1
Proposed ERA	Poor fen		G3	S3	1
Grand total					**53**

Special conservation areas

Reviewable special conservation areas (SCAs; Table 17) are those SCA types that may be reviewed or updated through the compartment review process as needed. Static SCAs (Table 18) are those SCA types that generally do not change or require updating (see Biodiversity in Section 3 for more information).

Table 17. Reviewable special conservation areas within the management area.

Reviewable Special Conservation Area Type and Name	Acres
Concentrated recreational area	**295**
Andrus Lake Campground	9
Bass Lake (Luce) Campground	16
Blind Sucker No. 1 Campground	8
Blind Sucker No. 2 Campground	5
Bodi Lake Campground	38
Canoe Lake Campground	9
Culhane Lake State Forest Campground	12
Cusino Lake Campground	10
East Branch of Fox River Campground	11
High Bridge State Forest Campground	3
Kingston Lake Campground	16
Lake Superior Campground	52
North Gemini Lake Campground	9
Perch Lake State Forest Campground	26
Pike Lake State Forest Campground	6
Reed and Green Bridge Campground	0
Ross Lake Campground	10
Shelldrake Dam	0
South Gemini Lake Campground	8
Two-Hearted River Mouth Boat Access Site	1
Two-Hearted River Mouth Campground	18
Unspecified	28
Contiguous resource area	**850**
Crisp Point/Browns Lake Proposed Natural Area	850
Habitat area or habitat corridor	**530**
Vermilion Point Important Bird Habitat	-
Whitefish Point Important Bird Area (IBA)	530
Mineral resource area	**15**
Camp 7 Gravel Pit	15
Possible Type 1 or Type 2 old growth	**1,055**
--	1,055
Visual management areas	**24**
Unspecified	24
Grand total	**2,769**

Table 18. Static special conservation areas within the management area.

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Common natural heritage element occurrences		**1,058**
Dry-mesic northern forest		3
Muskeg		1,002
Poor conifer swamp		53
Designated trout and coldwater stream buffer		**6,322**
--		2,512
Atwood Creek		21
Auger Creek		75
Baird Creek		64
Baker Creek		28
Black Creek		67
Blind Sucker River		108
Camp One Creek		39
Camp Seven Creek		54
Chapel Creek		24
Clear Creek		82
Cold Creek		13
Cris Brown Creek		18
Culhane Creek		46
Deer Creek		24
Driggs River		48
East Branch Fox River		155
East Branch Two Hearted River		173
East Creek		54
Fox River		172
Grand Marais Creek		5
Grass Creek		44
Hurricane River		22
Linton Creek		79
Little Beaver Creek		10
Little Fox River		220
Little Two Hearted River		189
Loon Creek		13
Mahoney Creek		7
Mosquito River		89
Murphy Creek		65
North Branch Murphy Creek		2
North Branch Two Hearted River		145
O'Briens Creek		2

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Pelican Creek		11
Porter Creek		17
Ross Creek		56
Savage Creek		59
Shelldrake River		73
Silver Creek		103
South Branch Linton Creek		66
South Branch Shelldrake River		158
Spray Creek		45
Spring Creek		50
Stony Creek		8
Sucker River		278
Sullivan Creek		6
Tahquamenon River		43
Threemile Creek		70
Trout Creek		36
Two Hearted River		357
Wabash Creek		53
West Branch Fox River		166
Designated trout and coldwater streams	**246.8**	
--	98.4	
Atwood Creek	0.8	
Auger Creek	3.0	
Baird Creek	2.6	
Baker Creek	1.0	
Black Creek	2.5	
Blind Sucker River	4.1	
Camp One Creek	1.4	
Camp Seven Creek	2.3	
Chapel Creek	0.9	
Clear Creek	3.2	
Cold Creek	0.4	
Cris Brown Creek	0.7	
Culhane Creek	1.7	
Deer Creek	0.9	
Driggs River	2.1	
East Branch Fox River	5.5	
East Branch Two Hearted River	7.1	
East Creek	2.0	
Fox River	6.4	
Grand Marais Creek	0.2	
Grass Creek	1.7	

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Hurricane River	0.8	
Linton Creek	3.3	
Little Beaver Creek	0.4	
Little Fox River	8.5	
Little Two Hearted River	8.0	
Loon Creek	0.6	
Mahoney Creek	0.3	
Mosquito River	3.5	
Murphy Creek	2.5	
North Branch Murphy Creek	0.0	
North Branch Two Hearted River	6.5	
O'Briens Creek	0.1	
Pelican Creek	0.4	
Porter Creek	0.7	
Ross Creek	2.2	
Savage Creek	2.2	
Shelldrake River	2.9	
Silver Creek	3.8	
South Branch Linton Creek	2.6	
South Branch Shelldrake River	6.6	
Spray Creek	1.8	
Spring Creek	1.8	
Stony Creek	0.3	
Sucker River	10.9	
Sullivan Creek	0.2	
Tahquamenon River	1.6	
Threemile Creek	2.6	
Trout Creek	1.2	
Two Hearted River	13.2	
Wabash Creek	2.1	
West Branch Fox River	6.4	
Important bird areas		**67**
Grand Marais to Whitefish Point beaches (piping plover)		< 1
Sleeper Lake burn		38
Tahquamenon Falls State Park and Munising Moraine I		2
Whitefish Point		27
Natural beauty roads	**3.1**	
Old Seney Road	1.0	
School Forest Road	1.3	
Whitewash Road	0.7	
Nondedicated natural areas		**166**

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Natural Area Betsy Lake Natural Area Preserve		6
Natural Area Crisp Point		46
Natural Area Deer Park		47
Natural Area Marsh Lakes		12
Natural Area Tahquamenon Falls Natural Area		1
Natural Area Vermilion Point		55
Wood turtle stream 100-foot buffer		**10**
Shelldrake River		10
Wood turtle stream 660-foot buffer		**64**
Shelldrake River		64
Grand total	**249.9**	**7,687**

Rare species

Rare species occurrences are compiled from the Michigan Natural Features Inventory biotics database (Table 18 and **Error! Reference source not found.**) and do not necessarily include all rare species found in this management area due to biases in survey effort and verifiable observation reporting over time.

Table 19. Rare animal species conservation status key.

Species Status	Species Status
E = endangered	LE = listed endangered
T = threatened	LT = listed threatened
SC = special concern	PDL = proposed for delisting

Table 20. Rare animal species occurrence within the Grand Marais Moraine Complex Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Accipiter gentilis	Northern goshawk	T		3
Animal	Alces alces*	Moose	SC		--
Animal	Antrostomus vociferus	Eastern whip-poor-will	T		1
Animal	Boloria freija	Freija fritillary	SC		1
Animal	Bombus borealis	Northern amber bumble bee	SC		2
Animal	Bombus terricola	Yellow banded bumble bee	SC		5
Animal	Botaurus lentiginosus	American bittern	SC		2
Animal	Brachionycha borealis	Boreal brachionyncha	SC		1
Animal	Buteo lineatus	Red-shouldered hawk	SC		1
Animal	Canachites canadensis	Spruce grouse	T		1
Animal	Canis lupus*	Gray wolf	SC	LE	--
Animal	Charadrius melodus	Piping plover	E	LE	4
Animal	Coregonus artedi	Lake herring or cisco	T		1

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Cottus ricei	Spoonhead sculpin	SC		1
Animal	Elliptio complanata	Eastern elliptio	SC		4
Animal	Euxoa aurulenta	Dune cutworm	SC		1
Animal	Falco columbarius	Merlin	SC		1
Animal	Gavia immer	Common loon	T		11
Animal	Glaucomys sabrinus	Northern flying squirrel	SC		1
Animal	Glyptemys insculpta	Wood turtle	T		1
Animal	Haliaeetus leucocephalus	Bald eagle	SC		7
Animal	Myotis lucifugus	Little brown bat	T		3
Animal	Myotis septentrionalis	Northern long-eared bat	T	LE	1
Animal	Necturus maculosus	Mudpuppy	SC		6
Animal	Opheodrys vernalis	Smooth green snake	SC		5
Animal	Pandion haliaetus	Osprey	SC		8
Animal	Picoides arcticus	Black-backed woodpecker	SC		1
Animal	Polygonia gracilis	Hoary comma	X		1
Animal	Setophaga kirtlandii	Kirtland's warbler	E		1
Animal	Somatochlora incurvata	Incurvate emerald	SC		1
Animal	Trimerotropis huroniana	Lake Huron locust	T		6
Animal	Tympanuchus phasianellus	Sharp-tailed grouse	SC		4
Total	-	-	-	-	**86**

**Occurrence information provided by field staff.*

Table 21. Rare plant species conservation status key.

Species Status	Species Status
E = endangered	LE = listed endangered
T = threatened	LT = listed threatened
SC = special concern	PDL = proposed for delisting

Table 22. Rare plant species occurrence within the Grand Marais Moraine Complex Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Plant	Crataegus douglasii	Douglas's hawthorn	SC		3
Plant	Drosera anglica	English sundew	SC		3
Plant	Empetrum nigrum	Black crowberry	T		3
Plant	Juncus stygius	Moor rush	E		1
Plant	Juncus vaseyi	Vasey's rush	T		1
Plant	Leymus mollis	American dune wild-rye	SC		10

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Plant	Littorella uniflora	American shore-grass	SC		4
Plant	Myriophyllum alterniflorum	Alternate-leaved water-milfoil	SC		2
Plant	Neottia auriculata	Auricled twayblade	SC		2
Plant	Potamogeton confervoides	Alga pondweed	SC		1
Plant	Pyrola minor	Lesser pyrola	SC		3
Plant	Rorippa aquatica	Lake cress	SC		1
Plant	Rubus acaulis	Dwarf raspberry	T		2
Plant	Salix pellita	Satiny willow	T		1
Plant	Spinulum canadense	Clubmoss	SC		1
Plant	Stellaria longipes	Stitchwort	SC		2
Plant	Tanacetum bipinnatum ssp. huronense	Lake Huron tansy	SC		6
Total	-	-	-	-	**46**

Non-ecological reference area natural communities

Natural communities that are identified with an element occurrence in the MNFI Biotics database, but that have not been given an additional ecological reference area designation, are recognized and managed accordingly (Table 23).

Table 23. Non-ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 24. Non-ecological reference area natural communities within the Grand Marais Moraine Management Area.

Community Type	Element Occurrence Rank	State Rank	Global Rank	Sum of Acreage	Count of Element Occurrence ID
Dry-mesic northern forest	AB	S3		3	1
Mesic northern forest	C	S3		44	2

Community Type	Element Occurrence Rank	State Rank	Global Rank	Sum of Acreage	Count of Element Occurrence ID
Muskeg	AB	S3		79	1
Muskeg	B	S3		814	2
Muskeg	BC	S3		109	2
Poor conifer swamp	AB	S4	G4	18	1
Poor conifer swamp	BC	S4	G4	35	1
Grand total				**1,102**	**10**

Forest health

Forest health concerns, both native and non-native, can have impacts on stand conditions and management decisions. The following insects (Table 25) and diseases (Table 26) could have an impact on management during the planning period and may need to be monitored and/or addressed.

Table 25. Defoliating insects of concern in the Grand Marais Moraine Complex Management Area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Spongy moth	Lymantria dispar dispar	Non-native	Yes
Forest tent caterpillar	Malacosoma disstria	Native	Yes
Large aspen tortrix	Choristoneura conflictana	Native	Yes
Spruce budworm	Choristoneura fumiferana	Native	Yes
Jack pine budworm	Choristoneura pinus	Native	Yes
Redheaded pine sawfly	Neodiprion lecontei	Native	Yes

Table 26. Maladies of concern in the Grand Marais Moraine Complex Management Area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Canker (stem infections)	Nectria cinnabarina	Native	Yes
Armillaria root rot	Armillaria mellea	Native	Yes
Heterobasidion root disease	Heterobasidion annosum	Native	No
Oak wilt	Bretziella fagacearum	Non-native	No

Aquatic resources

Riparian habitat

Approximately 199 miles of streams and rivers are found in the management area (Table 27). Streams/rivers classified as cold types comprise approximately 81% of the riverine mileage.

Table 27. Classification type and length of streams/rivers found within the management area.

Type	Length (miles)
Cold stream	103
Cold small river	23
Cold transitional stream	34
Cold transitional small river	1

Type	Length (miles)
Cold transitional large river	0
Warm transitional stream	37
Warm transitional small river	1
Warm transitional large river	0
Warm stream	0
Warm small river	0
Warm large river	<1

Lacustrine habitat

A total of 109 lakes and ponds of at least 1 surface acre are found in the management area (Table 28).

Table 28. Size and number of lakes and ponds located within the management area.

Lake Size Class (acres)	Number
1-99	96
100-499	12
500+	1

Wetlands

A total of 67,466 acres of wetlands are found in the management area (Table 29). Forested wetlands comprise approximately 93% of wetland types found in the management area.

Table 29. Area of emergent, forested and riverine wetland types found within the management area.

Wetland Type	Acres
Emergent	4,049
Forested	62,811
Riverine	586

Vernal pools and seeps

A total of 353 acres of vernal pools and seeps have been inventoried in the management area, while 505 acres of seeps have been identified.

Riparian vegetation cover

Lowland shrub and northern hardwood are predominant cover types present in a 100-meter riparian zone located next to streams/rivers in the management area (Table 30).

Table 30. Largest vegetative cover types (i.e., top 10) and area located in a 100-meter buffer of streams/rivers within the management area.

Cover Type	Acres
Lowland shrub	5,104
Northern hardwood	3,533
Lowland conifers	2,436

Cover Type	Acres
Natural white pine	2,058
Aspen	1,792
Natural mixed pines	1,770
Natural jack pine	1,636
Cedar	1,601
Natural red pine	1,509
Upland conifers	1,270

Watershed vegetation cover

The management area includes portions of important watersheds of the Tahquamenon River and Big Two Hearted River (Table 31 and Table 32). Northern hardwood and pines (i.e., red, white, jack) are major cover types of the state forest in each watershed.

Table 31. Largest vegetative cover types (i.e., top five) and area for the area of the Tahquamenon River watershed located within the management area.

Cover Type	Acres
Northern hardwood	10,326
Aspen	9,244
Lowland conifer	3,785
Planted red pine	2,211
Cedar	2,195

Table 32. Largest vegetative cover types (i.e., top five) and area for the area of the Big Two Hearted River watershed located within the management area.

Cover Type	Acres
Natural red pine	5,214
Natural white pine	3,949
Natural jack pine	3,385
Northern hardwood	3,259
Planted jack pine	2,261

Recreation

The Grand Marais Moraine Complex Management Area is generally accessible for recreation opportunities via County Road 407, Highway 123 and paved/gravel county roads and two-tracks. However, in some areas, access is restricted by creeks and wetland cover types and concern over impact to fragile areas, particularly along the Lake Superior shoreline.

This area is a destination for winter snowmobilers as well as summer tourists. Access to Pictured Rocks National Lakeshore is through this management area. When Pictured Rocks National Lakeshore campgrounds are full, park visitors often camp at nearby state forest campgrounds, and people frequently hike the Fox River Pathway from Kingston Lake State Forest Campground to Twelve Mile Beach campground in the national lakeshore.

This management area includes a well-developed system of snowmobile and off-road vehicle trails. Nonmotorized trails include significant sections of the North Country National Scenic Trail/Iron Belle Trail, Headquarters Lake Equestrian Trail and Fox River Pathway (Table 33).

There are numerous state forest campgrounds within the management area (Table 34), including the Mouth of the Two Hearted River, with 39 sites, and Headquarters Lake Equestrian, which includes a large equestrian day-use area. Tahquamenon Falls and Muskallonge Lake state parks provide added recreation opportunities adjacent to state forest land. Dispersed camping is also popular, particularly in the Deer Park area.

Table 33. Designated recreation trails by use type.

Recreation Category	Recreation Type	Number of Miles
Motorized recreation trails	Off-road vehicle (all types) Snowmobile	135.2 181.4
Nonmotorized recreation trails	Hiking Equestrian Biking Hunter access trails	106.2 24.5 1.3 17.9
Total		**466.5**

Note: Trail use types may overlap.

Table 34. State forest campgrounds

Name of State Forest Campground (SFCG)	Number of sites	Equestrian	ORV
Andrus Lake SFCG	25		
Bass Lake SFCG (Luce)	18		
Blind Sucker No. 2 SFCG	32		
Blind Sucker No.1 SFCG	13		
Bodi Lake SFCG	12		
Canoe Lake SFCG	4		
Culhane Lake SFCG	12		
Cusino Lake SFCG	6		
East Branch of Fox River SFCG	19		
Headquarters Lake SFCG and Trail Camp	6	X	
High Bridge SFCG	7		
Holland Lake SFCG	15		X
Kingston Lake SFCG	16		
Lake Superior SFCG	18		
Mouth of Two Hearted River SFCG	39		
North Gemini SFCG	17		
Perch Lake SFCG	35		
Pike Lake SFCG (Luce)	8		

Name of State Forest Campground (SFCG)	Number of sites	Equestrian	ORV
Pretty Lake SFCG	18		
Reed and Green Bridge SFCG	7		
Ross Lake SFCG	10		
South Gemini SFCG	8		

Blind Sucker River Flooding State Wildlife Management Area is located in northwest Luce County, about 12 miles east of Grand Marais. Several marshes and pothole lakes are inundated by and incorporated into the Blind Sucker Flooding. Most public use is fishing-oriented, with minor fall waterfowl hunting, moderate furbearer trapping activity and light winter ice fishing. In addition, there is increasing use of the flooding for bird-watching, canoeing and kayaking. Stanley Lake Flooding is centered along the Fox River in northern Schoolcraft County. There are a number of two-tracks providing access.

The Halifax and Melstrand GEMS, or Grouse Enhanced Management Sites, provide areas focused on upland bird hunting, with 12 and 4.7 miles, respectively, of hunter walking trails to facilitate access.

Opportunities for wildlife recreation within the management area include hunting for ruffed grouse, deer and bear, trapping of furbearing species and wildlife viewing. The area around the Two Hearted River is also popular for blueberry picking, kayaking, beach combing, fishing and bird watching. There are 20 boating access sites, providing access to inland lakes and floodings, the Two Hearted and Fox rivers and Lake Superior.

Table 35. Areas managed for hunting.

Type	Name	Acres
State wildlife management areas	Blind Sucker River Flooding Stanley Wildlife Flooding SWMA	4,753.0 2,355.5
State wildlife research areas	Cusino SWRA	0.8
Grouse Enhanced Management Sites	Halifax GEMS Melstrand GEMS	2,709.7 1,218.3
Total		**11,037.3**

Table 36. Boating access sites.

Name	Body of Water
Andrus Lake State Forest Campground	Andrus Lake
Bass Lake SFCG	Bass Lake
Blind Sucker #1 SFCG	Blind Sucker Flooding
Blind Sucker #2 SFCG	Blind Sucker Flooding
Bodi Lake SFCG	Bodi Lake
Brockies Pond	Brockies Trout Pond
Culhane SFCG	Culhane Lake
Kingston Lake SFCG	Kingston Lake

Mouth Of Two Hearted River SFCG	Two Hearted River
North Gemini Lake SFCG	Gemini Lake
Peanut Lake	Peanut Lake
Perch Lake SFCG	Perch Lake
Pike Lake SFCG	Pike Lake
Shelldrake Dam SFCG	Shelldrake Lake
Silver Creek Pond	Silver Creek Trout Pond
Spring Creek Trout Pond	Silver Creek Trout Pond
Stanley Lake SFCG	Stanley Lake
Tahquamenon Falls - River Mouth	Lake Superior
Tahquamenon Falls Bay	Lake Superior
Wagner Dam	Fox River

EUP management areas

Rudyard Silty Lake Plain

State forest area: 49,432 acres	Location: Eastern Upper Peninsula	Population centers: Sault Ste. Marie Kincheloe
Subsection: Rudyard Silty Lake Plain	Landforms: Broad clay lake plain Sand plain	Land cover: Forested: 36,520 acres Nonforested: 12,912 acres

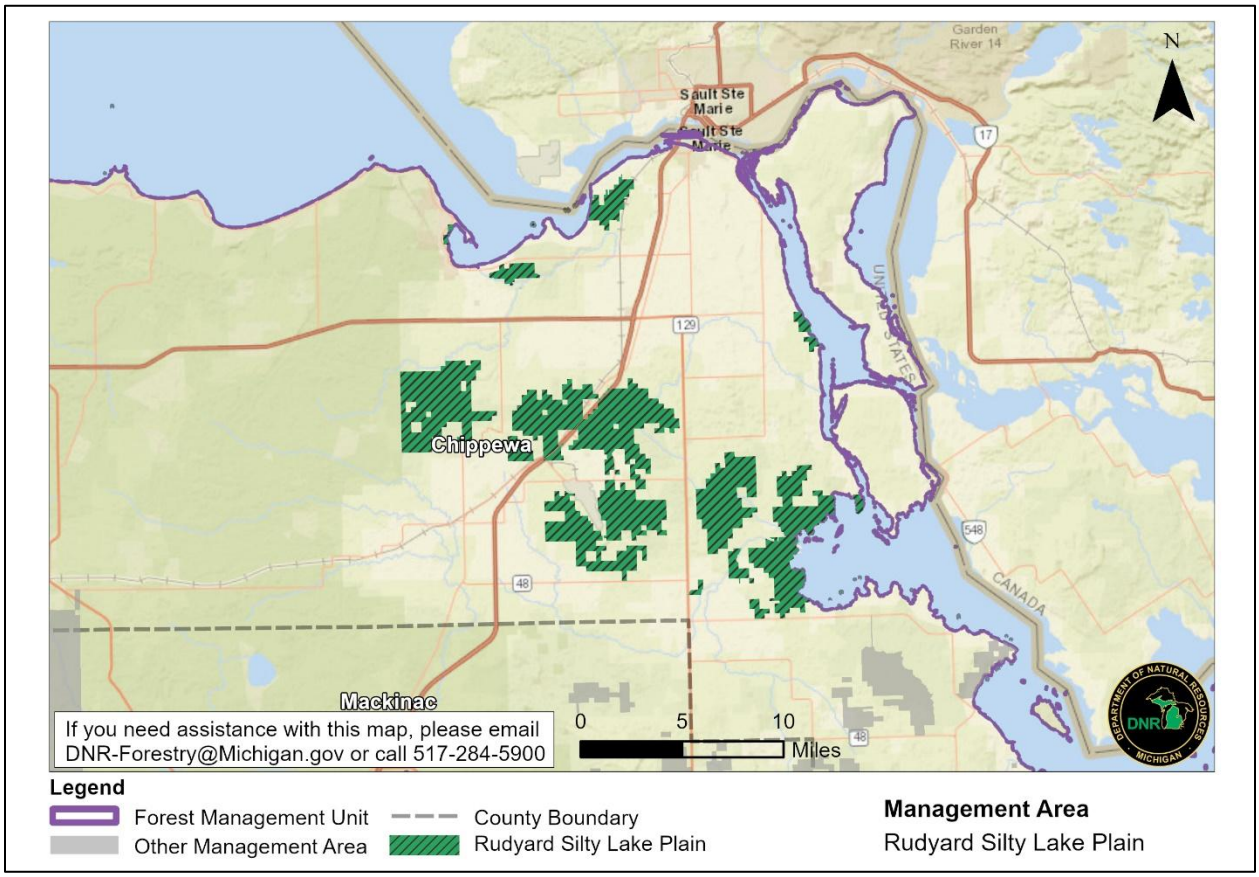


Figure 1. Rudyard Silty Lake Plain Management Area.

Forested landscape

Current and projected future condition

The Rudyard Silty Lake Plain Management Area includes a variety of ages and tolerance levels. Most of the acres are tolerant cover types in the old-aged category and occur on unavailable lowlands. The majority of intolerant cover types occur on available uplands in the young and mid-aged categories. Mid-tolerant cover types occur mostly on available uplands and lowlands in the mature age category (Figure 2).

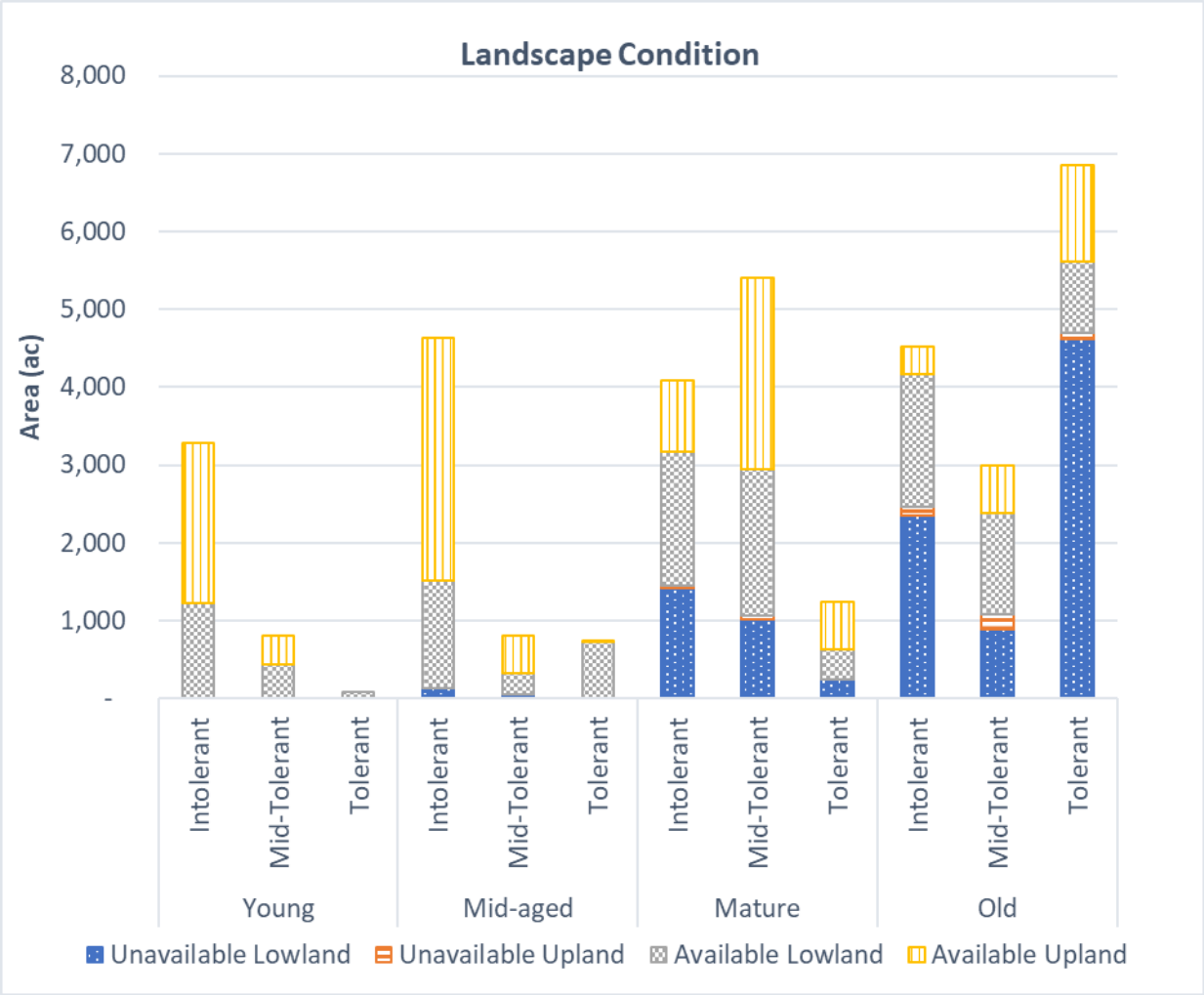


Figure 2. Forest diversity matrix showing the current distribution of forested acres across management availability, age category, landscape position and shade tolerance.

Landscape habitat conditions refine the management area landscape into featured species habitat context. Current and projected acres for the metrics identified in the management priorities (see Section 3) establish a baseline and future condition based on management over the planning period (

Table 1).

Table 1. Current acres of landscape habitat conditions.

Landscape Habitat Condition	Monitoring Metric	Current Acres
Young forest	Acres of 0- to 19-year stands in aspen and jack pine	2,048
Mature forest	Acres of 80-plus-year stands across cover types	14,364
Mature forest	Acres of 120-plus-year stands across cover types	2,744
Mesic conifer cover types	Acres of mesic conifer cover types	422
Mesic conifers in other cover types	Average canopy occupancy	19%
Mast – oak cover types	Acres of oak cover types	453
Mast tree species in other cover types	Acres of total canopy occupancy of mast tree acres (trace-100%)	7,350
Big trees	Total canopy stand occupancy of species in sawlog or greater size class	16,362
Nonforested openings	Acres of total herbaceous open land, upland shrub and crop land	830
Landscape forest matrix	Percent deciduous forest	51%
Landscape forest matrix	Percent coniferous forest	44%

Other important landscape-level habitat in this management area includes a large opening/shallow flooding complex known as the Munuscong Potholes, which is managed for waterfowl, sharptailed grouse and grassland/marsh-nesting birds.

Coastal wetlands associated with the St. Mary's River system and Munuscong Bay State Wildlife Area are dynamic wetland systems that provide habitat for yellow rail, marsh wren, osprey, common tern, black tern, muskrat and waterfowl. This is an area of cultural importance for the Anishinaabe, and restoration of wild rice within the Great Lakes coastal wetlands is a partnership priority.

The Rudyard Silty Lake Plain Management Area does not have any special analysis units. See Section 5 for a detailed description of the management direction and harvest goals of SAUs in other management areas.

The Rudyard Silty Lake Plain Management Area is comprised of 74% forested cover types and 26% nonforested cover types. Of the forested cover types, a greater percentage occurs on the lowland landscape position than the upland landscape positions. The largest contributors to upland cover types are aspen and northern hardwoods. Lowland aspen/balsam poplar, lowland deciduous, cedar and lowland spruce/fir are the most prominent cover types on the lowland landscape position. Lowland shrub is the most common nonforested cover type in the management area, representing 24% of the landscape (

Table 2).

Table 2. Landscape conditions and distribution of cover types.

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
Forested	Upland	Deciduous	Aspen	5,450	9,384	12,905	36,520
			Northern hardwood	1,830			
			Black/red hybrid oak	0			
			Northern red oak	408			
			Oak mix	45			
			Mixed upland deciduous	1,652			
		Mixed	Upland mixed forest	557	557		
		Coniferous	Planted red pine	1,693	2,964		
			Planted jack pine	195			
			Planted white pine	0			
			Planted mixed pine	4			
			Natural red pine	44			
			Natural jack pine	606			
			Natural white pine	107			
			Natural mixed pines	100			
			Upland spruce/fir	47			
			Upland conifers	159			
			Hemlock	8			
	Lowland	Deciduous	Lowland aspen/balsam poplar	4,582	9,086	23,615	
			Lowland deciduous	4,505			
		Mixed	Lowland mixed forest	1,303	1,303		
		Coniferous	Cedar	4,040	13,226		
			Lowland conifers	2,935			
			Lowland spruce/fir	4,183			
			Tamarack	2,067			
Nonforested	Upland	N/A	Herbaceous open land	710	N/A	1,284	12,912
			Upland shrub	120			
			Low density trees	328			
			Bare/sparsely vegetated	50			
			Cropland	0			
			Urban	76			
	Lowland	N/A	Lowland shrub	6,787	N/A	11,629	
			Marsh	3,363			
			Bog	253			
			Treed bog	543			
			Water	683			
						Grand Total:	49,432

Desired future condition

There are 25,340 acres (51% of the total management area and 69% of the forested area) that can be managed toward desired future conditions via commercial timber harvest in the Rudyard Silty Lake Plain Management Area (Table 3). Of that, approximately 15% is in the aspen cover type, while lowland aspen/balsam poplar, lowland deciduous and lowland spruce/fir cover around 8% each. The remaining cover types each represent less than 5% each, for a total of approximately 60% of the forested and available land in the management area.

Table 3. Current cover type composition by management availability.

RUDYARD SILTY LAKE PLAIN Forested Cover Type	Available Acres	Available %	Unavailable Acres	Unavailable %	Total Acres	Total %
Aspen	5,410	14.8%	40	0.1%	5,450	14.9%
Cedar	685	1.9%	3,356	9.2%	4,040	11.1%
Hemlock	0	0.0%	8	0.0%	8	0.0%
Lowland aspen/balsam poplar	3,126	8.6%	1,456	4.0%	4,582	12.5%
Lowland conifers	1,439	3.9%	1,496	4.1%	2,935	8.0%
Lowland deciduous	2,877	7.9%	1,628	4.5%	4,505	12.3%
Lowland mixed forest	986	2.7%	318	0.9%	1,303	3.6%
Lowland spruce/fir	3,252	8.9%	931	2.5%	4,183	11.5%
Mixed upland deciduous	1,457	4.0%	194	0.5%	1,652	4.5%
Natural jack pine	520	1.4%	86	0.2%	606	1.7%
Natural mixed pines	100	0.3%	0	0.0%	100	0.3%
Natural red pine	31	0.1%	14	0.0%	44	0.1%
Natural white pine	107	0.3%	0	0.0%	107	0.3%
Northern hardwood	1,745	4.8%	85	0.2%	1,830	5.0%
Northern red oak	408	1.1%	0	0.0%	408	1.1%
Oak mix	45	0.1%	0	0.0%	45	0.1%
Planted jack pine	195	0.5%	0	0.0%	195	0.5%
Planted mixed pine	4	0.0%	0	0.0%	4	0.0%
Planted red pine	1,693	4.6%	0	0.0%	1,693	4.6%
Tamarack	553	1.5%	1,514	4.1%	2,067	5.7%
Upland conifers	125	0.3%	35	0.1%	159	0.4%
Upland mixed forest	557	1.5%	0	0.0%	557	1.5%
Upland spruce/fir	27	0.1%	20	0.1%	47	0.1%
Grand total	**25,340**	**69.4%**	**11,180**	**30.6%**	**36,520**	**100.0%**

Table 4. Site conditions for unavailable acres.

Site Condition (Reason area is unavailable for commercial harvest)	Area (ac)	% of Unavailable Area
Too wet	2,092	18.7%
Deer wintering area	1,963	17.6%
Unproductive	1,724	15.4%
Blocked by obstacle	1,525	13.6%
Wildlife concerns	1,519	13.6%
Conservation values	1,314	11.8%
Best management practices	482	4.3%
Denied access	144	1.3%
Long-term retention	114	1.0%
Neighbor/interest group	108	1.0%
Species of special concern or T&E	97	0.9%
Other influence zones	40	0.4%
Too steep	21	0.2%
Recreational/scenic	20	0.2%
Other DNR/division processes	17	0.1%
Total unavailable	**11,180**	**100.0%**

Projected 10-year cover type management actions

Each cover type in the Rudyard Silty Lake Plain Management Area has unique age class and basal area class goals that describe the long-term desired future conditions. The calculated harvest levels needed during the first 10-year planning period are summarized in Table 5.

These harvests will help establish a desirable amount of regeneration for the even-aged cover types over the 10-year period or help to achieve desired basal area distribution among uneven-aged cover types like northern hardwoods. Implementing these silvicultural regimes will yield 78,703 cords, the planned harvest volume for the decade (

Table 6).

Table 5. Ten-year planning period harvest goals (acres) by cover type and silvicultural regime.

Silvicultural Regimes								
Cover Type	**Clearcut**	**Selection**	**Thinning**	**Group Selection**	**Shelterwood**	**Salvage Clearcut**	**Salvage Thinning**	**Grand Total**
Planted red pine	-	-	766	-	-	-	-	766
Aspen	727	-	-	-	-	-	-	727
Mixed upland deciduous	446	39	-	-	63	-	-	548
Northern hardwood	-	543	-	-	-	-	-	543
Lowland aspen/balsam poplar	404	-	-	-	-	-	-	404
Lowland deciduous	337	-	-	-	-	-	-	337
Lowland spruce/fir	305	-	-	-	-	-	-	305
Lowland conifers	254	-	-	-	-	-	-	254
Upland mixed forest	145	-	-	-	-	-	-	145
Natural jack pine	93	-	-	-	-	-	-	93
Tamarack	78	-	-	-	-	-	-	78
Northern red oak	8	-	-	32	-	-	-	39
Upland conifers	20	-	-	-	-	-	-	20
Upland spruce/fir	12	-	-	-	-	-	-	12
Totals	**2,827**	**582**	**766**	**32**	**63**	**-**	**-**	**4,270**

Table 6. Projected 10-year harvest volume by product and species.

10-Year Estimated Harvest Volume Projection Rudyard Silty Lake Plain Management Area			
Product	**Species**	**Volume Planned***	**Volume Prepared****
Pulpwood (cords)	Mixed hardwood	14,950	14,053
	Mixed softwood	8,390	7,886
	Mixed spruce	7,171	6,740
	Mixed aspen	6,932	6,516
	Red pine	4,189	3,937
	Mixed oak	1,523	1,431
	Jack pine	1,171	1,100
	White pine	683	642
	Pulpwood total	**45,007**	**42,307**
Sawtimber (MBF)	Red pine	4,493	4,224
	Red oak	3,418	3,213
	Red maple	2,558	2,405
	Mixed aspen	1,734	1,630
	White pine	1,691	1,589
	Sugar maple	1,516	1,425
	Basswood	220	207
	Mixed oak	206	193
	White oak	169	159
	Sawtimber total	**16,004**	**15,044**
	Total sawtimber harvest volume in cords	**33,696**	**31,674**
	Grand total harvest volume in cords	**78,703**	**73,981**

*Volume estimates based on 100% of the projected harvests for the 10-year planning period.
**Volume estimates based on 94% of the projected harvests for the 10-year planning period accounting for reduction in acres and associated volume once sales are prepared for bid.

There are very few cover-type transitions projected for the Rudyard Silty Lake Plain Management Area (Table 7). The managed area of each cover type is projected to remain fairly stable, as treatment regimes will not significantly change the amount of area in each cover type. The largest decrease forecasted is in the lowland deciduous cover type, where 113 acres will convert to other cover types through forest management and regeneration activities. The largest increase occurs in the lowland aspen/balsam poplar type, where 113 acres are projected to convert into this cover type.

Table 7. Projected 10-year cover type acres resulting from cover type transitions.

Cover Type	Current Acreage	Projected Acreage at End of 10-Year Planning Period	Projected 10-Year Change in Acreage
Aspen	5,450	5,496	47
Lowland aspen/balsam poplar	4,582	4,695	113
Lowland deciduous	4,505	4,392	-113
Lowland spruce/fir	4,183	4,148	-35
Cedar	4,040	4,040	0
Lowland conifers	2,935	2,923	-11
Tamarack	2,067	2,045	-22
Northern hardwood	1,830	1,859	29
Planted red pine	1,693	1,696	3
Mixed upland deciduous	1,652	1,644	-8
Lowland mixed forest	1,303	1,381	77
Natural jack pine	606	589	-17
Upland mixed forest	557	504	-53
Northern red oak	408	401	-7
Planted jack pine	195	204	9
Upland conifers	159	156	-4
Natural white pine	107	107	0
Natural mixed pines	100	100	0
Upland spruce/fir	47	42	-6
Oak mix	45	45	0
Natural red pine	44	44	0
Hemlock	8	8	0
Planted mixed pine	4	4	0
Lowland shrub	6,787	6,787	0
Marsh	3,363	3,363	0
Herbaceous open land	710	710	0
Water	683	683	0
Treed bog	543	543	0
Low density trees	328	328	0
Bog	253	253	0
Upland shrub	120	120	0
Urban	76	76	0
Bare/sparsely vegetated	50	50	0
Total:	**49,432**	**49,432**	**0**

Featured species current and projected habitat acres

There are seven featured species in this management area that span various cover types, age classes and stand-level conditions.

As noted in the featured species management priority (Section 3), it is recommended that these featured species habitat acres be viewed as acres of potential habitat, representing a condition on the landscape where the more nuanced aspects of each species' habitat requirements are likely to be found or managed for. As described in the introduction, the State Forest Management Plan modeling effort was limited by several factors, including the simplification of habitat attributes into MiFI variables. Therefore, when referring to habitat acres, these are potential habitat acres.

Current and projected total habitat acres by species across the decade provide a baseline and show the result of long-term management actions (Table 8). Some species show a loss in habitat over the next century. As mentioned in the featured species management priority (see Section 3), the current condition for many cover types is a surplus of acres in the 0-9 age class from the compensatory management approach applied in the previous decade. The model eventually evens out the age classes at a lower, sustainable level over time, usually within 50 years. For any species with northern hardwoods as a priority cover type, there is a perceived drop in acres between 40 and 60 years; this is due to the basal area dropping below 81, but because it only drops into the upper 70s, it is not expected to translate to any real habitat loss on the ground. Three of these species were not included in the State Forest Management Plan model but are included here to inform management decisions over the decade.

Table 8. Featured species current and projected total habitat acres (i.e., potential habitat).

Featured Species	Priority Cover Types	Total Habitat Acres Current	10-Year Projected Habitat Acres	50-Year Projected Habitat Acres	100-Year Projected Habitat Acres
Black bear	Generalist/mast	7,350	--	--	--
Blackburnian warbler	Northern hardwoods, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, hemlock	1,530	1,870	823	2,241
Marten U.P.	Northern hardwoods, mixed upland deciduous, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, lowland mixed	7,187	7,454	6,997	8,346

Featured Species	Priority Cover Types	Total Habitat Acres Current	10-Year Projected Habitat Acres	50-Year Projected Habitat Acres	100-Year Projected Habitat Acres
	forest, lowland conifers, hemlock, cedar				
Moose	To be determined	--	--	--	--
Ruffed grouse	Aspen	1,433	1,171	1,701	1,717
Sharp-tailed grouse	Herbaceous open land, upland shrub, low density trees, lowland shrub, bog, treed bog	8,741	--	--	--
Snowshoe hare forest	Aspen, cedar, hemlock, lowland aspen, lowland conifers, lowland mixed forest, lowland spruce/fir, mixed upland deciduous, natural jack pine, natural mixed pines, planted jack pine, upland spruce/fir	4,868	4,925	4,711	4,674
Wood turtle	Nonforested openings	--	--	--	--
White-tailed deer (food)	Food: Northern hardwood, oak mix, aspen, mixed upland deciduous, lowland deciduous, lowland aspen/balsam poplar, lowland mixed forest	20,331	20,415	20,870	21,280
White-tailed deer (shelter)*	Shelter: hemlock, cedar, planted red pine, planted white pine, planted mixed pine, natural red pine, natural white pine, natural mixed pines, upland conifers, upland spruce fir, lowland conifers	13,322	13,269	12,972	12,626

*Deer wintering complexes greater than 15,000 acres are modeled as a special analysis unit, or SAU, and information on them can be found in Section 5 of the plan. In deer wintering complexes less than 15,000

acres, harvest of cedar and hemlock is not allowed on range stands essential for survival, and secondary shelter is often protected as well. These areas are guided by the DNR Deer Winter Range Guidelines.

Cover type composition and associated featured species

Aspen

Current condition

Most of the aspen cover type is currently in the 30- to 39-year-old age class. (Figure 3). The past management regime has been primarily clearcut in the management area. Several age classes in this cover type have a deficit, including the 0- to 9-year age class and the 40- to 49-year and older age classes. Limited available acres in the older age classes will present managers with a challenge in achieving the desired regeneration during this planning period.

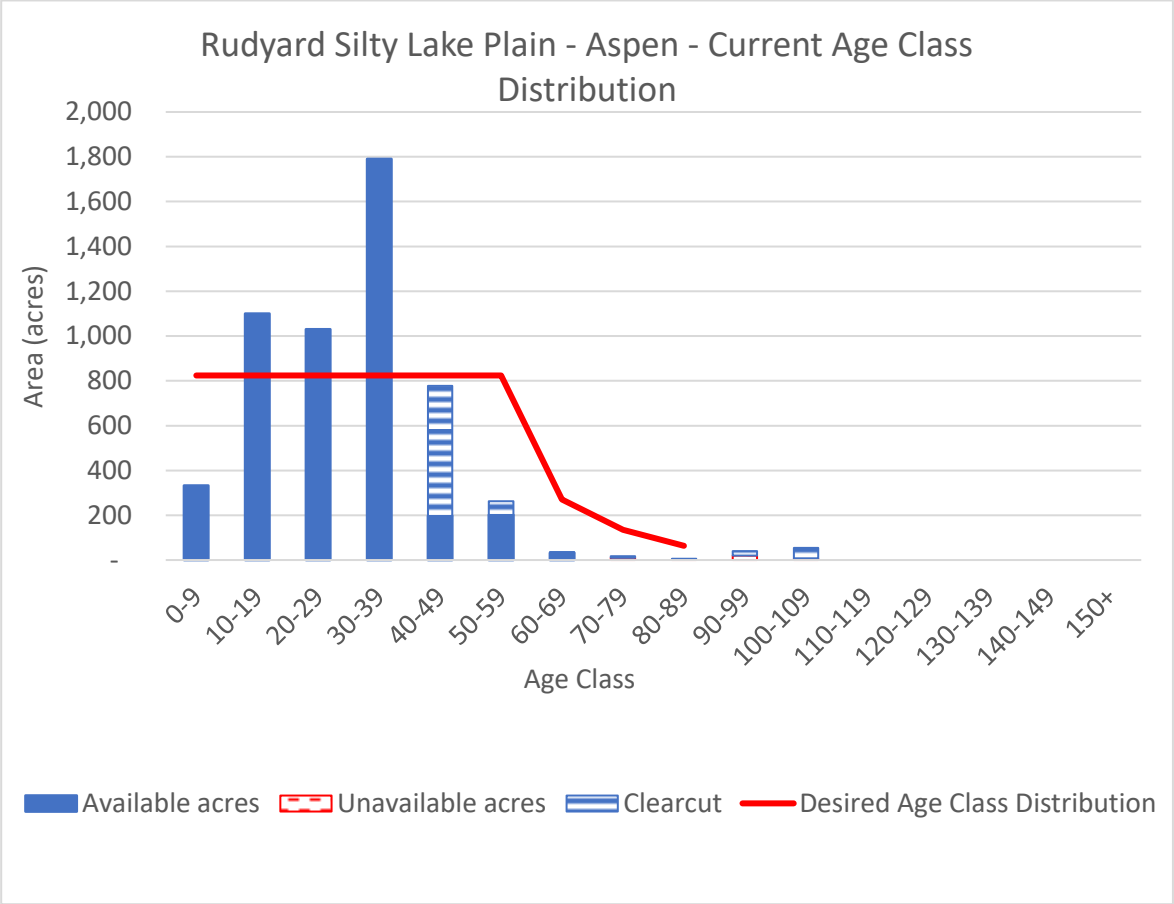


Figure 3. Current age class distribution, desired age class distribution and projected harvests in the aspen cover type in the Rudyard Silty Lake Plain Management Area.

Current conditions are a result of consistent commercial harvests and regeneration efforts on available aspen acres during the previous planning periods. A portion of this cover type meets the habitat requirements for ruffed grouse and snowshoe hare (Table 9).

Table 9. Featured species with aspen as a selected habitat cover type, habitat variables and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Aspen	Aspen Habitat Acres – Available	Aspen Habitat Acres – Unavailable
Ruffed grouse	Age category: 0-19 Size class: sapling	1,433	0
Snowshoe hare	Age category: 0-19 Size class: sapling	1,433	0
White-tailed deer	All ages and size classes	5,450	--

Desired future condition

The projected long-term cover type trend for aspen is stable in the Rudyard Silty Lake Plain Management Area. There are a few transitions into this cover type from other cover types and equally few transitions from aspen to other cover types forecasted in this management area.

The long-term goal for this cover type is balanced age classes between 0 and 50 years old for all available aspen stands in this management area. Maintaining lower acreage in old age classes continues to be desirable to ensure the aspen cover type is distributed within the desired age classes.

The end of the planning period will result in the establishment of 839 acres in the upcoming 0-9 age class. Progress toward the long-term age class distribution of aspen will take many decades in the management area (Figure 4).

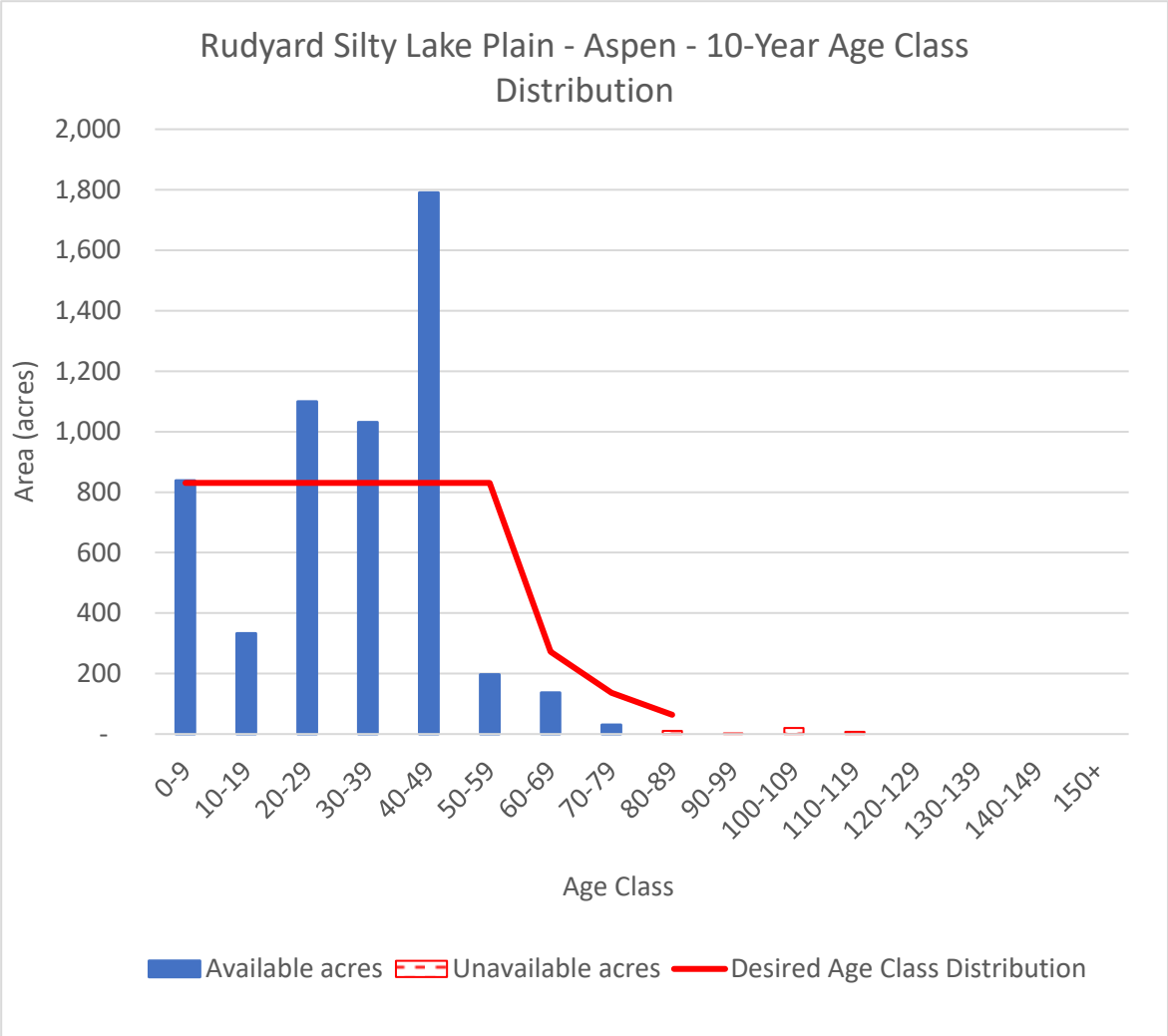


Figure 4. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The midterm age class distribution shows the population of aspen acres nearly reaching the desired future condition, with only a few age classes deviating from the target proportions (Figure 5). As is often the case, an extremely unbalanced condition in the first planning period can often result in the need to carry some acres slightly longer into older age classes to achieve the desired age class goals (Figure 5).

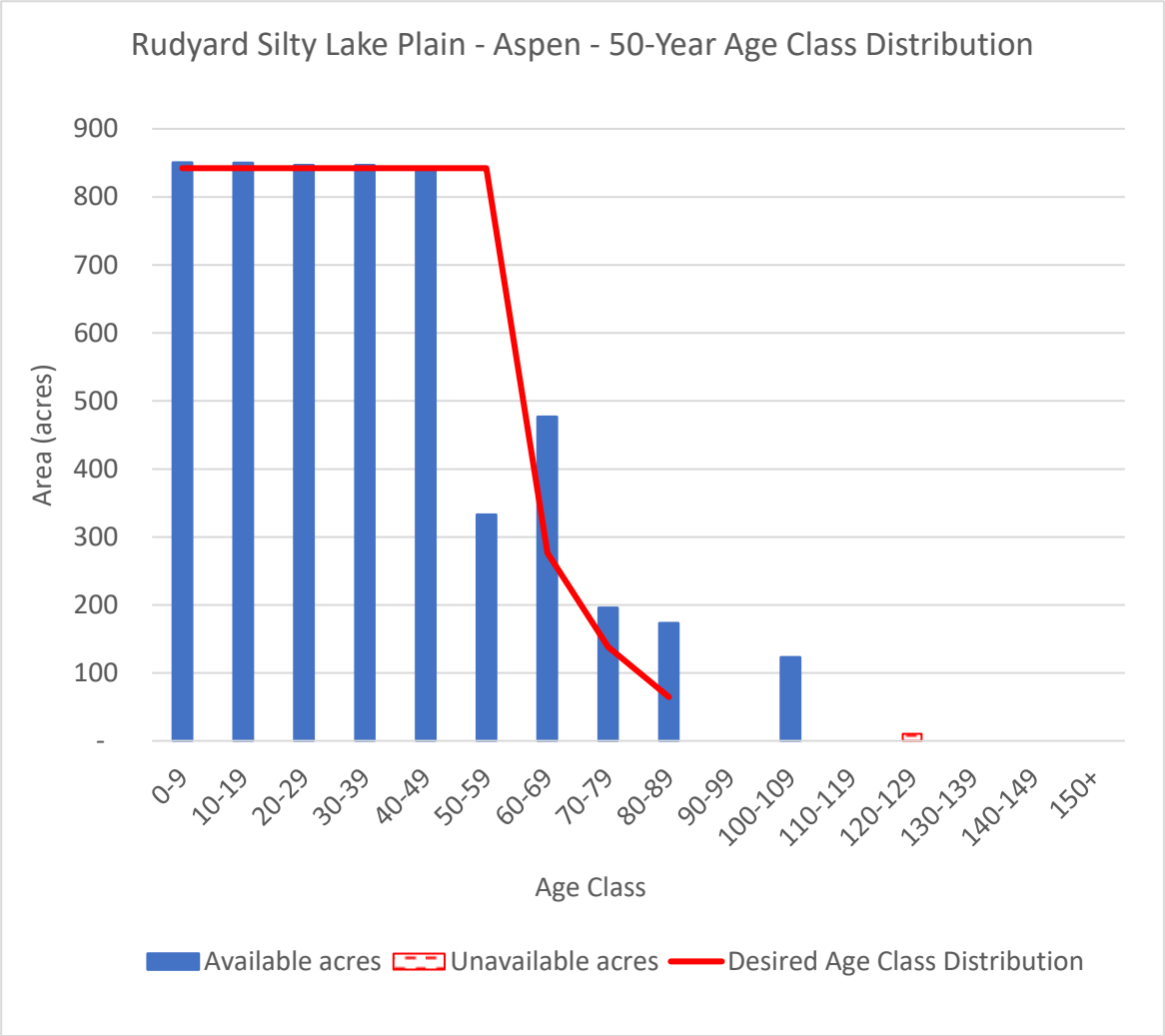


Figure 5. Projected midterm age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 6) will concentrate on the manageable acres of aspen in productive growing conditions while providing an even flow of forest products and a wide variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest.

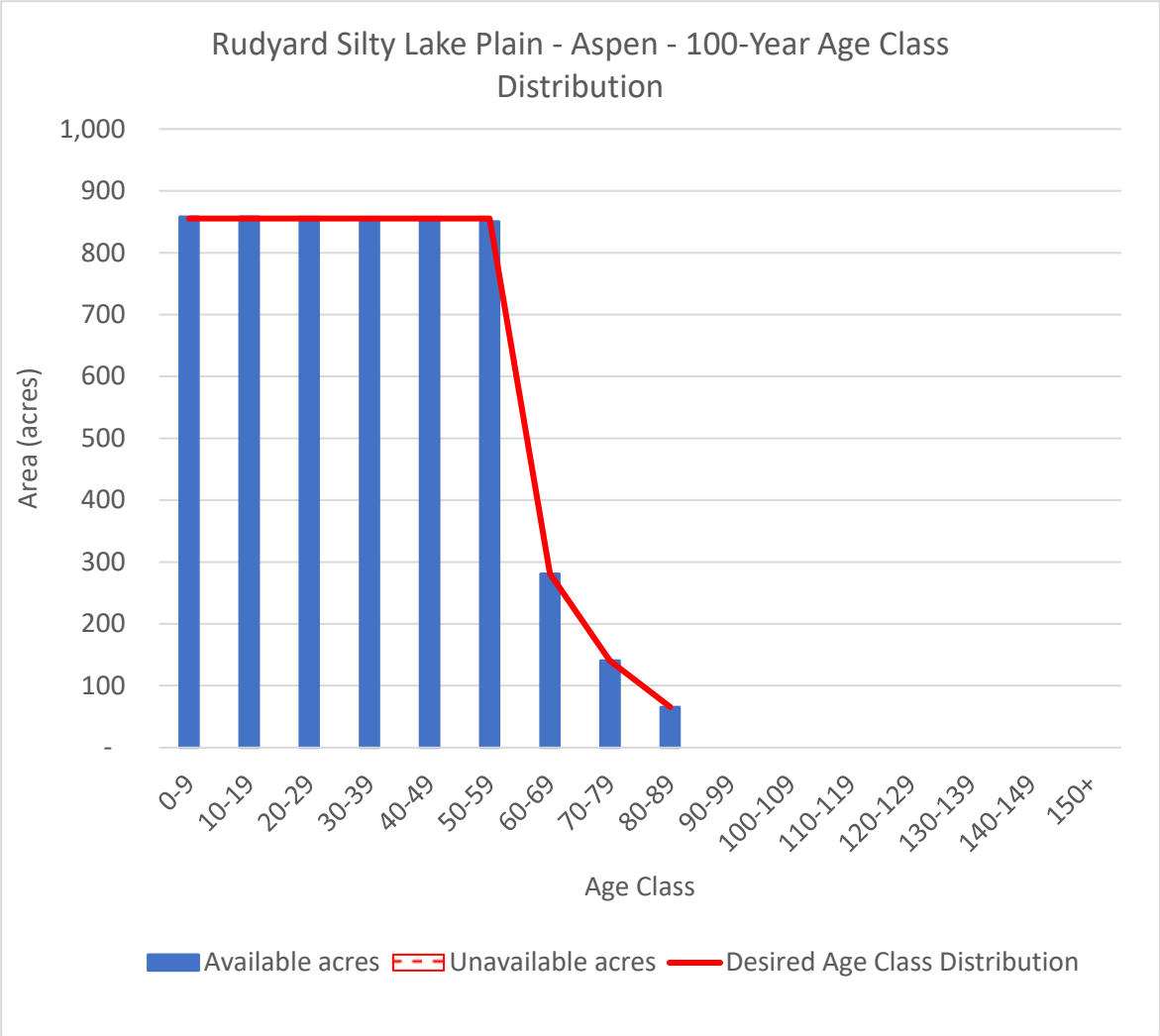


Figure 6. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

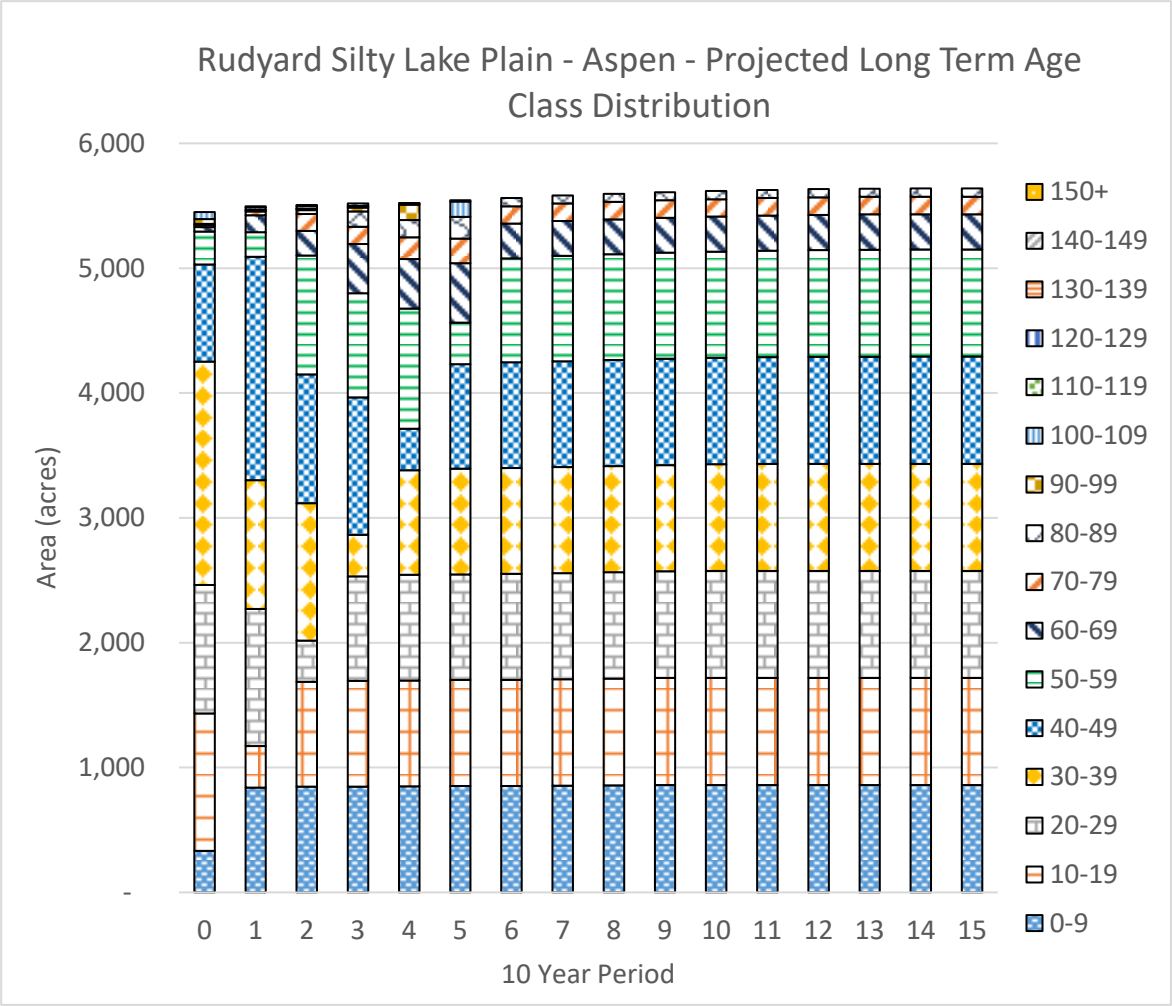


Figure 7. Projected age class distribution for all acres of aspen over the next 150 years.

Management actions

There are 727 acres of projected clearcut harvest in the aspen cover type during this planning period. This projection is not significantly different than the 831-acre desired age class distribution target of this planning cycle.

Lowland deciduous

Current condition

The Rudyard Silty Lake Plain Management Area has a surplus of acres in the 0- to 9-year-old age class due to the harvesting of mature and overmature acres on the landscape during the last planning period (Figure 8). The age class distribution is currently very unbalanced across almost all age class categories. The landscape position on which many of these acres occur contributes to the number of acres extending beyond the desired maximum age class tail of 110 years old.

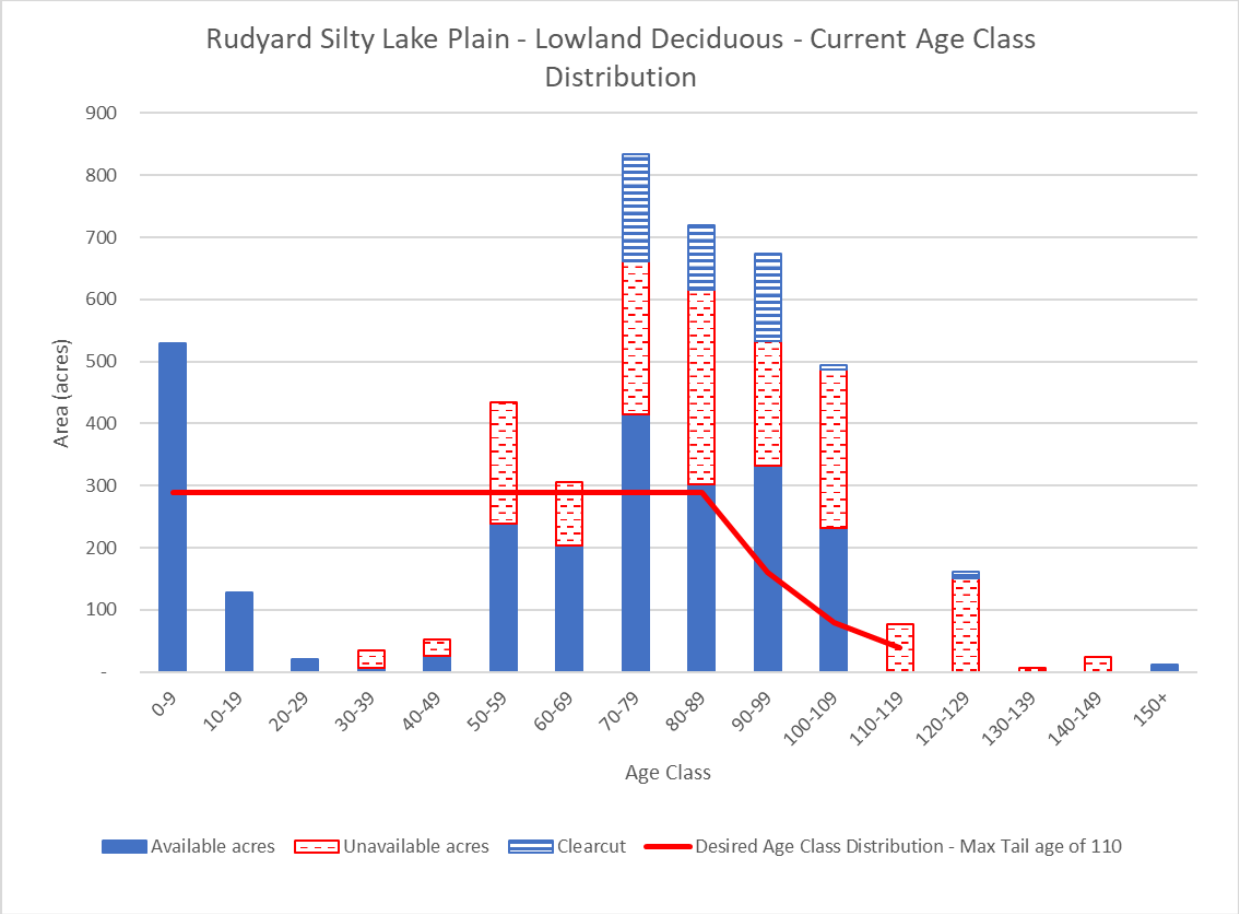


Figure 8. Current age class distribution, desired age class distribution and projected harvests in the lowland deciduous cover type in the Rudyard Silty Lake Plain management area.

Table 10. Featured species with lowland deciduous as a priority habitat cover type, habitat variables and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Lowland Deciduous	Lowland Deciduous Habitat Acres – Available	Lowland Deciduous Habitat Acres – Unavailable
White-tailed deer	All ages and size classes	4,505	--

Desired future condition

The projected long-term cover type trend for lowland deciduous is stable in the Rudyard Silty Lake Plain Management Area (Figure 9). There are very few transitions into and out of this cover type during this planning period.

The long-term goal for this cover type is balanced age classes between 0 and 50 years old for all available lowland deciduous acres and then decreasing number of acres until the max tail of 80 years old is reached.

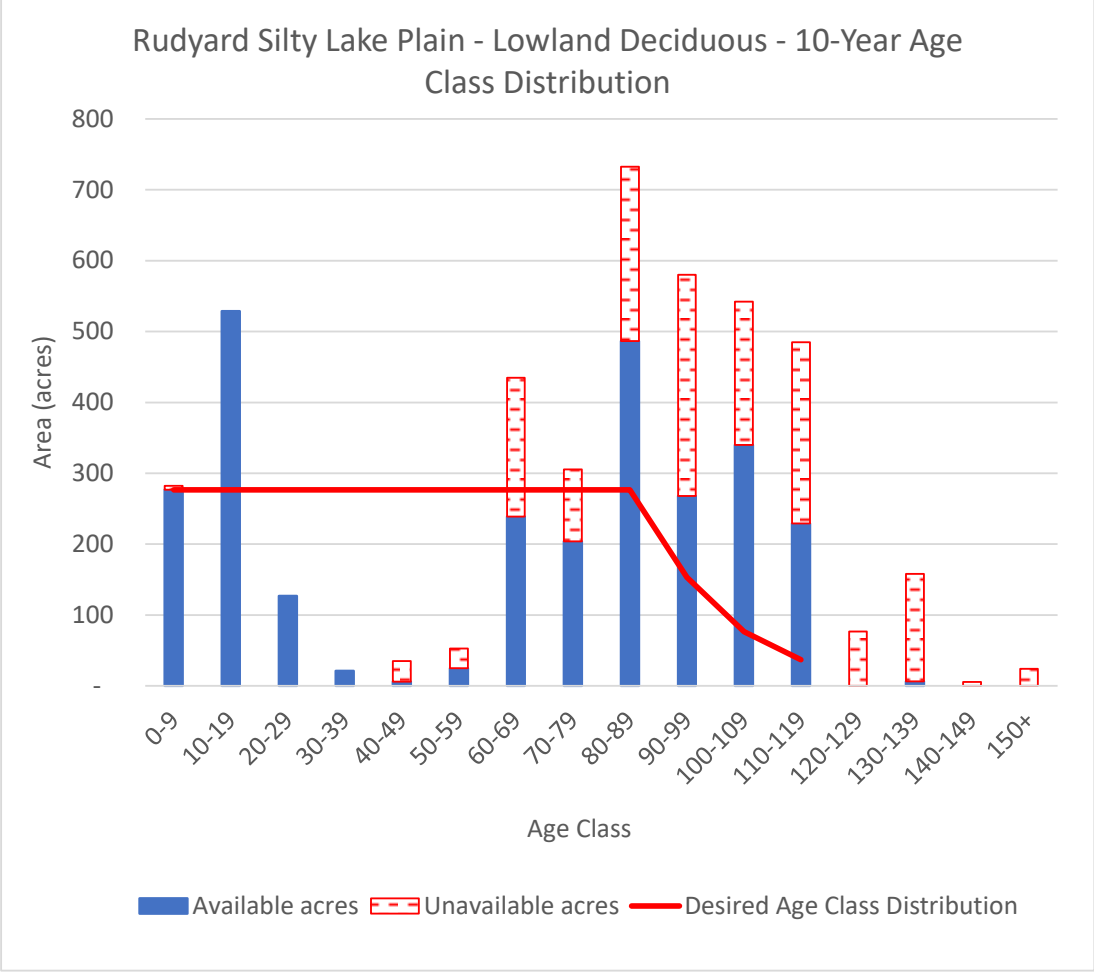


Figure 9. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The end of the planning period will result in the establishment of approximately 277 acres of lowland deciduous from the available acres. It will take many decades to achieve the desired balanced age class condition of lowland conifers (*Figure 10*).

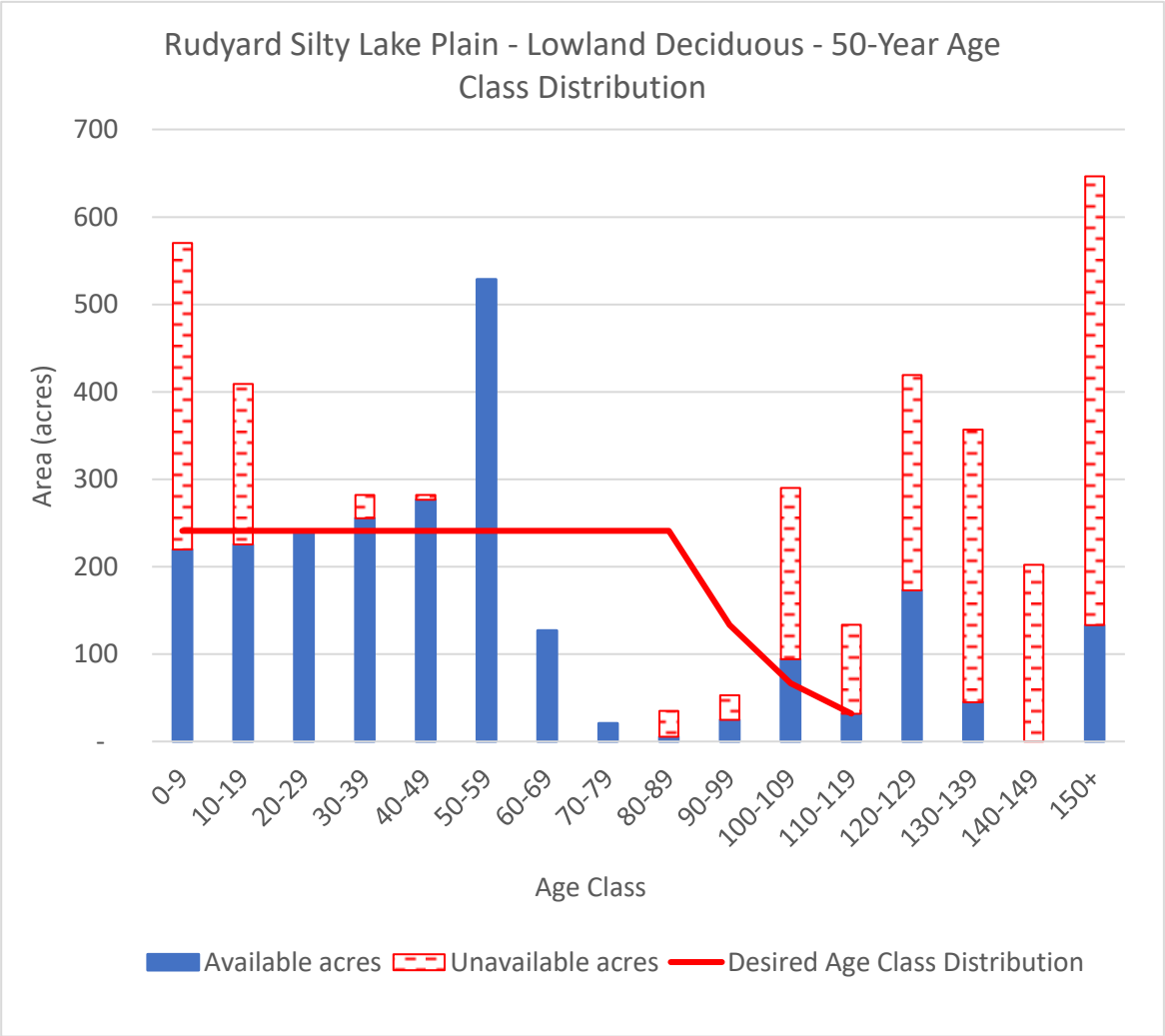


Figure 10. Projected midterm age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The midterm age class distribution of lowland deciduous is nearing the desired future condition for available acres in the age classes. The number of acres in the older age classes, 90 years old and older, continues to increase as the unavailable acres continue to move to the older age classes (Figure 11). As older stands of unavailable lowland deciduous continue to age and reach mortality through the process of senescence, natural regeneration of the stands does not convert them to other cover types, and they are still unavailable for commercial harvest.

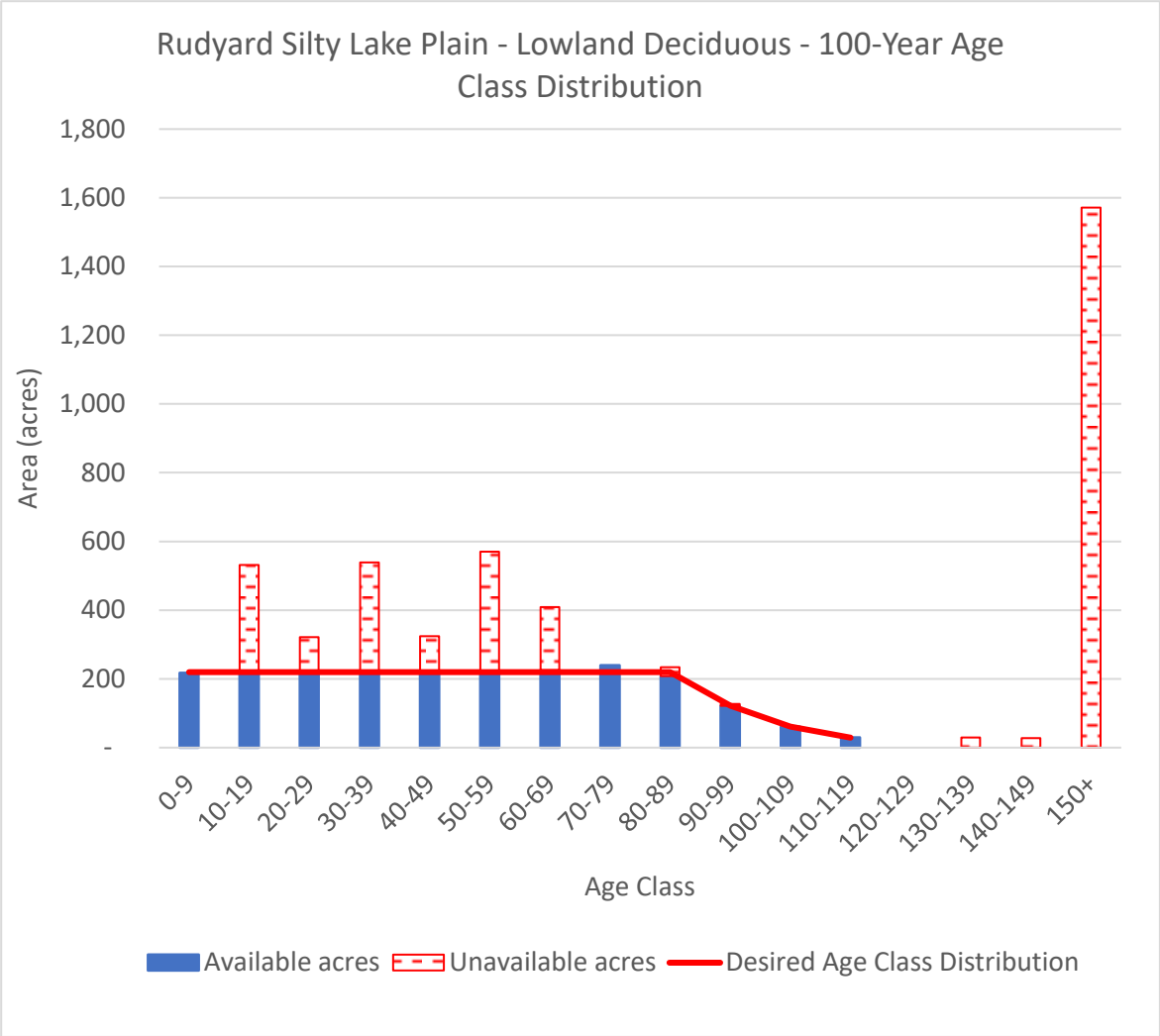


Figure 11. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 12) will concentrate on the manageable acres of lowland deciduous cover type in productive growing conditions while providing an even flow of forest products and a wide variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest.

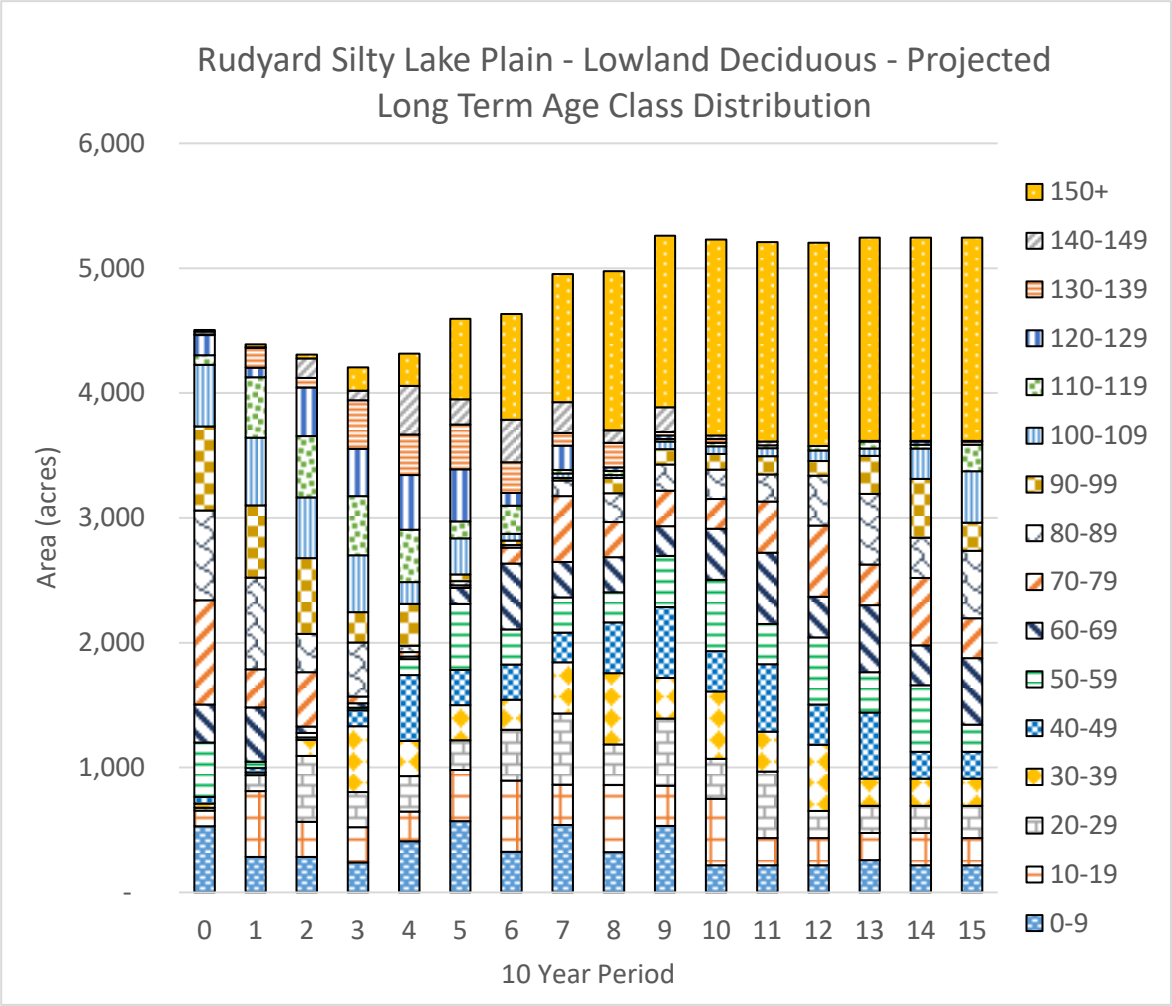


Figure 12. Projected age class distribution for all acres of lowland deciduous over the next 150 years in the Rudyard Silty Lake Plain Management Area.

Management actions

The desired future conditions and associated featured species habitat will be maintained and achieved through continued application of the projected harvest regime available on the 337 acres of projected clearcut harvest in the lowland deciduous cover type during the planning period. This is aligned with the desired establishment of lowland deciduous per decade for the 0- to 9-year-old age class.

Lowland spruce/fir

Current condition

The age class distribution is currently unbalanced in this management area. About 30% of the management area is unavailable for commercial harvest due to its landscape position or other management priorities such as unique natural communities or species of special concern. Unavailable acres will be subject to natural processes, resulting in a range of successional stages across this management area.

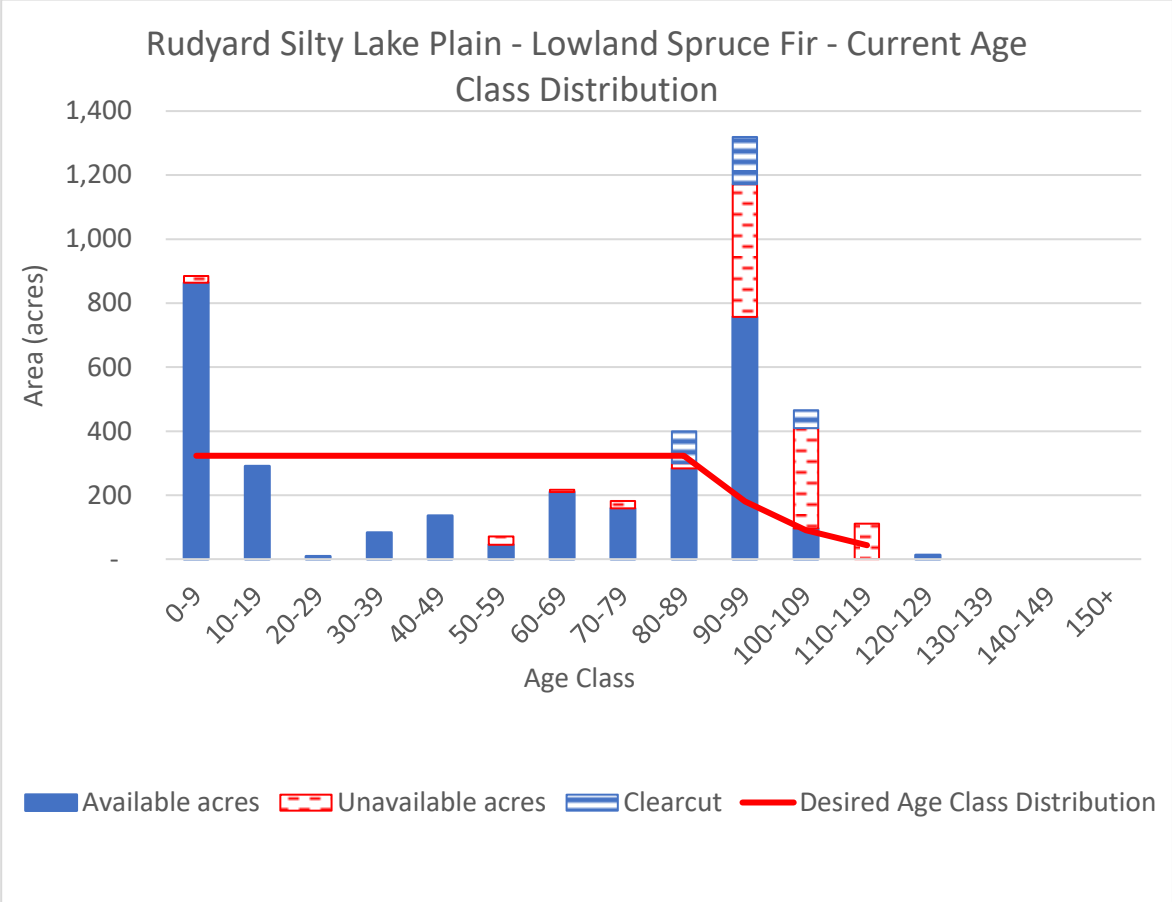


Figure 13. Current age class distribution and projected harvests in the lowland spruce/fir cover type in the Rudyard Silty Lake Plain Management Area.

Current conditions are a result of successful commercial harvest and natural regeneration efforts that have been in place in this management area for decades as well as unavailable acres due to landscape positions of the cover type. A portion of this cover type meets the habitat requirements for snowshoe hare (*Table 11*).

Table 11. Featured species with lowland spruce/fir as a priority habitat cover type, habitat variables and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Lowland Spruce/Fir	Lowland Spruce/Fir Habitat Acres – Available	Lowland Spruce/Fir Habitat Acres – Unavailable
Snowshoe hare	Age category: 0-19 Size class: sapling	1,155	21

Desired future condition

The projected long-term cover type trend for lowland spruce/fir is stable in the Rudyard Silty Lake Plain Management Area. There are very few projected transitions into or out of this cover type forecasted in the current planning period.

The long-term goal for this cover type is balanced age classes between 0 and 89 years old and a max lower proportion age class of 130 years old for all available lowland spruce/fir stands in this management area (Figure 14).

The end of the planning period will result in the establishment of 319 acres in the upcoming 0- to 9-year-old age class. Progress toward the long-term age class distribution of lowland spruce/fir will take many decades in the management area.

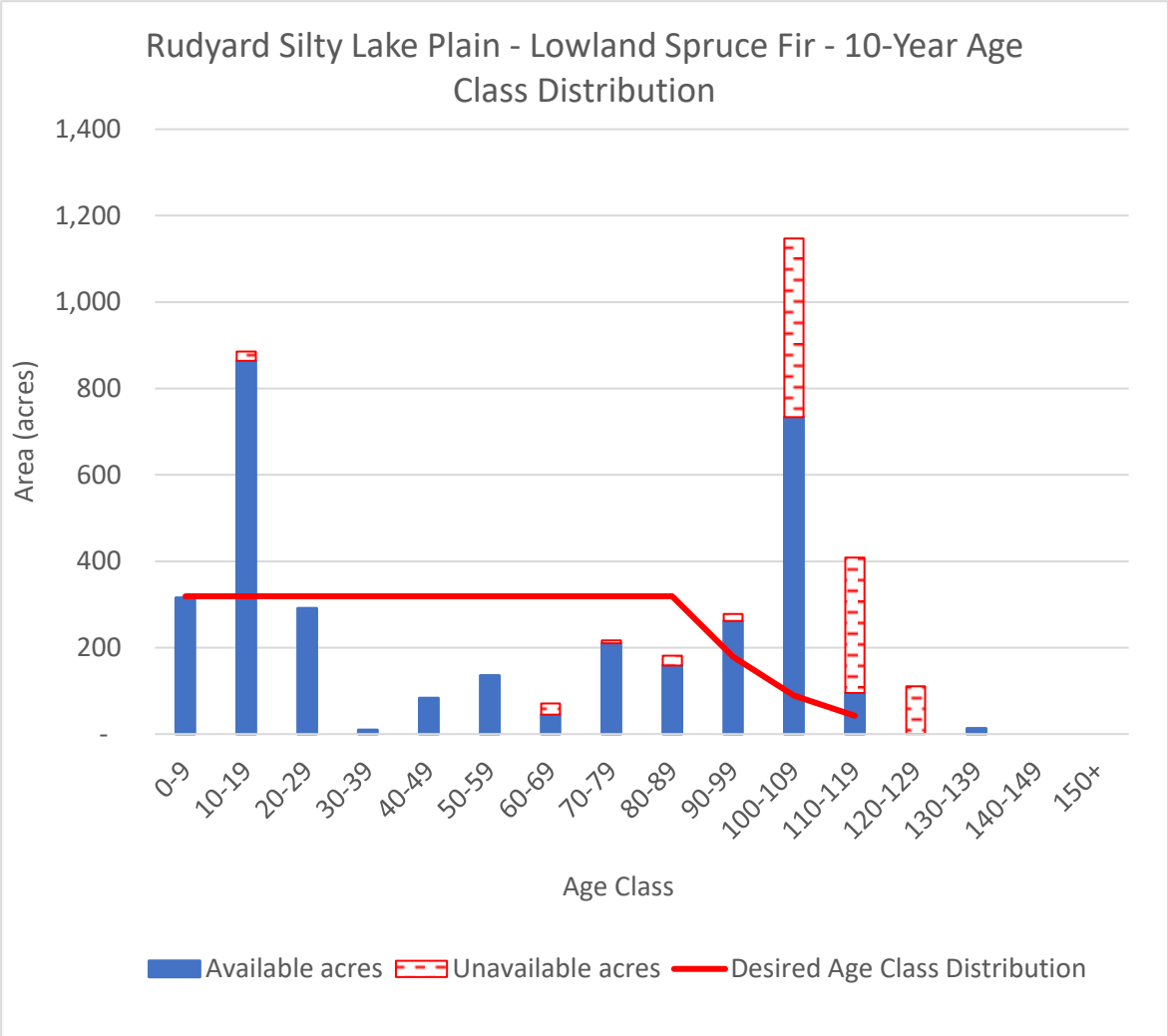


Figure 14. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The midterm age class distribution shows the population of lowland spruce/fir acres nearly reaching the desired future condition, especially in the younger age classes. The older age classes continue to show deficits due to the unbalanced condition during the first planning period (Figure 15). As is often the case, an extremely unbalanced condition in the first planning period can result in the need to carry some acres slightly longer into older age classes in future years to meet the desired distribution and achieve age class goals. Unavailable acres of this cover type, due to their landscape position or other factors, will continue to age through natural processes.

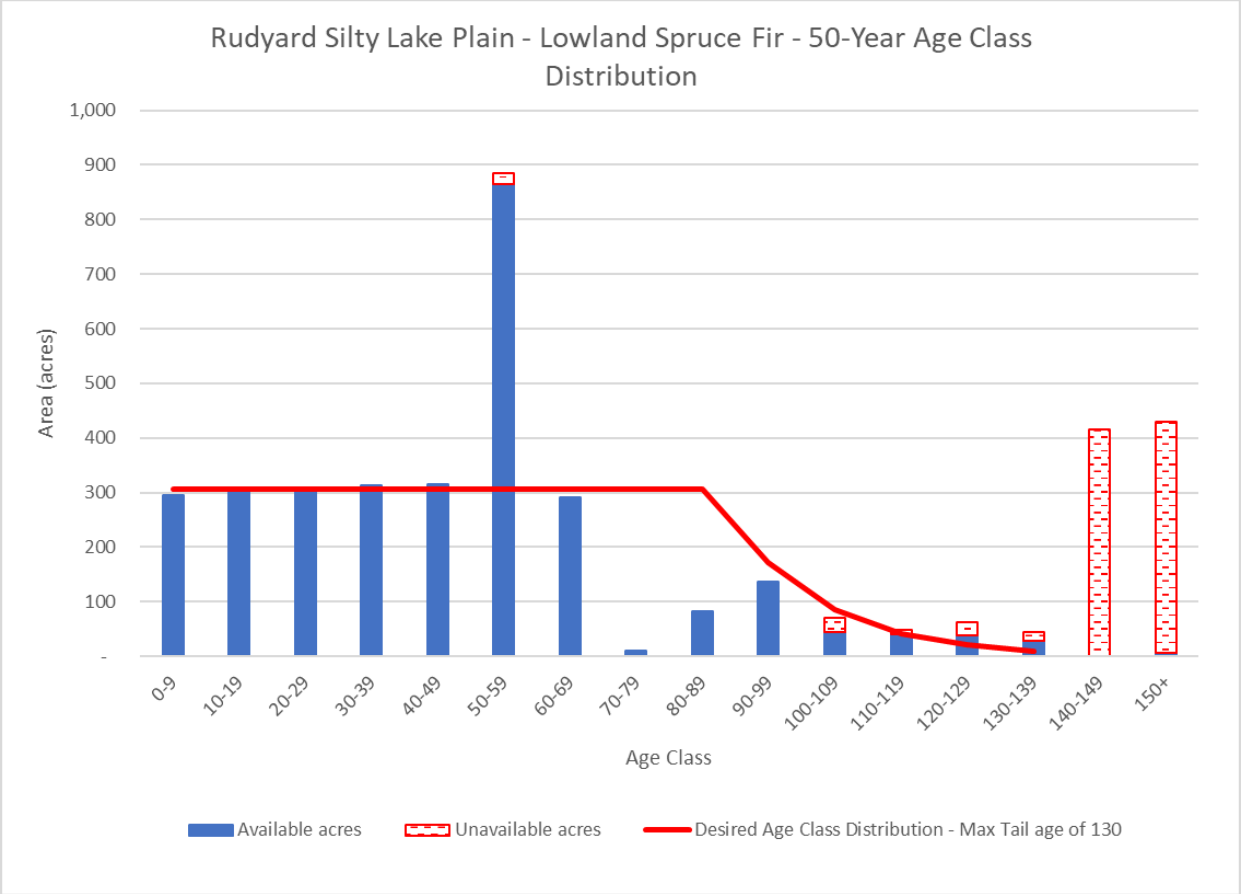


Figure 15. Projected midterm age class distribution at the end of the midterm planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 16) will concentrate on the manageable acres of lowland spruce/fir in productive growing conditions while providing an even flow of forest products and a wide variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest.

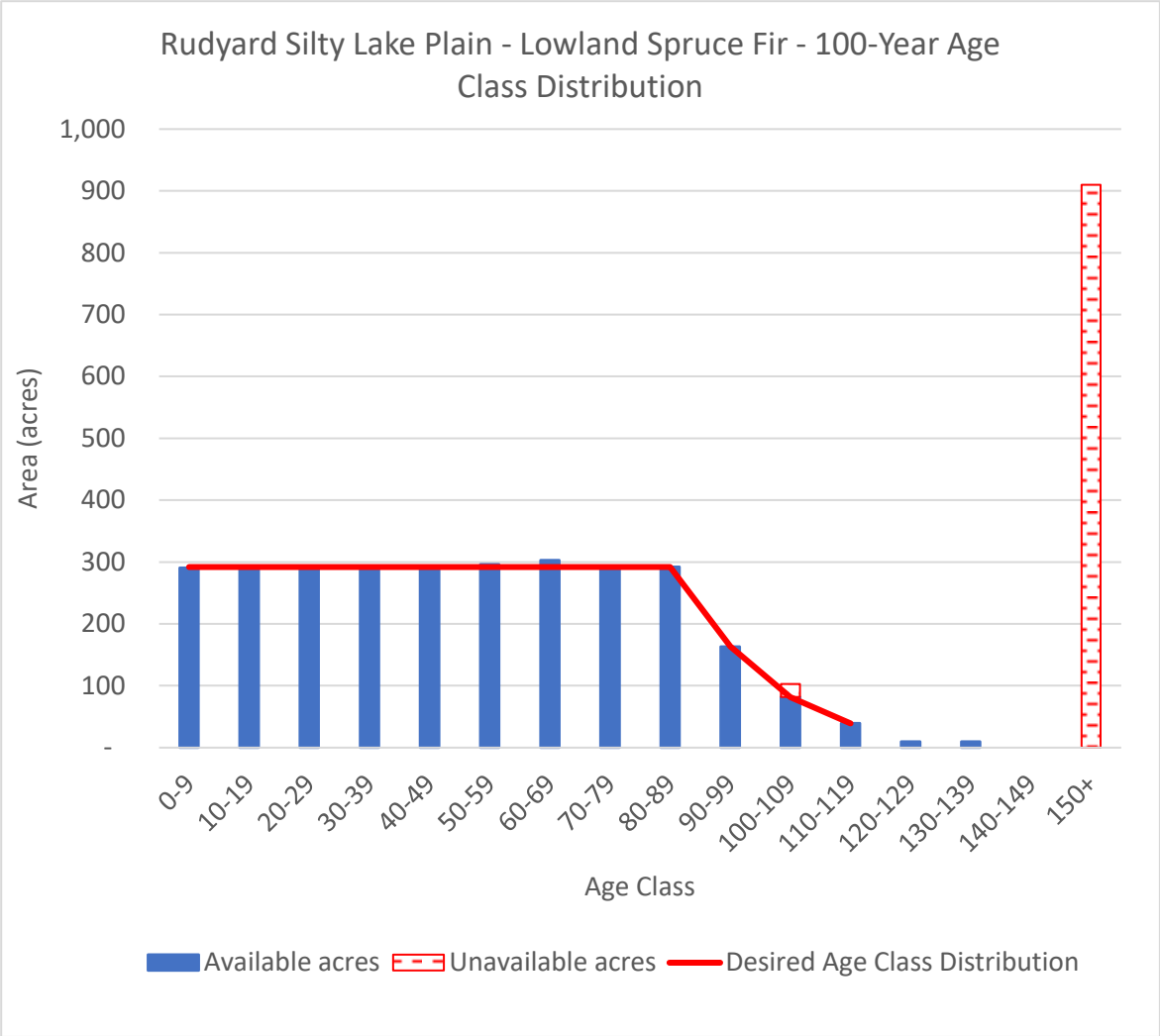


Figure 16. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

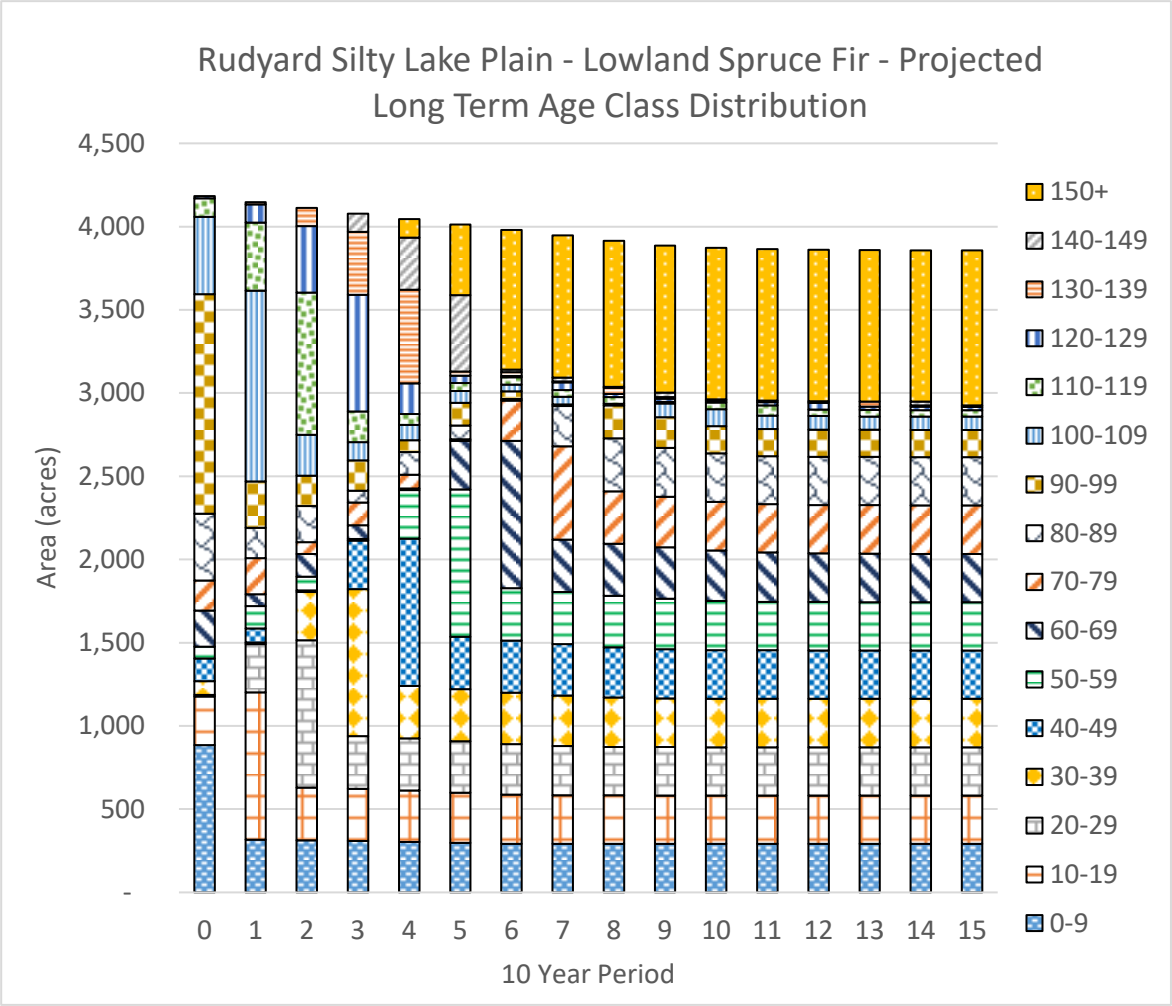


Figure 17. Projected age class distribution for all acres of lowland spruce/fir over the next 150 years.

Management actions

The desired forest conditions and associated featured species habitat will be maintained and achieved through continued application of the projected clearcut regime on 305 acres (Table 5). This projected harvest is nearly aligned with the desired age class distribution.

Lowland aspen/balsam poplar

Current condition

The Rudyard Silty Lake Plain Management Area has a surplus of acres in the 0- to 9-year-old age class due to the harvesting of mature and overmature acres on the landscape during the last planning period (Figure 18). The age class distribution is currently very unbalanced across almost all the age class categories. The landscape position on which many of these acres occur contributes to the number of acres extending beyond the desired maximum age class tail of 80 years old.

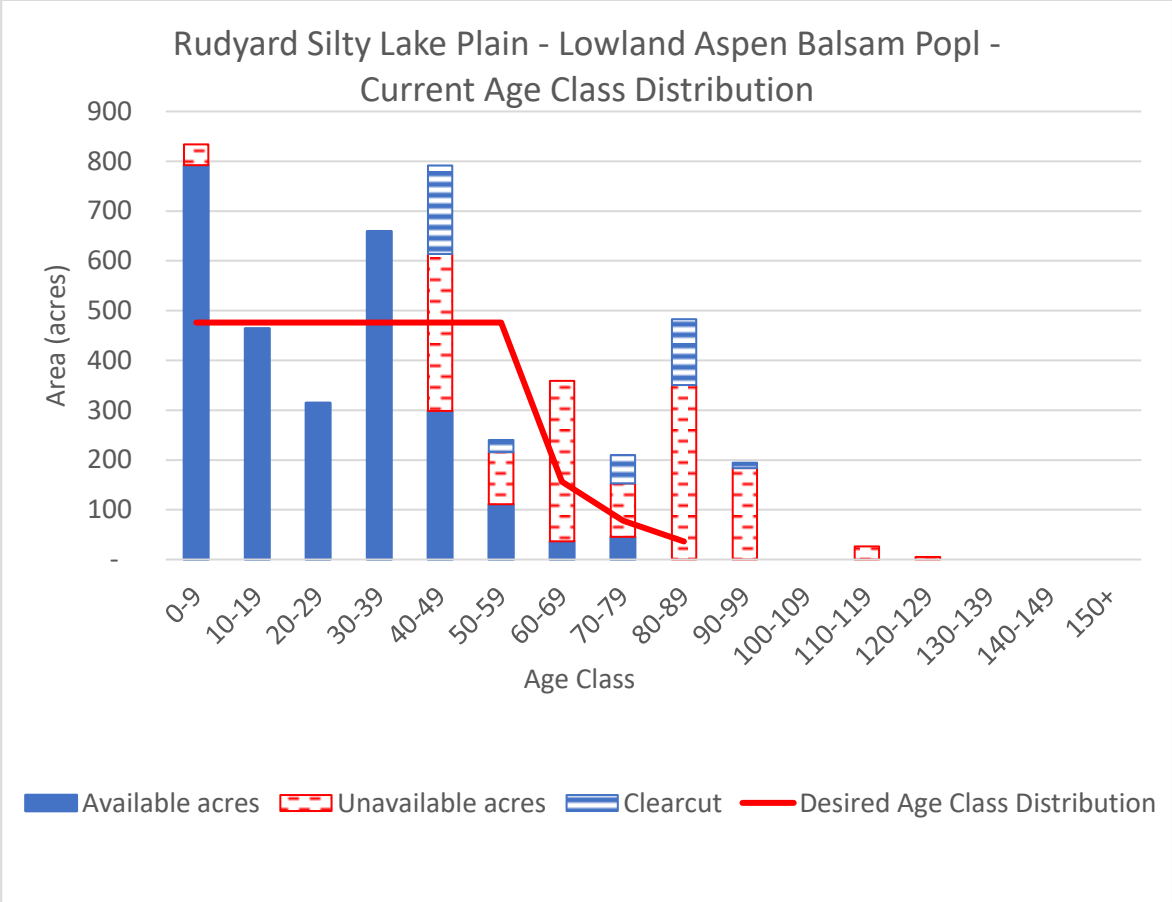


Figure 18. Current age class distribution, desired age class distribution and projected harvests in the aspen cover type in the Rudyard Silty Lake Plain management area.

Table 12. Featured species with lowland aspen/balsam poplar as a priority habitat cover type, habitat variables and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Lowland Aspen/Balsam Poplar	Lowland Aspen/Balsam Poplar Habitat Acres – Available	Lowland Aspen/Balsam Poplar Habitat Acres – Unavailable
Snowshoe hare	Age category: 0-19 Size class: sapling	1,256	42
White-tailed deer	All ages and size classes	4,183	--

Desired future condition

The projected long-term cover type trend for lowland aspen/balsam poplar is stable in the Rudyard Silty Lake Plain Management Area. There is a slight increase in transitions into this cover type during this planning period and the following three planning periods, while longer-term projections for the cover type show a slight downward trend in midterm periods and acreages stabilizing after the ninth planning period (*Figure 21*).

The long-term goal for this cover type is balanced age classes between 0 and 50 years old for all available lowland aspen/balsam poplar acres and lower proportions of available acres until the max tail of 80 years old is reached.

The end of the planning period will result in the establishment of approximately 511 acres of lowland aspen/balsam poplar from the available acres (*Figure 19*). It will take many decades to achieve the long-term desired balanced age class distribution of lowland conifers (*Figure 20*).

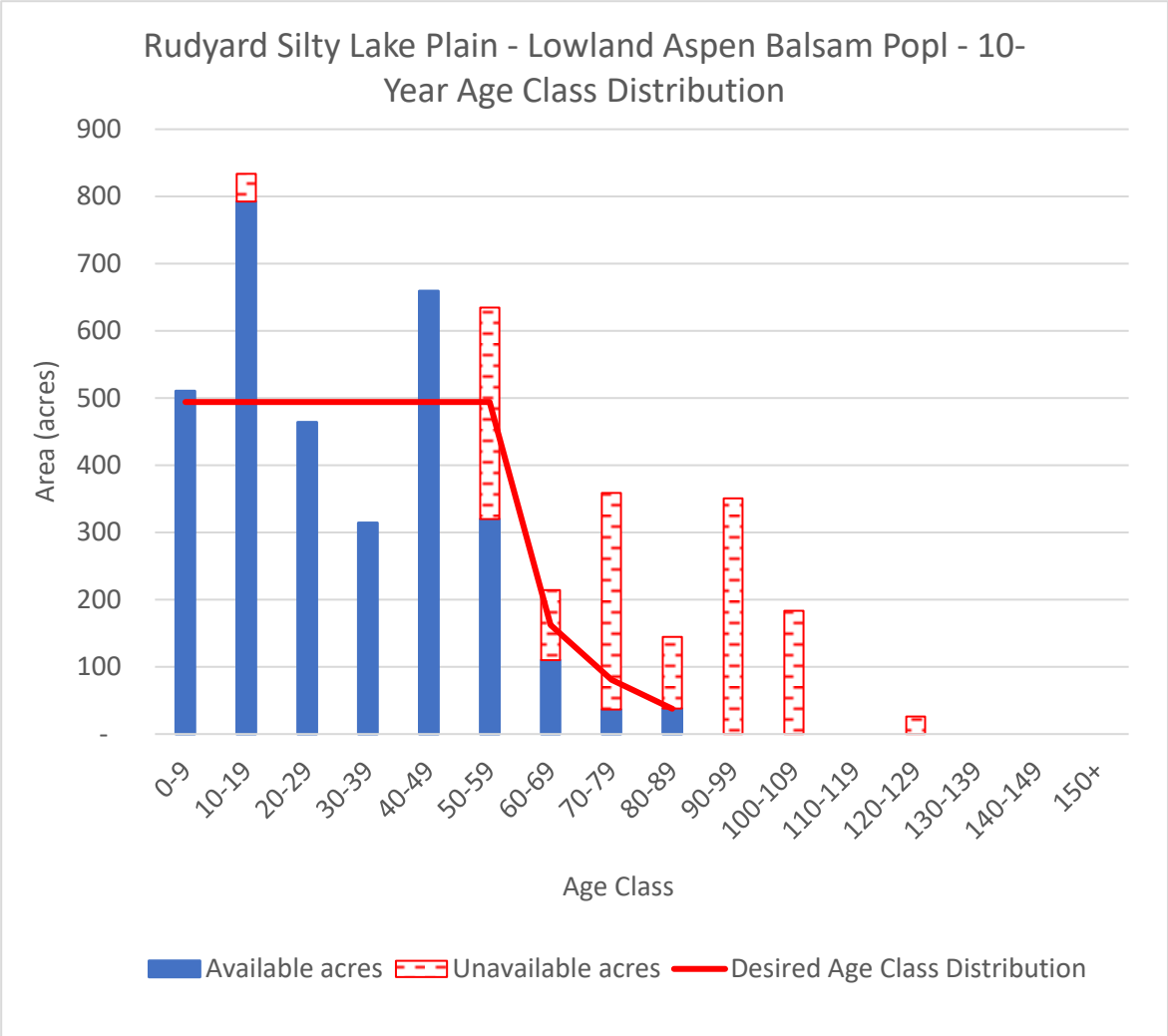


Figure 19. Short-term future age class distribution at the end of the 10-year planning period compared to long-term desired age class distribution.

The midterm age class distribution of lowland aspen/balsam poplar is nearing the desired future condition for available acres in the age classes. The number of acres in the older age classes, 90 years old and older, continues to increase as the unavailable acres continue to move to the older age classes (Figure 20).

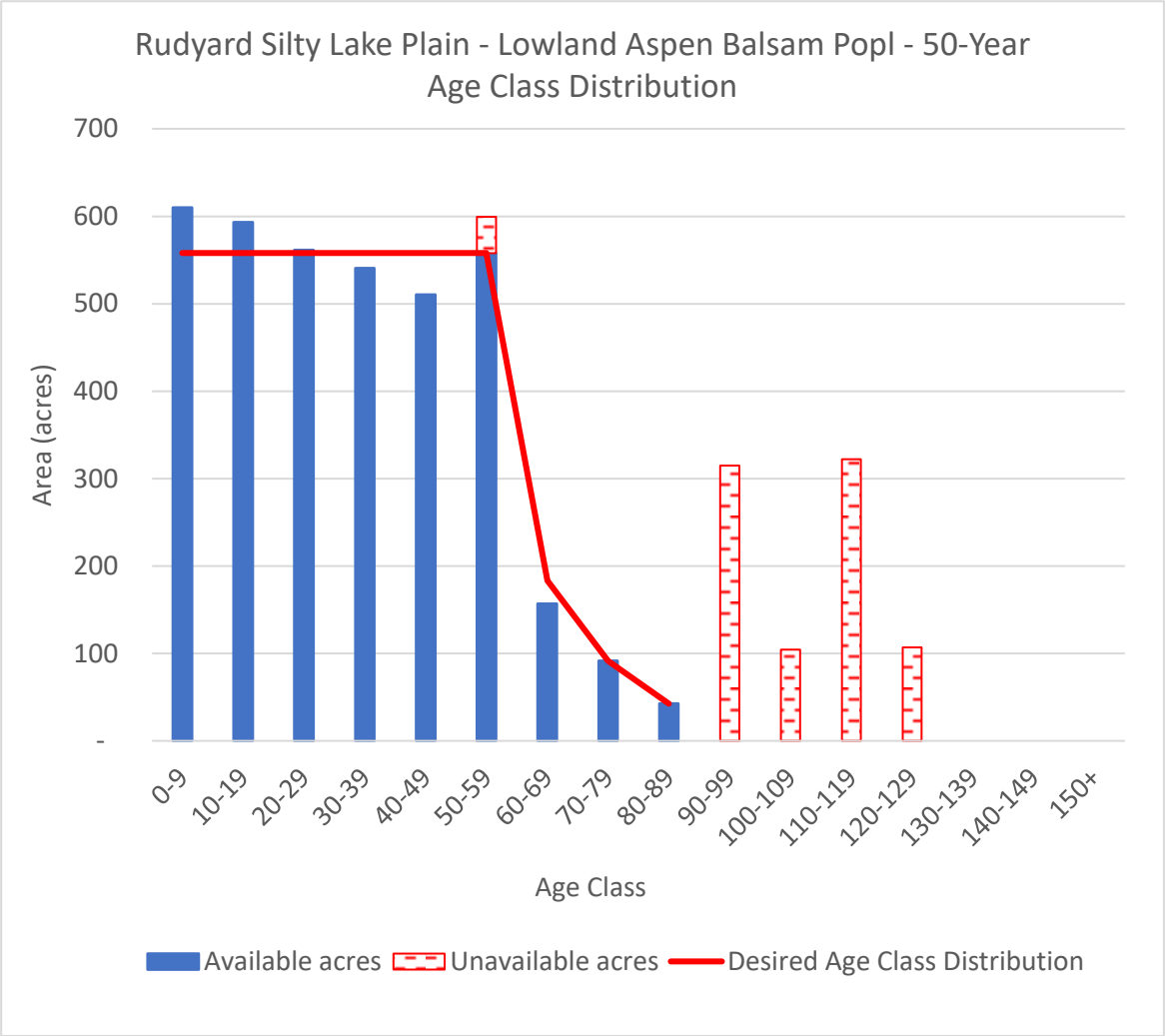


Figure 20. Projected midterm age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (*Figure 21*) will concentrate on the manageable acres of lowland aspen/balsam poplar cover type in productive growing conditions while providing an even flow of forest products and a wide variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest.

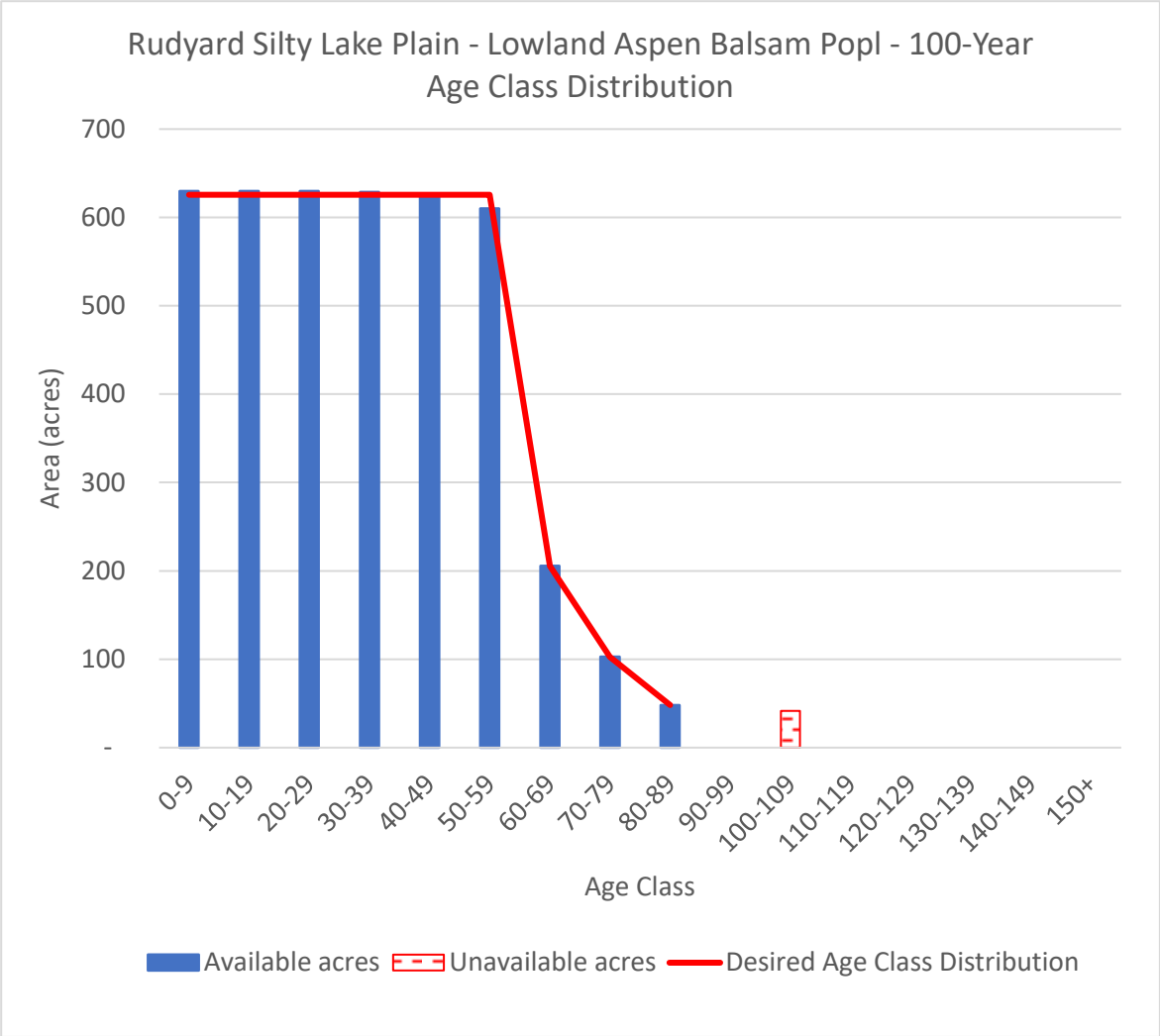


Figure 21. Projected long-term age class distribution at the end of the 10th planning period compared to long-term desired age class distribution.

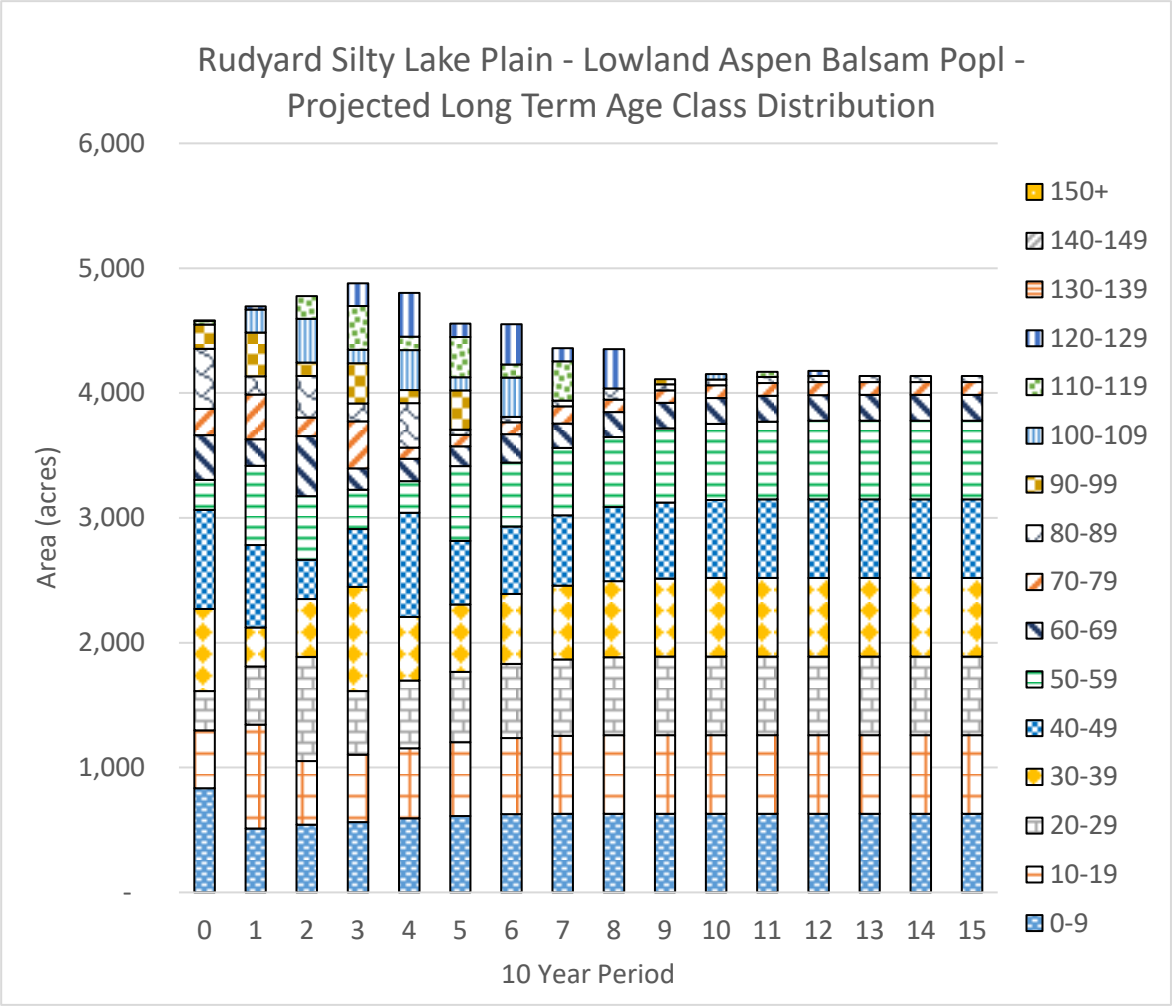


Figure 22. Projected age class distribution for all acres of lowland aspen/balsam poplar over the next 150 years in the Rudyard Silty Lake Plain Management Area.

Management actions

There are 404 acres of projected clearcut harvest in the lowland aspen/balsam poplar cover type during the planning period. This is just below the desired establishment of 494 acres of lowland aspen/balsam poplar per decade because of the current unbalanced age class condition and forecasted transitions into the cover type.

Conservation Area Network

High conservation value areas

There are up to nine different high conservation value area types that can be found in each management area (Table 13; see Biodiversity in Section 3 for more information).

Table 13. High conservation value areas within the Rudyard Silt Plain Management Area.

High Conservation Value Area Type and Name	Acres
Coastal environmental areas	**920**
	920
Dedicated management areas	**728**
	728
Deer wintering complex	**7,867**
	7,867
State wildlife management areas	**13,806**
Munuscong Bay SWMA	13,806
Verified Type 1 and Type 2 old growth	**45**
Type 1 old growth	45
Grand total	**23,366**

Ecological reference areas

Ecological reference areas, a type of HCVA, are higher-quality examples of functioning ecosystems that are primarily influenced by natural ecological processes.

Table 14. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 15. Ecological reference areas within the management area.

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	Number of Occurrences
Existing ERA	Great lakes marsh	AB			2
Existing ERA	Great lakes marsh	C			1
Existing ERA	Great lakes marsh	C	G2	S3	1
Existing ERA	Northern shrub thicket	B			1
Existing ERA	Poor fen	AB			1
Grand total					**6**

Special conservation areas

Reviewable special conservation areas (SCAs; Table 14) are those SCA types that may be reviewed or updated through the compartment review process as needed. Static SCAs (Table 15) are those SCA types that generally do not change or require updating (see Biodiversity in Section 3 for more information).

Table 16. Reviewable special conservation areas within the Rudyard Silty Plain Management Area.

Reviewable Special Conservation Area Type and Name	Acres
Concentrated recreational area	**306**
Algonquin Ski Trail	-
Kinross ORV Trailhead	1
Munoscong State Forest Campground	52
Pinebowl Pathway Trailhead	0
Rail Trail Corridor	253
Cultural or customary area	**22**
Wilson Road Sugar Bush	22
Mineral resource area	**85**
Chippewa County Road Commission	3
Payne & Dolan Inc.	83
Possible Type 1 or Type 2 old growth	**298**
--	298
Grand total	**711**

Table 17. Static special conservation areas within the Rudyard Silty Plain Management Area.

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Designated trout and coldwater stream buffer		**442**
--		279
Hutton Creek		109
North Pine River		22
Sanderson Creek		16
South Branch Waiska River		17
Designated trout and coldwater streams	**16.9**	
--	10.5	
Hutton Creek	4.3	
North Pine River	0.8	
Sanderson Creek	0.7	
South Branch Waiska River	0.6	
Great Lakes islands		**11**
Round Island		8
Unknown		3
Important bird areas		**1,203**
Rudyard Clay Plain		816
Sault Sainte Marie Clay Plain		386
Wood turtle stream 100-foot buffer		**1**
Waiska River		1
Wood turtle stream 660-foot buffer		**20**
Waiska River		20
Grand total	**16.9**	**1,676**

Rare species

Rare species occurrences are compiled from the Michigan Natural Features Inventory biotics database (Table 19, Table 20 and Table 21) and do not necessarily include all rare species found in this management area due to biases in survey effort and verifiable observation reporting over time.

Table 18. Rare plant and animal species conservation status key.

Species Status	Species Status
E = endangered	LE = listed endangered
T = threatened	LT = listed threatened
SC = special concern	PDL = proposed for delisting

Table 19. Rare animal species occurrence within the Rudyard Silty Lake Plain Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Acipenser fulvescens	Lake sturgeon	T		1
Animal	Alces alces	Moose	SC		1
Animal	Ammodramus savannarum	Grasshopper sparrow	SC		1
Animal	Bombus borealis	Northern amber bumble bee	SC		2
Animal	Botaurus lentiginosus	American bittern	SC		2
Animal	Buteo lineatus	Red-shouldered hawk	SC		1
Animal	Canis lupus*	Gray wolf	SC	LE	--
Animal	Chlidonias niger	Black tern	T		1
Animal	Cistothorus palustris	Marsh wren	SC		2
Animal	Coregonus artedi	Lake herring or cisco	T		1
Animal	Coturnicops noveboracensis	Yellow rail	T		2
Animal	Gallinula galeata	Common gallinule	T		1
Animal	Haliaeetus leucocephalus	Bald eagle	SC		9
Animal	Ixobrychus exilis	Least bittern	T		2
Animal	Myotis lucifugus	Little brown bat	T		1
Animal	Necturus maculosus	Mudpuppy	SC		1
Animal	Nycticorax nycticorax	Black-crowned night-heron	SC		1
Animal	Pandion haliaetus	Osprey	SC		3
Animal	Sterna hirundo	Common tern	T		1
Animal	Tympanuchus phasianellus	Sharp-tailed grouse	SC		3
Total	-	-	-	-	**36**

**Occurrence information provided by field staff.*

Table 20. Rare plant species occurrence within the Rudyard Silty Lake Plain Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Plant	Asplenium viride	Green spleenwort	SC		1
Plant	Draba cana	Ashy whitlow grass	E		1
Total	-	-	-	-	**2**

Table 21. Other rare species occurrence within the Rudyard Silty Lake Plain Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Other	Great blue heron rookery	Great blue heron rookery			2
Total	-	-	-	-	2

Non-ecological reference area natural communities

Natural communities that are identified with an element occurrence in the MNFI Biotics database, but that have not been given an additional ecological reference area designation, are recognized and managed accordingly (Table 22).

Table 22. Non-ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 23. Non-ecological reference area natural communities within the Rudyard Silty Lake Plain Management Area.

Community Type	Element Occurrence Rank	State Rank	Global Rank	Number of Occurrences
Dry-mesic northern forest	CD	S3	G4	2
Grand total				**2**

Forest health

Forest health concerns, both native and non-native, can have impacts on stand conditions and management decisions. The following insects (Table 24) and diseases (Table 25) could have an impact on management during the planning period and may need to be monitored and/or addressed.

Table 24. Defoliating insects of concern in the Rudyard Silty Lake Plain management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Spongy moth	Lymantria dispar dispar	Non-native	Yes

Forest tent caterpillar	Malacosoma disstria	Native	Yes
Large aspen tortrix	Choristoneura conflictana	Native	Yes
Spruce budworm	Choristoneura fumiferana	Native	Yes

Table 25. Maladies of concern in the Rudyard Silty Lake Plain management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Canker (stem infections)	Nectria cinnabarina	Native	Yes
Heterobasidion root disease	Heterobasidion annosum	Native	No
Armillaria root rot	Armillaria mellea	Native	Yes

Aquatic resources

Riparian habitat

A total of 28 miles of streams and rivers are found in the management area (Table 26). Streams/rivers classified as cold types comprise approximately 75% of the riverine mileage.

Table 26. Classification type and length of streams/rivers found within the management area.

Type	Length (miles)
Cold stream	1
Cold small river	0
Cold transitional stream	6
Cold transitional small river	0
Cold transitional large river	0
Warm transitional stream	7
Warm transitional small river	0
Warm transitional large river	0
Warm stream	11
Warm small river	3
Warm large river	0

Lacustrine habitat

A total of seven lakes and ponds of at least 1 surface acre are found in the management area (Table 27).

Table 27. Size and number of lakes and ponds located within the management area.

Lake Size Class (acres)	Number
1-99	6
100-499	1
500+	0

Wetlands

A total of 32,945 acres of wetlands are found in the management area (Table 28). Forested wetlands comprise approximately 90% of wetland types found in the management area.

Table 28. Area of emergent, forested and riverine wetland types found within the management area.

Wetland Type	Acres
Emergent	3,053
Forested	29,813
Riverine	79

Vernal pools and seeps

A total of 45 acres of vernal pools have been inventoried in the management area, while no areas of seeps have been identified.

Riparian vegetation cover

Lowland shrub, marsh and lowland aspen/balsam poplar are the predominant cover types present in a 100-meter riparian zone located next to streams/rivers in the management area (Table 29).

Table 29. Largest vegetative cover types (i.e., top 10) and area located in a 100-meter buffer of streams/rivers within the management area.

Cover Type	Acres
Lowland shrub	1,545
Marsh	995
Lowland aspen/balsam poplar	600
Lowland deciduous	520
Lowland spruce/fir	427
Aspen	384
Lowland conifers	186
Cedar	178
Mixed upland deciduous	175
Herbaceous open land	148

Watershed vegetation cover

The management area includes portions of important watersheds of the Munuscong River and Waiska River (Table 30 and Table 31). Aspen and lowland communities are major cover types of the state forest in each watershed.

Table 30. Largest vegetative cover types (i.e., top five) and area for the area of the Munuscong River watershed located within the management area.

Cover Type	Acres
Aspen	1,778
Lowland spruce/fir	1,709
Marsh	1,050
Planted red pine	1,022
Cedar	961

Note: Area of lowland marsh is based on forest inventory mapping standards. Other plans may differ in area (acres) and scope.

Table 31. Largest vegetative cover types (i.e., top five) and area for the area of the Waiska River watershed located within the management area.

Cover Type	Area (acres)
Aspen	2,127
Lowland shrub	2,047
Lowland aspen/balsam fir	1,709
Lowland spruce/fir	1,080
Marsh	823

Recreation

The Rudyard Silty Lake Plain Management Area consists of several fragmented blocks, which limits access both for public recreation and management. Wet conditions also limit access in some areas, while facilitating preservation of the rich conifer swamp. Road access will continue to be monitored to control dumping issues and potential impact to wetland soils.

Motorized recreation trails in this management area include several snowmobile and off-road vehicle trails. The 31-mile Kinross Motorcycle Trail is restricted to motorcycle use only by DNR director's order. Hiking trails include the Algonquin and Pine Bowl pathways/ski trails. The Pine Bowl Pathway is also open to equestrian use (Table 32).

There is just one state forest campground (rustic) within the management area, located on the Munuscong River a few miles inland from the St. Marys River (Table 33).

Table 32. Designated recreation trails by type.

Recreation Category	Recreation Type	Number of Miles
Motorized recreation trails	Off-road vehicle (all types) Snowmobile	35.2 25.7
Nonmotorized recreation trails	Hiking Equestrian Biking Hunter access trails	14.5 6.0 0 0
Total		**81.4**

Note: Trail use types may overlap.

Table 33. State forest campgrounds.

Name	Number of sites
Munuscong River State Forest Campground	25

Munuscong State Wildlife Management Area is over 14,200 acres (a small portion is in the neighboring management area) on the shores of Munuscong Lake (St. Marys River). Munuscong supports a diversity

of habitats and wildlife. The area is popular for hunting, trapping, canoeing, kayaking and birding/wildlife viewing.

Elsewhere in the management area, deer hunting is popular within the large swamp portion, and there is a long history of waterfowl hunting along the St. Marys River. Bird-watching is an increasingly popular pursuit.

Table 34. Areas managed for hunting.

Type	Name	Number of Acres
State wildlife management areas	Munuscong Bay SWMA	13,841.5

Table 35. Boating access sites.

Name	Body of Water
Conley Point	St Marys River
Munuscong River State Forest Campground	Munuscong River

EUP management areas

Seney Lake Plain

State forest area: 331,187 acres	Location: Interior central and eastern Upper Peninsula	Population centers: Manistique Newberry
Subsection: Seney Lake Plain	Landforms: Beach ridges and depressions Sand spits Transverse sand dunes Sand bars	Land cover: Forested: 217,345 acres Nonforested: 113,841 acres

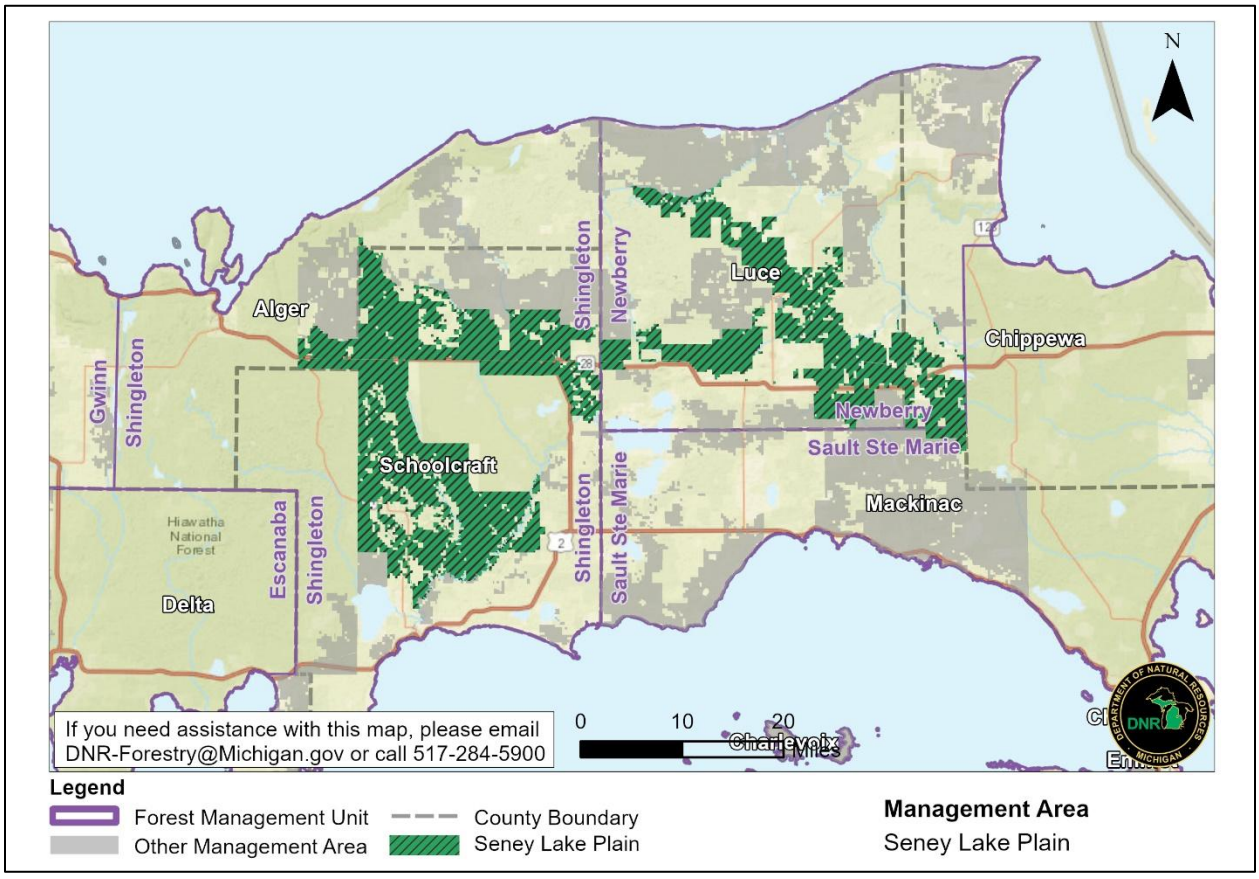


Figure 1. Seney Lake Plain Management Area.

Forested landscape

Current and projected future condition

The Seney Lake Plain Management Area includes a variety of tolerance levels occurring mostly in the mature and old age categories. The majority of tolerant cover types occur on unavailable lowlands in the old age category. Mid-tolerant cover types mostly occur on available uplands in the mature and old age categories, while the majority of the intolerant cover types occur in the mid-aged category on available uplands (Figure 2).

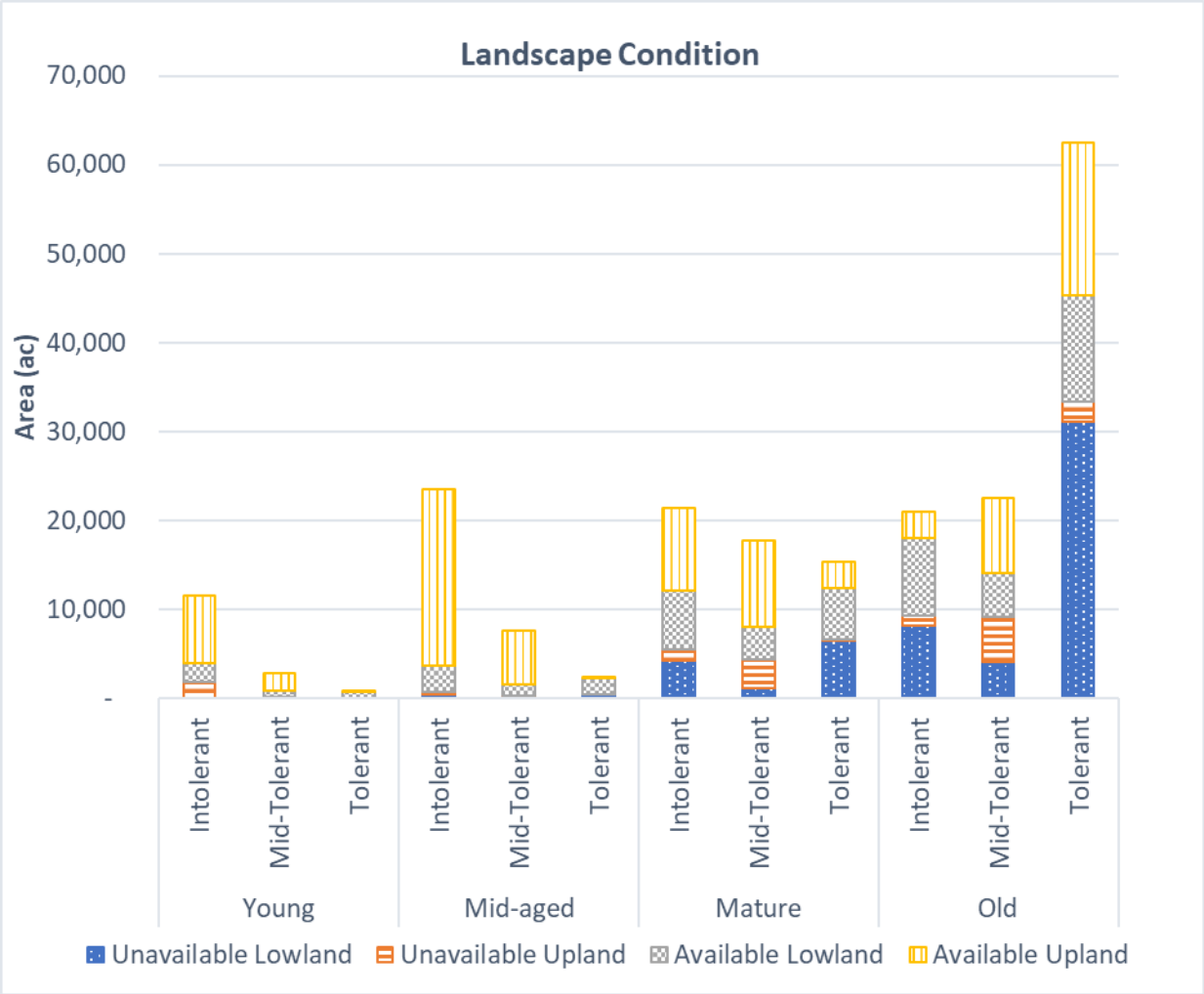


Figure 2. Forest diversity matrix showing the current distribution of forested acres across management availability, age category, landscape position and shade tolerance.

Landscape habitat conditions refine the management area landscape into featured species habitat context. Current and projected acres for the metrics identified in the management priorities (see Section 3) establish a baseline and future condition based on management over the planning period (

Table 1).

Table 1. Current acres for landscape habitat conditions.

Landscape Habitat Condition	Monitoring Metric	Current Acres
Young forest	Acres of 0- to 19-year stands in aspen and jack pine	9,309
Mature forest	Acres of 80-plus-year stands across cover types	105,921
Mature forest	Acres of 120-plus-year stands across cover types	45,655
Mesic conifer cover types	Acres of mesic conifer cover types	21,646
Mesic conifers in other cover types	Average canopy occupancy	52%
Mast – oak cover types	Acres of oak cover types	419
Mast tree species in other cover types	Acres of total canopy occupancy of mast tree acres (trace-100%)	26,329
Big trees	Acres of total canopy stand occupancy of species in sawlog or greater size class	86,964
Nonforested openings	Acres of total herbaceous open land, upland shrub and crop land	3,995
Landscape forest matrix	Percent deciduous forest	24%
Landscape forest matrix	Percent coniferous forest	70%

The Seney Lake Plain Management Area has the following special analysis units. These SAUs have specific cover-type goals, typically associated with wildlife habitat management. For any SAUs that overlap with this management area, SAU cover type goals take priority. Please see Section 5 for a detailed description of the management direction and harvest goals for each of these SAUs.

- Deer wintering complex – Hulbert Hendrie Sage River
- Deer wintering complex – McMillan Ten Curves
- Deer wintering complex – Cusino
- Deer wintering complex – Indian Lake
- Deer wintering complex – Gulliver Scott Point Rock River

The Seney Lake Plain Management Area is comprised of 66% forested cover types and 34% nonforested cover types. Of the forested cover types, there is a near-even split between the upland and lowland landscape positions. The largest contributors to upland cover types are natural jack pine, aspen and northern hardwoods. Lowland conifer, cedar and lowland spruce/fir make up 27% of the lowland landscape position. Lowland shrub is the most common nonforested cover type in the management area, representing 18% of the landscape (

Table 2).

Table 2. Current landscape context and distribution of cover types.

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
Forested	Upland	Deciduous	Aspen	15,977	37,324	106,234	217,345
			Northern hardwood	17,821			
			Black/red hybrid oak	0			
			Northern red oak	250			
			Oak mix	219			
			Mixed upland deciduous	3,057			
		Mixed	Upland mixed forest	4,732	4,732		
		Coniferous	Planted red pine	5,796	64,179		
			Planted jack pine	4,353			
			Planted white pine	150			
			Planted mixed pine	368			
			Natural red pine	6,931			
			Natural jack pine	24,950			
			Natural white pine	3,963			
			Natural mixed pines	9,052			
			Upland spruce/fir	887			
			Upland conifers	6,543			
			Hemlock	1,188			
	Lowland	Deciduous	Lowland aspen/balsam poplar	5,095	15,182	111,111	
			Lowland deciduous	10,087			
		Mixed	Lowland mixed forest	7,658	7,658		
		Coniferous	Cedar	28,337	88,272		
			Lowland conifers	32,269			
			Lowland spruce/fir	22,188			
			Tamarack	5,478			
Nonforested	Upland	N/A	Herbaceous open land	3,687	N/A	5,346	113,841
			Upland shrub	304			
			Low density trees	287			
			Bare/sparsely vegetated	42			
			Cropland	4			
			Urban	1,022			
	Lowland	N/A	Lowland shrub	59,740	N/A	108,495	
			Marsh	23,580			
			Bog	2,260			
			Treed bog	17,847			
			Water	5,069			
						Grand total:	**331,187**

There are 151,296 acres (46% of the total management area and 67% of the forested area) that can be managed toward desired future conditions via commercial timber harvest in the Seney Lake Plain Management Area (Table 3). Acres unavailable for management are categorized by site condition (Table 4). Of those, approximately 10% is within lowland conifers, about 10% in natural jack pine, 7.8% in northern hardwood and 7% in aspen cover types.

Table 3. Landscape conditions and cover type composition of the Seney Lake Plain Management Area.

SENEY LAKE PLAIN Forested Cover Type	Available Acres	Available %	Unavailable Acres	Unavailable %	Total Acres	Total %
Aspen	15,048	6.9%	937	0.4%	15,985	7.4%
Cedar	6,350	2.9%	21,988	10.1%	28,338	13.0%
Hemlock	701	0.3%	487	0.2%	1,188	0.5%
Lowland aspen/balsam poplar	4,467	2.1%	629	0.3%	5,096	2.3%
Lowland conifers	15,983	7.4%	16,291	7.5%	32,274	14.8%
Lowland deciduous	6,342	2.9%	3,745	1.7%	10,088	4.6%
Lowland mixed forest	5,740	2.6%	1,918	0.9%	7,658	3.5%
Lowland spruce/fir	12,976	6.0%	9,225	4.2%	22,200	10.2%
Mixed upland deciduous	2,268	1.0%	789	0.4%	3,057	1.4%
Natural jack pine	21,494	9.9%	3,489	1.6%	24,983	11.5%
Natural mixed pines	5,480	2.5%	3,582	1.6%	9,061	4.2%
Natural red pine	4,939	2.3%	1,998	0.9%	6,937	3.2%
Natural white pine	2,920	1.3%	1,045	0.5%	3,966	1.8%
Northern hardwood	16,851	7.7%	974	0.4%	17,825	8.2%
Northern red oak	244	0.1%	6	0.0%	250	0.1%
Oak mix	219	0.1%	0	0.0%	219	0.1%
Planted jack pine	4,351	2.0%	3	0.0%	4,354	2.0%
Planted mixed pine	365	0.2%	3	0.0%	368	0.2%
Planted red pine	5,703	2.6%	99	0.0%	5,802	2.7%
Tamarack	2,539	1.2%	2,940	1.4%	5,478	2.5%
Upland conifers	5,111	2.4%	1,434	0.7%	6,545	3.0%
Upland mixed forest	4,151	1.9%	582	0.3%	4,733	2.2%
Upland spruce/fir	737	0.3%	150	0.1%	887	0.4%
Grand total	**145,127**	**66.7%**	**72,312**	**33.3%**	**217,439**	**100.0%**

Table 4. Site conditions for unavailable acres.

Site Condition (Reason area is unavailable for commercial harvest)	Area (ac)	% of Unavailable Area
Conservation values	17,777	24.6%
Deer wintering area	13,182	18.2%
Unproductive	11,223	15.5%
Blocked by obstacle	8,306	11.5%
Best management practices	6,973	9.6%
Blocked by railroad	4,424	6.1%
Wildlife concerns	4,185	5.8%
Too wet	3,053	4.2%
Non-DNR agency concerns	975	1.3%
Federal/state/local law	973	1.3%
Long-term retention	364	0.5%
Denied access	320	0.4%
Nonmilitary lease/easement	298	0.4%
Too steep	96	0.1%
Other DNR/division processes	43	0.1%
Recreational/scenic	42	0.1%
Cannot regenerate	39	0.1%
Other influence zones	35	0.0%
Species of special concern or T&E	5	0.0%
Total unavailable	**72,312**	**100.0%**

Projected 10-year cover type management actions

Each cover type in the Seney Lake Plain Management Area has unique age class and basal area class goals that describe the long-term desired future conditions. The calculated harvest levels needed during the first 10-year planning period are summarized in Table 5. These harvest levels are necessary to begin achieving long-term planning goals. Implementing these silvicultural regimes will yield approximately 318,101 cords, the planned harvest volume for the decade (Table 6).

Table 5. Ten-year planning period harvest goals (acres) by cover type and silvicultural regime.

Silvicultural Regimes								
Cover Type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Salvage Clearcut	Salvage Thinning	Grand Total
Northern hardwood	216	3,357	-	277	230	-	-	4,079
Natural jack pine	2,692	-	-	-	-	-	-	2,692
Lowland conifers	2,477	-	-	-	-	-	-	2,477
Aspen	2,232	-	-	-	-	-	-	2,232
Lowland spruce/fir	1,683	-	-	-	-	-	-	1,683
Upland conifers	1,027	-	-	-	201	-	-	1,228

Silvicultural Regimes								
Lowland aspen/balsam poplar	872	-	-	-	-	-	-	872
Lowland deciduous	596	-	-	-	7	-	-	603
Planted red pine	97	-	478	-	-	-	-	575
Lowland mixed forest	482	-	-	-	-	-	-	482
Upland mixed forest	443	-	-	-	-	-	-	443
Mixed upland deciduous	238	27	-	-	48	-	-	314
Natural mixed pines	-	-	130	-	131	-	-	261
Upland spruce/fir	113	-	-	-	-	-	-	113
Northern red oak	17	-	-	68	-	-	-	85
Natural red pine	-	-	31	-	31	-	-	62
Planted mixed pine	59	-	-	-	-	-	-	59
Oak mix	37	-	-	-	-	-	-	37
Natural white pine	-	-	14	-	13	-	-	28
Planted white pine	-	-	23	-	-	-	-	23
Planted jack pine	5	-	-	-	-	-	-	5
Totals	**13,284**	**3,384**	**676**	**345**	**662**	**-**	**-**	**18,351**

Table 6. Projected 10-year harvest volume by species.

10-Year Estimated Harvest Volume Projection Seney Lake Plain Management Area Product	Species	Volume Planned *	Volume Prepared* *
Pulpwood (cords)	Mixed hardwood	56,992	53,573
	Mixed softwood	42,767	40,201
	Jack pine	39,245	36,891
	Mixed spruce	24,405	22,940
	Mixed aspen	19,155	18,005
	Red pine	6,886	6,473
	White pine	6,551	6,158
	Mixed oak	2,554	2,401
	Pulpwood total	**198,555**	**186,642**
	White pine	17,305	16,267
	Red pine	12,254	11,519
	Sugar maple	12,158	11,429
	Red maple	7,698	7,236

10-Year Estimated Harvest Volume Projection Seney Lake Plain Management Area Product	Species	Volume Planned *	Volume Prepared**
Sawtimber (MBF)	Mixed aspen	4,733	4,449
	Red oak	2,452	2,305
	Basswood	1,280	1,203
	White oak	215	202
	Mixed oak	203	191
	Sawtimber total	**58,299**	**54,801**
	Total sawtimber harvest volume in cords	**119,545**	**112,373**
	Grand total harvest volume in cords	**318,101**	**299,015**

*Volume estimates based on 100% of the projected harvests for the 10-year planning period.

**Volume estimates based on 94% of the projected harvests for the 10-year planning period accounting for reduction in acres and associated volume once sales are prepared for bid.

Although many cover types within the management area are projected to remain stable, there are some significant cover-type transitions projected (Table 7). Lowland mixed forest has the largest influx from other cover types, specifically lowland conifers and lowland spruce/fir. The lowland mixed forest cover types are projected to increase in acreage by approximately 14% or 1,136 acres, while lowland conifer cover types are expected to decrease by nearly 2.7% or 862 acres. This forecasted cover type transition supports objectives of the deer wintering complex special analysis units to move toward 50% of the complex as sustainable food stands, while maintaining all primary shelter and secondary shelter where possible. There is also a forecasted decrease in natural jack pine cover type by 3.7% or 917 acres.

Table 7. Projected 10-year cover type acres resulting from cover type transitions.

Cover Type	Current Acreage	Projected Acreage at End of 10-Year Planning Period	Projected 10-Year Change in Acreage
Lowland conifers	32,269	31,407	-862
Cedar	28,337	28,337	0
Natural jack pine	24,950	24,033	-917
Lowland spruce/fir	22,188	21,969	-218
Northern hardwood	17,821	17,920	98

Cover Type	Current Acreage	Projected Acreage at End of 10-Year Planning Period	Projected 10-Year Change in Acreage
Aspen	15,977	16,101	124
Lowland deciduous	10,087	10,124	37
Natural mixed pines	9,052	9,060	8
Lowland mixed forest	7,658	8,794	1,136
Natural red pine	6,931	6,931	0
Upland conifers	6,543	6,835	292
Planted red pine	5,796	6,016	220
Tamarack	5,478	5,478	0
Lowland aspen/balsam poplar	5,095	5,018	-77
Upland mixed forest	4,732	4,749	17
Planted jack pine	4,353	4,506	153
Natural white pine	3,963	3,963	0
Mixed upland deciduous	3,057	3,149	92
Hemlock	1,188	1,188	0
Upland spruce/fir	887	830	-57
Planted mixed pine	368	327	-40
Northern red oak	250	242	-8
Oak mix	219	219	0
Planted white pine	150	150	0
Black/red hybrid oak	0	0	0
Lowland shrub	59,740	59,740	0
Marsh	23,580	23,580	0
Treed bog	17,847	17,847	0
Water	5,069	5,069	0
Herbaceous open land	3,687	3,687	0
Bog	2,260	2,260	0
Urban	1,022	1,022	0
Upland shrub	304	304	0
Low density trees	287	287	0
Bare/sparsely vegetated	42	42	0
Cropland	4	4	0
Total:	**331,187**	**331,187**	**0**

Featured species current and projected habitat acres

There are 15 featured species in this management area that span various cover types, age classes and stand-level conditions.

As noted in the featured species management priority (Section 3), it is recommended that these featured species habitat acres be viewed as acres of potential habitat, representing a condition on the landscape where the more nuanced aspects of each species' habitat requirements are likely to be found or managed for. As described in the introduction, the modeling effort was limited by several factors including the simplification of habitat attributes into MiFI variables. Therefore, when referring to habitat acres, those are potential habitat acres.

Current and projected total habitat acres by species across the decade provide a baseline and show the result of long-term management actions (Table 8). Some species show a loss in habitat over the next century. As mentioned in the featured species management priority (see Section 3), the current condition for many cover types is a surplus of acres in the 0-9 age class from the compensatory management approach applied in the previous decade. The model eventually evens out the age classes at a lower, sustainable level over time, usually by 50 years. For any species with northern hardwoods as a priority cover type, there is a perceived drop in acres between 40 and 60 years; this is due to the basal area dropping below 81, but because it only drops into the upper 70s, it is not expected to translate to any real habitat loss on the ground. Three of these species were not included in the State Forest Management Plan model but are included here to inform management decisions over the decade.

Table 8. Featured species current and projected total habitat acres (i.e., potential habitat).

Featured Species	Priority Cover Types	Total Habitat Acres Current	10-Year Projected Habitat Acres	50-Year Projected Habitat Acres	100-Year Projected Habitat Acres
American woodcock	Aspen, lowland aspen, lowland deciduous	6,024	6,896	7,559	7,720
Black bear	Generalist/mast	26, 329	--	--	--
Black-backed woodpecker	Natural disturbance	--	--	--	--
Blackburnian warbler	Northern hardwoods, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, hemlock	24,322	29,678	28,402	40,273
Marten	Northern hardwoods, mixed upland deciduous, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, lowland mixed	61,962	72,504	70,931	85,756

Featured Species	Priority Cover Types	Total Habitat Acres Current	10-Year Projected Habitat Acres	50-Year Projected Habitat Acres	100-Year Projected Habitat Acres
	forest, lowland conifers, hemlock, cedar				
Moose	To be determined	--	--	--	--
Red crossbill habitat	Natural red pine, natural white pine, natural mixed pine, planted red pine	3,585	3,233	4,771	6,513
Ruffed grouse	Aspen	3,340	3,858	4,640	4,753
Sharp-tailed grouse	Herbaceous open land, upland shrub, low density trees, lowland shrub, bog, treed bog	84, 125	--	--	--
Snowshoe hare	Aspen, cedar, hemlock, lowland aspen, lowland conifers, lowland mixed forest, lowland spruce/fir, mixed upland deciduous, natural jack pine, natural mixed pines, planted jack pine, upland spruce/fir	30,269	32,785	21,029	21,607
Spruce grouse, mature	Natural jack pine, natural white pine, natural mixed pine, upland conifer, upland spruce/fir, lowland spruce/fir, lowland conifer, tamarack	36,416	37,787	55,729	59,342
Spruce grouse, young	Jack pine (natural and planted)	10,142	6,822	5,783	5,665
White-tailed deer (food)	Northern hardwood, oak mix, aspen, mixed upland deciduous, lowland deciduous, lowland aspen/balsam poplar, lowland mixed forest	64,895	66,631	70,231	74,000
White-tailed deer (shelter)	Hemlock, cedar, planted red pine, planted white pine, planted mixed pine,	117,670	116,745	117,571	116,623

Featured Species	Priority Cover Types	Total Habitat Acres Current	10-Year Projected Habitat Acres	50-Year Projected Habitat Acres	100-Year Projected Habitat Acres
	natural red pine, natural white pine, natural mixed pines, upland conifers, upland spruce fir, lowland conifers				
Wood thrush	Northern hardwoods, northern red oak, mixed upland deciduous, lowland deciduous	19,520	22,838	18,958	27,016
Wood turtle	Nonforested openings	--	--	--	--

These harvests will help establish a desirable amount of regeneration for the even-aged cover types over the 10-year period or help to achieve desired basal area distribution among uneven-aged cover types like northern hardwoods, as well as balance food and shelter in deer wintering complexes. The following sections will provide additional details for each of the significant cover types in the Seney Lake Plain Management Area.

Cover type composition and associated featured species

Natural jack pine

Current condition

Most of the natural jack pine cover type is currently between stand ages of 0 and 49 years old in the Seney Lake Plain Management Area (Figure 3). The age class distribution is currently unbalanced, especially in the 0- to 49-year-old age classes, where the bulk of acres occur. There is a deficit in the 50-59 and 60-69 age classes, which will lead to a deficit in the 0- to 9-year-old age class for the next planning period. A small number of acres extend beyond the desired maximum age class distribution.

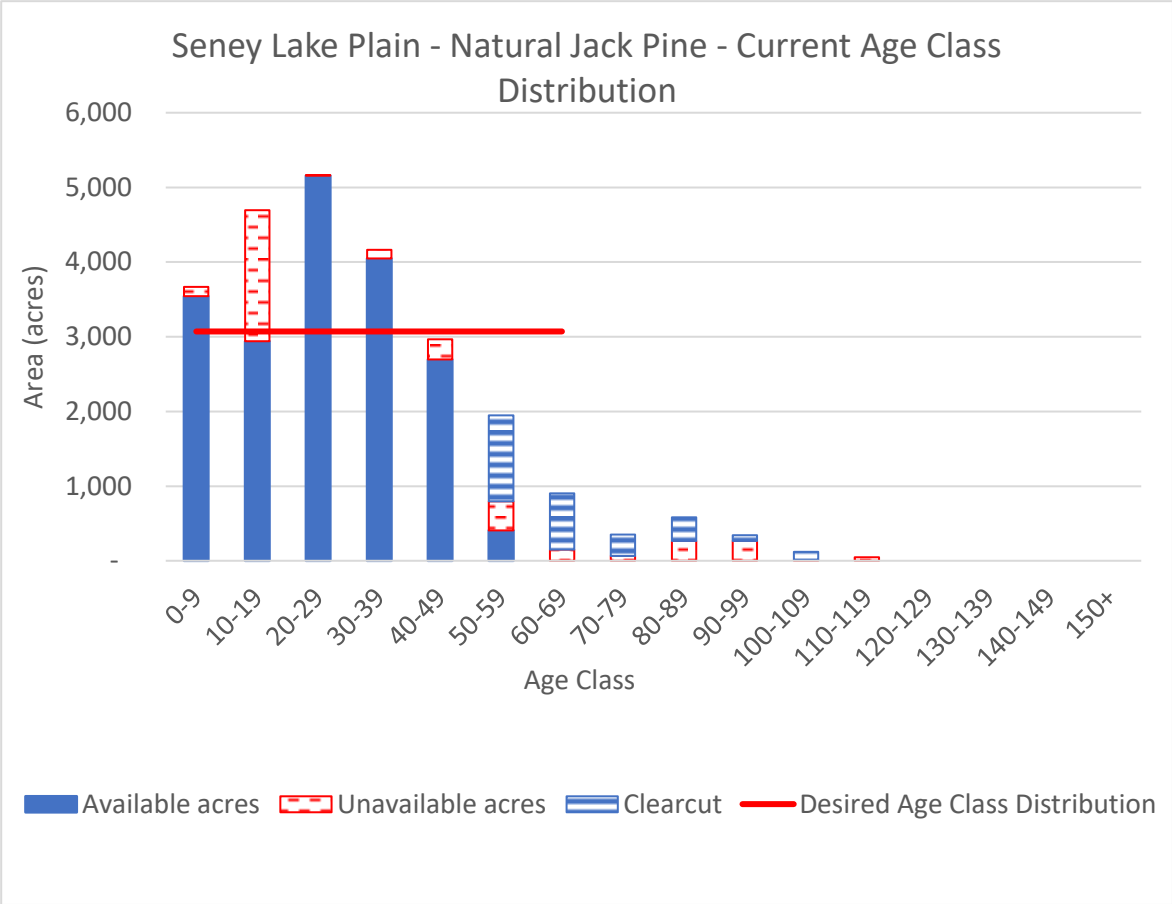


Figure 3. Current age class distribution and projected harvests in natural jack pine cover type in the Seney Lake Plain Management Area.

Current conditions are a result of consistent commercial harvests and regeneration efforts on available jack pine acres during the previous two planning periods. A portion of this cover type meets the habitat requirements for snowshoe hare and spruce grouse.

Table 9. Featured species with jack pine as a priority habitat cover type, habitat variables and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Jack Pine	Jack Pine Habitat Acres – Available	Jack Pine Habitat Acres – Unavailable
Snowshoe hare	Age category: 0-19 Size category: sapling	6,484	1,877
Spruce grouse	Age category: 0-19 Size category: sapling	8,265	1,877
Spruce grouse	Age category: 40+ Size category: sawlog	1,652	392

Desired future condition

The projected long-term cover type trend for natural jack pine is decreasing in the Seney Lake Plain Management Area. A significant proportion of the natural jack pine area falls in the unavailable category, and with natural succession, will eventually transition into other cover types long-term. Habitat elements in this cover type will be preserved due to the abundance of adjacent cover types.

The long-term goal for this cover type is balanced age classes between 0 and 60 years old for all available jack pine stands in this management area. Maintaining lower acreage in old age classes continues to be desirable to lessen the prevalence and severity of jack pine budworm outbreaks and to reduce the threat of damaging wildfire.

The end of the planning period will result in the establishment of a desirable number of acres in the 0- to 9-year-old age class. Progress toward the long-term desired age class distribution of jack pine will take many decades of even-aged management in this management area (Figure 5).

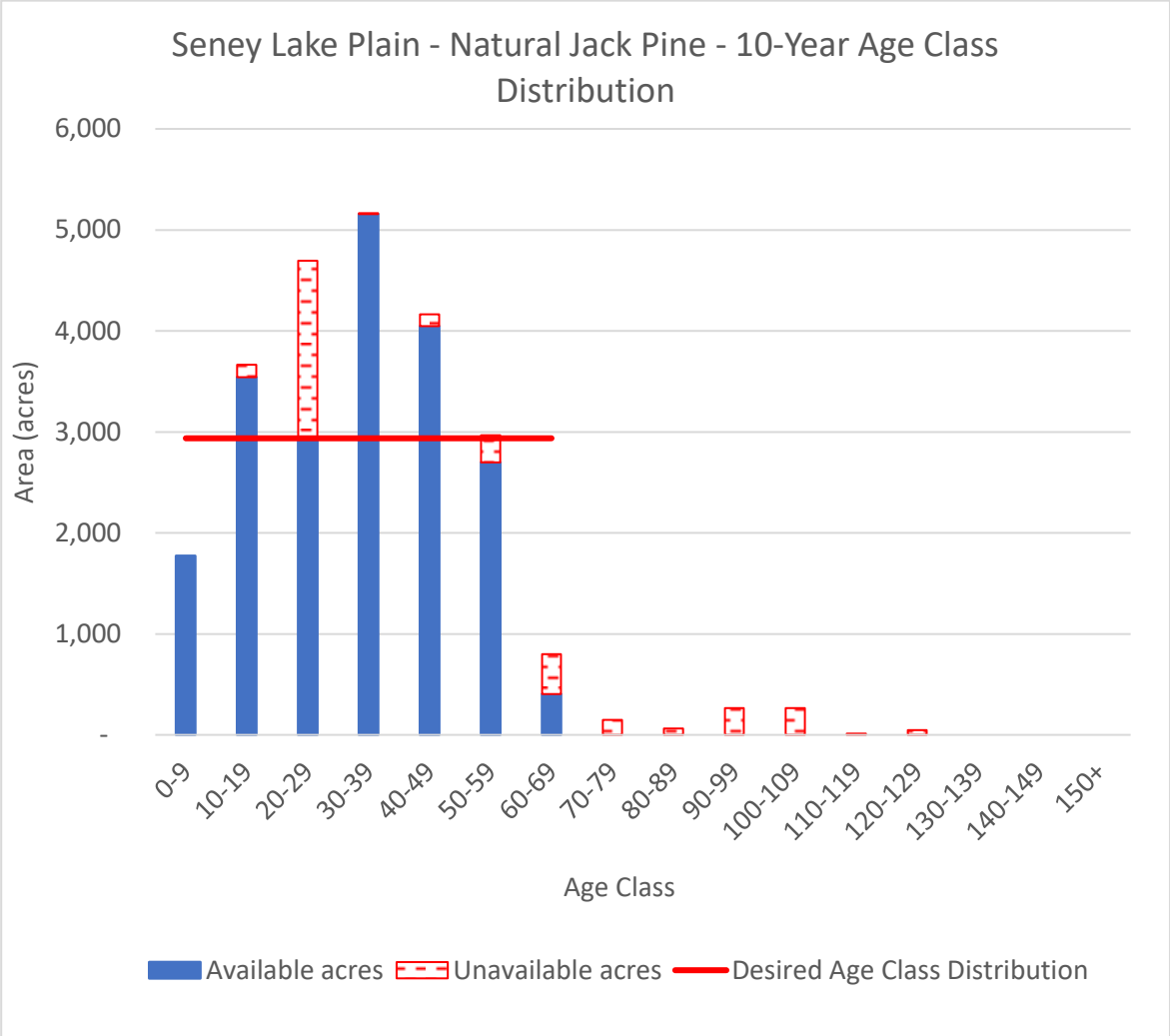


Figure 4. Short-term future age class distribution at the end of the 10-year planning period.

The midterm age class distribution of jack pine is beginning to reach the desired future condition for available acres (Figure 5). There is an increase in acres in the older age classes, beyond the desired age

of 60 years old, due to the number of unavailable acres in this management area. As is often the case, unbalanced age classes may result in the need to leave some acres in older age classes to achieve the desired age class distribution in future planning periods compared to the long-term desired age class distribution.

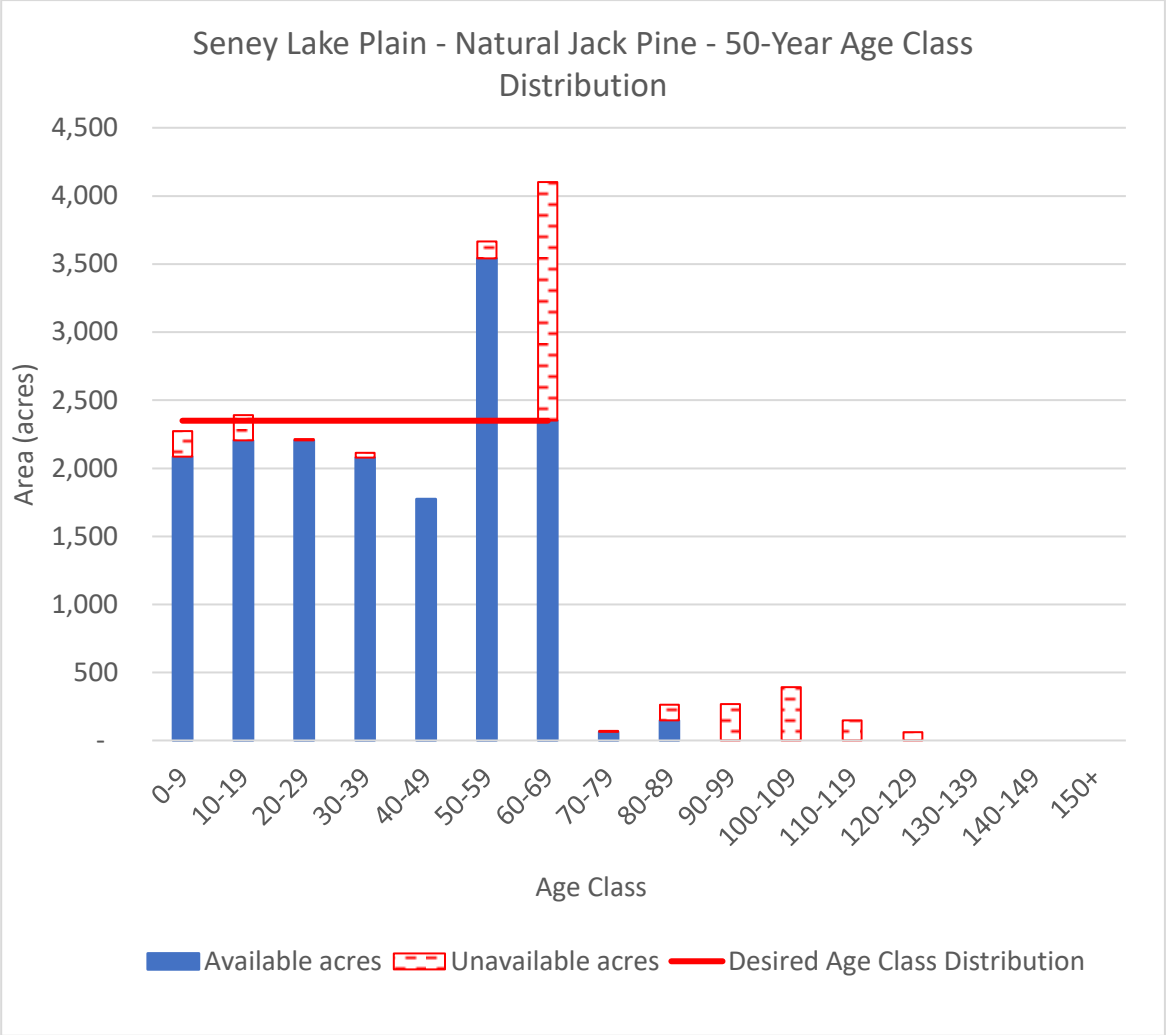


Figure 5. Projected midterm age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 6) will concentrate the manageable acres of jack pine in productive growing conditions while providing an even flow of forest products and a wide variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest.

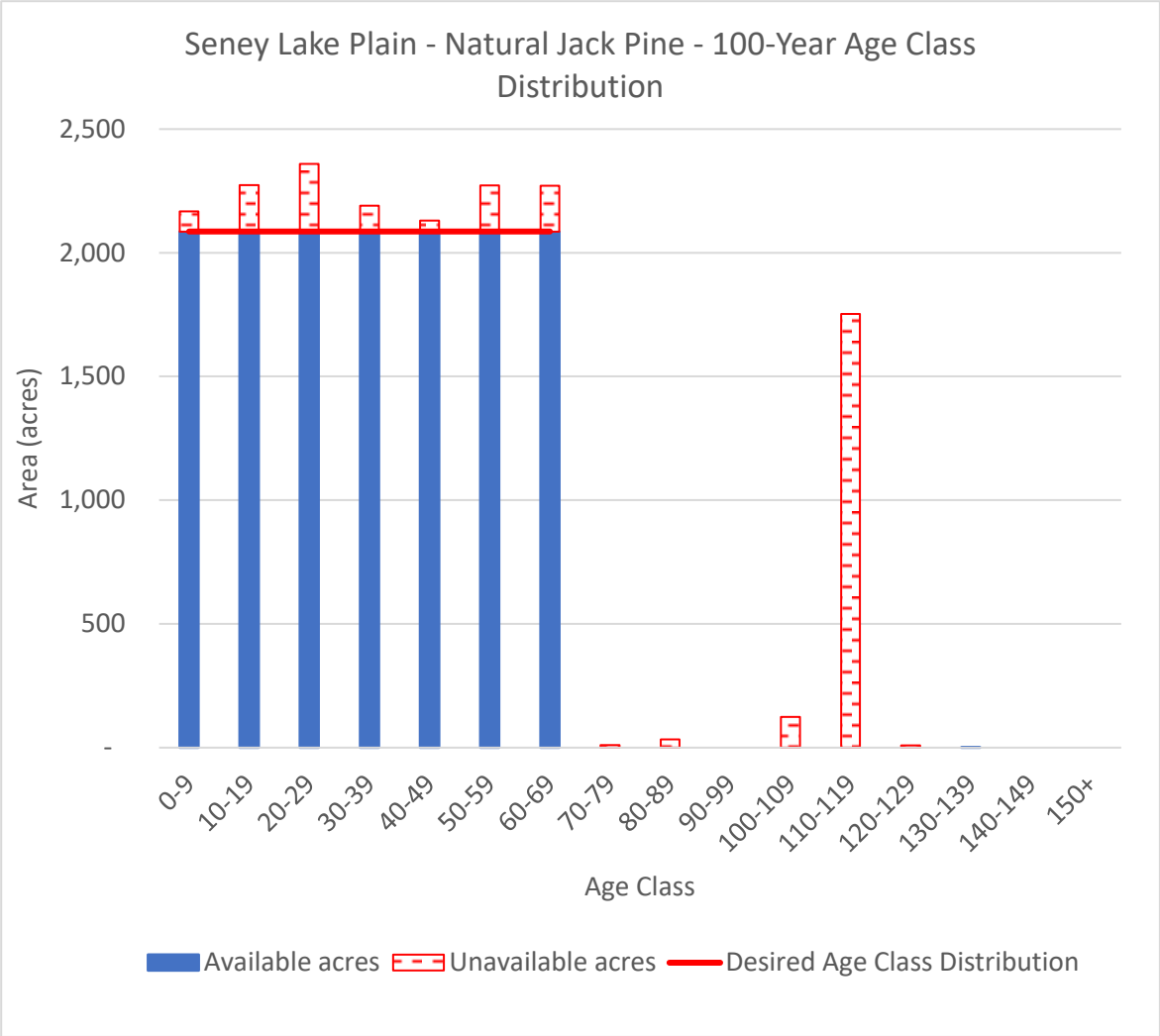


Figure 6. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

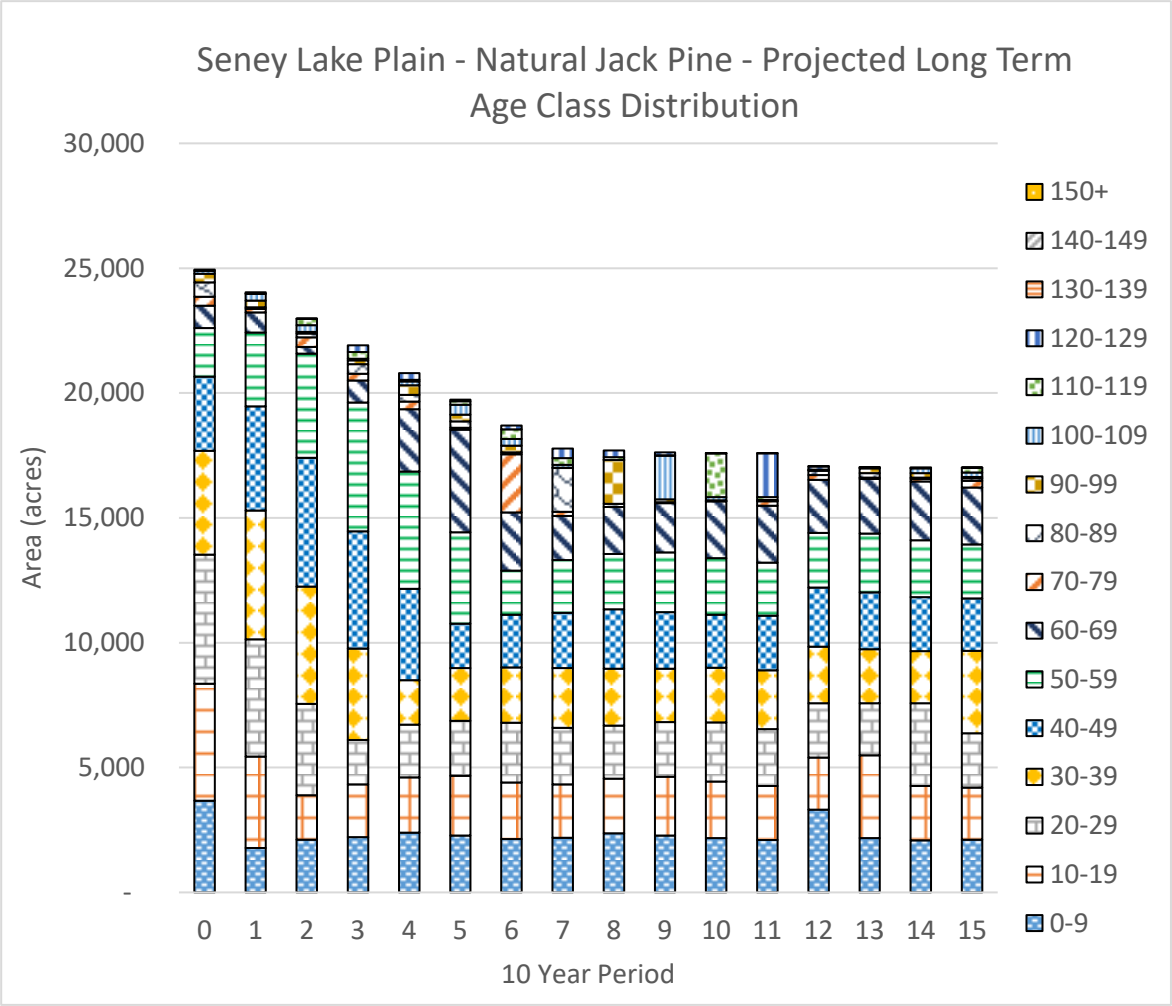


Figure 7. Projected age class distribution for all acres of jack pine over the next 150 years in the Seney Lake Plain Management Area.

Management actions

There are 2,692 acres of projected clearcut harvest in the natural jack pine cover type during the planning period. This falls slightly short of the desired establishment of 3,069 acres of natural jack pine per decade because of the current unbalanced age class condition and transitions out of the cover type.

Lowland conifer

Current condition

The Seney Lake Plain Management Area has a surplus of acres in the 0- to 9-year-old age class due to the harvesting of the large number of mature and overmature acres on the landscape (Figure 8). The age class distribution is currently very unbalanced across almost all the age class categories. Additionally, a deficit of available acres occurs in almost all age classes. The landscape position in which many of these acres occur contributes to the number of acres extending beyond the desired maximum age class tail of 110 years old.

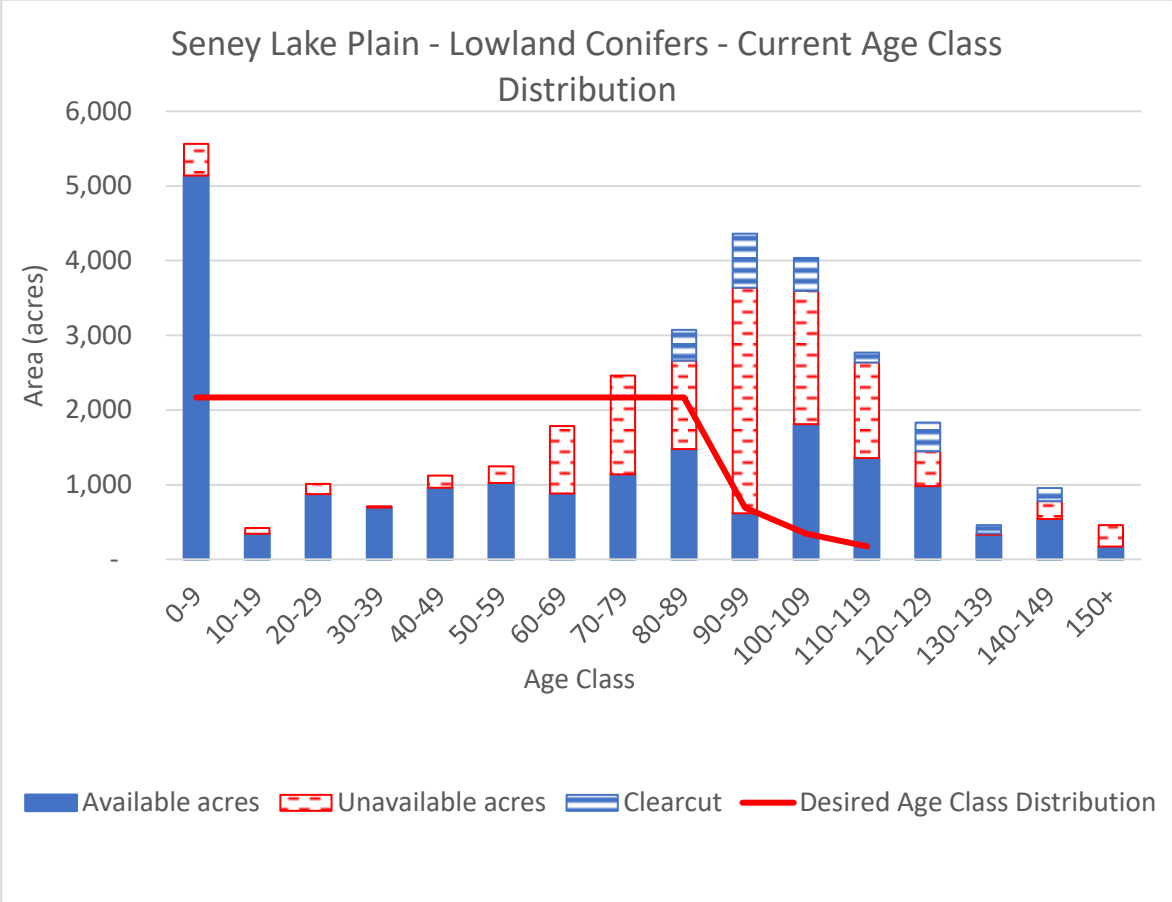


Figure 8. Current age class distribution, desired age class distribution and projected harvests in the aspen cover type over the 10-year planning period.

Table 10. Featured species with lowland conifers as a priority habitat cover type, habitat variables and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Lowland Conifers	Lowland Conifer Habitat Acres – Available	Lowland Conifer Habitat Acres – Unavailable
Snowshoe hare	Age category: 0-19 Size category: sapling	5,485	500

Featured Species	Featured Species Habitat – Lowland Conifers	Lowland Conifer Habitat Acres – Available	Lowland Conifer Habitat Acres – Unavailable
Spruce grouse	Age category: 40+ Size category: sawlog	8,559	8,019
Marten	Age category: 40+ Size category: pole, sawlog Basal area: 81+	7,215	6,664
White-tailed deer	All ages and size classes	32,269	--

Desired future condition

The projected long-term cover-type trend for lowland conifers is a decrease in total acres, especially in the first three planning phases, and then stabilizing in the later planning phases in the Seney Lake Plain Management Area (Figure 9). Transitions out of the cover type into lowland mixed forests are forecasted, as species diversity is expected to increase.

The long-term goal for this cover type is balanced age classes between 0 and 80 years old for all available lowland conifer acres and then decreasing in number of acres until the max tail of 110 years old is reached.

The end of the planning period will result in the establishment of approximately 1,811 acres of lowland conifers from the available acres. It will take many decades to achieve the long-term desired balanced age class distribution of lowland conifers (Figure 10).

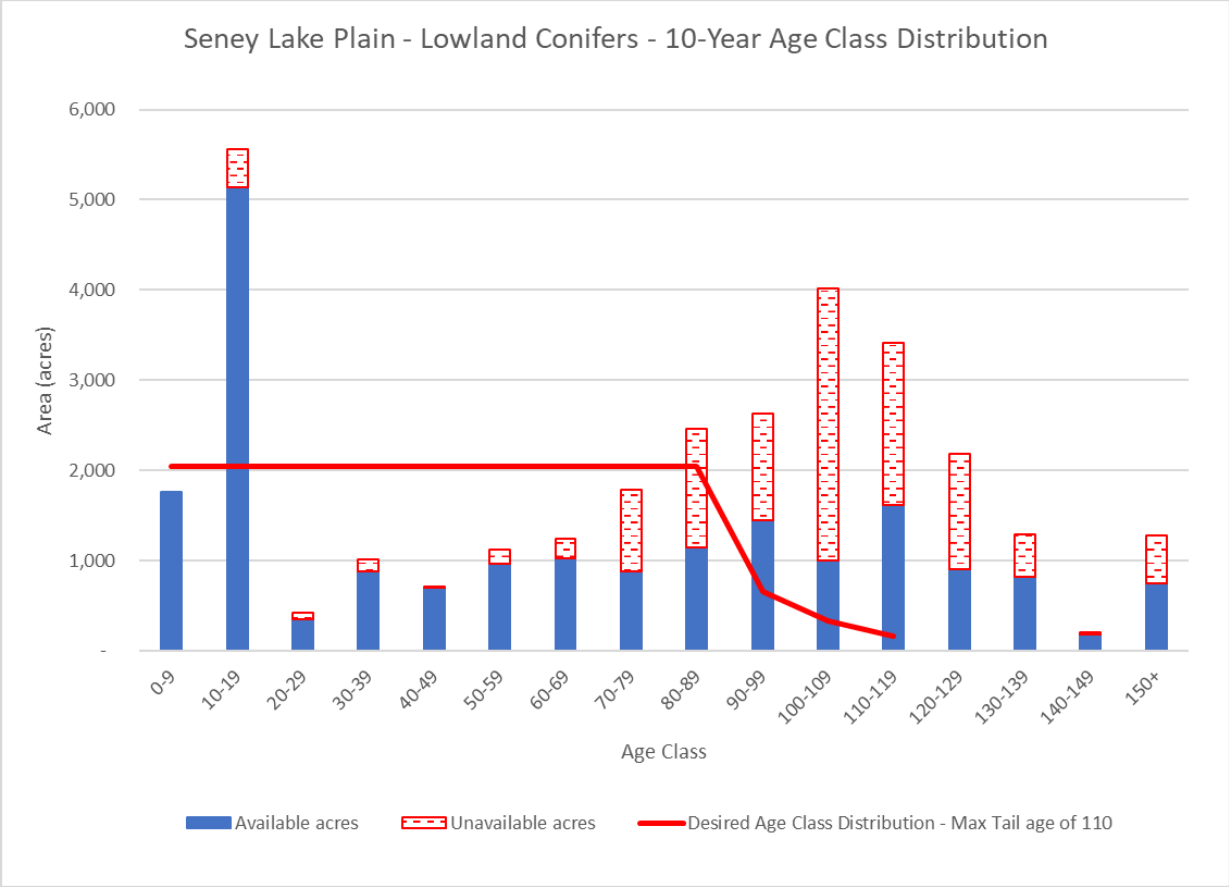


Figure 9. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The midterm age class distribution of lowland conifers is beginning to reach the desired future condition for available acres in the 0-9 through 40- to 49-year-old age classes and between the 90- to 99-year and 100- to 109-year age classes. The number of acres in the older age classes, 120 years old and older, continues to increase as the unavailable acres continue to move to the older age classes (Figure 10).

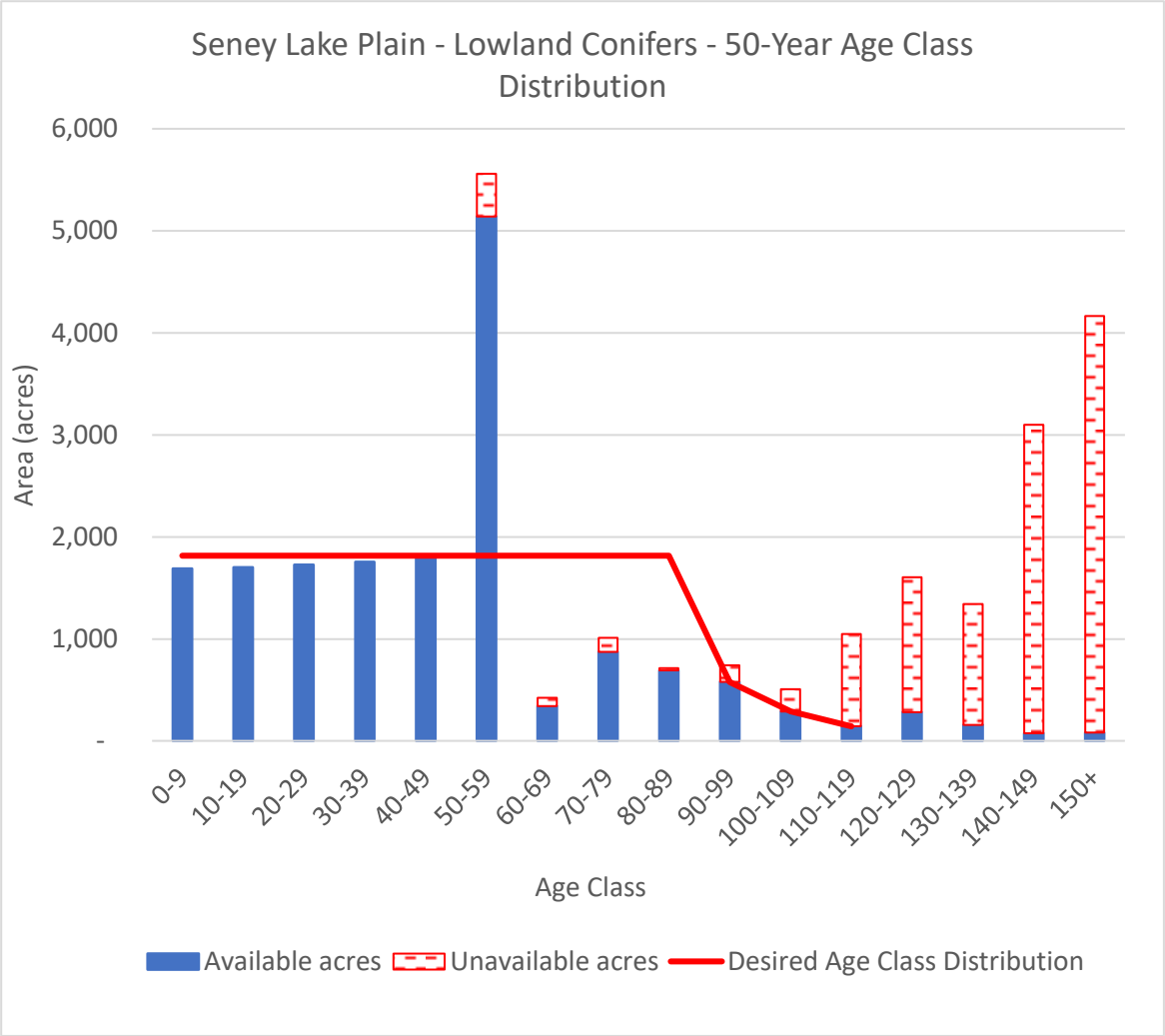


Figure 10. Projected midterm age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 11) will concentrate on the manageable acres of lowland conifer cover type in productive growing conditions while providing an even flow of forest products and a wide variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest.

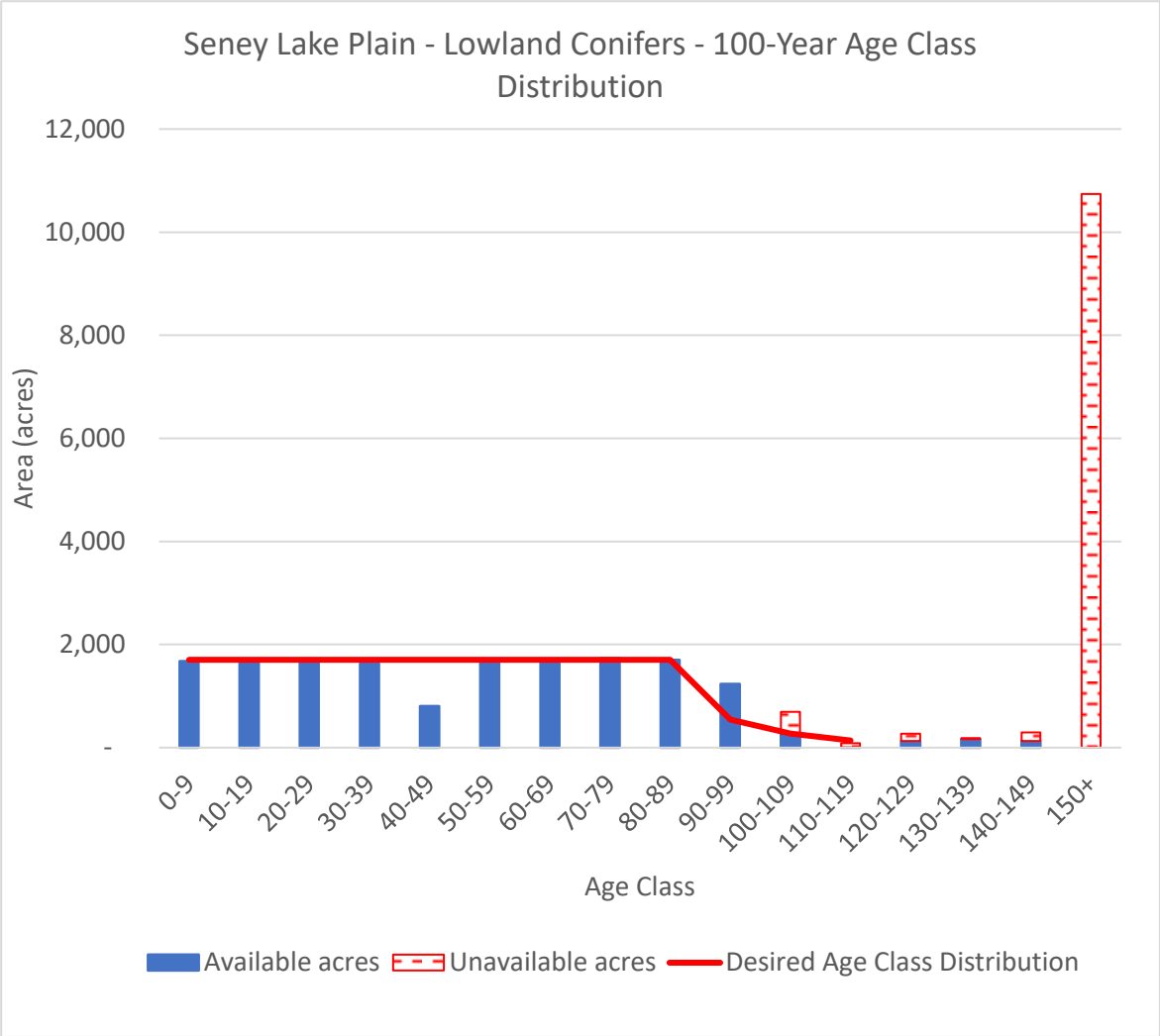


Figure 11. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

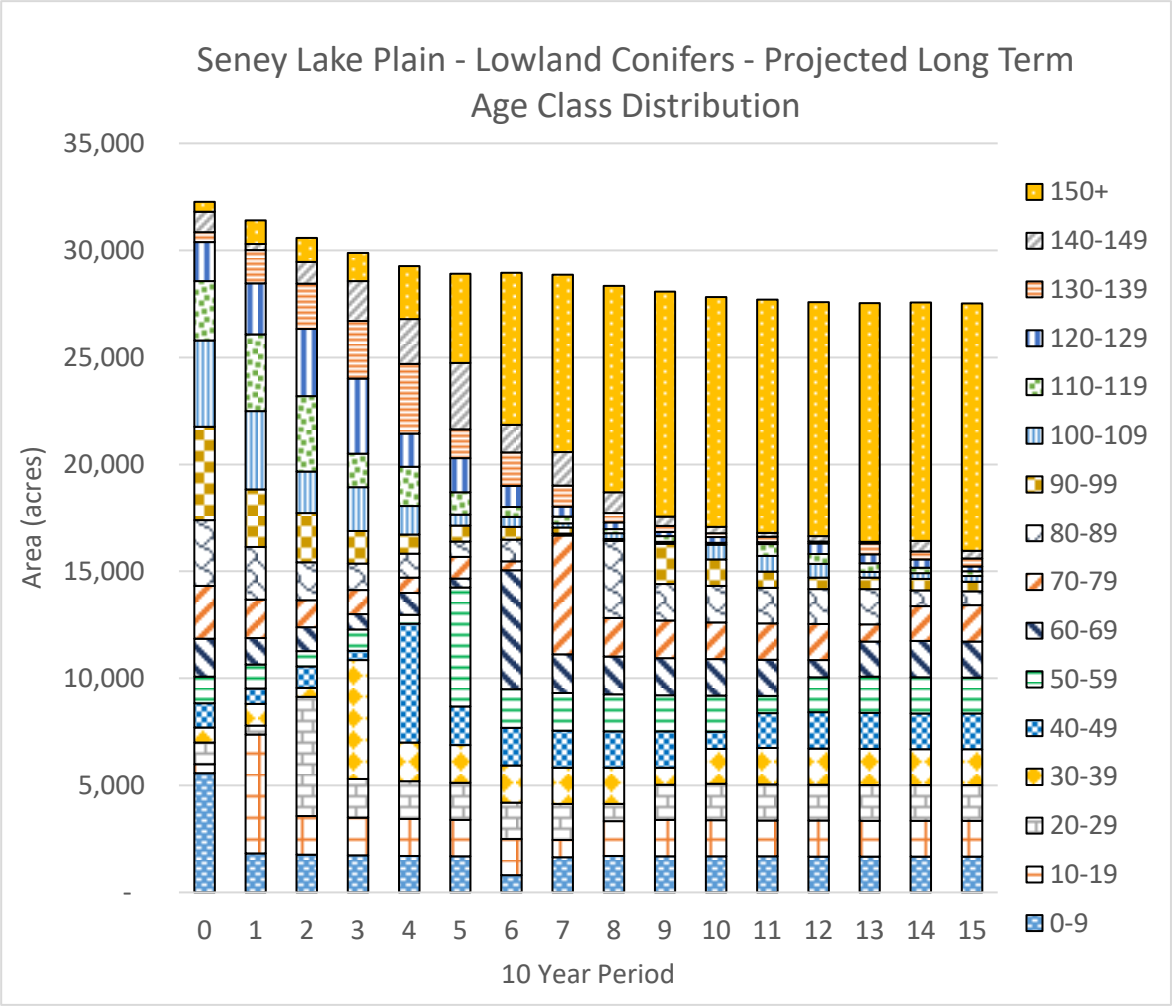


Figure 12. Projected age class distribution for all acres of lowland conifers over the next 150 years in the Seney Lake Plain Management Area.

Management actions

There are 2,477 acres of projected clearcut harvest in the lowland conifer cover type during the planning period. This is below the desired establishment of 2,077 acres of lowland conifer per decade because of the current unbalanced age class condition and deficit of desired established age class acres across almost all age categories. Significant proportions of this cover type being unavailable for management activity is a factor contributing to the deficit.

Retaining cedar and hemlock within this cover type is necessary to maintain/increase species diversity and habitat structure and is critical in areas of high deer densities, where recruitment of these tree species is unlikely due to browse pressure. Both hemlock and cedar are relatively uncommon on the landscape, have decreased significantly since European settlement and are long-lived species whose value is extremely high for wildlife.

Deer wintering complexes greater than 15,000 acres are modeled as a special analysis unit, and information on them can be found in Section 5 of the plan. In deer wintering complexes less than 15,000

acres, harvest of cedar and hemlock is not allowed within range stands essential for survival, and secondary shelter is often protected as well. These areas are guided by the DNR Deer Winter Range Guidelines.

Northern hardwoods

Current condition

Most of the northern hardwood cover type is currently between a stand age of 80-89 and 110-119 years old in the Seney Lake Plain Management Area (Figure 13). The past management regime has been primarily single tree selection, which allows for stand age to continue to increase over time. Some stands are beginning to achieve an uneven-aged condition, where a featured stand age becomes less evident, but the dominant age of these stands will likely increase past 150 years old prior to a younger age cohort becoming the prominent component of these stands.

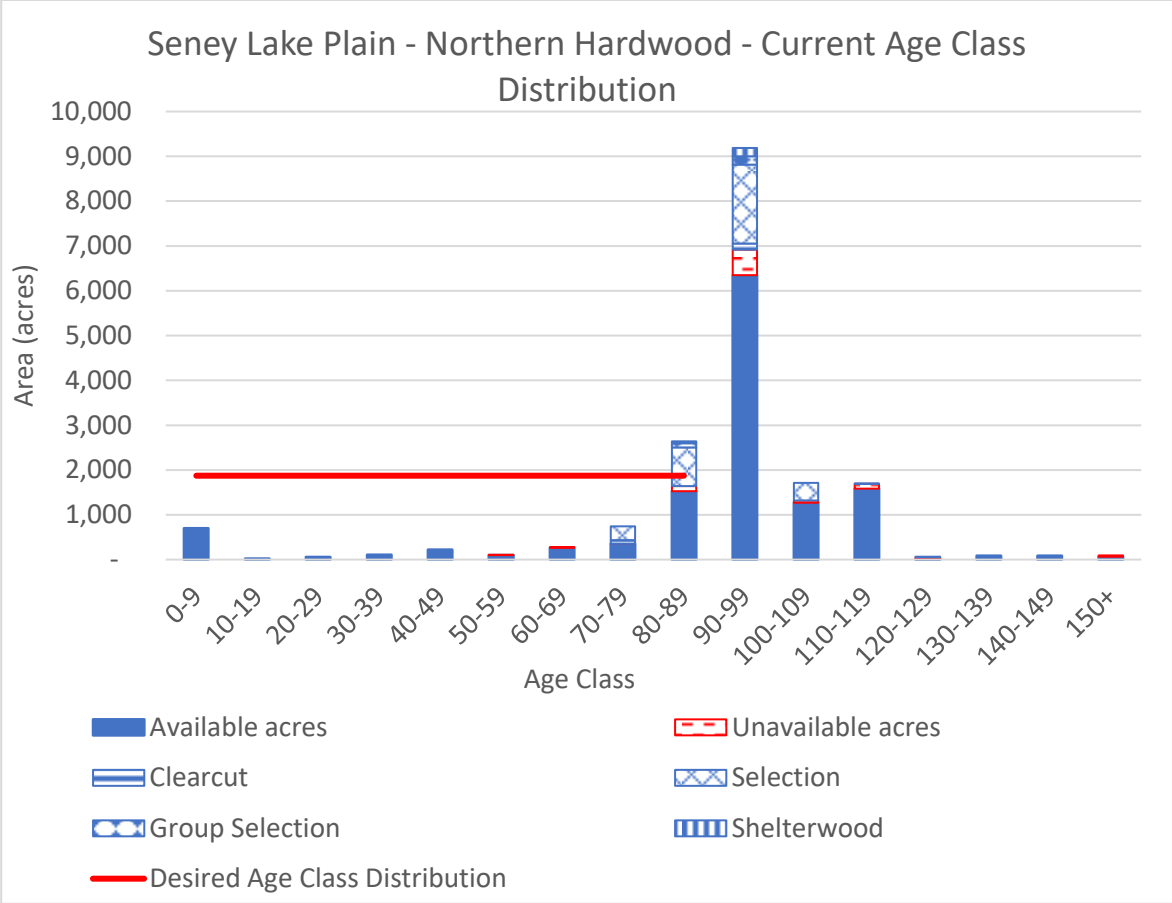


Figure 13. Current age class distribution and projected harvests in the northern hardwood cover type in the Seney Lake Plain Management Area.

The area of northern hardwood is well distributed in the ideal basal area classes for optimal growing conditions in the Seney Lake Plain Management Area (Figure 14). Current conditions are a result of beech salvage efforts in the previous planning period and a regulated selection harvest regime that has been in place in this management area for decades.

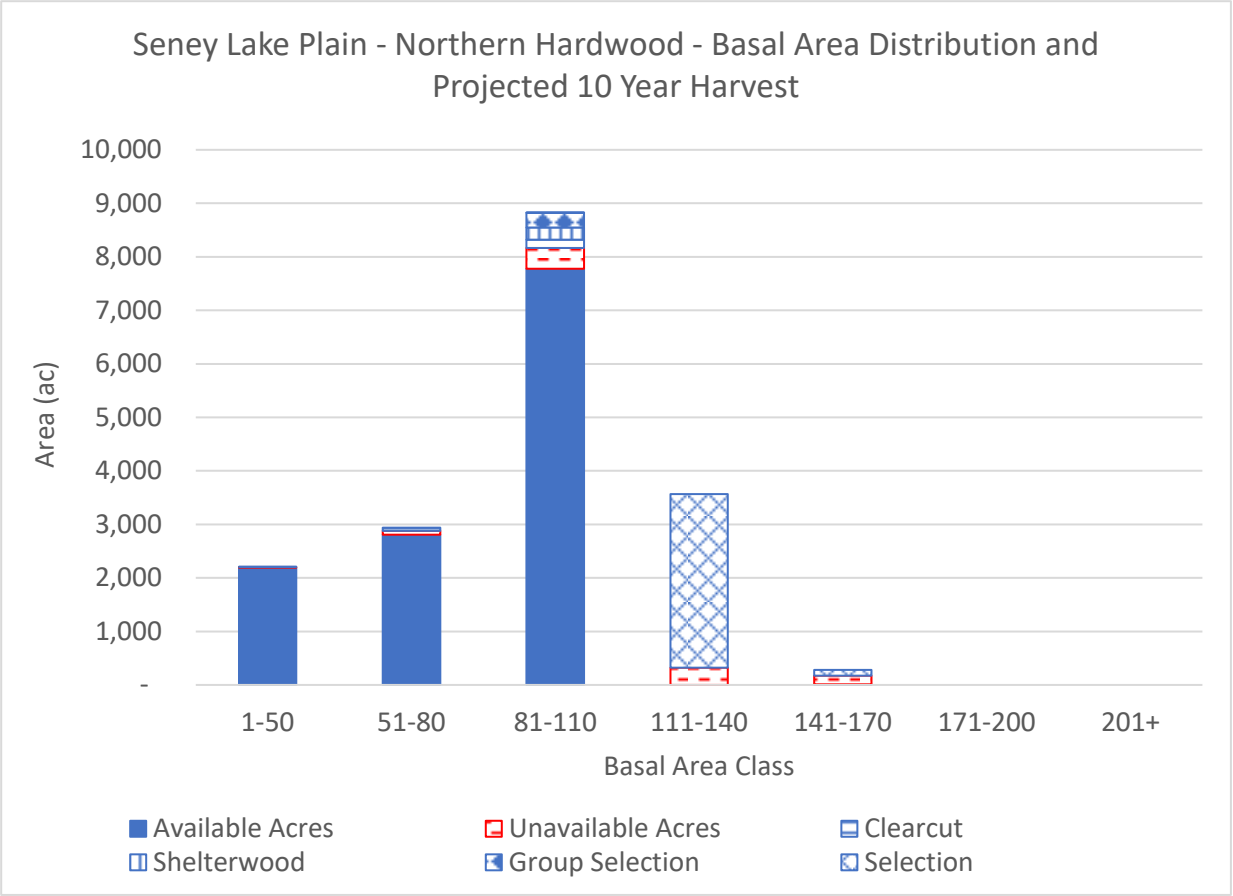


Figure 14. Current basal area distribution of the northern hardwood cover type as well as the projected harvests from each basal area class.

There are very few acres of unavailable northern hardwoods in the Seney Lake Plain Management Area. Selection is the primary silvicultural treatment projected during this 10-year planning period, along with group selection methods; however, there may be opportunities to utilize even-aged management silvicultural regimes to increase stem density, species composition and regeneration within the northern hardwood areas. A portion of this cover type meets the habitat requirements for blackburnian warbler, wood thrush, marten and white-tailed deer.

Table 11. Featured species with northern hardwoods as a priority habitat cover type, habitat variables and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Northern Hardwood	Northern Hardwood Habitat Acres – Available	Northern Hardwood Habitat Acres – Unavailable
Blackburnian warbler	Age category: 80+ Size category: pole, sawlog Basal area: 81+	10,820	847

Featured Species	Featured Species Habitat – Northern Hardwood	Northern Hardwood Habitat Acres – Available	Northern Hardwood Habitat Acres – Unavailable
Wood thrush	Age category: 40+ Size category: sawlog Basal area: 81+	11,863	866
Marten	Age category: 40+ Size category: pole, sawlog Basal area: 81+	10,280	847
White-tailed deer	All ages and size classes	17,821	--

Desired future condition

The projected long-term cover type trend for northern hardwood is slightly increasing in the Seney Lake Plain Management Area. There are very few transitions into this cover type from other cover types and equally few transitions from northern hardwoods to other cover types forecasted in this management area.

The desired basal area distribution is a bell-shaped curve, where a significant majority of the area is kept in the 81-110 basal area class, with recently harvested stands occupying the 51-80 class and stands that are ready for harvest occupying the 111-140 basal area class. Diameter distributions of the northern hardwood stands should follow the appropriate Q-curve relative to stand age and condition.

An uneven-aged condition is the long-term goal for all northern hardwood stands in this management area. An uneven-aged condition is achieved when there is no single discernable age cohort that is more prevalent than others across the stand area, as canopy gaps fill in with regenerating seedlings, saplings and poles, and remaining stems become sawlog-sized over time.

Regeneration and recruitment continue to be a focus in the northern hardwood cover type across this management area. The long-term sustainability of this cover type in an uneven-aged silvicultural regime is dependent on the successful establishment of northern hardwood species as well as the recruitment of those seedlings and saplings into the pole and sawlog classes. The Seney Lake Plain Management Area will take several decades to reach the desired future condition because of the impacts from beech bark disease. The amount of American beech that once occupied much of the northern hardwood stands has resulted in lower residual basal area and decreased stocking levels across much of the eastern Upper Peninsula.

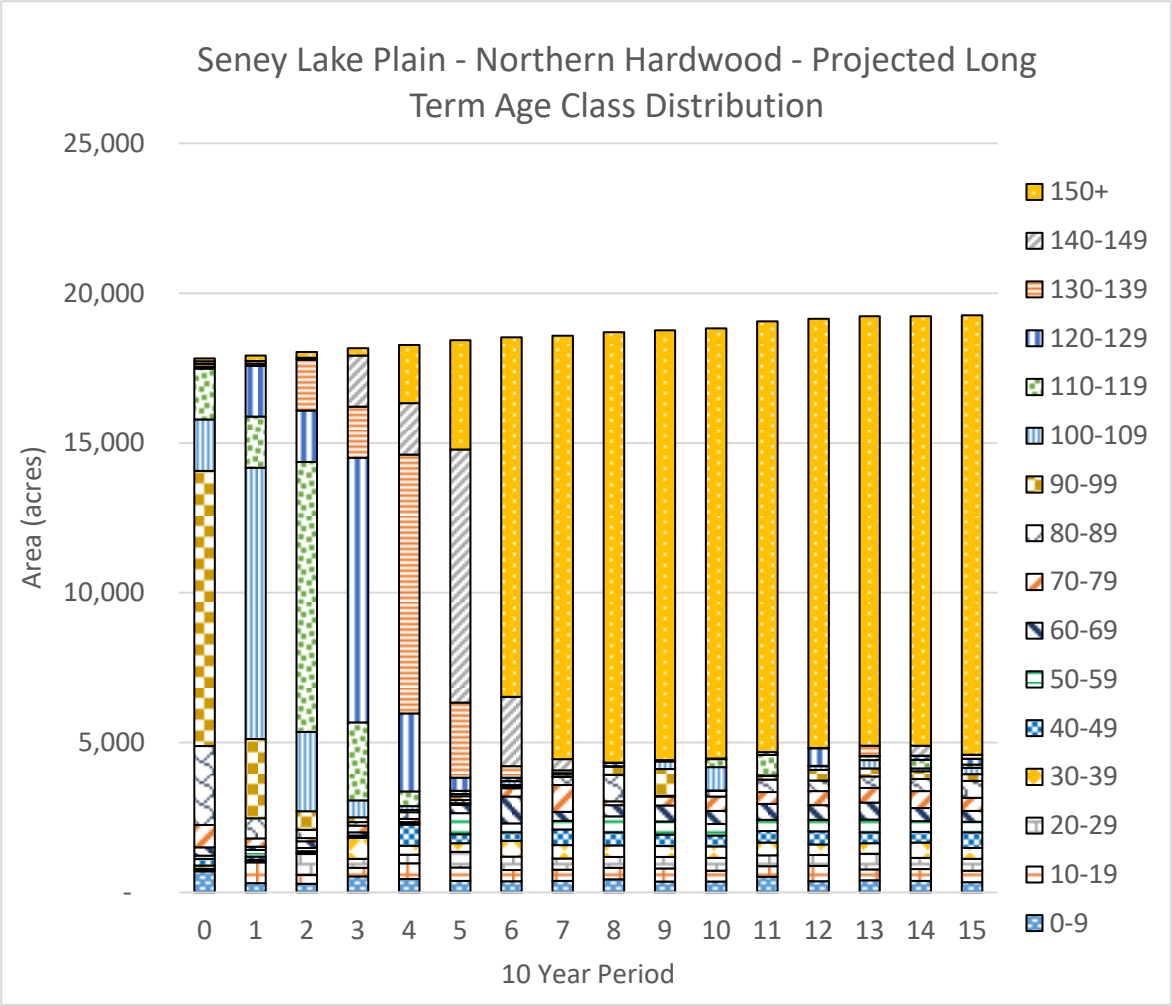


Figure 15. Projected age class distribution for all acres of northern hardwood over the next 150 years in the Seney Lake Plain Management Area.

Management actions

The desired forest conditions and associated featured species habitat will be maintained and achieved through continued application of the projected selection harvest regime on 3,357 acres in the first planning period. Multiple silvicultural regimes should continue to be considered as emerging research results become available. Planned projected harvest regimes also include 277 acres of group selection, 230 acres of shelterwood and 216 acres of clearcut harvest. Emphasis on larger canopy gaps should be used to encourage diverse regeneration of northern hardwood species while maintaining an overall long-term mature forest, closed-canopy landscape condition.

Aspen

Current condition

Most of the aspen cover type is currently in the 30- to 39-year-old age class (Figure 16). The past management regime has been primarily clearcut for this cover type. The 0-9, 10-19 and 50-59 age classes fall below the desired age class area goal. Limited available acres in the older age classes will present managers with a challenge in achieving the desired regeneration during this planning period.

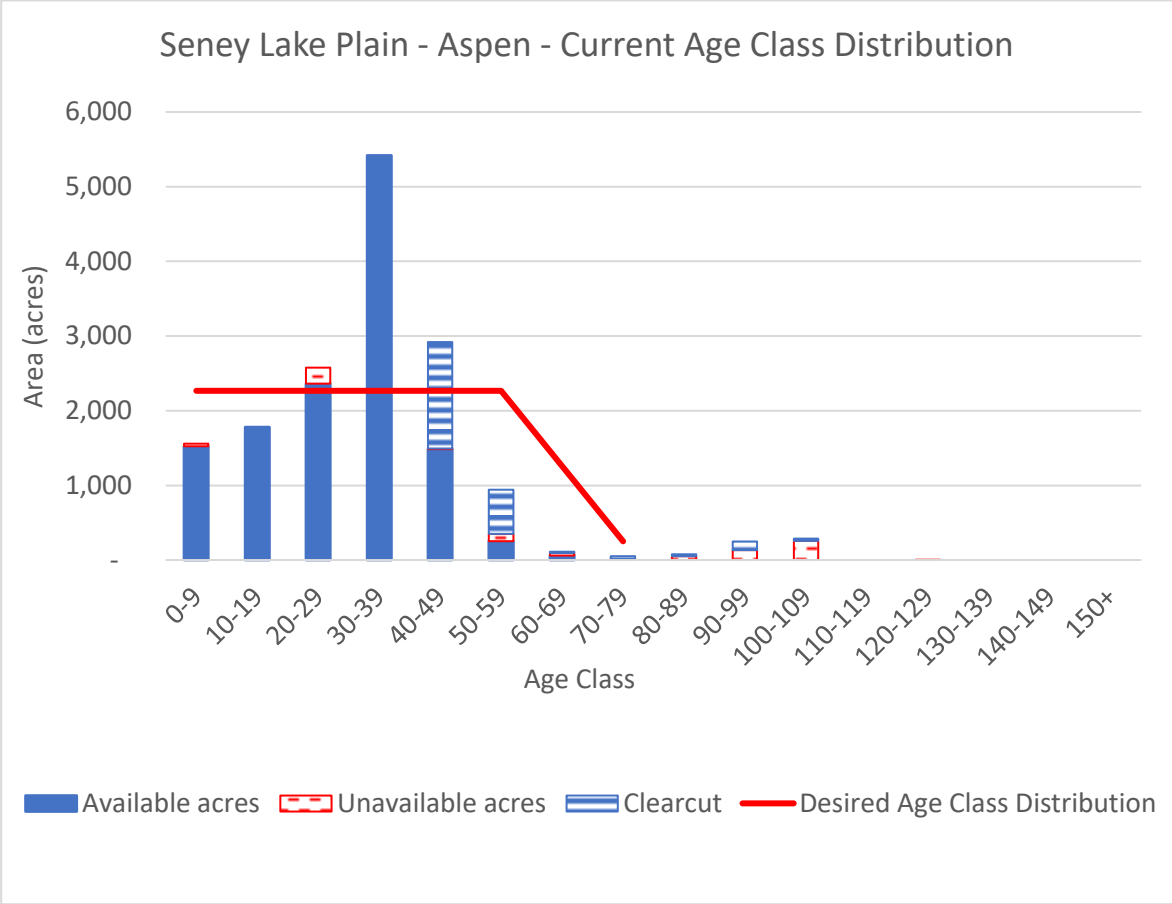


Figure 16. Current age class distribution, desired age class distribution and projected harvests in the aspen cover type over the 10-year planning period.

Current conditions are a result of consistent commercial harvests and regeneration efforts on available aspen acres during the previous planning periods. A portion of this cover type meets the habitat requirements for American woodcock, ruffed grouse, snowshoe hare and white-tailed deer.

Table 12. Featured species with aspen as a priority habitat cover type, habitat variables and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Aspen	Aspen Habitat Acres – Available	Aspen Habitat Acres – Unavailable
American woodcock	Age category: 0-19 Size class: sapling	3,303	37
Ruffed grouse	Age category: 0-19 Size class: sapling	3,303	37
Snowshoe hare	Age category: 0-19 Size class: sapling	3,303	37
White-tailed deer	All ages and size classes	15,997	--

Desired future condition

The projected long-term cover type trend for aspen is stable in the Seney Lake Plain Management Area. There are a few transitions into this cover type from other cover types and equally few transitions from aspen to other cover types forecasted in this management area.

The long-term goal for this cover type is balanced age classes between 0 and 50 years old for all available aspen stands in this management area. Maintaining lower acreage in old age classes continues to be desirable to ensure the aspen cover type is distributed within the desired age classes.

The end of the planning period will result in the establishment of the desired amount of regeneration in in the upcoming 0-9 age class, given the number of available acres in the current 40- to 49-year and 50- to 59-year age classes. Progress toward the long-term age class distribution of aspen will take many decades in the management area (Figure 17).

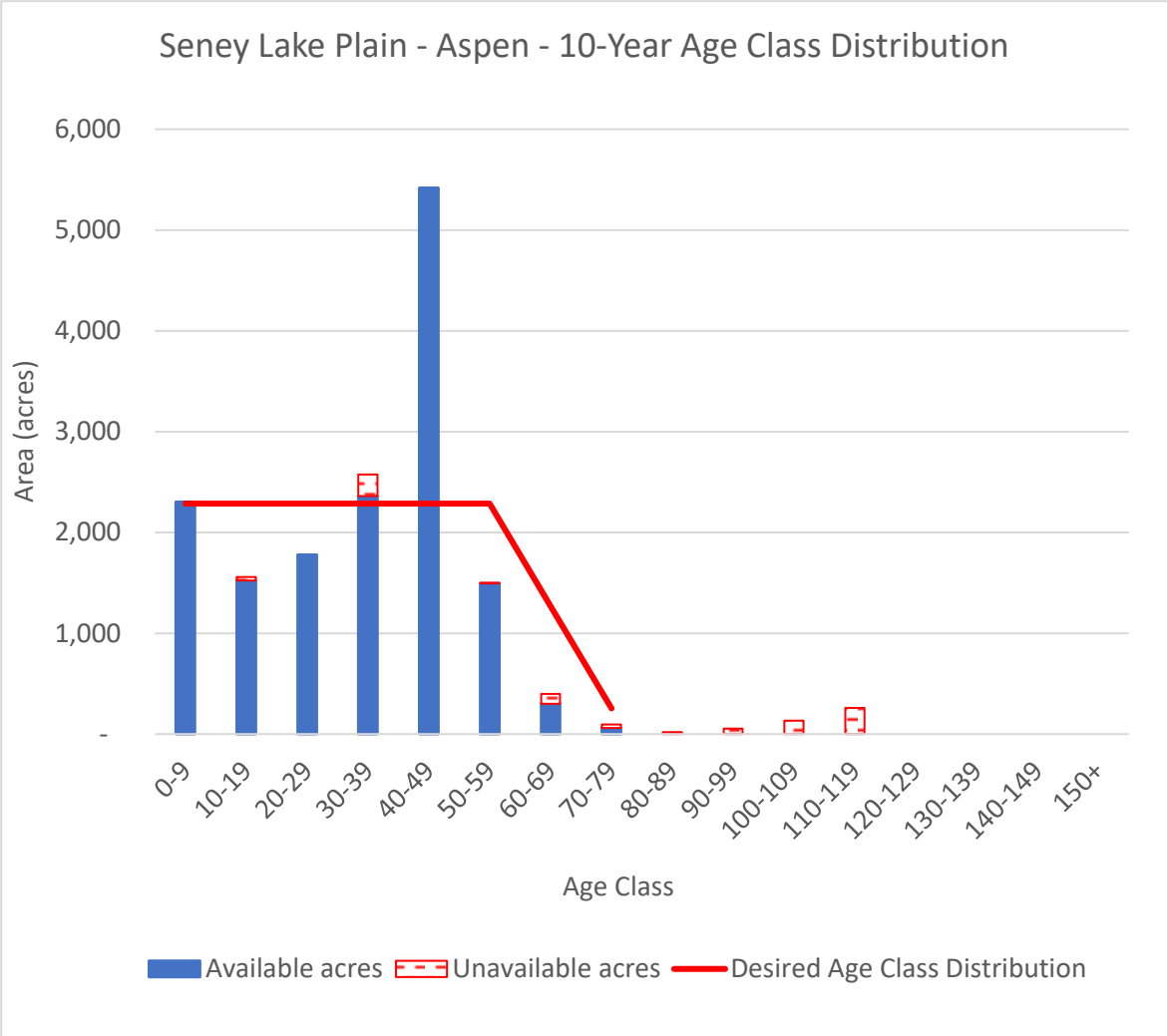


Figure 17. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The midterm age class distribution shows the population of aspen acres nearly reaching the desired future condition, with only a few age classes deviating from the target proportions (Figure 18). As is often the case, an unbalanced condition in the first planning period can often result in the need to carry some acres slightly longer into older age classes to achieve the desired age class goals.



Figure 18. Projected midterm age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 19) will concentrate the manageable acres of aspen in productive growing conditions while providing an even flow of forest products and a wide variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest.

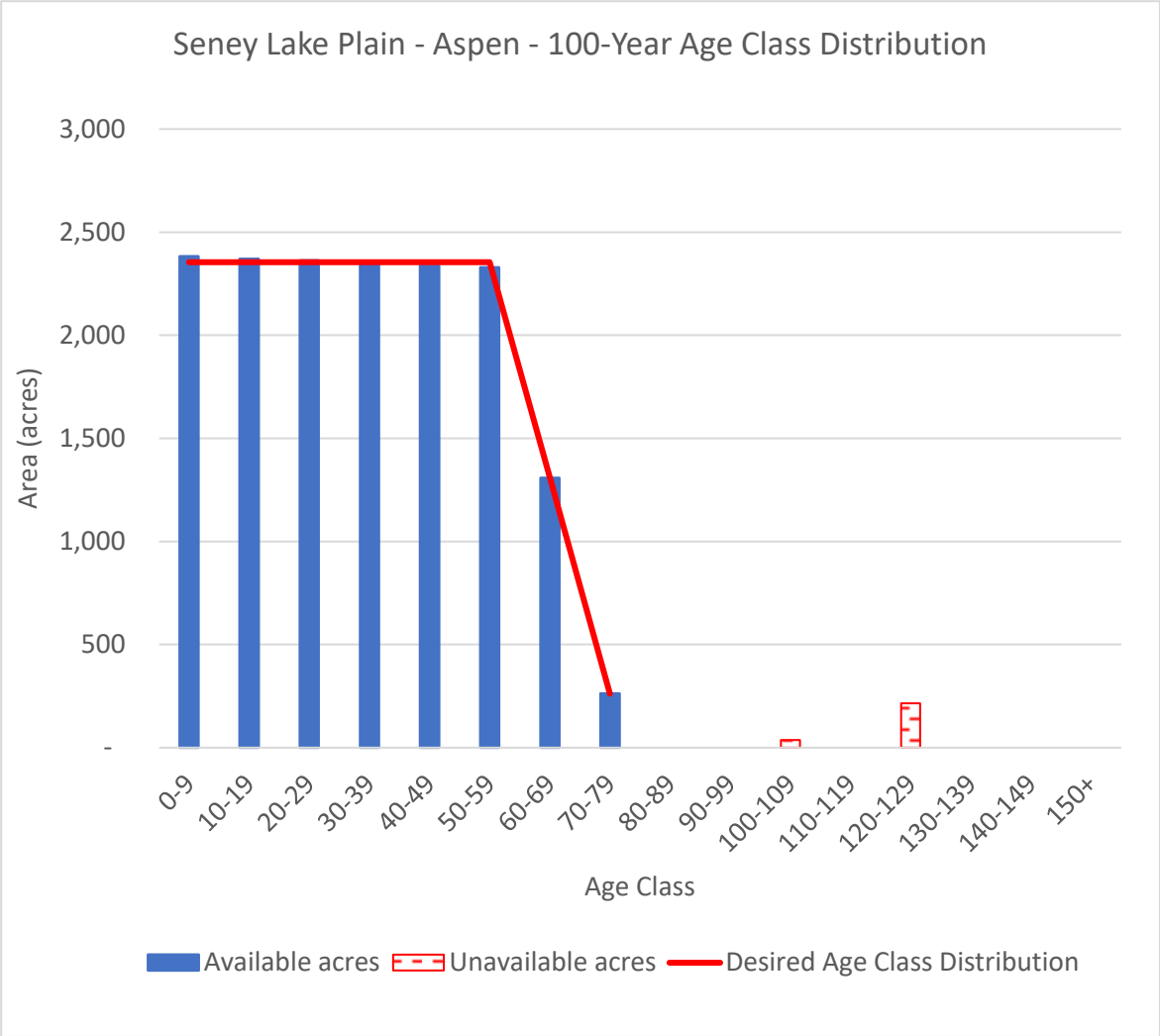


Figure 19. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

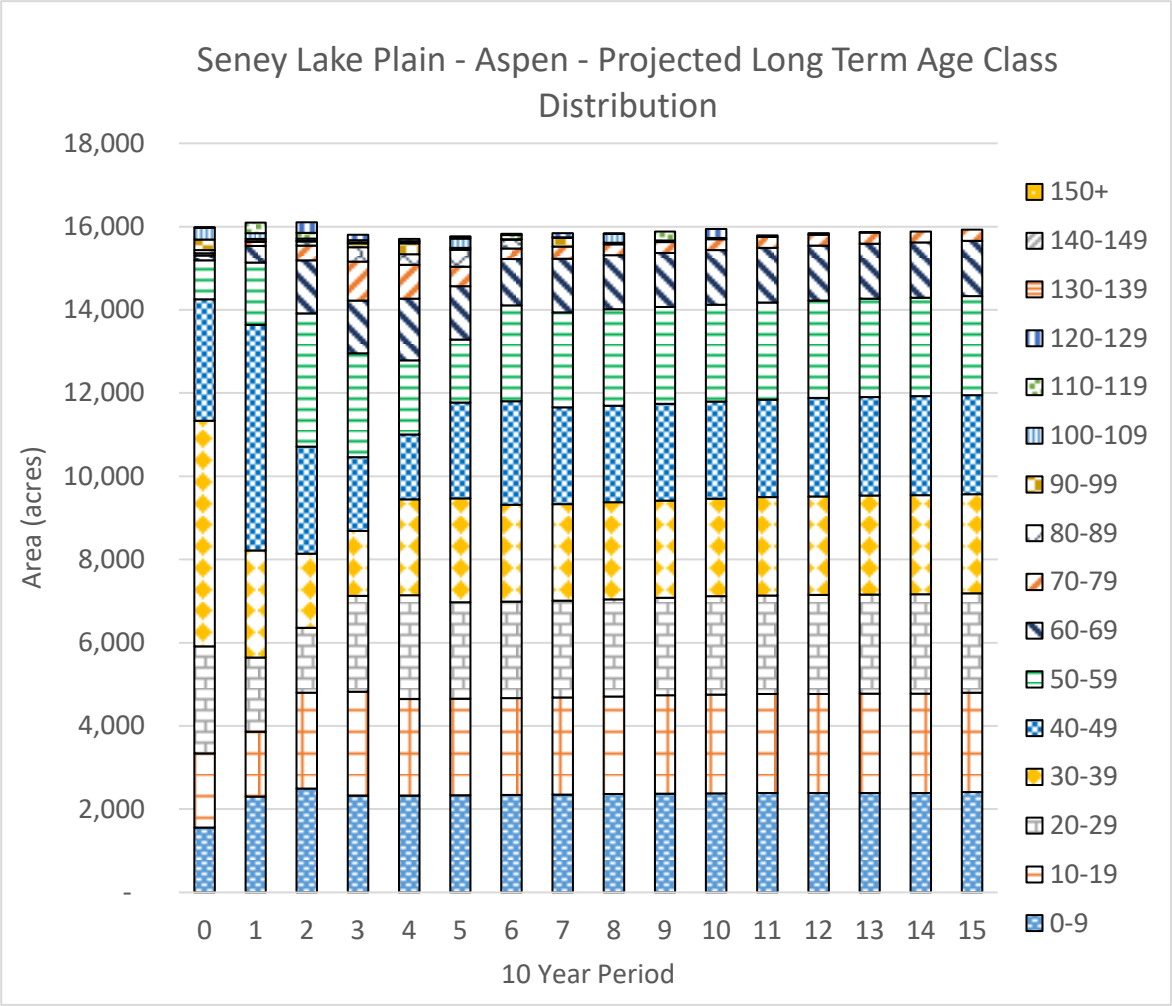


Figure 20. Projected age class distribution for all acres of aspen over the next 150 years in the Seney lake Plain Management Area.

Management actions

There are 2,232 acres of projected clearcut harvest in the aspen cover type during this planning period. This falls slightly short of the desired establishment of 2,267 acres per decade because of the current unbalanced condition.

Lowland spruce/fir

Current condition

The age class distribution is currently unbalanced in this management area. There is a deficit in several of the age class categories, including the 10- to 19-year-old through 50- to 59-year-old age classes. Nearly 40% of the cover type is considered unavailable for commercial forest management. Many stands are inaccessible due to their landscape position, active management operability within the stand or other management priorities such as unique natural communities or species of special concern. Unavailable acres will be subject to natural processes, resulting in a range of age classes across the cover type in the Seney Lake Plain Management Area.

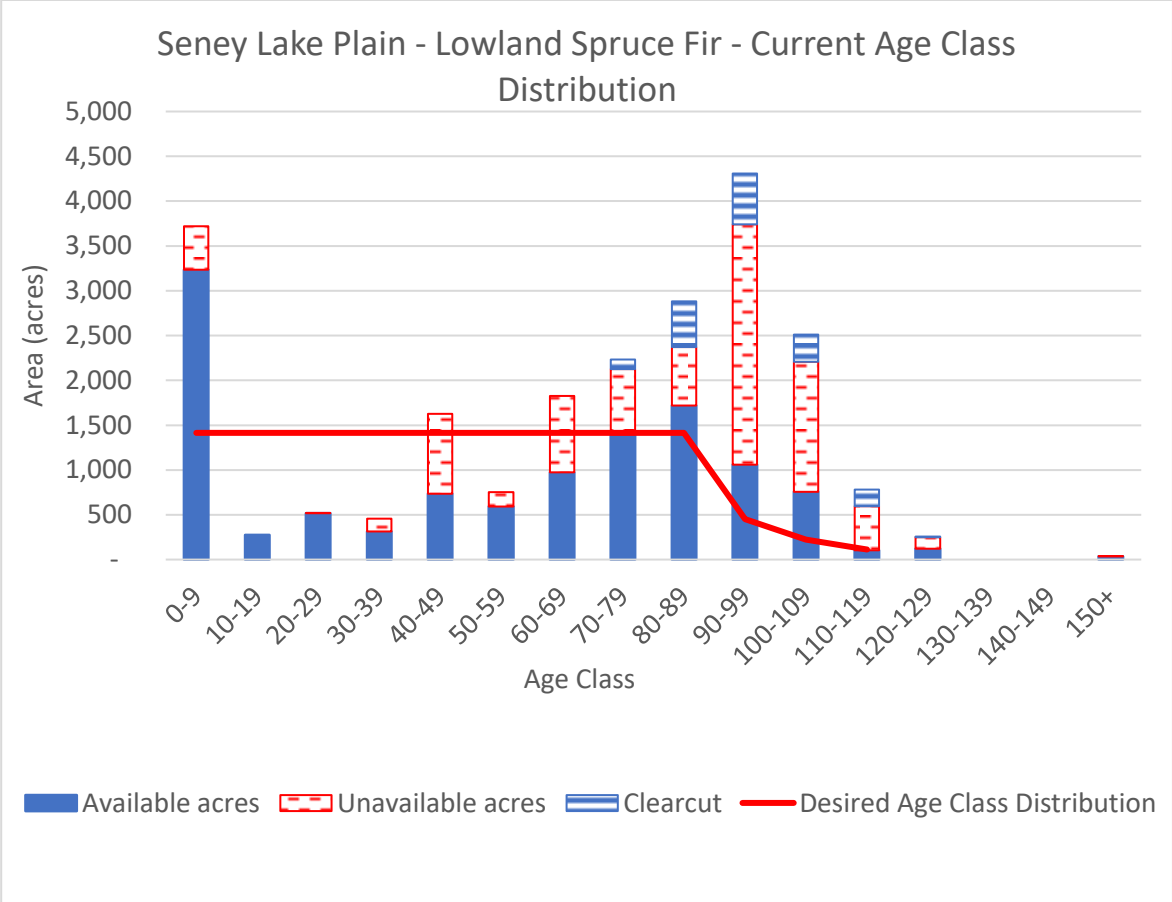


Figure 21. Current age class distribution and projected harvests in the lowland spruce/fir cover type in the Seney Lake Plain Management Area.

Current conditions are a result of successful commercial harvest efforts and natural regeneration as well as landscape positions of the cover type. A portion of this cover type meets the habitat requirements for snowshoe hare and spruce grouse.

Table 13. Featured species with lowland spruce/fir as a priority habitat cover type, habitat variables and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Lowland Spruce/Fir	Lowland Spruce/Fir Habitat Acres – Available	Lowland Spruce/Fir Habitat Acres – Unavailable
Snowshoe hare	Age category: 0-19 Size category: sapling	3,511	483
Spruce grouse	Age category: 40+ Size category: sawlog	2,216	2,742

Desired future condition

The projected long-term cover type trend for lowland spruce/fir is fairly stable in the Seney Lake Plain Management Area, with a slight downward trend in the initial planning period and a slight long-term downward trend across the 150-year projections (Figure 22). Transitions out of this cover type to lowland mixed forest are forecasted for the initial planning period.

The long-term goal for this cover type is balanced age classes between 0 and 89 years old and a max tail age of 110 years old for all available lowland spruce/fir stands in this management area.

The end of the planning period will result in the establishment of the desired amount of regeneration in in the upcoming 0-9 age class given the amount of merchantable and available acres in the older age classes. Progress toward the long-term age class distribution of lowland spruce/fir will take many decades in the management area (Figure 22).

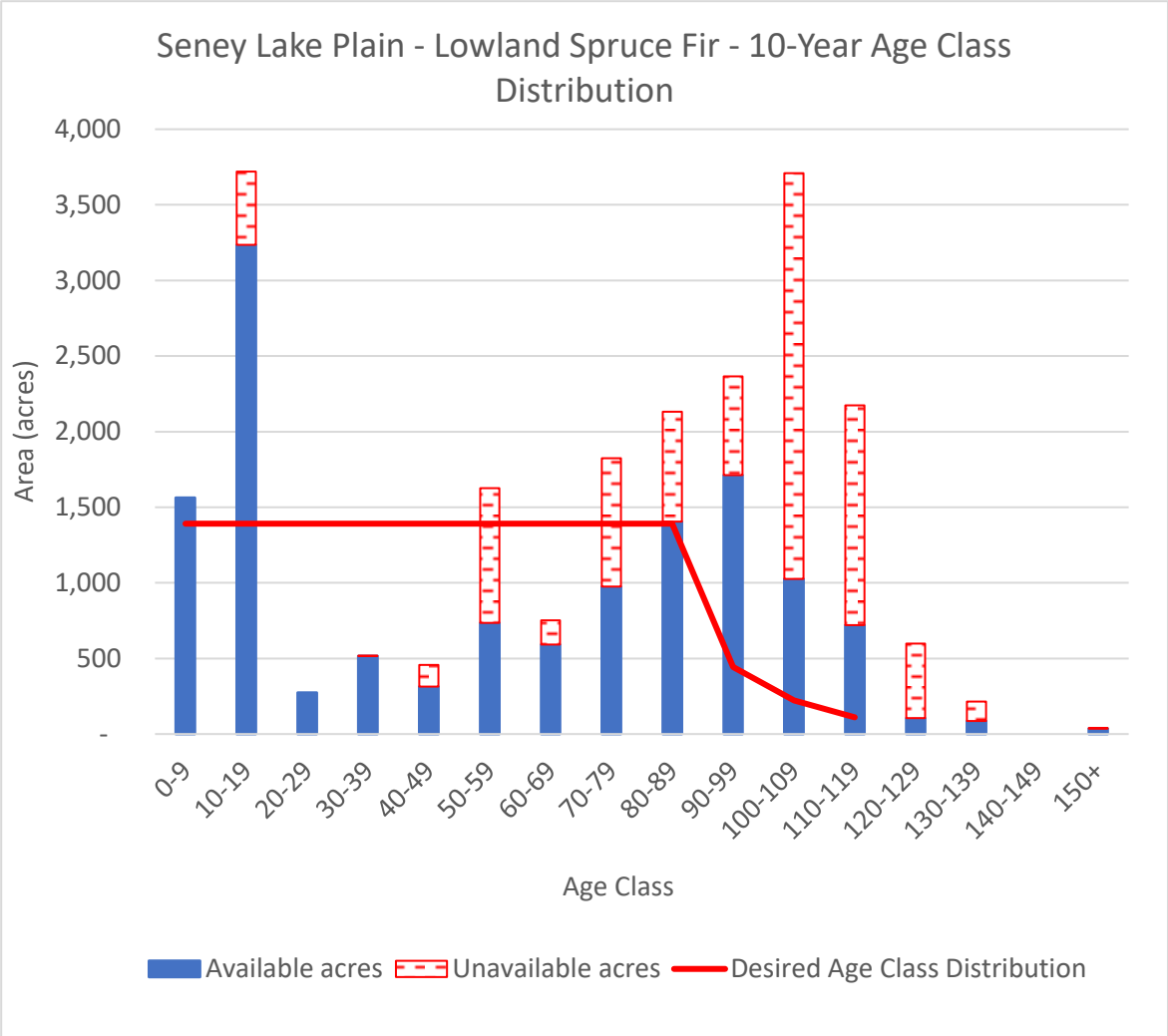


Figure 22. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The midterm age class distribution shows the population of lowland spruce/fir acres beginning to reach the desired future condition, especially in the younger age classes, with very little deviation. Older age classes continue to show deficits due to the unbalanced condition during the first planning period (Figure 23). As is often the case, an extremely unbalanced condition in the first planning period can result in the need to carry some acres slightly longer into older age classes in future years, including the 120- to 129-year-old age classes, in order to meet the desired distribution and achieve age class goals (Figure 23).

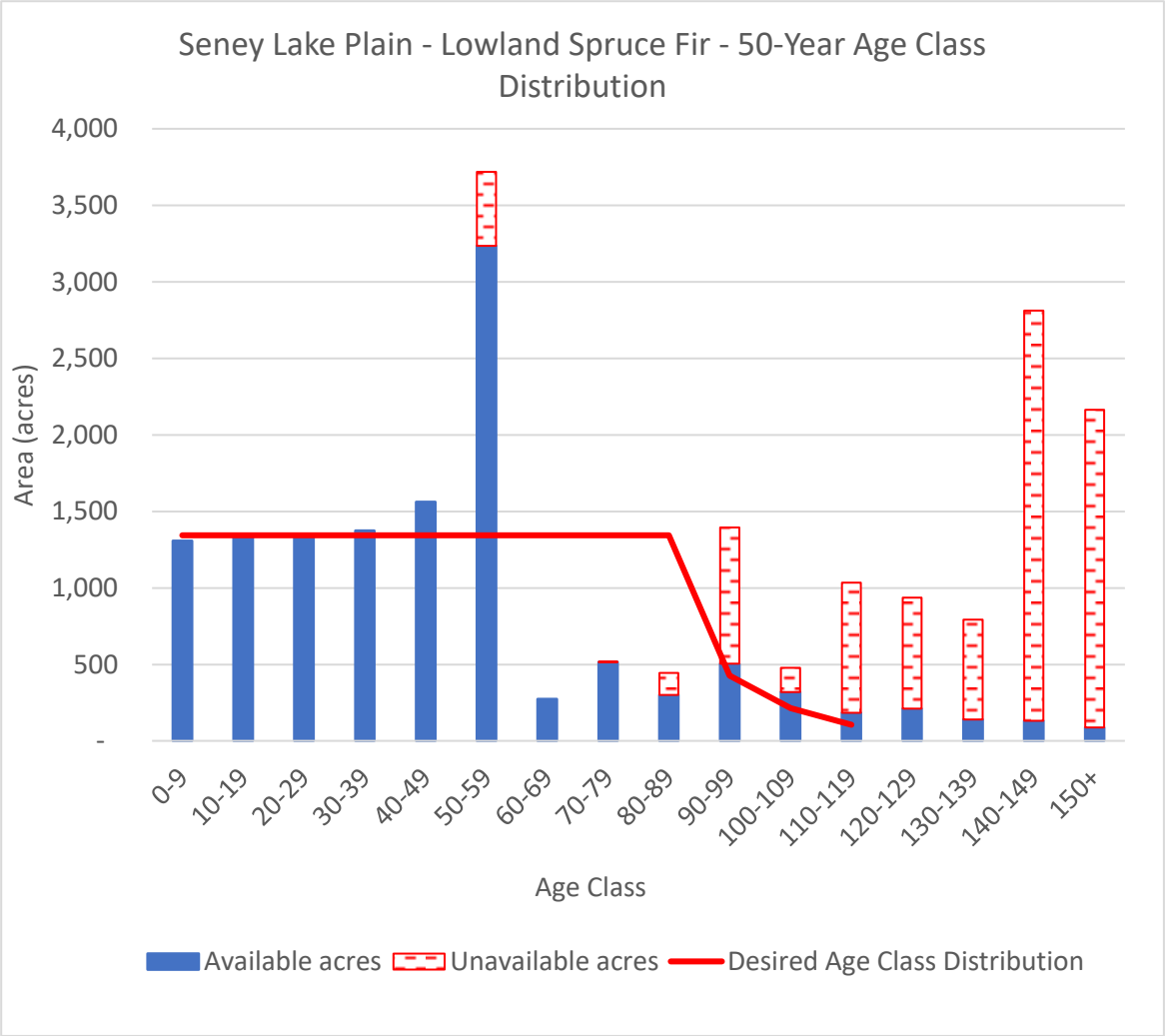


Figure 23. Projected midterm age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution will concentrate the manageable acres of lowland spruce/fir in productive growing conditions while providing an even flow of forest products and a wide variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest. Unavailable acres of the cover type will continue to age and allow natural processes to occur (Figure 24).

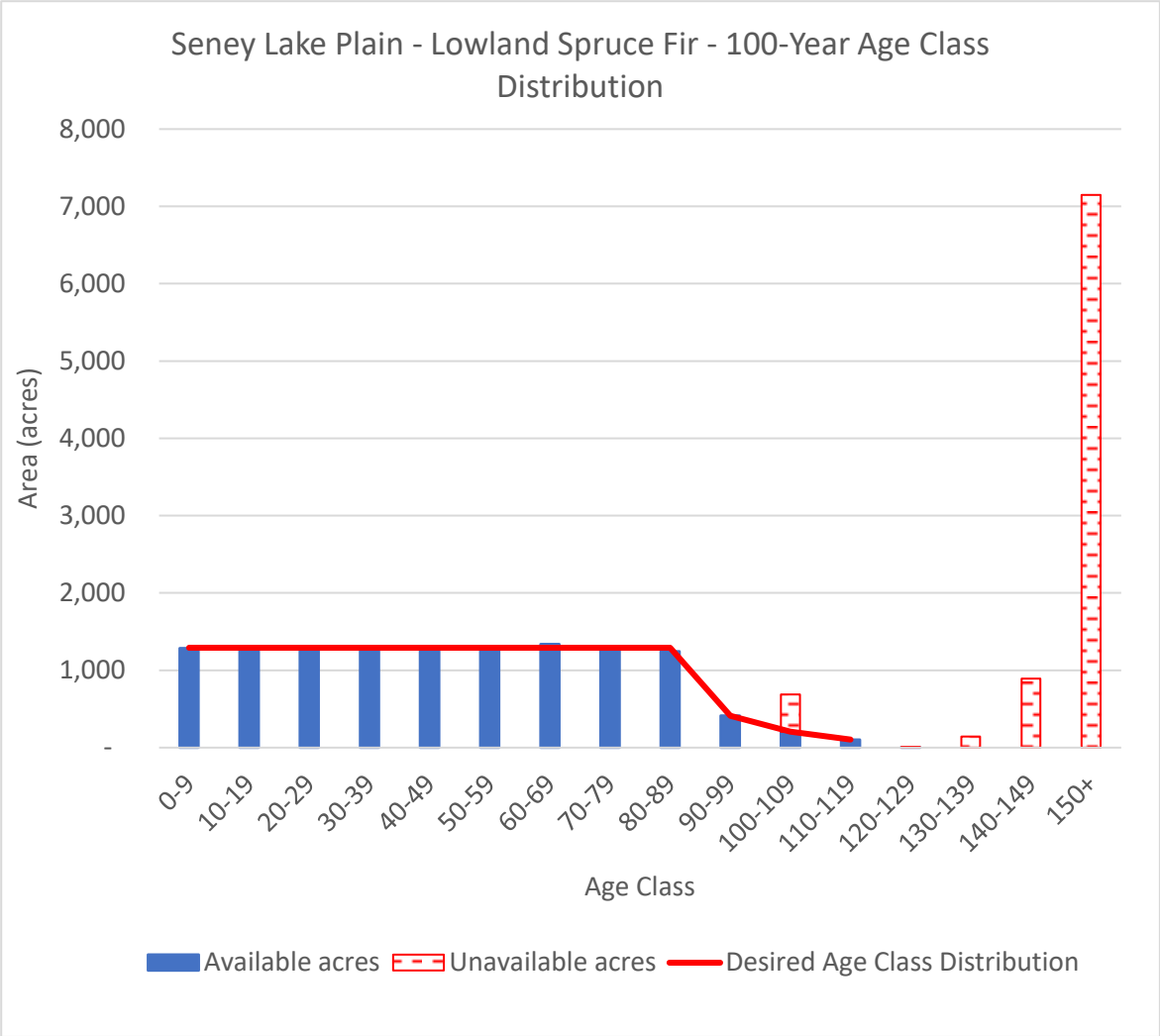


Figure 24. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

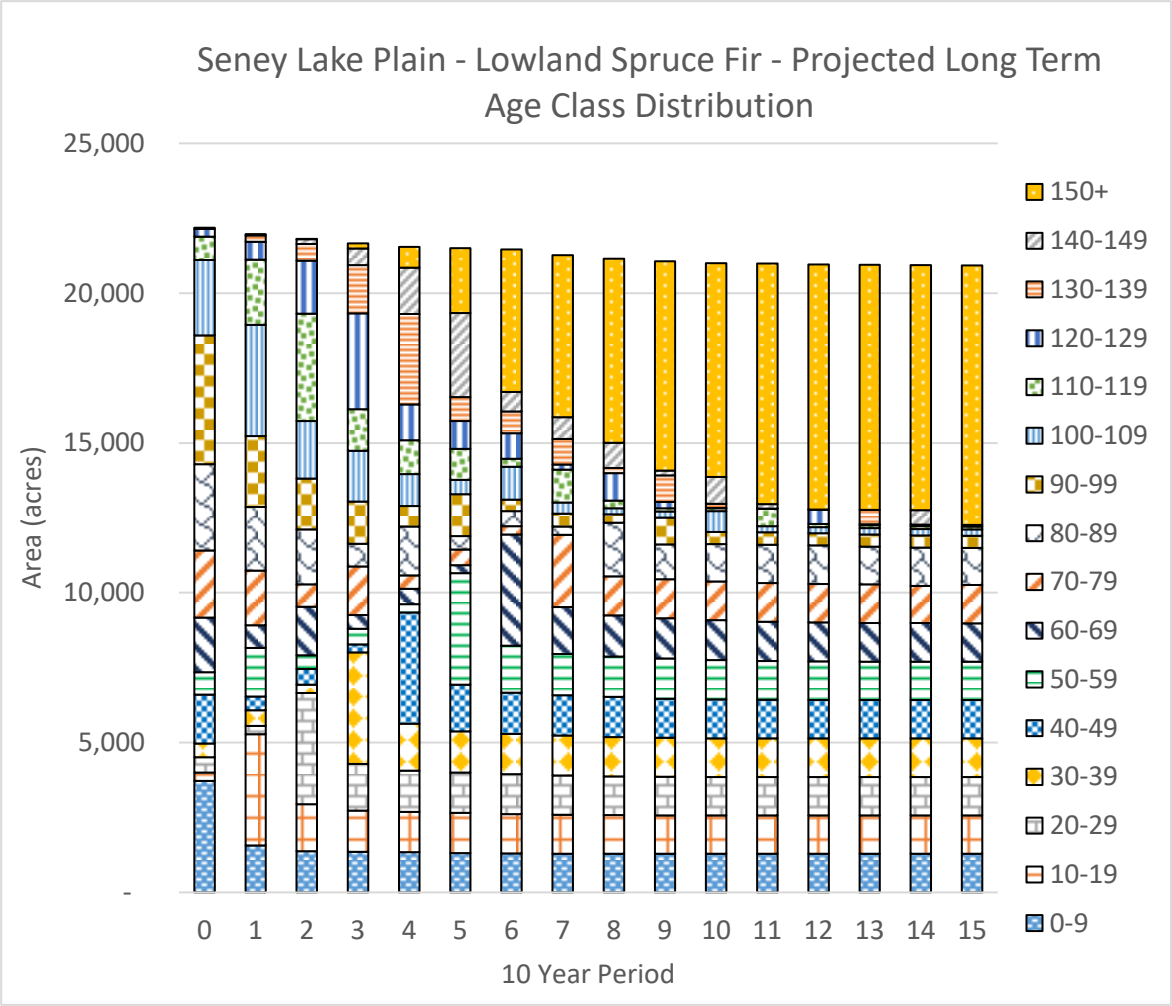


Figure 25. Projected age class distribution for all acres of lowland spruce/fir over the next 150 years in the Seney Lake Plain Management Area.

Management actions

The desired forest conditions and associated featured species habitat will be maintained and achieved through continued application of the projected clearcut harvest regime on 1,683 acres (Table 5).

Conservation area network

High conservation value areas

There are up to nine different high conservation value area types that can be found in each management area (Table 13; see Biodiversity in Section 3 for more information).

Table 13. High conservation value areas within the Seney Lake Plain Management Area.

High Conservation Value Area Type and Name	Acres
Coastal environmental areas	**920**
	920
Dedicated management areas	**728**
	728
Deer wintering complex	**7,867**
	7,867
State wildlife management areas	**13,806**
Munuscong Bay SWMA	13,806
Verified Type 1 and Type 2 old growth	**45**
Type 1 old growth	45
Grand total	**23,366**

Ecological reference areas

Ecological reference areas, a type of HCVA, are higher-quality examples of functioning ecosystems that are primarily influenced by natural ecological processes.

Table 14. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 15. Ecological reference areas within the management area.

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	Number of Occurrences
Existing ERA	Bog	AB	G3G5	S4	2
Existing ERA	Dry northern forest	AB	G3?	S3	1
Existing ERA	Dry northern forest	B	G3?	S3	1
Existing ERA	Dry northern forest	BC	G3?	S3	1
Existing ERA	Dry-mesic northern forest	AB			1
Existing ERA	Dry-mesic northern forest	AB	G4	S3	5
Existing ERA	Dry-mesic northern forest	BC	G4	S3	1
Existing ERA	Dry-mesic northern forest	D	G4	S3	1
Existing ERA	Hardwood-conifer swamp	AB			1
Existing ERA	Muskeg	A			2
Existing ERA	Muskeg	AB	G4G5	S3	1
Existing ERA	Northern fen	AB		S3	1
Existing ERA	Northern shrub thicket	AB	G4	S5	2
Existing ERA	Northern wet meadow	AB	G4G5	S4	2
Existing ERA	Patterned fen	A	GU	S2	4
Existing ERA	Patterned fen	AB	GU	S2	4
Existing ERA	Poor conifer swamp	B	G4	S4	2
Existing ERA	Poor fen	A			1
Existing ERA	Poor fen	AB	G3	S3	2
Existing ERA	Poor fen	B		S3	2
Existing ERA	Rich conifer swamp	AB			3
Existing ERA	Rich conifer swamp	AB	G4	S3	5
Existing ERA	Rich conifer swamp	C	G4	S3	1
Existing ERA	Rich tamarack swamp	A			1
Proposed ERA	Dry northern forest	A	G3?	S3	1
Proposed ERA	Dry northern forest	AB	G3?	S3	1
Proposed ERA	Dry northern forest	B	G3?	S3	1
Proposed ERA	Dry northern forest	C	G3?	S3	1
Proposed ERA	Northern fen		G3	S3	1
Proposed ERA	Northern fen	A	G3	S3	2
Proposed ERA	Poor fen	AB	G3	S3	2
Grand total					**56**

Special conservation areas

Reviewable special conservation areas (Table 16) are those SCA types that may be reviewed or updated through the compartment review process as needed. Static SCAs (Table 17) are those SCA types that generally do not change or require updating (see Biodiversity in Section 3 for more information).

Table 16. Reviewable special conservation areas within the Seney Lake Plain Management Area.

Reviewable Special Conservation Area Type and Name	Acres
Concentrated recreational area	**14**
Boat launch	1
Natalie Campground	13
Habitat area or habitat corridor	**3,214**
Maxton Plains: Alvar and associated natural communities	1,197
--	1,531
--	486
Mineral resource area	**9**
Dollarville Gravel Pit	2
Schoolcraft County Road Commission	7
Possible Type 1 or Type 2 old growth	**970**
--	970
Spring, wetlands or riparian areas	**890**
Maxton Plains: Alvar and associated natural communities	201
Tahquamenon River Spreads	689
Visual management areas	**20,948**
Pictured Rocks National Lakeshore	13,838
Two Hearted River Visual Management Area	7,110
Grand total	**26,045**

Table 17. Static special conservation areas within the management area.

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Common natural heritage element occurrences		**6,948**
Dry-mesic northern forest		39
Muskeg		6,708
Northern wet meadow		201
Designated trout and coldwater stream buffer		**6,432**
Unnamed		3,016
Auger Creek		275
Bev Creek		73
Brace Creek		72
Carlson Creek		14
Cold Creek		44
Dawson Creek		21
Deer Creek		79
Driggs River		209
East Branch Fox River		190
East Branch Sage River		190
East Branch Two Hearted River		45

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
East Creek		25
East Lake Creek		34
First Creek		63
Fox River		298
Gimlet Creek		24
Gronden Creek		13
Hendrie River		86
Hiawatha Creek		44
Hudson Creek		24
Johns Creek		15
Kings Creek		6
Little Dawson Creek		36
McLeod Ditch		9
Murphy Creek		220
North Branch Murphy Creek		11
North Branch Stutts Creek		98
North Branch Two Hearted River		94
Quinn Creek		63
Red Creek		14
Sage River		35
Savage Creek		6
Silver Creek		40
Sixteen Creek		45
South Branch Hendrie River		90
South Branch Two Hearted River		10
Southside Creek		25
Spring Creek		32
Stoner Creek		26
Stutts Creek		49
Syphon Creek		84
Tahquamenon River		50
Teaspoon Creek		96
Third Creek		89
Thirtynine Creek		1
Two Hearted River		15
West Branch Hendrie River		38
West Branch Hickey Creek		103
West Branch Sage River		78
West Branch Two Hearted River		117
Designated trout and coldwater streams	**252.4**	
	119.0	
Auger Creek	11.3	

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Bev Creek	2.7	
Brace Creek	2.7	
Carlson Creek	0.6	
Cold Creek	1.8	
Dawson Creek	0.9	
Deer Creek	3.1	
Driggs River	7.4	
East Branch Fox River	8.1	
East Branch Sage River	7.0	
East Branch Two Hearted River	1.9	
East Creek	1.0	
East Lake Creek	1.3	
First Creek	2.3	
Fox River	11.4	
Gimlet Creek	0.9	
Gronden Creek	0.6	
Hendrie River	3.4	
Hiawatha Creek	1.6	
Hudson Creek	1.1	
Johns Creek	0.6	
Kings Creek	0.2	
Little Dawson Creek	1.5	
McLeod Ditch	0.3	
Murphy Creek	8.7	
North Branch Murphy Creek	0.4	
North Branch Stutts Creek	3.8	
North Branch Two Hearted River	4.0	
Quinn Creek	2.3	
Red Creek	0.6	
Sage River	1.5	
Savage Creek	0.2	
Silver Creek	1.5	
Sixteen Creek	1.7	
South Branch Hendrie River	3.4	
South Branch Two Hearted River	0.4	
Southside Creek	0.9	
Spring Creek	1.2	
Stoner Creek	0.9	
Stutts Creek	1.9	
Syphon Creek	3.2	
Tahquamenon River	1.8	
Teaspoon Creek	4.2	

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Third Creek	3.6	
Two Hearted River	0.5	
West Branch Hendrie River	1.4	
West Branch Hickey Creek	4.0	
West Branch Sage River	3.0	
West Branch Two Hearted River	4.4	
Important bird areas		**16,898**
Dollarville Flooding		1,115
Raco Plains and Wilwin Wetland		1,203
Seney National Wildlife Refuge		274
Sleeper Lake Burn		14,293
Nondedicated natural areas		**1,125**
Natural Area McMahon Lake Strangmoor		1,125
Wood turtle stream 100-foot buffer		**362**
Creighton River		12
Duck Creek		28
Manistique River		255
Stutts Creek		68
Wood turtle stream 660-foot buffer		**2,023**
Creighton River		104
Duck Creek		174
Manistique River		1,399
Stutts Creek		347
Grand total	**252.4**	**33,776**

Rare species

Rare species occurrences are compiled from the Michigan Natural Features Inventory biotics database (Table 18) and do not necessarily include all rare species found in this management area due to biases in survey effort and verifiable observation reporting over time.

Table 18. Rare animal and plant species conservation status key.

Species Status	Species Status
E = endangered	LE = listed endangered
T = threatened	LT = listed threatened
SC = special concern	PDL = proposed for delisting

Table 19. Rare animal species occurrence within the Seney Lake Plain Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Accipiter gentilis	Northern goshawk	T		2
Animal	Alces alces	Moose	SC		1
Animal	Boloria frigga	Frigga fritillary	SC		4
Animal	Bombus borealis	Northern amber bumble bee	SC		5
Animal	Bombus fervidus	Yellow bumble bee	SC		1
Animal	Bombus terricola	Yellow banded bumble bee	SC		6
Animal	Botaurus lentiginosus	American bittern	SC		1
Animal	Canachites canadensis	Spruce grouse	T		2
Animal	Canis lupus*	Gray wolf	SC	LE	--
Animal	Coturnicops noveboracensis	Yellow rail	T		3
Animal	Falco columbarius	Merlin	SC		2
Animal	Gavia immer	Common loon	T		3
Animal	Glaucomys sabrinus	Northern flying squirrel	SC		2
Animal	Glyptemys insculpta	Wood turtle	T		4
Animal	Haliaeetus leucocephalus	Bald eagle	SC		5
Animal	Lithobates palustris	Pickerel frog	SC		1
Animal	Myotis septentrionalis	Northern long-eared bat	T	LE	1
Animal	Necturus maculosus	Mudpuppy	SC		3
Animal	Notropis dorsalis	Bigmouth shiner	T		1
Animal	Opheodrys vernalis	Smooth green snake	SC		2
Animal	Pandion haliaetus	Osprey	SC		7
Animal	Papaipema aweme	Aweme borer	SC		1
Animal	Plebejus idas nabokovi	Northern blue	T		2
Animal	Polygonia gracilis	Hoary comma	X		1
Animal	Setophaga kirtlandii	Kirtland's warbler	E		2
Animal	Somatochlora incurvata	Incurvate emerald	SC		1
Animal	Tympanuchus phasianellus	Sharp-tailed grouse	SC		3
Total	-	-	-	-	**66**

**Occurrence information provided by field staff.*

Table 20. Rare plant species occurrence within the Seney Lake Plain Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Plant	Bartonia paniculata	Panicled screwstem	T		1
Plant	Botrychium mormo	Goblin moonwort	E		1
Plant	Carex nigra	Black sedge	E		1

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Plant	Cirsium pitcheri	Pitcher's thistle	T	LT	1
Plant	Drosera anglica	English sundew	SC		1
Plant	Eleocharis nitida	Slender spike rush	E		1
Plant	Huperzia selago	Fir clubmoss	SC		3
Plant	Juncus vaseyi	Vasey's rush	T		2
Plant	Neottia auriculata	Auricled twayblade	SC		2
Plant	Petasites sagittatus	Sweet coltsfoot	T		7
Plant	Piptatherum canadense	Canada rice grass	T		1
Plant	Potamogeton confervoides	Alga pondweed	SC		4
Plant	Rubus acaulis	Dwarf raspberry	T		4
Plant	Salix pellita	Satiny willow	T		1
Plant	Stachys pilosa	Hairy hedge-nettle	SC		1
Plant	Tanacetum bipinnatum ssp. huronense	Lake Huron tansy	SC		1
Plant	Trichophorum clintonii	Clinton's bulrush	SC		4
Plant	Vaccinium cespitosum	Dwarf bilberry	T		3
Total	-	-	-	-	**39**

Table 21. Other occurrence within the Seney Lake Plain Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Other	Great blue heron rookery	Great blue heron rookery			2

Non-ecological reference area natural communities

Natural communities that are identified with an element occurrence in the MNFI Biotics database, but that have not been given an additional ecological reference area designation, are recognized and managed accordingly (Table 22).

Table 22. Non-ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence

Element Occurrence Rank	State Rank	Global Rank
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 23. Non- ecological reference area natural communities within the Seney Lake Plain Management Area.

Community Type	Element Occurrence Rank	State Rank	Global Rank	Number of Occurrences
Dry-mesic northern forest	AB	S3	G4	1
Dry-mesic northern forest	B	S3	G4	1
Muskeg	A	S3	G4G5	1
Muskeg	AB	S3	G4G5	1
Muskeg	BC	S3	G4G5	1
Northern wet meadow	A	S4	G4G5	1
Grand total				**6**

Forest health

Forest health concerns, both native and non-native, can have impacts on stand conditions and management decisions. The following insects (Table 24) and diseases (Table 25) could have an impact on management during the planning period and may need to be monitored and/or addressed.

Table 24. Defoliating insects of concern in the Seney Lake Plain Management Area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Spongy moth	Lymantria dispar dispar	Non-native	Yes
Forest tent caterpillar	Malacosoma disstria	Native	Yes
Large aspen tortrix	Choristoneura conflictana	Native	Yes
Spruce budworm	Choristoneura fumiferana	Native	Yes
Jack pine budworm	Choristoneura pinus	Native	Yes

Table 25. Maladies of concern in the Seney Lake Plain Management Area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Canker (stem infections)	Nectria cinnabarina	Native	Yes
Armillaria root rot	Armillaria mellea	Native	Yes
Heterobasidion root disease	Heterobasidion annosum	Native	No

Aquatic resources

Riparian habitat

A total of 507 miles of streams and rivers are found in the management area (Table 26). Streams/rivers classified as warm types comprise approximately 69% of the riverine mileage.

Table 26. Classification type and length of streams/rivers found within the management area.

Type	Length (miles)
Cold stream	85
Cold small river	24
Cold transitional stream	50
Cold transitional small river	0
Cold transitional large river	0
Warm transitional stream	235
Warm transitional small river	46
Warm transitional large river	20
Warm stream	1
Warm small river	23
Warm large river	23

Lacustrine habitat

A total of 41 lakes and ponds of at least 1 surface acre are found in the management area (Table 27).

Table 27. Size and number of lakes and ponds located within the management area.

Lake Size Class (acres)	Number
1-99	38
100-499	3
500+	0

Wetlands

A total of 280,415 acres of wetlands are found in the management area (Table 28). Forested wetlands comprise approximately 94% of wetland types found in the management area.

Table 28. Area of emergent, forested and riverine wetland types found within the management area.

Wetland Type	Acres
Emergent	15,862
Forested	263,368
Riverine	1,185

Vernal pools and seeps

A total of 371 acres of vernal pools and seeps have been inventoried in the management area, while 617 acres of seeps have been identified.

Riparian vegetation cover

Lowland shrub is the predominant cover type present in a 100-meter riparian zone located next to streams/rivers in the management area (Table 29).

Table 29. Largest vegetative cover types (i.e., top 10) and area located in a 100-meter buffer of streams/rivers within the management area.

Cover Type	Acres
Lowland shrub	17,501
Lowland conifers	4,817
Marsh	4,472
Cedar	4,320
Natural jack pine	2,712
Lowland deciduous	2,511
Northern hardwood	2,111
Lowland spruce/fir	1,699
Aspen	1,648
Natural mixed pines	1,505

Watershed vegetation cover

The management area includes portions of important watersheds of the Tahquamenon River and Manistique River (Table 30 and Table 31). Lowland shrub is a major cover type of state forest in each watershed.

Table 30. Largest vegetative cover types (i.e., top five) and area for the area of the Tahquamenon River watershed located within the management area.

Cover Type	Acres
Lowland shrub	20,985
Cedar	14,844
Lowland conifer	13,150
Lowland spruce/fir	8,473
Aspen	6,662

Table 31. Largest vegetative cover types (i.e., top five) and area for the area of the Manistique River watershed located within the management area.

Cover Type	Acres
Lowland shrub	41,930
Natural jack pine	22,464
Marsh	20,892
Lowland conifer	19,250
Cedar	18,075

Recreation

Public access to the Seney Lake Plain Management Area varies across the area, with some areas accessible by state, county or forest access roads and other areas with very limited access due to the large areas of marsh, swamp and lowland brush and barriers such as rivers, creeks and the Wisconsin Central Railroad. Recreational facilities found here include snowmobile trails, off-road vehicle trails and the Fox River Pathway. The Haywire State Trail (rail-trail), which travels from Marquette to Shingleton, passes through this management area and is designated for ORV and snowmobile use, with all nonmotorized uses also permitted (Table 32).

There are two small state forest campgrounds (rustic) within the management area, one on the Fox River and one on the Dollarville Flooding (Table 33). Dispersed camping is also popular in certain areas, such as along the Fox River. The management area is adjacent to the Hiawatha National Forest, expanding the dispersed recreation opportunities in the area.

Table 32. Designated recreation trails by type.

Recreation Category	Recreation Type	Number of Miles
Motorized recreation trails	Off-road vehicle (all types) Snowmobile	15.4 81
Nonmotorized recreation trails	Hiking Equestrian Biking	6.9 0 0
		103.3

Note: Trail use types may overlap.

Table 33. State forest campgrounds.

Name	Number of sites
Natalie State Forest Campground	12
Fox River State Forest Campground	7

There are three state wildlife management/research areas located within the management area. Dollarville Flooding offers waterfowl hunting, fishing, paddling and wildlife viewing opportunities. There is an accessible boardwalk near the boat launch, which provides public access to a hunting and wildlife

viewing blind overlooking the flooding. Bullock Ranch Flooding State Wildlife Management Area is a large area of land managed for wildlife, with parking lots located off M-28 (Table 34).

Deer, grouse and bear hunting, as well as trapping, fishing and mushroom picking, are popular within this management area.

Table 34. Areas managed for hunting.

Type	Name	Number of Acres
State wildlife management areas	Bullock Ranch Flooding SWMA Dollarville Flooding SWMA	12,635 2,978
Total		**15,613**

Boating access sites are available on the Tahquamenon River, the West Branch of the Manistique River and the Fox River, as well as on several small inland lakes and the Dollarville Flooding (Table 35). These water courses provide access for fishing, canoeing and kayaking. Private canoe outfitters operate on the Manistique and Tahquamenon rivers.

Table 35. Boating access sites.

Name	Waterbody
Ashford Lake	Ashford Lake
Dodge Lake	Dodge Lake
Dollarville Dam East	Tahquamenon River
Dollarville Dam West	Dollarville Flooding
Fox River State Forest Campground	Fox River
McPhee's Landing	Tahquamenon River
Natalie	Tahquamenon River
West Branch	West Branch Manistique River
Total	**8**

EUP management areas

St. Ignace Lake Plain

State forest area: 273,002 acres	Location: Interior central and eastern Upper Peninsula	Population centers: Naubinway Cedarville
Subsection: St. Ignace Lake Plain	Landforms: Flat lake beds Dune fields Shallow embayments Exposed limestone	Land cover: Forested: 233,011 acres Nonforested: 39,991 acres

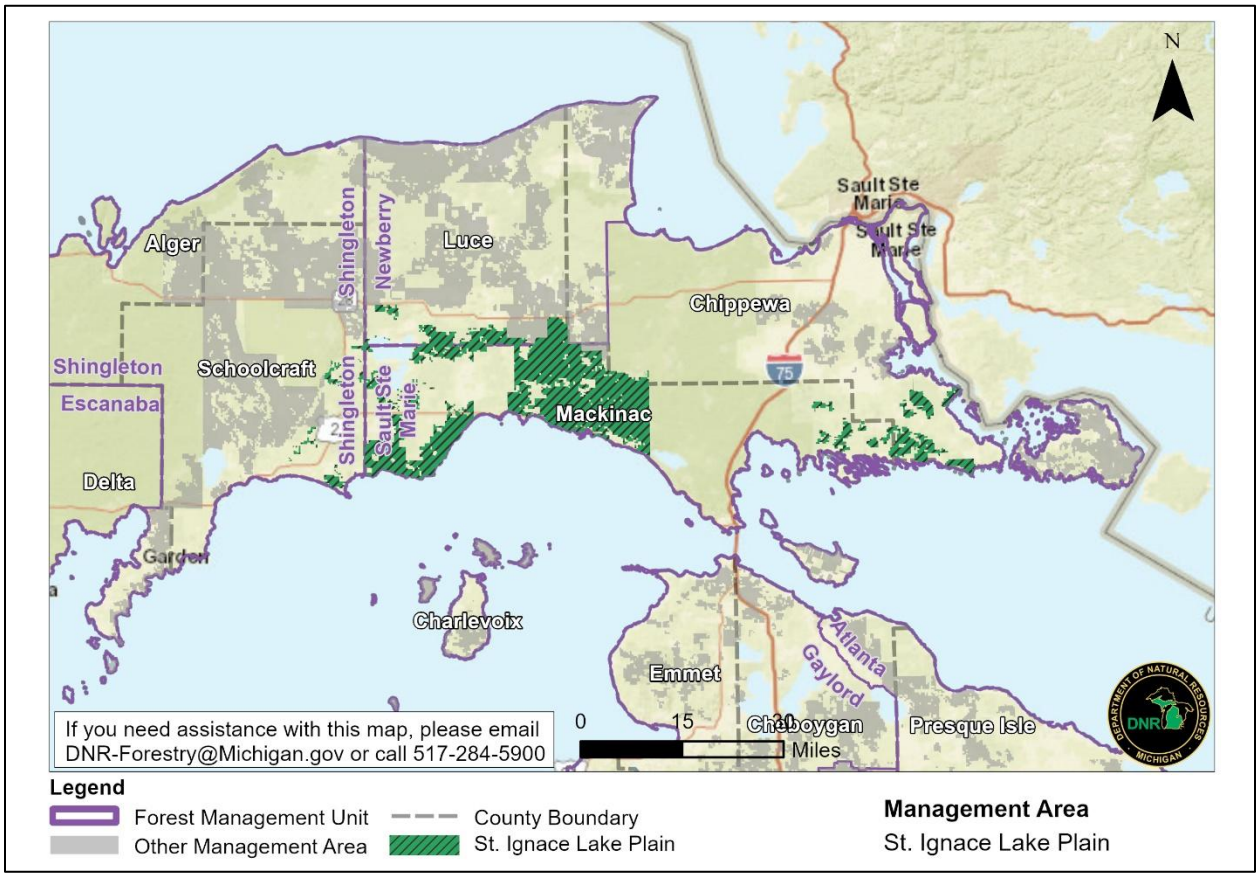


Figure 1. St. Ignace Lake Plain Management Area.

Forested landscape

Current and projected future condition

The St. Ignace Lake Plain Management Area includes a variety of tolerance levels, with most of the acres occurring in the old age categories. The majority of tolerant cover types occur on unavailable lowlands in the old age category. Mid-tolerant cover types mostly occur on available uplands in the mature and old age categories. The majority of the intolerant cover types occur in the mid-aged category on available uplands (Figure 2).

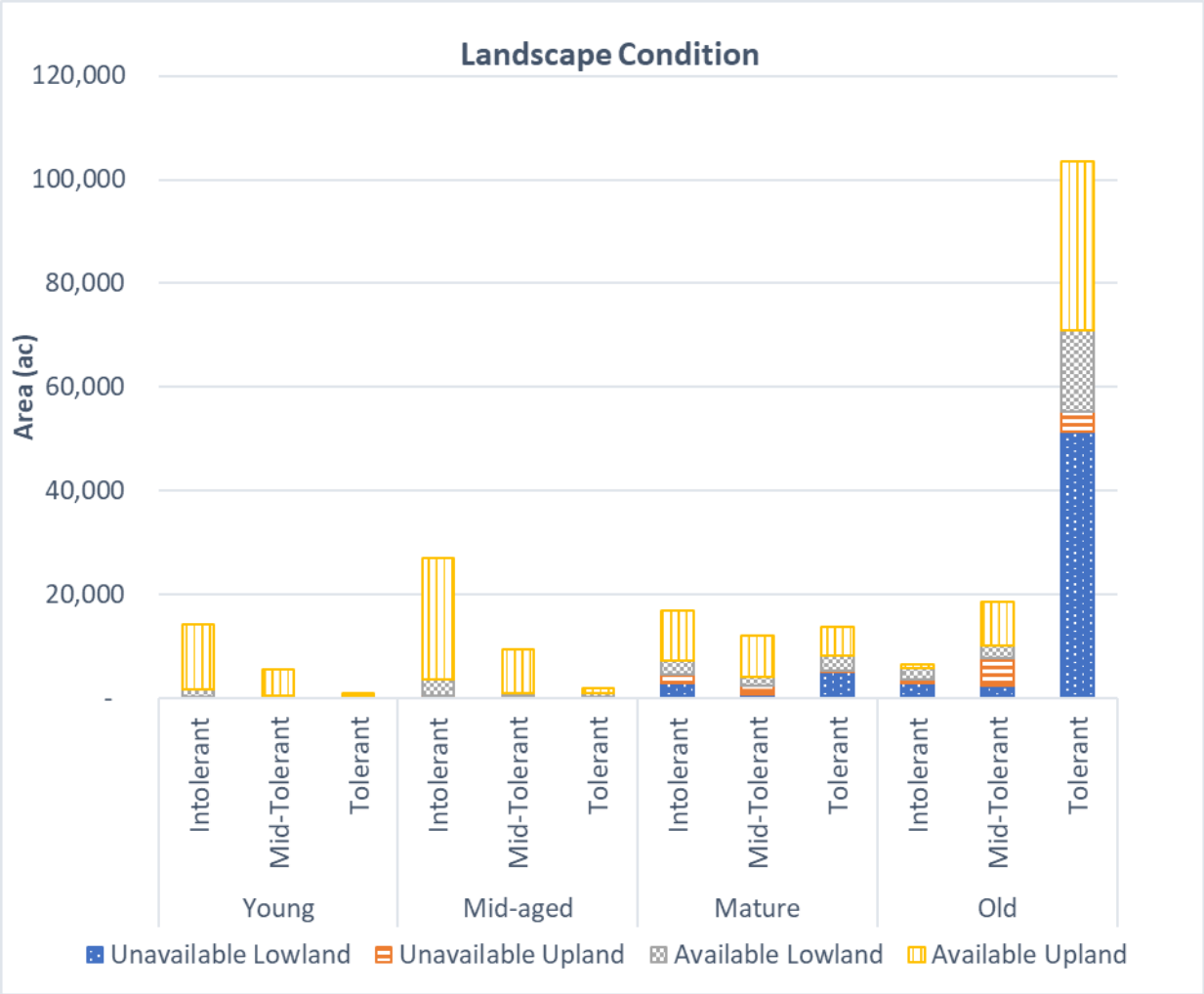


Figure 2. Forest diversity matrix showing the current distribution of forested acres across management availability, age category, landscape position and shade tolerance.

Landscape habitat conditions refine the management area landscape into featured species habitat context. Current and projected acres for the metrics identified in the management priorities (see Section 3) establish a baseline and future condition based on management over the planning period (Table 1).

Table 1. Current acres for landscape habitat conditions.

Landscape Habitat Condition	Monitoring Metric	Current Acres
Young forest	Acres of 0- to 19-year stands in aspen and jack pine	12,521
Mature forest	Acres of 80-plus-year stands across cover types	128,773
Mature forest	Acres of 120-plus-year stands across cover types	30,478
Mesic conifer cover types	Acres of mesic conifer cover types	13,488
Mesic conifers in other cover types	Average canopy occupancy	25%
Mast – oak cover types	Acres of oak cover types	453
Mast tree species in other cover types	Acres of total canopy occupancy of mast tree acres (trace-100%)	7,350
Big trees	Total canopy stand occupancy of species in sawlog or greater size class	89,547
Nonforested openings	Acres of total herbaceous open land, upland shrub and crop land	6,291
Landscape forest matrix	Percent deciduous forest	46%
Landscape forest matrix	Percent coniferous forest	49%

Another important landscape-level habitat in the management area is coastal habitat. The Great Lakes, particularly coastal and nearshore areas, provide globally or continentally important stopover sites for all groups of migratory birds: waterfowl, shorebirds, land birds (defined here as songbirds and raptors) and waterbirds (loons, grebes, cormorants, herons, rails, cranes gulls, and terns) (Ewert, et al., 2012). The Great Lakes shoreline provides essential stopover habitat for birds to rest, feed and shelter during migration. In addition to migration, the diverse coastal habitats where water and land meet provide unique habitats for breeding birds. Some of these areas are classified by Michigan Audubon as important bird areas. The Great Lakes shoreline provides habitat for several rare plant species that are endemic to the Great Lakes.

Forest managers and others doing intrusive activities within a mile of the coastline need to consider the potential impacts to migratory birds and breeding bird habitat.

The St. Ignace Lake Plain Management Area has the following special analysis units. These SAUs have specific cover-type goals, typically associated with wildlife habitat management. For any SAUs that overlap with this MA, SAU cover type goals take priority. See Section 5 for a detailed description of the management direction and harvest goals for each of these SAUs.

- Deer wintering complex – Gulliver Scott Point Rock River
- Deer wintering complex – McMillan Ten Curves
- Deer wintering complex – Hulbert Hendrie Sage River
- Deer wintering complex – Indian Lake

The St. Ignace Lake Plain Management Area is comprised of 85% forested cover types and 15% nonforested cover types. Of the forested cover types, 48% occur on the upland landscape position and 37% occur on lowlands. The largest contributors to upland cover types are aspen, northern hardwoods and planted red pine. Cedar comprises 31% of the lowland cover types, making it the most prominent cover type in this management area (

Table 2).

Table 2. Landscape conditions and distribution of cover types in the St. Ignace Lake Plain Management Area.

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
Forested	Upland	Deciduous	Aspen	45,459	96,147	132,302	233,011
			Northern hardwood	41,129			
			Black/red hybrid oak	0			
			Northern red oak	281			
			Oak mix	166			
			Mixed upland deciduous	9,113			
		Mixed	Upland mixed forest	6,475	6,475		
		Coniferous	Planted red pine	13,810	29,680		
			Planted jack pine	223			
			Planted white pine	48			
			Planted mixed pine	102			
			Natural red pine	679			
			Natural jack pine	1,334			
			Natural white pine	1,643			
			Natural mixed pines	1,855			
			Upland spruce/fir	2,964			
			Upland conifers	5,899			
			Hemlock	1,122			
	Lowland	Deciduous	Lowland aspen/balsam poplar	6,492	10,360	100,709	
			Lowland deciduous	3,868			
		Mixed	Lowland mixed forest	5,002	5,002		
		Coniferous	Cedar	57,069	85,348		
			Lowland conifers	19,327			
			Lowland spruce/fir	7,325			
			Tamarack	1,627			
Nonforested	Upland	N/A	Herbaceous open land	4,020	N/A	8,598	39,991
			Upland shrub	2,271			
			Low density trees	917			
			Bare/sparsely vegetated	791			
			Cropland	0			
			Urban	599			
	Lowland	N/A	Lowland shrub	19,837	N/A	31,393	
			Marsh	4,442			
			Bog	520			
			Treed bog	3,534			
			Water	3,060			
						Grand total:	**273,002**

There are 156,459 acres (57% of the total management area and 67% of the forested area) that can be managed toward desired future conditions via commercial timber harvest in the St. Ignace Lake Plain Management Area (Table 3). Of that, about 28% is in aspen cover type and approximately 25% is the northern hardwood cover type. The remaining 57% of the forested and available land in the management area is comprised of significant lesser proportions of the remaining cover types.

Table 3. Landscape conditions and cover type composition of the St. Ignace Lake Plain Management Area.

ST IGNACE LAKE PLAIN Forested Cover Type	Available Acres	Available %	Unavailable Acres	Unavailable %	Total Acres	Total %
Aspen	43,729	18.8%	1,740	0.7%	45,470	19.5%
Cedar	11,809	5.1%	45,261	19.4%	57,070	24.5%
Hemlock	595	0.3%	527	0.2%	1,122	0.5%
Lowland aspen/balsam poplar	5,985	2.6%	508	0.2%	6,492	2.8%
Lowland conifers	7,859	3.4%	11,471	4.9%	19,331	8.3%
Lowland deciduous	2,652	1.1%	1,217	0.5%	3,869	1.7%
Lowland mixed forest	2,989	1.3%	2,013	0.9%	5,002	2.1%
Lowland spruce/fir	3,076	1.3%	4,250	1.8%	7,326	3.1%
Mixed upland deciduous	7,541	3.2%	1,572	0.7%	9,113	3.9%
Natural jack pine	772	0.3%	563	0.2%	1,335	0.6%
Natural mixed pines	656	0.3%	1,201	0.5%	1,856	0.8%
Natural red pine	230	0.1%	450	0.2%	680	0.3%
Natural white pine	1,042	0.4%	601	0.3%	1,643	0.7%
Northern hardwood	37,978	16.3%	3,153	1.4%	41,131	17.6%
Northern red oak	281	0.1%	0	0.0%	281	0.1%
Oak mix	39	0.0%	127	0.1%	166	0.1%
Planted jack pine	223	0.1%	0	0.0%	223	0.1%
Planted mixed pine	92	0.0%	10	0.0%	102	0.0%
Planted red pine	13,473	5.8%	339	0.1%	13,812	5.9%
Planted white pine	48	0.0%	0	0.0%	48	0.0%
Tamarack	478	0.2%	1,149	0.5%	1,627	0.7%
Upland conifers	3,148	1.4%	2,753	1.2%	5,901	2.5%
Upland mixed forest	5,351	2.3%	1,125	0.5%	6,476	2.8%
Upland spruce/fir	2,219	1.0%	746	0.3%	2,965	1.3%
Grand total	**152,264**	**65.3%**	**80,777**	**34.7%**	**233,041**	**100.0%**

Table 4. Site conditions for unavailable acres.

Site Condition (Reason area is unavailable for commercial harvest)	Area (ac)	% of Unavailable Area
Deer wintering area	32,298	40.0%
Conservation values	19,699	24.4%
Too wet	7,778	9.6%
Best management practices	5,187	6.4%
Wildlife concerns	4,446	5.5%
Unproductive	2,722	3.4%
Blocked by obstacle	2,396	3.0%
Nonmilitary lease/easement	1,954	2.4%
Other DNR/division processes	1,720	2.1%
Denied access	601	0.7%
Long-term retention	529	0.7%
Too steep	455	0.6%
Rare landforms	281	0.3%
Blocked by railroad	246	0.3%
Species of special concern or T&E	180	0.2%
Recreational/scenic	176	0.2%
Other influence zones	64	0.1%
Federal/state/local law	23	0.0%
Cannot regenerate	18	0.0%
Historical/archaeological	5	0.0%
Total unavailable	**80,777**	**100.0%**

Projected 10-year cover type management actions

Each cover type in the St. Ignace Lake Plain Management Area has a unique age class and basal area class goals that describe the long-term desired future conditions. The calculated harvests levels needed during the first 10-year planning period are summarized in Table 5. These harvest levels are necessary to begin achieving long-term planning goals. Implementing these silvicultural regimes will yield 554,873 cords, the planned harvest volume for the decade (Table 7).

Table 5. Projected number of acres to be harvested by silvicultural regime for each cover type within the St. Ignace Lake Plain Management Area.

Silvicultural Regimes								
Cover Type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Salvage Clearcut	Salvage Thinning	Grand Total
Northern hardwood	218	10,365	-	586	-	-	-	11,169
Aspen	6,456	-	-	-	-	-	-	6,456
Planted red pine	1,516	-	2,226	-	-	-	-	3,742
Lowland conifers	1,318	-	-	-	-	-	-	1,318
Lowland aspen/balsam poplar	1,098	-	-	-	-	-	-	1,098
Mixed upland deciduous	918	76	-	-	-	-	-	993
Upland conifers	729	-	-	-	201	-	-	930
Lowland spruce/fir	667	-	-	-	-	-	-	667
Lowland mixed forest	386	-	-	-	-	-	-	386
Lowland deciduous	325	12	-	-	-	-	-	337
Upland spruce/fir	316	-	-	-	-	-	-	316
Upland mixed forest	252	-	-	-	-	-	-	252
Natural jack pine	127	-	-	-	-	-	-	127
Natural white pine	-	-	50	-	75	-	-	125
Tamarack	108	-	-	-	-	-	-	108
Planted mixed pine	12	-	6	-	-	-	-	18
Planted white pine	-	-	6	-	-	-	-	6
Totals	**14,446**	**10,452**	**2,288**	**586**	**276**	**-**	**-**	**28,047**

These harvests will help establish a desirable amount of regeneration for the even-aged cover types over the 10-year period or help to achieve desired basal area distribution among uneven-aged cover types like northern hardwoods. The following sections will provide additional details for each of the significant cover types in the St. Ignace Lake Plain Management Area.

Table 6. Projected 10-year cover type acres resulting from cover type transitions.

Cover Type	Current Acreage	Projected Acreage at End of 10-Year Planning Period	Projected 10-Year Change in Acreage
Cedar	57,069	57,069	0
Aspen	45,459	45,664	205
Northern hardwood	41,129	41,151	22
Lowland conifers	19,327	19,201	-126
Planted red pine	13,810	13,774	-36
Mixed upland deciduous	9,113	9,012	-101
Lowland spruce/fir	7,325	7,166	-159
Lowland aspen/balsam poplar	6,492	6,336	-156
Upland mixed forest	6,475	6,857	383
Upland conifers	5,899	5,603	-296
Lowland mixed forest	5,002	5,389	387
Lowland deciduous	3,868	3,953	86
Upland spruce/fir	2,964	2,798	-166
Natural mixed pines	1,855	1,858	2
Natural white pine	1,643	1,643	0
Tamarack	1,627	1,608	-19
Natural jack pine	1,334	1,308	-26
Hemlock	1,122	1,122	0
Natural red pine	679	679	0
Northern red oak	281	276	-5
Planted jack pine	223	239	16
Oak mix	166	166	0
Planted mixed pine	102	90	-12
Planted white pine	48	48	0
Lowland shrub	19,837	19,837	0
Marsh	4,442	4,442	0
Herbaceous open land	4,020	4,020	0
Treed bog	3,534	3,534	0
Water	3,060	3,060	0
Upland shrub	2,271	2,271	0
Low density trees	917	917	0
Bare/sparsely vegetated	791	791	0
Urban	599	599	0
Bog	520	520	0
Total:	**273,002**	**273,002**	**0**

Table 7. Projected 10-year harvest volume by product and species.

10-Year Estimated Harvest Volume Projection St. Ignace Lake Plain Management Area Product	Species	Volume Planned *	Volume Prepared**
Pulpwood (cords)	Mixed hardwood	87,951	82,674
	Mixed aspen	65,175	61,264
	Mixed softwood	40,931	38,475
	Mixed spruce	25,015	23,514
	Red pine	23,870	22,437
	White pine	6,281	5,904
	Mixed oak	4,735	4,451
	Jack pine	4,151	3,902
	Pulpwood total	**258,107**	**242,621**
Sawtimber (MBF)	Red pine	45,915	43,160
	Sugar maple	31,957	30,040
	Mixed aspen	21,120	19,853
	Red maple	14,731	13,847
	White pine	12,310	11,571
	Red oak	5,246	4,931
	Basswood	4,015	3,774
	White oak	2,654	2,495
	Mixed oak	547	514
	Sawtimber total	**138,494**	**130,184**
	Total sawtimber harvest volume in cords	**296,766**	**278,960**
	Grand total harvest volume in cords	**554,873**	**521,581**

*Volume estimates based on 100% of the projected harvests for the 10-year planning period.

**Volume estimates based on 94% of the projected harvests for the 10-year planning period accounting for reduction in acres and associated volume once sales are prepared for bid.

Desired future condition

Although many cover types within the management area are projected to remain stable, there are some significant cover-type transitions projected. Upland mixed forest and lowland mixed forest are expected to have the largest influx from other cover types and are projected to increase in abundance. Upland

mixed forest is projected to increase by 6%, or 383 acres, and lowland mixed forest cover types are projected to increase by approximately 7%, or 383 acres. Upland conifers and lowland spruce/fir are projected to have the most transitions out of the cover types, at 5% and 2.2%, respectively. This forecasted cover-type transition is related to habitat goals of the deer wintering complexes within the management area.

Featured species current and projected habitat acres

There are eleven featured species in this management area that span various cover types, age classes and stand-level conditions.

As noted in the featured species management priority (Section 3), it is recommended that these featured species habitat acres be viewed as acres of potential habitat, representing a condition on the landscape where the more nuanced aspects of each species' habitat requirements are likely to be found or managed for. As described in the introduction, the modeling effort was limited by several factors, including the simplification of habitat attributes into MiFI variables. Therefore, when referring to habitat acres, those are potential habitat acres.

Current and projected total habitat acres by species across the decade provide a baseline and show the result of long-term management actions (Table 8). Some species show a loss in habitat over the next century. As mentioned in the featured species management priority (Section 3), the current condition for many cover types is a surplus of acres in the 0-9 age class from the compensatory management approach applied in the previous decade. The model eventually evens out the age classes at a lower, sustainable level over time, usually by 50 years. For any species with northern hardwoods as a priority cover type, there is a perceived drop in acres between 40-60 years; this is due to the basal area dropping below 81, but because it only drops into the upper 70s, it is not expected to translate to any real habitat loss on the ground. Three of these species were not included in the State Forest Management Plan model but are included here to inform management decisions over the decade.

Table 8. Featured species current and projected total habitat acres (i.e., potential habitat).

Featured Species	Priority Cover types	Total Habitat Acres Current	10-Year Projected Habitat Acres	50-Year Projected Habitat Acres	100-Year Projected Habitat Acres
American woodcock, young	Aspen, lowland aspen, lowland deciduous	15,448	14,267	16,125	16,037
Black bear	Generalist/mast	7,350			
Blackburnian warbler	Northern hardwoods, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, hemlock	36,170	44,404	29,590	49,777

Featured Species	Priority Cover types	Total Habitat Acres Current	10-Year Projected Habitat Acres	50-Year Projected Habitat Acres	100-Year Projected Habitat Acres
Black-throated blue warbler	Northern hardwoods, mixed upland deciduous	29,868	38,064	22,383	41,838
Golden-winged warbler, young	Aspen, black-red hybrid oak, northern red oak, oak mix, tamarack	12,801	11,613	13,493	13,643
Marten, U.P.	Northern hardwoods, mixed upland deciduous, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, lowland mixed forest, lowland conifers, hemlock, cedar	100,054	112,039	97,604	119,416
Moose	To be determined	--	--	--	--
Ruffed grouse	Aspen	12,794	11,550	13,428	13,516
Sharp-tailed grouse	Herbaceous open land, upland shrub, low density trees, lowland shrub, bog, treed bog	31,099			
Snowshoe hare forest	Aspen, cedar, hemlock, lowland aspen, lowland conifers, lowland mixed forest, lowland spruce/fir, mixed upland deciduous, natural jack pine, natural mixed pines, planted jack pine, upland spruce/fir	22,938	24,374	21,249	21,359

Featured Species	Priority Cover types	Total Habitat Acres Current	10-Year Projected Habitat Acres	50-Year Projected Habitat Acres	100-Year Projected Habitat Acres
White-tailed deer (food)	Food: Northern hardwood, oak mix, aspen, mixed upland deciduous, lowland deciduous, lowland aspen/balsam poplar, lowland mixed forest	117,984	118,927	121,983	124,879
White-tailed deer (shelter)	Shelter: hemlock, cedar, planted red pine, planted white pine, planted mixed pine, natural red pine, natural white pine, natural mixed pines, upland conifers, upland spruce fir, lowland conifers	111,843	110,928	108,005	105,331
Wood turtle	Nonforested openings	--	--	--	--

Cover type composition and associated featured species

Aspen

Current condition

Most of the natural aspen cover type is currently between stand ages of 0 and 49 years old in the St. Ignace Lake Plain Management Area (Figure 3). The age class distribution is currently in an unbalanced condition. There is a deficit in the 50-59 and 60-69 age classes and a surplus in the age classes between 10- to 19-year-old and 40- to 49-year-old. A small number of acres extend beyond the desired maximum age class distribution. These acres are either prescribed for harvest or are unavailable for harvest.

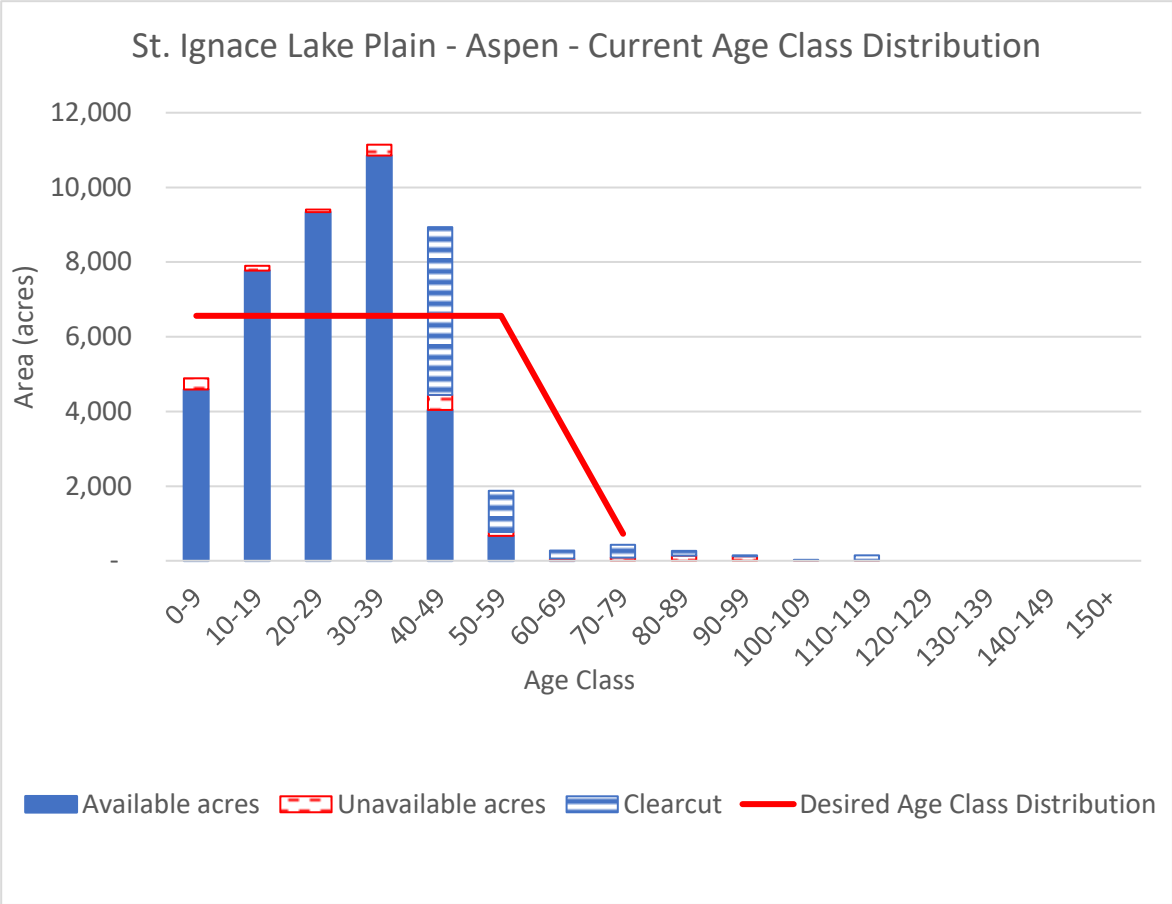


Figure 3. Current age class distribution and projected harvests in aspen cover type in the St. Ignace Lake Plain Management Area.

Current conditions are a result of consistent commercial harvests and regeneration efforts on available aspen acres during the previous planning periods. A portion of this cover type meets the habitat requirements for American woodcock, ruffed grouse and snowshoe hare.

Table 9. Featured species with aspen as a priority habitat cover type, habitat variables and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Aspen	Aspen Habitat Acres – Available	Aspen Habitat Acres – Unavailable
American woodcock	Age category: 0-19 Size class: sapling	12,357	437
Ruffed grouse	Age category: 0-19 Size class: sapling	12,357	437
Snowshoe hare	Age category: 0-19 Size class: sapling	12,357	437
White-tailed deer	All ages and size classes	45,459	--

Desired future condition

The projected long-term cover-type trend for aspen is stable in the St. Ignace Lake Plain Management Area. Much of the aspen area falls in the available category, and around 4% of the cover type is unavailable.

The long-term goal for this cover type is balanced age classes between 0 and 60 years old for all available aspen stands in this management area. Maintaining lower acreage in old age classes continues to be desirable to provide regulated harvests, wildlife habitat and recreation opportunities.

The end of the planning period will result in the establishment of 6,662 acres of aspen in the 0-9 age class, which is very slightly over the desired level of 6,589 acres. Progress toward the long-term desired age class distribution of aspen can be seen in the younger age classes, but it will take many decades of even-aged management for all age classes to reach the desired distribution, especially with the number of surplus aspen acres present (Figure 4).

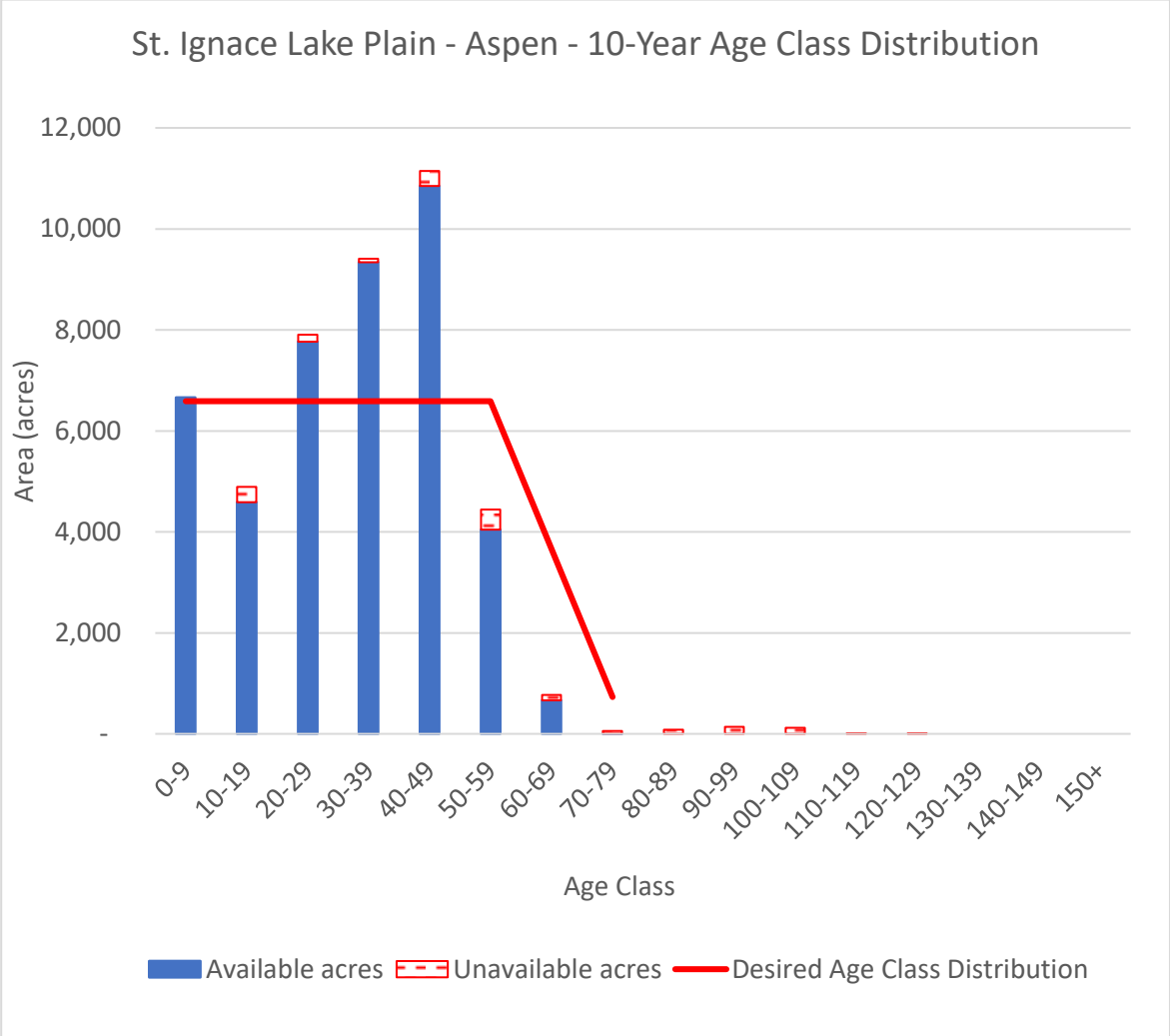


Figure 4. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The midterm age class distribution of aspen has nearly reached the desired future condition for available acres (Figure 5), with few deviations from the target proportions. There is a surplus of acres in the 70- to 99-year age classes that has been carried forward from previous planning periods. Some acres are shown beyond the max tail age of 70 years, of which a portion remains unavailable for harvest.

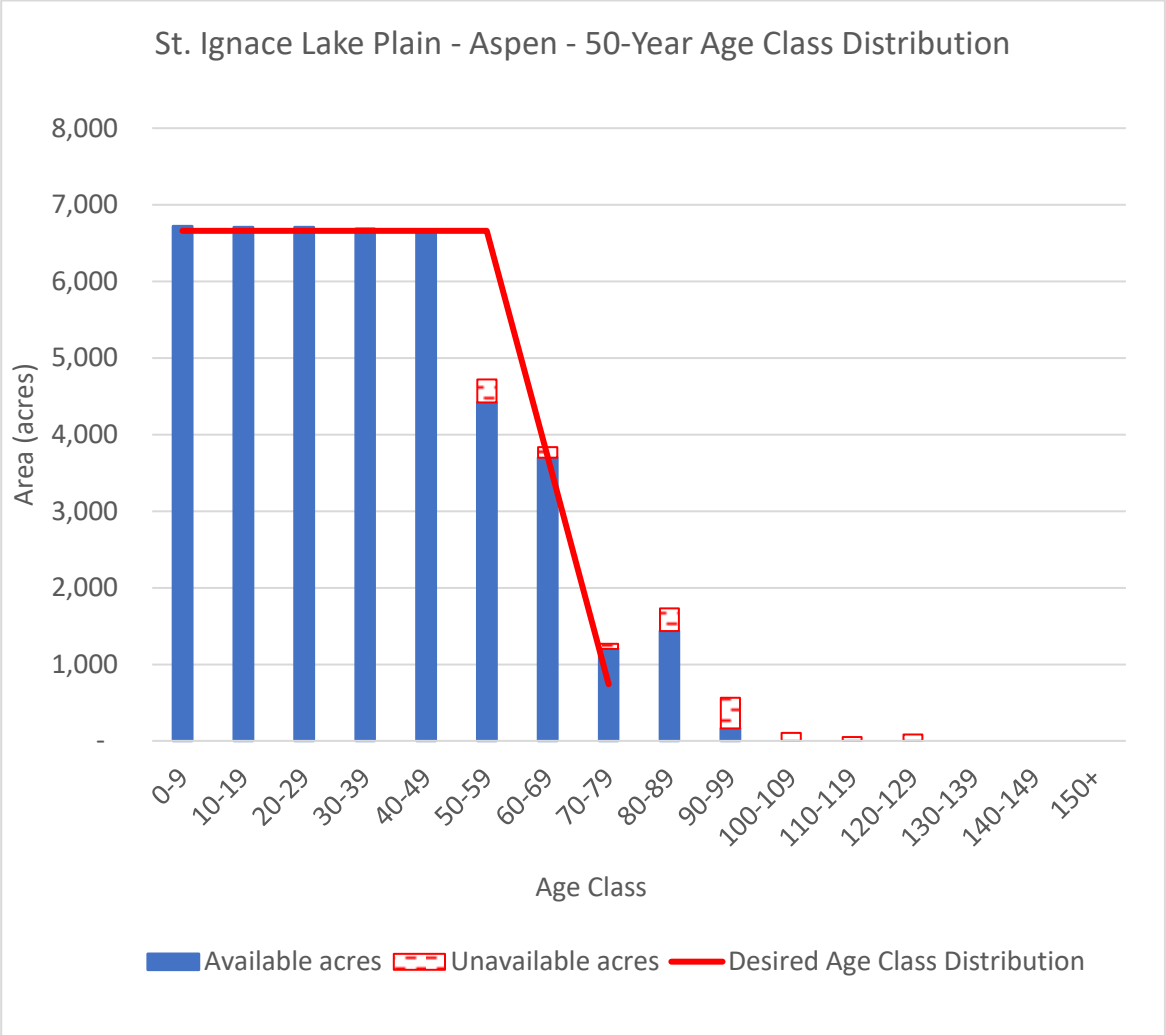


Figure 5. Projected midterm age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 6) will concentrate the manageable acres of aspen in productive growing conditions while providing an even flow of forest products and a wide variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest.

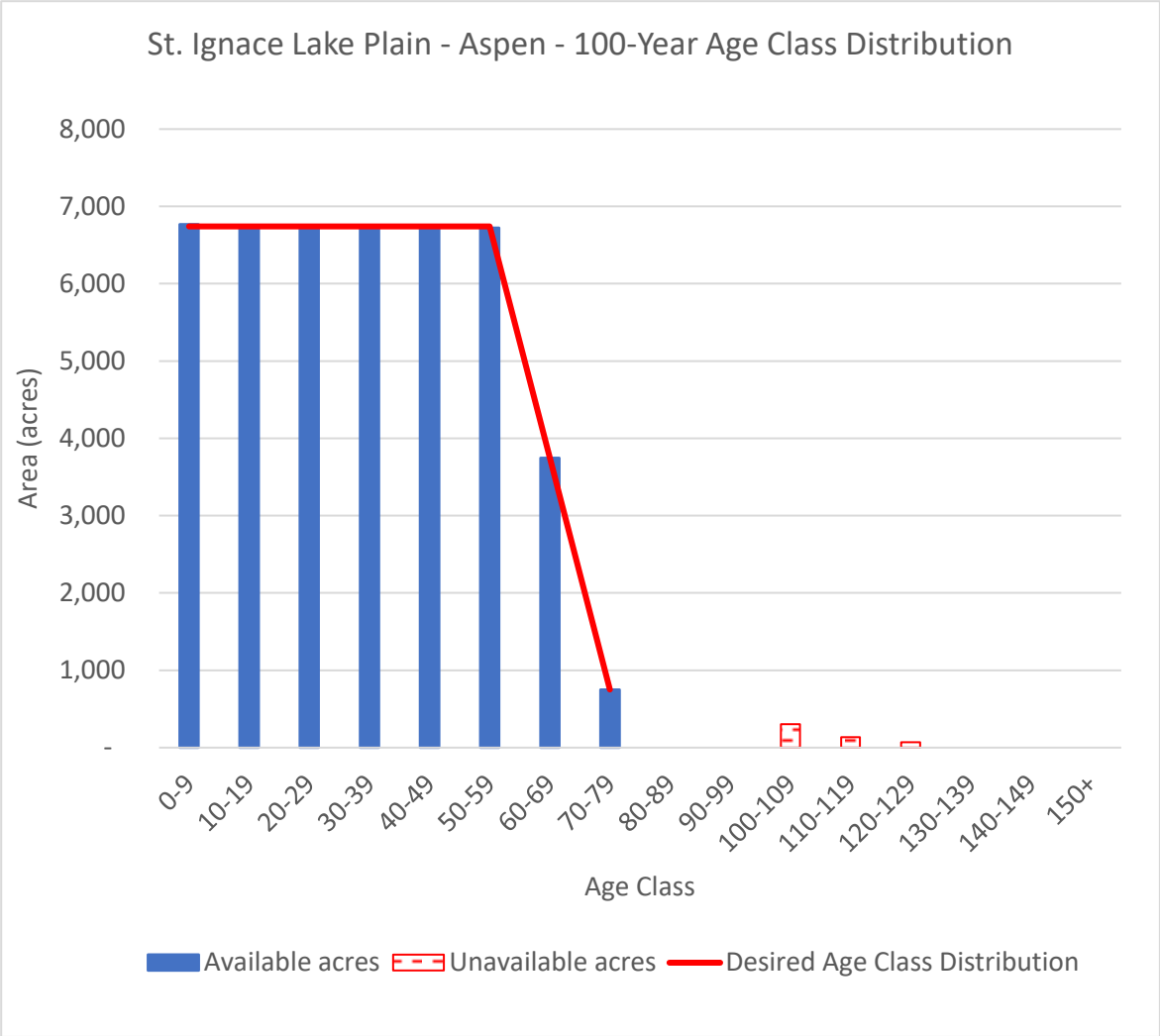


Figure 6. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

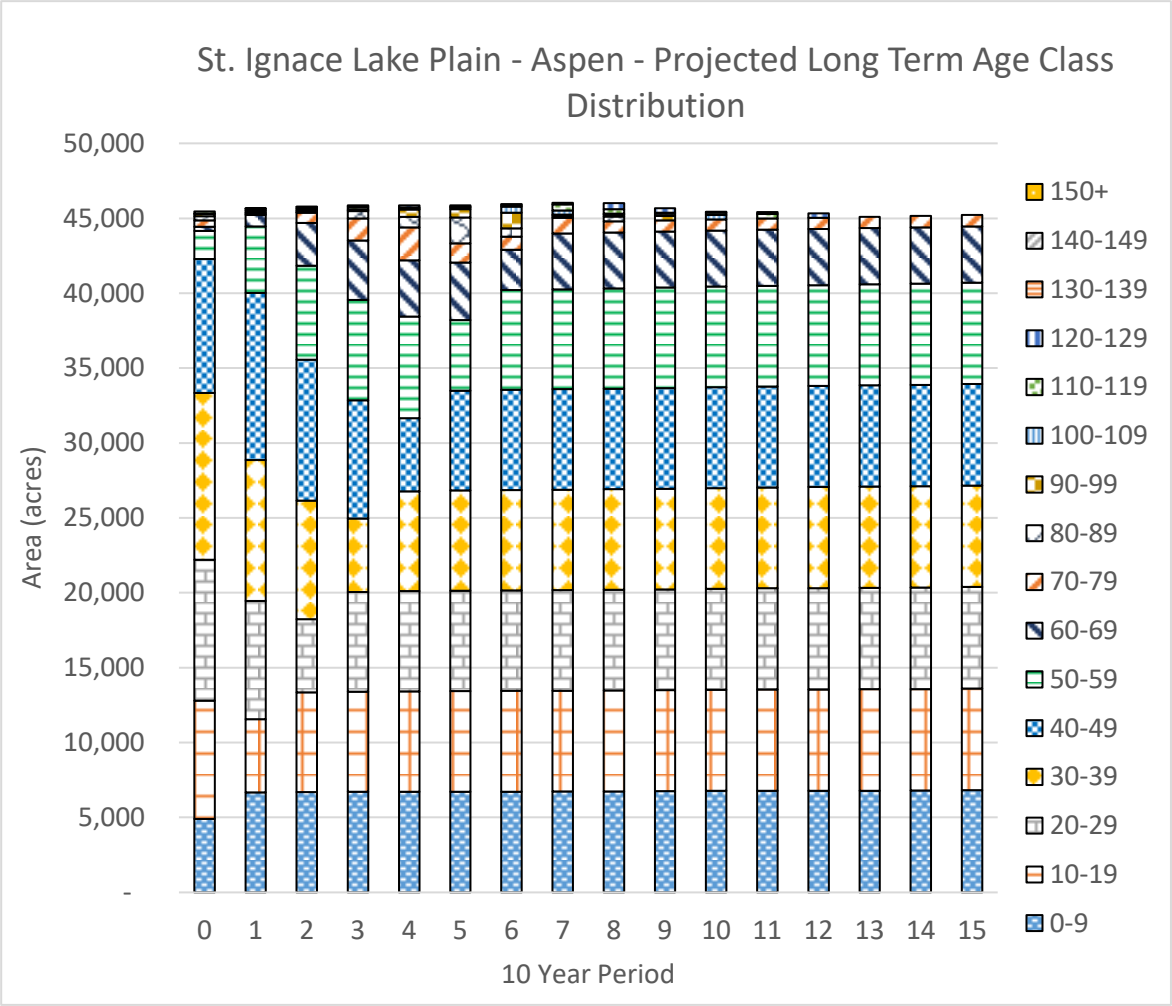


Figure 7. Projected age class distribution for all acres of aspen over the next 150 years in the St. Ignace Lake Plain Management Area.

Management actions

There are 6,456 acres of projected clearcut harvest in the aspen cover type during the planning period. This falls slightly short of the desired establishment of 6,589 acres of aspen per decade because of the current unbalanced age class condition.

Northern hardwoods

Current condition

Most of the northern hardwood cover type is currently between a stand age of 80 and 110 years old in the St. Ignace Lake Plain Management Area (Figure 8). The past management regime has been primarily single tree selection, which allows for stand age to continue to increase over time. Some stands are beginning to achieve an uneven-aged condition, where a featured stand age becomes less evident, but the dominant age of these stands will likely increase past 150 years old prior to a younger age cohort becoming the prominent component of these stands (Figure 10).

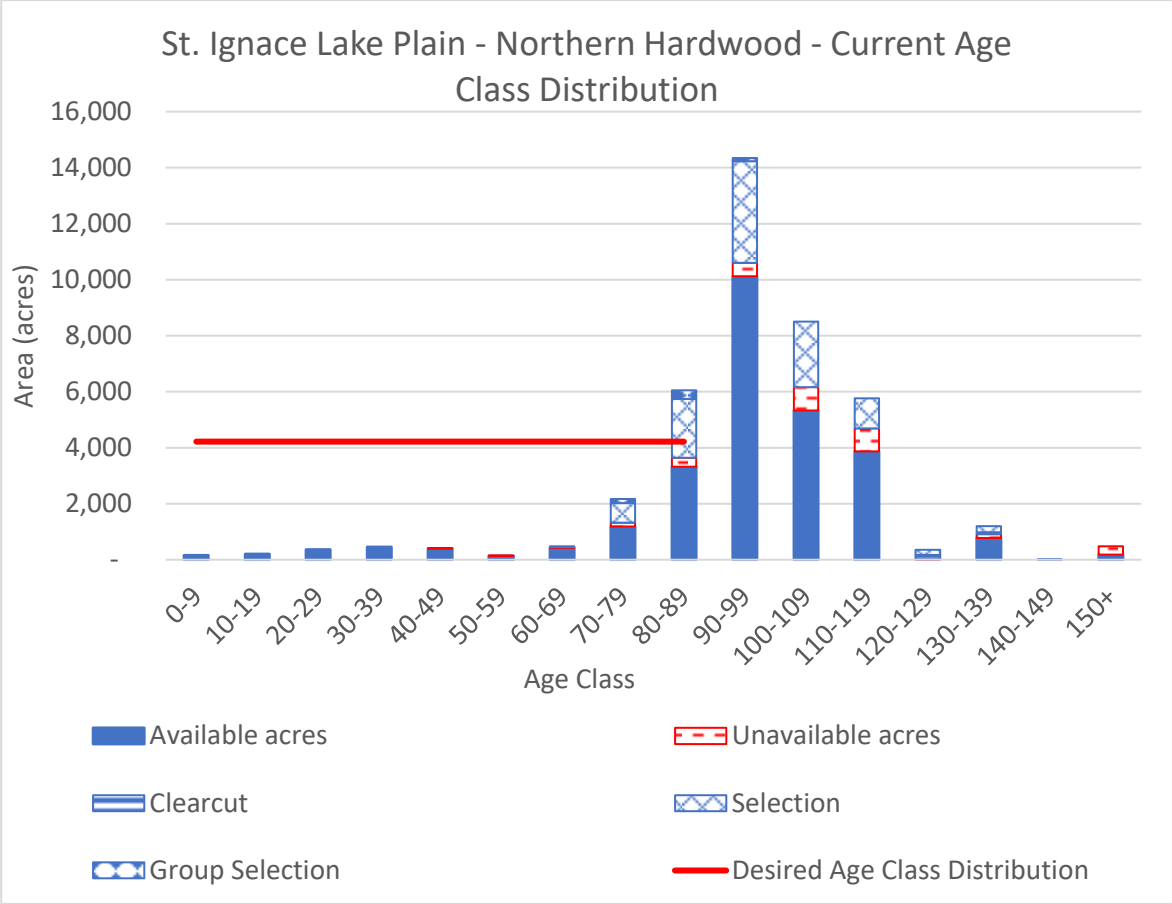


Figure 8. Current age class distribution and projected harvests in the northern hardwood cover type in the St. Ignace Lake Plain Management Area.

The area of northern hardwood is well distributed in the ideal basal area classes for optimal growing conditions in the St. Ignace Lake Plain Management Area (Figure 9). Current conditions are a result of beech salvage efforts in the previous planning period and a regulated selection harvest regime that has been in place in this management area for decades.

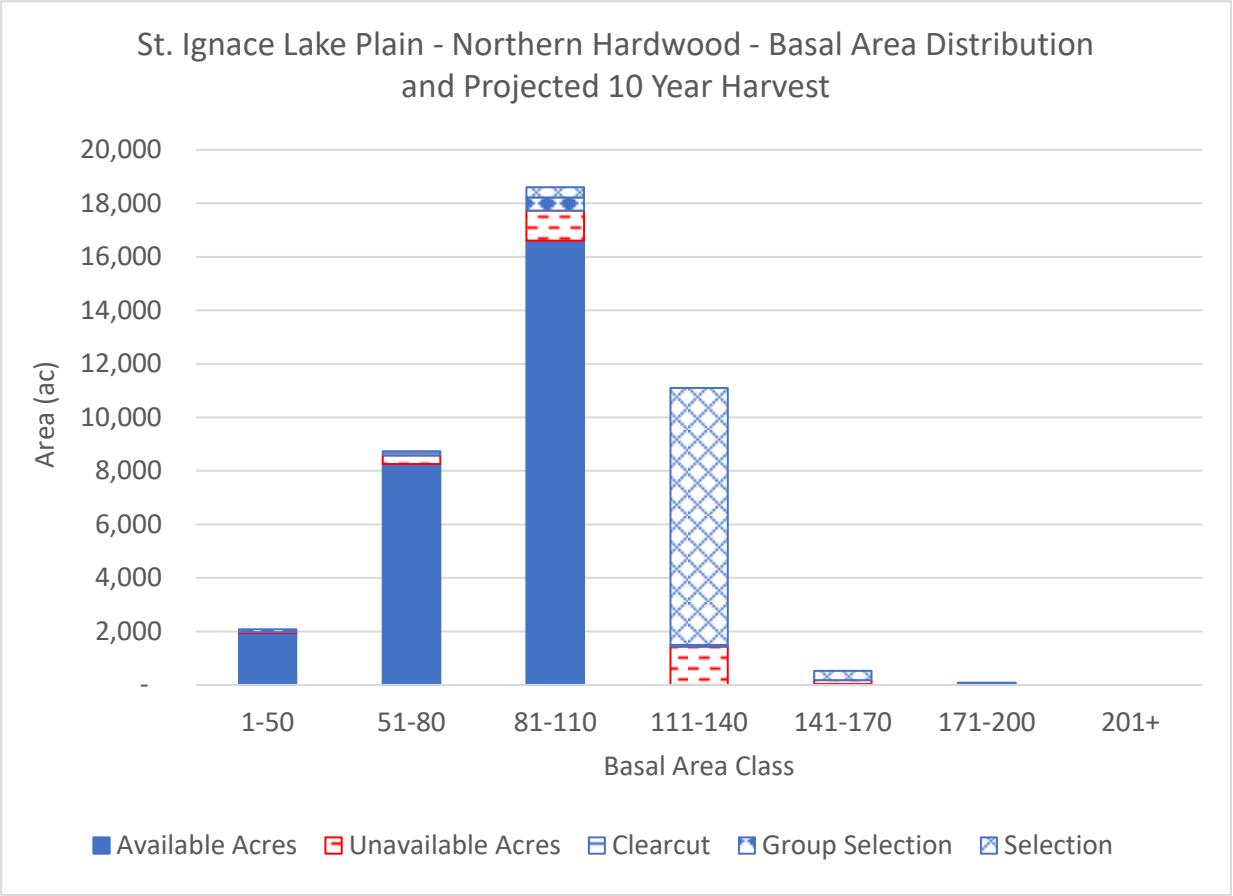


Figure 9. Current basal area distribution of the northern hardwood cover type as well as the projected harvests from each basal area class.

There are very few acres of unavailable northern hardwoods in the St. Ignace Lake Plain Management Area. Selection is the primary silvicultural treatment projected during this 10-year planning period, but there may be opportunities to utilize even-aged management silvicultural regimes to increase stem density, species composition and regeneration within the northern hardwood areas. A portion of this cover type meets the habitat requirements for blackburnian warbler, black-throated blue warbler, marten and white-tailed deer.

Table 10. Featured species with northern hardwoods as a priority habitat cover type, habitat variables and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Northern Hardwood	Northern Hardwood Habitat Acres – Available	Northern Hardwood Habitat Acres – Unavailable
Blackburnian warbler	Age category: 80+ Size category: pole, sawlog Basal area: 81+	25,183	2,870

Featured Species	Featured Species Habitat – Northern Hardwood	Northern Hardwood Habitat Acres – Available	Northern Hardwood Habitat Acres – Unavailable
Black-throated blue warbler	Age category: 80+ Size category: sawlog Basal area: 81+	25,183	2,870
Marten	Age category: 40+ Size category: pole, sawlog Basal area: 81+	25,183	2,870
White-tailed deer	All sizes and age classes	41,129	--

Desired future condition

The projected long-term cover-type trend for northern hardwood is stable in the St. Ignace Lake Plain Management Area. There are very few transitions into this cover type from other cover types and equally few transitions from northern hardwoods to other cover types forecasted in this management area.

The desired basal area distribution is a bell-shaped curve, where a significant majority of the area is kept in the 81-110 basal area class, with recently harvested stands occupying the 51-80 class and stands that are ready for harvest occupying the 111-140 basal area class. Diameter distributions of the northern hardwood stands should follow the appropriate Q-curve relative to stand age and condition.

An uneven-aged condition is the long-term goal for all northern hardwood stands in this management area. An uneven-aged condition is achieved when there is no single discernable age cohort that is more prevalent than others across the stand area, as canopy gaps fill in with regenerating seedlings, saplings and poles, and remaining stems become sawlog-sized over time.

Regeneration and recruitment continue to be a focus in the northern hardwood cover type across this management area. The long-term sustainability of this cover type in an uneven-aged silvicultural regime is dependent on the successful establishment of northern hardwood species as well as the recruitment of those seedlings and saplings into the pole and sawlog classes. It will take several decades for the St. Ignace Lake Plain Management Area to reach the desired future condition because of the impacts from beech bark disease. The amount of American beech that once occupied much of the northern hardwood stands has resulted in lower than normal residual basal area and decreased stocking levels across much of the eastern Upper Peninsula.

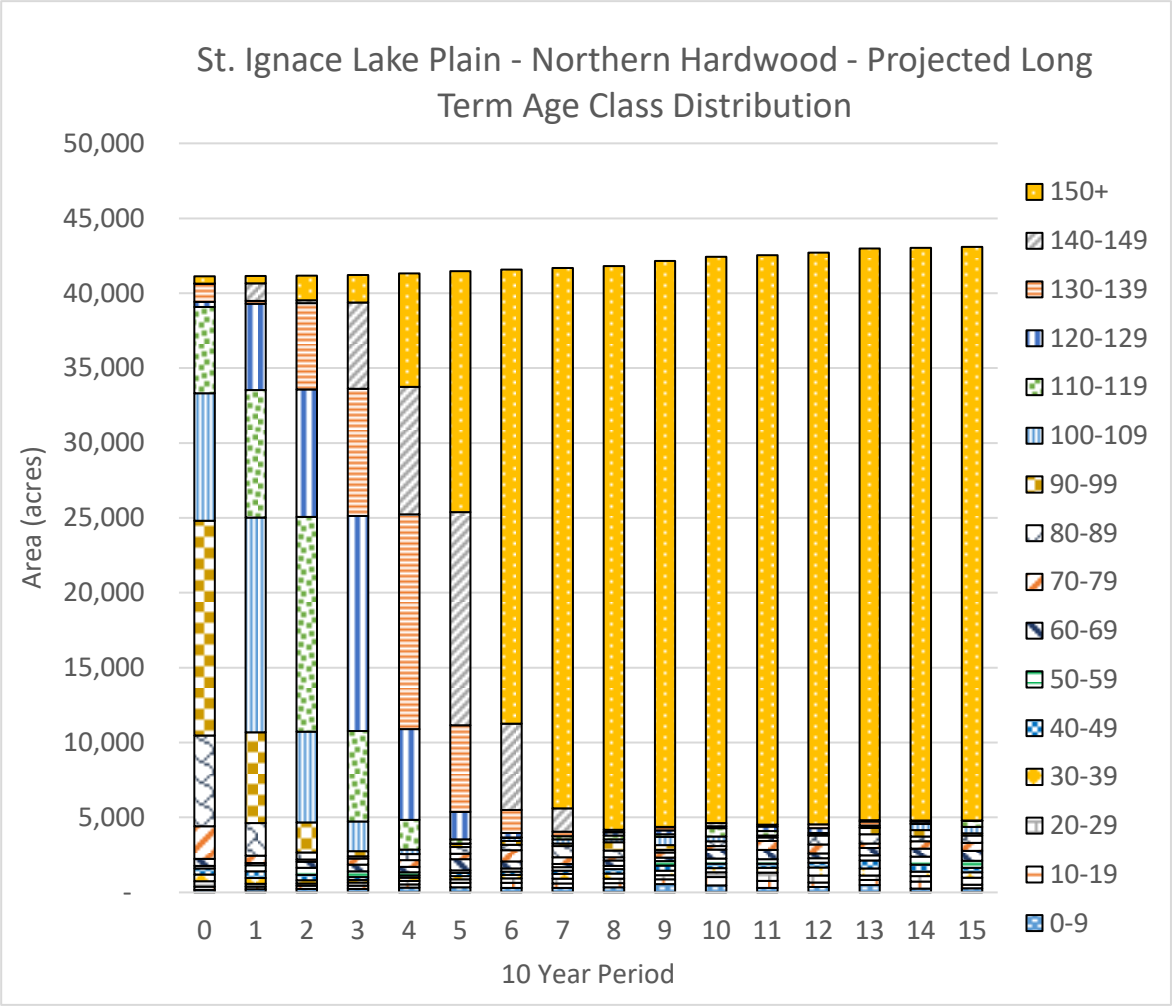


Figure 10. Projected age class distribution for all acres of northern hardwood over the next 150 years in the St. Ignace Lake Plain Management Area.

Management actions

The desired forest conditions and associated featured species habitat will be maintained and achieved through continued application of the projected selection harvest regime on 10,365 acres, clearcut on 218 acres and group selection on 586 acres (Table 5). Multiple silvicultural regimes should continue to be considered as emerging research results become available. Emphasis should be placed on larger canopy gaps to encourage diverse regeneration of northern hardwood species while maintaining an overall long-term mature forest, closed-canopy landscape condition.

Planted red pine

Current condition

Most of the planted red pine cover type is currently in the 0- to 29-year-old age classes, and nearly all the acres are available for commercial management; roughly 3% of the cover type is considered unavailable (Table 4). The past management regime has been primarily thinning every 10 years to achieve an approximate residual basal area of 120 square feet. The age class distribution in this cover type is in a very unbalanced condition.

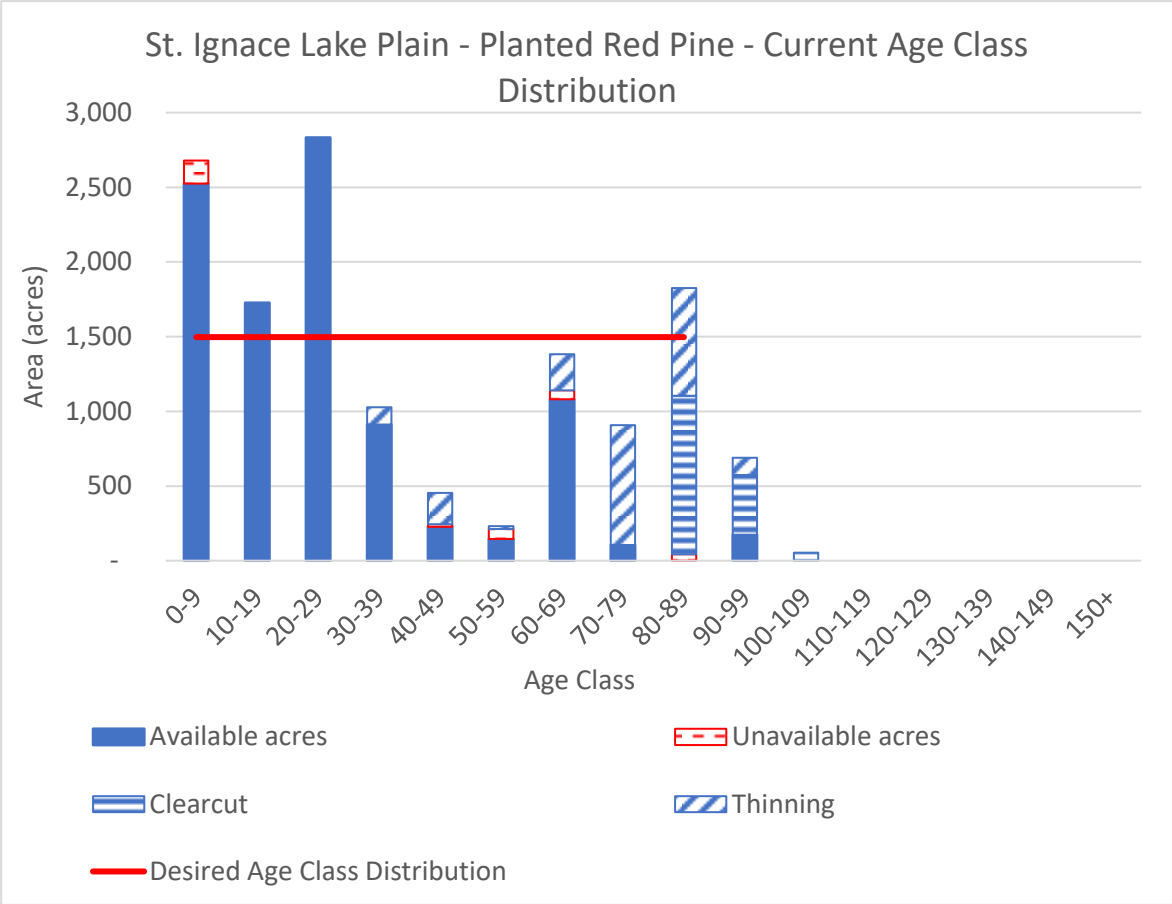


Figure 11. Current age class distribution, desired age class distribution and projected harvests in the planted red pine cover type over the 10-year planning period.

Current conditions are a result of plantations established during the 1930s by the Civilian Conservation Corps, most of which reached maturity during the previous two planning periods. Additionally, there have been consistent commercial harvests and regeneration efforts on available planted red pine acres during the previous planning periods.

Desired future condition

The projected long-term cover-type trend for planted red pine is stable in the St. Ignace Lake Plain Management Area. There are very few transitions into this cover type from other cover types and equally few transitions from planted red pine to other cover types forecasted in this management area.

The long-term goal for this cover type is balanced age classes between 0 and 80 years old for all available planted red pine stands in this management area. Maintaining lower acreage in old age classes continues to be desirable to lessen the prevalence and severity of diseases and to reduce the threat of damaging wildfire.

The end of the planning period will result in the establishment of 1,482 acres in the upcoming 0-9 age class. Progress toward the long-term age class distribution of planted red pine will take many decades in the management area (Figure 12).

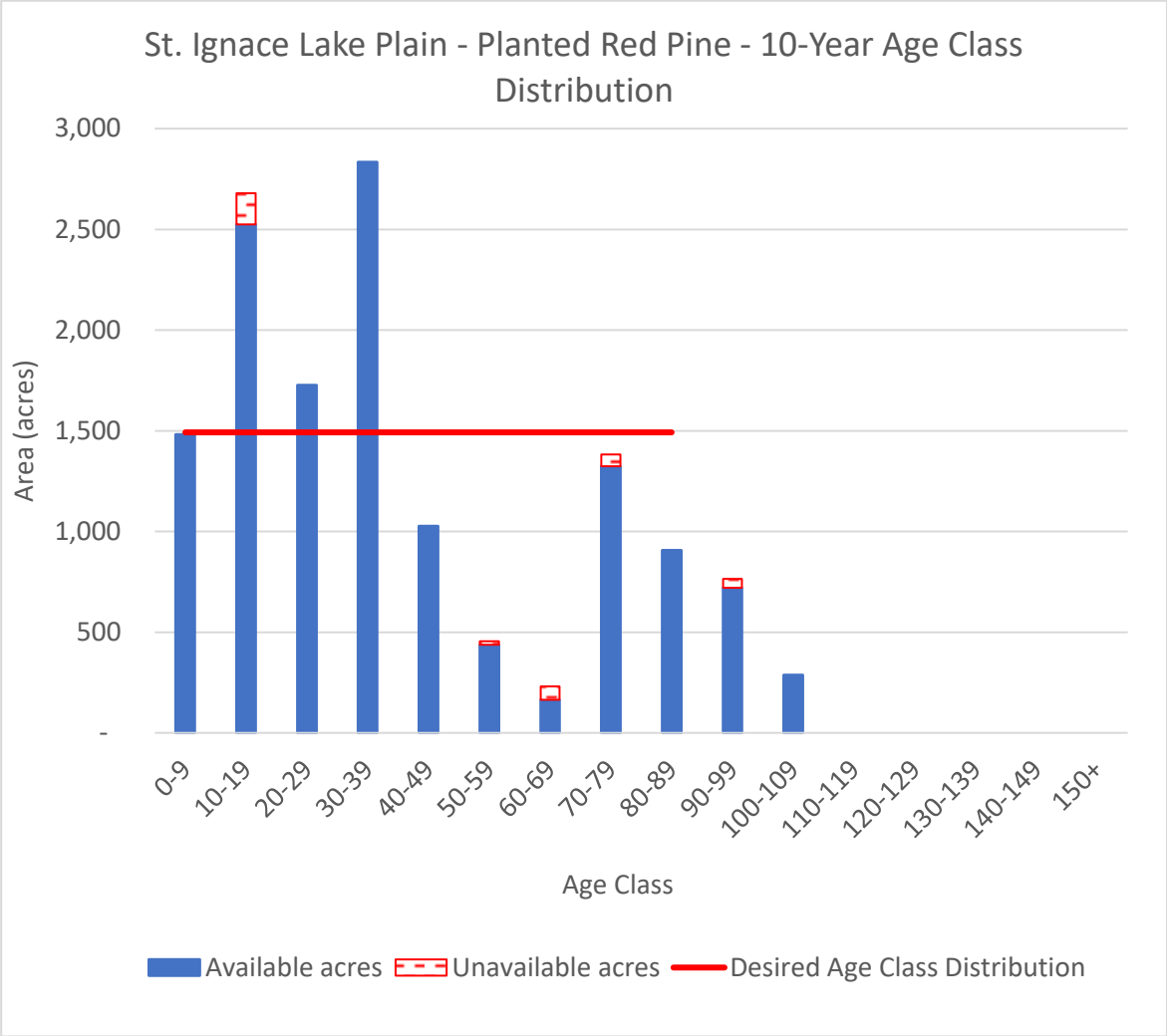


Figure 12. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

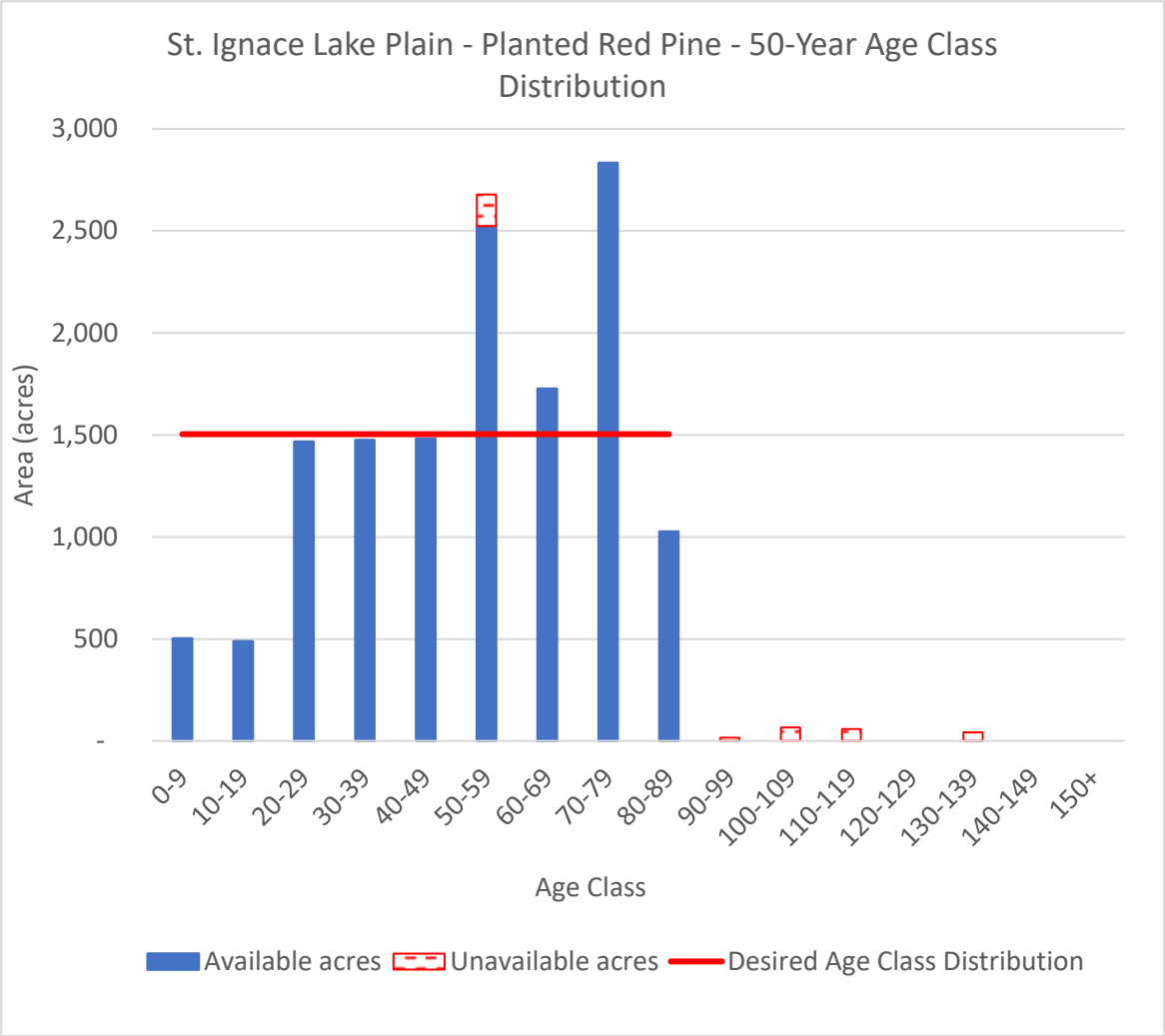


Figure 13. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The midterm age class distribution shows the population of planted red pine beginning to improve, with a few age classes nearing the desired future condition. As is often the case, an extremely unbalanced condition in the first planning period can often result in the need to carry some acres slightly longer into older age classes to achieve the desired age class goals (Figure 13).

The long-term achievement of the desired age class distribution (Figure 14) will concentrate the manageable acres of planted red pine in productive growing conditions while providing an even flow of forest products and a wide variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest.

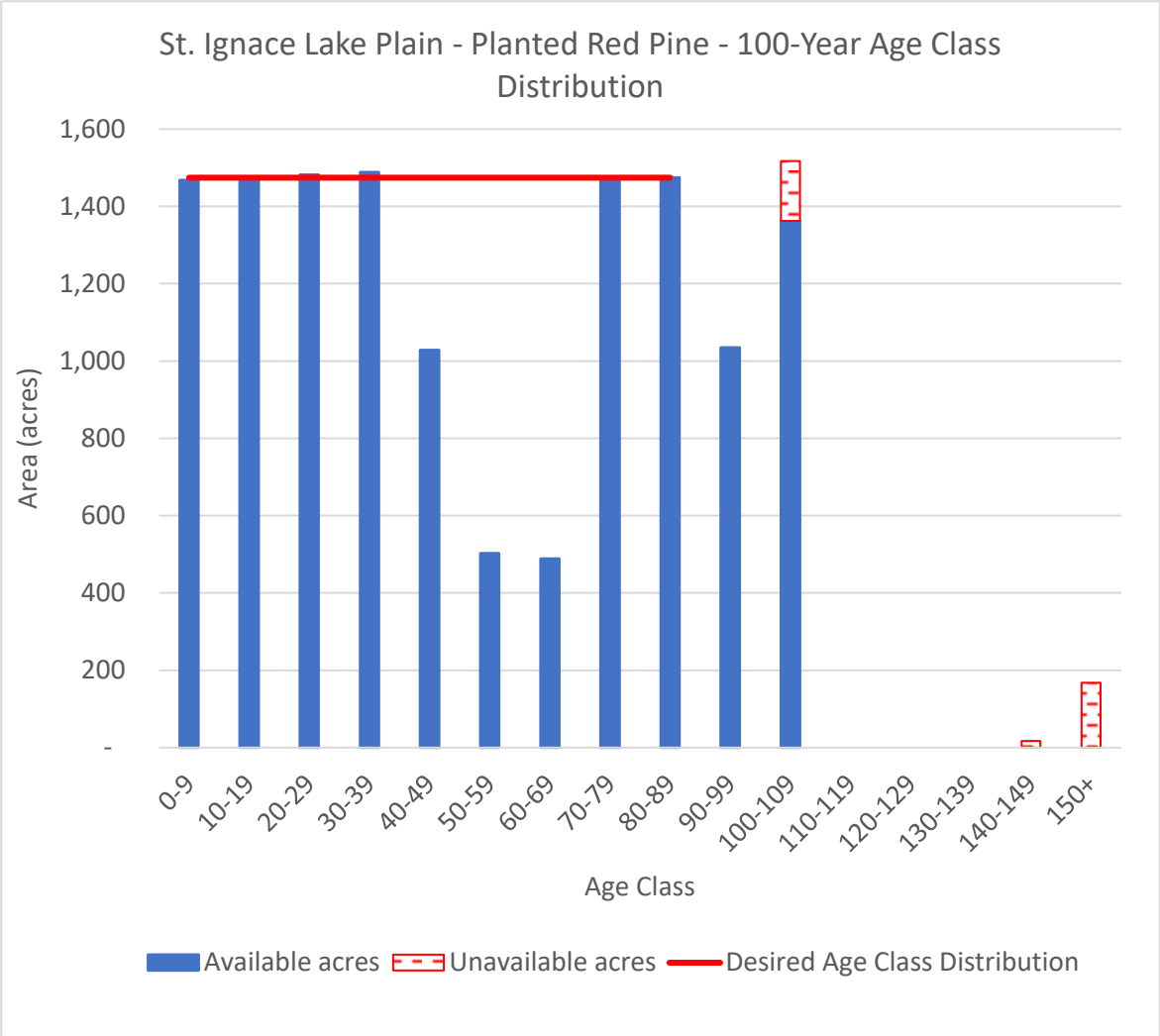


Figure 14. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

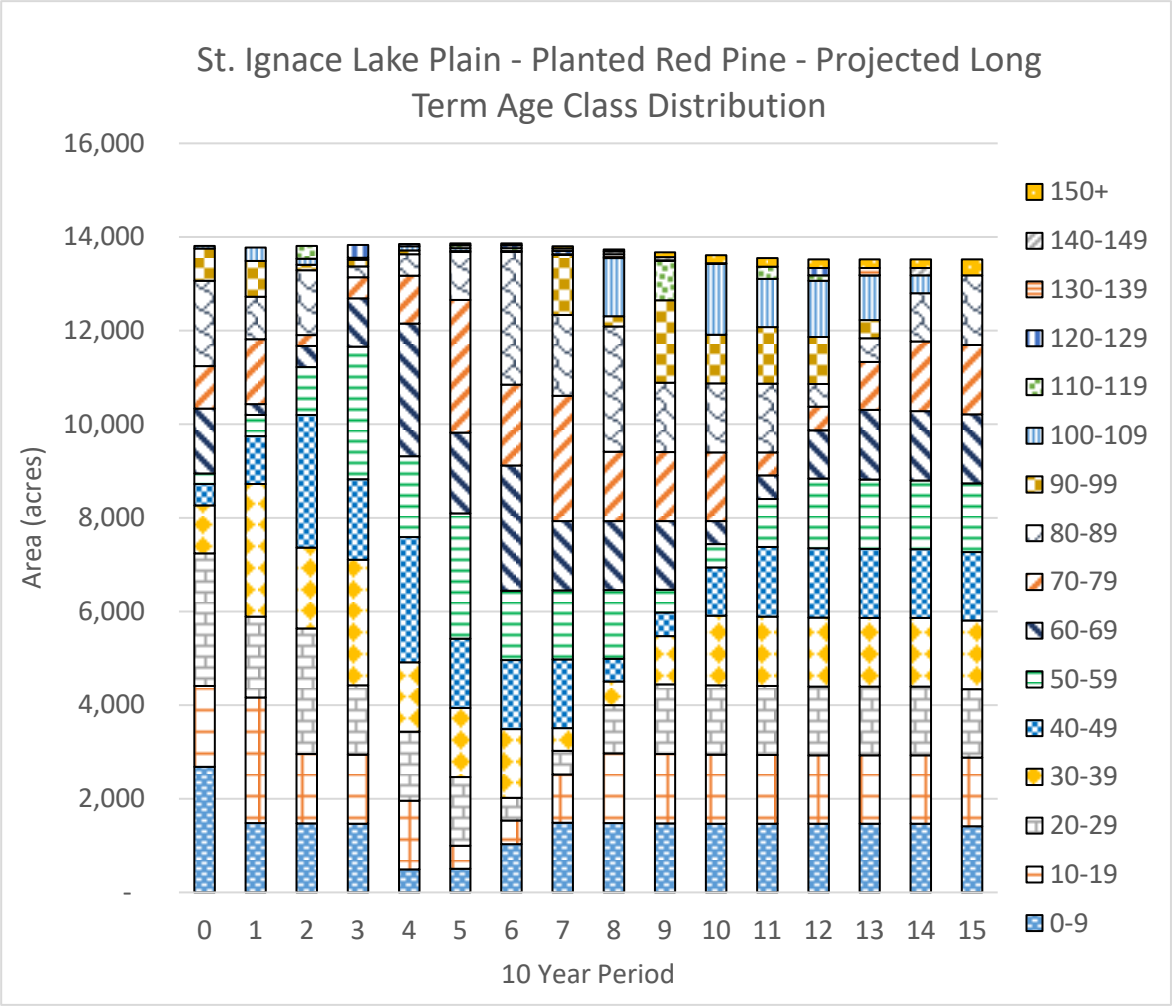


Figure 15. Projected age class distribution for all acres of planted red pine over the next 150 years in the St. Ignace Lake Plain Management Area.

Management actions

There are 1,516 acres of projected clearcut harvest in the planted red pine cover type during this planning period. This is slightly above the desired establishment of 1,493 acres per decade because of the current unbalanced condition. In addition to clearcut acres, there are 2,226 acres projected for thinning in this cover type.

Lowland conifers

Current condition

The St. Ignace Lake Plain Management Area has a surplus of acres in the 0- to 9-year age class due to harvesting of the large number of mature and overmature acres on the landscape (Figure 16). The age class distribution is currently very unbalanced across almost all the age class categories. Additionally, a deficit of available acres occurs in almost all age classes. The landscape position in which many of these acres occur contributes to the number of acres extending beyond the desired maximum age class tail of 80 years old. A portion of this cover type meets the habitat requirements for snowshoe hare and marten (

Table 11).

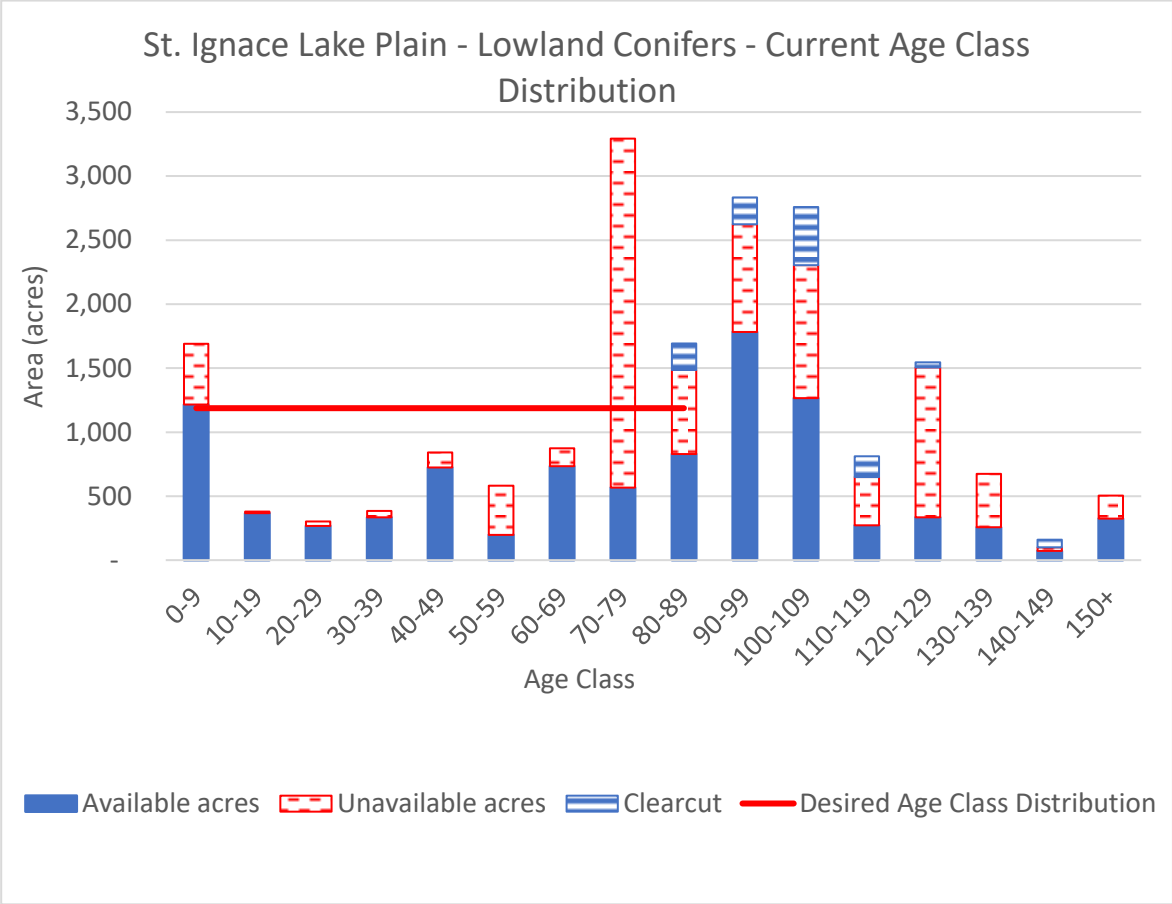


Figure 16. Current age class distribution, desired age class distribution and projected harvests in the lowland cover type over the 10-year planning period.

Table 11. Featured species with lowland conifers as a priority habitat cover type, habitat variables and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Lowland Conifer	Lowland Conifer Habitat Acres – Available	Lowland Conifer Habitat Acres – Unavailable
Snowshoe hare	Age category: 0-19 Size category: sapling	1,585	486
Marten	Age category: 40+ Size category: pole, sawlog Basal area: 81+	5,057	4,070

Desired future condition

The projected long-term cover-type trend for lowland conifers is fairly stable, but with a slight transition away from the cover type, in the St. Ignace Lake Plain Management Area. Transitions out of this cover type during this planning period are generally to the lowland mixed forest cover types. Transitions out of the cover type into lowland mixed forests are forecasted as species diversity is expected to increase.

Retaining cedar and hemlock within this cover type is necessary to maintain/increase species diversity and habitat structure and is critical in areas of high deer densities, where recruitment of these tree species is unlikely due to browse pressure. Both hemlock and cedar are relatively uncommon on the landscape, have decreased significantly since European settlement and are long-lived species whose value is extremely high for wildlife.

The long-term goal for this cover type is balanced age classes between 0 and 80 years old for all available lowland conifer acres and then decreasing in number of acres until the max tail of 110 years old is reached.

The end of the planning period will result in the establishment of approximately 1,126 acres of lowland conifers from the available acres. It will take many decades to achieve the long-term desired balanced age class distribution of lowland conifers (Figure 17).

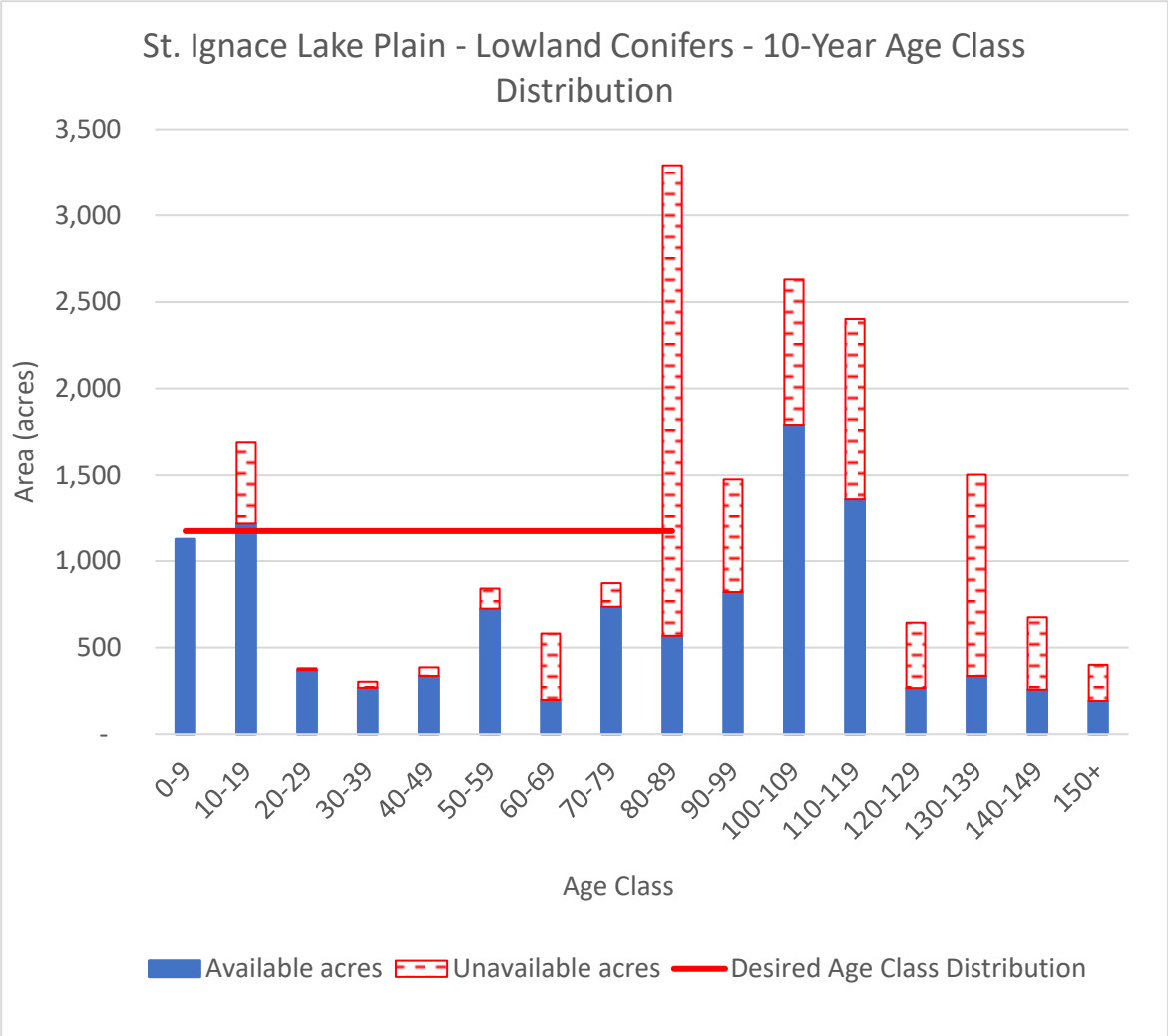


Figure 17. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The midterm age class distribution of lowland conifers is beginning to reach the desired future condition for available acres in the age classes between 20 and 40 years old. The number of acres in the older age classes, 120 years old and older, continues to increase as the unavailable acres continue to move to the older age classes (Figure 18).

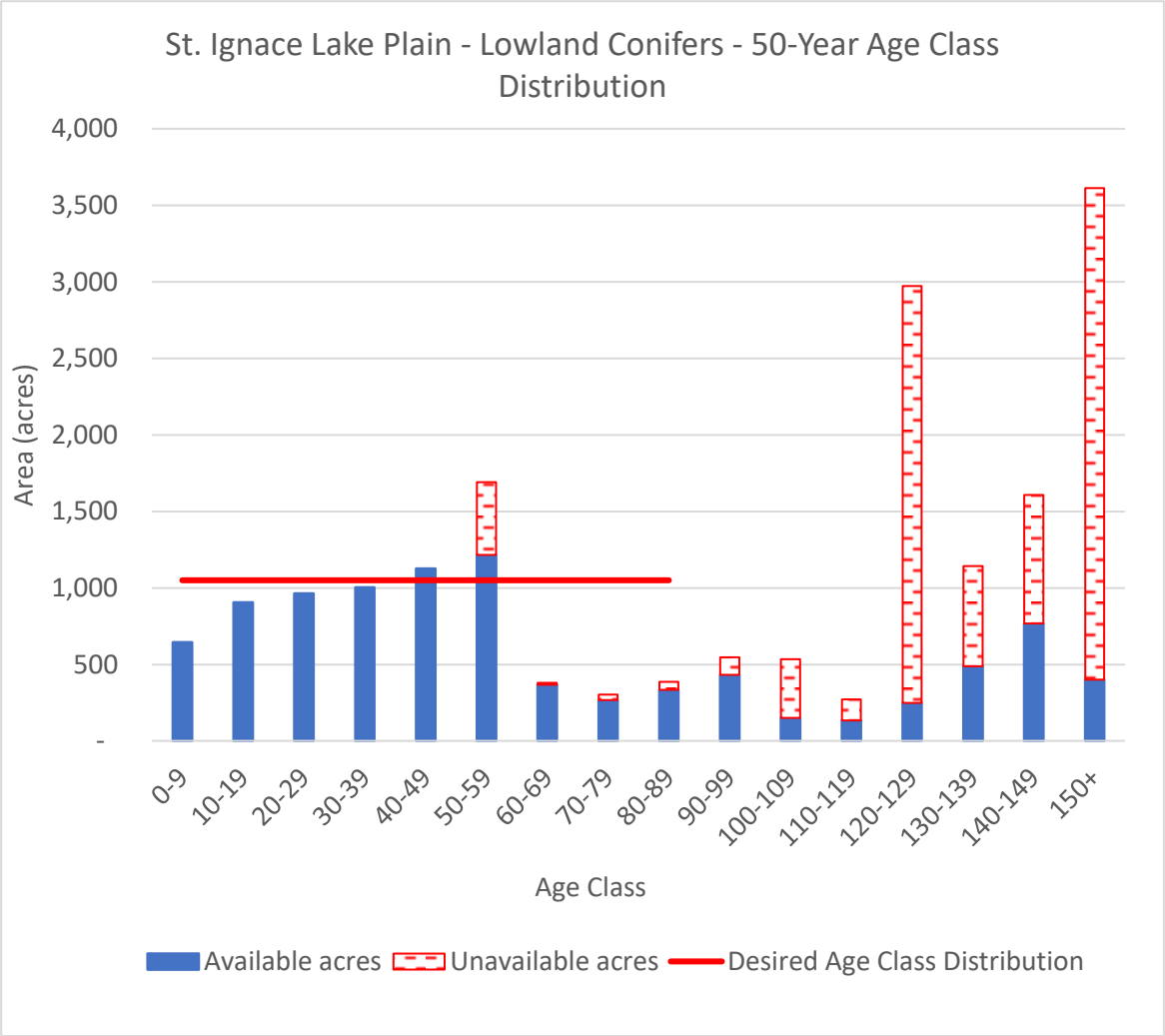


Figure 18. Projected midterm age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 19) will concentrate on the manageable acres of lowland conifer cover type in productive growing conditions while providing an even flow of forest products and a wide variety of wildlife habitat conditions across the landscape in young, mid-aged and mature forest.

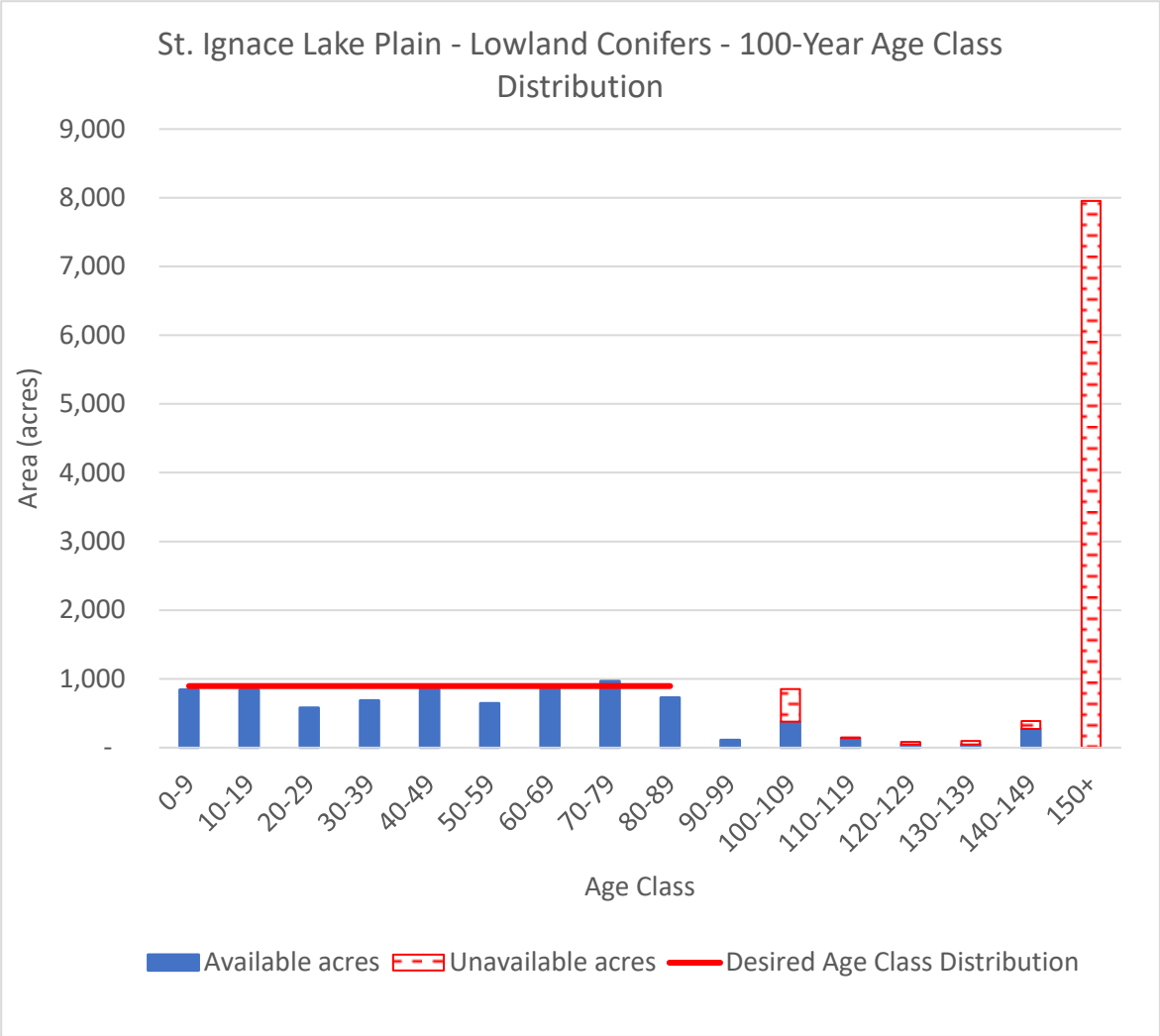


Figure 19. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

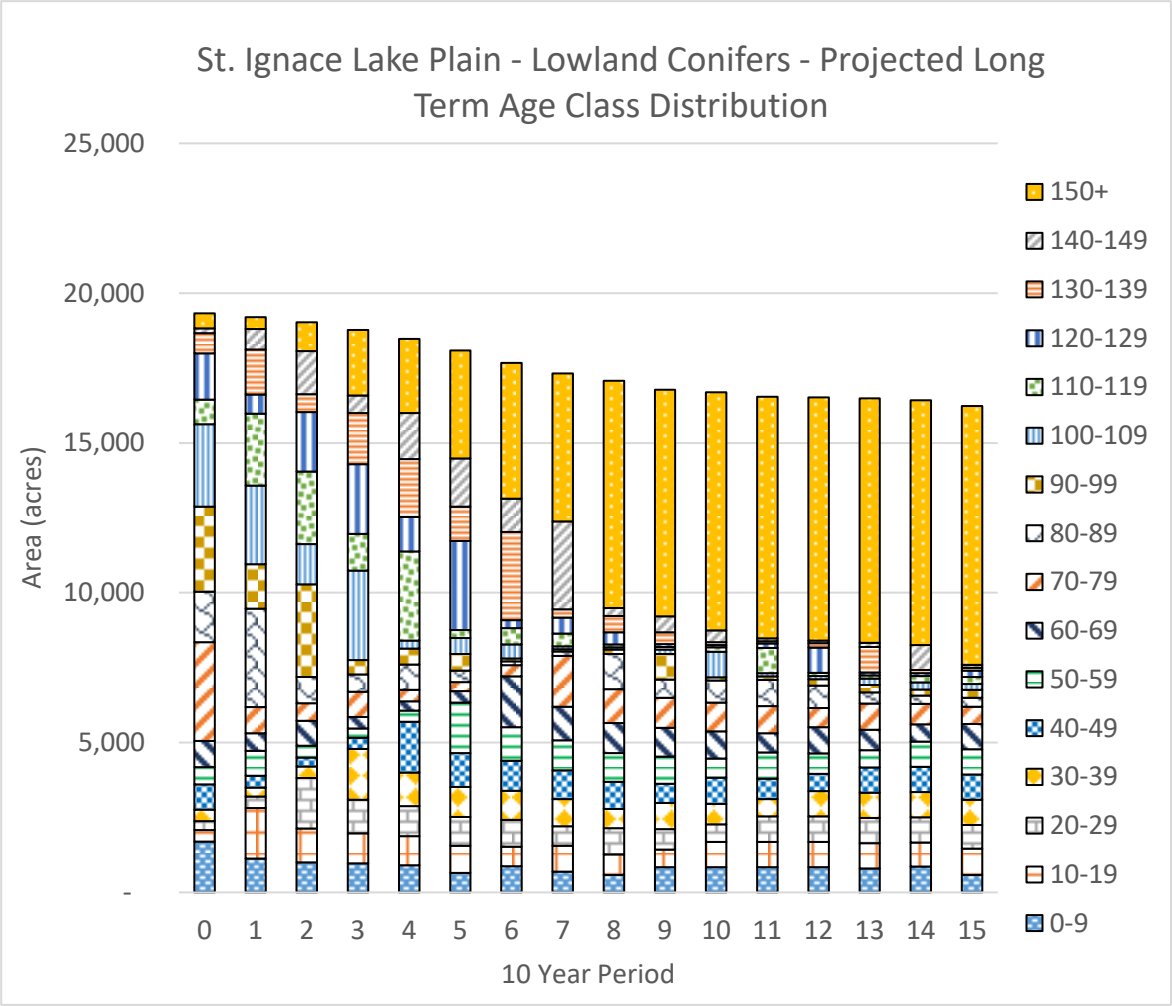


Figure 20. Projected age class distribution for all acres of lowland conifers over the next 150 years in the St. Ignace Lake Plain Management Area.

Management actions

There are 1,318 acres of projected clearcut harvest in the lowland conifer cover type during the planning period. This is above the desired establishment of 1,173 acres of lowland conifer per decade because of the current unbalanced age class condition and the number of acres beyond the desired max tail age of 80 years old.

Retaining cedar and hemlock within this cover type is necessary to maintain/increase species diversity and habitat structure and is critical in areas of high deer densities, where recruitment of these tree species is unlikely due to browse pressure. Both hemlock and cedar are relatively uncommon on the landscape, have decreased significantly since European settlement and are long-lived species whose value is extremely high for wildlife.

Cedar

Current condition

The majority of this cover type is over 100 years old, and it occurs mostly on acres unavailable for commercial harvest. The age class distribution is unbalanced, but regulated harvests are not a priority/focus in this cover type. A portion of this cover type meets the habitat requirements for white-tailed deer, snowshoe hare and marten.

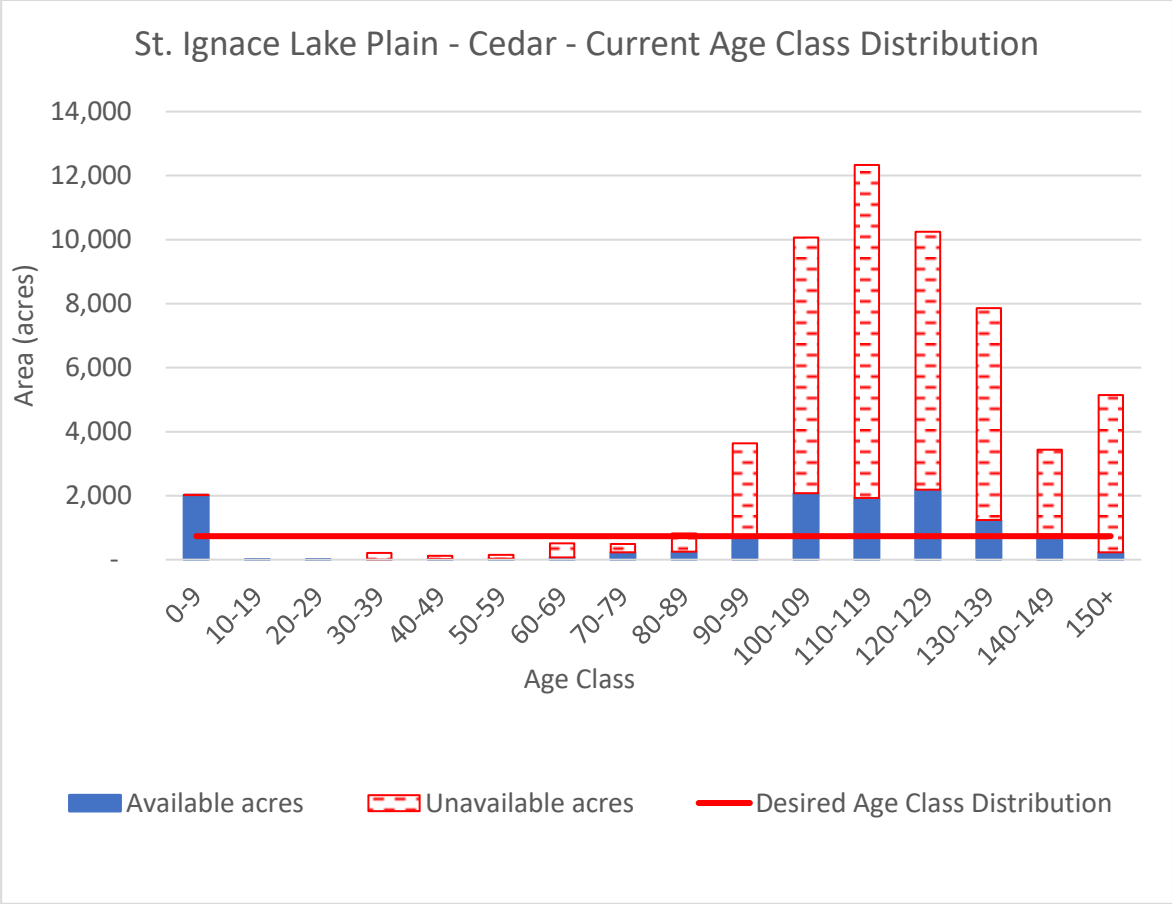


Figure 21. Current age class distribution and projected harvests in cedar cover type in the St. Ignace Lake Plain Management Area.

Table 12. Featured species with cedar as a priority habitat cover type, habitat variables and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Cedar	Cedar Habitat Acres – Available	Cedar Habitat Acres – Unavailable
Snowshoe hare	Age category: 80+ Size category: pole, sawlog Basal area: 81+	2,032	5
Marten	Age category: 40+	9,057	41,640

Featured Species	Featured Species Habitat – Cedar	Cedar Habitat Acres – Available	Cedar Habitat Acres – Unavailable
	Size category: pole, sawlog Basal area: 81+		
White-tailed deer, wintering complexes	All sizes and age classes	57,069	--

Desired future condition

The projected long-term cover type trend for cedar is stable in the St. Ignace Lake Plain Management Area. There are no projected transitions into or out of this cover type from other cover types forecasted.

The long-term goal for this cover type is to manage and maintain wildlife habitat.

Deer wintering complexes greater than 15,000 acres are modeled as a special analysis unit, or SAU, and information on them can be found in Section 5 of the plan. In deer wintering complexes less than 15,000 acres, harvest of cedar and hemlock is not usually acceptable within range stands essential for survival, and secondary shelter is often protected as well. These areas are guided by the DNR Deer Winter Range Guidelines.

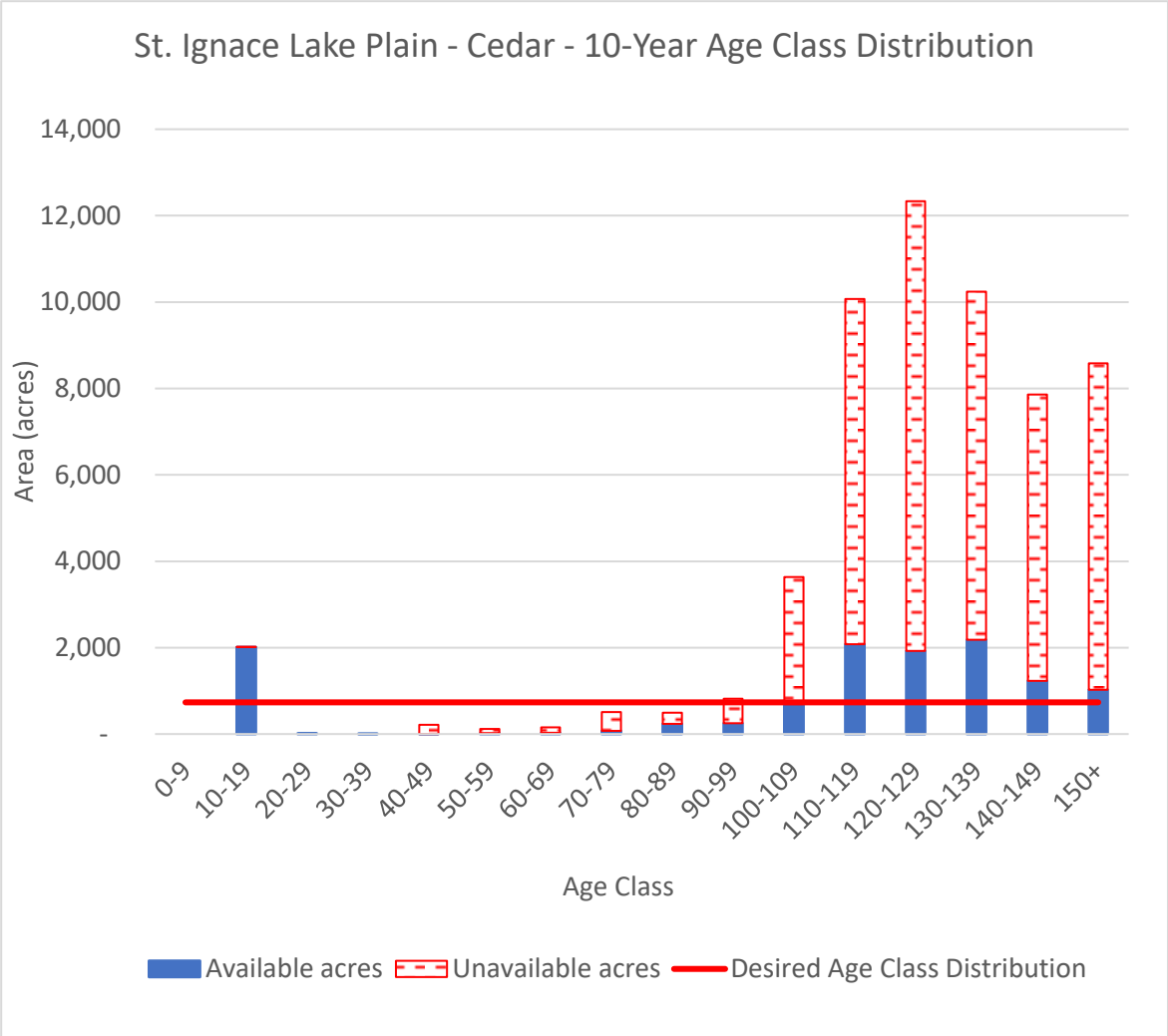


Figure 22. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The midterm age class distribution shows the population of cedar acres beginning to reach the desired future condition (Figure 23).

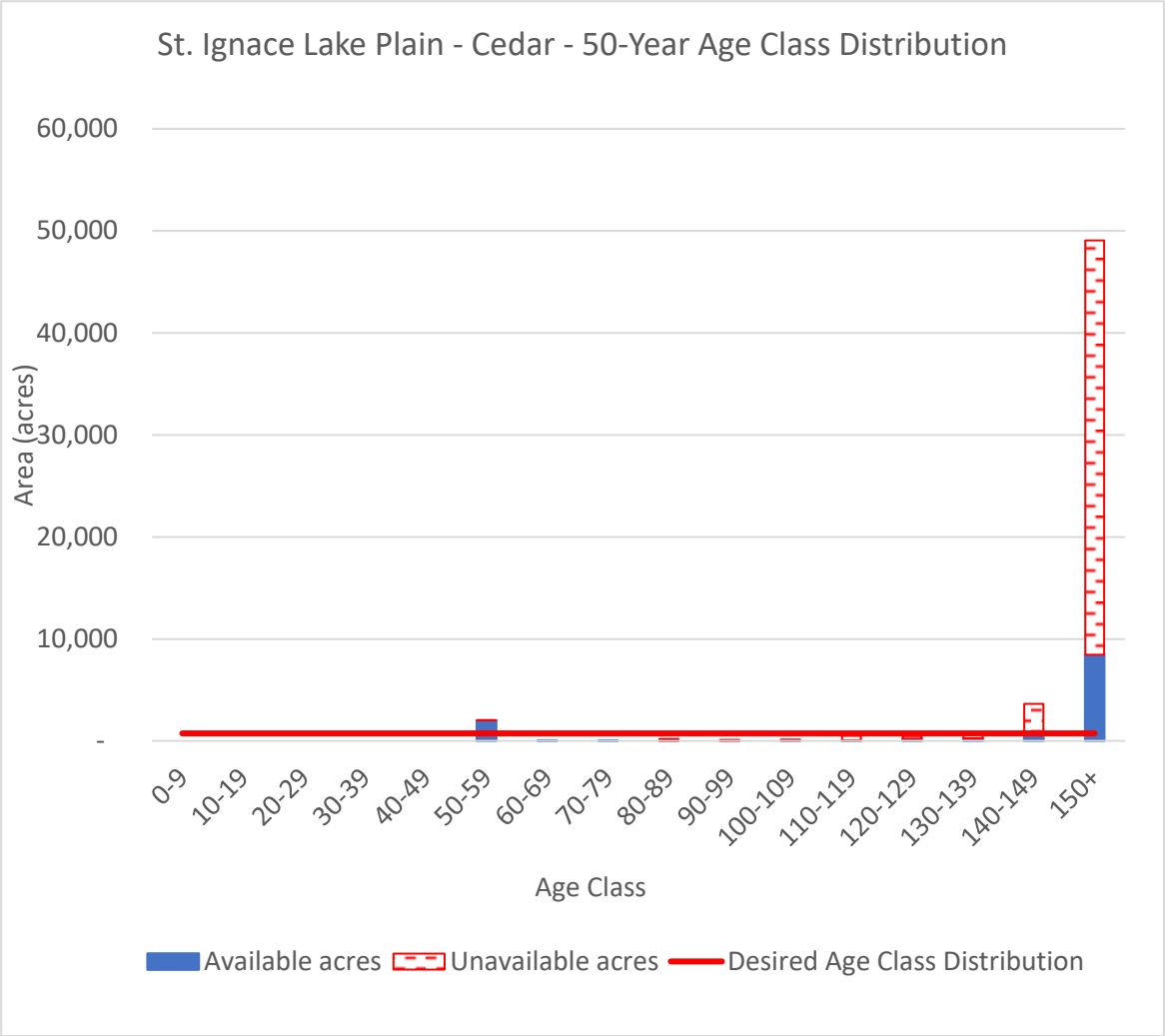


Figure 23. Projected midterm age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 24) will concentrate on the management of cedar within the deer wintering complex plans to provide a wide variety of wildlife habitat conditions across the landscape in mature forest.



Figure 24. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

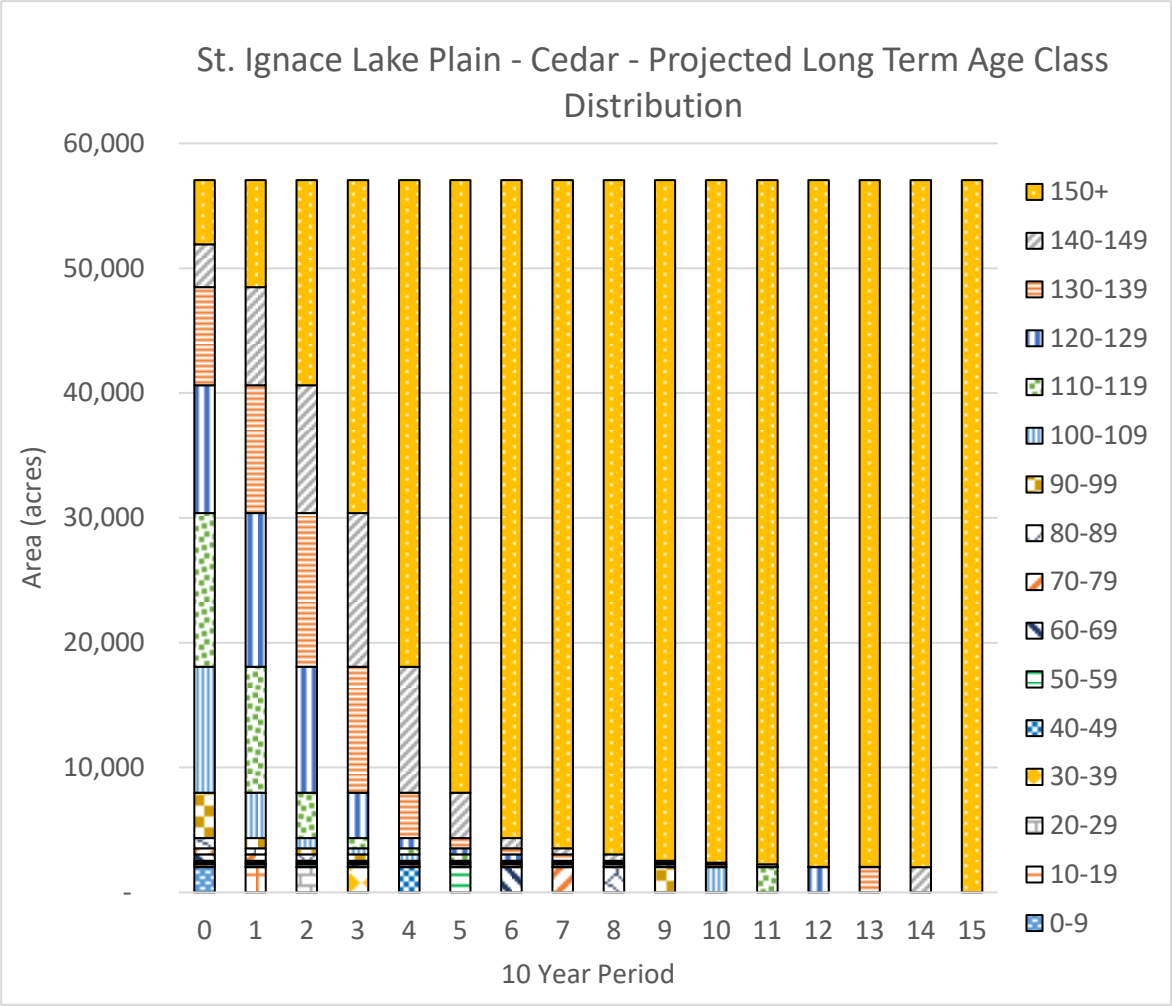


Figure 25. Projected age class distribution for all acres of cedar over the next 150 years in the St. Ignace Lake Plain Management Area.

Management actions

Maintaining this cover type where it exists on the landscape will be the primary action for this planning period. This cover type provides the best functional shelter habitat related to overwintering deer and deer wintering complexes (see Section 5) and can be a difficult cover type to recruit through commercial harvest. Continued understanding of how to recruit the cover type should be considered as emerging research becomes available.

Conservation Area Network

High conservation value areas

There are up to nine different high conservation value area types that can be found in each management area (Table 13; see Biodiversity in Section 3 for more information).

Table 13. High conservation value areas within the St. Ignace Lake Plain Management Area.

High Conservation Value Area Type and Name	Acres
Coastal environmental areas	**272**
	272
Critical coastal habitat (piping plover)	**612**
	612
Critical dunes	**2,226**
	2,226
Deer wintering complex	**115,392**
	115,392
Forest habitat core interior	**16,826**
	16,826
Natural areas legally dedicated	**537**
	537
Natural rivers vegetative buffer	**42**
	42
Natural rivers zoning district	**91**
	91
Northern long-eared bat hibernacula 0.25-mile buffer	**25**
Hendrie River Water Cave	25
State wildlife management areas	**2,722**
Black Creek Flooding SWMA	2,637
Cranberry Lake Flooding SWMA	84
Verified Type 1 and Type 2 old growth	**27**
Type 1 old growth	27
Grouse Enhanced Management Sites	**2,167**
Strickler GEMS	2,167
Grand total	**140,939**

Ecological reference areas

Ecological reference areas, a type of HCVA, are higher-quality examples of functioning ecosystems that are primarily influenced by natural ecological processes.

Table 14. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure

Element Occurrence Rank	State Rank	Global Rank
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 15. Ecological reference areas within the management area.

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	Number of Occurrences
Existing ERA	Bog	AB		S4	1
Existing ERA	Bog	C	G3G5	S4	1
Existing ERA	Cave	A	G4	S1	1
Existing ERA	Great Lakes marsh	BC			2
Existing ERA	Great Lakes marsh	C			1
Existing ERA	Interdunal wetland	AB			1
Existing ERA	Intermittent wetland	AB	G2	S3	1
Existing ERA	Limestone bedrock glade	C	G2G4	S2	1
Existing ERA	Limestone cobble shore	B			2
Existing ERA	Mesic northern forest	C			1
Existing ERA	Mesic northern forest	D			1
Existing ERA	Muskeg	B		S3	1
Existing ERA	Muskeg	B	G4G5	S3	1
Existing ERA	Muskeg	C	G4G5	S3	1
Existing ERA	Northern shrub thicket	AB	G4	S5	2
Existing ERA	Open dunes	B			1
Existing ERA	Poor conifer swamp	B	G4	S4	2
Existing ERA	Poor fen	AB	G3	S3	1
Existing ERA	Poor fen	BC	G3	S3	1
Existing ERA	Poor fen	C			1
Existing ERA	Rich conifer swamp	AB			1
Existing ERA	Rich conifer swamp	BC	G4	S3	1
Existing ERA	Rich conifer swamp	C	G4	S3	1
Existing ERA	Wooded dune and swale complex	AB			2
Existing ERA	Wooded dune and swale complex	B			4
Existing ERA	Wooded dune and swale complex	B			1
Existing ERA	Wooded dune and swale complex	BC			2

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	Number of Occurrences
Existing ERA	Wooded dune and swale complex	BC	G3	S3	1
Proposed ERA	Interdunal wetland	B	G2?	S2	
Proposed ERA	Intermittent wetland	C	G2	S3	1
Proposed ERA	Limestone bedrock glade	C	G2G4	S2	1
Proposed ERA	Patterned fen		GU	S2	1
Proposed ERA	Poor fen	C	G3	S3	1
Proposed ERA	Wooded dune and swale complex	C	G3	S3	1
Grand total					**42**

Special conservation areas

Reviewable special conservation areas (Table 16) are those SCA types that may be reviewed or updated through the compartment review process as needed. Static SCAs (Table 17) are those SCA types that generally do not change or require updating (see Biodiversity in Section 3 for more information).

Table 16. Reviewable special conservation areas within the St. Ignace Lake Plain Management Area.

Reviewable Special Conservation Area Type and Name	Acres
Concentrated recreational area	**176**
Big Knob Campground	12
Black River Campground	8
Detour State Forest Campground	19
Dunkles Landing	2
Garnet Lake Campground	2
Hog Island Point Campground	36
Little Brevoort Lake North Campground	20
Little Brevoort Lake South Campground	23
Milakokia Lake Campground	28
Milikokia Lake State Forest Campground	13
South Manistique Lake Campground	12
Cultural or customary area	**30**
Flower Creek Road Sugar Bush	12
Sand Ridge Sugar Bush	4
Winberg Road Sugar Bush	8
Zieglar Road Sugar Bush	6
Habitat area or habitat corridor	**4,053**
Scott Point	920
Scotty Bay Mesic Northern Forest	118
Seiner's Point	1,872
--	1,143

Reviewable Special Conservation Area Type and Name	Acres
Mineral resource area	**37**
Chippewa County Road Commission	2
Mackinac County Road Commission	35
Visual management area	**400**
Big Knob	270
Cut River Bridge	130
Total	**4,695**

Table 17. Static special conservation areas within the St. Ignace Lake Plain Management Area.

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Common natural heritage element occurrences		**3,394**
Mesic northern forest		236
Muskeg		3,158
Designated trout and coldwater stream buffer		**6,120**
Unnamed tributary		2,840
Albany Creek		44
Anguilm Creek		21
Bark Creek		43
Beaver Tail Creek		94
Black River		162
Borgstrom Creek		55
Brevoort River		320
Carp River		190
Cataract River		49
Crow River		55
Cut River		52
Davenport Creek		164
East Branch Black River		112
East Branch Sage River		124
East Mile Creek		63
First Creek		13
Flowers Creek		19
Hog Island Creek		207
Hudson Creek		30
Locke Creek		45
Mackinac Creek		17
Mattix Creek		14
McAlpine Creek		69
McKay Creek		50
Newton Creek		16
Norton Creek		27
O'Niel Creek		48

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Ozark Creek		45
Paquin Creek		124
Pearson Creek		48
Peters Creek		47
Point Patterson Creek		52
Prentiss Creek		7
Rapson Creek		9
Schwesinger Creek		37
Seiners Creek		66
Silver Creek		25
Skunk Creek		49
South Branch Carp River		191
South Branch Hendrie River		106
Taylor Creek		15
Third Creek		23
Trout Creek		21
Upper Black Creek		85
Upper Millecoquins River		59
West Branch Hendrie River		125
West Branch Sage River		41
Designated trout and coldwater streams	**235.4**	
Unnamed tributary	107.2	
Albany Creek	1.8	
Anguilm Creek	0.8	
Bark Creek	1.6	
Beaver Tail Creek	7.0	
Black River	6.2	
Borgstrom Creek	2.1	
Brevoort River	12.1	
Carp River	7.3	
Cataract River	1.9	
Crow River	2.1	
Cut River	1.9	
Davenport Creek	6.2	
East Branch Black River	4.3	
East Branch Sage River	4.6	
East Mile Creek	2.3	
First Creek	0.5	
Flowers Creek	0.7	
Hog Island Creek	7.7	
Hudson Creek	1.1	
Locke Creek	1.6	

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Mackinac Creek	0.6	
Mattix Creek	0.5	
McAlpine Creek	2.6	
McKay Creek	1.9	
Newton Creek	0.5	
Norton Creek	1.0	
O'Niel Creek	2.0	
Ozark Creek	1.7	
Paquin Creek	5.0	
Pearson Creek	1.7	
Peters Creek	1.7	
Point Patterson Creek	1.9	
Prentiss Creek	0.2	
Rapson Creek	0.4	
Schwesinger Creek	1.4	
Seiners Creek	2.4	
Silver Creek	0.9	
Skunk Creek	1.9	
South Branch Carp River	7.4	
South Branch Hendrie River	4.3	
Taylor Creek	0.6	
Third Creek	1.0	
Trout Creek	0.9	
Upper Black Creek	3.3	
Upper Millecoquins River	2.2	
West Branch Hendrie River	4.9	
West Branch Sage River	1.6	
Great Lakes islands		**5**
Important bird areas		**1,565**
Helmet Shoal and Saddlebag Island		1
Lower St. Mary's River and Potagannissing Bay		80
Port Inland		0
Raco Plains and Wilwin Wetland		1,393
Rudyard Clay Plain		0
Sand Products and Epoufette Island shoal		0
Seney National Wildlife Refuge		63
St. Vital Point beaches (piping plover)		27
Mussel stream Group 2 - state threatened or endangered	**0.2**	
Locke Creek-Manistique Lake	0.2	
Nondedicated natural areas		**3,523**
Natural area Crow River Mouth		518

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Natural area inholding		11
Natural area Seiner's Point		2,994
Wild and scenic rivers	**0.0**	
Carp Wild and Scenic River	0.0	
Wood turtle stream 100-foot buffer		**71**
Manistique River		30
Mead Creek		42
Wood turtle stream 660-foot buffer		**432**
Manistique River		184
Mead Creek		243
North Branch Milakokia River		4
Grand total	**235.5**	**15,110**

Rare species

Rare species occurrences are compiled from the Michigan Natural Features Inventory Biotics database (Table 19, **Error! Reference source not found.**, **Error! Reference source not found.**) and do not necessarily include all rare species found in this management area due to biases in survey effort and verifiable observation reporting over time.

Table 18. Rare animal and plant species conservation status key.

Status	Status
E = endangered	LE = listed endangered
T = threatened	LT = listed threatened
SC = special concern	PDL = proposed for delisting

Table 19. Rare animal species occurrence within the St. Ignace Lake Plain Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Accipiter gentilis	Northern goshawk	T		3
Animal	Alasmidonta viridis	Slippershell	T		1
Animal	Alces alces	Moose	SC		2
Animal	Bombus borealis	Northern amber bumble bee	SC		2
Animal	Bombus sandersoni	Sanderson's bumble bee	SC		1
Animal	Bombus terricola	Yellow banded bumble bee	SC		5
Animal	Botaurus lentiginosus	American bittern	SC		2
Animal	Buteo lineatus	Red-shouldered hawk	SC		14

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Canachites canadensis	Spruce grouse	T		1
Animal	Canis lupus*	Gray wolf	SC	LE	--
Animal	Charadrius melodus	Piping plover	E	LE	2
Animal	Cistothorus palustris	Marsh wren	SC		2
Animal	Coregonus artedi	Lake herring or cisco	T		2
Animal	Cottus ricei	Spoonhead sculpin	SC		1
Animal	Elliptio complanata	Eastern elliptio	SC		2
Animal	Euconulus alderi	A land snail (no common name)	T		1
Animal	Falco columbarius	Merlin	SC		1
Animal	Gavia immer	Common loon	T		16
Animal	Glyptemys insculpta	Wood turtle	T		1
Animal	Haliaeetus leucocephalus	Bald eagle	SC		21
Animal	Ixobrychus exilis	Least bittern	T		1
Animal	Lasmigona costata	Flutedshell	SC		1
Animal	Lithobates palustris	Pickerel frog	SC		2
Animal	Myotis lucifugus	Little brown bat	T		2
Animal	Necturus maculosus	Mudpuppy	SC		5
Animal	Nycticorax nycticorax	Black-crowned night-heron	SC		1
Animal	Opheodrys vernalis	Smooth green snake	SC		2
Animal	Pandion haliaetus	Osprey	SC		18
Animal	Planogyra asteriscus	Eastern flat-whorl	SC		1
Animal	Pupilla muscorum	Widespread column	SC		1
Animal	Sterna hirundo	Common tern	T		1
Animal	Trimerotropis huroniana	Lake Huron locust	T		12
Animal	Vertigo elatior	Tapered vertigo	SC		2
Animal	Vertigo nylanderi	Deep-throat vertigo	E		1
Grand total	-	-	-	-	130

**Occurrence information provided by field staff.*

Table 20. Rare plant species conservation status key.

Status	Status
E = endangered	LE = listed endangered
T = threatened	LT = listed threatened
SC = special concern	PDL = proposed for delisting

Table 21. Rare plant species occurrence within the St. Ignace Lake Plain Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Plant	Asplenium rhizophyllum	Walking fern	T		4
Plant	Asplenium viride	Green spleenwort	SC		1
Plant	Calypso bulbosa	Calypso or fairy-slipper	T		2
Plant	Cirsium pitcheri	Pitcher's thistle	T	LT	10
Plant	Coptidium lapponicum	Lapland buttercup	T		1
Plant	Cypripedium arietinum	Ram's head lady's-slipper	SC		3
Plant	Draba arabisans	Rock whitlow grass	SC		1
Plant	Huperzia selago	Fir clubmoss	SC		1
Plant	Iris lacustris	Dwarf lake iris	T	LT	7
Plant	Juncus stygius	Moor rush	E		1
Plant	Mimulus michiganensis	Michigan monkey flower	E	LE	1
Plant	Pinguicula vulgaris	Butterwort	SC		2
Plant	Platanthera unalascensis	Alaska orchid	SC		2
Plant	Potamogeton confervoides	Alga pondweed	SC		1
Plant	Potamogeton hillii	Hill's pondweed	T		1
Plant	Solidago houghtonii	Houghton's goldenrod	T	LT	9
Plant	Stellaria longipes	Stitchwort	SC		7
Plant	Tanacetum bipinnatum ssp. huronense	Lake Huron tansy	SC		11
Plant	Woodsia obtusa	Blunt-lobed woodsia	T		1
Total	-	-	-	-	**66**

Table 22. Other rare occurrence within the St. Ignace Lake Plain Management Area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Other	Great blue heron rookery	Great blue heron rookery			6
Other	Multiple bat hibernacula	Multiple bat hibernacula			1
Total	-	-	-	-	7

Non-ecological reference area community types

Natural communities that are identified with an element occurrence in the MNFI Biotics database, but that have not been given an additional ecological reference area designation, are recognized and managed accordingly (Table 23).

Table 23. Non-ecological reference area community types ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 24. Non-ecological reference area community types within the St. Ignace Lake Plain Management Area.

Community Type	Element Occurrence Rank	State Rank	Global Rank	Number of Occurrences
Mesic northern forest	BC	S3	G4	1
Muskeg	AB	S3	G4G5	1
Northern wet meadow	C	S4	G4G5	2
Grand total				**4**

Forest health

Forest health concerns, both native and non-native, can have impacts on stand conditions and management decisions. The following insects (Table 19) and diseases (Table 20) could have an impact on management during the planning period and may need to be monitored and/or addressed.

Table 25. Defoliating insects of concern in the St. Ignace Lake Plain Management Area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Spongy moth	Lymantria dispar dispar	Non-native	Yes
Forest tent caterpillar	Malacosoma disstria	Native	Yes
Large aspen tortrix	Choristoneura conflictana	Native	Yes
Spruce budworm	Choristoneura fumiferana	Native	Yes
Hemlock woolly adelgid	Adelges tsugae	Non-native	No

Table 26. Maladies of concern in the St. Ignace Lake Plain Management Area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Canker (stem infections)	Nectria cinnabarina	Native	Yes
Heterobasidion root disease	Heterobasidion annosum	Native	No
Oak Wilt	Bretziella fagacearum	Non-native	No
Armillaria root rot	Armillaria mellea	Native	Yes

Aquatic resources

Riparian habitat

Approximately 235 miles of streams and rivers are found in the management area (Table 27). Streams/rivers classified as cold types comprise approximately 77% of the riverine mileage.

Table 27. Classification type and length of streams/rivers found within the management area

Type	Length (miles)
Cold stream	146
Cold small river	0
Cold transitional stream	35
Cold transitional small river	0
Cold transitional large river	0
Warm transitional stream	46
Warm transitional small river	1
Warm transitional large river	0
Warm stream	6
Warm small river	1
Warm large river	<1

Lacustrine habitat

A total of 80 lakes and ponds of at least 1 surface acre are found in the management area (Table 28).

Table 28. Size and number of lakes and ponds located within the management area.

Lake Size Class (acres)	Number
1-99	64
100-499	11
500+	5

Wetlands

A total of 116,298 acres of wetlands are found in the management area (Table 29). Forested wetlands comprise approximately 95% of wetland types found in the management area.

Table 29. Area of emergent, forested and riverine wetland types found within the management area.

Wetland Type	Acres
Emergent	4,796
Forested	110,853
Riverine	649

Vernal pools and seeps

A total of 808 acres of vernal pools have been inventoried in the management area, while 608 acres of seeps have been identified.

Riparian vegetation cover

Lowland shrub, cedar and aspen are the predominant cover types present in a 100-meter riparian zone located next to streams/rivers in the management area (Table 30).

Table 30. Largest vegetative cover types (i.e., top 10) and area located in a 100-meter buffer of streams/rivers within the management area.

Cover Type	Acres
Lowland shrub	6,474
Cedar	6,312
Aspen	4,154
Lowland conifers	2,857
Northern hardwood	2,647
Marsh	2,564
Mixed upland deciduous	1,454
Upland conifers	1,274
Planted red pine	1,243
Upland mixed forest	774

Watershed vegetation cover

The management area includes portions of important watersheds of the Tahquamenon River and Manistique River (Table 31 and Table 32). Aspen and cedar are major cover types of the state forest in each watershed.

Table 31. Largest vegetative cover types (i.e., top five) and area for the area of the Tahquamenon River watershed located within the management area.

Cover Type	Acres
Aspen	5,062
Lowland shrub	2,468
Cedar	2,457
Northern hardwood	1,681
Planted red pine	1,525

Table 32. Largest vegetative cover types (i.e., top five) and area for the area of the Manistique River watershed located within the management area.

Cover Type	Acres
Cedar	3,565
Tamarack	276
Lowland conifer	260
Aspen	233

Cover Type	Acres
Northern hardwood	218

Recreation

Access for recreation is generally good throughout a large portion of the St Ignace Lake Plain Management Area, which sees heavy recreational use due to the proximity of Newberry, Naubinway and other communities. Most of the area is accessible by gravel and dirt two-track roads, although the Batty Doe Deer Yard area has limited access, and motorized access is restricted in the Strickler Grouse Enhanced Management Site to promote walk-in hunting opportunities. Illegal off-road vehicle activities are an issue within this management area, especially along the Lake Michigan shoreline.

Motorized recreation trails in the St Ignace Lake Plain Management Area include snowmobile and ORV trails and several trails restricted to motorcycle use: the Brevort-Trout Lake Motorcycle Trail, Sandtown Motorcycle Trail and Newberry-Rexton Motorcycle Trail. The St. Ignace-Trout Lake Rail-Trail, designated for snowmobile and ORV use, passes through this management area (Table 33).

Hiking trails include Big Knob-Crow Lake Pathway, Canada Lakes Ski Trail/Pathway, Marsh Lake Pathway and Switchback Ridge Pathway. Canada Lakes and Marsh Lake pathways are also open to biking. The biking route of the Iron Belle trail follows U.S. 2 along the lakeshore.

There are eight state forest campgrounds (rustic) within the management area, primarily located in the vicinity of the U.S. 2 corridor, which parallels the Lake Michigan shoreline and is part of the Lake Michigan Circle Tour. Dispersed camping is also popular in locations along the lakeshore. There are also a significant number of private campgrounds and resorts around the lakes in this management area, which contribute to the use of recreation facilities and support the local economy year-round (Table 34).

Table 33. Designated recreation trails by type.

Recreation Category	Recreation Type	# of Miles
Motorized recreation trails	Off-road vehicle (all types) Snowmobile	262.3 140.1
Nonmotorized recreation trails	Hiking Equestrian Biking Hunter access trails	32.3 0 25.2 6.8
Total		**466.7**

Note: Trail use types may overlap.

Table 34. State forest campgrounds.

Name	# of sites
Big Knob	23
Black River	12
DeTour	21
Hog Island Point	42
Little Brevort Lake, North	20
Mead Creek	9

Milakokia Lake	35
South Manistique Lake	30

Black Creek Flooding, on the east side of Manistique Lake, is an area managed for wildlife, with access off Manistique Lakes Road. The area includes branches of the Upper Black Creek and Portage Creek and is primarily wetland.

The Strickler Grouse Enhanced Management Site, east of Naubinway, provides access to intensively managed grouse habitat via hunter walking trails. The entire area is closed to motorized vehicles by a DNR director's order (Table 35).

Recreation opportunities within this management area are wide-ranging, including snowshoe hare, deer, bear, bobcat, waterfowl and ruffed grouse hunting, trapping, foraging for berries and mushrooms, fishing, horse riding, canoeing and kayaking, bird-watching, and sightseeing at the scenic overlooks.

Table 35. Areas managed for hunting.

Type	Name	Acres
State wildlife management areas	Black Creek Flooding SWMA	2,635.4
	Cranberry Lake Flooding SWMA	84.3
Grouse Enhanced Management Sites	Strickler GEMS	2,116.2
Total		**4,835.9**

Table 36. Boating access sites.

Name	Body of water
Bay City State Forest Campground	Bay City Lake
Cranberry Flooding	Cranberry Flooding
Kennedy Lake	Kennedy Lake
Little Brevort Lake – South	Little Brevort Lake
Little Brevort Lake State Forest Campground – North	Little Brevort Lake
Mead Creak State Forest Campground	Mead Creak
Milakokia Lake State Forest Campground	Milakokia Lake
Portage Creek	Portage Creek
Upper Millecoquin River	Upper Millecoquin River

Eco-Region

Western Upper Peninsula

State Forest Area: 882,630 acres	Location: Alger (western half), Baraga, Delta, Dickinson, Houghton, Iron, Keweenaw, Marquette, Menominee and Ontonagon counties
Population Centers: Escanaba, Houghton, Iron Mountain, Marquette and Menominee	Landcover: Forested: 781,760 acres Non-forested: 100,780 acres

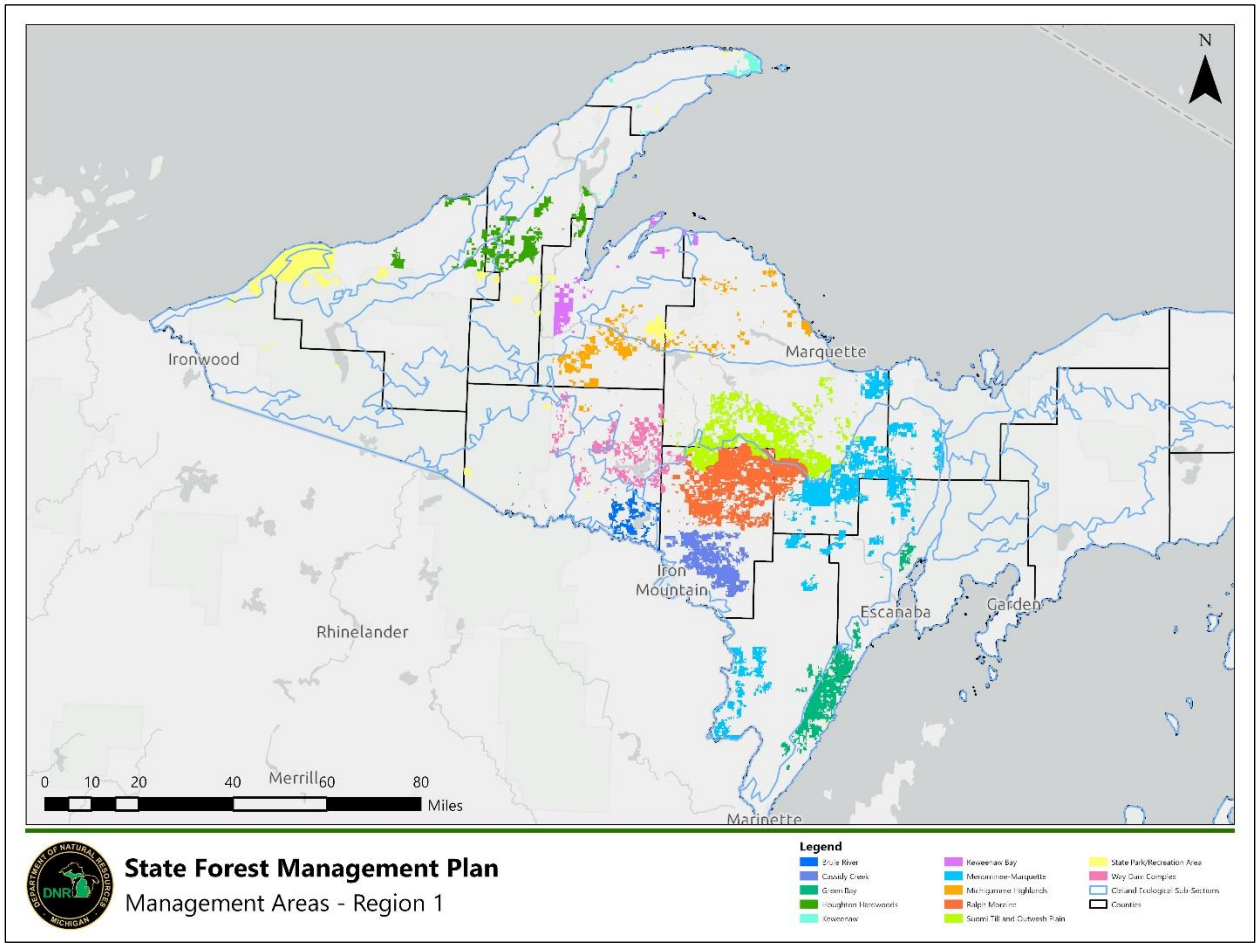


Figure 1. Western Upper Peninsula Management Areas.

Forested landscape

Current and projected future condition

The Western Upper Peninsula State Forest is dominated by forested cover types, with 89 percent of the area covered in forested stands (Table 1). The upland deciduous portion of that is 48 percent of the management area and comprised mostly of aspen and northern hardwood. Lowland shrub is the most common non-forested cover type in this management area, representing 5 percent of the landscape.

There are 561,349 acres (63 percent of the total WUP State Forest area and 77 percent of the forested area) that can be managed toward desired future conditions via commercial timber harvest (Table 2). Of that, over 29 percent is in the aspen cover type, 17 percent in northern hardwood, 5 percent in cedar, and 3 percent in lowland conifer. The remaining 21 cover types represent less than 23 percent of the forested and available land in the Western Upper Peninsula eco-region.

Table 1. Current landscape context and distribution of cover types.

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
Forested	Upland	Deciduous	Aspen	244,209	426,217	542,772	781,760
			Northern Hardwood	146,236			
			Black-Red Hybrid Oak	442			
			Northern Red Oak	5,230			
			Oak Mix	2,106			
			Mixed Upland Deciduous	27,992			
		Mixed	Upland Mixed Forest	27,139	27,139		
		Coniferous	Planted Red Pine	12,264	89,416		
			Planted Jack Pine	13,164			
			Planted White Pine	168			
			Planted Mixed Pine	636			
			Natural Red Pine	6,255			
			Natural Jack Pine	12,854			
			Natural White Pine	6,201			
			Natural Mixed Pines	7,457			
			Upland Spruce/Fir	6,861			
			Upland Conifers	15,450			
			Hemlock	8,107			
	Lowland	Deciduous	Lowland Aspen/Balsam Poplar	6,606	28,673	238,988	
			Lowland Deciduous	22,067			
		Mixed	Lowland Mixed Forest	19,022	19,022		
		Coniferous	Cedar	98,493	191,293		
			Lowland Conifers	47,855			
			Lowland Spruce/Fir	31,111			
			Tamarack	13,834			
Nonforested	Upland	N/A	Herbaceous Openland	9,215	N/A	23,000	100,870
			Upland Shrub	5,997			
			Low Density Trees	2,206			
			Bare/Sparsely Vegetated	1,978			
			Cropland	1,451			
			Urban	2,153			
	Lowland	N/A	Lowland Shrub	45,522	N/A	77,870	
			Marsh	7,511			
			Bog	5,264			
			Treed Bog	9,971			
			Water	9,602			
						Grand Total:	**882,630**

Table 2. Summary table describing the current cover type composition by management availability.

Western Upper Peninsula Forested Cover Type	Available Acres	Available %	Unavailable Acres	Unavailable %	Total Acres	Total %
Aspen	212,972	29.1%	8,353	1.1%	221,325	30.3%
Black-Red Hybrid Oak	270	0.0%	174	0.0%	443	0.1%
Cedar	34,390	4.7%	60,614	8.3%	95,003	13.0%
Hemlock	3,994	0.5%	4,007	0.5%	8,001	1.1%
Lowland Aspen/Balsam Poplar	5,452	0.7%	1,083	0.1%	6,535	0.9%
Lowland Conifers	20,757	2.8%	24,295	3.3%	45,052	6.2%
Lowland Deciduous	11,581	1.6%	9,818	1.3%	21,399	2.9%
Lowland Mixed Forest	12,166	1.7%	6,239	0.9%	18,406	2.5%
Lowland Spruce/Fir	15,716	2.1%	13,419	1.8%	29,135	4.0%
Mixed Upland Deciduous	19,741	2.7%	6,809	0.9%	26,551	3.6%
Natural Jack Pine	12,339	1.7%	437	0.1%	12,776	1.7%
Natural Mixed Pines	5,325	0.7%	2,002	0.3%	7,327	1.0%
Natural Red Pine	4,075	0.6%	1,963	0.3%	6,038	0.8%
Natural White Pine	4,966	0.7%	1,006	0.1%	5,972	0.8%
Northern Hardwood	125,988	17.2%	10,359	1.4%	136,347	18.6%
Northern Red Oak	3,716	0.5%	1,497	0.2%	5,213	0.7%
Oak Mix	2,000	0.3%	106	0.0%	2,106	0.3%
Planted Jack Pine	13,089	1.8%	38	0.0%	13,127	1.8%
Planted Mixed Pine	539	0.1%	0	0.0%	539	0.1%
Planted Red Pine	11,878	1.6%	71	0.0%	11,949	1.6%
Planted White Pine	161	0.0%	7	0.0%	168	0.0%
Tamarack	6,935	0.9%	6,187	0.8%	13,122	1.8%
Upland Conifers	9,474	1.3%	4,761	0.7%	14,235	1.9%
Upland Mixed Forest	19,621	2.7%	4,941	0.7%	24,562	3.4%
Upland Spruce/Fir	4,206	0.6%	1,924	0.3%	6,129	0.8%
Grand Total	**561,349**	**76.7%**	**170,112**	**23.3%**	**731,462**	**100.0%**

Table 3. Site conditions (reason area is unavailable for commercial harvest) for unavailable acres.

Site Condition (Reason area is unavailable for commercial harvest)	Area (ac)	% of Unavailable Area
BMPs	35,465	20.8%
Wildlife Concerns	28,560	16.8%
Deer Wintering Area	22,432	13.2%
Too Wet	17,625	10.4%
Conservation Values	16,967	10.0%
Unproductive	10,978	6.5%
Cannot Regenerate	10,279	6.0%
Too Steep	8,264	4.9%
Blocked by Obstacle	5,302	3.1%
Long-Term Retention	2,342	1.4%
Natural/Quiet/Wilderness Area	2,239	1.3%
Other Dept./Div. Processes	1,649	1.0%
Rare Landforms	1,615	0.9%
Recreational/Scenic	1,461	0.9%
Other Influence Zones	1,215	0.7%
Denied Access	1,179	0.7%
Species of special concern or T&E	1,013	0.6%
Total Unavailable	**170,112**	**100.0%**

Projected 10-year cover type management actions

Each cover type in this eco-region has a unique age class and basal area class goals that describe the long-term desired future conditions. The calculated harvest levels that are needed during the first 10-year planning period are summarized in Table 4. These harvest levels are necessary to begin achieving long-term planning goals. This will help establish a desirable amount of regeneration for even-aged cover types over the 10-year period or help achieve desired basal area distribution among uneven-aged cover types such as northern hardwoods.

Table 4. Ten-year planning period harvest goals (acres) by cover type and silvicultural regime.

Silvicultural Regimes								
Cover Type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Salvage Clearcut	Salvage Thinning	Grand Total
Northern Hardwood	852	48,759	-	278	355	-	-	50,244
Aspen	36,704	-	-	-	-	-	-	36,704
Mixed Upland Deciduous	2,497	1,120	-	-	409	-	-	4,026
Lowland Spruce/Fir	2,808	-	-	-	-	-	-	2,808
Lowland Conifers	2,477	-	-	-	-	-	-	2,477
Upland Mixed Forest	2,393	-	-	-	-	-	-	2,393
Planted Red Pine	51	-	1,695	-	-	-	-	1,745
Upland Conifers	1,509	-	9	-	157	-	-	1,675
Lowland Deciduous	1,085	81	-	-	29	-	-	1,195
Natural Jack Pine	1,107	-	-	-	-	-	-	1,107
Lowland Aspen/Balsam Poplar	1,051	-	-	-	-	-	-	1,051
Lowland Mixed Forest	887	-	-	-	-	-	-	887
Natural Mixed Pines	-	-	426	-	327	-	-	753
Upland Spruce/Fir	599	-	-	-	-	-	-	599
Planted Jack Pine	557	-	-	-	-	-	-	557
Tamarack	534	-	-	-	-	-	-	534
Natural White Pine	-	-	174	-	95	-	-	269
Hemlock	-	198	-	-	-	-	-	198
Natural Red Pine	-	-	41	-	120	-	-	161
Planted White Pine	-	-	143	-	-	-	-	143
Oak Mix	126	-	-	-	-	-	-	126
Northern Red Oak	9	-	-	-	-	-	-	9
Black Red Hybrid Oak	7	-	-	-	-	-	-	7
Totals	**55,253**	**50,157**	**2,488**	**278**	**1,492**	**-**	**-**	**109,668**

A few cover type transitions are projected for this eco-region (Table 5). The managed area of each cover type is projected to remain fairly stable as treatment regimes will not significantly change the amount of area in each cover type. The largest decrease forecasted is in the aspen cover type, where approximately 2,134 acres will convert to other cover types through forest management and

regeneration activities. The largest increase occurs on the upland mixed forest cover type where 1,974 acres are projected to convert into this cover type.

Table 5. Projected 10-year cover type acres resulting from cover type transitions.

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Aspen	244,209	242,075	-2,134
Northern Hardwood	146,236	146,029	-208
Cedar	98,493	98,493	0
Lowland Conifers	47,855	47,945	90
Lowland Spruce/Fir	31,111	30,183	-928
Mixed Upland Deciduous	27,992	27,814	-179
Upland Mixed Forest	27,139	29,113	1,974
Lowland Deciduous	22,067	21,657	-410
Lowland Mixed Forest	19,022	20,406	1,384
Upland Conifers	15,450	14,558	-892
Tamarack	13,834	13,655	-179
Planted Jack Pine	13,164	13,377	213
Natural Jack Pine	12,854	12,774	-80
Planted Red Pine	12,264	13,610	1,347
Hemlock	8,107	8,107	0
Natural Mixed Pines	7,457	7,457	0
Upland Spruce/Fir	6,861	6,445	-416
Lowland Aspen/Balsam Poplar	6,606	6,648	42
Natural Red Pine	6,255	6,255	0
Natural White Pine	6,201	6,357	156
Planted Mixed Pine	636	791	155
Black Red Hybrid Oak	442	444	1
Northern Red Oak	5,230	5,230	0
Oak Mix	2,106	2,118	12
Planted White Pine	168	218	50
Lowland Shrub	45,522	45,522	0
Treed Bog	9,971	9,971	0
Herbaceous Openland	9,215	9,215	0
Marsh	7,511	7,511	0
Upland Shrub	5,997	5,997	0
Bog	5,264	5,264	0
Low Density Trees	2,206	2,206	0
Urban	2,153	2,153	0
Bare/Sparsely Vegetated	1,978	1,978	0
Cropland	1,451	1,451	0
Water	9,602	9,602	0

	Total:	**882,630**	**882,630**	**0**

WUP Management Areas

Brule River

State Forest Area: 27,116 acres	Location: Wisconsin Michigan Border	Population Centers: Crystal Falls
Sub-Section: Crystal Falls Till and Outwash	Landforms: Bedrock knobs surrounded by extensive outwash plains	Landcover: Forested: 24,399 acres Non-forested: 2,717 acres

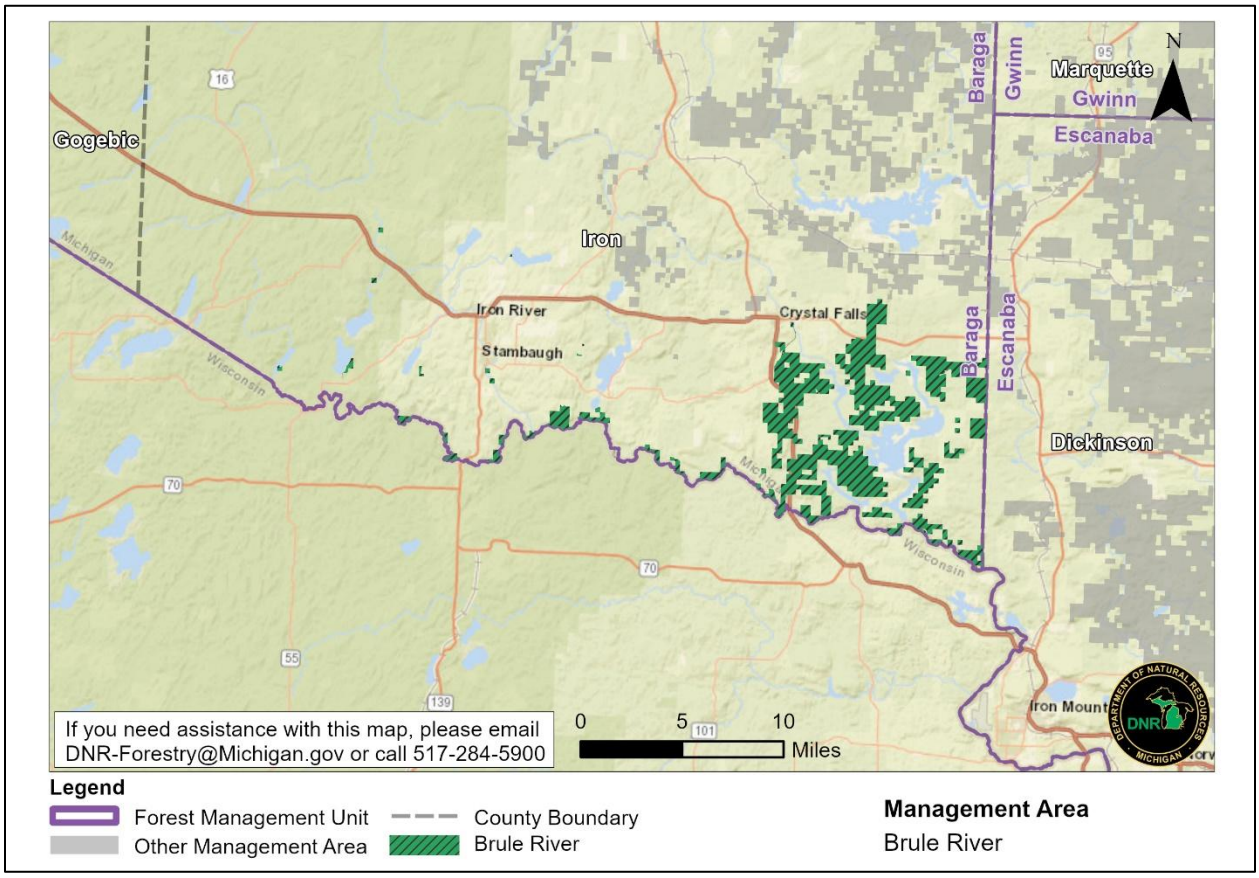


Figure 1. Map of the Brule River management area.

Forested Landscape

Current and projected future condition

The Brule River management area is dominated by young, shade-intolerant cover types that are largely upland and available. Intolerant deciduous cover types are relatively evenly distributed across age categories. Unavailable upland and lowland acres are more prevalent in the older age category.

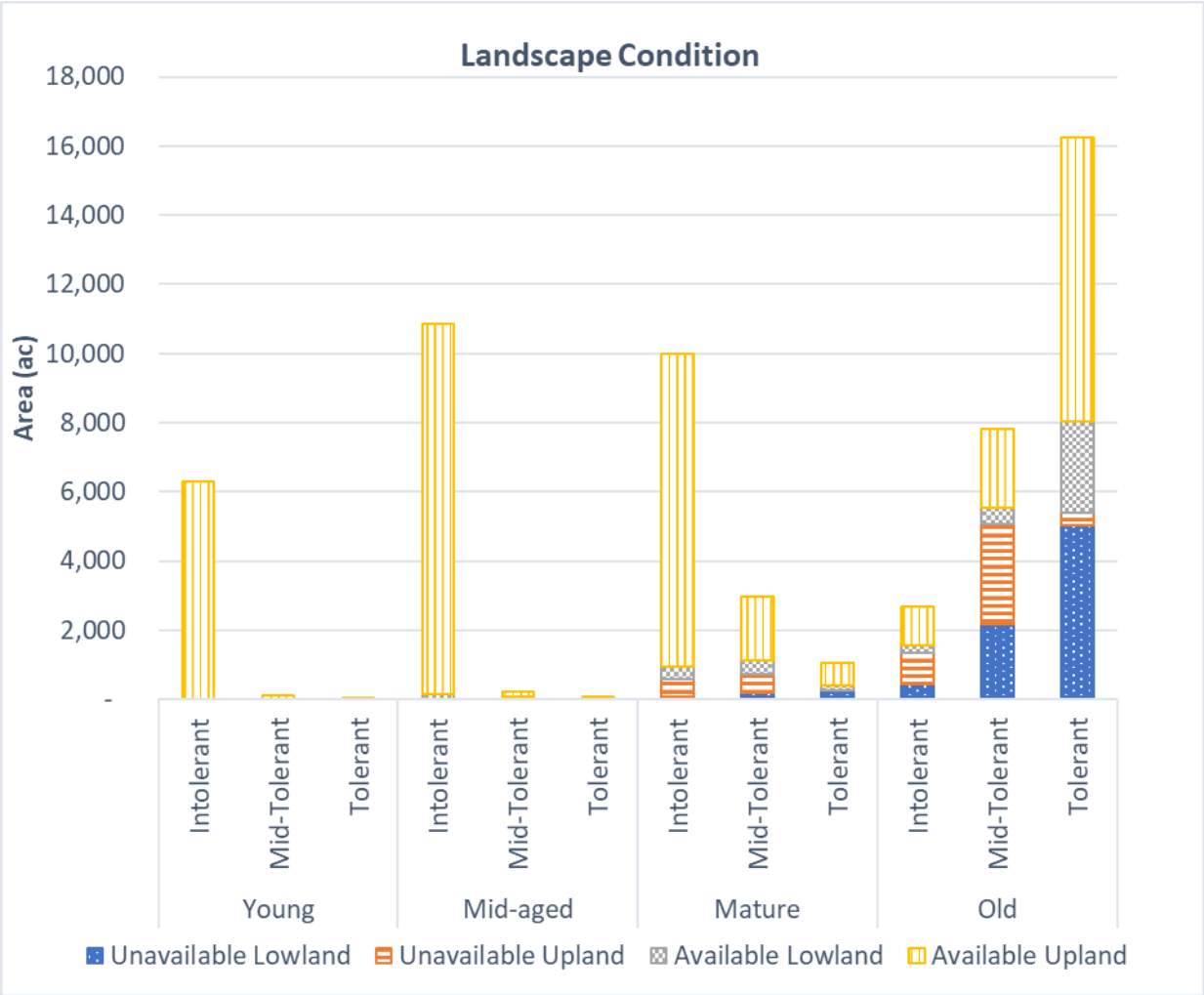


Figure 2. Forest diversity matrix showing the current distribution of forested acres across management availability, age category, landscape position and shade tolerance.

Landscape habitat conditions refine the management area landscape into featured species habitat context. Current and projected acres for the metrics identified in the Management Priorities (Section 3 Statewide/Regional) establish a baseline and future condition based on management over the planning period (Table 1).

Table 1. Current and projected acres for Landscape Habitat Conditions.

Landscape Habitat Condition	Monitoring Metric	Current Acres
Young forest	Acres of 0-19 stands in Aspen and Jack Pine	3,254
Mature forest	Acres of 80+ year stands across cover types	7,667
Mature forest	Acres of 120+ year stands across cover types	798
Mesic conifer cover types	Acres of mesic conifer cover types	1,132
Mesic conifers in other cover types	Average canopy occupancy	40%
Mast – oak cover types	Acres of Oak cover types	1,234
Mast tree species in other cover types	Total Acres of Canopy Occupancy of Mast Tree Acres (Trace-100%)	5,219
Big trees	Acres of Total Canopy Stand Occupancy of Species in Sawlog or Greater Size Class	8,239
Non-forested openings	Total Acres of herbaceous open land, upland shrub and cropland	1,119
Landscape forest matrix	Percent Deciduous Forest	65%
Landscape forest matrix	Percent Coniferous Forest	33%

The Brule River management area has the following Special Analysis Units (SAUs). These SAUs have specific cover type goals, typically associated with wildlife habitat management. For any SAUs that overlap with this MA, SAU cover type goals take priority as the SFMP model strives to meet the cover type goals across the MA, ensuring they are met. Please see Section 5 for a detailed description of the management direction and harvest goals for each of these SAUs.

- Deer Wintering Complex (DWC)-Iron-Floodwood

The Brule River Management Area is dominated by forested cover types with 90 percent of the area covered in forested stands (Table 2). The upland deciduous portion of that is 57 percent of the management area and comprised mostly of aspen and northern hardwood. Upland shrub is the most common non-forested cover type in this management area, representing 3 percent of the landscape.

Table 2. Current landscape context and distribution of cover types.

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
Forested	Upland	Deciduous	Aspen	11,562	15,408	21,691	24,399
			Northern hardwood	2,396			
			Black-red ybrid oak	180			
			Northern red oak	811			
			Oak mix	285			
			Mixed upland deciduous	174			
		Mixed	Upland mixed forest	436	436		
		Coniferous	Planted red pine	1,999	5,848		
			Planted jack pine	696			
			Planted white pine	0			
			Planted mixed pine	69			
			Natural red pine	376			
			Natural jack pine	1,575			
			Natural white pine	167			
			Natural mixed pines	694			
			Upland spruce/fir	85			
			Upland conifers	144			
			Hemlock	43			
	Lowland	Deciduous	Lowland aspen/balsam poplar	31	426	2,708	
			Lowland deciduous	395			
		Mixed	Lowland mixed forest	83	83		
		Coniferous	Cedar	610	2,199		
			Lowland conifers	586			
			Lowland spruce/fir	765			
			Tamarack	239			
Nonforested	Upland	N/A	Herbaceous openland	160	N/A	1,618	2,717
			Upland shrub	857			
			Low density trees	15			
			Bare/sparsely vegetated	30			
			Cropland	102			
			Urban	454			
	Lowland	N/A	Lowland shrub	614	N/A	1,099	
			Marsh	61			
			Bog	115			
			Treed bog	23			
			Water	285			
						Grand Total:	**27,116**

There are 20,511 acres (76 percent of the total management area and 84 percent of the forested area) that can be managed toward desired future conditions via commercial timber harvest in the Brule River Management Area (Table 3). More than 45 percent is in the aspen cover type, 10 percent in northern hardwood, 8 percent in planted red pine, and 7 percent in natural jack pine. The remaining 20 cover types represent less than 15 percent each of the forested and available land in the management area.

Table 3. Current cover type composition by management availability.

BRULE RIVER Forested Cover Type	Available Acres	Available %	Unavailable Acres	Unavailable %	Total Acres	Total %
Aspen	10,997	45.1%	565	2.3%	11,562	47.4%
Black-red hybrid oak	49	0.2%	131	0.5%	180	0.7%
Cedar	30	0.1%	580	2.4%	610	2.5%
Hemlock	0	0.0%	43	0.2%	43	0.2%
Lowland aspen/balsam poplar	0	0.0%	31	0.1%	31	0.1%
Lowland conifers	212	0.9%	374	1.5%	586	2.4%
Lowland deciduous	13	0.1%	382	1.6%	395	1.6%
Lowland mixed forest	28	0.1%	55	0.2%	83	0.3%
Lowland spruce/fir	96	0.4%	669	2.7%	765	3.1%
Mixed upland deciduous	23	0.1%	150	0.6%	174	0.7%
Natural jack pine	1,575	6.5%	0	0.0%	1,575	6.5%
Natural mixed pines	527	2.2%	167	0.7%	694	2.8%
Natural red pine	246	1.0%	131	0.5%	376	1.5%
Natural white pine	120	0.5%	47	0.2%	167	0.7%
Northern hardwood	2,320	9.5%	77	0.3%	2,396	9.8%
Northern red oak	235	1.0%	576	2.4%	811	3.3%
Oak mix	241	1.0%	45	0.2%	285	1.2%
Planted jack pine	696	2.9%	0	0.0%	696	2.9%
Planted mixed pine	69	0.3%	0	0.0%	69	0.3%
Planted red rine	1,999	8.2%	0	0.0%	1,999	8.2%
Tamarack	73	0.3%	166	0.7%	239	1.0%
Upland conifers	83	0.3%	61	0.3%	144	0.6%
Upland mixed forest	379	1.6%	57	0.2%	436	1.8%
Upland spruce/fir	6	0.0%	79	0.3%	85	0.3%
Grand Total	**20,016**	**82.0%**	**4,383**	**18.0%**	**24,400**	**100.0%**

Table 4. Site conditions (reason area is unavailable for commercial harvest) for unavailable acres.

Site Condition (Reason area is unavailable for commercial harvest)	Area (ac)	% of Unavailable Area
Wildlife concerns	1,948	44.4%
Too wet	731	16.7%
Deer wintering area	679	15.5%
BMPs	569	13.0%
Non-military lease/easement	178	4.1%
Denied access	110	2.5%
Historical/archaeological	50	1.1%
Too steep	43	1.0%
Long-term retention	38	0.9%
Recreational/scenic	17	0.4%
Unproductive	13	0.3%
Blocked by obstacle	5	0.1%
Total unavailable	**4,383**	**100.0%**

Management actions

Each cover type in the Brule River area has a unique age class and basal area class goals that describe the long-term desired future conditions. The harvests levels that are needed in the first planning period to begin achieving those long-term goals are summarized below (Table 5). These harvests will help establish a desirable amount of regeneration for the even-aged cover types over the 10-year period or help to achieve desired basal area distribution among uneven-aged cover types like northern hardwoods. Implementing these silvicultural regimes will yield 53,714 cords of wood, the planned harvest volume for the decade (Table 6).

Table 5. Ten-year planning period harvest goals (acres) by cover type and silvicultural regime.

Silvicultural Regimes								
Cover Type	**Clearcut**	**Selection**	**Thinning**	**Group Selection**	**Shelterwood**	**Salvage Clearcut**	**Salvage Thinning**	**Grand Total**
Aspen	1,824	-	-	-	-	-	-	1,824
Northern hardwood	-	669	-	-	-	-	-	669
Planted red pine	-	-	360	-	-	-	-	360
Natural jack pine	107	-	-	-	-	-	-	107
Natural mixed pines	-	-	38	-	48	-	-	85
Lowland conifers	40	-	-	-	-	-	-	40
Oak mix	35	-	-	-	-	-	-	35
Upland conifers	14	-	-	-	-	-	-	14
Mixed upland deciduous	5	-	-	-	-	-	-	5
Natural red pine	-	-	-	-	4	-	-	4
Totals	**2,024**	**669**	**398**	**-**	**52**	**-**	**-**	**3,142**

Table 6. Projected 10-year harvest volume by product and species.

10-Year Estimated Harvest Volume Projection Brule River Management Area Product	Species	Volume Planned*	Volume Prepared**
Pulpwood (cords)	Mixed aspen	16,984	15,965
	Mixed hardwood	6,884	6,471
	Mixed spruce	2,640	2,481
	Jack pine	2,581	2,426
	Red pine	2,361	2,220
	Mixed softwood	1,025	963
	Mixed oak	499	469
	White pine	424	399
	Pulpwood Total	**33,398**	**31,394**
Sawtimber (MBF)	Mixed aspen	2,501	2,351
	Red pine	2,397	2,253
	Sugar maple	2,215	2,082
	Red maple	942	885
	White pine	603	567
	Red oak	354	333
	Basswood	182	172
	Mixed oak	113	106
	White oak	21	20
	Sawtimber Total	**9,328**	**8,769**
	Total Sawtimber Harvest Volume in Cords	**20,316**	**19,097**
	Grand Total Harvest Volume in Cords	**53,714**	**50,491**

* Volume estimates based on 100% of the projected harvests for the 10 year planning period.

** Volume estimates based on 94% of the projected harvests for the 10 year planning period accounting for reduction in acres and associated volume once sales are prepared for bid.

There are very few cover type transitions projected in the Brule River area (Table 7). The managed area of each cover type is projected to remain relatively stable. The largest decrease forecasted is in the aspen cover type where 102 acres are expected to convert to other cover types through forest management activities. The largest increase is in red pine where 67 acres are expected to convert into that cover type.

Table 7. Projected 10-year cover type acres resulting from cover type transitions.

Cover Type	Current Acreage	Projected Acreage at End of 10-Year Planning Period	Projected 10-Year Change in Acreage
Aspen	11,562	11,460	-102
Northern hardwood	2,396	2,395	-1
Planted red pine	1,999	2,066	67
Natural jack pine	1,575	1,538	-37
Northern red oak	811	810	0
Lowland spruce/fir	765	765	0
Planted jack pine	696	736	40
Natural mixed pines	694	694	0
Cedar	610	610	0
Lowland conifers	586	586	0
Upland mixed forest	436	440	4
Lowland deciduous	395	393	-2
Natural red pine	376	376	0
Oak mix	285	285	0
Tamarack	239	236	-3
Black-red hybrid oak	180	180	0
Mixed upland deciduous	174	173	0
Natural white pine	167	168	1
Upland conifers	144	137	-7
Upland spruce/fir	85	85	0
Lowland mixed forest	83	87	4
Planted mixed pine	69	104	35
Hemlock	43	43	0
Lowland aspen/balsam poplar	31	31	0
Planted white pine	0	0	0
Upland shrub	857	857	0
Lowland shrub	614	614	0
Urban	454	454	0
Water	285	285	0
Herbaceous openland	160	160	0
Bog	115	115	0

Cover Type	Current Acreage	Projected Acreage at End of 10-Year Planning Period	Projected 10-Year Change in Acreage
Cropland	102	102	0
Marsh	61	61	0
Bare/sparsely vegetated	30	30	0
Treed Bog	23	23	0
Low Density Trees	15	15	0
Total	**27,116**	**27,116**	**0**

Featured species current and projected habitat acres

There are nine featured species in this management area that span various cover types, age classes, and stand level conditions.

As noted in the Featured Species Management Priority (Section 3), it is recommended that these featured species habitat acres be viewed as acres of potential habitat, representing a condition on the landscape where the more nuanced aspects of each species' habitat requirements are likely to be found or managed for. The modeling effort was limited by several factors including the simplification of habitat attributes into MiFI variables. Therefore, when referring to habitat acres what is being referred to is potential habitat acres.

Current and projected total habitat acres by species across the decade provide a baseline and show the result of long-term management actions (Table 8). Some species show a loss in habitat over the next century. The current condition for many cover types is a surplus of acres in the 0-9 age class from the compensatory management approach applied in the previous decade. The model eventually evens out the age classes at a lower, sustainable level over time, usually by 50 years. For any species with northern hardwoods as a priority cover type, there is a perceived drop in acres between 40-60 years. This is due to the basal area dropping below 81 but because it only drops into the upper 70s, it is not expected to translate to any real habitat loss on the ground. Two of these species were not included in the SFMP model but are included here to inform management decisions over the decade. White-tailed deer habitat acres are not limited to deer wintering complexes.

Table 8. Featured species current and projected total habitat acres (i.e., potential habitat).

Featured Species	Priority Covertypes	Total Habitat Acres Current	10-year Projected Habitat Acres	50-year Projected Habitat Acres	100-year Projected Habitat Acres
Black bear	Generalist/mast	5,219	--	--	--
Golden-winged warbler	Aspen, black/red hybrid oak, northern red oak, oak mix, tamarack	4,000	3,623	3,322	3,329

Featured Species	Priority Covertypes	Total Habitat Acres Current	10-year Projected Habitat Acres	50-year Projected Habitat Acres	100-year Projected Habitat Acres
Marten	Northern hardwoods, mixed upland deciduous, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, lowland mixed forest, lowland conifers, hemlock, cedar	3,390	4,128	3,252	4,494
Moose	To be determined	--	--	--	--
Ruffed grouse	Aspen	3,901	3,463	3,294	3,268
Snowshoe hare	Aspen, cedar, hemlock, lowland aspen, lowland conifers, lowland mixed forest, lowland spruce/fir, mixed upland deciduous, natural jack pine, natural mixed pines, planted jack pine, upland spruce/fir	5,363	4,826	3,947	3,952
White-tailed deer (food)	Northern hardwood, oak mix, aspen, mixed upland deciduous, lowland deciduous, lowland aspen/balsam poplar, lowland mixed forest	16,352	16,255	15,963	15,812
White-tailed deer (shelter)	Hemlock, cedar, planted red pine, planted white pine, planted mixed pine, natural red pine, natural white pine, natural mixed pines, upland conifers, upland spruce fir, lowland conifers	5,537	5,635	6,132	6,592
Wild turkey	Non-forested openings	175	--	--	--
Wood turtle	Non-forested openings	--	--	--	--

Deer Wintering Complexes (DWCs) that are greater than 15,000 acres are modeled as a Special Analysis Unit (SAU) and information on them can be found in Section 5 of the plan. In DWCs less than 15,000 acres, harvest of cedar and hemlock are not allowed within obligate range stands, and secondary shelter is often protected as well. These areas are guided by the DNR Deer Winter Range Guidelines.

Cover type composition and associated featured species

Aspen

Current condition

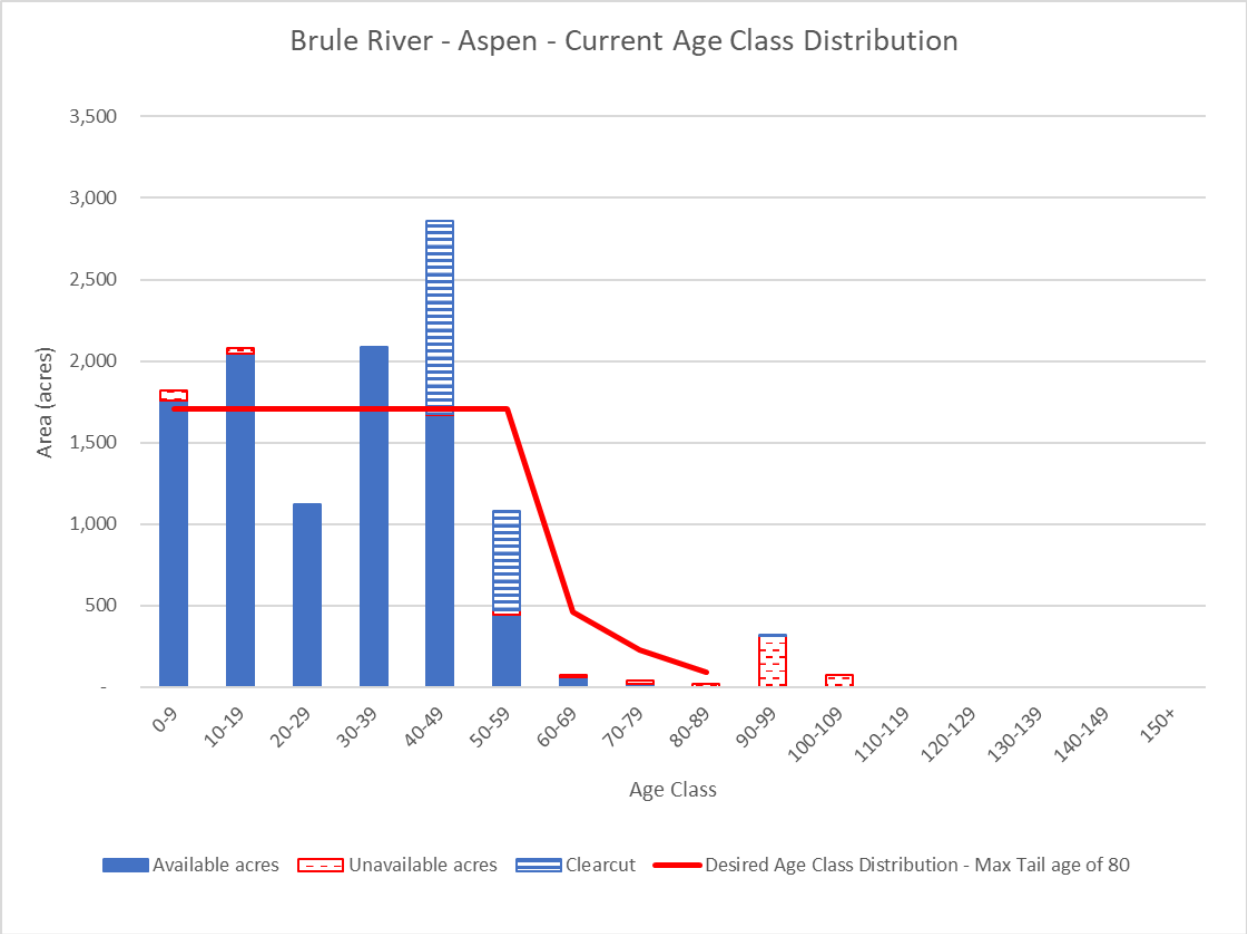


Figure 3. Current age class distribution, the desired age class distribution, and the projected harvests in the aspen cover type over the 10-year planning period.

The current age class distribution is somewhat unbalanced with a deficit of acres in ages 20-39 years old and a surplus of acres in the 4049-year-old age class. The younger age classes are in pretty good shape with only a slight surplus in each. Limited merchantable acres in the older age classes will present managers with a challenge in achieving the desired regeneration during this planning period. A portion of this cover type meets the habitat requirements for golden-winged warbler, ruffed grouse, snowshoe hare and white-tailed deer.

Table 9. Featured species with aspen as a priority habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Aspen	Aspen Habitat Acres - Available	Aspen Habitat Acres - Unavailable
Golden-winged warbler	Age category: 0-19 Size class: Sapling	3,901	98
Ruffed grouse	Age category: 0-19 Size class: sapling	3,901	98
Snowshoe hare	Age category: 0-19 Size class: sapling	3,901	98
White-tailed deer	All ages and size classes	11,562	--

Desired future condition

The desired age class distribution is to have a rotation age of 50 years with approximately 7 percent of the acres in an age class tail out to a maximum of 80-year age class.

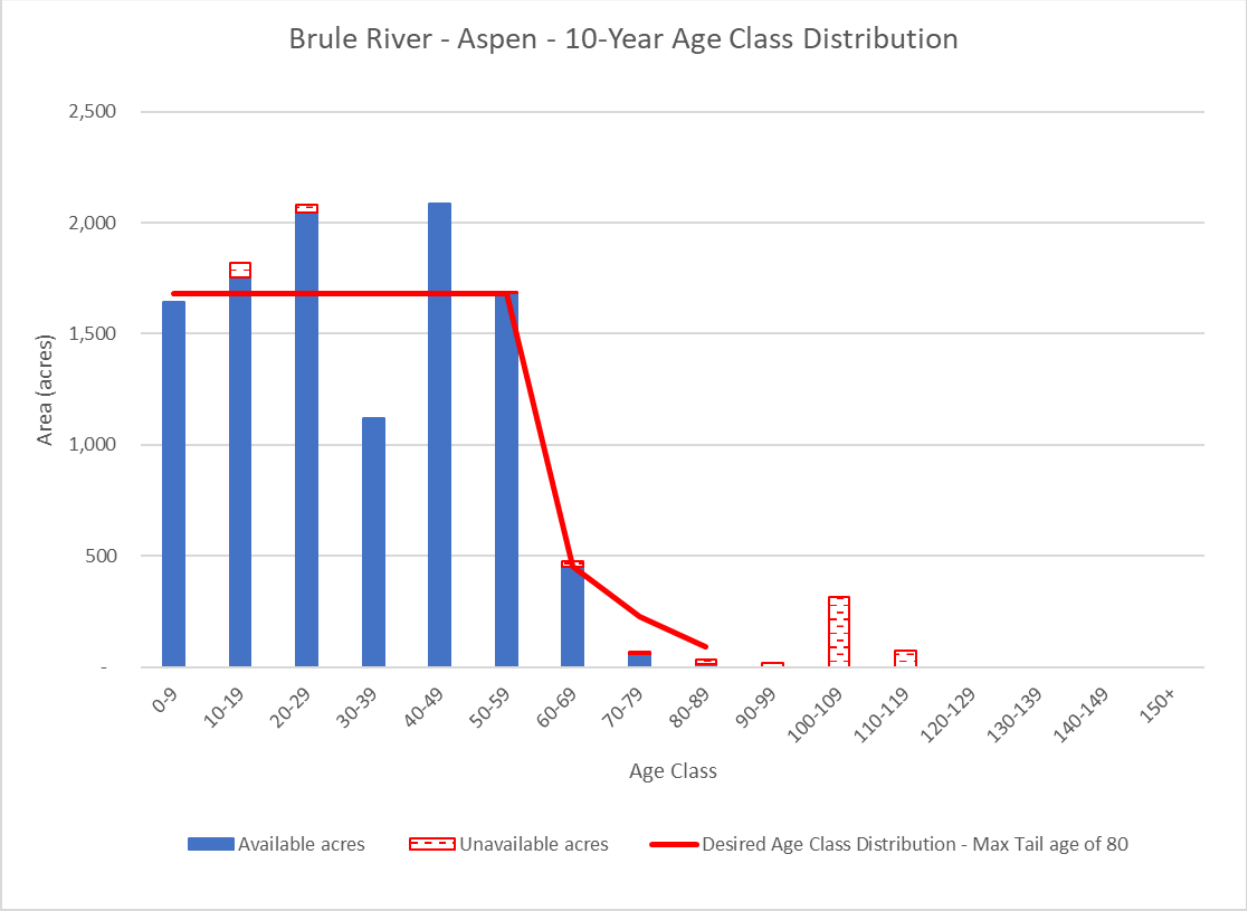


Figure 4. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The end of the planning period will result in the establishment of as many acres as possible in the upcoming 0-9 age class. Progress toward the long-term desired age class distribution of aspen will take many decades in this management area.

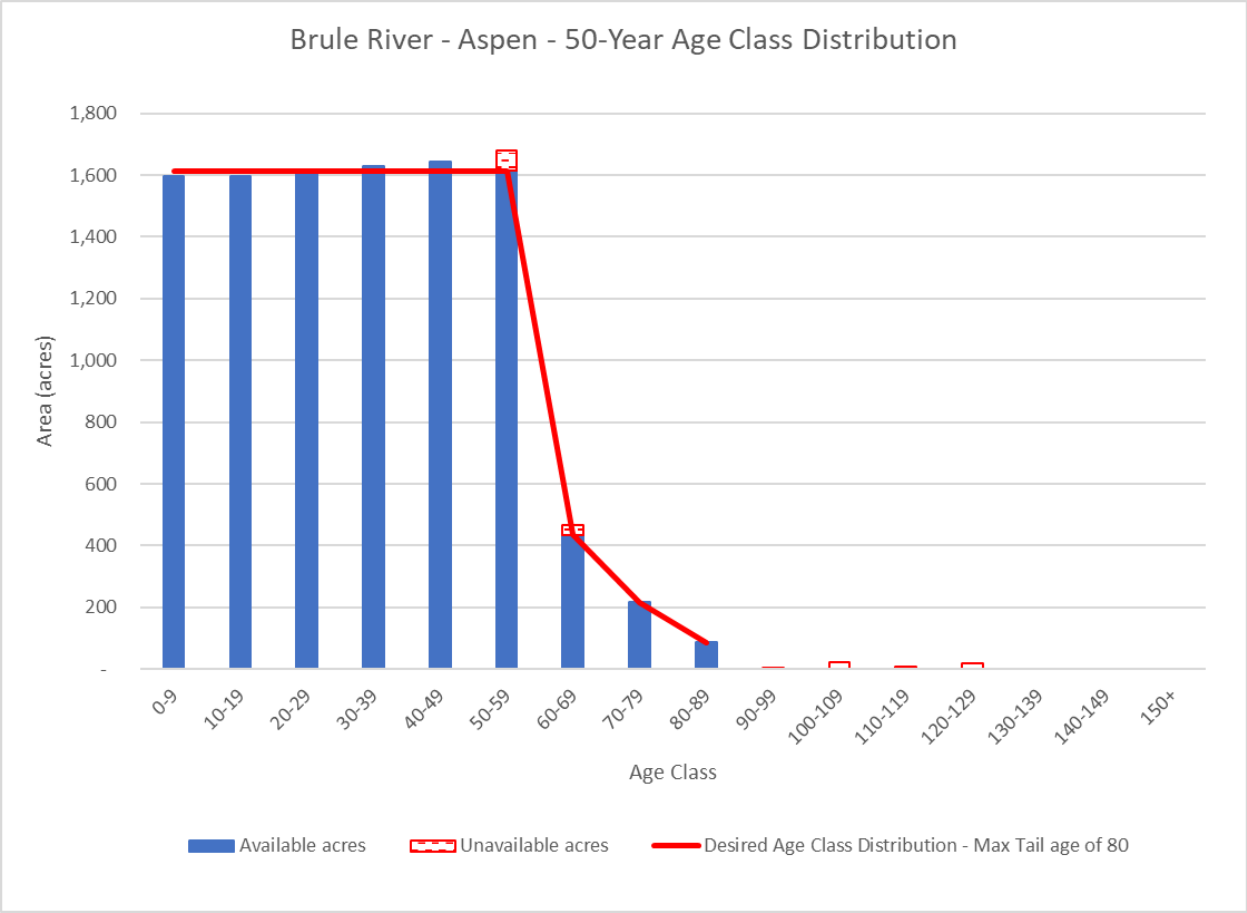


Figure 5. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of aspen acres reaching the desired future condition with only a few age classes deviating from the target proportions (Figure 5).

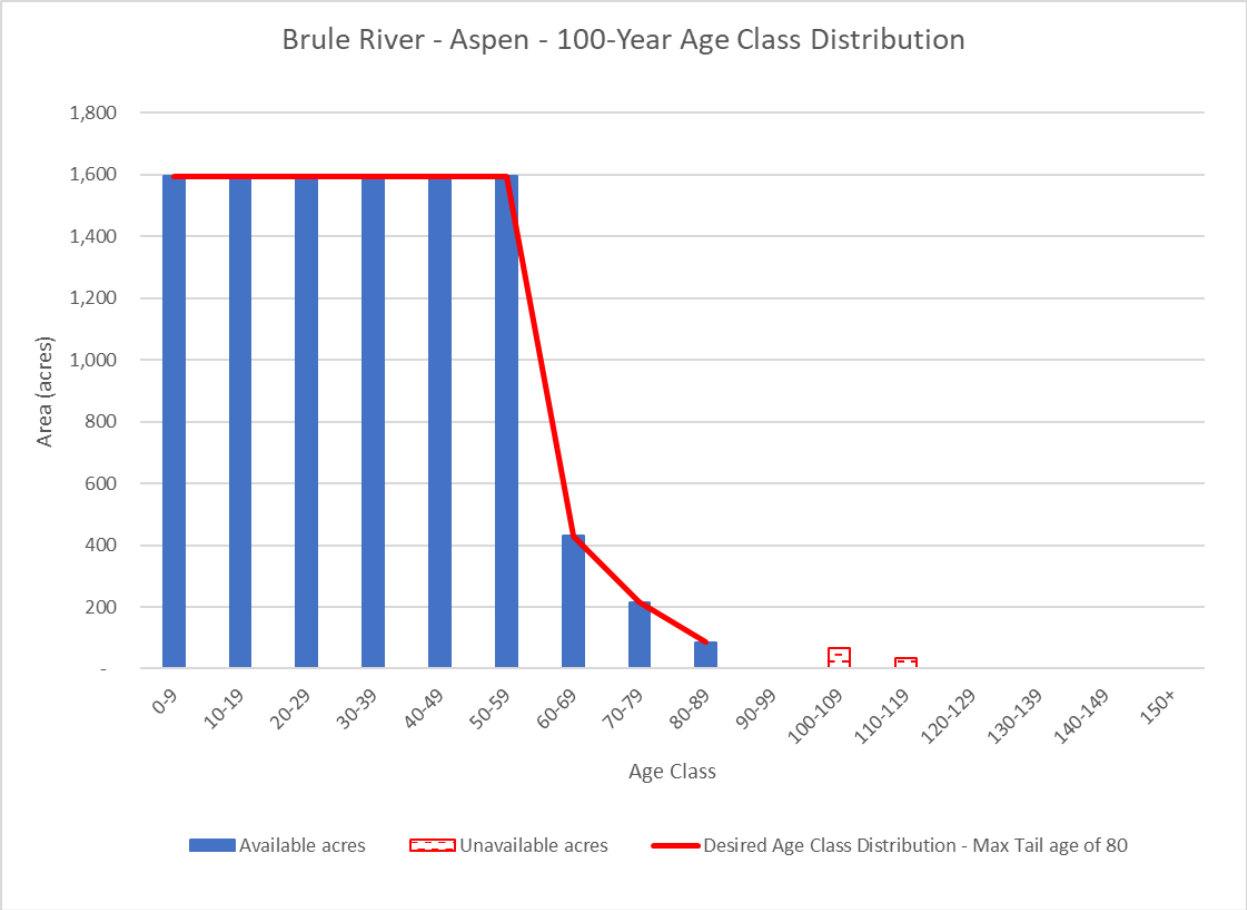


Figure 6. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 6) will concentrate the manageable acres of aspen in productive growing conditions while providing an even flow of forest products and a wide variety of wildlife habitat conditions across the landscape in young, mid-aged, and mature forest.

Management actions

There are 1,824 acres of projected clearcut harvest in the aspen cover type. It is expected that about 102 acres of aspen will be converted to other cover types. These add up to an expected 1,722 acres of regeneration in the aspen cover type over the next 10 years.

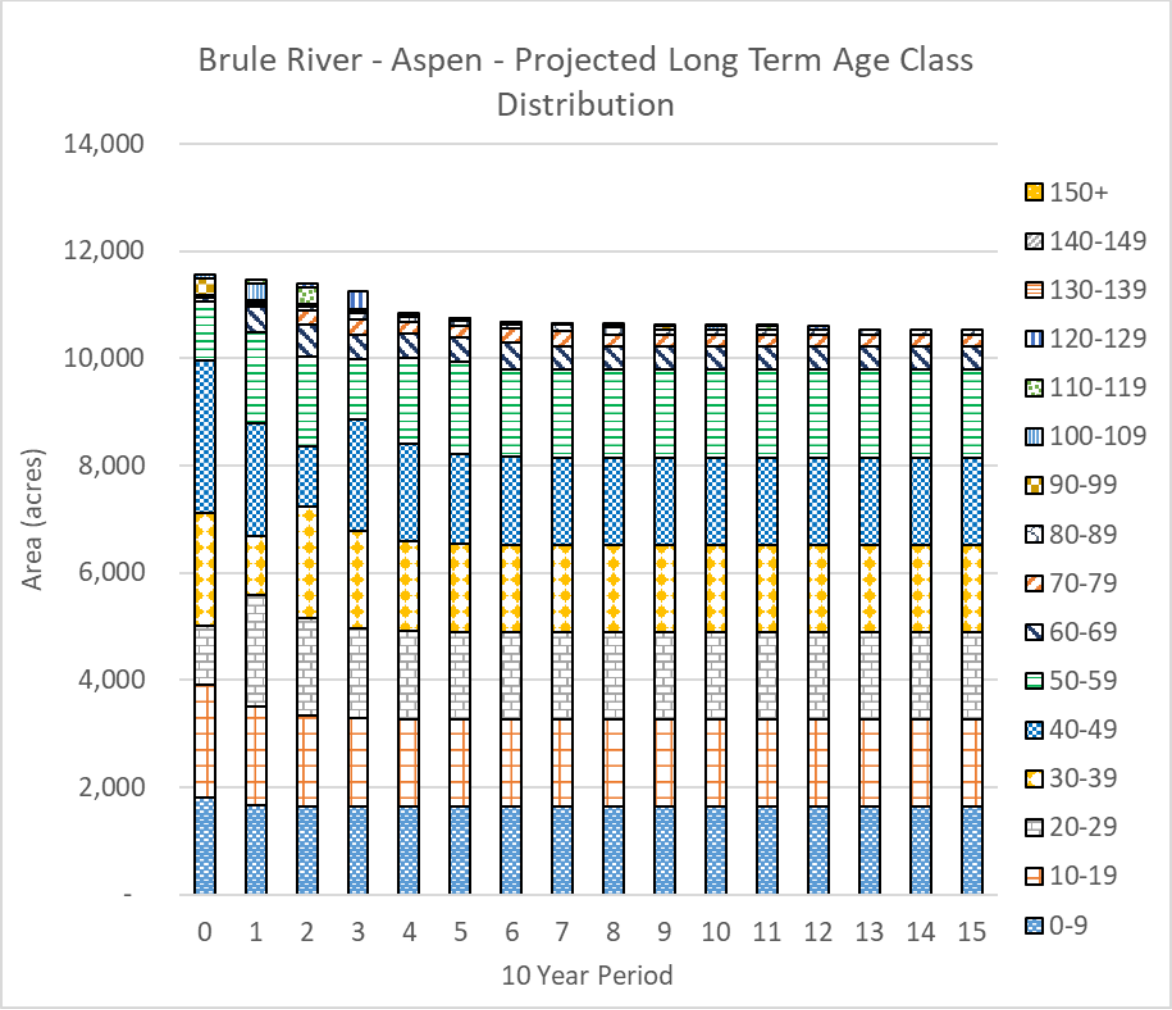


Figure 7. Projected age class distribution over 15, 10-year planning periods.

Northern hardwoods

Current condition

Most of the northern hardwood cover type in the Brule River area is currently between a stand age of 90 and 110 years old (Figure 8). The past management regime has been primarily single-tree selection, which allows for stand age to continue to increase over time. Some stands are beginning to achieve an uneven-aged condition where a featured stand age becomes less evident, but the dominant age of these stands will likely increase past 150 years old prior to a younger age cohort becoming the prominent component of these stands (Figure 10).

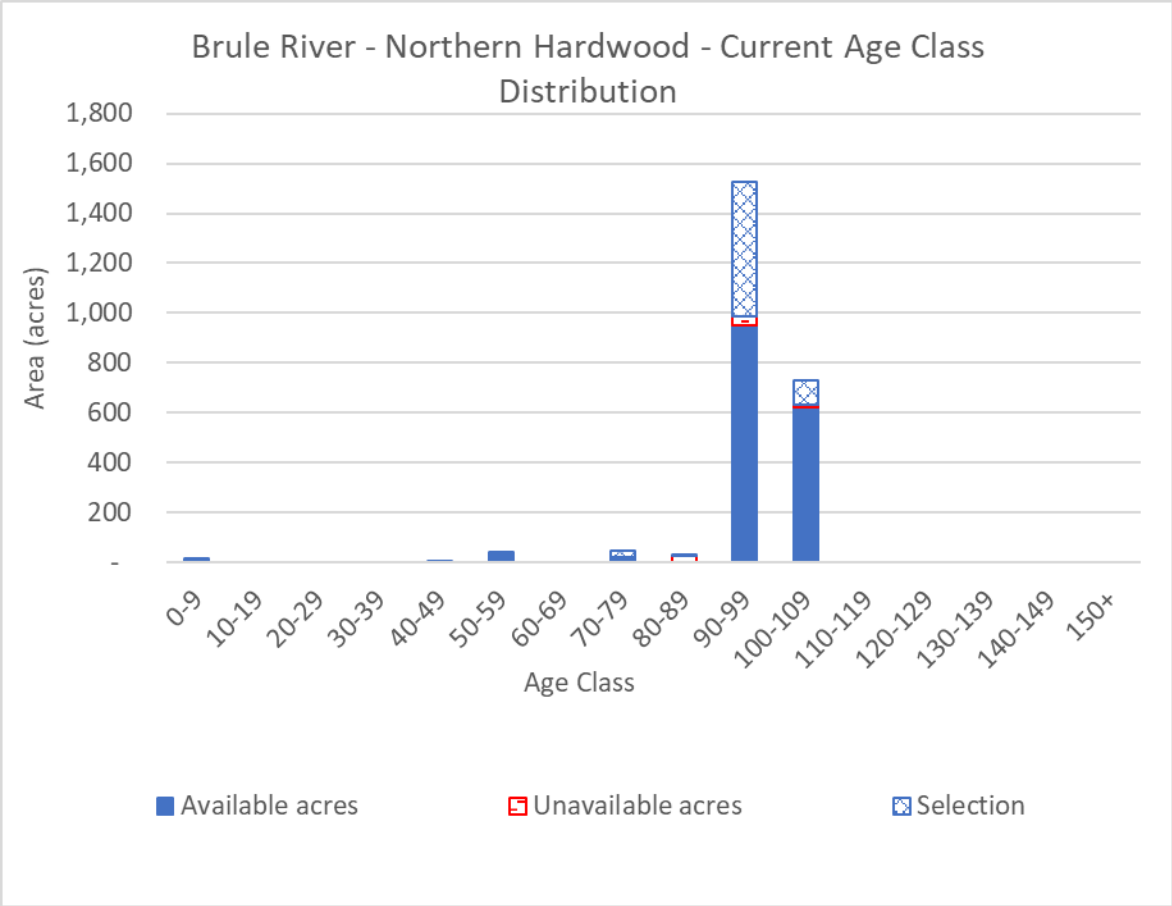


Figure 8. Current age class distribution and projected harvests in the northern hardwood cover type in the Brule River management area.

The area of northern hardwood is well distributed in the ideal basal area classes for optimal growing conditions in the Bule River management area (Figure 9). Current conditions are a result of a well-regulated selection harvest regime that has been in place in this management area for decades.

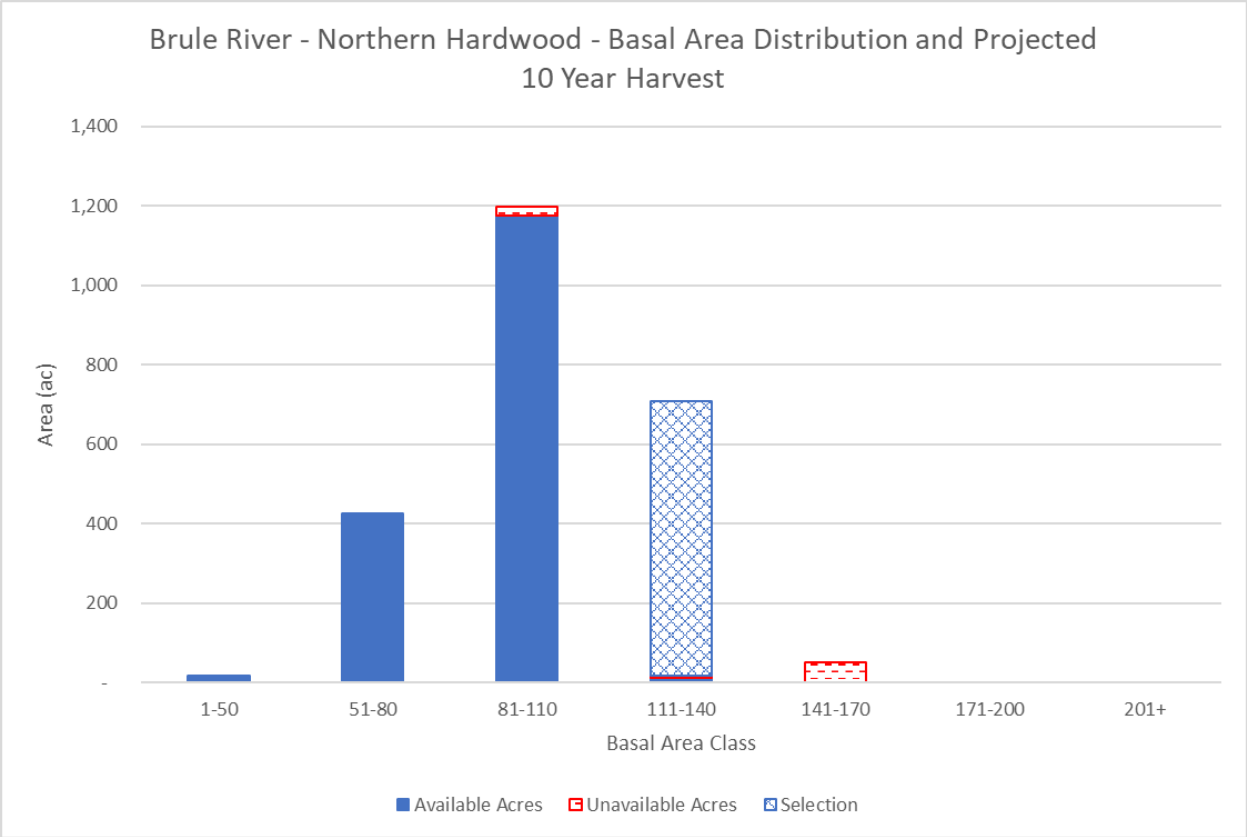


Figure 9 Current basal area distribution of the northern hardwood cover type as well as the projected harvests from each basal area class.

Table 9. Featured species with northern hardwoods as a priority habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Northern Hardwood	Northern Hardwood Habitat Acres-Available	Northern Hardwood Habitat Acres-Unavailable
Marten	Age category: 40+ Size category: pole, sawlog Basal area: 81+	1,817	77
White-tailed deer	All ages and size classes	2,396	--

Desired future condition

The projected long-term cover type trend for northern hardwood is stable in the Brule River management area. There are no transitions to or from this cover type expected in this management area in the next 10 years.

The desired basal area distribution is a bell-shaped curve where a significant majority of the area is kept in the 81-110 basal area class with recently harvested stands occupying the 51-80 class and stands that

are ready for harvest occupy the 111-140 basal area class. Diameter distributions of the northern hardwood stands should follow the appropriate Q-curve relative to stand age and condition.

An un-even aged condition is the long-term goal for all northern hardwood stands in this management area. An uneven-aged condition is achieved when there is no single discernable age cohort that is more prevalent than others across the stand area as canopy gaps fill in with regenerating seedlings, saplings, poles, and eventually remaining stems become sawlog-sized.

Regeneration and recruitment continue to be a focus in the northern hardwood cover type across this management area. The long-term sustainability of this cover type in an uneven-aged silvicultural regime is dependent on the successful establishment of northern hardwood species as well as the recruitment of those seedlings and saplings into the pole- and saw-log classes. Northern hardwood in the Brule River management area has regeneration and recruitment challenges due to cervid herbivory and competition from sedge.

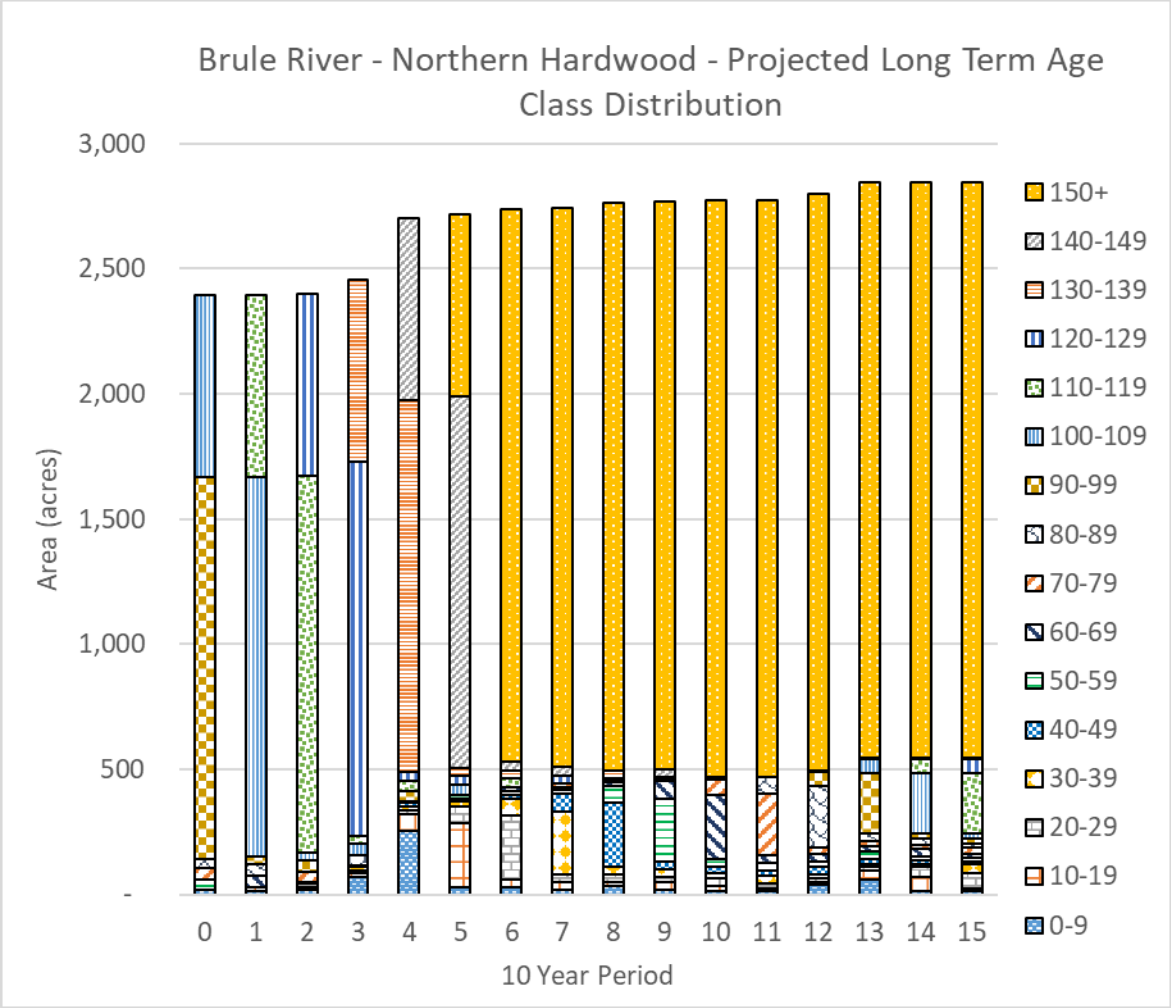


Figure 10. Projected age class distribution over 15,10-year planning periods.

Management actions

The desired forest conditions and associated featured species habitat will be maintained and achieved through continued application of the projected selection harvest regime on 669 acres (Table 5). Larger canopy gaps should be used to encourage diverse regeneration of northern hardwood species while maintaining an overall long-term, mature forest, closed canopy landscape condition. A small portion of the stands may need to be clearcut to get adequate regeneration; this is estimated to be about 8 acres.

Planted red pine

Current condition

The current age class distribution is very unbalanced with a surplus of acres in the 60-69- and 70–79-year-old age classes. The younger age classes have very few acres and are poorly distributed.

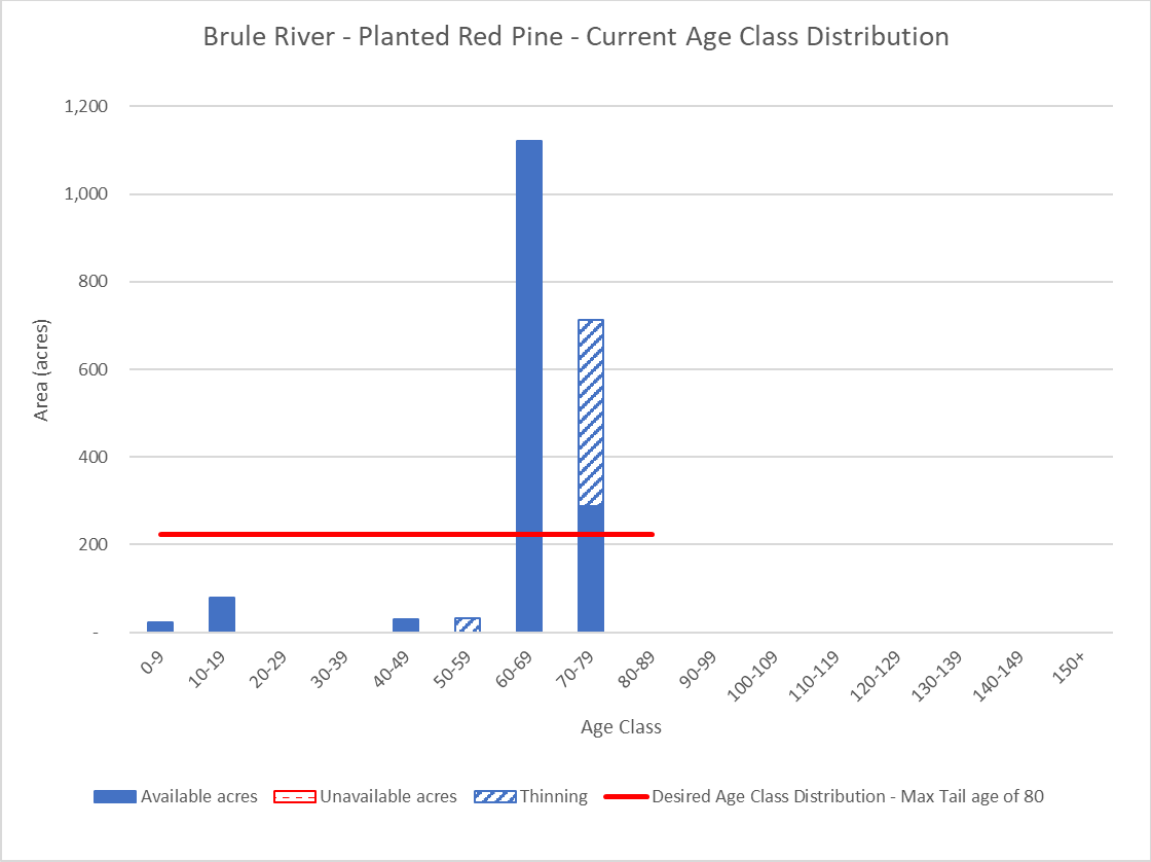


Figure 11. Current age class distribution, the desired age class distribution, and the projected harvests in the planted red pine cover type over the 10-year planning period.

Desired future condition

The desired future condition is to have an even age class distribution with a rotation age of 80 years.

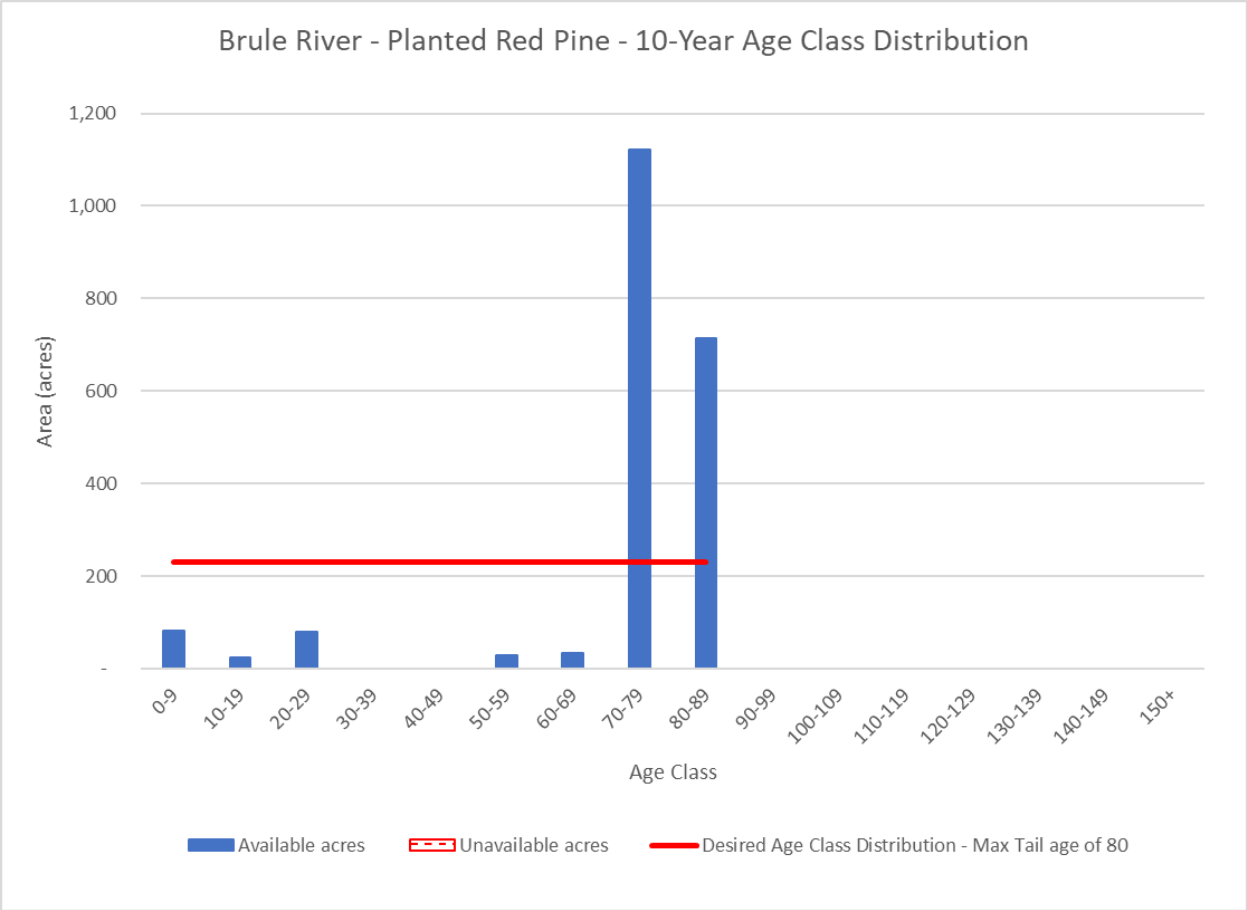


Figure 12. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The end of the planning period will result in the establishment of 67 acres in the upcoming 0-9 age class. Progress toward the long-term desired age class distribution of planted red pine will take many decades.

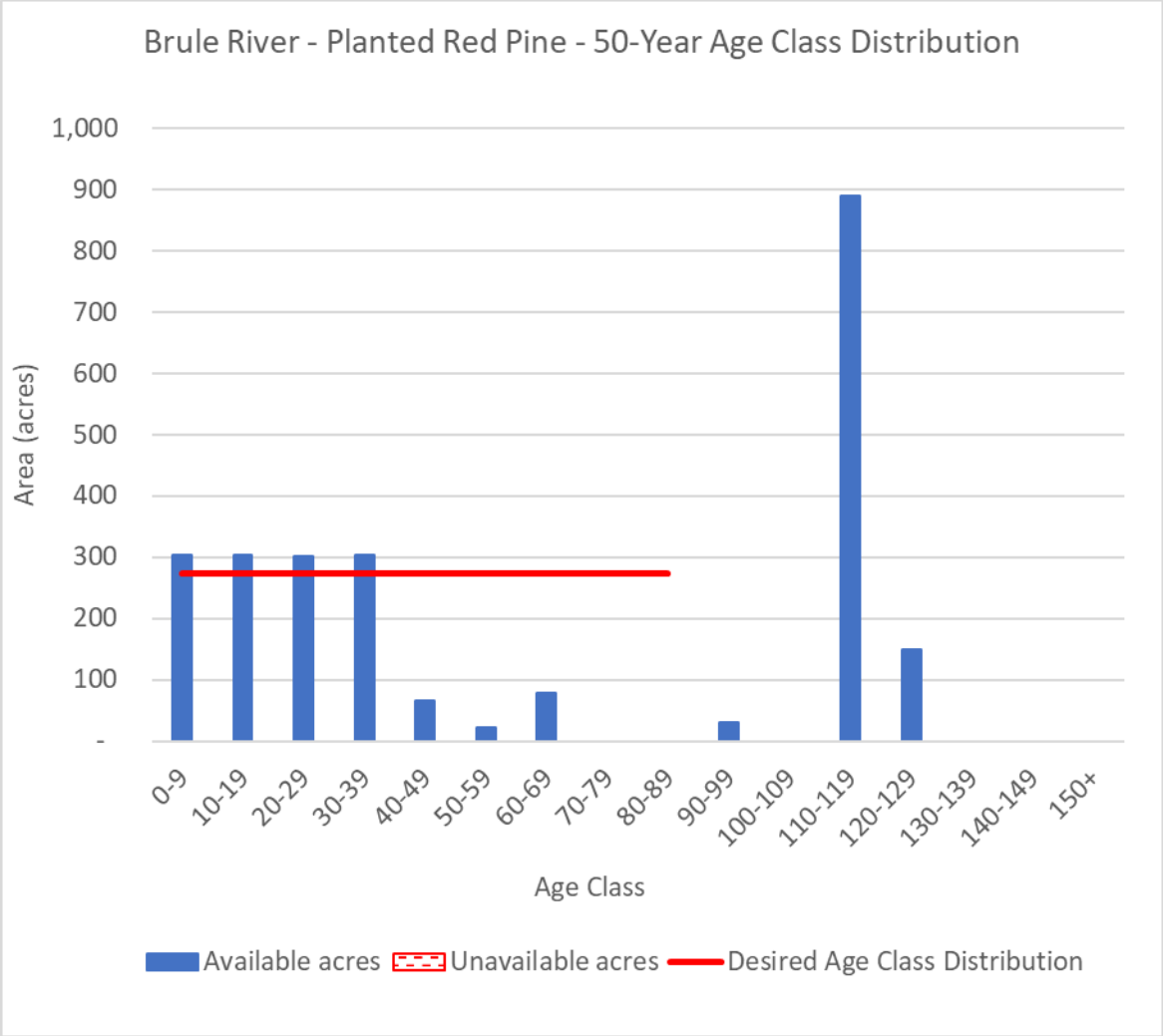


Figure 13. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of aspen acres reaching the desired future condition with only a few age classes deviating from the target proportions (Figure 13).

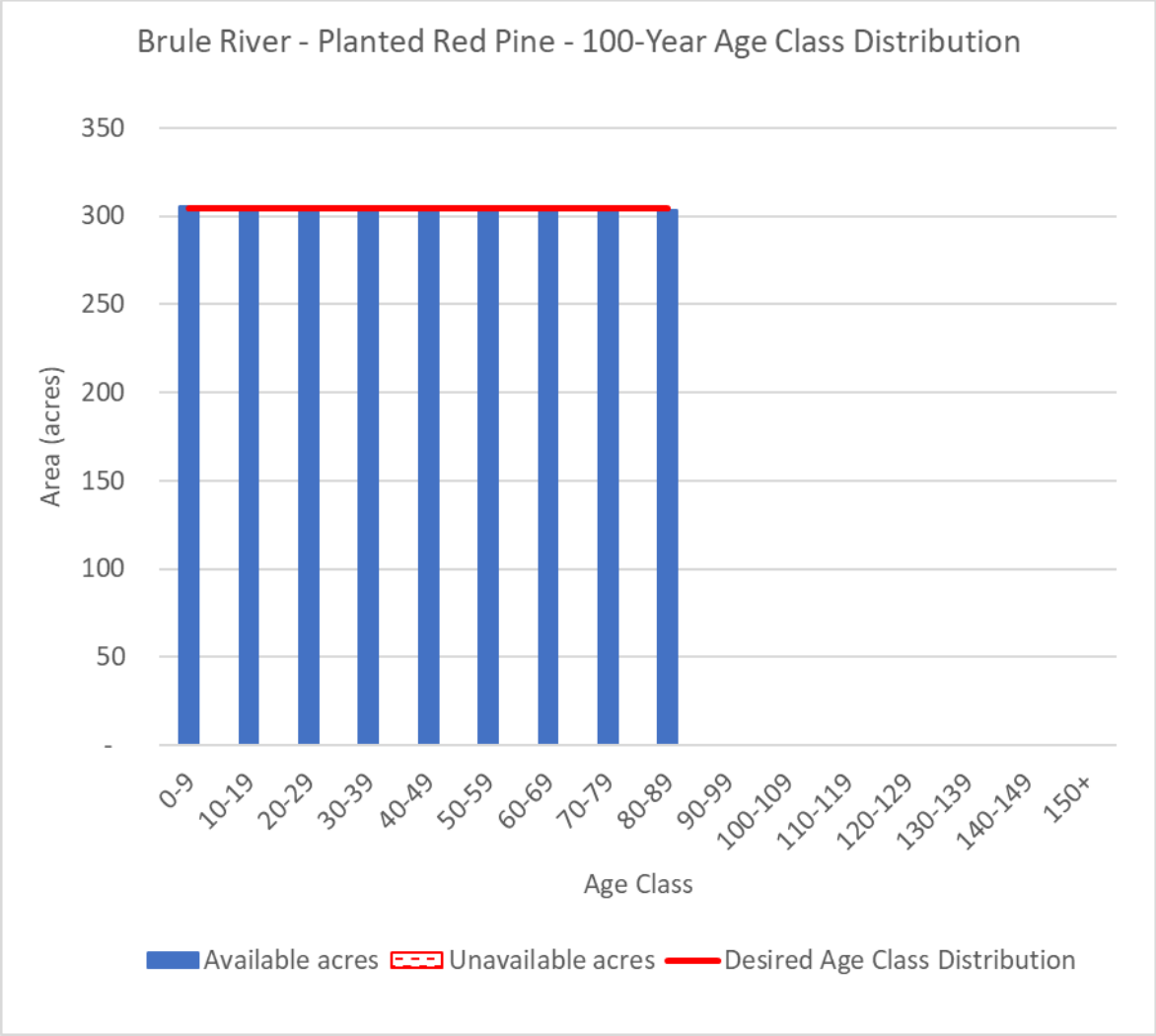


Figure 13. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 14) will concentrate the manageable acres of planted red pine in productive growing conditions while providing an even flow of forest products and a wide variety of wildlife habitat conditions across the landscape in young, mid-aged, and mature forest.

Management actions

There are 360 acres of projected thinning harvests in the red pine cover type. It is expected that about 67 acres of planted red pine will be converted from other cover types. These total an expected 67 acres of regeneration in the planted red pine cover type over the next 10 years.

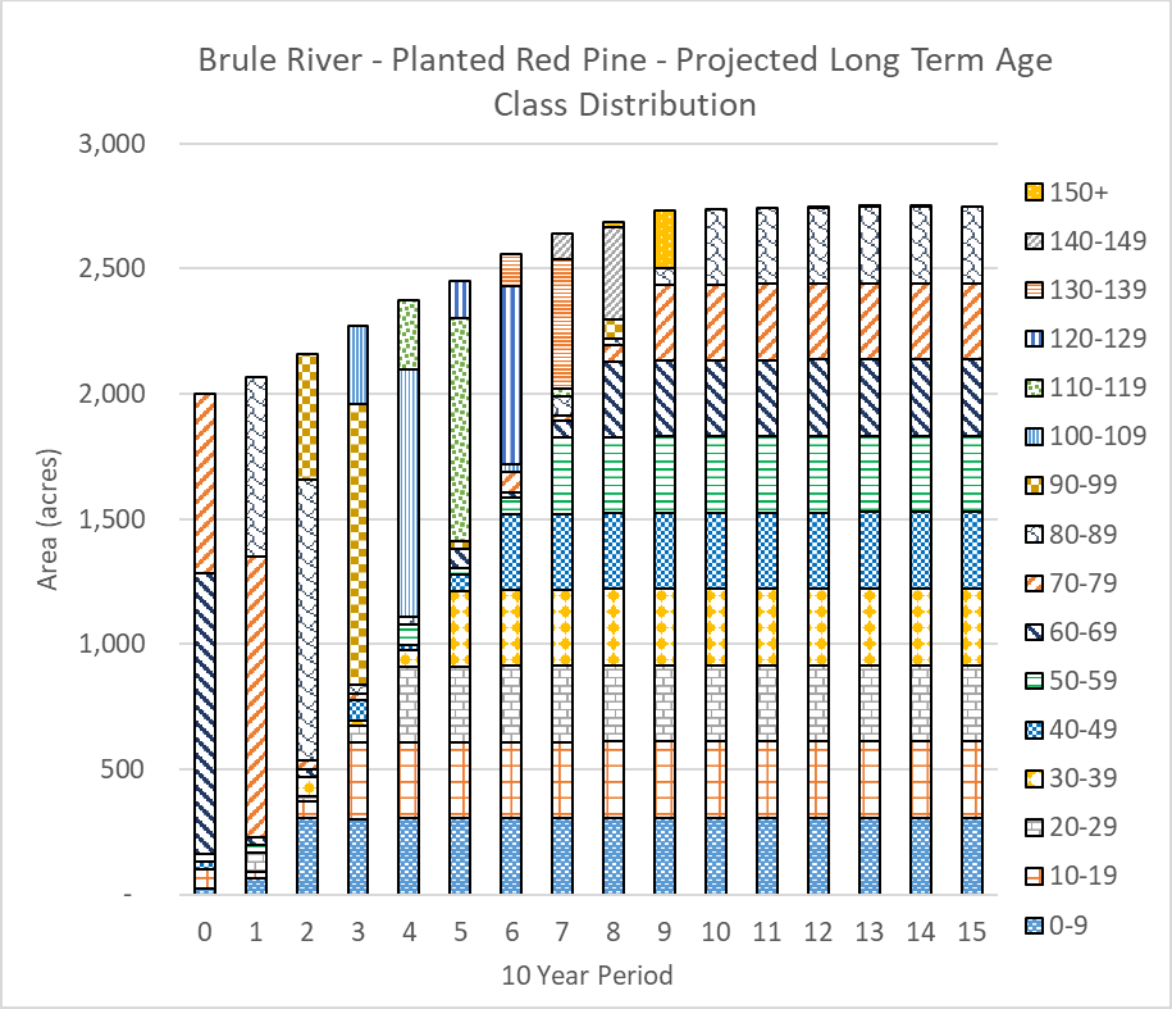


Figure 14. Projected age class distribution over 15, 10-year planning periods.

Natural jack pine

Current condition

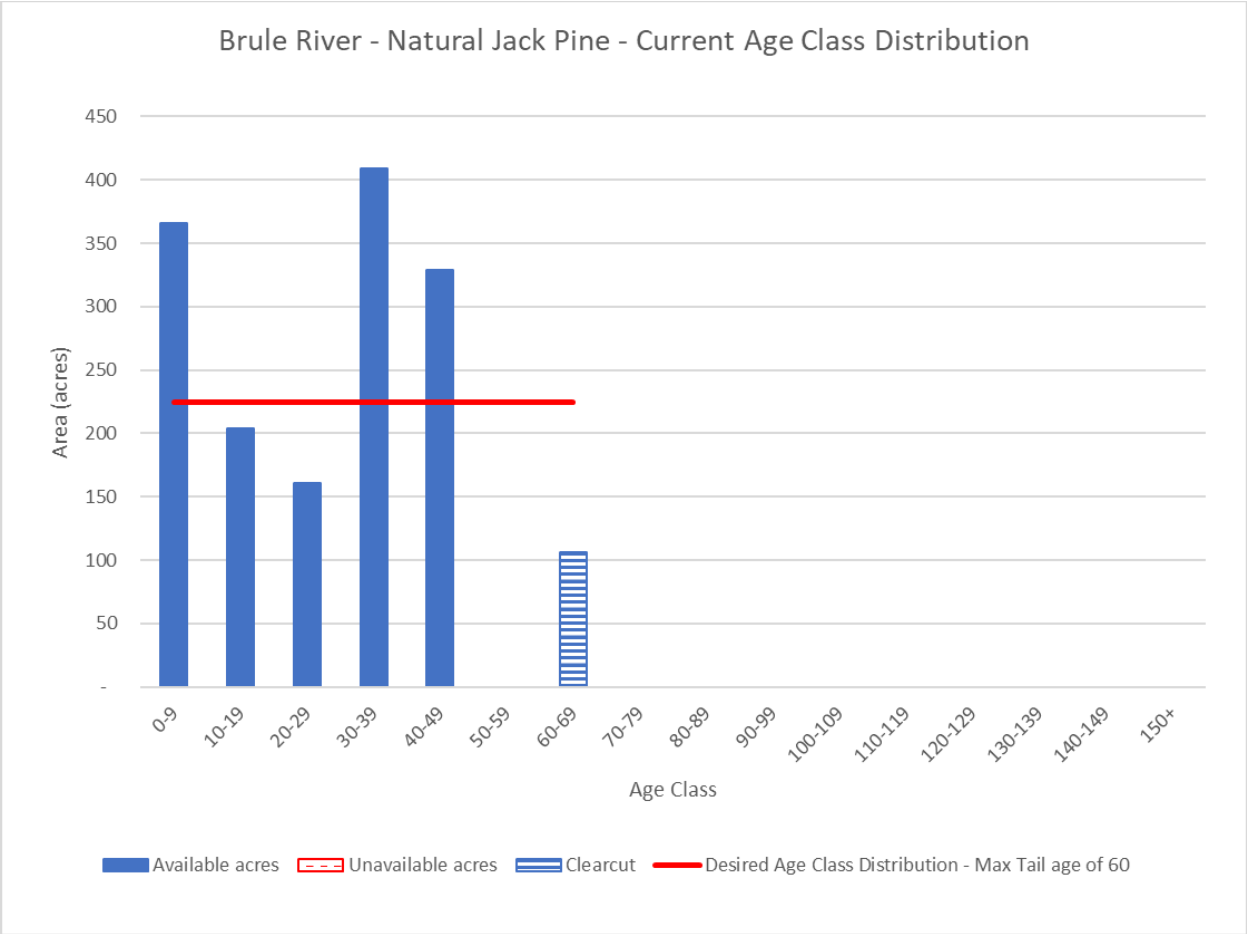


Figure 15. Current age class distribution, the desired age class distribution, and the projected harvests in the natural jack pine cover type over the 10-year planning period.

The current age class distribution is unbalanced with a deficit of acres in ages 10-29 years old and a surplus of acres in the 0-9 and in the 30-49 year-old age classes. Limited merchantable acres in the older age classes will present managers with a challenge in achieving the desired regeneration during this planning period. A portion of this cover type meets the habitat requirements for snowshoe hare.

Table 10. Featured species with natural jack pine as a priority habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat - Natural Jack Pine	Natural Jack Pine Habitat Acres - Available	Natural Jack Pine Habitat Acres - Unavailable
Snowshoe hare	Age category: 0-19 Size category: sapling	569	0

Desired future condition

The desired age class distribution is to have a rotation age of 60 years.

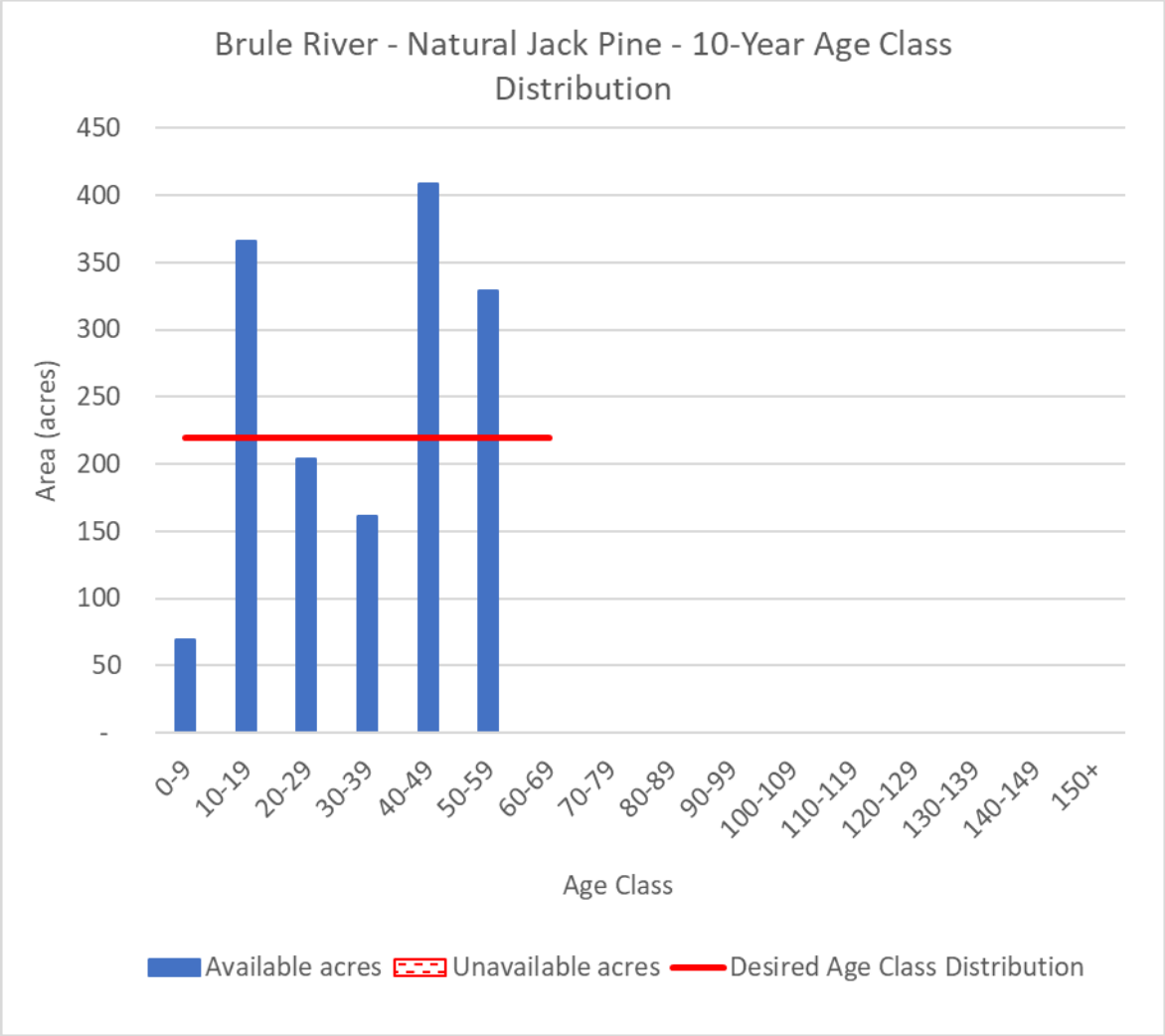


Figure 16. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The end of the planning period will result in the establishment of 69 acres in the upcoming 0-9 age class. Progress toward the long-term desired age class distribution of natural jack pine will take many decades in this management area.

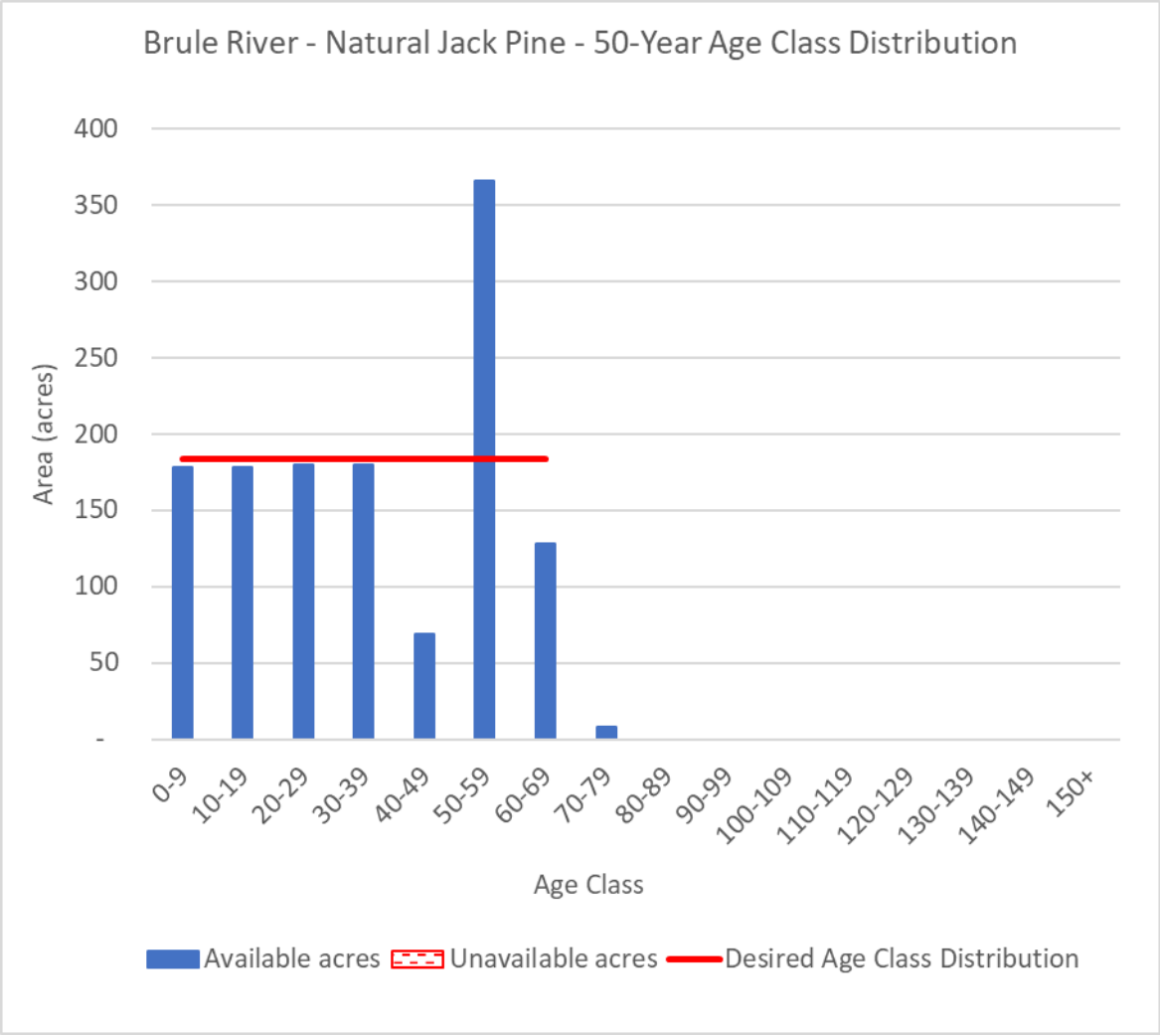


Figure 17. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of natural jack pine acres reaching the desired future condition with only a few age classes deviating from the target proportions (Figure 18).

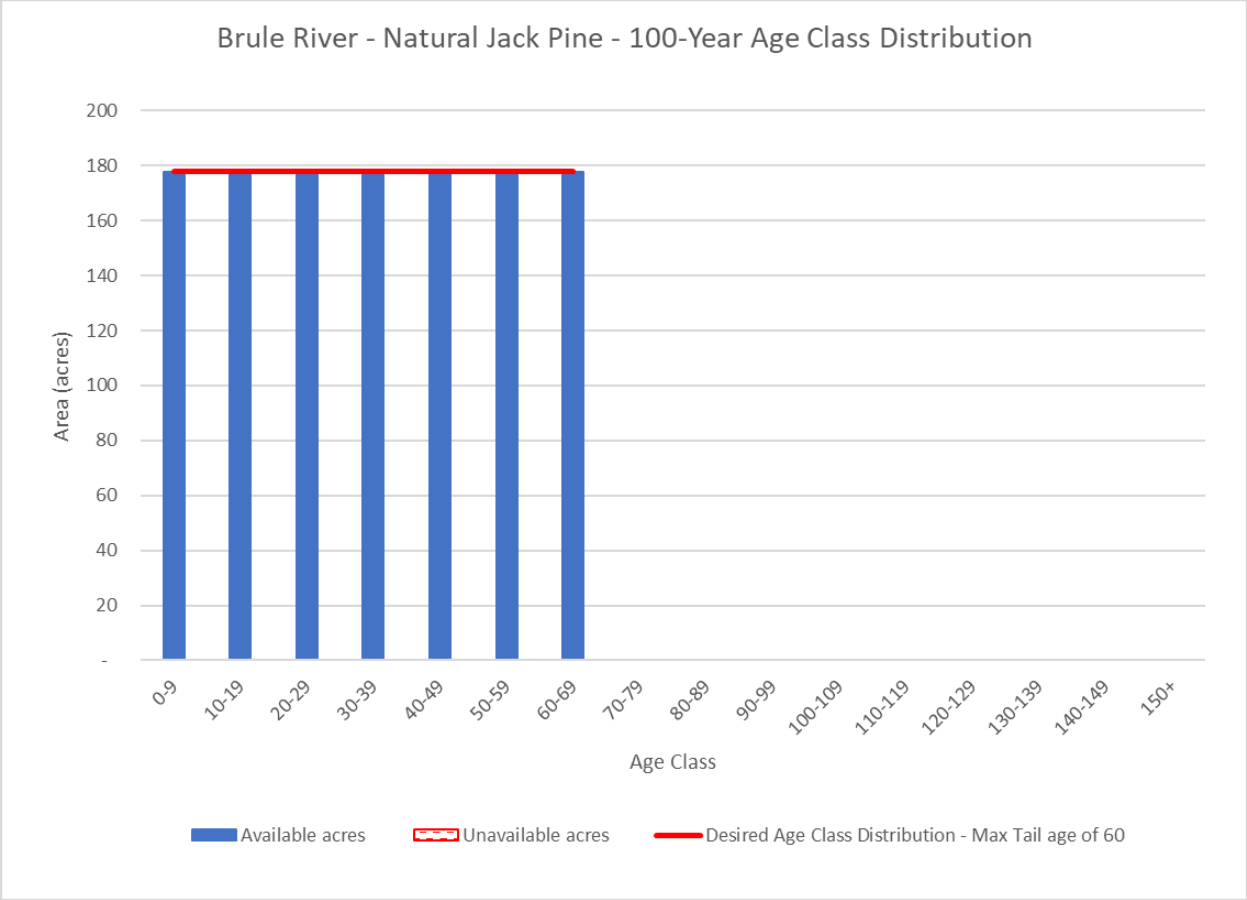


Figure 18. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 19) will concentrate the manageable acres of natural jack pine in productive growing conditions while providing an even flow of forest products and a wide variety of wildlife habitat conditions across the landscape in young, mid-aged, and mature forest.

Management actions

There are 107 acres of projected clearcut harvest in the natural jack pine cover type. It is expected that about 37 acres of natural jack pine will be converted to other cover types. These add up to an expected 70 acres of regeneration in the natural jack pine cover type over the next 10 years.

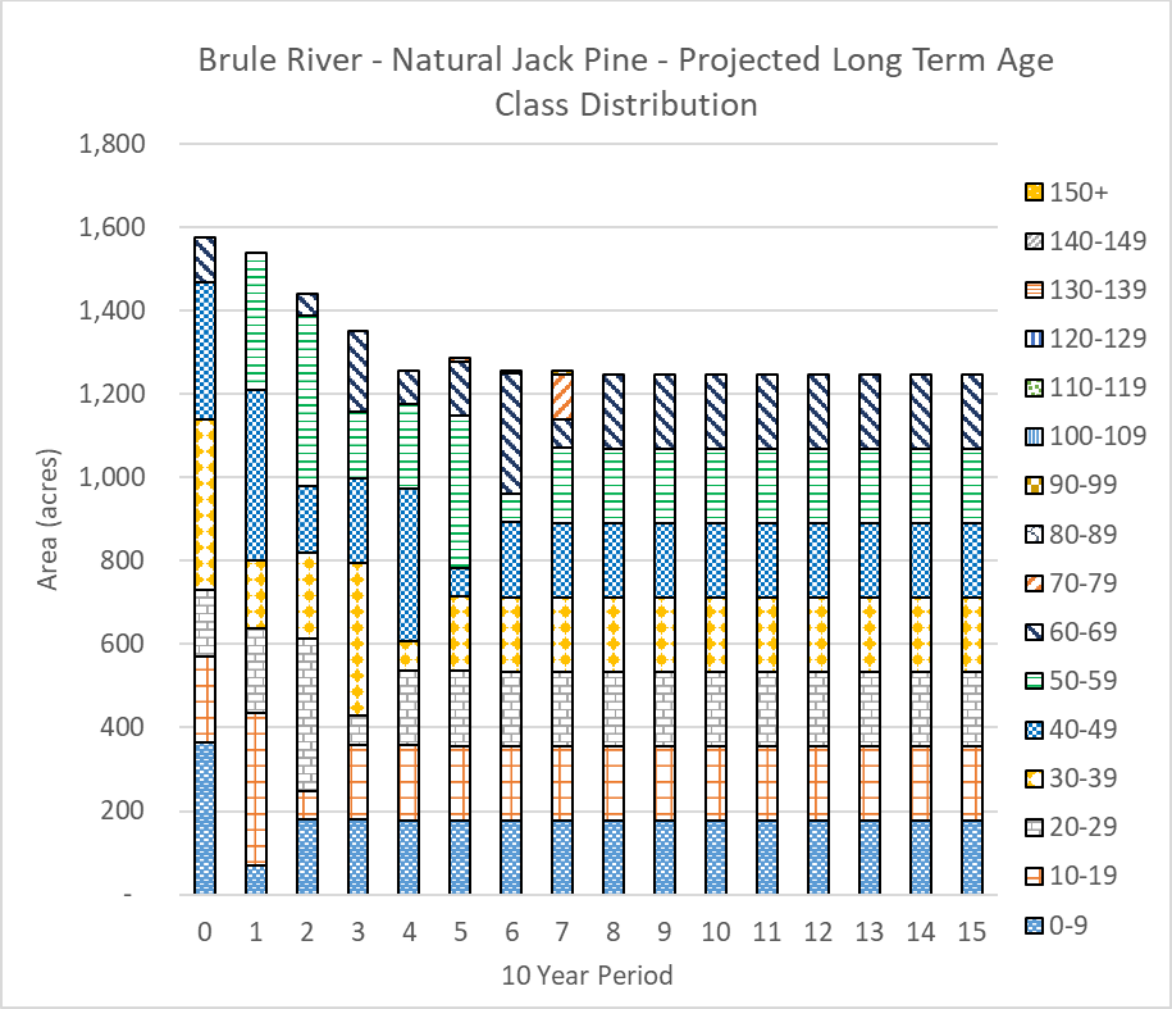


Figure 19. Projected age class distribution over 15, 10-year planning periods.

Conservation area network

High conservation value areas

There are up to nine different HCVA types that can be found in each management area (Table 20; see Biodiversity in Section 3 for more information).

Table 11. High conservation value areas within the Brule River management area.

High Conservation Value Area Type and Name	Acres
Deer Wintering Complex	**4,453**
	4,453
Grand Total	**4,453**

Ecological reference areas

Ecological Reference Areas (ERAs) are a type of HCVA and are higher quality examples of functioning ecosystems that are primarily influenced by natural ecological processes. There are no ERAs within this management area.

Special conservation areas

Reviewable special conservation areas (SCAs; Table 13) refers to those SCA types that may be reviewed or updated through the compartment review process as needed. Static SCAs (Table 14) refers to those SCA types that generally do not change or require updating (see Biodiversity in Section 3 for more information).

Table 13. Reviewable Special Conservation Areas within the Brule River management area.

Reviewable Special Conservation Area Type and Name	Acres
Concentrated Recreational Area	**129**
	129
Grand Total	**129**

Table 14. Static Special Conservation Areas within the Brule River management area.

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Deer Winter Range - Obligate and Conditional		**13,815**
Conditional		13,815
Designated Trout and Coldwater Stream Buffer		**648**
		229
Armstrong Creek		9

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Brule River		101
Camp Five Creek		12
Camp Six Creek		53
First Creek		26
Gages Creek		27
Iron River		15
Larson Creek		21
McGoverns Creek		2
North Branch Iron River		4
Olson Creek		16
Seven Springs Creek		15
South Branch Iron River		4
South Slough		15
Stager Creek		67
Sunset Creek		2
Tim Bowers Creek		26
Waterworks Creek		2
West Branch Armstrong Creek		2
Designated Trout and Coldwater Streams	**24.0**	
	8.3	
Armstrong Creek	0.3	
Brule River	3.8	
Camp Five Creek	0.5	
Camp Six Creek	2.0	
First Creek	1.0	
Gages Creek	1.0	
Iron River	0.6	
Larson Creek	0.9	
McGoverns Creek	0.1	
North Branch Iron River	0.1	
Olson Creek	0.6	
Seven Springs Creek	0.6	
South Branch Iron River	0.2	
South Slough	0.6	
Stager Creek	2.3	
Sunset Creek	0.1	
Tim Bowers Creek	0.9	
Waterworks Creek	0.1	
West Branch Armstrong Creek	0.1	
Important Bird Areas		**13**
Lauterman Lake		8

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Winegar Moraine & Iron Co. Northern Goshawk IBA		5
Mussel Stream Group 1 - State special concern	**0.8**	
Twin Falls Dam-Menominee River	0.8	
Wood Turtle Stream 100-foot buffer		**197**
		1
Brule River		98
Menominee River		36
Paint River		62
Wood Turtle Stream 660-foot buffer		**1,311**
		18
Brule River		599
Menominee River		269
Michigamme River		0
Paint River		425
Grand Total	**24.8**	**15,983**

Rare species

Rare species occurrences are compiled from the Michigan Natural Features Inventory Biotics database (Tables 16) and do not necessarily include all rare species found in this management area due to biases in survey effort and verifiable observation reporting over time.

Table 15. Rare animal and plant species conservation status key.

Status	Status
E = endangered	LE = listed endangered
T = threatened	LT = listed threatened
SC = special concern	PDL = proposed for delisting

Table 16. Rare animal species occurrence within the Brule River management area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Alces alces*	Moose	SC	--	--
Animal	Boloria freija	Freija fritillary	SC	--	1
Animal	Boloria frigga	Frigga fritillary	SC	--	1
Animal	Bombus borealis	Northern amber bumble bee	SC	--	2
Animal	Bombus sandersoni	Sanderson's bumble bee	SC	--	1

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Bombus terricola	Yellow-banded bumble bee	SC	--	2
Animal	Canis Lupus*	Gray wolf	SC	LE	--
Animal	Erebia discoidalis	Red-disked alpine	SC	--	1
Animal	Gavia immer	Common loon	T	--	7
Animal	Glyptemys insculpta	Wood turtle	T	--	1
Animal	Haliaeetus leucocephalus	Bald eagle	SC	--	8
Animal	Lasmigona compressa	Creek heelsplitter	SC	--	1
Animal	Opheodrys vernalis	Smooth green snake	SC	--	1
Animal	Ophiogomphus anomalus	Extra-striped snaketail	SC	--	1
Animal	Pandion haliaetus	Osprey	SC	--	7
Total	--	--	--	--	**34**

*Occurrence information provided by field staff.

Non-ERA natural communities

Natural communities that are identified with an element occurrence in the MNFI Biotics database, but that have not been given an additional ecological reference area designation are recognized and managed accordingly. There are no non-ERA natural communities in this management area.

Forest health

Forest health concerns, both native and non-native, can have impacts on stand conditions and management decisions. The following insects (Table 17) and diseases (Table 18) could have an impact on management during the planning period and may need to be monitored and/or addressed.

Table 17. Defoliating insects of concern in the Brule River management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Spongy moth	Lymantria dispar	Non-native	Yes
Forest tent caterpillar	Malacosoma disstria	Native	Yes
Large aspen tortrix	Choristoneura conflictana	Native	Yes
Spruce Budworm	Choristoneura fumiferana	Native	Yes

Watch for lingering ash with potential resistance to emerald ash borer as impacts increase.

Table 18. Maladies of concern in the Brule River management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Canker	Various	Various	Yes
Armillaria root rot	Armillaria spp.	Native	Yes
Oak wilt	Bretziella fagacearum	Non-native	Yes
Heterobasidion root disease	Heterobasidion annosum	Native	No

Report surviving mature beech trees that may be resistant to beech bark disease.

Aquatic resources

Riparian habitat

A total of 29 miles of streams and rivers are found in the management area (Table 19). Streams/rivers classified as cold types comprise approximately 76 percent of the riverine mileage.

Table 19. Classification type and length of streams/rivers found within the management area.

Type	Length (miles)
Cold stream	11
Cold small river	1
Cold transitional stream	7
Cold transitional small river	3
Cold transitional large river	0
Warm transitional stream	2
Warm transitional small river	0
Warm transitional large river	5
Warm stream	0
Warm small river	0
Warm large river	0

Lacustrine habitat

A total of 15 lakes and ponds of at least 1 surface acre are found in the management area (Table 20).

Table 20. Size and number of lakes and ponds located within the management area.

Lake Size Class (acres)	Number
1-99	9
100-499	4
500+	1

Wetlands

A total of 3,887 acres of wetlands lie in the management area (Table 21). Forested wetlands comprise approximately 91 percent of wetland types found in the management area.

Table 21. Area of emergent, forested, and riverine wetland types found within the management area.

Wetland Type	Acres
Emergent	136
Forested	3,546
Riverine	205

Vernal pools and seeps

A total of 437 acres of vernal pools and seeps have been inventoried in the management area while no areas of seeps have been identified.

Riparian vegetation cover

Aspen is the predominant cover type present in a 100-meter riparian zone located next to streams/rivers in the management area (Table 22).

Table 22. Largest vegetative cover types (i.e., top 10) and area located in a 100-meter buffer of streams/rivers within the management area.

Cover Type	Acres
Aspen	1,694
Lowland Shrub	333
Lowland Spruce/Fir	294
Lowland Conifers	242
Cedar	237
Northern Hardwood	206
Natural Mixed Pines	163
Lowland Deciduous	143
Planted Red Pine	124
Upland Shrub	102

Watershed vegetation cover

The management area includes portions of important watersheds of the Michigamme River and Iron River (Tables 23 and 24). Aspen is a major cover type of the state forest in each watershed.

Table 23. Largest vegetative cover types (i.e., top 5) and area of the Michigamme River watershed located within the management area.

Cover Type	Acres
Aspen	5,068
Northern hardwood	1,501
Planted red pine	578
Natural jack pine	553
Natural red pine	497

Table 24. Largest vegetative cover types (i.e., top 5) and area of the Iron River watershed located within the management area.

Cover Type	Acres
Aspen	79
Lowland conifer	61
Natural mixed pine	20
Northern hardwood	20
Lowland deciduous	7

Recreation

The Brule River area has variable access, with some isolated parcels. Several snowmobile and ORV trails cross the area. The Crystal Falls to Stager Rail Trail and Stateline Route are designated for ORV and snowmobile use and open to all non-motorized uses. The Glidden Lake State Forest Campground provides rustic camping opportunities and access to the Lake Mary Plains Ski Trail/Pathway, which is also open to mountain bikes.

Table 25. Designated recreation trails by type.

Recreation Category	Number of Miles
Motorized Recreation Trails	**54.8**
ORV (all types)	24.1
Snowmobile	30.7
Non-motorized Recreation Trails	**17.6**
Hiking	8.8
Equestrian	0
Biking	8.8
Total	**72.4**

Note: Trail use types may overlap.

Table 26. State Forest Campgrounds (SFCG).

Name	Number of Sites
Glidden Lake SFCG	23

There are no state wildlife management/research areas or areas managed specifically for hunting located within the MA.

The Brule River forms the southern boundary of this area and the border with Wisconsin. It is popular for canoeing and fishing.

Table 27. Boating access sites.

Name	Waterbody
Carney Dam	Brule River
Glidden Lake SFCG	Glidden Lake
Paint River Bridge	Paint River

Cassidy Creek

State Forest Area: 67,774 acres	Location: Southern Dickinson County	Population Centers: Norway, Kingsford, Iron Mountain
Sub-Section: West Green Bay Till and Lake Plain	Landforms: Bedrock knobs surrounded by extensive outwash plains	Landcover: Forested: 60,203 acres Non-forested: 7,571 acres

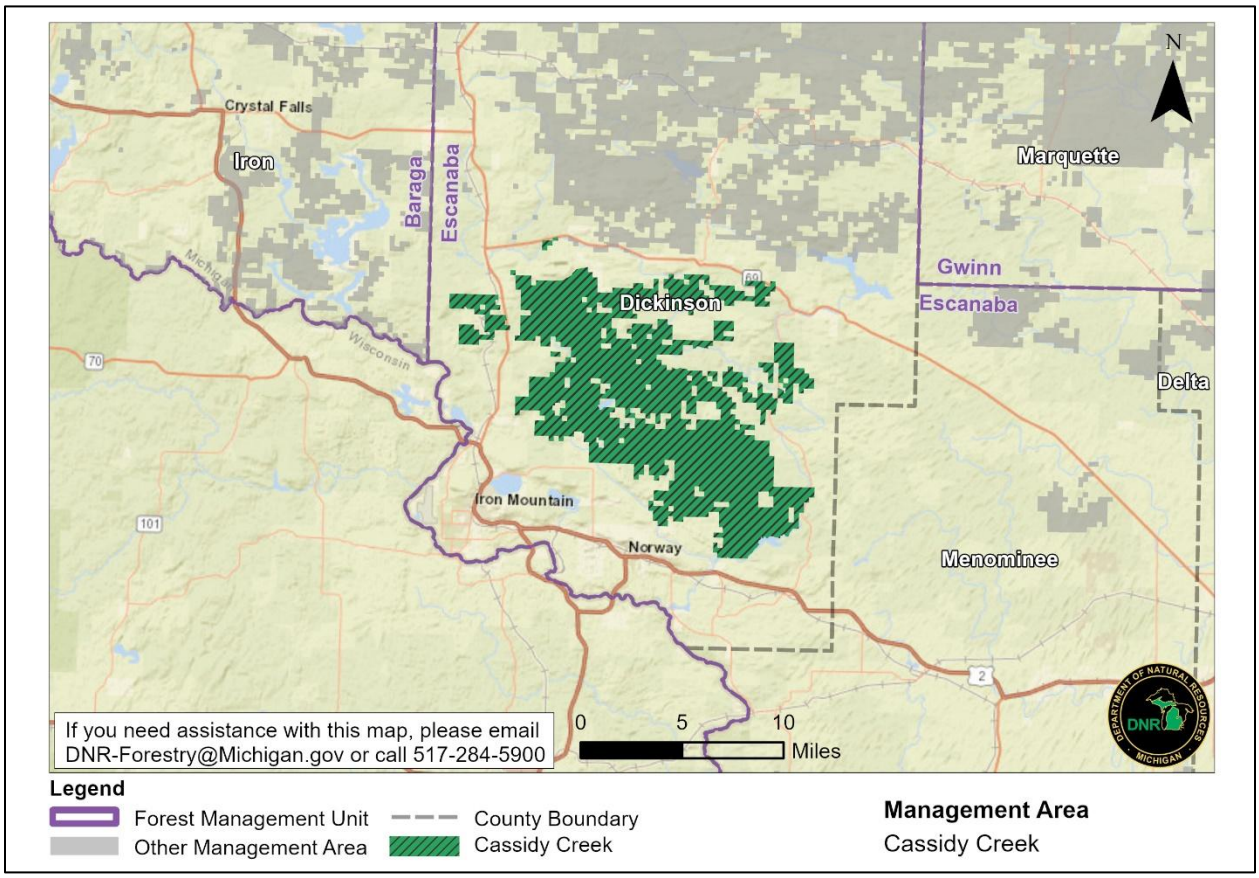


Figure 1. Map of the Cassidy Creek management area.

Forested landscape

Current and projected future condition

The Cassidy Creek management area is dominated by shade-intolerant cover types that are largely upland and available. Intolerant deciduous cover types are relatively evenly distributed across the age categories, while the unavailable upland and lowland acres are more prevalent in the older age category.

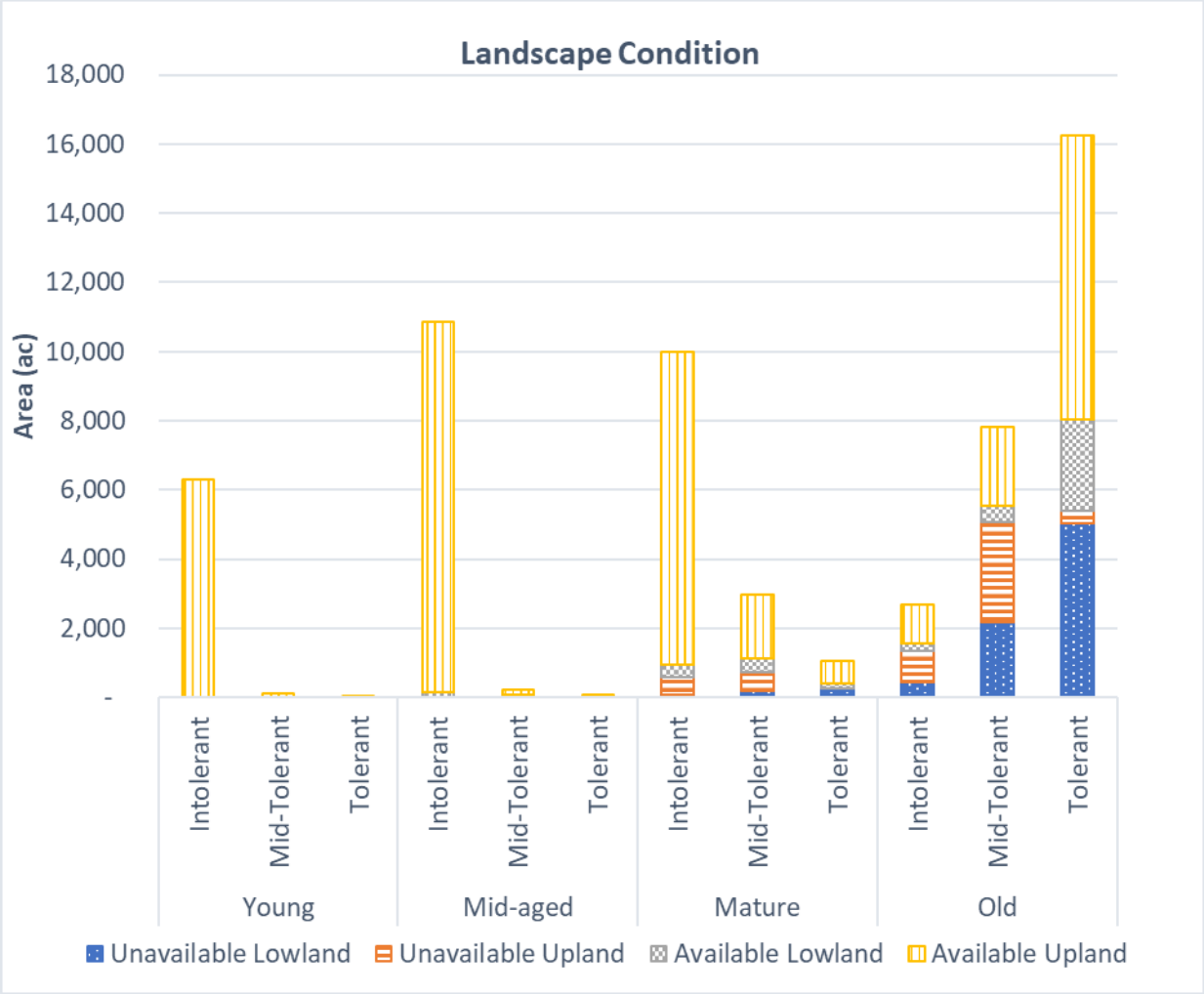


Figure 2. Forest diversity matrix showing the current distribution of forested acres across management availability, age category, landscape position and shade tolerance.

Landscape habitat conditions refine the management area landscape into featured species habitat context. Current and projected acres for the metrics identified in the Management Priorities (Section 3 Statewide/Regional) establish a baseline and future condition based on management over the planning period (Table 1).

Table 1. Current and projected acres for Landscape Habitat Conditions.

Landscape Habitat Condition	Monitoring Metric	Current Acres
Young forest	Acres of 0-19 stands in aspen and jack pine	6,428
Mature forest	Acres of 80+ year stands across cover types	26,771
Mature forest	Acres of 120+ year stands across cover types	9,718
Mesic conifer cover types	Acres of mesic conifer cover types	3,690
Mesic conifers in other cover types	Average canopy occupancy	35%
Mast – oak cover types	Acres of oak cover types	493
Mast tree species in other cover types	Acres of total canopy occupancy of mast tree acres (Trace-100%)	10,231
Big trees	Acres of total canopy stand occupancy of species in sawlog or greater size class	25,087
Non-forested openings	Acres of total herbaceous open land, upland shrub and cropland	640
Landscape forest matrix	Percent deciduous forest	71%
Landscape forest matrix	Percent coniferous forest	24%

The Cassidy Creek management area is dominated by forested cover types with 89 percent of the area covered in forested stands (Table 2). The upland deciduous portion of that is 59 percent of the management area and comprised mostly of aspen and northern hardwood. Lowland shrub is the most common non-forested cover type in this management area, representing 5 percent of the landscape.

Table 2. Current landscape context and distribution of cover types.

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
Forested	Upland	Deciduous	Aspen	29,254	39,657	47,393	60,203
			Northern hardwood	8,387			
			Black-red hybrid oak	0			
			Northern red oak	216			
			Oak mix	277			
			Mixed upland deciduous	1,523			
		Mixed	Upland mixed forest	1,743	1,743		
		Coniferous	Planted red pine	520	5,992		
			Planted jack pine	0			
			Planted white pine	151			
			Planted mixed pine	0			
			Natural red pine	1,605			
			Natural jack pine	27			
			Natural white pine	713			
			Natural mixed pines	1,632			
			Upland spruce/fir	211			
			Upland conifers	1,065			
			Hemlock	69			
	Lowland	Deciduous	Lowland aspen/balsam poplar	711	3,129	12,810	
			Lowland ceciduous	2,417			
		Mixed	Lowland mixed forest	1,040	1,040		
		Coniferous	Cedar	5,574	8,641		
			Lowland conifers	2,512			
			Lowland spruce/fir	329			
			Tamarack	226			
Nonforested	Upland	N/A	Herbaceous openland	496	N/A	1,698	7,571
			Upland shrub	121			
			Low density trees	37			
			Bare/sparsely vegetated	819			
			Cropland	23			
			Urban	203			
	Lowland	N/A	Lowland shrub	3,375	N/A	5,873	
			Marsh	489			
			Bog	136			
			Treed bog	74			
			Water	1,800			
						Grand Total:	**67,774**

There are 46,573 acres (68.7 percent of the total management area and 73.4 percent of the forested area) that can be managed toward desired future conditions via commercial timber harvest (Table 3). Acres unavailable for management are categorized by site condition (Table 4). Of that, over 46 percent is in the aspen cover type, 14 percent in northern hardwood, 4 percent in cedar, and 2 percent in upland mixed forest. The remaining 20 cover types represent about 12 percent of the forested and available land in the management area.

Table 3. Current cover type composition by management availability.

Cassidy Creek Forested Cover Type	Available Acres	Available %	Unavailable Acres	Unavailable %	Total Acres	Total %
Aspen	27,707	46.0%	1,547	2.6%	29,254	48.6%
Cedar	2,245	3.7%	3,330	5.5%	5,574	9.3%
Hemlock	37	0.1%	31	0.1%	69	0.1%
Lowland aspen/balsam poplar	526	0.9%	185	0.3%	711	1.2%
Lowland conifers	573	1.0%	1,939	3.2%	2,512	4.2%
Lowland deciduous	617	1.0%	1,801	3.0%	2,418	4.0%
Lowland mixed forest	434	0.7%	606	1.0%	1,040	1.7%
Lowland spruce/fir	157	0.3%	172	0.3%	329	0.5%
Mixed upland deciduous	875	1.5%	649	1.1%	1,524	2.5%
Natural jack pine	27	0.0%	0	0.0%	27	0.0%
Natural mixed pines	704	1.2%	928	1.5%	1,632	2.7%
Natural red pine	963	1.6%	641	1.1%	1,605	2.7%
Natural white pine	479	0.8%	234	0.4%	713	1.2%
Northern hardwood	8,175	13.6%	213	0.4%	8,387	13.9%
Northern red oak	182	0.3%	34	0.1%	216	0.4%
Oak mix	260	0.4%	18	0.0%	277	0.5%
Planted red pine	488	0.8%	32	0.1%	520	0.9%
Planted white pine	151	0.3%	0	0.0%	151	0.3%
Tamarack	49	0.1%	177	0.3%	226	0.4%
Upland conifers	567	0.9%	499	0.8%	1,065	1.8%
Upland mixed forest	1,164	1.9%	579	1.0%	1,743	2.9%
Upland spruce/fir	194	0.3%	17	0.0%	211	0.4%
Grand Total	**46,575**	**77.4%**	**13,630**	**22.6%**	**60,204**	**100.0%**

Table 4. Site Conditions (reason area is unavailable for commercial harvest) for unavailable acres.

Site Condition (Reason area is unavailable for commercial harvest)	Area (ac)	% of Unavailable Area
Too wet	2,869	21.0%
Cannot regenerate	2,686	19.7%
Too steep	2,417	17.7%
BMPs	2,106	15.5%
Wildlife concerns	1,348	9.9%
Blocked by obstacle	683	5.0%
Long-term retention	589	4.3%
Conservation values	224	1.6%
Other influence zones	176	1.3%
Recreational/scenic	174	1.3%
Deer wintering area	146	1.1%
Unproductive	96	0.7%
Denied access	46	0.3%
Other dept./div. processes	28	0.2%
Non-military lease/easement	23	0.2%
Species of special concern or T&E	20	0.1%
Total Unavailable	**13,630**	**100.0%**

Projected 10-year cover type management actions

Each cover type in the Cassidy Creek management area has a unique age class and basal area class goals that describe the long-term desired future conditions. The harvests levels needed in the first planning period to begin achieving those long-term goals are summarized below (Table 5). These harvests will help establish a desirable amount of regeneration for even-aged cover types over the 10-year period or help to achieve desired basal area distribution among uneven-aged cover types like northern hardwoods. Implementing these silvicultural regimes will yield 150,322 cords, the planned harvest volume for the decade (Table 6).

Table 5. Ten-year planning period harvest goals (acres) by cover type and silvicultural regime.

Silvicultural Regimes								
Cover Type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Salvage Clearcut	Salvage Thinning	Grand Total
Aspen	4,335	-	-	-	-	-	-	4,335
Northern hardwood	111	2,702	-	170	37	-	-	3,020
Natural mixed pines	-	-	131	-	162	-	-	293
Lowland aspen/balsam poplar	191	-	-	-	-	-	-	191
Planted white pine	-	-	143	-	-	-	-	143
Mixed upland deciduous	94	6	-	-	16	-	-	117
Lowland deciduous	110	-	-	-	-	-	-	110
Planted red pine	-	-	107	-	-	-	-	107
Lowland mixed forest	107	-	-	-	-	-	-	107
Upland conifers	107	-	-	-	-	-	-	107
Lowland conifers	105	-	-	-	-	-	-	105
Lowland spruce/fir	49	-	-	-	-	-	-	49
Natural red pine	-	-	2	-	30	-	-	33
Upland spruce/fir	25	-	-	-	-	-	-	25
Tamarack	7	-	-	-	-	-	-	7
Totals	**5,241**	**2,708**	**384**	**170**	**245**	**-**	**-**	**8,748**

Table 6. Projected 10-year harvest volume by product and species.

10-Year Estimated Harvest Volume Projection			
Product	**Species**	**Volume Planned***	**Volume Prepared****
Pulpwood (cords)	Mixed aspen	40,473	38,045
	Mixed hardwood	26,578	24,983
	Mixed spruce	7,130	6,702
	Mixed softwood	6,177	5,806
	White pine	3,347	3,146
	Red pine	1,936	1,820
	Jack pine	1,134	1,066
	Mixed oak	913	859
	Pulpwood Total	**87,687**	**82,426**
Sawtimber (MBF)	Mixed aspen	8,796	8,269
	Sugar maple	7,847	7,376
	Red maple	3,770	3,544
	White pine	3,337	3,137
	Red pine	2,612	2,455
	Red oak	1,721	1,617
	Basswood	828	778
	Mixed oak	116	109
	White oak	83	78
	Sawtimber Total	**29,110**	**27,363**
	Total Sawtimber Harvest Volume in Cords	**62,634**	**58,876**
	Grand Total Harvest Volume in Cords	**150,322**	**141,302**

* Volume estimates based on 100% of the projected harvests for the 10 year planning period.

** Volume estimates based on 94% of the projected harvests for the 10 year planning period accounting for reduction in acres and associated volume once sales are prepared for bid.

There are very few cover type transitions projected in the Cassidy Creek management area (Table 7). The managed area of each cover type is projected to remain relatively stable. The largest expected decrease is in the aspen cover type, where 201 acres are forecasted to convert to other cover types

through forest management activities. The largest increase is in upland mixed forest where 270 acres are expected to convert into that cover type.

Table7. Projected 10-year cover type acres resulting from cover type transitions.

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Aspen	29,254	29,053	-201
Northern hardwood	8,387	8,387	0
Cedar	5,574	5,574	0
Lowland conifers	2,512	2,494	-18
Lowland deciduous	2,417	2,388	-29
Upland mixed forest	1,743	2,013	270
Natural mixed pines	1,632	1,632	0
Natural red pine	1,605	1,605	0
Mixed upland deciduous	1,523	1,537	13
Upland conifers	1,065	991	-74
Lowland mixed forest	1,040	1,101	61
Natural white pine	713	725	12
Lowland aspen/balsam poplar	711	713	2
Planted red pine	520	523	3
Lowland spruce/fir	329	316	-13
Oak mix	277	277	0
Tamarack	226	224	-2
Northern red oak	216	216	0
Upland sruce/fir	211	188	-24
Planted white pine	151	151	0
Hemlock	69	69	0
Natural jack pine	27	27	0
Lowland shrub	3,375	3,375	0
Water	1,800	1,800	0
Bare/sparsely vegetated	819	819	0
Herbaceous openland	496	496	0
Marsh	489	489	0
Urban	203	203	0
Bog	136	136	0
Upland shrub	121	121	0
Treed bog	74	74	0
Low density trees	37	37	0
Cropland	23	23	0
Total:	**67,774**	**67,774**	**0**

Featured species: current and projected habitat acres

There are 12 featured species in this management area that span various cover types, age classes, and stand-level conditions.

It is recommended that these featured species habitat acres be viewed as acres of potential habitat, representing a condition on the landscape where the more nuanced aspects of each species' habitat requirements are likely to be found or managed for. As described in the introduction, the modeling effort was limited by several factors including the simplification of habitat attributes into MiFI variables. Therefore, habitat acres refers to is potential habitat acres.

Current and projected total habitat acres by species across the decade provide a baseline and show the result of long-term management actions (Table 8). Some species show a loss in habitat over the next century. As mentioned in the Featured Species Management Priority (Section 3), the current condition for many cover types is a surplus of acres in the 0-9 age class from the compensatory management approach applied in the previous decade. The model eventually evens out the age classes at a lower, sustainable level over time, usually by 50 years. For any species with northern hardwoods as a priority cover type, there is a perceived drop in acres between 40-60 years; this is due to the basal area dropping below 81. Because it only drops into the upper 70s, it is not expected to translate to any real habitat loss on the ground. Three of these species were not included in the SFMP model but are included here to inform management decisions over the decade.

Table 8. Featured species current and projected total habitat acres (i.e., potential habitat).

Featured Species	Priority Cover Types	Total Habitat Acres Current	10-year Projected Habitat Acres	50-year Projected Habitat Acres	100-year Projected Habitat Acres
Black bear	Mast	--	--	--	--
Black-backed woodpecker	Natural disturbance	--	--	--	--
Blackburnian warbler	Northern hardwoods, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, hemlock	10,692	12,662	9,565	12,878
Cerulean warbler breeding	Northern hardwoods, mixed upland deciduous, lowland deciduous	10,621	10,980	10,359	10,281
Golden-winged warbler young	Aspen, black-red hybrid oak, northern red oak, oak mix, tamarack	8,097	8,563	8,184	8,196
Marten UP	Northern hardwoods, mixed upland deciduous, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, lowland mixed forest, lowland conifers, hemlock, cedar	7,416	20,172	16,839	20,006
Moose	To be determined	--	--	--	--

Featured Species	Priority Cover Types	Total Habitat Acres Current	10-year Projected Habitat Acres	50-year Projected Habitat Acres	100-year Projected Habitat Acres
Snowshoe hare forest	Aspen, cedar, hemlock, lowland aspen, lowland conifers, lowland mixed forest, lowland spruce/fir, mixed upland deciduous, natural jack pine, natural mixed pines, planted jack pine, upland spruce/fir	8,572	9,609	8,906	8,897
White-tailed deer (food)	Northern hardwood, oak mix, aspen, mixed upland deciduous, lowland deciduous, lowland aspen/balsam poplar, lowland mixed forest	45,569	45,687	46,939	46,094
White-tailed deer (shelter)	Hemlock, cedar, planted red pine, planted white pine, planted mixed pine, natural red pine, natural white pine, natural mixed pines, upland conifers, upland spruce fir, lowland conifers	14,381	14,265	14,023	13,876
Wood thrush	Northern hardwoods, northern red oak, mixed upland deciduous, lowland deciduous	10,032	11,469	7,758	12,290
Wood turtle	Non-forested openings	--	--	--	--

Cover type composition and associated featured species

Aspen

Current Condition

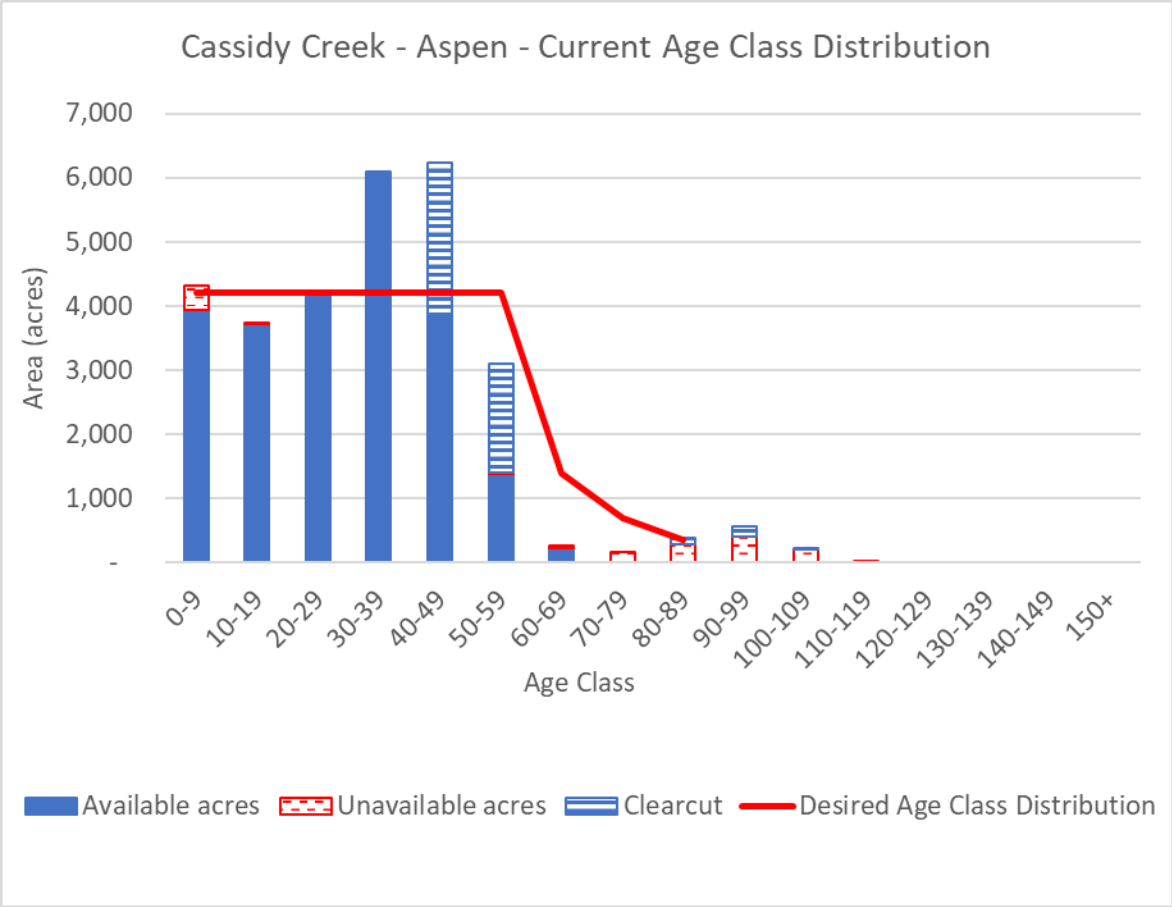


Figure 3. Current age class distribution, the desired age class distribution, and the projected harvests in the aspen cover type over the 10-year planning period.

The current age class distribution is somewhat unbalanced, with a deficit of acres in ages 60-79 years old tails and a surplus of acres in the 30-49 year-old age classes. The younger age classes are in pretty good shape with only a slight deficit in each. Limited merchantable acres in the older age classes will present managers with a challenge in achieving the desired regeneration during this planning period. A portion of this cover type meets the habitat requirements for golden-winged warbler, ruffed grouse, snowshoe hare and white-tailed deer.

Table 9. Featured species with aspen as a priority habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Aspen	Aspen Habitat Acres - Available	Aspen Habitat Acres - Unavailable
Golden-winged warbler	Age category: 0-19 Size class: Sapling	7,645	400
Ruffed grouse	Age category: 0-19 Size class: Sapling	7,645	400
Snowshoe hare	Age category: 0-19 Size class: Sapling	7,645	400
White-tailed deer	All ages and size classes	29,254	--

Desired Future Condition

The desired age class distribution is a rotation age of 50 years with approximately 9 percent of the acres in an age class tail to a maximum of 80-year age class.

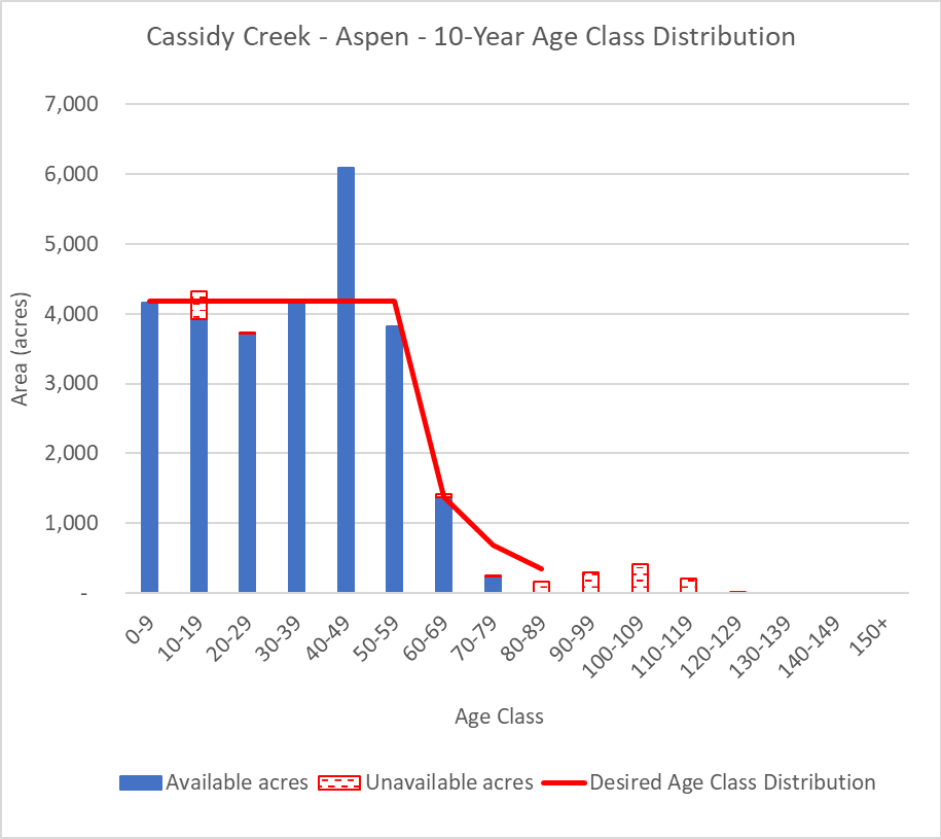


Figure 4. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The end of the planning period will result in the establishment of about 4,152 acres of aspen in the upcoming 0-9 age class. Progress toward the long-term desired age class distribution of aspen will only take a few decades in this management area.

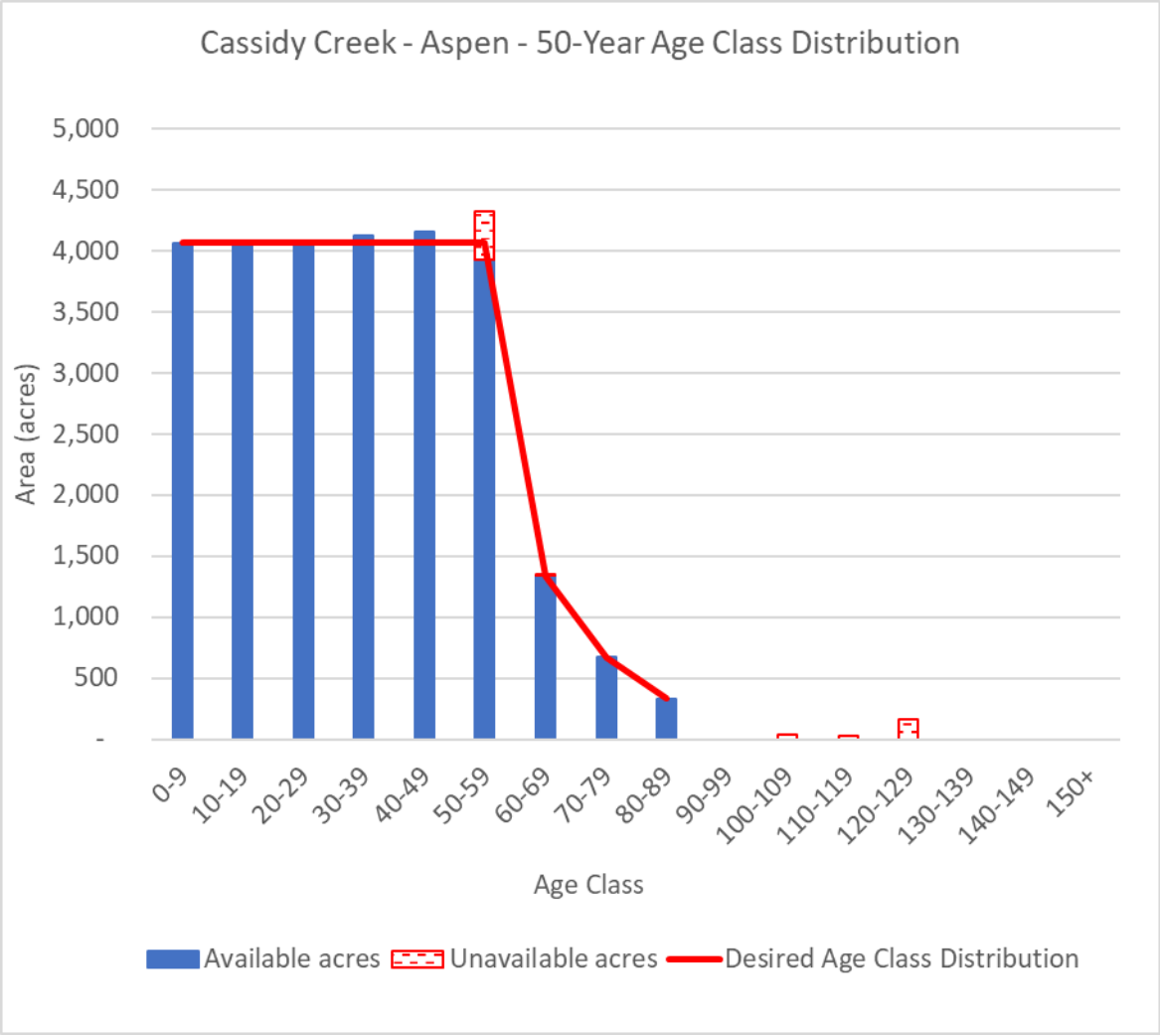


Figure 5. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of aspen acres reaching the desired future condition with only a few age classes deviating from the target proportions (Figure 5).

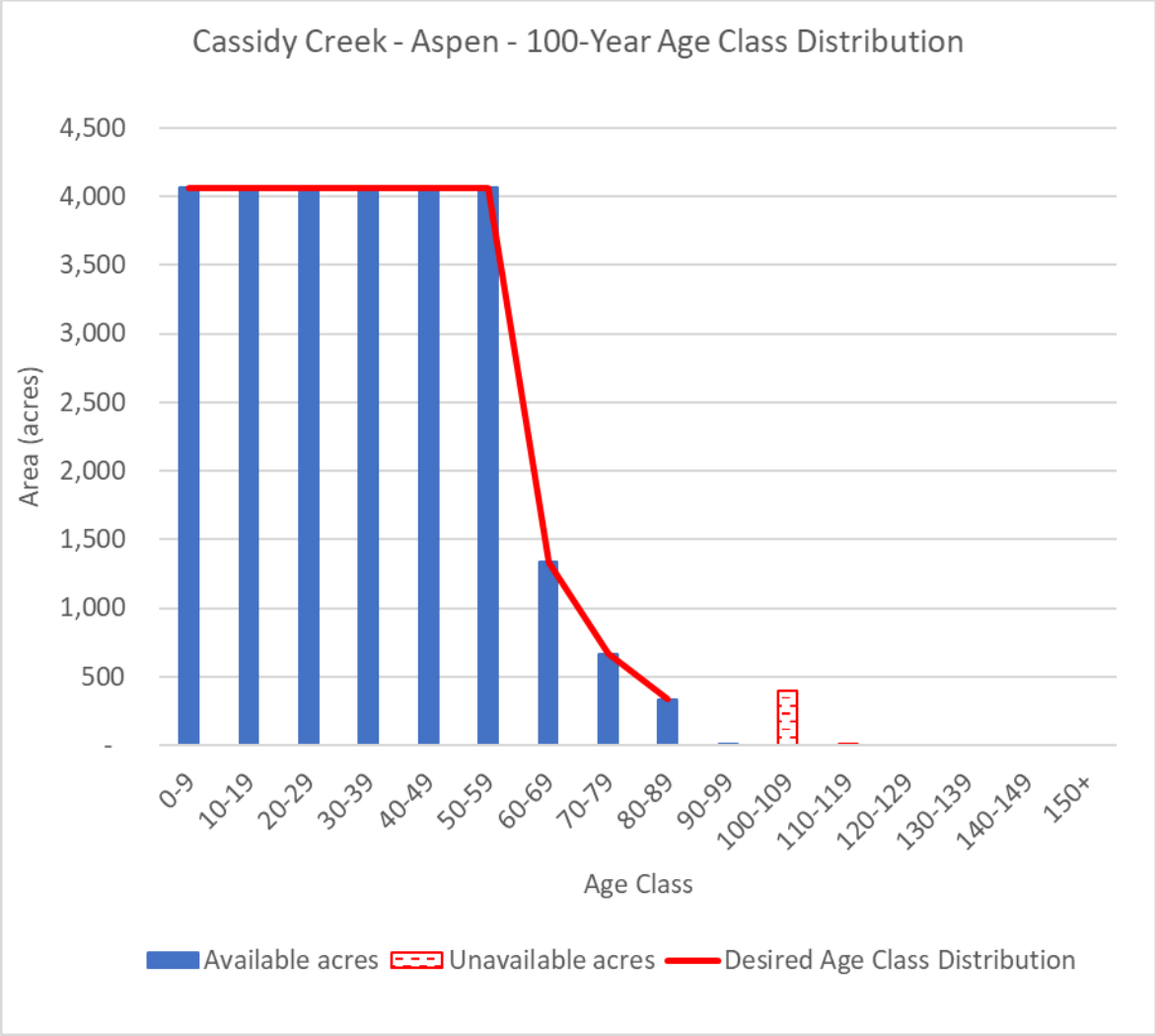


Figure 6. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 6) will concentrate the manageable acres of aspen in productive growing conditions while providing an even flow of forest products and a wide variety of wildlife habitat conditions across the landscape in young, mid-aged, and mature forest.

Management Actions

There are 4,335 acres of projected clearcut harvest in the aspen cover type. It is expected that about 210 acres of aspen will be converted to other cover types. These total to an expected 4,125 acres of regeneration in the aspen cover type over the next 10 years.

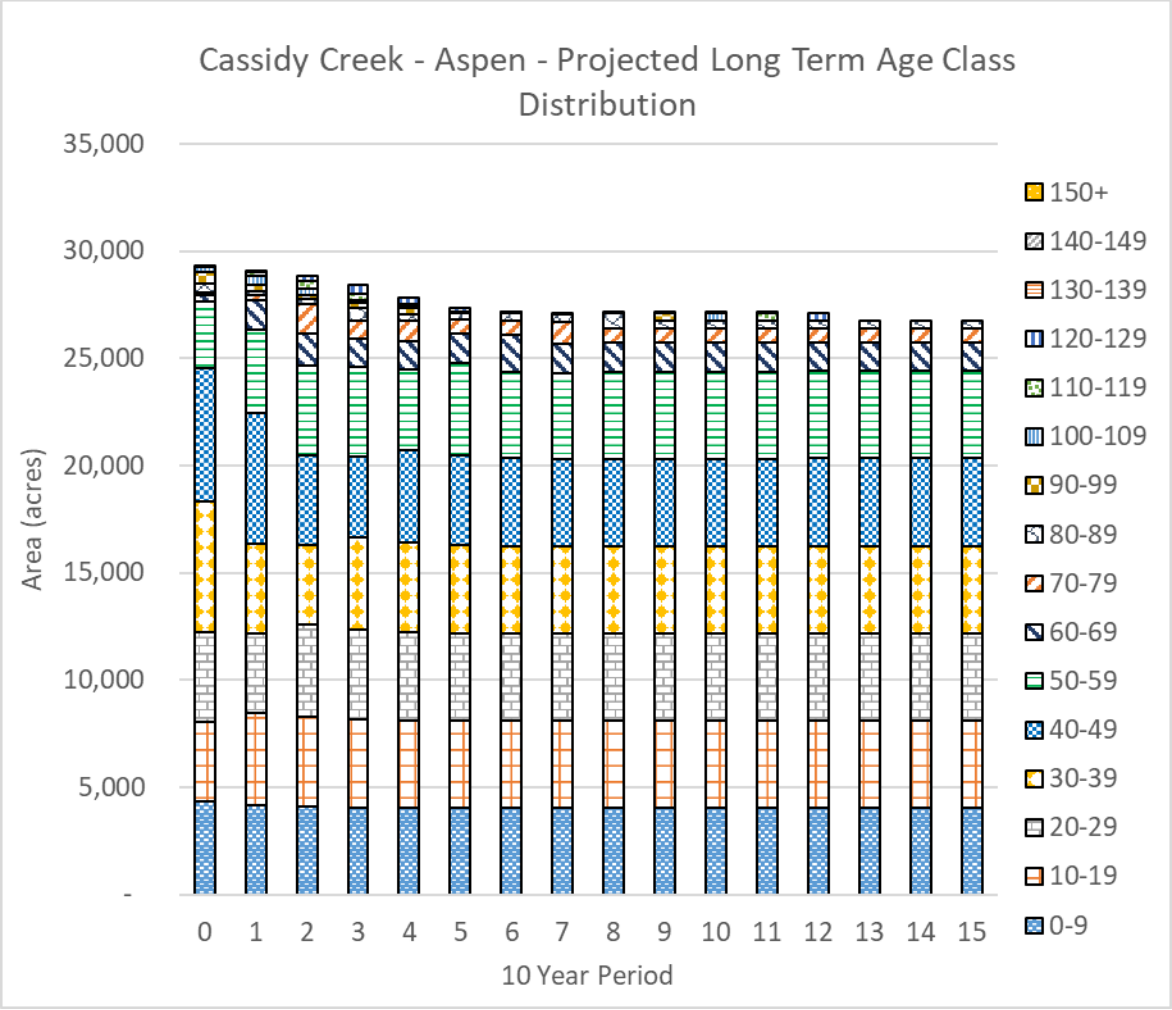


Figure 7. Projected age class distribution over 15 10-year planning periods.

Northern hardwoods

Current condition

Most of the northern hardwood cover type in the Cassidy Creek management area is currently between a stand age of 90 and 119 years old (Figure 8). The past management regime has been primarily single-tree selection, which allows for stand age to continue to increase overtime. Some stands are beginning to achieve an uneven-aged condition where a featured stand age becomes less evident, but the dominant age of these stands will likely increase past 150 years old prior to a younger age cohort becoming the prominent component of these stands (Figure 10).

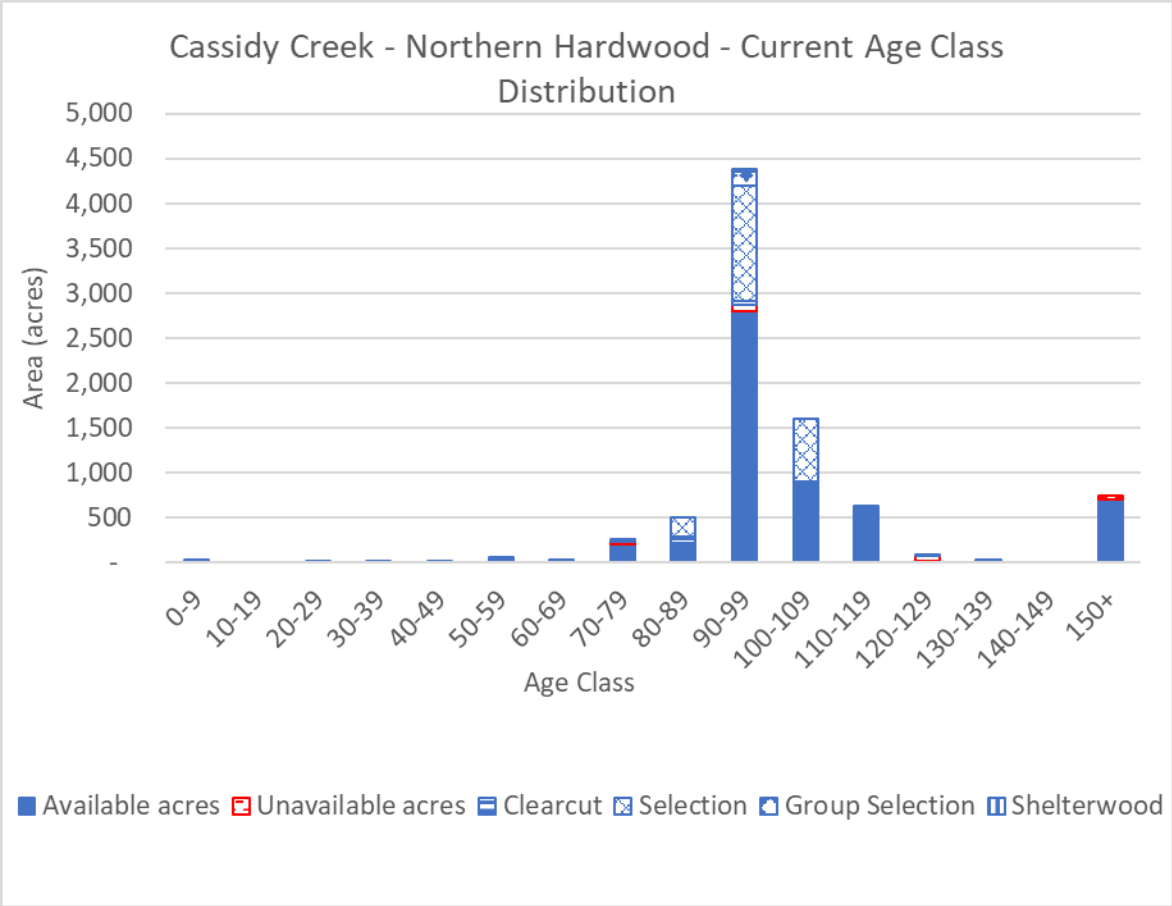


Figure 8. Current age class distribution and projected harvests in the northern hardwood cover type in the Cassidy Creek management area.

The area of northern hardwood is well distributed in the ideal basal area classes for optimal growing conditions in the Cassidy Creek management area (Figure 9). Current conditions are a result of a selection harvest regime that has been in place in this management area for decades.

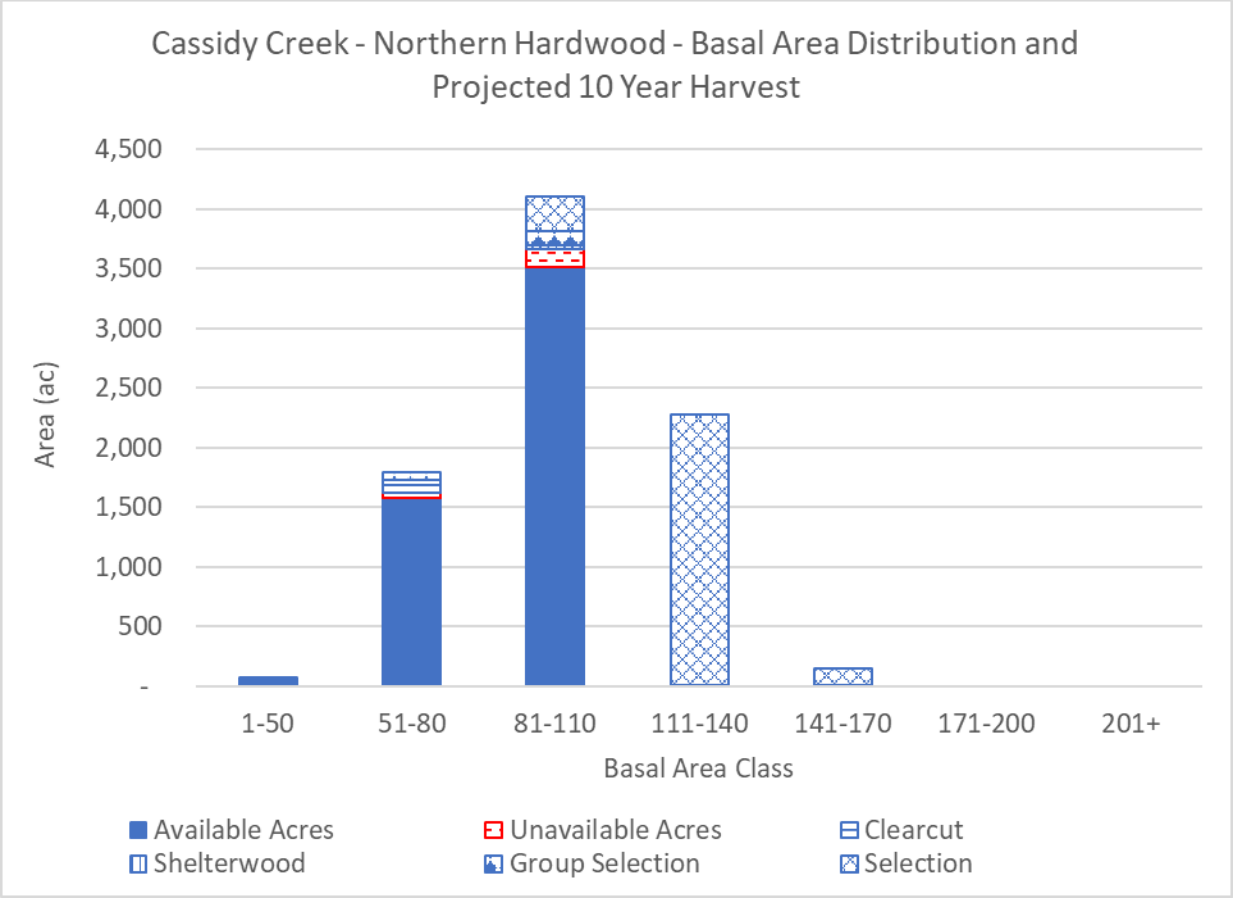


Figure 9. Current basal area distribution of the northern hardwood cover type as well as the projected harvests from each basal area class.

Table 10. Featured species with northern hardwoods as a priority habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Northern Hardwood	Northern Hardwood Habitat Acres - Available	Northern Hardwood Habitat Acres - Unavailable
Blackburnian warbler	Age category: 80+ Size category: Sawlog Basal area: 81+	6,260	129
Cerulean warbler	Age category: 50+ Size category: sawlog Basal area: 81+	7,787	176
Wood thrush	Age category: 40+ Size category: sawlog Basal area: 81+	6,547	166
Marten	Age category: 40+ Size category: pole, sawlog Basal Area: 81+	6,260	129

Featured Species	Featured Species Habitat – Northern Hardwood	Northern Hardwood Habitat Acres - Available	Northern Hardwood Habitat Acres - Unavailable
White-tailed deer	All ages and size classes	8,387	--

Desired Future Condition

The projected long-term cover type trend for northern hardwood is stable. There are no transitions to or from this cover type forecasted in this management area in the next 10 years.

The desired basal area distribution is a bell-shaped curve where a significant majority of the area is kept in the 81-110 basal area class with recently harvested stands occupying the 51-80 class and stands that are ready for harvest occupy the 111-140 basal area class. Diameter distributions of the northern hardwood stands should follow the appropriate Q-curve relative to stand age and condition.

An uneven-aged condition is the long-term goal for all northern hardwood stands in this management area. An uneven-aged condition is achieved when there is no single discernable age cohort that is more prevalent than others across the stand area as canopy gaps fill in with regenerating seedlings, saplings and poles. Eventually remaining stems become sawlog-sized over time.

Several patches ranging from 250 acres to greater than 500 acres with a closed canopy condition exist in this management area, which are suitable to species like blackburnian warbler, cerulean warbler and American Marten.

Regeneration and recruitment continue to be a focus in the northern hardwood cover type across this management area. The long-term sustainability of this cover type in an uneven-aged silvicultural regime depends on successful establishment of northern hardwood species as well as the recruitment of those seedlings and saplings into the pole and saw log classes. Northern hardwoods in the Cassidy Creek management area are challenged in regeneration and recruitment due the cervid herbivory and competition from sedge.

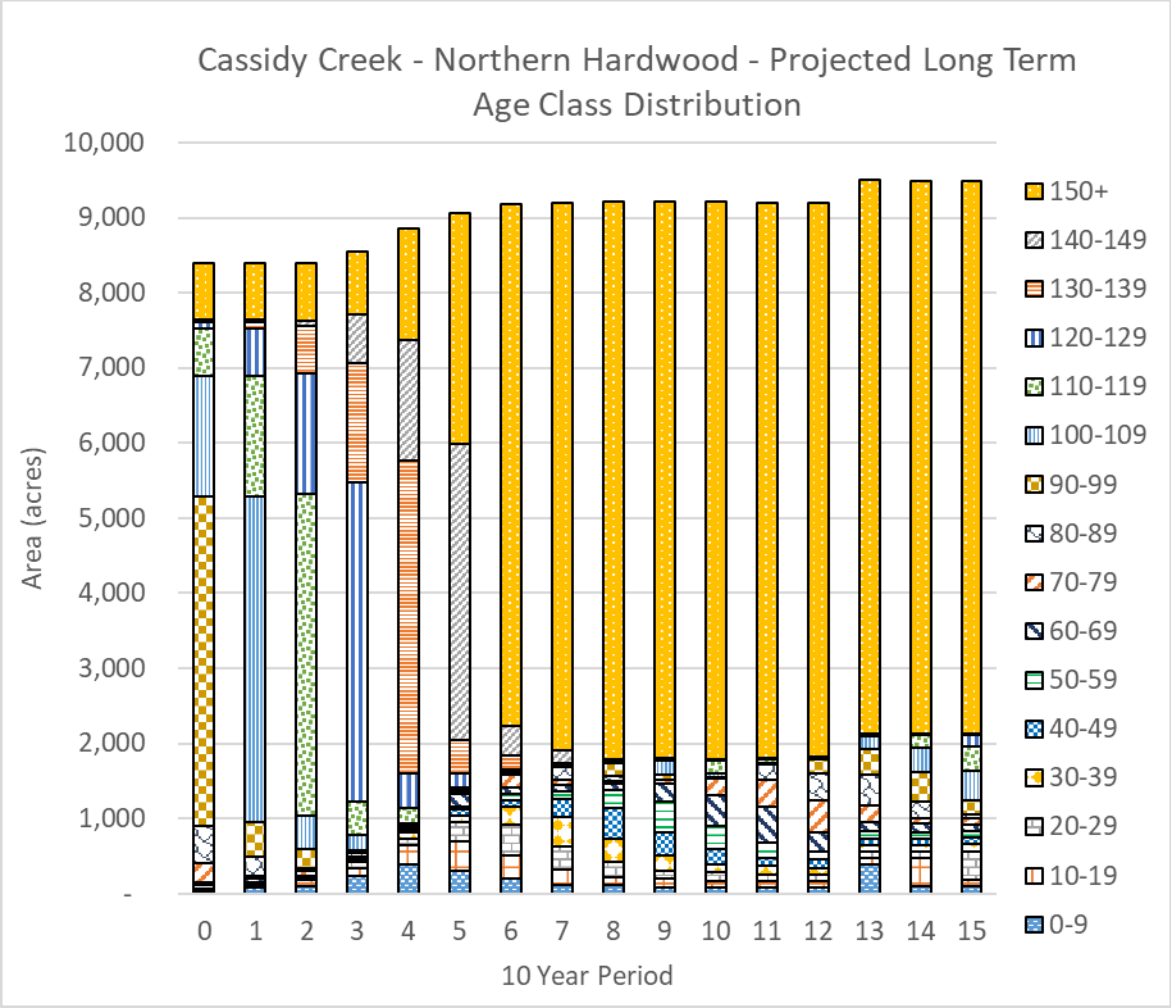


Figure 10. Projected age class distribution over fifteen 10-year planning periods.

Management actions

The desired forest conditions and associated featured species habitat will be maintained and achieved through continued application of the projected selection harvest regime on 2,908 acres, with some of those acres harvested through a group selection or shelterwood method to improve stand quality (Table 5). About 111 acres of lower-quality northern hardwood may be harvested to improve stand quality. Larger canopy gaps should be used to encourage diverse regeneration of northern hardwood species while maintaining an overall long-term mature forest, closed-canopy landscape condition. Treatments should be considered to reduce sedge mat competition with regeneration and cervid herbivory.

Cedar

Current condition

The current age class distribution shows a classic bell curve on an unmanaged even-aged stand with a surplus of acres in the 100-109-year-old age classes. The younger age classes have few to no acres. The reasons for this are not well understood, but many factors contribute to the lack of regeneration of the cover type. These include but are not limited to cervid herbivory, suppression of fire and the relatively young age of the stands.

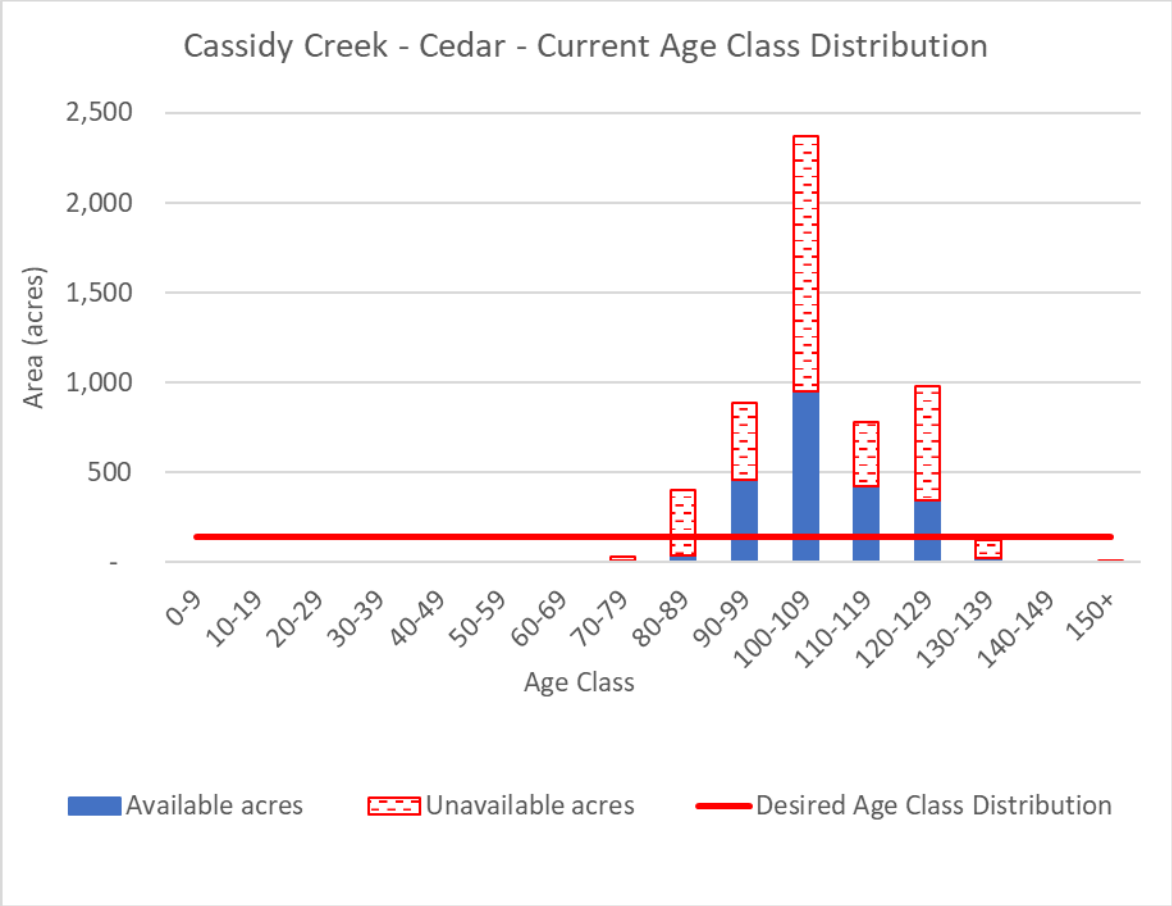


Figure 11. Current age class distribution, the desired age class distribution, and the projected harvests in the cedar cover type over the 10-year planning period.

Desired future condition

The desired future condition is to have an even age class distribution with a rotation age of 150+ years.

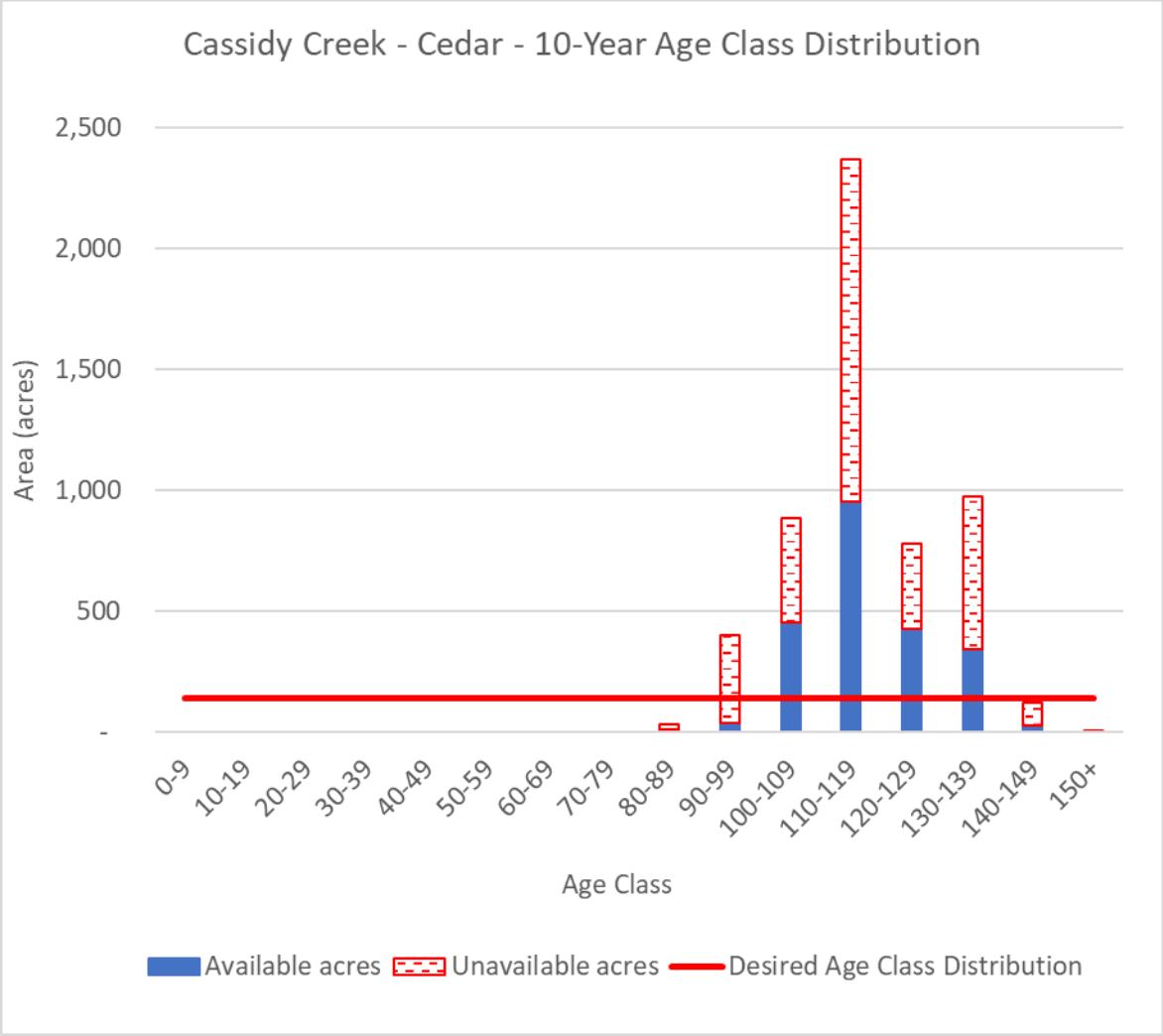


Figure 12. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The end of the planning period will result in the establishment of limited acres in the upcoming 0-9 age class. Progress toward the long-term desired age class distribution of cedar will take many decades in this management area. A portion of this cover type meets the habitat requirements for marten and white-tailed deer.

Table 11. Featured species with Cedar as a priority habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat - Cedar	Cedar Habitat Acres - Available	Cedar Habitat Acres - Unavailable
Snowshoe hare	Age category: 0-19 Size category: Sapling	0	0
Marten	Age category: 40+ Size category: Pole, Sawlog Basal area: 81+	1,960	2,900
White-tailed deer	All ages and size classes	5,574	--

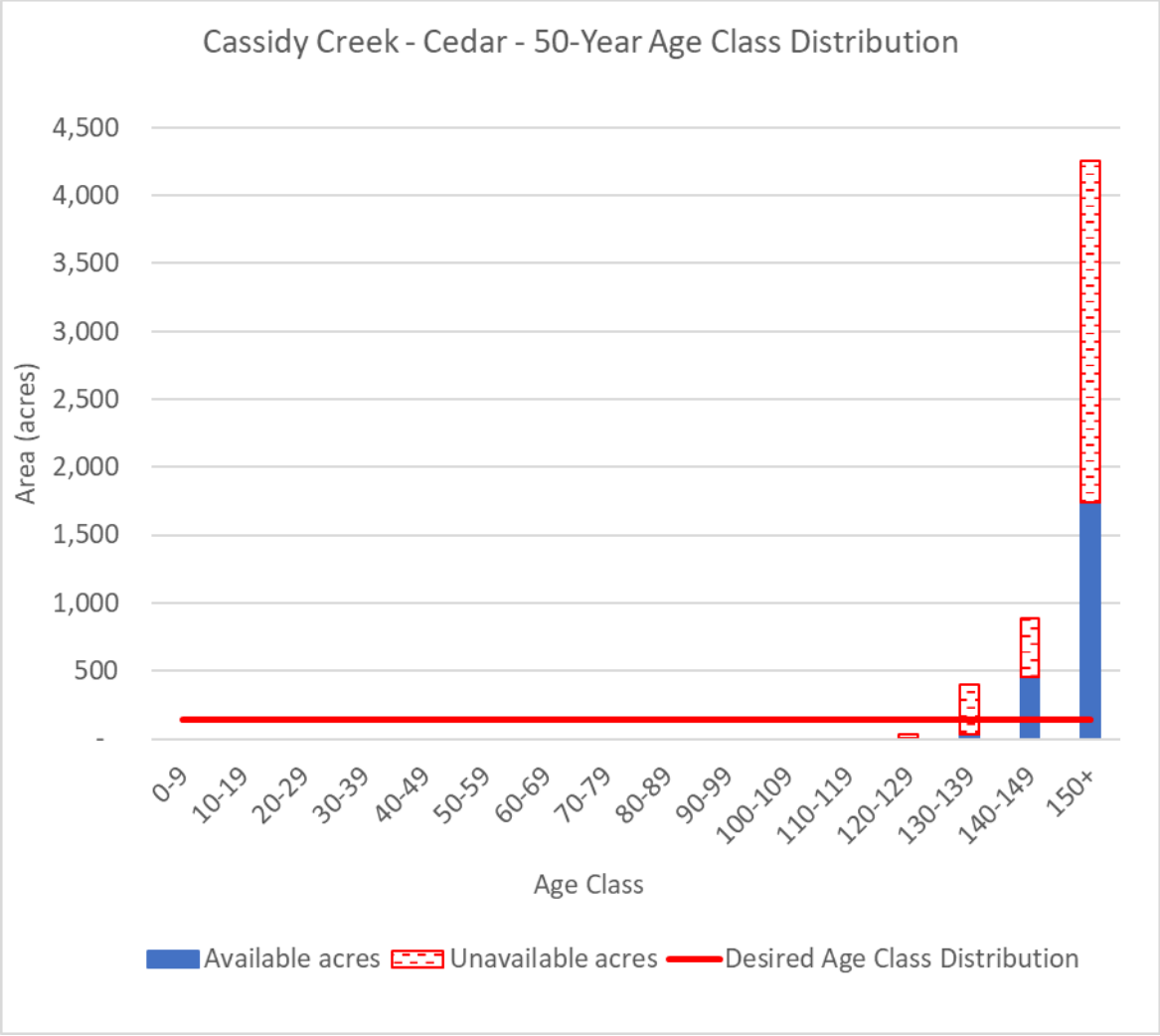


Figure 13. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of cedar acres aging with no acres regenerating (Figure 13).



Figure 14. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 14) will concentrate the manageable acres of cedar in productive growing conditions while providing a wide variety of wildlife habitat conditions across the landscape in young, mid-aged, and mature forest.

Management actions

There are no acres of projected harvests in the cedar cover type. It is expected some cedar will be cut in ongoing research and field trials as staff determines how to best regenerate this species as a cover type.

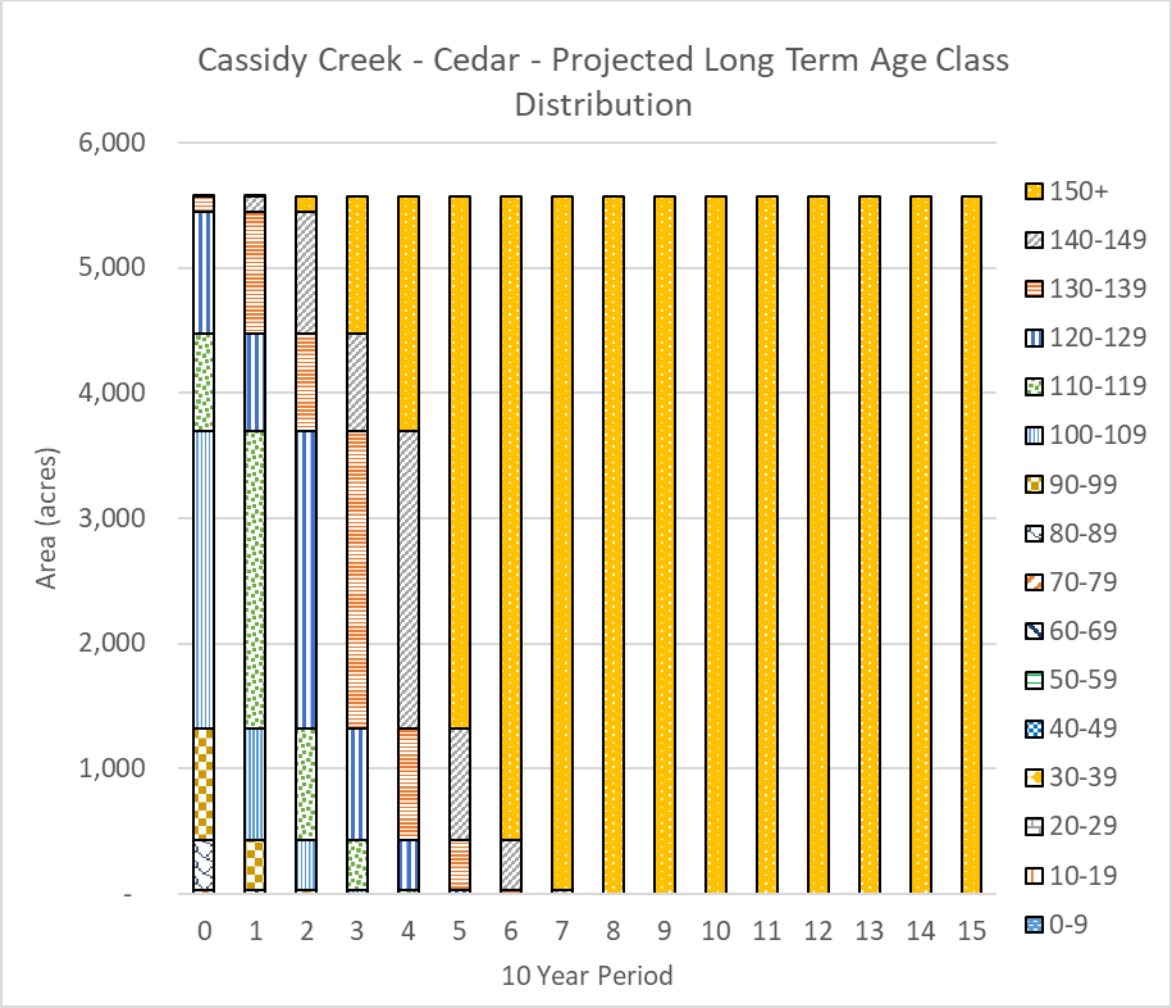


Figure 15. Projected age class distribution over 15, 10-year planning periods.

Upland mixed forest

Current condition

The current age class distribution is unbalanced with a deficit of acres in ages 10-79 years old and a surplus of acres in the 0-9 and in the 80–99-year-old age classes. Limited merchantable acres in the older age classes will present managers with a challenge in achieving the desired regeneration during this planning period.

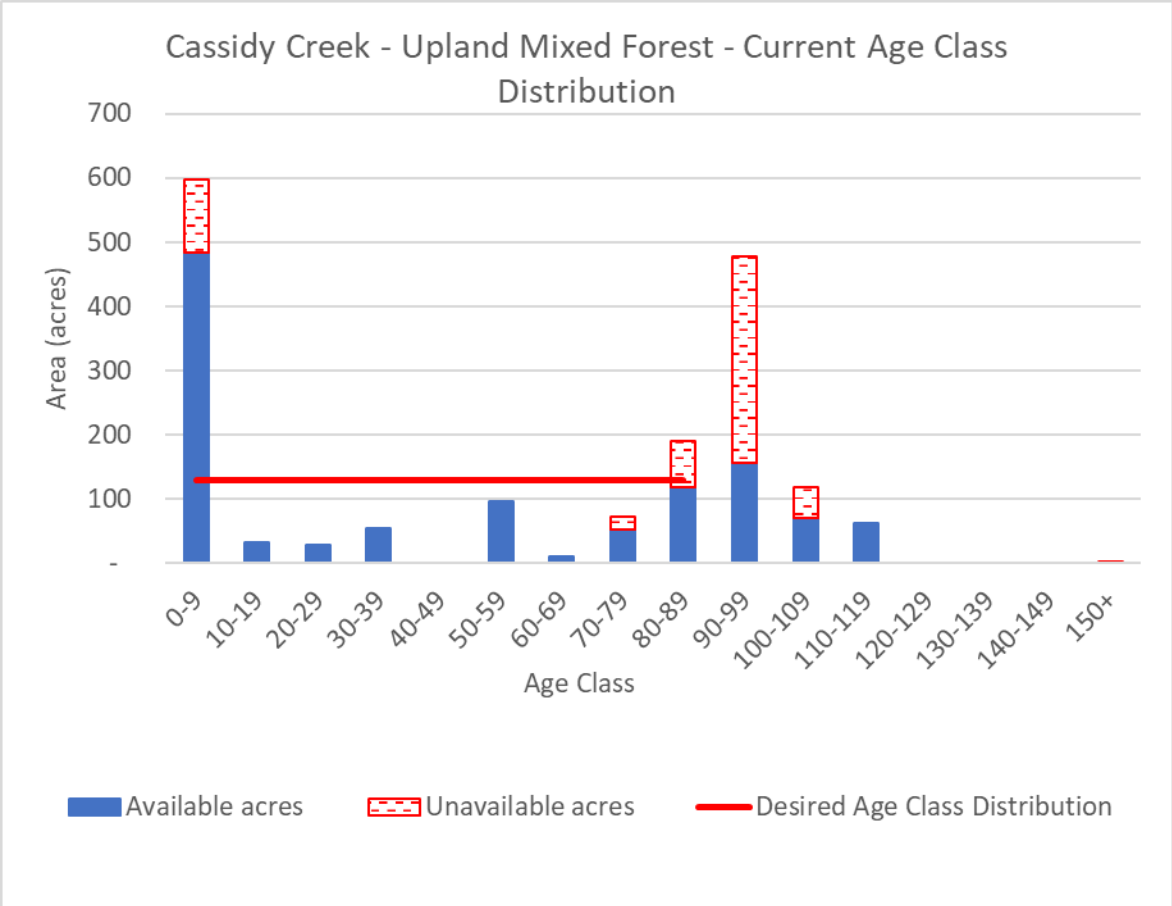


Figure 16. Current age class distribution, the desired age class distribution, and the projected harvests in the upland mixed forest cover type over the 10-year planning period.

Desired future condition

The desired age class distribution is to have a rotation age of 80 years.

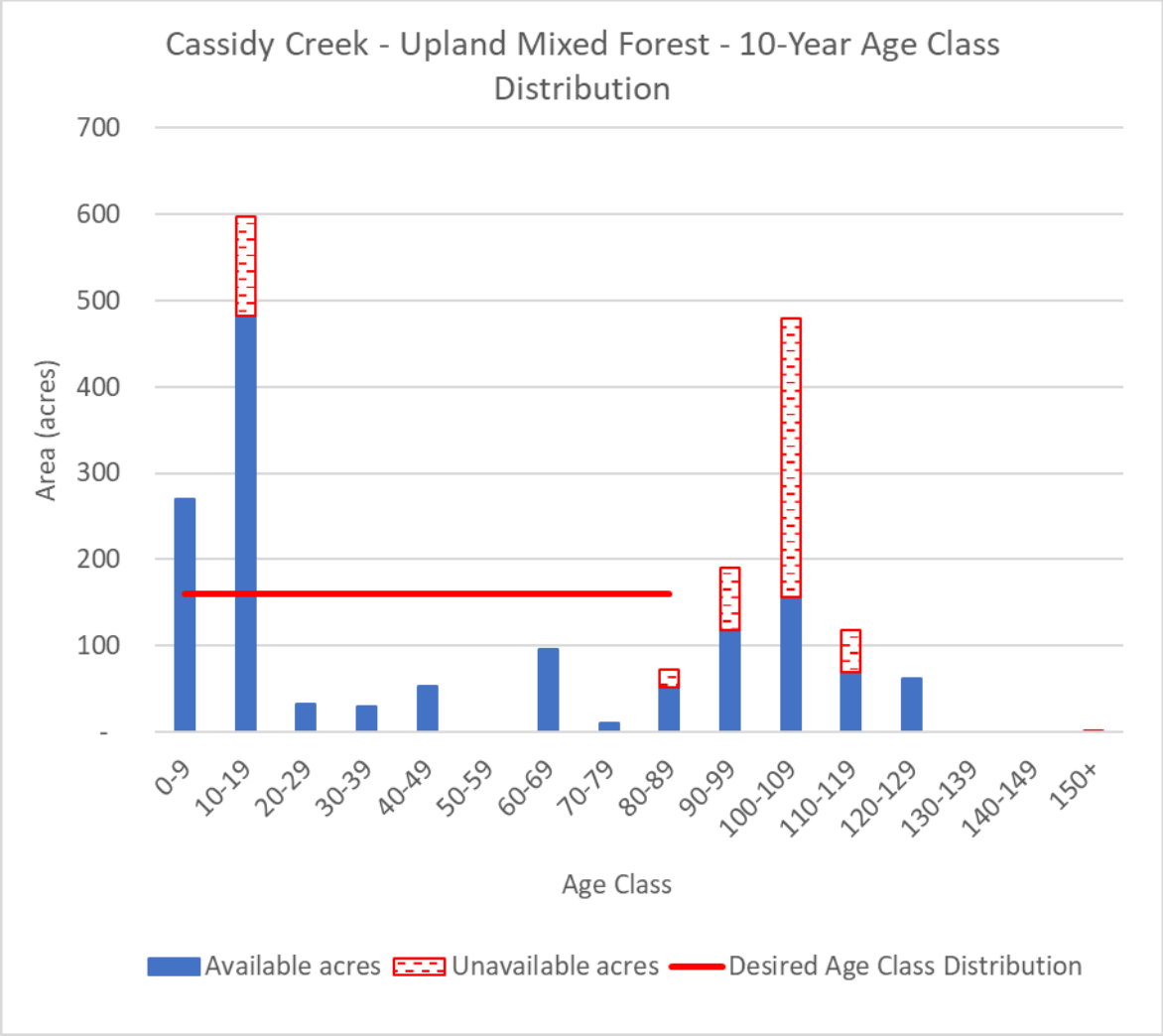


Figure 17. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The end of the planning period will result in the establishment of 270 acres in the upcoming 0-9 age class. This will primarily come from other cover types. Progress toward the long-term desired age class distribution of upland mixed forest will take many decades in this management area. A portion of this cover type meets the habitat requirements for blackburnian warbler and marten.

Table 12. Featured species with upland mixed forest as a priority habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Upland Mixed Forest	Upland Mixed Forest Habitat Acres - Available	Upland Mixed Forest Habitat Acres - Unavailable
Blackburnian warbler	Age category: 80+ Size category: Sawlog Basal area: 81+	247	436

Featured Species	Featured Species Habitat – Upland Mixed Forest	Upland Mixed Forest Habitat Acres - Available	Upland Mixed Forest Habitat Acres - Unavailable
Marten	Age category: 40+ Size category: pole, sawlog Basal area: 81+	247	436

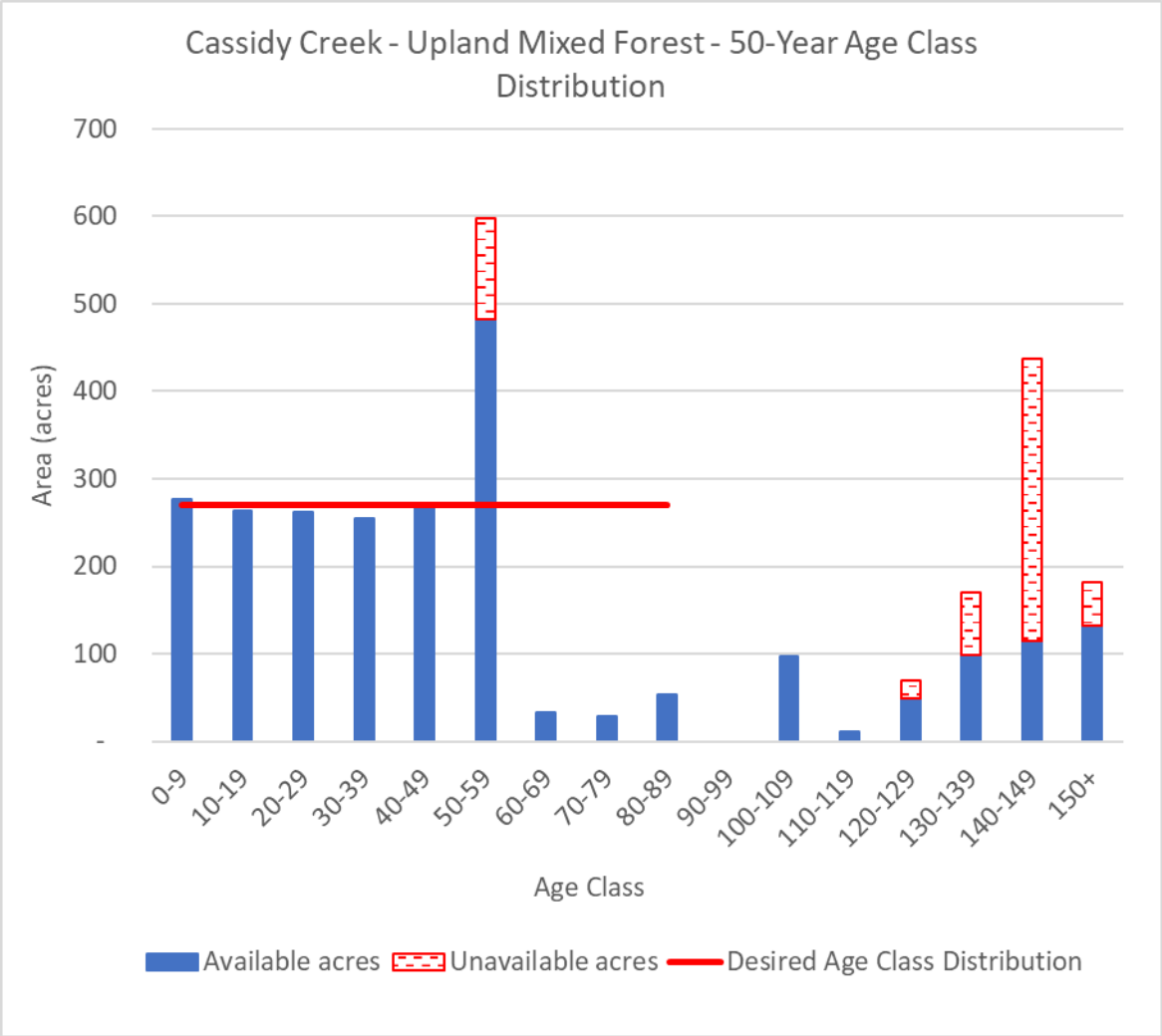


Figure 18. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of upland mixed forest acres working toward the desired future condition as the older age classes are treated (Figure 18).

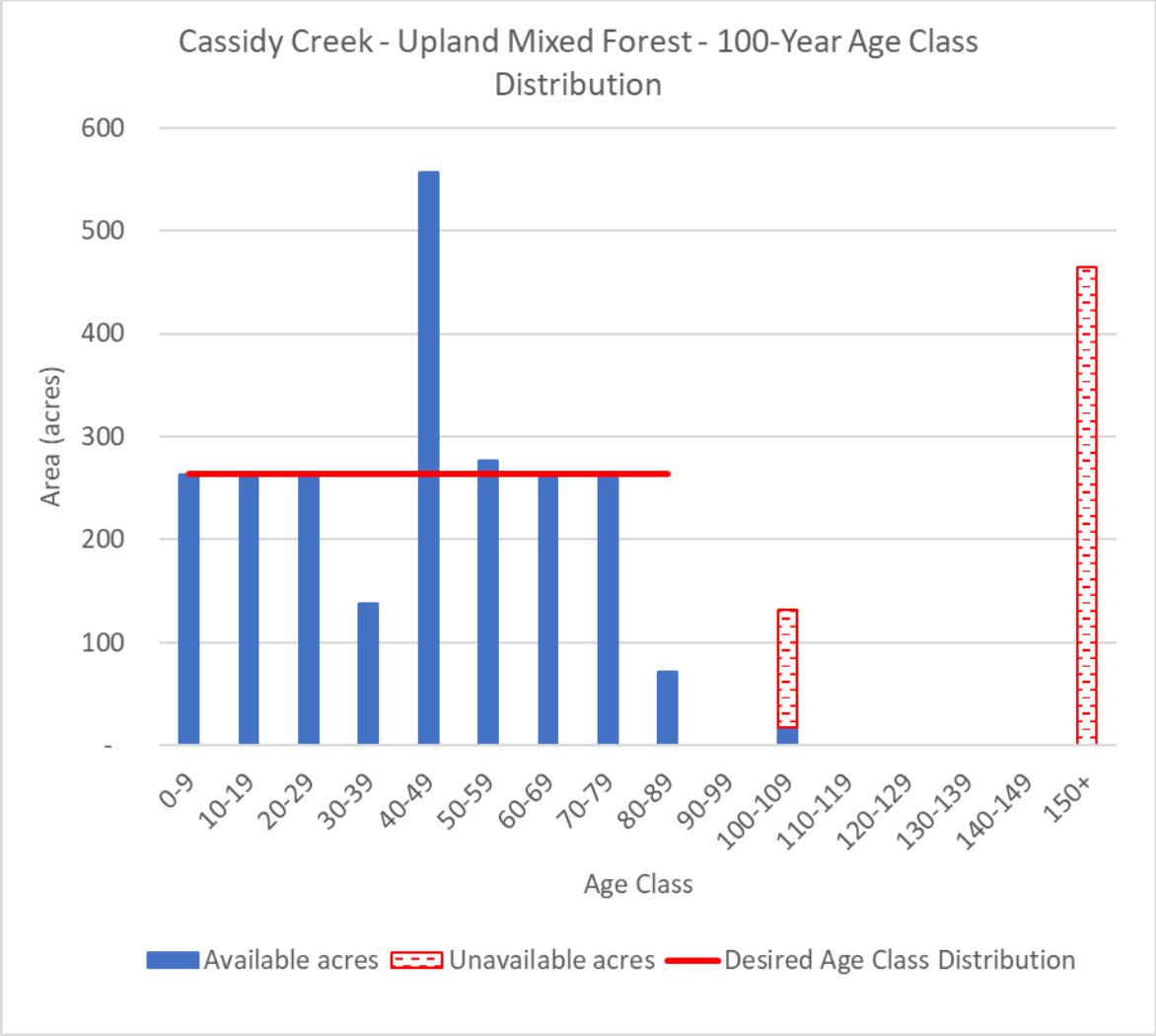


Figure 19. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 19) will concentrate the manageable acres of upland mixed forest in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged, and mature forest.

Management actions

There are no acres of projected harvest in the upland mixed forest cover type. It is expected that about 270 acres of upland mixed forest will be converted from other cover types. These total to an expected 270 acres of regeneration in the upland mixed forest cover type over the next 10 years.

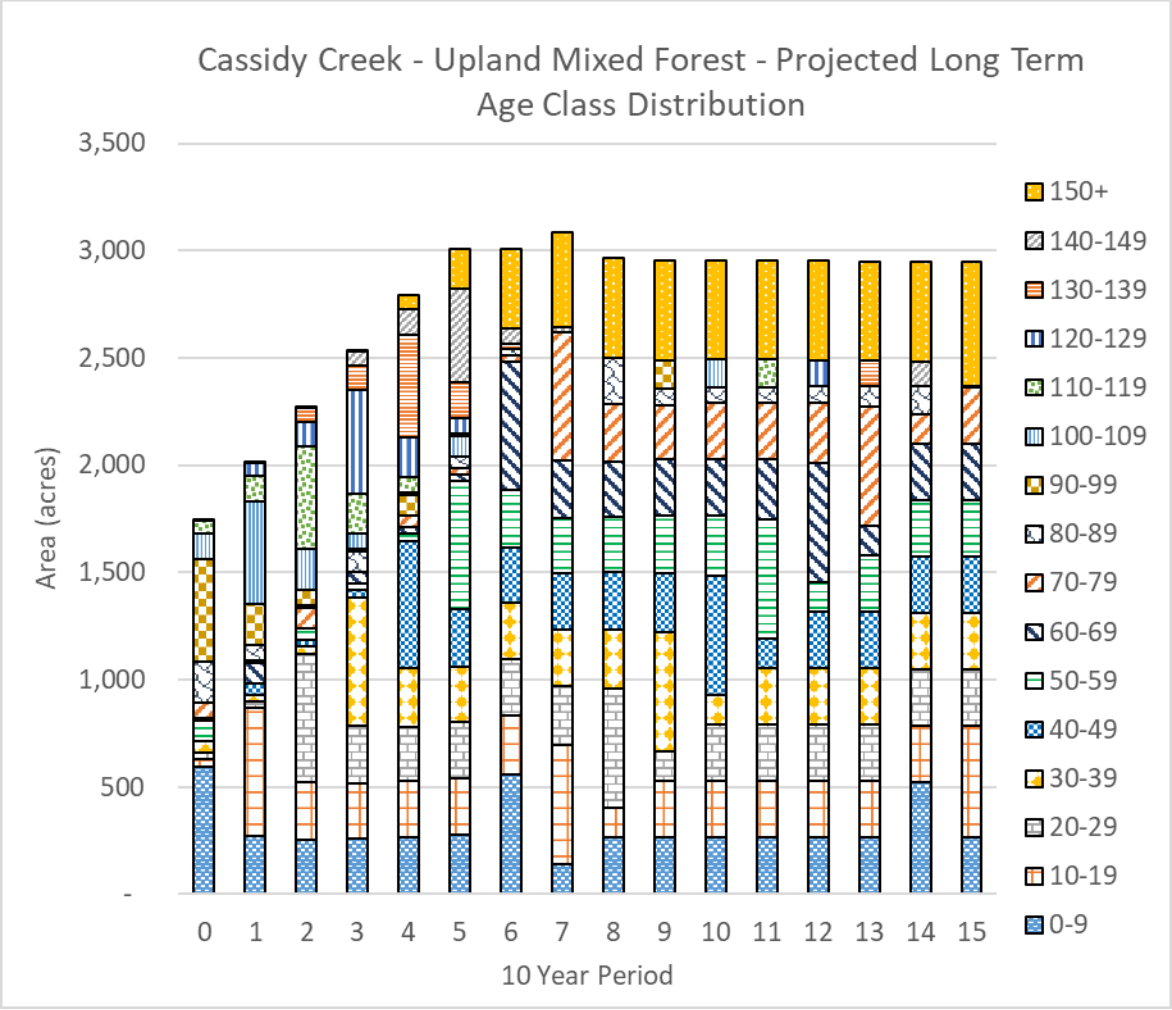


Figure 20. Projected age class distribution over 15,10-year planning periods.

Conservation Area Network

High Conservation Value Areas

There are up to eight different high conservation value area (HCVA) types that can be found in each management area (Table 13; see Biodiversity in Section 3 for more information).

Table 13. High conservation value areas within the Cassidy Creek management area.

High Conservation Value Area Type and Name	Acres
Forest Habitat Core Interior	**899**
	899
Northern Long-Eared Bat Hibernacula 2.5 mile Buffer	**4,366**
Iron Mountain Iron Mine (Tourist Mine)	705
Jones' Adit	630
Norway Mine	560
Randville Quarry Mine	2,313
Trader's Mine	158
State Wildlife Management Areas	**8,135**
Blomgrens' Marsh SWMA	582
Groveland Mine Flooding SWMA	6,867
Hancock Creek Flooding SWMA	686
Grand Total	**13,399**

Ecological reference areas

Ecological reference areas (ERAs) are a type of HCVA and are higher quality examples of functioning ecosystems that are primarily influenced by natural ecological processes.

Table 12. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 13. Ecological reference areas within the management area.

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	Number of Occurrences
Existing ERA	Dry-mesic northern forest	B			5
Existing ERA	Dry-mesic northern forest	B	G4	S3	1
Existing ERA	Granite bedrock glade	A	G3G5	S2	1
Existing ERA	Granite bedrock glade	AB	G3G5	S2	4
Existing ERA	Granite cliff	AB	G4G5	S2	2
Existing ERA	Submergent marsh	AB	GU	S4	2
Proposed ERA	Granite bedrock glade	B	G3G5	S2	1
Proposed ERA	Granite cliff	A	G4G5	S2	1
Proposed ERA	Granite cliff	AB	G4G5	S2	3
Proposed ERA	Northern hardwood swamp	B	G4	S3	1
Proposed ERA	Poor fen	AB	G3	S3	2
Grand Total					**23**

Special conservation areas

Reviewable special conservation areas (SCAs; Table 16) refers to those SCA types that may be reviewed or updated through the compartment review process as needed. Static SCAs (Table 22) refers to those SCA types that generally do not change or require updating (see Biodiversity in Section 3 for more information).

Table 16. Reviewable special conservation areas within the Cassidy Creek management area.

Reviewable Special Conservation Area Type and Name	Acres
Concentrated Recreational Area	**49**
Carney Lake Campground	23
East Pond Landing	1
North Pond Landing	19
South Pond landing	2
Unofficial landing	1
West Pond Landing	3
Habitat Area or Habitat Corridor	**14**
Cedar/Hemlock	2
Hemlock	12
Grand Total	**62**

Table 17. Static special conservation areas within the Cassidy Creek management area.

Reviewable Special Conservation Area Type and Name	Acres
Concentrated Recreational Area	**49**
Carney Lake Campground	23
East Pond Landing	1
North Pond Landing	19
South Pond landing	2
Unofficial landing	1
West Pond Landing	3
Habitat Area or Habitat Corridor	**14**
Cedar/Hemlock	2
Hemlock	12
Grand Total	**62**

Rare species

Rare species occurrences are compiled from the Michigan Natural Features Inventory Biotics database (Tables 19, 20 and 21) and do not necessarily include all rare species found in this management area due to biases in survey effort and verifiable observation reporting over time.

Table 14. Rare animal and plant species conservation status key.

Status	Status
E = endangered	LE = listed endangered
T = threatened	LT = listed threatened
SC = special concern	PDL = proposed for delisting

Table 19. Rare animal species occurrence within the Cassidy Creek management area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Alasmidonta viridis	Slippershell	T	--	1
Animal	Alces alces*	Moose	SC	--	--
Animal	Bombus borealis	Northern amber bumble bee	SC	--	3
Animal	Bombus terricola	Yellow-banded bumble bee	SC	--	1
Animal	Canis lupus*	Gray wolf	SC	LE	--
Animal	Gavia immer	Common loon	T	--	4
Animal	Glaucomys sabrinus	Northern flying squirrel	SC	--	1

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Glyptemys insculpta	Wood turtle	T	--	2
Animal	Haliaeetus leucocephalus	Bald eagle	SC	--	5
Animal	Lasmigona compressa	Creek heelsplitter	SC	--	3
Animal	Lasmigona costata	Flutedshell	SC	--	3
Animal	Ligumia recta	Black sandshell	T	--	1
Animal	Myotis lucifugus	Little brown bat	T	--	1
Animal	Myotis septentrionalis	Northern long-eared bat	T	LE	1
Animal	Necturus maculosus	Mudpuppy	SC	--	2
Animal	Pandion haliaetus	Osprey	SC	--	3
Total	--	--	--	--	**31**

**Occurrence information provided by field staff.*

Table 20. Rare plant species occurrence within the Cassidy Creek management area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Plant	Botrychium mormo	Goblin moonwort	E	--	1
Plant	Dryopteris fragrans	Fragrant cliff woodfern	SC	--	1
Plant	Pellaea atropurpurea	Purple cliff brake	T	--	1
Total	--	--	--	--	**3**

Table 21. Other rare occurrence within the Cassidy Creek management area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Other	Great Blue Heron Rookery	Great Blue Heron Rookery	--	--	3
Total	--	--	--	--	**3**

Non-ERA natural communities

Natural communities that are identified with an element occurrence in the MNFI Biotics database, but that have not been given an additional ecological reference area (ERA) designation, are recognized and managed accordingly (Table 23).

Table 15. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 23. Non-ERA natural communities in the management area.

Community Type	Element Occurrence Rank	State Rank	Global Rank	Number of Occurrences
Northern Wet Meadow	AB	S4	G4G5	3
Northern Wet Meadow	B	S4	G4G5	1
Northern Hardwood Swamp	B	S3		2
Grand Total				**6**

Forest health

Forest health concerns, both native and non-native, can have impacts on stand conditions and management decisions. The following insects (Table 24) and diseases (Table 25) could have an impact on management during the planning period and may need to be monitored and/or addressed.

Table 24. Defoliating insects of concern in the Cassidy Creek management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Spongy moth	Lymantria dispar	Non-native	Yes
Forest tent caterpillar	Malacosoma disstria	Native	Yes
Large aspen tortrix	Choristoneura conflictana	Native	Yes
Spruce budworm	Choristoneura fumiferana	Native	Yes

Watch for lingering ash with potential resistance to emerald ash borer as impacts to ash increase.

Table 25. Maladies of concern in the Cassidy Creek management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Canker	Various	Various	Yes
Armillaria root rot	Armillaria spp.	Native	Yes
Oak Wilt	Bretziella fagacearum	Non-native	No

Aquatic resources

Riparian habitat

A total of 97 miles of streams and rivers are found in the management area (Table 26). Streams/rivers classified as warm types comprise approximately 72 percent of the riverine mileage.

Table 26. Classification type and length of streams/rivers found within the management area.

Type	Length (miles)
Cold stream	12
Cold small river	0
Cold transitional stream	15
Cold transitional small river	0
Cold transitional large river	0
Warm transitional stream	57
Warm transitional small river	12
Warm transitional large river	1
Warm stream	0
Warm small river	0
Warm large river	0

Lacustrine habitat

A total of 20 lakes and ponds of at least one surface acre are found in the management area (Table 27).

Table 27. Size and number of lakes and ponds located within the management area.

Lake Size Class (acres)	Number
1-99	14
100-499	6
500+	0

Wetlands

The management area contains a total of 15,855 acres of wetlands (Table 28). Forested wetlands comprise approximately 89 percent of wetland types found in the management area.

Table 28. Area of emergent, forested, and riverine wetland types found within the management area.

Wetland Type	Acres
Emergent	1,619
Forested	14,134
Riverine	102

Vernal pools and seeps

A total of 1,024 acres of vernal pools and seeps have been inventoried and 800 acres of seeps have been identified.

Riparian vegetation cover

Aspen, lowland shrub and cedar are the predominant cover type present in a 100-meter riparian zone located next to streams/rivers in the management area (Table 29).

Table 29. Largest vegetative cover types (i.e., top 10) and area located in a 100-meter buffer of streams/rivers within the management area.

Cover Type	Acres
Aspen	3,551
Lowland shrub	2,222
Cedar	1,089
Lowland conifers	690
Lowland deciduous	672
Mixed upland deciduous	539
Northern hardwood	460
Natural mixed pines	443
Upland mixed forest	401
Marsh	368

Watershed vegetation cover

The management area includes portions of important watersheds of the Pine Creek and Sturgeon River (Tables 30 and 31). Aspen and northern hardwoods are major cover types of the state forest in each watershed.

Table 30. Largest vegetative cover types (i.e., top 5) and area of the Pine Creek watershed located within the management area.

Cover Type	Acres
Aspen	19,579
Northern hardwood	5,111
Cedar	3,895
Lowland shrub	2,251
Lowland conifer	1,628

Table 31. Largest vegetative cover types (i.e., top 5) and area of the Sturgeon River watershed located within the management area.

Cover Type	Acres
Aspen	8,680
Northern hardwood	2,313
Cedar	1,434
Mixed upland deciduous	1,263
Lowland shrub	1,038

Recreation

The Cassidy Creek area has generally good public recreation and management access. Snowmobile and off-road vehicle routes cross the area, including the Felch and Norway ORV routes. The Merriman East Pathway is a bike and hike trail in the Groveland Mines area. There is one state forest campground (rustic) within the management area, Carney Lake.

Table 32. Designated Recreation Trails by type

Recreation Category	Recreation Type
Motorized Recreation Trails	**104.9**
ORV (all types)	57.9
Snowmobiles	47.0
Non-motorized Recreation Trails	**17**
Hiking	8.5
Equestrian	0
Biking	8.5
Grand Total	**121**.9

Note: Trail use types may overlap.

Table 33. State forest campgrounds (SFCG).

Name	Number of Sites	ORV Access
Carney Lake SFCG	16	--

Within the Cassidy Creek area there are two areas managed for hunting. The flooding at Bloomgren's Marsh wildlife management area is used extensively by hunters, trappers, and for bird watching and wildlife viewing. Hancock Creek flooding provides several access points for hunting and wildlife viewing.

Table 34. Areas managed for hunting.

Type	Number of Acres
State Wildlife Management Areas	--
Bloomgren's Marsh Flooding SWMA	580.8
Hancock Creek Flooding SWMA	685.4
Total	**1,266.2**

There are six boating access sites on the ponds of the former Groveland Iron Mine, acquired by the state of Michigan in the mid-1990s. These ponds are popular for fishing. Other boating access sites provide access to small inland lakes and the West Branch of the Sturgeon River.

Table 35. Boating access sites (BAS).

Name	Waterbody
Benton Lake	Benton Lake
Carney Lake SFCG	Carney Lake
Groveland Mine East Pond	East Pond (Groveland Mine)
Groveland Mine Island Pond	Island Pond (Groveland Mine)
Groveland Mine West Pond	West Pond (Groveland Mine)
Pond #1	Pond #1 (Groveland Mine)
Rock Lake	Rock Lake
South Pond	South Lake (Groveland Mine)
West Branch Sturgeon River	West Branch Sturgeon River

Green Bay

State Forest Area: 67,045 acres	**Location:** Shores of Green Bay	**Population Centers:** Escanaba, Gladstone, Menominee
Sub-Section: Green Bay Sandy Plain	**Landforms:** Flat lake bed, deltaic deposits of sand, parabolic dune fields, and shallow embayments containing transverse dunes	**Landcover:** Forested: 57,596 acres Non-forested: 9,449 acres

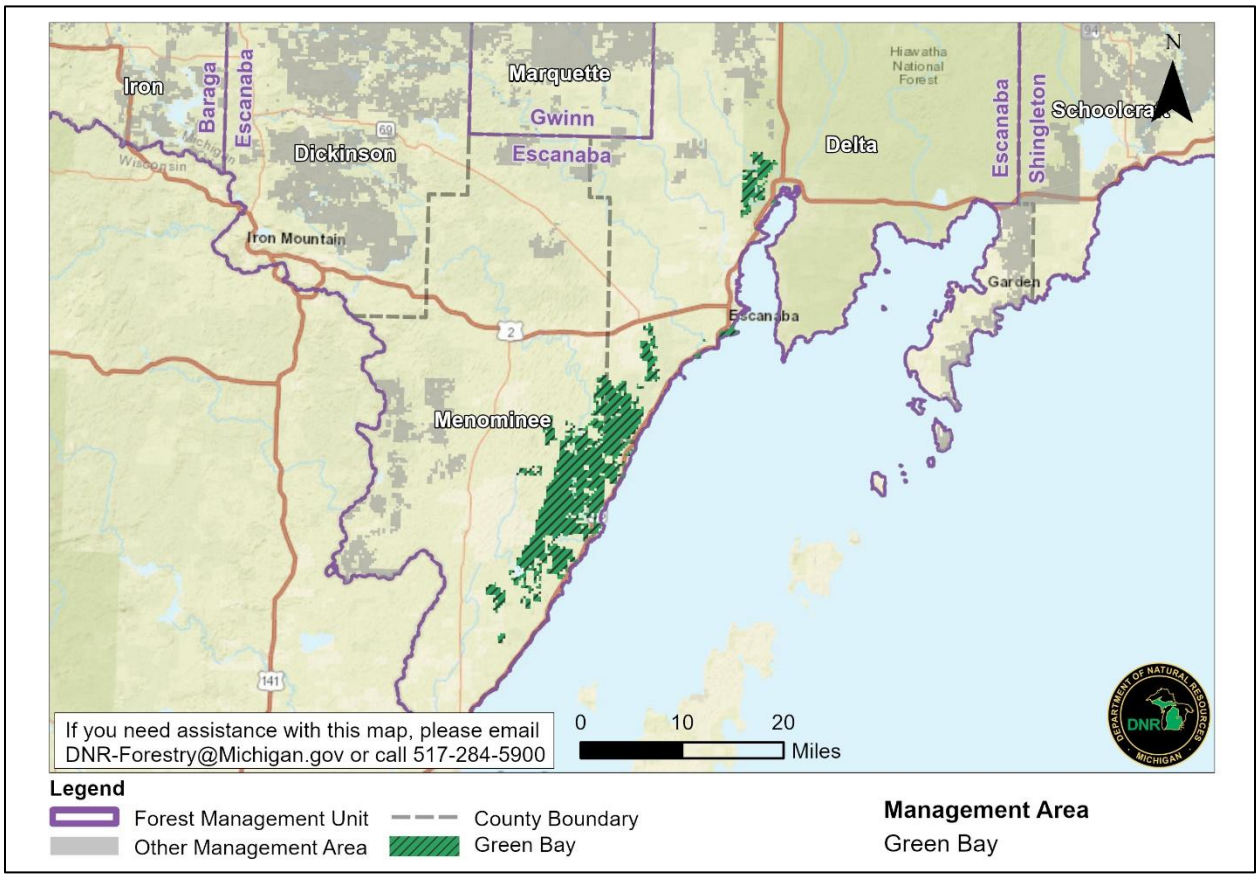


Figure 1. Map of the Green Bay management area.

Forested landscape

Current and projected future condition

The Green Bay management area is dominated by shade-tolerant cover types. Intolerant deciduous cover types are relatively evenly distributed across age categories, while the unavailable upland and lowland acres are more prevalent in the older age category.

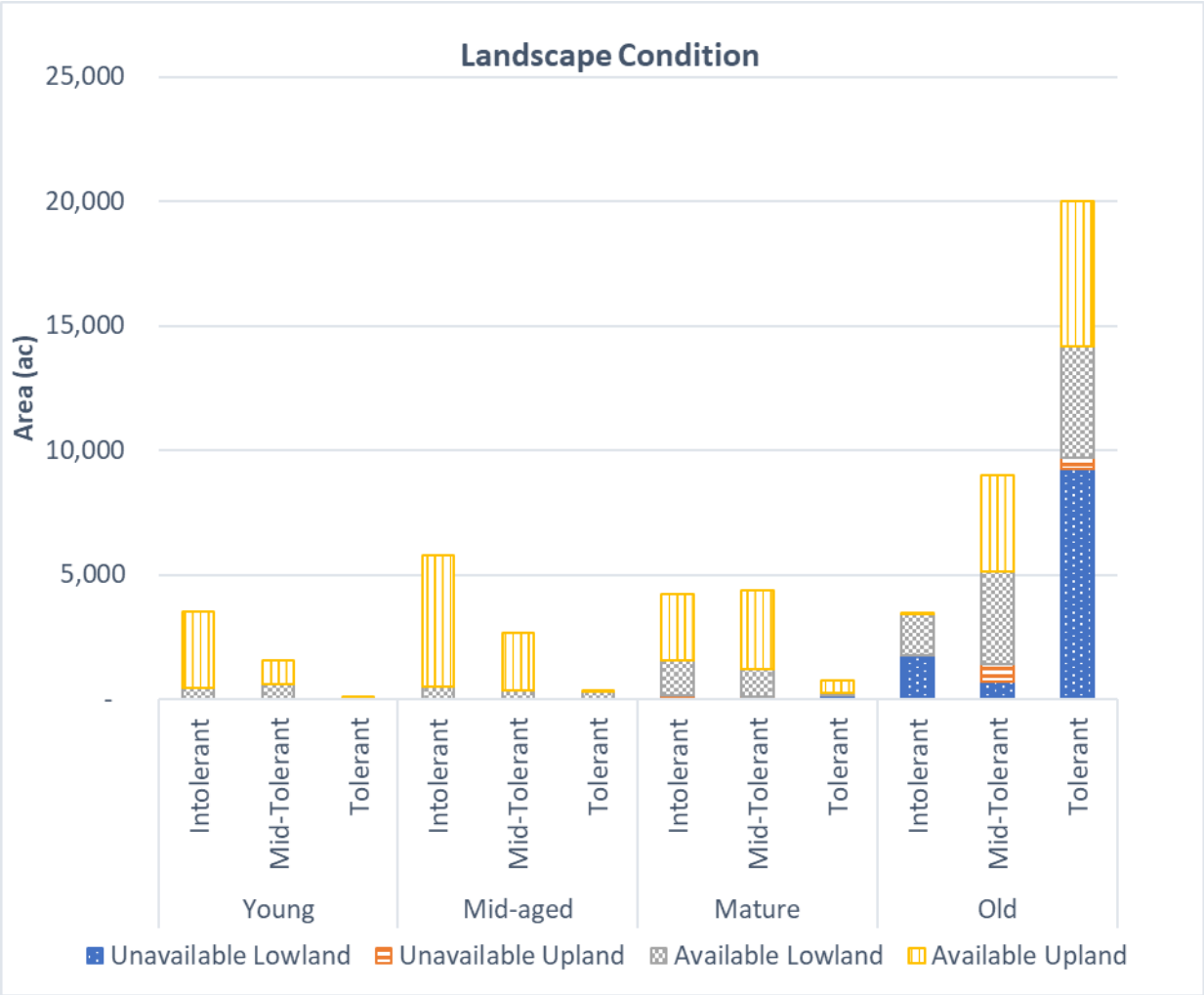


Figure 2. Forest diversity matrix showing current distribution of forested acres across management availability, age category, landscape position and shade tolerance.

Landscape habitat conditions refine the management area landscape into featured species habitat context. Current and projected acres for the metrics identified in the Management Priorities (Section 3 Statewide/Regional) establish a baseline and future condition based on management over the planning period (Table 1).

Table 1. Current and projected acres for Landscape Habitat Conditions.

Landscape Habitat Condition	Monitoring Metric	Current Acres
Young forest	Acres of 0-19 stands in aspen and jack pine	3,041
Mature forest	Acres of 80+ year stands across cover types	32,332
Mature forest	Acres of 120+ year stands across cover types	19,102
Mesic conifer cover types	Acres of mesic conifer cover types	5,695
Mesic conifers in other cover types	Average canopy occupancy	35%
Mast – oak cover types	Acres of oak cover types	2
Mast tree species in other cover types	Acres of total canopy occupancy of mast tree acres (Trace-100%)	7,290
Big trees	Acres of total canopy stand occupancy of species in sawlog or greater size class	27,893
Non-forested openings	Acres of total herbaceous open land, upland shrub and cropland	553
Landscape forest matrix	Percent ceciduous forest	44%
Landscape forest matrix	Percent coniferous forest	47%

Another important landscape level habitat in this management area is coastal habitat. The Great Lakes, particularly coastal and nearshore areas, provide globally or continentally important stopover sites for all groups of migratory birds: waterfowl, shorebirds, landbirds (defined here as songbirds and raptors), and waterbirds (loons, grebes, cormorants, herons, rails, cranes, gulls, and terns) (Ewert, et. Al 2012). The Great Lakes shoreline provides essential stopover habitat for birds to rest, feed, and shelter during migration. In addition to migration, the diverse coastal habitats where water and land meet provides unique habitats for breeding birds. Some of these areas are classified by Michigan Audubon as Important Bird Areas (IBAs). The Great Lakes shoreline is habitat for several rare plant species that are endemic to the Great Lakes.

Forest management and other intrusive activities within a mile of the coastline need to consider the potential impacts to migratory birds and breeding bird habitat.

The Green Bay management area has the following Special Analysis Units (SAUs). These SAUs have specific cover type goals typically associated with wildlife habitat management. For any SAUs that overlap with this MA, SAU cover type goals take priority as the SFMP model strives to ensure cover type goals across the area are met. Please see Section 5 for a detailed description of the management direction and harvest goals for each of these SAUs.

- Grouse Enhanced Management (GEM)-Cedar River

The Green Bay management area is dominated by forested cover types with 86 percent of the area covered in forested stands (Table 2). The upland deciduous portion of that is 29 percent of the

management area and comprised mostly of aspen. The lowland coniferous portion is 29 percent of the management area and comprised mostly of cedar. Lowland shrub is the most common non-forested cover type in this management area, representing 8 percent of the landscape.

Table 2. Summary table describing the landscape conditions and distribution of cover types in the Green Bay management area.

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
Forested	Upland	Deciduous	Aspen	11,134	19,401	29,548	57,596
			Northern hardwood	4,877			
			Black-red hybrid oak	0			
			Northern red oak	2			
			Oak mix	0			
			Mixed upland deciduous	3,389			
		Mixed	Upland mixed forest	2,675	2,675		
		Coniferous	Planted red pine	1,194	7,472		
			Planted jack pine	42			
			Planted white pine	7			
			Planted mixed pine	0			
			Natural eed pine	534			
			Natural jack pine	0			
			Natural white pine	585			
			Natural mixed pines	754			
			Upland spruce/fir	435			
			Upland conifers	2,234			
			Hemlock	1,687			
	Lowland	Deciduous	Lowland aspen/balsam poplar	1,147	5,832	28,048	
			Lowland deciduous	4,686			
		Mixed	Lowland mixed forest	2,675	2,675		
		Coniferous	Cedar	11,601	19,541		
			Lowland conifers	2,806			
			Lowland spruce/fir	4,153			

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
			Tamarack	981			
Nonforested	Upland	N/A	Herbaceous openland	445	N/A	754	9,449
			Upland shrub	107			
			Low density trees	57			
			Bare/sparsely vegetated	75			
			Cropland	1			
			Urban	69			
	Lowland	N/A	Lowland shrub	5,673	N/A	8,695	
			Marsh	1,100			
			Bog	330			
			Treed bog	1,000			
			Water	592			
						Grand Total:	67,045

Table 3. Summary table describing the landscape conditions and cover type composition of the Green Bay management area.

Green Bay Forested Cover Type	Available Acres	Available %	Unavailable Acres	Unavailable %	Total Acres	Total %
Aspen	11,066	19.2%	68	0.1%	11,134	19.3%
Cedar	3,238	5.6%	8,363	14.5%	11,601	20.1%
Hemlock	1,429	2.5%	258	0.4%	1,687	2.9%
Lowland aspen/balsam poplar	1,147	2.0%	0	0.0%	1,147	2.0%
Lowland conifers	1,923	3.3%	883	1.5%	2,806	4.9%
Lowland deciduous	3,961	6.9%	725	1.3%	4,686	8.1%
Lowland mixed forest	2,338	4.1%	337	0.6%	2,675	4.6%

Green Bay Forested Cover Type	Available Acres	Available %	Unavailable Acres	Unavailable %	Total Acres	Total %
Lowland spruce/fir	2,499	4.3%	1,655	2.9%	4,154	7.2%
Mixed upland deciduous	3,067	5.3%	322	0.6%	3,389	5.9%
Natural mixed pines	754	1.3%	0	0.0%	754	1.3%
Natural red pine	489	0.8%	45	0.1%	534	0.9%
Natural white pine	585	1.0%	0	0.0%	585	1.0%
Northern hardwood	4,678	8.1%	200	0.3%	4,878	8.5%
Northern red oak	2	0.0%	0	0.0%	2	0.0%
Planted jack pine	42	0.1%	0	0.0%	42	0.1%
Planted red pine	1,194	2.1%	0	0.0%	1,194	2.1%
Planted white pine	0	0.0%	7	0.0%	7	0.0%
Tamarack	762	1.3%	219	0.4%	981	1.7%
Upland conifers	2,059	3.6%	175	0.3%	2,234	3.9%
Upland mixed forest	2,455	4.3%	220	0.4%	2,675	4.6%
Upland spruce/fir	435	0.8%	0	0.0%	435	0.8%
Grand Total	**44,121**	**76.6%**	**13,477**	**23.4%**	**57,599**	**100%**

Table 4. Site Condition (reason area is unavailable for commercial harvest) acres for the Green Bay Management Area.

Site Condition (Reason area is unavailable for commercial harvest)	Area (ac)	% of Unavailable Area
Wildlife concerns	9,402	61.1%
BMPs	1,554	10.1%
Conservation values	1,457	9.5%
Unproductive	928	6.0%
Species of special concern or T&E	793	5.2%
Other dept./div. processes	289	1.9%
Long-term retention	275	1.8%
Blocked by obstacle	155	1.0%

Site Condition (Reason area is unavailable for commercial harvest)	Area (ac)	% of Unavailable Area
Neighbor or interest group	142	0.9%
Too wet	122	0.8%
Recreational/scenic	80	0.5%
Denied access	79	0.5%
Deer wintering area	39	0.3%
Cannot regenerate	28	0.2%
Other influence zones	26	0.2%
Too steep	15	0.1%
Total unavailable	**15,384**	**100.0%**

Management actions

Each cover type in the Green Bay management area has a unique age class and basal area class goals that describe the long-term desired future conditions. The harvests levels that are needed in the first planning period to begin achieving those long-term goals are summarized below (Table 5).

Silvicultural Regimes

Cover Type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Salvage Clearcut	Salvage Thinning	Grand Total
Aspen	2,024	-	-	-	-	-	-	2,024
Northern hardwood	74	889	-	-	21	-	-	983
Lowland spruce/fir	588	-	-	-	-	-	-	588
Lowland deciduous	404	59	-	-	14	-	-	477
Planted red ine	-	-	442	-	-	-	-	442
Mixed upland deciduous	390	-	-	-	19	-	-	410
Upland conifers	337	-	1	-	60	-	-	399
Upland mixed forest	188	-	-	-	-	-	-	188
Lowland aspen/balsam poplar	185	-	-	-	-	-	-	185
Lowland conifers	163	-	-	-	-	-	-	163
Tamarack	98	-	-	-	-	-	-	98
Upland spruce/fir	63	-	-	-	-	-	-	63

Silvicultural Regimes								
Cover Type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Salvage Clearcut	Salvage Thinning	Grand Total
Natural Mixed pines	-	-	25	-	15	-	-	40
Lowland Mixed forest	38	-	-	-	-	-	-	38
Totals	**4,552**	**948**	**469**	**-**	**129**	**-**	**-**	**6,097**

Table 5. Ten-year planning period harvest goals (acres) by cover type and silvicultural regime.

These harvests will help establish a desirable amount of regeneration for even-aged cover types over the 10-year period or help to achieve desired basal area distribution among uneven-aged cover types like northern hardwoods. The following sections will provide additional details for each of the significant cover types in the Green Bay management area.

Table 6. Ten-year estimated harvest volume by product and species.

10-Year Estimated Harvest Volume Projection Green Bay Management Area Product	Species	Volume Planned*	Volume Prepared**
Pulpwood (cords)	Mixed aspen	18,619	17,502
	Mixed hardwood	18,037	16,955
	Mixed softwood	11,847	11,136
	Mixed spruce	8,119	7,632
	Red pine	3,379	3,176
	White pine	1,551	1,458
	Mixed oak	1,330	1,251
	Jack pine	387	364
	Pulpwood Total	**63,269**	**59,473**
Sawtimber (MBF)	White pine	3,446	3,239
	Mixed aspen	3,274	3,078
	Red pine	3,054	2,870
	Sugar maple	2,982	2,803
	Red maple	2,224	2,091
	Red oak	1,693	1,592
	Basswood	347	327
	White oak	327	308
	Mixed oak	69	65
	Sawtimber Total	**17,417**	**16,372**
	Total Sawtimber Harvest Volume in Cords	**36,228**	**34,054**
	Grand Total Harvest Volume in Cords	**99,497**	**93,527**

10-Year Estimated Harvest Volume Projection Green Bay Management Area Product	Species	Volume Planned*	Volume Prepared**
* Volume estimates based on 100% of the projected harvests for the 10 year planning period. ** Volume estimates based on 94% of the projected harvests for the 10 year planning period accounting for reduction in acres and associated volume once sales are prepared for bid.			

There are very few cover type transitions projected in the Green Bay area. The managed area of each cover type is projected to remain relatively stable. The largest decrease expected is in the upland conifer cover type, where 180 acres are forecasted to convert to other cover types through forest management activities. The largest increase is in Lowland mixed forest where 246 acres are expected to convert into that cover type.

Table 7. Projected 10-year cover type acres resulting from cover type transitions.

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Cedar	11,601	11,601	0
Aspen	11,134	11,081	-52
Northern hardwood	4,877	4,889	12
Lowland deciduous	4,686	4,551	-135
Lowland spruce/fir	4,153	3,999	-155
Mixed upland deciduous	3,389	3,342	-47
Lowland conifers	2,806	2,867	61
Upland mixed forest	2,675	2,903	228
Lowland mixed forest	2,675	2,921	246

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Upland conifers	2,234	2,054	-180
Hemlock	1,687	1,687	0
Planted red pine	1,194	1,246	52
Lowland aspen/balsam poplar	1,147	1,159	12
Tamarack	981	950	-31
Natural mixed pines	754	754	0
Natural white pine	585	619	34
Natural red pine	534	534	0
Upland spruce/fir	435	388	-47
Planted jack pine	42	42	0
Planted white pine	7	7	0
Northern red pak	2	2	0
Lowland shrub	5,673	5,673	0
Marsh	1,100	1,100	0
Treed bog	1,000	1,000	0
Water	592	592	0
Herbaceous openland	445	445	0
Bog	330	330	0
Upland shrub	107	107	0
Bare/Sparsely vegetated	75	75	0
Urban	69	69	0
Low density trees	57	57	0
Cropland	1	1	0
Total:	**67,045**	**67,045**	**0**

Featured species current and projected habitat acres.

There are seven featured species in this management area that span various cover types, age classes, and stand level conditions.

It is recommended that these featured species habitat acres be viewed as acres of potential habitat, representing a condition on the landscape where the more nuanced aspects of each species' habitat requirements are likely to be found or managed for. As described in the introduction, the modeling effort was limited by several factors including the simplification of habitat attributes into MiFI variables. Therefore, when referring to habitat acres what is being referred to is potential habitat acres.

Current and projected total habitat acres by species across the decade provide a baseline and show the result of long-term management actions (Table 8). Some species show a loss in habitat over the next century. As mentioned in the Featured Species Management Priority (Section 3), the current condition for many cover types is a surplus of acres in the 0-9 age class from the compensatory management approach applied in the previous decade. The model eventually evens out the age classes at a lower, sustainable level over time, usually by 50 years. For any species with northern hardwoods as a priority cover type, there is a perceived drop in acres between 40-60 years; this is due to the basal area dropping below 81 but because it only drops into the upper 70s, it is not expected to translate to any real habitat loss on the ground. Two of these species were not included in the SFMP model and don't show projected habitat acres but are included here to inform management decisions over the decade.

Table 8. Featured species current and projected total habitat acres (i.e., potential habitat).

Featured Species	Priority Cover types	Total Habitat Acres Current	10-year Projected Habitat Acres	50-year Projected Habitat Acres	100-year Projected Habitat Acres
American woodcock	Aspen, lowland aspen, lowland deciduous	6,434	6,739	4,409	4,837
Black bear	Mast/lowland conifer	7,290 / 2,806	--	--	--
Black-backed woodpecker	Natural Disturbance	--	--	--	--
Blackburnian warbler	Northern hardwoods, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, hemlock	6,694	7,313	5,631	8,404
Ruffed grouse	Aspen	3,938	4,146	3,787	3,857
Wood thrush	Northern hardwoods, northern red oak, mixed upland deciduous, lowland deciduous	5,491	6,333	7,702	8,695
Wood turtle	Non-forested openings	--	--	--	--

Cover type composition and associated wildlife species

Aspen

Current Condition

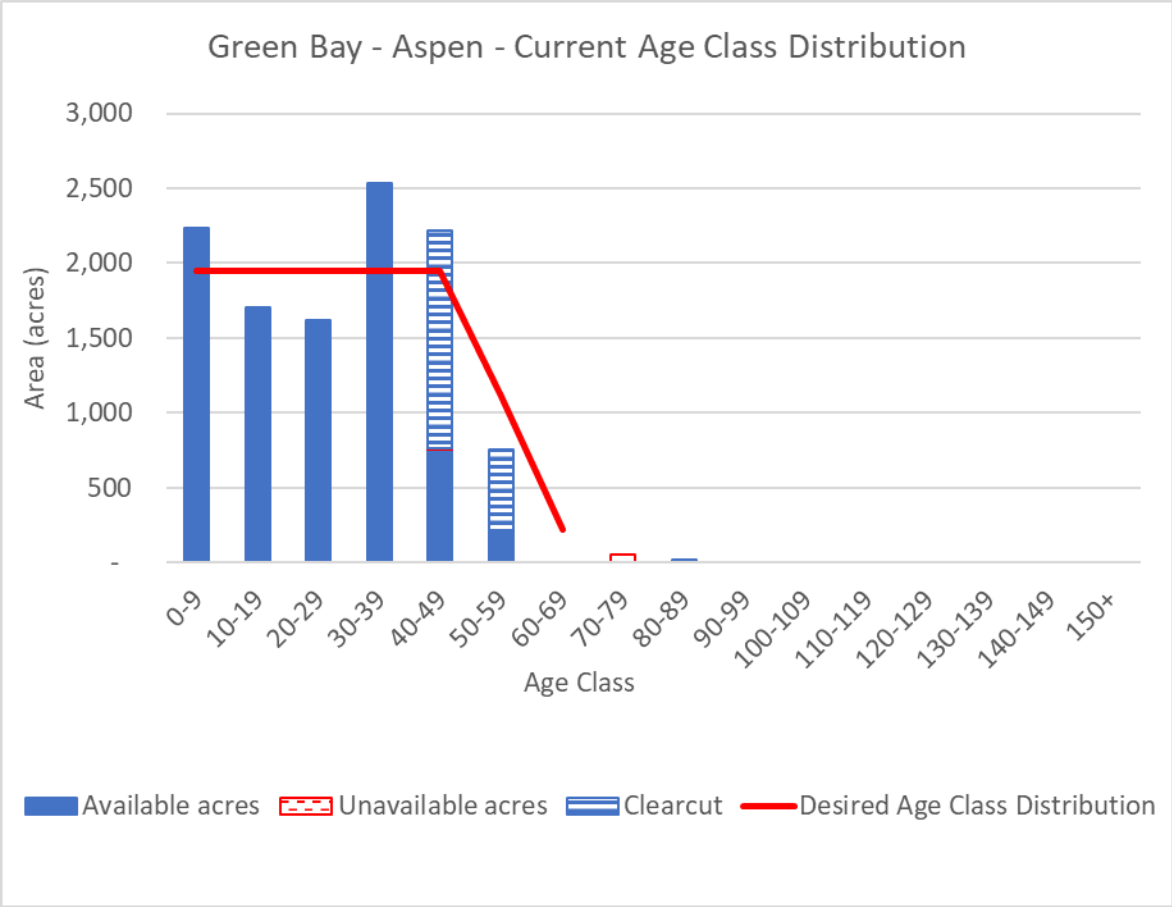


Figure 3. Current age class distribution, the desired age class distribution, and the projected harvests in the aspen cover type over the 10-year planning period.

The current age class distribution is somewhat unbalanced with a deficit of acres in ages 10-29 years old and a surplus of acres in the 0-9 and the 30-49-year-old age classes.

The end of the planning period will result in the establishment of about 1,913 acres of aspen in the upcoming 0-9 age class. Progress toward the long-term desired age-class distribution of aspen will only take a few decades in this management area. A portion of this cover type meets the habitat requirements for American woodcock and ruffed grouse.

Table 6. Featured species with aspen as a priority habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Aspen	Aspen Habitat Acres - Available	Aspen Habitat Acres - Unavailable
American woodcock	Age category: 0-19 Size class: Sapling	3,938	0
Ruffed grouse	Age category: 0-19 Size class: Sapling	3,938	0

Desired future condition

The desired age class distribution is to have a rotation age of 40 years with approximately 12 percent of the acres in an age class tail out to a maximum of 60-year age class.

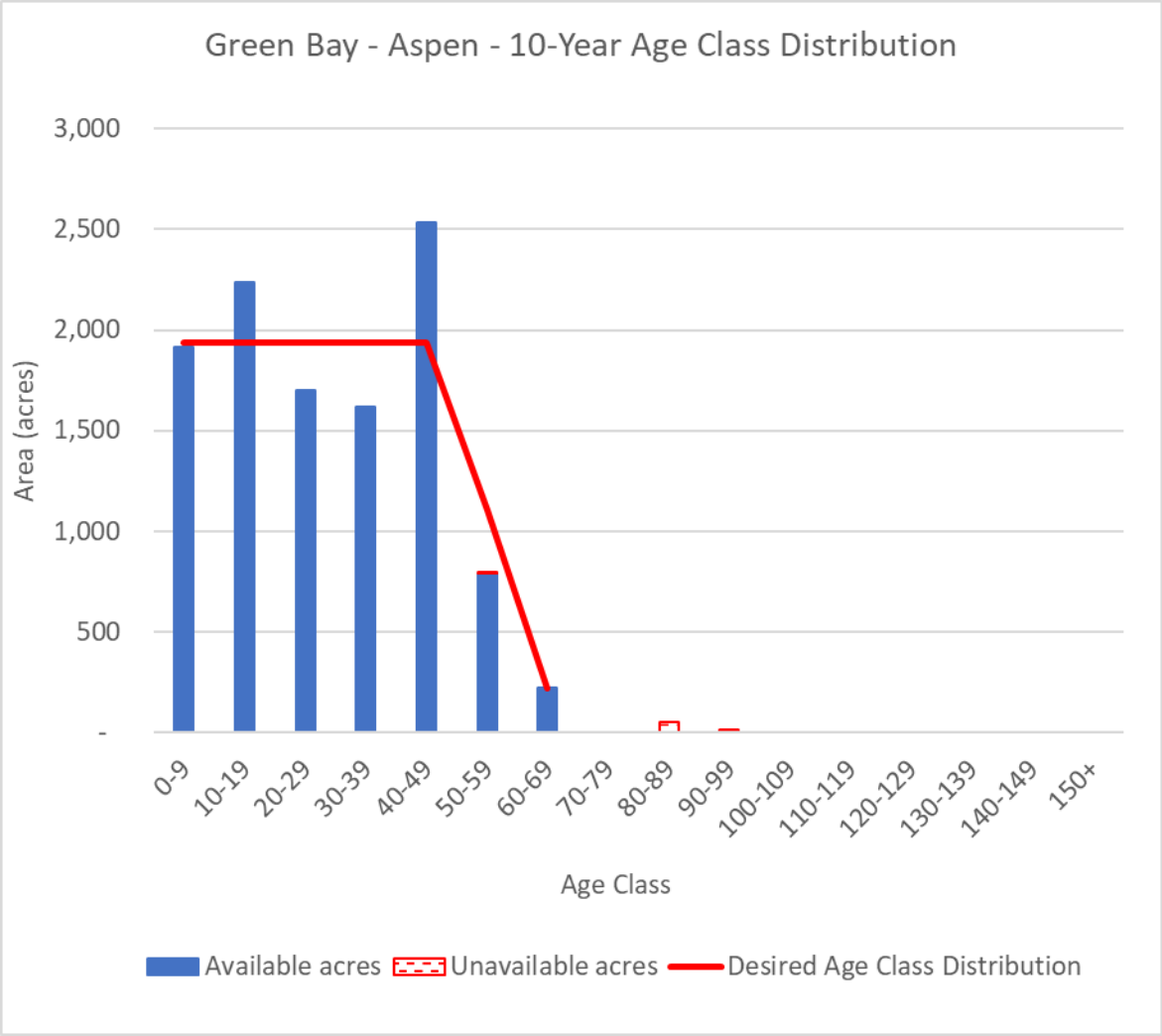


Figure 4. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

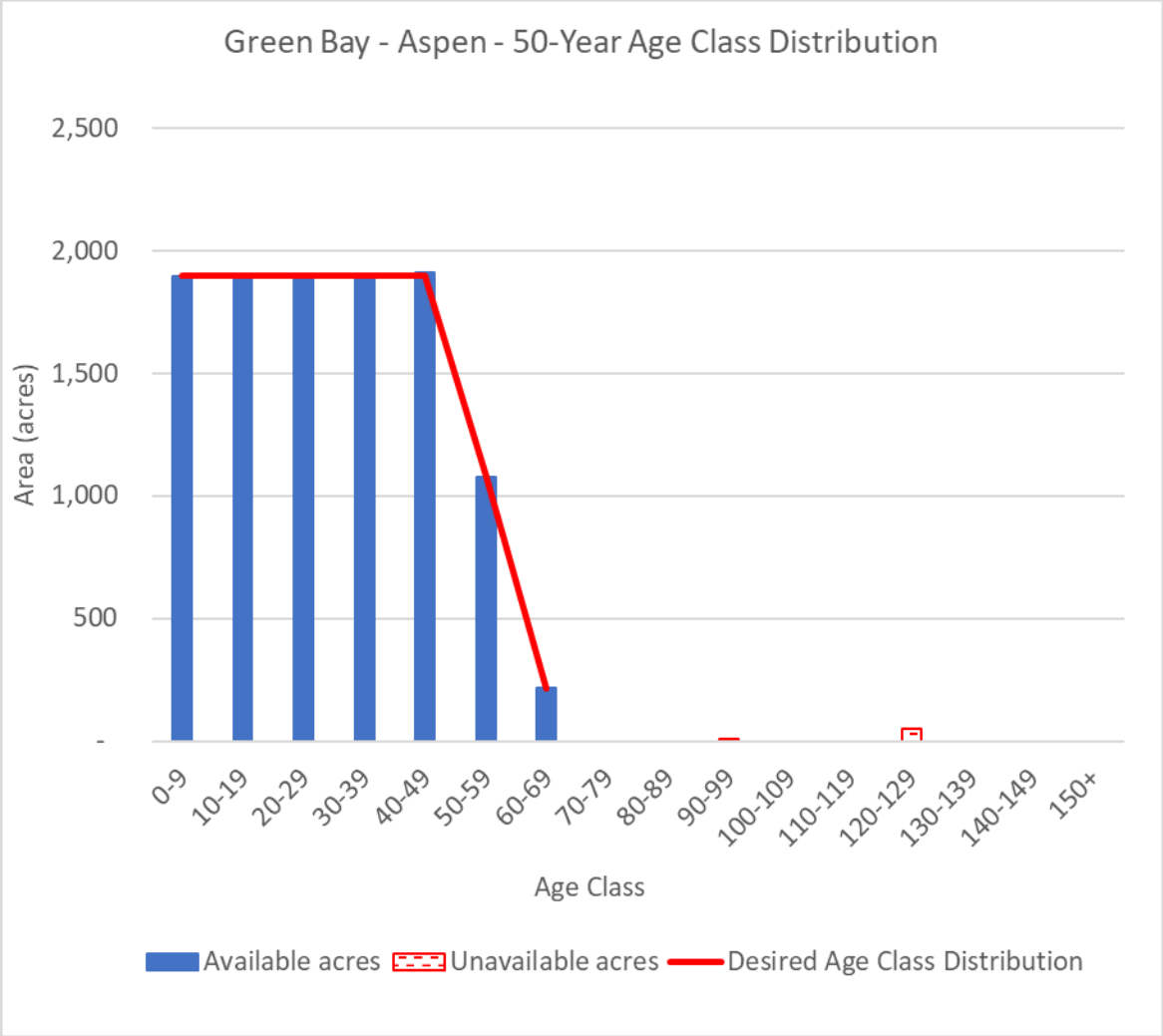


Figure 5. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of aspen acres reaching the desired future condition with only a few age classes deviating from the target proportions (Figure 5).

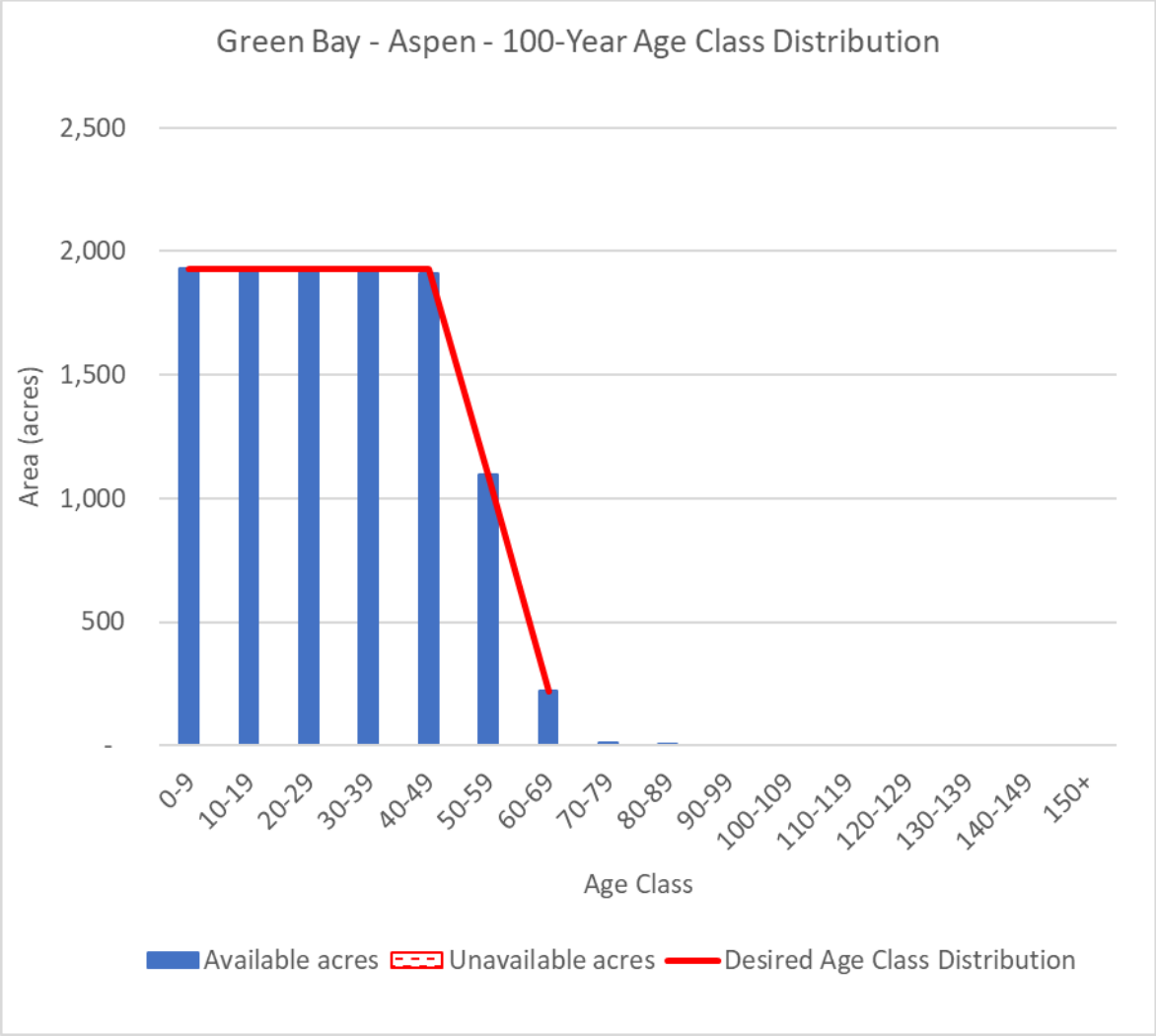


Figure 6. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age-class distribution.

The long-term achievement of the desired age class distribution (Figure 6) will concentrate the manageable acres of aspen in productive growing conditions while providing an even flow of forest products and a wide variety of wildlife habitat conditions across the landscape in young, mid-aged, and mature forests.

Management actions

There are 2,024 acres of projected clearcut harvest in the aspen cover type. It is expected that about 52 acres of aspen will be converted to other cover types. These total to an expected 1,972 acres of regeneration in the aspen cover type over the next 10 years.

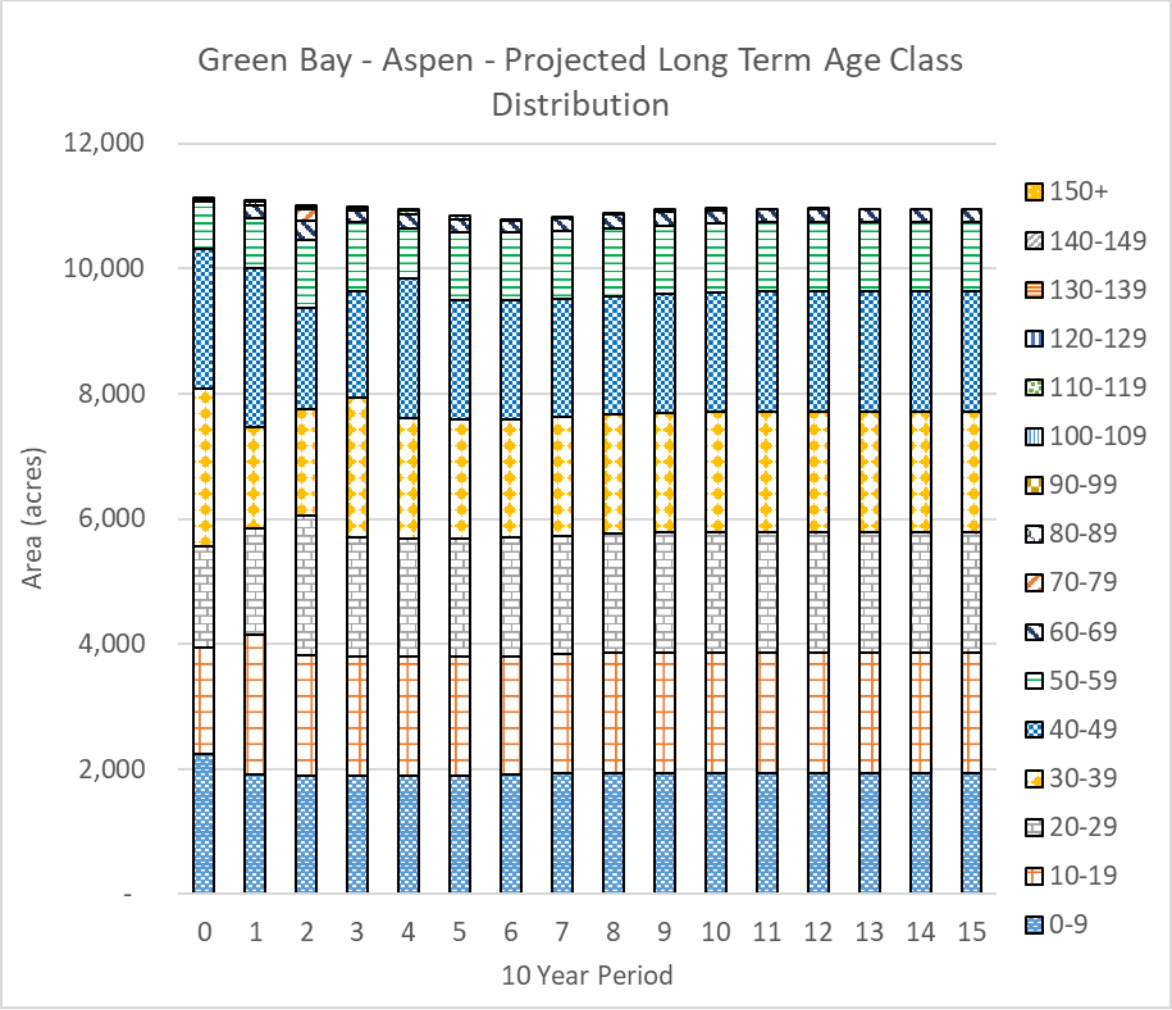


Figure 7. Projected age class distribution over 15, 10-year planning periods.

Northern hardwoods

Current condition

Most of the northern hardwood cover type is currently between a stand age of 90 and 99 years old in the Green Bay management area (Figure 8). The past management regime has been primarily single-tree selection, which allows for stand age to continue to increase overtime. Some stands are beginning to achieve an uneven-aged condition where a featured stand age becomes less evident, but the dominant age of these stands will likely increase past 150 years old prior to a younger age cohort becoming the prominent component of these stands (Figure 10). A portion of the stand have been managed under an even-aged system due to poor quality stands or a predominance of red maple in those stands.

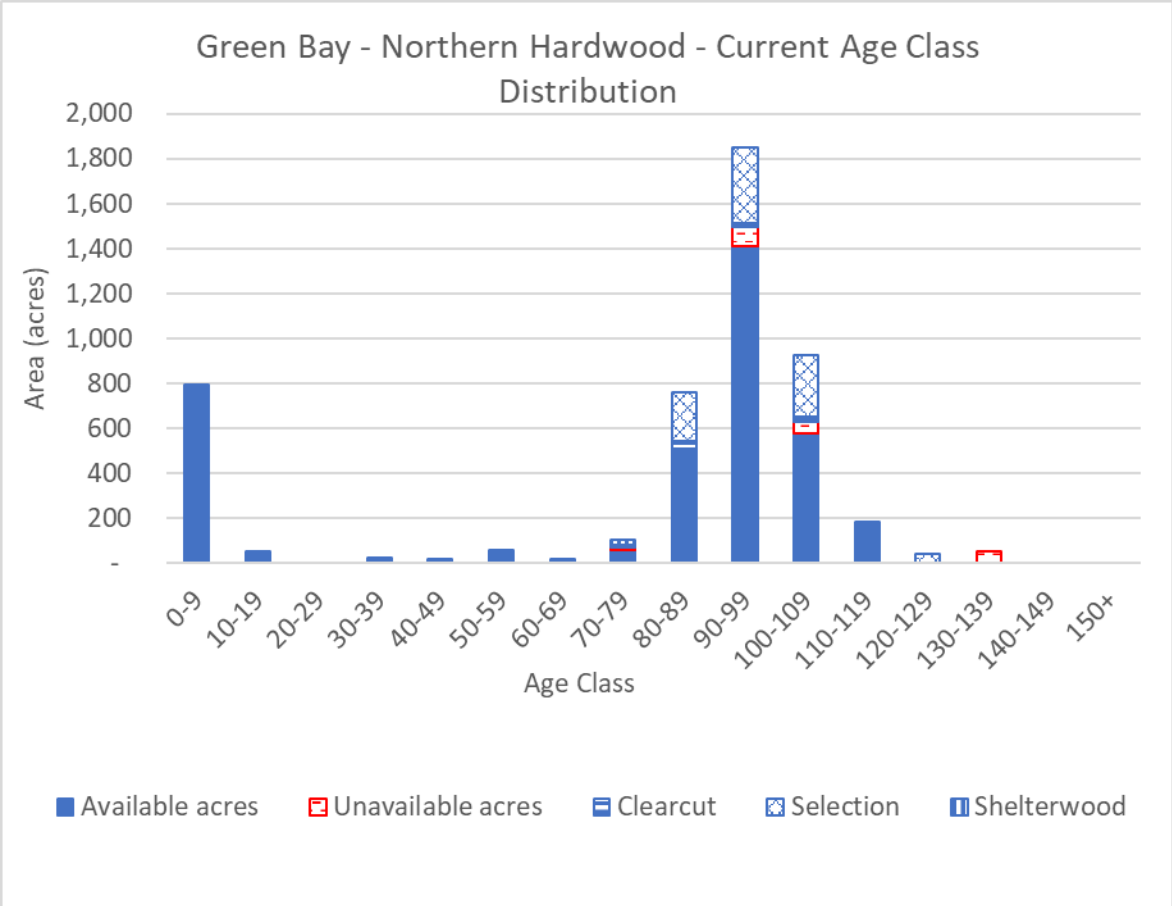


Figure 8. Current age class distribution and projected harvests in the northern hardwood cover type in the Green Bay management area.

The area of northern hardwood is well distributed in the ideal basal area classes for optimal growing conditions in the Green Bay management area (Figure 9). Current conditions are a result of a selection harvest regime that has been in place in this management area for decades. A portion of this cover type meets the habitat requirements for blackburnian warbler and marten including patches of contiguous habitat that are greater than 250 acres in size.

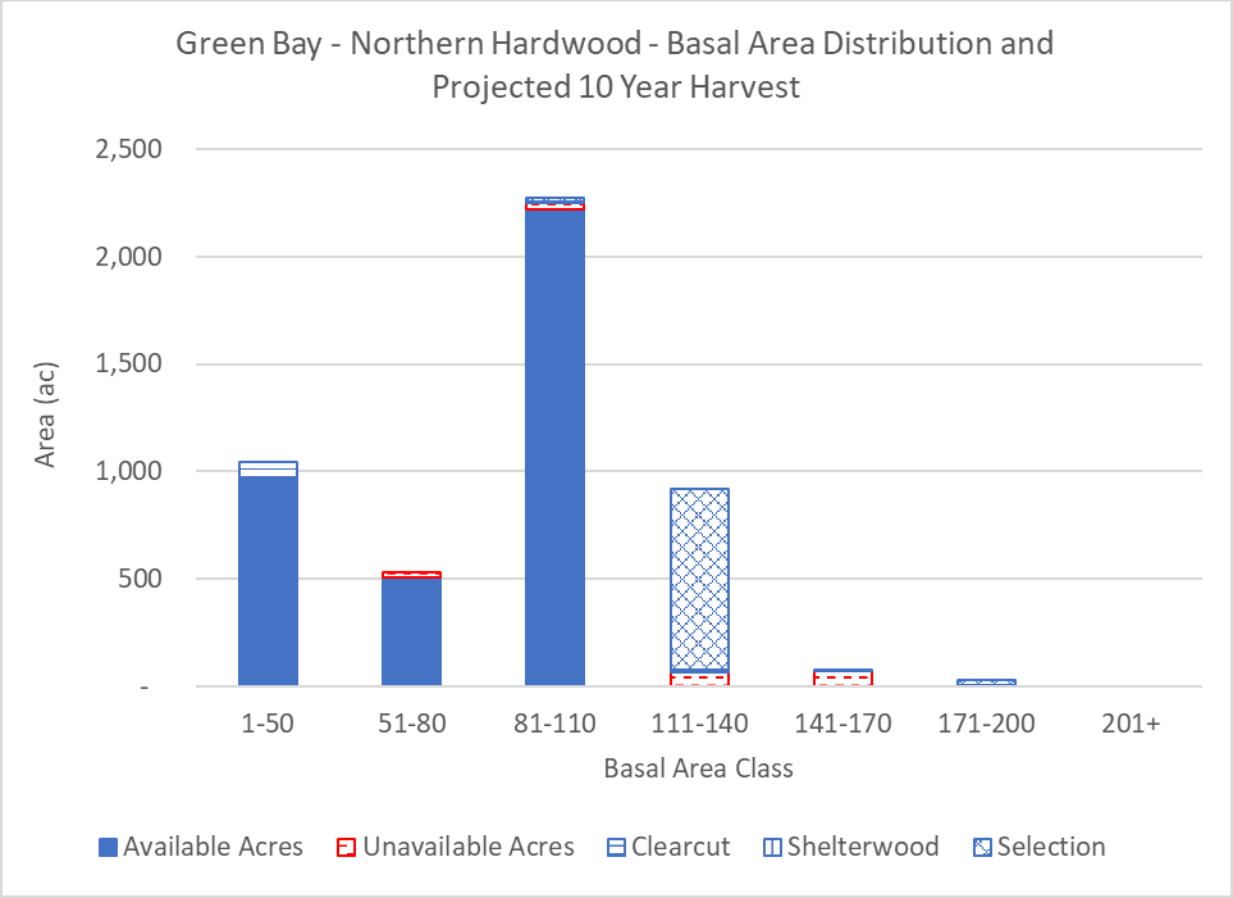


Figure 9. Current basal area distribution of the northern hardwood cover type as well as the projected harvests from each basal area class.

Table 9. Featured species with northern hardwoods as a priority habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Northern Hardwood	Northern Hardwood Habitat Acres- Available	Northern Hardwood Habitat Acres- Unavailable
Blackburnian warbler	Age category: 80+ Size category: pole, sawlog Basal area: 81+	2,991	108
Marten	Age category: 40+ Size category: pole, sawlog Basal area: 81+	2,991	108
Wood thrush	Age category: 40+ Size category: sawlog Basal area: 81+	3,105	119

Desired future condition

The projected long-term cover type trend for northern hardwood is stable in the Green Bay management area. There are about 12 acres transitioning to this cover type in the next 10 years.

The desired basal area distribution is a bell-shaped curve where a significant majority of the area is kept in the 81-110 basal area class with recently harvested stands occupying the 51-80 class and stands that are ready for harvest occupy the 111-140 basal area class. Diameter distributions of the northern hardwood stands should follow the appropriate Q-curve relative to stand age and condition. Some lower quality northern hardwood stands that aren't able to support high quality hardwoods will continue to be managed under an even-aged system.

An uneven-aged condition is the long-term goal for all northern hardwood stands in this management area. An uneven-aged condition is achieved when there is no single discernable age cohort that is more prevalent than others across the stand area as canopy gaps fill in with regenerating seedlings, saplings, poles and eventually remaining stems become sawlog-sized over time.

Regeneration and recruitment continue to be a focus in the northern hardwood cover type across this management area. The long-term sustainability of this cover type in an uneven-aged silvicultural regime depends on the successful establishment of northern hardwood species as well as recruitment of those seedlings and saplings into the pole and saw log classes. Northern hardwood in the Green Bay management area has challenges in regeneration and recruitment due to cervid herbivory and the poor potential of many of the stands.

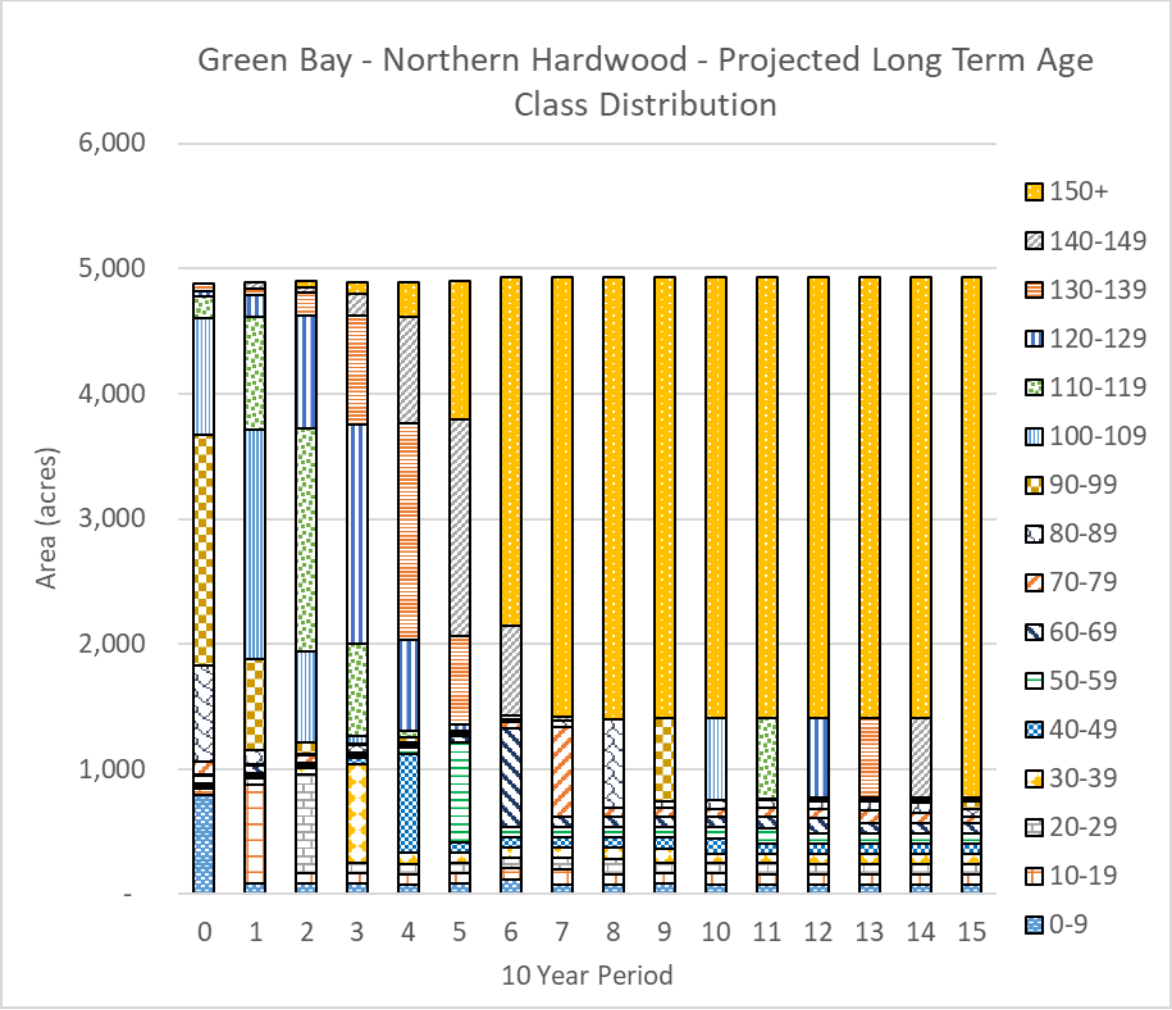


Figure 10. Projected age class distribution over 15, 10-year planning periods.

Management actions

The desired future conditions and associated featured species habitat will be maintained and achieved through continued application of the projected selection harvest regime on 889 acres. About 74 acres will be managed under an even-aged system with some of those acres harvested through a clearcut or shelterwood method to improve stand quality (Table 4). Larger canopy gaps should be used to encourage diverse regeneration of northern hardwood species while maintaining an overall long-term mature forest, closed-canopy landscape condition.

Lowland deciduous

Current condition

The current age class distribution is unbalanced with a deficit of acres in ages 10-79 years old and a surplus of acres in the 0-9 and in the 80-99-year-old age classes. Limited merchantable acres in the older age classes will present managers with a challenge in achieving desired regeneration during this planning period. Much of this has been clearcut over the last 10 years due to salvage operations related emerald ash borer infestations.

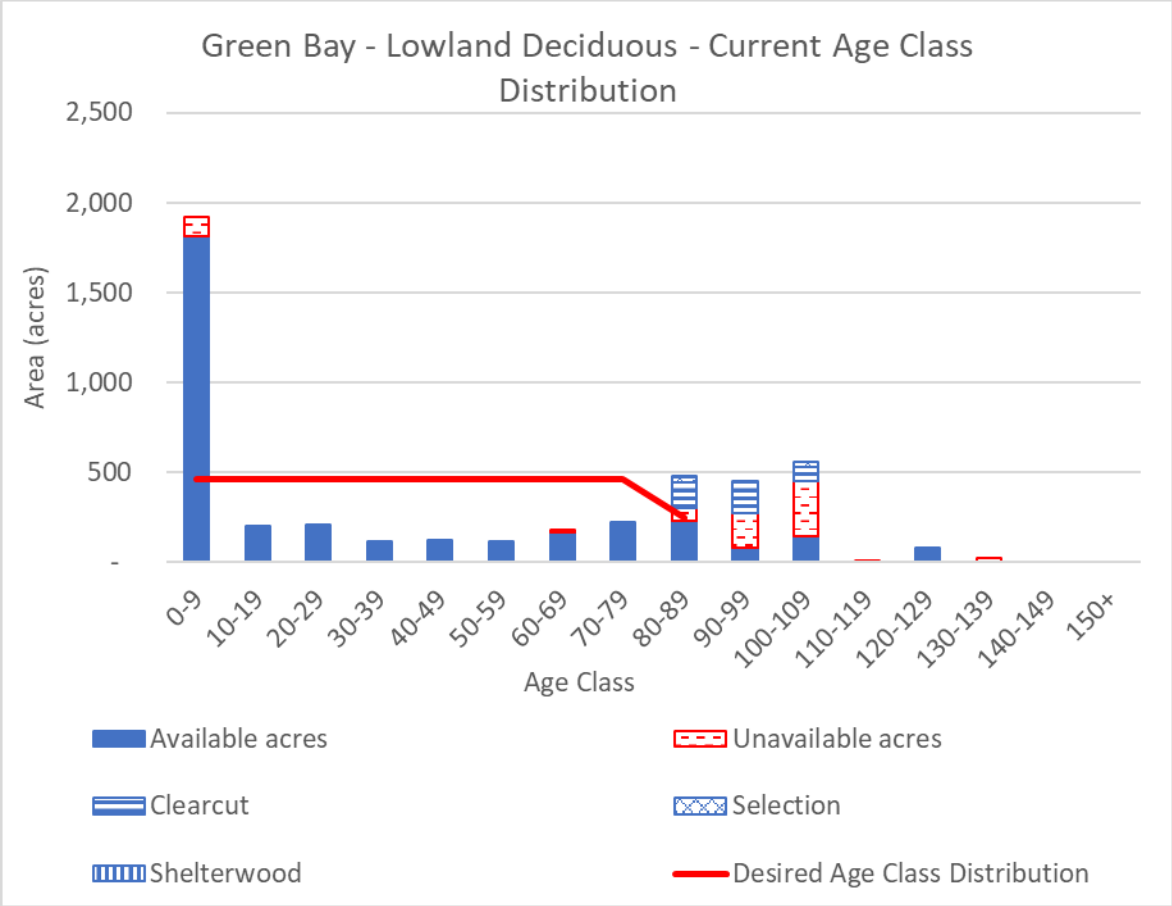


Figure 11. Current age class distribution, the desired age class distribution, and the projected harvests in the lowland deciduous cover type over the 10-year planning period.

Table 10. Featured species with lowland deciduous as a priority habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – lowland deciduous	Lowland deciduous Habitat Acres - Available	Lowland deciduous Habitat Acres - Unavailable
American woodcock	Age category: 0-19 Size class: Sapling	2,001	109

Featured Species	Featured Species Habitat – lowland deciduous	Lowland deciduous Habitat Acres - Available	Lowland deciduous Habitat Acres - Unavailable
Wood thrush	Age category: 40+ Size category: Sawlog Basal area: 81+	656	477

Desired future condition

The desired age class distribution is to have a rotation age of 70 years with approximately 6 percent of the acres in an age class tail out to a maximum of 60-year age class.



Figure 12. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The end of the planning period will result in the establishment of 256 acres in the upcoming 0-9 age class. Progress toward the long-term desired age class distribution of lowland deciduous cover types will

take many decades. A portion of this cover type meets the habitat requirements for American woodcock.

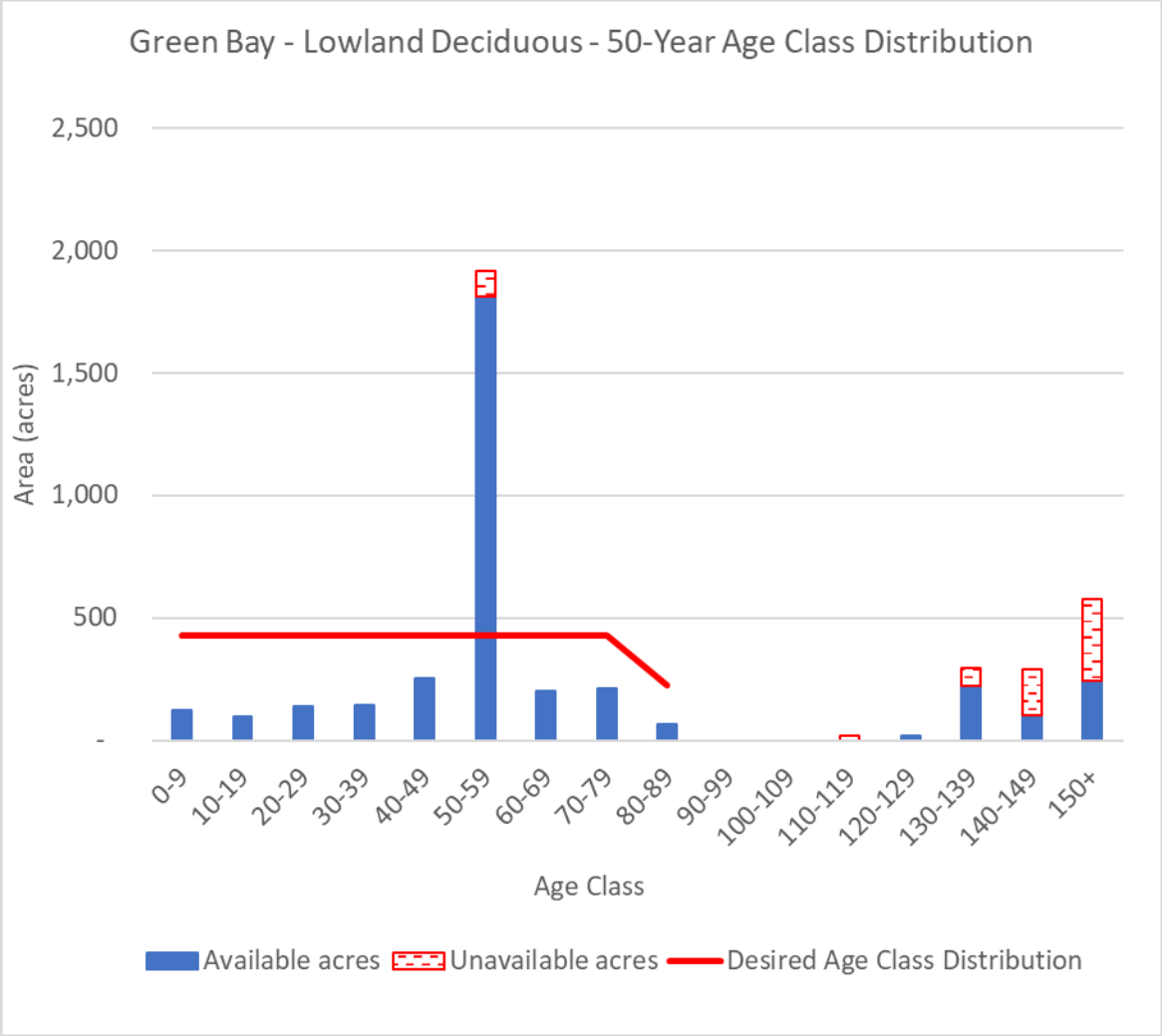


Figure 13. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The mid-term age-class distribution shows the population of lowland deciduous acres working toward the desired future condition as the older age classes are treated (Figure 13).

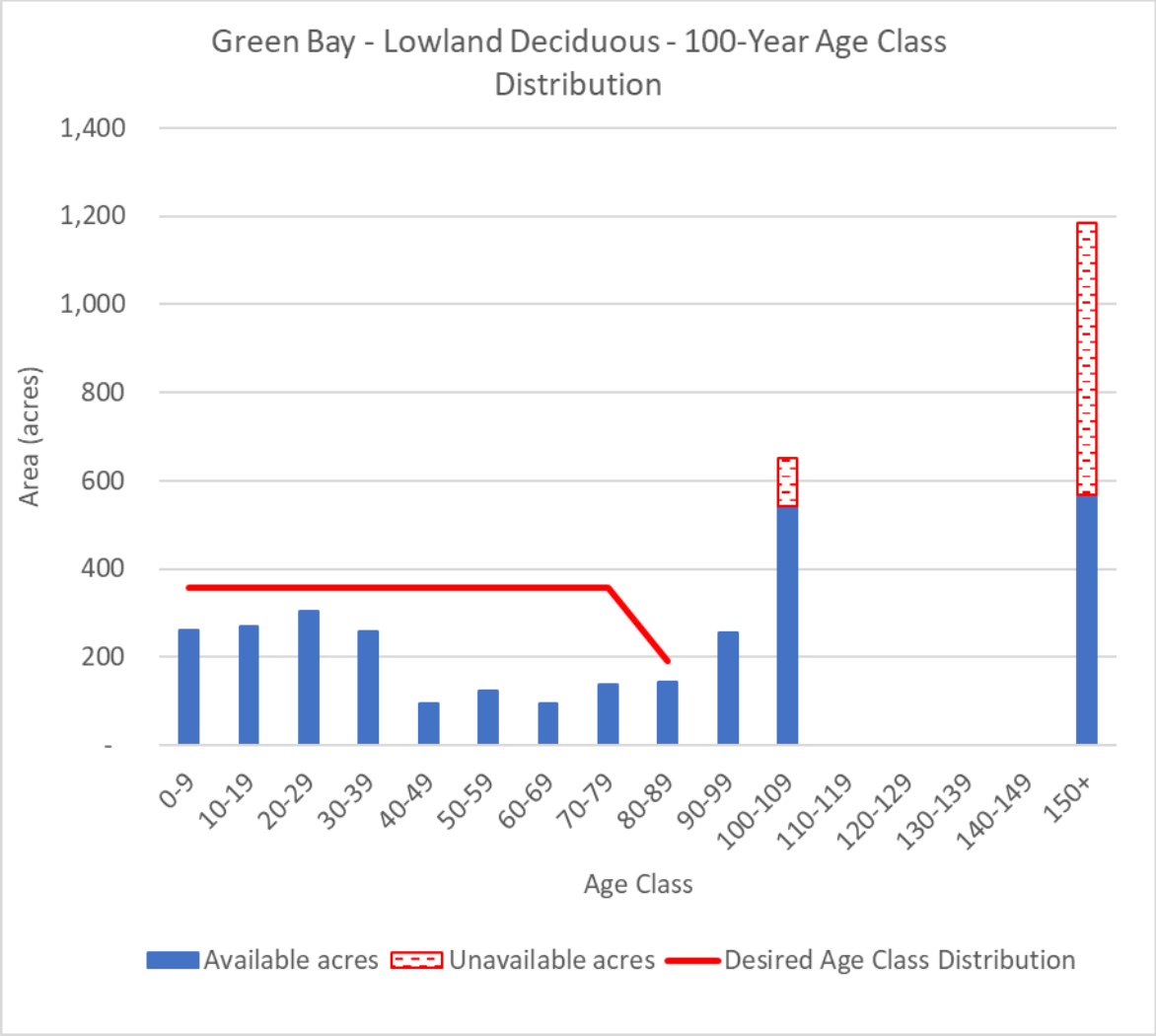


Figure 14. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 14) will concentrate the manageable acres of upland mixed forest in productive growing conditions while providing an even flow of forest products and a wide variety of wildlife habitat conditions across the landscape in young, mid-aged, and mature forest.

Management actions

There are 477 acres of projected harvest in the lowland deciduous cover type. It is expected that about 135 acres of lowland deciduous will convert to other cover types. These total to an expected 342 acres of regeneration in the lowland deciduous cover type over the next 10 years.

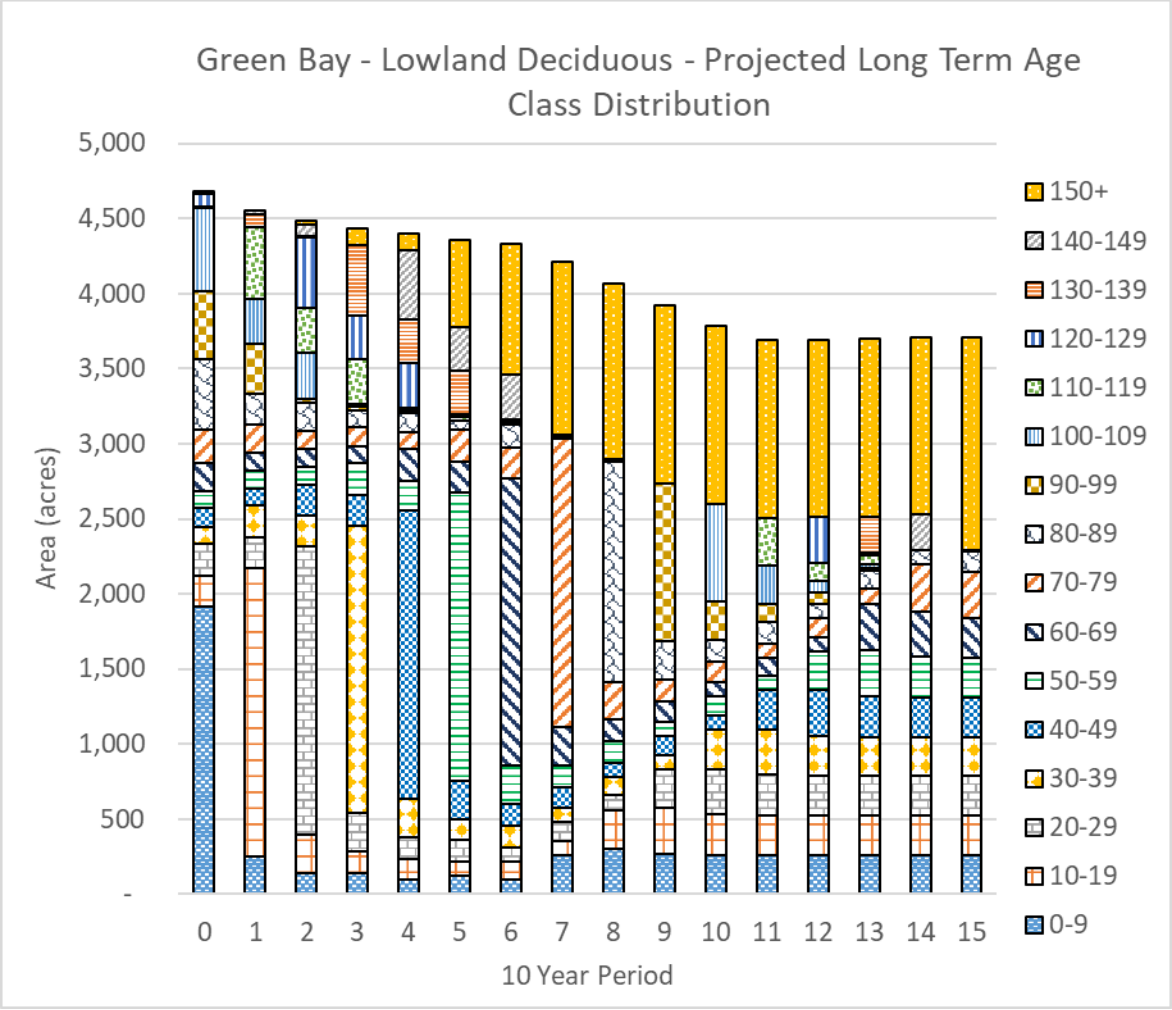


Figure 15. Projected age class distribution over 15, 10-year planning periods.

Cedar

Current condition

The current age class distribution shows a classic bell curve, an unmanaged even-aged stand with a surplus of acres in the 110-119-year-old age classes. The younger age classes have few to no acres. The reasons for this are not well understood, but many factors contribute to the lack of regeneration of the cover type. These include but are not limited to cervid herbivory, suppression of fire and the relatively young age of the stands.

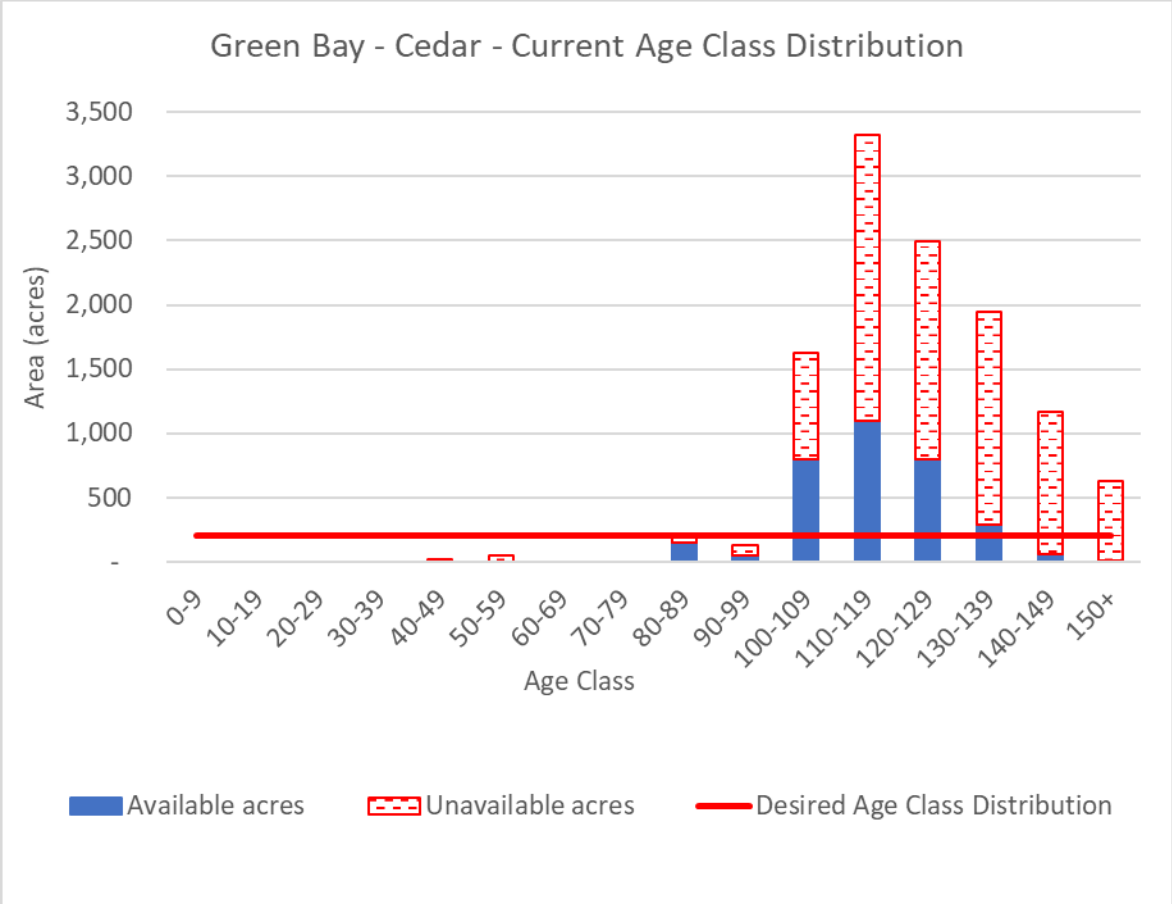


Figure 16. Current age class distribution, the desired age class distribution, and the projected harvests in the cedar cover type over the 10-year planning period.

While there are no featured species chosen in this MA that use the cedar cover type, it should be noted that northern white-cedar stands support 84 species of animals: 47 birds, 34 mammals, and three herptiles. 51 species are permanent residents of cedar stands, 30 reside there only in summer, two are migrants, and white-tailed deer is exclusively a winter resident. A total of 16 rare plants and 15 rare animals appear here. Conifer swamps especially rich with white cedar provide habitat for many types of amphibians, songbirds, reptiles, and mammals seeking water, insects, and dense cover.

Desired future condition

The desired future condition is to have an even-age class distribution with a rotation age of 150+ years.



Figure 17. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The end of the planning period will result in establishing limited acres in the upcoming 0-9 age class. Progress toward the long-term desired age class distribution of cedar will take many decades in this management area.

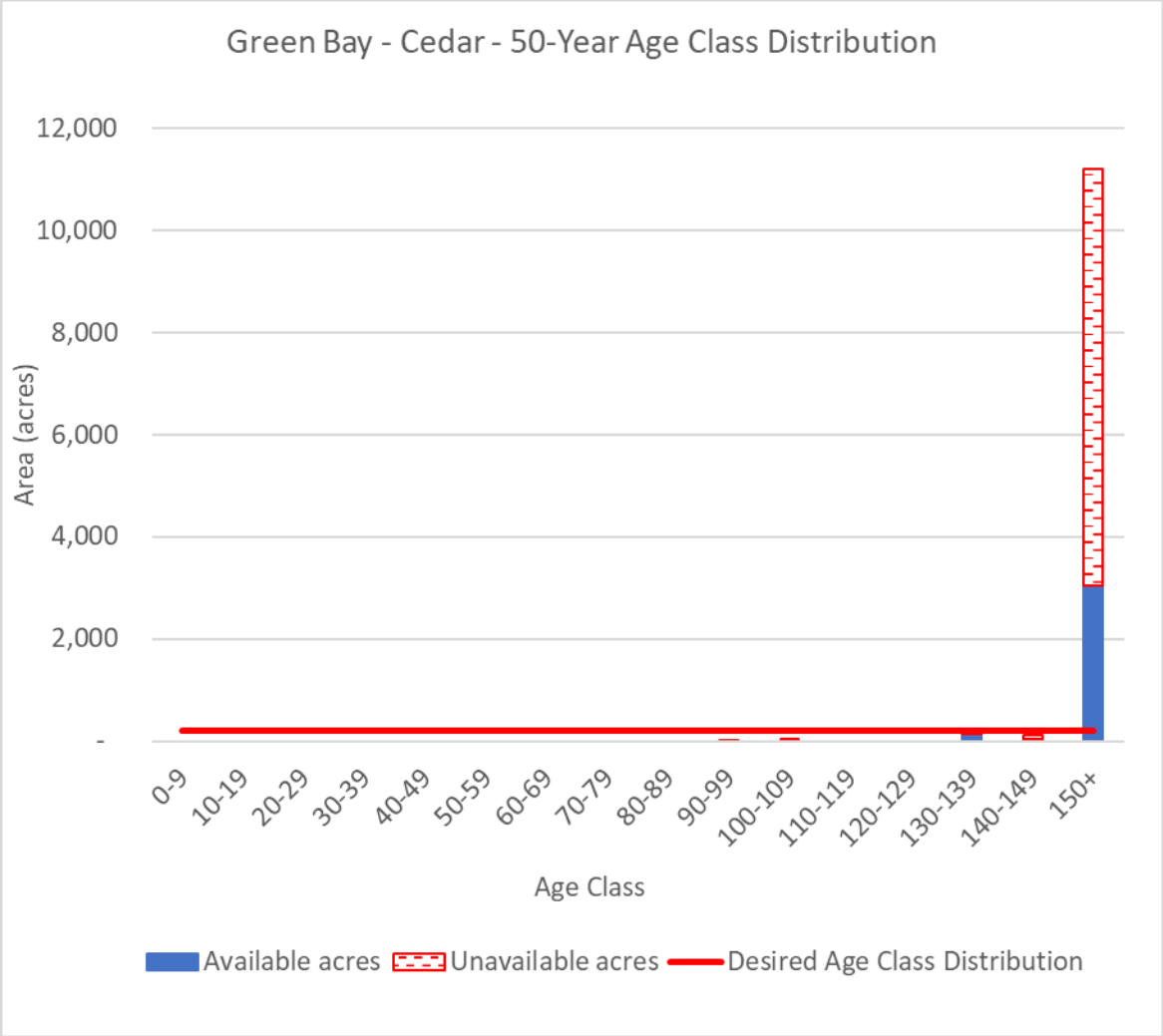


Figure 18. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of cedar acres aging with only a few acres regenerating (Figure 18).

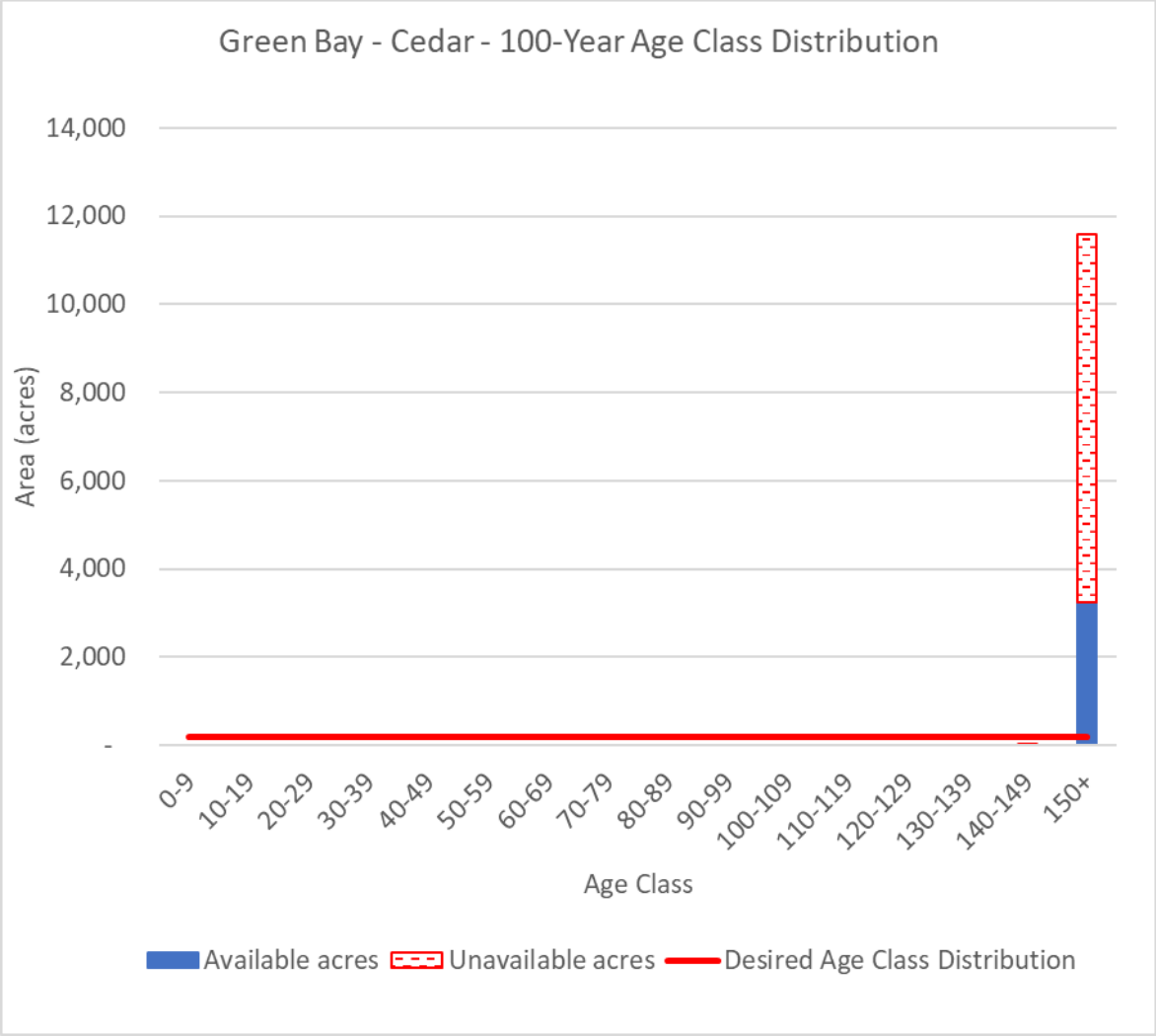


Figure 19. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age-class distribution.

The long-term achievement of the desired age class distribution (Figure 19) will concentrate the manageable acres of cedar in productive growing conditions while providing some forest products and a wide variety of wildlife habitat conditions across the landscape in young, mid-aged, and mature forest.

Management actions

There are no acres of projected harvests in the cedar cover type. It is expected some cedar will be cut in ongoing research and field trials as it learned how to best regenerate this species as a cover type.

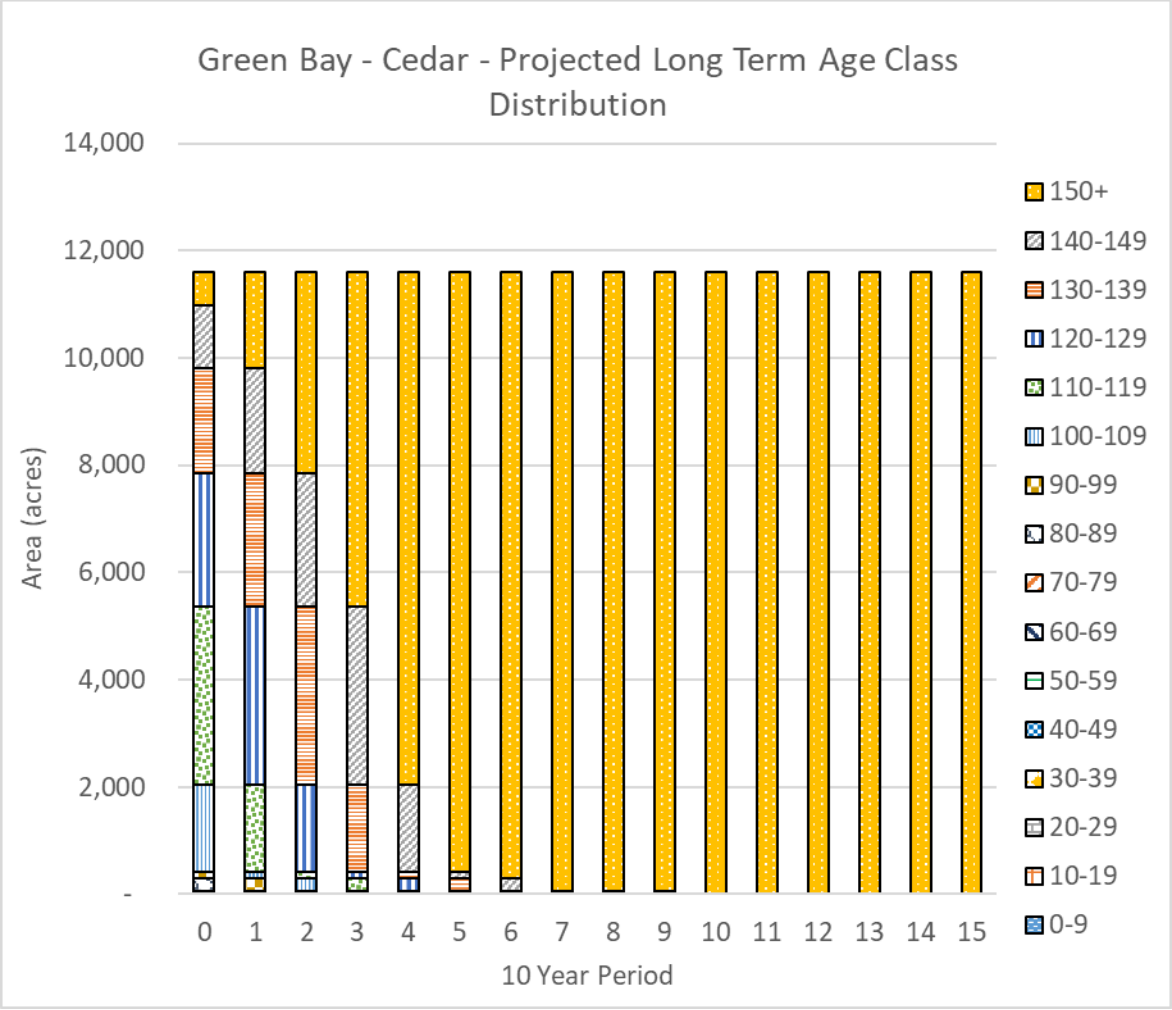


Figure 20. Projected age class distribution over 15, 10-year planning periods.

Mixed upland deciduous

Current condition

The current age-class distribution is unbalanced, with a deficit of acres in the 10-29-year-old and 60-69-year-old age classes and a surplus of acres in the 0-9 year-old age classes.

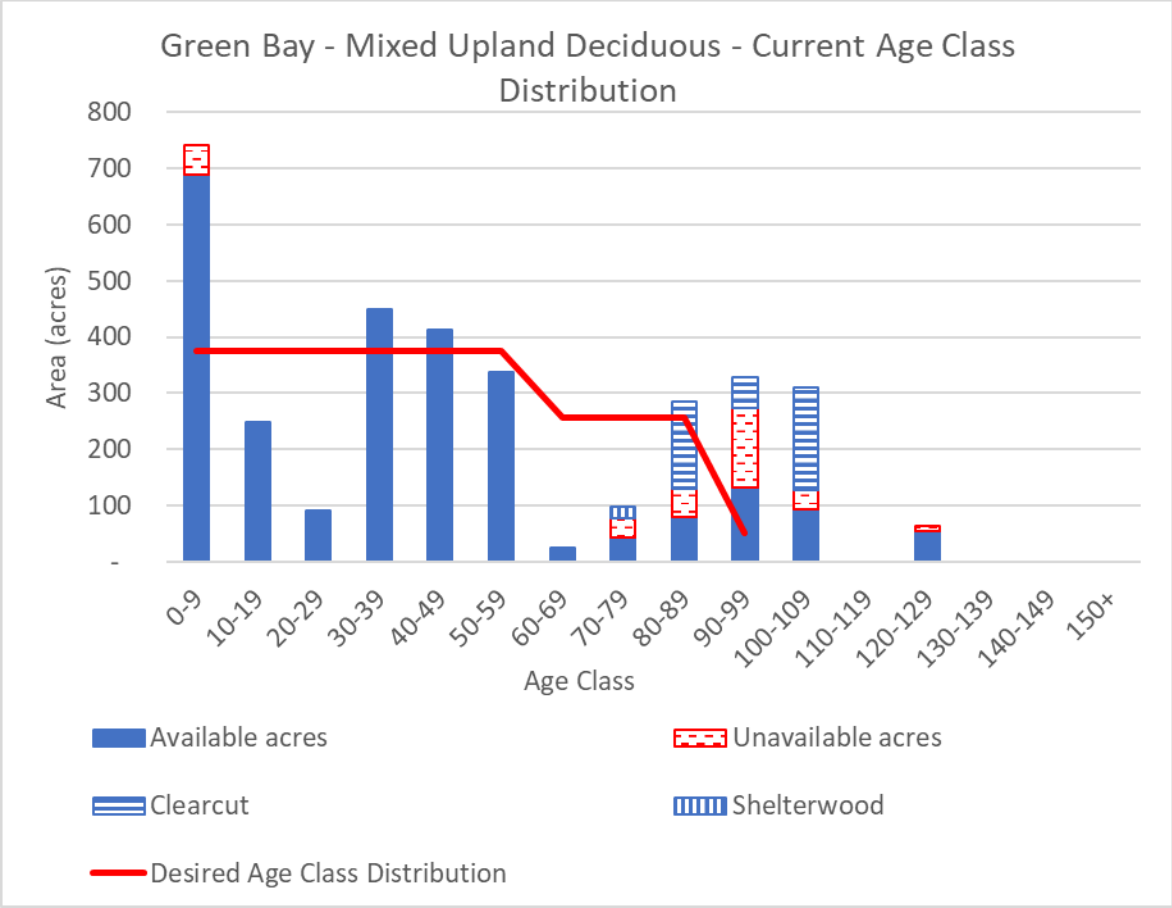


Figure 21. Current age class distribution, desired age class distribution and projected harvests in the mixed upland deciduous cover type over the 10-year planning period.

Table 10. Featured species with mixed upland deciduous as a priority habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – lowland deciduous	Lowland deciduous Habitat Acres - Available	Lowland deciduous Habitat Acres - Unavailable
Wood thrush	Age category: 40+ Size category: sawlog Basal area: 81+	862	270

Desired future condition

The desired age class distribution is to have a rotation age of 50 years for 73 percent of the population, with an age class tail of 80 year for 25 percent of the population, and an age class tail of 90 year for the last 2 percent of the population.

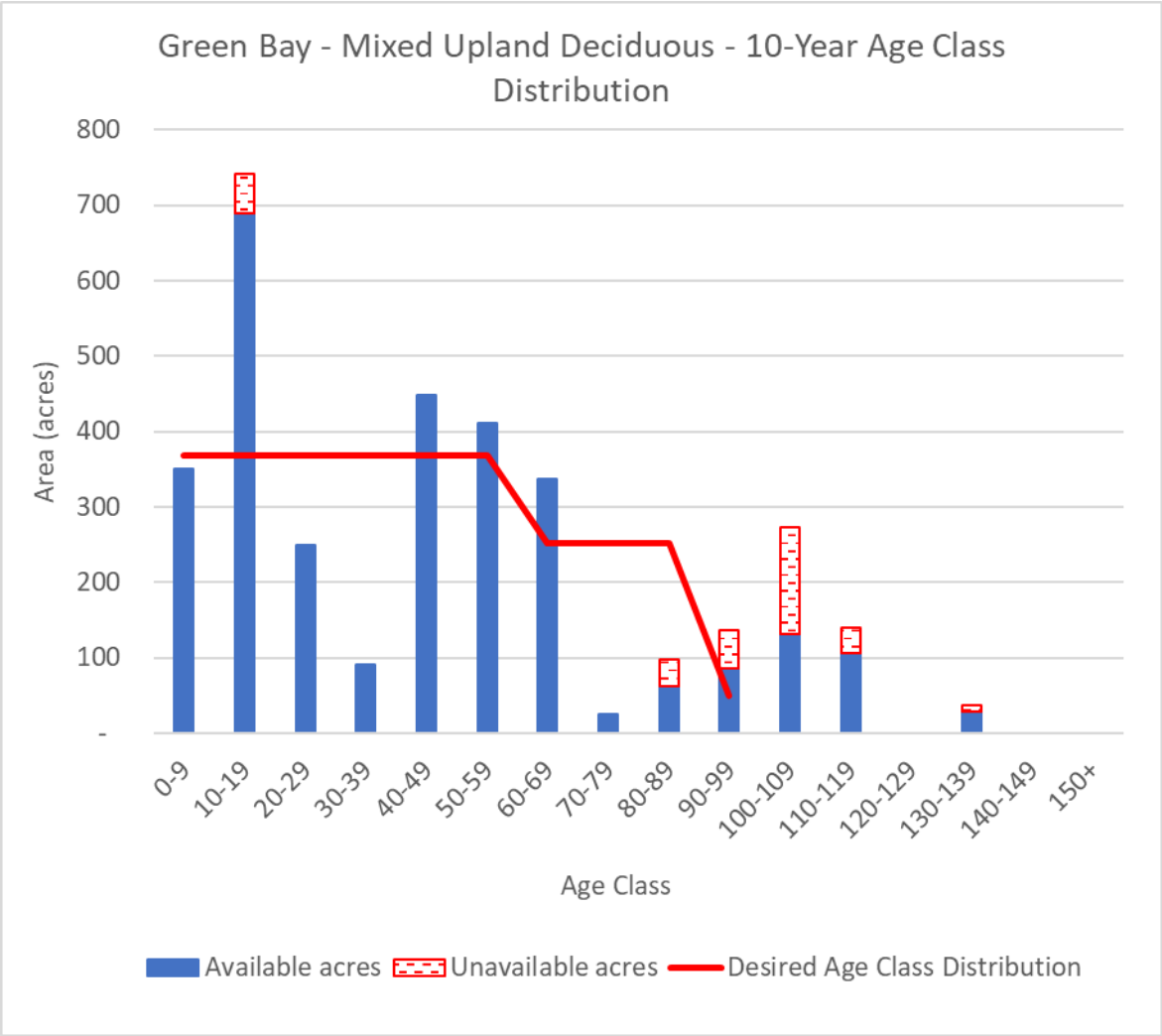


Figure 22. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The end of the planning period will result in the establishment of 351 acres in the upcoming 0-9 age class. Progress toward the long-term desired age class distribution of upland mixed forest will take many decades in this management area.

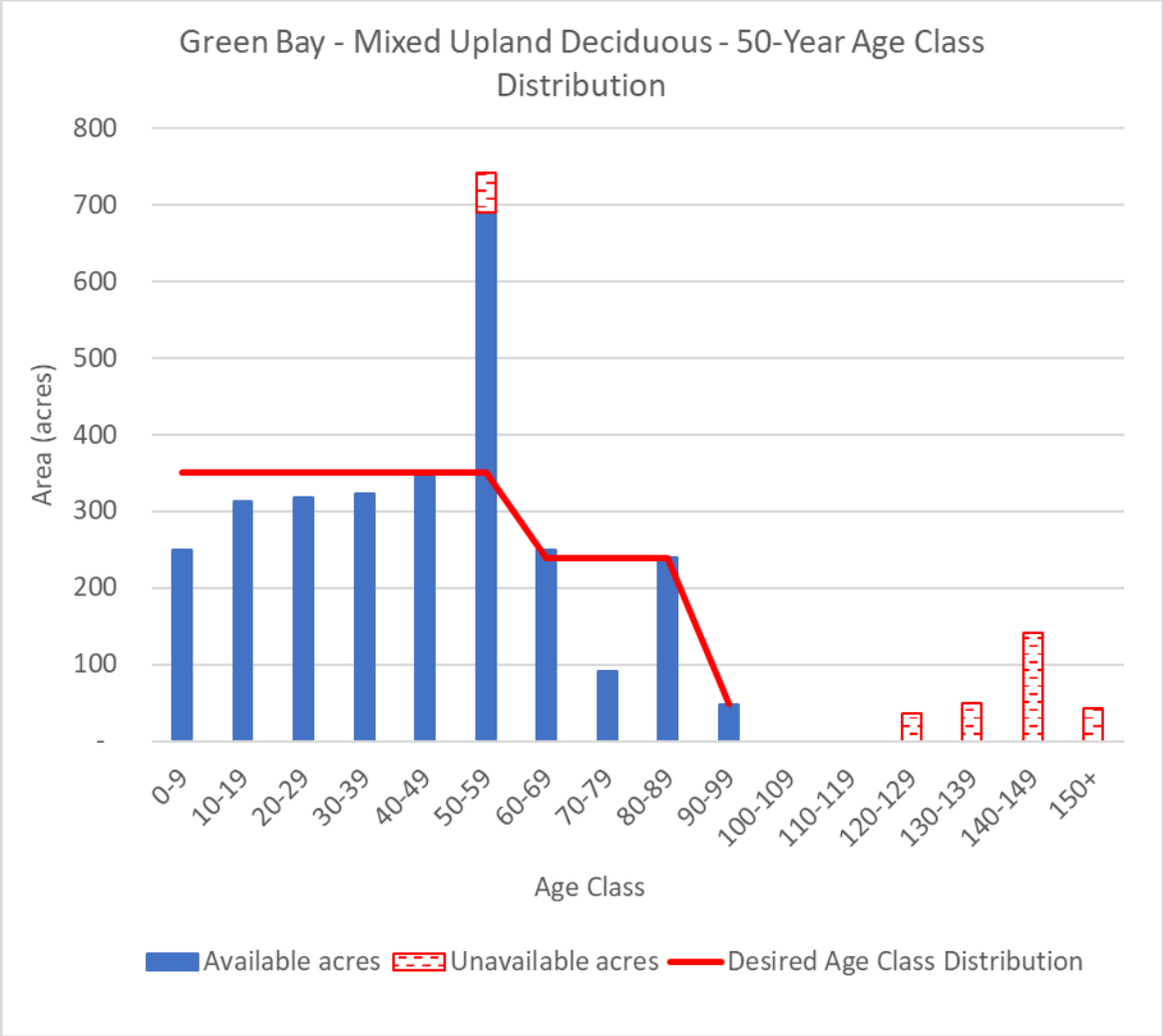


Figure 23. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of mixed upland deciduous acres working toward the desired future condition as the older age classes are treated (Figure 23).

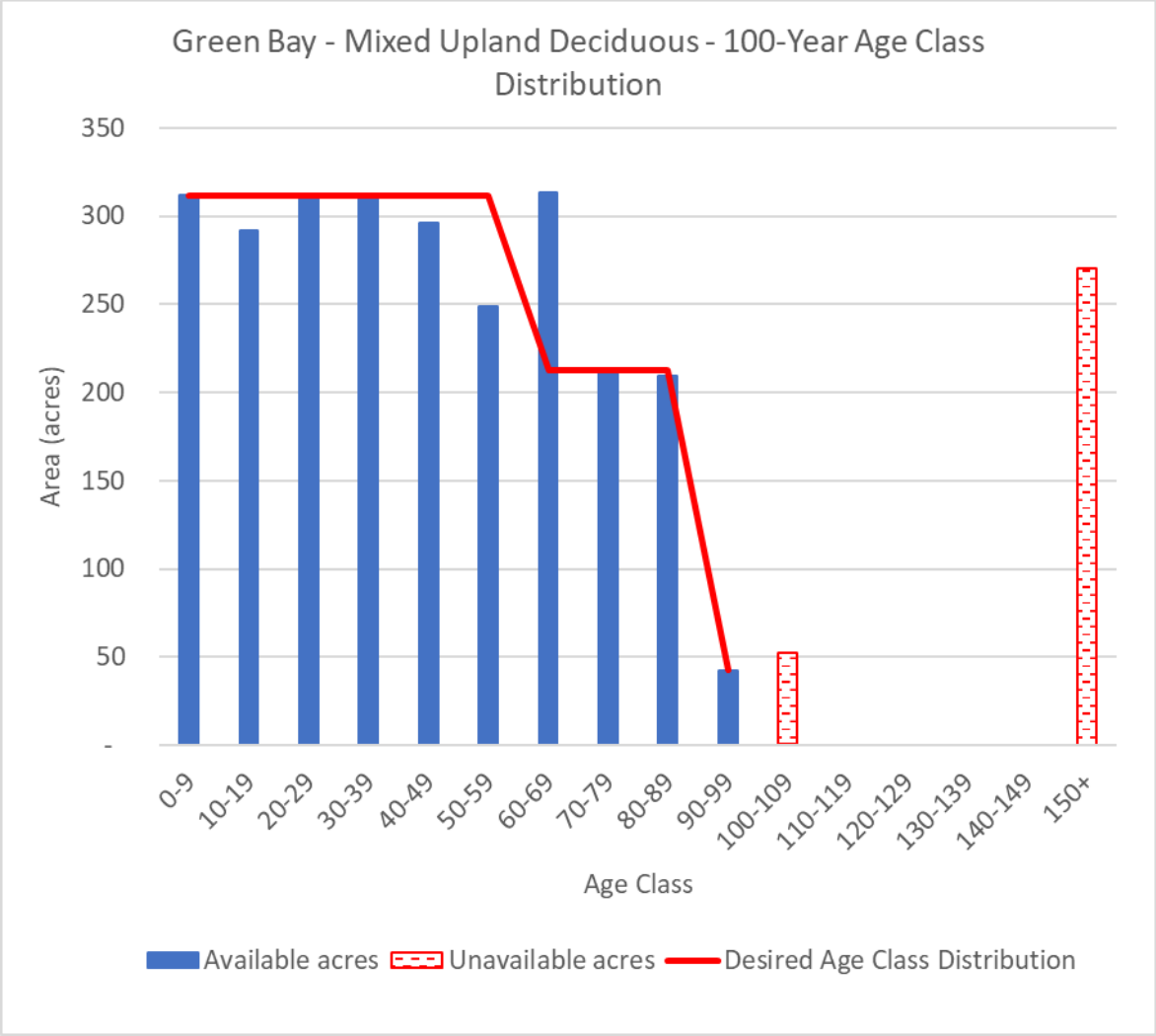


Figure 24. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 24) will concentrate the manageable acres of mixed upland deciduous in productive growing conditions while providing an even flow of forest products and a wide variety of wildlife habitat conditions across the landscape in young, mid-aged, and mature forest.

Management actions

There are 410 acres of projected harvest in the mixed upland deciduous cover type. It is expected that about 47 acres of upland mixed forest will convert to other cover types. These total to an expected 363 acres of regeneration in the mixed upland deciduous cover type over the next 10 years.

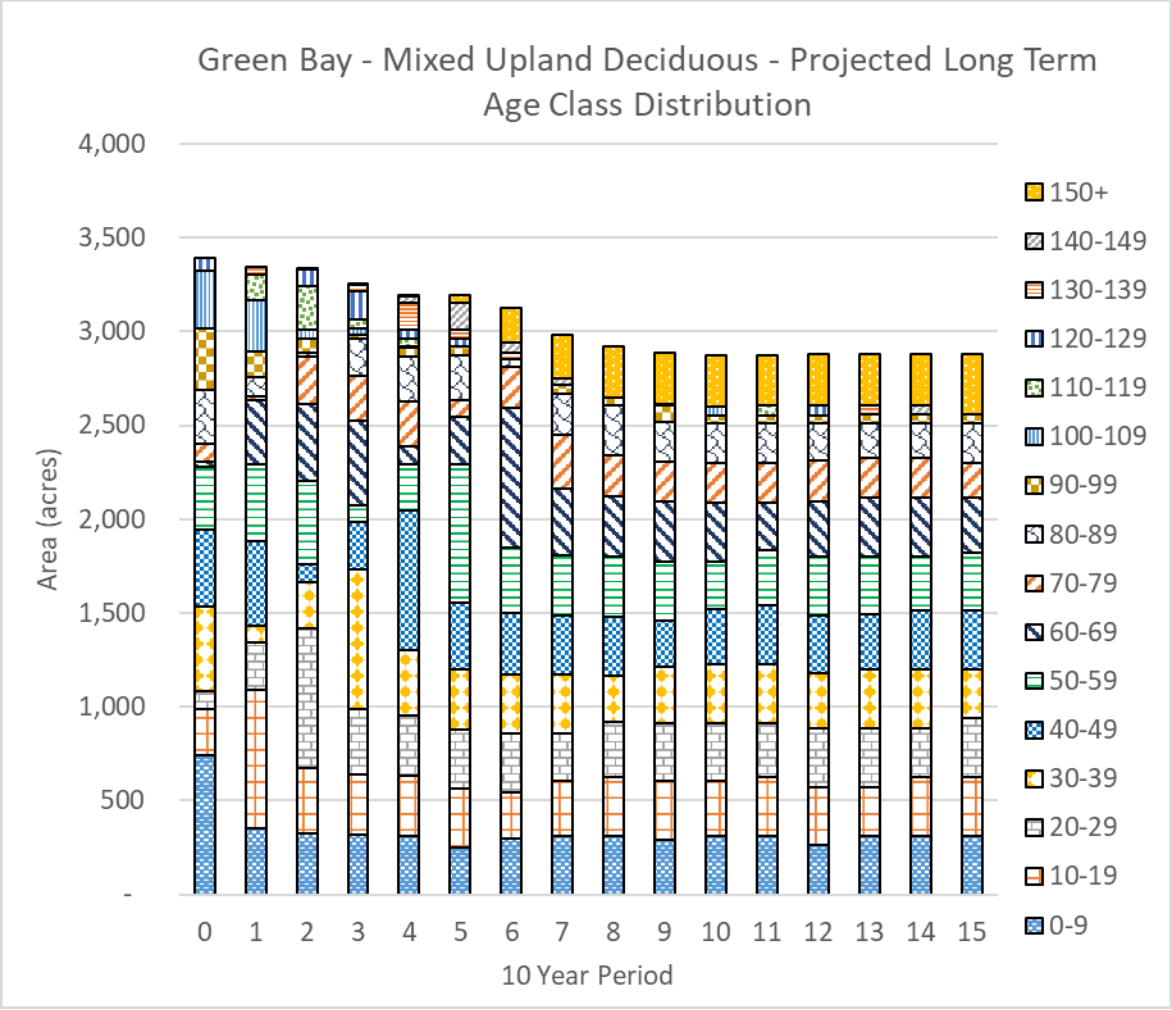


Figure 25. Projected age class distribution over 15, 10-year planning periods.

Conservation area network

High conservation value areas

There are up to nine different HCVA types that can be found in each management area (Table 11; see Biodiversity in Section 3 for more information).

Table 11. High conservation value areas within the Green Bay management area.

High Conservation Value Area Type and Name	Acres
Coastal Environmental Areas	**166**
	166
State Wildlife Management Areas	**273**
Portage Marsh SWMA unit of Waterloo SRA	273
GEMS	**3,088**
Cedar River	3,088
Grand Total	**3,527**

Ecological reference areas

Ecological Reference Areas (ERAs) are a type of HCVA and are higher quality examples of functioning ecosystems that are primarily influenced by natural ecological processes.

Table 16. Ecological reference area natural community ranking based on NatureServe .

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 17. Ecological reference areas within the management area.

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	Number of Occurrences
Existing ERA	Bog	AB	G3G5	S4	1
Existing ERA	Mesic northern forest	C	<Null>		1
Existing ERA	Muskeg	B	G4G5	S3	2

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	Number of Occurrences
Existing ERA	Muskeg	BC	G4G5	S3	1
Existing ERA	Poor fen	BC	G3	S3	2
Existing ERA	Rich conifer swamp	C	G4	S3	2
Grand Total					**9**

Special conservation areas

Reviewable special conservation areas (SCAs; Table 14) refers to those that may be reviewed or updated through the compartment review process. Static SCAs (Table 15) refers to those SCA types that generally do not change or require updating (see Biodiversity in Section 3 for more information).

Table 14. Reviewable special conservation areas within the Green Bay management area.

Reviewable Special Conservation Area Type and Name	Acres
Concentrated Recreational Area	**883**
Days River Pathway Recreation Area	883
Habitat Area or Habitat Corridor	**3,555**
33046014	23
33046020	92
33046023	6
33046026	23
33046027	4
33046028	34
33083046	46
33083049	2
33083054	5
7 Mile Marsh complex	626
Durow Marsh	670
Hayward Lake Management Area	2,027
Mineral Resource Area	**3**
Limpert Pit	3
Possible Type 1 or Type 2 Old Growth	**6**
--	6
Spring, Wetlands, or Riparian Areas	**1,535**
33046036	91
33046037	91
33046043	22
33046045	42
33046047	35

Reviewable Special Conservation Area Type and Name	Acres
33046049	46
33046050	21
33046051	143
33046052	27
33046053	66
33046054	13
Area 1	8
Area 2	40
Area 3	49
Escanaba 45 1	37
Escanaba 45 3	35
Peterson Pond	647
SCA No. 1	12
SCA No. 2	27
SCA No. 3	83
Grand Total	**5,982**

Table 15. Static special conservation areas within the Green Bay management area.

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Deer Winter Range - Obligate and Conditional		**73,383**
Conditional		73,383
Designated Trout and Cold Water Stream Buffer		**310**
		294
Laraby Creek		16
Designated Trout and Coldwater Streams	**10.8**	
	10.2	
Laraby Creek	0.6	
Great Lakes Islands		**10**
Unknown		10
Important Bird Areas		**370**
Little Bay de Noc (inc. Portage Marsh & Aronson Island sandbar)		370
Mussel Stream Group 2 - State threatened or endangered	**1.7**	
Devils Creek	1.3	
Elwood Creek-Cedar River	0.5	
Wood Turtle Stream 100-foot Buffer		**288**
		19
Cedar River		270

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Wood Turtle Stream 660-foot Buffer		**1,692**
		107
Cedar River		1,585
Grand Total	**12.5**	**76,053**

Rare species

Rare species occurrences are compiled from the Michigan Natural Features Inventory Biotics database (Tables 17 and 18) and do not necessarily include all rare species found in this management area due to biases in survey effort and verifiable observation reporting over time.

Table 16. Rare animal and plant species conservation status key.

Status	Status
E = endangered	LE = listed endangered
T = threatened	LT = listed threatened
SC = special concern	PDL = proposed for delisting

Table 17. Rare animal species occurrence within the Green Bay management area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Accipiter gentilis	Northern goshawk	T	--	2
Animal	Alasmidonta viridis	Slippershell	T	--	3
Animal	Bombus borealis	Northern amber bumble bee	SC	--	2
Animal	Bombus terricola	Yellow banded bumble bee	SC	--	2
Animal	Botaurus lentiginosus	American bittern	SC	--	1
Animal	Buteo lineatus	Red-shouldered hawk	SC	--	3
Animal	Canis lupus*	Gray wolf	SC	LE	--
Animal	Chlidonias niger	Black tern	T	--	1
Animal	Circus hudsonius	Northern harrier	SC	--	1

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Cistothorus palustris	Marsh wren	SC	--	2
Animal	Cottus ricei	Spoonhead sculpin	SC	--	1
Animal	Coturnicops noveboracensis	Yellow rail	T	--	1
Animal	Elliptio complanata	Eastern elliptio	SC	--	1
Animal	Falco columbarius	Merlin	SC	--	1
Animal	Gallinula galeata	Common gallinule	T	--	1
Animal	Gavia immer	Common loon	T	--	1
Animal	Glyptemys insculpta	Wood turtle	T	--	1
Animal	Haliaeetus leucocephalus	Bald eagle	SC	--	9
Animal	Hydroprogne caspia	Caspian tern	T	--	1
Animal	Ixobrychus exilis	Least bittern	T	--	1
Animal	Lasmigona costata	Flutedshell	SC	--	1
Animal	Lithobates palustris	Pickerel frog	SC	--	1
Animal	Myotis lucifugus	Little brown bat	T	--	1
Animal	Necturus maculosus	Mudpuppy	SC	--	4
Animal	Nycticorax nycticorax	Black-crowned night-heron	SC	--	2
Animal	Pandion haliaetus	Osprey	SC	--	1
Animal	Sterna hirundo	Common tern	T	--	1
Total	--	--	--	--	**46**

**Occurrence information provided by field staff.*

Table 18. Other rare occurrence within the Green Bay management area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Other	Great Blue Heron Rookery	Great Blue Heron Rookery	--	--	3
Total	**--**	**--**	**--**	**--**	**3**

Non-ERA natural communities

Natural communities that are identified with an element occurrence in the MNFI Biotics database, but that have not been given an additional ecological reference area (ERA) designation, are recognized and managed accordingly (Table 20.)

Table 19. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 20. Non-ERA Natural Communities within the Green Bay management area.

Community Type	Element Occurrence Rank	State Rank	Global Rank	Number of Occurrences
Muskeg	C	S3		2
Northern Shrub Thicket	C	S5	G4	2
Grand Total				**4**

Forest health

Forest health concerns, both native and non-native, can have impacts on stand conditions and management decisions. The following insects (Table 21) and diseases (Table 22) could have an impact on management during the planning period and may need to be monitored and/or addressed

Table 21. Defoliating insects of concern in the Green Bay management area.

Common Name	Scientific Name	Native/Non-native	Known Presence

Spongy moth	Lymantria dispar	Non-native	Yes
Forest tent caterpillar	Malacosoma disstria	Native	Yes
Large aspen tortrix	Choristoneura conflictana	Native	Yes
Spruce budworm	Choristoneura fumiferana	Native	Yes
Hemlock woolly adelgid	Adelges tsugae	Non-native	No

Watch for lingering ash with potential resistance to emerald ash borer.

Table 22. Maladies of concern in the Green Bay management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Canker	Various	Various	Yes
Armillaria root rot	Armillaria spp.	Native	Yes
Heterobasidion root disease	Heterobasidion annosum	Native	No

Aquatic resources

Riparian habitat

A total of 75 miles of streams and rivers are found in the management area (Table 23). Streams/rivers classified as warm types comprise 100 percent of the riverine mileage.

Table 23. Classification type and length of streams/rivers found within the management area.

Type	Length (miles)
Cold stream	0
Cold small river	0
Cold transitional stream	0
Cold transitional small river	0
Cold transitional large river	0
Warm transitional stream	31
Warm transitional small river	0
Warm transitional large river	1
Warm stream	32
Warm small river	<1
Warm large river	11

Lacustrine Habitat

A total of seven lakes and ponds of at least one surface acre are found in the management area (Table 24).

Table 24. Size and number of lakes and ponds located within the management area.

Lake Size Class (acres)	Number
1-99	5
100-499	2
500+	0

Wetlands

A total of 50,256 acres of wetlands lie in the management area (Table 25). Forested wetlands comprise approximately 96 percent of wetland types found in the management area.

Table 25. Area of emergent, forested, and riverine wetland types found within the management area.

Wetland Type	Acres
Emergent	1,871
Forested	48,213
Riverine	172

Vernal pools and seeps

A total of 75 acres of vernal pools have been inventoried in the management area while no areas of seeps have been identified.

Riparian vegetation cover

Lowland shrub, aspen, lowland deciduous, cedar and mixed upland deciduous are the predominant cover types present in a 100-meter riparian zone located next to streams/rivers in the management area (Table 26).

Table 26. Largest vegetative cover types (i.e., top 10) and area located in a 100-meter buffer of streams/rivers within the management area.

Cover Type	Acres
Lowland shrub	1,804
Aspen	1,433
Lowland deciduous	1,022
Cedar	960
Mixed upland deciduous	917
Marsh	768
Northern hardwood	529
Upland conifers	368
Lowland mixed forest	331

Cover Type	Acres
Upland mixed forest	292

Watershed vegetation cover

The management area includes portions of important watersheds of the Cedar River and Days River (Tables 27 and 28). Aspen is a major cover type of the state forest in each watershed.

Table 27. Largest vegetative cover types (i.e., top 5) and area of the Cedar River watershed located within the management area.

Cover Type	Acres
Aspen	7,056
Cedar	5,834
Lowland shrub	3,360
Northern hardwood	3,217
Lowland deciduous	2,456

Table 28. Largest vegetative cover types (i.e., top 5) and area of the Days River watershed located within the management area.

Cover Type	Acres
Aspen	967
Planted red pine	536
Cedar	440
Natural red pine	392
Lowland conifer	228

Recreation

The Green Bay area has good access for public recreation and management. The Forest Islands ORV Trail and Route is in this area. The Cedar River Pathway, open to hiking, biking and equestrian use, is located adjacent to the Cedar River North state forest campground. The Days River Pathway, northeast of Gladstone, provides opportunities for hiking, biking and skiing on a variety of terrain.

The Cedar River North rustic campground offers sites for tents or small trailers and six equestrian sites with horse corrals. It is situated on the Cedar River, which offers excellent paddling and fishing opportunities. Additional recreation opportunities are provided by J.W. Wells State Park, which is adjacent to state forest land on the shores of Green Bay.

Table 29. Designated recreation trails by type.

Recreation Category	Number of Miles
Motorized Recreation Trails	**57.6**
ORV (all types)	47.7
Snowmobiles	9.9

Recreation Category	Number of Miles
Non-motorized Recreation Trails	**55.1**
Hiking	19.8
Equestrian	8.1
Biking	19.8
Hunter Walking Trails	7.4
Total	**112.7**

Note: Trail use types may overlap.

Table 30. State Forest Campgrounds (SFCGs).

Name	Number of Sites	Equestrian Sites
Cedar River North SFCG and Trail Camp	18	6

The Cedar River GEM, about 4.5 miles northwest of Cedar River, provides hundreds of acres of aspen and miles of beautiful rivers and streams with hunting for grouse and woodcock accessible via over seven miles of walking trails. Boating access sites provide access to the Cedar River, Ford River and Lake Michigan.

Table 31. Areas managed for hunting

Type	Name	Number of Acres
Grouse Enhancement Management Sites	Cedar River GEM	3,085.8

Table 32. Boating access sites (BAS).

Name	Waterbody
Cedar River Mouth	Cedar River/Lake Michigan
Cedar River North SFCG	Cedar River
Ford River Mouth	Ford River/Lake Michigan

Houghton Hardwoods

State Forest Area: 63,406 acres	Location: Base of Keweenaw Peninsula	Population Centers: Houghton Baraga
Sub-Section: Keweenaw Coarse Till and Lake Plain	Landforms: Ground moraine ridges Lake plain Water reworked moraine	Landcover: Forested: (acres) Non-forested: (acres)

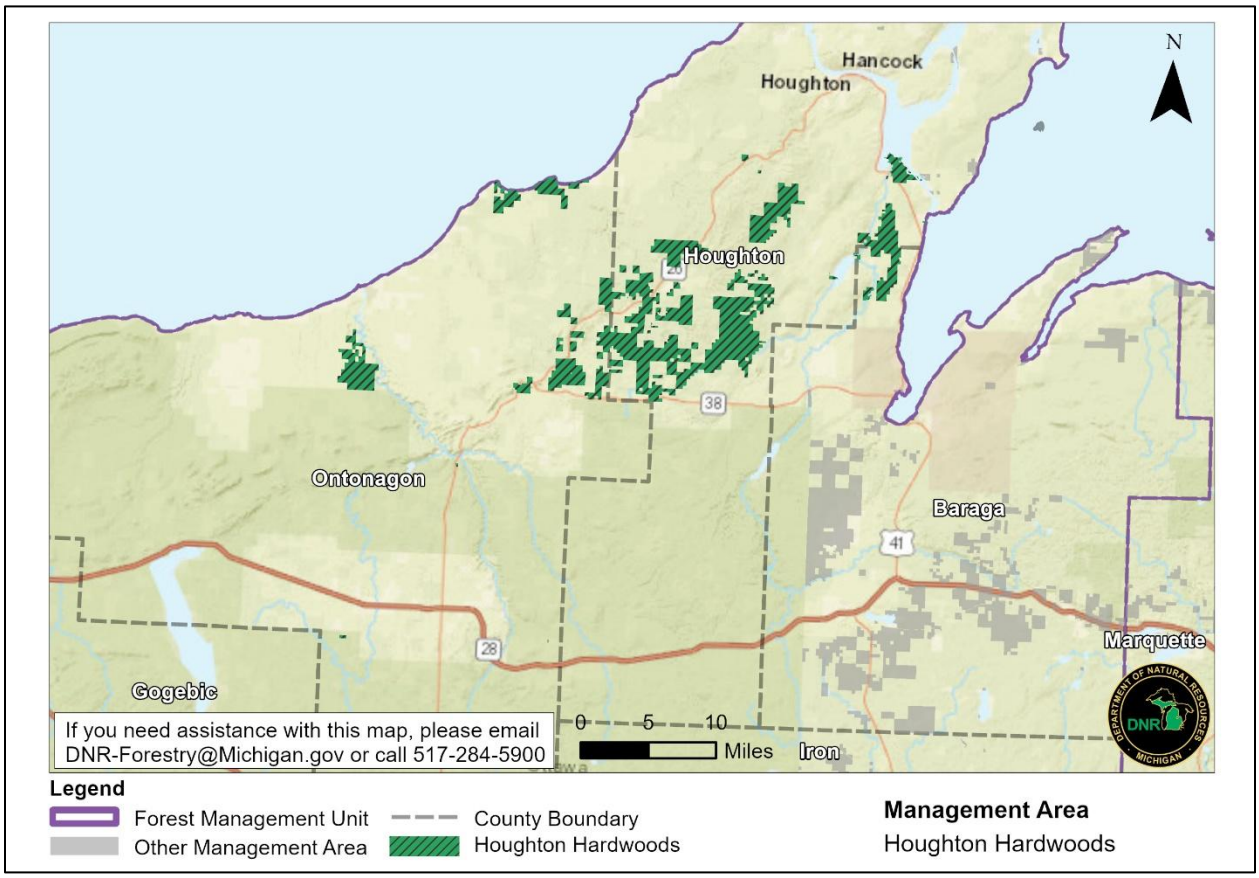


Figure 1. Map of the Houghton Hardwoods management area.

Forested landscape

Current and projected future condition

The Houghton Hardwoods management area is dominated by old, tolerant cover types that are largely upland and available. Intolerant deciduous cover types are relatively evenly distributed across the age categories, while unavailable upland and lowland acres are more prevalent in the old age category.

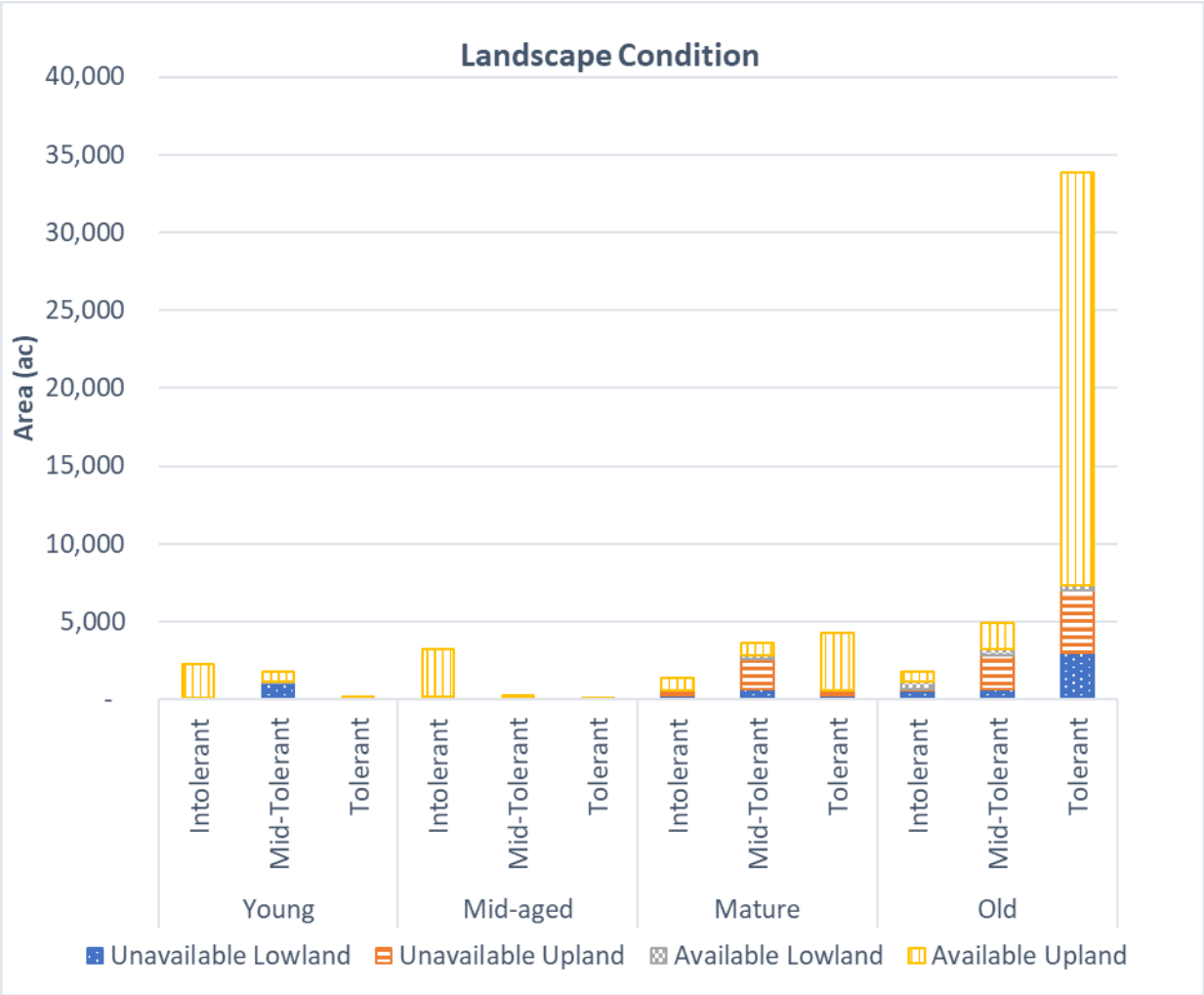


Figure 2. Forest diversity matrix showing the current distribution of forested acres across management availability, age category, landscape position and shade tolerance.

Landscape habitat conditions refine the management area landscape into featured species habitat context. Current and projected acres for the metrics identified in the Management Priorities (Section 3 Statewide/Regional) establish a baseline and future condition based on management over the planning period (Table 1).

Table 1. Current and projected acres for Landscape Habitat Conditions.

Landscape Habitat Condition	Monitoring Metric	Current Acres
Young forest	Acres of 0-19 stands in aspen and jack pine	2,156
Mature forest	Acres of 80+ year stands across cover types	40,504
Mature Ffrest	Acres of 120+ year stands across cover types	21,566
Mesic conifer cover types	Acres of mesic conifer cover types	3,093
Mesic conifers in other cover types	Average canopy occupancy	15%
Mast – oak cover types	Acres of oak cover types	710
Mast tree species in other cover types	Acres of total canopy occupancy of mast tree acres (Trace-100%)	28,628
Big trees	Acres of total canopy stand occupancy of species in sawlog or greater size class	48,743
Non-forested openings	Acres of total herbaceous open land, upland shrub and cropland	1,250
Landscape forest matrix	Percent deciduous forest	81%
Landscape forest matrix	Percent coniferous forest	14%

Another important landscape level habitat in the management area is coastal habitat. The Great Lakes, particularly coastal and nearshore areas, provide globally or continentally important stopover sites for all groups of migratory birds: waterfowl, shorebirds, landbirds (defined here as songbirds and raptors), and waterbirds (loons, grebes, cormorants, herons, rails, cranes, gulls, and terns) (Ewert, et. Al 2012). The Great Lakes shoreline provides essential stopover habitat for birds to rest, feed, and shelter during migration. In addition to migration, the diverse coastal habitats where water and land meet provides unique habitats for breeding birds. Some of these areas are classified by Michigan Audubon as Important Bird Areas (IBAs). The Great Lakes shoreline is habitat for several rare plant species that are endemic to the Great Lakes.

Forest management and other intrusive activities within a mile of the coastline need to consider the potential impacts to migratory birds and breeding bird habitat.

The Houghton Hardwoods management area has the following Special Analysis Units (SAUs). These SAUs have specific cover type goals, typically associated with wildlife habitat management. For any SAUs that overlap with this MA, SAU cover type goals take priority as the SFMP model strives to meet the cover type goals across the MA, ensuring they are met. Please see Section 5 for a detailed description of the management direction and harvest goals for each of these SAUs.

- Grouse Enhanced Management (GEM)-Hazel Swamp

The Houghton Hardwoods management area is dominated by forested cover types with 91% of the area covered in forested stands (Table 2). The upland deciduous portion of that is 68% of the management area and comprised mostly of northern hardwood, aspen, and mixed upland deciduous. Lowland shrub

is the most common non-forested cover type in this management area, representing 4 percent of the landscape.

Table 2. Summary table describing the landscape conditions and distribution of cover types in the Houghton Hardwoods management area.

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
Forested	Upland	Deciduous	Aspen	6,557	43,342	49,002	57,550
			Northern hardwood	32,423			
			Blackred hybrid oak	0			
			Northern red oak	666			
			Oak mix	51			
			Mixed upland deciduous	3,645			
		Mixed	Upland mixed forest	2,552	2,552		
		Coniferous	Planted red pine	0	3,107		
			Planted jack pine	15			
			Planted white pine	0			
			Planted mixed pine	0			
			Natural red pine	0			
			Natural jack pine	0			
			Natural white pine	6			
			Natural mixed pines	0			
			Upland spruce/fir	73			
			Upland conifers	1,482			
			Hemlock	1,531			
	Lowland	Deciduous	Lowland aspen/balsam poplar	337	3,004	8,548	
			Lowland deciduous	2,666			
		Mixed	Lowland mixed forest	488	488		
		Coniferous	Cedar	460	5,057		
			Lowland conifers	3,315			
			Lowland spruce/fir	269			
			Tamarack	1,013			
Nonforested	Upland	N/A	Herbaceous openland	927	N/A	1,524	5,850
			Upland shrub	149			
			Low density trees	8			
			Bare/sparsely vegetated	100			
			Cropland	174			
			Urban	165			
	Lowland	N/A	Lowland shrub	2,811	N/A	4,327	
			Marsh	694			
			Bog	38			
			Treed bog	52			
			Water	732			
						Grand Total:	**63,400**

There are 42,166 acres (66 percent of the total management area and 73 percent of the forested area) that can be managed toward desired future conditions via commercial timber harvest in the Houghton Hardwoods management area (Table 2). Of that, more than 50 percent is in the northern hardwood cover type, 11 percent in aspen, and 3.5 percent in mixed upland deciduous. The remaining 15 cover types represent less than 2 percent each of the forested and available land in the management area.

Table 3. Landscape conditions and cover type composition of the Houghton Hardwoods management area.

HOUGHTON HARDWOODS Forested Cover Type	Available Acres	Available %	Unavailable Acres	Unavailable %	Total Acres	Total %
Aspen	6,275	10.9%	281	0.5%	6,557	11.4%
Cedar	128	0.2%	332	0.6%	460	0.8%
Hemlock	481	0.8%	1,050	1.8%	1,531	2.7%
Lowland aspen/balsam poplar	251	0.4%	87	0.2%	337	0.6%
Lowland conifers	306	0.5%	3,009	5.2%	3,315	5.8%
Lowland deciduous	576	1.0%	2,090	3.6%	2,667	4.6%
Lowland mixed forest	222	0.4%	266	0.5%	488	0.8%
Lowland spruce/fir	29	0.1%	240	0.4%	269	0.5%
Mixed upland deciduous	2,025	3.5%	1,621	2.8%	3,646	6.3%
Natural white pine	6	0.0%	0	0.0%	6	0.0%
Northern hardwood	29,221	50.8%	3,203	5.6%	32,425	56.3%
Northern red oak	635	1.1%	31	0.1%	666	1.2%
Oak mix	7	0.0%	44	0.1%	51	0.1%
Planted jack pine	15	0.0%	0	0.0%	15	0.0%
Tamarack	461	0.8%	553	1.0%	1,013	1.8%
Upland conifers	706	1.2%	776	1.3%	1,482	2.6%
Upland mixed forest	824	1.4%	1,729	3.0%	2,552	4.4%
Upland spruce/fir	0	0.0%	73	0.1%	73	0.1%
Grand Total	**42,168**	**73.3%**	**15,384**	**26.7%**	**57,552**	**100.0%**

Table 4. Site condition (reason area is unavailable for commercial harvest) acres for the Houghton Hardwoods Management Area.

Site Condition (Reason area is unavailable for commercial harvest)	Area (ac)	% of Unavailable Area
BMPs	6,032	39.2%
Wildlife concerns	3,112	20.2%
Too wet	3,090	20.1%
Too steep	1,606	10.4%
Other influence zones	391	2.5%
Rare landforms	339	2.2%
Conservation values	218	1.4%
Species of special concern or T&E	155	1.0%
Denied access	143	0.9%
Blocked by obstacle	106	0.7%
Other dept./div. processes	82	0.5%
Deer wintering area	41	0.3%
Non-military lease/easement	23	0.1%
Long-term retention	18	0.1%
Unproductive	12	0.1%
Federal/state/local law	7	0.0%
Historical/Archaeological	6	0.0%
Recreational/scenic	4	0.0%
Total unavailable	**15,384**	**100.0%**

Management actions

Each cover type in the Houghton Hardwoods management area has unique age class and basal area class goals that describe the long-term desired future conditions. The harvest levels needed in the first planning period to begin achieving those long-term goals are summarized below (Table 5)

Table 5. Ten-year planning period harvest goals (acres) by cover type and silvicultural regime.

Silvicultural Regimes								
Cover Type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Salvage Clearcut	Salvage Thinning	Grand Total
Northern hardwood	-	12,934	-	-	-	-	-	12,934
Mixed upland deciduous	145	915	-	-	166	-	-	1,225
Aspen	646	-	-	-	-	-	-	646
Upland mixed forest	281	-	-	-	-	-	-	281
Upland conifers	251	-	-	-	5	-	-	256
Lowland deciduous	59	-	-	-	-	-	-	59
Hemlock	-	52	-	-	-	-	-	52
Lowland aspen/balsam poplar	41	-	-	-	-	-	-	41
Tamarack	10	-	-	-	-	-	-	10
Lowland conifers	5	-	-	-	-	-	-	5
Totals	**1,439**	**13,900**	**-**	**-**	**171**	**-**	**-**	**15,510**

These harvests will help establish a desirable amount of regeneration for the even-aged cover types over the 10-year period or help to achieve desired basal area distribution among uneven-aged cover types such as northern hardwoods. The following sections will provide additional details for each of the significant cover types in the Houghton Hardwoods management area.

Table 6. Ten-year estimated harvest volume by product and species for the Houghton Hardwoods Management Area.

10-Year Estimated Harvest Volume Projection Houghton Hardwoods Management Area Product	Species	Volume Planned*	Volume Prepared**
Pulpwood (cords)	Mixed hardwood	72,757	68,392
	Mixed softwood	14,399	13,535
	Mixed aspen	6,232	5,858
	Mixed spruce	2,488	2,339
	Red pine	1,725	1,621
	White pine	1,422	1,336
	Mixed oak	944	887
	Jack pine	131	123
	Pulpwood Total	**100,097**	**94,091**
Sawtimber (MBF)	Sugar maple	47,160	44,330
	Red maple	7,498	7,048
	Basswood	4,647	4,368
	White pine	3,908	3,673
	Mixed aspen	3,485	3,276
	Red pine	3,362	3,160
	Red oak	2,813	2,644
	White oak	253	238
	Mixed oak	71	67
	Sawtimber Total	**73,196**	**68,804**
	Total Sawtimber Harvest Volume in Cords	**154,509**	**145,238**
	Grand Total Harvest Volume in Cords	**254,606**	**239,329**

* Volume estimates based on 100% of the projected harvests for the 10-year planning period.

** Volume estimates based on 94% of the projected harvests for the 10 year planning period accounting for reduction in acres and associated volume once sales are prepared for bid.

There are very few cover type transitions projected in the Houghton hardwoods management area. The managed area of each cover type is projected to remain relatively stable as treatment regimens will not change the amount of area in each cover type more than 0.8 percent. The largest expected decrease is

in the upland conifer cover type, where 145 acres are forecasted to convert to other cover types through forest management activities. The largest increase is in aspen, where 68 acres are expected to convert into that cover type.

Table 7. Projected 10-year cover type acres resulting from cover type transitions.

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Northern hardwood	32,423	32,423	0
Aspen	6,557	6,625	68
Mixed upland deciduous	3,645	3,702	57
Lowland conifers	3,315	3,323	7
Lowland deciduous	2,666	2,633	-33
Upland mixed forest	2,552	2,539	-13
Hemlock	1,531	1,531	0
Upland conifers	1,482	1,337	-145
Tamarack	1,013	996	-17
Northern red oak	666	666	0
Lowland mixed forest	488	529	41
Cedar	460	460	0
Lowland aspen/balsam poplar	337	341	3
Lowland spruce/fir	269	267	-1
Upland spruce/fir	73	73	0
Oak mix	51	51	0
Planted jack pine	15	15	0
Natural white pine	6	28	22
Planted red pine	0	11	11
Lowland shrub	2,811	2,811	0
Herbaceous openland	927	927	0
Water	732	732	0
Marsh	694	694	0
Cropland	174	174	0
Urban	165	165	0
Upland shrub	149	149	0
Bare/sparsely vegetated	100	100	0
Treed bog	52	52	0
Bog	38	38	0
Low density trees	8	8	0
Total:	**63,400**	**63,400**	**0**

Featured species current and projected habitat acres

There are 11 featured species in this management area that span various cover types, age classes, and stand-level conditions.

It is recommended that these featured species habitat acres be viewed as acres of potential habitat, representing a condition on the landscape where the more nuanced aspects of each species' habitat requirements are likely to be found or managed for. As described in the introduction, the modeling effort was limited by several factors including the simplification of habitat attributes into MiFI variables. When referring to habitat acres, the true reference is potential habitat acres.

Current and projected total habitat acres by species across the decade provide a baseline and show the result of long-term management actions (Table 8). Some species show a loss in habitat over the next century. As mentioned in the Featured Species Management Priority (Section 3), the current condition for many cover types is a surplus of acres in the 0-9 age class from the compensatory management approach applied in the previous decade. The model eventually evens out the age classes at a lower, sustainable level over time, usually by 50 years. For any species with northern hardwoods as a priority cover type, there is a perceived drop in acres between 40-60 years; this is due to the basal area dropping below 81. Because it only drops into the upper 70s, it is not expected to translate to any real habitat loss on the ground. Black bear was not included in the SFMP model, so only has current habitat acres. That is included here to inform management decisions over the decade.

Table 8. Featured species current and projected total habitat acres (i.e., potential habitat).

Featured Species	Priority Cover Types	Total Habitat Acres Current	10-year Projected Habitat Acres	50-year Projected Habitat Acres	100-year Projected Habitat Acres
American woodcock	Aspen, lowland aspen, lowland deciduous	2,296	2,027	2,297	2,284
Black bear	Generalist/mast	28,628	--	--	--
Blackburnian warbler	Northern hardwoods, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, hemlock	32,014	34,927	23,556	36,612
Black-throated blue warbler	Northern hardwoods, mixed upland deciduous	29,148	33,059	22,097	35,204
Golden-winged warbler	Aspen, black-red hybrid oak, northern red oak, oak mix, tamarack	2,210	1,892	2,161	2,209
Marten	Northern hardwoods, mixed upland deciduous, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland	36,423	40,363	29,916	43,138

Featured Species	Priority Cover Types	Total Habitat Acres Current	10-year Projected Habitat Acres	50-year Projected Habitat Acres	100-year Projected Habitat Acres
	spruce/fir, lowland mixed forest, lowland conifers, hemlock, cedar				
Moose	To be determined	--	--	--	--
Ruffed Grouse	Aspen	2,159	1,788	2,062	2,109
Snowshoe hare	Aspen, cedar, hemlock, lowland aspen, lowland conifers, lowland mixed forest, lowland spruce/fir, mixed upland deciduous, natural jack pine, natural mixed pines, planted jack pine, upland spruce/fir	3,010	2,686	2,589	2,584
White-tailed deer (food)	Food: Northern hardwood, oak mix, aspen, mixed upland deciduous, lowland deciduous, lowland aspen/balsam poplar, lowland mixed forest	49,386	49,510	49,637	49,765
White-tailed deer (shelter)*	Shelter: hemlock, cedar, planted red pine, planted white pine, planted mixed pine, natural red pine, natural white pine, natural mixed pines, upland conifers, upland spruce fir, lowland conifers	7,136	7,030	6,970	6,874
Wood turtle	Non-forested openings	--	--	--	--

Deer Wintering Complexes (DWCs) that are greater than 15,000 acres are modeled as Special Analysis Units and information on them can be found in Section 5 of the plan. In DWCs less than 15,000 acres, harvest of cedar and hemlock are not allowed within obligate range stands, and secondary shelter is often protected as well. These areas are guided by the DNR Deer Winter Range Guidelines.

Cover type composition and associated wildlife species

Northern hardwoods

Current condition

Most of the northern hardwood cover type in this management area is currently between a stand age of 70 and 110 years old (Figure 3). The past management regime has been primarily single-tree selection, which allows for stand age to continue to increase over time. Some stands are beginning to achieve an uneven-aged condition where a featured stand age becomes less evident, but the dominant age of these stands will likely increase past 150 years old before a younger age cohort becomes the prominent component of these stands (Figure 5).

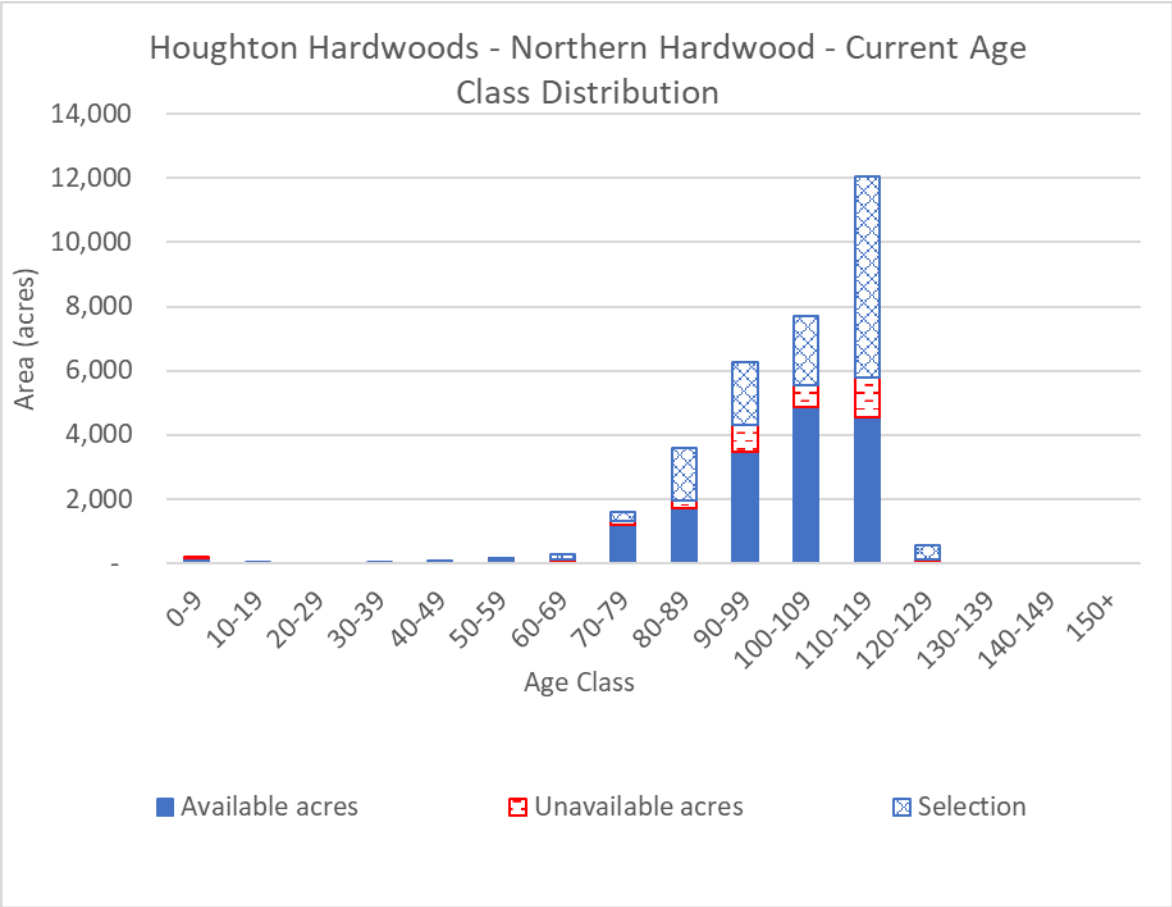


Figure 3. Current age class distribution and projected harvests in the northern hardwood cover type in the Houghton Hardwoods management area.

The area of northern hardwood is well distributed in the ideal basal area classes for optimal growing conditions in the Houghton hardwoods management area (Figure 3). Current conditions are a result of a well-regulated selection harvest regime that has been in place in this management area for decades. A

portion of this cover type meets the habitat requirements for blackburnian warbler, black-throated blue warbler and marten.

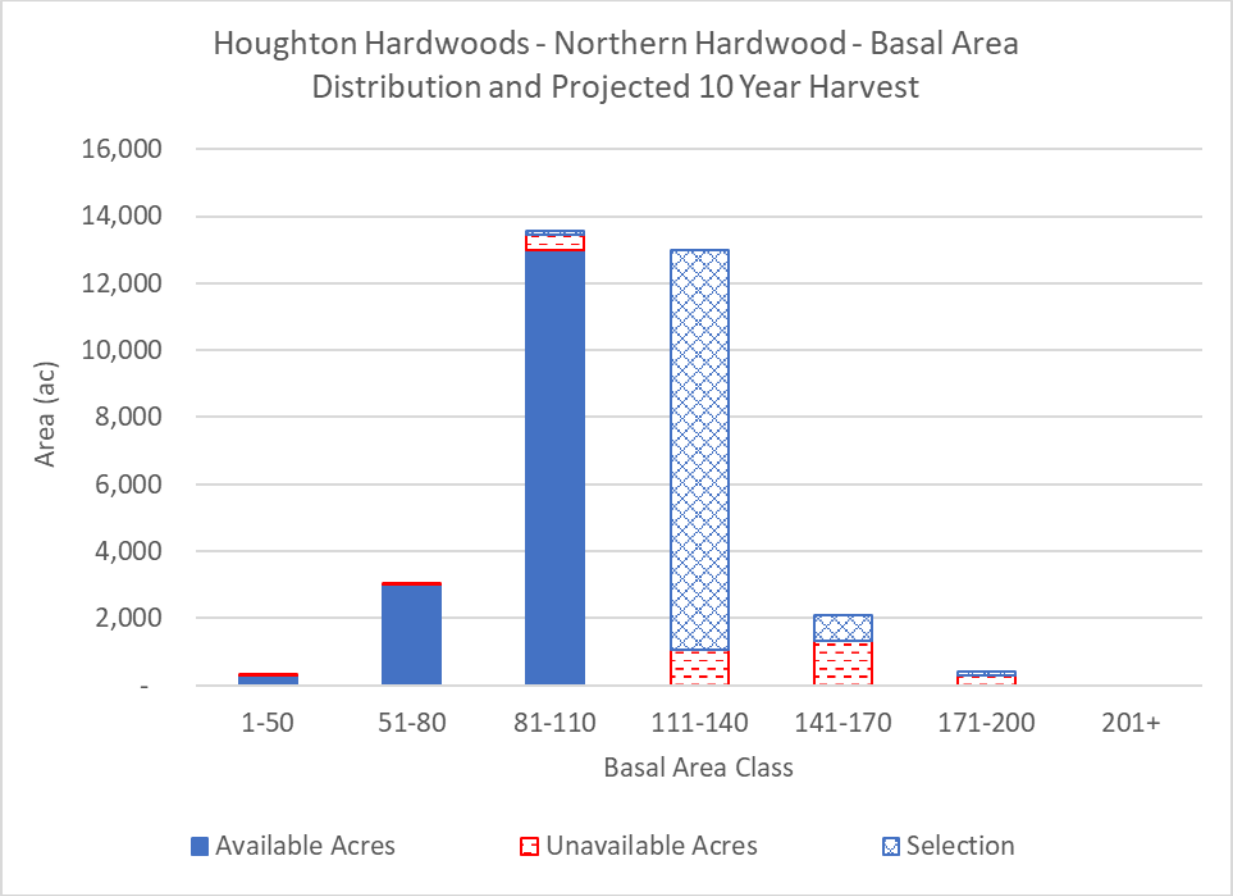


Figure 4. Current basal area distribution of the northern hardwood cover type as well as the projected harvests from each basal area class.

Table 9. Featured species with northern hardwoods as a priority habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Northern Hardwood	Northern Hardwood Habitat Acres- Available	Northern Hardwood Habitat Acres- Unavailable
Blackburnian warbler	Age category: 80+ Size category: Pole, Sawlog Basal area: 81+	24,476	2,980
Black-throated blue warbler	Age category: 80+ Size category: Sawlog Basal area: 81+	24,476	2,980
Marten	Age category: 40+ Size category: Pole, Sawlog	24,476	2,980

Featured Species	Featured Species Habitat – Northern Hardwood	Northern Hardwood Habitat Acres- Available	Northern Hardwood Habitat Acres- Unavailable
	Basal area: 81+		
White-tailed deer	All sizes and age classes	49,385	--

Desired future condition

The projected long-term cover type trend for northern hardwood in this management area is stable. There are very few transitions into this cover type from other cover types forecasted in this management area and equally few transitions from northern hardwoods to other cover types.

The desired basal area distribution is a bell-shaped curve where a significant majority of the area is kept in the 81-110 basal area class, with recently harvested stands occupying the 51-80 class and stands that are ready for harvest occupy the 111-140 basal area class. Diameter distributions of the northern hardwood stands should follow the appropriate Q-curve relative to stand age and condition.

An uneven-aged condition is the long-term goal for all northern hardwood stands in this management area. An uneven-aged condition is achieved when there is no single discernable age cohort that is more prevalent than others across the stand area as canopy gaps fill in with regenerating seedlings, saplings, poles, and eventually remaining stems become sawlog sized over time.

Regeneration and recruitment continue to be a focus in the northern hardwood cover type across this management area. The long-term sustainability of this cover type in an uneven-aged silvicultural regime depends on successful establishment of northern hardwood species as well as recruitment of those seedlings and saplings into the pole and saw log classes. The Houghton Hardwoods management area is considered to be a step ahead of other management areas dominated by northern hardwoods because it is west of the native range of American beech. Additionally, most areas have a reduced impact from cervid herbivory because of a greater average winter snow depth.

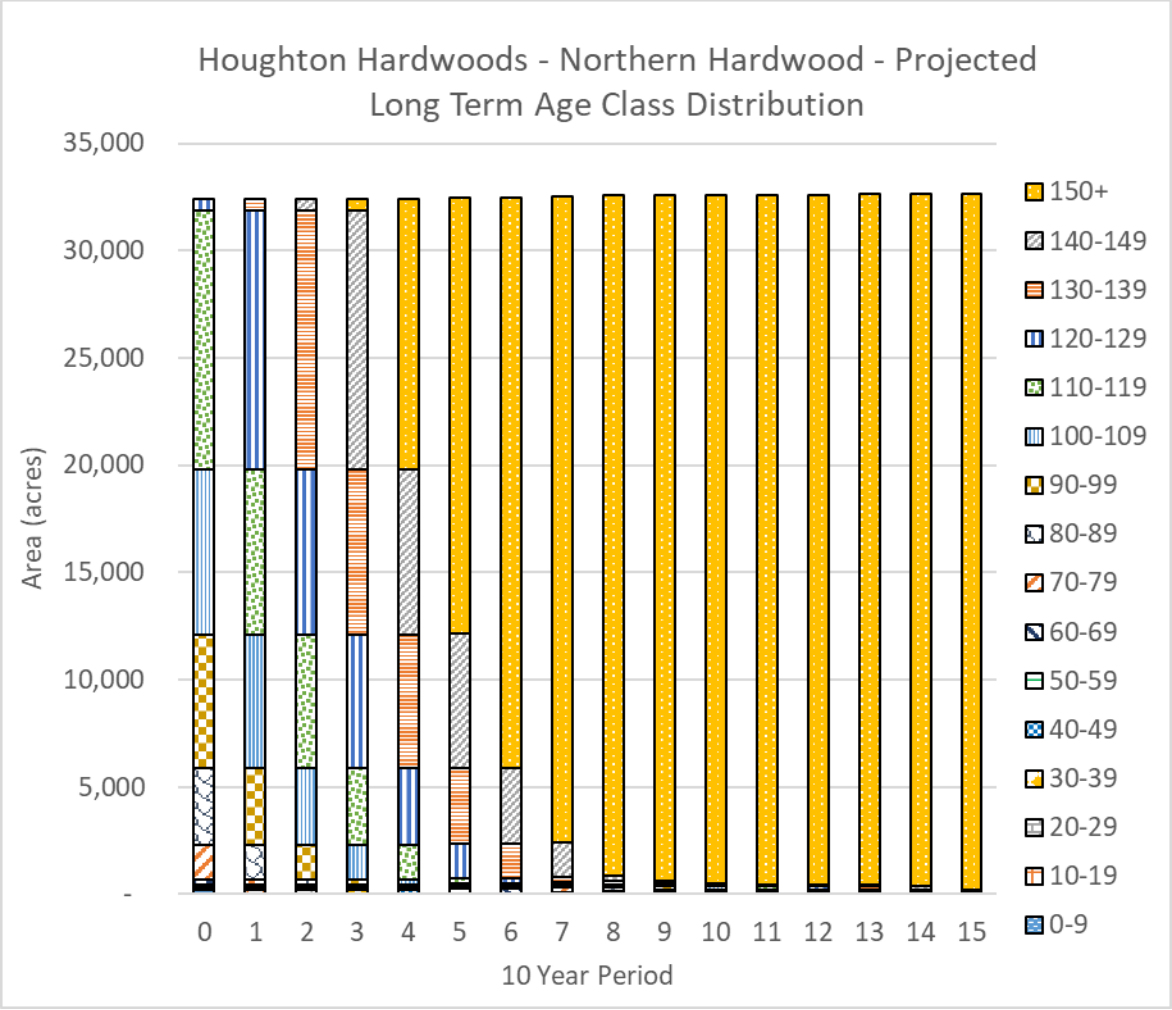


Figure 5. Projected age class distribution over 15, 10-year planning periods.

Management actions

The desired forest conditions and associated featured species habitat will be maintained and achieved through continued application of the projected selection harvest regime on 12,934 acres (Table 5). Larger canopy gaps should be used to encourage diverse regeneration of northern hardwood species while maintaining an overall long-term mature forest closed canopy landscape condition.

Aspen

Current Condition

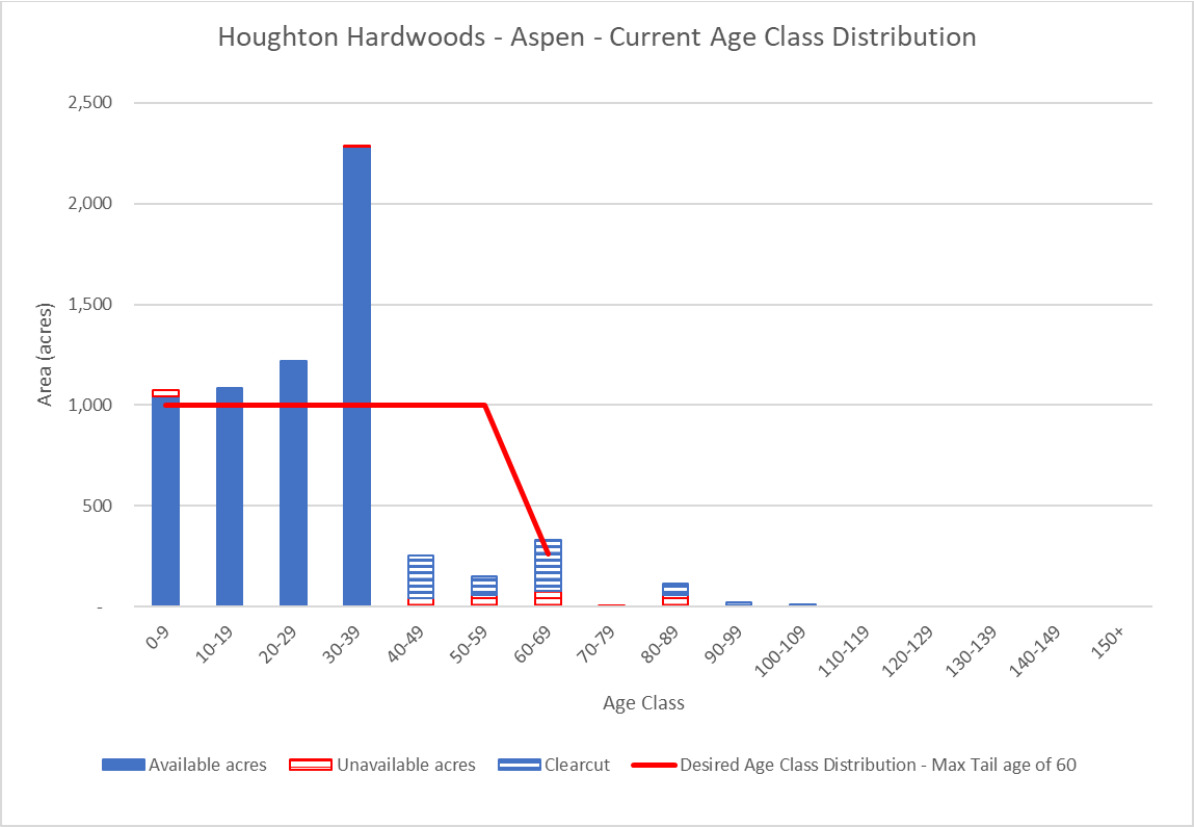


Figure 6. Current age class distribution, the desired age class distribution, and the projected harvests in the aspen cover type over the 10-year planning period.

The current age class distribution is quite unbalanced, with a deficit of acres in ages greater than 40 years old and a surplus of acres in the 30–-9-year-old age class. The younger age classes are in pretty good shape with only a slight surplus in each. Limited merchantable acres in the older age classes will present managers with a challenge in achieving the desired regeneration during this planning period. A portion of this cover type meets the habitat requirements for golden-winged warbler, ruffed grouse and American woodcock.

Table 10. Featured species with aspen as a priority habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Aspen	Aspen Habitat Acres - Available	Aspen Habitat Acres - Unavailable
Golden-winged warbler	Age category: 0-19 Size class: sapling	2,131	28
Ruffed grouse	Age category: 0-19 Size class: sapling	2,131	28

Featured Species	Featured Species Habitat – Aspen	Aspen Habitat Acres - Available	Aspen Habitat Acres - Unavailable
American woodcock	Age category: 0-19 Size class: sapling	2,131	28
White-tailed deer	All ages and size classes	6,557	--

Desired future condition

The desired age class distribution is to have a rotation age of 50 years with approximately 4 percent of the acres in an age class tail out to a maximum of 60-year age class.

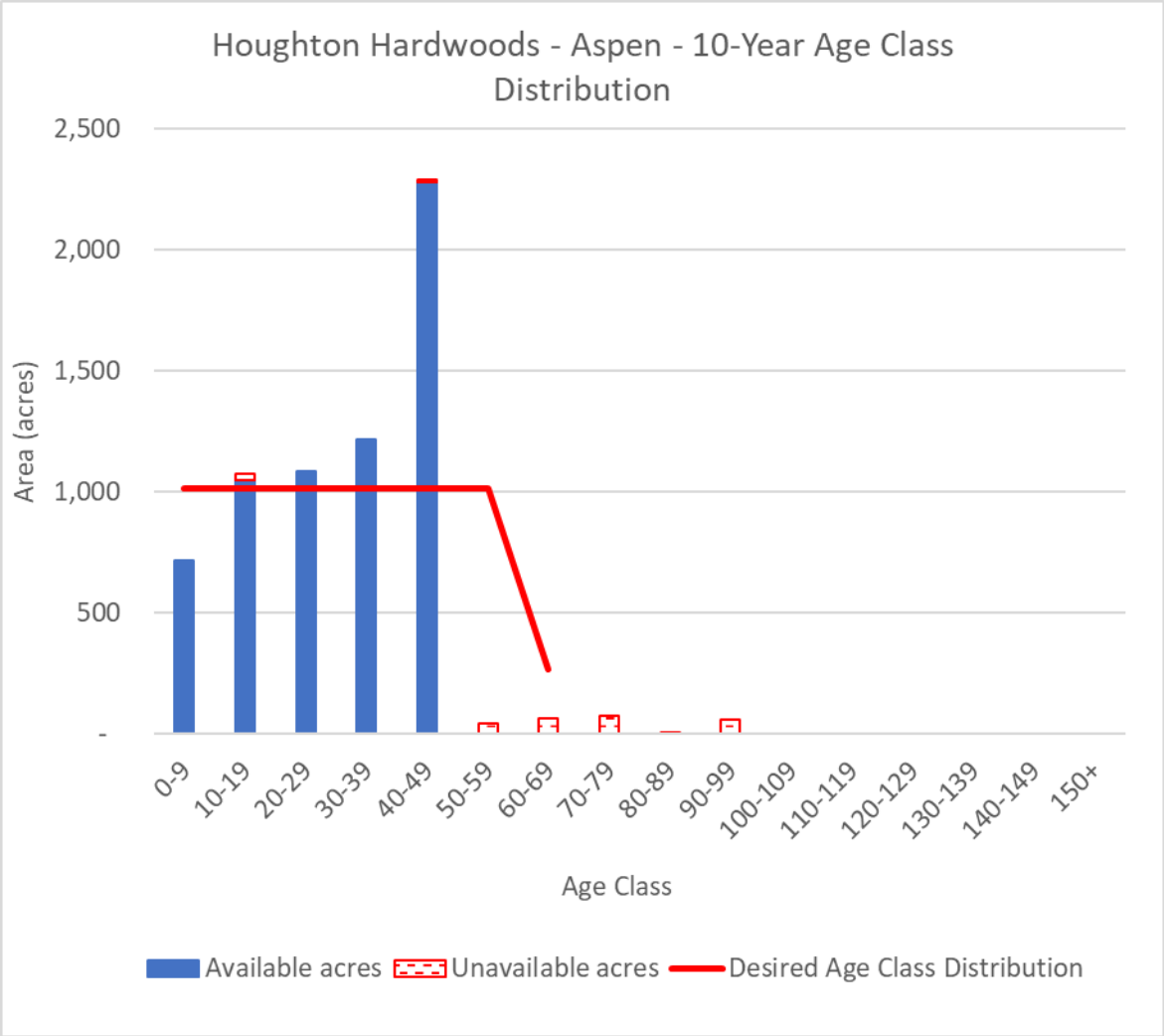


Figure 7. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The end of the planning period will result in the establishment of 714 acres in the upcoming 0-9 age class. Progress toward the long-term desired age class distribution of aspen will take many decades.

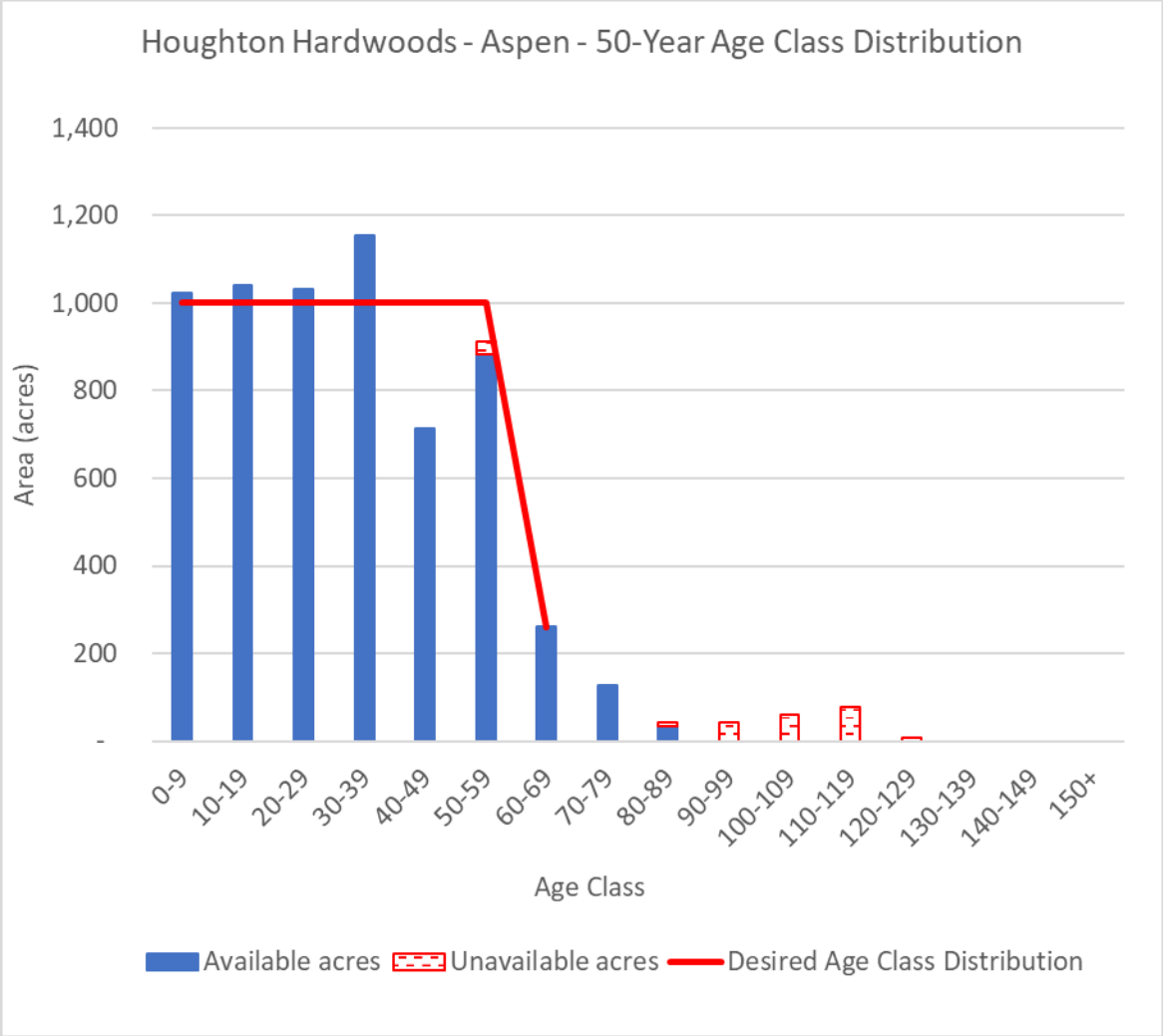


Figure 8. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows aspen acres nearly reaching the desired future condition with only a few age classes deviating from the target proportions (Figure 8). As is often the case, an extremely un-balanced condition in the first planning period can result in the need to carry some acres slightly longer into older age classes in future years to smooth out the distribution and achieve age class goals as seen in Figure 9.

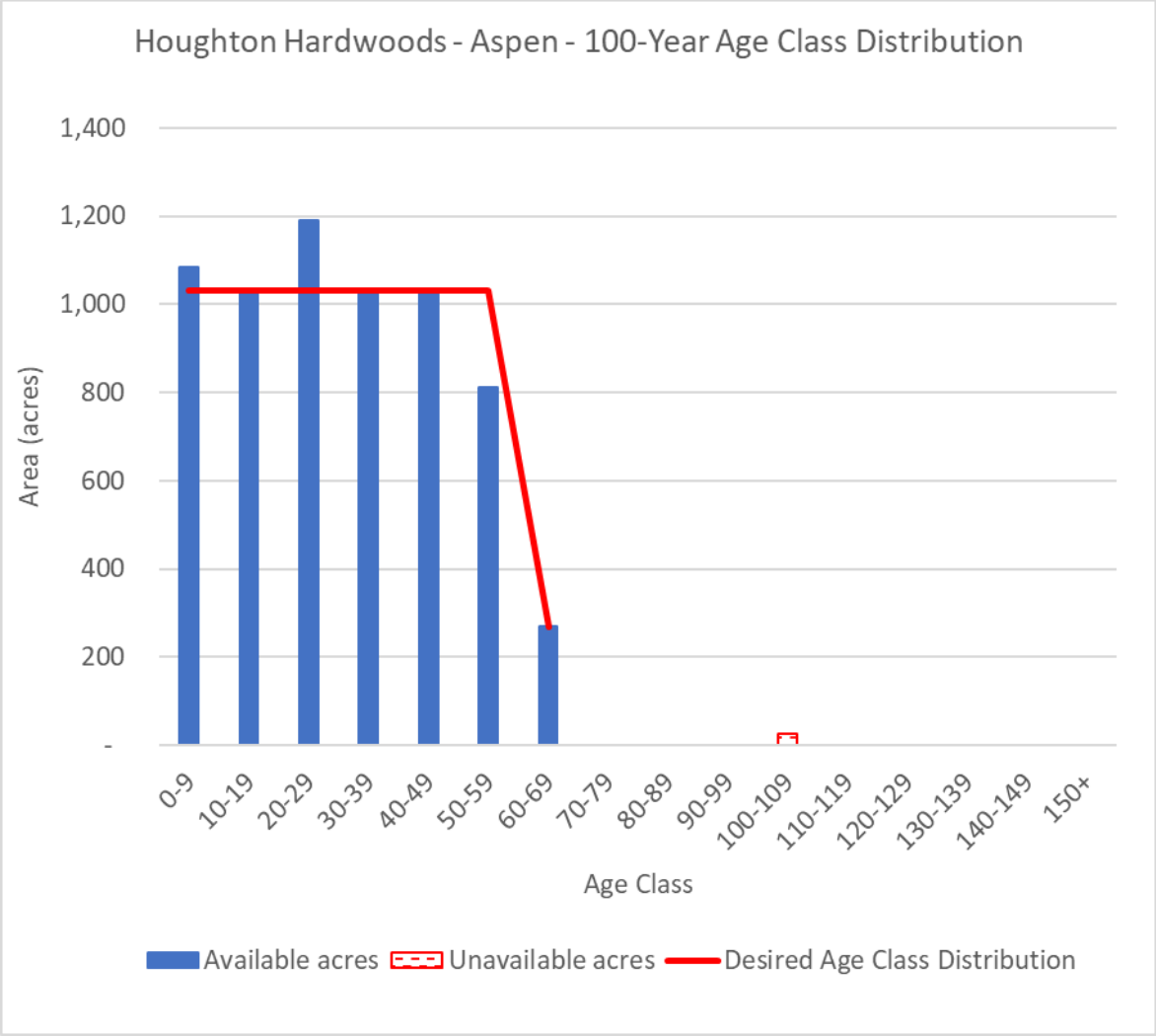


Figure 9. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 9) will concentrate the manageable acres of aspen in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged, and mature forest.

Management actions

There is clearcut harvest totaling a projected 646 acres in the aspen cover type and 68 more acres that will be converting to aspen from other cover types. These are expected to total 714 acres of regeneration in the aspen cover type over the next 10 years. This falls slightly short of the desired establishment of 1,030 acres per decade because of the current unbalanced condition resulting in a low amount of merchantable timber to regenerate.

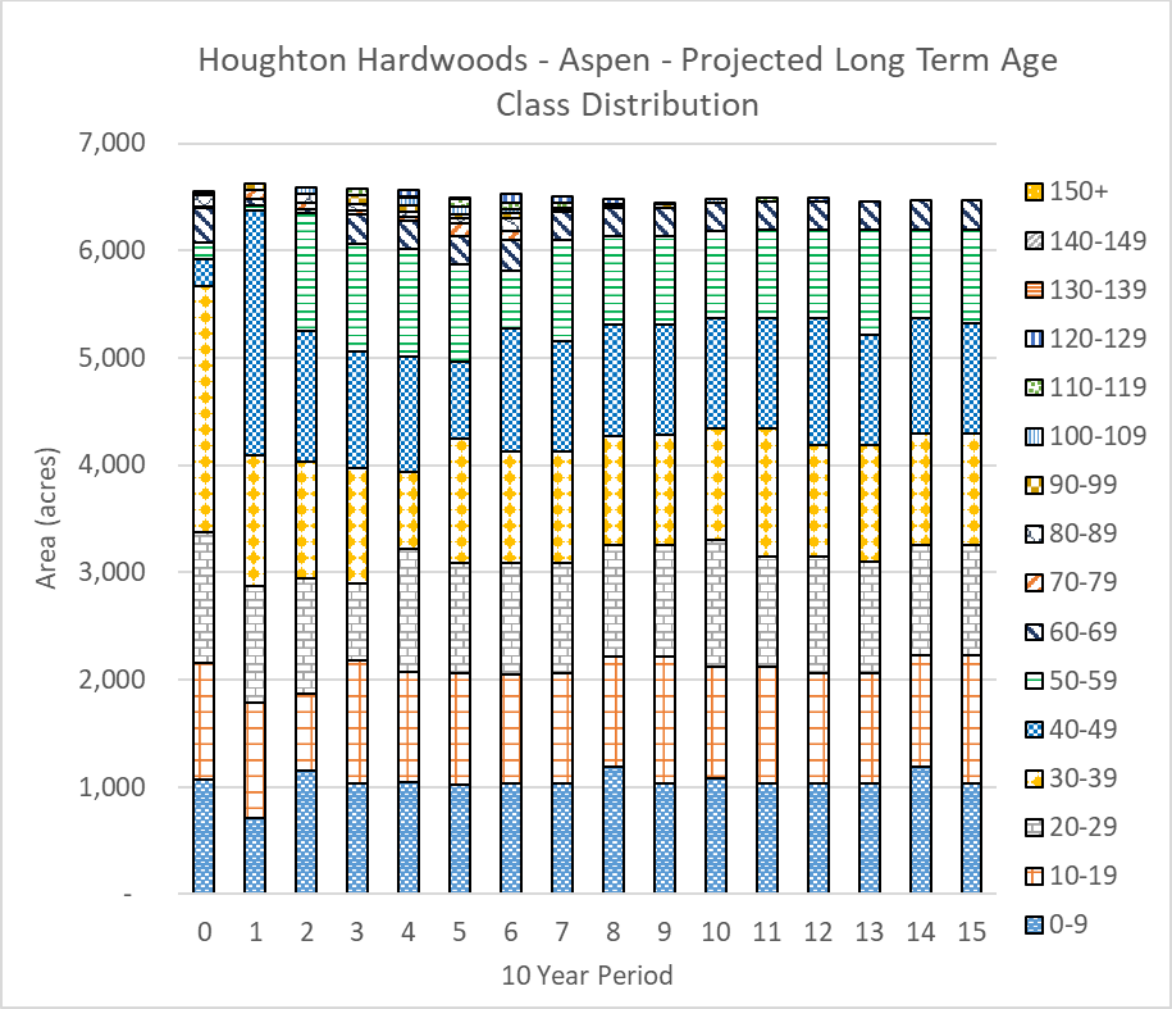


Figure 10. Projected age class distribution over 15, 10-year planning periods.

Conservation area network

High conservation value areas

There are up to nine different HCVA types that can be found in each management area (Table 11; see Biodiversity in Section 3 for more information).

Table 11. High conservation value areas within the Houghton Hardwoods management area.

High Conservation Value Area Type and Name	Acres
Deer Wintering Complex	**5,475**
	5,475
Northern Long Eared Bat Hibernacula 0.25mi Buffer	**499**
Adventure Adit	25
Adventure Mine	5
Aztec Mine	124
Hilton Shaft 1	111
Indiana Mine	125
Merchant Mine	15
Merchant's Adit North	17
Merchant's Adit South	17
South Lake Mine	60
Toltec Mine	0
Northern Long Eared Bat Hibernacula 2.5mi Buffer	**23,390**
Adventure Adit	687
Adventure Mine	687
Algonquin Adit #2 (Mark's Adit)	3,787
Aztec Mine	1,125
Belt Mine	2,156
Caledonia Mine Complex	18
Hilton Shaft 1	838
Indiana Mine	4,093
Mass C Adit	444
Merchant Mine	687
Merchant's Adit North	687
Merchant's Adit South	687
Ogimaw Adit	416
Ogimaw Mine	484
Old Flintsteel River Adit B	53
Piscatauqau Mine	2,663
Ridge Adit	687
South Lake Mine	1,581
Toltec Mine	1,063
West Evergreen Bluff Mine	547

High Conservation Value Area Type and Name	Acres
State Wildlife Management Areas	**7,455**
Sturgeon River Sloughs SWMA	7,455
GEMS	**2,375**
Hazel Swamp	2,375
Grand Total	**39,194**

Ecological reference areas

Ecological Reference Areas (ERAs) are a type of HCVA and are higher quality examples of functioning ecosystems that are primarily influenced by natural ecological processes.

Table 18. Ecological reference area natural community ranking based on NatureServe .

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 19. Ecological reference areas within the management area

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	Number of Occurrences
Existing ERA	Great Lakes Marsh	B			2
Existing ERA	Mesic Northern Forest	BC			1
Existing ERA	Northern Hardwood Swamp	B			1
Existing ERA	Northern Shrub Thicket	AB			1
Existing ERA	Northern Shrub Thicket	AB	G4	S5	2
Existing ERA	Sand and Gravel Beach	B			1
Existing ERA	Sandstone Bedrock Lakeshore	AB	G4G5	S2	2
Existing ERA	Sandstone Cobble Shore	AB			3
Grand Total					**13**

Special Conservation Areas

Reviewable special conservation areas (SCAs; Table 14) refers to those SCA types that may be reviewed or updated through the compartment review process as needed. Static SCAs (Table 15) refers to those SCA types that generally do not change or require updating (see Biodiversity in Section 3 for more information).

Table 14. Reviewable special conservation areas within the Houghton Hardwoods management area.

Reviewable Special Conservation Area Type and Name	Acres
Concentrated Recreational Area	**1,762**
Arnhiem Tamarack Complex.	1,317
Clear Lake & Horseshoe Lake	14
Emily Lake	0
Greenier Creek	29
Pike Lake Access Site	3
Pike Lake Flooding WLD	7
Sandy Lake	10
Sturgeon River wildlife travel corridor.	91
Unspecified	292
Habitat Area or Habitat Corridor	**843**
11057045	45
Bear Creek	451
Otter River	177
Sleepy Creek	170
Mineral Resource Area	**24**
Simar Sand Pit	24
Spring, Wetlands, or Riparian Areas	**951**
11068030	82
Black Creek	138
Bruno Creek	89
Otter River tributaries	241
West branch of the Otter River	401
Visual Management Areas	**66**
11068002	66
Grand Total	**3,647**

Table 15. Static special conservation areas within the Houghton Hardwoods management area.

Static SCA Type and Name	Acres	Sum of Length (miles)
High Priority Trout Streams	**--**	**29**
Adventure Creek	--	3
Ahola Creek	--	0.03
Black Creek	--	1
Butch Creek	--	2
Clear Creek	--	2
East Branch Firesteel River	--	0.14
East Sleeping River	--	1
Elm River	--	2
Holland Creek	--	3
Little Misery River	--	0.01
Misery River	--	0.15
Otter River	--	3
Portage River	--	0.43
Red Creek	--	0.50
Salmon Trout River	--	5
Senecal Creek	--	0.33
Shawmut Creek	--	1
Sleepy Creek	--	1
Snake River	--	3
West Branch Firesteel River	--	0.83
West Branch Otter River	--	0.23
West Sleeping River	--	0.34
Long-Eared Bat Hibernacula	**374**	**--**
Adventure Adit	25	--
Adventure Mine	5	--
Aztec Mine	124	--
Hilton Shaft 1	111	--
Merchant Mine	15	--
Merchant's Adit North	17	--
Merchant's Adit South	17	--
South Lake Mine	60	--
Toltec Mine	0.42	--
State Wildlife Management Areas	**7,455**	**--**
Sturgeon River Sloughs SWMA	7,455	--
Grand Total	**7,828**	**29**

Rare species

Rare species occurrences are compiled from the Michigan Natural Features Inventory Biotics database (Tables 17, 18 and 19) and do not necessarily include all rare species found in this management area due to biases in survey effort and verifiable observation reporting over time.

Table 16. Rare animal and plant species conservation status key.

Status	Status
E = endangered	LE = listed endangered
T = threatened	LT = listed threatened
SC = special concern	PDL = proposed for delisting

Table 17. Rare animal species occurrence within the Houghton Hardwoods management area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Acipenser fulvescens	Lake sturgeon	T	--	2
Animal	Alces alces*	Moose	SC	--	--
Animal	Bombus borealis	Northern amber bumble bee	SC	--	1
Animal	Bombus terricola	Yellow banded bumble bee	SC	--	1
Animal	Botaurus lentiginosus	American bittern	SC	--	1
Animal	Canis lupus*	Gray wolf	SC	LE	--
Animal	Coregonus artedi	Lake herring or Cisco	T	--	2
Animal	Elliptio complanata	Eastern elliptio	SC	--	1
Animal	Gallinula galeata	Common gallinule	T	--	1
Animal	Gavia immer	Common loon	T	--	4
Animal	Glyptemys insculpta	Wood turtle	T	--	1
Animal	Haliaeetus leucocephalus	Bald eagle	SC	--	5
Animal	Ixobrychus exilis	Least bittern	T	--	1
Animal	Ligumia recta	Black sandshell	T	--	1
Animal	Lithobates palustris	Pickerel frog	SC	--	1
Animal	Myotis lucifugus	Little brown bat	T	--	2
Animal	Myotis septentrionalis	Northern long-eared bat	T	LE	1
Animal	Necturus maculosus	Mudpuppy	SC	--	2

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Notropis dorsalis	Bigmouth shiner	T	--	3
Animal	Perimyotis subflavus	Tricolored bat	T	--	1
Animal	Sander canadensis	Sauger	E	--	2
Total	--	--	--	--	**33**

**Occurrence information provided by field staff.*

Table 18. Rare plant species occurrence within the Houghton Hardwoods management area.

Community Type	Element Occurrence Rank	State Rank	Global Rank	Number of Occurrences
Asplenium rhizophyllum	C	S2S3	G5	1
Astragalus canadensis	H	S1S2	G5	1
Callitriche hermaphroditica	H	S2	G5	1
Crataegus douglasii	H	S3S4	G5	1
Cystopteris laurentiana	E	S1S2	G3	1
Mertensia paniculata	H	SNR	G5	1
Potamogeton vaseyi	E	S1S2	G4	1
Ribes oxyacanthoides	H	S3	G5	1
Trisetum spicatum	E	S2S3	G5	1
Grand Total	-	-	-	9

Non-ERA natural communities

Natural communities that are identified with an element occurrence in the MNFI Biotics database, but that have not been given an additional ecological reference area (ERA) designation. They are recognized and managed accordingly. There are no non-ERA natural communities in the management area.

Forest health

Forest health concerns, both native and non-native, can have impacts on stand conditions and management decisions. The following insects (Table 20) and diseases (Table 21) could have an impact on management during the planning period and may need to be monitored and/or addressed.

Table 20. Defoliating insects of concern in the Houghton Hardwoods management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Spongy moth	Lymantria dispar	Non-native	Yes
Forest tent caterpillar	Malacosoma disstria	Native	Yes
Large aspen tortrix	Choristoneura conflictana	Native	Yes

Spruce budworm	Choristoneura fumiferana	Native	Yes

Watch for lingering ash with potential resistance to emerald ash borer.

Table 21. Maladies of concern in the Houghton Hardwoods management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Canker	Various	Various	Yes
Armillaria root rot	Armillaria spp.	Native	Yes
Oak Wilt	Bretziella fagacearum	Non-native	No

Aquatic resources

Riparian habitat

A total of 153 miles of streams and rivers are found in the management area (Table 22). Streams/rivers classified as cold types comprise approximately 65 percent of the riverine mileage.

Table 22. Classification type and length of streams/rivers found within the management area.

Type	Length (miles)
Cold stream	99
Cold small river	1
Cold transitional stream	0
Cold transitional small river	0
Cold transitional large river	0
Warm transitional stream	45
Warm transitional small river	1
Warm transitional large river	5
Warm stream	1
Warm small river	1
Warm large river	<1

Lacustrine habitat

A total of 17 lakes and ponds of at least 1 acre of surface area are found in this management area (Table 23).

Table 23. Size and number of lakes and ponds located within the management area.

Lake Size Class (acres)	Number
1-99	12
100-499	2
500+	3

Wetlands

A total of 12,141 acres of wetlands can be found in the management area (Table 24). Forested wetlands comprise approximately 81 percent of wetland types found in the management area.

Table 24. Area of emergent, forested, and riverine wetland types found within the management area.

Wetland Type	Acres
Emergent	1,612
Forested	9,878
Riverine	651

Vernal pools and seeps

A total of 16 acres of vernal pools have been inventoried in the management area while no areas of seeps have been identified.

Riparian vegetation cover

Northern hardwood is the predominant cover type present in a 100-meter riparian zone located next to streams/rivers in the management area (Table 25).

Table 25. Largest vegetative cover types (i.e., top 10) and area located in a 100-meter buffer of streams/rivers within the management area.

Cover Type	Acres
Northern hardwood	6,017
Mixed upland deciduous	1,620
Upland mixed forest	1,398
Lowland conifers	1,314
Lowland shrub	1,236
Aspen	1,193
Lowland deciduous	800
Upland conifers	604
Hemlock	372
Lowland mixed forest	239

Watershed vegetation cover

The management area includes portions of important watersheds of the Otter and Sturgeon rivers (Tables 26 and 27). Aspen is a major cover type of the state forest in each watershed.

Table 26. Largest vegetative cover types (i.e., top 5) and area of the Otter watershed located within the management area.

Cover Type	Acres
Aspen	18,966
Northern Hardwood	3,133
Cedar	1,624
Lowland Shrub	1,150
Lowland Conifer	924

Table 27. Largest vegetative cover types (i.e., top 5) and area of the Sturgeon River watershed located within the management area.

Cover Type	Acres
Aspen	1,873
Northern Hardwood	1,035
Cedar	941
Mixed Upland Deciduous	858
Lowland Shrub	690

Recreation

Access in the Houghton Hardwoods varies, with some very remote areas with few roads. In other areas, a complex network of forest roads supplies public access for hunting and fishing, as well as timber harvest, sometimes across large industrial or small private ownerships. Rail trails include the Baraga-

Chassell trail, which crosses the area from south to north and the Bill Nicholls Route, designated for off-road vehicle and snowmobile use and open to all non-motorized uses.

There is one state forest campground (rustic) within the management area at Emily Lake.

Table 28. Designated Recreation Trails by type.

Recreation Category	Number of Miles
Motorized Recreation Trails	**30.3**
ORV (all types)	10.6
Snowmobile	19.7
Non-motorized Recreation Trails	**7.8**
Hiking	0
Equestrian	0
Biking	0
Hunter walking trails	7.8
Total	**38.1**

Note: Trail use types may overlap.

Table 29. State Forest Campgrounds.

Name	Number of sites
Emily Lake campground	9

Bordered on the west by the Sturgeon River and on the north by Portage Lake and the Portage River, Sturgeon River Sloughs SWMA offers excellent duck and goose hunting opportunities, as well as wildlife viewing, birding, canoeing/kayaking and fishing. A 1.75-mile hiking trail is present on the northern part of the property with an observation platform overlooking the marsh. A portion of the site is a wildlife refuge closed to the public.

The Hazel Swamp GEM, approximately 15 miles northwest of Baraga, provides hunter walking trails through stands of aspen with changing elevations, providing a unique hunting experience for grouse and woodcock.

Several boating access sites are scattered around area lakes and provide access to the Portage and Misery rivers.

Table 30. Areas managed for hunting.

Type	Name	Number of Acres
State Wildlife Management Areas	Sturgeon River Sloughs SWMA	7,450.8
Grouse Enhancement Management Sites	Hazel Swamp GEM	2,375.1
Total	--	**9,825.9**

Table 31. Boating access sites (BAS).

Name	Waterbody
Clear Lake	Clear Lake
Emily Lake SFCG	Emily Lake
Lake Perrault	Lake Perrault
Misery River Mouth	Misery River Mouth/Lake Superior
Otter Lake Dam	Otter Lake
Pike Lake	Pike Lake
Sandy Lake	Sandy Lake
Sturgeon River Sloughs	Portage River

Keweenaw

State Forest Area: 12,030 acres	Location: Keweenaw Peninsula	Population Centers: Hancock, Copper Harbor
Sub-Section: Sisu Copper Range	Landforms: Exposed bedrock knobs, ground- and end-moraines	Landcover: Forested: 10,694 acres Non-forested: 1,336 acres

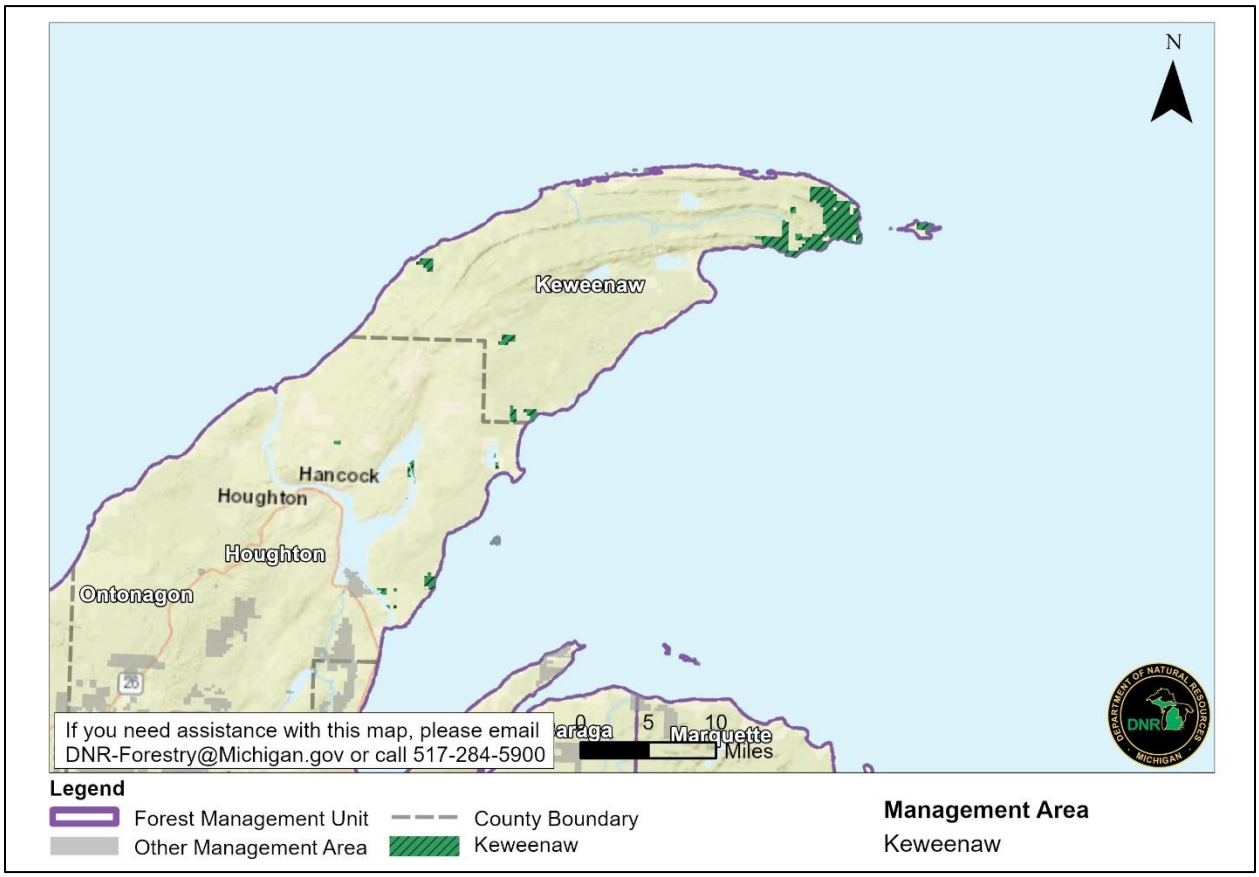


Figure 1. Map of the Keweenaw management area.

Forested andscape

Current and projected future condition

The Keweenaw management area is dominated by shade-tolerant and mid-tolerant cover types and many unavailable acres. Tolerant upland cover types are relatively evenly distributed across the age categories, while unavailable upland and lowland acres are more prevalent in the older age category.

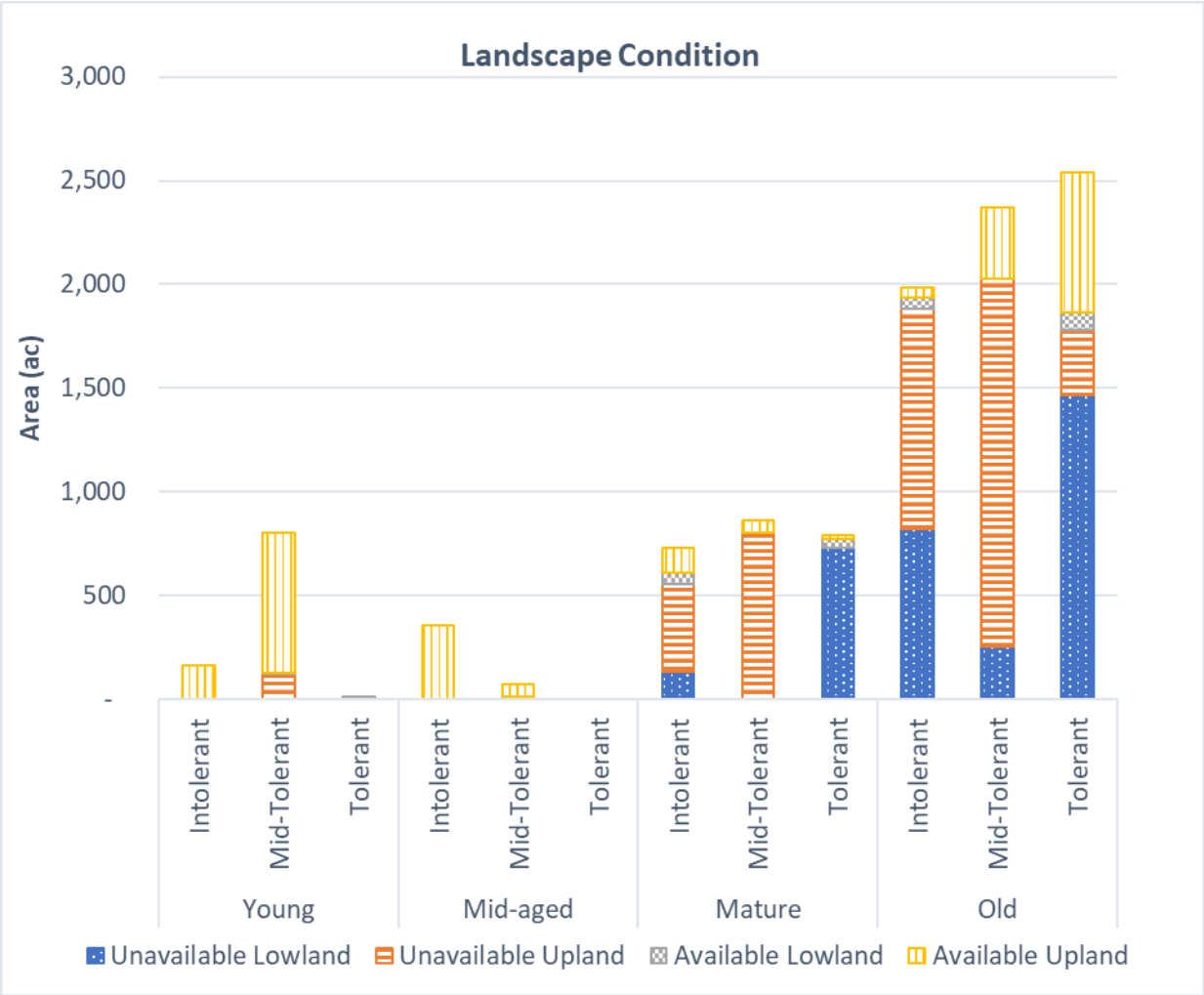


Figure 2. Forest diversity matrix showing the current distribution of forested acres across management availability, age category, landscape position and shade tolerance.

Landscape habitat conditions refine the management area landscape into featured species habitat context. Current and projected acres for the metrics identified in the Management Priorities (Section 3 Statewide/Regional) establish a baseline and future condition based on management over the planning period (Table 1).

Table 1. Current and projected acres for Landscape Habitat Conditions.

Landscape Habitat Condition	Monitoring Metric	Current Acres
Young forest	Acres of 0-19 stands in aspen and jack pine	978
Mature forest	Acres of 80+ year stands across cover types	6,514
Mature forest	Acres of 120+ year stands across cover types	3,460
Mesic conifer cover types	Acres of mesic conifer cover types	1,617
Mesic conifers in other cover types	Average canopy occupancy	26%
Mast – oak cover types	Acres of oak cover types	102
Mast tree species in other cover types	Acres of total canopy occupancy of mast tree acres (Trace-100%)	3,279
Big trees	Acres of total canopy stand occupancy of species in sawlog or greater size Class	15,138
Non-forested openings	Acres of total herbaceous open land, upland shrub and cropland	4
Landscape forest matrix	Percent deciduous forest	45%
Landscape Forest Matrix	Percent coniferous forest	47%

Coastal habitat is important within the management area. The Great Lakes, particularly coastal and nearshore areas, provide globally or continentally important stopover sites for all groups of migratory birds: waterfowl, shorebirds, landbirds (defined here as songbirds and raptors), and waterbirds (loons, grebes, cormorants, herons, rails, cranes, gulls, and terns) (Ewert, et. Al 2012). The Great Lakes shoreline provides essential stopover habitat for birds to rest, feed, and shelter during migration. In addition to migration, the diverse coastal habitats where water and land meet provides unique habitats for breeding birds. Some of these areas are classified by Michigan Audubon as Important Bird Areas (IBAs). The Great Lakes shoreline is habitat for several rare plant species that are endemic to the Great Lakes.

Forest management and other intrusive activities within a mile of the coastline need to consider the potential impacts to migratory birds and breeding bird habitat.

The Keweenaw management area is dominated by forested cover types, with 89 percent of the area covered in forested stands (Table 2). The upland deciduous portion of that is 39 percent of the management area and comprised mostly of aspen. The lowland conifer portion is 31 percent of the management area and comprised mostly of lowland conifer. Lowland shrub is the most common non-forested cover type in this management area, representing 4 percent of the landscape.

Table 2. Landscape conditions and distribution of cover types in the Keweenaw management area.

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
Forested	Upland	Deciduous	Aspen	2,051	4,669	7,024	10,694
			Northern Hardwood	760			
			Black Red Hybrid Oak	0			
			Northern Red Oak	102			
			Oak Mix	0			
			Mixed Upland Deciduous	1,756			
		Mixed	Upland Mixed Forest	660	660		
		Coniferous	Planted Red Pine	0	1,696		
			Planted Jack Pine	0			
			Planted White Pine	0			
			Planted Mixed Pine	0			
			Natural Red Pine	78			
			Natural Jack Pine	0			
			Natural White Pine	63			
			Natural Mixed Pines	0			
			Upland Spruce/Fir	390			
			Upland Conifers	1,164			
			Hemlock	0			
	Lowland	Deciduous	Lowland Aspen/Balsam Poplar	39	184	3,670	
			Lowland Deciduous	145			
		Mixed	Lowland Mixed Forest	135	135		
		Coniferous	Cedar	976	3,351		
			Lowland Conifers	1,353			
			Lowland Spruce/Fir	798			
			Tamarack	223			
Nonforested	Upland	N/A	Herbaceous Openland	4	N/A	57	1,336
			Upland Shrub	0			
			Low Density Trees	0			
			Bare/Sparsely Vegetated	49			
			Cropland	0			
			Urban	4			
	Lowland	N/A	Lowland Shrub	428	N/A	1,279	
			Marsh	64			
			Bog	115			
			Treed Bog	19			
			Water	654			
						Grand Total	12,030

There are 2,780 acres (23.1 percent of the total management area and 26.0 percent of the forested area) that can be managed toward desired future conditions through commercial timber harvest in the Keweenaw management area (Table 3). Of that, more than 9 percent is in the aspen cover type, 7 percent is mixed upland deciduous, and 5 percent is in northern hardwood. The remaining 13 cover types represent about 5 percent of the forested and available land in the management area.

Table 3. Landscape conditions and cover type composition of the Keweenaw management area.

Keweenaw Forested Cover Type	Available Acres	Available %	Unavailable Acres	Unavailable %	Total Acres	Total %
Aspen	997	9.3%	1,053	9.8%	2,051	19.2%
Cedar	83	0.8%	893	8.4%	976	9.1%
Lowland aspen/balsam poplar	39	0.4%	0	0.0%	39	0.4%
Lowland conifers	49	0.5%	1,305	12.2%	1,353	12.7%
Lowland deciduous	12	0.1%	133	1.2%	145	1.4%
Lowland mixed forest	0	0.0%	135	1.3%	135	1.3%
Lowland spruce/fir	71	0.7%	727	6.8%	798	7.5%
Mixed upland deciduous	715	6.7%	1,041	9.7%	1,756	16.4%
Natural red pine	55	0.5%	23	0.2%	78	0.7%
Natural white pine	4	0.0%	59	0.5%	63	0.6%
Northern hardwood	502	4.7%	259	2.4%	760	7.1%
Northern red oak	8	0.1%	95	0.9%	102	1.0%
Tamarack	0	0.0%	223	2.1%	223	2.1%
Upland conifers	33	0.3%	1,131	10.6%	1,164	10.9%
Upland mixed forest	162	1.5%	499	4.7%	660	6.2%
Upland spruce/fir	50	0.5%	340	3.2%	390	3.6%
Grand Total	**2,780**	**26.0%**	**7,914**	**74.0%**	**10,694**	**100.0%**

Table 4. Site condition (reason area is unavailable for commercial harvest) acres for the Keweenaw Management Area.

Site Condition (Reason area is unavailable for commercial harvest)	Area (ac)	% of Unavailable Area
Conservation values	3,639	46.0%
Too wet	1,110	14.0%
Rare landforms	1,024	12.9%
Recreational/scenic	667	8.4%
Federal/state/local law	421	5.3%
Blocked by obstacle	313	4.0%
BMPs	238	3.0%
Too steep	212	2.7%
Other influence zones	139	1.8%

Site Condition (Reason area is unavailable for commercial harvest)	Area (ac)	% of Unavailable Area
Denied access	106	1.3%
Wildlife concerns	19	0.2%
Non-military lease/easement	13	0.2%
Deer wintering area	12	0.2%
Long-term retention	2	0.0%
Total Unavailable	**7,914**	**100.0%**

Management actions

Each cover type in the Keweenaw management area has a unique age class and basal area class goals that describe the long term desired future conditions. The Keweenaw management area is being managed under a carbon sequestration project. No harvests are planned over the lifetime of the project (Table 5). There are no cover type transitions projected in this area. The managed area of each cover type is projected to remain stable except for natural disturbance (Table 6).

Table 5. Ten-year planning period harvest goals (acres) by cover type and silvicultural regime (no harvests)

Silvicultural Regimes								
Cover Type	**Clearcut**	**Selection**	**Thinning**	**Group Selection**	**Shelterwood**	**Salvage Clearcut**	**Salvage Thinning**	**Grand Total**
Northern red oak	-	-	-	-	-	-	-	-
Upland mixed forest	-	-	-	-	-	-	-	-
Planted red pine	-	-	-	-	-	-	-	-
Black Red hybrid oak	-	-	-	-	-	-	-	-
Natural white pine	-	-	-	-	-	-	-	-
Cedar	-	-	-	-	-	-	-	-
Planted jack pine	-	-	-	-	-	-	-	-
Hemlock	-	-	-	-	-	-	-	-
Tamarack	-	-	-	-	-	-	-	-
Lowland aspen/balsam poplar	-	-	-	-	-	-	-	-
Aspen	-	-	-	-	-	-	-	-
Lowland conifers	-	-	-	-	-	-	-	-
Northern hardwood	-	-	-	-	-	-	-	-
Lowland deciduous	-	-	-	-	-	-	-	-
Oak mix	-	-	-	-	-	-	-	-
Lowland mixed forest	-	-	-	-	-	-	-	-
Planted mixed pine	-	-	-	-	-	-	-	-
Lowland spruce/fir	-	-	-	-	-	-	-	-
Planted white pine	-	-	-	-	-	-	-	-
Mixed upland deciduous	-	-	-	-	-	-	-	-
Upland conifers	-	-	-	-	-	-	-	-
Natural jack pine	-	-	-	-	-	-	-	-
Upland spruce/fir	-	-	-	-	-	-	-	-
Natural mixed pines	-	-	-	-	-	-	-	-
Natural red pine	-	-	-	-	-	-	-	-
Totals	-	-	-	-	-	-	-	-

Table 6. Projected 10-year cover type acres resulting from cover type transitions.

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Aspen	2,051	2,051	0
Mixed upland deciduous	1,756	1,756	0
Lowland conifers	1,353	1,353	0
Upland conifers	1,164	1,164	0
Cedar	976	976	0
Lowland spruce/fir	798	798	0
Northern hardwood	760	760	0
Upland mixed forest	660	660	0
Upland spruce/fir	390	390	0
Tamarack	223	223	0
Lowland deciduous	145	145	0
Lowland mixed forest	135	135	0
Northern red oak	102	102	0
Natural red pine	78	78	0
Natural white pine	63	63	0
Lowland aspen/balsam poplar	39	39	0
Water	654	654	0
Lowland shrub	428	428	0
Bog	115	115	0
Marsh	64	64	0
Bare/sparsely vegetated	49	49	0
Treed Bog	19	19	0
Urban	4	4	0
Herbaceous openland	4	4	0
Total:	**12,030**	**12,030**	**0**

Featured species current and projected habitat acres

There are six featured species in this management area that span various cover types, age classes, and stand level conditions.

As noted in the Featured Species Management Priority (Section 3), it is recommended that these featured species habitat acres be viewed as acres of potential habitat, representing a condition on the landscape where the more nuanced aspects of each species' habitat requirements are likely to be found or managed for. As described in the introduction, the modeling effort was limited by several factors

including the simplification of habitat attributes into MiFI variables. Current and projected total habitat acres by species across the decade provide a baseline and show the result of long-term management actions (Table 7). Some species show a loss in habitat over the next century. As mentioned in the Featured Species Management Priority (Section 3), the current condition for many cover types is a surplus of acres in the 0-9 age class from the compensatory management approach applied in the previous decade. The model eventually evens out the age classes at a lower, sustainable level over time, usually by 50 years. For any species with northern hardwoods as a priority cover type, there is a perceived drop in acres between 40 to 60 years; this is due to the basal area dropping below 81. Because it only drops into the upper 70s, it is not expected to translate to any real habitat loss on the ground. Black bear is not included in the model so shows only current potential habitat acres. It is included here to inform management decisions over the decade.

Table 7. Featured species current and projected total habitat acres (i.e., potential habitat).

Featured Species	Priority Cover types	Total Habitat Acres Current	10-year Projected Habitat Acres	50-year Projected Habitat Acres	100-year Projected Habitat Acres
Black bear	Generalist/mast	3,279	--	--	--
Blackburnian warbler	Northern hardwoods, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, hemlock	1,720	1,892	2,444	2,987
Marten UP	Northern hardwoods, mixed upland deciduous, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, lowland mixed forest, lowland conifers, hemlock, cedar	4,041	4,626	5,808	7,120
Ruffed Grouse	Aspen	504	482	--	--
Snowshoe hare forest	Aspen, cedar, hemlock, lowland aspen, lowland conifers, lowland mixed forest, lowland spruce/fir, mixed upland deciduous, natural jack pine, natural mixed pines, planted jack pine, upland spruce/fir	1,223	777	--	--
White-tailed deer (food)	Northern hardwood, oak mix, aspen, mixed upland deciduous, lowland deciduous, lowland aspen/balsam poplar, lowland mixed forest	5,647	5,647	5,542	5,542

Featured Species	Priority Cover types	Total Habitat Acres Current	10-year Projected Habitat Acres	50-year Projected Habitat Acres	100-year Projected Habitat Acres
White-tailed deer (shelter)*	Hemlock, cedar, planted red pine, planted white pine, planted mixed pine, natural red pine, natural white pine, natural mixed pines, upland conifers, upland spruce fir, lowland conifers	4,823	4,823	4,929	4,929

Deer Wintering Complexes (DWC) that are greater than 15,000 acres are modeled as a special analysis unit and information on them can be found in Section 5 of the plan. In DWCs less than 15,000 acres, harvest of cedar and hemlock are not allowed within obligate range stands, and secondary shelter is often protected as well. These areas are guided by the DNR Deer Winter Range Guidelines.

Cover type composition and associated wildlife species

Aspen

Current condition

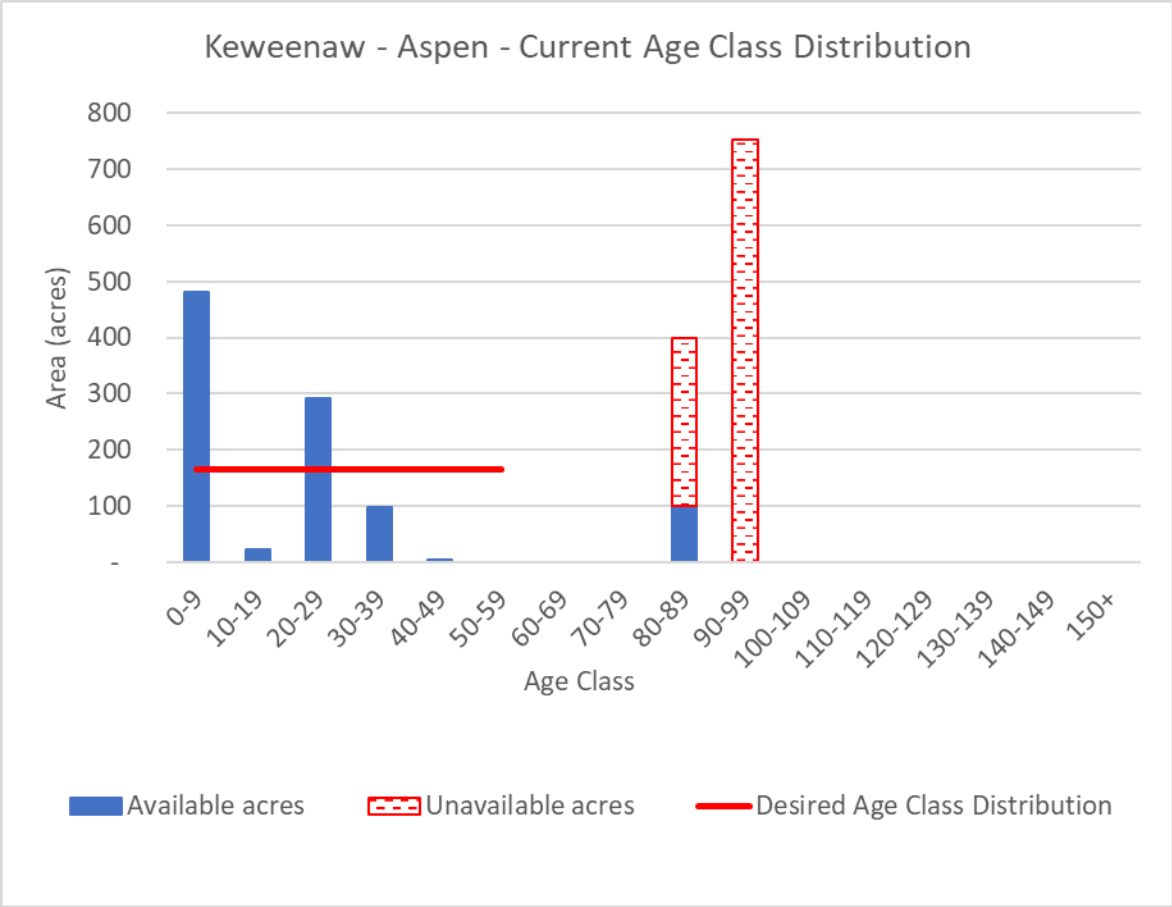


Figure 3. Current age class distribution, the desired age class distribution, and the projected harvests in the aspen cover type over the 10-year planning period.

The current age class distribution is very unbalanced with a deficit of acres in the 10-19 and the 30-59-year-old age classes and a surplus of acres in the 0-9 and the 20-29-year-old age classes. This aspen in this area will be allowed to age naturally and allowed to senesce into more long-lived cover types. A portion of this cover type currently meets the habitat requirements for ruffed grouse and snowshoe hare for the next decade.

Table 8. Featured species with aspen as a priority habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Aspen	Aspen Habitat Acres-Available	Aspen Habitat Acres-Unavailable
Ruffed grouse	Age category: 0-19 Size category: sapling	504	0
Snowshoe hare	Age category: 0-19 Size category: sapling	504	0
White-tailed deer	All ages and size classes	2,051	0

Desired Future Condition

The aspen in this area will be allowed to age naturally and allowed to senesce into more long-lived cover types.

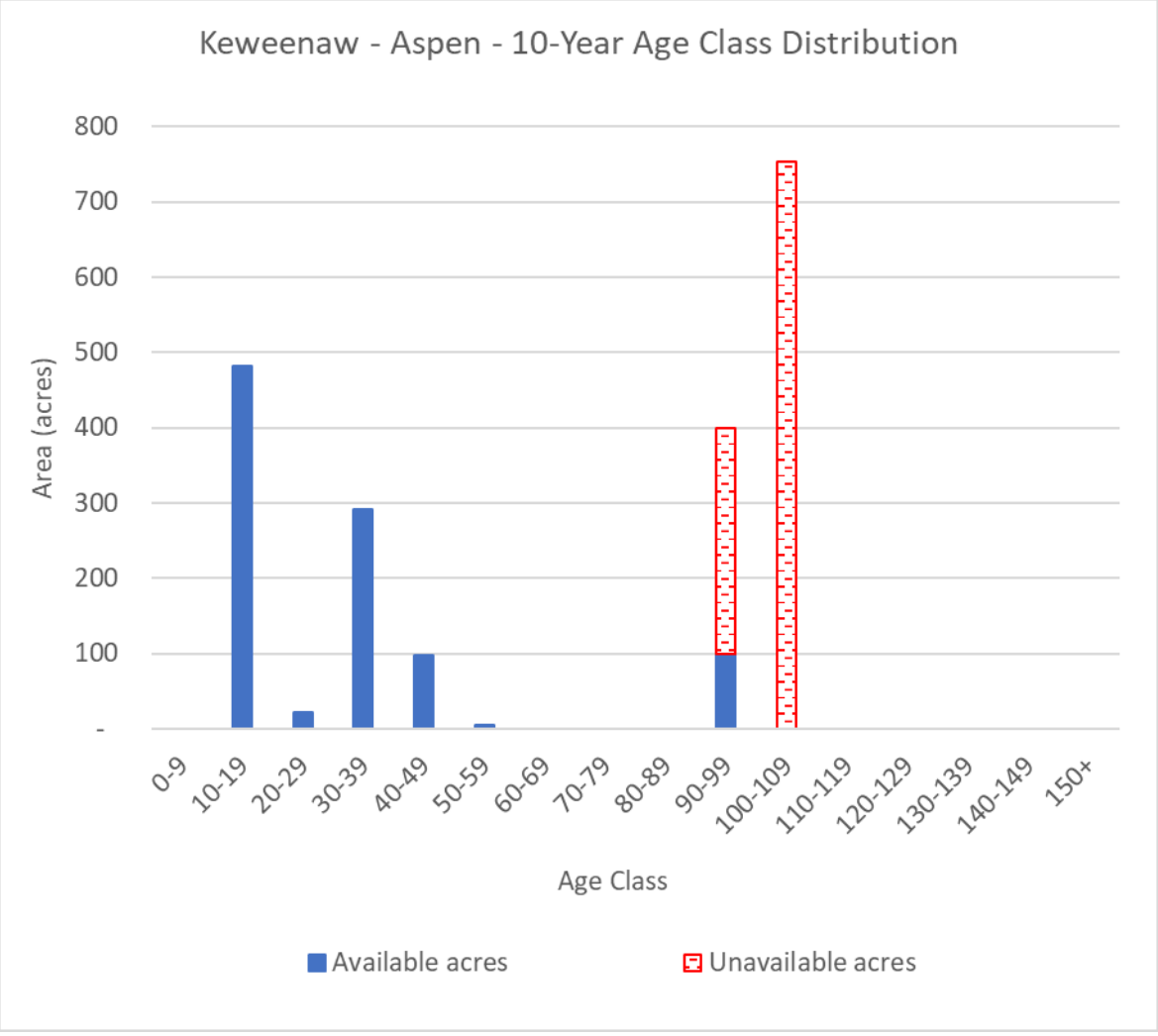


Figure 4. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The end of the planning period will result in no acres of aspen in the upcoming 0-9 age class, eliminating the small amount of available habitat for snowshoe hare and ruffed grouse in this cover type.

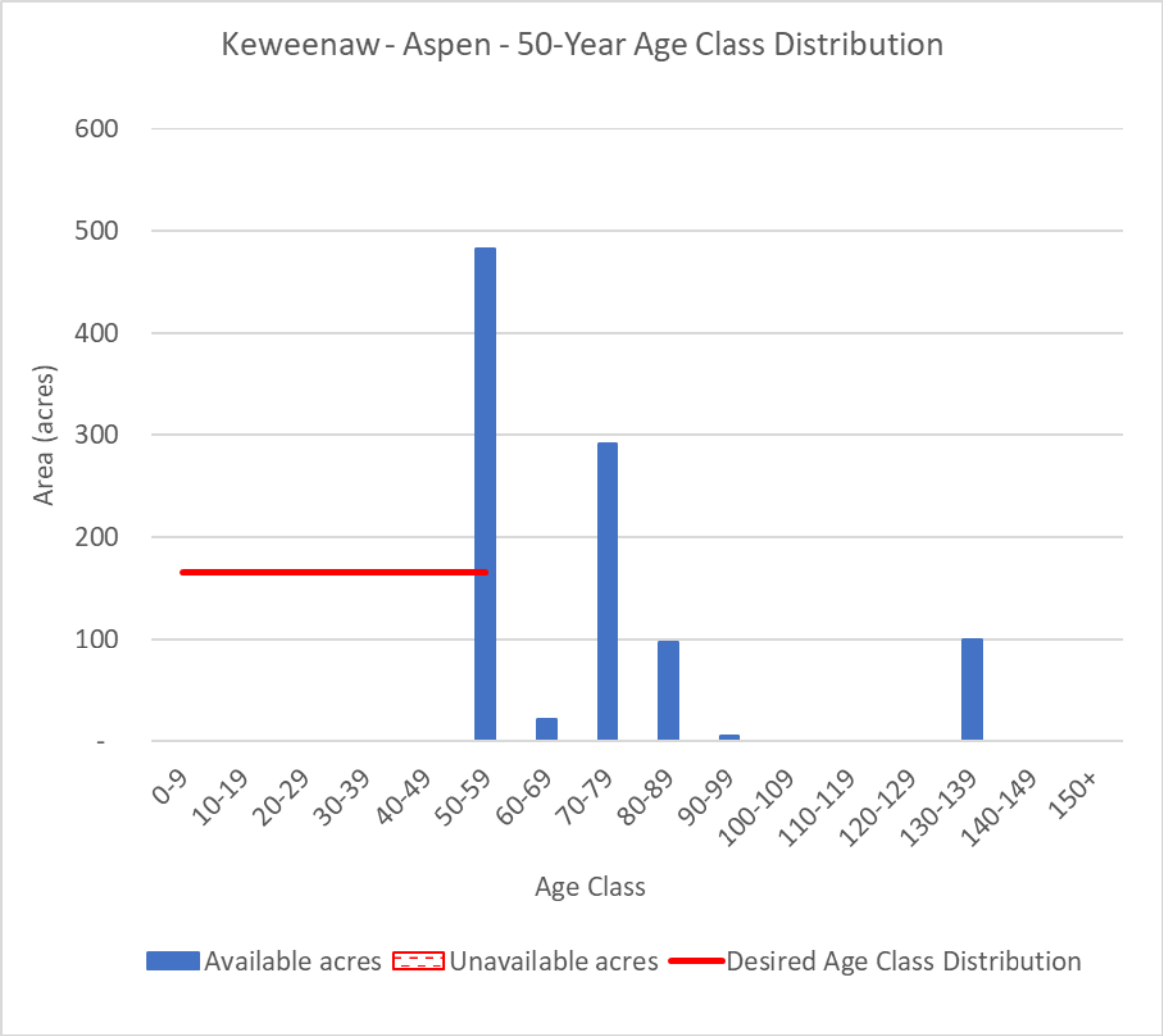


Figure 5. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The mid-term age-class distribution shows the population of aspen acres reaching the end of their natural life span and senescing into other cover types (Figure 5).



Figure 6. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

Management Actions

There are no acres of projected harvests in the aspen cover type. It is expected that no acres of aspen will be converted to other cover types through management action. No acres of aspen will be regenerated over the next 10 years.

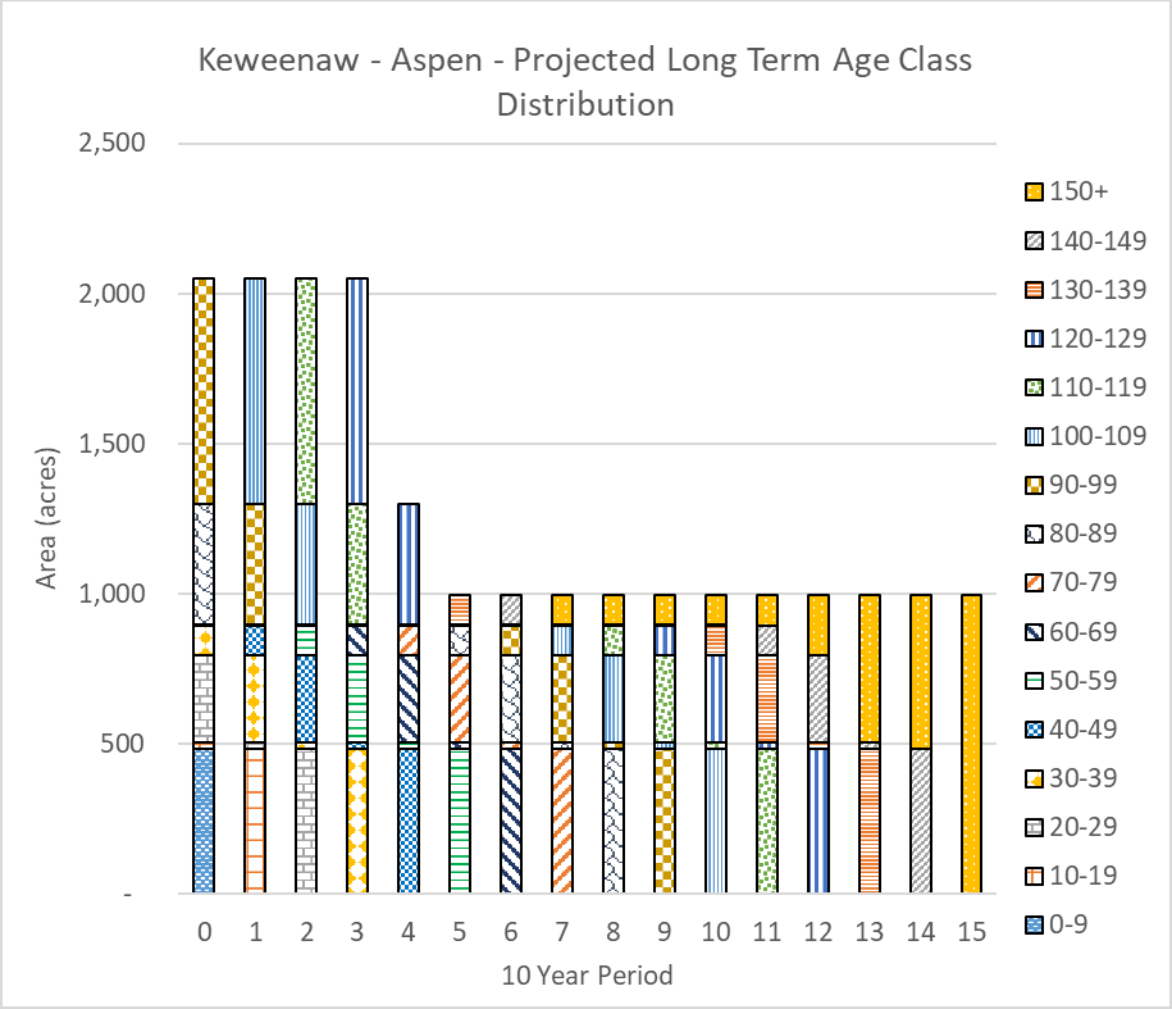


Figure 7. Projected age class distribution over 15, 10-year planning periods.

Mixed upland deciduous

Current condition

The current age class distribution is unbalanced with a deficit of acres in the 40-99 year-old age classes, and a surplus of acres in the 0-19-year-old age classes.

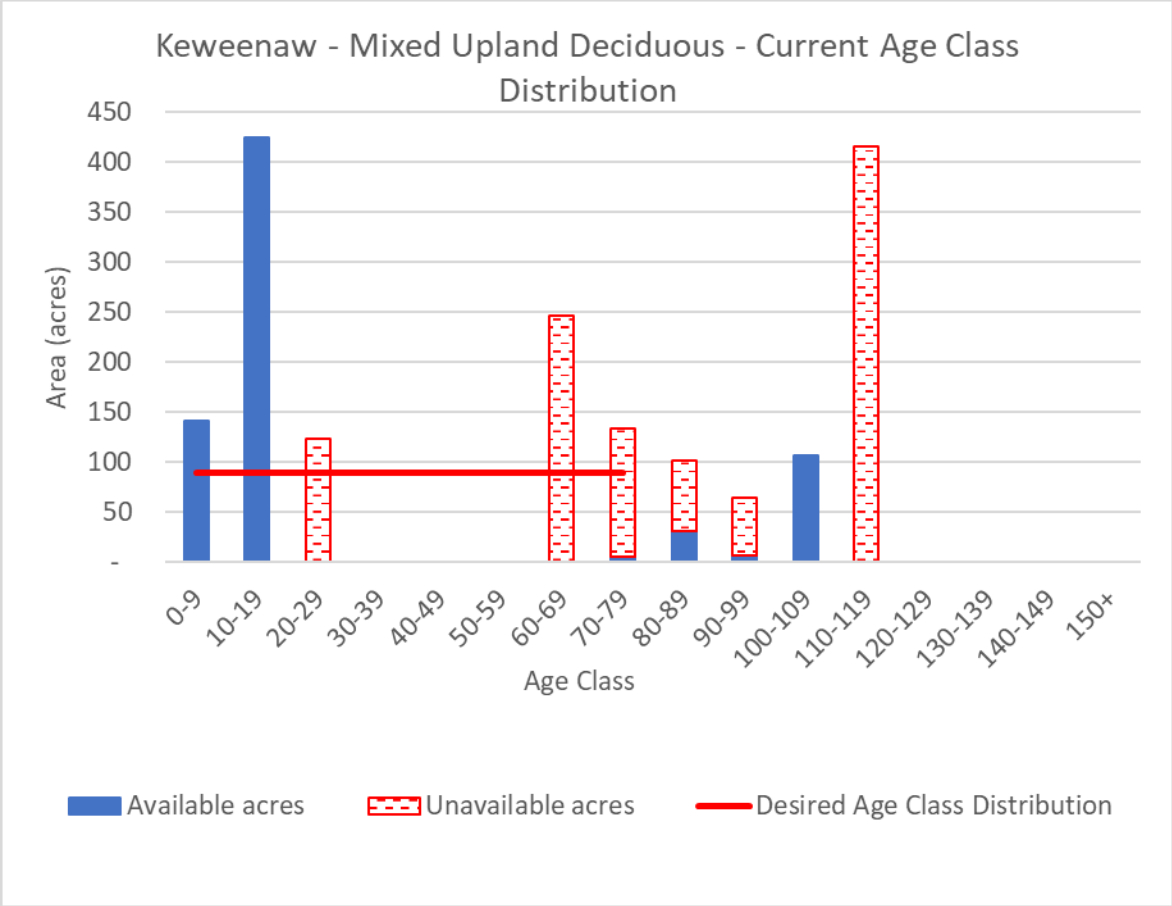


Figure 8. Current age class distribution, the desired age class distribution, and the projected harvests in the mixed upland deciduous cover type over the 10-year planning period.

Table 9. Featured species with mixed upland deciduous as a priority habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Mixed Upland Deciduous	Mixed Upland Deciduous Habitat Acres-Available	Mixed Upland Deciduous Habitat Acres-Unavailable
Marten	Age category: 40+ Size category: pole, sawlog	144	545
Snowshoe hare	Age category: 0-19 Size category: Sapling	566	0

Featured Species	Featured Species Habitat – Mixed Upland Deciduous	Mixed Upland Deciduous Habitat Acres- Available	Mixed Upland Deciduous Habitat Acres- Unavailable
White-tailed deer	All ages and size classes	1,756	--

Desired future condition

Mixed upland deciduous in this area will be allowed to age naturally and senesce into more long-lived cover types.

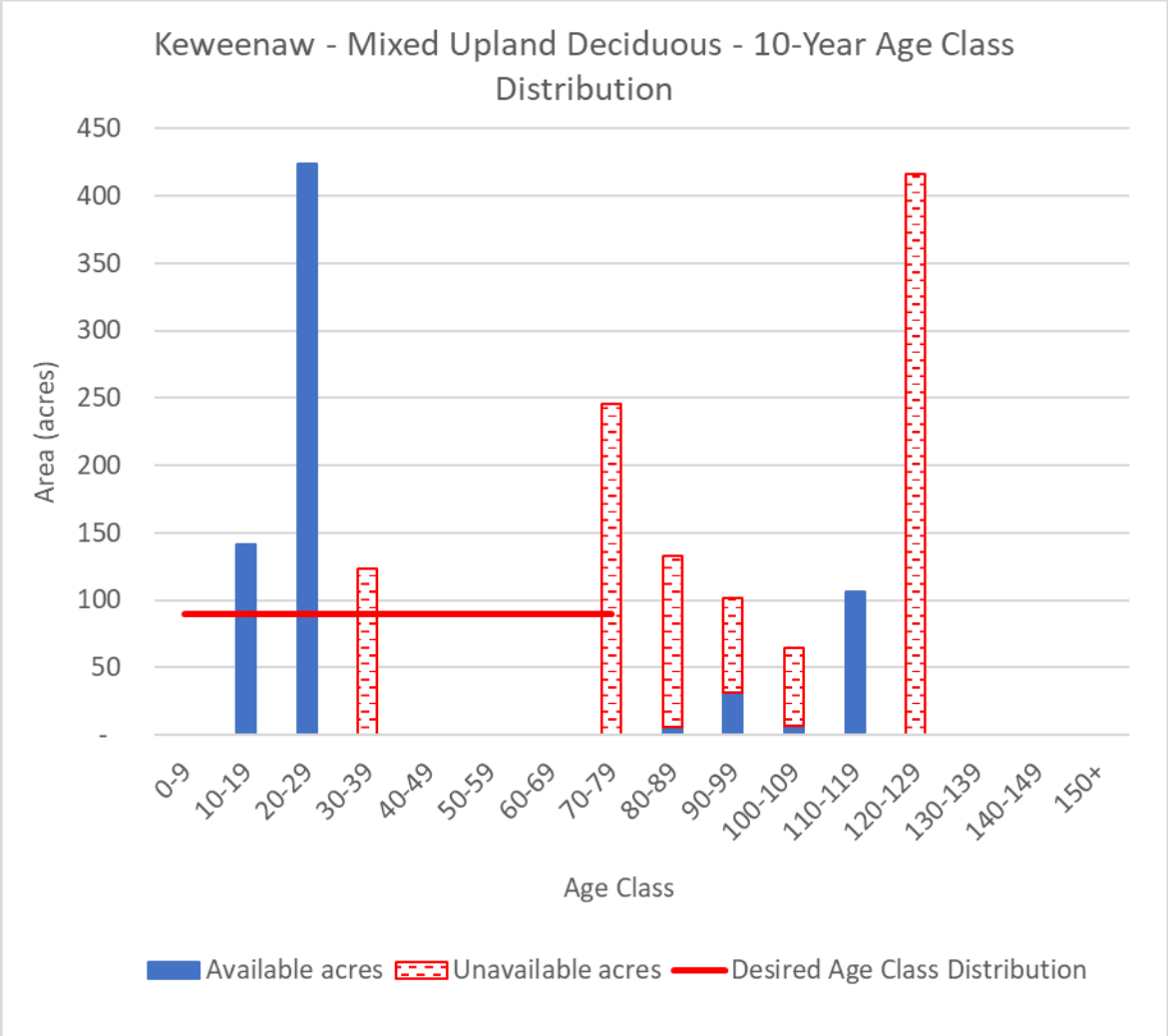


Figure 9. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The end of the planning period will result in having zero acres in the upcoming 0-9 age class.



Figure 10. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of mixed upland deciduous acres reaching the end of their natural life span and senescing into other cover types. Most likely these acres will grade into a more northern hardwood cover type as shorter-lived species fall out of the mix (Figure 10).

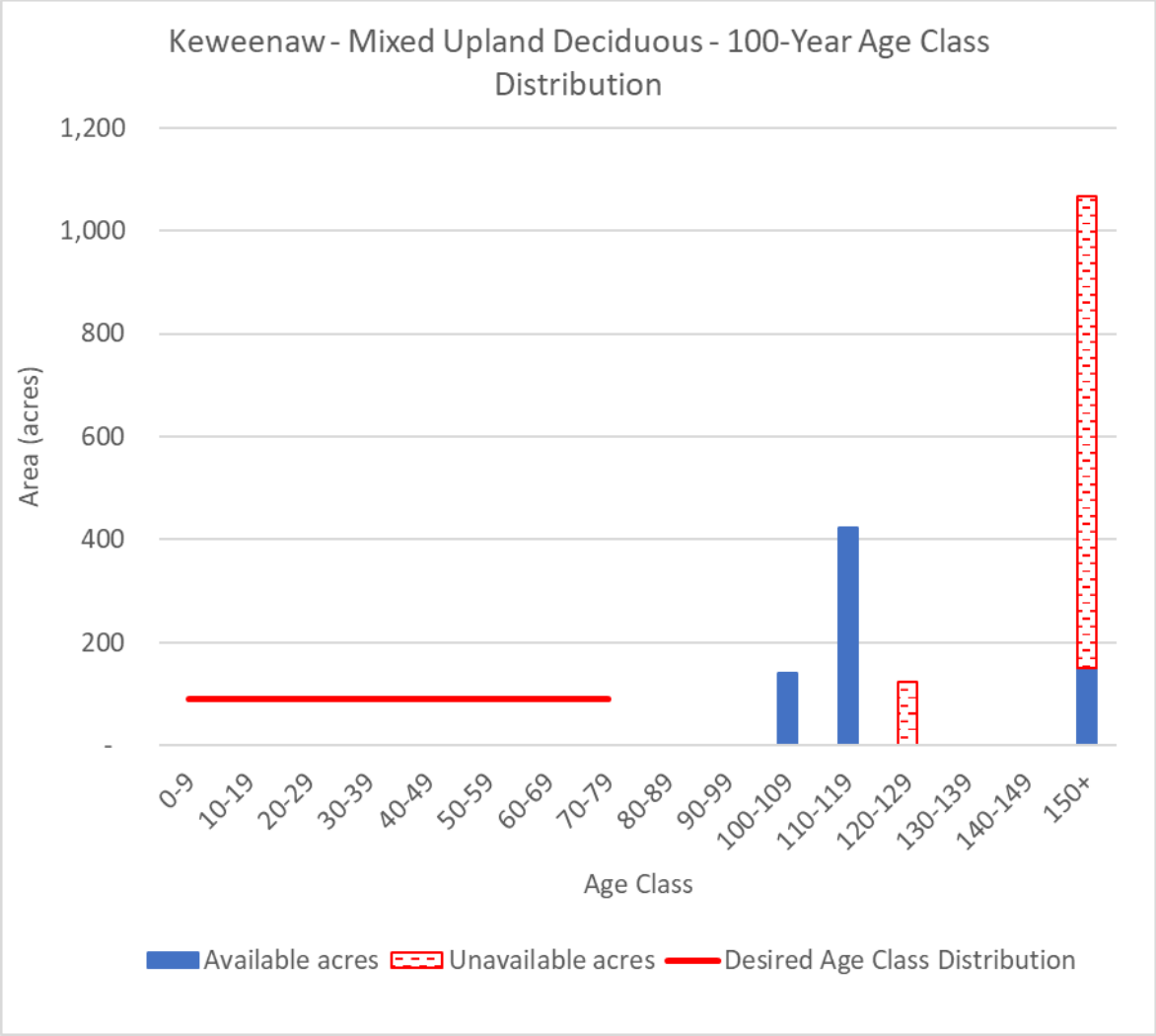


Figure 11. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 11) will concentrate the manageable acres of mixed upland deciduous in productive growing conditions while providing carbon sequestration and a wide variety of wildlife habitat conditions across the landscape in mid aged and mature forests.

Management actions

There are no acres of projected harvest in the mixed upland deciduous cover type. No acres of regeneration are expected over the next 10 years.

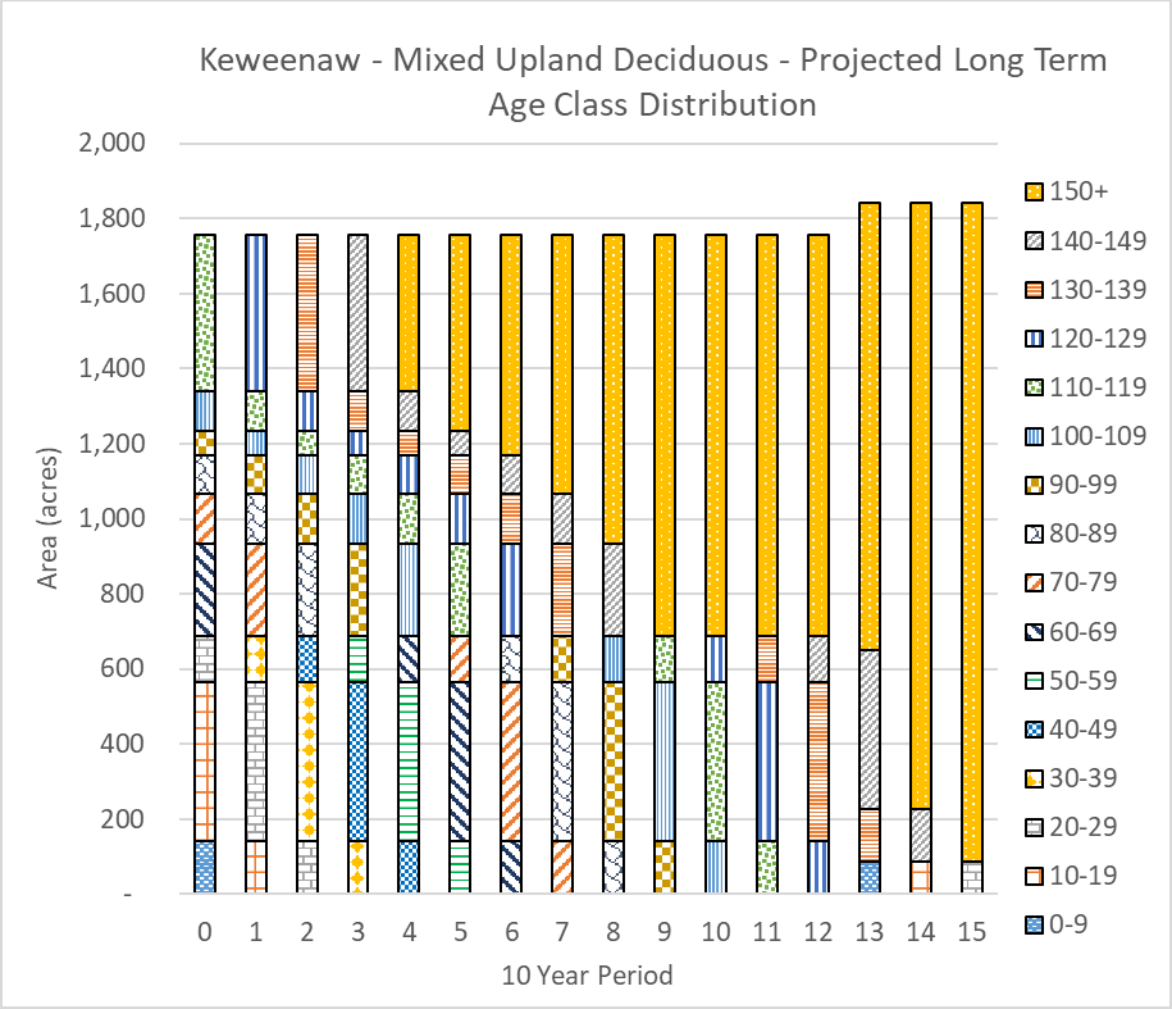


Figure 12. Projected age class distribution over 15, 10-year planning periods.

Northern hardwoods

Current condition

Most of the northern hardwood cover type in the management area is between the ages of 100 and 109 years old (Figure 4). The past management regime has been primarily single-tree selection, which allows for stand age to continue to increase over time. Some stands are beginning to achieve an uneven-aged condition where a featured stand age becomes less evident, but the dominant age of these stands will likely increase past 150 years old before a younger age cohort becomes the prominent component of these stands (Figure 15). A portion of the stand has been managed under an even-aged system due to poor quality stands or a predominance of red maple in those stands.

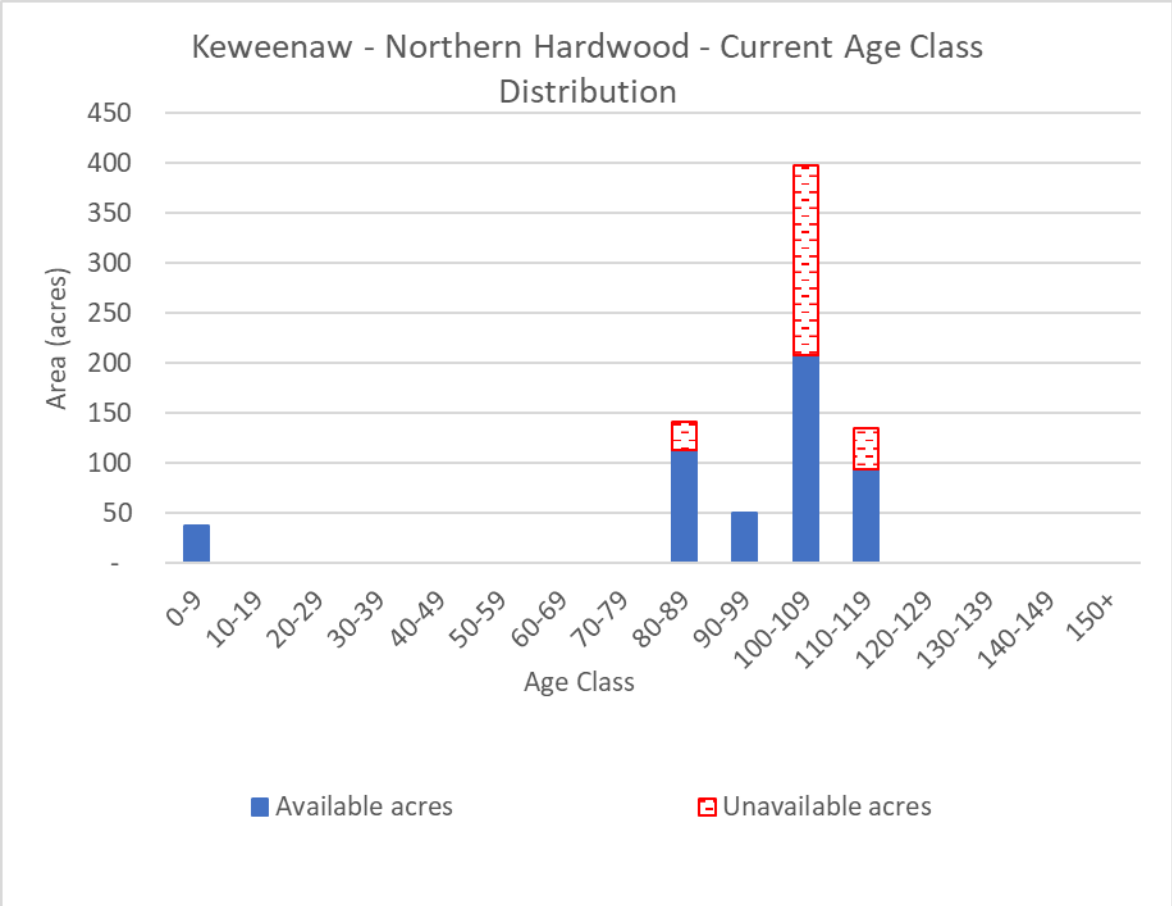


Figure 13. Current age class distribution and projected harvests in the northern hardwood cover type in the Keweenaw management area.

The area of northern hardwood is not well distributed in the ideal basal area classes for optimal growing conditions (Figure 13). Current conditions are a result of heavy cutting by industrial owners before the state acquired the land in 2006. Little active management is expected for many decades.

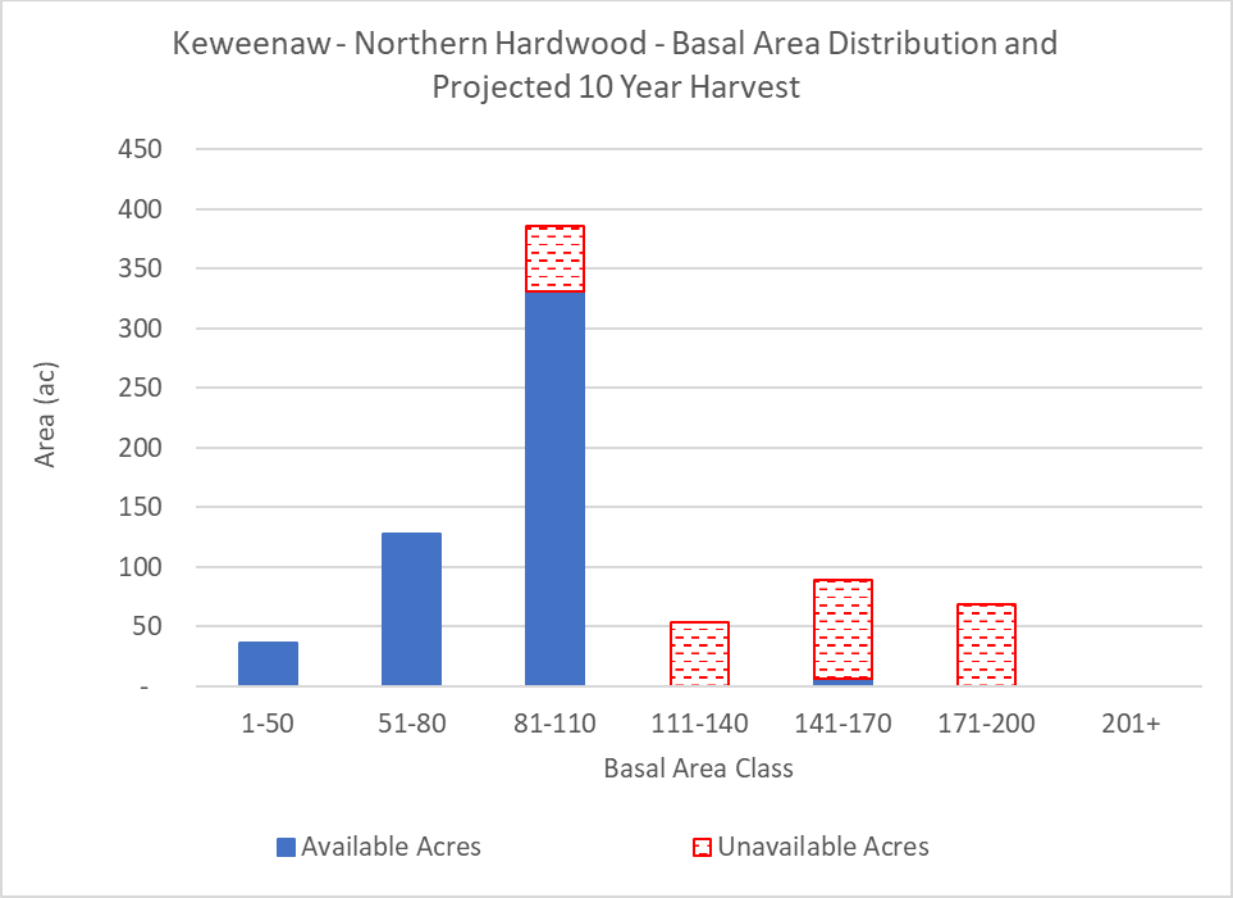


Figure 14. Current basal area distribution of the northern hardwood cover type as well as the projected harvests from each basal area class.

Table 10. Featured species with northern hardwoods as a priority habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Northern Hardwood	Northern Hardwood Habitat Acres- Available	Northern Hardwood Habitat Acres- Unavailable
Blackburnian warbler	Age category: 80+ Size category: pole, sawlog Basal area: 81+	337	259
Marten	Age category: 40+ Size category: pole, sawlog Basal area: 81+	337	259
White-tailed deer	All ages and size classes	760	--

Desired future condition

The projected long-term cover type trend for northern hardwood is stable to increasing in the Keweenaw management area as other cover types age and grade into northern hardwood.

An uneven-aged condition is the long-term goal for all northern hardwood stands in this management area. An uneven-aged condition is achieved when there is no single discernable age cohort that is more prevalent than others across the stand area as canopy gaps fill in with regenerating seedlings, saplings, poles, and eventually remaining stems become sawlog-sized over time.

Regeneration and recruitment continue to be a focus in the northern hardwood cover type across this management area. The long-term sustainability of this cover type in an uneven-aged silvicultural regime is dependent on the successful establishment of northern hardwood species as well as the recruitment of those seedlings and saplings into the pole and saw log classes.

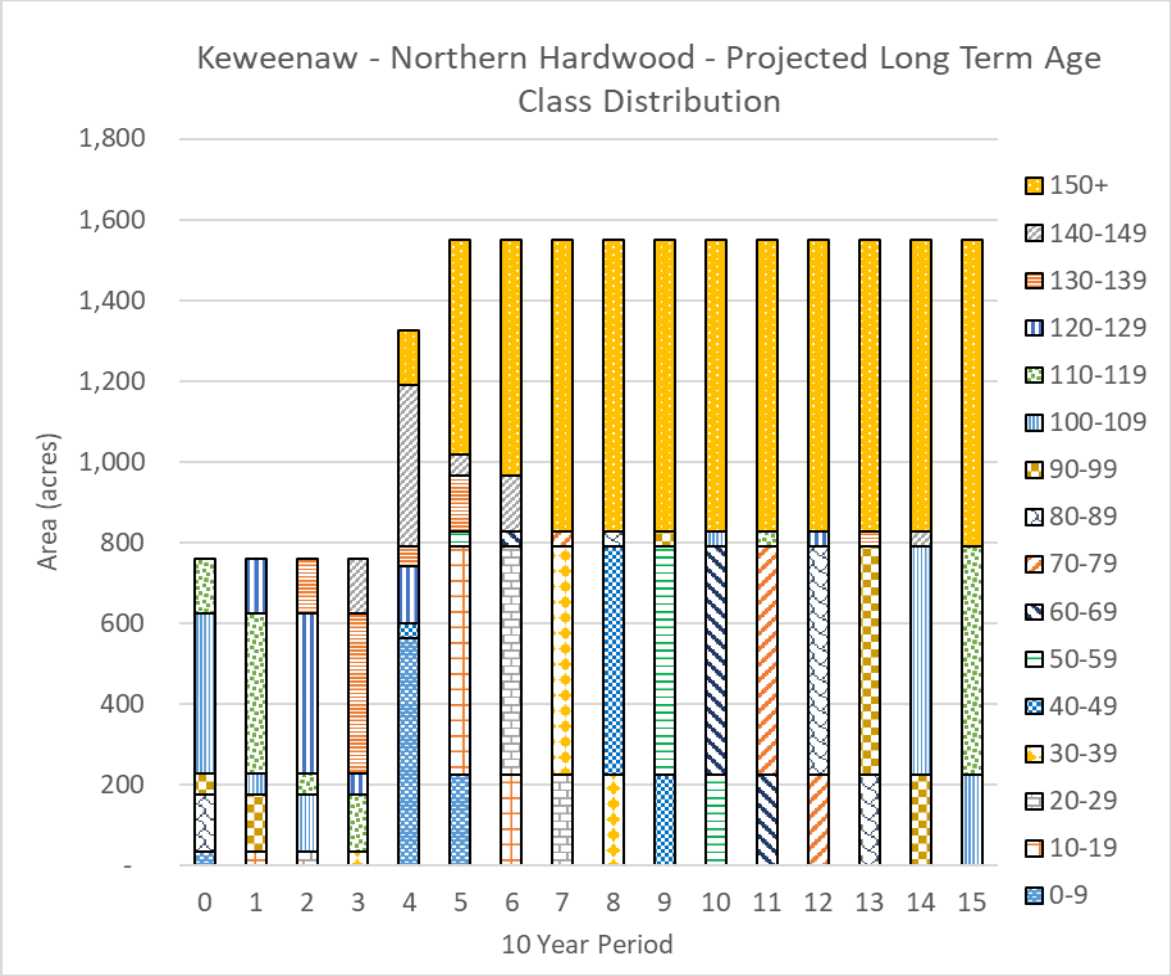


Figure 15. Graph showing the projected age class distribution over 15, 10-year planning periods.

Management actions

The desired forest conditions and associated featured species habitat will be allowed to mature through natural processes.

Conservation area network

High conservation value areas

There are up to nine different HCVA types that can be found in each management area (Table 11; see Biodiversity in Section 3 for more information)

Table 11. High conservation value areas within the Keweenaw management area.

High Conservation Value Area Type and Name	Acres
Deer Wintering Complex	**5,160**
Forest Habitat Core Interior	**755**
Northern Long Eared Bat Hibernacula 2.5mi Buffer	**4,362**
Lac LaBelle Mine	4,362
State Wildlife Management Areas	**167**
Sturgeon River Sloughs SWMA	167
Verified Type 1 and Type 2 Old Growth	**2,591**
Type 1 Old Growth	6
Type 2 Old Growth	2,585
Grand Total	**13,035**

Ecological reference areas

Ecological Reference Areas (ERAs) are a type of HCVA and are higher quality examples of functioning ecosystems that are primarily influenced by natural ecological processes.

Table 20. Ecological reference area natural community ranking based on NatureServe .

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 21. Ecological reference areas within the management area.

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	Number of Occurrences
Existing ERA	Bog	B	G3G5	S4	1
Existing ERA	Boreal forest	AB	GU	S3	4
Existing ERA	Dry-mesic northern forest	B	G4	S3	1
Existing ERA	Emergent marsh	AB	GU	S4	2
Existing ERA	Great Lakes marsh	B			1
Existing ERA	Northern fen	AB	G3	S3	1
Existing ERA	Patterned Fen	AB	GU	S2	2
Existing ERA	Rich Conifer swamp	AB	G4	S3	1
Existing ERA	Rich Conifer swamp	B	G4	S3	1
Existing ERA	Sand and gravel beach	AB	G3?	S3	2
Existing ERA	Sandstone lakeshore cliff	AB			1
Existing ERA	Submergent marsh	AB	GU	S4	1
Existing ERA	Volcanic bedrock glade	A	GU	S2	2
Existing ERA	Volcanic bedrock glade	AB	GU	S2	1
Existing ERA	Volcanic bedrock Lakeshore	A	G4G5	S2	10
Existing ERA	Volcanic cliff	B	G4G5	S2	1
Existing ERA	Volcanic cobble shore	A	G4G5	S3	5
Existing ERA	Wooded dune and swale complex	B	G3	S3	1
Existing ERA	Wooded dune and swale Complex	BC	G3	S3	1
Proposed ERA	Boreal forest	AB	GU	S3	1
Proposed ERA	Volcanic bedrock glade	AB	GU	S2	
Proposed ERA	Volcanic bedrock glade	BC	GU	S2	1
Proposed ERA	Volcanic lakeshore cliff	AB	GU	S1	
Grand Total					**41**

Special conservation areas

Reviewable special conservation areas (SCAs; Table 14) refers to those SCA types that may be reviewed or updated through the compartment review process as needed. Static SCAs (Table 15) refers to those SCA types that generally do not change or require updating (see Biodiversity in Section 3 for more information).

Table 14. Reviewable special conservation areas within the Keweenaw management area.

Reviewable Special Conservation Area Type and Name	Acres
Concentrated Recreational Area	**179**
Traverse River	48
Unspecified River	132
Habitat Area or Habitat Corridor	**39**

Reviewable Special Conservation Area Type and Name	Acres
Lake Shore Raptor Nesting Area	
Possible Type 1 or Type 2 Old Growth	**4,534**
--	4,534
Grand Total	**4,752**

Table 15. Static special conservation areas within the Keweenaw management area.

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Common Natural Heritage Element Occurrences		**194**
Poor Conifer Swamp		188
Volcanic Cobble Shore		7
Designated Trout and Cold Water Stream Buffer		**272**
<Null>		77
Boston Creek		6
Camp Creek		5
Copper Creek		11
Finns Creek		6
Hoar Creek		19
Le Chance Creek		6
Montreal River		89
Silver Creek		9
Tobacco River		6
Union Creek		38
Designated Trout and Coldwater Streams	**9.9**	
	2.9	
Boston Creek	0.2	
Camp Creek	0.2	
Copper Creek	0.4	
Finns Creek	0.2	
Hoar Creek	0.7	
Le Chance Creek	0.2	
Montreal River	3.3	
Silver Creek	0.3	
Tobacco River	0.2	
Union Creek	1.3	
Great Lakes Islands		**314**
Manitou Island		314
Wood Turtle Stream 660ft Buffer		**18**
Portage River		18
Grand Total	**9.9**	**798**

Rare Species

Rare species occurrences are compiled from the Michigan Natural Features Inventory Biotics database (Tables 17 and 18) and do not necessarily include all rare species found in this management area due to biases in survey effort and verifiable observation reporting over time.

Table 22. Rare animal and plant species conservation status key.

Status	Status
E = endangered	LE = listed endangered
T = threatened	LT = listed threatened
SC = special concern	PDL = proposed for delisting

Table 17. Rare species occurrence within the Keweenaw management area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Bombus terricola	Yellow banded bumble bee	SC	--	1
Animal	Canis lupus	Gray wolf	SC	LE	--
Animal	Elliptio complanata	Eastern elliptio	SC	--	1
Animal	Gavia immer	Common loon	T	--	2
Animal	Haliaeetus leucocephalus	Bald eagle	SC	--	6
Total	--	--	--	--	**10**

Table 18. Rare plant species occurrence within the Keweenaw management area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Plant	Arnica cordifolia	Heart-leaved arnica	E	--	1
Plant	Bistorta vivipara	Alpine bistort	T	--	1
Plant	Calypso bulbosa	Calypso or fairy-slipper	T	--	1
Plant	Carex atratiformis	Sedge	T	--	1
Plant	Carex rossii	Ross's sedge	T	--	1
Plant	Castilleja septentrionalis	Pale Indian paintbrush	T	--	3

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Plant	Collinsia parviflora	Small blue-eyed Mary	SC	--	1
Plant	Crataegus douglasii	Douglas's hawthorn	SC	--	1
Plant	Drosera anglica	English sundew	SC	--	1
Plant	Dryopteris filix-mas	Male fern	SC	--	1
Plant	Elymus glaucus	Blue wild-rye	SC	--	1
Plant	Empetrum nigrum	Black crowberry	T	--	1
Plant	Gentiana linearis	Narrow-leaved gentian	T	--	1
Plant	Littorella uniflora	American shore-grass	SC	--	3
Plant	Mertensia paniculata	Northern Bluebell	SC	--	1
Plant	Moehringia macrophylla	Big-leaf sandwort	T	--	1
Plant	Myriophyllum alterniflorum	Alternate-leaved water-milfoil	SC	--	1
Plant	Neottia auriculata	Auricled twayblade	SC	--	1
Plant	Packera indecora	Northern ragwort	T	--	1
Plant	Phleum alpinum	Mountain timothy	X	--	1
Plant	Poa alpina	Alpine bluegrass	T	--	2
Plant	Sagina nodosa	Pearlwort	T	--	1
Plant	Trisetum spicatum	Downy oat-grass	SC	--	3
Plant	Vaccinium cespitosum	Dwarf bilberry	T	--	1
Plant	Viola epipsila	Northern marsh violet	X	--	1
Total	--	--	--	--	**32**

Non-ERA natural communities

Natural communities that are identified with an element occurrence in the MNFI Biotics database, but that have not been given an additional ecological reference area (ERA) designation, are recognized and managed accordingly (Table 20).

Table 19. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 20. Non-ERA Natural Communities within the Keweenaw management area.

Community Type	Element Occurrence Rank	State Rank	Global Rank	Number of Occurrences
Poor conifer swamp	AB	S4	G4	1
Poor conifer swamp	B	S4	G4	1
Volcanic cobble shore	A	S3		1
Grand Total				**3**

Forest health

Forest health concerns, both native and non-native, can have impacts on stand conditions and management decisions. The following insects (Table 21) and diseases (Table 22) could have an impact on management during the planning period and may need to be monitored and/or addressed.

Table 21. Defoliating insects of concern in the Keweenaw management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Spongy moth	Spongy moth	Lymantria dispar	Yes
Forest tent caterpillar	Forest tent caterpillar	Malacosoma disstria	Yes
Large aspen tortrix	Large aspen tortrix	Choristoneura conflictana	Yes
Spruce budworm	Spruce budworm	Choristoneura fumiferana	Yes

Watch for lingering ash with potential resistance to emerald ash borer.

Table 22. Maladies of concern in the Keweenaw management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Canker	Various	Various	Yes
Armillaria root rot	*Armillaria spp.*	Native	Yes

Aquatic Resources

Riparian Habitat

A total of 13 miles of streams and rivers are found in the management area (Table 23). Streams/rivers classified as cold types comprise approximately 69 percent of the riverine mileage.

Table 23. Classification type and length of streams/rivers found within the management area.

Type	Length (miles)
Cold stream	9
Cold small river	0
Cold transitional stream	0
Cold transitional small river	0
Cold transitional large river	0
Warm transitional stream	4
Warm transitional small river	0
Warm transitional large river	0
Warm stream	0
Warm small river	<1
Warm large river	0

Lacustrine habitat

A total of two lakes and ponds of at least one surface acre are found in the management area (Table 24).

Table 24. Size and number of lakes and ponds located within the management area.

Lake Size Class (acres)	Number
1-99	2
100-499	0
500+	0

Wetlands

A total of 3,567 acres of wetlands is found in the management area (Table 25). Forested wetlands comprise approximately 94 percent of wetland types found in the management area.

Table 25. Area of emergent, forested, and riverine wetland types found within the management area.

Wetland Type	Acres
Emergent	204
Forested	3,345
Riverine	18

Vernal pools and seeps

No vernal pools and seeps have been inventoried in the management area.

Riparian vegetation cover

Upland conifers, cedar, and lowland conifers are the predominant cover types present in a 100-meter riparian zone located next to streams/rivers in the management area (Table 26).

Table 26. Largest vegetative cover types (i.e., top 10) and area located in a 100-meter buffer of streams/rivers within the management area.

Cover Type	Acres
Upland conifers	416
Cedar	317
Lowland conifers	233
Lowland shrub	221
Mixed upland deciduous	140
Northern hardwood	82
Upland spruce/fir	73
Lowland deciduous	65
Lowland mixed forest	63
Lowland spruce/Ffr	62

Watershed vegetation cover

The management area includes portions of important watersheds of the Otter and Sturgeon rivers (Tables 27and 28). Major cover types in the Otter River watershed include mixed upland deciduous and upland conifers; major cover types in the Sturgeon River watershed include aspen and cedar.

Table 27. Largest vegetative cover types (i.e., top five) and area of the Otter River watershed located within the management area.

Cover Type	Acres
Mixed upland deciduous	383
Upland conifers	319
Lowland deciduous	124
Cedar	64
Lowland conifer	40

Table 28. Largest vegetative cover types (i.e., top 5) and area of the Sturgeon River watershed located within the management area.

Cover Type	Acres
Aspen	117
Cedar	107
Lowland shrub	59
Lowland conifer	55
Mixed upland deciduous	44

Recreation

Despite its remote location, the tip of the Keweenaw Peninsula has a fair amount of public recreation and management access via state forest roads. The Keweenaw Peninsula is a popular snowmobiling destination, with a snowmobile trail providing access through the management area to the tip of the peninsula. The remainder of the area consists of isolated parcels with limited public access. There are no designated non-motorized trails or state forest campgrounds within the management area. However, the Copper Harbor Trails Club supports a renowned network of mountain bike trails in the area and Fort Wilkins State Park at Copper Harbor provides modern camping facilities. A network of rail trails and snowmobile routes are primarily on private land.

Table 29. Designated recreation trails by type:

Recreation Category	Recreation Type	Number of Miles
Motorized recreation trails	ORV (all types)	1.9
Motorized recreation trails	Snowmobile	6.1
Non-motorized recreation trails	Hiking	0
Non-motorized recreation trails	Equestrian	0
Non-motorized recreation trails	Biking	0
Non-motorized recreation trails	Hunter Walking Trails	0
Total	--	**8**

Note: Trail use types may overlap.

Table 30. Areas managed for hunting.

Type	Name	Number of Acres
State Wildlife Management Areas	Sturgeon River Sloughs SWMA	165

Table 31. Boating access sites (BAS).

Name	Waterbody
Boston Pond	Boston Pond
Rice Lake	Rice Lake
Thayer Lake	Thayer Lake

Keweenaw Bay

State Forest Area: 27,563 acres	Location: Keweenaw Bay Shore	Population Centers: Baraga, L'Anse
Sub-Section: Keweenaw Coarse Till and Lake Plain	Landforms: large broad ridges 150 to 500 feet high	Landcover: Forested: 25,286 acres Non-forested: 2,277 acres

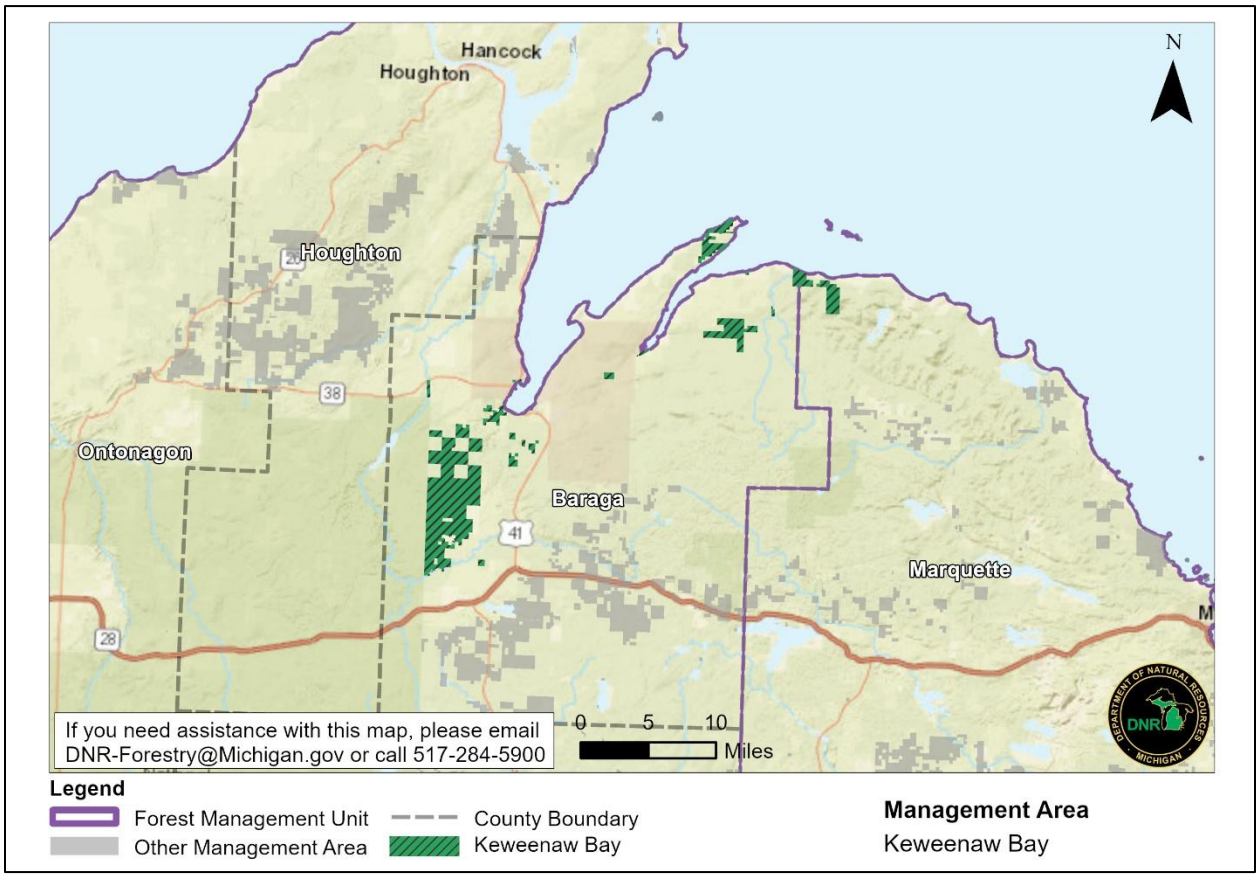


Figure 1. Map of the Keweenaw Bay management area.

Forested landscape

Current condition

The Keweenaw Bay management area is dominated by shade-intolerant cover types. Tolerant upland cover types are relatively evenly distributed across the age categories, while the unavailable upland and lowland acres are more prevalent in the older age category.

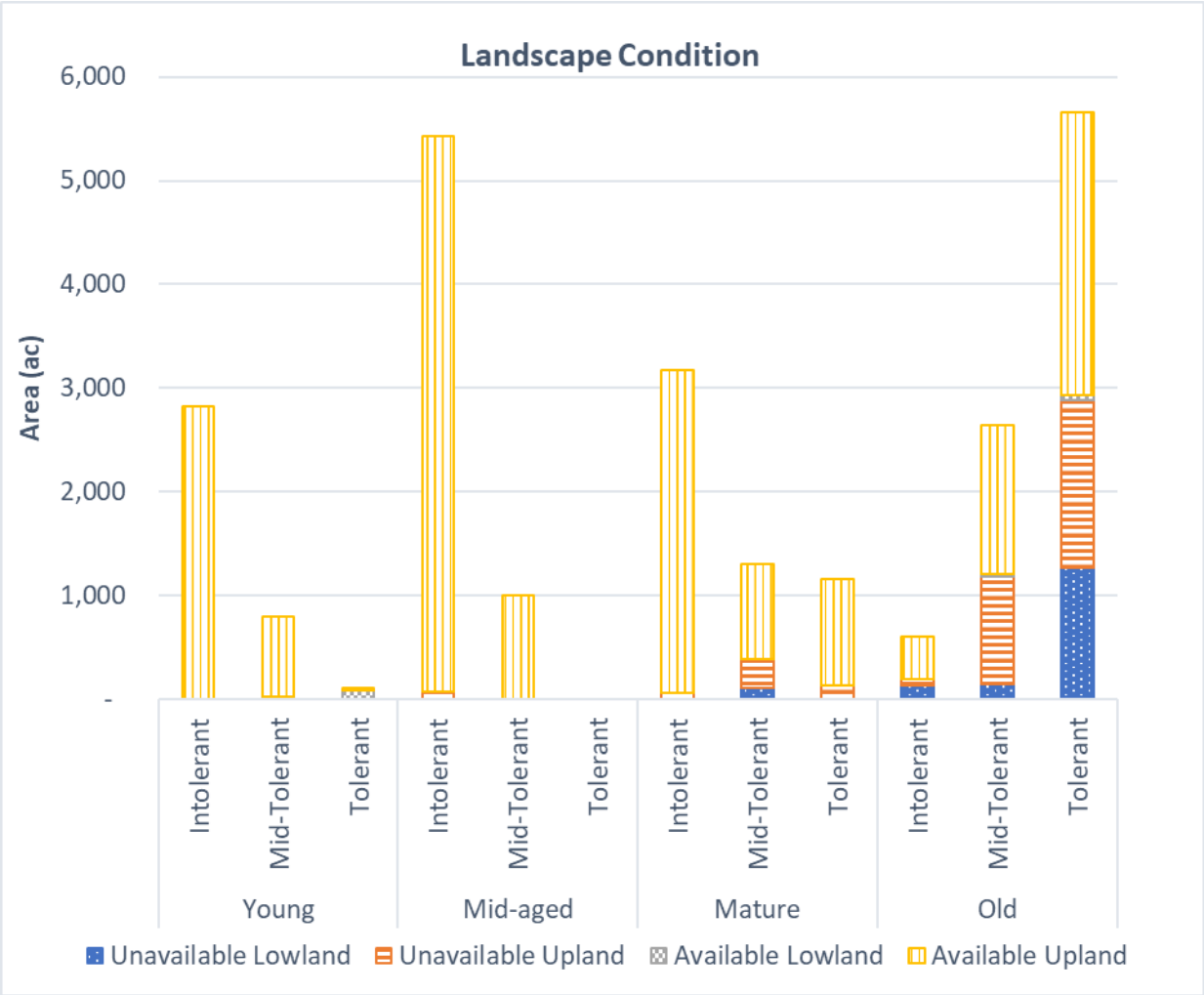


Figure 2. Forest diversity matrix showing the current distribution of forested acres across management availability, age category, landscape position and shade tolerance.

Landscape habitat conditions refine the management area landscape in the context of featured species habitat. Current and projected acres for the metrics identified in the Management Priorities (Section 3 Statewide/Regional) establish a baseline and future condition based on management over the planning period (Table 1).

Table 1. Current and projected acres for landscape habitat conditions.

Landscape Habitat Condition	Monitoring Metric	Current Acres
Young forest	Acres of 0-19 stands in Aspen and Jack Pine	2,779
Mature forest	Acres of 80+ year stands across cover types	8,912
Mature forest	Acres of 120+ year stands across cover types	6,184
Mesic conifer cover types	Acres of mesic conifer cover types	3,425
Mesic conifers in other cover types	Average canopy occupancy	26%
Mast – oak cover types	Acres of Oak cover types	244
Mast tree species in other cover types	Acres of total canopy occupancy of mast tree acres (Trace-100%)	11,633
Big trees	Acres of total canopy stand occupancy of species in sawlog or greater size class	15,138
Non-forested openings	Acres of total herbaceous open land, upland shrub and cropland	1,215
Landscape forest matrix	Percent deciduous forest	47%
Landscape forest matrix	Percent coniferous forest	48%

Another important landscape level habitat in the Management Area is coastal habitat. The Great Lakes, particularly coastal and nearshore areas, provide globally or continentally important stopover sites for all groups of migratory birds: waterfowl, shorebirds, landbirds (defined here as songbirds and raptors), and waterbirds (loons, grebes, cormorants, herons, rails, cranes, gulls, and terns) (Ewert, et. Al 2012). The Great Lakes shoreline provides essential stopover habitat for birds to rest, feed, and shelter during migration. In addition to migration, the diverse coastal habitats where water and land meet provides unique habitats for breeding birds. Some of these areas are classified by Michigan Audubon as Important Bird Areas (IBAs). The Great Lakes shoreline is habitat for several rare plant species that are endemic to the Great Lakes.

Forest management and other intrusive activities within a mile of the coastline need to consider the potential impacts to migratory birds and breeding bird habitat.

The Keweenaw Bay management area is dominated by forested cover types with 85 percent of the area covered in forested stands (Table 2). The upland deciduous portion of that is 42 percent of the management area and comprised mostly of aspen. The upland coniferous portion is 38 percent of the management area and comprised mostly of natural jack pine. Herbaceous openland and cropland are the most common non-forested cover types in this management area, representing 4 percent of the landscape.

Table 2. Summary table describing the landscape conditions and distribution of cover types in the Keweenaw Bay management area.

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
Forested	Upland	Deciduous	Aspen	5,042	11,705	23,410	25,286
			Northern hardwood	3,518			
			Black Red rybrid oak	0			
			Northern red oak	211			
			Oak mix	33			
			Mixed upland deciduous	2,901			
		Mixed	Upland mixed forest	1,206	1,206		
		Coniferous	Planted red pine	28	10,499		
			Planted jack pine	2,782			
			Planted white pine	0			
			Planted mixed pine	0			
			Natural red pine	142			
			Natural jack pine	4,123			
			Natural white pine	120			
			Natural mixed pines	536			
			Upland spruce/fir	10			
			Upland conifers	875			
			Hemlock	1,884			
	Lowland	Deciduous	Lowland aspen/balsam poplar	0	138	1,876	
			Lowland deciduous	138			
		Mixed	Lowland mixed forest	171	171		
		Coniferous	Cedar	282	1,567		
			Lowland conifers	1,140			
			Lowland spruce/fir	33			
			Tamarack	112			
Nonforested	Upland	N/A	Herbaceous openland	591	N/A	1,449	2,277
			Upland shrub	3			
			Low density trees	123			
			Bare/sparsely vegetated	71			
			Cropland	621			
			Urban	41			
	Lowland	N/A	Lowland shrub	129	N/A	827	
			Marsh	468			
			Bog	19			
			Treed bog	75			
			Water	136			
						Grand Total:	**27,563**

There are 20,356 acres (73.9 percent of the total management area and 80.5 percent of the forested area) that can be managed toward desired future conditions via commercial timber harvest in the Keweenaw Bay management area (Table 3). Of that, over 19 percent is in the aspen cover type, 16 percent is in natural jack pine, 11 percent in northern hardwood, 11 percent in planted jack pine, and 10% in mixed upland deciduous. The remaining 16 cover types represent about 13 percent of the forested and available land in the management area.

Table 3. Summary table describing the landscape conditions and cover type composition of the Keweenaw Bay management area.

Keweenaw Forested Cover Type	Available Acres	Available %	Unavailable Acres	Unavailable %	Total Acres	Total %
Aspen	4,900	19.4%	142	0.6%	5,042	19.9%
Cedar	32	0.1%	250	1.0%	282	1.1%
Hemlock	880	3.5%	1,004	4.0%	1,884	7.4%
Lowland conifers	114	0.4%	1,027	4.1%	1,140	4.5%
Lowland deciduous	25	0.1%	113	0.4%	138	0.5%
Lowland mixed forest	28	0.1%	143	0.6%	171	0.7%
Lowland spruce/fir	4	0.0%	29	0.1%	33	0.1%
Mixed upland deciduous	2,455	9.7%	446	1.8%	2,901	11.5%
Natural jack pine	4,100	16.2%	23	0.1%	4,123	16.3%
Natural mixed pines	450	1.8%	86	0.3%	536	2.1%
Natural Red Pine	119	0.5%	23	0.1%	142	0.6%
Natural white pine	107	0.4%	14	0.1%	120	0.5%
Northern hardwood	2,792	11.0%	727	2.9%	3,518	13.9%
Northern red oak	181	0.7%	29	0.1%	211	0.8%
Oak Mix	33	0.1%	0	0.0%	33	0.1%
Planted jack pine	2,782	11.0%	0	0.0%	2,782	11.0%
Planted red pine	28	0.1%	0	0.0%	28	0.1%
Tamarack	0	0.0%	113	0.4%	113	0.4%
Upland conifers	474	1.9%	401	1.6%	875	3.5%
Upland mixed forest	847	3.3%	359	1.4%	1,206	4.8%
Upland spruce/fir	6	0.0%	4	0.0%	10	0.0%
Grand Total	**20,356**	**80.5%**	**4,931**	**19.5%**	**25,287**	**100.0%**

Table 4. Site condition (reason area is unavailable for commercial harvest) acres for the Keweenaw Bay Management Area.

Site Condition (Reason area is unavailable for commercial harvest)	Area (ac)	% of Unavailable Area
Too steep	1,670	33.9%
BMPs	1,059	21.5%
Deer wintering area	907	18.4%
Too wet	669	13.6%
Other dept./div. processes	149	3.0%
Rare landforms	127	2.6%
Denied access	124	2.5%
Wildlife concerns	78	1.6%
Other influence zones	51	1.0%
Recreational/scenic	46	0.9%
Non-Military lease/easement	23	0.5%
Blocked by obstacle	15	0.3%
Long-term retention	13	0.3%
Total unavailable	**4,931**	**100.0%**

Management actions

Each cover type in the Keweenaw Bay management area has a unique age class and basal area class goals that describe the long-term desired future conditions. The harvests levels needed in the first planning period to begin achieving those long-term goals are summarized below (Table 5). These harvests will help establish a desirable amount of regeneration for the even-aged cover types over the 10-year period and help to achieve desired basal area distribution among uneven-aged cover types like northern hardwoods. The following sections will provide additional details for each of the significant cover types in the Keweenaw Bay management area.

Table 5. Ten-year planning period harvest goals (acres) by cover type and silvicultural regime.

Silvicultural Regimes								
Cover Type	**Clearcut**	**Selection**	**Thinning**	**Group Selection**	**Shelterwood**	**Salvage Clearcut**	**Salvage Thinning**	**Grand Total**
Northern hardwood	-	1,452	-	-	-	-	-	1,452
Aspen	790	-	-	-	-	-	-	790
Mixed upland deciduous	347	53	-	-	-	-	-	400
Natural jack pine	197	-	-	-	-	-	-	197
Upland Mixed Forest	98	-	-	-	-	-	-	98
Hemlock	-	49	-	-	-	-	-	49
Planted jack pine	21	-	-	-	-	-	-	21
Upland spruce/fir	6	-	-	-	-	-	-	6
Lowland conifers	4	-	-	-	-	-	-	4
Totals	**1,462**	**1,554**	**-**	**-**	**-**	**-**	**-**	**3,017**

Table 6. Ten-year estimated harvest volume by product and species for the Keweenaw Bay management area.

10-Year Estimated Harvest Volume Projection Keweenaw Bay Management Area			
Product	**Species**	**Volume Planned***	**Volume Prepared****
Pulpwood (cords)	Mixed hardwood	12,339	11,599
	Mixed aspen	6,267	5,891
	Mixed softwood	2,629	2,471
	Jack pine	2,305	2,167
	Mixed spruce	1,822	1,712
	White pine	658	619
	Mixed oak	640	602
	Red pine	214	201
	Pulpwood Total	**26,874**	**25,261**
Sawtimber (MBF)	Sugar maple	3,821	3,592
	Mixed aspen	2,438	2,292
	Red maple	2,351	2,210
	White pine	1,782	1,675
	Red oak	1,358	1,276
	Red pine	585	550
	Basswood	510	479
	White oak	233	219
	Mixed oak	18	17
	Sawtimber Total	**13,096**	**12,310**
	Total Sawtimber Harvest Volume in Cords	**27,657**	**25,997**
	Grand Total Harvest Volume in Cords	**54,531**	**51,259**

* Volume estimates based on 100% of the projected harvests for the 10 year planning period.

** Volume estimates based on 94% of the projected harvests for the 10 year planning period accounting for reduction in acres and associated volume once sales are prepared for bid.

There are very few cover type transitions projected in this management area. The managed area of each cover type is expected to remain relatively stable. The largest decrease forecasted is in the aspen cover type, where 38 acres are expected to convert to other cover types through forest management activities. The largest increase is in mixed upland deciduous. where 85 acres are expected to convert into that cover type.

Table 7. Projected 10-year cover type acres resulting from cover type transitions

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Aspen	5,042	5,002	-40
Natural jack pine	4,123	4,090	-33
Northern hardwood	3,518	3,518	0
Mixed upland deciduous	2,901	2,984	84
Planted jack pine	2,782	2,815	33
Hemlock	1,884	1,884	0
Upland mixed forest	1,206	1,183	-23
Lowland conifers	1,140	1,140	-1
Upland conifers	875	855	-20
Natural mixed pines	536	536	0
Cedar	282	282	0
Northern red oak	211	211	0
Lowland mixed forest	171	174	3
Natural red pine	142	142	0
Lowland deciduous	138	136	-2
Natural white pine	120	124	3
Tamarack	112	112	0
Oak mix	33	33	0
Lowland spruce/fir	33	33	0
Planted red pine	28	28	1
Upland spruce/fir	10	6	-4
Lowland aspen/balsam poplar	0	0	0
Cropland	621	621	0
Herbaceous openland	591	591	0
Marsh	468	468	0
Water	136	136	0
Lowland shrub	129	129	0
Low density trees	123	123	0
Treed bog	75	75	0

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Bare/sparsely vegetated	71	71	0
Urban	41	41	0
Bog	19	19	0
Upland shrub	3	3	0
Total:	**27,563**	**27,563**	**0**

Current and projected habitat acres for featured species

There are 11featured species in this management area spanning various cover types, age classes, and stand level conditions.

It is recommended that these featured species habitat acres be viewed as acres of potential habitat, representing a condition on the landscape where the more nuanced aspects of each species' habitat requirements are likely to be found or managed for. As described in the introduction, the modeling effort was limited by several factors including the simplification of habitat attributes into MiFI variables. When referring to habitat acres, this document refers to potential habitat acres.

Current and projected total habitat acres by species across the decade provide a baseline and show the result of long-term management actions (Table 8). Some species show a loss in habitat over the next century. As mentioned in the Featured Species Management Priority (Section 3), the current condition for many cover types is a surplus of acres in the 0-9 age class from the compensatory management approach applied in the previous decade. The model eventually evens out the age classes at a lower, sustainable level over time, usually by 50 years. For any species with northern hardwoods as a priority cover type, there is a perceived drop in acres between 40-60 years; this is due to the basal area dropping below 81. Because it only drops into the upper 70s, it is not expected to translate to any real habitat loss on the ground. Three of these species were not included in the SFMP model but are included here with their current acres of potential habitat.

Table 8. Featured species current and projected total habitat acres (i.e., potential habitat).

Featured Species	Priority Cover Types	Total Habitat Acres Current	10-year Projected Habitat Acres	50-year Projected Habitat Acres	100-year Projected Habitat Acres
American woodcock	Aspen, lowland aspen, lowland deciduous	2,296	2,027	2,297	2,284
Black bear	Mast	11,633	--	--	--
Black-backed woodpecker	Natural Disturbance	--	--	--	--
Kirtland's warbler	Natural jack pine, planted jack pine in Baraga Outwash Plains	779	--	--	--

Featured Species	Priority Cover Types	Total Habitat Acres Current	10-year Projected Habitat Acres	50-year Projected Habitat Acres	100-year Projected Habitat Acres
Moose	To be determined	--	--	--	--
Ruffed Grouse	Aspen	2,159	1,788	2,062	2,109
Snowshoe hare	Aspen, cedar, hemlock, lowland aspen, lowland conifers, lowland mixed forest, lowland spruce/fir, mixed upland deciduous, natural jack pine, natural mixed pines, planted jack pine, upland spruce/fir	3,010	2,686	2,589	2,584
White-tailed deer (food)	Northern hardwood, oak mix, aspen, mixed upland deciduous, lowland deciduous, lowland aspen/balsam poplar, lowland mixed forest	13,220	13,240	13,405	13,494
White-tailed deer (shelter)	Hemlock, cedar, planted red pine, planted white pine, planted mixed pine, natural red pine, natural white pine, natural mixed pines, upland conifers, upland spruce fir, lowland conifers	5,050	5,029	4,870	4,782
Wild turkey	Non-forested openings	714	--	--	--
Wood turtle	Non-forested openings	--	--	--	--

Cover type composition and associated wildlife species

Aspen

Current Condition

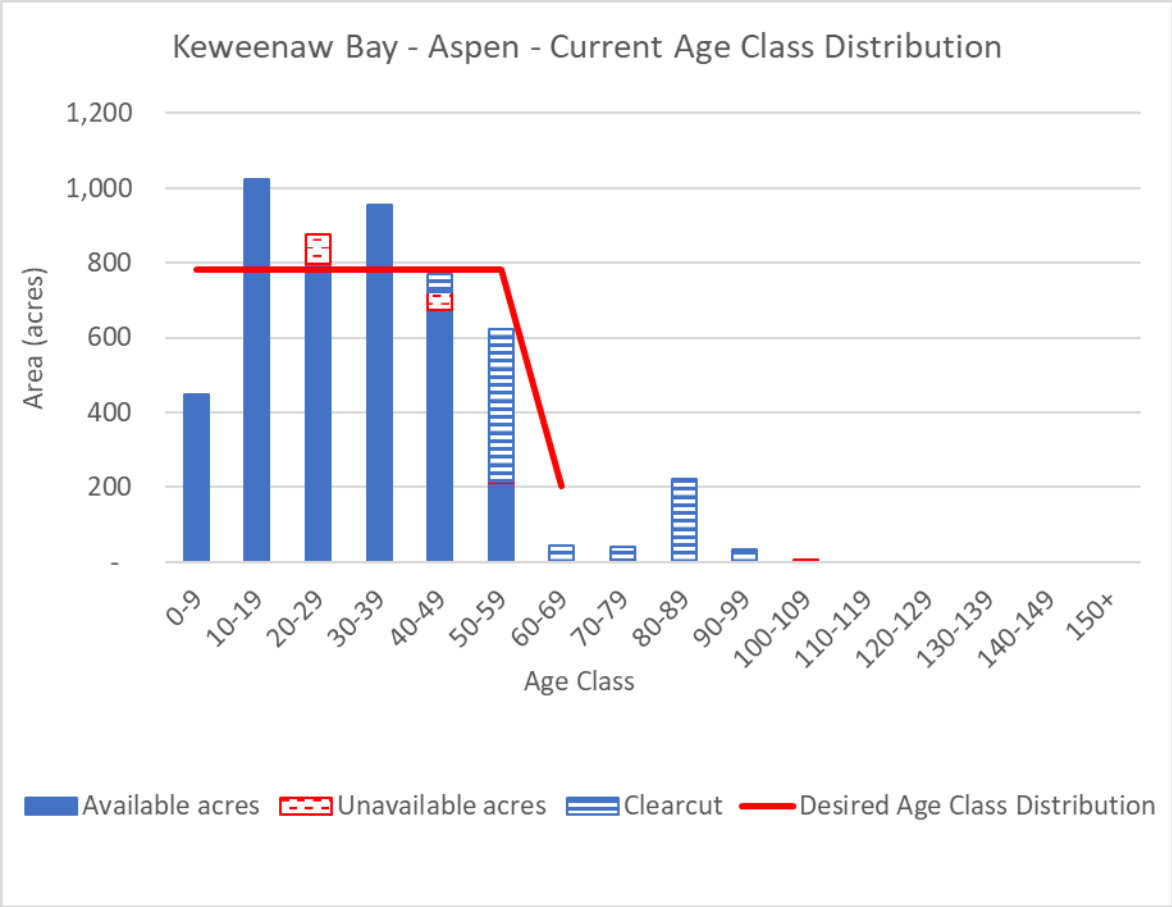


Figure 3. Current age class distribution, desired age class distribution, and projected harvests in the aspen cover type over the 10-year planning period.

The current age class distribution is unbalanced with a deficit of acres in the 0-9 and the 50-59-year-old age classes and a surplus of acres in the 10-19 and the 30-39-year-old age classes. A portion of this cover type meets the habitat requirements for ruffed grouse, American woodcock, and snowshoe hare.

Table 9. Featured species with aspen as a priority habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Aspen	Aspen Habitat Acres-Available	Aspen Habitat Acres-Unavailable
Ruffed grouse	Age category: 0-19 Size category: Sapling	1,472	0

Featured Species	Featured Species Habitat – Aspen	Aspen Habitat Acres-Available	Aspen Habitat Acres-Unavailable
American woodcock	Age category: 0-19 Size category: sapling	1,472	0
Snowshoe hare	Age category: 0-19 Size category: Sapling	1,472	0
White-tailed deer	All ages and size classes	5,042	--

Desired future condition

The desired age class distribution is to have a rotation age of 50 years with approximately 4 percent of the acres in an age class tail out to a maximum of 60-year age class.

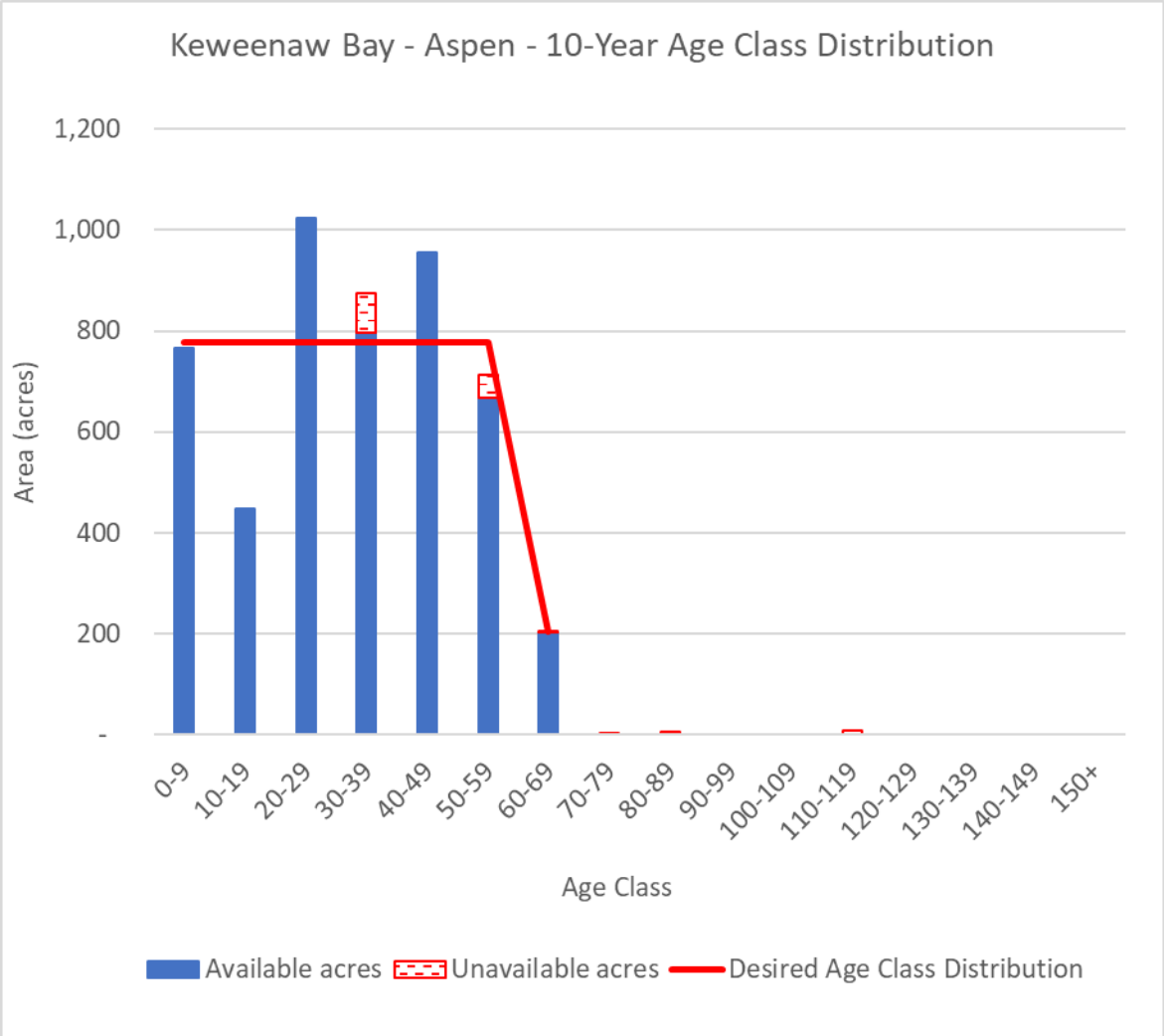


Figure 4. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The end of the planning period will result in the establishment of 766 acres of aspen in the upcoming 0-9 age class. Progress toward the long-term desired age class distribution of aspen will take a few decades in this management area.

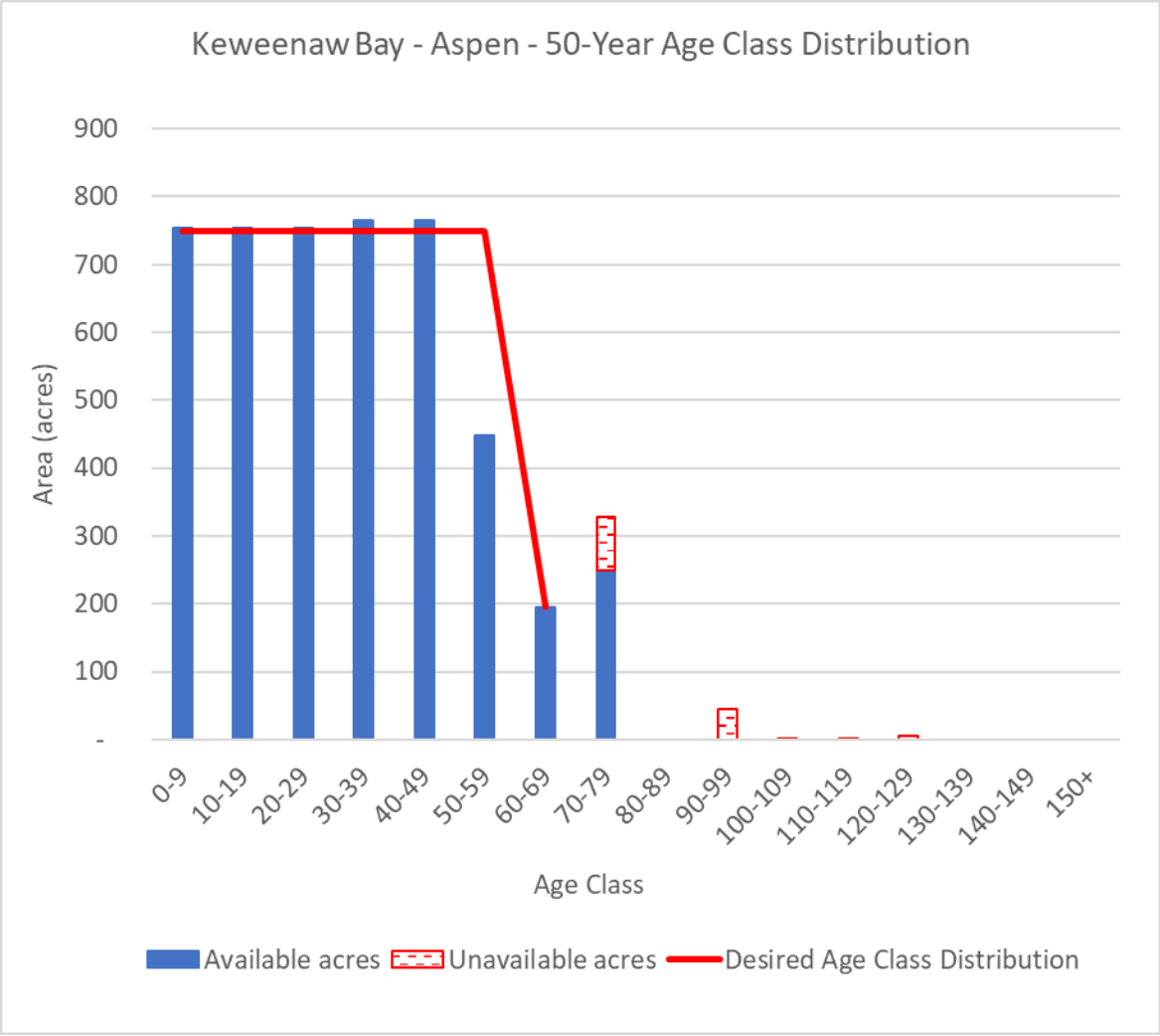


Figure 5. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of aspen acres nearly reaching the desired future condition with only a few age classes deviating from the target proportions (Figure 5).

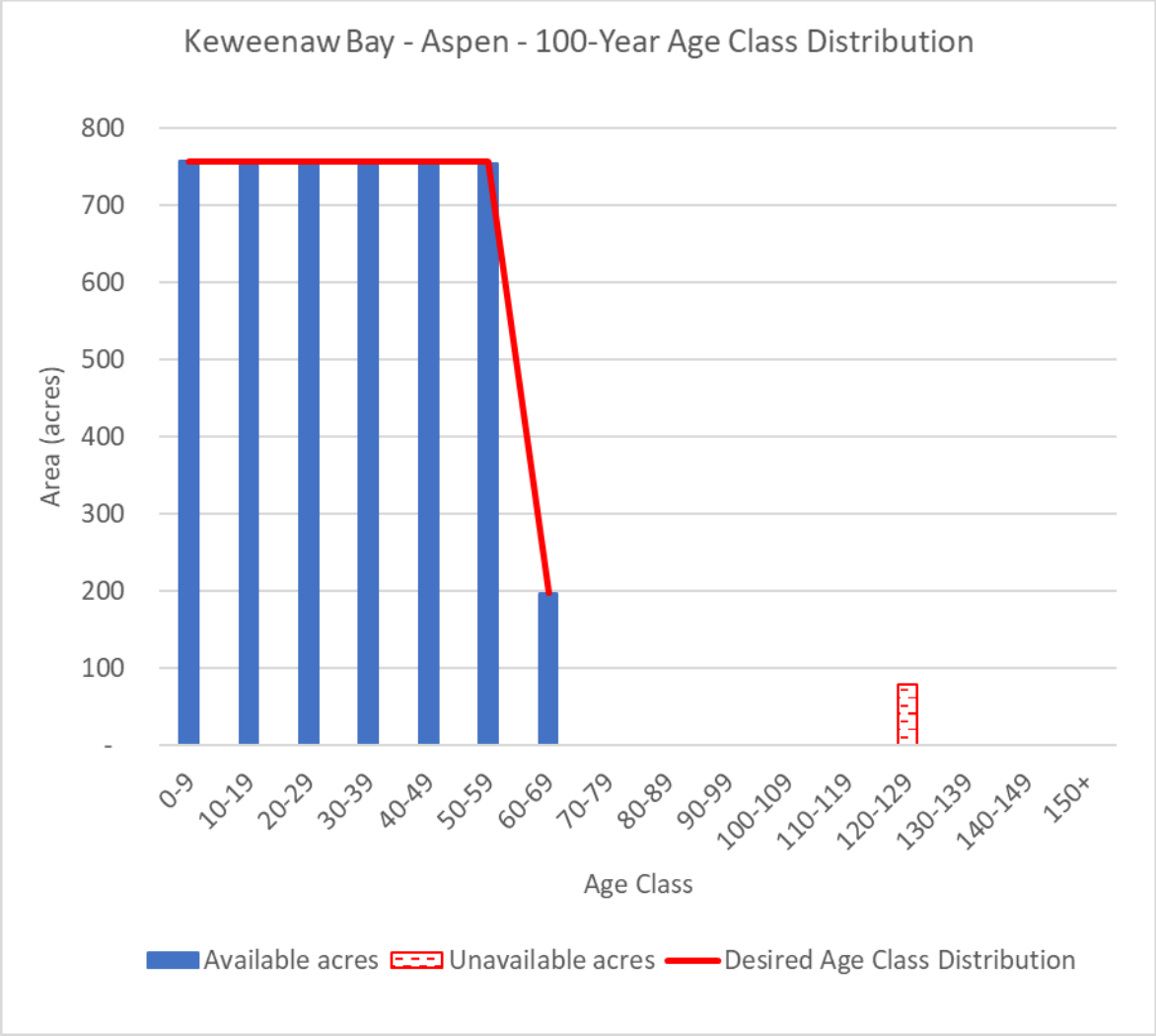


Figure 6. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 6) will concentrate the manageable acres of aspen in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged, and mature forest.

Management actions

There are 790 acres of projected clearcut harvest in the aspen cover type. It is expected that about 40 acres of aspen will be converted to other cover types. These total to an expected 750 acres of regeneration in the aspen cover type over the next 10 years.

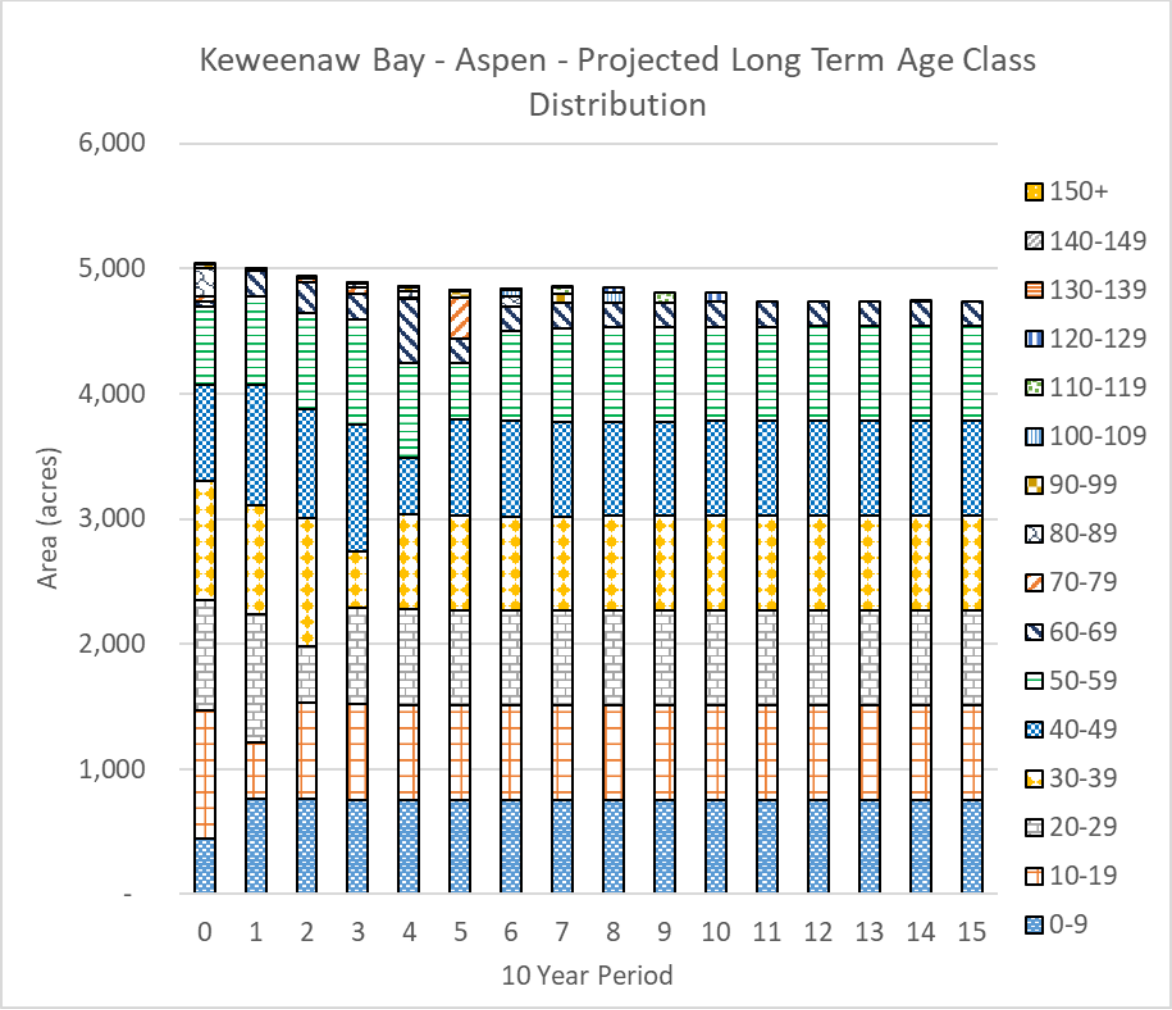


Figure 7. Projected age class distribution over 15, 10-year planning periods.

Natural jack pine

Current condition

The current age class distribution is unbalanced with a deficit of acres in the 0-29 year-old age classes, and a surplus of acres in the 30-49-year-old age classes.

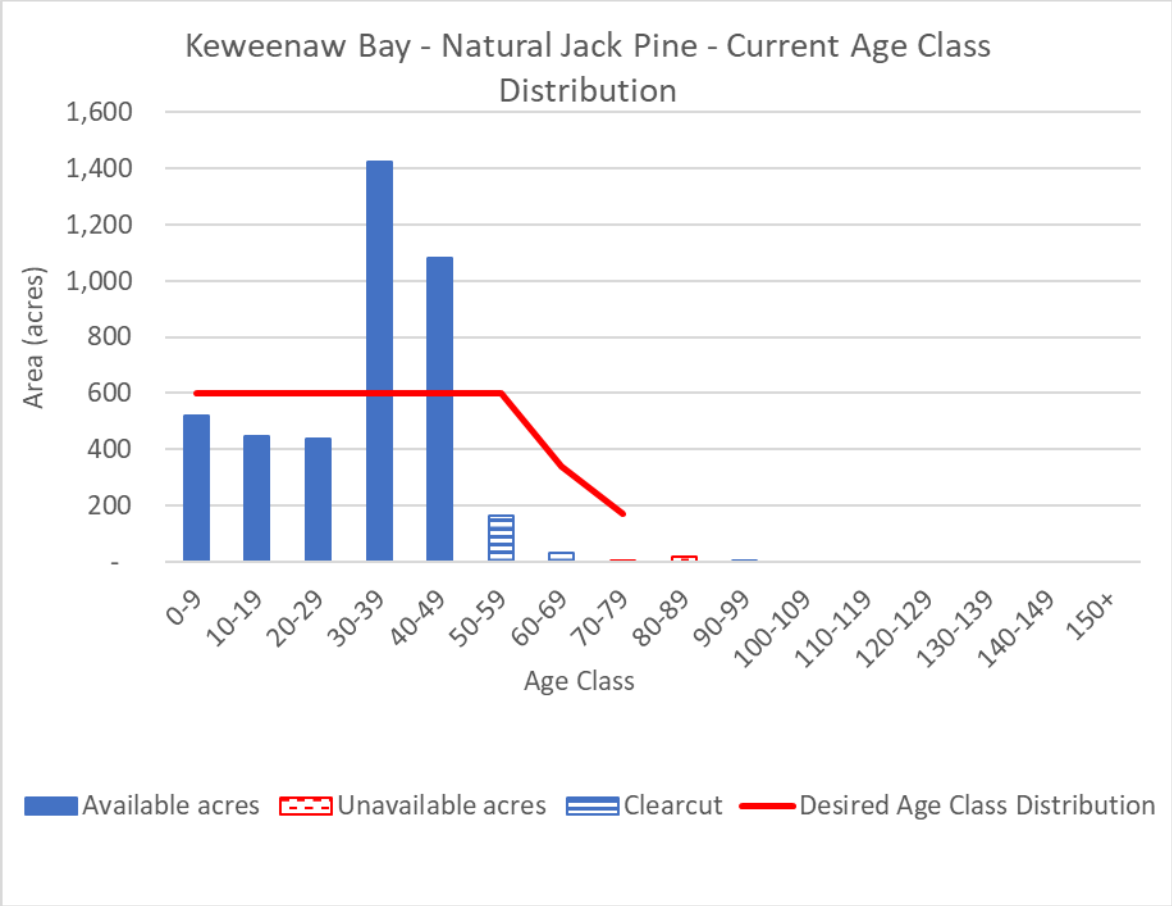


Figure 8. Current age class distribution, the desired age class distribution, and the projected harvests in the natural jack pine cover type over the 10-year planning period.

A portion of this cover type meets the habitat requirements for Kirtland's warbler and snowshoe hare. Jack pine habitat acres calculated for Kirtland's warbler are those acres found within outwash plains in the Baraga Plains and will be managed in a minimum 200-acre patch size.

Table 10. Featured species with natural jack pine as a priority habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Jackpine	Jack Pine Habitat Acres- Available	Jack Pine Habitat Acres- Unavailable
Kirtland's warbler	Age category: 5-15 Size category: sapling	779 (included planted)	0

Featured Species	Featured Species Habitat – Jackpine	Jack Pine Habitat Acres- Available	Jack Pine Habitat Acres- Unavailable
Snowshoe hare	Age category: 0-19 Size category: sapling	963	0

Desired future condition

The desired age class distribution is to have a rotation age of 50 years with approximately 8 percent of the acres in an age class tail out to the 60-year age class, and 4 percent of the acres in an age class tail out to the 70-year age class.

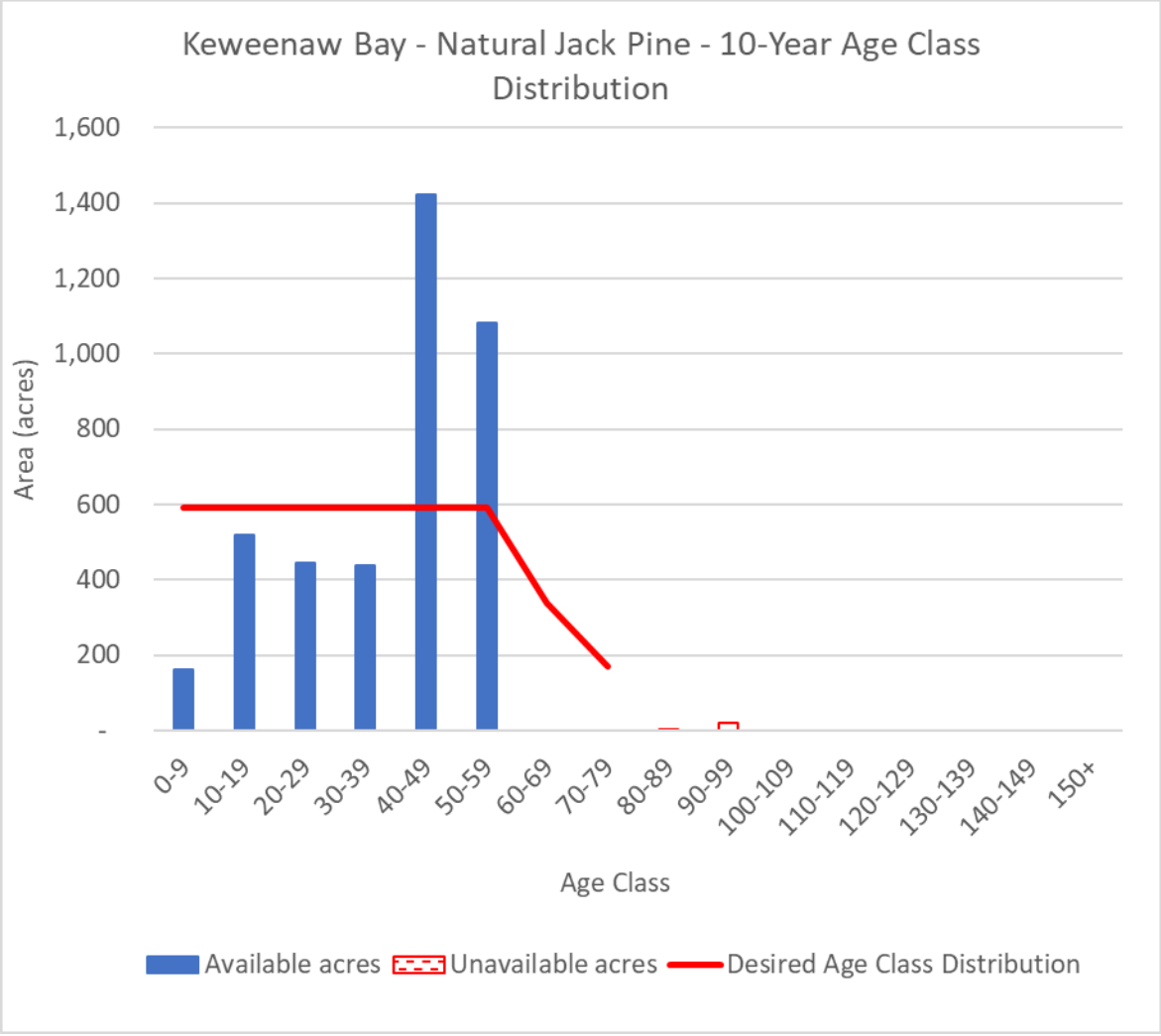


Figure 9. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The end of the planning period will result in the establishment of 163 acres in the upcoming 0-9 age class. Progress toward the long-term desired age class distribution of natural jack pine will take many decades in this management area.

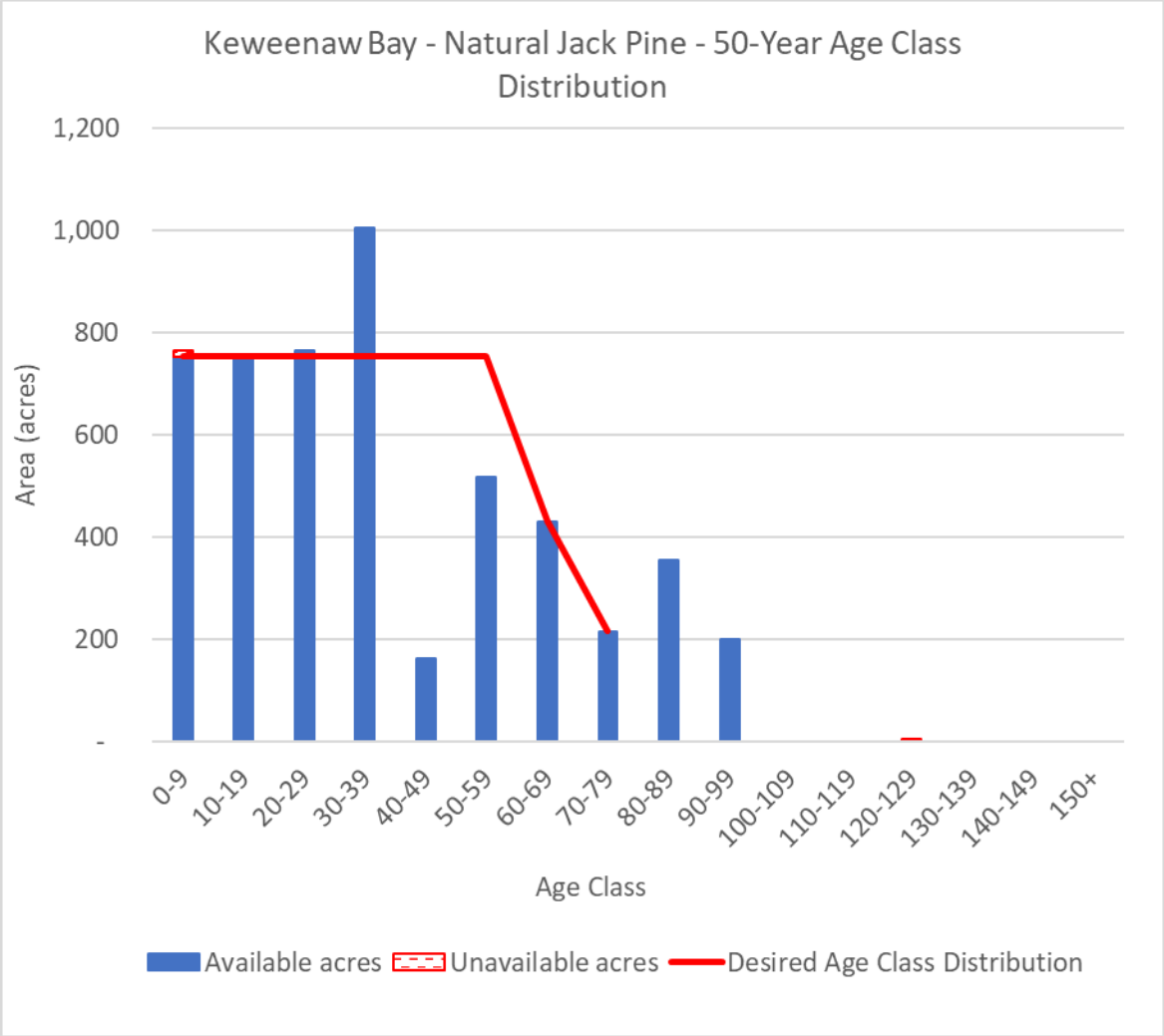


Figure 10. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of natural jack pine acres, working toward the desired future condition as the older age classes are treated (Figure 10).

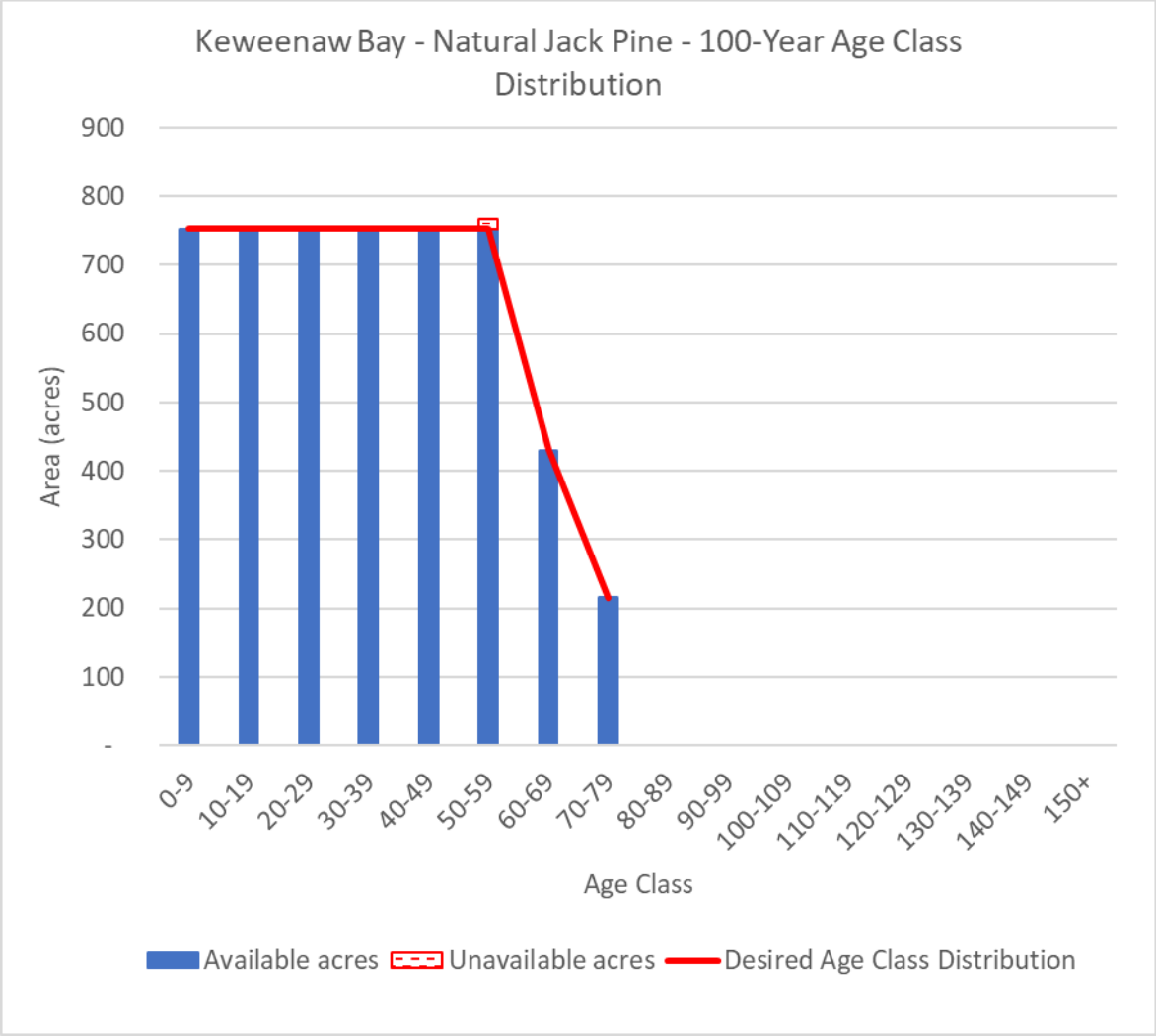


Figure 11. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 11) will concentrate the manageable acres of natural jack pine in productive growing conditions while providing an even flow of forest products and a wide variety of wildlife habitat conditions across the landscape in young, mid-aged, and mature forest.

Management Aations

There are 197 acres of projected harvest in the natural jack pine cover type. It is expected that about 33 acres of natural jack pine will convert to other cover types. These total to an expected 164 acres of regeneration in the natural jack pine cover type over the next 10 years.

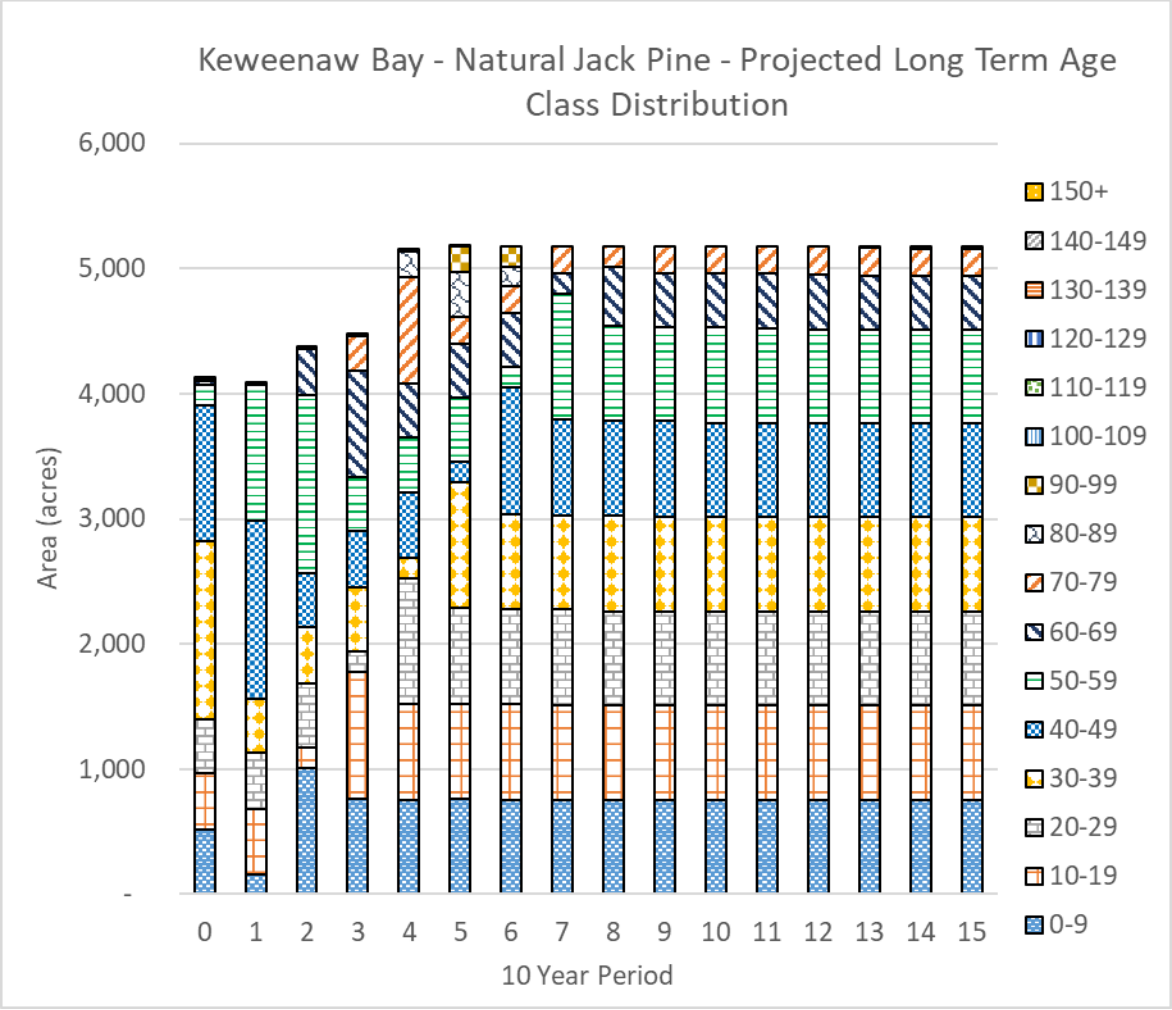


Figure 12. Projected age class distribution over 15, 10-year planning periods.

Northern hardwoods

Current condition

Most of the northern hardwood cover type in the management area is currently between a stand age of 100 -119 years old (Figure 13). The past management regime has been primarily single-tree selection, which allows for stand age to continue to increase overtime. Some stands are beginning to achieve an uneven-aged condition where a featured stand age becomes less evident, but the dominant age of these stands will likely increase past 150 years old before a younger age cohort becomes the prominent component of these stands (Figure 15).

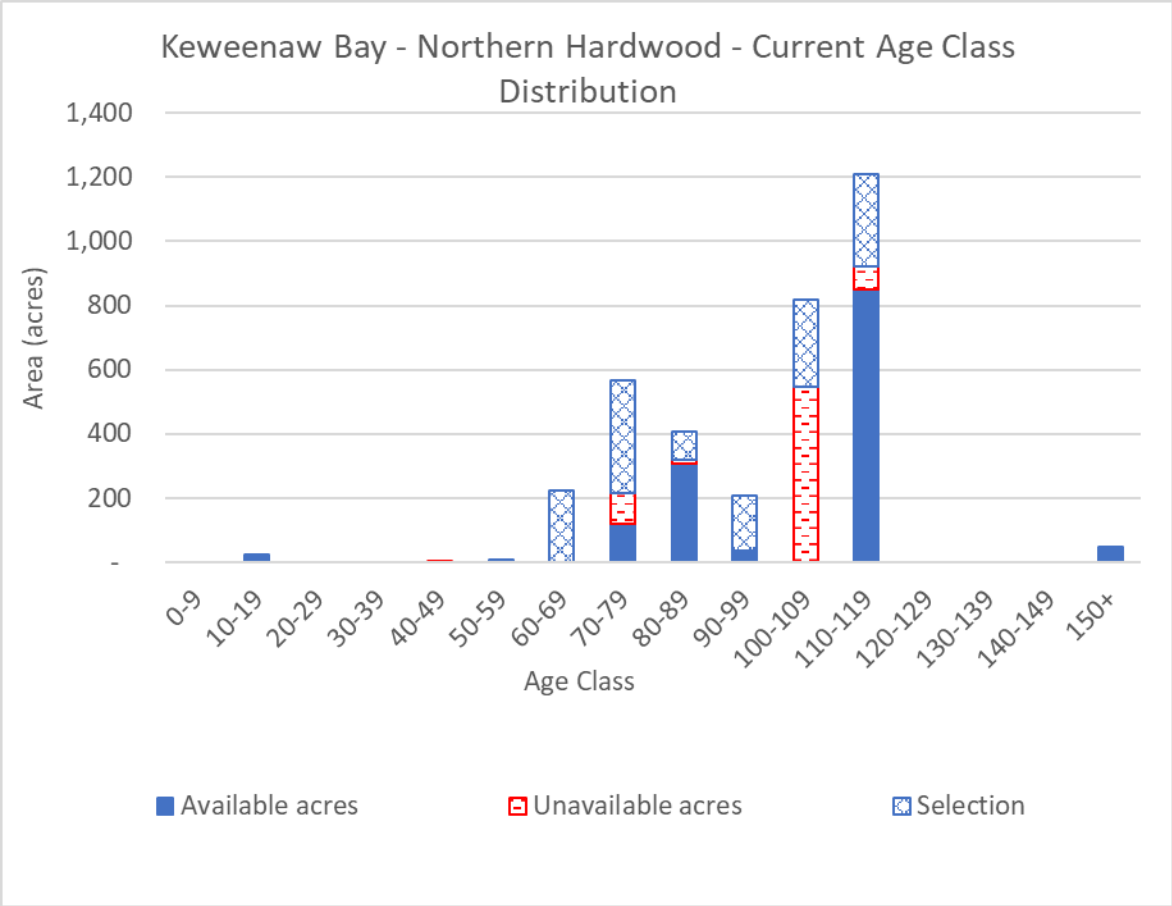


Figure 13. Current age class distribution and projected harvests in the northern hardwood cover type in the Keweenaw Bay management area.

The area of northern hardwood in this area is well distributed in the ideal basal area classes for optimal growing conditions (Figure 14). Current conditions are a result of a selection harvest regime that has been in place in this management area for decades.

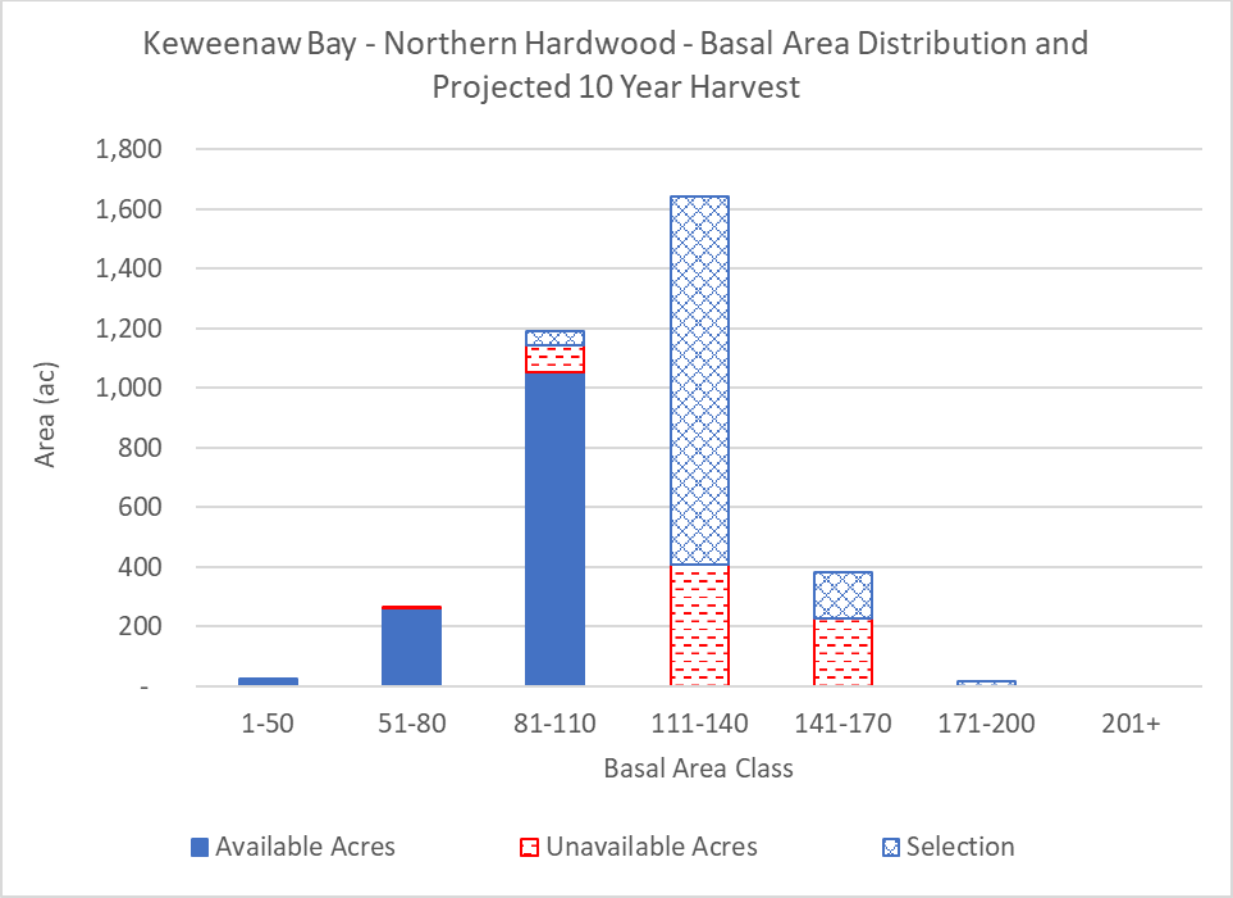


Figure 14. Current basal area distribution of the northern hardwood cover type as well as the projected harvests from each basal area class.

A portion of this cover type meets the habitat requirements for marten and white-tailed deer.

Table 11. Featured species with northern hardwoods as a priority habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Northern Hardwood	Northern Hardwood Habitat Acres-Available	Northern Hardwood Habitat Acres-Unavailable
Marten	Age category: 40+ Size category: pole, sawlog Basal area: 81+	1,802	631
White-tailed deer	All ages and size classes	3,518	--

Desired future condition

The projected long-term cover type trend for northern hardwood in this management area is stable. There are no acres transitioning from this cover type in the next 10 years.

The desired basal area distribution is a bell-shaped curve where a significant majority of the area is kept in the 81-110 basal area class with recently harvested stands occupying the 51-80 class and stands that are ready for harvest occupy the 111-140 basal area class. Diameter distributions of the northern hardwood stands should follow the appropriate Q-curve relative to stand age and condition.

An uneven-aged condition is the long-term goal for all northern hardwood stands in this management area. An uneven-aged condition is achieved when there is no single discernable age cohort that is more prevalent than others across the stand area as canopy gaps fill in with regenerating seedlings, saplings, poles, and remaining stems become sawlogsized over time.

Regeneration and recruitment continue to be a focus in the northern hardwood cover type across this management area. The long-term sustainability of this cover type in an uneven-aged silvicultural regime is dependent on the successful establishment of northern hardwood species as well as the recruitment of those seedlings and saplings into the pole and saw log classes.

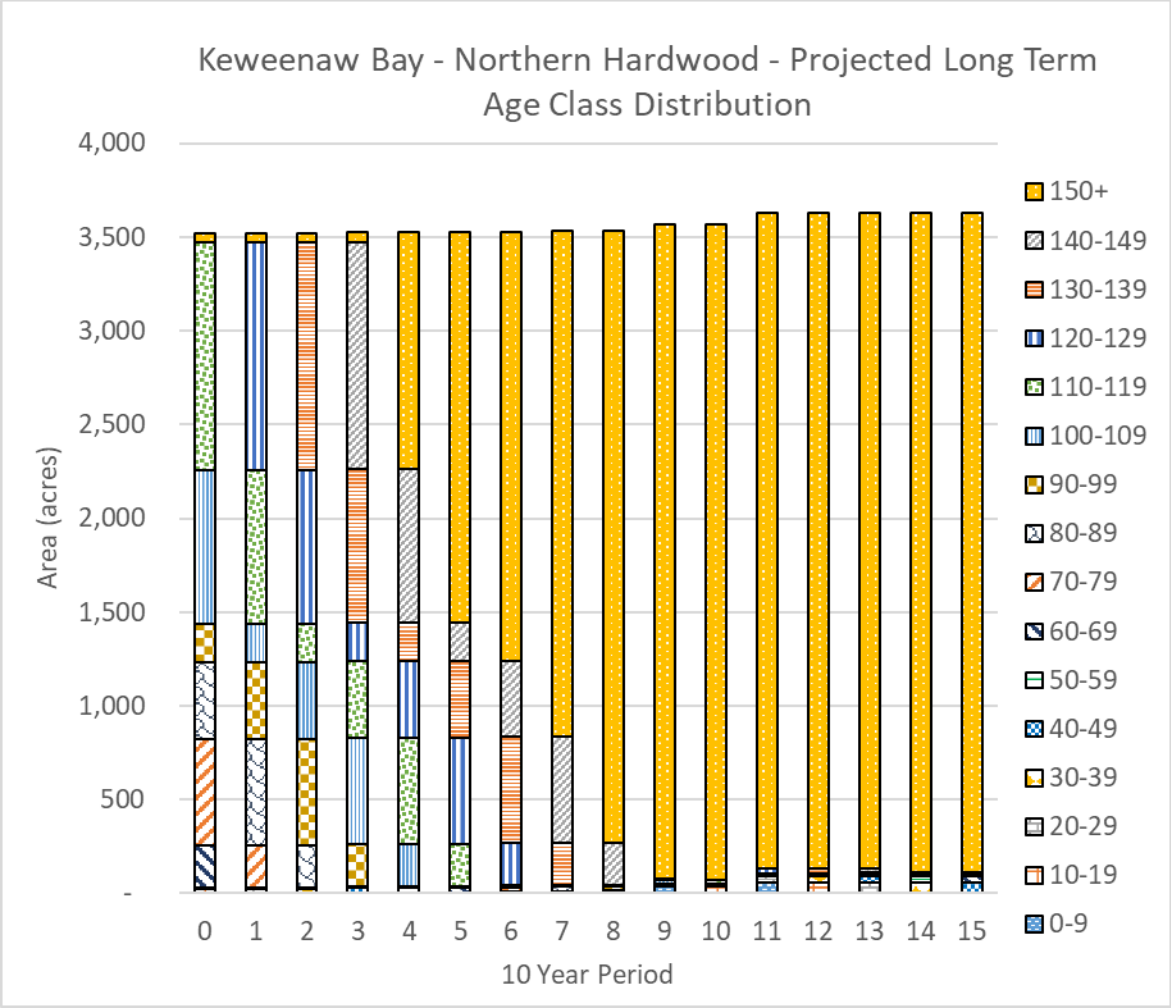


Figure 15. Projected age class distribution over 15, 10-year planning periods.

Management actions

The desired forest conditions and associated featured species habitat will be maintained and achieved through continued application of the projected selection harvest regime on 1,452 acres (Table 5). Larger canopy gaps should be used to encourage diverse regeneration of northern hardwood species while maintaining an overall long-term mature forest closed canopy landscape condition.

Planted jack pine

Current condition

The current age class distribution is somewhat unbalanced with a deficit of acres in the 0-19-year old age classes and a surplus of acres in the 40-49-year-old age classes.

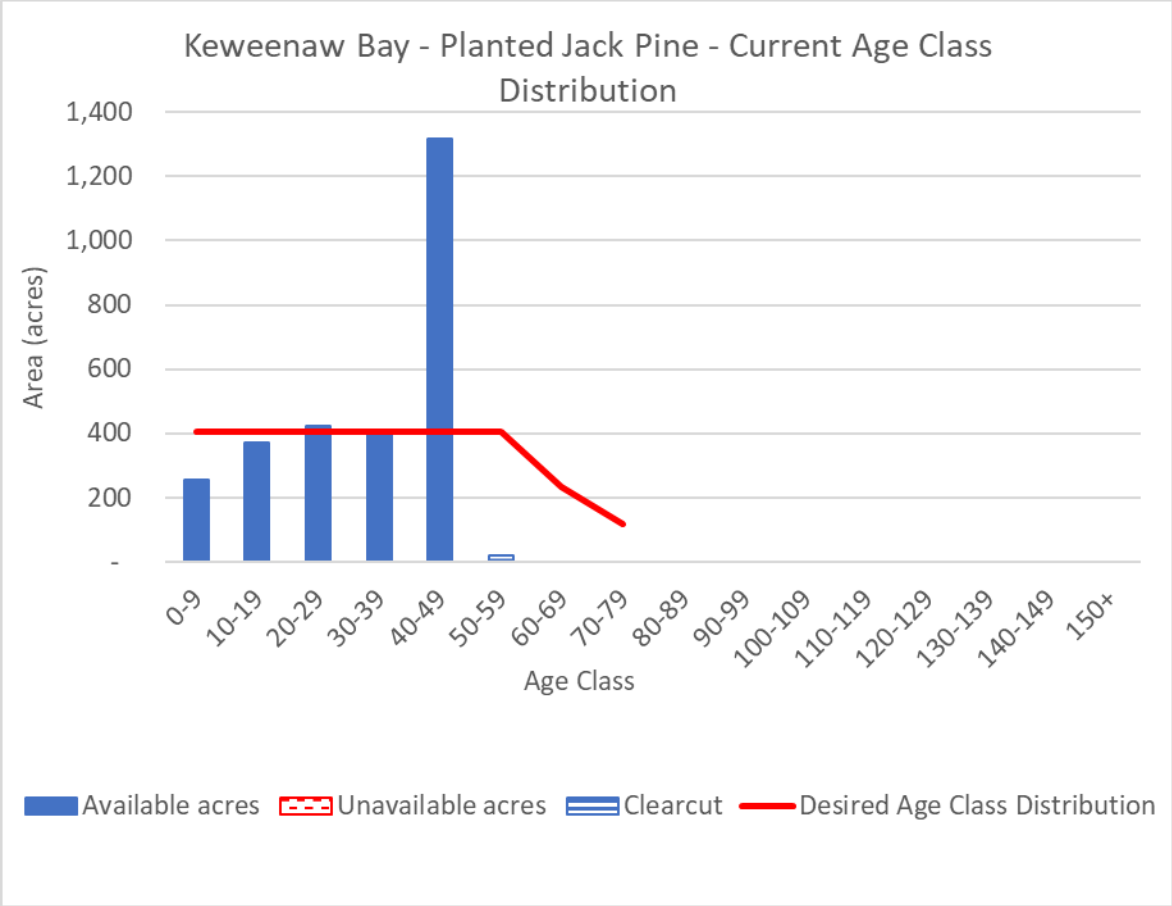


Figure 16. Current age class distribution, the desired age class distribution, and the projected harvests in the planted Jack pine cover type over the 10-year planning period.

A portion of this cover type meets the habitat requirements for Kirtland's warbler and snowshoe hare. Jack pine habitat acres calculated for Kirtland's warbler are those acres found within outwash plains in the Baraga Plains and will be managed in a minimum 200-acre patch size.

Table 12. Featured species with planted jack pine as a priority habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Jackpine	Jack Pine Habitat Acres- Available	Jack Pine Habitat Acres- Unavailable
Kirtland's warbler	Age category: 5-15 Size category: sapling	779 (includes natural)	0

Featured Species	Featured Species Habitat – Jackpine	Jack Pine Habitat Acres- Available	Jack Pine Habitat Acres- Unavailable
Snowshoe hare	Age category: 0-19 Size category: sapling	625	0

Desired future condition

The desired age class distribution is to have a rotation age of 50 years with approximately 8 percent of the acres in an age class tail out to the 60-year age class, and 4 percent of the acres in an age class tail out to the 70-year age class.

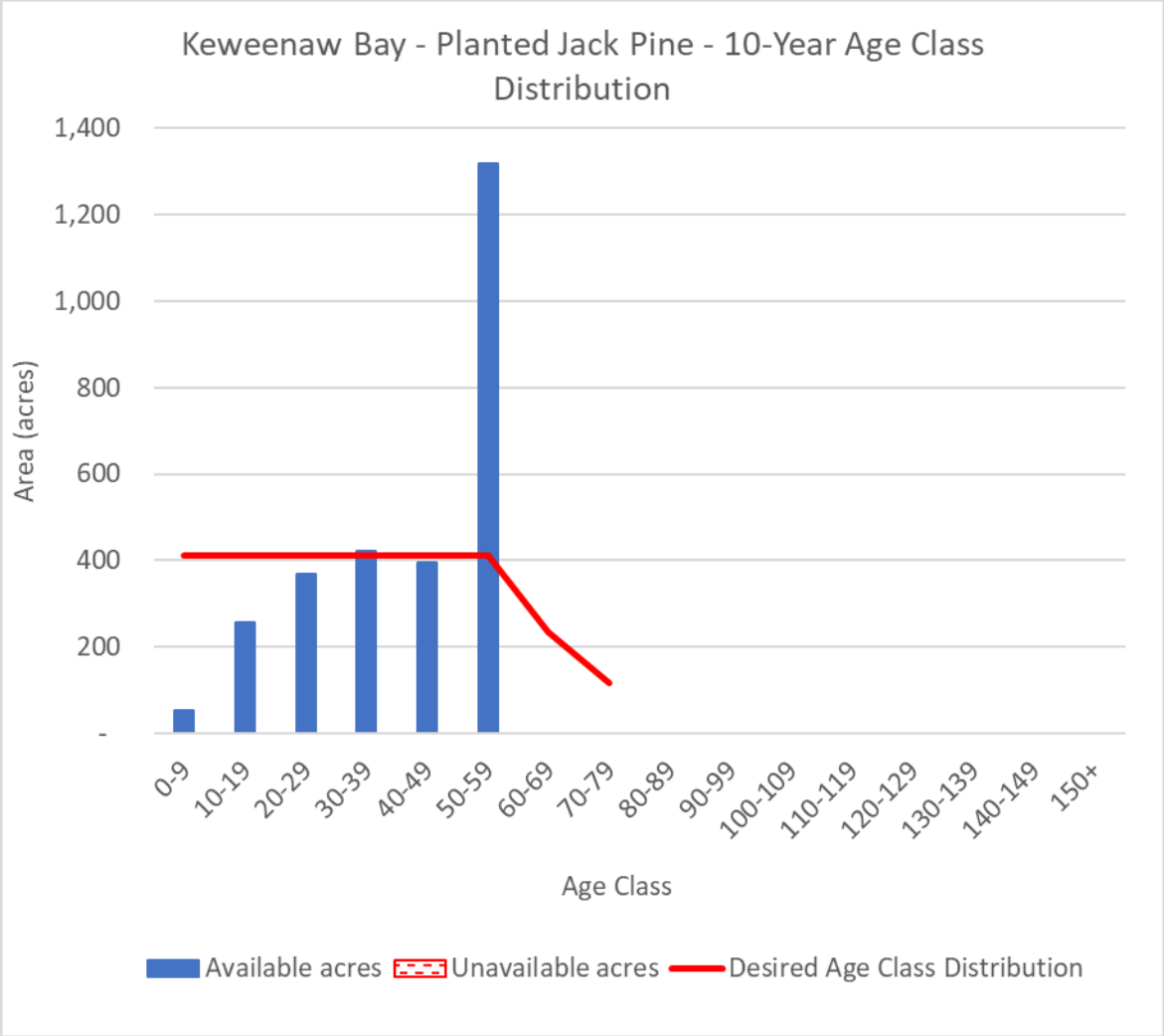


Figure 17. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The end of the planning period will result in the establishment of 54 acres in the upcoming 0-9 age class. Progress toward the long-term desired age class distribution of planted jack pine will take many decades.

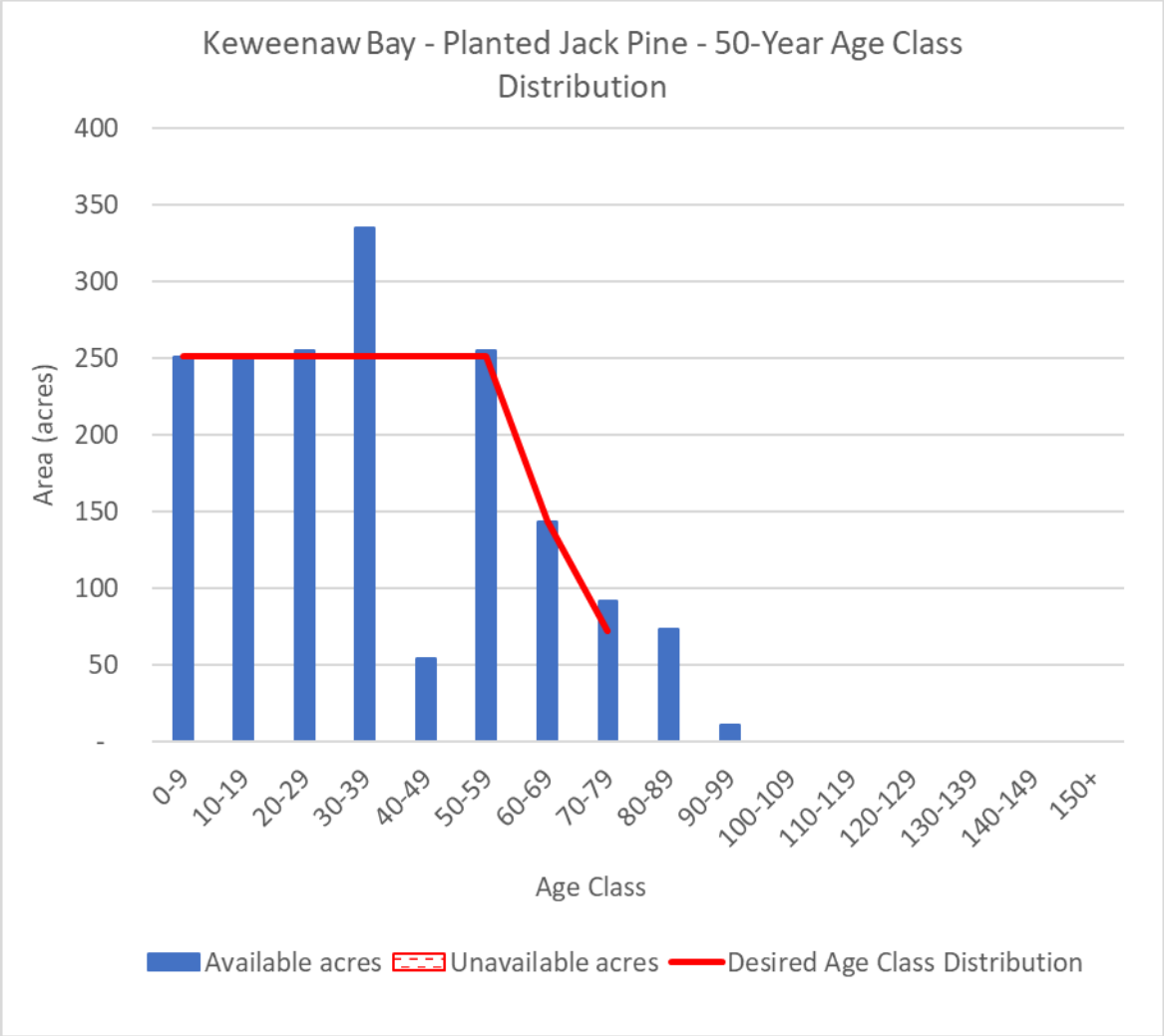


Figure 18. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The mid-term age-class distribution shows the population of planted jack pine acres working toward the desired future condition ats the older age classes are treated (Figure 18).

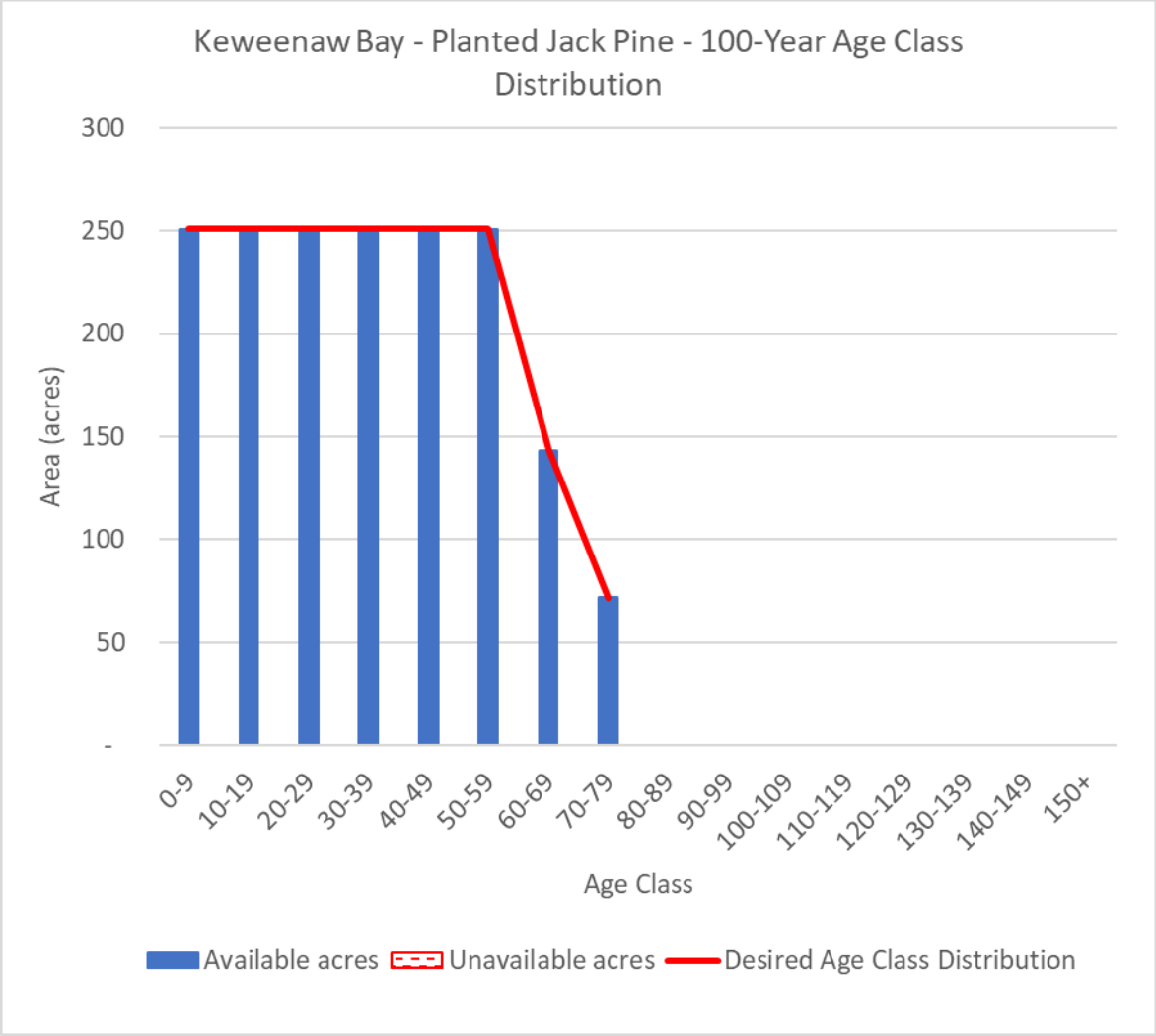


Figure 19. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 19) will concentrate the manageable acres of planted jack pine in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged, and mature forest.

Management actions

There are 21 acres of projected harvest in the planted jack pine cover type. It is expected that about 33 acres of planted jack pine will be converted from other cover types. These total to an expected 54 acres of regeneration in the planted jack pine cover type over the next 10 years.

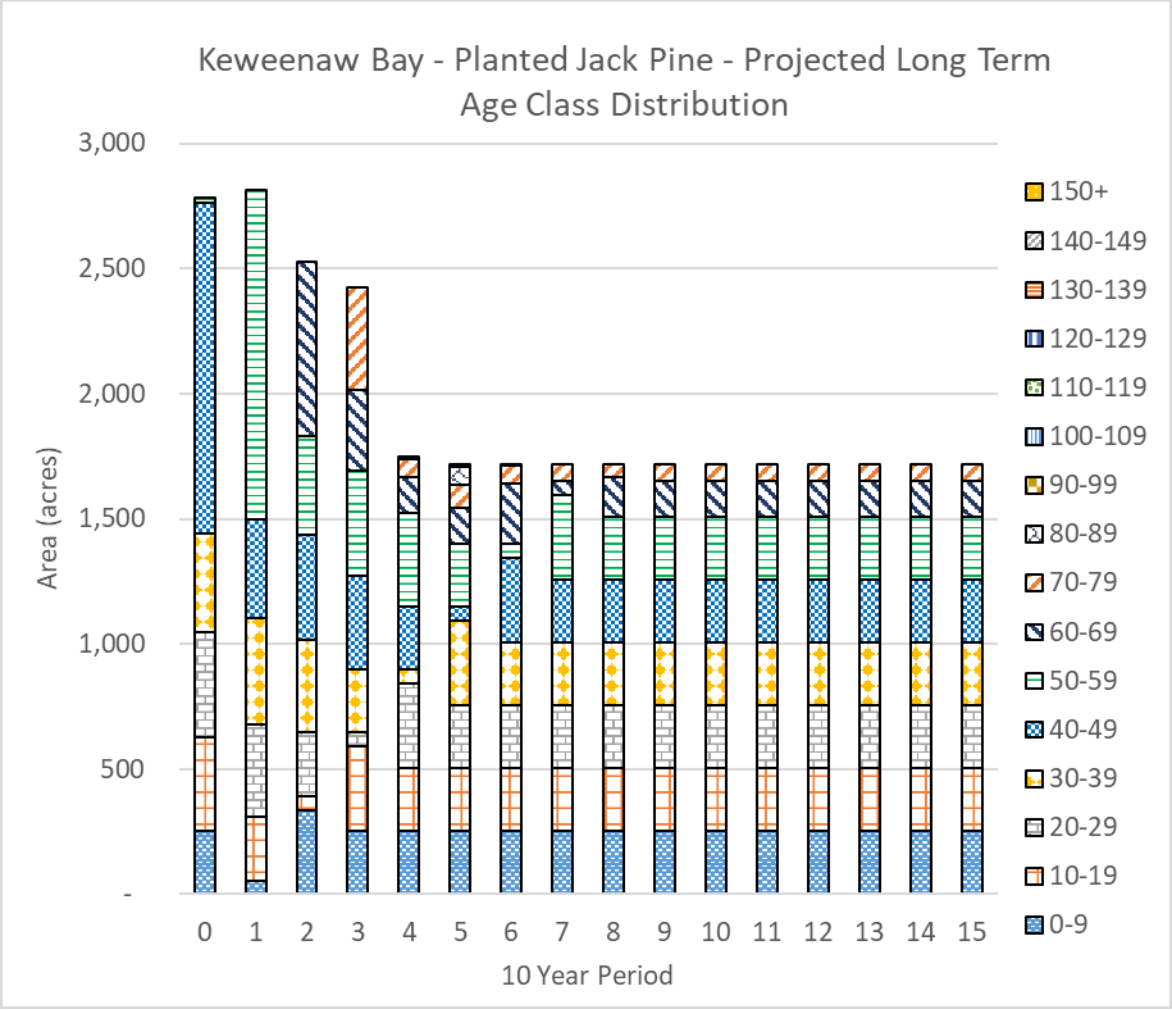


Figure 20. Projected age class distribution over 15, 10-year planning periods.

Mixed upland deciduous

Current condition

The current age class distribution is somewhat unbalanced with a deficit of acres in the 20-39-year-old age classes, and a surplus of acres in the 0-9- and 110-119-year-old age classes.

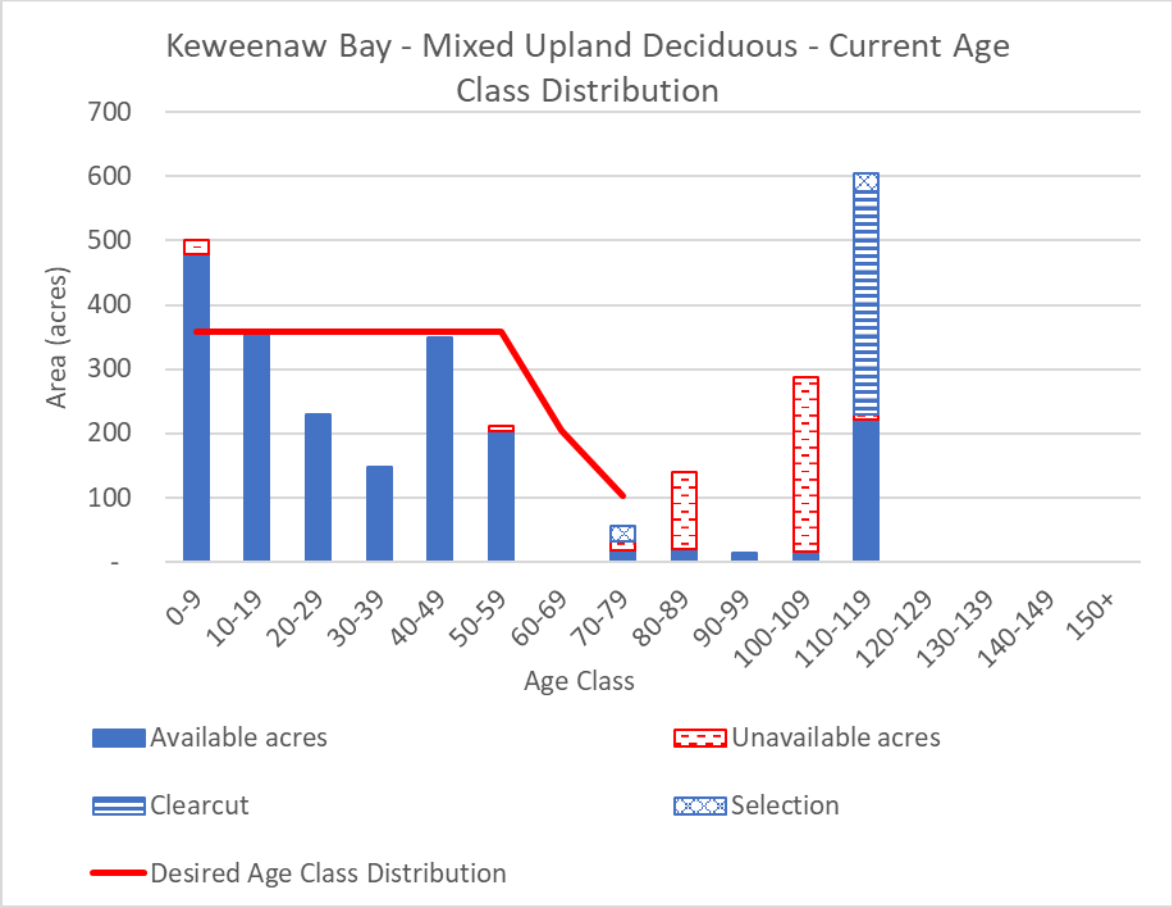


Figure 21. Current age class distribution, the desired age class distribution, and the projected harvests in mixed upland deciduous cover type over the 10-year planning period.

The current age class distribution is somewhat unbalanced with a deficit of acres in the 20-39-year-old age classes, and a surplus of acres in the 0-9- and 110-119-year-old age classes. A portion of this cover type meets the habitat requirements for marten and snowshoe hare.

Table 13. Featured species with mixed upland deciduous as a priority habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Mixed Upland Deciduous	Mixed Upland Deciduous Habitat Acres- Available	Mixed Upland Deciduous Habitat Acres- Unavailable
Marten	Age category: 40+ Size category: pole, sawlog Basal area: 81+	434	385
Snowshoe hare	Age category: 0-19 Size category: sapling	841	23
White-tailed deer	All ages and size classes	2,901	--

Desired future condition

The desired age class distribution is to have a rotation age of 50 years with approximately 8 percent of the acres in an age class tail out to the 60-year age class, and 4 percent of the acres in an age class tail out to the 70-year age class.

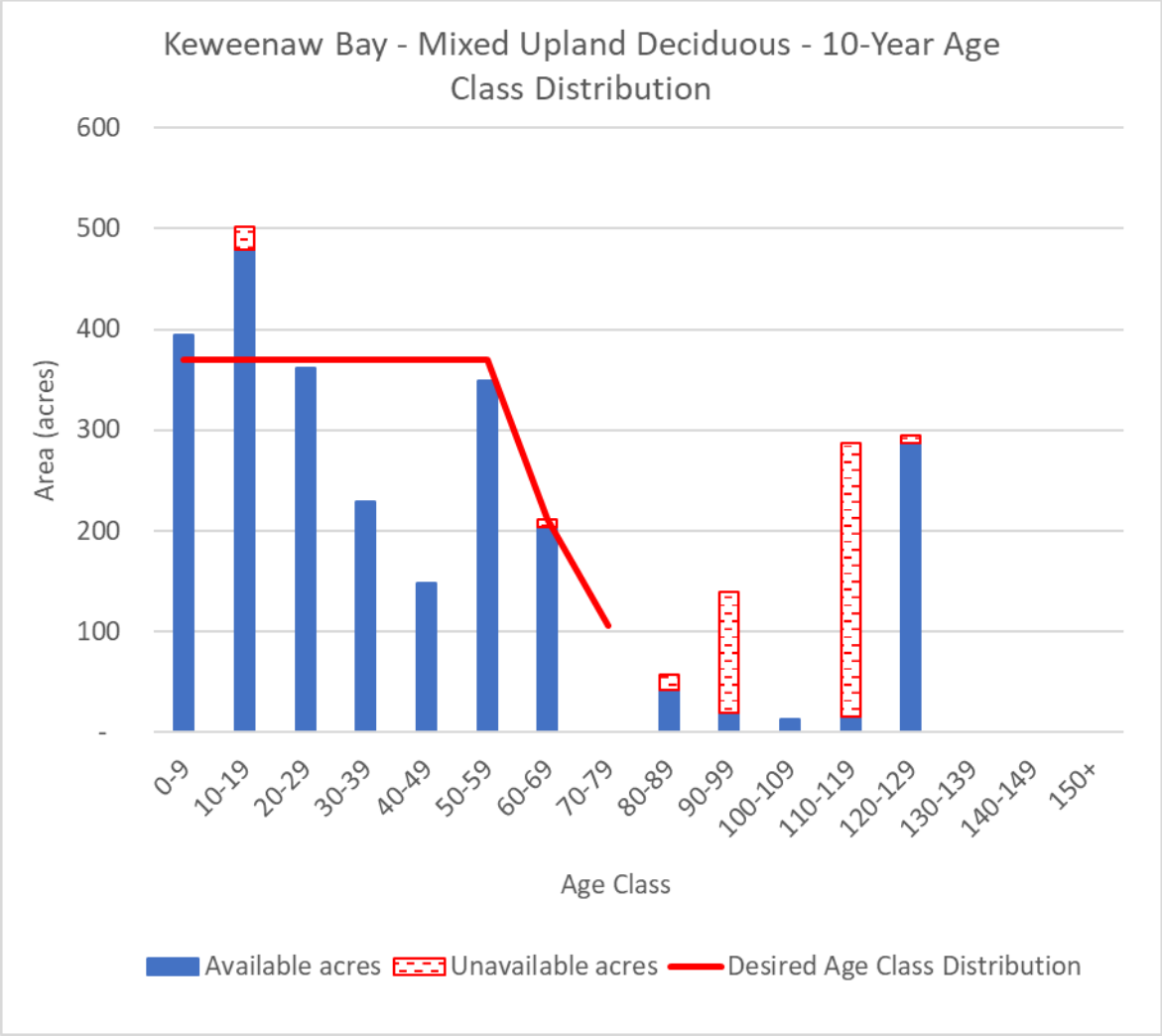


Figure 22. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The end of the planning period will result in the establishment of 395 acres in the upcoming 0-9 age class. Progress toward the long-term desired age class distribution of mixed upland deciduous will take many decades.

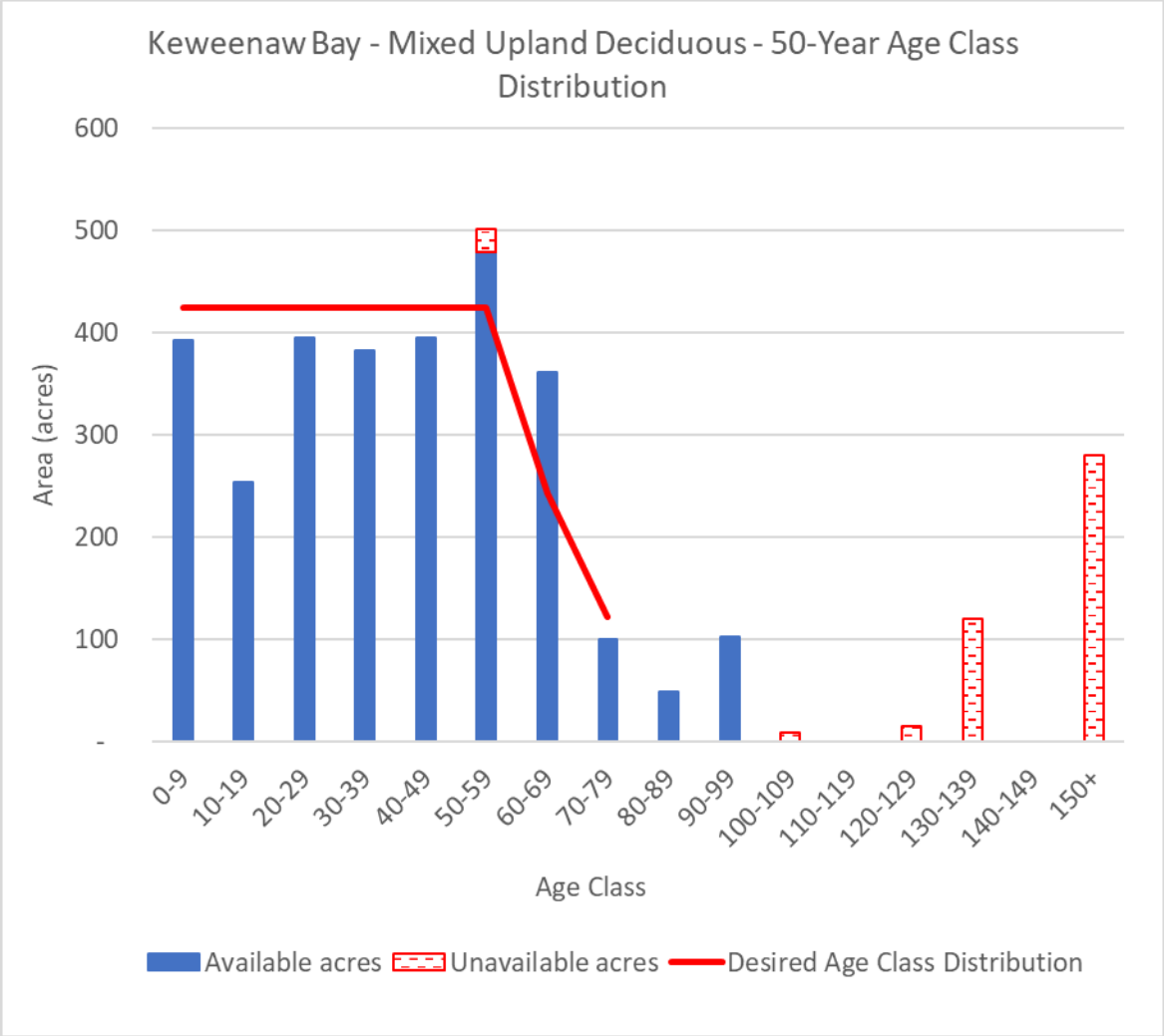


Figure 23. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of mixed upland deciduous acres working toward the desired future condition as the older age classes are treated (Figure 23).

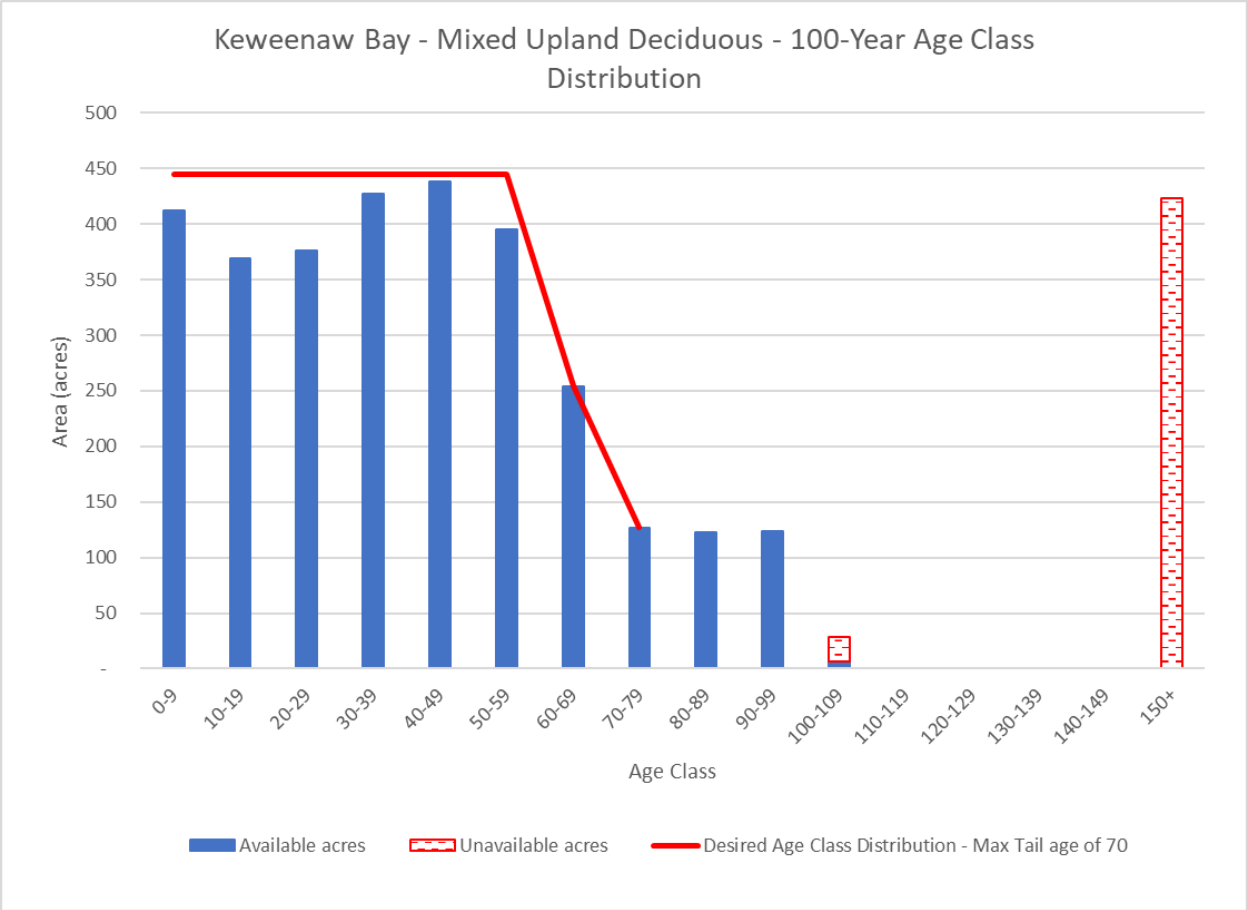


Figure 24. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 24) will concentrate the manageable acres of mixed upland deciduous in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged, and mature forest.

Management actions

There are 347 acres of clearcut, and 53 acres of selection harvests projected in the mixed upland deciduous cover type. It is expected that about 84 acres of mixed upland deciduous will be converted from other cover types. These total to an expected 484 acres of regeneration in the mixed upland deciduous cover type over the next 10 years.

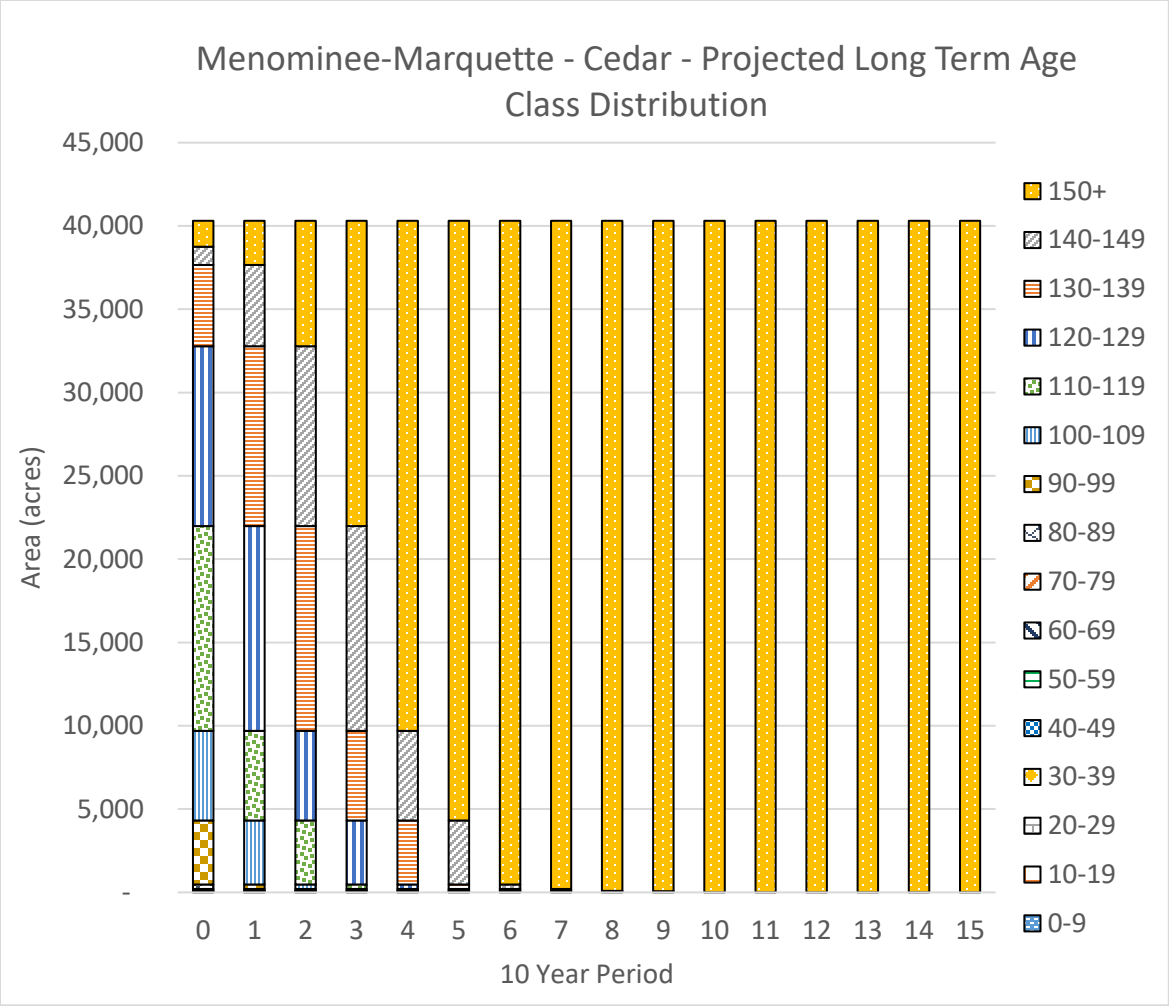


Figure 25. Projected age class distribution over 15, 10-year planning periods.

Conservation area network

High conservation value areas

There are up to nine different HCVA types that can be found in each management area (Table 14; see Biodiversity in Section 3 for more information).

Table 14. High conservation value areas within the Keweenaw Bay management area.

High Conservation Value Area Type and Name	Acres
Coastal Environmental Areas	**39**
Dedicated Management Areas	**2,268**
Deer Wintering Complex	**9,733**
Northern Long-Eared Bat Hibernacula 2.5 mile Buffer	**1**
Taylor Adit	1
Grand Total	**12,041**

Ecological reference areas

Ecological Reference Areas (ERAs) are a type of HCVA and are higher quality examples of functioning ecosystems that are primarily influenced by natural ecological processes.

Table 23. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 24. Ecological reference areas within the management area

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	Number of Occurrences
Existing ERA	Boreal forest		GU	S3	1
Existing ERA	Great Lakes marsh	B			1
Existing ERA	Intermittent wetland	AB			1

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	Number of Occurrences
Existing ERA	Pine barrens	D	G3	S2	1
Existing ERA	Sandstone bedrock lakeshore	AB			4
Existing ERA	Sandstone bedrock lakeshore	B			1
Existing ERA	Sandstone cobble shore	AB			2
Existing ERA	Sandstone lakeshore cliff	AB			2
Proposed ERA	Boreal forest	BC	GU	S3	2
Proposed ERA	Granite bedrock glade	A	G3G5	S2	1
Proposed ERA	Sandstone cobble shore	B	G2G3	S2	
Proposed ERA	Sandstone lakeshore cliff	AB	G3	S2	1
Grand Total					**17**

Special conservation areas

Reviewable special conservation areas (SCAs; Table 17) refers to those SCA types that may be reviewed or updated through the compartment review process as needed. Static SCAs (Table 18) refers to those SCA types that generally do not change or require updating (see Biodiversity in Section 3 for more information).

Table 17. Reviewable special conservation areas within the Keweenaw Bay management area.

Reviewable Special Conservation Area Type and Name	Acres
Concentrated Recreational Area	**36**
Big Eric's Bridge Campground	6
Sturgeon River	30
Mineral Resource Area	**30**
Baraga County Road Commission	30
Spring, Wetlands, or Riparian Areas	**91**
Six Mile Creek	91
Grand Total	**156**

Table 18. Static special conservation areas within the Keweenaw Bay management area.

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Common Natural Heritage Element Occurrences		**31**
Mesic Northern Forest		31
Designated Trout and Cold Water Stream Buffer		**865**
Unnamed		397
Black Creek		37
Boyles Creek		6
Burns Creek		26
East Branch Huron River		6

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Falls River		25
Fossom Creek		50
Gristmill Creek		9
Hazel Creek		17
Hershley Creek		22
Huron River		49
Little Huron River		19
Menge Creek		12
Mustard Creek		10
Nesters Creek		29
Ogemaw Creek		2
Silver River		19
Sixmile Creek		113
Taylor Creek		16
West Branch Huron River		3
Designated Trout and Coldwater Streams	**32.1**	
	14.7	
Black Creek	1.4	
Boyles Creek	0.2	
Burns Creek	0.9	
East Branch Huron River	0.3	
Falls River	1.0	
Fossom Creek	1.8	
Gristmill Creek	0.3	
Hazel Creek	0.6	
Hershley Creek	0.8	
Huron River	1.7	
Little Huron River	0.8	
Menge Creek	0.4	
Mustard Creek	0.4	
Nesters Creek	1.0	
Silver River	0.8	
Sixmile Creek	4.1	
Taylor Creek	0.6	
West Branch Huron River	0.1	
Important Bird Areas		**5,822**
Baraga Plains		5,822
Wild and Scenic Rivers	**0.0**	
Sturgeon Wild and Scenic River	0.0	
Wood Turtle Stream 100ft Buffer		**73**
Nesters Creek		27
Sturgeon River		42

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
West Branch Huron River		4
Wood Turtle Stream 660-foot buffer		**429**
Nesters Creek		189
Sturgeon River		212
West Branch Huron River		27
Grand Total	**32.1**	**7,220**

Rare species

Rare species occurrences are compiled from the Michigan Natural Features Inventory Biotics database (Tables 20 and 21) and do not necessarily include all rare species found in this management area due to biases in survey effort and verifiable observation reporting over time.

Table 25. Rare animal and plant species conservation status key.

Status	Status
E = endangered	LE = listed endangered
T = threatened	LT = listed threatened
SC = special concern	PDL = proposed for delisting

Table 20. Rare animal species occurrence within the Keweenaw Bay management area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Alces alces*	Moose	SC	--	--
Animal	Boloria freija	Freija fritillary	SC	--	1
Animal	Boloria frigga	Frigga fritillary	SC	--	1
Animal	Bombus borealis	Northern amber bumble bee	SC	--	2
Animal	Bombus sandersoni	Sanderson's bumble bee	SC	--	1
Animal	Bombus terricola	Yellow banded bumble bee	SC	--	3
Animal	Brachionycha borealis	Boreal brachionyncha	SC	--	1
Animal	Canachites canadensis	Spruce grouse	T	--	1
Animal	Canis lupus*	Gray wolf	SC	LE	--
Animal	Erebia discoidalis	Red-disked alpine	SC	--	1
Animal	Glyptemys insculpta	Wood turtle	T	--	2

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Lithobates palustris	Pickerel frog	SC	--	1
Animal	Necturus maculosus	Mudpuppy	SC	--	2
Animal	Opheodrys vernalis	Smooth green snake	SC	--	2
Animal	Picoides arcticus	Black-backed woodpecker	SC	--	1
Animal	Setophaga kirtlandii	Kirtland's warbler	E	--	1
Total	--	--	--	--	**20**

Table 21. Rare plant species occurrence within the Keweenaw Bay management area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Plant	Cerastium brachypodum	Shortstalk chickweed	T	--	1
Plant	Galearis spectabilis	Showy orchis	T	--	1
Plant	Littorella uniflora	American shore-grass	SC	--	1
Plant	Piptatherum canadense	Canada rice grass	T	--	1
Plant	Ribes oxyacanthoides	Northern gooseberry	SC	--	1
Total	--	--	--	--	**5**

Non-ERA natural communities

Natural communities that are identified with an element occurrence in the MNFI Biotics database, but that have not been given an additional ecological reference area (ERA) designation, are recognized and managed accordingly (Table 23).

Table 26. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 23. Non-ERA natural communities within the Keweenaw Bay management area

Community Type	Element Occurrence Rank	State Rank	Global Rank	Number of Occurrences
Mesic Northern Forest	**AB**	S3		1
Grand Total				**1**

Forest health

Forest health concerns, both native and non-native, can have impacts on stand conditions and management decisions. The following insects (Table 24) and diseases (Table 25) could have an impact on management during the planning period and may need to be monitored and/or addressed.

Table 24. Defoliating insects of concern in the Keweenaw Bay management area.

Common Name	Scientific Name	Native/non-native	
Spongy moth	Lymantria dispar	Non-native	Yes
Forest tent caterpillar	Malacosoma disstria	Native	Yes
Large aspen tortrix	Choristoneura conflictana	Native	Yes
Spruce budworm	Choristoneura fumiferana	Native	Yes
Jack pine budworm	Choristoneura pinus	Native	Yes
Redheaded pine sawfly	Neodiprion sertifer	Non-native	No

Watch for lingering ash with potential resistance to emerald ash borer.

Table 25. Maladies of concern in the Keweenaw Bay management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Canker	Various	Various	Yes
Armillaria root rot	Armillaria spp.	Native	Yes
Oak wilt	Bretziella fagacearum	Non-native	No

Aquatic resources

Riparian habitat

A total of 27 miles of streams and rivers are found in the management area (Table 26). Streams/rivers classified as cold types comprise approximately 78 percent of the riverine mileage.

Table 26. Classification type and length of streams/rivers found within the management area.

Type	Length (miles)
Cold stream	20
Cold small river	1
Cold transitional stream	0
Cold transitional small river	0
Cold transitional large river	0
Warm transitional stream	1
Warm transitional small river	3
Warm transitional large river	2
Warm stream	0
Warm small river	0
Warm large river	0

Lacustrine Habitat

A total of two lakes and ponds of at least one surface acre are found in the management area (Table 27).

Table 27. Size and number of lakes and ponds located within the management area.

Lake Size Class (acres)	Number
1-99	1
100-499	1
500+	0

Wetlands

A total of 2,313 acres of wetlands are found in the management area (Table 28). Forested wetlands comprise approximately 86 percent of wetland types found in the management area.

Table 28. Area of emergent, forested, and riverine wetland types found within the management area.

Wetland Type	Acres
Emergent	222
Forested	1,991
Riverine	100

Vernal pools and seeps

A total of 217 acres of vernal pools and seeps have been inventoried in the management area while no areas of seeps have been identified.

Riparian vegetation cover

Northern hardwood, aspen, mixed upland deciduous and upland mixed forest are the predominant cover types present in a 100-meter riparian zone located next to streams/rivers in the management area (Table 29).

Table 29. Largest vegetative cover types (i.e., top 10) and area located in a 100-meter buffer of streams/rivers within the management area.

Cover Type	Acres
Northern Hardwood	730
Aspen	537
Mixed Upland Deciduous	416
Lowland Conifers	338
Upland Mixed Forest	281
Hemlock	276
Upland Conifers	271
Cedar	143
Marsh	127
Natural Mixed Pines	80

Watershed vegetation cover

The management area includes portions of important watersheds of the Huron River and Sturgeon River (Tables 30 and 31). Northern hardwood and aspen are major cover types of the state forest in each watershed.

Table 30. Largest vegetative cover types (i.e., top 5) and area of the Huron River watershed located within the management area.

Cover Type	Acres
Northern Hardwood	980
Lowland Conifer	485
Aspen	474

Cover Type	Acres
Mixed Upland Deciduous	244
Upland Conifer	156

Table 31. Largest vegetative cover types (i.e., top 5) and area of the Sturgeon River watershed located within the management area.

Cover Type	Acres
Aspen	2,601
Natural Jack Pine	2,565
Northern Hardwood	2,190
Planted Jack Pine	1,525
Upland Mixed Forest	960

Recreation

Most of this management area has good access for public recreation and management, although there are some smaller, isolated parcels. Motorized vehicle trails include multiple snowmobile trails and the Baraga Plains ORV trail that loops through the area. Nearly 10 miles of the North Country National Scenic Trail/Iron Belle Trail crosses the south end of this MA. There are state forest campgrounds (rustic) at Big Lake and on the Huron River.

Table 32. Designated recreation trails by type.

Recreation Category	Recreation Type	Number of Miles
Motorized Recreation Trails	ORV (all types)	28
Motorized Recreation Trails	Snowmobile	19.9
Non-motorized Recreation Trails	Hiking	9.9
Non-motorized Recreation Trails	Equestrian	0
Non-motorized Recreation Trails	Biking	0
Non-motorized Recreation Trails	Hunter Walking Trails	0
Total	--	**58.3**

Note: Trail use types may overlap.

Table 33. State forest campgrounds

Name	Number of Sites	ORV Access
Big Eric's Bridge campground	21	--
Big Lake campground	15	--

Baraga Plains State Waterfowl (Wildlife) Management Area is located adjacent to USDA Forest Service land. The wildlife management area includes clearings for goose management and a wildlife refuge which is closed seasonally. The area is well-used by waterfowl hunters in the fall.

Boating access sites provide access to the Huron, Sturgeon and Silver rivers, as well as at Big Lake campground.

Table 34. Areas Managed for Hunting

Type	Name	Number of Acres
State Wildlife Management Areas	Baraga Plains SWMA	12,844.8

Table 35. Boating access sites (BAS).

Name	Waterbody
Big Eric's Bridge campground	Huron River
Big Lake campground	Big Lake
Silver River Falls	Silver River
Silver River	Silver River
Sturgeon River	Sturgeon River

Menominee-Marquette

State Forest Area: 196,600 acres	Location: Central Upper Peninsula	Population Centers: Marquette, Menominee
Sub-Section: West Green Bay Till Plain	Landforms: Broad till plain (ground moraine), drumlins oriented northeast-southwest	Landcover: Forested: 177,784 acres Non-forested: 18,816 acres

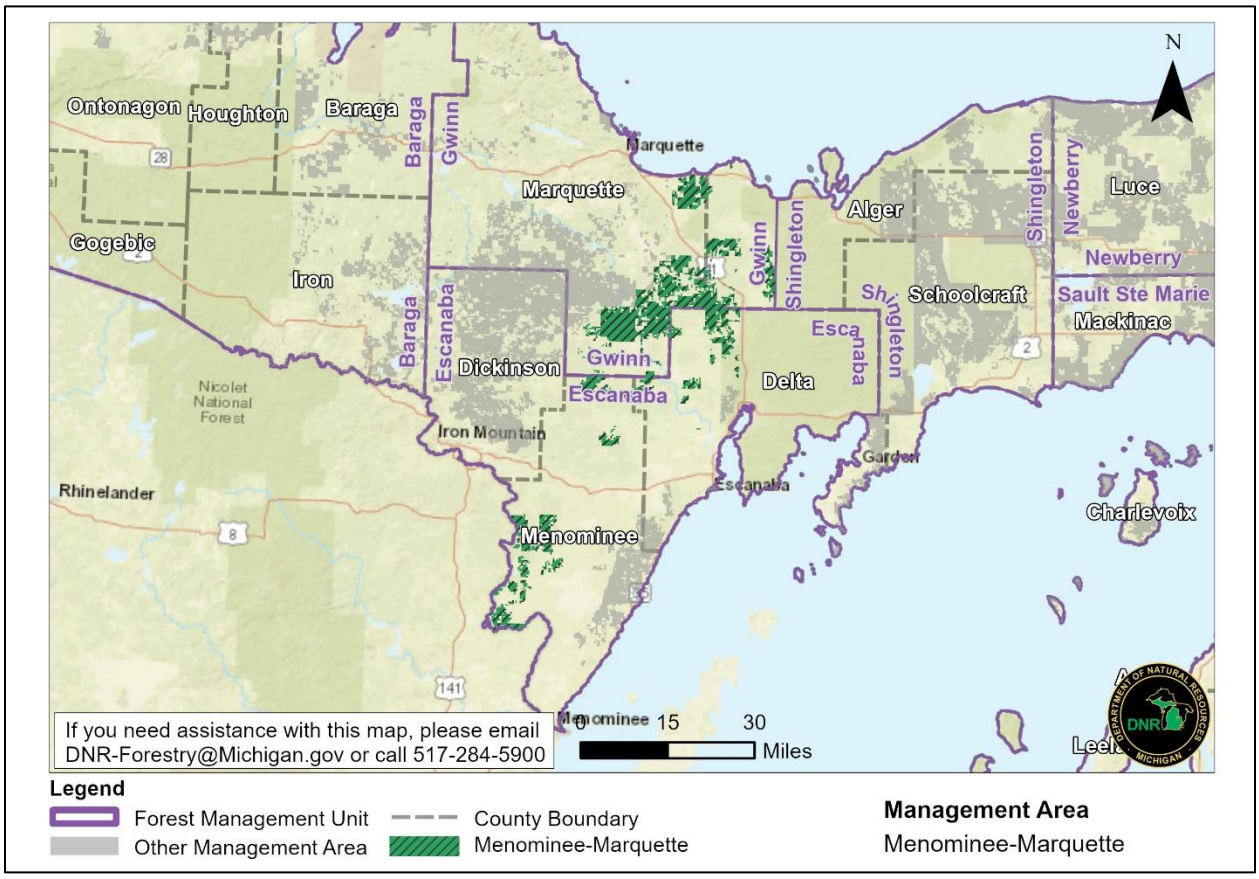


Figure 1. Map of the Menominee-Marquette management area.

Forested landscape

Current condition

The Menominee-Marquette management area is dominated by shade-tolerant cover types. Intolerant upland cover types are relatively evenly distributed across the age categories, while the unavailable upland and lowland acres are more prevalent in the older age category.

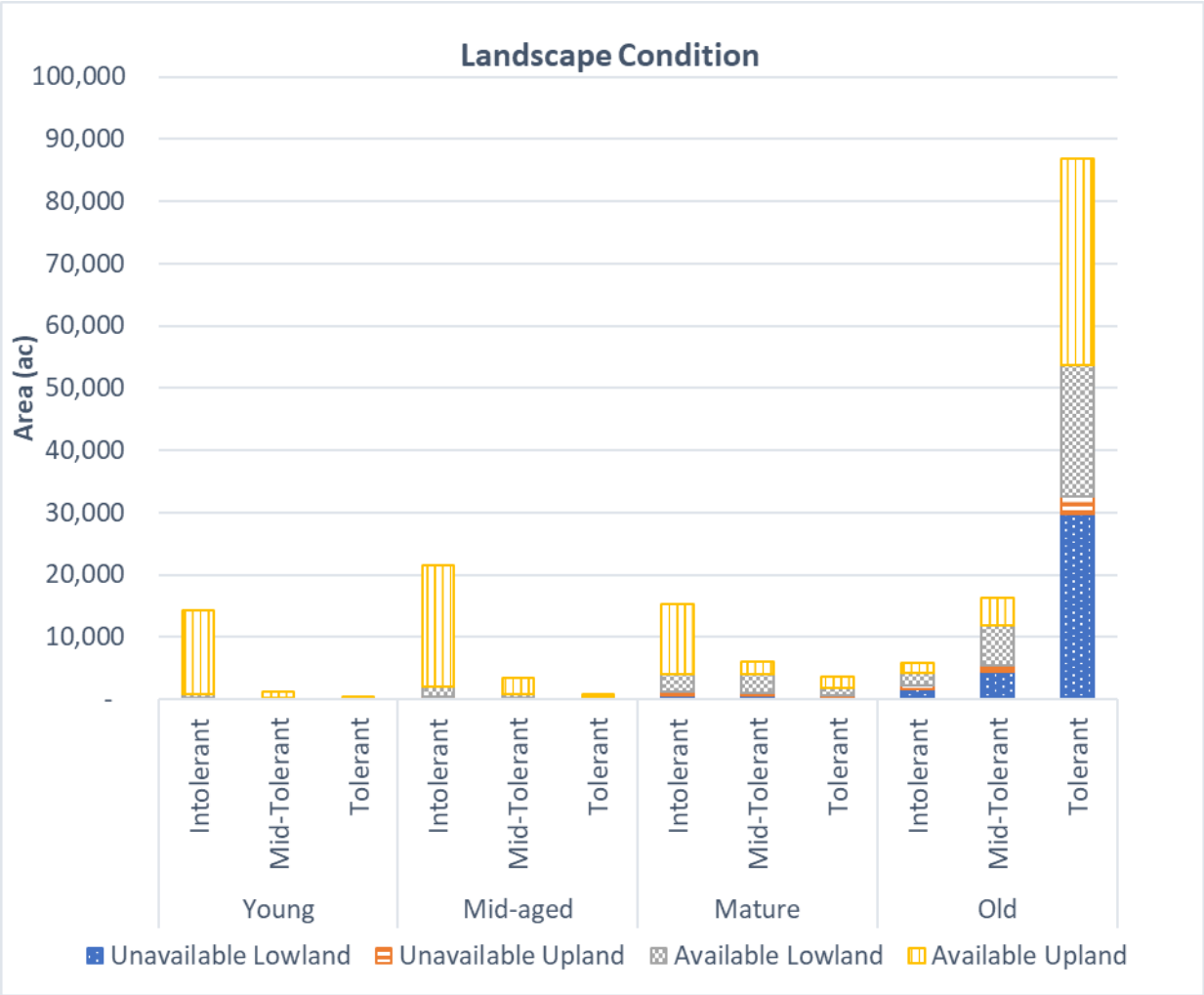


Figure 2. Forest diversity matrix showing the current distribution of forested acres across management availability, age category, landscape position and shade tolerance.

Landscape habitat conditions refine the management area landscape into featured species habitat context. Current and projected acres for the metrics identified in the management priorities (Section 3 Statewide/Regional) establish a baseline and future condition based on management over the planning period (Table 1).

Table 1. Current and projected acres for landscape habitat conditions.

Landscape Habitat Condition	Monitoring Metric	Current Acres
Young forest	Acres of 0-19 stands in aspen and jack pine	13,475
Mature forest	Acres of 80+ year stands across cover types	109,033
Mature forest	Acres of 120+ year stands across cover types	62,750
Mesic conifer cover types	Acres of mesic conifer cover types	6,045
Mesic conifers in other cover types	Average canopy occupancy	18%
Mast – oak cover types	Acres of oak cover types	1,546
Mast tree species in other cover types	Acres of total canopy occupancy of mast tree acres (Trace-100%)	45,615
Big trees	Acres of total canopy stand occupancy of species in sawlog or greater size class	70,841
Non-forested openings	Acres of total herbaceous open land, upland shrub and cropland	3,618
Landscape forest matrix	Percent deciduous forest	54%
Landscape forest matrix	Percent coniferous forest	38%

Another important landscape level habitat in the area is coastal habitat. The Great Lakes, particularly coastal and nearshore areas, provide globally or continentally important stopover sites for all groups of migratory birds: waterfowl, shorebirds, landbirds (defined here as songbirds and raptors), and waterbirds (loons, grebes, cormorants, herons, rails, cranes, gulls, and terns) (Ewert, et. Al 2012). The Great Lakes shoreline provides essential stopover habitat for birds to rest, feed, and shelter during migration. In addition to migration, the diverse coastal habitats where water and land meet provides unique habitats for breeding birds. Some of these areas are classified by Michigan Audubon as Important Bird Areas. The Great Lakes shoreline is habitat for several rare plant species that are endemic to the Great Lakes.

Forest management and other intrusive activities within a mile of the coastline need to consider the potential impacts to migratory birds and breeding bird habitat.

The Menominee-Marquette management area has the following Special Analysis Units. These SAUs have specific cover type goals, typically associated with wildlife habitat management. For any SAUs that overlap with this MA, SAU cover type goals take priority as the SFMP model strives to meet the cover type goals across the management area.

- Deer Wintering Complex -Arnold-Ford River
- Deer Wintering Complex -Dead Horse-North Perkins

The Menominee-Marquette management area is dominated by forested cover types, with 90 percent of the area covered in forested stands (Table 2). The upland deciduous portion of that is 44 percent of the

management area and is comprised mostly of aspen. The upland coniferous portion is 4 percent and comprised mostly of upland conifer. Lowland shrub is the most common non-forested cover type in this management area, representing 5 percent of the landscape.

Table 2. Summary table describing the landscape conditions and distribution of cover types in the Menominee-Marquette management area.

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
Forested	Upland	Deciduous	Aspen	45,266	86,364	98,022	177,784
			Northern Hardwood	35,323			
			Black Red Hybrid Oak	94			
			Northern Red Oak	842			
			Oak Mix	611			
			Mixed Upland Deciduous	4,229			
		Mixed	Upland Mixed Forest	4,269	4,269		
		Coniferous	Planted Red Pine	665	7,389		
			Planted Jack Pine	153			
			Planted White Pine	0			
			Planted Mixed Pine	0			
			Natural Red Pine	495			
			Natural Jack Pine	24			
			Natural White Pine	1,016			
			Natural Mixed Pines	409			
			Upland Spruce/Fir	1,077			
			Upland Conifers	1,810			
			Hemlock	1,742			
	Lowland	Deciduous	Lowland Aspen/Balsam Poplar	1,791	9,946	79,762	
			Lowland Deciduous	8,155			
		Mixed	Lowland Mixed Forest	8,813	8,813		
		Coniferous	Cedar	40,304	61,003		
			Lowland Conifers	12,971			
			Lowland Spruce/Fir	3,952			
			Tamarack	3,775			
Nonforested	Upland	N/A	Herbaceous Openland	2,666	N/A	4,401	18,816
			Upland Shrub	563			
			Low Density Trees	397			
			Bare/Sparsely Vegetated	126			
			Cropland	389			
			Urban	259			
	Lowland	N/A	Lowland Shrub	8,978	N/A	14,415	
			Marsh	1,473			
			Bog	546			
			Treed Bog	2,359			
			Water	1,059			
						Grand Total	196,600

There are 133,611 acres (68.4 percent of the total management area and 75.6 percent of the forested area) that can be managed toward desired future conditions via commercial timber harvest in the area (Table 3). Of that, 25 percent is in the aspen cover type, 19 percent is in northern hardwood, 9 percent in cedar, and 5 percent in lowland conifer. The remaining 19 cover types represent about 42 percent of the forested and available land in the management area.

Table 3. Summary table describing the landscape conditions and cover type composition of the Menominee-Marquette management area.

MENOMINEE-MARQUETTE						
Forested Cover Type	Available Acres	Available %	Unavailable Acres	Unavailable %	Total Acres	Total %
Aspen	43,863	24.7%	1,407	0.8%	45,270	25.5%
Black-red hybrid oak	94	0.1%	0	0.0%	94	0.1%
Cedar	15,467	8.7%	24,839	14.0%	40,306	22.7%
Hemlock	954	0.5%	788	0.4%	1,742	1.0%
Lowland aspen/balsam poplar	1,684	0.9%	108	0.1%	1,791	1.0%
Lowland conifers	7,795	4.4%	5,178	2.9%	12,972	7.3%
Lowland deciduous	5,145	2.9%	3,011	1.7%	8,156	4.6%
Lowland mixed forest	6,237	3.5%	2,577	1.4%	8,814	5.0%
Lowland spruce/fir	2,658	1.5%	1,295	0.7%	3,953	2.2%
Mixed upland deciduous	3,618	2.0%	612	0.3%	4,231	2.4%
Natural jack pine	0	0.0%	24	0.0%	24	0.0%
Natural mixed pines	409	0.2%	0	0.0%	409	0.2%
Natural red pine	478	0.3%	18	0.0%	495	0.3%
Natural white pine	1,000	0.6%	15	0.0%	1,016	0.6%
Northern hardwood	33,071	18.6%	2,255	1.3%	35,326	19.9%
Northern red oak	764	0.4%	78	0.0%	842	0.5%
Oak mix	611	0.3%	0	0.0%	611	0.3%
Planted jack pine	153	0.1%	0	0.0%	153	0.1%
Planted red pine	665	0.4%	0	0.0%	665	0.4%
Tamarack	2,859	1.6%	917	0.5%	3,776	2.1%
Upland conifers	1,279	0.7%	532	0.3%	1,811	1.0%
Upland mixed forest	3,972	2.2%	297	0.2%	4,270	2.4%
Upland spruce/fir	835	0.5%	242	0.1%	1,077	0.6%
Grand Total	**133,611**	**75.1%**	**44,191**	**24.9%**	**177,802**	**100.0%**

Table 4. Site condition (reason area is unavailable for commercial harvest) acres for the Menominee-Marquette management area.

Site Condition (Reason area is unavailable for commercial harvest)	Area (ac)	% of Unavailable Area
Wildlife concerns	13,657	30.9%
BMPs	7,887	17.8%
Conservation values	6,434	14.6%
Deer wintering area	4,267	9.7%
Unproductive	3,249	7.4%
Natural/quiet/wilderness area	2,432	5.5%
Too wet	2,028	4.6%
Cannot regenerate	1,530	3.5%
Blocked by obstacle	1,234	2.8%
Long-term retention	815	1.8%
Other influence zones	274	0.6%
Other dept./div. Processes	223	0.5%
Historical/archaeological	66	0.1%
Too steep	50	0.1%
Denied access	34	0.1%
Species of special concern or T&E	11	0.0%
Total unavailable	**44,191**	**100.0%**

Management actions

Each cover type in the Menominee-Marquette management area has a unique age class and basal area class goals that describe the long-term desired future conditions. The harvests levels that are needed in the first planning period to begin achieving those long-term goals are summarized below (Table 5).

Table 5. Ten-year planning period harvest goals (acres) by cover type and silvicultural regime.

Silvicultural Regimes								
Cover Type	**Clearcut**	**Selection**	**Thinning**	**Group Selection**	**Shelterwood**	**Salvage Clearcut**	**Salvage Thinning**	**Grand Total**
Northern hardwood	458	8,210	-	-	227	-	-	8,895
Aspen	6,663	-	-	-	-	-	-	6,663
Lowland conifers	947	-	-	-	-	-	-	947
Mixed upland deciduous	803	44	-	-	78	-	-	925
Upland mixed forest	918	-	-	-	-	-	-	918
Lowland mixed forest	659	-	-	-	-	-	-	659
Lowland deciduous	409	20	-	-	11	-	-	440
Lowland aspen/balsam poplar	401	-	-	-	-	-	-	401
Upland spruce/fir	160	-	-	-	-	-	-	160
Upland conifers	75	-	-	-	22	-	-	97
Planted red pine	-	-	89	-	-	-	-	89
Hemlock	-	82	-	-	-	-	-	82
Natural white pine	-	-	44	-	22	-	-	66
Natural mixed pines	-	-	58	-	6	-	-	64
Northern red oak	9	-	-	-	-	-	-	9
Black-red hybrid oak	6	-	-	-	-	-	-	6
Tamarack	6	-	-	-	-	-	-	6
Totals	**11,515**	**8,356**	**190**	**-**	**367**	**-**	**-**	**20,427**

These harvests will help establish a desirable amount of regeneration for the even-aged cover types over the 10-year period or help to achieve desired basal area distribution among uneven-aged cover types like northern hardwoods. The following sections will provide additional details for each of the significant cover types in the area.

Table 6. Ten-year 10 year estimated harvest volume by product and species for the Menominee-Marquette management area.

10-Year Estimated Harvest Volume Projection Menominee-Marquette Management Area			
Product	**Species**	**Volume Planned***	**Volume Prepared****
Pulpwood (cords)	Mixed Hardwood	73,904	69,470
	Mixed Aspen	59,970	56,372
	Mixed Softwood	28,432	26,726
	Mixed Spruce	14,292	13,434
	White Pine	3,055	2,872
	Mixed Oak	2,720	2,557
	Red Pine	2,641	2,482
	Jack Pine	1,335	1,255
	Pulpwood Total	**186,350**	**175,169**
Sawtimber (MBF)	Sugar Maple	24,512	23,041
	Red Maple	11,824	11,114
	Mixed Aspen	10,952	10,295
	White Pine	7,630	7,172
	Red Pine	5,619	5,282
	Red Oak	4,589	4,313
	Basswood	3,025	2,843
	White Oak	795	748
	Mixed Oak	318	299
	Sawtimber Total	**69,263**	**65,107**
	Total Sawtimber Harvest Volume in Cords	**146,123**	**137,356**
	Grand Total Harvest Volume in Cords	**332,473**	**312,524**

* Volume estimates based on 100% of the projected harvests for the 10 year planning period.

** Volume estimates based on 94% of the projected harvests for the 10 year planning period accounting for reduction in acres and associated volume once sales are prepared for bid.

There are very few cover type transitions projected in the Menominee-Marquette management area. The managed area of each cover type is projected to remain relatively stable. The largest decrease forecasted is in the mixed upland deciduous cover type, where 192 acres are expected to convert to other cover types through forest management activities. The largest increase is in upland mixed forest, where 320 acres are expected to convert into that cover type.

Table 7. Projected 10-year cover type acres resulting from cover type transitions.

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Aspen	45,266	45,429	163
Cedar	40,304	40,304	0
Northern hardwood	35,323	35,148	-175
Lowland conifers	12,971	12,782	-189
Lowland mixed forest	8,813	9,080	267
Lowland deciduous	8,155	7,991	-164
Upland mixed forest	4,269	4,589	320
Mixed upland deciduous	4,229	4,037	-192
Lowland spruce/fir	3,952	4,008	55
Tamarack	3,775	3,774	-1
Upland conifers	1,810	1,703	-107
Lowland aspen/balsam Poplar	1,791	1,823	32
Hemlock	1,742	1,742	0
Upland spruce/fir	1,077	968	-109
Natural white pine	1,016	1,034	19
Northern redoOak	842	841	-1
Planted red pine	665	715	50
Oak mix	611	611	0
Natural red pine	495	495	0
Natural mixed pines	409	409	0
Planted jack pine	153	153	0
Black-red hybrid oak	94	94	0
Natural jack pine	24	24	0
Planted mixed pine	0	16	16
Planted white pine	0	16	16
Lowland shrub	8,978	8,978	0
Herbaceous openland	2,666	2,666	0
Treed bog	2,359	2,359	0
Marsh	1,473	1,473	0

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Water	1,059	1,059	0
Upland shrub	563	563	0
Bog	546	546	0
Low density trees	397	397	0
Cropland	389	389	0
Urban	259	259	0
Bare/sparsely vegetated	126	126	0
Total:	**196,600**	**196,600**	**0**

Featured species current and projected habitat acres

There are 13 featured species in this management area that span various cover types, age classes, and stand-level conditions.

It is recommended that these featured species habitat acres be viewed as acres of potential habitat, representing a condition on the landscape where the more nuanced aspects of each species' habitat requirements are likely to be found or managed for. As described in the introduction, the modeling effort was limited by several factors including the simplification of habitat attributes into MiFI variables. Current and projected total habitat acres by species across the decade provide a baseline and show the result of long-term management actions (Table 8). Some species show a loss in habitat over the next century. The current condition for many cover types is a surplus of acres in the 0-9 age class from the compensatory management approach applied in the previous decade. The model eventually evens out the age classes at a lower, sustainable level over time, usually by 50 years. For any species with northern hardwoods as a priority cover type, there is a perceived drop in acres between 40-60 years; this is due to the basal area dropping below 81. Because it only drops into the upper 70s, it is not expected to translate to any real habitat loss on the ground. Three of these species were not included in the SFMP model but are included here to inform management decisions over the decade.

Table 8. Featured species current and projected total habitat acres (i.e., potential habitat).

Featured Species	Priority Cover Types	Total Habitat Acres Current	10-year Projected Habitat Acres	50-year Projected Habitat Acres	100-year Projected Habitat Acres
American woodcock	Aspen, lowland aspen, lowland deciduous	18,214	17,194	14,899	15,187
Black bear	Generalist/mast	45,615	--	--	--
Black-backed woodpecker	Natural Disturbance	--	--	--	--

Featured Species	Priority Cover Types	Total Habitat Acres Current	10-year Projected Habitat Acres	50-year Projected Habitat Acres	100-year Projected Habitat Acres
Cerulean warbler	Northern hardwoods, mixed upland deciduous, lowland deciduous	36,322	37,824	36,033	35,753
Golden-winged warbler	Aspen, black-red hybrid oak, northern red oak, oak mix, tamarack	18,564	16,468	14,101	14,205
Marten	Northern hardwoods, mixed upland deciduous, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, lowland mixed forest, lowland conifers, hemlock, cedar	79,758	85,788	71,300	84,352
Moose	To be determined	--	--	--	--
Ruffed Grouse	Aspen	16,603	14,947	13,652	13,756
Snowshoe hare	Aspen, cedar, hemlock, lowland aspen, lowland conifers, lowland mixed forest, lowland spruce/fir, mixed upland deciduous, natural jack pine, natural mixed pines, planted jack pine, upland spruce/fir	24,414	24,753	18,757	19,005
White-tailed deer (food)	Northern hardwood, oak mix, aspen, mixed upland deciduous, lowland deciduous, lowland aspen/balsam poplar, lowland mixed forest	103,392	109,589	110,393	110,778
White-tailed deer (shelter)	Hemlock, cedar, planted red pine, planted white pine, planted mixed pine, natural red pine, natural white pine, natural mixed pines, upland conifers, upland spruce fir, lowland conifers	64,440	64,243	63,689	63,720
Wild turkey	Non-forested openings	3,064	--	--	--
Wood turtle	Non-forested openings	--	--	--	--

Cover type composition and associated wildlife species

Aspen

Current condition

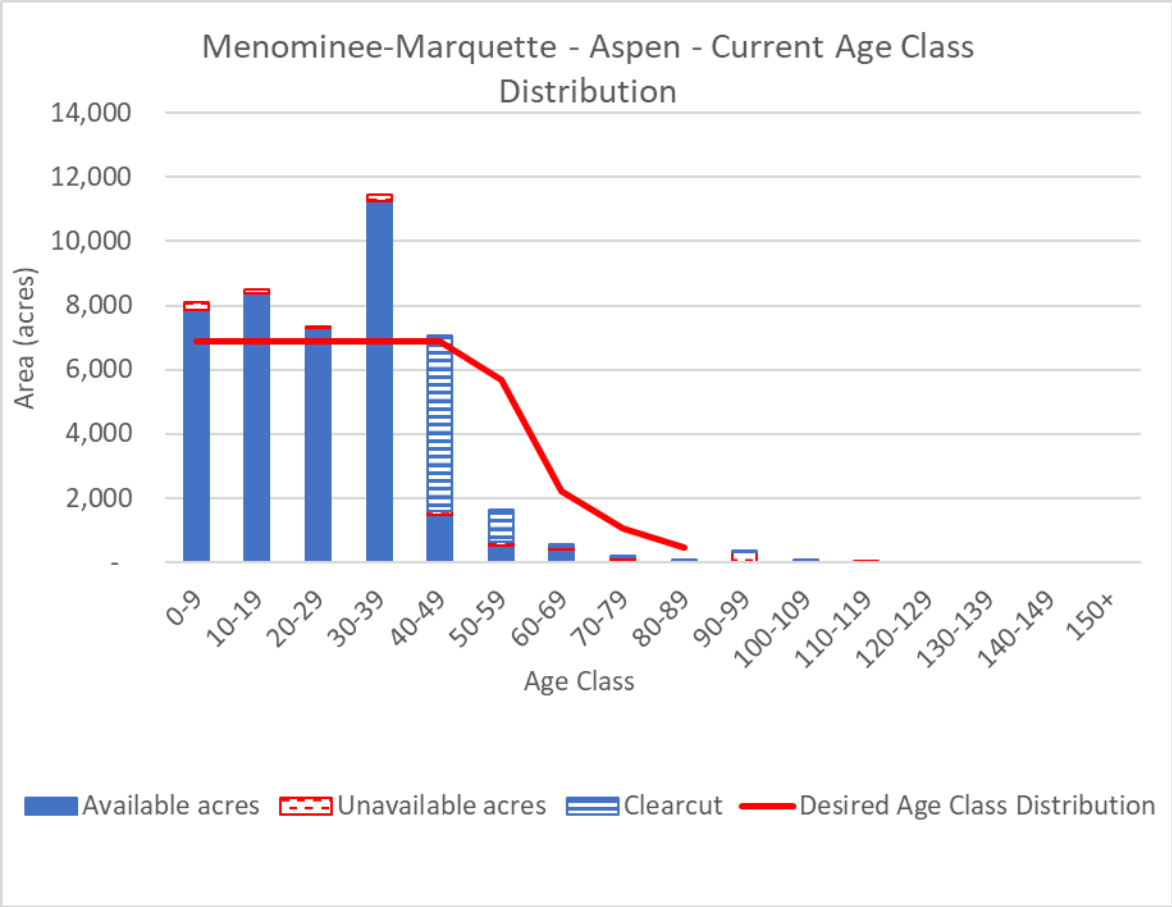


Figure 3. Current age-class distribution, the desired age-class distribution, and the projected harvests in the aspen cover type over the 10-year planning period.

The current age class distribution is unbalanced with a deficit of acres in the 50-89-year-old age classes and a surplus of acres in the 0-49-year-old age classes.

Table 9. Featured species with aspen as a priority habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Aspen	Aspen Habitat Acres - Available	Aspen Habitat Acres - Unavailable
Golden-winged warbler	Age category: 0-19 Size class: Sapling	16,221	382
American woodcock	Age category: 0-19 Size class: Sapling	16,221	382

Featured Species	Featured Species Habitat – Aspen	Aspen Habitat Acres - Available	Aspen Habitat Acres - Unavailable
Ruffed grouse	Age category: 0-19 Size class: sapling	16,221	382
Snowshoe hare	Age category: 0-19 Size class: sapling	16,221	382
White-tailed deer	All ages and size classes	46,266	--

Desired future condition

The desired age class distribution is to have a rotation age of 40 years with approximately 13 percent of the acres in an age class tail out to the 50 year age class, 5 percent of the acres in an age class tail out to the 60 year age class, 2 percent of the acres in an age class tail out to the 70 year age class and 1 percent of the acres in an age class tail out to the 80-year age class.

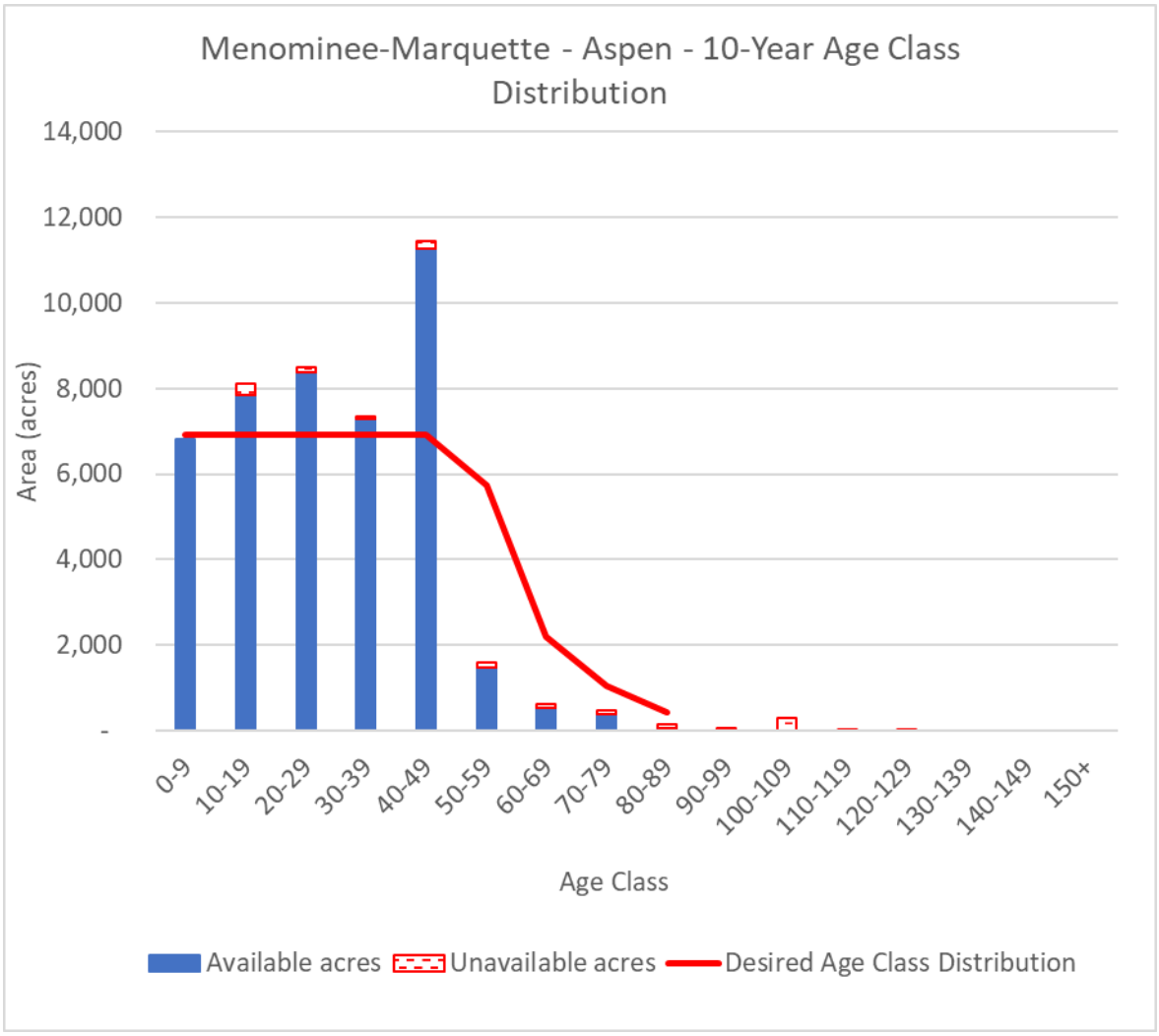


Figure 4. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The end of the planning period will result in the establishment of 6,825 acres of aspen in the upcoming 0-9 age class. Progress toward the long-term desired age class distribution of aspen will take a few decades in this management area.

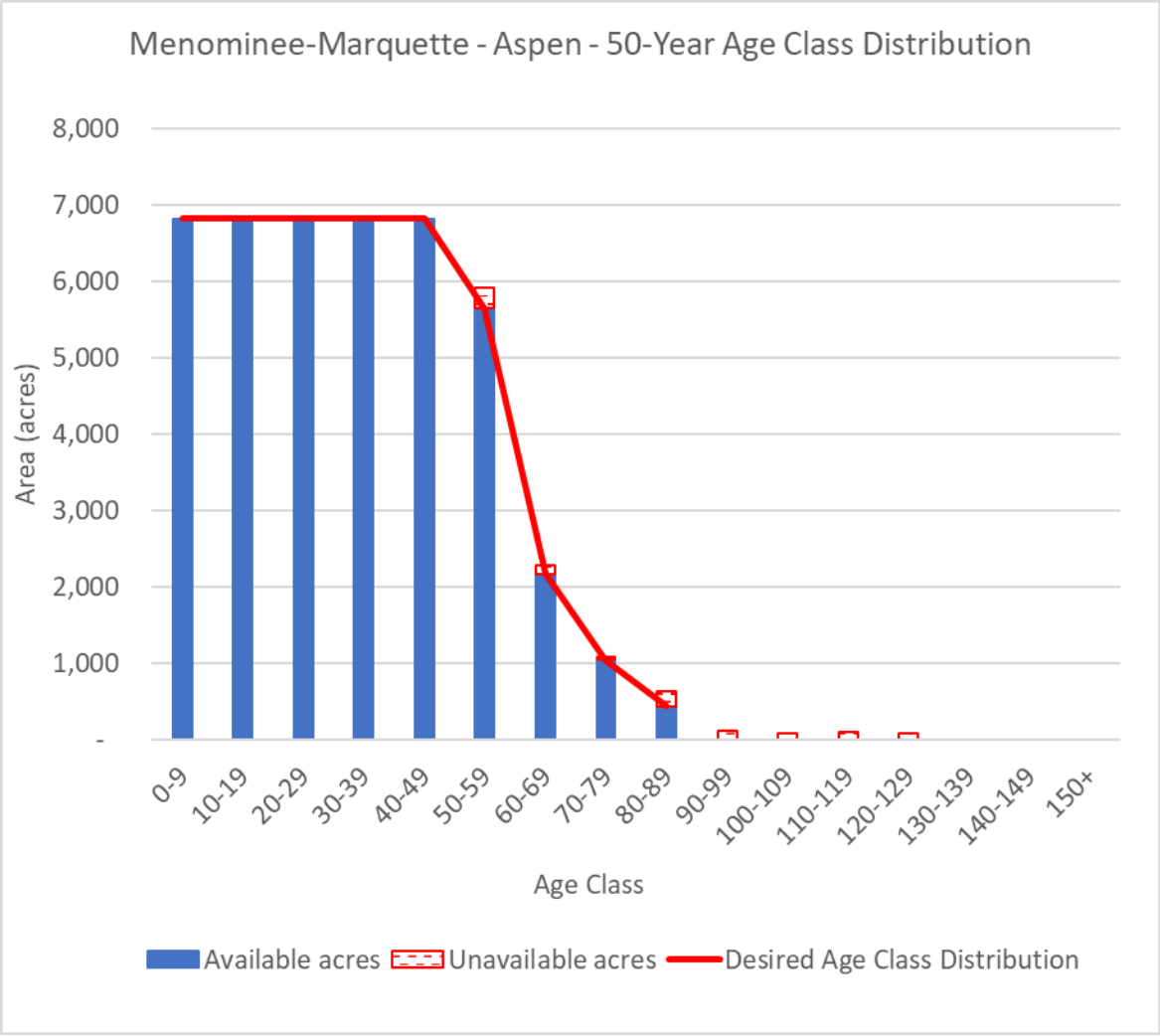


Figure 5. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of aspen acres nearly reaching the desired future condition with few age classes deviating from the target proportions (Figure 5).

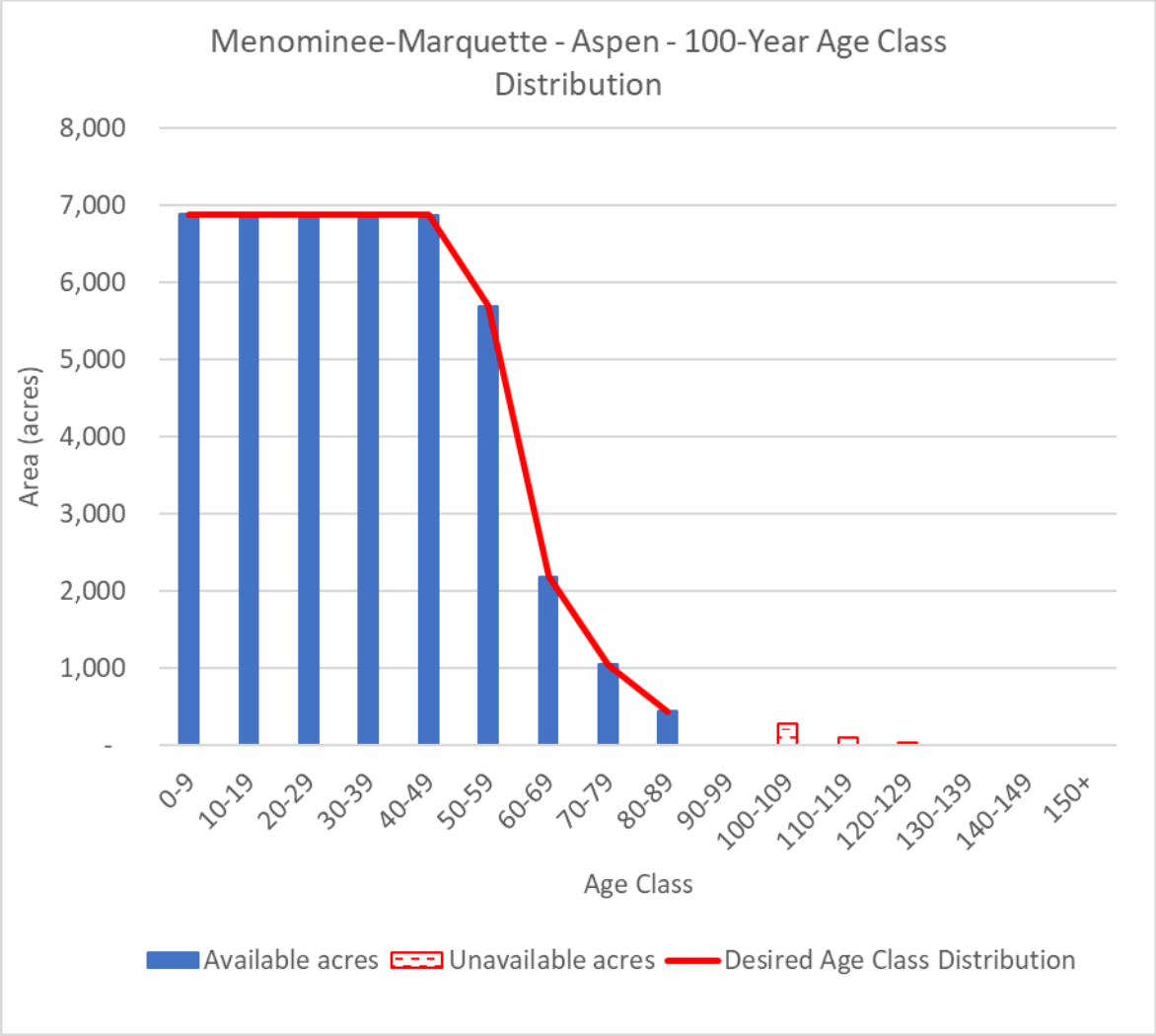


Figure 6. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 6) will concentrate the manageable acres of aspen in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged, and mature forest.

Management actions

There are 6,663 acres of projected clearcut harvest in the aspen cover type. It is expected that about 163 acres of aspen will be converted from other cover types. These total to an expected 6,826 acres of regeneration in the aspen cover type over the next 10 years.

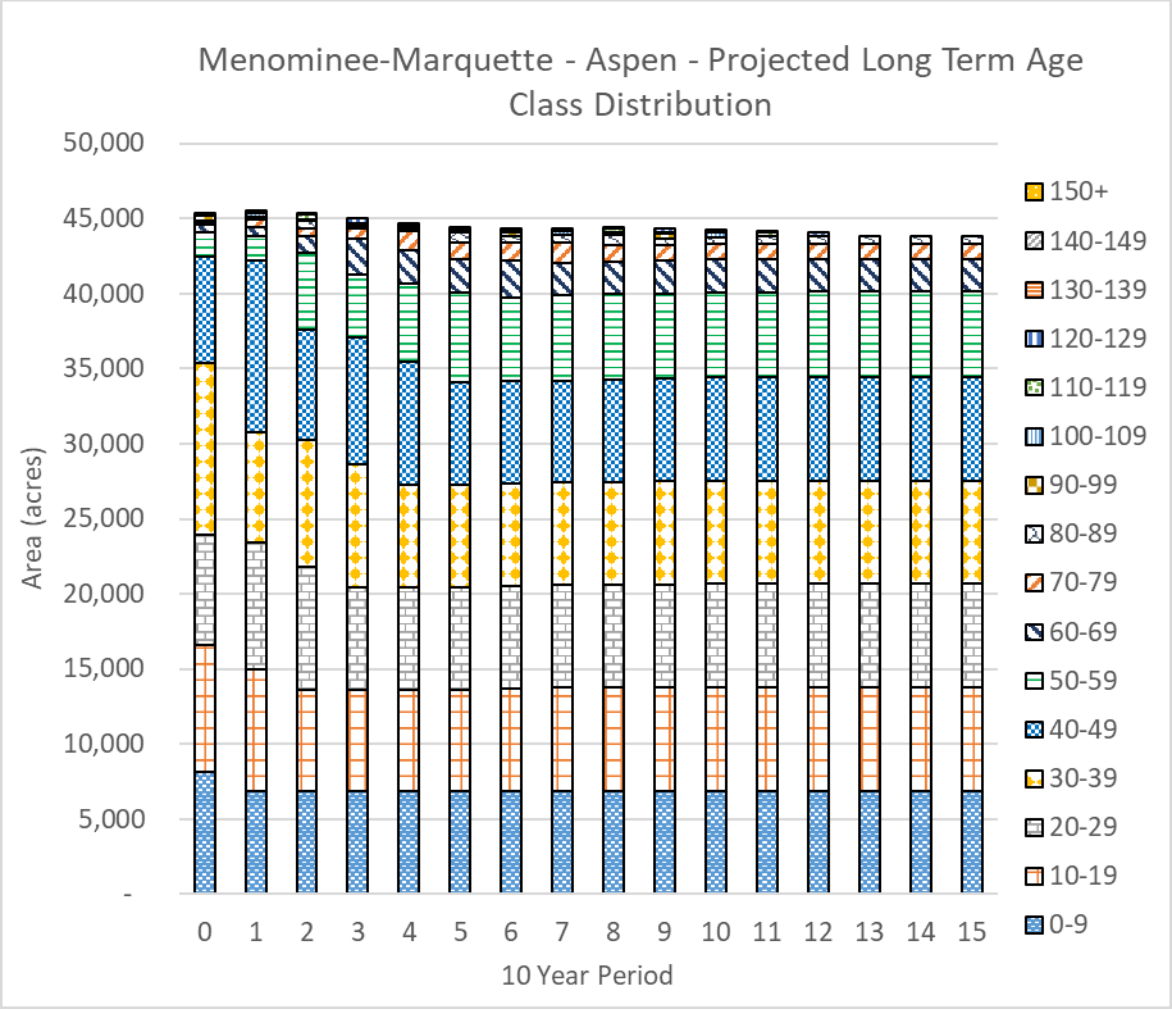


Figure 7. Projected age class distribution over 15, 10-year planning periods.

Northern hardwoods

Current condition

Most of the northern hardwood cover typein the Menominee-Marquette management area is between a stand age of 100-119 years (Figure 8). The past management regime has been primarily single-tree selection, which allows for stand age to continue to increase over time. Some stands are beginning to achieve an uneven-aged condition where a featured stands age becomes less evident, but the dominant age of these stands will likely increase past 150 years old prior to a younger age cohort becoming the prominent component of these stands (Figure 10). A portion of the stands have been managed under an even-aged system due to poor quality stands or a predominance of red maple in those stands. A portion of this cover type meets the habitat requirements for marten, blackburnian warbler, cerulean warbler and white-tailed deer.

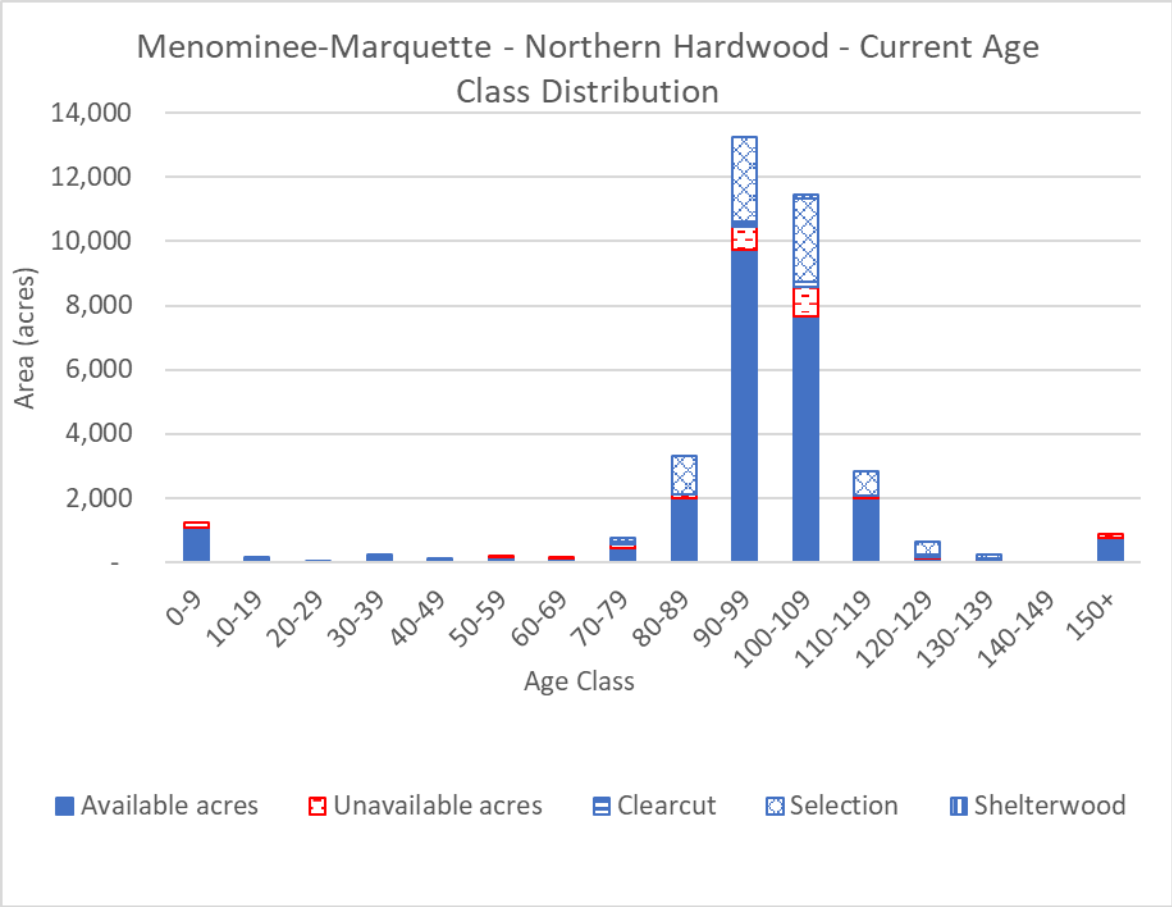


Figure 8. Current age class distribution and projected harvests in the northern hardwood cover type in the Menominee-Marquette management area.

The area of northern hardwood is well distributed in the ideal basal area classes for optimal growing conditions in the Menominee-Marquette management area (Figure 9).

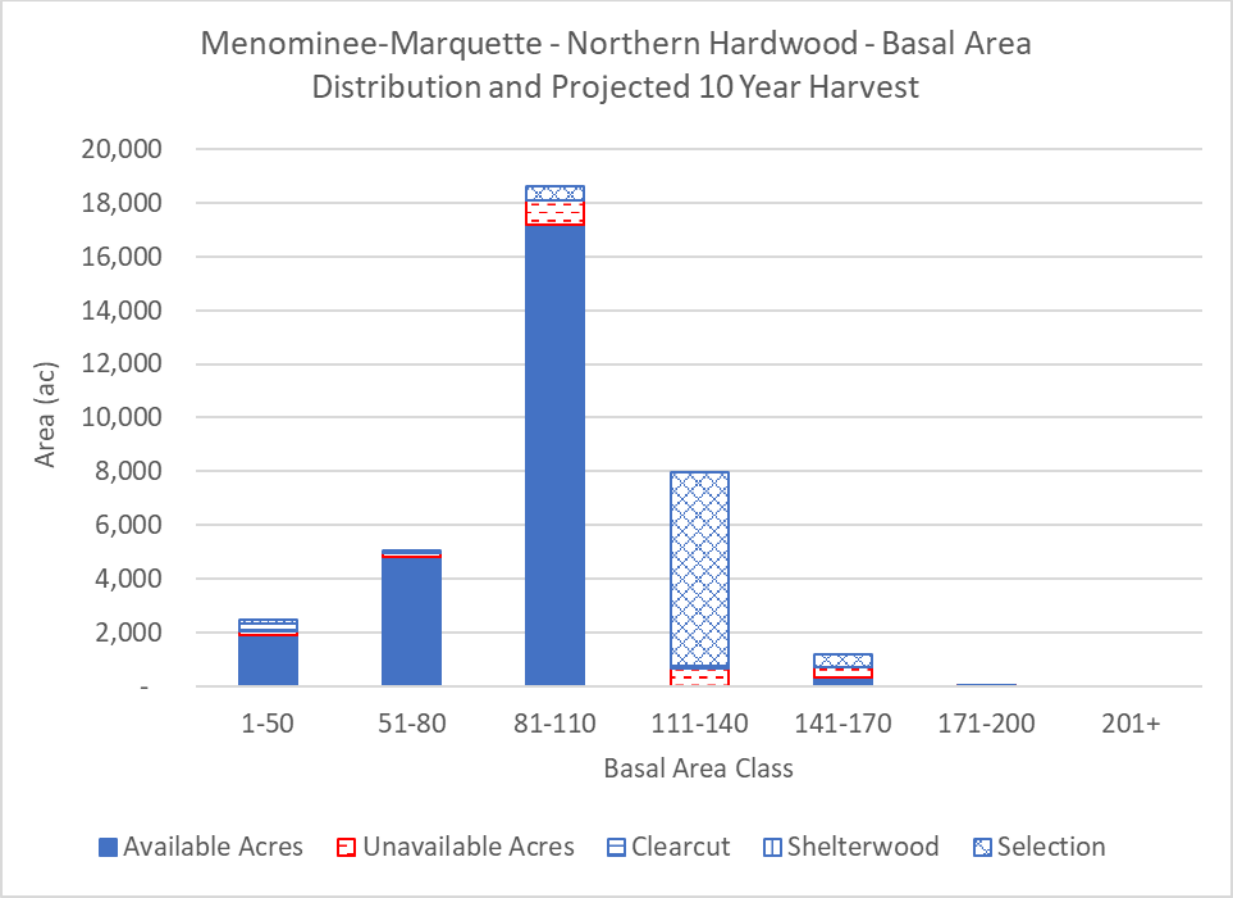


Figure 9. Current basal area distribution of the northern hardwood cover type as well as the projected harvests from each basal area class.

Table 10. Featured species with northern hardwoods as a priority habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Northern Hardwood	Northern Hardwood Habitat Acres- Available	Northern Hardwood Habitat Acres- Unavailable
Cerulean warbler	Age category: 50+ Size category: pole, sawlog Basal area: 81+	29,833	1,937
Black-throated blue warbler	Age category: 80+ Size category: sawlog Basal area: 81+	25,010	1,794
Marten	Age category: 40+ Size category: Pole, Sawlog Basal area: 81+	25,010	1,794
White-tailed deer	All ages and size classes	35,323	--

Desired future condition

The projected long-term cover type trend for northern hardwood is somewhat stable in the management area. There are 175 acres transitioning from this cover type in the next 10 years.

The desired basal area distribution is a bell-shaped curve where a significant majority of the area is kept in the 81-110 basal area class with recently harvested stands occupying the 51-80 basal area class and stands that are ready for harvest occupy the 111-140 class. Diameter distributions of the northern hardwood stands should follow the appropriate Q-curve relative to stand age and condition.

An uneven-aged condition is the long-term goal for all northern hardwood stands in this management area. An uneven-aged condition is achieved when there is no single discernable age cohort that is more prevalent than others across the stand area as canopy gaps fill in with regenerating seedlings, saplings, poles and eventually remaining stems become sawlog-sized over time.

Regeneration and recruitment continue to be a focus in the northern hardwood cover type across this management area. The long-term sustainability of this cover type in an uneven-aged silvicultural regime is dependent on the successful establishment of northern hardwood species as well as the recruitment of those seedlings and saplings into the pole and saw log classes. Northern hardwood in the Menominee-Marquette management area has challenges in regeneration and recruitment due to cervid herbivory and the poor potential of many of the stands.

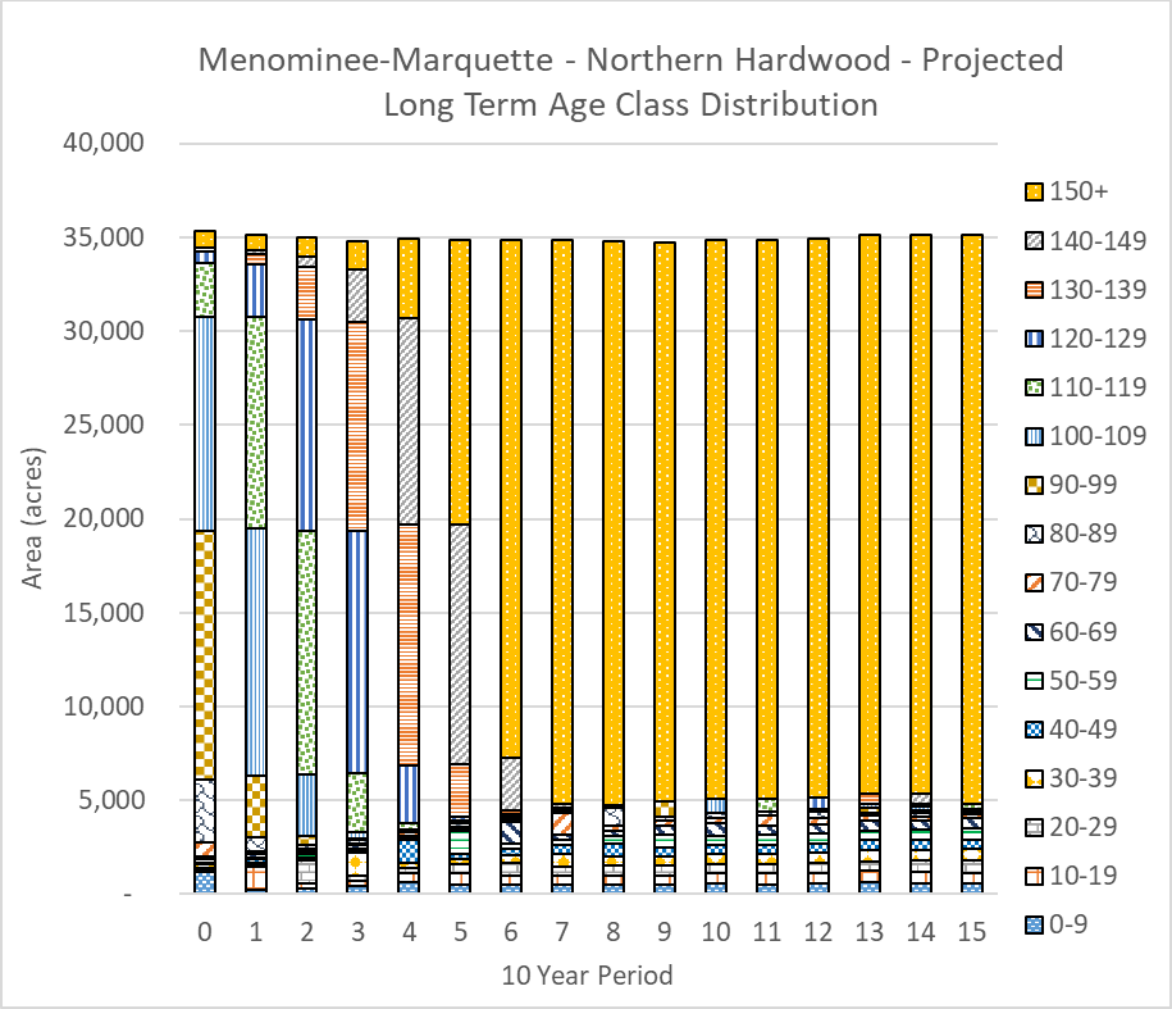


Figure 10. Projected age class distribution over 15, 10-year planning periods.

Management actions

The desired forest conditions and associated featured species habitat will be maintained and achieved through continued application of the projected selection harvest regime on 8,210 acres. About 458 acres will be managed under an even-aged system with some of those acres harvested through a clearcut or shelterwood method to improve stand quality (Table 5). Larger canopy gaps should be used to encourage diverse regeneration of northern hardwood species while maintaining an overall long term mature forest closed canopy landscape condition.

Cedar

Current condition

The current age class distribution shows a classic bell curve: an unmanaged even-aged stand with a surplus of acres in the 110-129-year-old age classes. The younger age classes have few to no acres. The reasons for this are not well understood, but many factors contribute to the lack of regeneration of the cover type including cervid herbivory, suppression of fire and the relatively young age of the stands. A portion of this cover type meets the habitat requirements for marten and white-tailed deer, but not for snowshoe hare because the stands are not in younger age classes (Table 11).

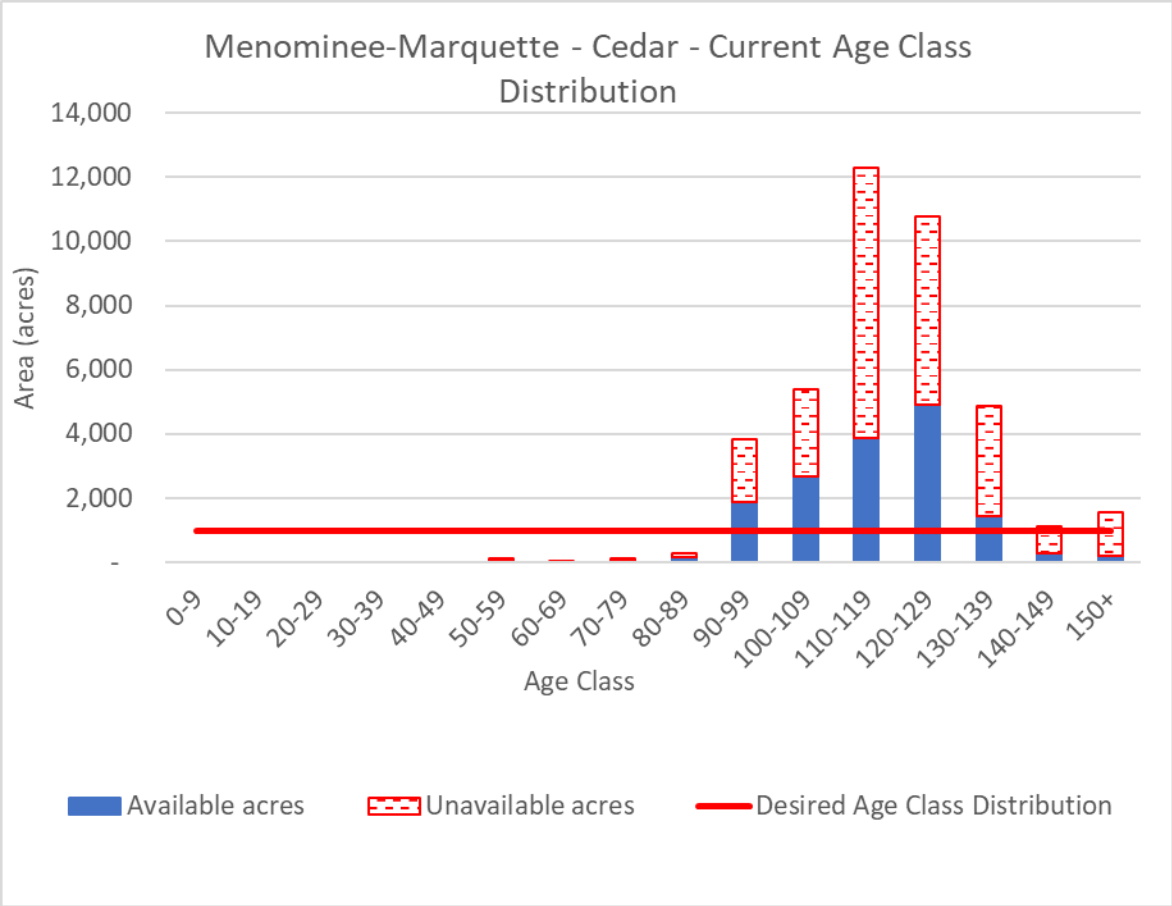


Figure 11. Current age class distribution, desired age class distribution and projected harvests in the cedar cover type over the 10-year planning period.

Table 11. Featured species with cedar as a priority habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat - Cedar	Cedar Habitat Acres - Available	Cedar Habitat Acres - Unavailable
Snowshoe hare	Age category: 0-19 Size category: Sapling	0	0

Featured Species	Featured Species Habitat - Cedar	Cedar Habitat Acres - Available	Cedar Habitat Acres - Unavailable
Marten	Age category: 40+ Size category: pole, Sswlog Basal area: 81+	14,282	24,131
White-tailed deer	All ages and size classes	--	40,304

Desired future condition

The desired future condition is to have an even age class distribution with a rotation age of 150+ years.

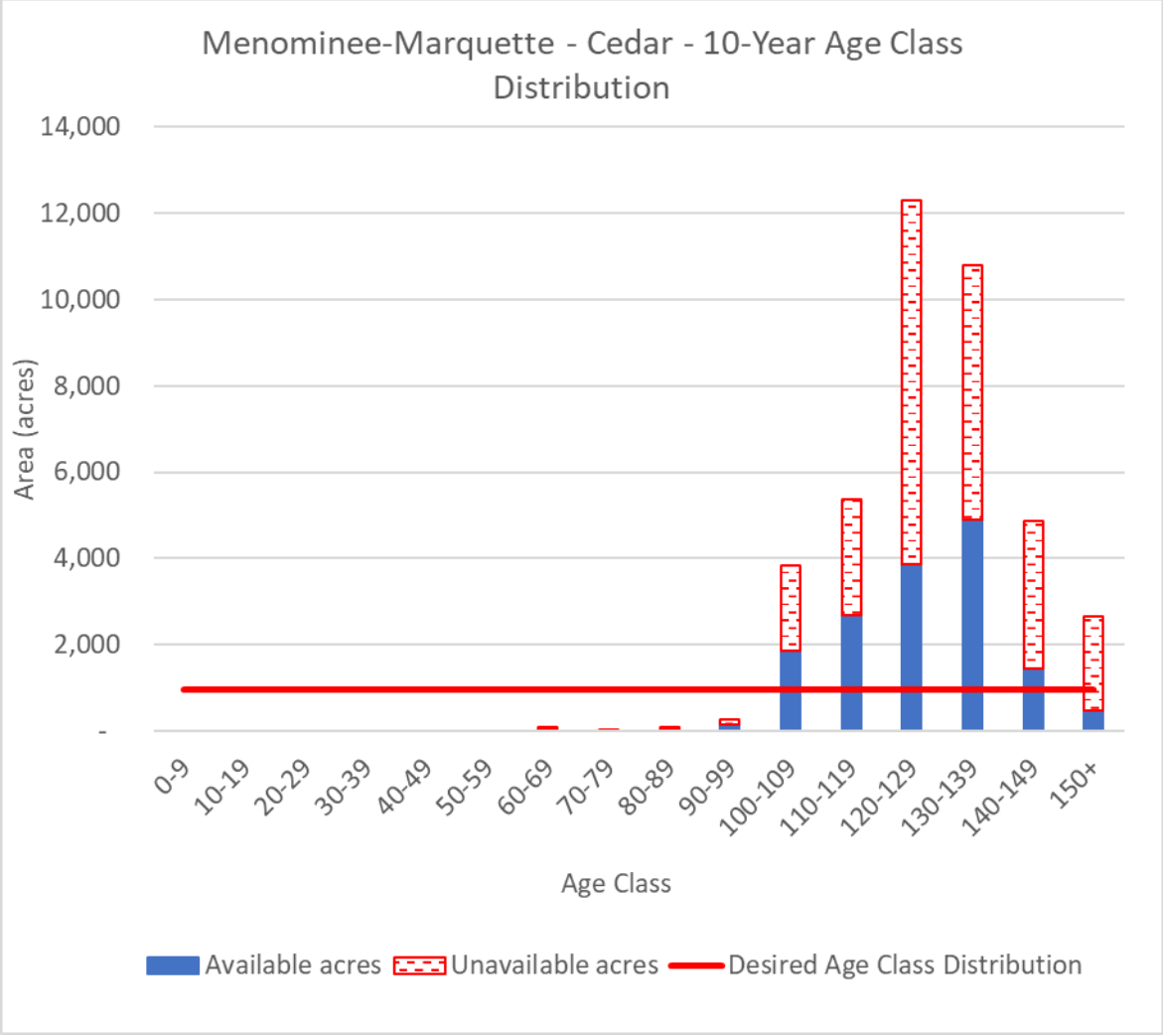


Figure 12. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The end of the planning period will result in the establishment of limited acres in the upcoming 0-9 age class. Progress toward the long-term desired age class distribution of cedar will take many decades in this management area.

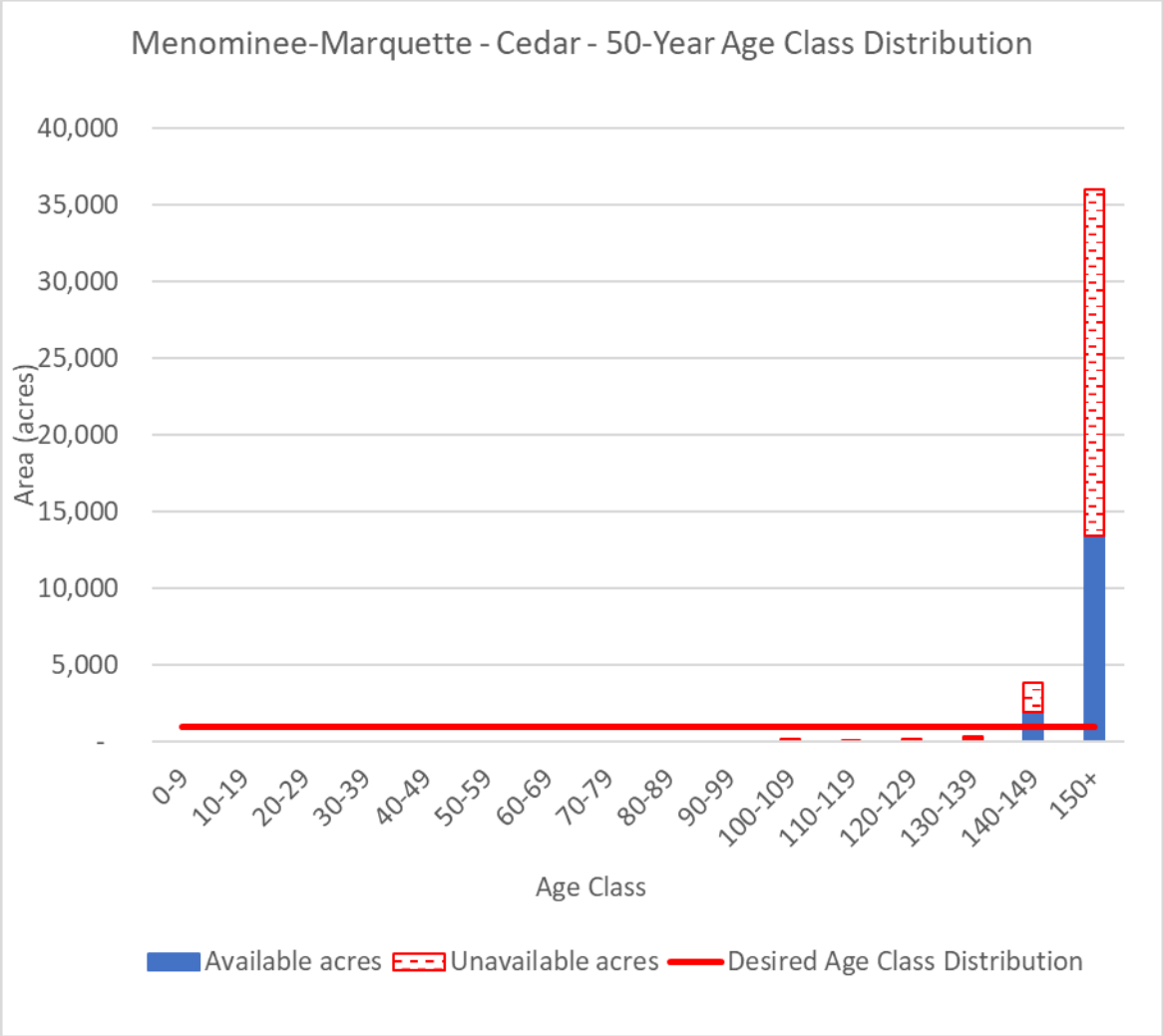


Figure 13. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of cedar acres aging with no acres recruiting (Figure 13).

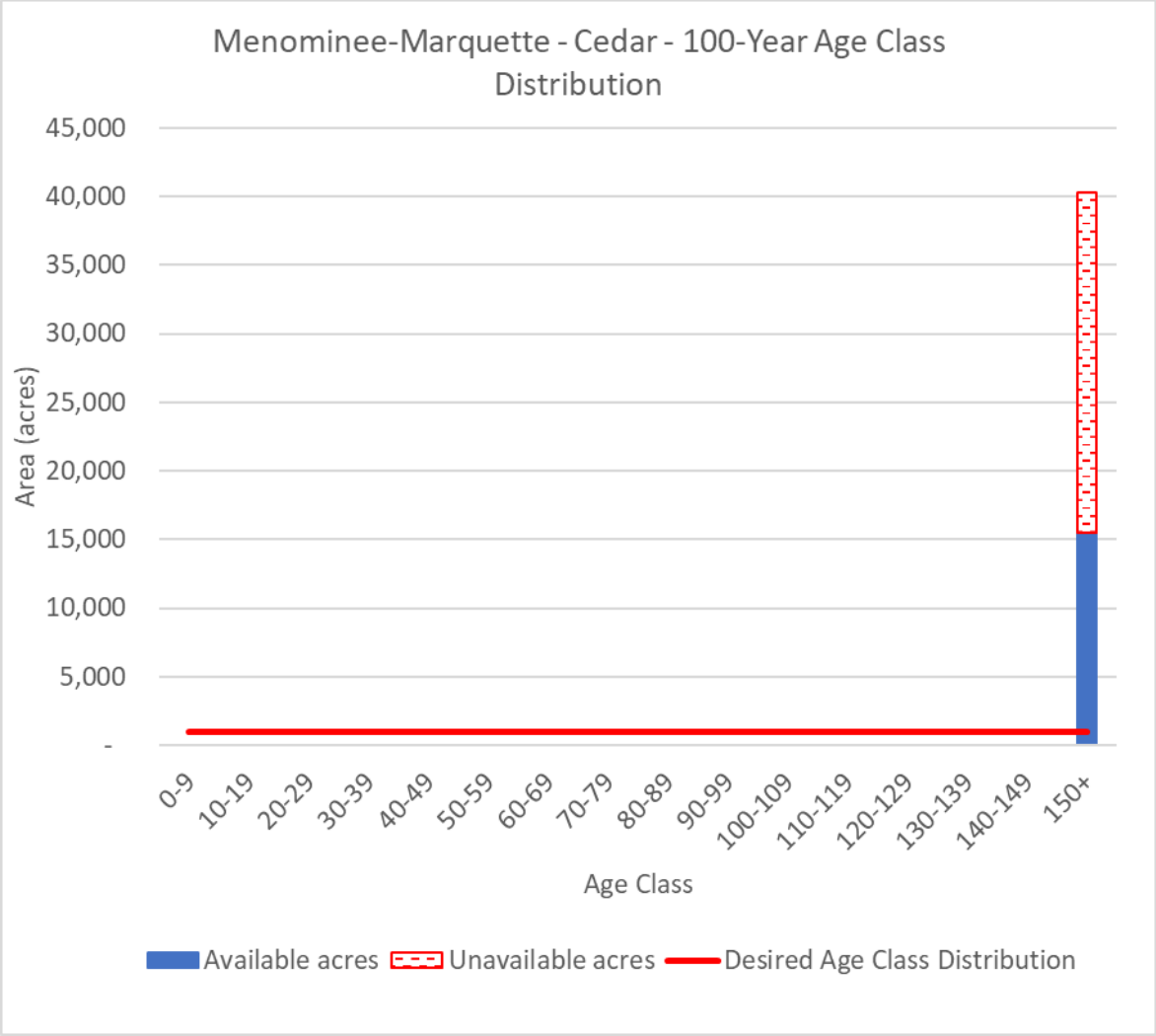


Figure 14. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 14) will concentrate the manageable acres of cedar in productive growing conditions while providing some forest products and a wide variety of wildlife habitat conditions across the landscape in young, mid-aged, and mature forest.

Management actions

There are no acres of projected harvests in the cedar cover type. It is expected some cedar will be cut in ongoing research and field trials as staff researches how to best recruit this species as a cover type.

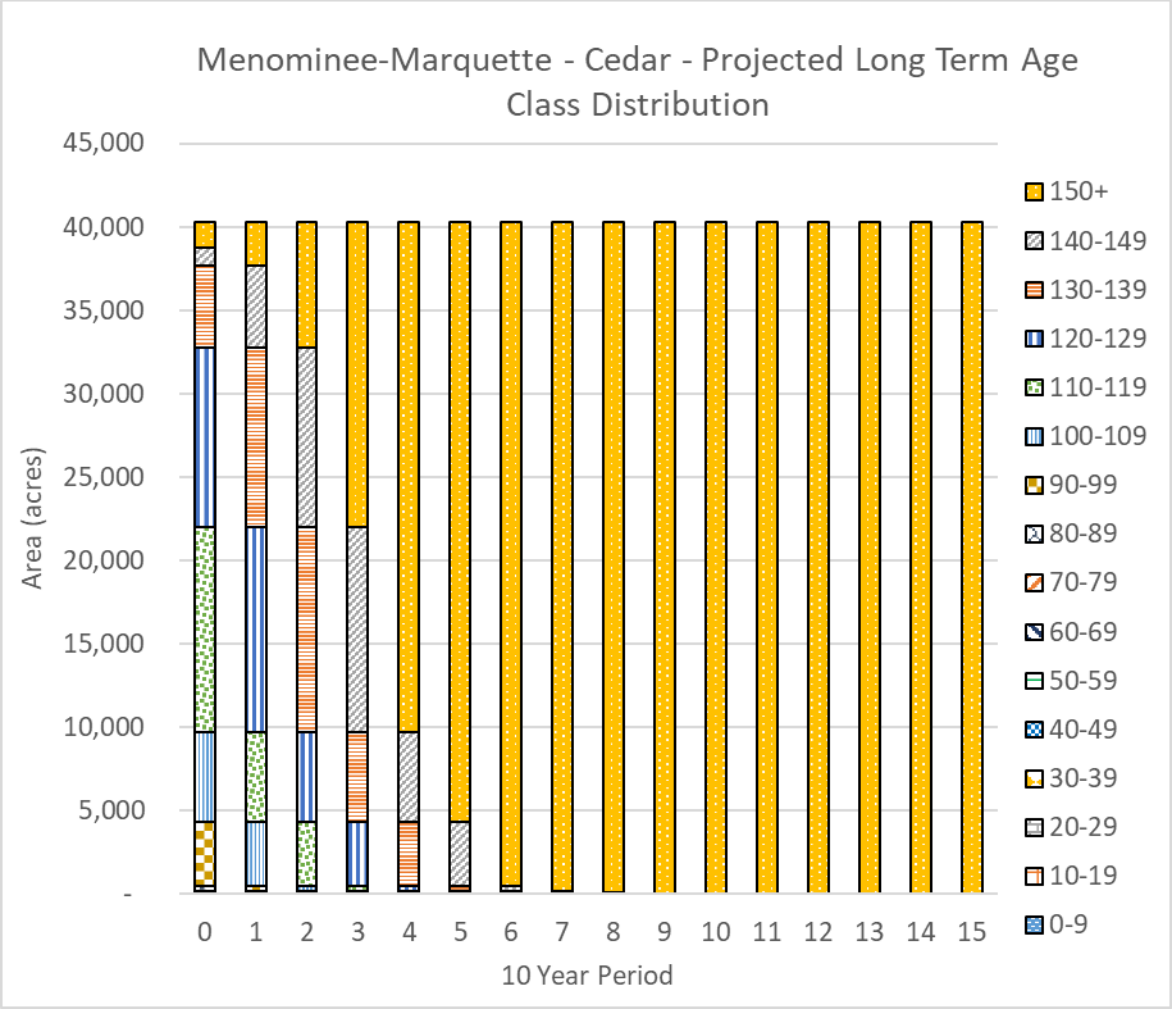


Figure 15. Projected age class distribution over 15, 10-year planning periods.

Conservation area network

High conservation value areas

There are up to nine different HCVA types that can be found in each management area (Table 12; see Biodiversity in Section 3 for more information).

Table 12. High conservation value areas within the Menominee-Marquette management area.

High Conservation Value Area Type and Name	Acres
Deer Wintering Complex	**40,107**
	40,107
Forest Habitat Core Interior	**7,641**
	7,641
Natural Area's Legally Dedicated	**2,328**
	2,328
State Wildlife Research Areas	**5,502**
Au Train Basin SWMA	5,502
Grand Total	**55,579**

Ecological reference areas

Ecological Reference Areas (ERAs) are a type of HCVA and are higher quality examples of functioning ecosystems that are primarily influenced by natural ecological processes.

Table 27. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 28. Ecological reference areas within the management area

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	Number of Occurrences
Existing ERA	Alvar	BC		S1	1

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	Number of Occurrences
Existing ERA	Floodplain Forest	BC	G3?	S3	1
Existing ERA	Hardwood-Conifer Swamp	B	G4	S3	1
Existing ERA	Mesic Northern Forest	B			2
Existing ERA	Mesic Northern Forest	BC	G4	S3	4
Existing ERA	Northern Fen	B	G3	S3	2
Existing ERA	Oak-Pine Barrens	CD			1
Existing ERA	Poor Conifer Swamp	B	G4	S4	1
Existing ERA	Rich Conifer Swamp	BC	G4	S3	2
Proposed ERA	Rich Conifer Swamp	AB	G4	S3	1
Proposed ERA	Rich Conifer Swamp	B	G4	S3	1
Grand Total					**17**

Special conservation areas

Reviewable special conservation areas (SCAs; Table 15) refers to those SCA types that may be reviewed or updated through the compartment review process as needed. Static SCAs (Table 16) refers to those SCA types that generally do not change or require updating (see Biodiversity in Section 3 for more information).

Table 15. Reviewable special conservation areas within the Menominee-Marquette management area.

Reviewable Special Conservation Area Type and Name	Acres
Concentrated Recreational Area	**961**
Unspecified	959
Whitefish river Boating Access Site	2
Contiguous Resource Area	**183**
33003017	25
33003020	39
33003021	11
33003022	10
33003024	1
33003025	98
Cultural or Customary Area	**21**
Unspecified	22
Habitat Area or Habitat Corridor	**3,213**
33066029	759
33066031	7
33066034	11
33066035	16

Reviewable Special Conservation Area Type and Name	Acres
33066039	35
33066041	12
33066047	10
33066048	51
33066049	357
Bear Point	156
Habitat Area Removal	76
Habitat Area Removal	208
Hardwood island 1	7
Hardwood island 2	10
Hunter's Brook	202
Hunter’s Brook Riparian Corridor	86
Johnson Creek island grass	8
Longrie Lake	125
Sawmill	415
Sawmill Creek	252
Sawmill Swamp	178
sca1	17
sca2	40
sca3	26
sca4	5
sca5	40
Unspecified	89
Watson cut across hemlock	18
Mineral Resource Area	**0**
Forest Service Pit	0
Spring, Wetlands, or Riparian Areas	**3,167**
1	41
2	42
3	15
4	14
5	9
10	245
11	500
12	39
13	151
14	42
15	48
16	199
17	26
32008	78
33066051	16

Reviewable Special Conservation Area Type and Name	Acres
33066054	15
33101009	299
along Deer Creek	17
Basin hardwoods	22
Deer Creek	54
DeHaas Creek riparian corridor	19
Ford River riparian corridor	21
Friday Creek riparian area	128
Johnson Creek and tributary	71
Johnson Creek brush	41
Johnson Creek tributary buffer	56
Lone Pine Creek brush	5
Lone Pine Creek deciduous	37
Lone Pine Creek N	28
Lone Pine Creek SE	27
Lone Pine Creek SW	24
Lone Pine Creek travel	29
Middle Deer Creek tributary	40
Mud Creek	3
Mud Creek 2	8
Mud Creek 3	11
Mud Creek 4	12
Mud Creek confluence	95
Mud Creek headwaters	104
N. werners Creek tributary	15
Pemene Creek riparian corridor	47
Raid River pools	34
Rapid River corridor N.	40
Rapid River drainage	12
Rapid River mid pools	12
Rapid River North	25
Rapid River pool	1
Rapid River wetlands	27
Ross Creek	54
S. Werners Creek tributary	42
Sawmill shrub	4
Shakey River riparian area	227
Visual Management Areas	**6**
KC Hemlock visual	6
Grand Total	**7,552**

Table 16. Static special conservation areas within the Menominee-Marquette management area.

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Common Natural Heritage Element Occurrences		**181**
Hardwood-conifer swamp		101
Mesic northern forest		79
Deer Winter Range - Obligate and Conditional		**51,682**
Conditional		51,682
Designated Trout and Cold Water Stream Buffer		**2,328**
<Null>		1,426
Black Creek		16
Blom Creek		28
Boudreau Creek		26
Burke Creek		45
Chocolay River		58
Deer Creek		5
DeHaas Creek		39
Dorow Creek		17
East Branch Sand River		22
East Branch Whitefish River		9
Hammond Brook		24
Huber Creek		13
Johnson Creek		74
Leisner Creek		17
Little Shakey Creek		71
Miscauna Creek		37
North Branch Deer Creek		89
Pemene Creek		116
Rapid River		19
Reno Creek		14
Ross Creek		25
Sand River		79
Shakey River		20
Spring Creek		39
Designated Trout and Coldwater Streams	**87.2**	
<Null>	53.0	
Black Creek	0.6	
Blom Creek	1.0	
Boudreau Creek	1.0	
Burke Creek	1.7	
Chocolay River	2.1	
Deer Creek	0.2	
DeHaas Creek	1.4	

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Dorow Creek	0.6	
East Branch Sand River	1.0	
East Branch Whitefish River	0.4	
Hammond Brook	0.9	
Huber Creek	0.5	
Johnson Creek	3.2	
Leisner Creek	0.6	
Little Shakey Creek	2.8	
Miscauna Creek	1.4	
North Branch Deer Creek	3.2	
Pemene Creek	4.5	
Rapid River	0.7	
Reno Creek	0.5	
Ross Creek	0.9	
Sand River	3.1	
Shakey River	0.7	
Spring Creek	1.4	
Mussel Stream Group 2 - state threatened or endangered	**3.6**	
Grand Rapid Dam-Menominee River	2.5	
The Oxbow-Menominee River	1.1	
Non-dedicated Natural Areas		**1,512**
Natural Area Shakey Lakes		1,512
Wild and Scenic Rivers	**0.8**	
Whitefish Wild and Scenic River	0.8	
Wood Turtle Stream 100-foot buffer		**139**
Elm Creek		13
Ford River		127
Wood Turtle Stream 660-foot buffer		**828**
Elm Creek		106
Ford River		722
Grand Total	**91.7**	**56,670**

Rare species

Rare species occurrences are compiled from the Michigan Natural Features Inventory Biotics database (Tables 19,019 and 20) and do not necessarily include all rare species found in this management area due to biases in survey effort and verifiable observation reporting over time.

Table 29. Rare animal and plant species conservation status key.

Status	Status
E = endangered	LE = listed endangered

T = threatened	LT = listed threatened
SC = special concern	PDL = proposed for delisting

Table 18. Rare animal species occurrence within the Menominee-Marquette management area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Accipiter gentilis	Northern goshawk	T	--	3
Animal	Acipenser fulvescens	Lake sturgeon	T	--	1
Animal	Alasmidonta marginata	Elktoe	SC	--	1
Animal	Alasmidonta viridis	Slippershell	T	--	2
Animal	Alces alces	Moose	SC	--	1
Animal	Ammodramus savannarum	Grasshopper sparrow	SC	--	1
Animal	Bombus borealis	Northern amber bumble bee	SC	--	2
Animal	Bombus terricola	Yellow-banded bumble bee	SC	--	5
Animal	Buteo lineatus	Red-shouldered hawk	SC	--	3
Animal	Canis lupus*	Gray wolf	SC	LE	--
Animal	Emydoidea blandingii	Blanding's turtle	SC	--	1
Animal	Gavia immer	Common loon	T	--	1
Animal	Glyptemys insculpta	Wood turtle	T	--	6
Animal	Haliaeetus leucocephalus	Bald eagle	SC	--	11
Animal	Lasmigona compressa	Creek heelsplitter	SC	--	2
Animal	Ligumia recta	Black sandshell	T	--	1
Animal	Lithobates palustris	Pickerel frog	SC	--	1
Animal	Myotis lucifugus	Little brown bat	T	--	2
Animal	Necturus maculosus	Mudpuppy	SC	--	4

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Nicrophorus americanus	American burying beetle	X	LE	2
Animal	Obovaria olivaria	Hickorynut	E	--	2
Animal	Opheodrys vernalis	Smooth green snake	SC	--	1
Animal	Pandion haliaetus	Osprey	SC	--	2
Animal	Pleurobema sintoxia	Round pigtoe	SC	--	1
Animal	Rallus elegans	King rail	E	--	1
Animal	Sphaerium fabale	River fingernail clam	SC	--	1
Animal	Spiza americana	Dickcissel	SC	--	1
Total	--	--	--	--	**59**

**Occurrence information provided by field staff.*

Table 19. Rare plant species occurrence within the Menominee-Marquette management area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Plant	Allium schoenoprasum	Chives	T	--	1
Plant	Amerorchis rotundifolia	Small round-leaved orchis	E	--	2
Plant	Asclepias ovalifolia	Dwarf milkweed	E	--	4
Plant	Astragalus canadensis	Canadian milk vetch	SC	--	1
Plant	Astragalus neglectus	Cooper's milk vetch	SC	--	1
Plant	Calypso bulbosa	Calypso or fairy-slipper	T	--	2
Plant	Carex assiniboinensis	Assiniboia sedge	T	--	1
Plant	Carex richardsonii	Richardson's sedge	SC	--	1
Plant	Cirsium hillii	Hill's thistle	SC	--	2
Plant	Cypripedium arietinum	Ram's head lady's-slipper	SC	--	1

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Plant	Graphephorummelicoides	Purple false oats	SC	--	1
Plant	Iris lacustris	Dwarf lake iris	T	LT	2
Plant	Juncus vaseyi	Vasey's rush	T	--	3
Plant	Parnassia palustris	Marsh grass-of-parnassus	T	--	1
Plant	Rumex occidentalis	Western dock	E	--	2
Plant	Tanacetum bipinnatum ssp. huronense	Lake Huron tansy	SC	--	1
Plant	Trisetum spicatum	Downy oat-grass	SC	--	1
Plant	Viola novae-angliae	New England violet	T	--	1
Total	--	--	--	--	**28**

Table 20. Other rare occurrence within the Menominee-Marquette management area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Other	Great Blue Heron Rookery	Great Blue Heron Rookery	--	--	2
Total	--	--	--	--	**2**

Non-ERA natural communities

Natural communities that are identified with an element occurrence in the MNFI Biotics database, but that have not been given an additional ecological reference area (ERA) designation, are recognized and managed accordingly (Table 22).

Table 30. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure

Element Occurrence Rank	State Rank	Global Rank
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 22. Non-ERA Natural Communities within the Menominee-Marquette management area.

Community Type	Element Occurrence Rank	State Rank	Global Rank	Number of Occurrences
Hardwood-conifer swamp	BC	S3		1
Hardwood-conifer swamp	C	S3		2
Mesic northern forest	AB	S3		1
Mesic northern forest	CD	S3		2
Grand Total				**6**

Forest health

Forest health concerns, both native and non-native, can have impacts on stand conditions and management decisions. The following insects (Table 23) and diseases (Table 24) could have an impact on management during the planning period and may need to be monitored and/or addressed.

Table 23. Defoliating insects of concern in the Menominee-Marquette management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Spongy moth	Lymantria dispar	Non-native	Yes
Forest tent caterpillar	Malacosoma disstria	Native	Yes
Large aspen tortrix	Choristoneura conflictana	Native	Yes
Spruce budworm	Choristoneura fumiferana	Native	Yes

Watch for lingering ash with potential resistance to emerald ash borer.

Table 24. Maladies of concern in the Menominee-Marquette management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Canker	Various	Various	Yes
Armillaria root rot	Armillaria spp.	Native	Yes
Oak wilt	Bretziella fagacearum	Non-native	Yes

Aquatic resources

Riparian habitat

A total of 187 miles of streams and rivers are found in the management area (Table 25). Streams/rivers classified as warm types comprise approximately 81 percent of the riverine mileage.

Table 25. Classification type and length of streams/rivers found within the management area.

Type	Length (miles)
Cold stream	6
Cold small river	0
Cold transitional stream	29
Cold transitional small river	0
Cold transitional large river	0
Warm transitional stream	83
Warm transitional small river	6
Warm transitional large river	10
Warm stream	47
Warm small river	4
Warm large river	2

Lacustrine habitat

A total of 10 lakes and ponds of at least 1 surface acre are found in the management area (Table 26).

Table 26. Size and number of lakes and ponds located within the management area.

Lake Size Class (acres)	Number
1-99	9
100-499	1
500+	0

Wetlands

A total of 92,739 acres of wetlands are found in the management area (Table 23). Forested wetlands comprise approximately 97 percent of wetland types found in the management area.

Table 27. Area of emergent, forested, and riverine wetland types found within the management area.

Wetland Type	Acres
Emergent	1,797
Forested	90,120
Riverine	822

Vernal pools and seeps

A total of 2,035 acres of vernal pools and seeps have been inventoried in the management area while no areas of seeps have been identified.

Riparian vegetation cover

Lowland shrub, cedar and northern hardwood are the predominant cover types present in a 100-meter riparian zone located next to streams/rivers in the management area (Table 28).

Table 28. Largest vegetative cover types (i.e., top 10) and area located in a 100-meter buffer of streams/rivers within the management area.

Cover Type	Acres
Lowland Shrub	4,386
Cedar	3,599
Northern Hardwood	3,281
Aspen	2,504
Lowland Conifers	1,719
Lowland Deciduous	1,441
Lowland Mixed Forest	1,089
Water	810
Marsh	568
Mixed Upland Deciduous	451

Watershed vegetation cover

The management area includes portions of important watersheds of the Escanaba River and Ford River (Tables 29 and 30). Cedar, aspen, and northern hardwood are major cover types of the state forest in each watershed.

Table 29. Largest vegetative cover types (i.e., top 5) and area of the Escanaba River watershed located within the management area.

Cover Type	Acres
Cedar	17,494
Aspen	12,776
Northern Hardwood	6,007
Lowland Conifer	3,342
Lowland Shrub	2,551

Table 30. Largest vegetative cover types (i.e., top 5) and area of the Ford River watershed located within the management area.

Cover Type	Acres
Cedar	5,315
Aspen	2,895
Northern Hardwood	1,453
Tamarack	1,042
Lowland Spruce/Fir	852

Recreation

The Menominee-Marquette management area, which covers an area from the Wisconsin border along the Menominee River to Lake Superior, has variable levels of access for public recreation and management. The area along the Menominee River generally has good access from county and state forest roads. In other areas, scattered parcels have limited access.

Several offroad-vehicle routes and snowmobile trails cross through this management area. The Marquette-Munising Junction Trail (rail trail) provides motorized and non-motorized uses on a paved shoulder along M-28 with views of Lake Superior. The North Country National Scenic Trail/Iron Belle Trail also passes through the management area close to the Lake Superior shoreline. The Tyoga Historical Pathway, located near Deerton, runs along the Laughing Whitefish River through the old logging town of Tyoga.

There are no state forest campgrounds on state land in this area. However, Forest Lake State Forest Campground is leased by the DNR from Green Leaf Timber Holding Inc. and provides 26 rustic sites on Forest Lake south of Au Train, as well as a boating access site.

Table 31. Designated Recreation Trails by type.

Recreation Category	Recreation Type	Number of Miles
Motorized recreation trails	ORV (all types)	15
Motorized recreation trails	Snowmobile	15
Non-motorized recreation trails	Hiking	7.8
Non-motorized recreation trails	Equestrian	0
Non-motorized recreation trails	Biking	0
Non-motorized recreation trails	Hunter Walking Trails	0
Total	--	**37.8**

Note: Trail use types may overlap.

Au Train Basin Waterfowl Project, located south of Au Train, includes state forest land as well as local cooperators of UP Power Company and the USDA Forest Service. The project area includes a wildlife refuge which is closed seasonally in the fall to support migrating waterfowl. The area is managed for goose hunting and to provide habitat for featured species. The SWMA provides a host of recreational opportunities, including hunting, trapping, snowmobiling, hiking, bird watching and wildlife viewing.

Table 32. Areas Managed for Hunting

Type	Name	Number of Acres
State Wildlife Management Areas	Au Train Basin SWMA	5,498.2
Total	**--**	**5,498.2**

There are numerous boating access sites within the management area, providing access to the Escanaba, Whitefish, Menominee and Rapid rivers, as well as several inland lakes and creeks, providing ample opportunities for canoeing and fishing. The adjacent Menominee River State Recreation Area provides additional access to the Menominee River.

Table 33. Boating Access Sites.

Name	Waterbody
Escanaba River	Escanaba River
Lake Ann	Lake Ann
Lake Le Vasseur	Lake Le Vasseur
Laughing Whitefish River (John H. Hammer)	Laughing Whitefish River
Old Menominee River	Menominee River
Rapid River	Rapid River
Sand River Flooding (or Sand Lake Flooding)	Sand River Flooding
Sawmill Creek	Sawmill Creek
Sturgeon Landing	Menominee River
West Branch of Whitefish River	West Branch of Whitefish River
Whitefish River	Whitefish River

Michigamme Highlands

State Forest Area: 63,877 acres	Location: North Western Marquette and South Eastern Baraga Counties	Population Centers: Ishpeming, Negaunee, Covington
Sub-Section: Michigamme Highlands	Landforms: Generally bedrock controlled topography, the character of the topography is variable	Landcover: Forested: 53,629 acres Non-forested: 10,248 acres

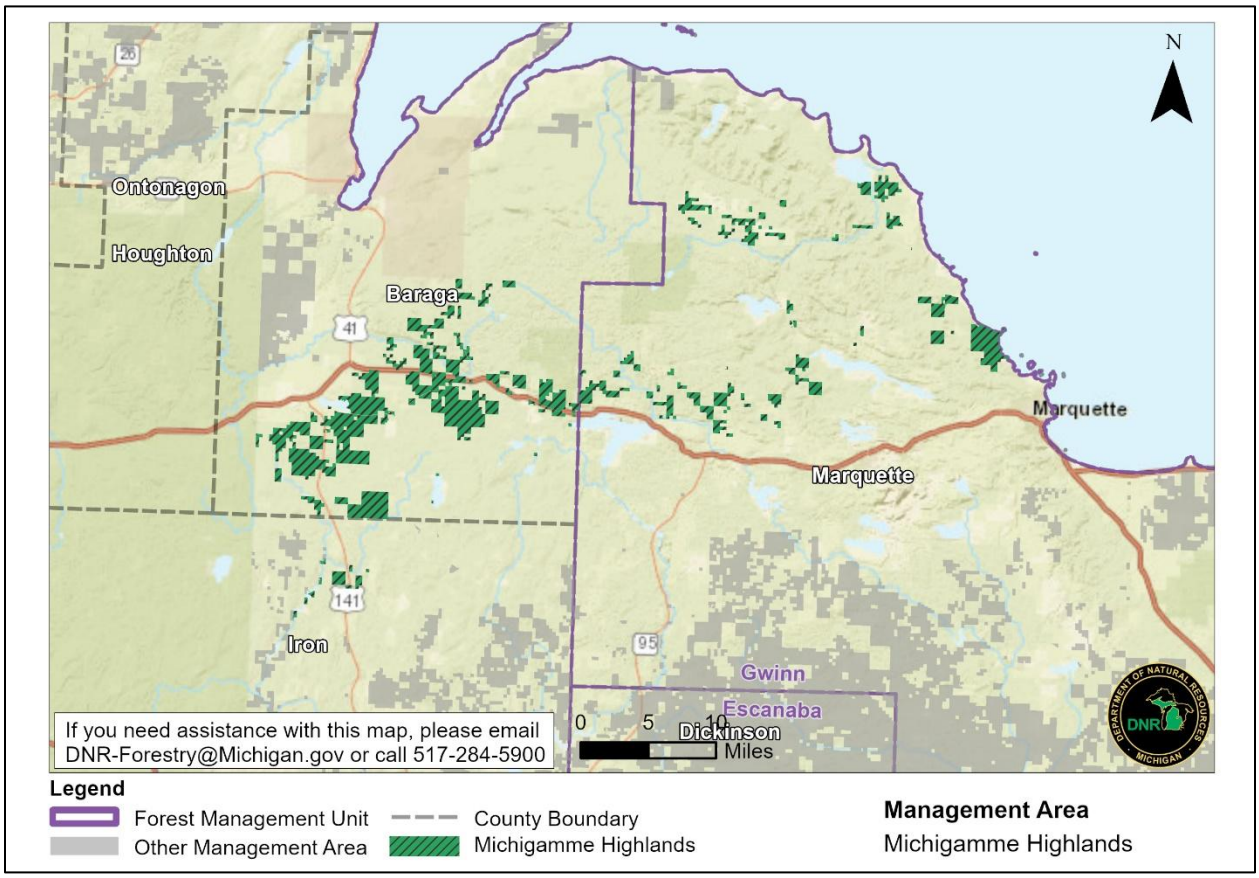


Figure 1. Map of the Michigamme Highlands management area.

Forested landscape

Current and projected future condition

The Michigamme Highlands management area is dominated by shade-tolerant cover types. Intolerant upland cover types are relatively evenly distributed across the age categories, while the unavailable upland and lowland acres are more prevalent in the older age category.

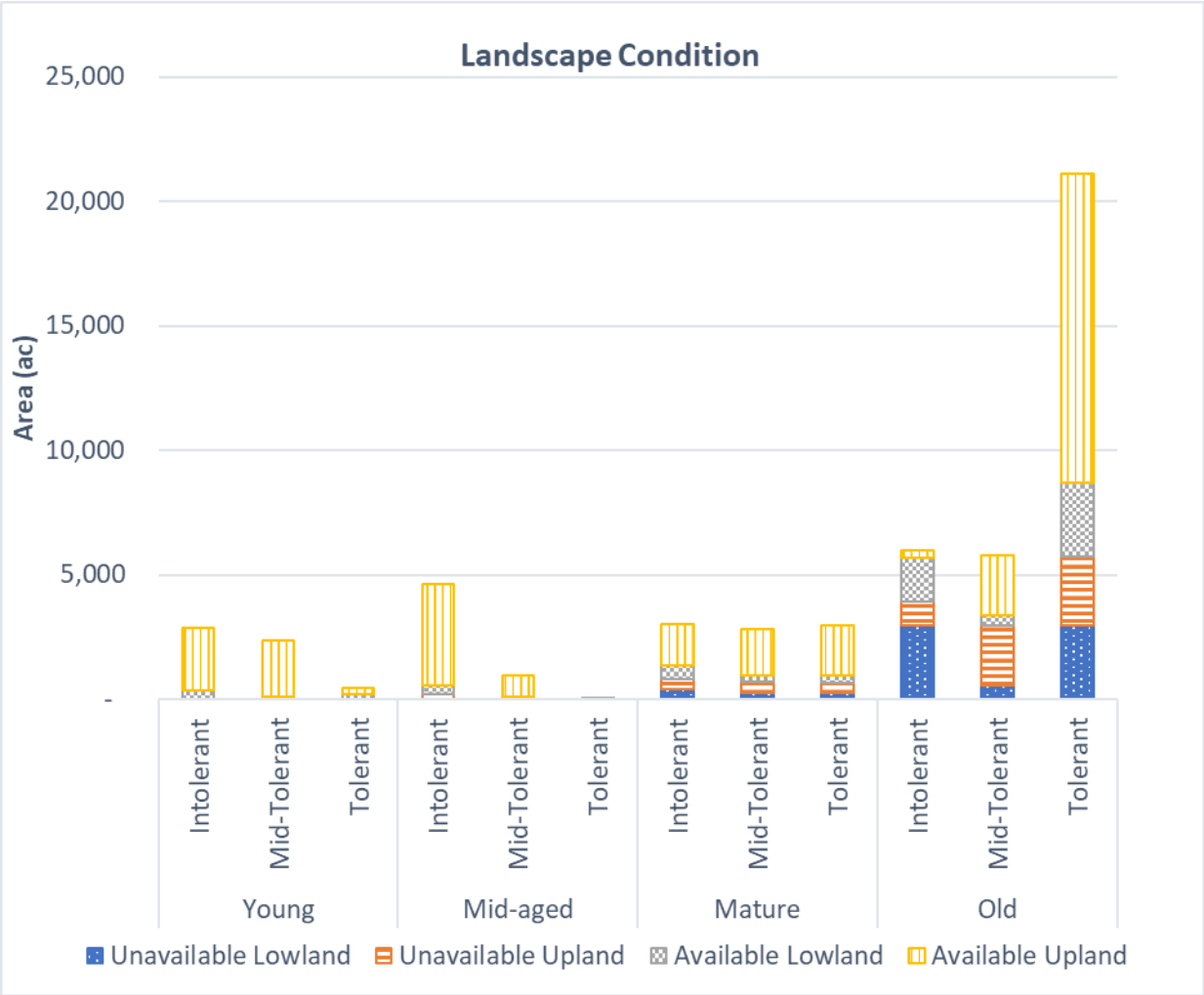


Figure 2. Forest diversity matrix showing the current distribution of forested acres across management availability, age category, landscape position and shade tolerance.

Landscape habitat conditions refine the management area landscape into featured species habitat context. Current and projected acres for the metrics identified in the Management Priorities (Section 3 Statewide/Regional) establish a baseline and future condition based on management over the planning period (Table 1).

Table 1. Current and projected acres for Landscape Habitat Conditions.

Landscape Habitat Condition	Monitoring Metric	Current Acres
Young forest	Acres of 0-19 stands in aspen and jack pine	2,279
Mature forest	Acres of 80+ year stands across cover types	32,879
Mature forest	Acres of 120+ year stands across cover types	16,618
Mesic conifer cover types	Acres of mesic conifer cover types	5,427
Mesic conifers in other cover types	Average canopy occupancy	24%
Mast – oak cover types	Acres of oak cover types	1,546
Mast tree species in other cover types	Acres of total canopy occupancy of mast tree acres (Trace-100%)	45,615
Big trees	Acres of total canopy stand occupancy of species in sawlog or greater size class	36,983
Non-forested Openings	Acres of total herbaceous open land, upland shrub and cropland	550
Landscape forest matrix	Percent deciduous forest	54%
Landscape forest matrix	Percent coniferous forest	37%

Another important landscape level habitat in this management area is coastal habitat. The Great Lakes, particularly coastal and nearshore areas, provide globally or continentally important stopover sites for all groups of migratory birds: waterfowl, shorebirds, landbirds (defined here as songbirds and raptors), and waterbirds (loons, grebes, cormorants, herons, rails, cranes, gulls, and terns) (Ewert, et. Al 2012). The Great Lakes shoreline provides essential stopover habitat for birds to rest, feed, and shelter during migration. In addition to migration, the diverse coastal habitats where water and land meet provides unique habitats for breeding birds. Some of these areas are classified by Michigan Audubon as Important Bird Areas. The Great Lakes shoreline is habitat for several rare plant species that are endemic to the Great Lakes.

Forest management and other intrusive activities within a mile of the coastline need to consider the potential impacts to migratory birds and breeding bird habitat.

The Michigamme Highlands management area is dominated by forested cover types with 84 percent of the area covered in forested stands (Table 2). The upland deciduous portion of that is 43% and comprised mostly of Northern hardwood. The upland coniferous portion is 12% and comprised mostly of the upland conifer cover type. Lowland shrub is the most common non-forested cover type in this management area representing 7 percent of the landscape.

Table 2. Landscape conditions and distribution of cover types in the Michigamme Highlands management area.

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
Forested	Upland	Deciduous	Aspen	6,480	27,501	38,774	53,629
			Northern hardwood	15,863			
			Black-red hybrid oak	0			
			Northern red oak	451			
			Oak mix	188			
			Mixed upland deciduous	4,520			
		Mixed	Upland mixed forest	3,416	3,416		
		Coniferous	Planted red pine	148	7,857		
			Planted jack pine	1,066			
			Planted white pine	0			
			Planted mixed pine	0			
			Natural red pine	686			
			Natural jack pine	1,434			
			Natural white pine	644			
			Natural mixed pines	259			
			Upland spruce/fir	1,206			
			Upland conifers	1,536			
			Hemlock	879			
	Lowland	Deciduous	Lowland aspen/balsam poplar	489	1,329	14,855	
			Lowland deciduous	840			
		Mixed	Lowland mixed forest	1,433	1,433		
		Coniferous	Cedar	2,229	12,093		
			Lowland conifers	4,355			
			Lowland spruce/fir	4,794			
			Tamarack	715			
Nonforested	Upland	N/A	Herbaceous openland	347	N/A	1,814	10,248
			Upland shrub	203			
			Low-density trees	473			
			Bare/sparsely vegetated	458			
			Cropland	0			
			Urban	332			
	Lowland	N/A	Lowland shrub	4,754	N/A	8,434	
			Marsh	1,858			
			Bog	310			
			Treed bog	131			
			Water	1,381			
						Grand Total:	**63,877**

There are 38,509 acres (60.3 percent of the total area and 71.8 percent of the forested area) that can be managed toward desired future conditions via commercial timber harvest in the Michigamme management area (Table 3). Of that, over 25 percent is in the northern hardwood cover type, 11 percent is in aspen, 7 percent in mixed upland deciduous, and 6 percent in upland mixed forest. The remaining 18 cover types represent about 24 percent of the forested and available land in the management area.

Table 3. Landscape conditions and cover type composition of the Michigamme Highlands management area.

MICHIGAMME HIGHLANDS Forested Cover Type	Available Acres	Available %	Unavailable Acres	Unavailable %	Total Acres	Total %
Aspen	5,710	10.6%	770	1.4%	6,480	12.1%
Cedar	1,319	2.5%	911	1.7%	2,229	4.2%
Hemlock	86	0.2%	792	1.5%	879	1.6%
Lowland Aspen/Balsam Poplar	479	0.9%	10	0.0%	489	0.9%
Lowland Conifers	2,043	3.8%	2,313	4.3%	4,355	8.1%
Lowland Deciduous	345	0.6%	495	0.9%	840	1.6%
Lowland Mixed Forest	1,138	2.1%	295	0.6%	1,433	2.7%
Lowland Spruce/Fir	2,060	3.8%	2,735	5.1%	4,794	8.9%
Mixed Upland Deciduous	3,463	6.5%	1,058	2.0%	4,520	8.4%
Natural Jack Pine	1,382	2.6%	52	0.1%	1,434	2.7%
Natural Mixed Pines	43	0.1%	217	0.4%	259	0.5%
Natural Red Pine	0	0.0%	686	1.3%	686	1.3%
Natural White Pine	597	1.1%	50	0.1%	647	1.2%
Northern Hardwood	13,462	25.1%	2,403	4.5%	15,864	29.6%
Northern Red Oak	65	0.1%	386	0.7%	451	0.8%
Oak Mix	188	0.3%	0	0.0%	188	0.3%
Planted Jack Pine	1,054	2.0%	12	0.0%	1,066	2.0%
Planted Red Pine	148	0.3%	0	0.0%	148	0.3%
Tamarack	110	0.2%	605	1.1%	715	1.3%
Upland Conifers	1,079	2.0%	457	0.9%	1,537	2.9%
Upland Mixed Forest	2,978	5.6%	438	0.8%	3,416	6.4%
Upland Spruce/Fir	768	1.4%	437	0.8%	1,206	2.2%
Grand Total	**38,514**	**71.8%**	**15,121**	**28.2%**	**53,635**	**100.0%**

Table 4. Site condition (reason area is unavailable for commercial harvest) acres for the Michigamme Highlands management area.

Site Condition (Reason area is unavailable for commercial harvest)	Area (ac)	% of Unavailable Area
Conservation values	3,384	22.4%
Too wet	3,211	21.2%
BMPs	2,768	18.3%
Unproductive	1,692	11.2%
Too steep	1,658	11.0%
Blocked by obstacle	491	3.2%
Denied access	464	3.1%
Recreational/scenic	457	3.0%
Deer wintering area	217	1.4%
Non-military lease/easement	160	1.1%
Other dept./div. processes	159	1.1%
Wildlife concerns	145	1.0%
Rare landforms	127	0.8%
Other influence zones	119	0.8%
Long-term retention	47	0.3%
Blocked by railroad	20	0.1%
Cannot regenerate	2	0.0%
Total unavailable	**15,121**	**100.0%**

Management actions

Each cover type in the Michigamme Highlands has a unique age class and basal area class goals that describe the long-term desired future conditions. The harvest levels needed in the first planning period to begin achieving those long-term goals are summarized below (Table 5).

Table 5. Ten-year planning period harvest goals (acres) by cover type and silvicultural regime.

Silvicultural Regimes								
Cover Type	**Clearcut**	**Selection**	**Thinning**	**Group Selection**	**Shelterwood**	**Salvage Clearcut**	**Salvage Thinning**	**Grand Total**
Northern hardwood	102	4,831	-	-	63	-	-	4,996
Aspen	820	-	-	-	-	-	-	820
Upland mixed forest	518	-	-	-	-	-	-	518
Lowland spruce/fir	367	-	-	-	-	-	-	367
Mixed upland deciduous	208	88	-	-	48	-	-	344
Lowland conifers	194	-	-	-	-	-	-	194
Natural jack pine	190	-	-	-	-	-	-	190
Lowland deciduous	59	-	-	-	4	-	-	63
Planted jack pine	25	-	-	-	-	-	-	25
Hemlock	-	15	-	-	-	-	-	15
Tamarack	8	-	-	-	-	-	-	8
Totals	**2,491**	**4,934**	**-**	**-**	**114**	**-**	**-**	**7,540**

These harvests will help establish a desirable amount of regeneration for the even-aged cover types over the 10-year period or help to achieve desired basal area distribution among uneven-aged cover types like northern hardwoods. The following sections will provide additional details for each of the significant cover types in the management area.

Table 6. Ten-year estimated harvest volume by product and species for the Michigamme Highlands management area.

10-Year Estimated Harvest Volume Projection Michigamme Highlands Management Area			
Product	**Species**	**Volume Planned***	**Volume Prepared****
Pulpwood (cords)	Mixed hardwood	32,635	30,677
	Mixed softwood	10,703	10,061
	Mixed aspen	8,043	7,560
	Mixed spruce	4,737	4,453
	Jack pine	3,117	2,930
	White pine	855	803
	Mixed oak	835	785
	Red Pine	550	517
	Pulpwood Total	**61,475**	**57,786**
Sawtimber (MBF)	Sugar maple	15,993	15,033
	Red maple	4,385	4,122
	Basswood	1,903	1,789
	Red oak	1,661	1,561
	Mixed aspen	1,390	1,307
	White pine	1,120	1,053
	Red pine	1,024	963
	White oak	329	309
	Mixed oak	145	136
	Sawtimber Total	**27,949**	**26,272**
	Total Sawtimber Harvest Volume in Cords	**58,531**	**55,019**
	Grand Total Harvest Volume in Cords	**120,006**	**112,806**

* Volume estimates based on 100% of the projected harvests for the 10 year planning period.

** Volume estimates based on 94% of the projected harvests for the 10 year planning period accounting for reduction in acres and associated volume once sales are prepared for bid.

Few cover type transitions are projected in the management area. The managed area of each cover type is projected to remain relatively stable.The largest decrease forecasted is in the lowland spruce/fir cover type, where 307 acres are expected to convert to other cover types through forest management activities. The largest increase is in lowland mixed forest where 250 acres are expected to convert into that cover type.

Table 7. Projected 10-year cover type acres resulting from cover type transitions.

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Northern hardwood	15,863	15,794	-68
Aspen	6,480	6,555	75
Lowland spruce/fir	4,794	4,486	-307
Mixed upland deciduous	4,520	4,610	89
Lowland conifers	4,355	4,431	75
Upland mixed forest	3,416	3,264	-151
Cedar	2,229	2,229	0
Upland conifers	1,536	1,573	37
Natural jack pine	1,434	1,380	-54
Lowland mixed forest	1,433	1,682	250
Upland spruce/fir	1,206	1,206	0
Planted jack pine	1,066	1,060	-6
Hemlock	879	879	0
Lowland deciduous	840	822	-18
Tamarack	715	713	-2
Natural red pine	686	686	0
Natural white pine	644	644	0
Lowland aspen/balsam Poplar	489	491	3
Northern red oak	451	450	0
Natural mixed pines	259	259	0
Oak mix	188	200	12
Planted red pine	148	213	64
Black-red hybrid oak	0	1	1
Lowland shrub	4,754	4,754	0
Marsh	1,858	1,858	0
Water	1,381	1,381	0
Low density trees	473	473	0
Bare/sparsely vegetated	458	458	0
Herbaceous openland	347	347	0

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Urban	332	332	0
Bog	310	310	0
Upland shrub	203	203	0
Treed bog	131	131	0
Total:	**63,877**	**63,877**	**0**

Featured species current and projected habitat acres

There are 16 featured species in this management area that span various cover types, age classes, and stand-level conditions.

As noted in the Featured Species Management Priority (Section 3), it is recommended that these featured species habitat acres be viewed as acres of potential habitat, representing a condition on the landscape where the more nuanced aspects of each species' habitat requirements are likely to be found or managed for. The modeling effort was limited by several factors including the simplification of habitat attributes into MiFI variables. When referring to habitat acres what is being referred to is potential habitat acres.

Current and projected total habitat acres by species across the decade provide a baseline and show the result of long-term management actions (Table 8). Some species show a loss in habitat over the next century. As mentioned in the Featured Species Management Priority (Section 3), the current condition for many cover types is a surplus of acres in the 0-9 age class from the compensatory management approach applied in the previous decade. The model eventually evens out the age classes at a lower, sustainable level over time, usually by 50 years. For any species with northern hardwoods as a priority cover type, there is a perceived drop in acres between 40-60 years; this is due to the basal area dropping below 81. Bbecause it only drops into the upper 70s, it is not expected to translate to any real habitat loss on the ground. Three of these species were not included in the SFMP model but are included here to inform management decisions over the decade.

Table 8. Featured species current and projected total habitat acres (i.e., potential habitat).

Featured Species	Priority Cover types	Total Habitat Acres Current	10-year Projected Habitat Acres	50-year Projected Habitat Acres	100-year Projected Habitat Acres
Black bear	Mast	45,615	--	--	--
Black-backed woodpecker	Natural disturbance	--	--	--	--
Blackburnian warbler	Northern hardwoods, upland mixed forest, natural white pine, natural mixed pines,	14,743	17,588	10,269	18,456

Featured Species	Priority Cover types	Total Habitat Acres Current	10-year Projected Habitat Acres	50-year Projected Habitat Acres	100-year Projected Habitat Acres
	upland conifers, upland spruce/fir, hemlock				
Black-throated blue warbler	Northern hardwoods, mixed upland deciduous	12,512	15,434	8,194	15,964
Cerulean warbler	Northern hardwoods, mixed upland deciduous, lowland deciduous	15,114	16,956	16,346	16,513
Kirtland's warbler	Planted jack pine, natural jack pine	347	--	--	--
Marten	Northern hardwoods, mixed upland deciduous, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, lowland mixed forest, lowland conifers, hemlock, cedar	19,341	22,900	15,417	24,515
Moose	To be determined	--	--	--	--
Red crossbill	Natural red pine, natural white pine, natural mixed pine, planted red pine	697	601	418	498
Ruffed grouse	Aspen	1,747	1,807	1,926	2,010
Snowshoe hare	Aspen, cedar, hemlock, lowland aspen, lowland conifers, lowland mixed forest, lowland spruce/fir, mixed upland deciduous, natural jack pine, natural mixed pines, planted jack pine, upland spruce/fir	7,485	7,303	4,641	4,985
Spruce grouse mature forest	Natural jack pine, natural white pine, natural mixed pine, upland conifer, upland spruce/fir, lowland spruce/fir, lowland conifer, tamarack	6,010	6,951	8,405	9,484
Spruce grouse young jack pine	Jack pine (natural and planted)	765	536	574	556
White-tailed deer (food)	Northern hardwood, oak mix, aspen, mixed upland deciduous, lowland deciduous, lowland	33,678	33,870	35,110	35,539

Featured Species	Priority Cover types	Total Habitat Acres Current	10-year Projected Habitat Acres	50-year Projected Habitat Acres	100-year Projected Habitat Acres
	aspen/balsam poplar, lowland mixed forest				
White-tailed deer (shelter)	Hemlock, cedar, planted red pine, planted white pine, planted mixed pine, natural red pine, natural white pine, natural mixed pines, upland conifers, upland spruce fir, lowland conifers	16,735	16,605	15,667	15,439
Wild turkey	Non-forested openings	820	--	--	--
Wood turtle	Non-forested openings	--	--	--	--
Wood thrush	Northern hardwoods, northern red oak, mixed upland deciduous, lowland deciduous	15,239	16,594	10,971	18,745

Deer wintering complexes that are greater than 15,000 acres are modeled as special analysis units and information on them can be found in Section 5 of the plan. In DWCs less than 15,000 acres, harvest of cedar and hemlock are not allowed within obligate range stands, and secondary shelter is often protected as well. These areas are guided by the DNR Deer Winter Range Guidelines.

Cover type composition and associated wildlife species

Northern hardwoods

Current condition

Most of the northern hardwood cover type in this management area is currently between a stand age of 100-119-years-old (Figure 3). The past management regime has been primarily single-tree selection. which allows for stand age to continue to increase over time. Some stands are beginning to achieve an uneven-aged condition where a featured stand age becomes less evident, but the dominant age of these stands will likely increase past 150 years old before a younger age cohort becomes the prominent component (Figure 5). A portion of the stands has been managed under an even-aged system due to poor quality stands or a predominance of red maple in those stands. A portion of this cover type meets the habitat requirements for blackburnian warbler, black-throated blue warbler, cerulean warbler, marten, wood thrush and white-tailed deer.

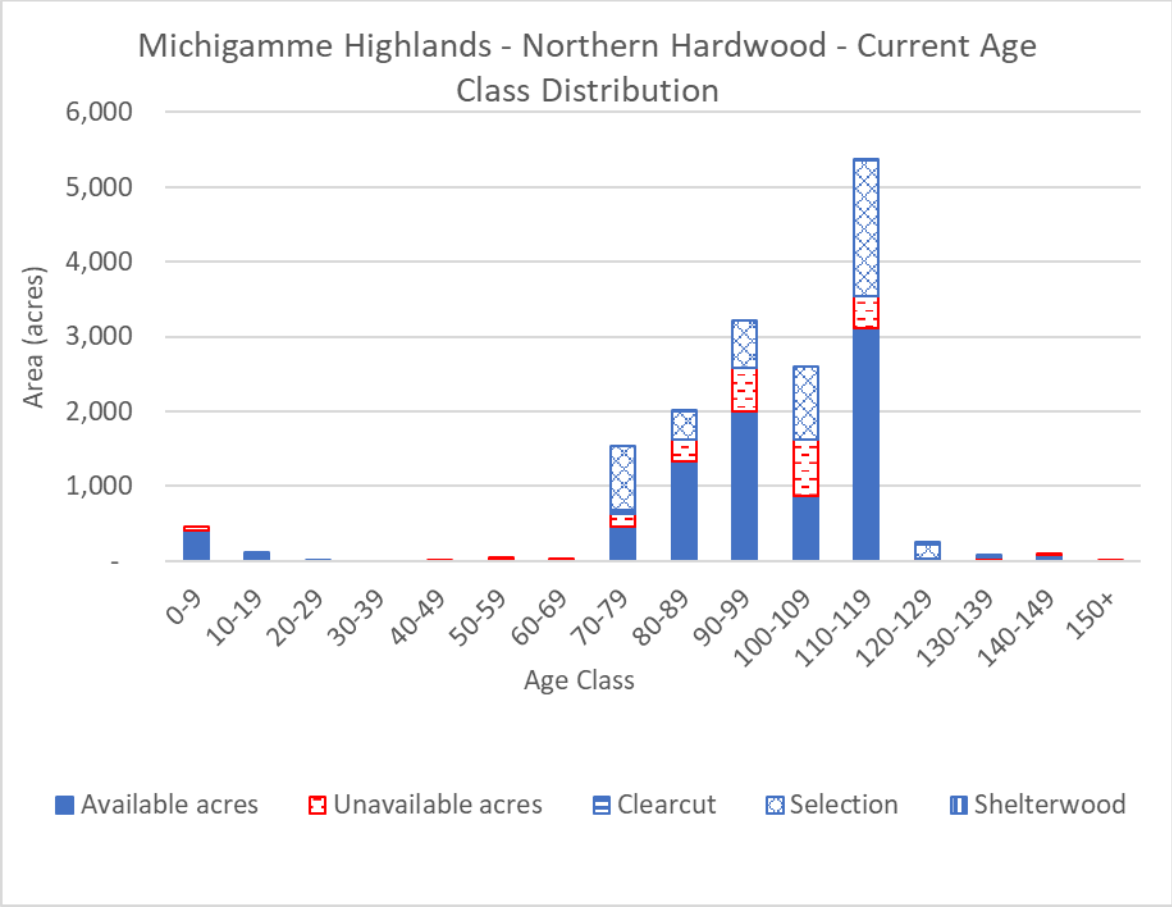


Figure 3. Current age class distribution and projected harvests in the northern hardwood cover type in the Michigamme Highlands management area.

The area of northern hardwood is fairly well distributed in the ideal basal area classes for optimal growing conditions in this management area (Figure 4).

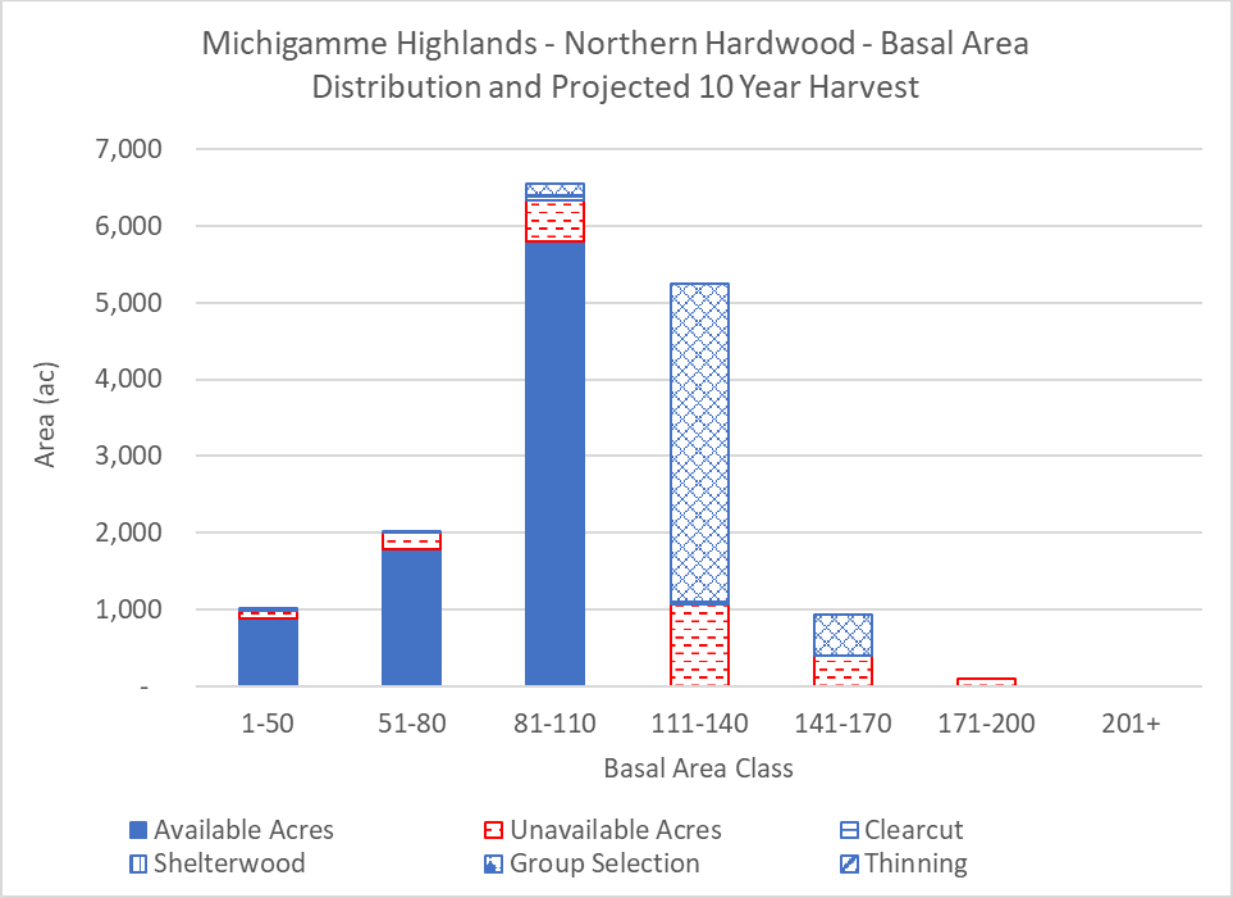


Figure 4. Current basal area distribution of the northern hardwood cover type and projected harvests from each basal area class.

Table 9. Featured species with northern hardwoods as a priority habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Northern Hardwood	Northern Hardwood Habitat Acres- Available	Northern Hardwood Habitat Acres- Unavailable
Cerulean warbler	Age category: 50+ Size category: Pole, Sawlog Basal area: 81+	11,343	2,127
Blackburnian warbler	Age category: 80+ Size category: Sawlog Basal area: 81+	9,471	1939
Black-throated blue warbler	Age category: 80+ Size category: Sawlog Basal area: 81+	9,471	1939
Wood thrush	Age category: 40+ Size category: Sawlog Basal area: 81+	10,778	2,067

Featured Species	Featured Species Habitat – Northern Hardwood	Northern Hardwood Habitat Acres- Available	Northern Hardwood Habitat Acres- Unavailable
Marten	Age category: 40+ Size category: pole, sawlog Basal area: 81+	9,471	1,939
White-tailed deer	All ages and size classes	15,683	--

Desired future condition

The projected long- term cover type trend for northern hardwood is somewhat stable. There are 68 acres transitioning from this cover type in the next 10 years.

The desired basal area distribution is a bell-shaped curve where a significant majority of the area is kept in the 81-110 basal area class with recently harvested stands occupying the 51-80 class and stands that are ready for harvest occupy the 111-140 basal area class. Diameter distributions of the northern hardwood stands should follow the appropriate Q-curve relative to stand age and condition.

An uneven-aged condition is the long-term goal for all northern hardwood stands in this management area. An uneven-aged condition is achieved when there is no single discernable age cohort that is more prevalent than others across the stand area as canopy gaps fill in with regenerating seedlings, saplings amdpoles/ Eventually remaining stems become sawlog-sized over time.

Regeneration and recruitment continue to be a focus in the northern hardwood cover type across this management area. The long-term sustainability of this cover type in an uneven-aged silvicultural regime depends on the successful establishment of northern hardwood species as well as the recruitment of those seedlings and saplings into the pole and saw log classes. Northern hardwood in the Michigamme Highlands management area has challenges in regeneration and recruitment due to cervid herbivory and poor site conditions of some stands.

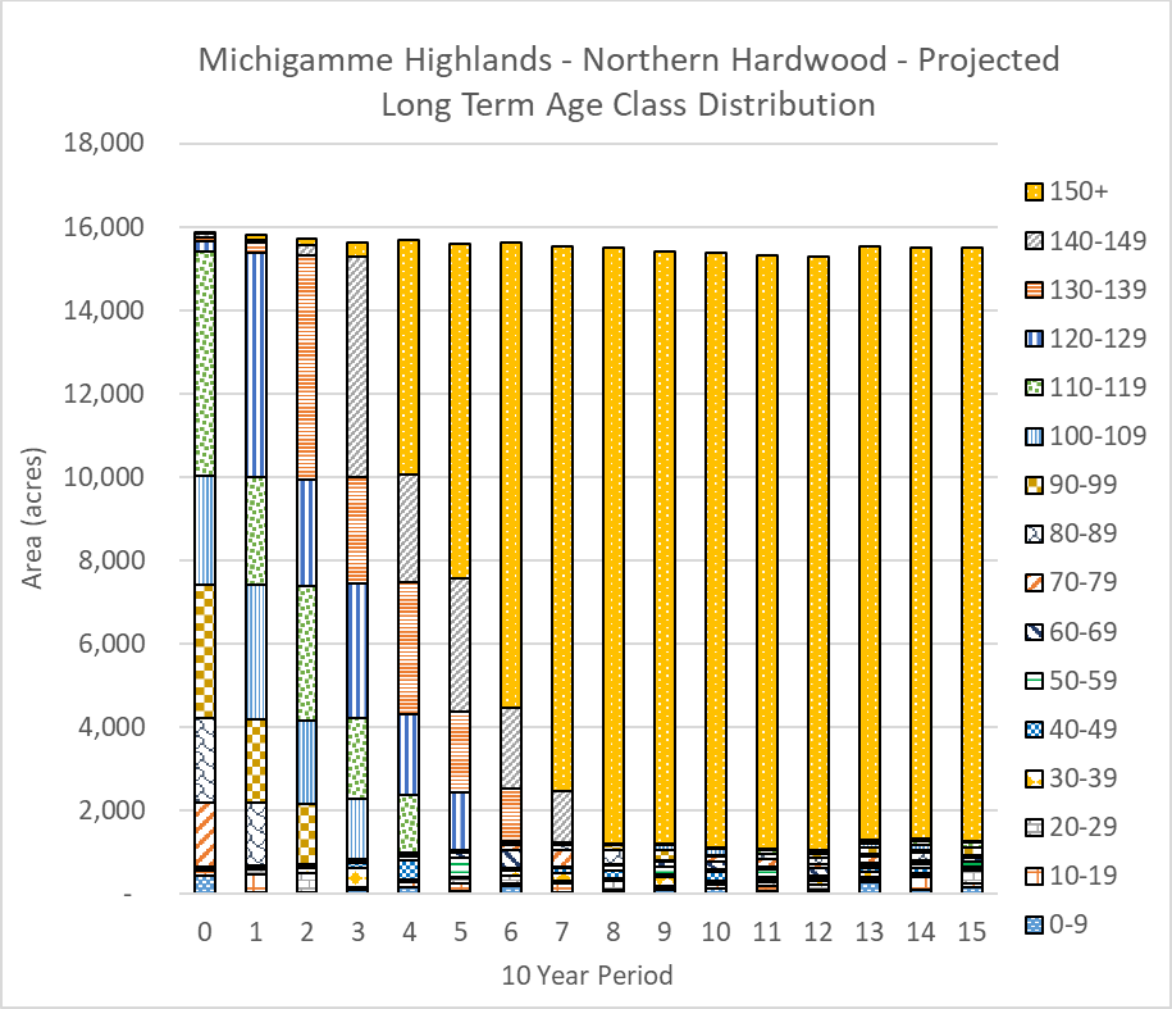


Figure 5. Projected age class distribution over 15. 10-year planning periods.

Management actions

The desired forest conditions and associated featured species habitat will be maintained and achieved through continued application of the projected selection harvest regime on 4,831 acres. About 165 acres will be managed under an even-aged system, with some of those acres harvested through a clearcut or shelterwood method to improve stand quality (Table 5). Larger canopy gaps should be used to encourage diverse regeneration of northern hardwood species while maintaining an overall long-term mature forest, closed-canopy landscape condition.

Aspen

Current condition

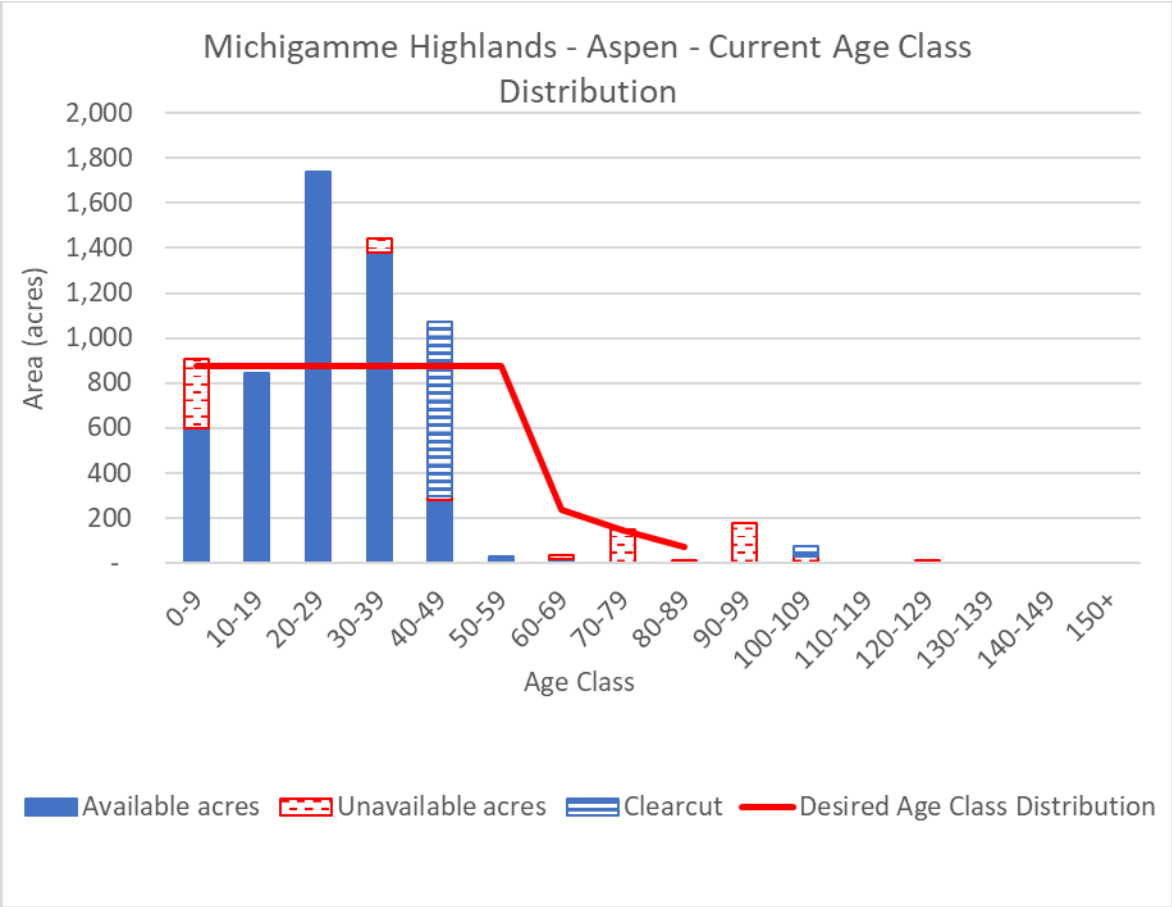


Figure 6. Current age class distribution, desired age class distribution, and projected harvests in the aspen cover type over the 10-year planning period.

The current age class distribution is unbalanced with a deficit of acres in the 50-89 and the 0-19-year-old age classes and a surplus of acres in the 20-49 year-old age classes. A portion of this cover type meets the habitat requirements for ruffed grouse and snowshoe hare (Table 7).

Table 10. Featured species with aspen as a priority habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Aspen	Aspen Habitat Acres - Available	Aspen Habitat Acres - Unavailable
Snowshoe hare	Age category: 0-19 Size class: sapling	1,443	305
Ruffed grouse	Age category: 0-19 Size class: sapling	1,443	305
White-tailed deer	All ages and size classes	6,480	--

Desired future condition

The desired age class distribution is to have a rotation age of 50 years for approximately 92 percent of the acres, then 4 percent of the acres in an age class tail out to the 60-year age class, 3 percent of the acres in an age class tail out to the 70-year age class, and 1 percent in an age class tail out to the 80-year age class.

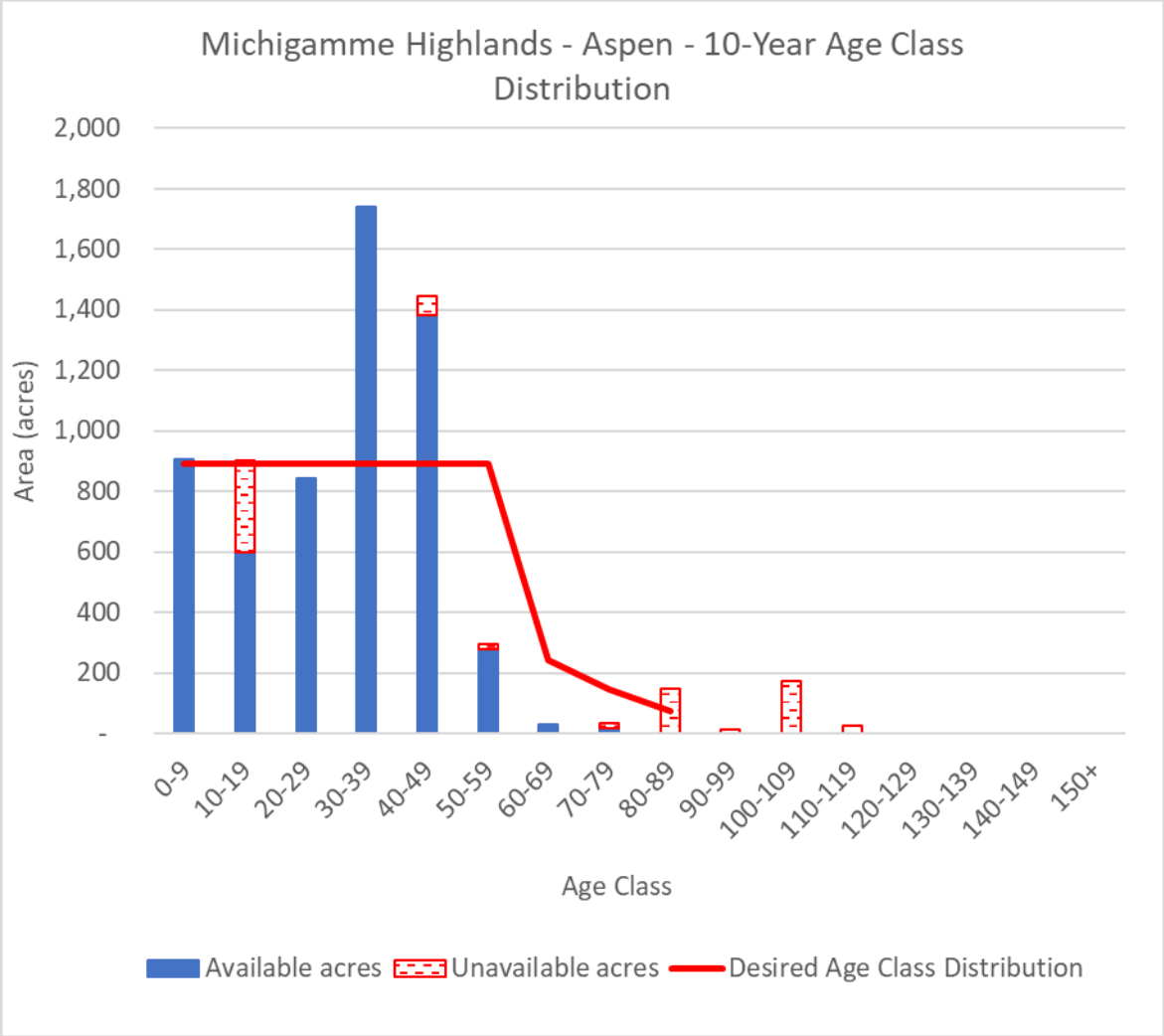


Figure 7. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The end of the planning period will result in the establishment of 903 acres of aspen in the upcoming 0-9 age class. Progress toward the long-term desired age class distribution of aspen will take a few decades.

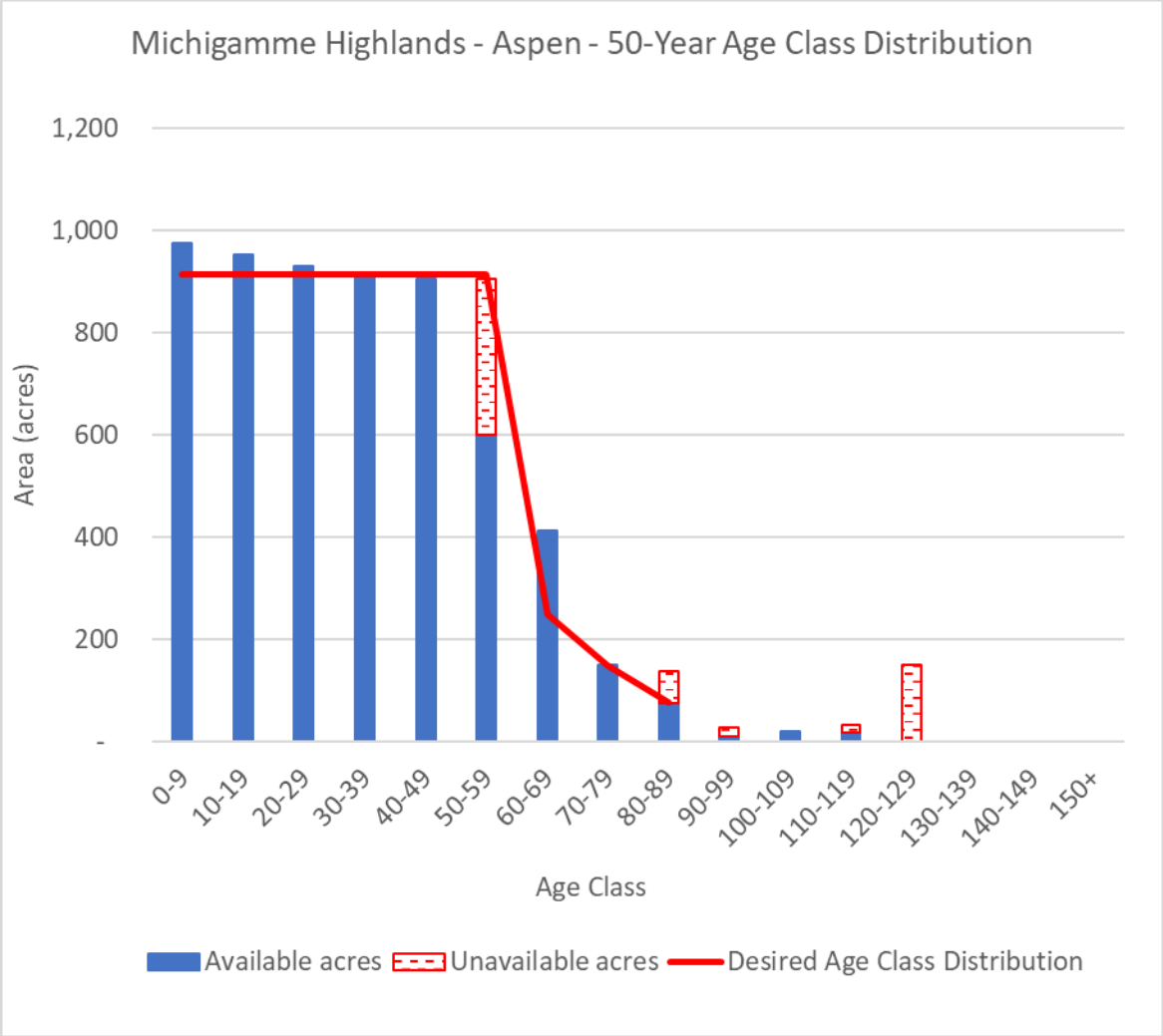


Figure 8. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows aspen acres nearly reaching the desired future condition with few age classes deviating from the target proportions (Figure 8).

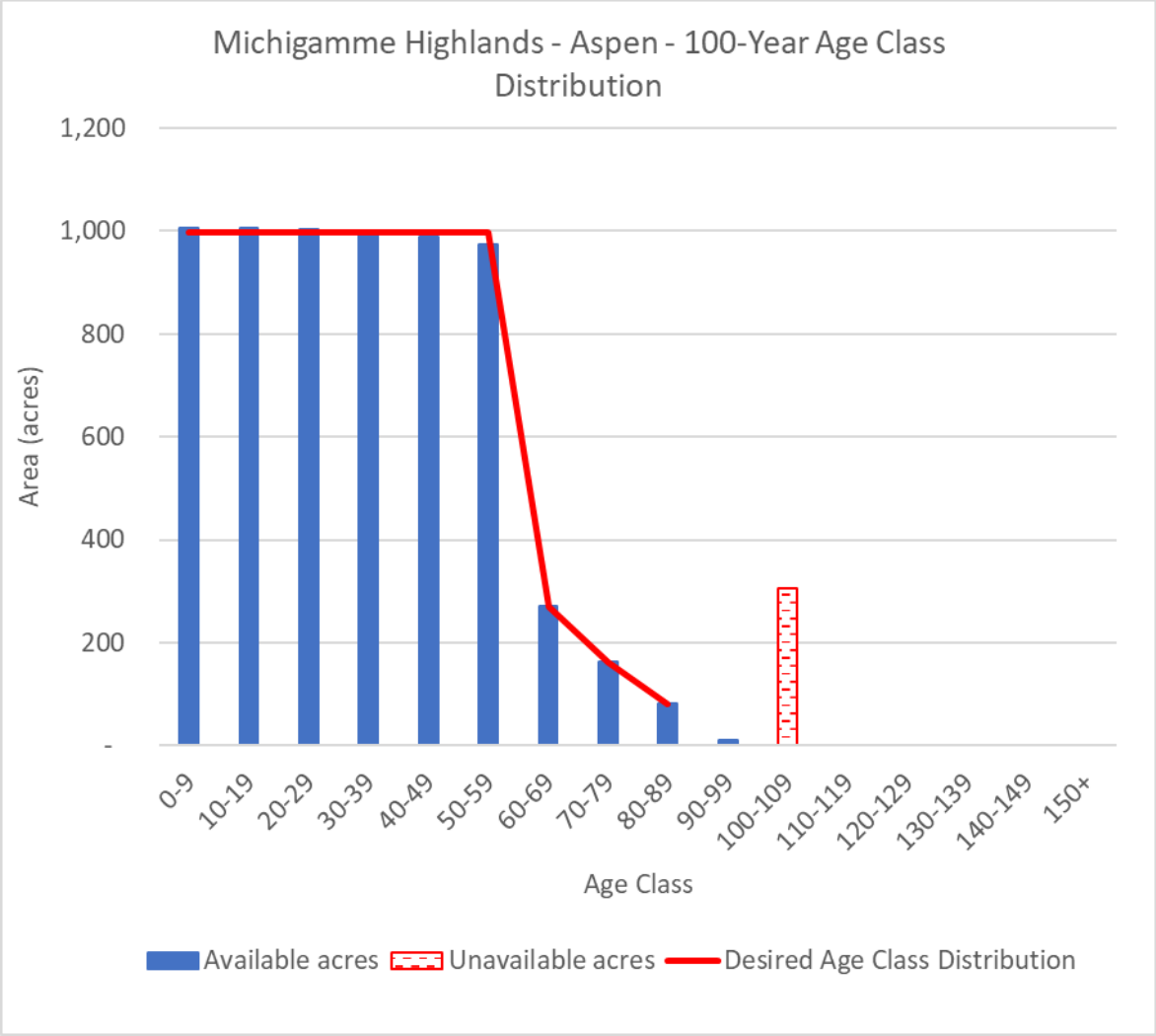


Figure 9. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 9) will concentrate the manageable acres of aspen in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged, and mature forest.

Management actions

There are 820 acres of projected clearcut harvest in the aspen cover type. bout 75 acres of aspen is expected to be converted from other cover types. These total to an expected 895 acres of regeneration in the aspen cover type over the next 10 years.

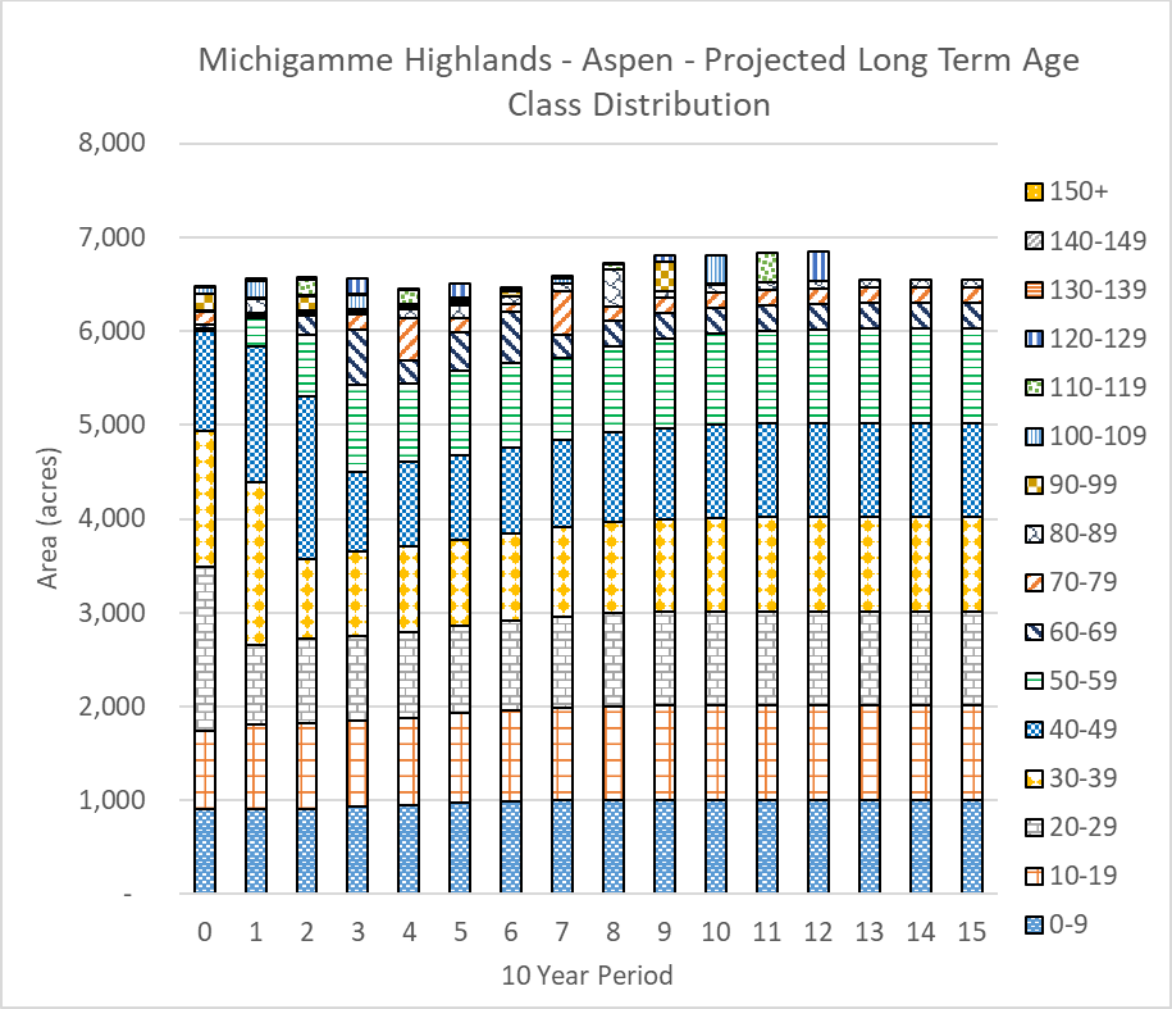


Figure 10. Projected age class distribution over 15, 10-year planning periods.

Mixed upland deciduous

Current condition

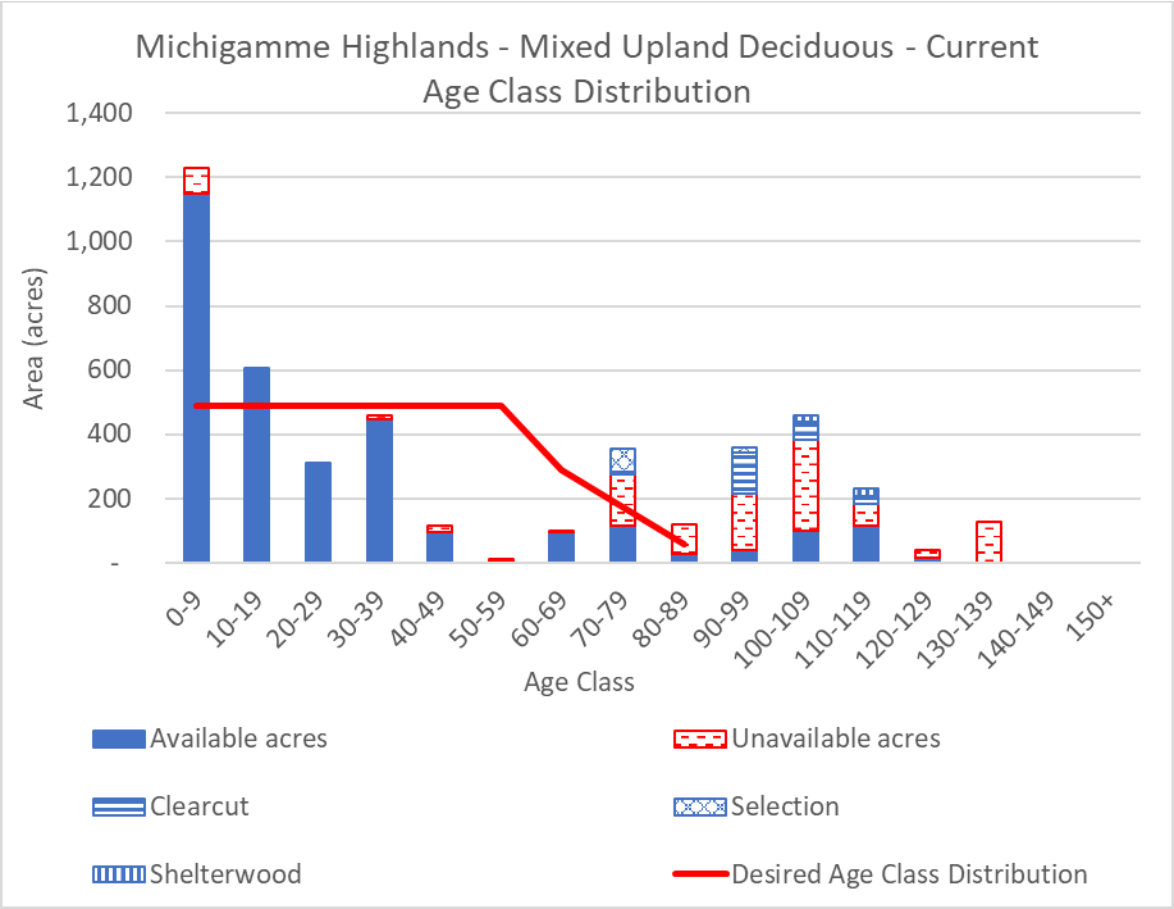


Figure 11. Current age class distribution, the desired age class distribution, and the projected harvests in mixed upland deciduous cover type over the 10-year planning period.

The current age class distribution is unbalanced, with a deficit of acres in the 20-69-year-old age classes, and a surplus of acres in the 0-19 and 70+ age classes. A portion of this cover type meets the habitat requirements for cerulean warbler, snowshoe hare, marten, and white-tailed deer.

Table 11. Featured species with mixed upland deciduous as a priority habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Mixed Upland Deciduous	Mixed Upland Deciduous Habitat Acres- Available	Mixed Upland Deciduous Habitat Acres- Unavailable
Marten	Age category: 40+ Size category: pole, sawlog Basal area: 81+	398	703

Featured Species	Featured Species Habitat – Mixed Upland Deciduous	Mixed Upland Deciduous Habitat Acres- Available	Mixed Upland Deciduous Habitat Acres- Unavailable
Cerulean warbler	Age category: 50+ Size category: pole, sawlog Basal Area: 81+	423	749
Snowshoe hare	Age category: 0-19 Size category: sapling	1,756	78
White-tailed deer	All ages and size classes	4,520	--

Desired future condition

The desired age class distribution is to have a rotation age of 50 years with approximately 8 percent of the acres in an age class tail out to the 60-year age class, 5 percent tail out to the 70-year age class, and 2 percent tail out to the 80-year age class.

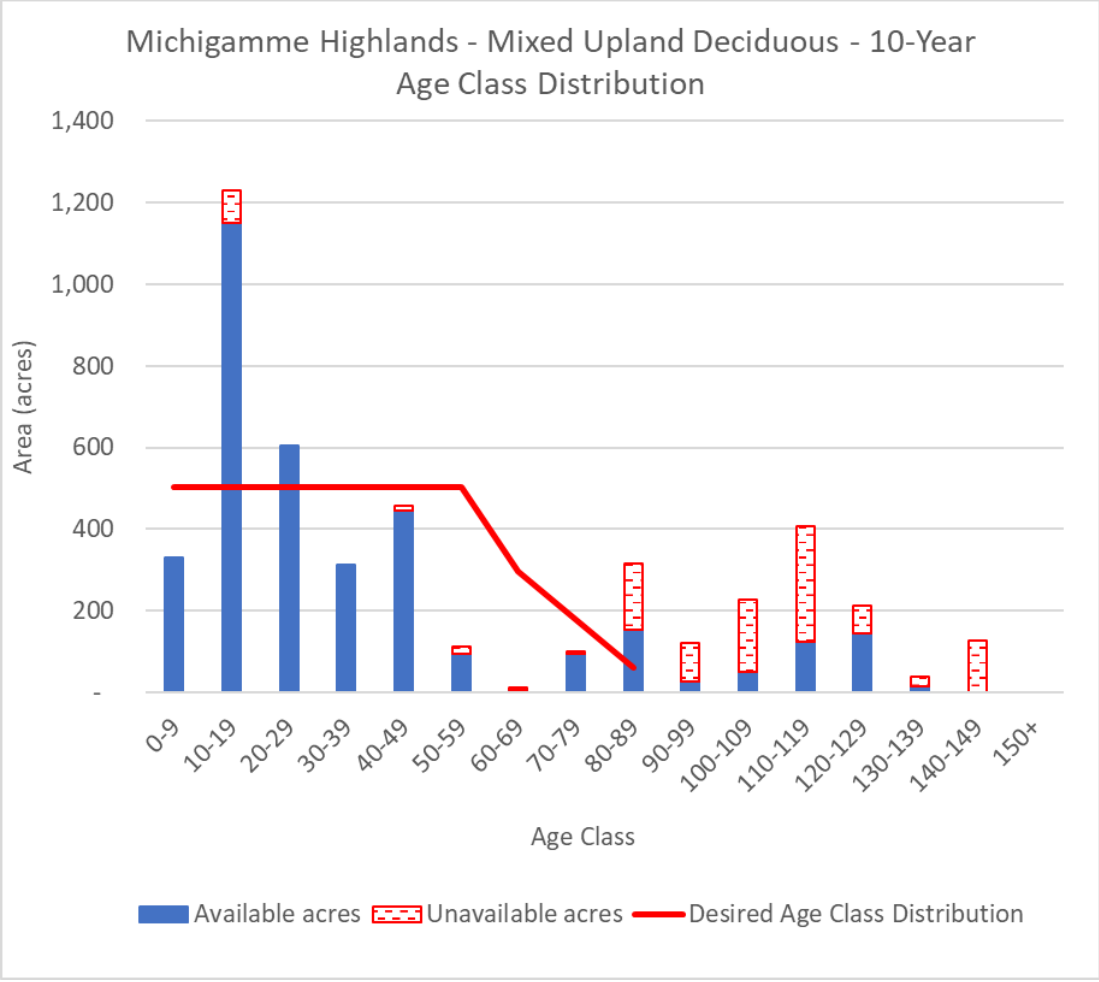


Figure 12. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The end of the planning period will result in the establishment of 329 acres in the upcoming 0-9 age class. Progress toward the long-term desired age class distribution of mixed upland deciduous will take many decades.

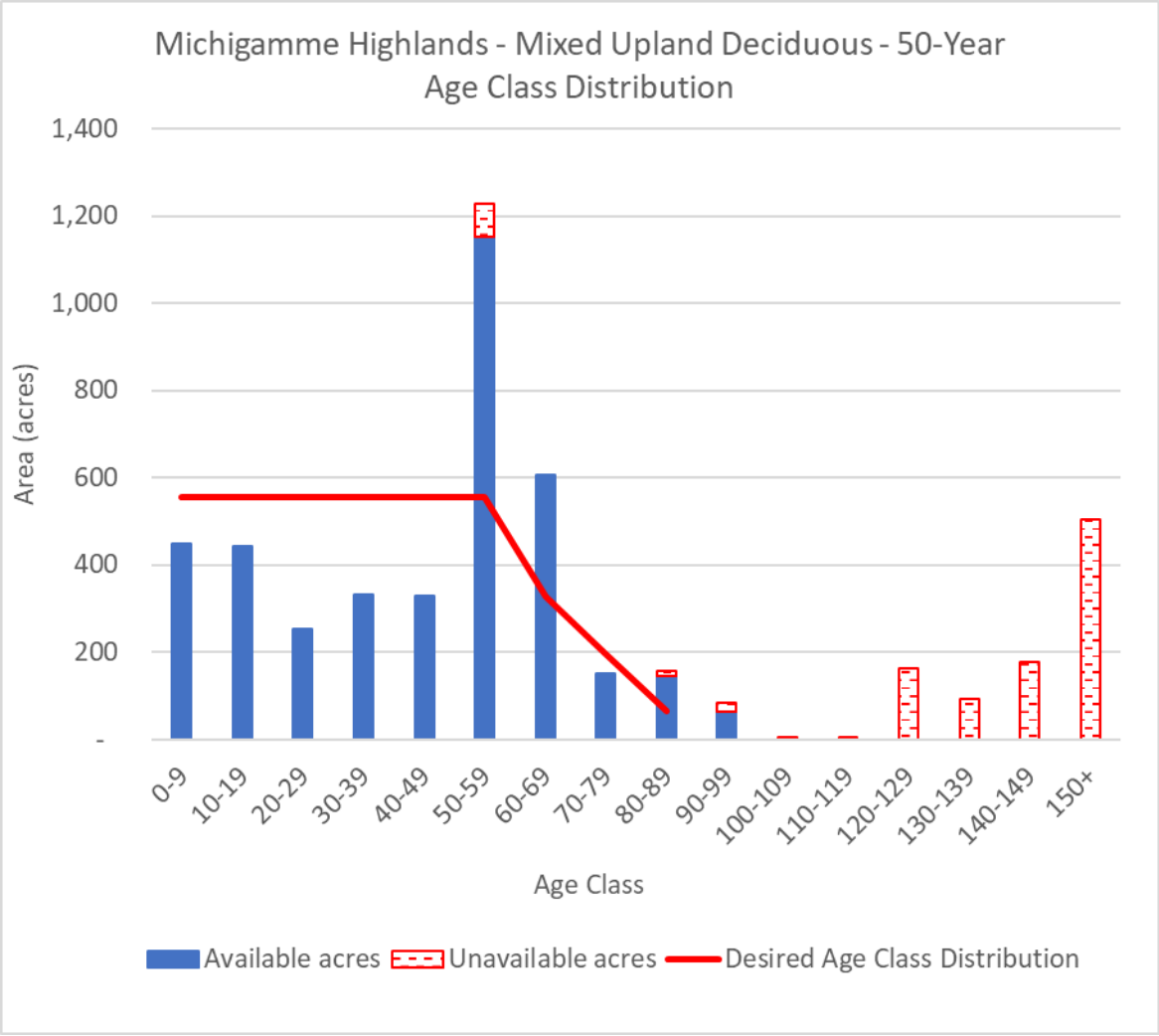


Figure 13. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of mixed upland deciduous acres working toward the desired future condition as older age classes are treated (Figure 13).

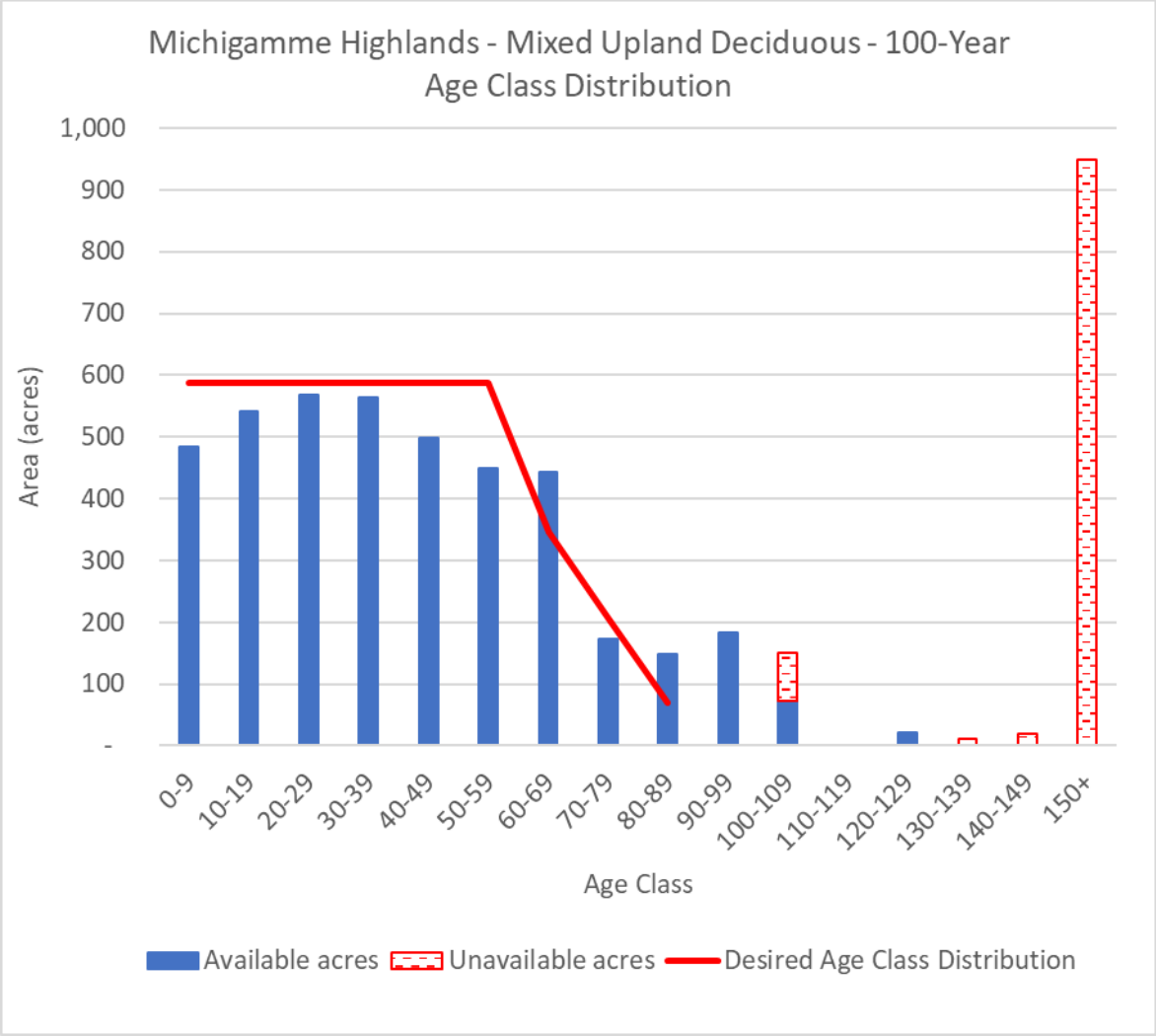


Figure 14. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 14) will concentrate the manageable acres of mixed upland deciduous in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged, and mature forest.

Management actions

There are 208 acres of clearcut, 88 acres of selection, and 48 acres of shelterwood method harvests projected in the mixed upland deciduous cover type. It is expected that about 91 acres of mixed upland deciduous will be converted from other cover types. These total to an expected 435 acres of regeneration in the cover type over the next 10 years.

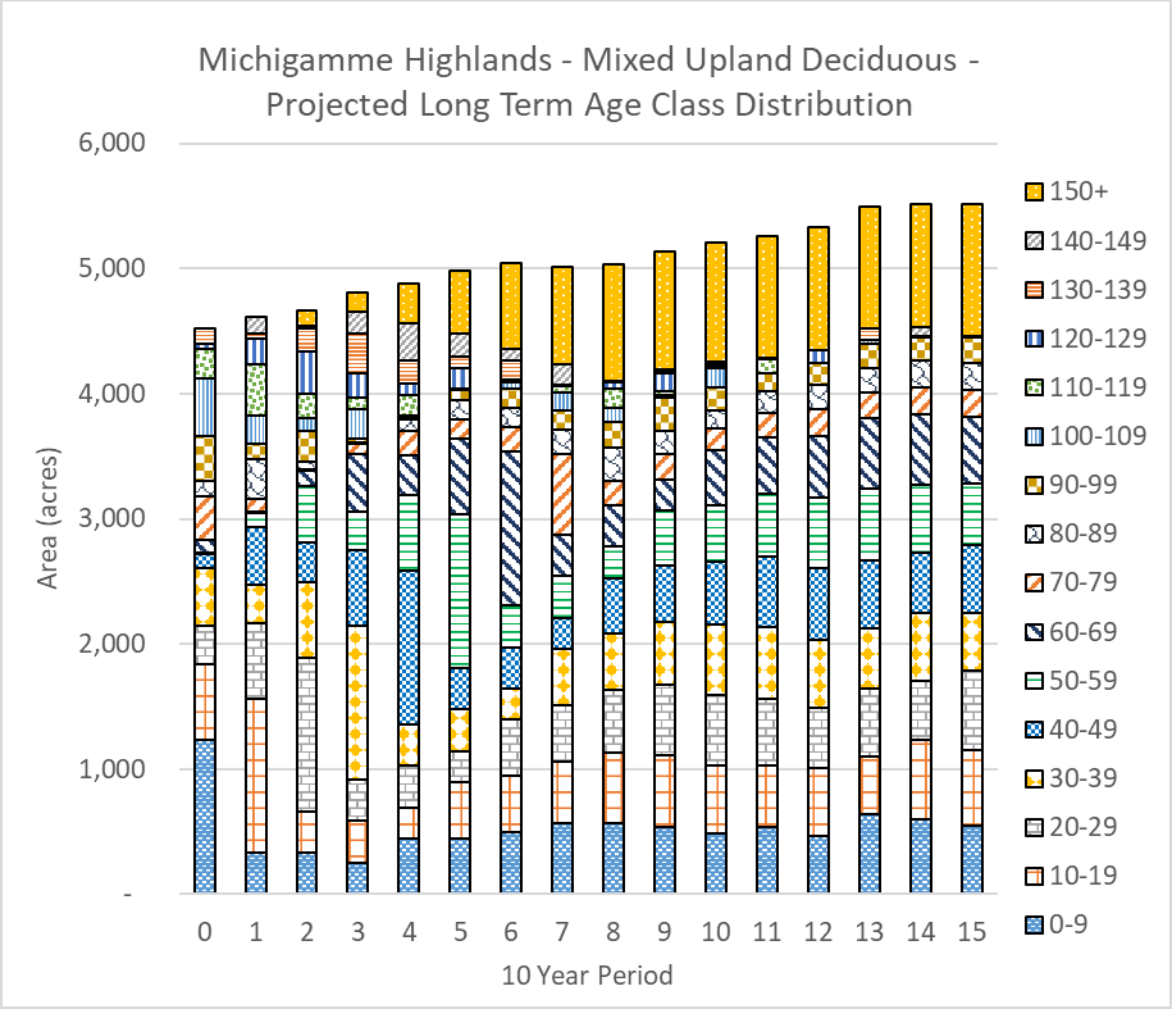


Figure 15. Projected age class distribution over 15, 10-year planning periods.

Upland mixed forest

Current condition

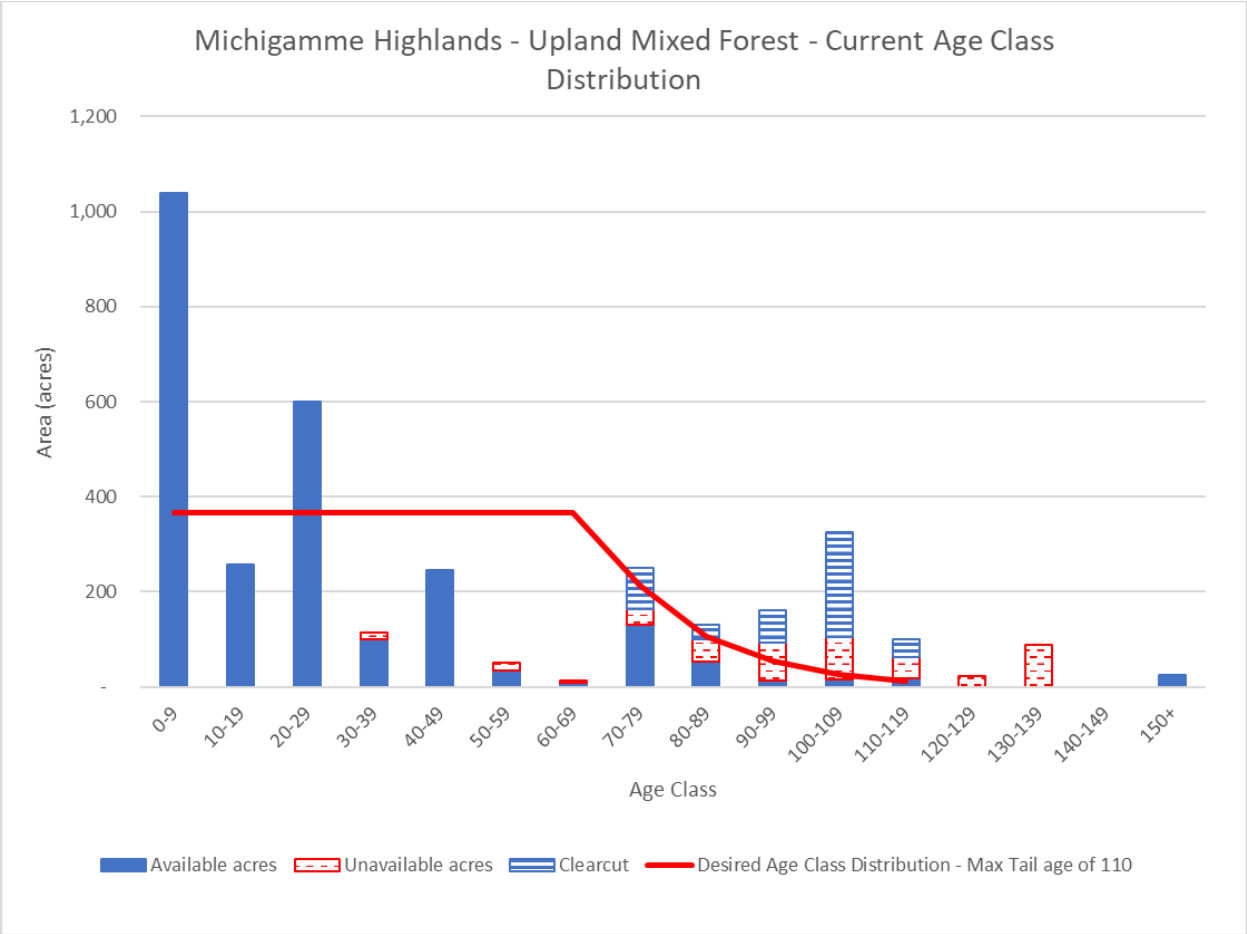


Figure 16. Current age class distribution, desired age class distribution and projected harvests in upland mixed forest cover type over the 10-year planning period.

The current age class distribution is very unbalanced with a deficit of acres in the 10-19- and 30-69-year-old age classes, and a surplus of acres in the 0-9-, 30-69-, and 70+ classes. A portion of this cover type meets the habitat requirements for marten and blackburnian warbler.

Table 12. Featured species with upland mixed forest as a priority habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Upland Mixed Forest	Upland Mixed Forest Habitat Acres - Available	Upland Mixed Forest Habitat Acres - Unavailable
Blackburnian warbler	Age category: 80+ Size category: Sawlog Basal area: 81+	274	349

Featured Species	Featured Species Habitat – Upland Mixed Forest	Upland Mixed Forest Habitat Acres - Available	Upland Mixed Forest Habitat Acres - Unavailable
Marten	Age category: 40+ Size category: pole, sawlog Basal area: 81+	274	349

Desired future condition

The desired age class distribution is to have a rotation age of 60 years with approximately 7 percent of the acres in an age class tail out to the 70-year age class, 4 percent tail out to the 80-year age class, 2 percent tail out to the 90-year age class, and 1 percent tail out to the 100-year age class.

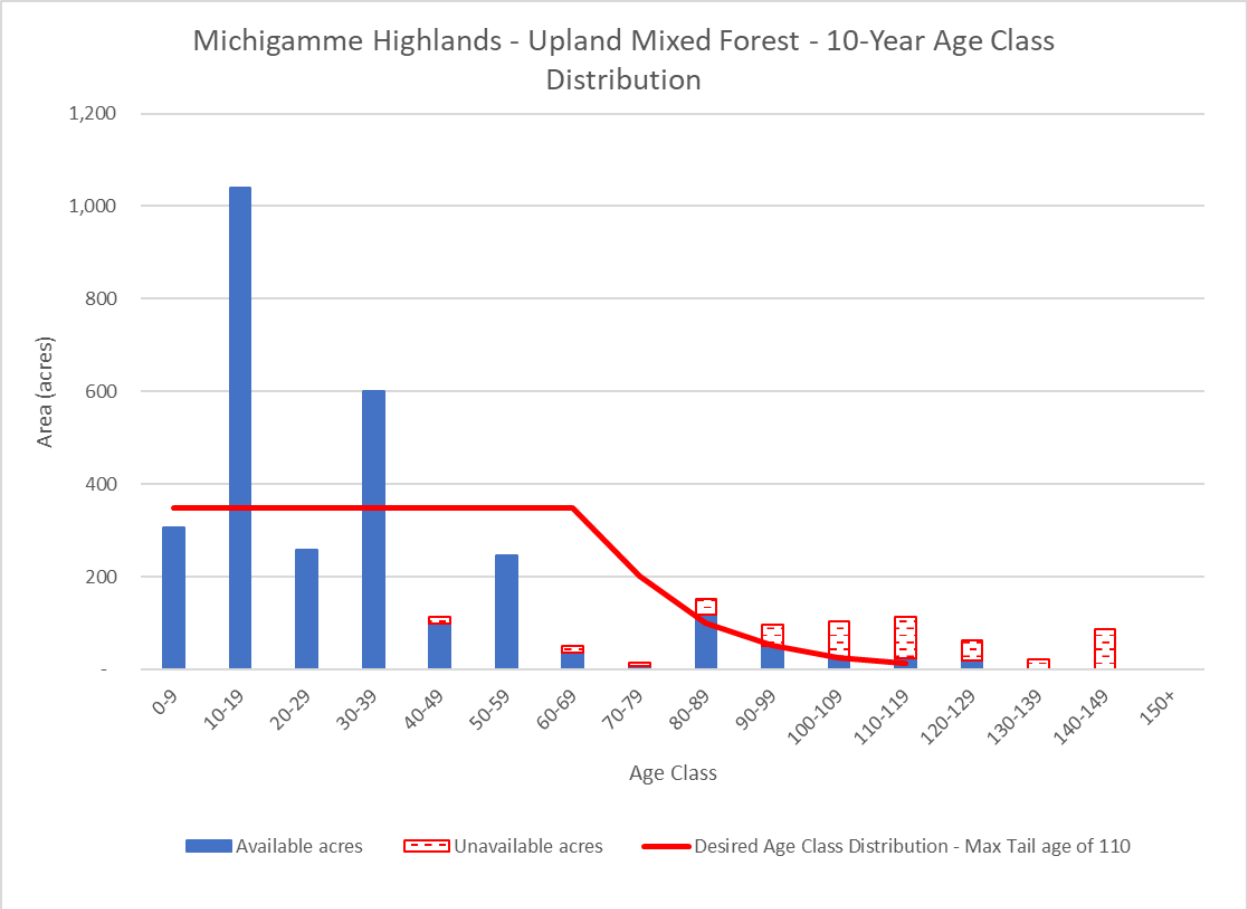


Figure 17. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The end of the planning period will result in the establishment of 331 acres in the upcoming 0-9 age class. Progress toward the long-term desired age class distribution of upland mixed forest will take many decades in this management area.

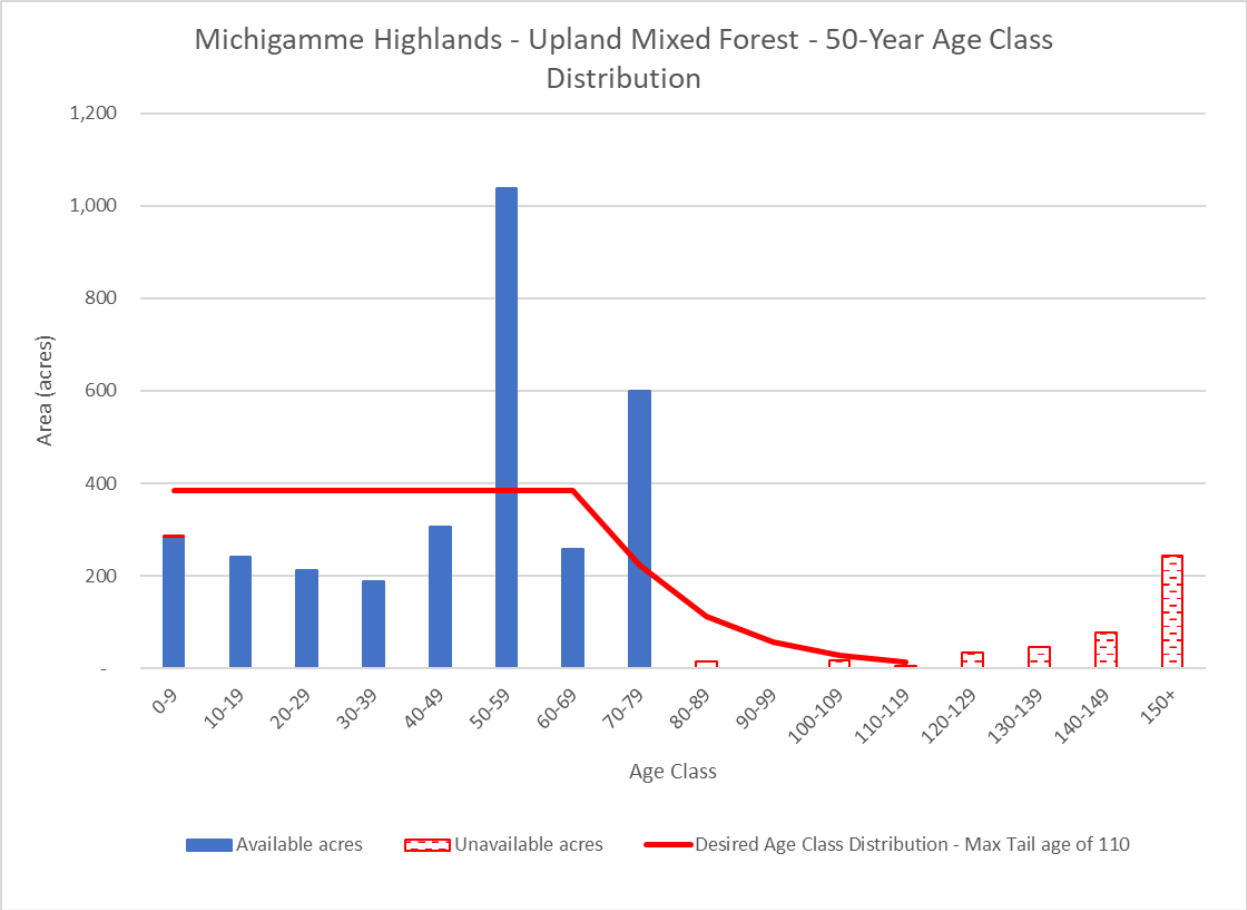


Figure 18. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of upland mixed forest acres working toward the desired future condition as the older age classes are treated (Figure 18).

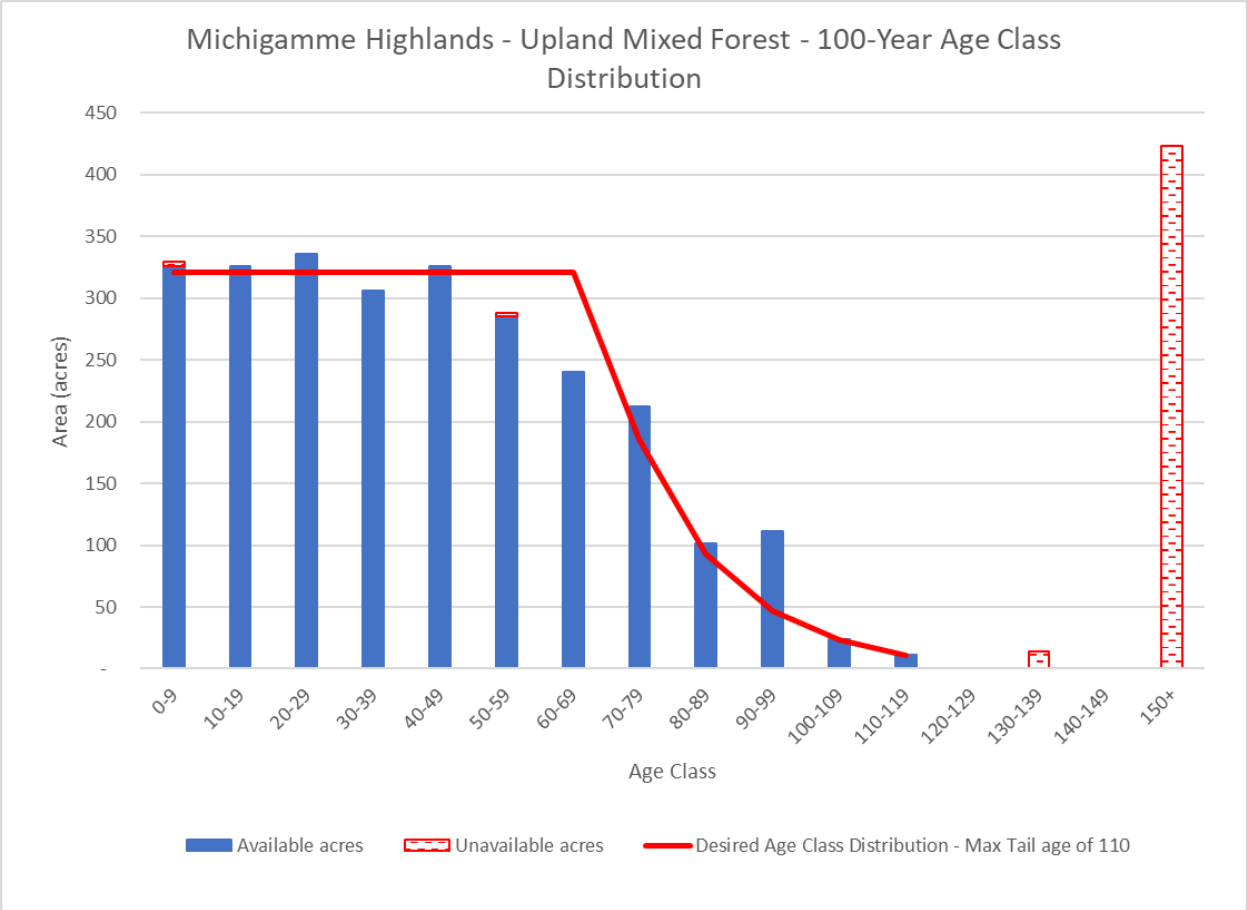


Figure 19. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 19) will concentrate the manageable acres of mixed upland deciduous in productive growing conditions while providing an even flow of forest products and a wide variety of wildlife habitat conditions across the landscape in young, mid-aged, and mature forest.

Management actions

There are 445 acres of clearcut harvests projected in the upland mixed forest cover type. It is expected that about 155 acres of upland mixed forest will be converted to other cover types. These total to an expected 290 acres of regeneration in the upland mixed forest cover type over the next 10 years.

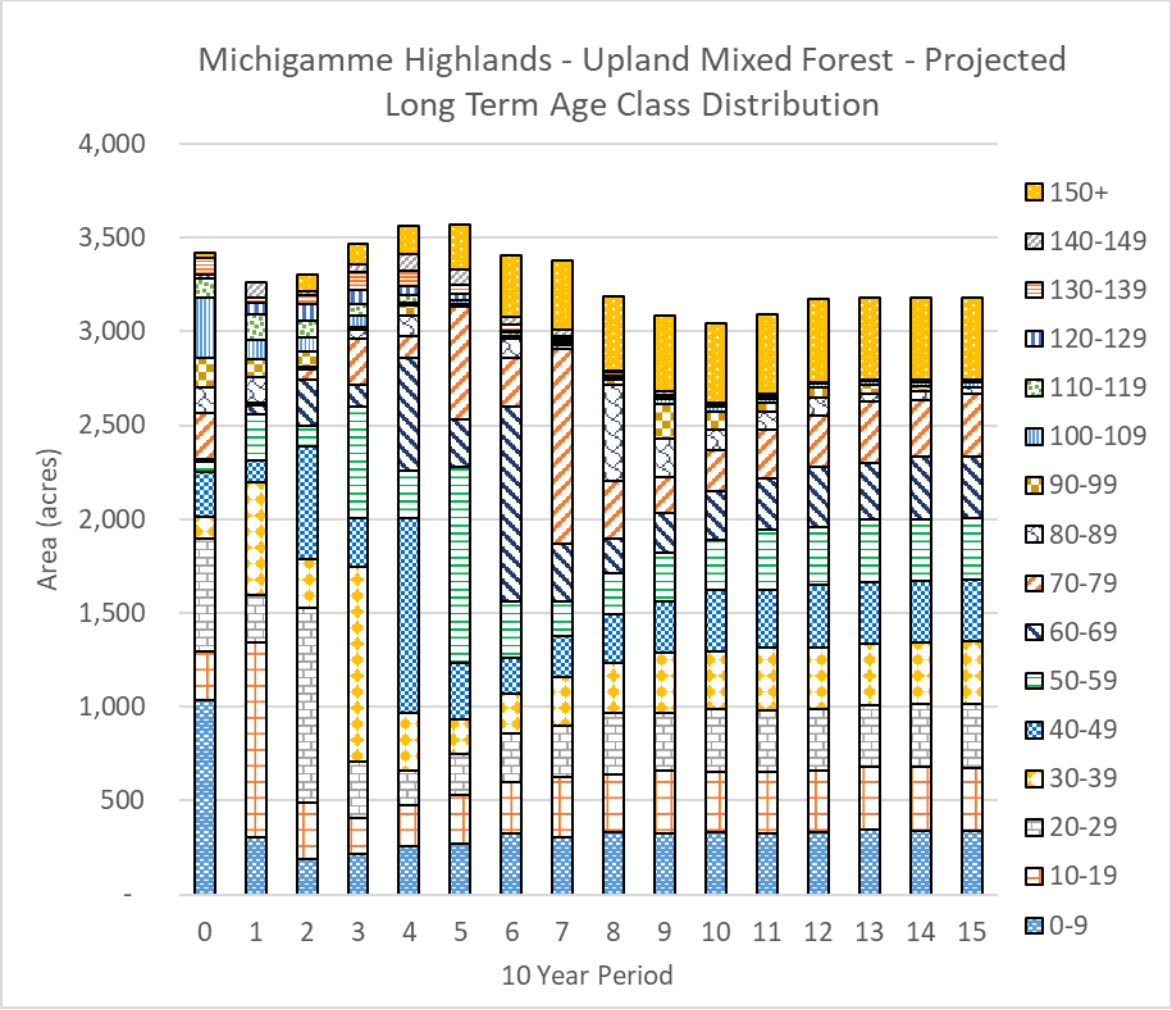


Figure 20. Projected age class distribution over 15, 10-year planning periods.

Conservation area network

High conservation value areas

There are up to nine different HCVA types that can be found in each management area (Table 13; see Biodiversity in Section 3 for more information)

Table 13. High conservation value areas within the Michigamme Highlands management area.

High Conservation Value Area Type and Name	Acres
Dedicated Management Areas	**16**
	16
Deer Wintering Complex	**5,842**
	5,842
Forest Habitat Core Interior	**4,012**
	4,012
Northern Long-Eared Bat Hibernacula 2.5 mile buffer	**12**
Goodrich Adit B	12
Verified Type 1 and Type 2 Old Growth	**163**
Type 1 Old Growth	20
Type 2 Old Growth	144
Grand Total	**10,044**

Ecological reference areas

Ecological Reference Areas (ERAs) are a type of HCVA and are higher quality examples of functioning ecosystems primarily influenced by natural ecological processes.

Table 31. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 32. Ecological reference areas within the management area

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	Number of Occurrences
Existing ERA	Bog	B			1
Existing ERA	Dry-mesic northern forest	A	G4	S3	1
Existing ERA	Dry-mesic northern forest	B			5
Existing ERA	Dry-mesic northern forest	C	G4	S3	1
Existing ERA	Granite bedrock glade	AB			2
Existing ERA	Granite bedrock glade	AB		S2	1
Existing ERA	Granite bedrock glade	AB	G3G5	S2	2
Existing ERA	Granite bedrock glade	B	G3G5	S2	1
Existing ERA	Granite cliff	A	G4G5	S2	4
Existing ERA	Granite cliff	AB			2
Existing ERA	Granite cliff	AB	G4G5	S2	1
Existing ERA	Granite cliff	B	G4G5	S2	3
Existing ERA	Mesic northern forest	AB	G4	S3	2
Existing ERA	Mesic northern forest	B			2
Existing ERA	Mesic northern forest	B	G4	S3	3
Existing ERA	Mesic northern forest	BC	G4	S3	3
Existing ERA	Northern shrub thicket	AB			1
Existing ERA	Northern shrub thicket	AB	G4	S5	1
Existing ERA	Northern wet meadow	AB	G4G5	S4	1
Existing ERA	Northern wet meadow	B			1
Existing ERA	Poor fen	B			1
Existing ERA	Rich conifer swamp	BC	G4	S3	1
Existing ERA	Sandstone lakeshore cliff	AB	G3	S2	1
Existing ERA	Submergent marsh	A	GU	S4	2
Existing ERA	Wooded dune and swale complex	BC			1
Existing ERA	Wooded dune and swale complex	BC	G3	S3	1
Proposed ERA	Dry northern forest	B	G3?	S3	1
Proposed ERA	Granite bedrock glade		G3G5	S2	1
Proposed ERA	Granite bedrock glade	AB	G3G5	S2	1
Proposed ERA	Granite cliff	B	G4G5	S2	3
Proposed ERA	Poor fen	B	G3	S3	1
Proposed ERA	Sand and gravel beach	AB	G3?	S3	1
Proposed ERA	Granite bedrock lakeshore	AB	G4G5	S2	3
Proposed ERA	Granite lakeshore cliff	AB	GU	S1	2
Grand Total					**58**

Special conservation areas

Reviewable special conservation areas (SCAs; Table 16) refers to those SCA types that may be reviewed or updated through the compartment review process as needed. Static SCAs (Table 17) refers to those SCA types that generally do not change or require updating (see Biodiversity in Section 3 for more information).

Table 16. Reviewable special conservation areas within the Michigamme Highlands management area.

Reviewable Special Conservation Area Type and Name	Acres
Concentrated Recreational Area	**84**
Unspecified	1
Beaufort Lake Campground	2
King Lake Boat Launch	0
Unspecified	81
Cultural or Customary Area	**7**
Eagle Rock	7
Habitat Area or Habitat Corridor	**546**
Unspecified	49
Sturgeon River	309
Unspecified	189
Mineral Resource Area	**29**
Baraga County Road Commission	15
North Nestoria Pits	14
Possible Type 1 or Type 2 Old Growth	**246**
--	246
Spring, Wetlands, or Riparian Areas	**212**
2	52
11	36
32202014	37
32202022	9
32202038	28
Unspecified	50
Visual Management Areas	**508**
Islands	14
LPI Lakeside	492
LPI parking	2
Grand Total	**1,632**

Table 17. Static special conservation areas within the Michigamme Highlands management area.

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Common Natural Heritage Element Occurrences		**200**
Dry-mesic northern forest		20
Hardwood-conifer swamp		35
Mesic northern forest		135
Northern wet meadow		10
Designated Trout and Cold Water Stream Buffer		**1,392**
		691
Barnhardt Creek		58
Bismark Creek		19
Brown Creek		18
County Line Creek		10
Dead River		1
Deer Creek		17
East Branch Fence River		1
East Branch Net River		18
Fox Farm Creek		5
Gilbert Creek		7
Harlow Creek		66
Johnson Creek		71
Koops Creek		7
Little Garlic River		87
Lost Creek		4
Mulligan Creek		24
Nash Creek		21
Salmon Trout River		5
Second River		10
Start Creek		19
Tracy Creek		30
West Branch Net River		169
Wilson Creek		2
Yellow Dog River		32
Designated Trout and Coldwater Streams	**51.4**	
	25.3	
Barnhardt Creek	2.1	
Bismark Creek	0.7	
Brown Creek	0.6	
County Line Creek	0.4	
Deer Creek	0.6	
East Branch Fence River	0.0	
East Branch Net River	0.7	
Fox Farm Creek	0.2	

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Gilbert Creek	0.3	
Harlow Creek	2.5	
Johnson Creek	2.6	
Koops Creek	0.2	
Little Garlic River	3.3	
Lost Creek	0.2	
Mulligan Creek	0.9	
Nash Creek	0.8	
Salmon Trout River	0.2	
Second River	0.3	
Start Creek	0.7	
Tracy Creek	1.1	
West Branch Net River	6.3	
Wilson Creek	0.1	
Yellow Dog River	1.2	
Great Lakes Islands		**15**
Little Presque Isle		15
Important Bird Areas		**18,181**
Peshekee HIghlands LTA		14,912
Yellow Dog Plains		3,269
Non-dedicated Natural Areas		**696**
Natural Area Little Presque Isle Natural Area		452
Natural Area Little Presque Isle Wilderness Area		15
Natural Area Rocking Chair Lakes Natural Area		229
Wood Turtle Stream 100ft Buffer		**10**
Sturgeon River		10
Wood Turtle Stream 660ft Buffer		**73**
Sturgeon River		73
Grand Total	**51.4**	**20,567**

Rare species

Rare species occurrences are compiled from the Michigan Natural Features Inventory Biotics database (Tables 19, 20 and 21) and do not necessarily include all rare species found in this management area due to biases in survey effort and verifiable observation reporting over time.

Table 33. Rare animal and plant species conservation status key.

Status	Status
E = endangered	LE = listed endangered
T = threatened	LT = listed threatened
SC = special concern	PDL = proposed for delisting

Table 19. Rare animal species occurrence within the Michigamme Highlands management area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Accipiter gentilis	Northern goshawk	T	--	1
Animal	Alces alces*	Moose	SC	--	--
Animal	Boloria freija	Freija fritillary	SC	--	1
Animal	Boloria frigga	Frigga fritillary	SC	--	1
Animal	Bombus borealis	Northern amber bumble bee	SC	--	1
Animal	Bombus terricola	Yellow banded bumble bee	SC	--	7
Animal	Canachites canadensis	Spruce grouse	T	--	1
Animal	Canis lupus*	Gray wolf	SC	LE	--
Animal	Coregonus artedi	Lake herring or Cisco	T	--	1
Animal	Elliptio complanata	Eastern elliptio	SC	--	1
Animal	Erebia discoidalis	Red-disked alpine	SC	--	1
Animal	Gavia immer	Common loon	T	--	6
Animal	Glyptemys insculpta	Wood turtle	T	--	1
Animal	Haliaeetus leucocephalus	Bald eagle	SC	--	4
Animal	Myotis septentrionalis	Northern long-eared bat	T	LE	1
Animal	Opheodrys vernalis	Smooth green snake	SC	--	1
Animal	Pandion haliaetus	Osprey	SC	--	5
Animal	Setophaga kirtlandii	Kirtland's warbler	E	--	1
Total	--	--	--	--	**34**

**Occurrence information provided by field staff*

Table 20. Rare plant species occurrence within the Michigamme Highlands management area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Plant	Cypripedium arietinum	Ram's head lady's-slipper	SC	--	1
Plant	Draba arabisans	Rock whitlow grass	SC	--	1
Plant	Gentiana linearis	Narrow-leaved gentian	T	--	3
Plant	Juncus stygius	Moor rush	E	--	1
Plant	Mertensia paniculata	Northern Bluebell	SC	--	1
Plant	Piptatherum canadense	Canada rice grass	T	--	2
Plant	Pterospora andromedea	Pine-drops	T	--	1
Plant	Ribes oxyacanthoides	Northern gooseberry	SC	--	1
Plant	Salix pellita	Satiny willow	T	--	1
Total	--	--	--	--	**12**

Table 21. Other rare occurrence within the Michigamme Highlands management area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Other	Great Blue Heron Rookery	Great Blue Heron Rookery	--	--	1
Other	Multiple Bat Hibernacula	Multiple Bat Hibernacula	--	--	1
Total	--	--	--	--	**2**

Non-ERA natural communities

Natural communities that are identified with an element occurrence in the MNFI Biotics database, but that have not been given an additional ecological reference area (ERA) designation, are recognized and managed accordingly (Table 23).

Table 34. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 23. Non-ERA Natural Community Occurrence within the Michigamme Highlands management area.

Community Type	Element Occurrence Rank	State Rank	Global Rank	Number of Occurrences
Dry-mesic northern forest	B	S3		1
Dry-mesic northern forest	BC	S3		1
Hardwood-conifer swamp	B	S3		1
Mesic northern forest	BC	S3		2
Mesic northern forest	C	S3		2
Northern wet meadow	AB	S4	G4G5	1
Northern wet meadow	B	S4	G4G5	2
Poor conifer swamp	C	S4	G4	2
Grand Total				**12**

Forest health

Forest health concerns, both native and non-native, can have impacts on stand conditions and management decisions. The following insects (Table 24) and diseases (Table 25 could have an impact on management during the planning period and may need to be monitored and/or addressed.

Table 24. Defoliating insects of concern in the Michigamme Highlands management area.

Common Name	Scientific Name	Native/Non-native	Known Presence

Spongy moth	Lymantria dispar	Non-native	Yes
Forest tent caterpillar	Malacosoma disstria	Native	Yes
Large aspen tortrix	Choristoneura conflictana	Native	Yes
Spruce budworm	Choristoneura fumiferana	Native	Yes

Watch for lingering ash with potential resistance to emerald ash borer.

Table 25. Maladies of concern in the Michigamme Highlands management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Canker	Various	Various	Yes
Armillaria root rot	Armillaria spp.	Native	Yes
Oak Wilt	Bretziella fagacearum	Non-native	No

Aquatic resources

Riparian habitat

A total of 109 miles of streams and rivers are found in the management area (Table 26). Streams/rivers classified as warm types comprise approximately 61 percent of the riverine mileage.

Table 26. Classification type and length of streams/rivers found within the management area.

Type	Length (miles)
Cold stream	35
Cold small river	0
Cold transitional stream	7
Cold transitional small river	0
Cold transitional large river	0
Warm transitional stream	66
Warm transitional small river	1
Warm transitional large river	0
Warm stream	0
Warm small river	0
Warm large river	0

Lacustrine habitat

A total of 29 lakes and ponds of at least one surface acre are found in the management area (Table 27).

Table 27. Size and number of lakes and ponds located within the management area.

Lake Size Class (acres)	Number
1-99	19
100-499	6

Lake Size Class (acres)	Number
500+	4

Wetlands

A total of 22,777 acres of wetlands are found in the management area (Table 28). Forested wetlands comprise approximately 97 percent of wetland types found in the management area.

Table 28. Area of emergent, forested, and riverine wetland types found within the management area.

Wetland Type	Acres
Emergent	686
Forested	21,980
Riverine	111

Vernal pools and seeps

A total of 202 acres of vernal pools and seeps have been inventoried in the management area while no areas of seeps have been identified.

Riparian vegetation cover

Lowland shrub and northern hardwood are the predominant cover types present in a 100-meter riparian zone located next to streams/rivers in the management area (Table 26).

Table 29. Largest vegetative cover types (i.e., top 10) and area located in a 100-meter buffer of streams/rivers within the management area.

Cover Type	Acres
Lowland shrub	2,836
Northern hardwood	1,537
Lowland conifers	981
Lowland spruce/fir	807
Marsh	704
Mixed upland deciduous	691
Aspen	634
Upland mixed forest	476
Cedar	444
Upland spruce/fir	441

Watershed vegetation cover

The management area includes portions of important watersheds of the Peshekee River and Yellow Dog River (Tables 30 and 31). Northern hardwood is a major cover type in the Peshekee River watershed of the state forest while Jack Pine is a major cover type in the Yellow Dog River watershed of the state forest.

Table 30. Largest vegetative cover types (i.e., top 5) and area of the Peshekee River watershed located within the management area.

Cover Type	Acres
Northern hardwood	640
Mixed upland forest	338
Mixed upland deciduous	195
Lowland conifer	188
Lowland spruce/fir	173

Table 31. Largest vegetative cover types (i.e., top five) and area of the Yellow Dog River watershed located within the management area.

Cover Type	Acres
Natural jack pine	951
Cedar	484
Northern hardwood	425
Lowland shrub	395
Aspen	350

Recreation

The Michigamme Highlands management area is made up of a number of fragmented parcels north and west of Marquette. Non-motorized recreation opportunities are concentrated in Little Presque Isle, set along the Lake Superior shoreline just a few miles from Marquette. This popular area contains over 18 miles of trails for hiking, biking, and snowshoeing, six rustic cabins available for rent (the only such amenity on state fprest land) and access to Harlow Lake for boating and fishing. The North Country National Scenic Trail/ Iron Belle Trail passes through this area along the lakeshore. The mouth of the Huron River is also a popular area for beachgoers.

Access varies across the remainder of the management area, with snowmobile trails, a portion of the Clowry-Nestoria Rail-Trail open to ORVs and snowmobiles, two small state forest campgrounds and boating access sites on several small inland lakes. The expansive Craig Lake State Park provides additional recreation opportunities adjacent to state forest land. There are no areas managed specifically for hunting in this management area.

Table 32. Designated Recreation Trails by type.

Recreation Category	Recreation Type	Number of Miles
Motorized recreation trails	ORV (all types)	2.6
Motorized recreation trails	Snowmobile	14.5
Non-motorized recreation trails	Hiking	45.1
Non-motorized recreation trails	Equestrian	0
Non-motorized recreation trails	Biking	32.8
Non-motorized recreation trails	Hunter Walking Trails	0
Total	--	**95**

Note: Trail use types may overlap.

Table 33. State forest campgrounds.

Name	Number of Sites
Little Presque Isle cabins	6
Beaufort Lake campground	7
King Lake campground	6

Table 34. Boating Access Sites.

Name	Waterbody
Deer Lake	Deer Lake
Harlow Lake	Harlow Lake
King Lake campground	King Lake
Net River Flooding	Net River Flooding
Parent Lake	Parent Lake
Ruth Lake	Ruth Lake
Silver Lake	Silver Lake

Ralph Moraine

State Forest Area: 155,418 acres	Location: North Dickinson and Portions of South Western Marquette Counties	Population Centers: Ralph, Sagola
Sub-Section: West Green Bay Till Plain	Landforms: Broad Till Plain, and ground moraine	Landcover: Forested: 139,688 acres Non-forested: 15,729 acres

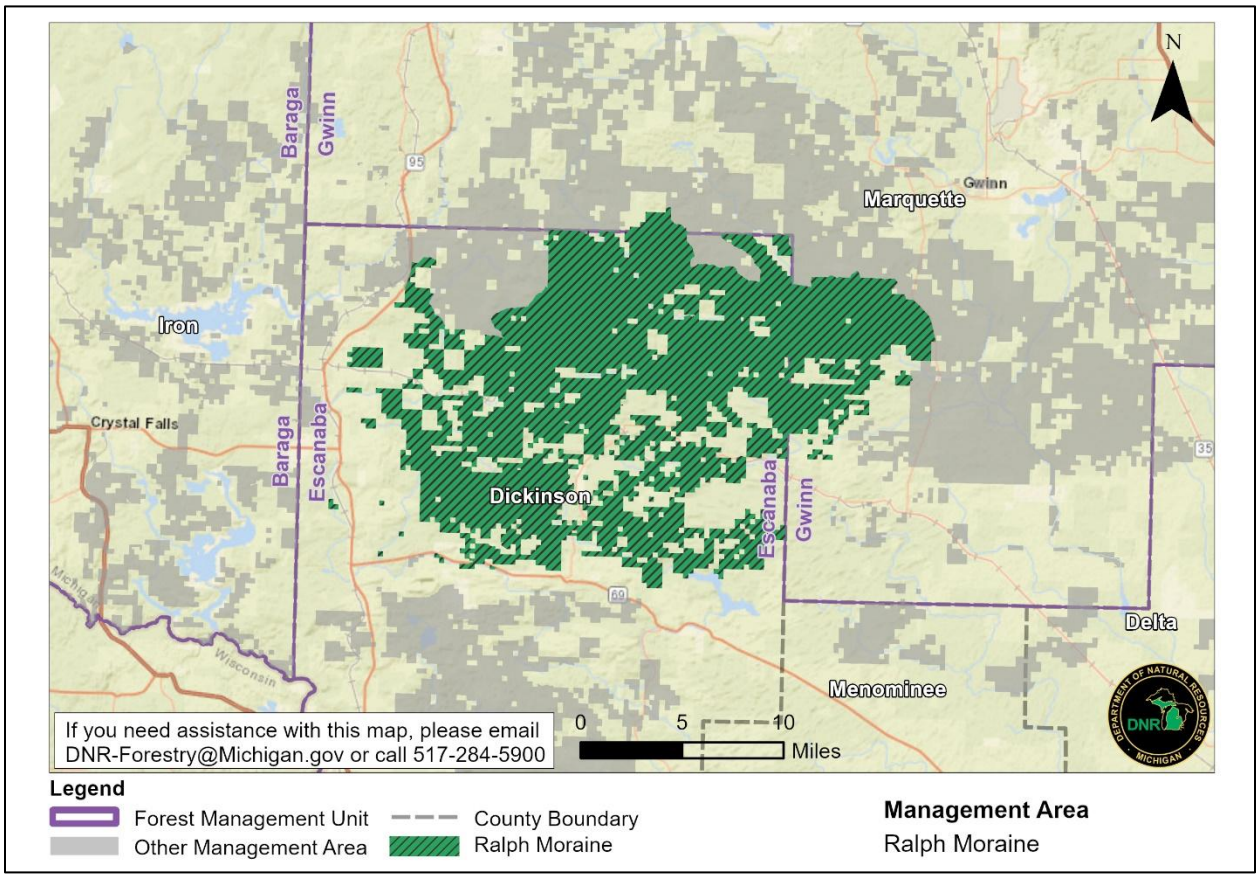


Figure 1. Map of the Ralph Moraine management area.

Forested landscape

Current and projected future condition

The Ralph Moraine management area is dominated by shade-intolerant cover types in the young and mid-aged categories. Intolerant upland cover types dominate the older age categories, while the unavailable lowland acres are more prevalent in the old age category.

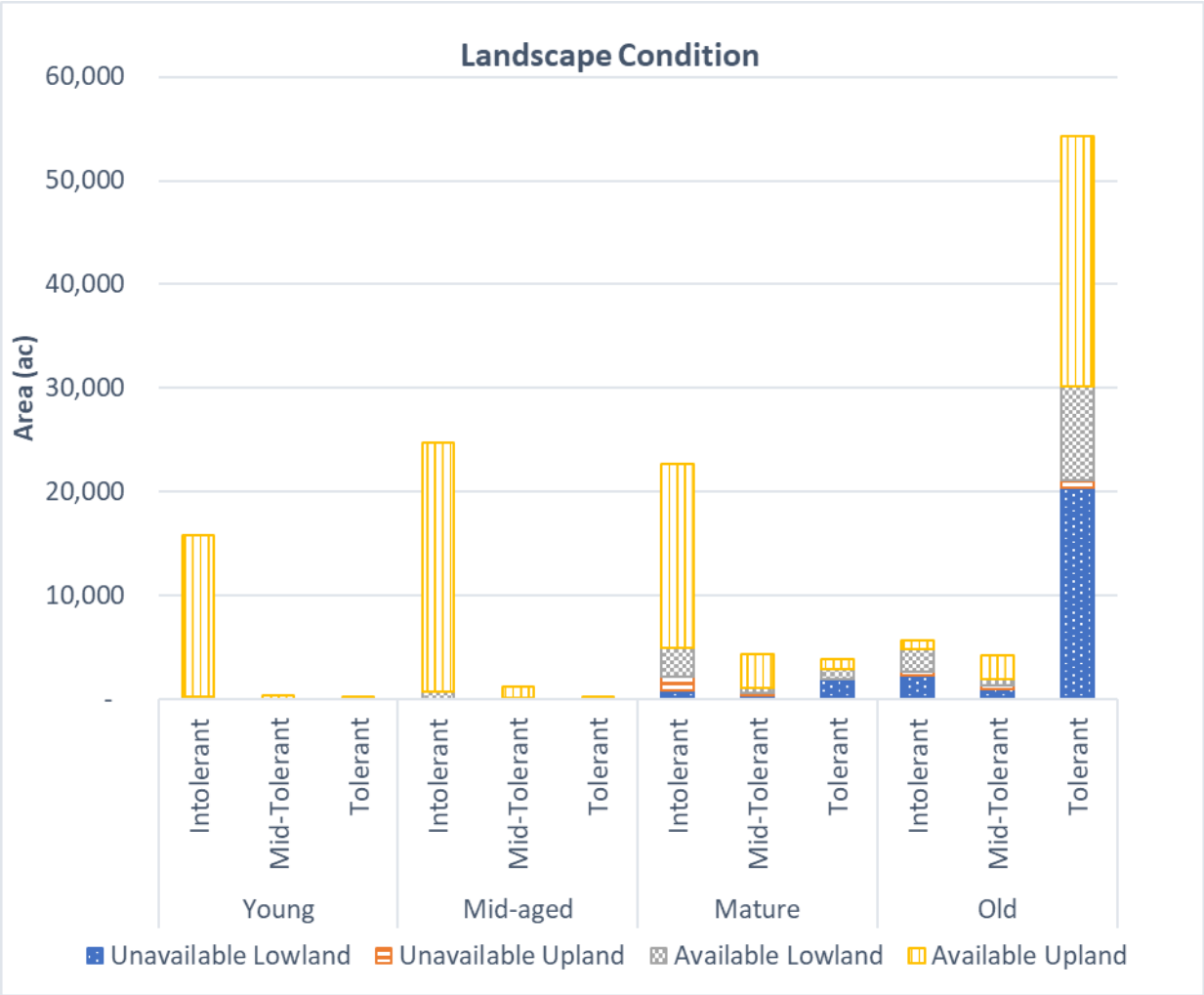


Figure 2. Forest diversity matrix showing the current distribution of forested acres across management availability, age category, landscape position and shade tolerance.

Landscape habitat conditions refine the management area landscape into featured species habitat context. Current and projected acres for the metrics identified in the Management Priorities (Section 3 Statewide/Regional) establish a baseline and future condition based on management over the planning period (Table 1).

Table 1. Current and projected acres for Landscape Habitat Conditions.

Landscape Habitat Condition	Monitoring Metric	Current Acres
Young forest	Acres of 0-19 stands in aspen and jack Pine	16,038
Mature forest	Acres of 80+ year stands across cover types	63,809
Mature forest	Acres of 120+ year stands across cover types	25,306
Mesic conifer cover types	Acres of mesic conifer cover types	3,596
Mesic conifers in other Cover types	Average canopy occupancy	24%
Mast – oak cover Types	Acres of oak cover types	326
Mast tree species in other cover types	Acres of total canopy occupancy of mast tree acres (trace-100%)	11,834
Big Trees	Acres of total canopy stand occupancy of species in sawlog or greater size class	50,169
Non-forested openings	Acres of total herbaceous open land, upland shrub and cropland	3,578
Landscape forest matrix	Percent deciduous forest	63%
Landscape forest matrix	Percent coniferous forest	34%

The Ralph Moraine management area has the following Special Analysis Units (SAUs). These SAUs have specific cover type goals, typically associated with wildlife habitat management. For any SAUs that overlap with this MA, SAU cover type goals take priority as the SFMP model strives to meet the cover type goals across the MA. Please see Section 5 for a detailed description of the management direction and harvest goals for each of these SAUs.

- Deer Wintering Complex: Arnold-Ford River
- Deer Wintering Complex: Iron-Floodwood
- Grouse Enhanced Management: Bill Rollo Memorial GEMS
- Grouse Enhanced Management: Ralph

The Ralph Moraine management area is dominated by forested cover types with 90 percent of the area covered in forested stands (Table 2). The upland deciduous portion of that is 55 percent of the management area and comprised mostly of aspen. The upland coniferous portion is 4 percent of the management area and comprised mostly of planted and natural red pine. Cedar is the most common lowland conifer in this management area, representing 15 percent of the landscape. Lowland shrub is the most common non-forested cover type in this management area, representing 7 percent of the landscape.

Table 2. Landscape conditions and distribution of cover types in the Ralph Moraine management area.

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
Forested	Upland	Deciduous	Aspen	58,946	85,336	94,696	139,688
			Northern hardwood	24,568			
			Black-red hybrid oak	0			
			Northern red oak	326			
			Oak mix	0			
			Mixed upland deciduous	1,496			
		Mixed	Upland mixed forest	2,468	2,468		
		Coniferous	Planted red pine	1,570	6,892		
			Planted jack pine	200			
			Planted white pine	0			
			Planted mixed pine	9			
			Natural red pine	1,120			
			Natural jack pine	398			
			Natural white pine	767			
			Natural mixed pines	625			
			Upland spruce/fir	1,121			
			Upland conifers	970			
			Hemlock	112			
	Lowland	Deciduous	Lowland aspen/balsam poplar	1,701	3,175	44,992	
			Lowland deciduous	1,474			
		Mixed	Lowland mixed forest	1,810	1,810		
		Coniferous	Cedar	22,872	40,007		
			Lowland conifers	8,828			
			Lowland spruce/fir	4,915			
			Tamarack	3,392			
Nonforested	Upland	N/A	Herbaceous openland	1,857	N/A	3,578	15,729
			Upland shrub	1,094			
			Low density trees	345			
			Bare/sparsely vegetated	131			
			Cropland	44			
			Urban	107			
	Lowland	N/A	Lowland shrub	9,097	N/A	12,151	
			Marsh	338			
			Bog	215			
			Treed bog	1,545			
			Water	956			
						Grand Total:	**155,418**

There are 109,579 acres (71.1 percent of the total management area and 78.4 percent of the forested area) that can be managed toward desired future conditions via commercial timber harvest (Table 3). Of that, over 41 percent is in the aspen cover type, 18% is in northern hardwood, and 5% in cedar. The remaining 19 cover types represent about 19% of the forested and available land in the management area.

Table 3. Summary table describing the landscape conditions and cover type composition of the Michigamme Highlands management area.

RALPH MORAINE Forested Cover Type	Available Acres	Available %	Unavailable Acres	Unavailable %	Total Acres	Total %
Aspen	57,559	41.2%	1,393	1.0%	58,952	42.2%
Cedar	6,748	4.8%	16,116	11.5%	22,863	16.4%
Hemlock	81	0.1%	31	0.0%	112	0.1%
Lowland aspen/balsam poplar	1,083	0.8%	619	0.4%	1,702	1.2%
Lowland conifers	3,886	2.8%	4,942	3.5%	8,828	6.3%
Lowland deciduous	596	0.4%	878	0.6%	1,474	1.1%
Lowland mixed forest	1,290	0.9%	521	0.4%	1,811	1.3%
Lowland spruce/fir	3,269	2.3%	1,647	1.2%	4,915	3.5%
Mixed upland deciduous	1,354	1.0%	142	0.1%	1,496	1.1%
Natural jack pine	396	0.3%	2	0.0%	398	0.3%
Natural mixed pines	535	0.4%	90	0.1%	625	0.4%
Natural red pine	927	0.7%	194	0.1%	1,120	0.8%
Natural white pine	344	0.2%	424	0.3%	768	0.6%
Northern hardwood	24,445	17.5%	123	0.1%	24,569	17.6%
Northern red oak	115	0.1%	211	0.2%	326	0.2%
Planted jack pine	200	0.1%	0	0.0%	200	0.1%
Planted Mixed Pine	9	0.0%	0	0.0%	9	0.0%
Planted red pine	1,570	1.1%	0	0.0%	1,570	1.1%
Tamarack	1,309	0.9%	2,084	1.5%	3,392	2.4%
Upland conifers	800	0.6%	170	0.1%	970	0.7%
Upland mixed forest	2,232	1.6%	236	0.2%	2,468	1.8%
Upland spruce/fir	830	0.6%	291	0.2%	1,121	0.8%
Grand Total	**109,579**	**78.4%**	**30,111**	**21.6%**	**139,690**	**100.0%**

Table 4. Site Condition (reason area is unavailable for commercial harvest) acres for the Ralph Moraine management area.

Site Condition (Reason area is unavailable for commercial harvest)	Area (ac)	% of Unavailable Area
Deer wintering area	10,615	35.3%
Cannot regenerate	6,820	22.6%
BMPs	4,929	16.4%
Unproductive	2,393	7.9%
Too wet	2,041	6.8%
Wildlife concerns	1,164	3.9%
Other dept./div. processes	792	2.6%
Long-term retention	457	1.5%
Conservation values	455	1.5%
Species of special concern or T&E	139	0.5%
Blocked by obstacle	114	0.4%
Too steep	90	0.3%
Other influence zones	65	0.2%
Non-military lease/easement	34	0.1%
Denied access	5	0.0%
Total Unavailable	**30,111**	**100.0%**

Management actions

Each cover type in the Ralph Moraine management area has a unique age class and basal area class goals that describe the long-term desired future conditions. The harvests levels that are needed in the first planning period to begin achieving those long-term goals are summarized below (Table 4).

These harvests will help establish a desirable amount of regeneration for the even-aged cover types over the 10-year period or help to achieve desired basal area distribution among un-even aged cover types like northern hardwoods. The following sections will provide additional details for each significant cover type in the Ralph Moraine management area.

Table 5. Ten-year planning period harvest goals (acres) by cover type and silvicultural regime.

Silvicultural Regimes								
Cover Type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Salvage Clearcut	Salvage Thinning	Grand Total
Northern hardwood	49	11,057	-	-	-	-	-	11,106
Aspen	8,130	-	-	-	-	-	-	8,130
Lowland spruce/fir	712	-	-	-	-	-	-	712
Lowland conifers	562	-	-	-	-	-	-	562
Upland mixed forest	343	-	-	-	-	-	-	343
Planted red pine	-	-	326	-	-	-	-	326
Mixed upland deciduous	288	-	-	-	34	-	-	322
Lowland aspen/balsam poplar	201	-	-	-	-	-	-	201
Tamarack	188	-	-	-	-	-	-	188
Natural mixed pines	-	-	119	-	46	-	-	165
Upland Ssruce/fir	148	-	-	-	-	-	-	148
Natural jack pine	99	-	-	-	-	-	-	99
Natural red pine	-	-	10	-	51	-	-	61
Natural white pine	-	-	21	-	-	-	-	21
Upland conifers	19	-	-	-	-	-	-	19
Planted jack pine	12	-	-	-	-	-	-	12
Lowland mixed forest	7	-	-	-	-	-	-	7
Lowland deciduous	3	-	-	-	-	-	-	3
Totals	**10,761**	**11,057**	**476**	**-**	**130**	**-**	**-**	**22,424**

Table 6. Ten-year 10 year estimated harvest volume by product and species for the Ralph Moraine management area.

10-Year Estimated Harvest Volume Projection Ralph Moraine Management Area Product	Species	Volume Planned*	Volume Prepared**
Pulpwood (cords)	Mixed hardwood	75,619	71,082
	Mixed aspen	62,241	58,507
	Mixed softwood	29,331	27,571
	Mixed spruce	18,543	17,430
	Jack pine	3,015	2,834
	Red pine	2,881	2,708
	Mixed oak	1,797	1,689
	White pine	1,776	1,669
	Pulpwood Total	**195,203**	**183,491**
Sawtimber (MBF)	Sugar maple	30,576	28,742
	Mixed aspen	16,741	15,737
	Red maple	11,414	10,729
	Red pine	3,875	3,642
	Basswood	3,713	3,490
	White pine	3,500	3,290
	Red oak	3,368	3,166
	Mixed oak	191	180
	White oak	181	171
	Sawtimber Total	**73,560**	**69,147**
	Total sawtimber varvest volume in cords	**156,619**	**147,222**
	Grand total harvest volume in cords	**351,822**	**330,713**

* Volume estimates based on 100% of the projected harvests for the 10-year planning period.

** Volume estimates based on 94% of the projected harvests for the 10-year planning period accounting for reduction in acres and associated volume once sales are prepared for bid.

Few cover type transitions are projected. The managed area of each cover type is projected to remain relatively stable. The largest decrease forecasted is in the lowland spruce/fir cover type, where 366 acres are forecasted to convert to other cover types through forest management activities. The largest increase is in lowland mixed forest, where 304 acres are expected to convert into that cover type.

Table 7. Projected 10-year cover type acres resulting from cover type transitions.

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Aspen	58,946	58,977	30
Northern hardwood	24,568	24,575	7
Cedar	22,872	22,872	0
Lowland conifers	8,828	8,884	56
Lowland spruce/fir	4,915	4,725	-191
Tamarack	3,392	3,341	-51
Upland mixed forest	2,468	2,516	49
Lowland Mixed Forest	1,810	2,014	204
Lowland aspen/balsam poplar	1,701	1,693	-8
Planted red pine	1,570	1,661	90
Mixed upland deciduous	1,496	1,407	-89
Lowland deciduous	1,474	1,464	-10
Upland spruce/fir	1,121	1,022	-99
Natural red pine	1,120	1,120	0
Upland conifers	970	971	1
Natural white pine	767	769	2
Natural mixed pines	625	625	0
Natural jack pine	398	374	-24
Northern red oak	326	326	0
Planted jack pine	200	194	-6
Hemlock	112	112	0
Planted mixed pine	9	29	20
Planted white pine	0	20	20
Lowland shrub	9,097	9,097	0
Herbaceous openland	1,857	1,857	0
Treed bog	1,545	1,545	0
Upland shrub	1,094	1,094	0
Water	956	956	0
Low density trees	345	345	0
Marsh	338	338	0
Bog	215	215	0

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Bare/sparsely vegetated	131	131	0
Urban	107	107	0
Cropland	44	44	0
Total:	**155,418**	**155,418**	**0**

Featured species current and projected habitat acres

There are 14 featured species in this management area that span various cover types, age classes and stand level conditions.

As noted in the Featured Species Management Priority (Section 3), it is recommended that these featured species habitat acres be viewed as acres of potential habitat, representing a condition on the landscape where the more nuanced aspects of each species' habitat requirements are likely to be found or managed for. As described in the introduction, the modeling effort was limited by several factors including the simplification of habitat attributes into MiFI variables. Current and projected total habitat acres by species across the decade provide a baseline and show the result of long-term management actions (Table 8). Some species show a loss in habitat over the next century. As mentioned in the Featured Species Management Priority (Section 3), the current condition for many cover types is a surplus of acres in the 0-9 age class from the compensatory management approach applied in the previous decade. The model eventually evens out the age classes at a lower, sustainable level over time, usually by 50 years. For any species with northern hardwoods as a priority cover type, there is a perceived drop in acres between 40-60 years. This is due to the basal area dropping below 81. but because it only drops into the upper 70s, it is not expected to translate to any real habitat loss on the ground. Three of these species were not included in the SFMP model but are included here to inform management decisions over the decade.

Table 8. Featured species current and projected total habitat acres (i.e., potential habitat).

Featured Species	Priority Cover Types	Total Habitat Acres Current	10-year Projected Habitat Acres	50-year Projected Habitat Acres	100-year Projected Habitat Acres
American woodcock	Aspen, lowland aspen, lowland deciduous	1,924	1,977	2,155	2,246
Black bear	Mast	11,834	--	--	--
Black-backed woodpecker	Natural disturbance	--	--	--	--
Blackburnian warbler	Northern hardwoods, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, hemlock	14,743	17,588	10,269	18,456

Featured Species	Priority Cover Types	Total Habitat Acres Current	10-year Projected Habitat Acres	50-year Projected Habitat Acres	100-year Projected Habitat Acres
Golden-winged warbler	Aspen, black-red hybrid oak, northern red oak, oak mix, tamarack	1,827	1,917	2,003	2,101
Kirtland's warbler	Natural jack pine, planted jack pine (Voelker Outwash Plains)	42	--	--	--
Marten	Northern hardwoods, mixed upland deciduous, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, lowland mixed forest, lowland conifers, hemlock, cedar	19,341	22,900	15,417	24,515
Moose	To be determined	--	--	--	--
Ruffed grouse	Aspen	1,747	1,807	1,926	2,010
Snowshoe hare	Aspen, cedar, hemlock, lowland aspen, lowland conifers, lowland mixed forest, lowland spruce/fir, mixed upland deciduous, natural jack pine, natural mixed pines, planted jack pine, upland spruce/fir	7,485	7,303	4,641	4,985
White-tailed deer (food)	Northern hardwood, oak mix, aspen, mixed upland deciduous, lowland deciduous, lowland aspen/balsam poplar, lowland mixed forest	92,789	92,954	93,581	93,993
White-tailed deer (shelter)	Hemlock, cedar, planted red pine, planted white pine, planted mixed pine, natural red pine, natural white pine, natural mixed pines, upland conifers, upland spruce fir, lowland conifers	42,909	42,825	42,480	42,273
Wild turkey	Non-forested openings	2,202	--	--	--
Wood turtle	Non-forested openings	--	--	--	--
Wood thrush	Northern hardwoods, northern red oak, mixed upland deciduous, lowland deciduous	15,239	16,594	10,971	18,745

Cover type composition and associated wildlife species

Aspen

Current condition

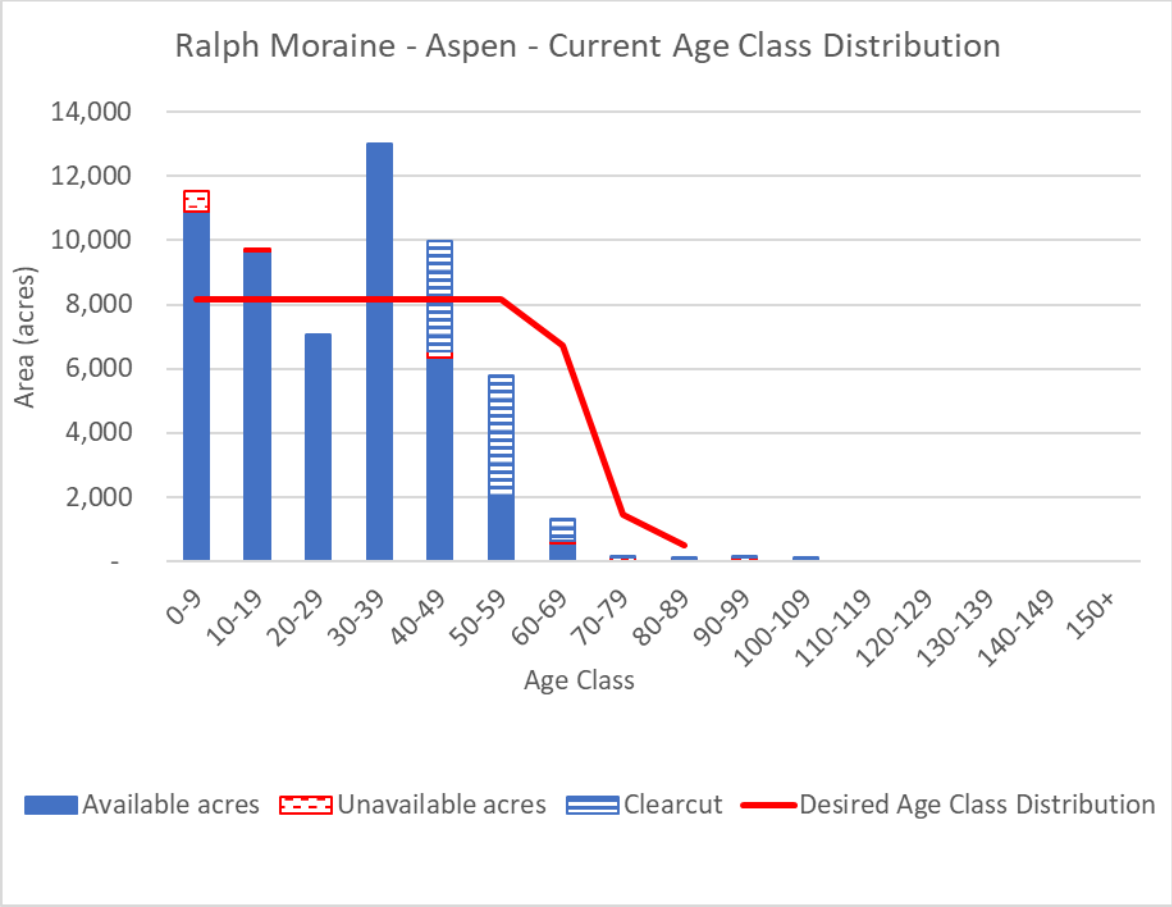


Figure 3. Current age class distribution, desired age class distribution and projected harvests in the aspen cover type over the 10-year planning period.

The current age class distribution is unbalanced with a deficit of acres in the 20-29- and the 50-89-year-old age classes and a surplus of acres in the 0-19- and 30-49-year-old age classes. A portion of this cover type meets the habitat requirements for golden-winged warbler, woodcock, ruffed grouse and snowshoe hare (Table 6).

Table 9. Featured species with aspen as a priority habitat cover type, habitat variables, and current potential acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Aspen	Aspen Potential Habitat Acres - Available	Aspen Potential Habitat Acres - Unavailable
Golden-winged warbler	Age category: 0-19 Size class: sapling	20,589	714
American woodcock	Age category: 0-19 Size class: sapling	20,589	714
Ruffed grouse	Age category: 0-19 Size class: sapling	20,589	714
Snowshoe hare	Age category: 0-19 Size class: sapling	20,589	714
White-tailed deer	All ages and size classes	58,946	--

Desired future condition

The desired age class distribution is to have a rotation age of 50 years for approximately 85% of the acres, then 12 percent of the acres in an age class tail out to the 60-year age class, 3 percent of the acres in an age class tail out to the 70-year age class, and 1 percent of the acres in an age class tail out to the 80-year age class.

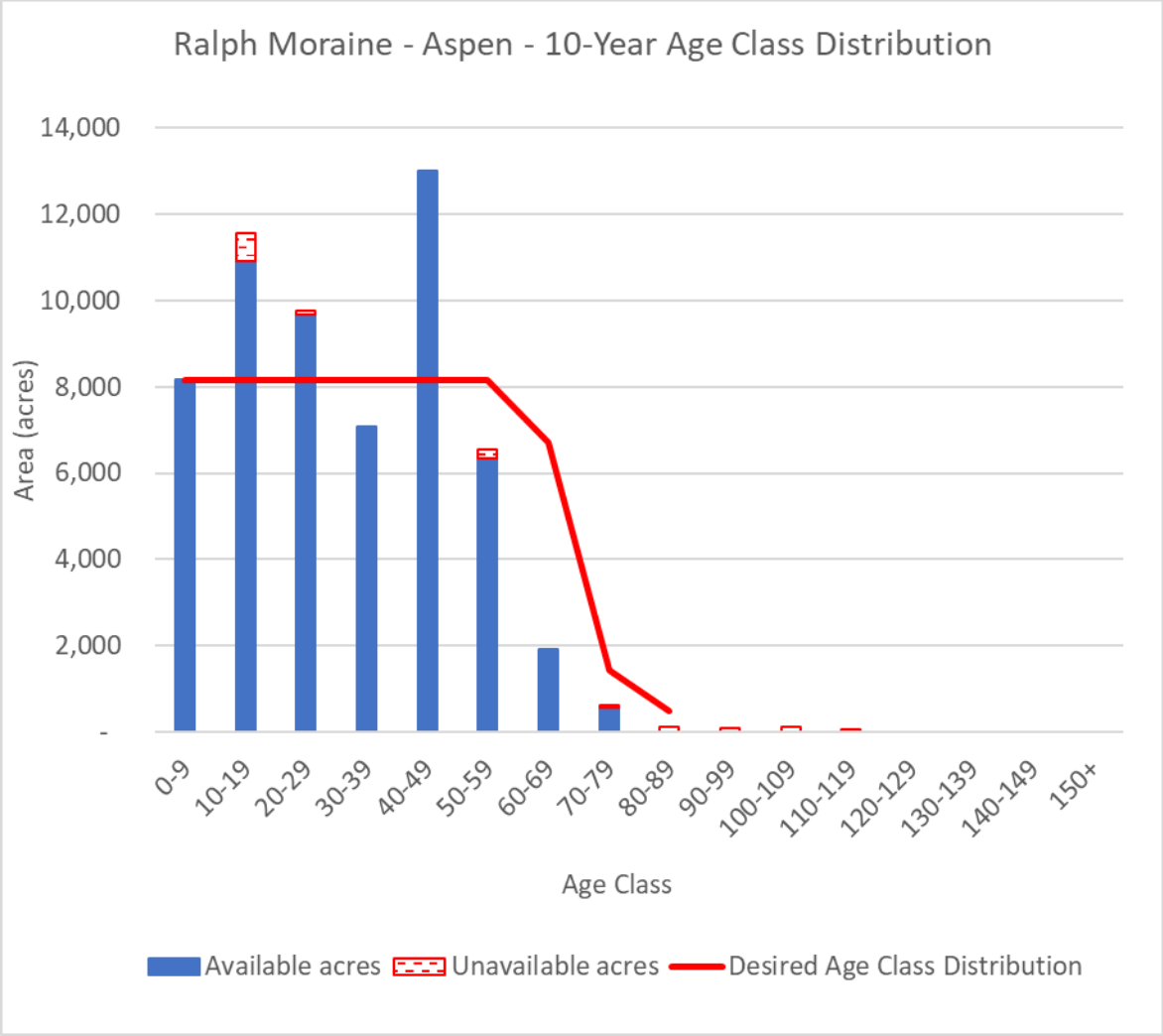


Figure 4. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The end of the planning period will result in the establishment of 8,160 acres of aspen in the upcoming 0-9 age class. Progress toward the long-term desired age class distribution of aspen will take a few decades in this management area.

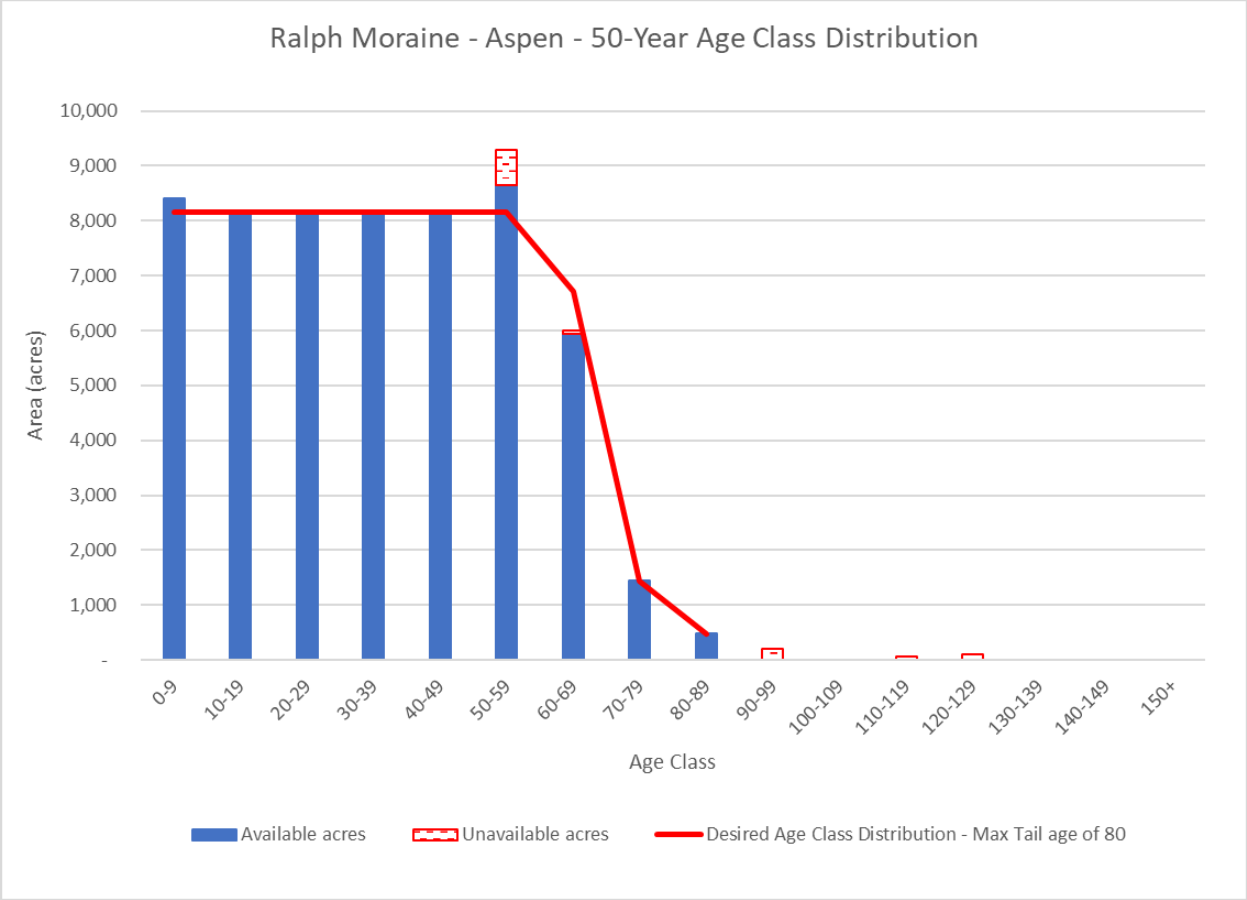


Figure 5. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of aspen acres nearly reaching the desired future condition with few age classes deviating from the target proportions (Figure 5).

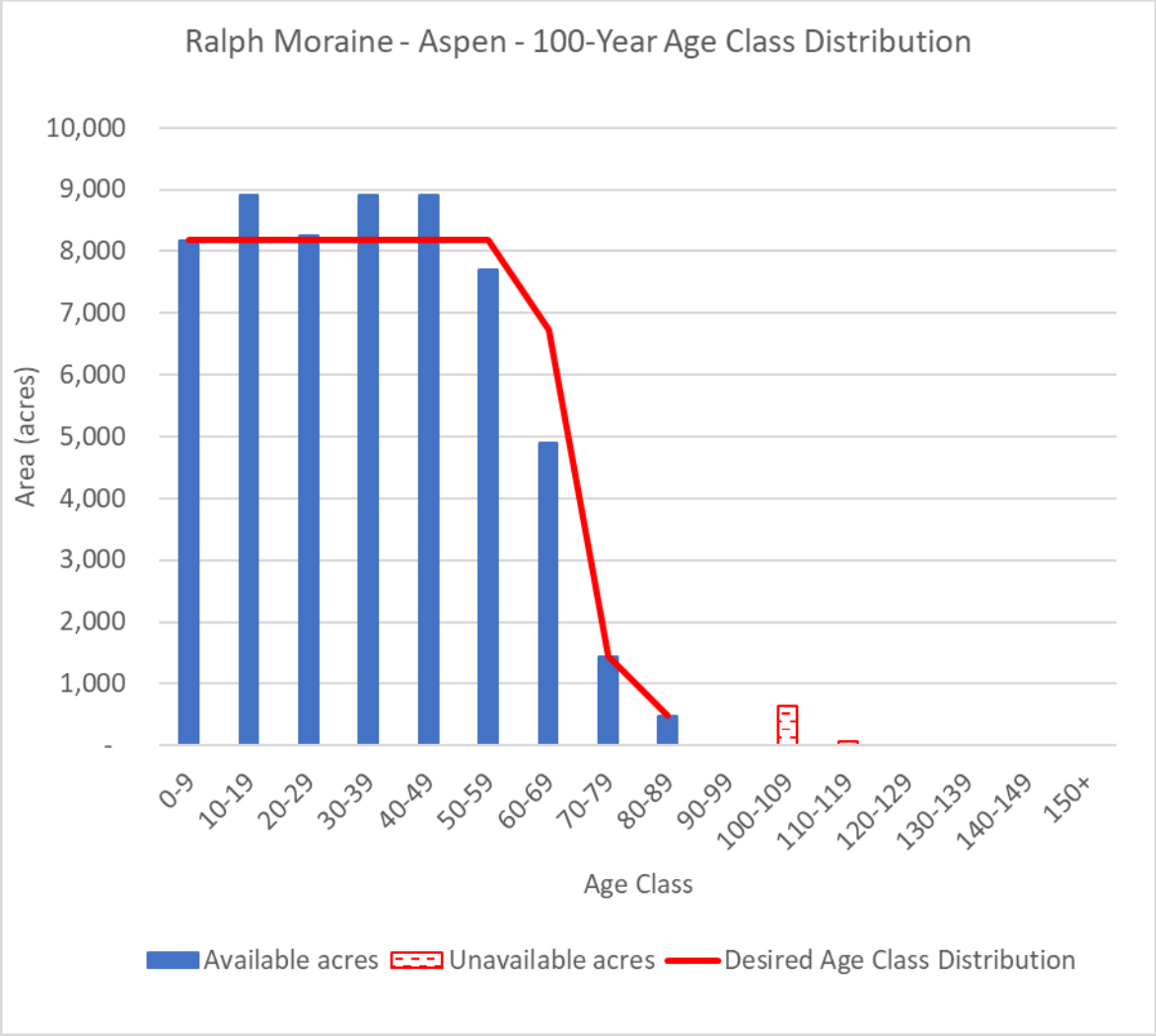


Figure 6. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 6) will concentrate the manageable acres of aspen in productive growing conditions while providing an even flow of forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged, and mature forest.

Management actions

There are 8,130 acres of projected clearcut harvest in the aspen cover type. It is expected that about 44 acres of aspen will be converted from other cover types. These total to an expected 8,154 acres of regeneration over the next 10 years.

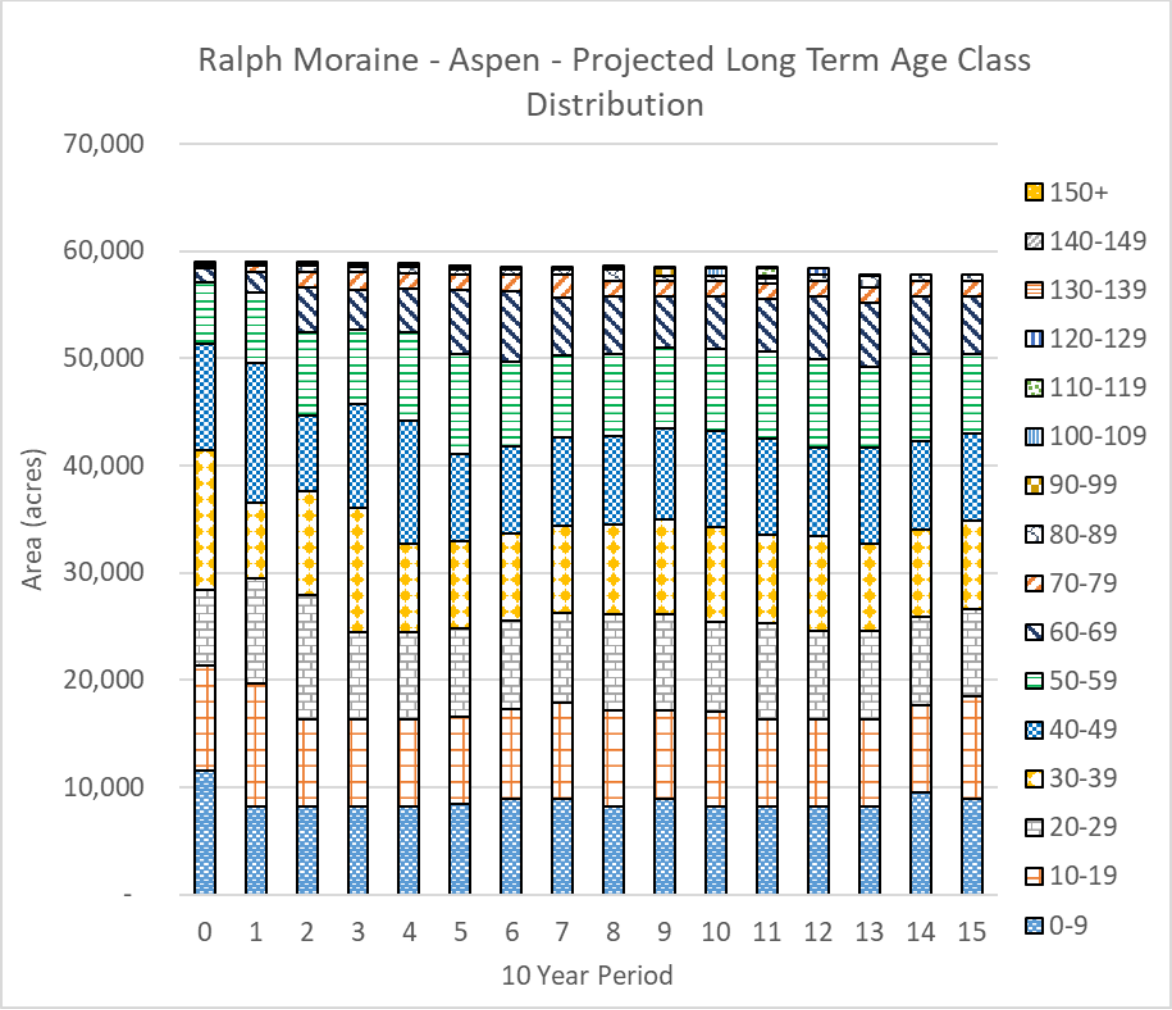


Figure 7. Projected age class distribution over 15, 10-year planning periods.

Northern hardwoods

Current Condition

Most of the northern hardwood cover type is currently between a stand age of 90 and 109 years old in the Ralph Moraine management area (Figure 8). The past management regime has been primarily single-tree selection which allows stand age to increase overtime. Some stands are beginning to achieve an uneven-aged condition where a featured stand age becomes less evident, but the dominant age of these stands will likely increase past 150 years old prior to a younger age cohort becoming the prominent component of these stands (Figure 10).

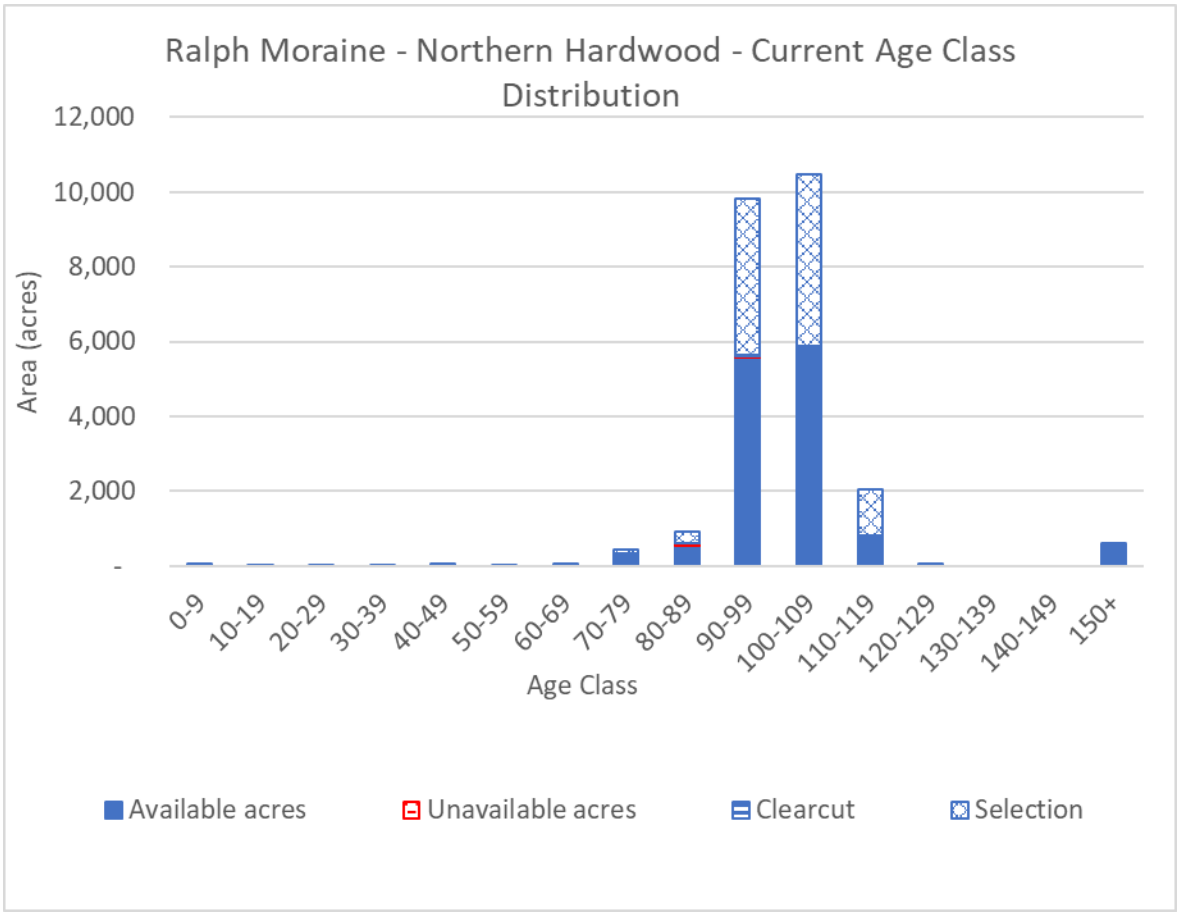


Figure 8. Current age class distribution and projected harvests in the northern hardwood cover type in the Ralph Moraine management area.

The area of northern hardwood is fairly well distributed in the ideal basal area classes for optimal growing conditions in the Ralph Moraine management area (Figure 9). A portion of this cover type meets the habitat requirements for blackburnian warbler, wood thrush, marten and white-tailed deer (Table 7).

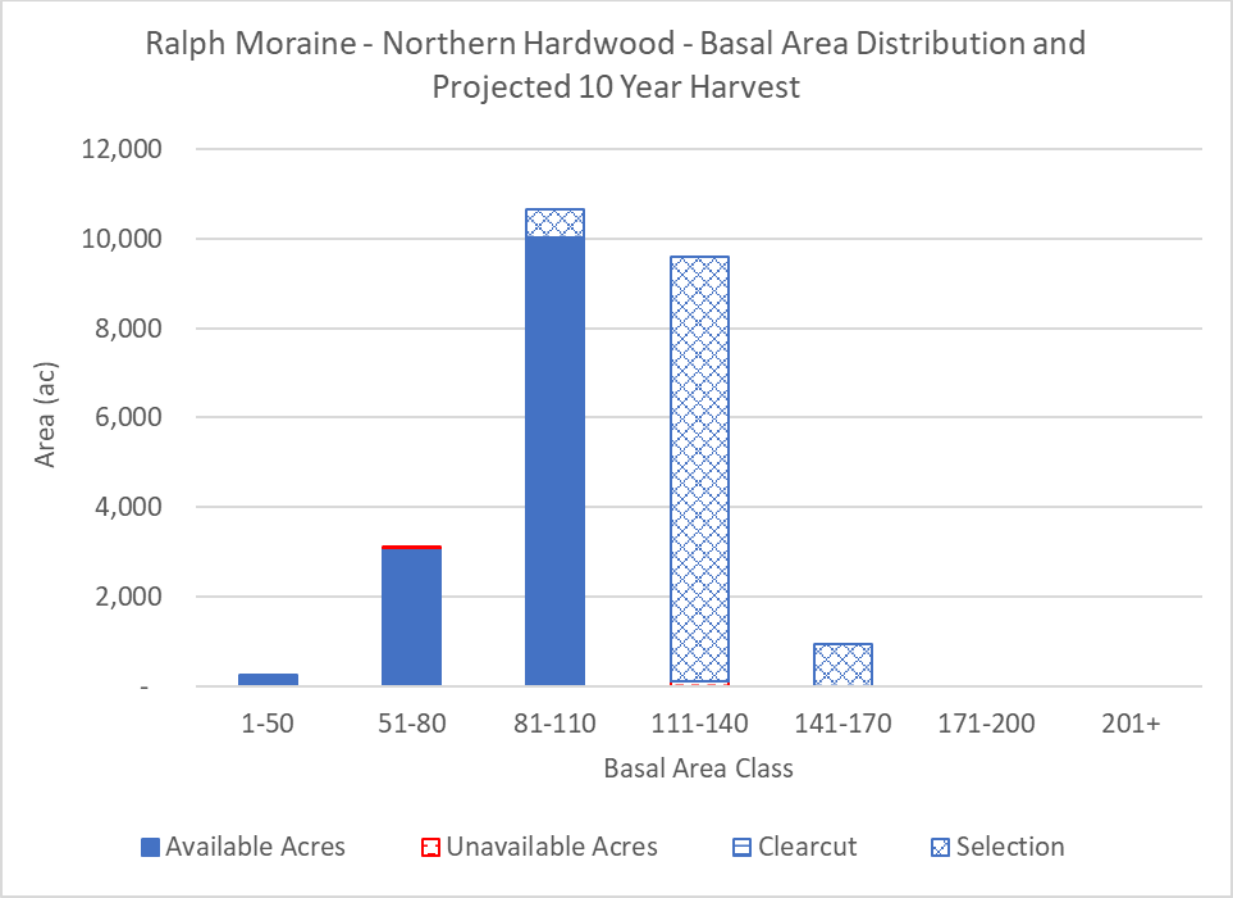


Figure 9. Current basal area distribution of the northern hardwood cover type as well as the projected harvests from each basal area class.

Table 10. Featured species with northern hardwoods as a priority habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Northern Hardwood	Northern Hardwood Potential Habitat Acres- Available	Northern Hardwood Potential Habitat Acres- Unavailable
Blackburnian warbler	Age category: 80+ Size category: Sawlog Basal area: 81+	20,664	104
Wood thrush	Age category: 40+ Size category: sawlog Basal Area: 81+	21,107	104
Marten	Age category: 40+ Size category: pole, sawlog Basal area: 81+	20,664	104
White-tailed deer	All ages and size classes	24,568	--

Desired future condition

The projected long-term cover type trend for northern hardwood is somewhat stable. There are 8 acres transitioning to this cover type in the next 10 years.

The desired basal area distribution is a bell-shaped curve where a significant majority of the area is kept in the 81-110 basal area class with recently harvested stands occupying the 51-80 class and stands that are ready for harvest occupying the 111-140 basal area class. Diameter distributions of the northern hardwood stands should follow the appropriate Q-curve relative to stand age and condition.

An uneven-aged condition is the long-term goal for all northern hardwood stands in this management area. An uneven-aged condition is achieved when there is no single discernable age cohort that is more prevalent than others across the stand area as canopy gaps fill in with regenerating seedlings, saplings, poles, and eventually remaining stems become sawlog sized over time.

Regeneration and recruitment continue to be a focus in the northern hardwood cover type across this management area. The long-term sustainability of this cover type in an un-even aged silvicultural regime is dependent on the successful establishment of northern hardwood species as well as the recruitment of those seedlings and saplings into the pole and saw log classes. Northern hardwood in the Ralph Moraine management area is challenged in regeneration and recruitment due to cervid herbivory and poor site conditions in some of the stands.

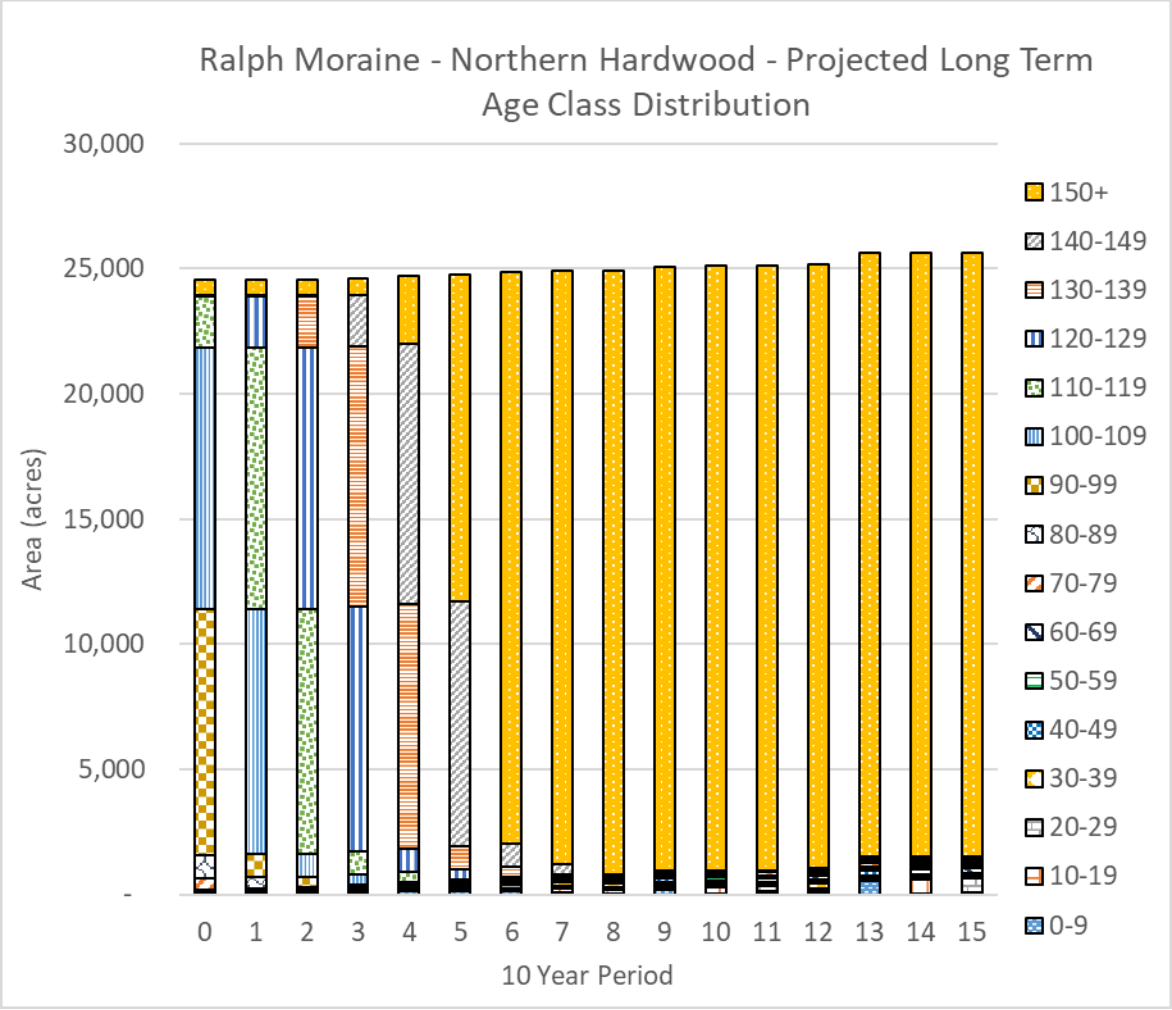


Figure 10. Projected age class distribution over 15. 10-year planning periods.

Management actions

The desired forest conditions and associated featured species habitat will be maintained and achieved through continued application of the projected selection harvest regime on 11,017 acres. About 51 acres will be managed under an even-aged system, with some of those acres harvested through a clearcut or shelterwood method to improve stand quality (Table 5). Larger canopy gaps should be used to encourage diverse regeneration of northern hardwood species while maintaining an overall long-term mature forest closed-canopy landscape condition.

Cedar

Current condition

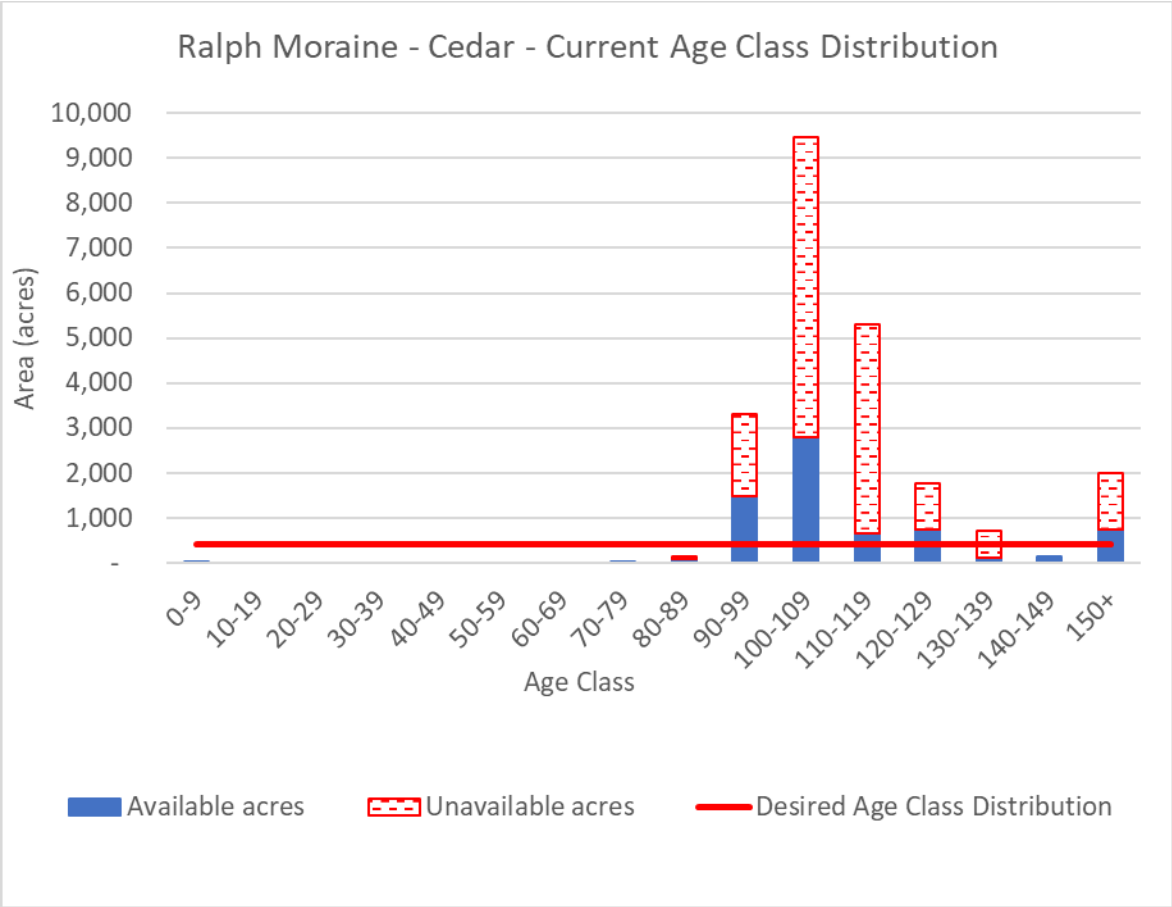


Figure 11. Current age class distribution, the desired age class distribution, and the projected harvests in the cedar cover type over the 10-year planning period.

The current age class distribution shows a classic bell curve of an unmanaged even-aged stand with a surplus of acres in the 100-109-year-old age classes. The younger age classes have few to no acres. The reasons for this are not well understood, but many factors contribute to the lack of regeneration of the cover type. These include but are not limited to cervid herbivory, suppression of fire, and the relatively young age of the stands. A portion of this cover type meets the habitat requirements of snowshoe hare, marten and white-tailed deer (Table 11).

Table 11. Featured species with cedar as a priority habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat - Cedar	Cedar Habitat Acres - Available	Cedar Habitat Acres - Unavailable
Snowshoe hare	Age category: 0-19 Size category: sapling	20	0
Marten	Age category: 40+ Size category: pole, sawlog Basal area: 81+	6,494	15,652
White-tailed deer	All ages and size classes	--	22,872

Desired future condition

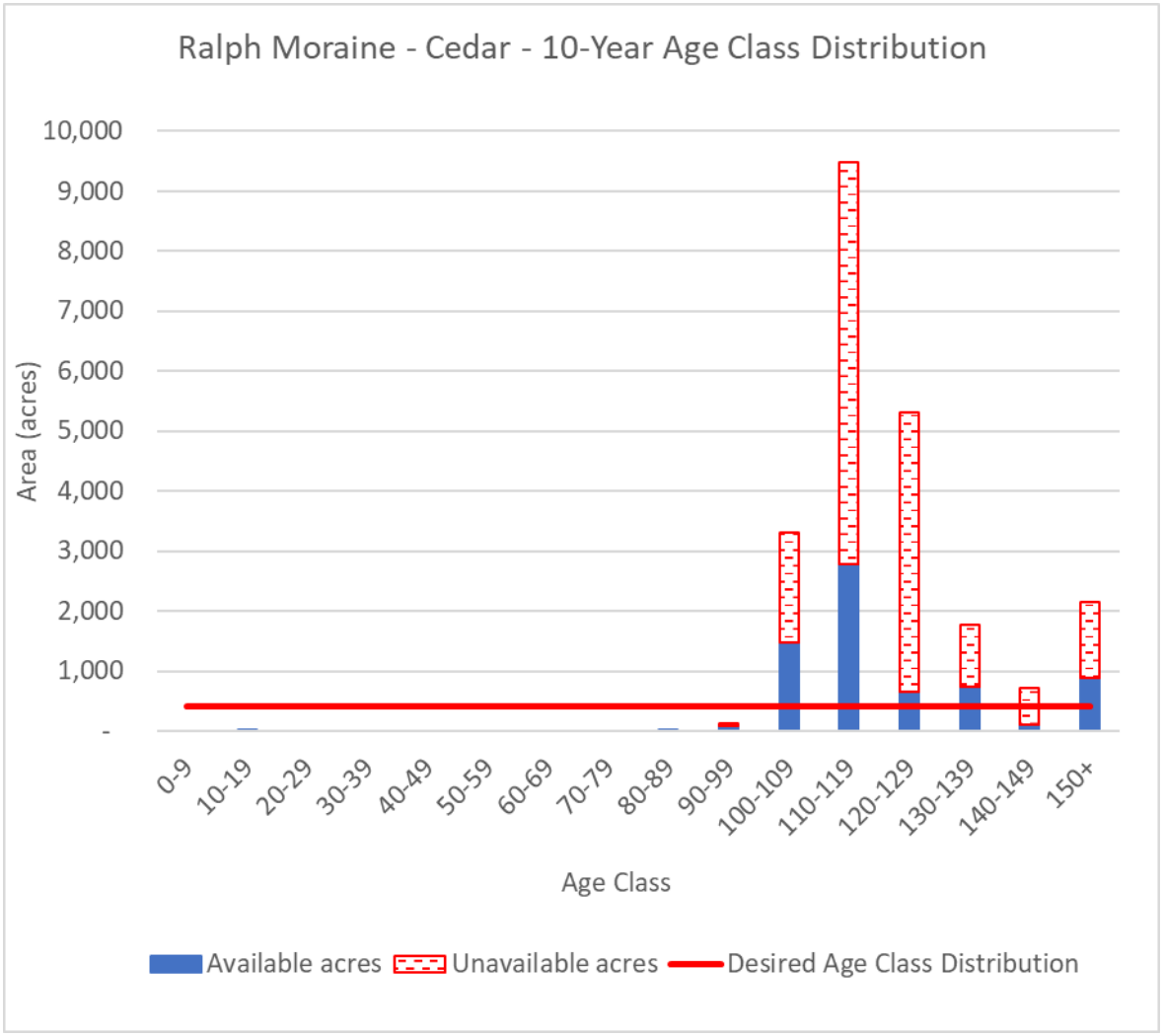


Figure 12. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The end of the planning period will result in the establishment of no acres in the upcoming 0-9 age class. Progress toward the long-term desired age class distribution of cedar will take many decades in this management area.



Figure 13. Projected mid-term age class distribution at the end of the fifth planning period compared to long-term desired age class distribution.

The mid-term age class distribution shows the population of cedar acres aging with only a few acres regenerating (Figure 13).



Figure 14. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 14) will concentrate the manageable acres of cedar in productive growing conditions while providing some forest products and a variety of wildlife habitat conditions across the landscape in young, mid-aged, and mature forest.

Management actions

There are no acres of projected harvests in the cedar cover type. It is expected some cedar will be cut in ongoing research and field trials to learn how to best regenerate this species.

Deer wintering complexes (DWC) greater than 15,000 acres are modeled as Special Analysis Units and information on them can be found in Section 5 of the plan. In DWCs less than 15,000 acres, harvest of cedar and hemlock are not allowed within obligate range stands, and secondary shelter is often protected as well. These areas are guided by the DNR Deer Winter Range Guidelines.



Figure 15. Projected age class distribution over fifteen 10-year planning periods.

Conservation area network

High conservation value areas

There are no high conservation value areas in this management area.

Ecological reference areas

Ecological reference areas (ERAs) are higher quality examples of functioning ecosystems that are primarily influenced by natural ecological processes.

Table 35. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 36. Ecological reference areas within the management area.

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	Number of Occurrences
Existing ERA	Dry-mesic northern forest	B	G4	S3	1
Existing ERA	Poor conifer swamp	AB	G4	S4	1
Grand Total					**2**

Special conservation areas

Reviewable special conservation areas (SCAs; Table 14) may be reviewed or updated through the compartment review process as needed. Static SCAs (Table 15) generally do not change or require updating (see Biodiversity in Section 3 for more information).

Table 14. Reviewable special conservation areas within the Ralph Moraine management area.

Reviewable Special Conservation Area Type and Name	Acres
Concentrated Recreational Area	**72**
6 Mile Lake Boating Access Site	1

Reviewable Special Conservation Area Type and Name	Acres
Chandler Brook lowlands	50
Gene's Pond Campground	21
Habitat Area or Habitat Corridor	**472**
Chandler Brook island	8
Compartment 61 deer yarding area	29
Compartment 61 deer yarding area	203
Hemlock/white pine island	6
Landon fir	13
Landon Lake fir	5
Landon Upland	10
W Branch travel corridor.	32
W. Bob's Lake	166
Possible Type 1 or Type 2 Old Growth	**1,187**
--	1,187
Spring, Wetlands, or Riparian Areas	**126**
Landon Lake	14
Landon/Chandler lowland	112
Grand Total	**1,857**

Table 15. Static special conservation areas within the Ralph Moraine management area.

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Deer Winter Range - Obligate and Conditional		**4,662**
Conditional		4,662
Designated Trout and Cold Water Stream Buffer		**2,979**
		1,033
Big Brook		103
Bryan Creek		99
Cady Creek		56
Camp Eleven Creek		4
East Branch Sturgeon River		152
Flat Rock Creek		62
Ford River		91
Hayes Creek		39
Little Brook		80
McGregor Creek		179
North Branch Ford River		291
North Branch Sturgeon River		116
Poplar Creek		25
Schwartz Creek		128
Sixmile Creek		92

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Skunk Creek		105
Turner Creek		79
Twomile Creek		95
Weber Creek		31
West Branch Sturgeon River		110
Wild West Creek		9
Designated Trout and Coldwater Streams	**111.1**	
	37.6	
Big Brook	3.0	
Bryan Creek	3.8	
Cady Creek	2.1	
Camp Eleven Creek	0.2	
East Branch Sturgeon River	5.6	
Flat Rock Creek	2.3	
Ford River	3.3	
Hayes Creek	1.5	
Little Brook	3.8	
McGregor Creek	6.6	
North Branch Ford River	11.0	
North Branch Sturgeon River	4.4	
Poplar Creek	1.0	
Schwartz Creek	4.7	
Sixmile Creek	3.4	
Skunk Creek	4.0	
Turner Creek	2.9	
Twomile Creek	4.1	
Weber Creek	1.2	
West Branch Sturgeon River	4.2	
Wild West Creek	0.3	
Mussel Stream Group 2 - State threatened or endangered	**4.0**	
Peronto Lake-East Branch Sturgeon River	3.3	
Skunk Creek-East Branch Sturgeon River	0.7	
Natural Beauty Roads	**2.4**	
C C Rd	1.3	
Camp Three Rd	1.1	
Wood Turtle Stream 100ft Buffer		**89**
Ford River		7
North Branch Ford River		29
West Branch Escanaba River		53
Wood Turtle Stream 660ft Buffer		**561**
Ford River		58

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
North Branch Ford River		184
West Branch Escanaba River		319
Grand Total	**117.4**	**8,290**

Rare species

Rare species occurrences are compiled from the Michigan Natural Features Inventory Biotics database (Tables 17 and 18) and do not necessarily include all rare species found in this management area due to biases in survey effort and verifiable observation reporting over time.

Table 37. Rare animal and plant species conservation status key.

Status	Status
E = endangered	LE = listed endangered
T = threatened	LT = listed threatened
SC = special concern	PDL = proposed for delisting

Table 17. Rare animal species occurrence within the Ralph Moraine management area

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Alces alces*	Moose	SC	--	--
Animal	Bombus borealis	Northern amber bumble bee	SC	--	3
Animal	Bombus terricola	Yellow banded bumble bee	SC	--	2
Animal	Canis lupus*	Gray wolf	SC	LE	--
Animal	Gavia immer	Common loon	T	--	2
Animal	Glyptemys insculpta	Wood turtle	T	--	2
Animal	Haliaeetus leucocephalus	Bald eagle	SC	--	4
Animal	Lasmigona compressa	Creek heelsplitter	SC	--	1
Animal	Melanoplus walshii	Walsh's short-winged grasshopper	SC	--	1
Animal	Necturus maculosus	Mudpuppy	SC	--	1
Animal	Pandion haliaetus	Osprey	SC	--	3

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Picoides arcticus	Black-backed woodpecker	SC	--	1
Total	--	--	--	--	**20**

**Occurrence information provided by field staff.*

Table 18. Other rare occurrence within the Ralph Moraine management area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Other	Great Blue Heron Rookery	Great Blue Heron Rookery	--	--	3
Total	--	--	--	--	**3**

Non-ERA natural communities

Natural communities identified with an element occurrence in the MNFI Biotics database, but do not have an additional ecological reference area (ERA) designation, are recognized and managed accordingly. There are no non-ERA natural communities in the management area.

Forest health

Forest health concerns, both native and non-native, can have impacts on stand conditions and management decisions. The following insects (Table 19) and diseases (Table 20) could have an impact on management during the planning period and may need to be monitored and/or addressed.

Table 19. Defoliating insects of concern in the Ralph Moraine management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Spongy moth	Lymantria dispar	Non-native	Yes
Forest tent caterpillar	Malacosoma disstria	Native	Yes
Large aspen tortrix	Choristoneura conflictana	Native	Yes
Spruce budworm	Choristoneura fumiferana	Native	Yes

Watch for lingering ash with potential resistance to emerald ash borer.

Table 20. Maladies of concern in the Ralph Moraine management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Canker	Various	Various	Yes
Armillaria root rot	Armillaria spp.	Native	Yes
Oak Wilt	Bretziella fagacearum	Non-native	No

Aquatic resources

Riparian habitat

A total of 161 miles of streams and rivers are found in the management area (Table 21). Streams/rivers classified as cold types comprise approximately 57 percent of the riverine mileage.

Table 21. Classification type and length of streams/rivers found within the management area.

Type	Length (miles)
Cold stream	25
Cold small river	0
Cold transitional stream	66
Cold transitional small river	0
Cold transitional large river	0
Warm transitional stream	29
Warm transitional small river	37
Warm transitional large river	0
Warm stream	4
Warm small river	0
Warm large river	0

Lacustrine habitat

A total of 17 lakes and ponds of at least 1 surface acre are found in the management area (Table 22).

Table 22. Size and number of lakes and ponds located within the management area.

Lake Size Class (acres)	Number
1-99	15
100-499	0
500+	2

Wetlands

A total of 58,691 acres of wetlands lie in the management area (Table 23). Forested wetlands comprise approximately 97 percent of wetland types found in the management area.

Table 23. Area of emergent, forested, and riverine wetland types found within the management area.

Wetland Type	Acres
Emergent	1,545
Forested	57,037
Riverine	109

Vernal pools and seeps

A total of 1,137 acres of vernal pools and seeps have been inventoried in the management area while no areas of seeps have been identified.

Riparian vegetation cover

Lowland shrub, cedar and aspen are the predominant cove types in a 100-meter riparian zone located next to streams/rivers in the management area (Table 24).

Table 24. Largest vegetative cover types (i.e., top 10) and area located in a 100-meter buffer of streams/rivers within the management area.

Cover Type	Acres
Lowland shrub	5,826
Cedar	4,032
Aspen	3,043
Lowland conifers	1,521
Lowland spruce/fir	855
Lowland aspen/balsam poplar	485
Northern hardwood	463
Lowland mixed forest	398
Lowland deciduous	334
Upland spruce/fir	286

Watershed vegetation cover

The management area includes portions of important watersheds of the Ford River and Sturgeon River (Tables 25and 26). Aspen, cedar, and northern hardwood are major cover types.

Table 25. Largest vegetative cover types (i.e., top five) and area of the Ford River watershed located within the management area.

Cover Type	Acres
Aspen	24,538
Cedar	9,016
Northern hardwood	8,076
Lowland shrub	3,541
Lowland conifer	3,321

Table 26. Largest vegetative cover types (i.e., top 5) and area of the Sturgeon River watershed located within the management area.

Cover Type	Acres
Aspen	16,067
Northern hardwood	8,482

Cover Type	Acres
Cedar	6,099
Lowland shrub	2,384
Lowland conifer	1,312

Recreation

The Ralph Moraine management area has good access for recreation and management. One off-road vehicle route and two major snowmobile routes pass through this area: UP-32 runs east-west in the north of the area and UP-5 runs north-south in the west. There are no designated non-motorized trails except for hunter walking trails within the two Grouse Enhanced Management Sites.

One state forest campground (rustic) is located within the management area on Gene's Pond flooding, with water access available.

Table 27. Designated recreation trails by type.

Recreation Category	Recreation Type	Number of Miles
Motorized recreation trails	ORV (all types)	5.9
Motorized recreation trails	Snowmobile	47.1
Non-motorized recreation trails	Hiking	0
Non-motorized recreation trails	Equestrian	0
Non-motorized recreation trails	Biking	0
Non-motorized recreation trails	Hunter walking trails	23.4
Total	--	**76.3**

Note: Trail use types may overlap.

Table 28. State forest campgrounds.

Name	Number of Sites
Gene's Pond campground	14

The management area contains several floodings formerly designated as wildlife management areas. In 2020 these were removed as uniquely named focus areas for the DNR's Wildlife Division and are managed as part of state forest co-management activities.

The Bill Rollo Memorial and Ralph Grouse Enhanced Management Sites are easily accessible from county roads, providing hunter walking trails through aspen stands and beautiful scenery for premiere grouse and woodcock hunting opportunities.

There are six boating access sites in this management area, providing access to the Escanaba River, Gene's Pond and several small inland lakes.

Table 29. Areas Managed for Hunting.

Type	Name	Number of Acres

State Wildlife Management Areas	Gene's Pond Flooding SWMA	3,350.4
GEMS	Bill Rollo Memorial GEMS Ralph GEMS	6,833.1 5,272.9
Total	--	**18,048.6**

Table 30. Boating Access Sites.

Name	Waterbody
Gene's Pond campground	Gene's Pond
Lower Dam campground	West Branch Escanaba River
Pickerel Lake	Pickerel Lake
Six Mile Lake	Six Mile Lake
Solberg Lake	Solberg Lake
West Branch campground	West Branch Escanaba River

Suomi Till and Outwash Plain

State Forest Area: 142,739 acres	Location: Portions of North Dickinson and South Western Marquette Counties	Population Centers: Gwinn, Palmer, Witch Lake
Sub-Section: Suomi Till and Outwash Plain	Landforms: Ice-stagnation features, end moraines, ground moraine, and outwash	Landcover: Forested: 124,579 acres Non-forested: 18,160 acres

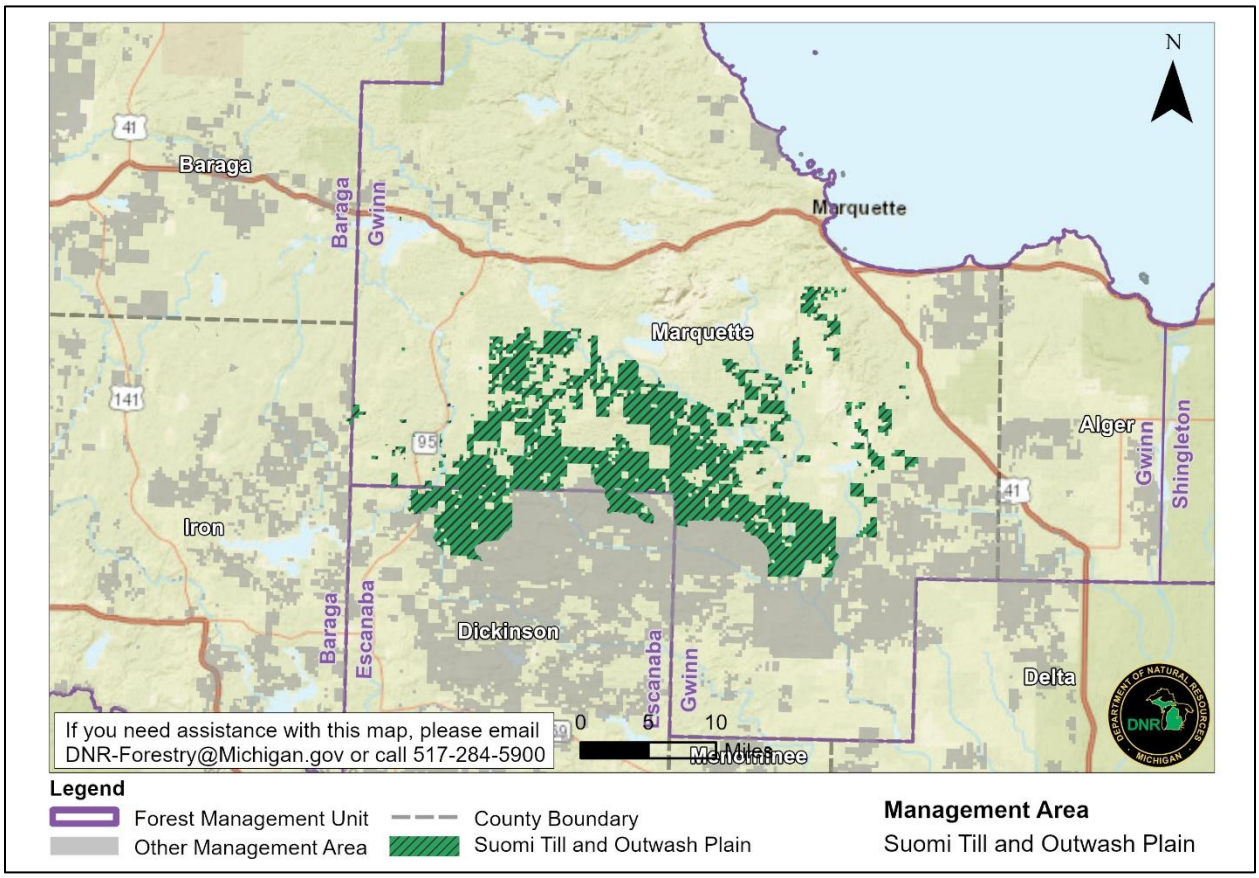


Figure 1. Map of the Suomi Till and Outwash Plain management area.

Forested landscape

Current and projected future condition

The Suomi Till and Outwash Plain management area is dominated by shade-intolerant cover types in the young and mid-aged categories. Tolerant cover types dominate the older age categories, while the unavailable lowland acres are more prevalent in the old age category.

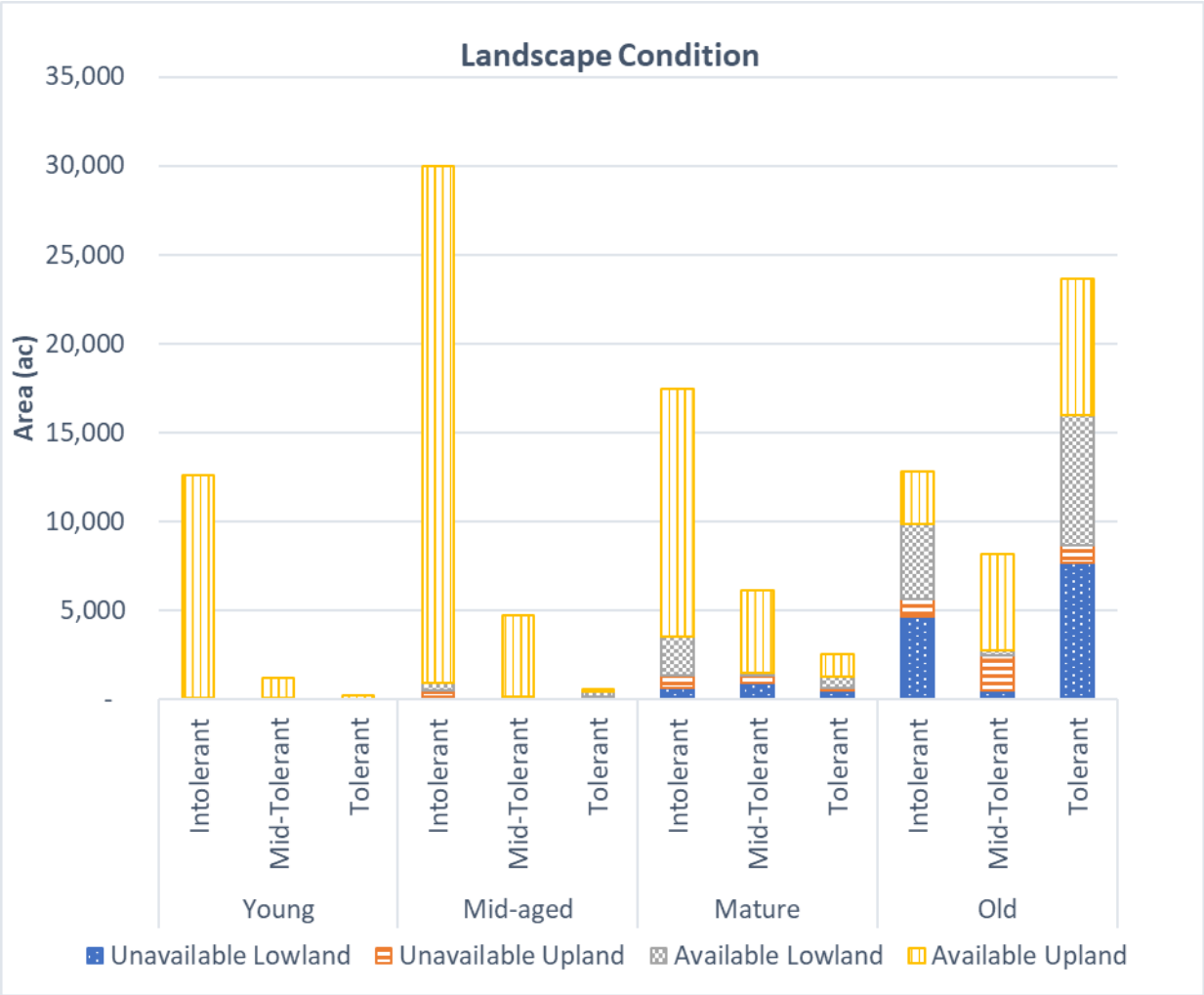


Figure 2. Forest diversity matrix showing the current distribution of forested acres across management availability, age category, landscape position and shade tolerance.

Landscape habitat conditions refine the management area landscape into featured species habitat context. Current and projected acres for the metrics identified in the Management Priorities (Section 3 Statewide/Regional) establish a baseline and future condition based on management over the planning period (Table 1).

Table 1. Current and projected acres for landscape habitat conditions.

Landscape Habitat Condition	Monitoring Metric	Current Acres
Young forest	Acres of 0-19 stands in Aspen and Jack Pine	14,008
Mature forest	Acres of 80+ year stands across cover types	44,618
Mature forest	Acres of 120+ year stands across cover types	18,816
Mesic conifer cover types	Acres of mesic conifer cover types	8,836
Mesic conifers in other cover types	Average canopy occupancy	41%
Mast – oak cover types	Acres of Oak cover types	2,313
Mast tree species in other cover types	Acres of Total Canopy Occupancy of Mast Tree Acres (Trace-100%)	32,993
Big trees	Acres of Total Canopy Stand Occupancy of Species in Sawlog or Greater Size Class	58,127
Non-forested openings	Acres of Total herbaceous open land, upland shrub and cropland	4,092
Landscape forest matrix	Percent Deciduous Forest	48%
Landscape forest matrix	Percent Coniferous Forest	47%

The Suomi Till and Outwash Plain management area has the following Special Analysis Units (SAUs). These SAUs have specific cover type goals, typically associated with wildlife habitat management. For any SAUs that overlap with this MA, SAU cover type goals take priority as the SFMP model strives to meet the cover type goals across the MA, ensuring they are met. Please see Section 5 for a detailed description of the management direction and harvest goals for each of these SAUs.

- Deer Wintering Complex (DWC): Iron-Floodwood
- Grouse Enhanced Management (GEM): Bill Rollo Memorial GEMS

The Suomi Till and Outwash Plain management area is dominated by forested cover types with 87 percent of the area covered in forested stands (Table 2). The upland deciduous portion of that is 65 percent of the management area and comprised mostly of aspen. The upland coniferous portion is 21 percent of the management area and is comprised mostly of planted and natural jack pine. Cedar is the most common lowland conifer representing 7 percent of the landscape. Lowland shrub is the most common non-forested cover type, representing 4 percent of the landscape.

Table 2. Landscape conditions and distribution of cover types in the Suomi Till and Outwash Plain management area.

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
Forested	Upland	Deciduous	Aspen	45,022	58,575	93,205	124,579
			Northern hardwood	8,222			
			Black-red hybrid oak	169			
			Northern red oak	1,588			
			Oak mix	661			
			Mixed upland deciduous	2,914			
		Mixed	Upland mixed forest	5,136	5,136		
		Coniferous	Planted red pine	5,823	29,494		
			Planted jack pine	8,173			
			Planted white pine	9			
			Planted mixed pine	460			
			Natural red pine	1,001			
			Natural jack pine	5,195			
			Natural white pine	1,887			
			Natural mixed pines	2,418			
			Upland spruce/fir	1,519			
			Upland conifers	2,953			
			Hemlock	56			
	Lowland	Deciduous	Lowland aspen/balsam poplar	288	768	31,374	
			Lowland deciduous	480			
		Mixed	Lowland mixed forest	1,756	1,756		
		Coniferous	Cedar	10,102	28,851		
			Lowland conifers	7,183			
			Lowland spruce/fir	9,123			
			Tamarack	2,443			
Nonforested	Upland	N/A	Herbaceous openland	1,593	N/A	5,117	18,160
			Upland shrub	2,402			
			Low density trees	665			
			Bare/sparsely vegetated	38			
			Cropland	97			
			Urban	323			
	Lowland	N/A	Lowland shrub	6,093	N/A	13,042	
			Marsh	544			
			Bog	2,481			
			Treed bog	2,900			
			Water	1,024			
						Grand Total:	142,739

There are 103,630 acres (72.7 percent of the total management area and 83.3 percent of the forested area) that can be managed toward desired future conditions via commercial timber harvest in the Suomi Till and Outwash Plain management area (Table 3). Of that, more than 35 percent is in the aspen cover type, 7 percent is in planted jack pine, 6 percent in northern hardwood, and 5 percent in planted red pine. The remaining 19 cover types represent about 19 percent of the forested and available land in the management area.

Table 3. Landscape conditions and cover type composition of the Suomi Till and Outwash Plain management area.

Forested Cover Type	Available Acres	Available Percent	Unavailable Acres	Unavailable Percent	Total Acres	Total Percent
Aspen	43,895	35.2%	1,127	0.9%	**45,022**	**36.1%**
Cedar	5,101	4.1%	5,001	4.0%	**10,102**	**8.1%**
Lowland spruce fir	4,955	4.0%	4,168	3.3%	**9,123**	**7.3%**
Northern hardwood	7,348	5.9%	874	0.7%	**8,222**	**6.6%**
Planted jack pine	8,148	6.5%	25	0.0%	**8,173**	**6.6%**
Lowland conifers	3,934	3.2%	3,249	2.6%	**7,183**	**5.8%**
Planted red pine	5,785	4.6%	38	0.0%	**5,823**	**4.7%**
Natural jack pine	4,859	3.9%	336	0.3%	**5,195**	**4.2%**
Upland mixed forest	4,632	3.7%	504	0.4%	**5,136**	**4.1%**
Upland conifers	2,394	1.9%	559	0.4%	**2,953**	**2.4%**
Mixed upland deciduous	2,144	1.7%	770	0.6%	**2,914**	**2.3%**
Tamarack	1,311	1.1%	1,132	0.9%	**2,443**	**2.0%**
Natural mixed pines	1,904	1.5%	515	0.4%	**2,418**	**1.9%**
Natural white pine	1,724	1.4%	163	0.1%	**1,887**	**1.5%**
Lowland mixed forest	451	0.4%	1,305	1.0%	**1,756**	**1.4%**
Northern red oak	1,531	1.2%	57	0.0%	**1,588**	**1.3%**
Upland spruce fir	1,092	0.9%	427	0.3%	**1,519**	**1.2%**
Natural red pine	799	0.6%	203	0.2%	**1,001**	**0.8%**
Oak mix	661	0.5%	0	0.0%	**661**	**0.5%**
Lowland deciduous	290	0.2%	190	0.2%	**480**	**0.4%**
Planted mixed pine	460	0.4%	0	0.0%	**460**	**0.4%**
Lowland aspen balsam poplar	244	0.2%	44	0.0%	**288**	**0.2%**
Black-red hybrid oak	127	0.1%	42	0.0%	**169**	**0.1%**
Hemlock	46	0.0%	10	0.0%	**56**	**0.0%**
Planted white pine	9	0.0%	0	0.0%	**9**	**0.0%**
Total	**103,841**	**83.4%**	**20,739**	**16.6%**	**124,579**	**100.0%**

Table 4. Site condition (reason area is unavailable for commercial harvesting) acres for the Suomi Till and Outwash Plain management area.

Site Condition (Reason area is unavailable for commercial harvest)	Area (ac)	% of Unavailable Area
BMPs	8,814	42.0%
Unproductive	2,778	13.2%
Deer wintering area	2,562	12.2%
Conservation values	1,943	9.3%
Blocked by obstacle	1,834	8.7%
Too wet	1,382	6.6%
Too steep	824	3.9%
Cannot regenerate	241	1.1%
Long-term retention	237	1.1%
Wildlife concerns	177	0.8%
Other dept./div. Processes	57	0.3%
Denied access	46	0.2%
Recreational/scenic	37	0.2%
Neighbor / interest group	25	0.1%
Other influence zones	15	0.1%
Non-military lease/easement	1	0.0%
Total Unavailable	**20,971**	**100.0%**

Management actions

Each cover type in the Suomi Till and Outwash Plain management area has a unique age class and basal area class goals that describe the long-term desired future conditions. The harvests levels that are needed in the first planning period to begin achieving those long-term goals are summarized below (Table 5).

Table 5. Ten-year planning period harvest goals (acres) by cover type and silvicultural regime.

Silvicultural Regimes								
Cover Type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Salvage Clearcut	Salvage Thinning	Grand Total
Aspen	8,169	-	-	-	-	-	-	8,169
Northern hardwood	45	2,244	-	109	3	-	-	2,400
Lowland spruce/fir	911	-	-	-	-	-	-	911
Upland conifers	593	-	8	-	70	-	-	670
Natural jack pine	516	-	-	-	-	-	-	516
Planted jack pine	498	-	-	-	-	-	-	498
Planted red pine	51	-	370	-	-	-	-	421
Lowland conifers	342	-	-	-	-	-	-	342
Natural white pine	-	-	97	-	68	-	-	165
Mixed upland deciduous	121	14	-	-	21	-	-	155
Tamarack	133	-	-	-	-	-	-	133
Natural mixed pines	-	-	55	-	50	-	-	106
Oak mix	92	-	-	-	-	-	-	92
Upland spruce/fir	79	-	-	-	-	-	-	79
Natural red dine	-	-	29	-	27	-	-	56
Lowland deciduous	26	-	-	-	-	-	-	26
Lowland aspen/balsam poplar	24	-	-	-	-	-	-	24
Upland mixed forest	24	-	-	-	-	-	-	24
Black-red hybrid oak	1	-	-	-	-	-	-	1
Totals	**11,624**	**2,257**	**559**	**109**	**238**	**-**	**-**	**14,788**

These harvests will help establish a desirable amount of regeneration for even-aged cover types over the 10-year period or help to achieve desired basal area distribution among uneven-aged cover types like northern hardwoods. The following sections will provide additional details for each of the significant cover types in the Suomi Till and Outwash Plain management area.

Table 6. Ten-year estimated Harvest Volume by product and species for the Suomi Till and Outwash Plain management area.

10-Year Estimated Harvest Volume Projection Suomi Till and Outwash Plain Management Area			
Product	**Species**	**Volume Planned***	**Volume Prepared** ***
Pulpwood (cords)	Mixed aspen	68,551	64,438
	Mixed hardwood	33,596	31,581
	Mixed spruce	21,407	20,122
	Mixed softwood	15,425	14,499
	Jack pine	14,215	13,362
	Red pine	3,779	3,552
	White pine	3,770	3,544
	Mixed oak	1,851	1,740
	Pulpwood Total	**162,594**	**152,838**
Sawtimber (MBF)	Mixed aspen	11,234	10,560
	Sugar maple	7,786	7,318
	Red pine	6,644	6,245
	White pine	6,265	5,889
	Red maple	3,883	3,650
	Red oak	1,345	1,265
	Basswood	727	683
	Mixed oak	447	420
	White oak	389	365
	Sawtimber Total	**38,719**	**36,396**
	Total Sawtimber Harvest Volume in Cords	**82,215**	**77,282**
	Grand Total Harvest Volume in Cords	**244,809**	**230,121**

* Volume estimates based on 100% of the projected harvests for the 10 year planning period.

** Volume estimates based on 94% of the projected harvests for the 10 year planning period accounting for reduction in acres and associated volume once sales are prepared for bid.

There are few cover type transitions projected in the Suomi Till and Outwash Plain management area. The managed area of each cover type is projected to remain relatively stable. The largest decrease forecasted is in the aspen cover type where 1,427 acres are forecasted to convert to other cover types through forest management activities. The largest increase is in planted red pine where 922 acres are expected to convert into that cover type.

Table 7. Projected 10-year cover type acres resulting from cover type transitions.

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Aspen	45,022	43,601	-1,420
Cedar	10,102	10,102	0
Lowland spruce/fir	9,123	8,844	-279
Northern hardwood	8,222	8,230	8
Planted jack pine	8,173	8,325	152
Lowland conifers	7,183	7,273	90
Planted red pine	5,823	6,741	918
Natural jack pine	5,195	5,263	69
Upland mixed forest	5,136	5,757	621
Upland conifers	2,953	2,619	-334
Mixed upland deciduous	2,914	2,895	-19
Tamarack	2,443	2,393	-50
Natural mixed pines	2,418	2,418	0
Natural white pine	1,887	1,940	53
Lowland mixed forest	1,756	2,007	251
Northern red oak	1,588	1,589	1
Upland spruce/fir	1,519	1,463	-56
Natural red pine	1,001	1,001	0
Oak mix	661	661	0
Lowland deciduous	480	471	-9
Planted mixed pine	460	463	4
Lowland aspen/balsam poplar	288	285	-2
Black-red hybrid oak	169	169	0
Hemlock	56	56	0
Planted white pine	9	13	4
Lowland shrub	6,093	6,093	0
Treed bog	2,900	2,900	0
Bog	2,481	2,481	0
Upland shrub	2,402	2,402	0
Herbaceous openland	1,593	1,593	0

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Water	1,024	1,024	0
Low density trees	665	665	0
Marsh	544	544	0
Urban	323	323	0
Cropland	97	97	0
Bare/sparsely vegetated	38	38	0
Total:	**142,739**	**142,739**	**0**

Featured species current and projected habitat acres

A dozen featured species in this management area that span various cover types, age classes, and stand level conditions.

As noted in the Featured Species Management Priority (Section 3), it is recommended that these featured species habitat acres be viewed as acres of potential habitat, representing a condition on the landscape where the more nuanced aspects of each species' habitat requirements are likely to be found or managed for. As described in the introduction, the modeling effort was limited by several factors including the simplification of habitat attributes into MiFI variables. Current and projected total habitat acres by species across the decade provide a baseline and show the result of long-term management actions (Table 8). Some species show a loss in habitat over the next century. As mentioned in the Featured Species Management Priority (Section 3), the current condition for many cover types is a surplus of acres in the 0-9 age class from the compensatory management approach applied in the previous decade. The model eventually evens out the age classes at a lower, sustainable level over time, usually by 50 years. For any species with northern hardwoods as a priority cover type, there is a perceived drop in acres between 40-60 years. This is due to the basal area dropping below 81, but because it only drops into the upper 70s, it is not expected to translate to any real habitat loss on the ground. Two of these species were not included in the SFMP model but are included here to inform management decisions over the decade.

Table 8. Featured species current and projected total habitat acres (i.e., potential habitat).

Featured Species	Priority Cover Types	Total Habitat Acres Current	10-year Projected Habitat Acres	50-year Projected Habitat Acres	100-year Projected Habitat Acres
Black bear	Mast	11,834	--	--	--
Black-backed woodpecker	Natural D\disturbance	--	--	--	--

Featured Species	Priority Cover Types	Total Habitat Acres Current	10-year Projected Habitat Acres	50-year Projected Habitat Acres	100-year Projected Habitat Acres
Blackburnian warbler	Northern hardwoods, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, hemlock	10,288	12,992	9,879	14,886
Golden-winged warbler young	Aspen, black-red hybrid oak, northern red oak, oak mix, tamarack	12,936	13,483	12,608	12,722
Kirtland's warbler	Natural jack pine, planted jack pine (Floodwood Plains, Sand Plains, Voelker Plains)	1,684	--	--	--
Marten	Northern hardwoods, mixed upland deciduous, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, lowland mixed forest, lowland conifers, hemlock, cedar	24,586	27,753	24,524	29,972
Moose	To be determined	--	--	--	--
Red crossbill	Natural red pine, natural white pine, natural mixed pine, planted red pine	1,538	1,256	1,648	2,299
Ruffed grouse	Aspen	12,376	12,726	12,219	12,297
Snowshoe hare	Aspen, cedar, hemlock, lowland aspen, lowland conifers, lowland mixed forest, lowland spruce/fir, mixed upland deciduous, natural jack pine, natural mixed pines, planted jack pine, upland spruce/fir	20,446	21,825	19,230	19,058

Featured Species	Priority Cover Types	Total Habitat Acres Current	10-year Projected Habitat Acres	50-year Projected Habitat Acres	100-year Projected Habitat Acres
White-tailed deer (food)	Northern hardwood, oak mix, aspen, mixed upland deciduous, lowland deciduous, lowland aspen/balsam poplar, lowland mixed forest	66,234	65,653	63,077	63,369
White-tailed deer (shelter)*	Hemlock, cedar, planted red pine, planted white pine, planted mixed pine, natural red pine, natural white pine, natural mixed pines, upland conifers, upland spruce fir, lowland conifers	42,534	42,946	45,167	45,104
Wood turtle	Non-forested openings	--	--	--	--

Deer wintering complexes that are greater than 15,000 acres are modeled as special analysis units and information on them can be found in Section 5 of the plan. In complexes less than 15,000 acres, harvest of cedar and hemlock are not allowed within obligate range stands, and secondary shelter is often protected as well. These areas are guided by the DNR Deer Winter Range Guidelines.

Cover type composition and associated wildlife species

Aspen

Current condition

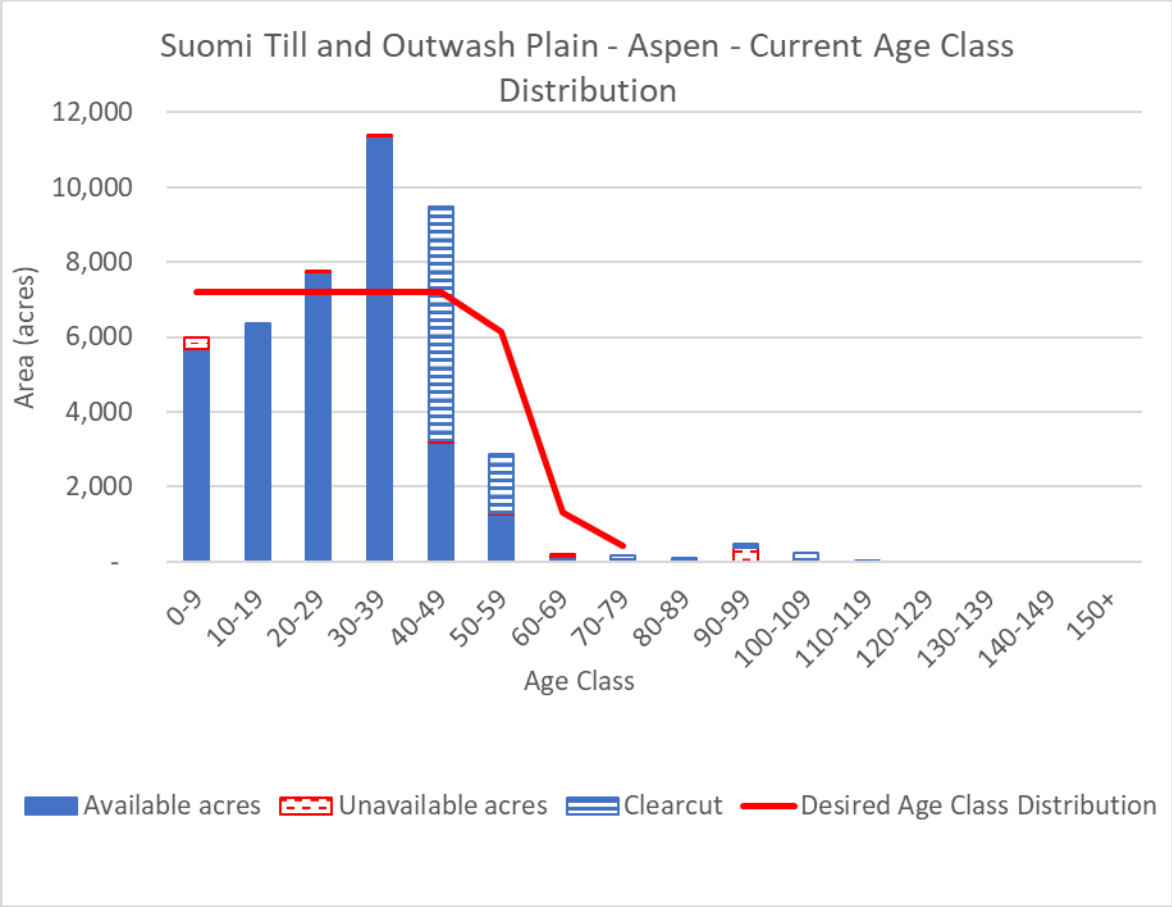


Figure 3. Current age class distribution, the desired age class distribution, and the projected harvests in the aspen cover type over the 10-year planning period.

The current age class distribution is unbalanced, with a deficit of acres in the 0-19- and the 50-79-year-old age classes and a surplus of acres in the 20-49-year old age classes. A portion of this cover type meets the habitat requirements for golden-winged warbler, snowshoe hare, ruffed grouse and white-tailed deer.

Table 9. Featured species with aspen as a priority habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Aspen	Aspen Habitat Acres - Available	Aspen Habitat Acres - Unavailable
Golden-winged warbler	Age category: 0-19 Size class: sapling	12,036	340

Featured Species	Featured Species Habitat – Aspen	Aspen Habitat Acres - Available	Aspen Habitat Acres - Unavailable
Ruffed grouse	Age category: 0-19 Size class: sapling	12,036	340
Snowshoe hare	Age category: 0-19 Size class: sapling	12,036	340
White-tailed deer	All ages and size classes	45,022	--

Desired future condition

The desired age class distribution is to have a rotation age of 40 years for approximately 82 percent of the acres, then 14 percent of the acres in an age class tail out to the 50-year age class, 3 percent of the acres in an age class tail out to the 60-year age class, and 1 percent of the acres in an age class tail out to the 70 year age class.

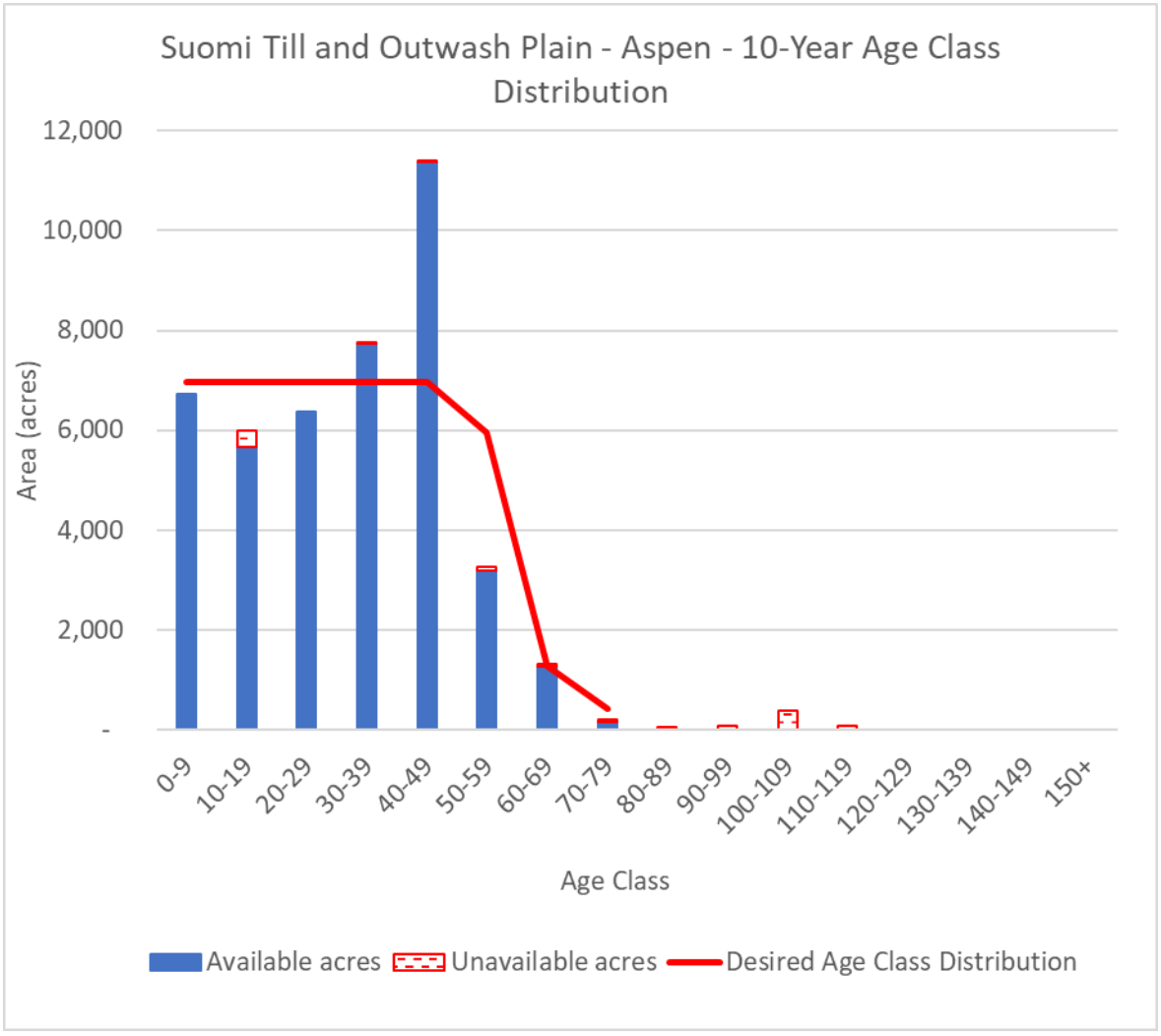


Figure 4. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The end of the planning period will result in establishing 6,721 acres of aspen in the upcoming 0-9 age class. Progress toward the long-term desired age class distribution of aspen will take a few decades in this management area.

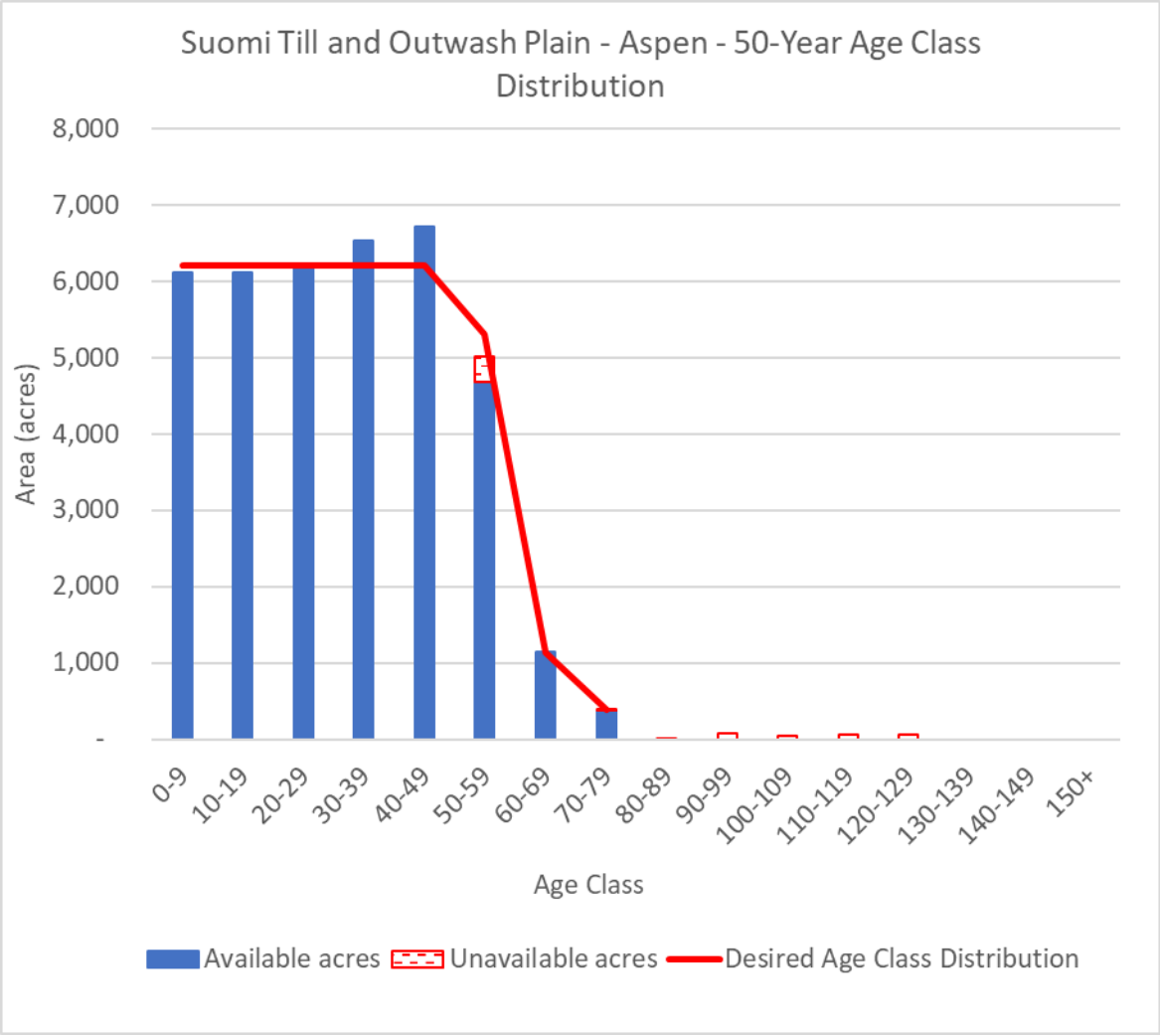


Figure 5. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows aspen acres nearly reaching the desired future condition with few age classes deviating from the target proportions (Figure 5).

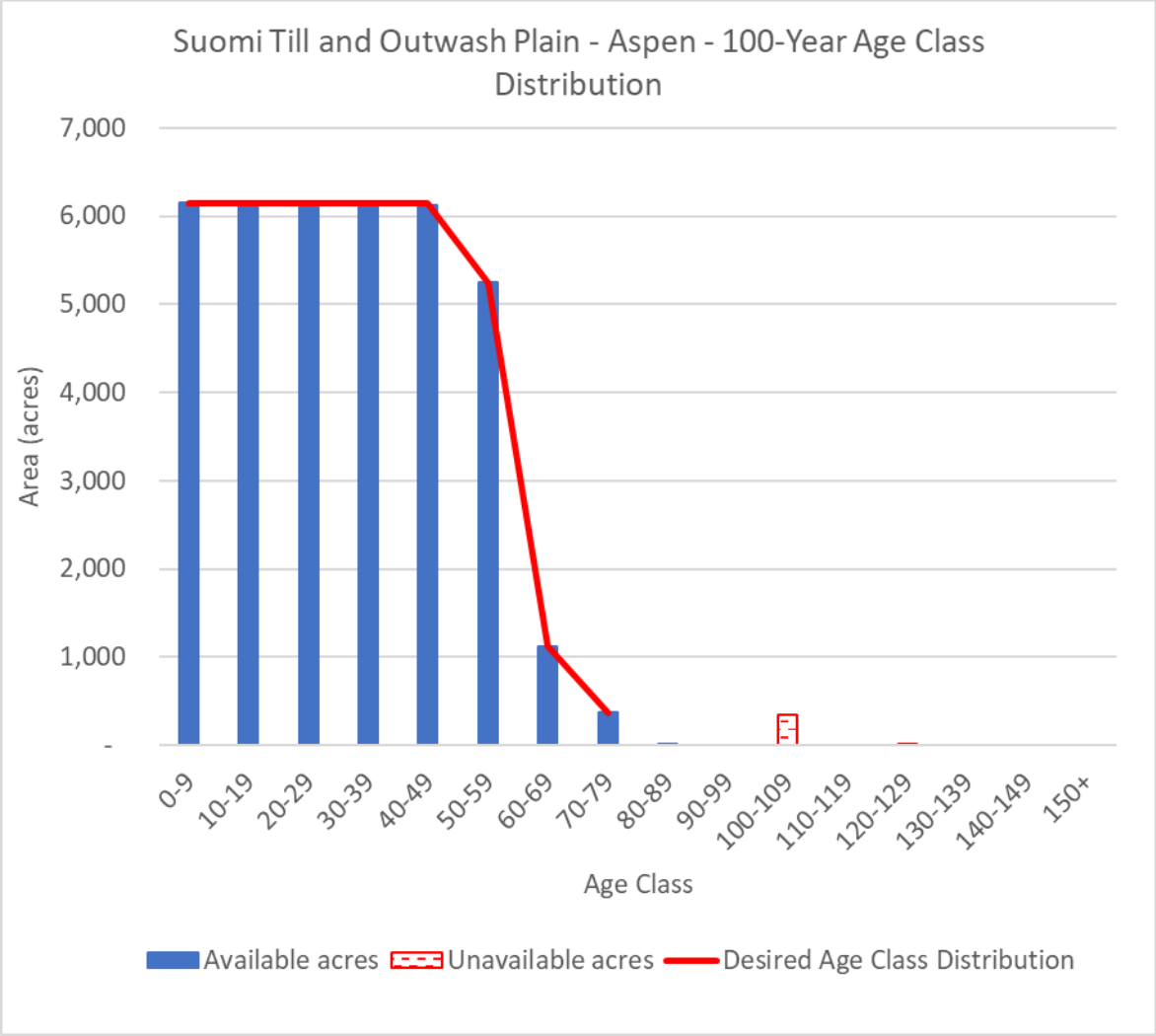


Figure 6. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 6) will concentrate the manageable acres of aspen in productive growing conditions while providing an even flow of forest products and a wide variety of wildlife habitat conditions across the landscape in young, mid-aged, and mature forest.

Management actions

There are 8,169 acres of projected clearcut harvest in the aspen cover type. It is expected that about 1,420 acres of aspen will be converted to other cover types. These total to an expected 6,749 acres of regeneration in the aspen cover type over the next 10 years.

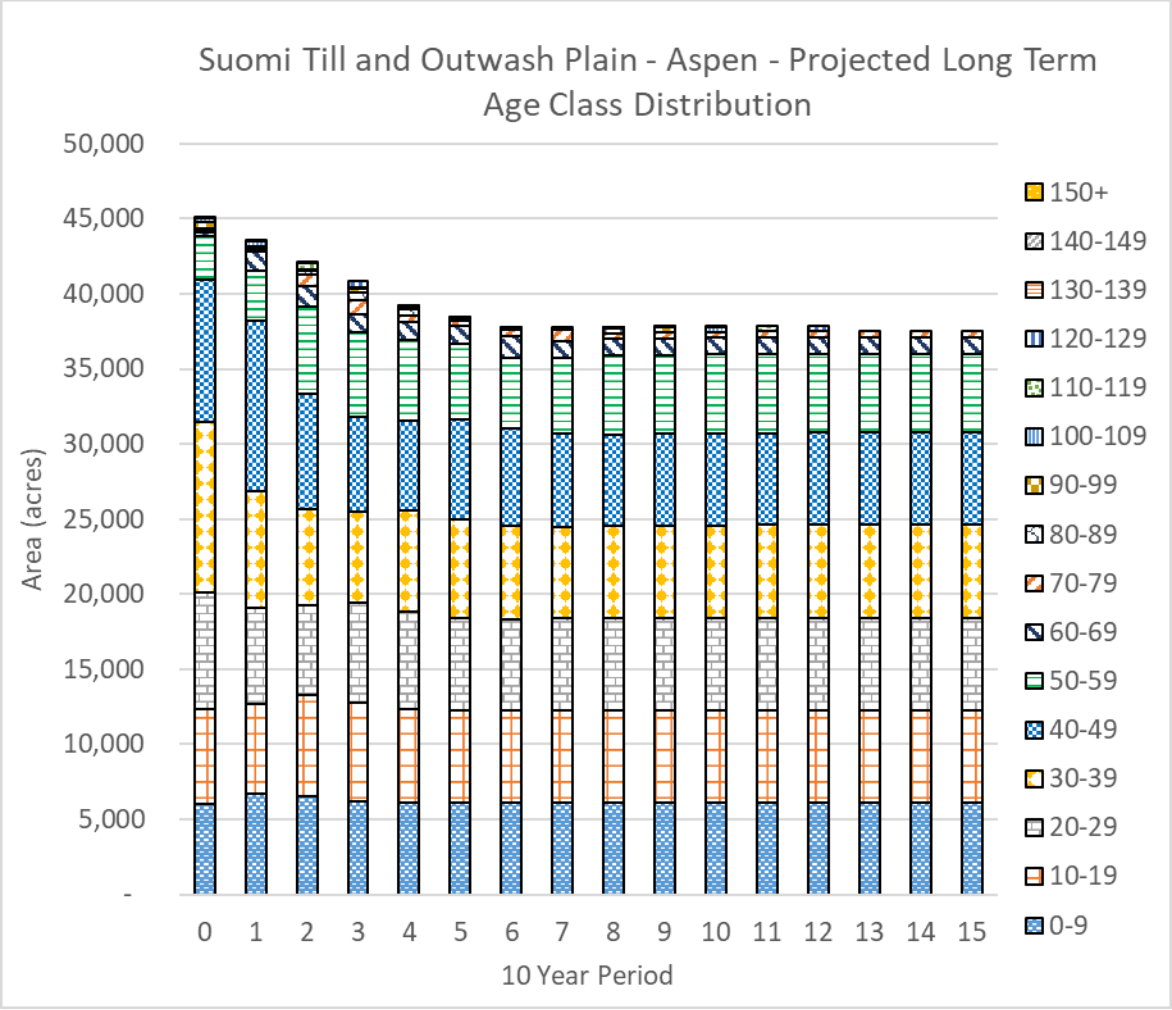


Figure 7. Projected age class distribution over fifteen 10-year planning periods.

Planted jack pine

Current condition

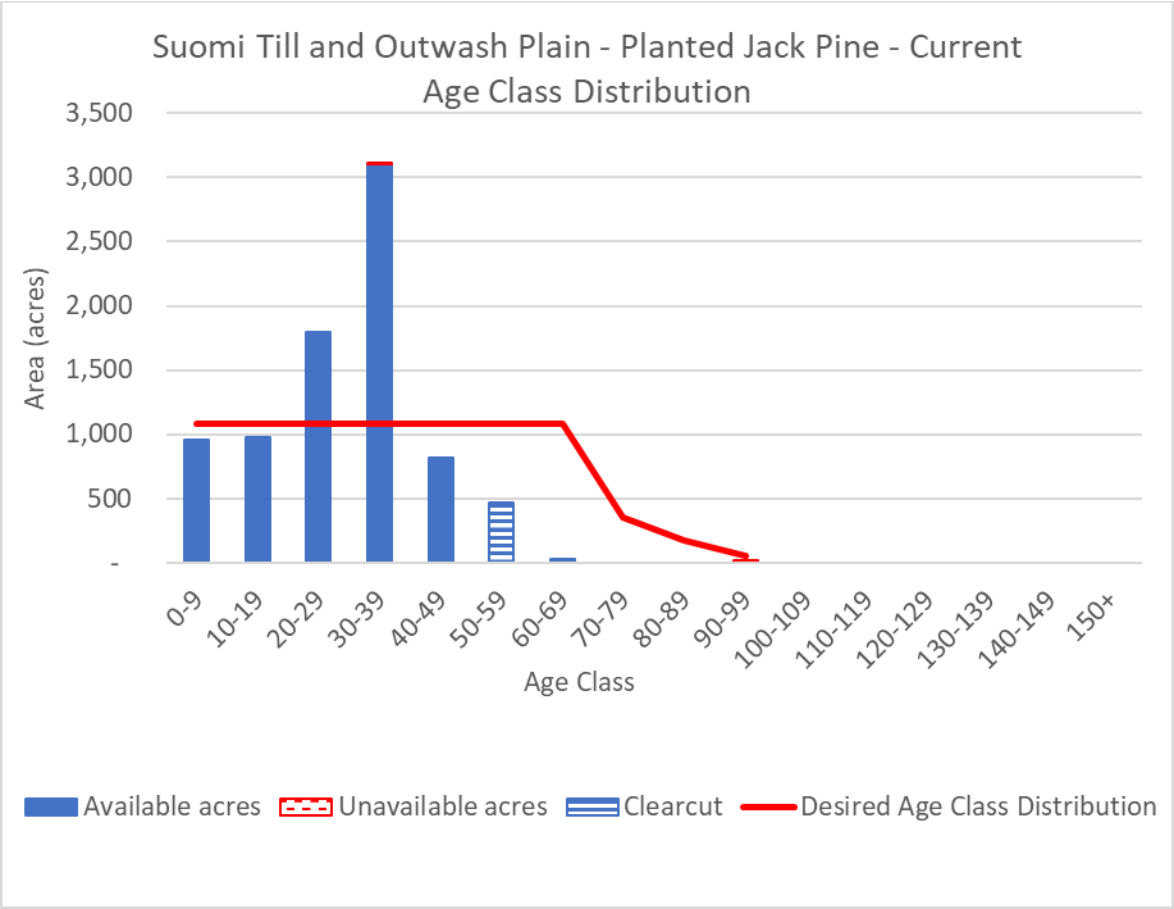


Figure 8. Current age class distribution, the desired age class distribution, and the projected harvests in the planted jack pine cover type over the 10-year planning period.

The current age class distribution is unbalanced with a deficit of acres in the 0-19- and the 40-89year-old age classes, and a surplus of acres in the 20-39-year-old age classes. A portion of this cover type meets the habitat requirements for snowshoe hare and Kirtland's warbler. Kirtland's warbler habitat acres are from Floodwood Plains, Sand Plains, Voelker Plains only and should be harvested in a minimum of 200-acre patches.

Table 7. Featured species with planted jack pine as a selected habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Planted Jackpine	Planted Jack Pine Habitat Acres-Available	Planted Jack Pine Habitat Acres-Unavailable
Kirtland's warbler	Age category: 0-19 Size category: sapling	1,684 (includes natural jack pine)	0

Featured Species	Featured Species Habitat – Planted Jackpine	Planted Jack Pine Habitat Acres-Available	Planted Jack Pine Habitat Acres-Unavailable
Snowshoe hare	Age category: 0-19 Size category: sapling	1,940	0

Desired future condition

The desired age class distribution is to have a rotation age of 60 years with approximately 4 percent of the acres in an age class tail out to the 70-year age class, 2 percent of the acres in an age class tail out to the 80 year age class, and 1 percent of the acres in an age class tail out to the 90-year age class.

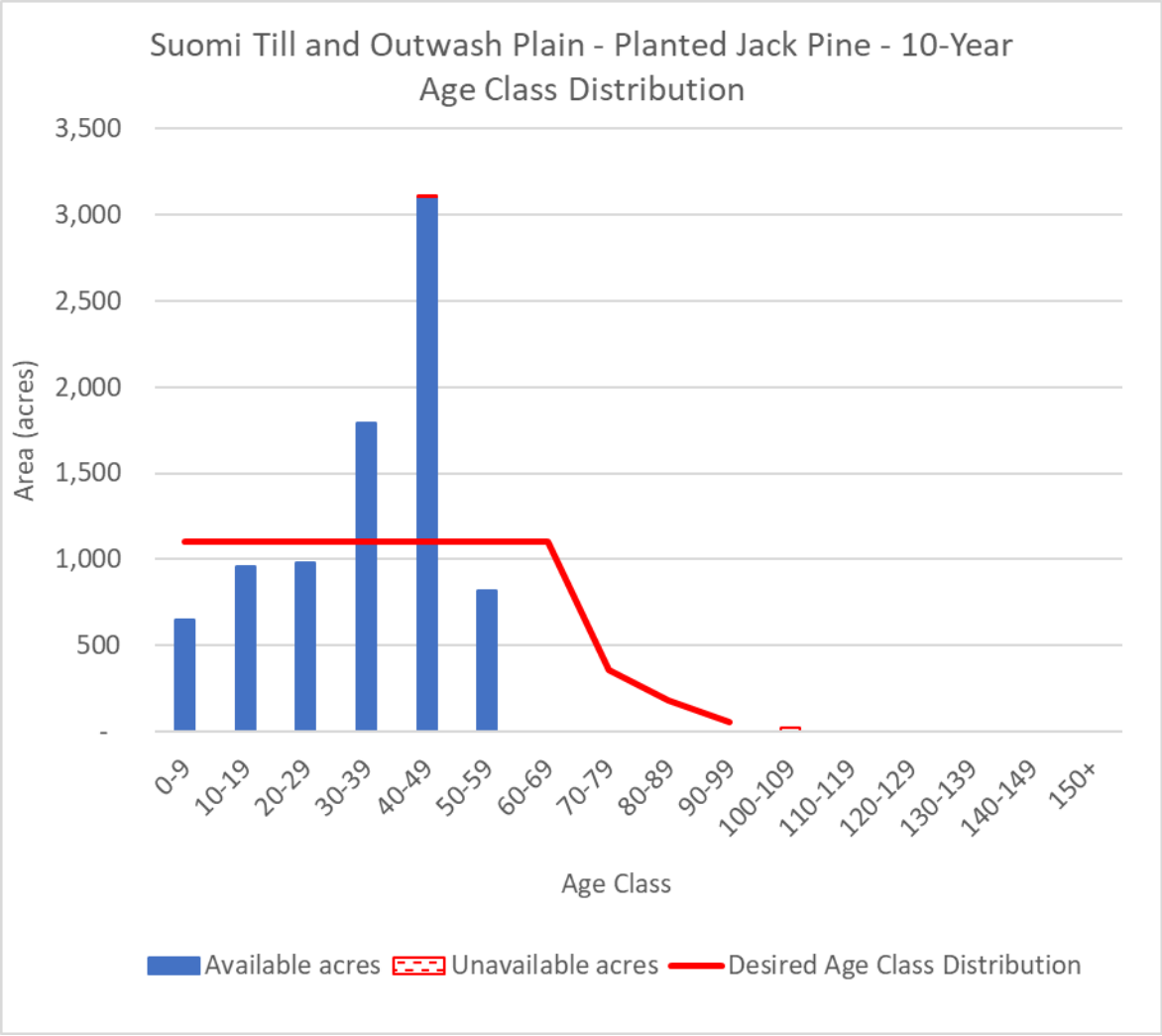


Figure 9. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The end of the planning period will result in the establishment of 650 acres in the upcoming 0-9 age class. Progress toward the long-term desired age class distribution of planted jack pine will take many decades in this management area.

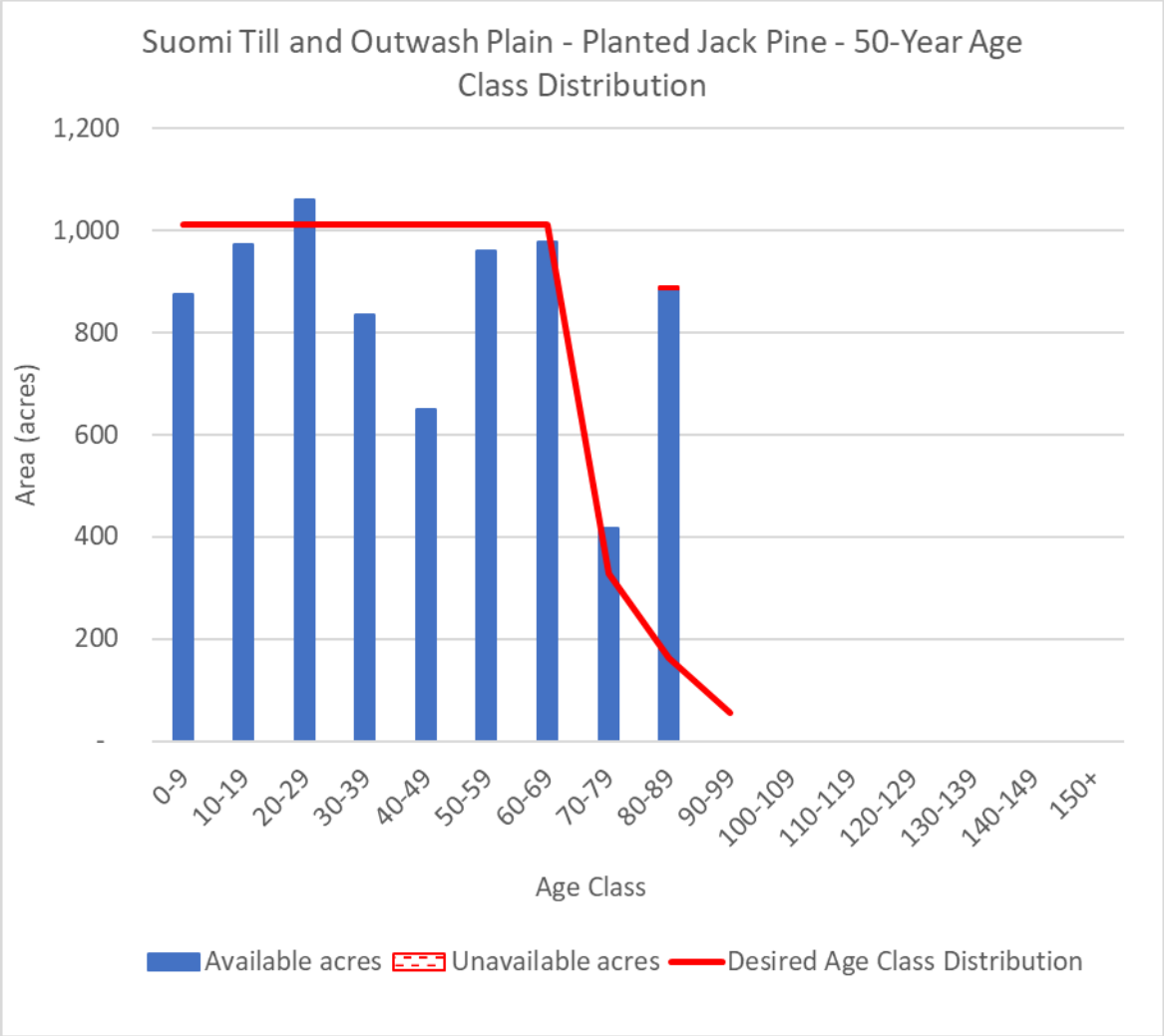


Figure 10. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of planted jack pine acres working toward the desired future condition as the older age classes are treated (Figure 10).

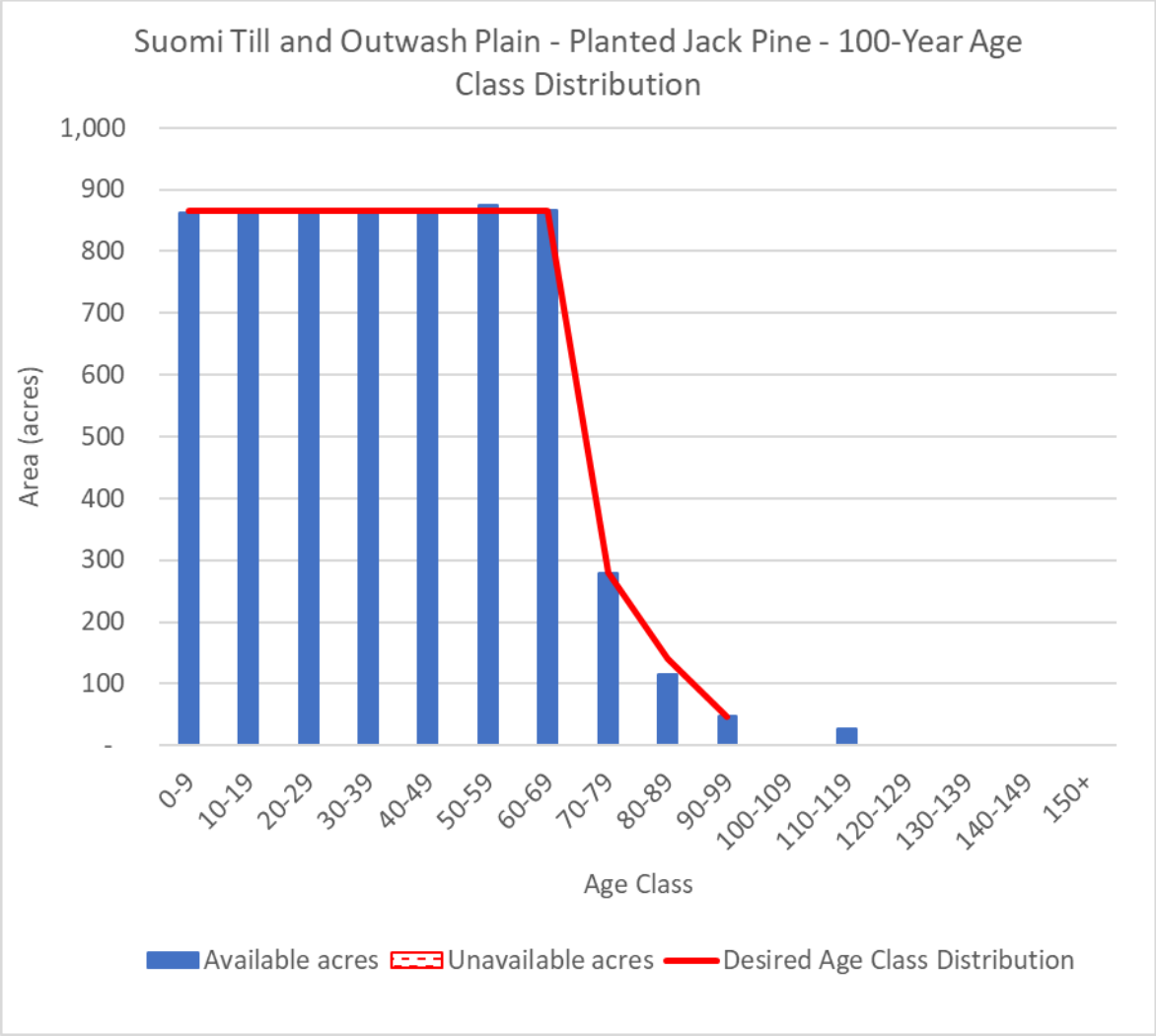


Figure 11. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 11) will concentrate the manageable acres of planted jack pine in productive growing conditions while providing an even flow of forest products and a wide variety of wildlife habitat conditions across the landscape in young, mid-aged, and mature forest.

Management actions

There are 498 acres of projected harvest in the planted jack pine cover type. It is expected that about 152 acres of planted jack pine will be converted from other cover types. These total to an expected 650 acres of regeneration in the planted jack pine cover type over the next 10 years.

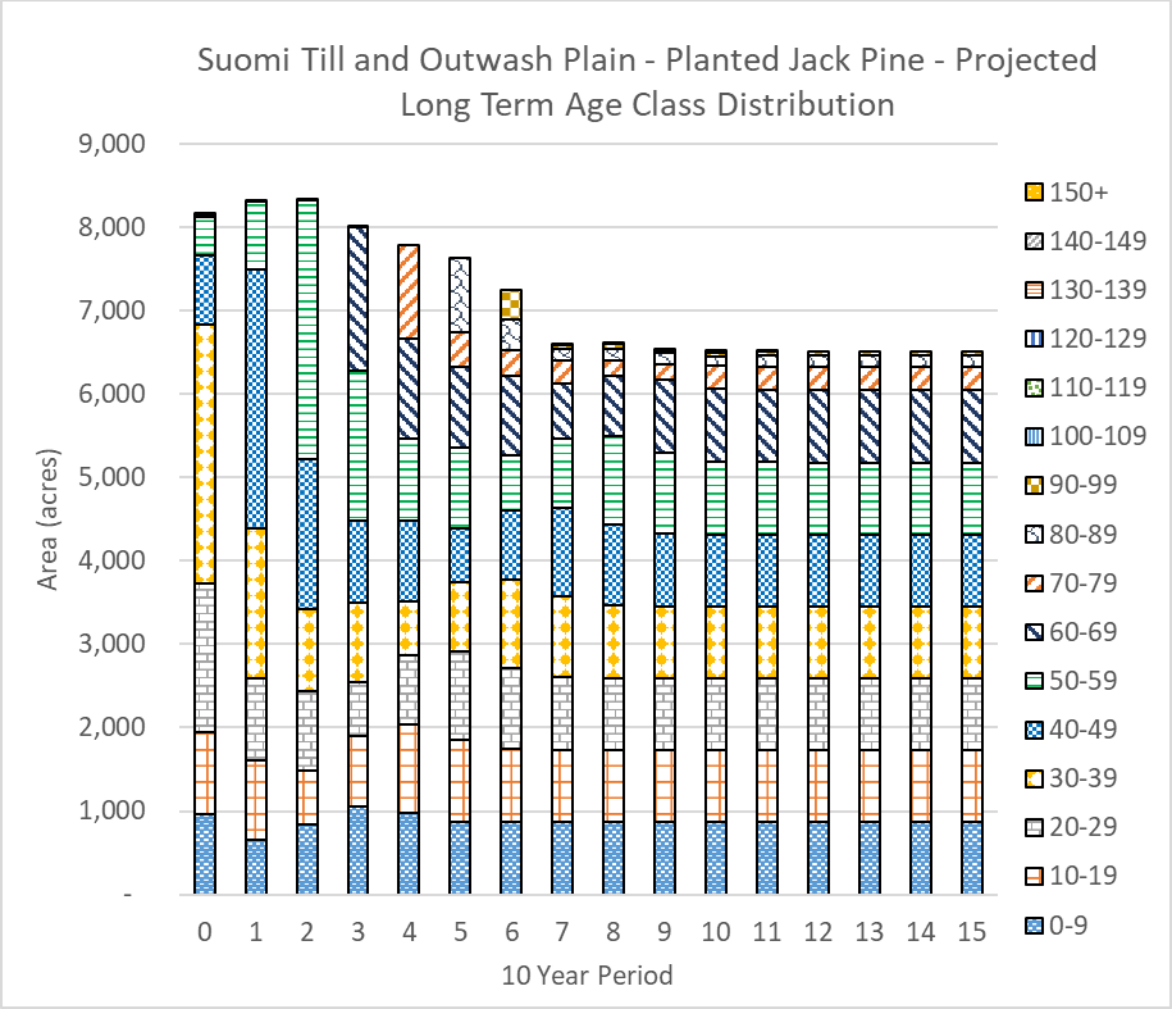


Figure 12. Projected age class distribution over 15. 10-year planning periods.

Northern hardwoods

Current condition

Most of the northern hardwood cover type is currently between a stand age of 90 and 99 years old in the Suomi Till and Outwash Plain management area (Figure 13). The past management regime has been primarily single-tree selection, which allows for stand age to continue to increase overtime. Some stands are beginning to achieve an uneven-aged condition where a featured stand age becomes less evident, but the dominant age of these stands will likely increase past 150 years old prior to a younger age cohort becoming the prominent component of these stands (Figure 15).

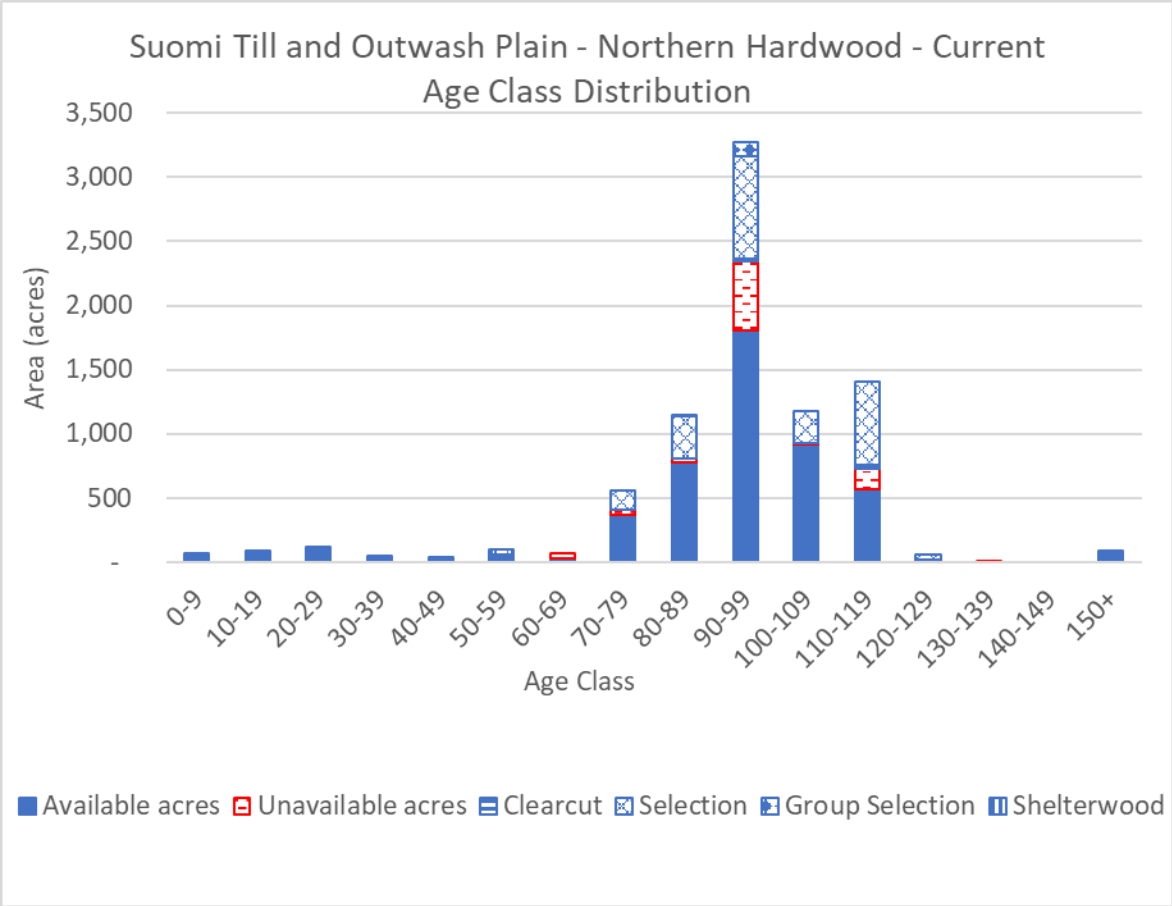


Figure 13. Current age class distribution and projected harvests in the northern hardwood cover type in the Suomi Till and Outwash Plain management area.

The area of northern hardwood is fairly well distributed in the ideal basal area classes for optimal growing conditions in the Suomi Till and Outwash Plain management area (Figure 14). A portion of this cover type meets the habitat requirements for marten, blackburnian warbler and white-tailed deer (Table 8).

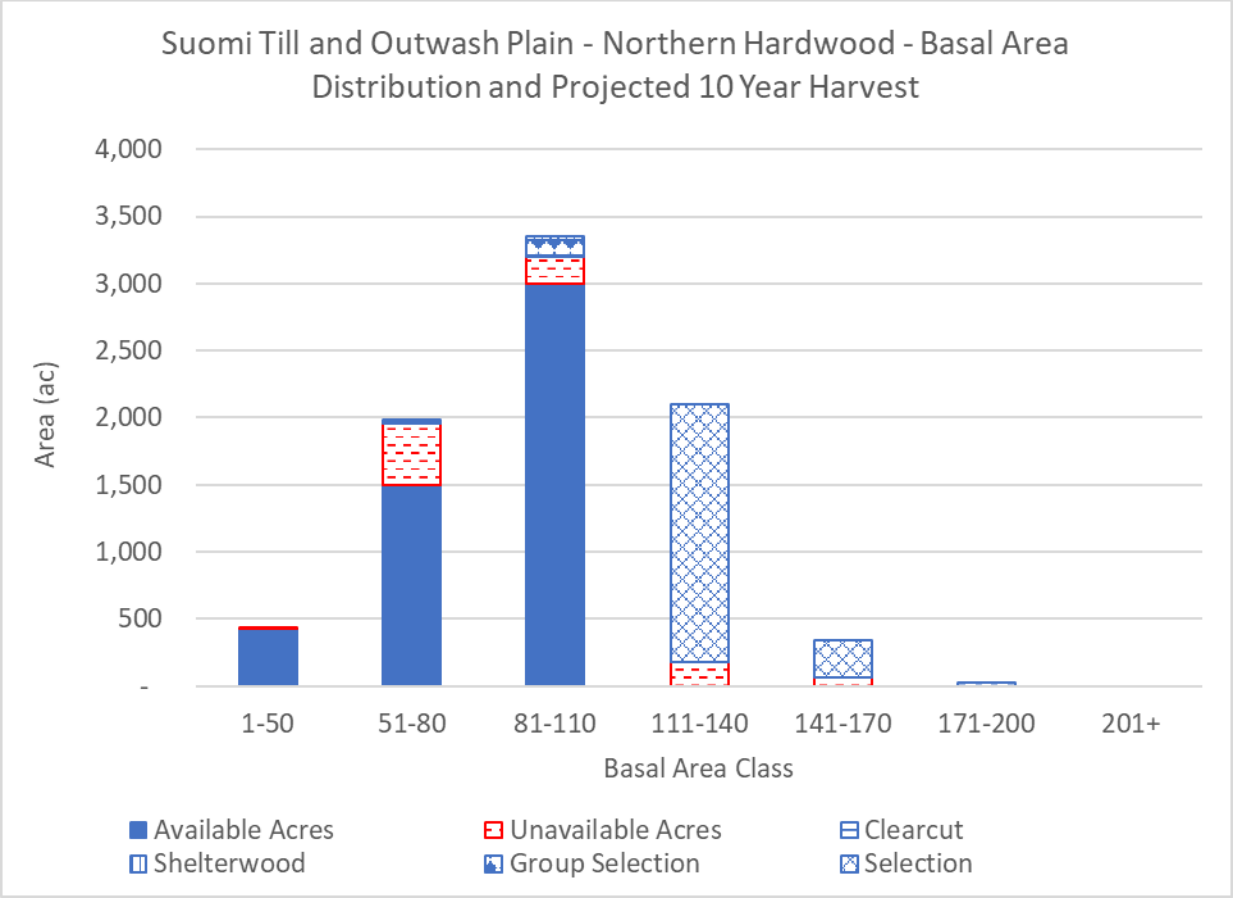


Figure 14. Current basal area distribution of the northern hardwood cover type as well as the projected harvests from each basal area class.

Table 8. Featured species with northern hardwoods as a priority habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Northern Hardwood	Northern Hardwood Habitat Acres- Available	Northern Hardwood Habitat Acres- Unavailable
Blackburnian warbler	Age category: 80+ Size category: sawlog Basal area: 81+	4,918	354
Marten	Age category: 40+ Size category: pole, sawlog Basal area: 81+	4,918	354
White-tailed deer	All sizes and age classes	8,222	--

Desired future condition

The projected long-term cover type trend for northern hardwood is somewhat stable in the Suomi Till and Outwash Plain management area. There are 8 acres transitioning to this cover type in the next ten years.

The desired basal area distribution is a bell-shaped curve where a significant majority of the area is kept in the 81-110 basal area class with recently harvested stands occupying the 51-80 class and stands that are ready for harvest occupy the 111-140 basal area class. Diameter distributions of the northern hardwood stands should follow the appropriate Q-curve relative to stand age and condition.

An uneven-aged condition is the long-term goal for all northern hardwood stands in this management area. An uneven-aged condition is achieved when there is no single discernable age cohort that is more prevalent than others across the stand area as canopy gaps fill in with regenerating seedlings, saplings, poles, and eventually remaining stems become sawlog sized over time.

Regeneration and recruitment continue to be a focus in the northern hardwood cover type across this management area. The long-term sustainability of this cover type in an uneven-aged silvicultural regime depends on the successful establishment of northern hardwood as well as the recruitment of those seedlings and saplings into the pole and sawlog classes. Northern hardwood in the Suomi Till and Outwash Plain management area have challenges in regeneration and recruitment due to cervid herbivory and poor site conditions in some stands.

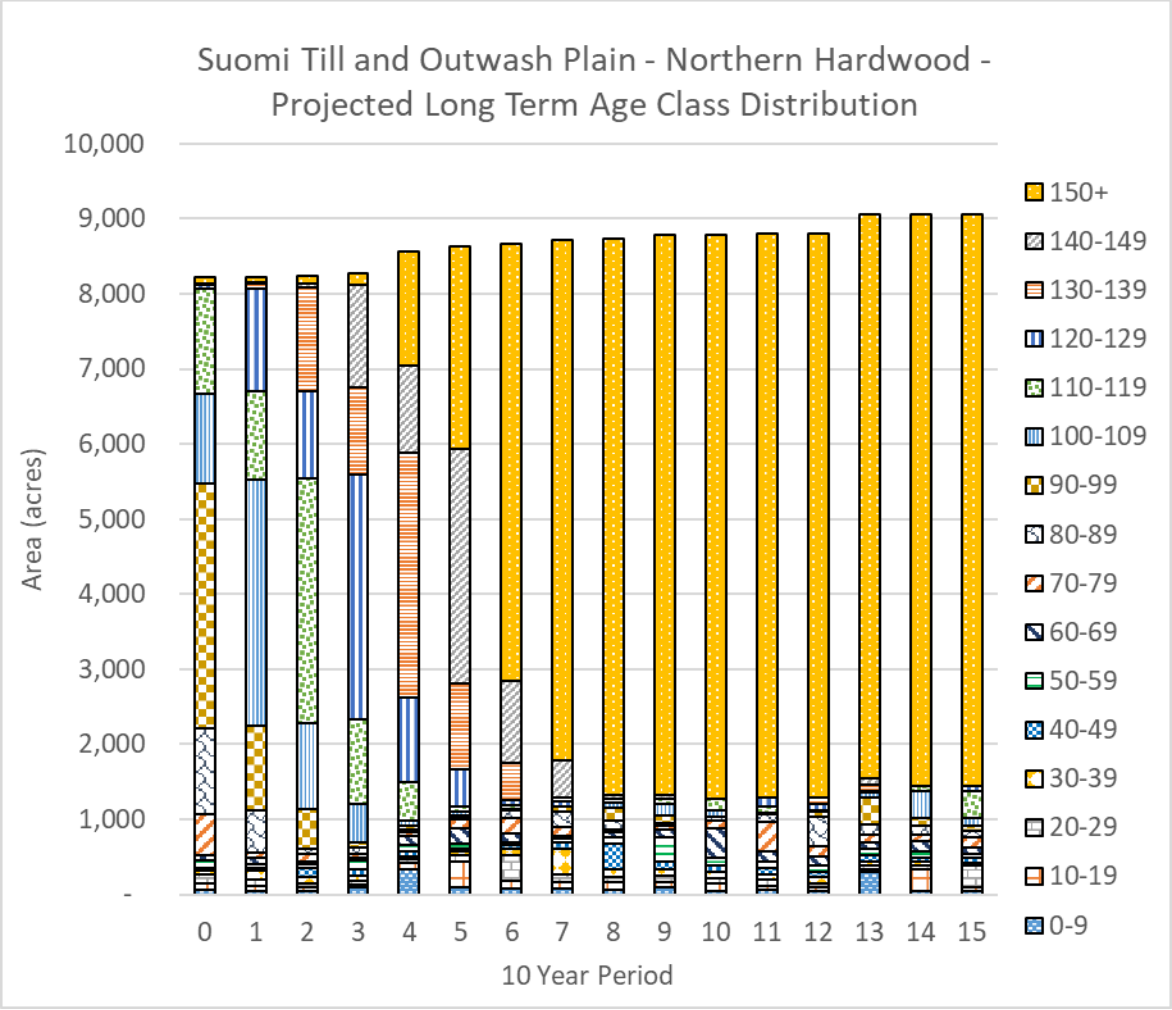


Figure 15. Projected age class distribution over 15, 10-year planning periods.

Management actions

The desired future conditions and associated featured species habitat will be maintained and achieved through continued application of the projected selection harvest regime on 2,353 acres. About 48 acres will be managed under an even-aged system with some of those acres harvested through a clearcut or shelterwood method to improve stand quality (Table 5). Larger canopy gaps should be used to encourage diverse regeneration of northern hardwood species while maintaining an overall long-term mature forest closed-canopy landscape condition.

Planted red pine

Current condition

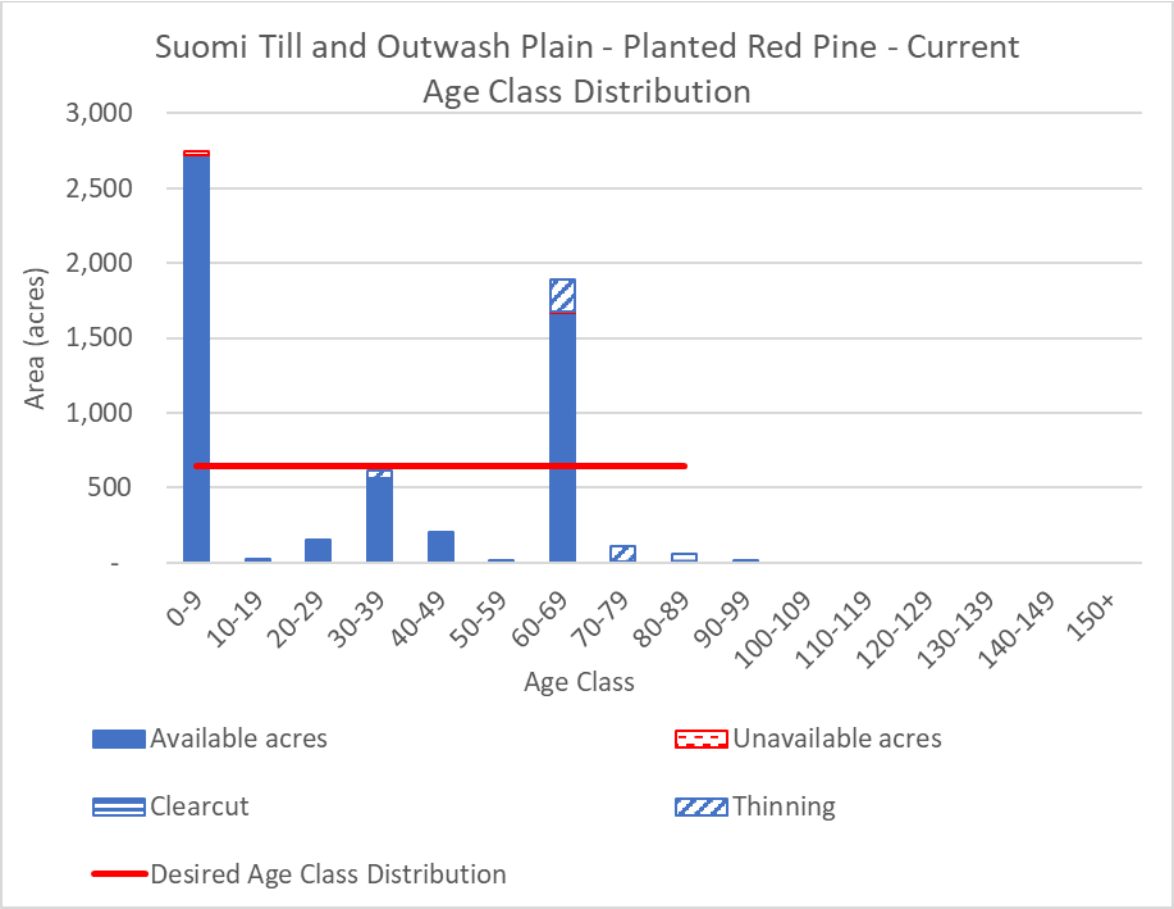


Figure 16. Current age class distribution, the desired age class distribution, and the projected harvests in the planted red pine cover type over the 10-year planning period.

The current age class distribution is unbalanced with a deficit of acres in the 10-59- and 70-89-year-old age classes and a surplus of acres in the 0-9- and 60-69-year-old age classes.

Desired future condition

The desired age class distribution is to have a rotation age of 80 years.



Figure 17. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The end of the planning period will result in the establishment of 969 acres in the upcoming 0-9 age class. Progress toward the long-term desired age class distribution of planted red pine will take many decades.

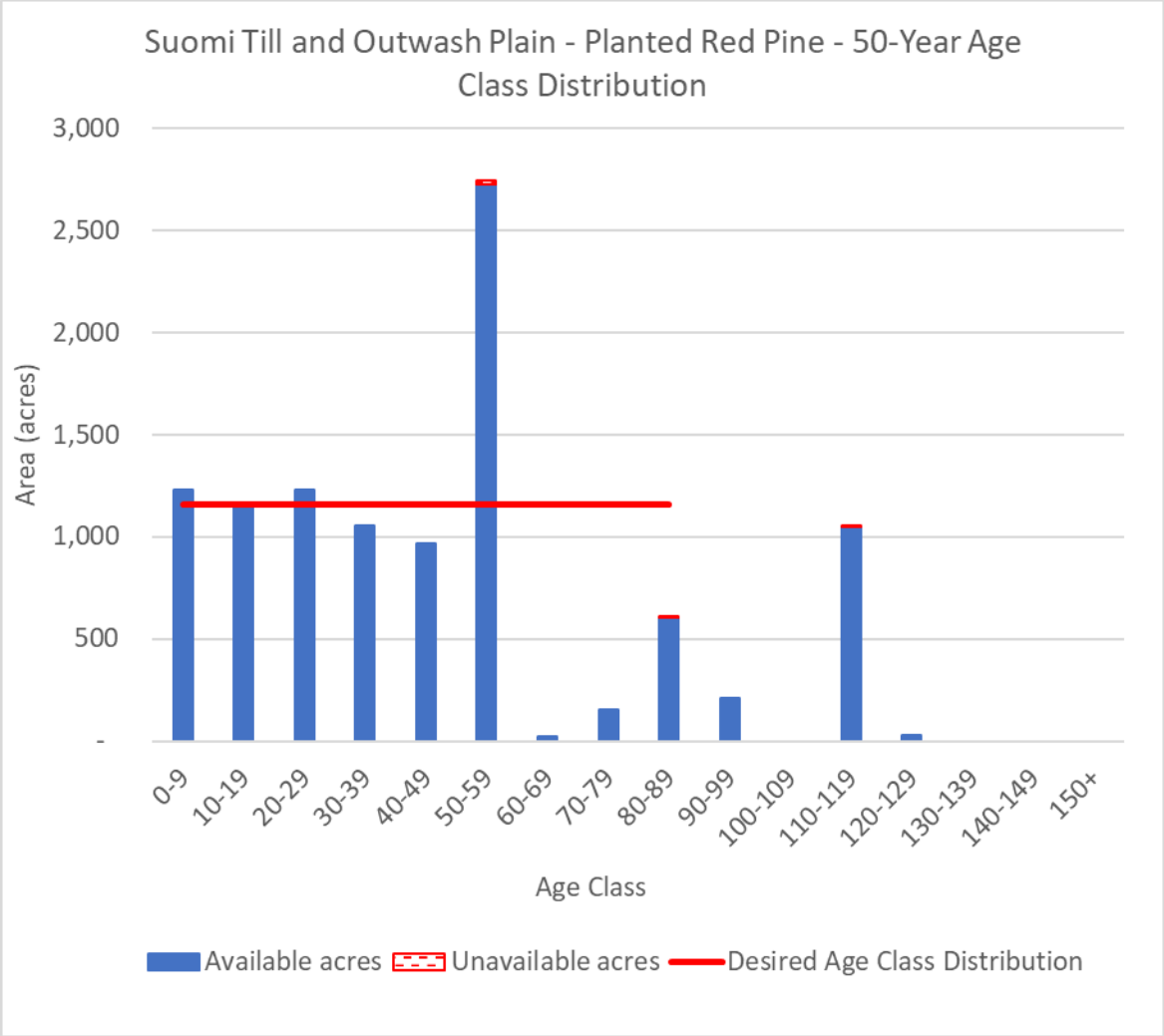


Figure 18. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of planted red pine acres working toward the desired future condition as older age classes are treated (Figure 18).

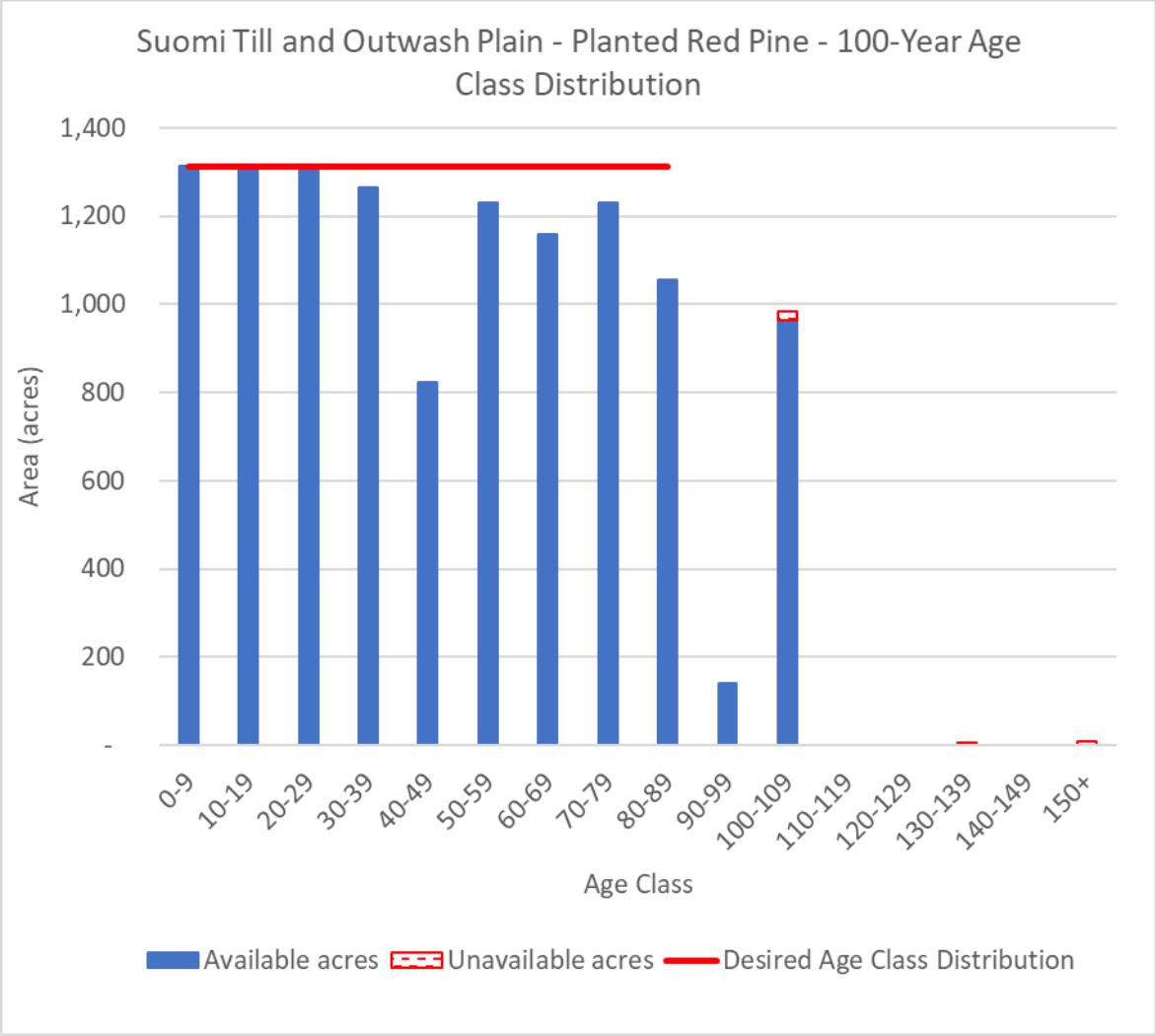


Figure 19. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 19) will concentrate the manageable acres of planted red pine in productive growing conditions while providing an even flow of forest products and a wide variety of wildlife habitat conditions across the landscape in young, mid-aged, and mature forest.

Management actions

There are 51 acres of projected harvest in the planted red pine cover type. It is expected that about 918 acres of planted red pine will be converted from other cover types. These add up to an expected 969 acres of regeneration in the planted red pine cover type over the next 10 years. An additional 370 acres of planted red pine are projected to be thinned to improve stand health and productivity.

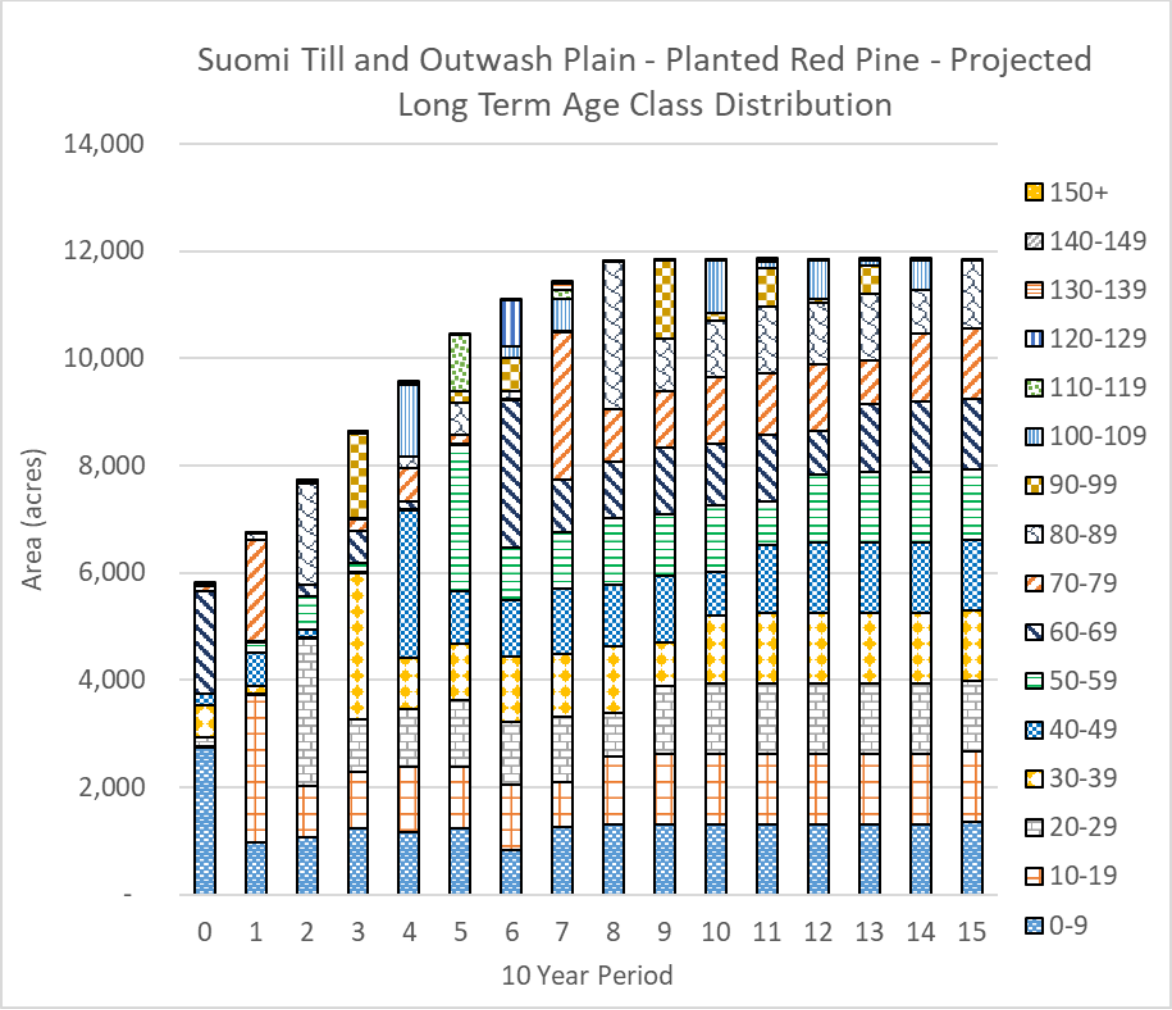


Figure 20. Projected age class distribution over 15, 10-year planning periods.

Conservation area network

High conservation value areas

There are up to nine different HCVA types that can be found in each management area (Table 13; see Biodiversity in Section 3 for more information). There are currently no HCVAs in this management area.

Ecological reference areas

Ecological reference areas (ERAs) are higher quality examples of functioning ecosystems that are primarily influenced by natural ecological processes.

Table 38. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 39. Ecological reference areas within the management area

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	Number of Occurrences
Existing ERA	Dry-mesic northern forest	BC			1
Existing ERA	Mesic northern forest	C			1
Existing ERA	Patterned fen	B			1
Existing ERA	Poor conifer swamp	AB	G4	S4	1
Existing ERA	Poor conifer swamp	BC	G4	S4	1
Existing ERA	Rich conifer swamp	BC			1
Existing ERA	Rich conifer swamp	C		S3	1
Proposed ERA	Poor fen	AB	G3	S3	1
Grand Total					**8**

Special conservation areas

Reviewable special conservation areas (SCAs; Table 11) refers to those SCA types that may be reviewed or updated through the compartment review process as needed. Static SCAs (Table 12) refers to those

SCA types that generally do not change or require updating (see Biodiversity in Section 3 for more information).

Table 11. Reviewable special conservation areas within the Suomi Till and Outwash Plain management area.

Reviewable Special Conservation Area Type and Name	Acres
Concentrated Recreational Area	**504**
32262	140
Anderson Lake	16
Bass Lake (Marquette) Campground	6
Little Lake Campground	16
Little Lake	16
Pike Lake (Marquette) Campground	7
Squaw Lake Campground	15
Unspecified	288
Habitat Area or Habitat Corridor	**274**
Bear Creek island	6
Bear Creek tributary buffer	3
Bob's Creek hardwood island	9
Bob's Lake pine	3
cedar	8
--	17
--	20
--	11
--	199
Possible Type 1 or Type 2 Old Growth	**45**
--	45
Spring, Wetlands, or Riparian Areas	**2,375**
1	3
2	96
3	9
4	15
5	12
6	21
7	19
8	23
9	25
11	183
12	114
13	41
14	49
15	45
16	35

Reviewable Special Conservation Area Type and Name	Acres
32001	465
32043	20
32063	51
32242	237
330222	82
32032102	60
32242047	50
32252015	56
32252036	15
Bryan Creek SCA North	131
Bryan Creek SCA South	124
Escanaba 1	25
Escanaba 2	23
Escanaba 3	55
Escanaba 4	51
Escanaba 5	35
Escanaba 6	68
Escanaba 7	21
Michigamme 1	1
Miller Creek and Chandler Brook	37
--	51
Trout 1	22
Trout 2	3
Trout Falls	3
Visual Management Areas	**415**
32039	10
32045	18
Anderson Lake	7
Anderson Lake XC ski, Flacks Lk	330
Escanaba River	50
Grand Total	**3,617**

Table 12. Static special conservation areas within the Suomi Till and Outwash Plain management area.

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Designated Trout and Cold Water Stream Buffer		**3,807**
		1,876
Bass Creek		53
Bear Creek		101

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Big Brook		137
Bobs Creek		12
Bryan Creek		148
Camp Eleven Creek		128
Cedar Creek		13
Cherry Creek		58
Chocolay River		9
East Branch Chocolay River		21
Flat Rock Creek		180
Flopper Creek		109
Halfway Creek		22
Little Brook		50
McGregor Creek		49
Mitchigan River		87
Norby Creek		14
North Branch Ford River		47
Peterson Creek		16
Poplar Creek		134
Rocky Creek		13
Schwartz Creek		73
Sheen Creek		20
Trout Falls Creek		8
Twomile Creek		147
West Branch Chocolay River		8
West Branch Middle Branch Escanaba River		123
Wild West Creek		108
Wilson Creek		43
Designated Trout and Coldwater Streams	**141.1**	
	69.0	
Bass Creek	2.0	
Bear Creek	3.9	
Big Brook	6.2	
Bobs Creek	0.4	
Bryan Creek	5.6	
Camp Eleven Creek	4.8	
Cedar Creek	0.3	
Cherry Creek	2.1	
Chocolay River	0.3	
East Branch Chocolay River	0.8	
Flat Rock Creek	6.7	

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Flopper Creek	4.0	
Halfway Creek	0.8	
Little Brook	1.0	
McGregor Creek	1.8	
Mitchigan River	3.4	
Norby Creek	0.5	
North Branch Ford River	1.9	
Peterson Creek	0.6	
Poplar Creek	4.9	
Rocky Creek	0.5	
Schwartz Creek	2.7	
Sheen Creek	0.9	
Trout Falls Creek	0.3	
Twomile Creek	5.0	
West Branch Chocolay River	0.3	
West Branch Middle Branch Escanaba River	4.7	
Wild West Creek	3.9	
Wilson Creek	1.7	
Wood Turtle Stream 100-foot buffer		**158**
Escanaba River		36
Michigamme River		70
Middle Branch Escanaba River		51
Wood Turtle Stream 660-footbBuffer		**1,109**
Escanaba River		273
Michigamme River		487
Middle Branch Escanaba River		350
Grand Total	**141.1**	**5,074**

Rare species

Rare species occurrences are compiled from the Michigan Natural Features Inventory Biotics database (Tables 14, 15 and 16) and do not necessarily include all rare species found in this management area due to biases in survey effort and verifiable observation reporting over time.

Table 40. Rare animal and plant species conservation status key.

Status	Status
E = endangered	LE = listed endangered
T = threatened	LT = listed threatened
SC = special concern	PDL = proposed for delisting

Table 14. Rare animal species occurrence within the Suomi Till and Outwash Plain management area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Accipiter gentilis	Northern goshawk	T	--	1
Animal	Alces alces*	Moose	SC	--	--
Animal	Boloria freija	Freija fritillary	SC	--	1
Animal	Boloria frigga	Frigga fritillary	SC	--	3
Animal	Bombus terricola	Yellow banded bumble bee	SC	--	1
Animal	Canis lupus*	Gray wolf	SC	LE	--
Animal	Erebia discoidalis	Red-disked alpine	SC	--	1
Animal	Gavia immer	Common loon	T	--	6
Animal	Haliaeetus leucocephalus	Bald eagle	SC	--	1
Animal	Lithobates palustris	Pickerel frog	SC	--	2
Animal	Lynx canadensis	Lynx	E	LT	1
Animal	Myotis septentrionalis	Northern long-eared bat	T	LE	1
Animal	Necturus maculosus	Mudpuppy	SC	--	2
Animal	Opheodrys vernalis	Smooth green snake	SC	--	2
Animal	Pandion haliaetus	Osprey	SC	--	3
Animal	Picoides arcticus	Black-backed woodpecker	SC	--	1
Animal	Setophaga kirtlandii	Kirtland's warbler	E	--	2
Total	--	--	--	--	**28**

**Occurrence information provided by field staff.*

Table 15. Rare plant species occurrence within the Suomi Till and Outwash Plain management area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Plant	Gentiana linearis	Narrow-leaved gentian	T	--	1
Plant	Piptatherum canadense	Canada rice grass	T	--	1

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Plant	Rubus acaulis	Dwarf raspberry	T	--	1
Total	--	--	--	--	**3**

Table 16. Other rare occurrences within the Suomi Till and Outwash Plain management area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Other	Great Blue Heron Rookery	Great Blue Heron Rookery	--	--	2
Total	--	--	--	--	**2**

Non-ERA natural communities

Natural communities that are identified with an element occurrence in the MNFI Biotics database, but that have not been given an additional ecological reference area designation are recognized and managed accordingly. There are currently no non-ERA natural communities in the management area.

Forest health

Forest health concerns, both native and non-native, can affect stand conditions and management decisions. The following insects (Table 17) and diseases (Table 18) could have an impact on management during the planning period and may need to be monitored and/or addressed.

Table 17. Defoliating insects of concern in the Suomi Till and Outwash Plain management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Spongy moth	Lymantria dispar	Non-native	Yes
Forest tent caterpillar	Malacosoma disstria	Native	Yes
Large aspen tortrix	Choristoneura conflictana	Native	Yes
Spruce budworm	Choristoneura fumiferana	Native	Yes
Jack pine budworm	Choristoneura pinus	Native	Yes

Watch for lingering ash with potential resistance to emerald ash borer.

Table 18. Maladies of concern in the Suomi Till and Outwash Plain management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Canker	Various	Various	Yes
Armillaria root rot	Armillaria spp.	Native	Yes
Oak wilt	Bretziella fagacearum	Non-native	No

Aquatic resources

Riparian habitat

A total of 150 miles of streams and rivers are found in the management area (Table 19). Streams/rivers classified as cold types comprise approximately 66 percent of the riverine mileage.

Table 19. Classification type and length of streams/rivers found within the management area.

Type	Length (miles)
Cold stream	73
Cold small river	0
Cold transitional stream	26
Cold transitional small river	0
Cold transitional large river	0
Warm transitional stream	22
Warm transitional small river	9
Warm transitional large river	7
Warm stream	13
Warm small river	0
Warm large river	0

Lacustrine Habitat

A total of 49 lakes and ponds of at least 1 surface acre are found in the management area (Table 20).

Table 20. Size and number of lakes and ponds located within the management area.

Lake Size Class (acres)	Number
1-99	41
100-499	7
500+	1

Wetlands

A total of 45,359 acres of wetlands can be found in the management area (Table 21). Forested wetlands comprise approximately 96 percent of wetland types found in the management area.

Table 21. Area of emergent, forested, and riverine wetland types found within the management area.

Wetland Type	Acres
Emergent	1,533
Forested	43,689
Riverine	137

Vernal pools and seeps

A total of 1,326 acres of vernal pools and seeps have been inventoried in the management area while no areas of seeps have been identified.

Riparian vegetation cover

Lowland shrub, aspen, and lowland spruce/fir are the predominant cover types present in a 100-meter riparian zone located next to streams/rivers in the management area (Table 22).

Table 22. Largest vegetative cover types (i.e., top 10) and area located in a 100-meter buffer of streams/rivers within the management area.

Cover Type	Acres
Lowland shrub	3,732
Aspen	2,643
Lowland spruce/fir	2,255
Lowland conifers	1,716
Cedar	1,505
Upland mixed forest	716
Northern hardwood	705
Upland conifers	684
Mixed upland deciduous	636
Natural jack pine	462

Watershed vegetation cover

The management area includes portions of important watersheds of the Escanaba River and Michigamme River (Tables 23 and 24). Aspen is a major state forest cover type in each watershed.

Table 23. Top 5 vegetative cover types and area of the Escanaba River watershed located within the management area.

Cover Type	Acres
Aspen	33,785
Lowland spruce/fir	8,416
Planted jack pine	7,721
Cedar	6,935
Lowland conifer	5,980

Table 24. Largest vegetative cover types and area of the Michigamme River watershed located within the management area.

Cover Type	Acres
Aspen	5,095
Northern hardwood	518
Cedar	430

Cover Type	Acres
Herbaceous openland	391
Upland shrub	379

Recreation

The Suomi Till and Outwash Plain management area generally has good public recreation and management access. However, some areas are fragmented and remote with few public access roads. Motorized trails in the management area include snowmobile trails, the Bass Lake Motorcycle Trail (24-mile loop), the Porterfield Lake Motorcycle Trail (30.5 miles) and off-road vehicle G Route. The Little Lake-Chatham Snowmobile Trail (rail-trail) is on the east side of the management area. Non-motorized pathways include the Blueberry Ridge, Anderson Lake and Flacks Lake Pathways (hiking trails) and the Thunder Valley Equestrian Trail.

Four state forest campgrounds (rustic) are located within the area, each providing water access.

Table 25. Designated recreation trails by type.

Recreation Category	Recreation Type	Number of Miles
Motorized recreation trails	ORV (all types)	57.2
Motorized recreation trails	Snowmobile	31.3
Non-motorized recreation trails	Hiking	19.1
Non-motorized recreation trails	Equestrian	11.6
Non-motorized recreation trails	Biking	0
Non-motorized recreation trails	Hunter Walking Trails	0
Total	--	119.2

Note: Trail use types may overlap.

Table 26. State forest campgrounds.

Name	Number of Sites	ORV Access
Bass Lake	22	X
Ski-kwe zaag'igan	15	X
Anderson Lake West	13	
Little Lake	16	

There are no areas managed specifically for hunting in this management area. Boating access sites are numerous, providing access to the Escanaba River and inland lakes.

Table 27. Boating access sites (BAS).

Name	Waterbody

Anderson Lake West campground	Anderson Lake
Big Trout Lake	Big Trout Lake
East Branch Escanaba River	East Branch Escanaba River
East Branch Escanaba River	East Branch Escanaba River
Horseshoe Lake campground	Horseshoe Lake
Lake Michigamme	Lake Michigamme
Little Lake campground	Little Lake
Main Branch Escanaba River	Main Branch Escanaba River
Pike Lake campground	Pike Lake
Sporley Lake	Sporley Lake
Ski-kwe zaag'igan campground (new name 2023)	Ski-kwe zaag'igan Lake
Twin Lake	Twin Lake
West Bass Lake campground	West Bass Lake

Way Dam Complex

State Forest Area: 59,070 acres	Location: North Eastern Iron County	Population Centers: Crystal Falls, Amasa
Sub-Section: Suomi Till and Outwash Plain	Landforms: Ice-stagnation features, end moraines, ground moraine, and outwash	Landcover: Forested: 50,353 acres Non-forested: 8,717 acres

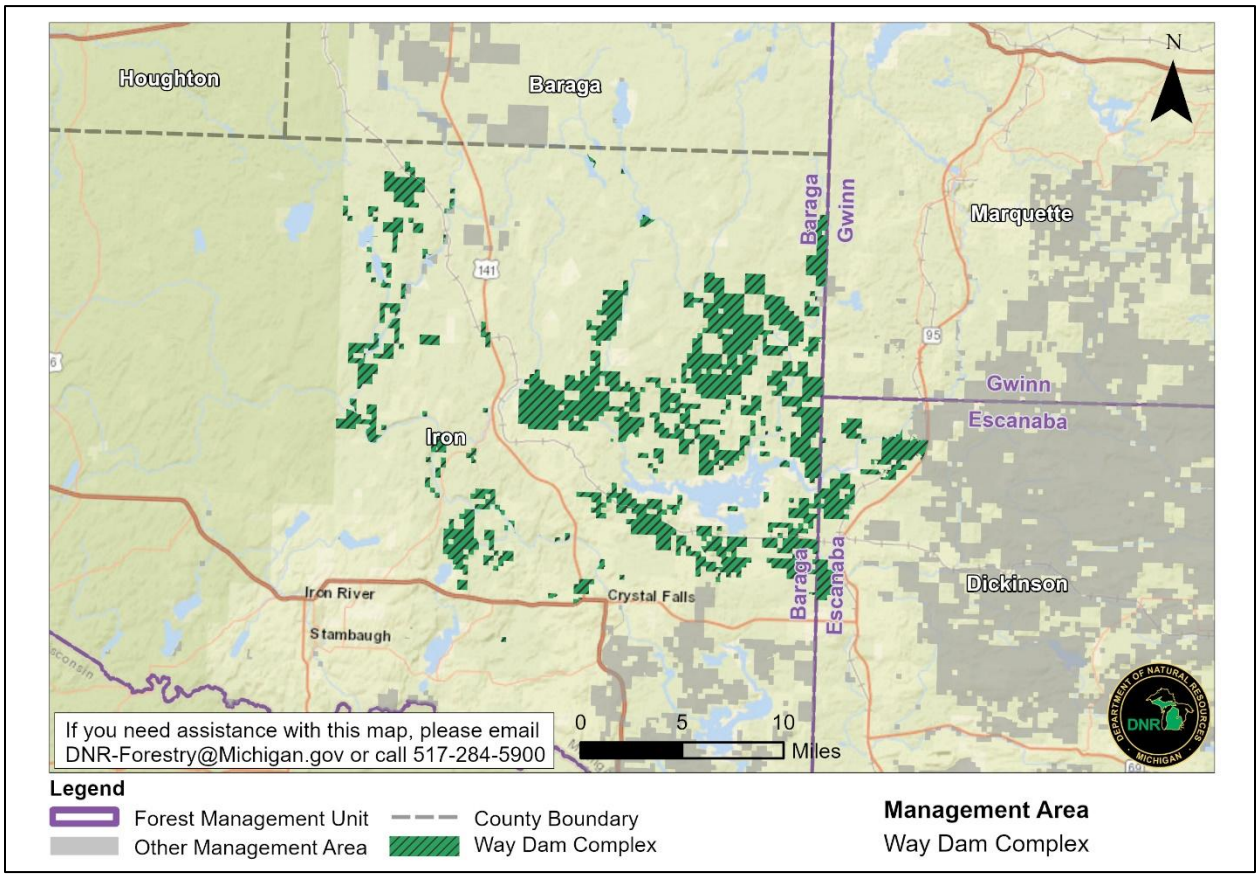


Figure 1. Map of the Way Dam Complex management area.

Forested landscape

Current and projected future condition

The Way Dam Complex management area is dominated by shade intolerant cover types in the young and mid-aged categories. Tolerant cover types dominateolder age categories, while unavailable lowland acres are more prevalent in the older age category.

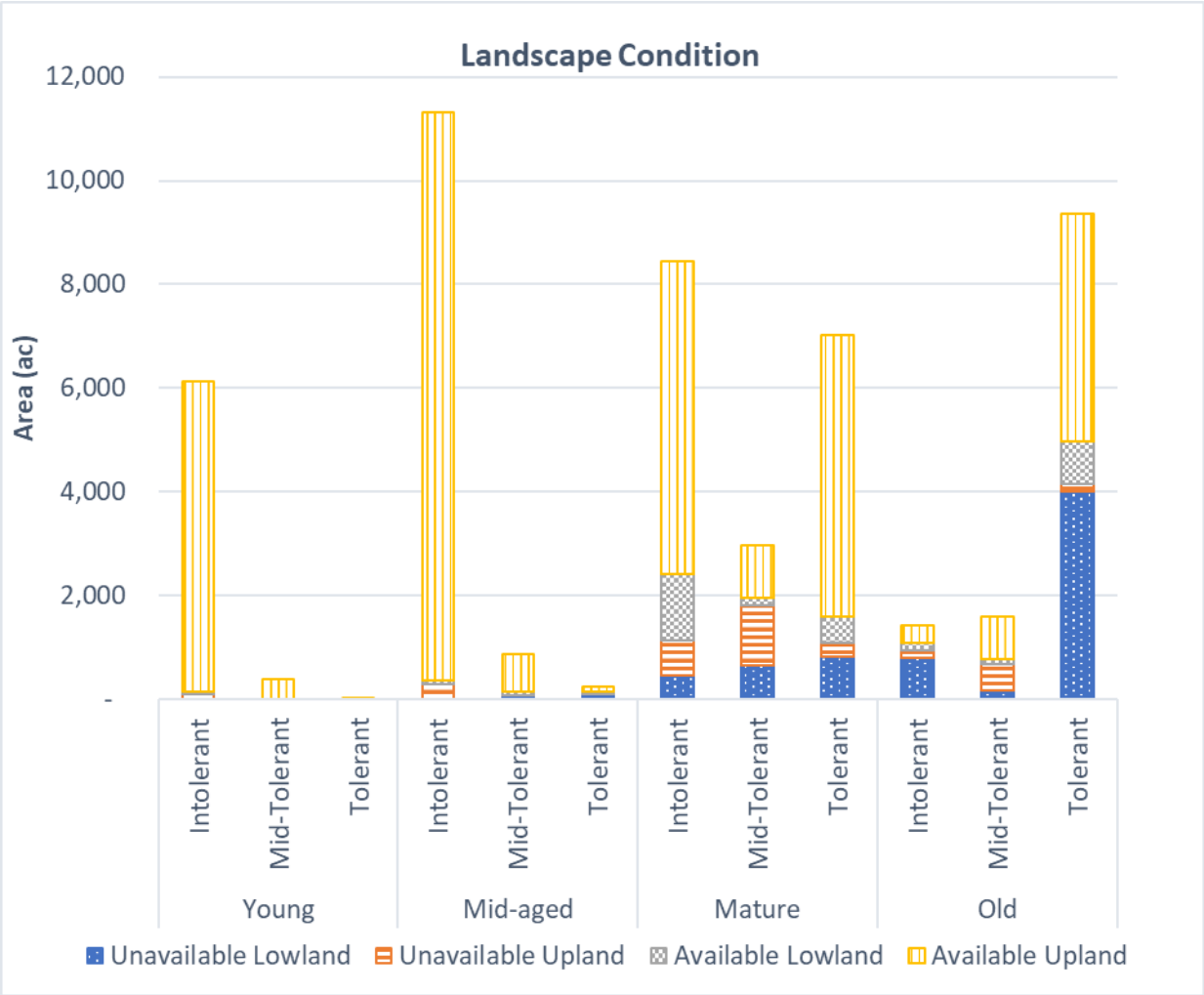


Figure 2. Forest diversity matrix showing the current distribution of forested acres across management availability, age category, landscape position and shade tolerance.

Landscape habitat conditions refine the landscape into featured species habitat context. Current and projected acres for the metrics identified in the Management Priorities (Section 3 Statewide/Regional) establish a baseline and future condition based on management over the planning period (Table 1).

Table 1. Current and projected acres for landscape habitat conditions.

Landscape Habitat Condition	Monitoring Metric	Current Acres
Young forest	Acres of 0-19 stands in Aspen and Jack Pine	6,531
Mature forest	Acres of 80+ year stands across cover types	12,384
Mature forest	Acres of 120+ year stands across cover types	2,900
Mesic conifer cover types	Acres of mesic conifer cover types	2,421
Mesic conifers in other cover types	Average canopy occupancy	27%
Mast – oak cover types	Acres of Oak cover types	18
Mast tree species in other cover types	Acres of Total Canopy Occupancy of Mast Tree Acres (Trace-100%)	12,842
Big trees	Acres of Total Canopy Stand Occupancy of Species in Sawlog or Greater Size Class	26,811
Non-forested openings	Acres of Total herbaceous open land, upland shrub and cropland	627
Landscape forest matrix	Percent Deciduous Forest	70%
Landscape forest matrix	Percent Coniferous Forest	24%

The Way Dam Complex management area has the following Special Analysis Units (SAUs). These SAUs have specific cover type goals, typically associated with wildlife habitat management. For any SAUs that overlap with this MA, SAU cover type goals take priority as the SFMP model strives to meet the cover type goals across the management area. Please see Section 5 for a detailed description of management direction and harvest goals for each of these SAUs.

- Deer Wintering Complex: Deerfoot Lodge
- Deer Wintering Complex: Iron-Floodwood

The Way Dam Complex management area is dominated by forested cover types with 85 percent of the area covered in forested stands (Table 2). The upland deciduous portion of that is 68 percent of the management area and comprised mostly of aspen. The upland coniferous portion is 5 percent of the management area and is comprised mostly of upland conifer cover type. Cedar is the most common lowland conifer in this management area, representing 6 percent of the landscape. Lowland shrub is the most common non-forested cover type in this management area, representing 6% of the landscape.

Table 2. Landscape conditions and distribution of cover types in the Way Dam Complex management area.

Land Type	Landscape Position	Forest Type	Cover Type	Area (ac)	Land Type	Landscape Position	Forest Type
Forested	Upland	Deciduous	Aspen	22,897	34,259	40,007	50,353
			Northern hardwood	9,899			
			Black-red hybrid oak	0			
			Northern red oak	18			
			Oak mix	0			
			Mixed upland deciduous	1,446			
		Mixed	Upland mixed forest	2,579	2,579		
		Coniferous	Planted red pine	316	3,169		
			Planted jack pine	37			
			Planted white pine	0			
			Planted mixed pine	98			
			Natural red pine	218			
			Natural jack pine	79			
			Natural white pine	233			
			Natural mixed pines	131			
			Upland spruce/fir	733			
			Upland conifers	1,217			
			Hemlock	106			
	Lowland	Deciduous	Lowland aspen/balsam Poplar	72	744	10,346	
			Lowland deciduous	672			
		Mixed	Lowland mixed forest	619	619		
		Coniferous	Cedar	3,483	8,983		
			Lowland conifers	2,804			
			Lowland spruce/fir	1,981			
			Tamarack	714			
Nonforested	Upland	N/A	Herbaceous openland	129	N/A	990	8,717
			Upland shrub	498			
			Low density trees	87			
			Bare/sparsely vegetated	82			
			Cropland	0			
			Urban	195			
			Lowland shrub	3,570			
			Marsh	422			

	Lowland	N/A	Bog	960	N/A	7,727	
			Treed bog	1,793			
			Water	984			
						Grand Total:	**59,070**

There are 39,952 acres (70.5 percent of the total management area and 79.3 percent of the forested area) that can be managed toward desired future conditions via commercial timber harvest in the Way Dam Complex management area (Table 3). Of that, more than 44 percent is in the aspen cover type and 19.2% in northern hardwood. The remaining cover types represent about 19 percent of the forested and available land in the management area.

Table 3. Summary table describing the landscape conditions and cover type composition of the Way Dam Complex management area.

Waydam Complex						
Forested Cover Type	**Available Acres**	**Available %**	**Unavailable Acres**	**Unavailable %**	**Total Acres**	**Total %**
Aspen	22,257	44.2%	643	1.3%	22,900	45.5%
Cedar	722	1.4%	2,762	5.5%	3,484	6.9%
Hemlock	12	0.0%	93	0.2%	106	0.2%
Lowland aspen/balsam poplar	31	0.1%	42	0.1%	72	0.1%
Lowland conifers	652	1.3%	2,152	4.3%	2,804	5.6%
Lowland deciduous	116	0.2%	557	1.1%	673	1.3%
Lowland mixed Forest	250	0.5%	369	0.7%	619	1.2%
Lowland spruce/fir	1,238	2.5%	744	1.5%	1,982	3.9%
Mixed upland deciduous	658	1.3%	789	1.6%	1,447	2.9%
Natural jack pine	8	0.0%	71	0.1%	79	0.2%
Natural mixed pines	66	0.1%	65	0.1%	131	0.3%
Natural red pine	147	0.3%	73	0.1%	219	0.4%
Natural white pine	199	0.4%	35	0.1%	233	0.5%
Northern hardwood	9,648	19.2%	251	0.5%	9,899	19.7%
Northern red oak	9	0.0%	9	0.0%	18	0.0%
Planted jack pine	37	0.1%	0	0.0%	37	0.1%
Planted mixed pine	98	0.2%	0	0.0%	98	0.2%
Planted red pine	229	0.5%	88	0.2%	316	0.6%
Tamarack	278	0.6%	437	0.9%	714	1.4%
Upland conifers	976	1.9%	242	0.5%	1,217	2.4%

Upland mixed forest	2,064	4.1%	515	1.0%	2,579	5.1%
Upland spruce/fir	259	0.5%	475	0.9%	734	1.5%
Grand Total	**39,952**	**79.3%**	**10,409**	**20.7%**	**50,361**	**100.0%**

Table 4. Site condition (reason area is unavailable for commercial harvest) acres for the Way Dam Complex management area.

Site Condition (Reason area is unavailable for commercial harvest)	Area (ac)	% of Unavailable Area
Deer wintering area	4,970	47.7%
BMPs	1,615	15.5%
Too wet	1,249	12.0%
Blocked by obstacle	693	6.7%
Unproductive	603	5.8%
Wildlife concerns	564	5.4%
Non-military lease/easement	381	3.7%
Long-term retention	81	0.8%
Denied access	58	0.6%
Conservation values	48	0.5%
Species of special concern or T&E	42	0.4%
Neighbor / interest group	41	0.4%
Too steep	26	0.3%
Other dept./div. processes	17	0.2%
Other influence zones	10	0.1%
Recreational/scenic	6	0.1%
Blocked by railroad	4	0.0%
Total unavailable	**10,409**	**100.0%**

Management actions

Each cover type in the Way Dam Complex management area has a unique age class and basal area class goals that describe the long-term desired future conditions. The harvest levels that are needed in the first planning period to begin achieving those long-term goals are summarized below (Table 5).

Table 5. Ten-year planning period harvest goals (acres) by cover type and silvicultural regime.

Silvicultural Regimes								
Cover Type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Salvage Clearcut	Salvage Thinning	Grand Total
Northern hardwood	13	3,772	-	-	6	-	-	3,790
Aspen	3,304	-	-	-	-	-	-	3,304
Lowland Shspruce/fir	181	-	-	-	-	-	-	181
Mixed upland deciduous	96	-	-	-	27	-	-	123
Upland spruce/fir	118	-	-	-	-	-	-	118
Upland conifers	113	-	-	-	-	-	-	113
Lowland conifers	113	-	-	-	-	-	-	113
Tamarack	85	-	-	-	-	-	-	85
Lowland mixed forest	76	-	-	-	-	-	-	76
Upland mixed forest	22	-	-	-	-	-	-	22
Natural white pine	-	-	12	-	5	-	-	17
Lowland deciduous	15	2	-	-	-	-	-	17
Natural red pine	-	-	-	-	8	-	-	8
Lowland aspen/balsam poplar	7	-	-	-	-	-	-	7
Totals	**4,143**	**3,774**	**12**	**-**	**46**	**-**	**-**	**7,975**

Table 6. Ten-year estimated Harvest Volume for the Way Dam Complex management area.

There are few cover type transitions projected in the Way Dam Complex management area. The managed area of each cover type is projected to remain relatively stable. The largest decrease forecasted is in the aspen cover type, where 655 acres are forecasted to convert to other cover types through forest management activities. The largest increase is in upland mixed forests, where 668 acres are expected to convert into that cover type.

Table 7. Projected 10-year cover type acres resulting from cover type transitions.

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Aspen	22,897	22,242	-655
Northern hardwood	9,899	9,906	7
Cedar	3,483	3,483	0
Lowland conifers	2,804	2,820	16
Upland mixed forest	2,579	3,248	668
Lowland spruce/fir	1,981	1,944	-37
Mixed upland deciduous	1,446	1,372	-74

Cover Type	Current acreage	Projected acreage at end of 10-year planning period	Projected 10-year change in acreage
Upland conifers	1,217	1,153	-64
Upland spruce/fir	733	657	-76
Tamarack	714	693	-21
Lowland deciduous	672	665	-7
Lowland mixed forest	619	668	49
Planted red pine	316	407	91
Natural white pine	233	244	11
Natural red pine	218	218	0
Natural mixed pines	131	131	0
Hemlock	106	106	0
Planted mixed pine	98	179	81
Natural jack pine	79	79	0
Lowland aspen/balsam poplar	72	72	0
Planted jack pine	37	37	0
Northern red oak	18	18	0
Planted white pine	0	11	11
Lowland shrub	3,570	3,570	0
Treed bog	1,793	1,793	0
Water	984	984	0
Bog	960	960	0
Upland shrub	498	498	0
Marsh	422	422	0
Urban	195	195	0
Herbaceous openland	129	129	0
Low density trees	87	87	0
Bare/sparsely vegetated	82	82	0
Total:	**59,070**	**59,070**	**0**

Featured species current and projected habitat acres

There are 11 featured species in this management area that span various cover types, age classes, and stand level conditions.

As noted in the Featured Species Management Priority (Section 3), it is recommended that these featured species habitat acres be viewed as acres of potential habitat, representing a condition on the landscape where the more nuanced aspects of each species' habitat requirements are likely to be found or managed for. As described in the introduction, the modeling effort was limited by several factors including the simplification of habitat attributes into MiFI variables. Therefore, when referring to habitat acres what is being referred to is potential habitat acres.

Current and projected total habitat acres by species across the decade provide a baseline and show the result of long-term management actions (Table 8). Some species show a loss in habitat over the next century. As mentioned in the Featured Species Management Priority (Section 3), the current condition for many cover types is a surplus of acres in the 0-9 age class from the compensatory management approach applied in the previous decade. The model eventually evens out the age classes at a lower, sustainable level over time, usually by 50 years. For any species with northern hardwoods as a priority cover type, there is a perceived drop in acres between 40-60 years; this is due to the basal area dropping below 81. Because it only drops into the upper 70s, it is not expected to translate to any real habitat loss on the ground. Two of these species were not included in the SFMP model but are included here to inform management decisions over the decade. White-tailed deer habitat acres are not limited to deer wintering complexes.

Table 8. Featured species current and projected total habitat acres (i.e., potential habitat).

Featured Species	Priority Cover Types	Total Habitat Acres Current	10-year Projected Habitat Acres	50-year Projected Habitat Acres	100-year Projected Habitat Acres
Black bear	Generalist/mast	12,842	--	--	--
Cerulean warbler	Northern hardwoods, mixed upland deciduous, lowland deciduous	6,239	9,900	10,785	10,824
Golden-winged warbler	Aspen, black-red hybrid oak, northern red oak, oak mix, tamarack	6,166	5,765	4,859	5,428
Marten	Northern hardwoods, mixed upland deciduous, upland mixed forest, natural white pine, natural mixed pines, upland conifers, upland spruce/fir, lowland mixed forest, lowland conifers, hemlock, cedar	10,574	15,137	12,396	17,327
Moose	To be determined	--	--	--	--
Ruffed grouse	Aspen	6,056	5,645	4,856	5,269
Snowshoe hare	Aspen, cedar, hemlock, lowland aspen, lowland conifers, lowland mixed forest, lowland spruce/fir, mixed upland deciduous, natural jack pine, natural mixed pines, planted jack pine, upland spruce/fir	6,638	7,109	5,771	6,237
White-tailed deer (food)	Food: northern hardwood, oak mix, aspen, mixed upland deciduous, lowland deciduous, lowland aspen/balsam poplar, lowland mixed forest	38,202	38,176	37,546	36,985

Featured Species	Priority Cover Types	Total Habitat Acres Current	10-year Projected Habitat Acres	50-year Projected Habitat Acres	100-year Projected Habitat Acres
White-tailed deer (shelter)*	Shelter: hemlock, cedar, planted red pine, planted white pine, planted mixed pine, natural red pine, natural white pine, natural mixed pines, upland conifers, upland spruce fir, lowland conifers	11,321	11,352	11,993	12,635
Wild turkey	Non-forested openings	215	--	--	--
Wood thrush	Northern hardwoods, northern red oak, mixed upland deciduous, lowland deciduous	9,976	11,159	6,833	11,260
Wood turtle	Non-forested openings	--	--	--	--

Deer Wintering Complexes that are greater than 15,000 acres are modeled as a special analysis units and information on them can be found in section 5 of the plan. In complexes less than 15,000 acres, harvest of cedar and hemlock are not allowed within obligate range stands, and secondary shelter is often protected as well. These areas are guided by the DNR Deer Winter Range Guidelines.

Cover type composition and associated wildlife species

Aspen

Current Condition

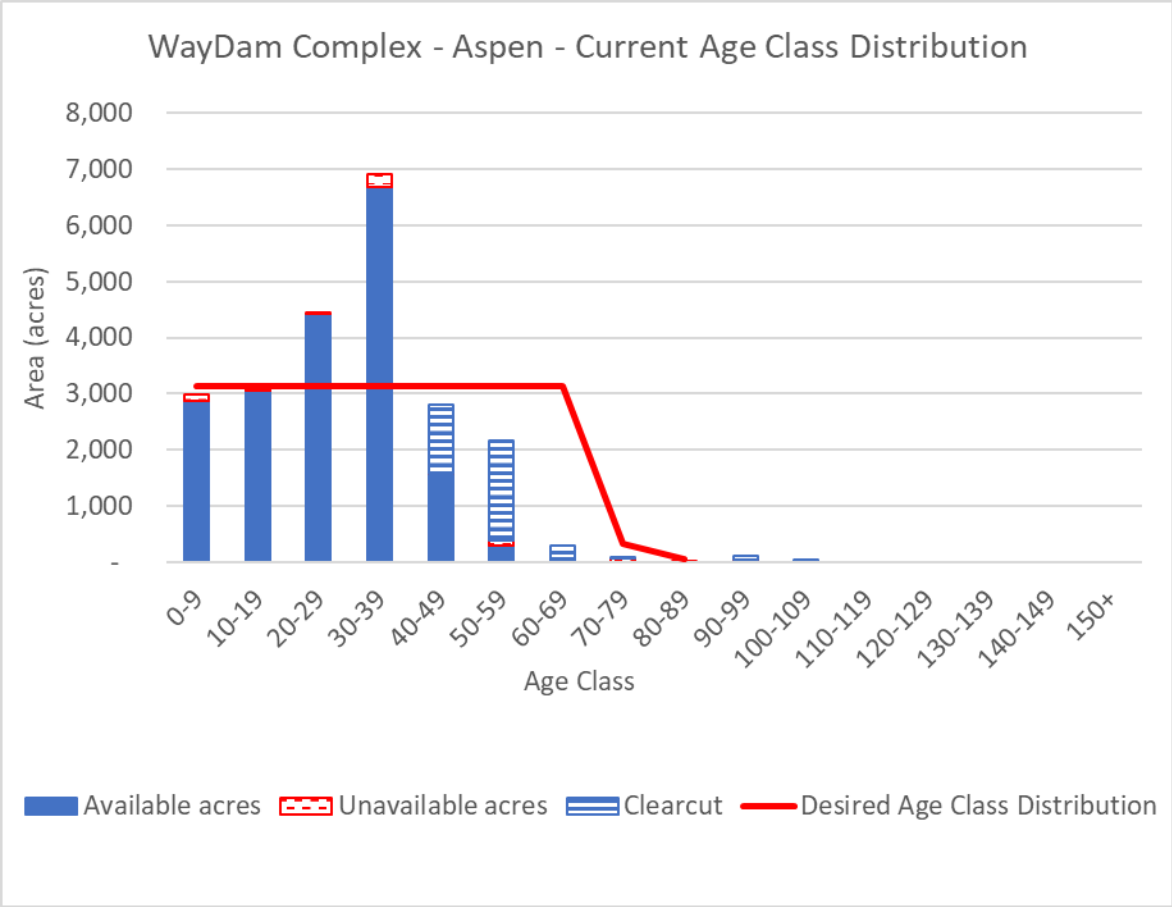


Figure 3. Current age class distribution, the desired age class distribution, and the projected harvests in the aspen cover type over the 10-year planning period.

The current age class distribution is unbalanced, with a deficit of acres in the 40-89-year-old age classes and a surplus of acres in the 20-39-year-old age classes. A portion of this cover type meets the habitat requirements for golden-winged warbler, ruffed grouse, snowshoe hare and white-tailed deer (Table 8).

Table 8. Featured species with aspen as a priority habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Aspen	Aspen Habitat Acres - Available	Aspen Habitat Acres - Unavailable
Golden-winged warbler	Age category: 0-19 Size class: sapling	5,909	147
Ruffed grouse	Age category: 0-19 Size class: sapling	5,909	147
Snowshoe hare	Age category: 0-19 Size class: sapling	5,909	147
White-tailed deer	All ages and size classes	22,897	--

Desired future condition

The desired age class distribution is to have a rotation age of 60 years for approximately 98 percent of the acres, then 1.6% of the acres in an age class tail out to the 70-year age class, and 0.4 percent of the acres in an age class tail out to the 80-year age class.

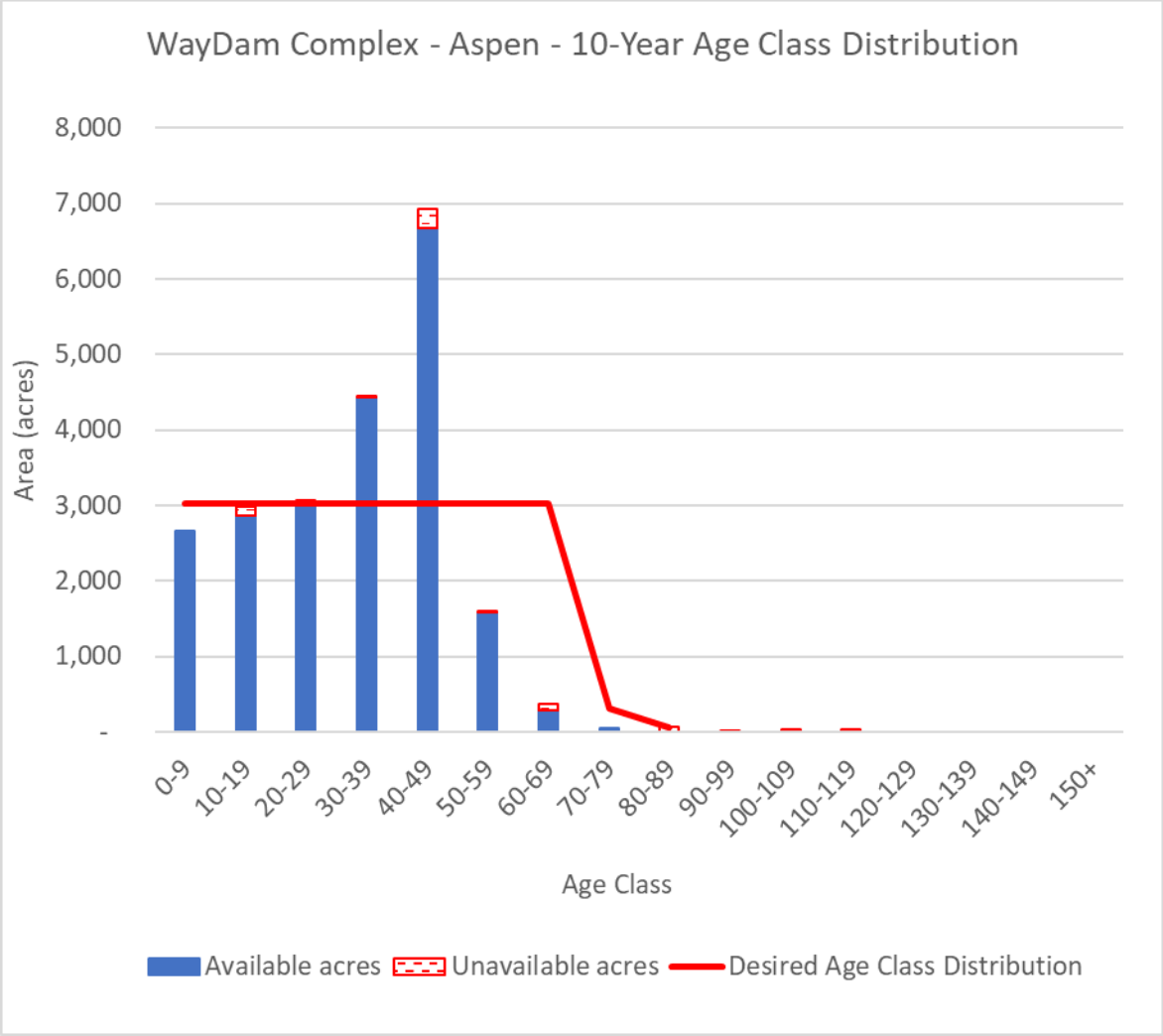


Figure 4. Short-term future age class distribution at the end of the 10-year planning period compared to the long-term desired age class distribution.

The end of the planning period will result in the establishment of 2,656 acres of aspen in the upcoming 0-9 age class. Progress toward the long-term desired age class distribution of aspen will take a few decades in this management area.

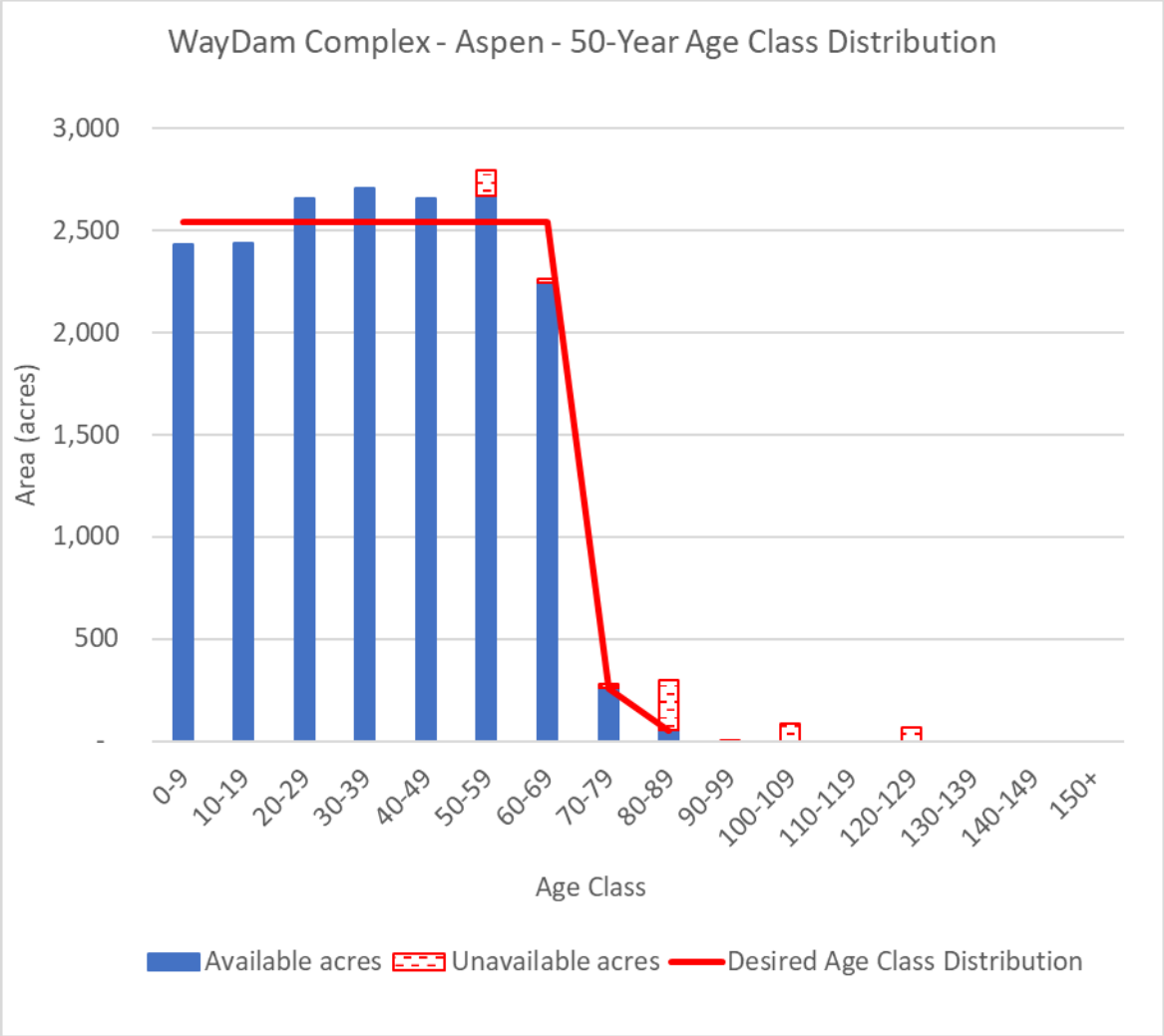


Figure 5. Projected mid-term age class distribution at the end of the fifth planning period compared to the long-term desired age class distribution.

The mid-term age class distribution shows the population of aspen acres nearly reaching the desired future condition with few age classes deviating from the target proportions (Figure 5).

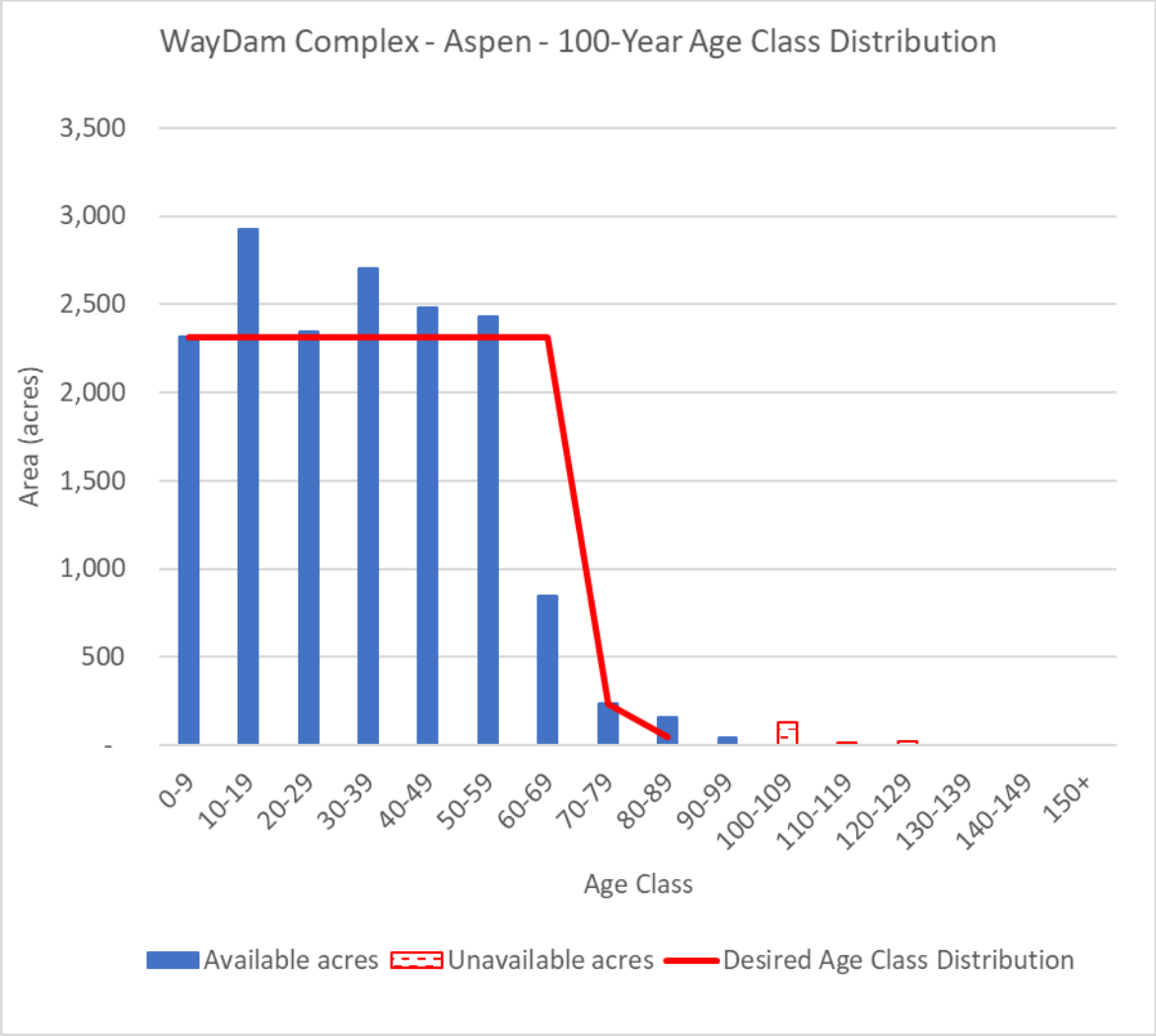


Figure 6. Projected long-term age class distribution at the end of the 10th planning period compared to the long-term desired age class distribution.

The long-term achievement of the desired age class distribution (Figure 6) will concentrate the manageable acres of aspen in productive growing conditions while providing an even flow of forest products and a wide variety of wildlife habitat conditions across the landscape in young, mid-aged, and mature forest.

Management actions

There are 3,304 acres of projected clearcut harvest in the aspen cover type. It is expected that about 655 acres of aspen will convert to other cover types. These total to an expected 2,649 acres of regeneration in the aspen cover type over the next 10 years.

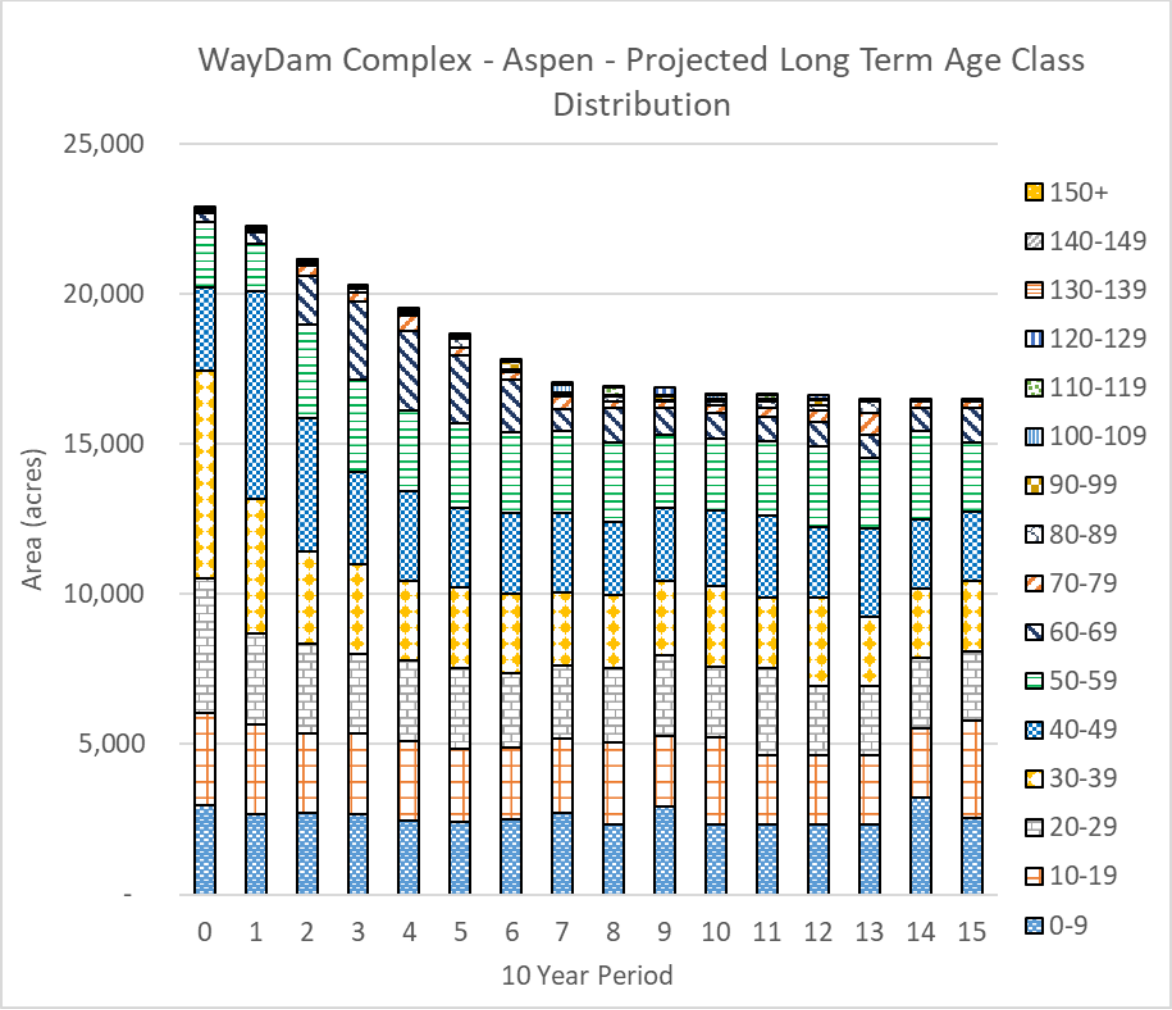


Figure 7. Projected age class distribution over 15, 10-year planning periods.

Northern hardwoods

Current condition

Most of the northern hardwood cover type is currently between a stand age of 70-79-years-old in the Way Dam Complex management area (Figure 8). The past management regime has been primarily single-tree selection, which allows for stand age to continue to increase overtime. Some stands are beginning to achieve an uneven-aged condition where a featured stand age becomes less evident, but the dominant age of these stands will likely increase past 150 years old prior to a younger age cohort becoming the prominent component of these stands (Figure 10). A portion of this cover type meets the habitat requirements of wood thrush, marten, cerulean warbler and white-tailed deer (Table 9).

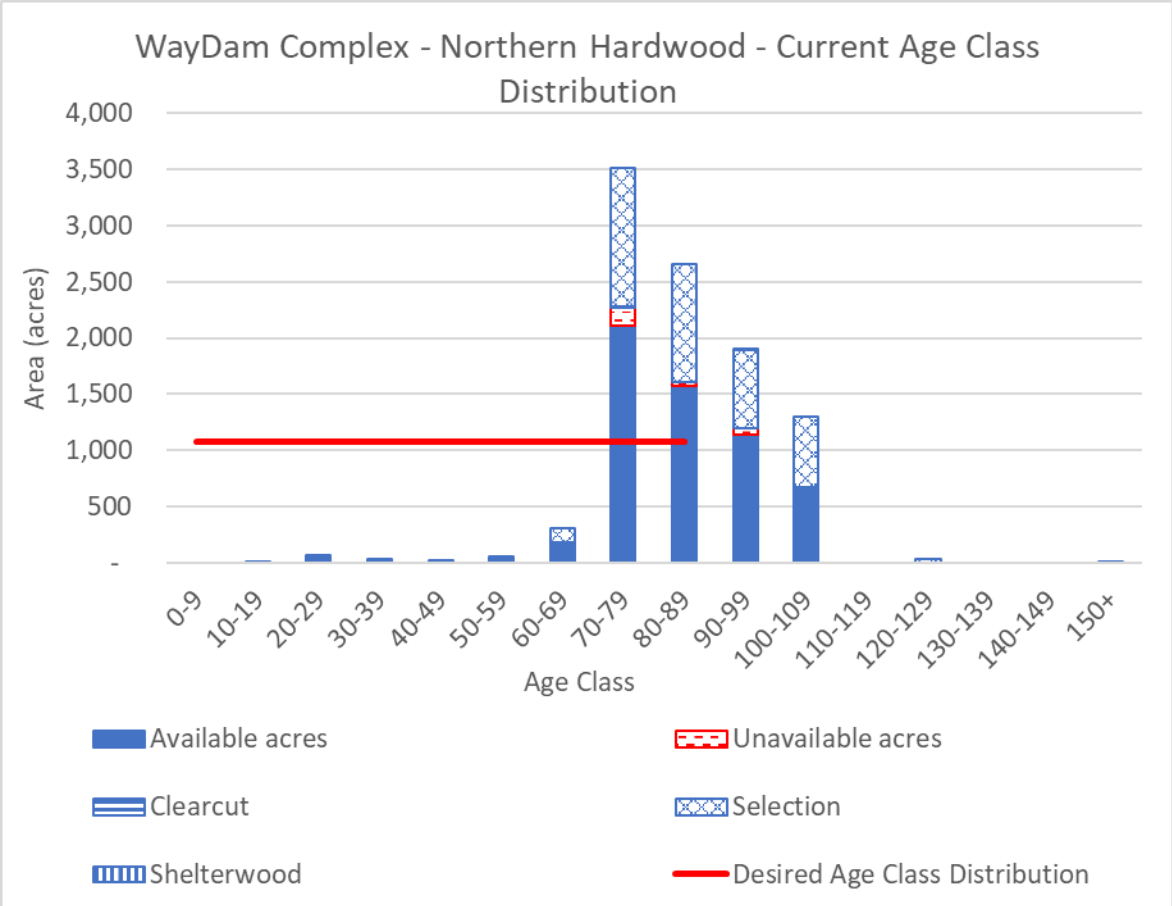


Figure 8. Current age class distribution and projected harvests in the northern hardwood cover type in the Way Dam Complex management area.

The area of northern hardwood is fairly well distributed in the ideal basal area classes for optimal growing conditions in the Way Dam Complex management area (Figure 9).

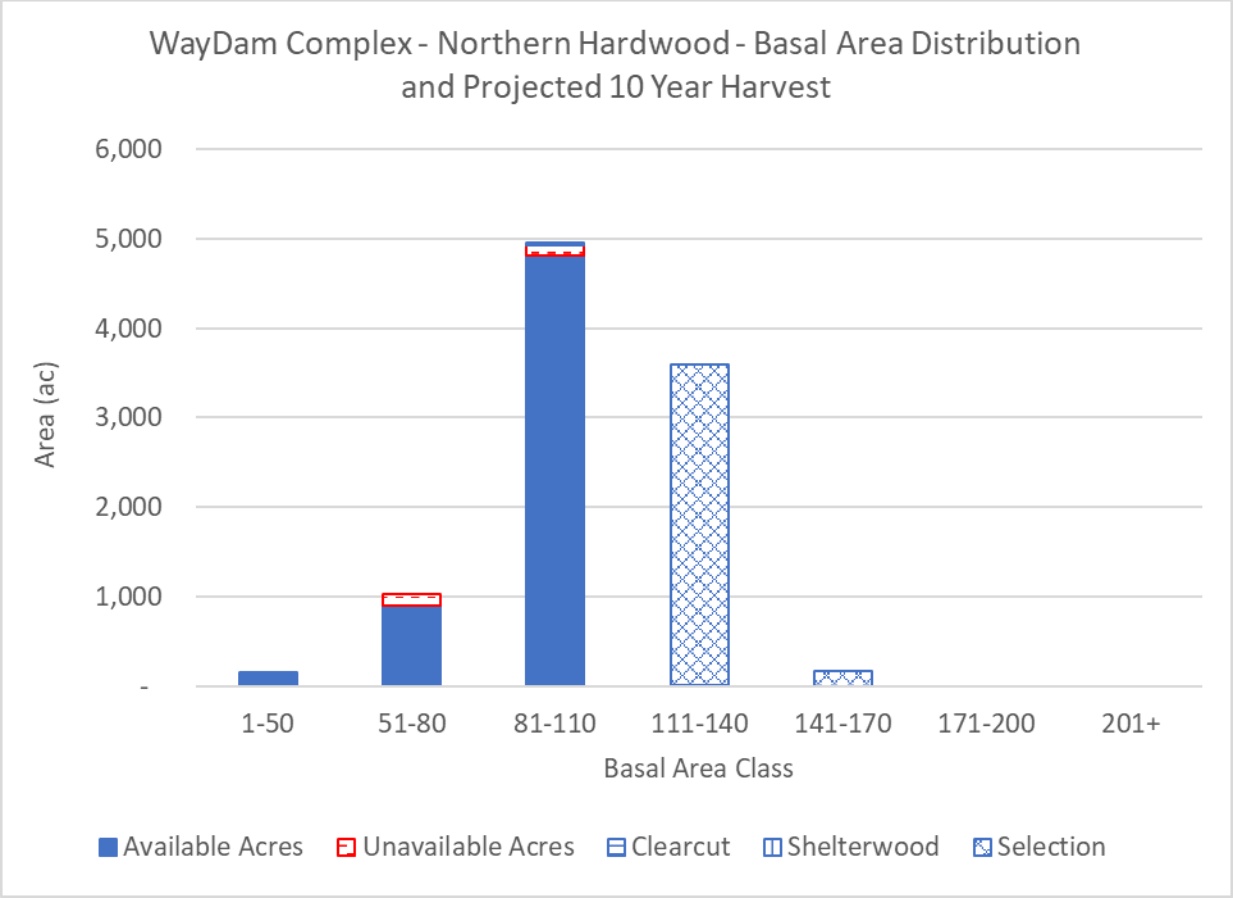


Figure 9. Current basal area distribution of the northern hardwood cover type as well as the projected harvests from each basal area class.

Table 9. Featured species with northern hardwoods as a priority habitat cover type, habitat variables, and current acres (i.e., potential habitat).

Featured Species	Featured Species Habitat – Northern Hardwood	Northern Hardwood Habitat Acres- Available	Northern Hardwood Habitat Acres- Unavailable
Cerulean warbler	Age category: 50+ Size category: pole, sawlog Basal area: 81+	5,805	89
Wood thrush	Age category: 40+ Size category: sawlog Basal area: 81+	8,604	116
Marten	Age category: 40+ Size category: pole, sawlog Basal area: 81+	5,252	76
White-tailed deer	All sizes and age classes	9,899	--

Desired future condition

The projected long-term cover type trend for northern hardwood is somewhat stable in the Way Dam Complex management area. There are 7 acres transitioning into this cover type in the next 10 years.

The desired basal area distribution is a bell-shaped curve where a significant majority of the area is kept in the 81-110 basal area class, with recently harvested stands occupying the 51-80 age class and stands that are ready for harvest occupying the 111-140 basal area class. Diameter distributions of the northern hardwood stands should follow the appropriate Q-curve relative to stand age and condition.

An uneven-aged condition is the long-term goal for all northern hardwood stands in this management area. An uneven-aged condition is achieved when there is no single discernable age cohort that is more prevalent than others across the stand area as canopy gaps fill in with regenerating seedlings, saplings, poles, and eventually remaining stems become sawlog sized over time.

Regeneration and recruitment continue to be a focus in the northern hardwood cover type across this management area. The long-term sustainability of this cover type in an uneven-aged silvicultural regime depends on the successful establishment of northern hardwood species as well as recruitment of those seedlings and saplings into the pole and sawlog classes. Northern hardwood in the Way Dam Complex management area face challenges in regeneration and recruitment due to cervid herbivory and poor site conditions in some of the stands.

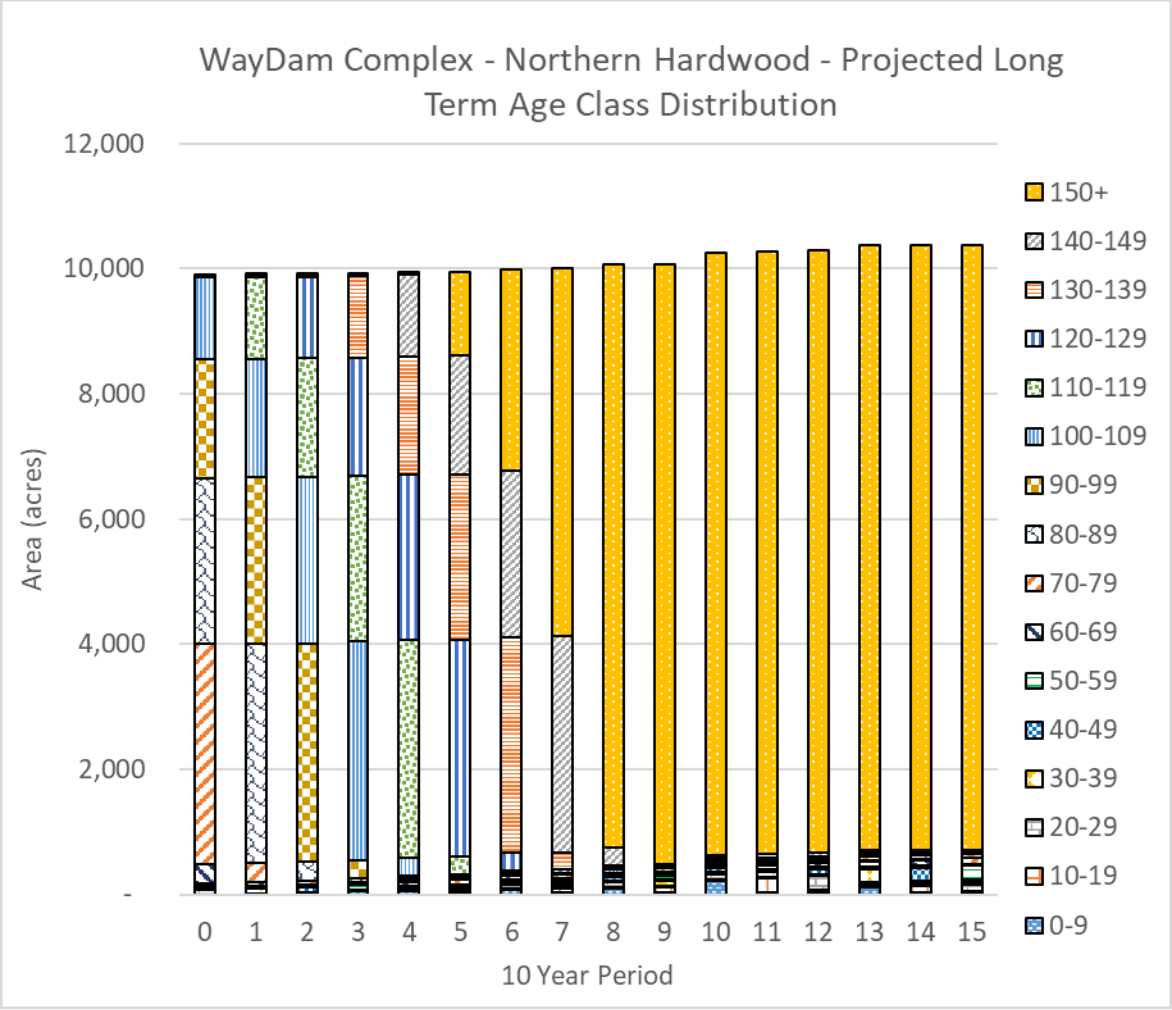


Figure 10. Projected age class distribution over 15, 10-year planning periods.

Management actions

The desired forest conditions and associated featured species habitat will be maintained and achieved through continued application of the projected selection harvest regime on 3,772 acres. About 19 acres will be managed under an even-aged system, with some of those acres harvested through a clearcut or shelterwood method to improve stand quality (Table 5). Larger canopy gaps should be used to encourage diverse regeneration of northern hardwood species while maintaining an overall long-term mature forest closed canopy landscape condition.

Conservation area network

High conservation value areas

There are up to nine different HCVA types that can be found in each management area (Table 10; see Biodiversity in Section 3 for more information)

Table 10. High conservation value areas within the Keweenaw management area.

High Conservation Value Area Type and Name	Acres
Deer wintering complex	**38,757**
	38,757
Grand Total	**38,757**

Ecological reference areas

Ecological Reference Areas (ERAs) are higher quality examples of functioning ecosystems that are primarily influenced by natural ecological processes.

Table 41. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 42. Ecological reference areas within the management area

Ecological Reference Area Type	Community Type	EO Rank	Global Rank	State Rank	Number of Occurrences
Existing ERA	Dry-mesic northern forest	C	G4	S3	1
Existing ERA	Muskeg	B	G4G5	S3	1
Existing ERA	Northern shrub thicket	B	G4	S5	1
Existing ERA	Northern wet meadow	B	G4G5	S4	1
Existing ERA	Rich conifer swamp	BC	G4	S3	1
Grand Total					**5**

Special conservation areas

Reviewable special conservation areas (SCAs, Table 13) refers to types that may be reviewed or updated through the compartment review process as needed. Static SCAs (Table 14) refers to those that generally do not change or require updating (see Biodiversity in Section 3 for more information).

Table 13. Reviewable special conservation areas within the Way Dam Complex management area.

Reviewable Special Conservation Area Type and Name	Acres
Habitat Area or Habitat Corridor	**1,962**
deer winter range	1,962
Grand Total	**1,962**

Table 14. Static special conservation areas within the Way Dam Complex management area.

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Designated Trout and Cold Water Stream Buffer		**3,807**
		1,876
Bass Creek		53
Bear Creek		101
Big Brook		137
Bobs Creek		12
Bryan Creek		148
Camp Eleven Creek		128
Cedar Creek		13
Cherry Creek		58
Chocolay River		9
East Branch Chocolay River		21
Flat Rock Creek		180
Flopper Creek		109
Halfway Creek		22
Little Brook		50
McGregor Creek		49
Mitchigan River		87
Norby Creek		14
North Branch Ford River		47
Peterson Creek		16
Poplar Creek		134
Rocky Creek		13
Schwartz Creek		73
Sheen Creek		20
Trout Falls Creek		8

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Twomile Creek		147
West Branch Chocolay River		8
West Branch Middle Branch Escanaba River		123
Wild West Creek		108
Wilson Creek		43
Designated Trout and Coldwater Streams	**141.1**	
	69.0	
Bass Creek	2.0	
Bear Creek	3.9	
Big Brook	6.2	
Bobs Creek	0.4	
Bryan Creek	5.6	
Camp Eleven Creek	4.8	
Cedar Creek	0.3	
Cherry Creek	2.1	
Chocolay River	0.3	
East Branch Chocolay River	0.8	
Flat Rock Creek	6.7	
Flopper Creek	4.0	
Halfway Creek	0.8	
Little Brook	1.0	
McGregor Creek	1.8	
Mitchigan River	3.4	
Norby Creek	0.5	
North Branch Ford River	1.9	
Peterson Creek	0.6	
Poplar Creek	4.9	
Rocky Creek	0.5	
Schwartz Creek	2.7	
Sheen Creek	0.9	
Trout Falls Creek	0.3	
Twomile Creek	5.0	
West Branch Chocolay River	0.3	
West Branch Middle Branch Escanaba River	4.7	
Wild West Creek	3.9	
Wilson Creek	1.7	
Wood Turtle Stream 100ft Buffer		**158**
Escanaba River		36
Michigamme River		70
Middle Branch Escanaba River		51

Static Special Conservation Area Type and Name	Sum of Length (Miles)	Sum of Acres
Wood Turtle Stream 660ft Buffer		**1,109**
Escanaba River		273
Michigamme River		487
Middle Branch Escanaba River		350
Grand Total	**141.1**	**5,074**

Rare species

Rare species occurrences are compiled from the Michigan Natural Features Inventory Biotics database (Tables 16 and 17) and do not necessarily include all rare species found in this management area due to biases in survey effort and verifiable observation reporting over time.

Table 43. Rare animal and plant species conservation status key.

Status	Status
E = endangered	LE = listed endangered
T = threatened	LT = listed threatened
SC = special concern	PDL = proposed for delisting

Table 16. Rare animal species occurrence within the Way Dam Complex management area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Animal	Alces alces	Moose	SC	--	--
Animal	Boloria freija	Freija fritillary	SC	--	2
Animal	Bombus borealis	Northern amber bumble bee	SC	--	1
Animal	Buteo lineatus	Red-shouldered hawk	SC	--	1
Animal	Canis lupus	Gray wolf	SC	LE	--
Animal	Gavia immer	Common loon	T	--	9
Animal	Haliaeetus leucocephalus	Bald eagle	SC	--	10
Animal	Lasmigona compressa	Creek heelsplitter	SC	--	1
Animal	Lithobates palustris	Pickerel frog	SC	--	2
Animal	Pandion haliaetus	Osprey	SC	--	2

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Total	--	--	--	--	**28**

Table 17. Other rare occurrences within the Way Dam Complex management area.

Element Category	Scientific Name	Common Name	State Status	Federal Status	Number of Occurrences
Other	Great Blue Heron Rookery	Great Blue Heron Rookery	--	--	1
Total	--	--	--	--	**1**

Non-ERA natural communities

Natural communities identified with an element occurrence in the MNFI Biotics database, but that have not been given an additional ecological reference area (ERA) designation, are recognized and managed accordingly (Table 19).

Table 18. Ecological reference area natural community ranking based on NatureServe.

Element Occurrence Rank	State Rank	Global Rank
A: excellent	S1: critically imperiled	G1: critically imperiled
B: good	S2: imperiled	G2: imperiled
C: fair	S3: rare	G3: very rare
D: poor	S4: apparently secure	G4: apparently secure
E: extant	S5: demonstrably secure	G5: demonstrably secure
H: historical	SX: extirpated	GH: historical occurrence
F: not found		GU: status uncertain
X: extirpated		GX: extinct
		?: inexact

Table 19. Non-ERA Natural Communities within the Way Dam management area.

Community Type	Element Occurrence Rank	State Rank	Global Rank	Number of Occurrences
Northern Wet Meadow	B	S4	G4G5	1
Grand Total				**1**

Forest health

Forest health concerns, both native and non-native, can have impacts on stand conditions and management decisions. The following insects (Table 20) and diseases (Table 21) could have an impact on management during the planning period and may need to be monitored and/or addressed.

Table 20. Defoliating insects of concern in the Way Dam Complex management area.

Common Name	Scientific Name	Native/Non-native	Knows Presence
Spongy moth	Lymantria dispar	Non-native	Yes
Forest tent caterpillar	Malacosoma disstria	Native	Yes
Large aspen tortrix	Choristoneura conflictana	Native	Yes
Spruce budworm	Choristoneura fumiferana	Native	Yes

Watch for lingering ash with potential resistance to emerald ash borer.

Table 21. Maladies of concern in the Way Dam Complex management area.

Common Name	Scientific Name	Native/Non-native	Known Presence
Canker	Various	Various	Yes
Armillaria root rot	Armillaria spp.	Native	Yes

Aquatic resources

Riparian habitat

A total of 77 miles of streams and rivers are found in the management area (Table 22). Streams/rivers classified as cold types comprise approximately 62 percent of the riverine mileage.

Table 22. Classification type and length of streams/rivers found within the management area.

Type	Length (miles)
Cold stream	21
Cold small river	0
Cold transitional stream	25
Cold transitional small river	2
Cold transitional large river	0
Warm transitional stream	13
Warm transitional small river	12
Warm transitional large river	4
Warm stream	0
Warm small river	0
Warm large river	<1

Lacustrine habitat

A total of 46 lakes and ponds of at least 1 surface acre are found in the management area (Table 23).

Table 23. Size and number of lakes and ponds located within the management area.

Lake Size Class (acres)	Number
1-99	21
100-499	0
500+	25

Wetlands

A total of 19,449 acres of wetlands can be found in the management area (Table 24). Forested wetlands comprise approximately 92% of wetland types found in the management area.

Table 24. Area of emergent, forested, and riverine wetland types found within the management area.

Wetland Type	Acres
Emergent	1,090
Forested	17,988
Riverine	371

Vernal pools and seeps

A total of 437 acres of vernal pools and seeps have been inventoried in the management area while no areas of seeps have been identified.

Riparian vegetation cover

Aspen and lowland shrub are the predominant cover type present in a 100-meter riparian zone located next to streams/rivers in the management area (Table 25).

Table 25. Largest vegetative cover types (i.e., top 10) and area located in a 100-meter buffer of streams/rivers within the management area.

Cover Type	Acres
Aspen	2,158
Lowland shrub	1,994
Lowland conifers	879
Treed bog	694
Cedar	581
Upland spruce/fir	530
Northern hardwood	495
Lowland spruce/fir	412
Mixed upland deciduous	390
Marsh	346

Watershed vegetation cover

The management area includes portions of important watersheds of the Michigamme and Paint rivers (Tables 26 and 27). Aspen and northern hardwoods are major cover types of the state forest in each watershed.

Table 26. Largest vegetative cover types (top 5) and area of the Michigamme River watershed located within the management area.

Cover Type	Acres
Aspen	18,180
Northern hardwood	6,666
Lowland shrub	2,397
Lowland conifer	2,012
Cedar	1,609

Table 27. Largest vegetative cover types (i.e., top 5) and area of the Paint River watershed located within the management area.

Cover Type	Acres
Aspen	5,244
Northern hardwood	3,179
Cedar	1,209
Lowland shrub	1,045
Lowland conifer	764

Recreation

The Way Dam Complex management area is fragmented, with fair to poor public recreation and management access. Roads are gravel or poor dirt roads and there are access issues with undivided

interest and crossing privately owned land. Three snowmobile trails pass through the management area and a small portion of the Iron River-Crystal Falls ORV Route (rail-trail). There are no designated non-motorized trails. Deer Lake state forest campground provides rustic camping opportunities and access to Deer Lake.

Table 28. Designated Recreation Trails by type.

Recreation Category	Recreation Type	Number of Miles
Motorized recreation trails	ORV (all types)	2.5
Motorized recreation trails	Snowmobile	21.8
Non-motorized Recreation Trails	Hiking	0
Non-motorized Recreation Trails	Equestrian	0
Non-motorized Recreation Trails	Biking	0
Non-motorized Recreation Trails	Hunter Walking Trails	0
Total	--	**24.3**

Note: Trail use types may overlap.

Table 29. State Forest Campgrounds (SFCG).

Name	Number of Sites
Deer Lake campground	12

There are no areas managed specifically for hunting in this management area.

Boating access sites are located on several area lakes and four access sites along the Paint and Net River systems.

Table 30. Boating Access Sites.

Name	Waterbody
Cable Lake	Cable Lake
Erickson's Landing	Paint River
Fire Lake	Fire Lake
Holmes Lake	Holmes Lake
Lake Ellen SFCG	Lake Ellen
Net River Flooding	Net River Flooding
Silver Lake	Silver Lake
Snake Rapids	Net River
The Wide Waters	Net River

Special analysis units

Introduction

The term “special analysis unit” stemmed from a need to describe geographic areas that already had management plans or guidance documents but that do not align with state forest management areas. These geographic areas all have specific sets of goals and objectives related to wildlife habitat or desired future forest conditions and are relevant to capture in the State Forest Management Plan model. By specifically incorporating these areas into the model as attributes of stands, outputs can be generated for them. They then can be used in model constraints, and specific transition proportions can be applied to help guide management activities.

It is quite common that a management plan written for a particular species, such as Kirtland’s warbler, includes specific goals for cover types such as planted and natural jack pine. Other cover types, like aspen, that fall within those focused areas can be managed according to the broader management area plan. This level of specificity allows for complementary management of both management area-level cover type and habitat goals and the more focused goals related to special analysis units.

There are five types of special analysis units across all three ecoregions of the state forest (Figure 1), all with a specific set of management goals outlined in their respective guidance document or management plans:

1. **Pigeon River Country State Forest**
    a. Guiding document: A Concept of Management for the Pigeon River Country (2007).
    b. Purpose: Protect area from overuse and overdevelopment and later provide desired future conditions of the forest.
2. **Elk Management Area**
    a. Guiding document: Michigan Elk Management Plan (2012).
    b. Purpose: Provides strategic guidance for managing elk in Michigan.
3. **Grouse Enhanced Management Site**
    a. Guiding document: Grouse Enhanced Management Plans (2014-2016).
    b. Purpose:
        i. Provide unique hunting opportunities.
        ii. Promote hunter recruitment and retention.
        iii. Expand local economies.
        iv. Provide a destination point for the traveling wing-shooter.
        v. Accelerate timber harvest opportunities (shorter rotation length on aspen).
4. **Kirtland’s Warbler Essential Habitat**
    a. Guiding documents:
        i. Kirtland’s Warbler Operational Plan (2022).
        ii. Kirtland’s Warbler Breeding Range Conservation Plan (2015).
    b. Purpose: Provides information and operational guidance to Department of Natural Resources staff, our conservation partners and the public on how the DNR will manage state-administered lands for the Kirtland’s warbler.

5. **Deer Wintering Complexes**
    a. Guiding documents: Deer Wintering Complex Plans (2016).
    b. Purpose: Provide information and strategies for managing lands to benefit deer wintering within the deer wintering complexes.

Specific goals or management strategies in each individual plan that depend on habitat management via commercial timber harvesting were selected, and an effort was made to incorporate those goals into the modeling effort of this State Forest Management Plan. Incorporating these special analysis unit goals started by establishing relevant units and spatially joining those with overlapping stands.

One of the 18 themes used in creating the SAU section of the model used the data that allowed for unique objective functions, outputs, constraints, goals, actions and transitions to be specified. These unique modeling elements, which impact the overall harvest schedule of the preferred solution, helped nest the SAU goals into the management area harvest targets, implemented each year through the compartment review process. The following sections will discuss the unique elements incorporated into the State Forest Management Plan model for each special analysis unit.

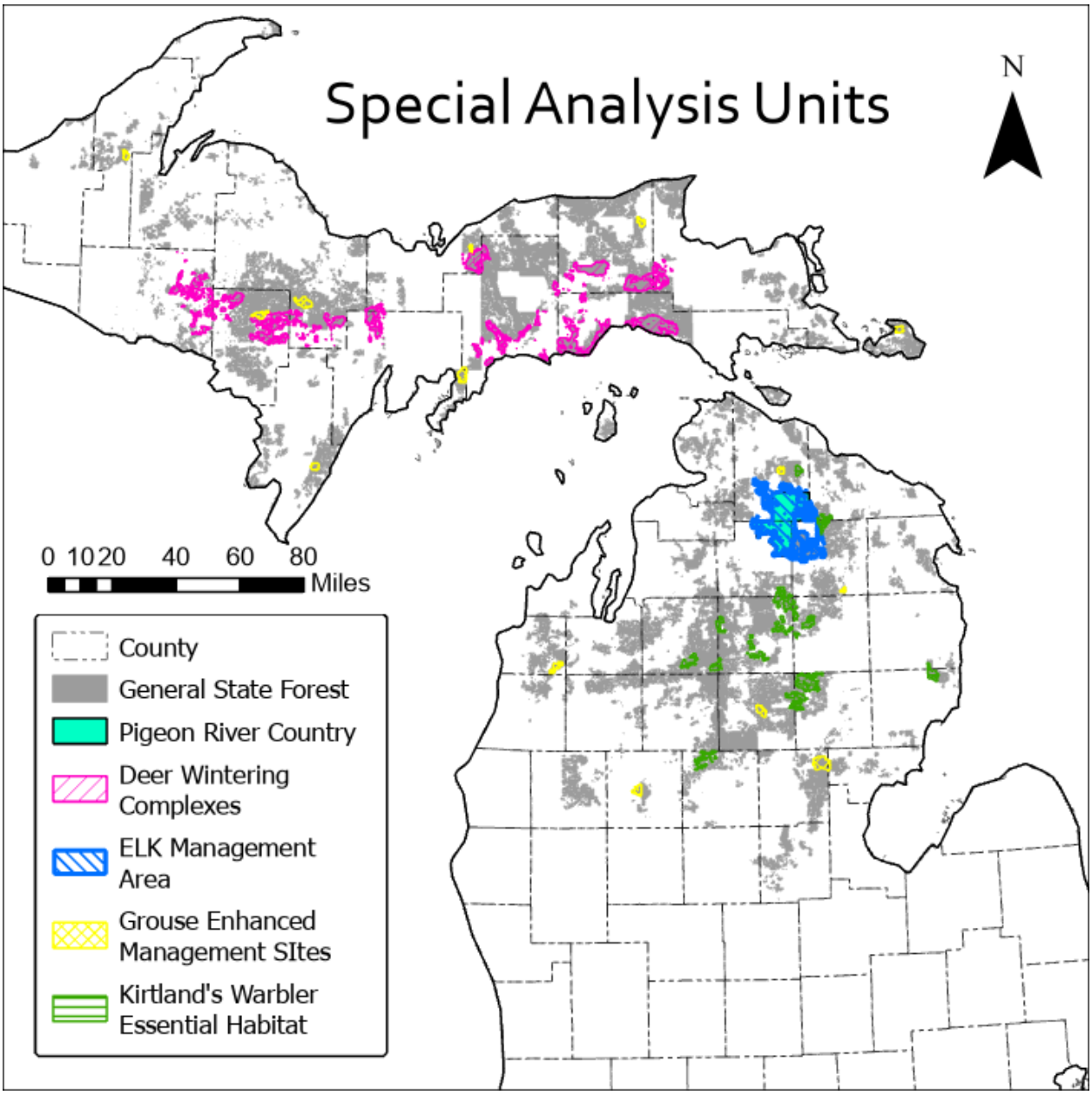


Figure 1. The five types of special analysis units across the state forest.

Pigeon River Country State Forest

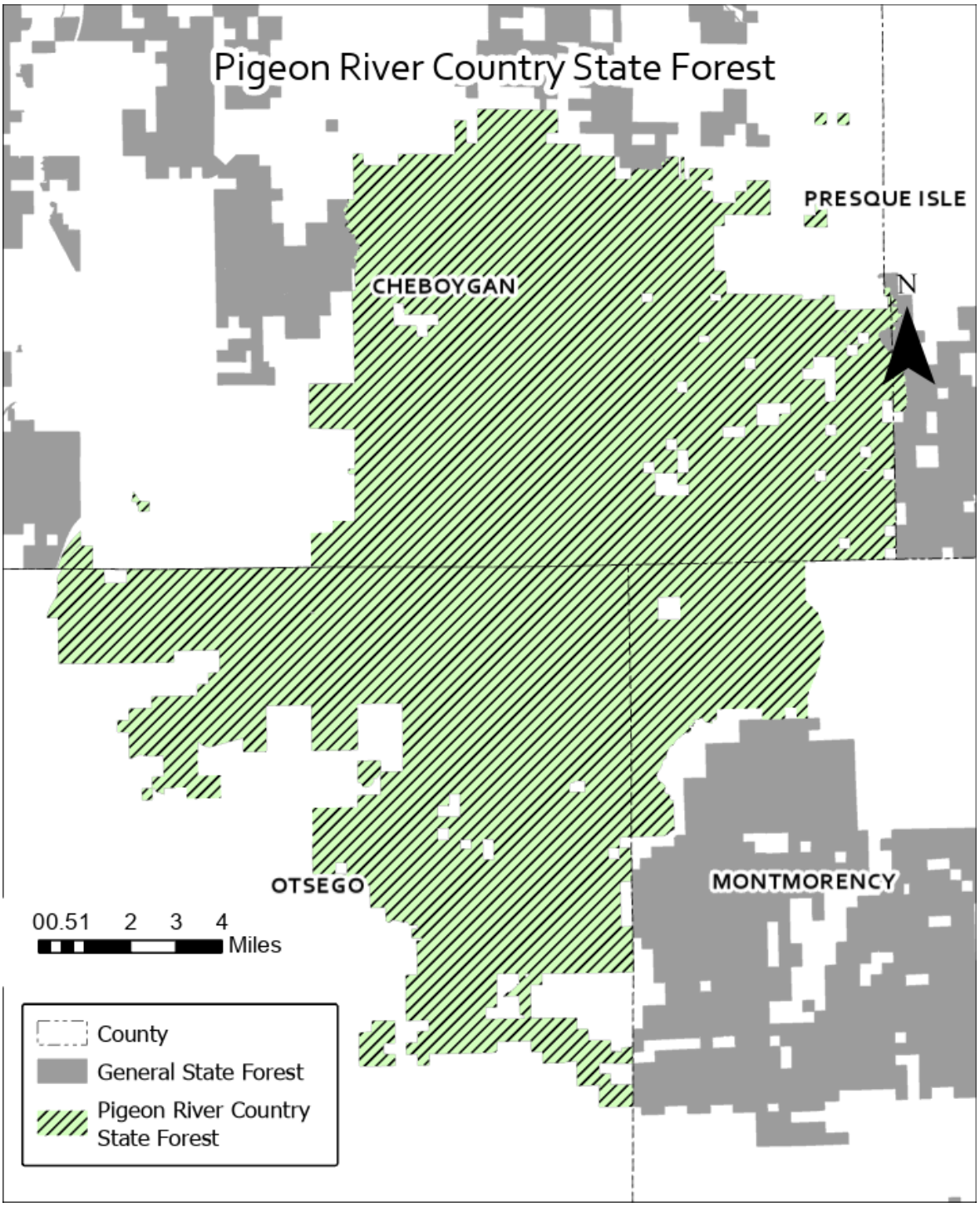


Figure 1. The Pigeon River Country State Forest Special Analysis Unit geographic boundary.

Description

The Pigeon River Country State Forest Special Analysis Unit (Figure 1), synonymous with the forest management unit, is located in Cheboygan, Montmorency and Otsego counties in the northern Lower Peninsula. This forest management unit has been recognized as a unique part of the state forest since its beginning and has several unique features that make it special. The following excerpt from the Concept of Management for the Pigeon River Country sums up its uniqueness:

> *The Pigeon River Country (PRC) is indeed a special place held in trust for the people of Michigan. There are many fascinating sides to the story of this beautiful piece of our state – its rather unusual history, the way the elk herd began, the struggle for and against oil drilling, what's happened over the past quarter-century as a result, and what we might expect to happen in years to come. It's a rich story that has developed over more than a century of land use and abuse, a story that exposes human folly which appeared at the time to be wisdom, and human wisdom most thought folly at the time. When the Concept of Management for the Pigeon River Country (Concept) was first adopted by the Michigan Department of Natural Resources (DNR) in December 1973, it represented the collective wisdom of many individuals, representing many organizations and interest groups, who all shared a common purpose – to protect the Lower Peninsula's last "Big Wild" from overuse and overdevelopment. 19th and early 20th century attitudes about treating natural resources as commodities, to exploit without restraint, had changed with the hard-won recognition that resources must be managed wisely if they are to be there for future generations.*
>
> *One purpose of this updated Concept of Management is to make sure that overuse doesn't happen. P.S. Lovejoy, a conservation leader of national stature in the first half of the 20th century, had seen firsthand too much of what had taken place here. A once pristine forest that had become a landscape denuded of trees; its rivers choked with sand and silt, a place bereft of wildlife. "It was Lovejoy who first recognized the Pigeon River Country as special. He called it 'the Big Wild'…. He led the charge to increase state holdings around the Pigeon River State Forest that started with 6,468 tax-reverted acres in 1919 and had expanded to over 19,200 by mid-1928, thanks to hunting license revenues." (Pfeifer 1974) "He viewed 'parked-up campsites', widening of county roads and other development as a 'poison' to the Pigeon River. He wanted a wild area…" (Cutler 1976) To protect its wild character from overuse, development will be more limited and people's activities will be more restricted than on most other state forest lands.*
>
> *The Pigeon River Country Advisory Council (Council) is made up of eighteen citizen members, three ex-officio members from the Department of Natural Resources, and one ex-officio member from the Department of Environmental Quality who was added to the Council in 1997. Since 1973, the Council has worked tirelessly and with great resolve to keep the management of Pigeon River Country in line with the Concept, and responsive to the wishes of people who use it and who may be affected by its use and management. During the past three decades, forest, wildlife and fisheries management practices have evolved with advances in scientific knowledge. Several large private tracts have been acquired by the state and added to the Pigeon River Country. Some state lands that had been managed by other FOREST MANAGEMENT Units have been added to the PRC. The*

area around the PRC has experienced growth, and patterns of recreational use have changed bringing new pressures to bear on the effort to protect the "Big Wild."

Special analysis unit goals

The Concept of Management has eight broad goals; the three of those with more specific objectives that could be incorporated into the State Forest Management Plan model are bolded below.

1. **Manage the elk population and elk habitat so the Pigeon River Country State Forest remains the nucleus of Michigan's elk herd.**
2. Provide needed habitat and seclusion for diverse fish and wildlife species.
3. Provide recreational opportunities for people in keeping with the wild character of the area and to provide peace and quiet through control of disruptive activities.
4. **Manage game species such as woodcock, grouse, deer and others for hunting and viewing opportunities.**
5. Protect water quality, stream habitat and manage the streams for a naturalized trout fishery, and the lakes for trout and game fish.
6. **Manage forest resources in a sustainable manner for desired future habitat conditions.**
7. Manage mineral resources in a manner consistent with existing legal requirements and these objectives
8. Protect the Pigeon River Country from overuse and overdevelopment which could destroy its wild character.

Current and desired future conditions

The first goal for managing the elk habitat is further described in the Forest Cover and Wildlife Habitat Management section, which states:

> *Adequate distribution and abundance of young, regenerating forest stands is critical to sustaining habitat for elk and many other species of wildlife requiring open or early successional habitats. Young forests are defined as being 0-9 years in age. Clear-cuts, and to a lesser extent tree and shelterwood cuts, are the three primary silvicultural methods used that result in even-age young forests. The cover types where even-age management will be applied are aspen, jack pine, low quality northern hardwoods, oak, red pine, lowland poplar, swamp conifers, paper birch, spruce-fir and white pine. Current forest analysis suggests that just over 50% of the forest is in those cover types that may be managed for early successional habitat. To maintain adequate elk habitat, managing the entire PRC for 7 to 8% in early successional age classes is the recommended objective.*

This objective was incorporated into the SFMP model by creating first an aggregate of the current equivalent cover types listed above, then an inventory area output that used the aggregate cover type and the Pigeon River Country Forest Management Unit as mask values that added up acres in the 0-9 age class. A separate set of theme-based outputs summed acres across each forest management unit and could also be used to represent this objective for the Pigeon River Country specifically. Two goal statements were then created that stated the area in the 0-9 age class of the specified cover types

should be greater than or equal to 7 percent and less than or equal to 8 percent of the total area of the Pigeon River forest management unit.

The current condition of the aspen 0-9 age class is slightly above the target at 8.2% of the Pigeon River Country. This is due to management strategies used during the last planning period (compensatory approach) that resulted in an elevated amount of regeneration and a reduction in what was the 40-49 age class. The SFMP model, also incentivized by the age class goals of each cover type in each management area, maintains the minimum requirement of 7-8%, with 7,730 acres in the 0-9 age class in each period moving forward as shown in Table 1 and Figure 2.

Table 1. Aspen 0-9 age class area and total aspen area across the Pigeon River Country State Forest Special Analysis Unit.

Model Period	Pigeon River Country (PRC) Age 0-9 Acres	Percent in 0-9 Age Class	PRC Aspen Type Acres	PRC Aspen Type Percent	Total PRC Acres
Current	9,038	8.2%	25,149	23%	**110,425**
1	7,730	7.0%	26,031	24%	**110,425**
2	7,730	7.0%	26,162	24%	**110,425**
3	7,730	7.0%	26,169	24%	**110,425**
4	7,730	7.0%	26,197	24%	**110,425**
5	7,730	7.0%	26,204	24%	**110,425**
6	7,730	7.0%	26,283	24%	**110,425**
7	7,730	7.0%	26,338	24%	**110,425**
8	7,730	7.0%	26,123	24%	**110,425**
9	7,730	7.0%	25,803	23%	**110,425**
10	7,730	7.0%	25,581	23%	**110,425**

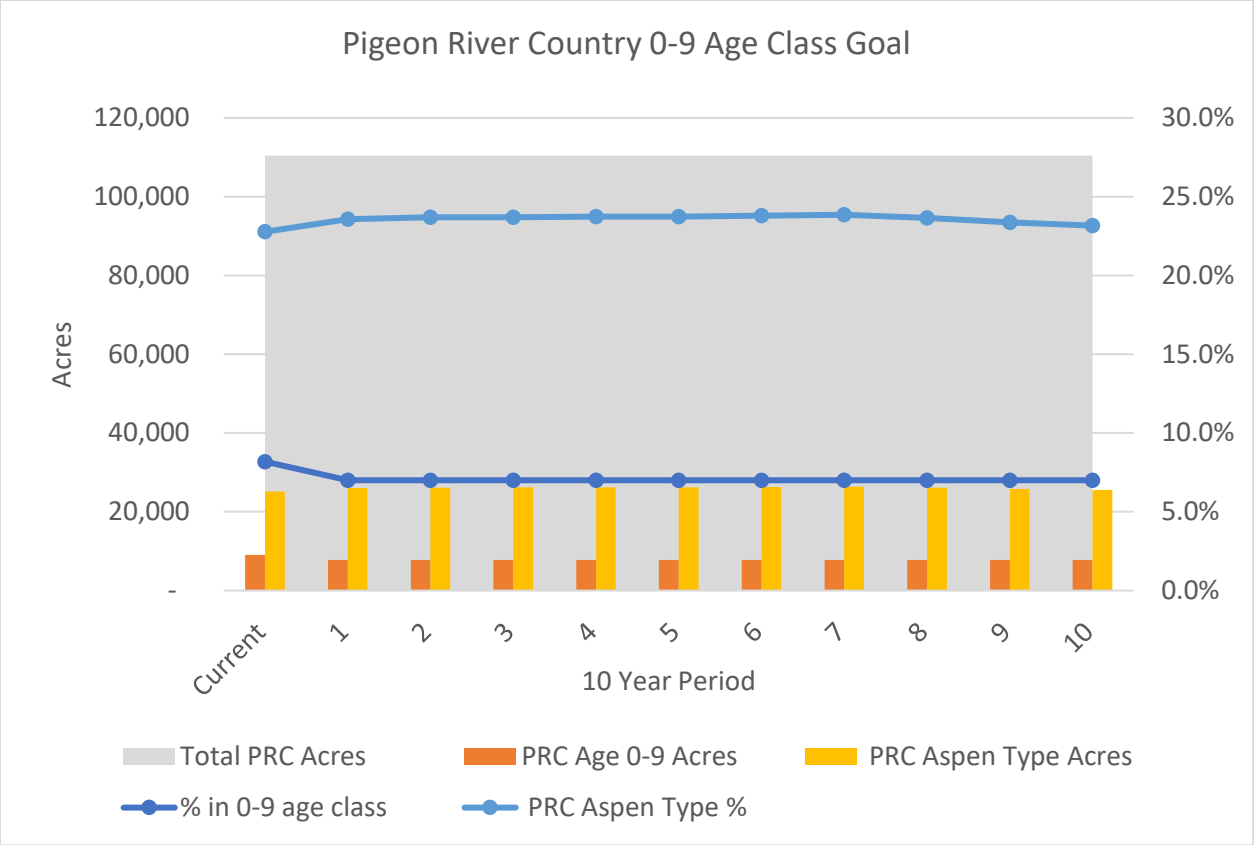


Figure 2. The 0-9 age class in the Pigeon River Country State Forest Special Analysis Unit.

The Concept of Management also states in this section that, "The objective will be to maintain at least 27 percent of the (Pigeon River Country) as aspen" as it relates to early successional stages of forest development and the benefits that stage has for many game species as stated in goal 4 above. This was incorporated into the model by generating another inventory area that adds up acres of aspen within the Pigeon River Forest Management Unit and then referencing that output in a similar goal statement that says the area of aspen in the forest should be greater than or equal to 27 percent of the total area in each period.

The goal of 27 percent aspen was created under the older "operations inventory" forest inventory system, which used a different classification system for determining cover types of stands. As stated in the Concept of Management, "Forest stands, where aspen is the principal component, **are considered** an aspen type." This system allowed stand examiners to assign a cover type to stands based on management intent rather than actual species occupancy and often resulted in more acres of the aspen cover type than estimates based on canopy species proportions. The current inventory system calculates the cover types, and the general rule is that stands must have greater than or equal to 40 percent of the canopy occupied by aspen species to be an aspen cover type (which is the lowest threshold for all species/cover types). One other consideration is that there were no upland mixed cover types in the old operations inventory system, so many stands with small components of aspen species were captured in the aspen cover type. Currently they are captured as mixed upland deciduous or upland mixed forest if there is a conifer component present. These factors have contributed to a current condition that falls below the stated goal of 27 percent, with a current value of 23 percent. The SFMP model is able to show

conversion from other cover types to aspen, which results in an increase to 24 percent, but is unable to achieve a higher proportion.

The Concept of Management also includes an objective that the amount of upland open land in the Pigeon River Country should be 6-7% of the entire area. There were no conversions from forested types to nonforested types projected in the SFMP model as a result of management discussions, so there is no movement projected related to this objective. The capability does exist, and an output was generated to track the amount of upland open lands, but the focus right now is to maintain existing open lands and prevent encroachment of tree species from converting them to a forested condition.

Increasing or maintaining mast production is also an objective in the Concept of Management, but because mast can come from a variety of species and cover types, it would be difficult to create a meaningful set of goals to inform the modeling effort. Instead, efforts to maintain or increase mast-producing components of stands will be handled through implementation as specific prescriptions are made through the compartment review process. Conversion away from oak cover types is discouraged, and maintenance of oak components at the highest level possible will continue to be the objective of such treatments.

Northern hardwood management is also discussed, and many of the objectives could be better achieved with individual prescriptions at the stand level. One objective for northern hardwood included managing a small proportion of this cover type with an even-aged stem rather than the typical uneven-aged approach. This goal coincides with the overall goals of the Wolverine Moraines and the Presque Isle Lake and Till Plains management areas and applies to the portions of those management areas that fall within the Pigeon River Country State Forest Special Analysis Unit.

The sixth goal listed above is more broadly concerned with sustainable forest management for desired future habitat conditions. This was accomplished by adding specific Pigeon River Country age class goals to each cover type managed with an even-aged system. This helps to regulate harvests and create a desirable age class distribution across the landscape to ensure an even flow of timber harvest and diverse habitat conditions. This is accomplished through the creation of specific age class outputs for each cover type, then using those outputs in an expression that specifies a proportion relative to outputs representing all available acres across the Pigeon River Country in that same cover type. The goal statements incentivize the model to achieve the desired age class distribution in each cover type as soon as possible, then maintain that distribution through strategic harvesting levels.

The age class goals for aspen in the Pigeon River Country use a base rotation age of 50 years (Figure 3; once balanced, most stands will be prescribed once they reach 50 years old as seen in Figure 4) by intending to carry about 14 percent of the available aspen acres in six age classes from 0-9 through 50-59. There is also an age class tail that will hold an additional 14 percent of the population across three older age classes in the 60-69 (8 percent), 70-79 (4 percent) and 80-89 (2 percent) age classes. Stands to be held in these additional age classes should be chosen carefully to ensure that holding these stands a little longer will not result in loss of the cover type due to diminished tree vigor and coppice regeneration capabilities. Stands located on productive sites with a high proportion of bigtooth aspen are good candidates for these age class tails.

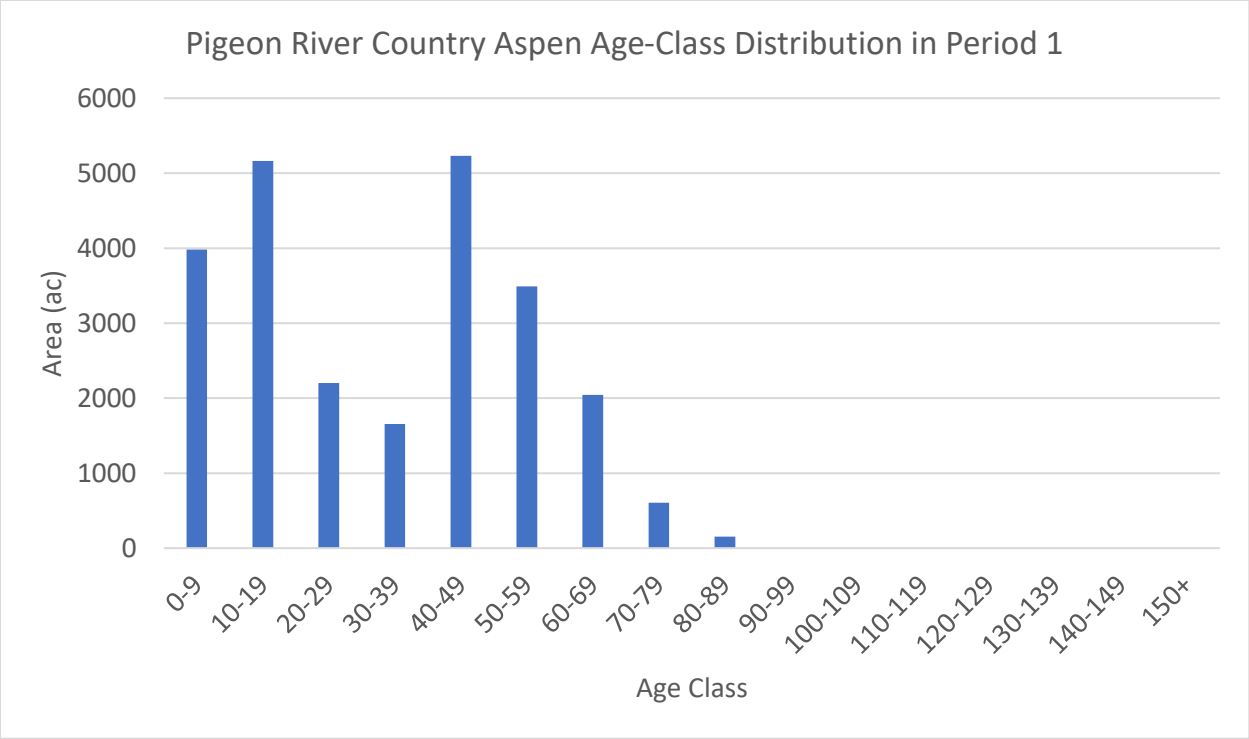


Figure 3. Aspen age class distribution after the planning period in the Pigeon River Country State Forest Special Analysis Unit.

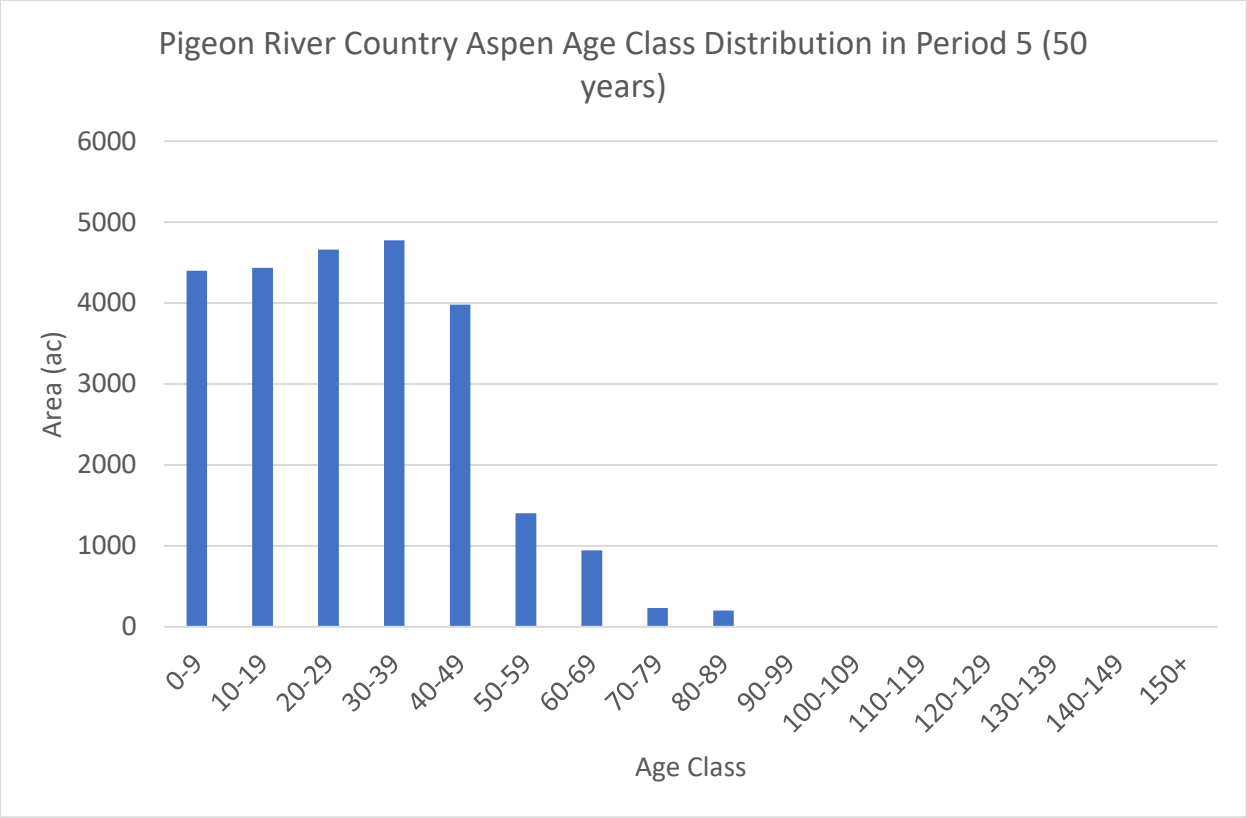


Figure 4. Aspen age class distribution in period 5 showing balanced condition.

Age class tails help provide both realistic harvesting options and beneficial habitat elements across numerous even-aged cover types. Planning for a small amount of additional area to be held beyond a single rotation age provides managers with opportunities to distribute treatments, both spatially and temporally, in landscapes that may not currently be in a desirable condition (e.g., large blocks of same age class). This practice has been in place for decades, but the planning has not accounted for it, which results in falling short of stated harvest objectives. The habitat-related objective of age class tails is to encourage more mature forest habitat elements to develop at the stand level and be present across the landscape to include lands both available and unavailable for commercial timber harvest. Mature forest habitat elements often include, but are not limited to, a higher component of living trees with cavities for small mammal and bird nesting opportunities, standing dead snags, dead and downed material for coarse woody debris, diverse vertical and horizontal structure, a more developed shrub species component, and large crowned canopy trees with raptor nesting opportunities.

Pine management encourages transitions away from plantation-style management to more natural regeneration of diverse deciduous, coniferous and mixed stands. This was represented in the SFMP model through transitions when regeneration harvest actions occur on planted red pine – the majority of those stands are projected to convert to mixed cover types and natural pine.

Management actions

The Period 1 projected harvest levels by silvicultural method provided in Table 2 will help ensure management in the Pigeon River Country aligns with the goals in the Concept of Management. Stand selection will be up to local land managers and biologists, but the overall harvest levels will help ensure

a balance of long-term sustainability and habitat creation is achieved. Salvage harvest will be conducted on stands based on field assessments and may differ from projections shown. Stands that were severely damaged in the 2025 ice storm have been factored in as well, resulting in a decrease in harvest levels to compensate for the surplus regeneration and decreased basal area.

Table 2. Projected period 1 harvests by silvicultural method for the Pigeon River Country State Forest Special Analysis Unit.

Cover Type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Salvage Clearcut	Salvage Thinning	Total
Northern hardwood	-	-	-	-	-	-	2,779	**2,779**
Planted red pine	171	-	1,497	-	-	-	987	**2,655**
Aspen	1,594	-	-	-	-	410	-	**2,004**
Mixed upland deciduous	1,794	-	-	-	-	-	-	**1,794**
Natural mixed pines	-	-	116	-	326	-	209	**651**
Natural white pine	-	-	114	-	210	-	89	**413**
Northern red oak	-	-	-	-	-	13	393	**406**
Natural red pine	-	-	13	-	154	-	55	**222**
Upland mixed forest	201	-	-	-	-	-	-	**201**
Upland spruce/fir	136	-	-	-	-	-	-	**136**
Natural jack pine	-	-	-	-	-	109	-	**109**
Planted mixed pine	-	-	85	-	-	-	-	**85**
Planted white pine	-	-	33	-	-	-	-	**33**
Black/red hybrid oak	31	-	-	-	-	-	-	**31**
Planted jack pine	-	-	-	-	-	22	-	**22**
Hemlock	-	1	-	-	-	-	-	**1**
Total	**3,927**	**144**	**1,859**	**-**	**689**	**2,758**	**2,165**	**11,541**

Elk Management Area

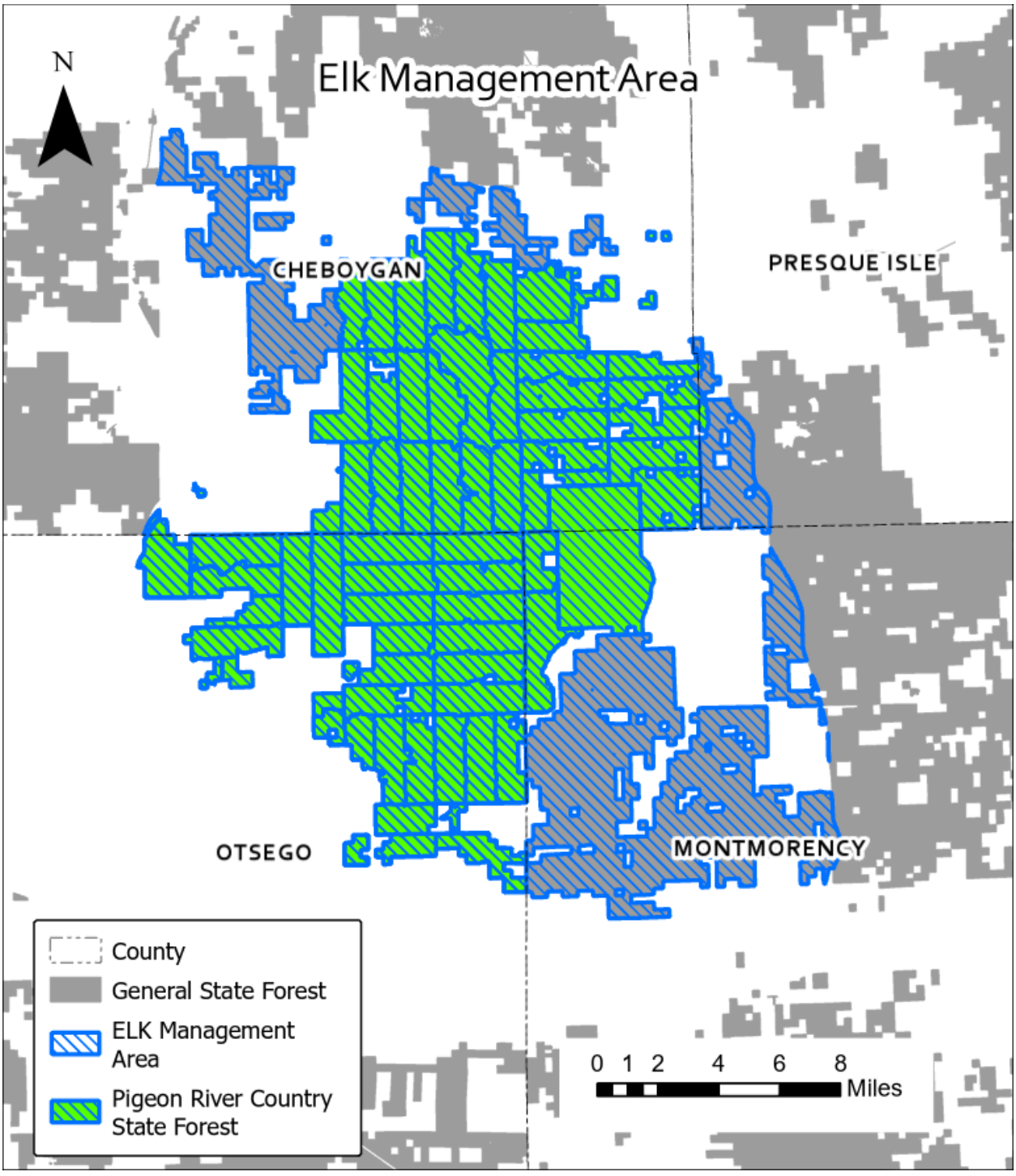


Figure 1. The Elk Management Area Special Analysis Unit geographic boundary.

Description

The purpose of the Elk Management Area Special Analysis Unit is to represent habitat goals derived from the Elk Management Plan through forest cover-type management. The overall goals and objectives are similar to those in the Pigeon River Country Concept of Management but cover a slightly larger area extending north into the Gaylord Forest Management Unit and east into Atlanta Forest Management Unit. The following is an excerpt from the Michigan Elk Management Plan:

> *"This plan provides strategic guidance for the management of elk in Michigan. This guidance will help: 1) manage for a sustainable elk population in balance with habitat; 2) use hunting as the primary method to control elk numbers, herd composition and distribution; 3) enhance public understanding of elk management in Michigan. This plan is appropriately aligned with the Wildlife Division strategic plan, "Guiding Principles and Strategies"…*

Special analysis unit goals

The following goals are represented in the Elk Management Plan:

1. Maintain 6-7% as grass and upland brush types.
2. Manage the forest to maintain the proportion of aspen at the same level (no net loss of aspen).
3. Maintain mast production by red, white, northern pin oak and beech and increase production if silviculturally appropriate.
4. Manage for mixed pine stands using natural regeneration that promotes both coniferous and deciduous species.
5. Managers must also be cognizant of the total amount of all early successional vegetation types and make efforts to provide consistent amounts over the decades.

These goals are consistent with those of the Pigeon River Country Concept of Management and are replicated throughout the SFMP model in the form of age class goals for each management area and the Pigeon River Country, specific Elk Management Area Special Analysis Unit transitions, and a specific aspen cover type constraint providing for no net loss over time.

Current and desired future conditions

The grass and upland brush types are not impacted by the SFMP model, as there are no transitions to nonforested cover types, resulting in no change over time. Small amounts of conversions are likely to occur and will be discussed locally through the compartment review process. Maintaining the current proportion of the aspen cover type was incorporated into the SFMP model by creating a specific output that sums the acreage of aspen within the Elk Management Area Special Analysis Unit, then referencing that output in a goal statement relative to the entire area covered by the Elk Management Plan. The goal statement incentivizes the SFMP model to maintain the same or a greater amount of aspen in future periods throughout the 15-period planning horizon (Figure 2).

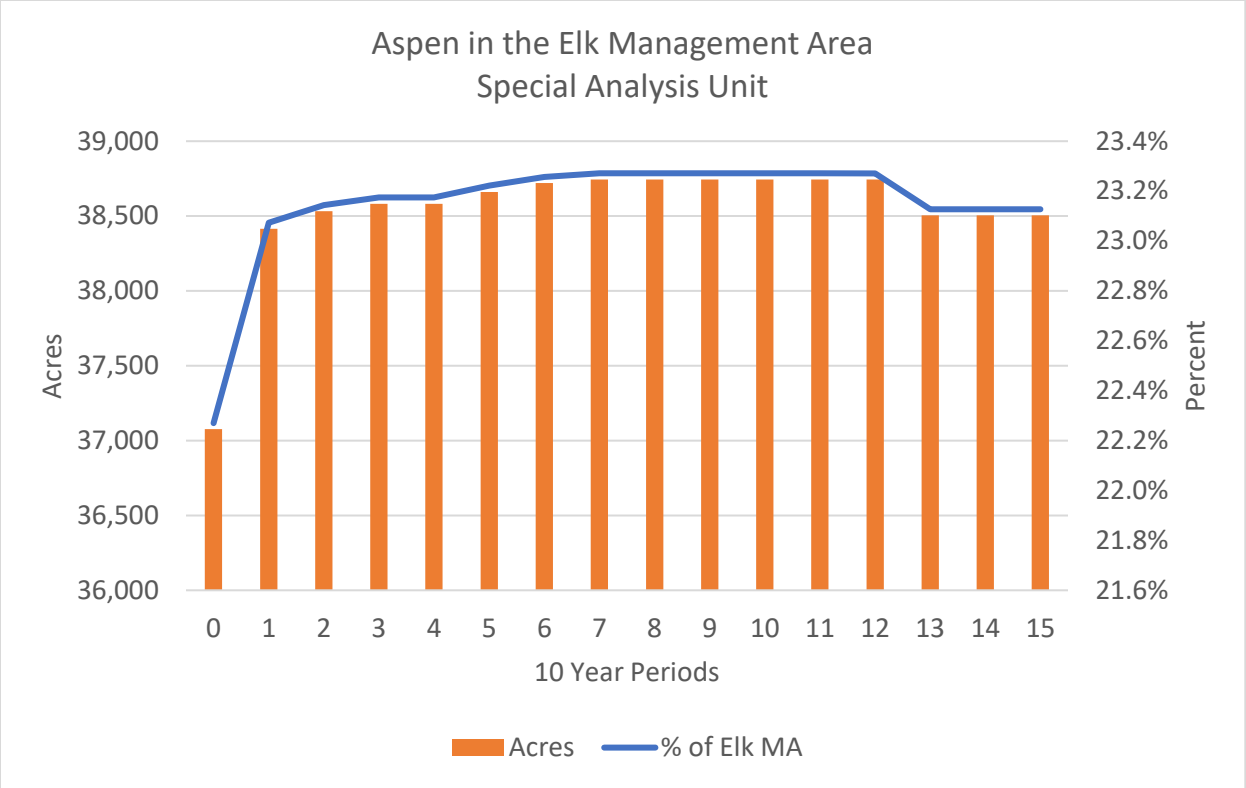


Figure 2. Aspen cover type acres in the Elk Management Area Special Analysis Unit.

The slight decrease from period 12 to period 13 is likely a result of aspen located on lands unavailable for commercial timber management senescing to more mid-or late-successional cover types.

The mast production goals in the Elk Management Plan will be challenging to achieve:

1. The loss of American beech trees, due to beech bark disease, as a component of the northern hardwoods cover type will significantly reduce in hard mast across the landscape.
2. Regeneration and recruitment of oak species at densities prior to harvest has proven to be difficult to achieve. This is likely due to a couple of key factors, including:
    a. Our resistance to replicate the rather harsh disturbance of the logging era (large-scale repeated harvests – first pine, then hardwood – and subsequent wildfires of logging slash) that occurred around 1890 to 1930, resulting in the significant oak component we see today in mature stands on dry-mesic and dry-xeric sites.
    b. Significantly more herbivory occurring on regenerating stands when compared to the time when these stands were established.

The State Forest Management Plan model indicates a decline in oak types because of these factors, while more acres of mixed upland deciduous can be expected, containing a substantial oak component. Efforts to both retain and regenerate oak will be specified in nearly all prescriptions on stands containing oak species (Figure 3).

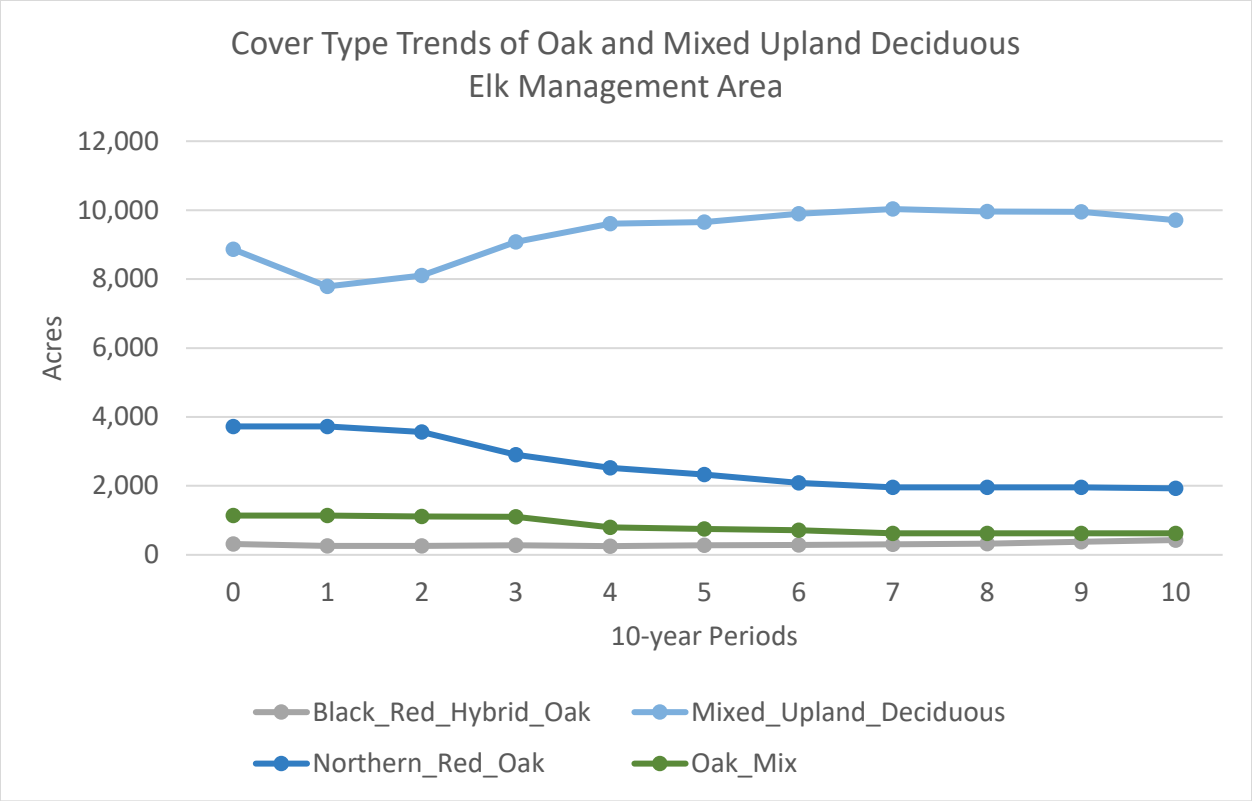


Figure 3. Trends for oak cover types in the Elk Management Area.

Pine management in the Elk Management Area encourages transitions away from plantation-style management and more natural regeneration of more diverse deciduous, coniferous and mixed stands. This was represented in the State Forest Management Plan model through transitions when regeneration harvest actions occur. The code shows the source stands being diverted to other mixed and natural cover-type targets after a regeneration harvest occurs. These transitions result in a projected decrease in the planted pine types and a subsequent increase in all three natural pine types as well as upland mixed forest, which contains a mix of both coniferous and deciduous tree species (Figure 4).

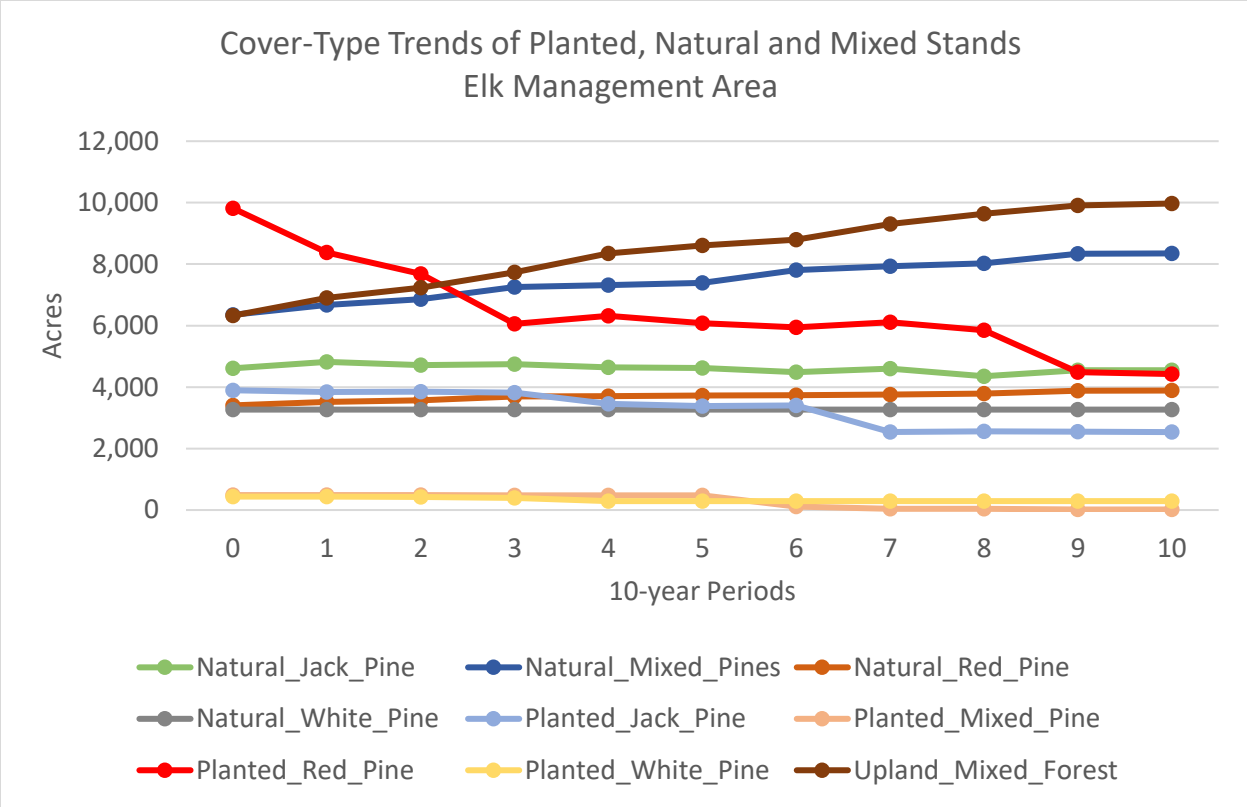


Figure 4. Cover-type trends of planted and natural pine types in the Elk Management Area.

Early successional cover types will be maintained across the Elk Management Area through specific age class goals for the Pigeon River Country Forest Management Unit and the Wolverine Moraines and Presque Isle Lake and Till Plain management areas. The resulting age class distribution of important even-aged cover types like aspen is projected to remain relatively well balanced for the Elk Management Area (Figures 5 and 6).

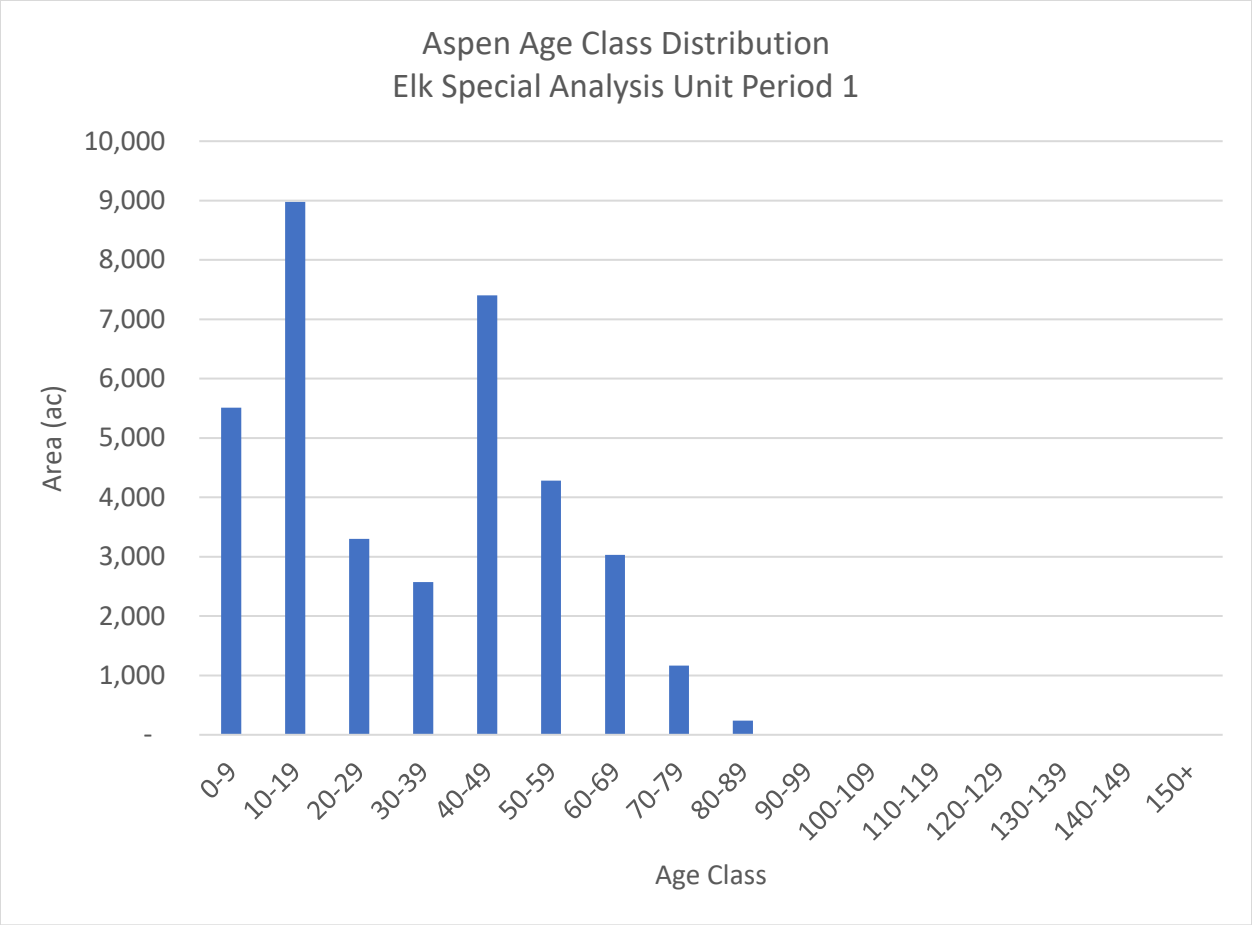


Figure 5. Aspen age class distribution in the Elk Management Area Special Analysis Unit after 10-year planning period.

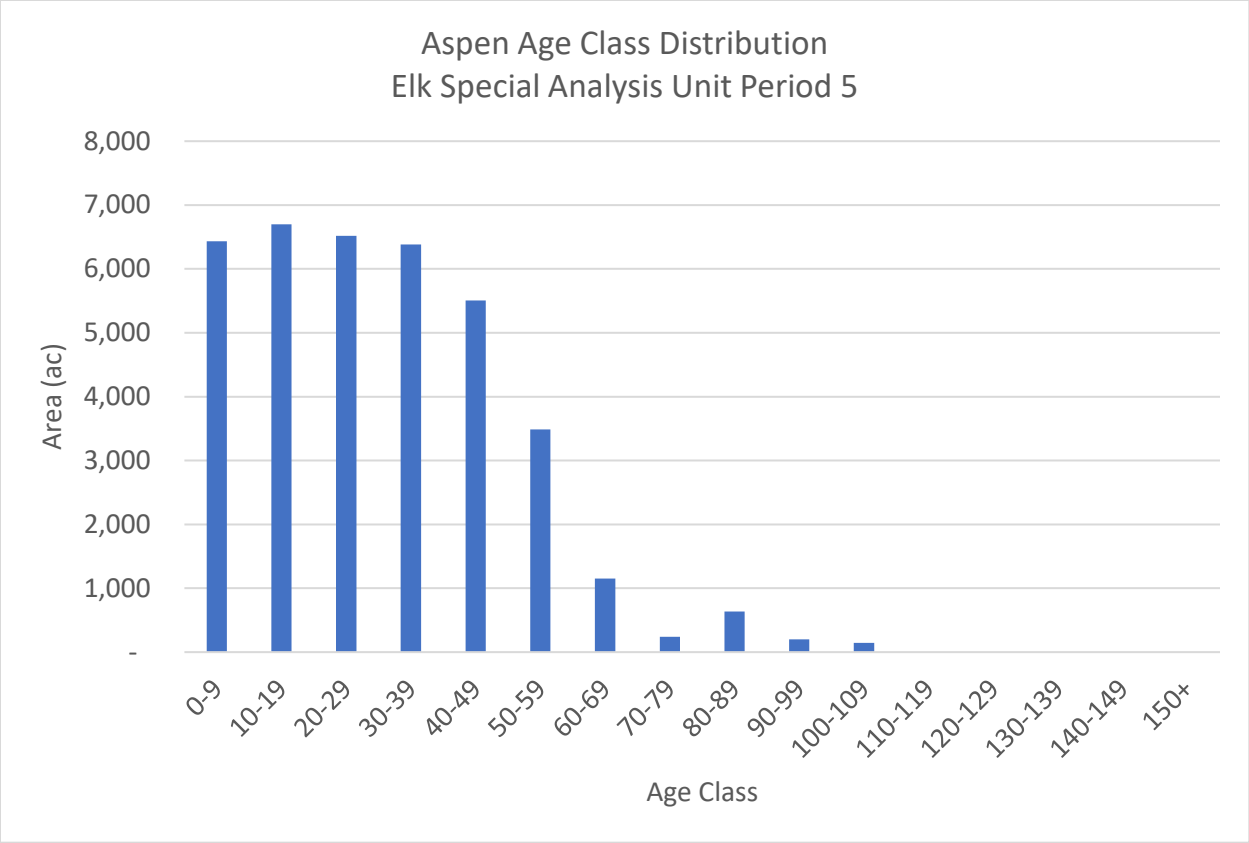


Figure 6. Aspen age class distribution in the Elk Management Area Special Analysis Unit after 50 years of management.

Management actions

The Period 1 projected harvest levels by silvicultural method provided in Table 1 will help ensure the management in the Elk Management Area aligns with the goals in the Michigan Elk Management Plan. Stand selection will be up to the local land managers and biologists, but the overall harvest levels will help ensure a balance of long-term sustainability and habitat creation is achieved.

Table 1. Harvest projections for the Elk Management Area.

Cover Type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Salvage Clearcut	Salvage Thinning	Total
Planted red pine	729	-	2,675	-	-	658	1,045	**5,106**
Northern hardwood	-	733	-	168	-	2,203	1,145	**4,248**
Aspen	2,507	-	-	-	-	552	-	**3,060**
Mixed upland deciduous	2,808	-	-	-	55	-	-	**2,864**
Northern red oak	89	-	-	100	-	290	493	**972**
Natural mixed pines	-	-	125	-	389	-	271	**786**
Natural white pine	-	-	114	-	217	-	89	**420**
Natural red pine	-	-	49	-	154	-	162	**365**
Lowland conifers	352	-	-	-	-	-	-	**352**

Cover Type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Salvage Clearcut	Salvage Thinning	Total
Natural jack pine	63	-	-	-	-	276	-	**339**
Upland mixed forest	277	-	-	-	-	-	-	**277**
Upland spruce/fir	136	-	-	-	-	-	-	**136**
Black/red hybrid oak	125	-	-	-	11	-	-	**135**
Planted jack pine	-	-	-	-	-	112	-	**112**
Planted white pine	-	-	88	-	-	-	-	**88**
Planted mixed pine	-	-	85	-	-	-	-	**85**
Lowland aspen/balsam poplar	51	-	-	-	-	-	-	**51**
Hemlock	-	33	-	-	-	-	-	**33**
Lowland deciduous	22	-	-	-	5	-	-	**26**
Tamarack	20	-	-	-	-	-	-	**20**
Lowland spruce/fir	10	-	-	-	-	-	-	**10**
Cedar	-	-	-	5	-	-	-	**5**
Total	**7,189**	**766**	**3,136**	**273**	**830**	**4,091**	**3,204**	**19,488**

Grouse Enhanced Management Sites

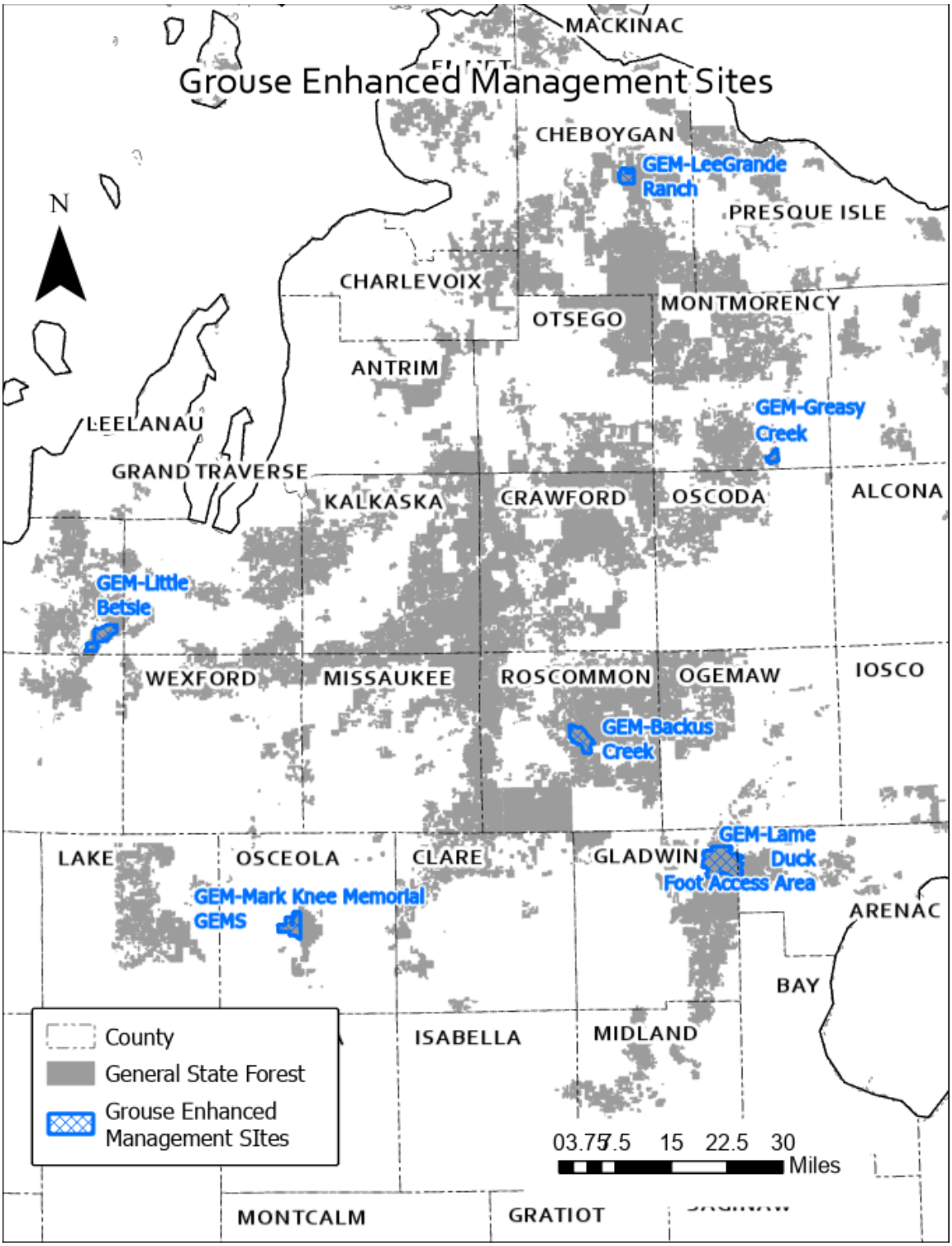


Figure 1. The geographic distribution of GEMS in the northern Lower Peninsula.

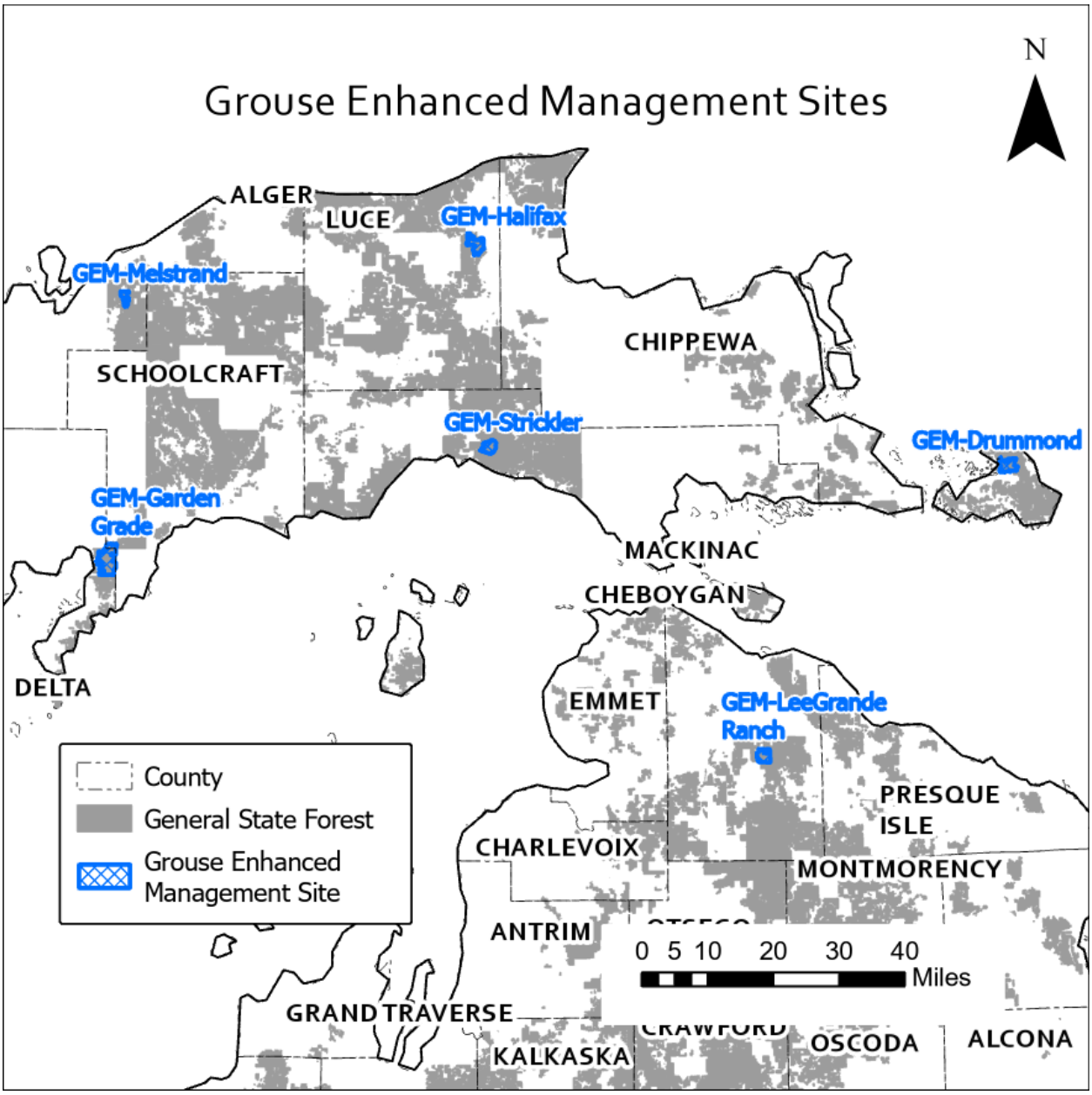


Figure 2. The geographic distribution of GEMS in the eastern Upper Peninsula.

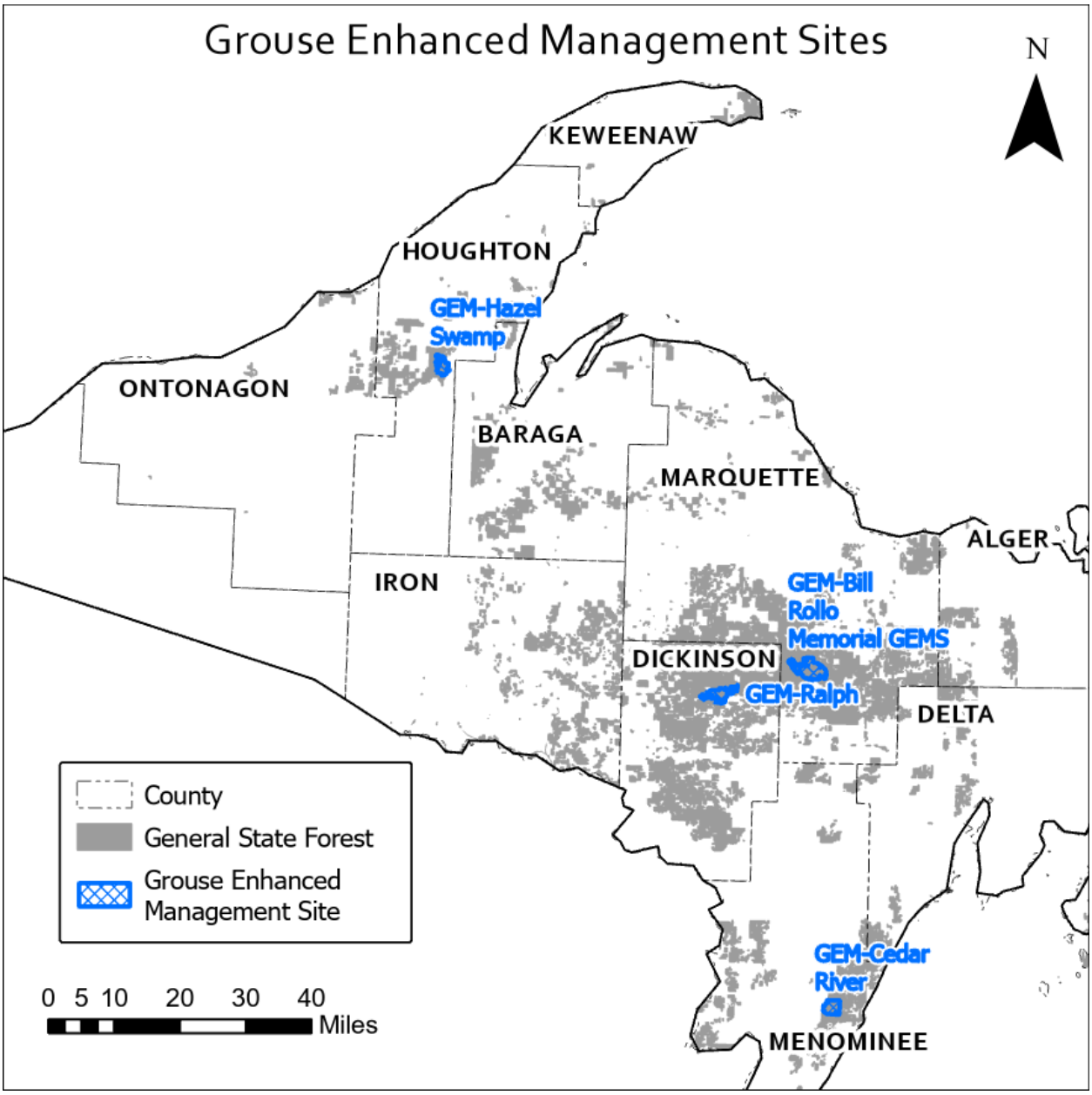


Figure 3. The geographic distribution of GEMS in the western Upper Peninsula.

Description

As part of a statewide grouse hunting improvement initiative, the Michigan DNR has created Grouse Enhanced Management System throughout the northern Lower Peninsula and the Upper Peninsula. These GEMS vary in size and configuration, but they are all intended to meet the following goals:

- Provide unique, walk-in-hunting opportunities.
- Promote hunter recruitment and retention.
- Expand local economies.
- Provide a destination for the traveling wing-shooter.
- Accelerate timber harvest opportunities.

To date, there are 15 established GEMS using intensive forest management to enhance grouse habitat and establish trail systems for walk-in hunting access. These areas are destinations for novice or traveling wing-hunters, as well as wildlife viewers and hiking enthusiasts. Though primarily for grouse, these intensively managed sites benefit other species including woodcock, turkey and white-tailed deer.

Special analysis unit goals

The primary goal of maximizing early successional habitat through accelerated timber harvests is represented in the SFMP model through a series of age class goals that incentivize the model to create and maintain an age class distribution designed with a relatively strict 40- to 50-year-old rotation age (Table 3).

Table 3. Rotation age of aspen types in GEMS across Michigan's state forest.

Grouse Enhanced Management Site	Rotation Age of Aspen Types
Backus Creek	40-49
Bill Rollo Memorial	40-49
Cedar River	40-49
Drummond	50-59
Garden Grade	40-49
Greasy Creek	40-49
Halifax	40-49
Hazel Swamp	40-49
Lame Duck	50-59
Lee Grande	40-49
Little Betsie	50-59
Mark Knee Memorial	50-59
Melstrand	40-49
Ralph	40-49
Strickler	40-49

Current and desired future conditions

Aspen stands will be harvested and regenerated shortly after they become commercially viable at a level that creates a relatively balanced condition of the aspen cover type across each site and maximizes the number of acres in the 0-9 and 10-19 age classes that are ideal for both ruffed grouse and American woodcock. The following graphs (Figures 4 through 16) represent projected future age classes and overall aspen abundance in each GEMS from the SFMP model.

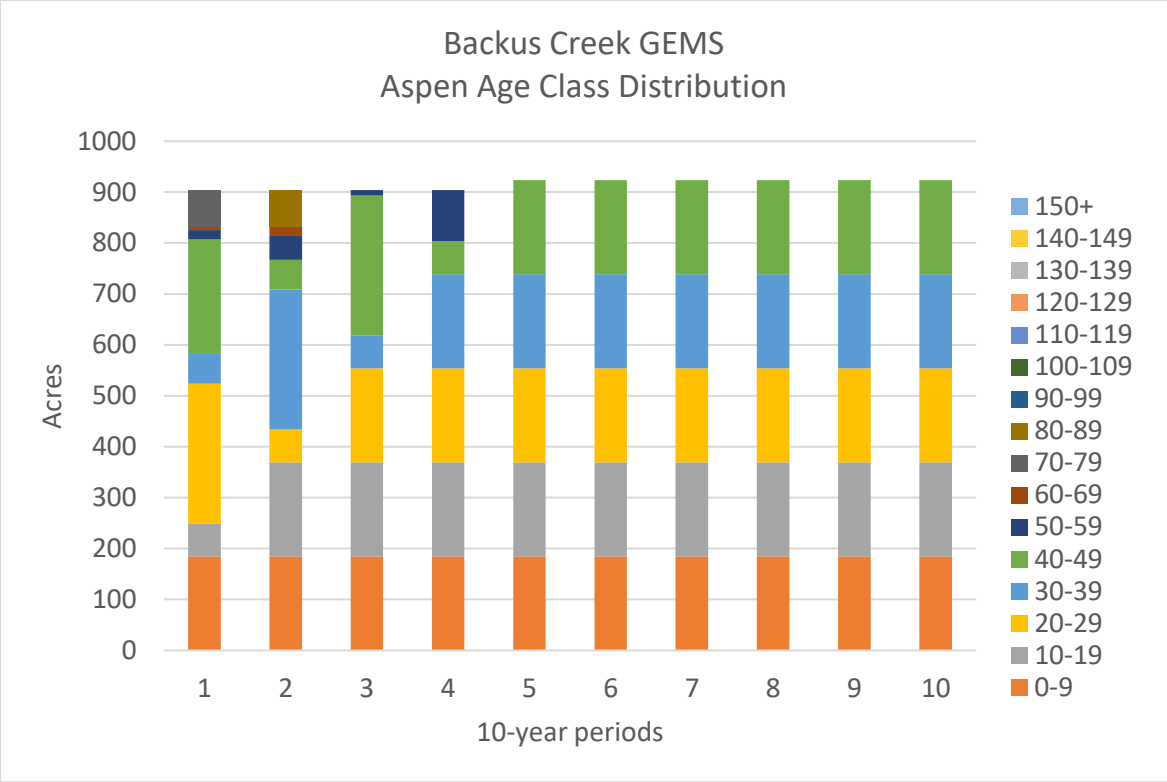


Figure 4. Projected aspen age class distribution across all 15 10-year model periods in the Backus Creek GEMS.

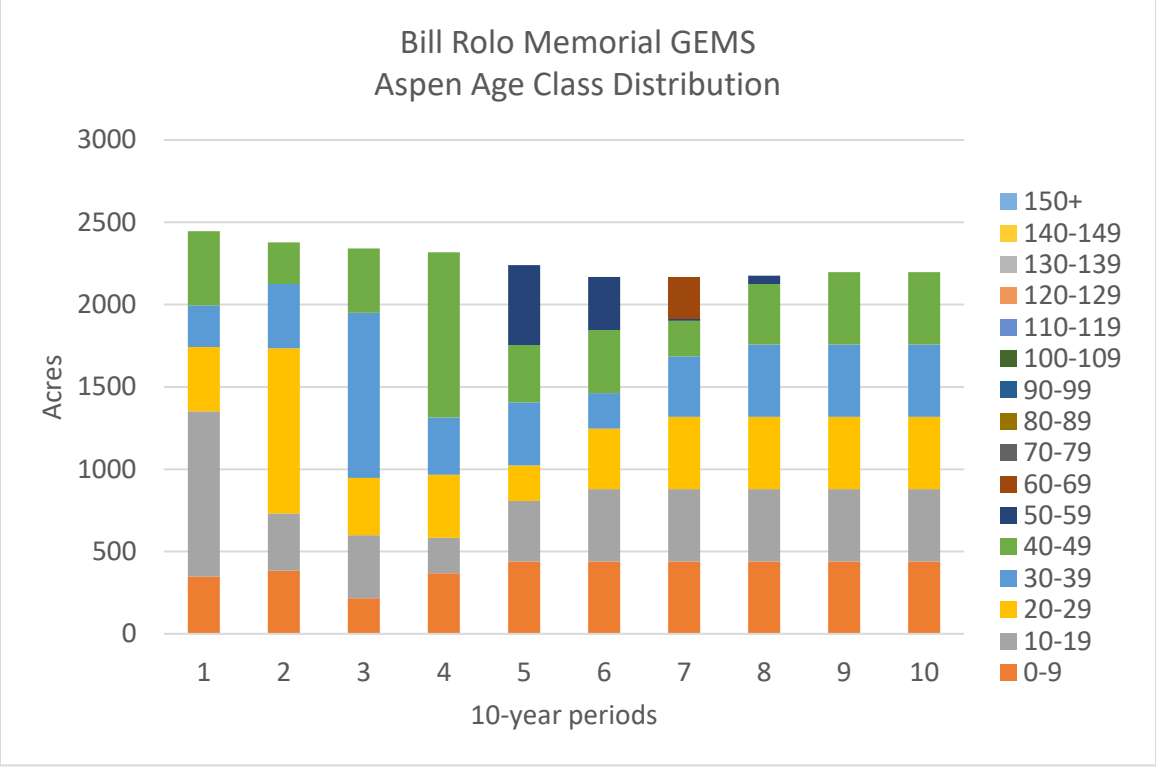


Figure 5. Projected aspen age class distribution across all 15 10-year model periods in the Bill Rolo Memorial GEMS.

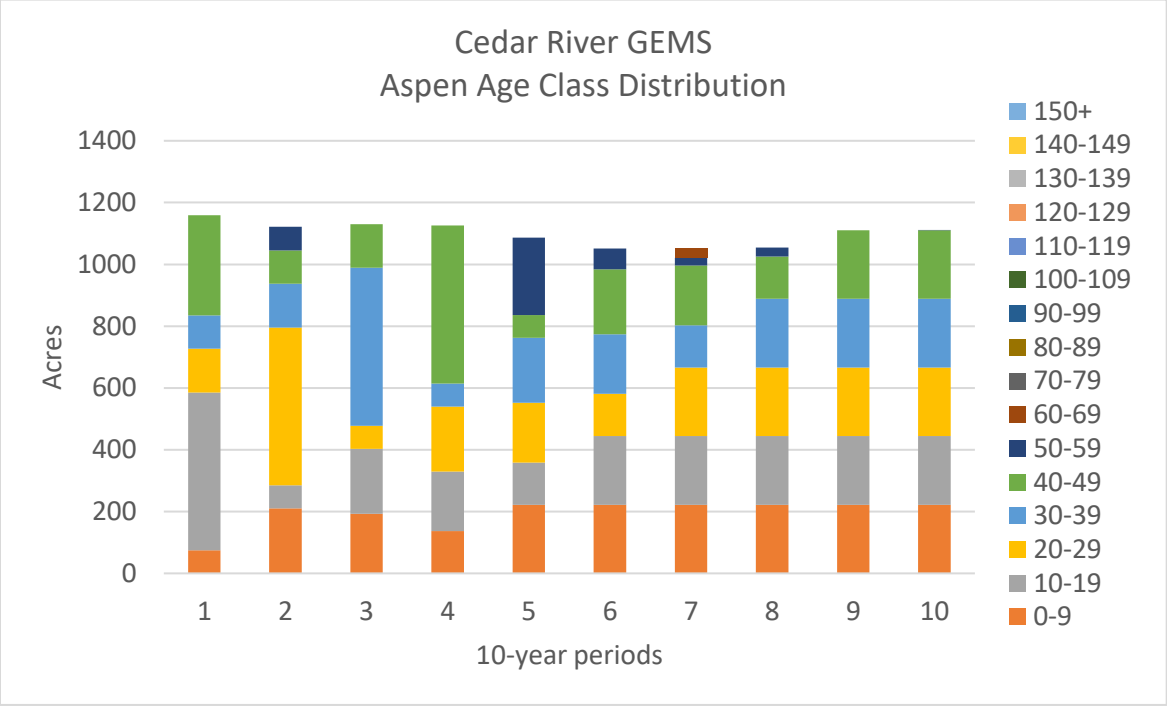


Figure 6. Projected aspen age class distribution across all 15 10-year model periods in the Cedar River GEMS.

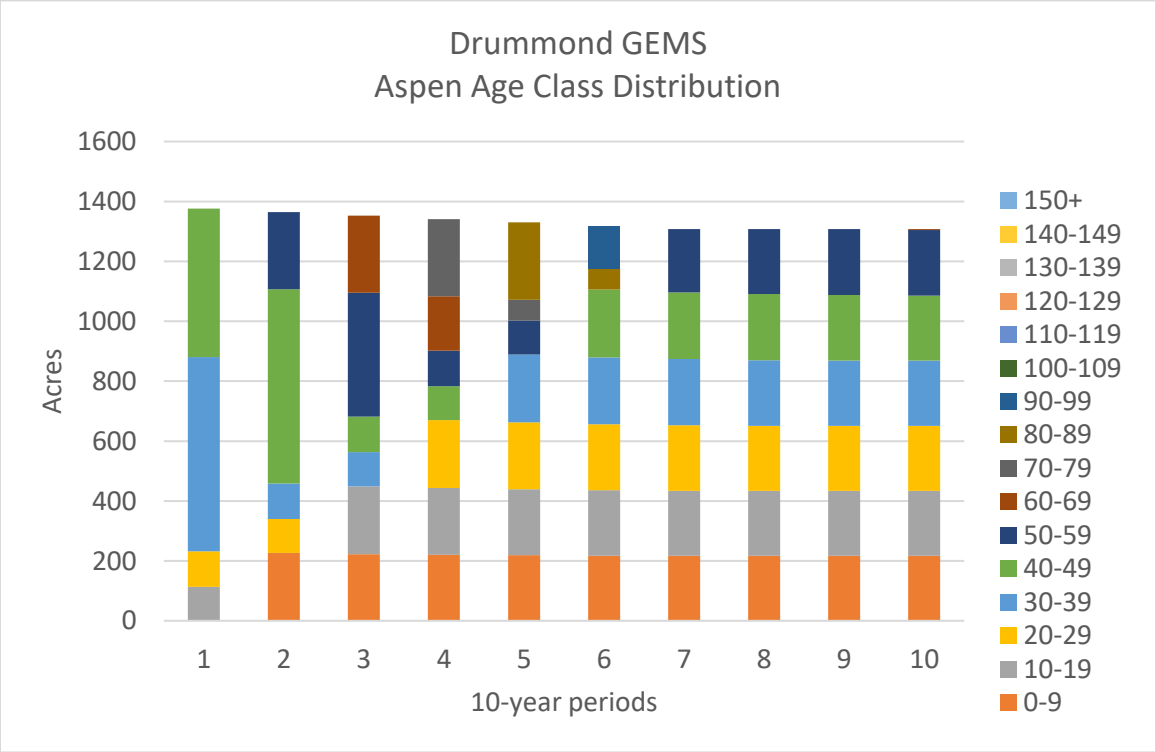


Figure 7. Projected aspen age class distribution across all 15 10-year model periods in the Drummond GEMS.

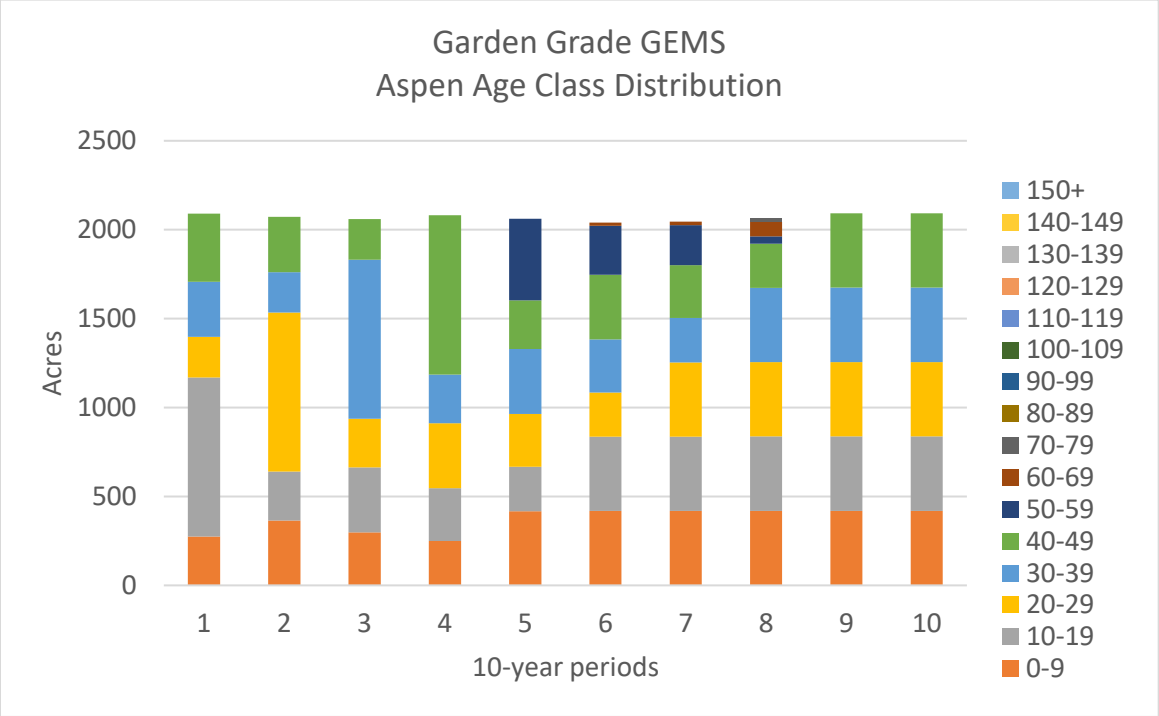


Figure 8. Projected aspen age class distribution across all 15 10-year model periods in the Garden Grade GEMS.

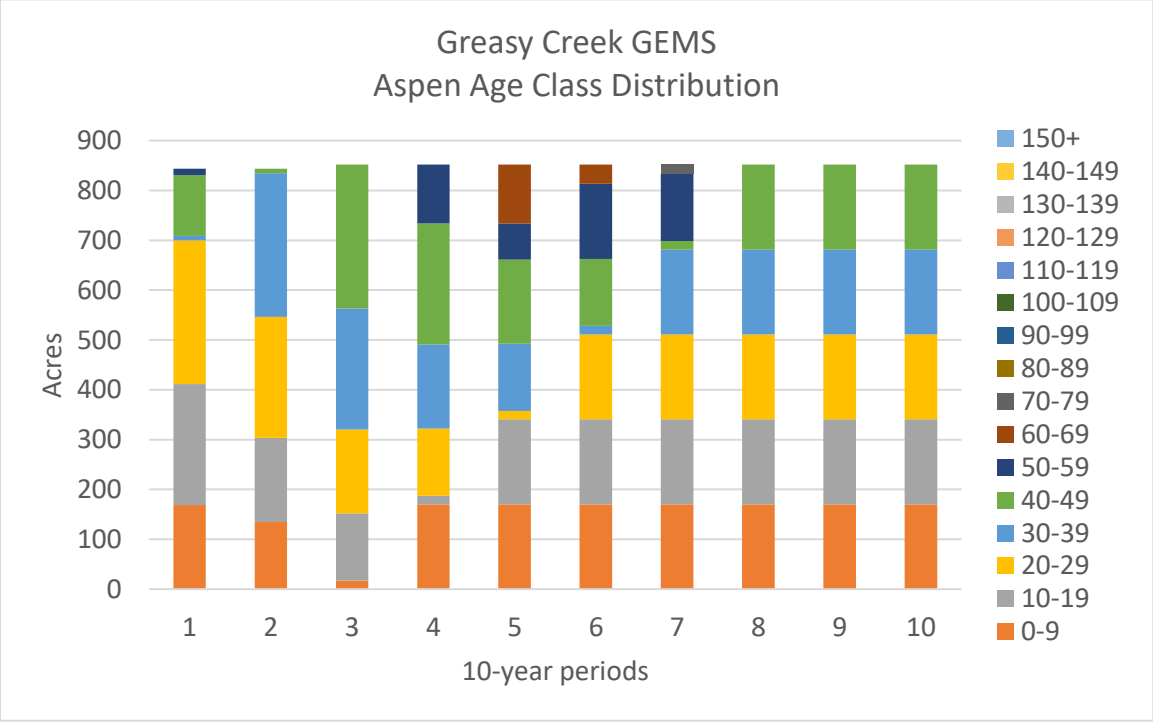


Figure 9. Projected aspen age class distribution across all 15 10-year model periods in the Greasy Creek GEMS.

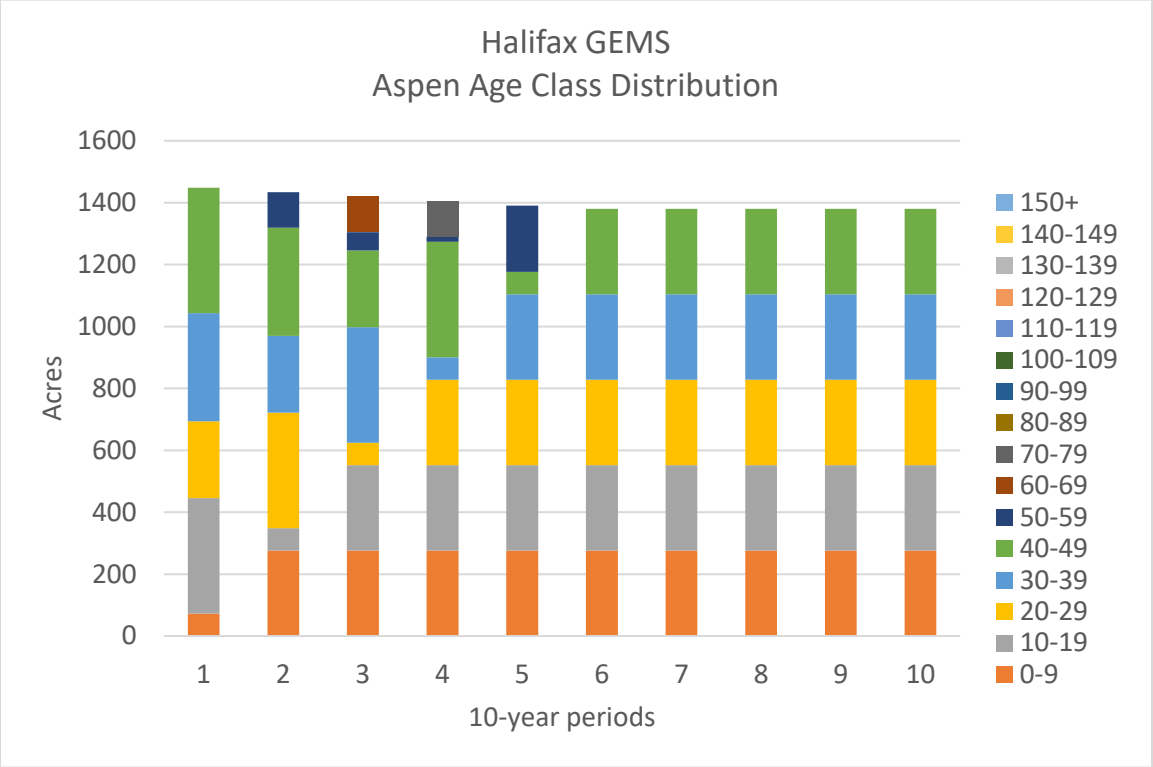


Figure 10. Projected aspen age class distribution across all 15 10-year model periods in the Halifax GEMS.

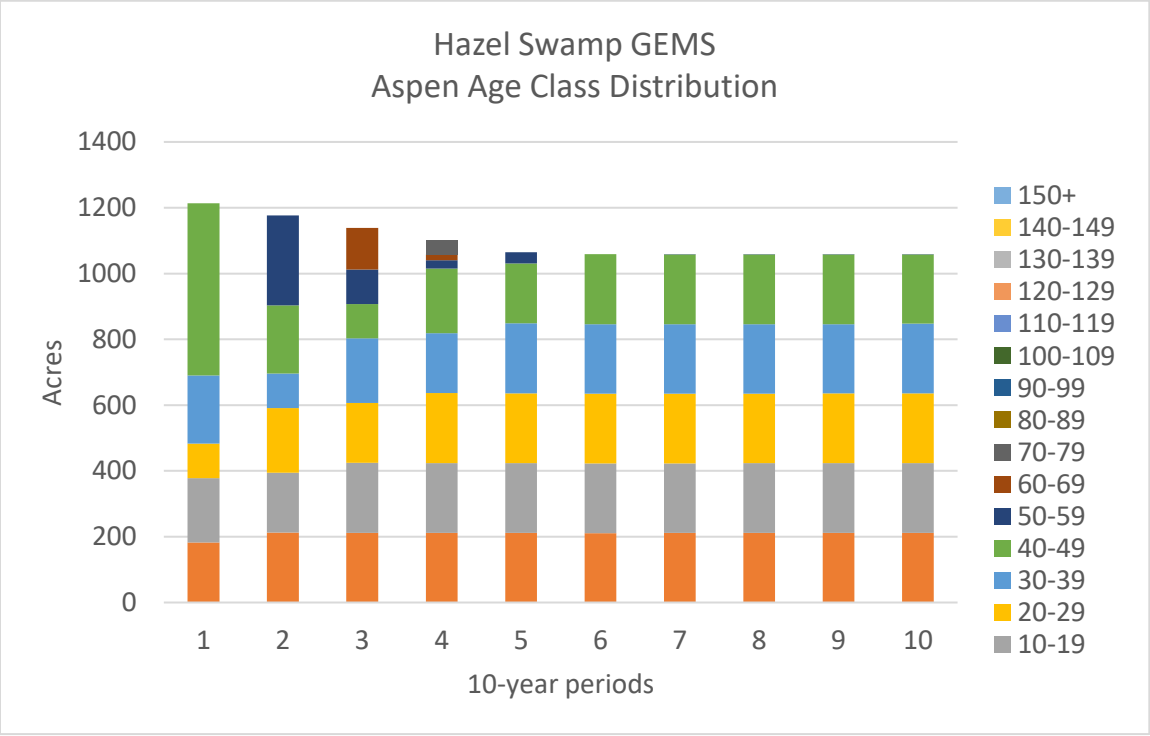


Figure 10. Projected aspen age class distribution across all 15 10-year model periods in the Hazel Swamp GEMS.

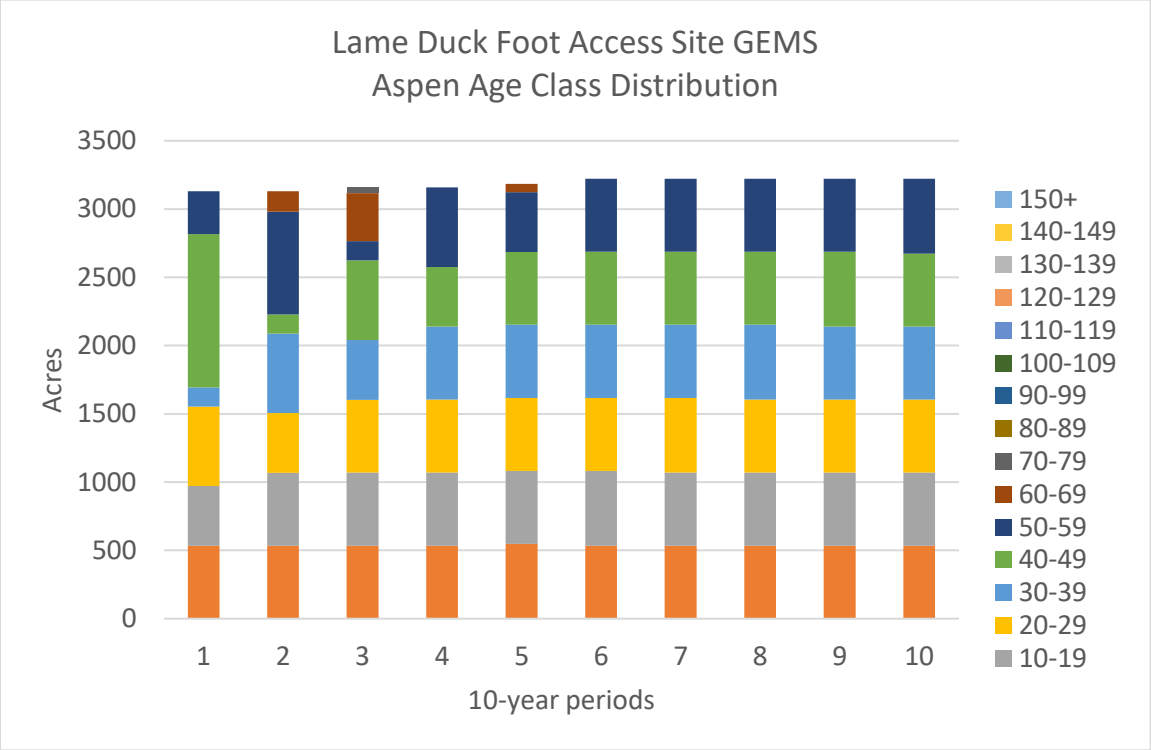


Figure 11. Projected aspen age class distribution across all 15 10-year model periods in the Lame Duck Foot Access GEMS.

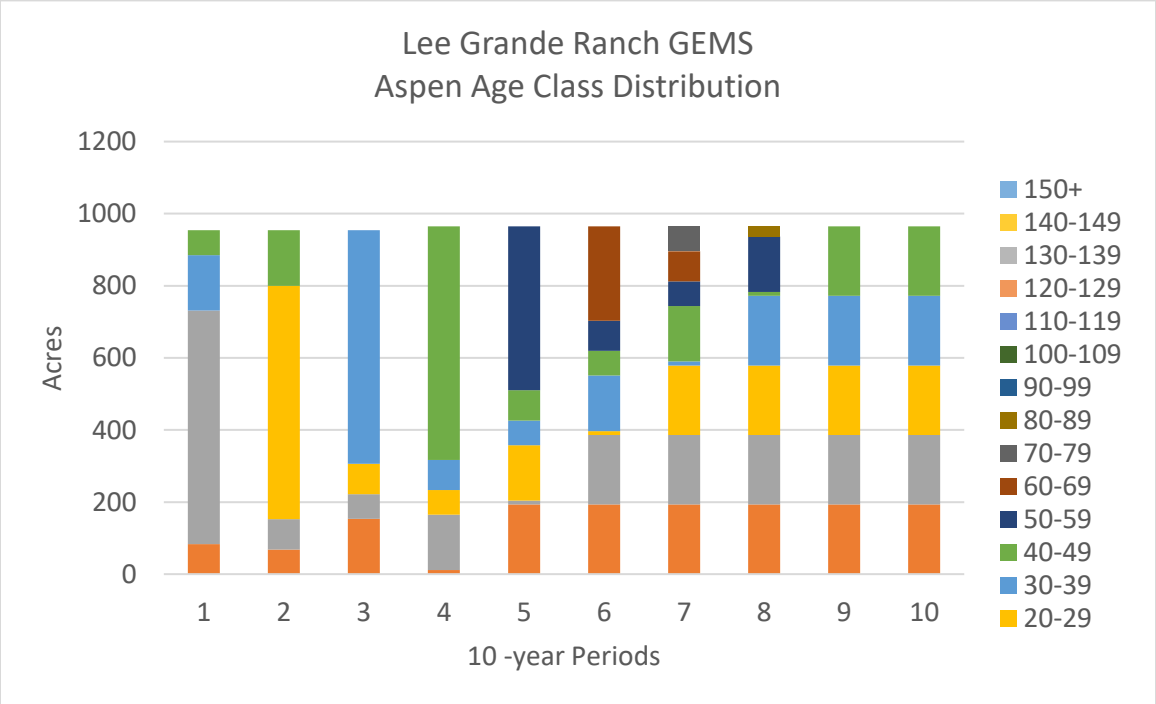


Figure 12. Projected aspen age class distribution across all 15 10-year model periods in the Lee Grande Ranch GEMS.

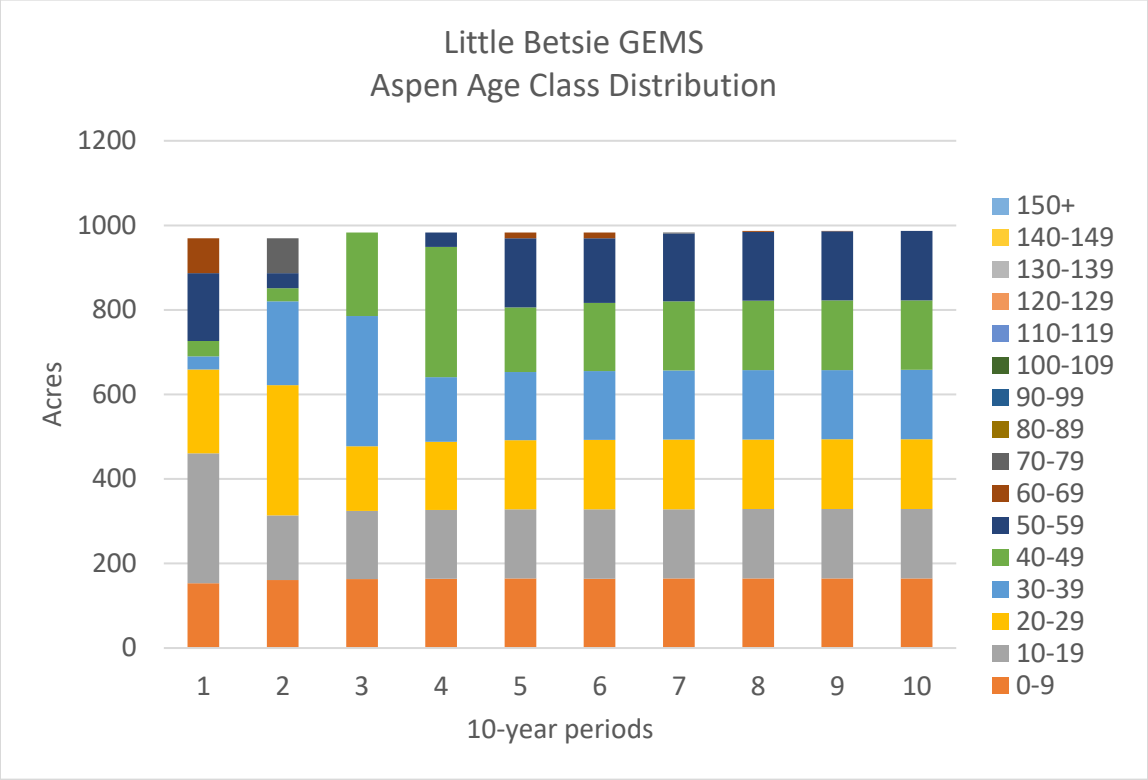


Figure 13. Projected aspen age class distribution across all 15 10-year model periods in the Little Betsie GEMS.

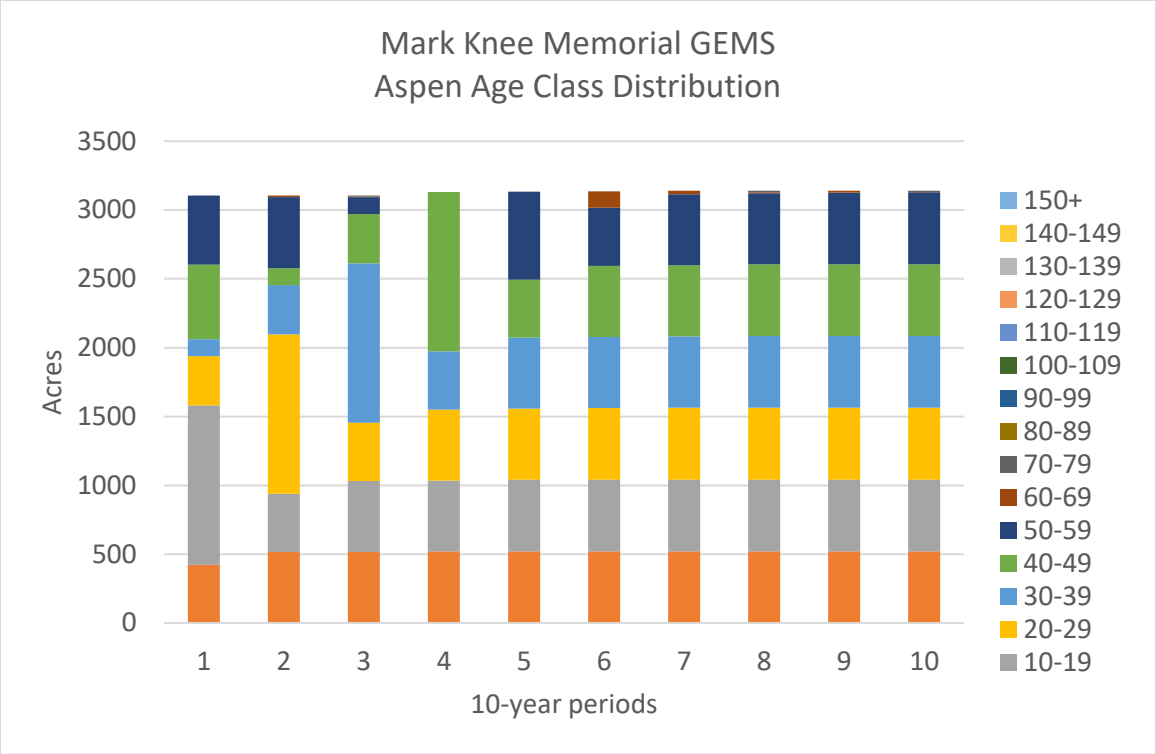


Figure 14. Projected aspen age class distribution across all 15 10-year model periods in the Mark Knee Memorial GEMS.

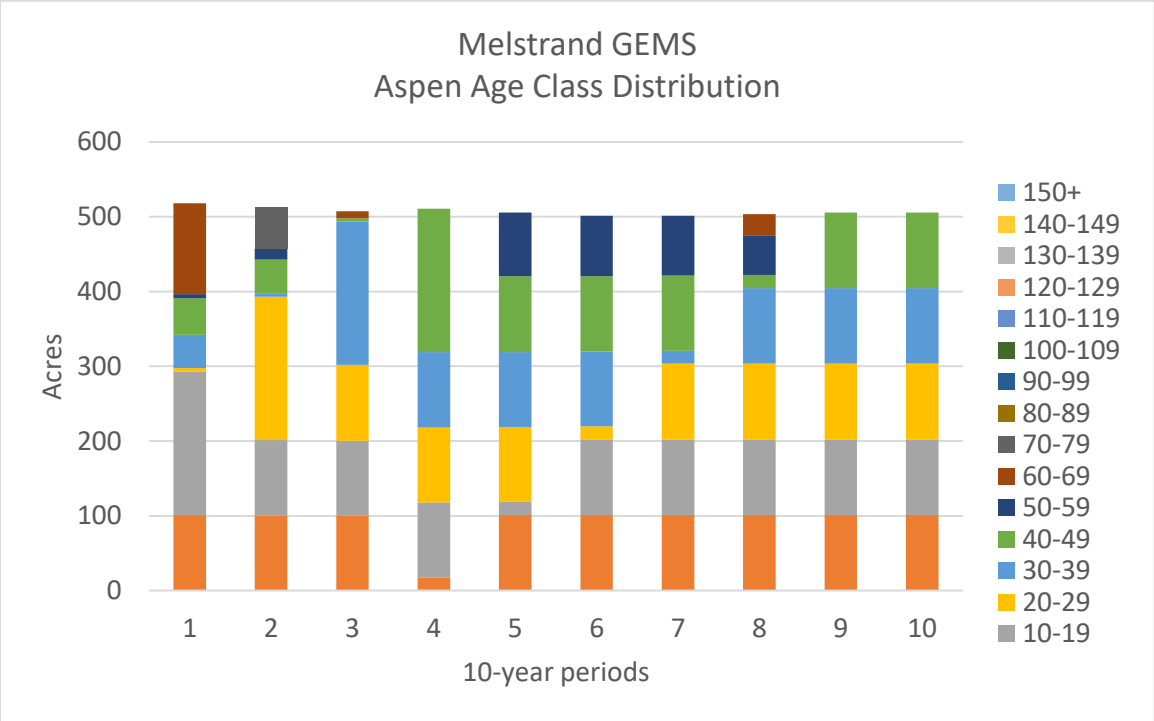


Figure 15. Projected aspen age class distribution across all 15 10-year model periods in the Melstrand GEMS.

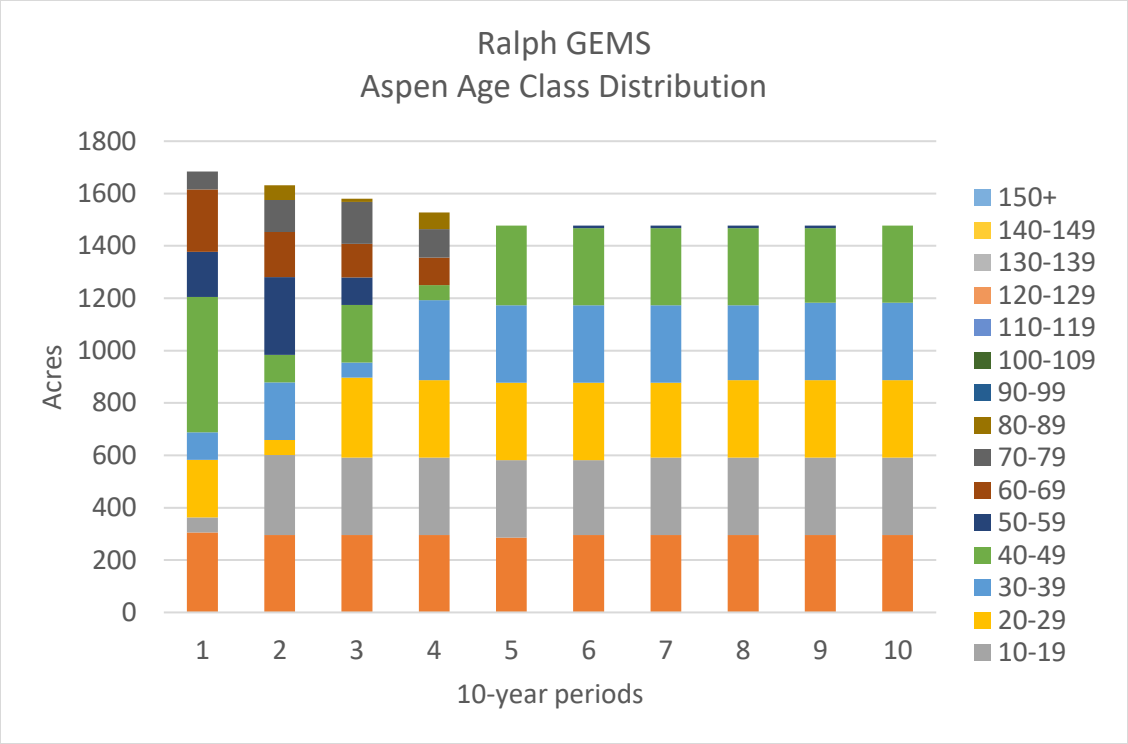


Figure 16. Projected aspen age class distribution across all 15 10-year model periods in the Ralph GEMS.

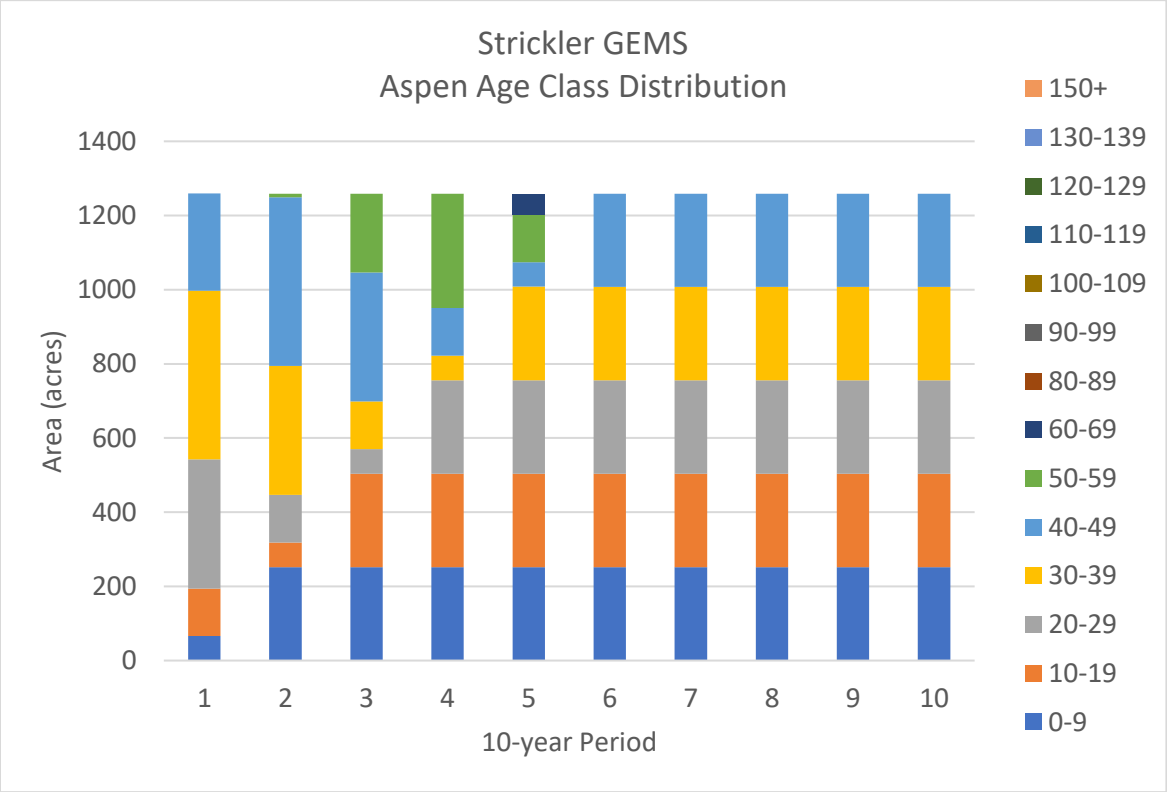


Figure 17. Projected aspen age class distribution across all 15 10-year model periods in the Strickler GEMS.

Management actions

The aspen age class distributions shown in the above graphs can be achieved over time by carefully regenerating the desired amount of aspen in each 10-year period. Projected aspen harvest levels for each GEMS for the next 10 years are shown Table 1.

Table 4. Projected 10-year aspen harvests in each GEMS site.

GEMS/Cover Type	Clearcut Acres
Backus Creek	**168**
Aspen	148
Lowland aspen/balsam poplar	20
Bill Rollo Memorial GEMS	**409**
Aspen	409
Cedar River	**87**
Aspen	87
Drummond	**38**
Lowland aspen/balsam poplar	38
Garden Grade	**287**
Aspen	287
Greasy Creek	**170**
Aspen	170
Halifax	**72**
Aspen	72
Hazel Swamp	**223**
Aspen	214
Lowland aspen/balsam poplar	8
Lame Duck Foot Access Area	**1,070**
Aspen	535
Lowland aspen/balsam poplar	535
Lee Grande Ranch	**88**
Aspen	84
Lowland aspen/balsam poplar	5
Little Betsie	**153**
Aspen	153
Mark Knee Memorial GEMS	**410**
Aspen	410
Melstrand	**111**
Aspen	111
Ralph	**397**
Aspen	358
Lowland aspen/balsam poplar	39
Strickler	**66**
Aspen	10
Lowland aspen/balsam poplar	56

GEMS/Cover Type	Clearcut Acres
Grand Total	**3,683**

Kirtland’s Warbler Essential Habitat

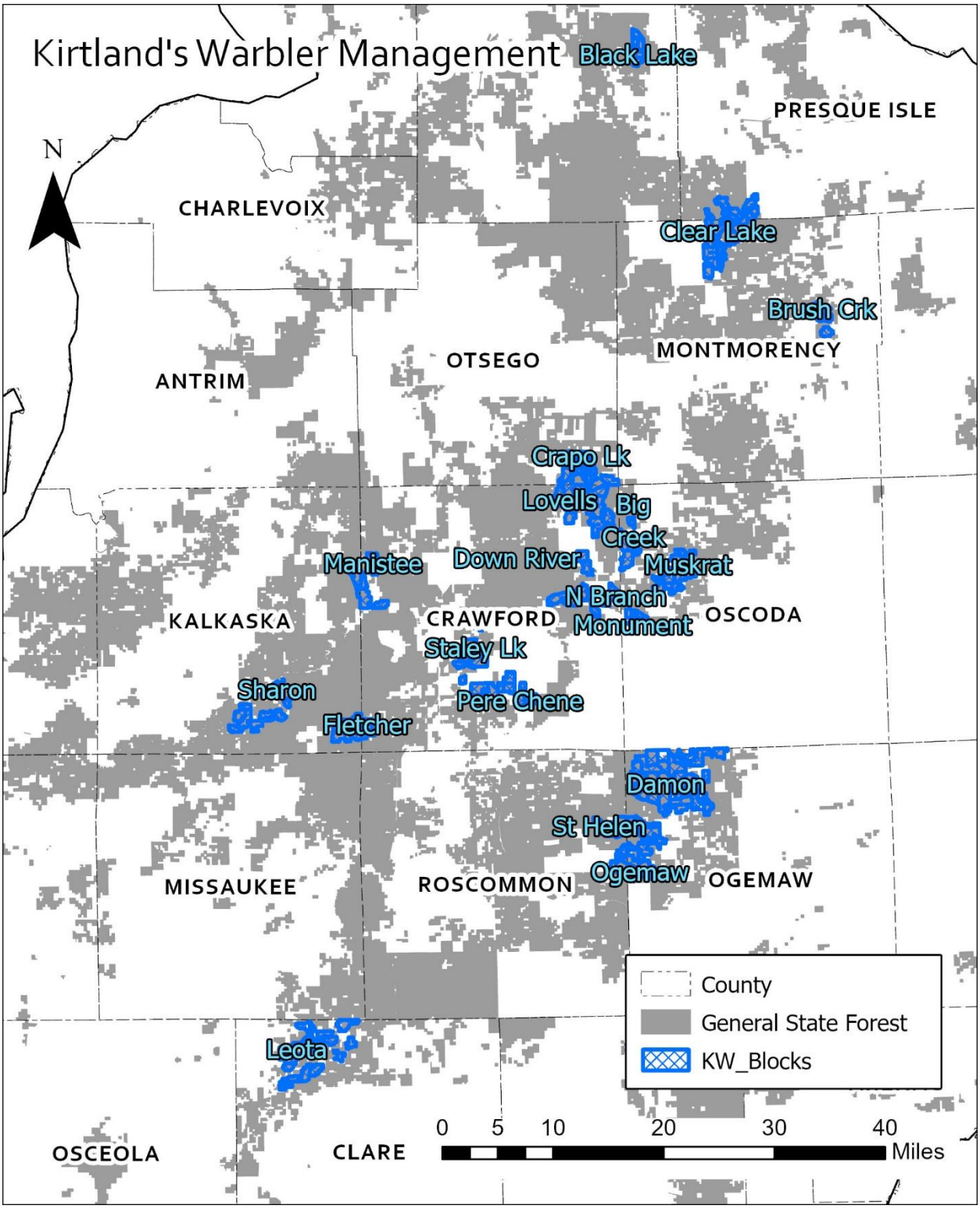


Figure 1. Kirtland’s Warbler Special Analysis Unit geographic distribution in the northern Lower Peninsula.

Description

The Kirtland's Warbler Habitat Management Special Analysis Unit (Figure 1) is comprised of 90,273 acres spread across the northern Lower Peninsula on xeric outwash plains where jack pine is commonly found growing naturally and aligns with the Kirtland's warbler essential habitat high value conservation area.

Special analysis unit goals

Typically, SAU goals are derived from habitat goals defined in a DNR species plan. When the draft of this State Forest Management Plan went out for tribal and public review in 2024, the Kirtland's warbler SAU goals reflected what is in the 2022 DNR Kirtland's warbler operational plan. Since then, in 2025, the DNR's Kirtland's warbler planning team completed a habitat program reassessment and made some notable and necessary changes, including updates to the habitat goal. This renders the operational plan outdated, and it will be revised once the revised version of the species' breeding range conservation plan is finalized and approved, anticipated by late 2026.

In the meantime, there was no opportunity to provide updated model outputs for the SAU with the new habitat goal number. Instead, data from the habitat program planning effort is provided for transparency.

The previous habitat goal for the decade was to create 15,600 acres of habitat to support 750 breeding pairs of Kirtland's warblers on state forest land in the northern Lower Peninsula, with an additional commitment to manage for 50 birds in the Upper Peninsula. After the reassessment, the goal is now 12,080 acres of habitat creation over the next decade, to support approximately 700 birds on state forest land in the northern Lower Peninsula, with the same commitment to manage for 50 birds in the U.P. The goal decrease is due to an increase in the rotation age and the difference between the total acres of essential habitat used in previous calculations versus the acres within essential habitat that can actually be managed for jack pine. The actual manageable land base is 84,573 acres once lowland, aspen and other similar cover types are removed from calculations. The decadal habitat creation goal of 12,080 acres represents what can reasonably and sustainably be achieved long-term.

Once the State Forest Management Plan is in the implementation phase, the DNR's Kirtland's warbler planning team will turn back to the SFMP model and use the opportunity to update the SAU.

Current and desired future conditions

The management framework in the 2022 DNR KW operational plan uses six age classes and is not likely to produce commercially viable jack pine stems at 50-59 years old given the average planting densities of 1,452 stems per acre. Recognition of this shortly thereafter prompted extensive analysis of the current condition and desired future condition of Kirtland's warbler essential habitat. Data from Dr. David Rothstein (Michigan State University) showing the diameter differences in jack pine suggested that the rotation age should be increased to 60 years, resulting in an age class distribution with seven age classes. Further, it was revealed that there is a current deficit in commercially viable jack pine and red pine to support harvesting and regeneration needs to create a desirable level of habitat for warbler breeding requirements. This is because the age class distribution of jack pine in essential habitat skews young; most of the acres are under 40 years old, which doesn't leave enough in the older, commercially marketable age classes to meet the habitat goal. To address this gap, the planning team identified the potential for commercial harvest in the 30-year age class for the biomass market and for mastication in

the 20-year age class as ways to supplement annual habitat creation and ensure the goal is met. Mastication is the use of a forestry mower to mulch small-diameter trees, and in this case it would be used across a stand to restart habitat.

The challenge was to figure out how many supplemental acres of younger age classes could be harvested commercially and marketed for biomass, as well as how many acres needed to be cleared using mastication to prepare sites for planting. The Woodstock model offered the opportunity to run various scenarios. In 2022, the modeling team evaluated the current condition of the stands that were eligible to receive one of three treatments based on their age and relative average stem diameter:

1. Commercial roundwood production (60-plus years old).
2. Biomass (30-39 years old).
3. Mastication (20-29 years old).

A model scenario was developed for the Kirtland's Warbler Special Analysis Unit using an objective function to minimize mastication and fill in with as little biomass as possible for the first period, also supplementing with the areas that were commercially viable for roundwood production, all while trying to maintain enough habitat to support 750 breeding Kirtland's warbler pairs in the northern Lower Peninsula, which was thought possible at the time. Transitions were also specified to convert eligible stands to planted jack pine whenever possible to maximize the amount of area available for habitat creation. The model solution for projected harvest levels by type and period are shown in Figure 2.

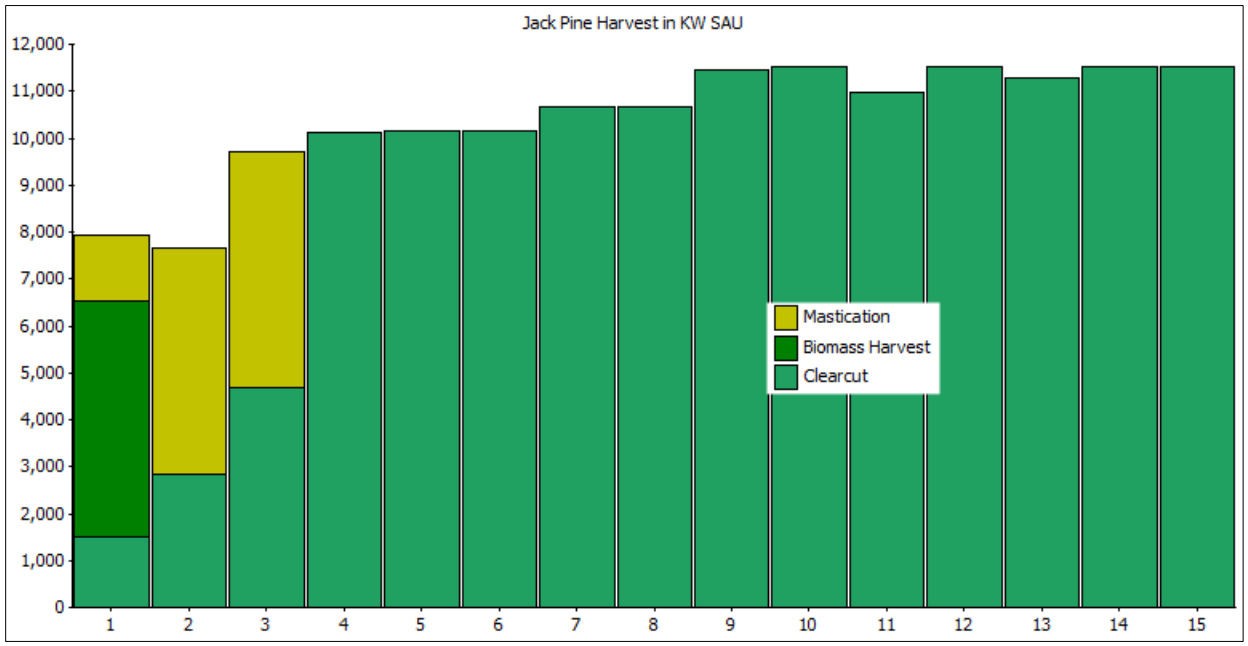


Figure 2. Acres of jack pine harvest/site clearing by method in the Kirtland's Warbler Special Analysis Unit from the 2022 SAU model.

The jack pine harvest (and mastication) levels above for each period provided a plausible solution to minimize mastication treatments and supplement with commercial harvests to return to a long-term sustainable solution that uses only traditional clearcut harvests producing a viable pulpwood/roundwood product. Additional acres of harvest from other cover types like planted red pine

are also forecasted and will be converted to jack pine in each period, resulting in a gradual increase in jack pine across the warbler unit (Figures 3, 4).

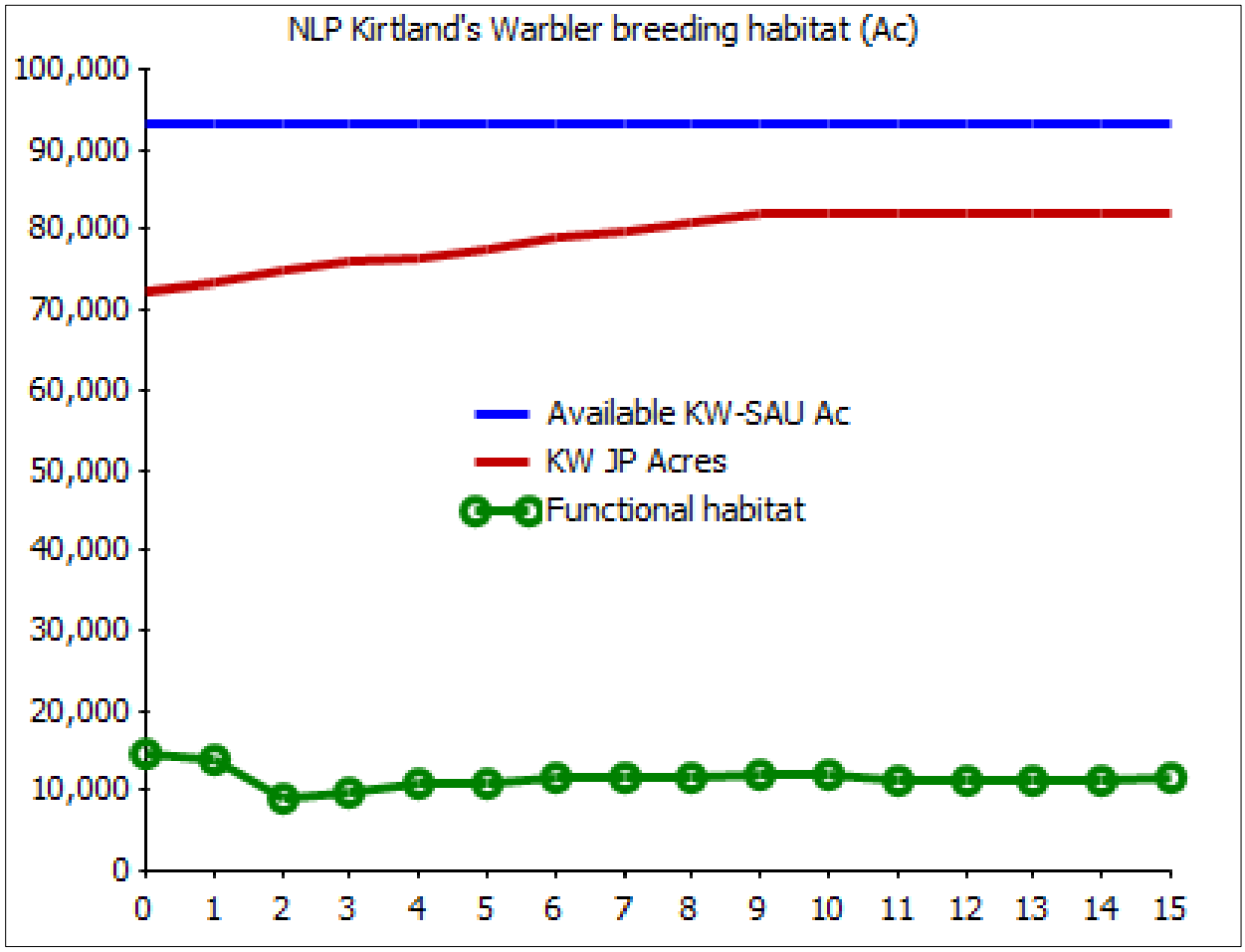


Figure 3. Kirtland's warbler jack pine and functional habitat acres in the special analysis unit from the 2022 SAU model.

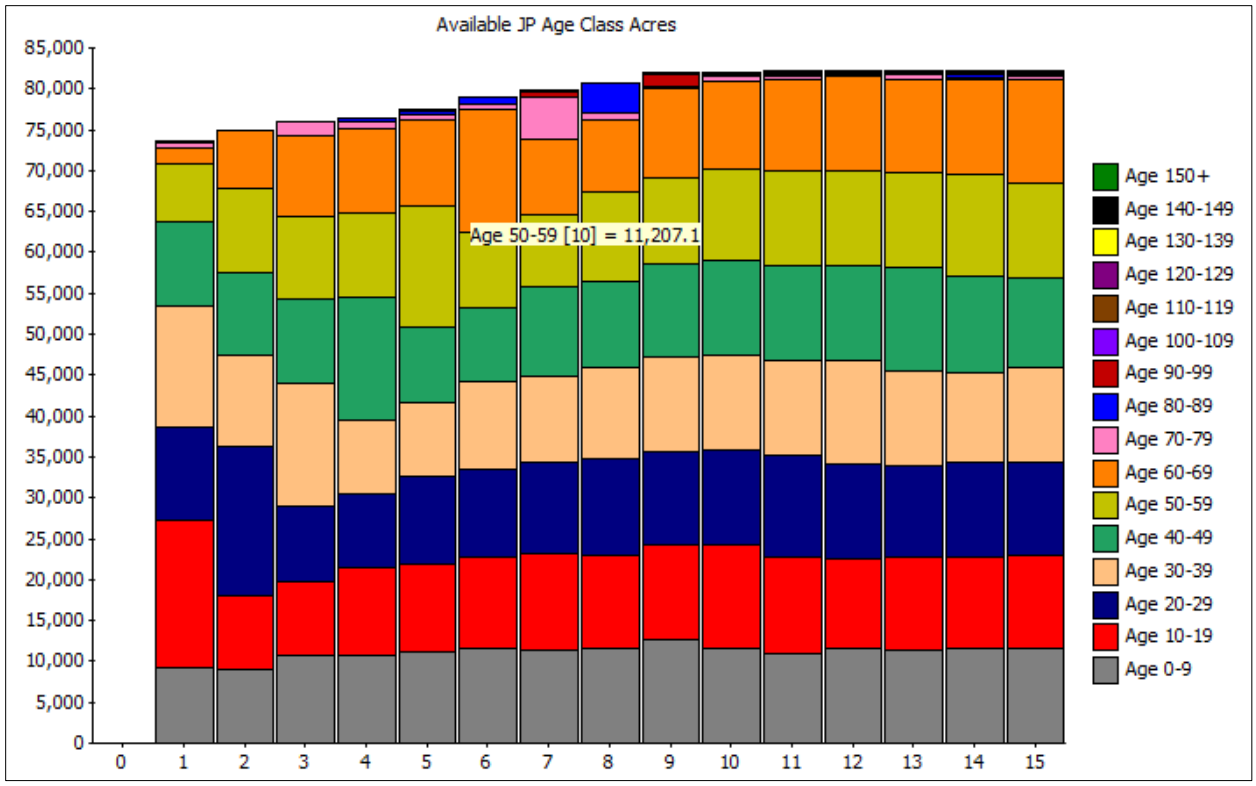


Figure 4. Projected jack pine age class distribution across the Kirtland's Warbler Special Analysis Unit in each 10-year period from the 2022 SAU model.

The model also projected the number of breeding pairs over time. Due to a lack of habitat in the first two periods, the results show a decline from current numbers before rebounding and leveling off as a more sustainable level of harvest is achieved (Figure 5).

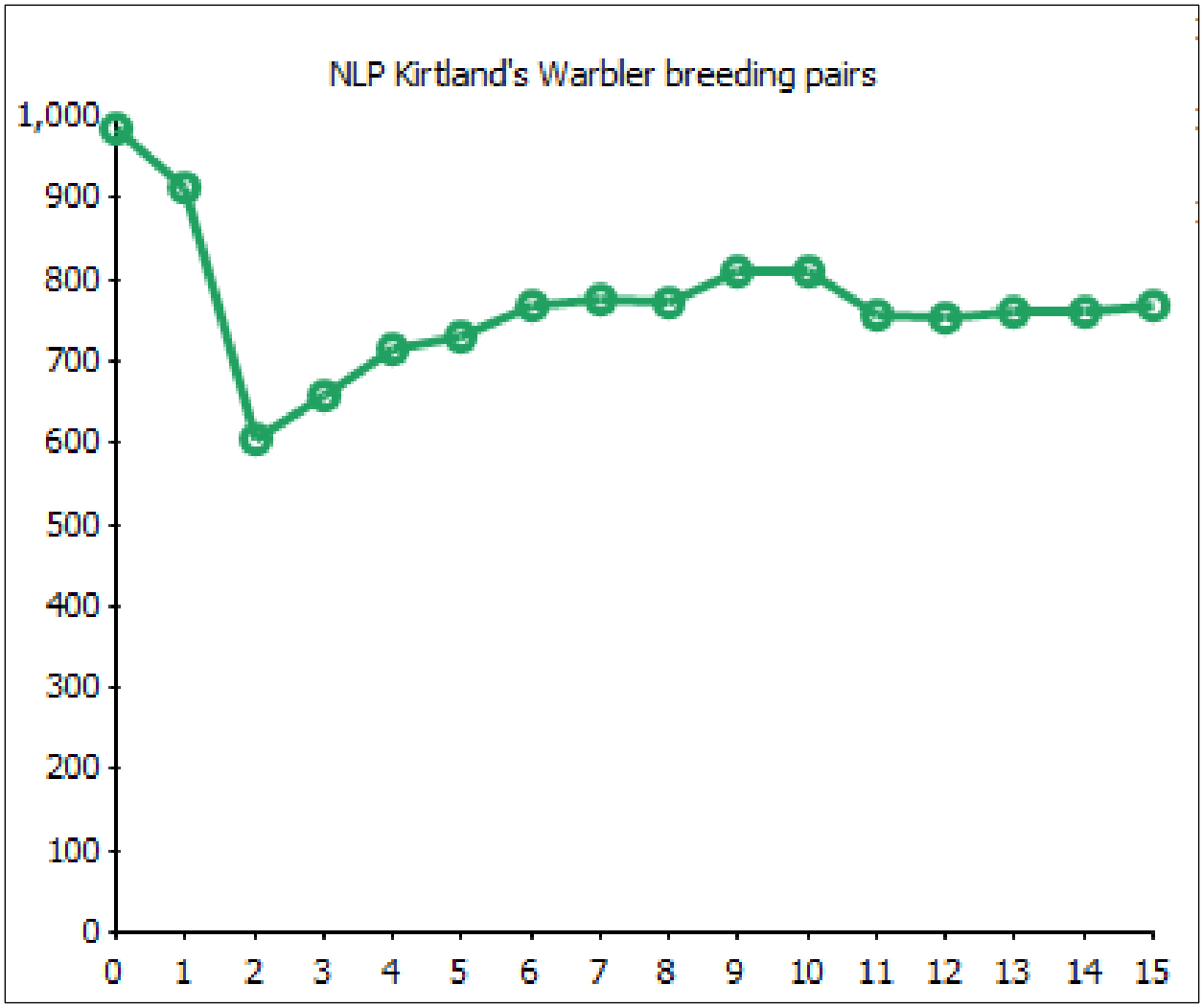


Figure 5. Projected number of breeding pairs of Kirtland's warblers on state forest land in the northern Lower Peninsula from the 2022 SAU model.

Since the SAU model was run in 2022, the planning team has continued to refine the habitat management program. This has included revisions to essential habitat boundaries to reduce the area that can't be managed for jack pine, an increase in the minimum management block size (300 to 500 acres) where possible, the purchase of a masticator through a grant with a minimum acreage commitment and finer resolution of the manageable land base for Kirtland's warbler within essential habitat. This refers to only those acres that can be managed for jack pine; there are many small areas of lowland, aspen and other cover types interspersed within essential habitat.

The result of both the model run and the subsequent program revisions is that, within a commercial pulpwood framework, the habitat goal must be reduced to be sustainable long-term. To balance seven age classes across the manageable land base, the new decadal habitat goal is 12,080 acres. The reduction in habitat creation is expected to be offset by the gradual increase in patch size to a minimum of 500 acres, creating habitat that will support higher bird densities. Larger habitat patches (minimum of 300 and maximum of 1,200 acres) across the landscape are expected to result in bird densities nearing

15 acres per breeding pair, sustaining around 700 breeding pairs on state forest land in the northern Lower Peninsula. Though management is intensive, maximizing bird densities within the Kirtland's warbler essential habitat footprint allows for the ability to manage for other values in other places.

Management actions

Even though the 2022 SAU model uses some outdated numbers, and thus can't be used to generate specific harvest goals for the planning period, the feasibility it showed in using alternate treatment methods to eventually balance age classes and maintain bird numbers is still informative in treatment planning. The following 12-year management actions (Table 1) were developed by the planning team in 2025 and serve as the current habitat treatment plan until the SAU can be updated in the SFMP model. The 12-year total is slightly higher than expected when applying a 12,080-acre decadal habitat goal. However, given that the model projects an initial downturn in both habitat and bird numbers, the slight increase in acreage this represents is anticipated to help offset those without getting too far off track. Further, planned acres and timing are always subject to operational adjustments; the planning team will monitor and adjust annually throughout implementation.

Prescribed fire was not included in the SAU model run, but since then, there has been growing interest in attempting to add it as a management tool. Some sites were identified as options by the planning team, which are reflected in the planned management actions. However, uncertainties remain related to safety, funding and feasibility, such that the acres listed here may change, be delayed or be transferred to one of the other treatment methods.

Following this plan will help to provide enough Kirtland's warbler breeding habitat to support a sustainable population given the current condition of the forested landscape.

Table 1. Planned treatment acres by treatment type within the Kirtland's Warbler Special Analysis Unit over the next 12 years.

Treatment Preparation Year	Biomass	Clearcut	Mastication	Rx Burn	Total Acres
2026	394	1,128	674	207	**2,403**
2027	1,076	25	798	--	**1,900**
2028	457	161	503	280	**1,401**
2029	947	159	--	--	**1,106**
2030	360	639	--	--	**1,000**
2031	839	130	109	--	**1,078**
2032	1,328	190	64	144	**1,726**
2033	--	449	254	--	**703**
2034	247	292	--	--	**539**
2035	--	--	905	--	**905**
2036	1,213	--	--	--	**1,213**
2037	758	344	--	--	**1,102**
2038	634	90	203	--	**927**
Total Acres	**8,252**	**3,607**	**3,509**	**631**	**16,000**

Deer Wintering Complexes

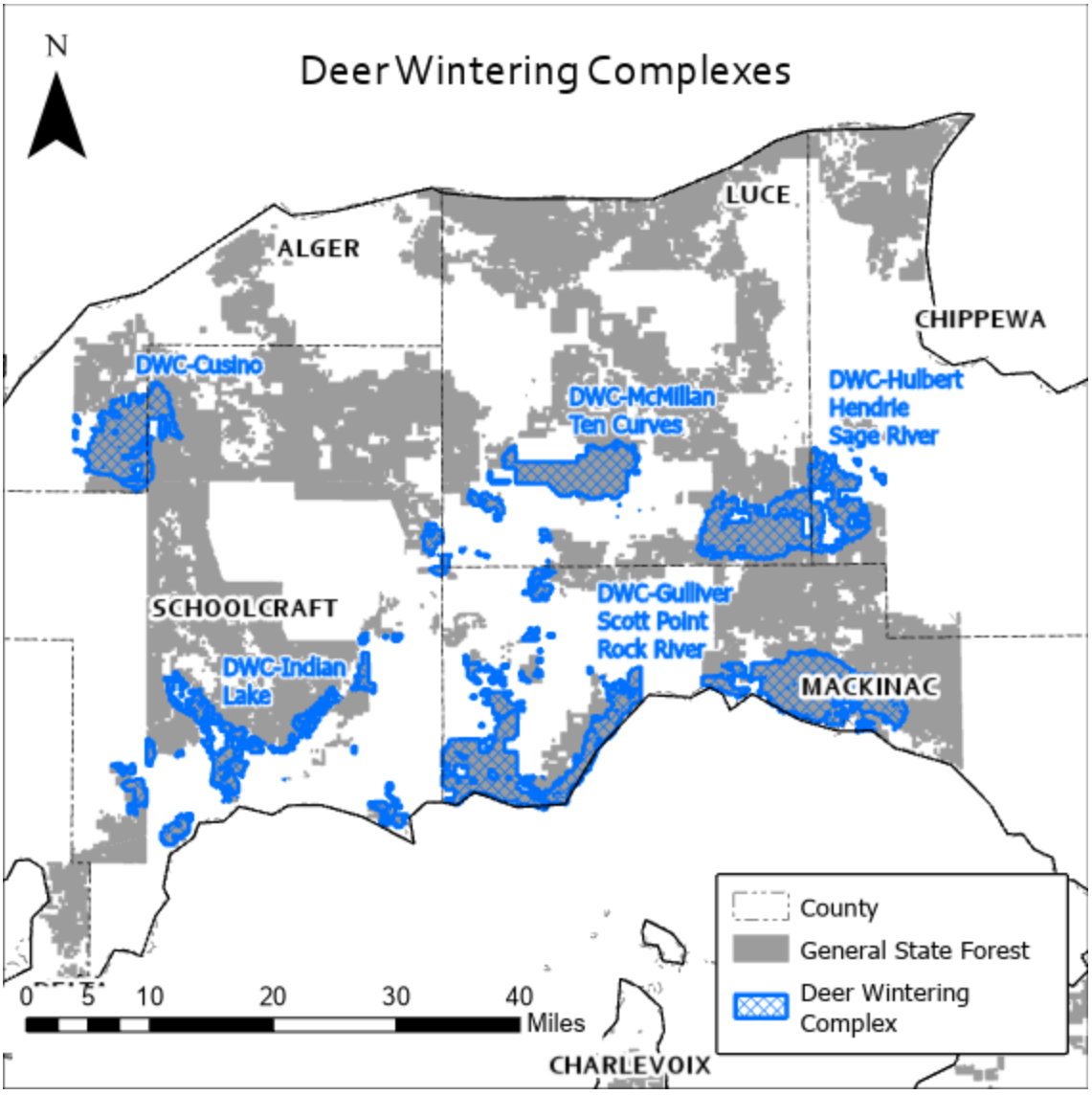


Figure 1. Geographic distribution of the eastern Upper Peninsula deer wintering complex special analysis units.

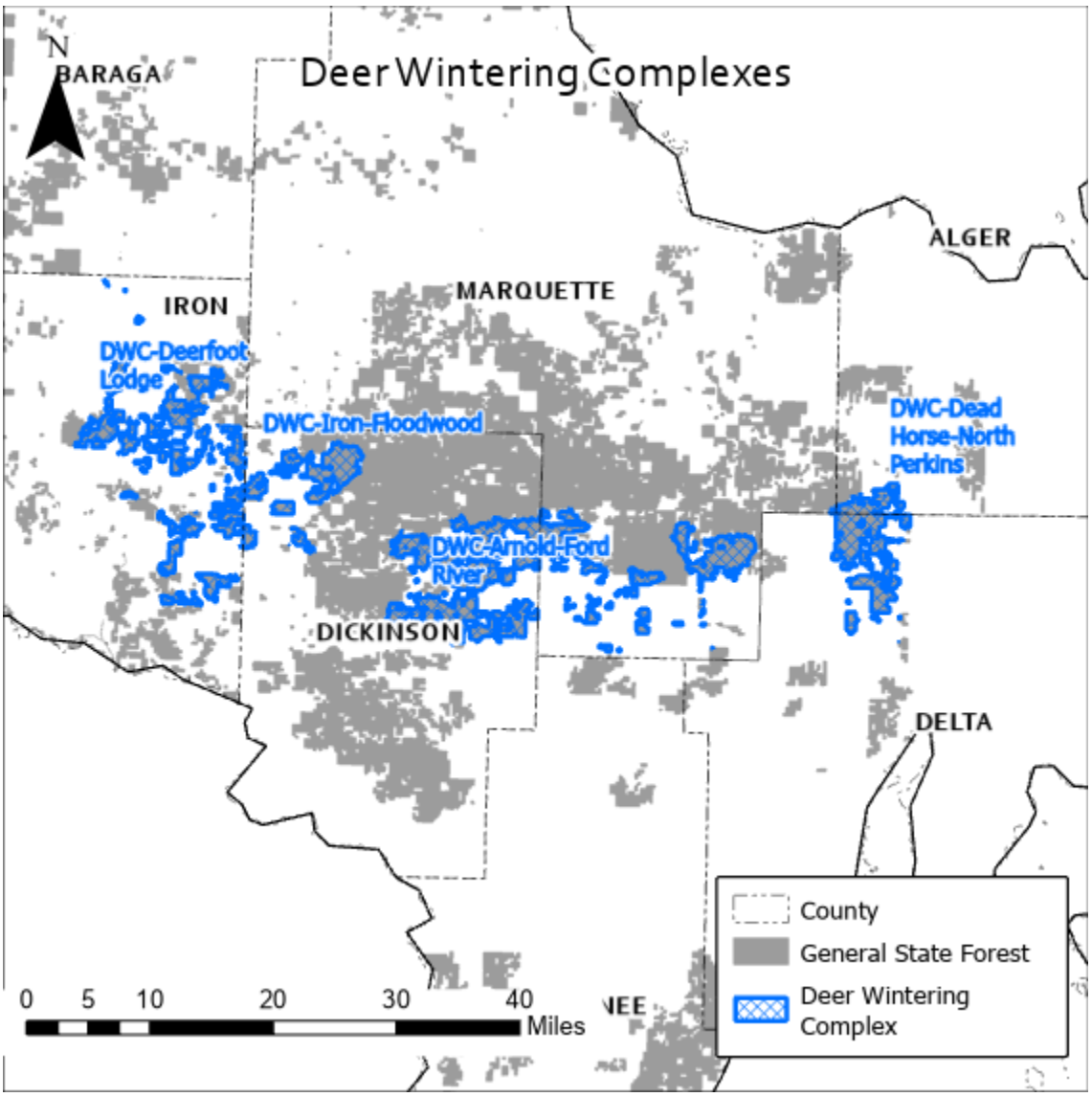


Figure 2. Geographic distribution of the western Upper Peninsula deer wintering complex special analysis units.

Description

Deer wintering complexes included in this planning effort as a special analysis unit contain greater than 15,000 acres of state forest land and have a management plan already in place. Guidance for the modeling work specific to the wintering complexes was pulled from these plans and incorporated into the model in various ways. A summary of the important components of complexes can be found in each plan. An example from the Hulbert-Sage River Deer Wintering Complex Management Plan states:

> *In most of Upper Michigan, deer begin migrating to wintering complexes when snow accumulates between 12-18 inches, typically in mid-late December. Deer remain on their winter ranges until snow melts in spring and their mobility is restored. This confinement period on winter range can vary from 60 days to well over 100 days during an especially long winter. Significant winter-related deer deaths plus reduced physical condition and*

high newborn fawn mortality occur with durations of 90-100 days with greater than 12 inches of snow covering the ground. The U.P. winters of 1996 and 2014 had winter durations greater than 100 days and are remembered as especially severe for deer. To survive these long confinement periods on winter range, deer seek locations that provide both shelter and food suitably interspersed across the landscape.

Conifer stands with high canopy closure provide deer with shelter by reducing snow depths beneath the canopy and facilitating movement via extensive connected packed trails. Trail systems provide easier access to food and also assist deer in evading predators. These shelter stands also reduce wind chill and perhaps radiant heat loss. Shelter is defined by several categories:

- *Functional Shelter: Conifer stands with at least 70% canopy closure and tree heights greater than 30 feet. These thresholds for canopy closure and height ensure the stand is effective at intercepting snow, resulting in decreased snow depths and increased mobility for deer to access food and avoid predators.*
- *Primary Shelter Species: Cedar and hemlock trees provide the best functional shelter as they intercept larger amounts of snow than other conifers. These species also are a favored winter food source which makes them difficult to regenerate and recruit back into the stand canopy. These species are long lived, however, and on some sites may survive 400 years or more. Most stands in the UP are 100-200 years old.*
- *Secondary Shelter Species: White spruce, balsam fir and white pine intercept less snow than cedar and hemlock but contribute to functional shelter especially when mixed with cedar and hemlock trees. These trees also provide feeding corridors through hardwood stands and shelter during periods of lower snow depth. Often these species occur as a component of mixed stands in the transitions between upland and lowland, such as in red maple stands.*

Food is an integral habitat component for deer in winter. While adult deer can enter winter with sizeable fat reserves, fawns have not yet completed skeletal growth and therefore carry smaller percentages of fat. Thus, fawns must have dependable access to food to survive the winter. Some key sources of winter food are:

- *Cedar and hemlock fronds where accessible.*
- *Litter fall – cedar and hemlock fronds, hardwood stems, and lichens dropped due to wind and snow action.*
- *Hardwood browse – most of the browse is available in aspen, red maple and northern hardwood stands, either as felled tops from winter timber harvest activity or as regenerating stems of trees and shrubs such as red-osier dogwood in years following timber harvests or natural disturbances such as windfall.*
- *Oak acorns –deer are able to access acorns early and late in the winter as snow depths allow.*

- *Spring herbaceous foods – forest openings inside and adjacent to DWC's often provide protein-rich food for several weeks in spring and fall before deer enter or vacate the complexes.*

Seven individual outputs were created for the State Forest Management Plan model that helped add up acres of each component that was at the cover-type level.

1. **All shelter** – All acres in the shelter cover types regardless of age and stocking:
    a. Hemlock
    b. Cedar
    c. Lowland conifers
    d. Upland conifers
    e. Upland spruce fir
    f. Lowland spruce fir
    g. Planted red pine
    h. Planted white pine
    i. Natural red pine
    j. Natural white pine
    k. Natural mixed pine
2. **Primary shelter** – Acres of the following cover types:
    a. Hemlock
    b. Cedar
3. **Secondary shelter** – Acres of the following cover types:
    a. Lowland conifers
    b. Upland conifers
    c. Upland spruce fir
    d. Lowland spruce fir
    e. Planted red pine
    f. Planted white pine
    g. Natural red pine
    h. Natural white pine
    i. Natural mixed pine
4. **Functional shelter** – A subset of acres in the cover types that have a/an:
    a. Age greater than or equal to 40 years old
    b. Diameter greater than or equal to 4 inches
    c. Canopy cover greater than or equal to 51%
5. **All food** – Acres in the food cover type regardless of age and stocking:
    a. Aspen
    b. Lowland aspen
    c. Northern hardwoods
    d. Lowland deciduous
    e. Upland mixed forest
    f. Lowland mixed forest
    g. Oak mix
6. **Functional food** – A subset of acres in the "all food" cover types dependent on age:
    a. Age classes 0-9 and 10-19 (providing browse opportunities)
7. **Functional food** – Northern hardwood selection harvest:
    a. Food created as tops are left from the harvest

These thematic outputs generated acres of each component specific to each deer wintering complex so they could be used in the goal statements as well as graphics displaying scenario results.

Special analysis unit goals

The overall long-range goal of the deer wintering complexes is to reach a 50:50 ratio of shelter and food types in each complex while providing a consistent flow of food resources available to wintering deer. The management of deer wintering complexes is focused on providing and maintaining deer habitat over maximizing timber harvest.

Specific goals were extracted from the Hulbert – Sage River Deer Wintering Complex Management Plan but remain consistent across the other wintering complexes.

Deer winter range goal:

1. Sustainably manage shelter and food resources on deer winter range to reduce overwinter deer population fluctuations by:
    a. Maintaining or enhancing conifer shelter, thereby facilitating deer movement to obtain food.
    b. Providing high-quality food adjacent to shelter.

Deer wintering complex objectives:

2. Move toward 50% of the complex in shelter species.
    a. Maintain primary shelter (cedar and hemlock).
    b. Increase secondary shelter (white spruce, balsam fir, white pine and mixed stands) when below 50%.
3. Move toward 50% of the complex in sustainable food stands to enhance available browse.

Sustainable management of both food and secondary shelter cover types was incorporated into the model using specific age class goals for each relevant cover type in each wintering complex. This incentivizes the model to only harvest at a level that would generate a balanced age class distribution over time in each cover type specific to each complex. These goals help address concerns from the previous planning period where age class goals were only set at the management area level and not specific to each deer wintering complex.

The specific age class goals essentially perform area regulation strategies specific to each food and shelter cover type in each deer wintering complex, bringing confidence to a sustainable flow of habitat components over time. Goal 1.b. from above will have to be accomplished during the implementation phase at the local unit level during the compartment review process. The State Forest Management Plan model does not have spatial relationships built in to ensure proximity requirements are met between food and shelter stands. Likewise, avoiding additional fragmentation should be considered related to this goal, with the intention of not increasing fragmentation of shelter stands, which increases energy expenditures for wintering deer. The wintering complex objective 2.a. was incorporated into the management plan model by relying on site conditions, making those stands unavailable for management, and no age class goals were created for cedar and hemlock cover types.

Objectives 2.b. and 3 are accomplished through a specific set of transitions in the management plan model that shows a gradual cover type conversion on a subset of stands harvested over time. The actual selection of stands to convert from food to shelter and vice versa must be done in the field and informed by the importance of individual stands to wintering deer, species composition and prescription specifications resulting in desirable conversions that benefit deer.

Current and desired future conditions

All deer wintering complexes in the eastern Upper Peninsula have a higher component of shelter than food, and conversions are relatively straightforward as mixed coniferous/deciduous stands currently providing secondary shelter can be converted to food stands by expanding the deciduous species component. Western Upper Peninsula deer wintering complexes are in the opposite condition, and accomplishing these objectives requires a bit more effort in regenerating a higher conifer component both through artificial and natural means by converting food cover types to those providing shelter.

These stand conversions from shelter to food and vice versa are not bound by the same requirements or criteria that would be applied to stands outside of the deer wintering complexes. For example, planting mixed pine species (can include white, red and jack pine) when converting food stands to shelter does not need to meet conditions for free-to-grow requirements, spacing or limiting species composition. In addition, flat planting may be desirable, and herbicide treatments for the plantings are likely not desirable in these situations where the competing stems provide a food source for wintering deer. Similarly, retention of conifer species is generally encouraged in aspen and other food stand harvests, as opposed to a more traditional clearcut with very little retention, if it is determined beneficial for deer. Likewise, converting secondary shelter to food stands can be done while retaining small patches of conifer that make the resulting stands more favorable to wintering deer.

The following series of graphs (Figures 3 through 11) illustrates these current conditions and projected improvements through transitions in each period for the “all food” and “all shelter” outputs, as well as the subset of those cover types as functional components that are providing those elements in each period.

Eastern Upper Peninsula deer wintering complexes

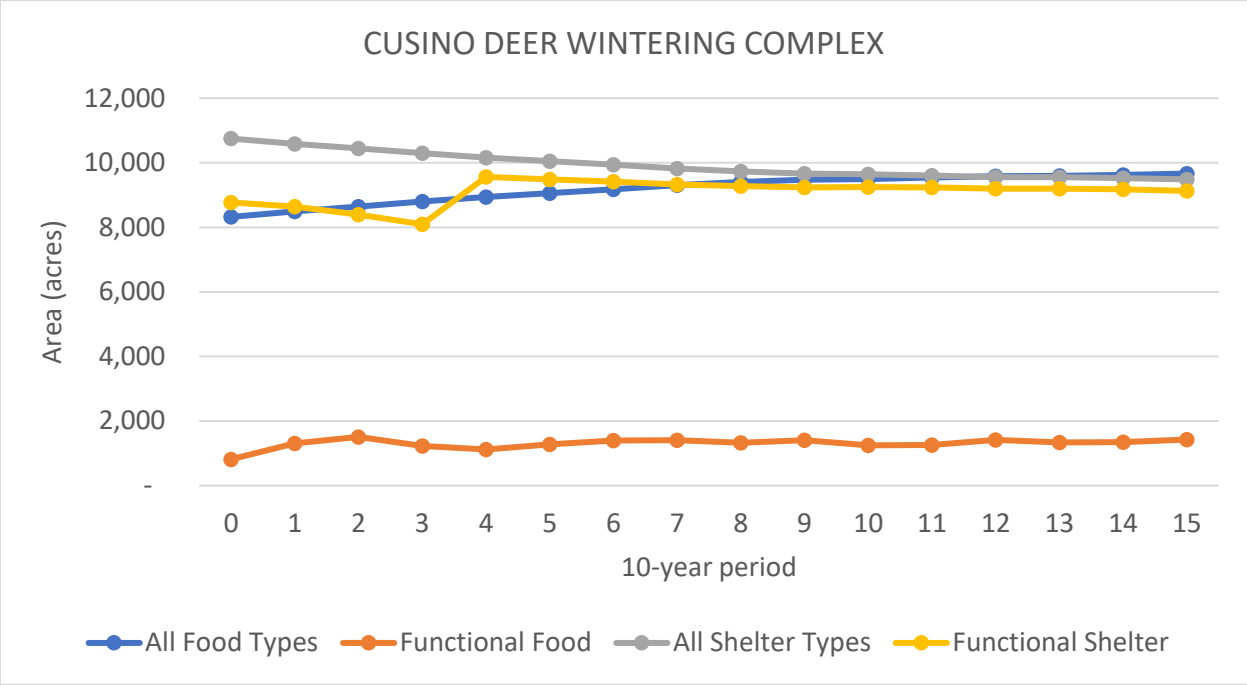


Figure 3. Acres of current and projected food and shelter habitat across all 15 model periods (150 years) in the Cusino Deer Wintering Complex.

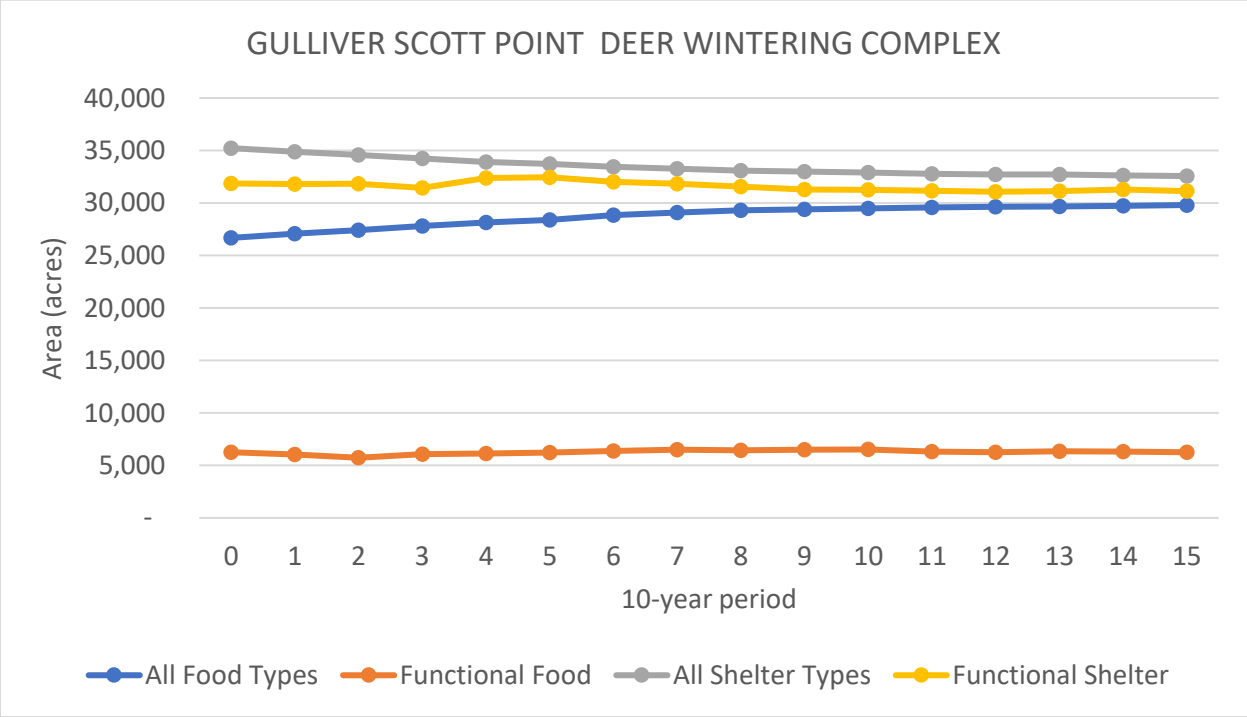


Figure 4. Acres of current and projected food and shelter habitat across all 15 model periods (150 years) in the Gulliver Scott Point Deer Wintering Complex.

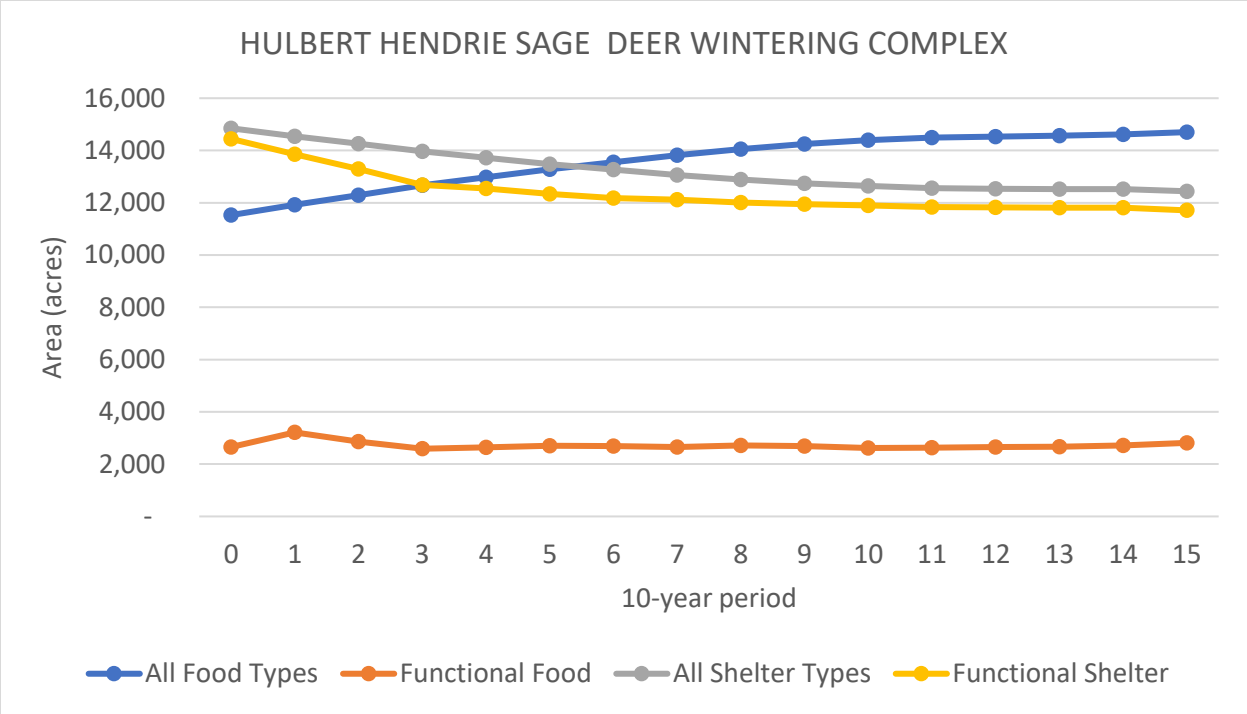


Figure 5. Acres of current and projected food and shelter habitat across all 15 model periods (150 years) in the Hulbert Hendrie Sage Deer Wintering Complex.

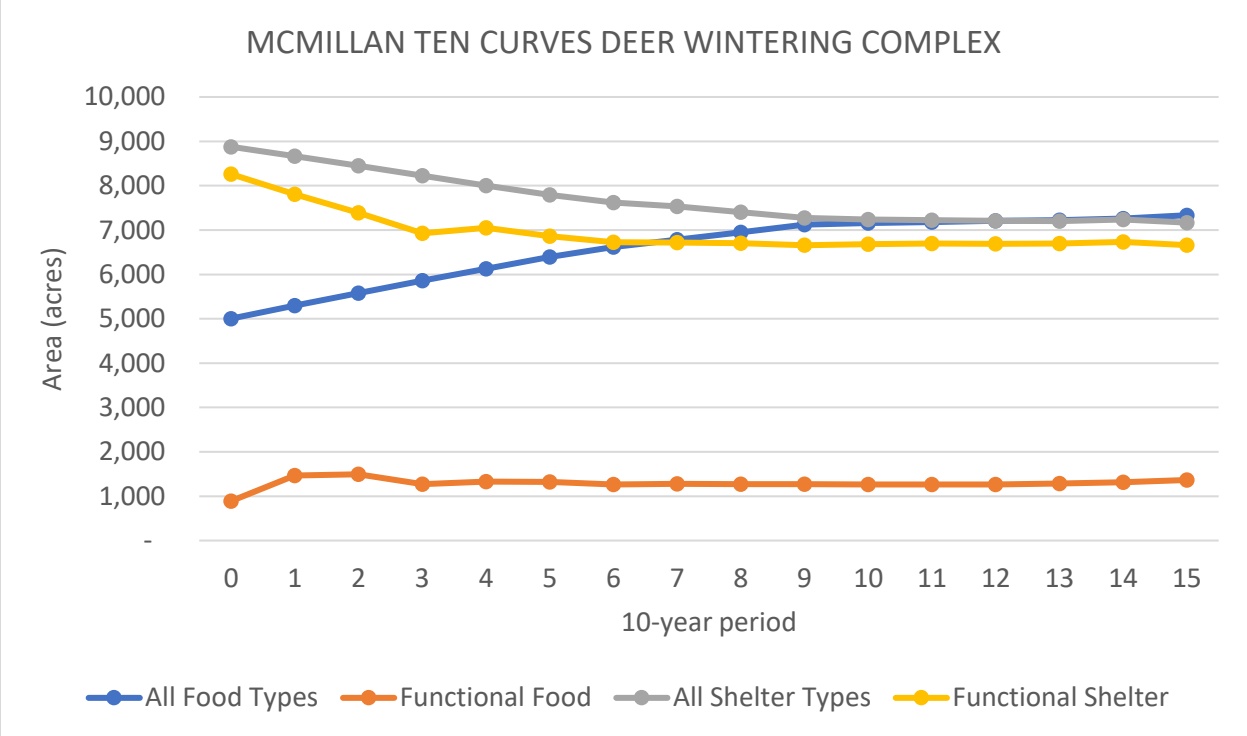


Figure 6. Acres of current and projected food and shelter habitat across all 15 model periods (150 years) in the McMillan Ten Curves Deer Wintering Complex.

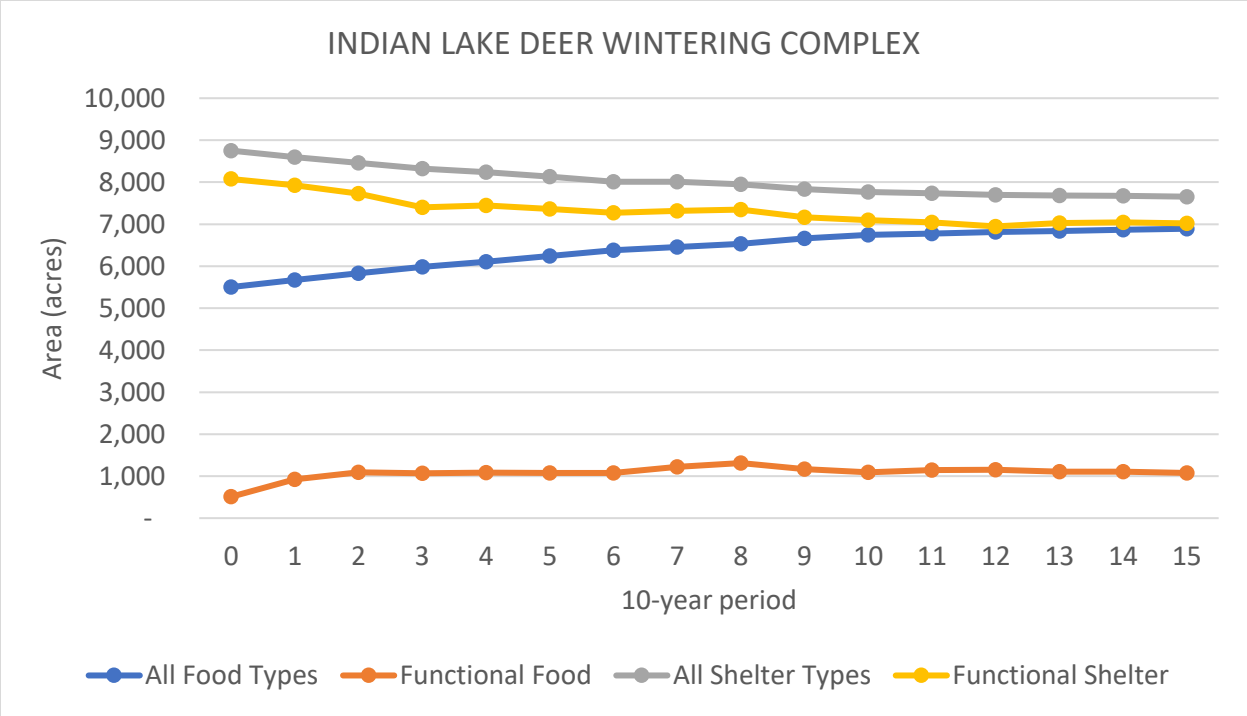


Figure 7. Acres of current and projected food and shelter habitat across all 15 model periods (150 years) in the Indian Lake Deer Wintering Complex.

Western Upper Peninsula deer wintering complexes

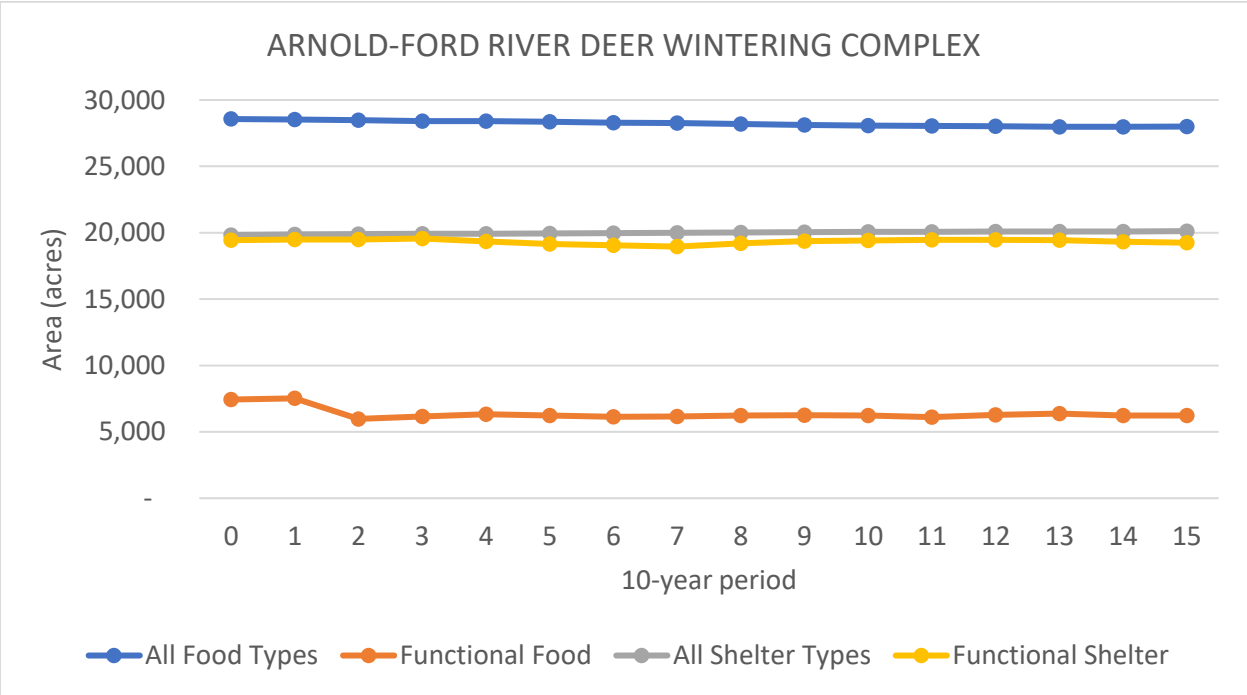


Figure 8. Acres of current and projected food and shelter habitat across all 15 model periods (150 years) in the Arnold Ford River Deer Wintering Complex.

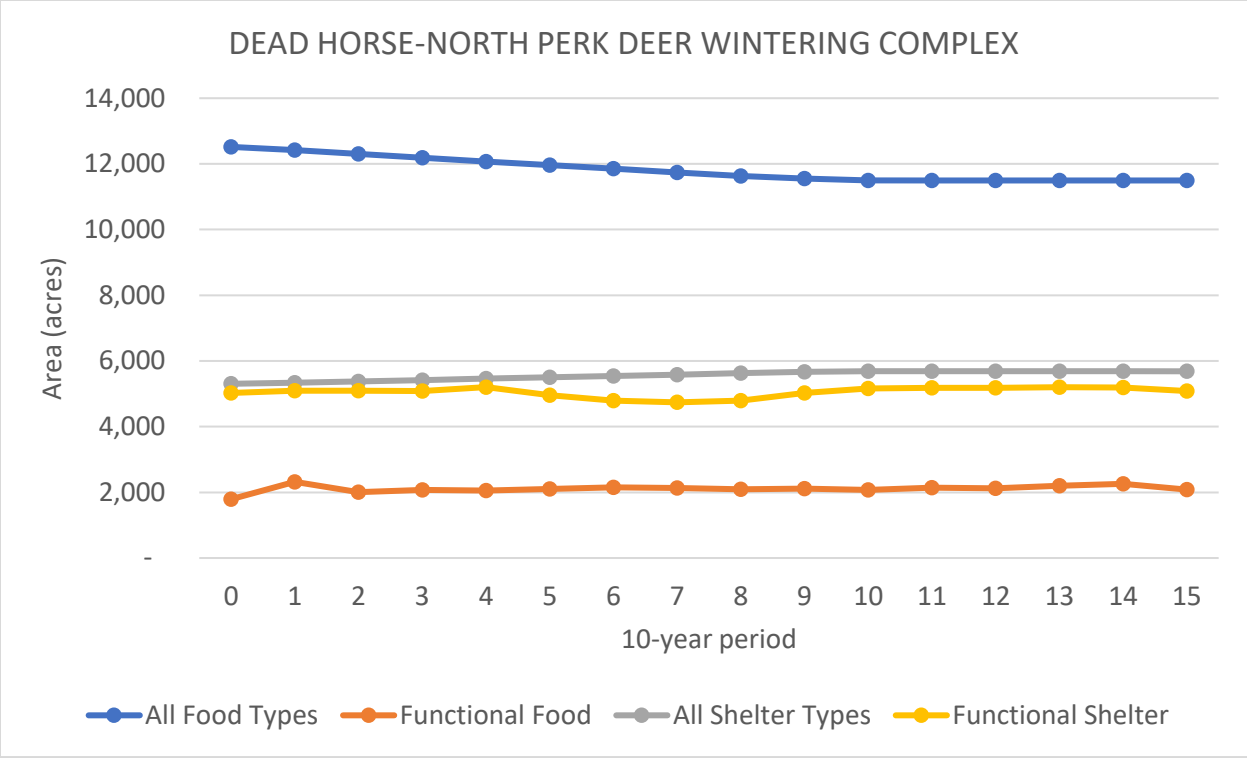


Figure 9. Acres of current and projected food and shelter habitat across all 15 model periods (150 years) in the Dead Horse North Perk Deer Wintering Complex.

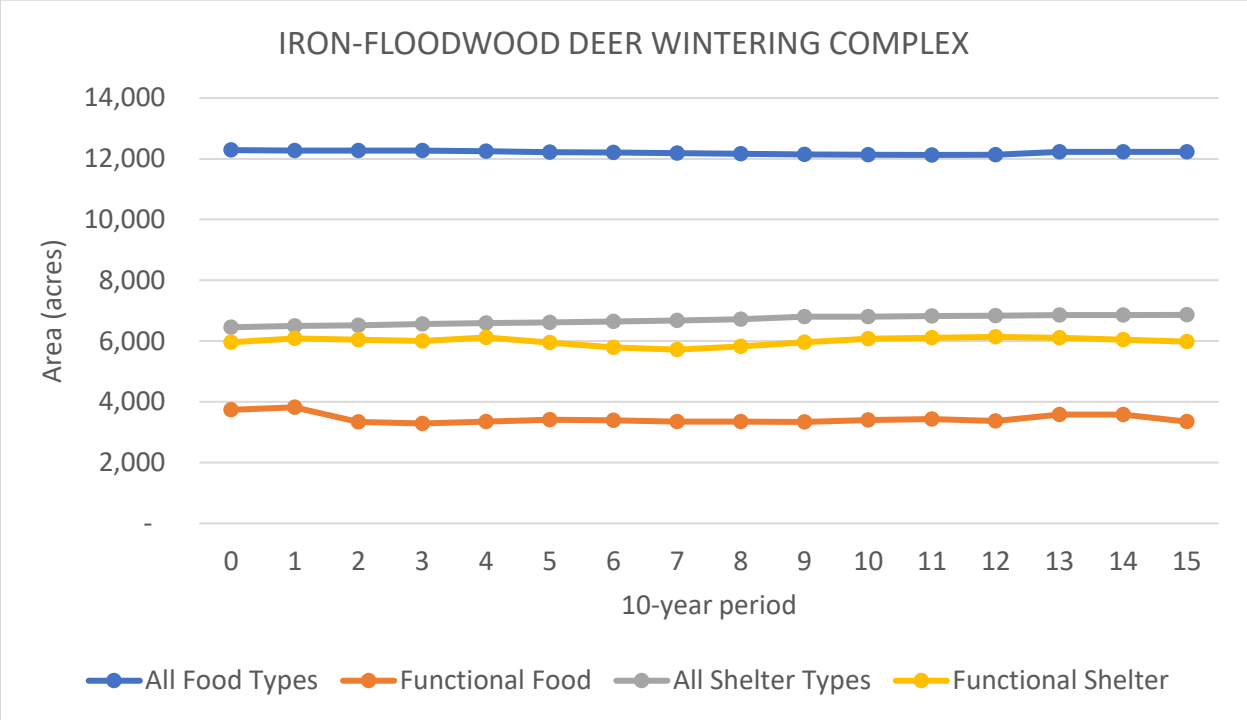


Figure 10. Acres of current and projected food and shelter habitat across all 15 model periods (150 years) in the Deer Foot Lodge Deer Wintering Complex.

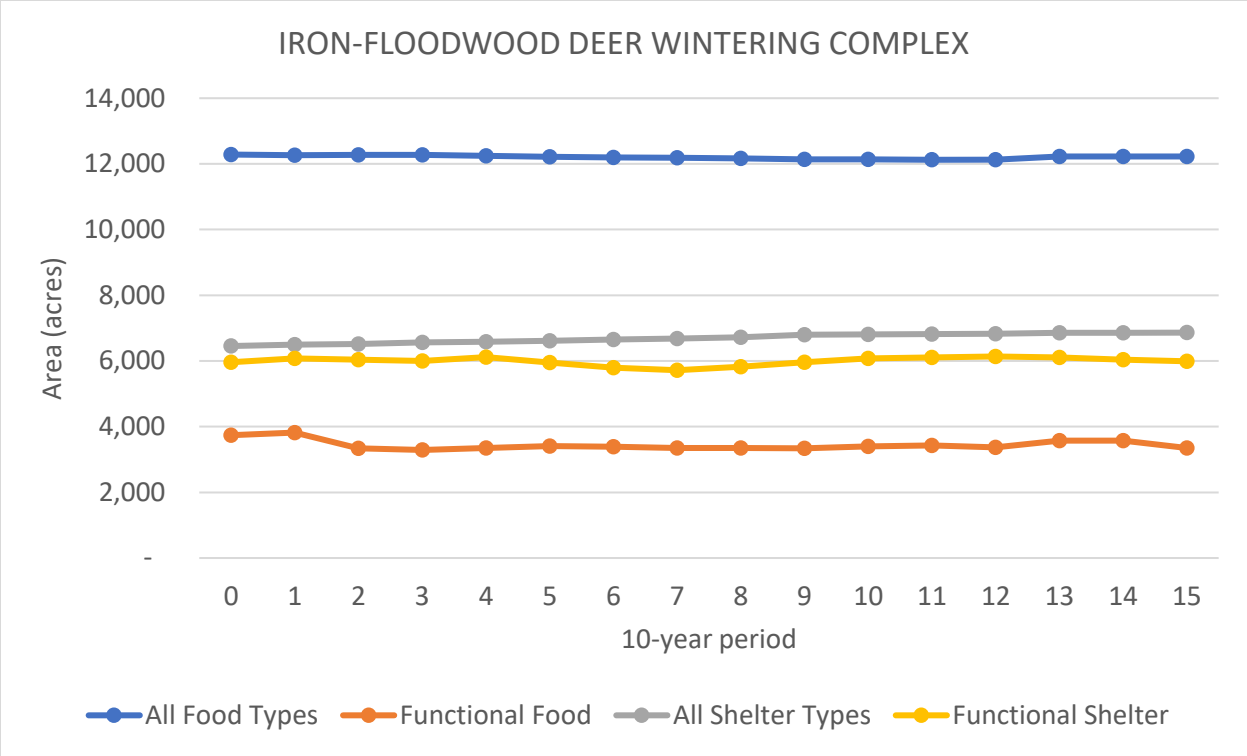


Figure 11. Acres of current and projected food and shelter habitat across all 15 model periods (150 years) in the Iron Floodwood Deer Wintering Complex.

Management actions

The following projected timber harvest levels (Tables 1 through 9) will help inform local decisions during the compartment review process to help us strive for sustainable harvest levels and habitat creation in the planning period and contribute to the longer-range goals. Efforts to refine these harvest projections should be made to work out spatial considerations, importance of maintaining crucial stands for wintering deer, timing of harvests within the decade, access concerns and timber sale marketability.

Furthermore, the projected harvest type can be changed or modified to meet the goals of the deer wintering complex for any given stand. For instance, a traditional aspen clearcut with little retention would be modified to retain all conifers, which benefits numerous wildlife species, including wintering deer. Likewise, when transitioning shelter to food, retaining pockets of dense conifer will improve the future stand qualities for deer. Another possibility is that a particular projected harvest might be dropped or delayed if a stand is still functional and healthy and benefits deer.

Lastly, harvests in deer wintering complexes will have specific conditions and special circumstances that govern sales and prescriptions and should not be bound by standard methods of those treatment types occurring outside of DWCs.

Eastern Upper Peninsula deer wintering complexes

Table 1. Projected harvest levels by silvicultural method this planning period in the Cusino Deer Wintering Complex.

Cover Type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Total
Northern hardwood	286	1,560	-	475	-	**2,321**
Lowland conifers	158	-	-	-	-	**158**
Lowland deciduous	112	-	-	-	-	**112**
Aspen	75	-	-	-	-	**75**
Lowland mixed forest	46	-	-	-	-	**46**
Upland conifers	11	-	-	-	30	**41**
Lowland aspen/balsam poplar	39	-	-	-	-	**39**
Mixed upland deciduous	20	-	-	-	-	**20**
Lowland spruce/fir	16	-	-	-	-	**16**
Planted red pine	-	-	9	-	-	**9**
Total	**763**	**1,560**	**9**	**475**	**30**	**2,836**

Table 2. Projected harvest levels by silvicultural method this planning period in the Gulliver Scott Point Rock River Deer Wintering Complex.

Cover Type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Total
Aspen	1,819	-	-	-	-	**1,819**
Northern hardwood	-	1,259	-	-	-	**1,259**
Lowland conifers	353	-	-	-	-	**353**
Planted red pine	268	-	60	-	-	**328**
Lowland aspen/balsam poplar	229	-	-	-	-	**229**
Lowland deciduous	117	-	-	-	-	**117**
Upland conifers	103	-	-	-	5	**108**
Upland spruce/fir	95	-	-	-	-	**95**
Natural white pine	-	-	10	-	75	**85**
Lowland spruce/fir	84	-	-	-	-	**84**
Lowland mixed forest	80	-	-	-	-	**80**
Upland mixed forest	80	-	-	-	-	**80**
Mixed upland deciduous	54	-	-	-	-	**54**
Planted mixed pine	12	-	-	-	-	**12**
Natural mixed pines	-	-	-	-	2	**2**
Total	**3,295**	**1,259**	**70**	**-**	**82**	**4,706**

Table 3. Projected harvest levels by silvicultural method this planning period in the Hulbert Hendrie Sage River Deer Wintering Complex.

Cover Type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Total
Northern hardwood	70	542	-	417	37	**1,065**
Lowland conifers	633	-	-	-	-	**633**
Aspen	476	-	-	-	-	**476**
Lowland mixed forest	231	-	-	-	-	**231**
Lowland aspen/balsam poplar	147	-	-	-	-	**147**
Upland conifers	-	-	-	-	113	**113**
Lowland spruce/fir	103	-	-	-	-	**103**
Mixed upland deciduous	89	-	-	-	-	**89**
Upland mixed forest	32	-	-	-	-	**32**
Upland spruce/fir	18	-	-	-	-	**18**
Lowland deciduous	-	12	-	-	-	**12**
Natural white pine	-	-	-	-	9	**9**
Planted red pine	4	-	-	-	-	**4**
Total	**1,803**	**554**	**-**	**417**	**158**	**2,932**

Table 4. Projected harvest levels by silvicultural method this planning period in the Indian Lake Deer Wintering Complex.

Cover Type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Total
Northern hardwood	-	654	-	9	-	**663**
Planted red pine	159	-	143	-	-	**302**
Aspen	222	-	-	-	-	**222**
Lowland conifers	158	-	-	-	-	**158**
Mixed upland deciduous	96	-	-	-	-	**96**
Upland conifers	18	-	-	-	62	**79**
Northern red oak	-	-	-	68	-	**68**
Oak mix	30	-	-	-	-	**30**
Lowland spruce/fir	30	-	-	-	-	**30**
Lowland aspen/balsam poplar	23	-	-	-	-	**23**
Natural white pine	-	-	22	-	-	**22**
Lowland deciduous	12	-	-	-	-	**12**
Upland spruce/fir	10	-	-	-	-	**10**
Natural red pine	-	-	-	-	9	**9**
Lowland mixed forest	8	-	-	-	-	**8**
Natural mixed pines	-	-	-	-	2	**2**
Total	**767**	**654**	**165**	**77**	**73**	**1,736**

Table 5. Projected harvest levels by silvicultural method this planning period in the McMillan Ten Curves Deer Wintering Complex.

Cover Type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Total
Lowland conifers	442	-	-	-	-	**442**
Northern hardwood	4	231	-	12	-	**246**
Natural jack pine	165	-	-	-	-	**165**
Lowland aspen/balsam poplar	162	-	-	-	-	**162**
Aspen	131	-	-	-	-	**131**
Lowland deciduous	126	-	-	-	-	**126**
Lowland mixed forest	97	-	-	-	-	**97**
Lowland spruce/fir	84	-	-	-	-	**84**
Upland conifers	-	-	-	-	23	**23**
Upland mixed forest	10	-	-	-	-	**10**
Total	**1,220**	**231**	**-**	**12**	**23**	**1,485**

Western Upper Peninsula deer wintering complexes

Table 6. Projected harvest levels by silvicultural method this planning period in the Arnold Ford River Deer Wintering Complex.

Cover Type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Total
Northern hardwood	-	3,960	-	-	-	**3,960**
Aspen	2,787	-	-	-	-	**2,787**
Mixed upland deciduous	100	19	-	-	-	**119**
Tamarack	95	-	-	-	-	**95**
Lowland aspen/balsam poplar	42	-	-	-	-	**42**
Upland mixed forest	24	-	-	-	-	**24**
Upland spruce/fir	22	-	-	-	-	**22**
Planted red pine	-	-	15	-	-	**15**
Lowland mixed forest	8	-	-	-	-	**8**
Lowland deciduous	3	-	-	-	3	**6**
Total	**3,080**	**3,979**	**15**	**-**	**3**	**7,077**

Table 7. Projected harvest levels by silvicultural method this planning period in the Dead Horse North Perkins Deer Wintering Complex.

Cover Type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Total
Northern hardwood	60	1,176	-	-	-	**1,235**
Aspen	559	-	-	-	-	**559**
Lowland mixed forest	205	-	-	-	-	**205**
Mixed upland deciduous	88	-	-	-	-	**88**
Lowland aspen/balsam poplar	81	-	-	-	-	**81**
Upland mixed forest	55	-	-	-	-	**55**
Lowland deciduous	17	20	-	-	8	**44**
Upland spruce/fir	7	-	-	-	-	**7**
Tamarack	6	-	-	-	-	**6**
Total	**1,076**	**1,195**	**-**	**-**	**8**	**2,279**

Table 8. Projected harvest levels by silvicultural method this planning period in the Deer Foot Lodge Deer Wintering Complex.

Cover Type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Total
Northern hardwood	-	1,135	-	-	-	**1,135**
Aspen	1,071	-	-	-	-	**1,071**
Lowland mixed forest	76	-	-	-	-	**76**
Tamarack	39	-	-	-	-	**39**
Mixed upland deciduous	36	-	-	-	-	**36**
Upland spruce/fir	19	-	-	-	-	**19**
Natural red pine	-	-	-	-	8	**8**
Natural white pine	-	-	-	-	5	**5**
Total	**1,240**	**1,135**	**-**	**-**	**13**	**2,388**

Table 9. Projected harvest levels by silvicultural method this planning period in the Iron Floodwood Deer Wintering Complex.

Cover Type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Total
Aspen	1,572	-	-	-	-	**1,572**
Northern hardwood	77	418	-	-	9	**503**
Planted red pine	-	-	103	-	-	**103**
Tamarack	77	-	-	-	-	**77**
Natural mixed pines	-	-	-	-	48	**48**
Upland mixed forest	24	-	-	-	-	**24**
Lowland deciduous	15	2	-	-	-	**17**
Mixed upland deciduous	13	-	-	-	-	**13**
Planted jack pine	12	-	-	-	-	**12**
Natural red pine	-	-	-	-	12	**12**
Natural jack pine	8	-	-	-	-	**8**
Lowland aspen/balsam poplar	7	-	-	-	-	**7**
Total	**1,803**	**420**	**103**	**-**	**68**	**2,394**

Plan Implementation

Introduction

Implementation of the State Forest Management Plan (SFMP) goals, objectives, and management actions will be accomplished using various strategies and mechanisms. Each management priority may be influenced by programs and processes across multiple Michigan Department of Natural Resources divisions, and each has its own systems in place to help manage that resource. Considering the array of management priorities, affiliated programs and staff that manage them, the plan writing team committed to keeping a core segment together for the planning period that will focus on implementation and monitoring efforts.

The SFMP implementation and monitoring team will consist of the statewide forest planning and modeling specialist (Forest Resources Division), two regional wildlife planner/ecologists (Wildlife Division), and four district-level Forest planning and inventory specialists. Participation from Parks and Recreation planning specialists and Fisheries Division staff will be requested as needed. Team oversight will be led by planning section leaders in FRD and Wildlife.

Implementation strategy

The team will create a database that organizes SFMP goals, objectives, and management actions so that focused effort can be assigned to specific programs and relevant staff. Management actions can be recorded and progress toward desired future conditions can be reported annually to support monitoring needs. Specific metrics listed in each management priority section will be recorded as actions occur.

A significant part of implementation work is focused on commercial timber harvest to create both desired future conditions of forested cover types and wildlife habitat conditions. The SFMP model was created to help ensure that management of state forest land in Michigan creates a long-term sustainable supply of forest products and wildlife habitat while providing recreation opportunities and protecting natural and cultural resources for the people of Michigan. The model generated information for a 150-year planning horizon to create a long-term view of sustainability as it relates to multiple values. The first 10-year period of that horizon is included in this plan.

The harvest levels, by management area, forest management unit, special analysis unit, cover type, age class, basal area class, availability and silvicultural method were extracted from the first period of the overall harvest schedule and allocated to eligible stands in a spatial stands layer. Because each stand is part of a compartment, and each compartment has a designated year of entry, a projected annual harvest schedule could be created representing a feasible implementation solution. The spatial allocation provides an estimated level of harvest for each compartment and year of entry for each cover type in each management area. Individual stand selection may vary depending on other factors the model does not consider, such as spatial juxtaposition of treatments, harvest timing efficiencies, access issues, local area age class diversity and disturbance levels.

Other limitations exist in the “stand selection” performed by the spatial allocation of the harvest schedule to the SFMP stand shape file, especially in the cover types eligible for selection, group

selection, shelterwood, and thinning treatments. The basal area ranges used in the MiFI system of forest inventory resulted in an inability to accurately forecast stands that would be ready for a thinning or selection harvest within the next decade. Because of this, spatial allocation of these types of treatments could fall on stands that are not quite ready for a thinning or a selection harvest. It is fully anticipated that at a compartment level, deviations from projected harvests will occur, but projected harvest levels will be prescribed at a higher scale across the management area each year of entry.

Shelterwood and group selection treatments are projected based on a percentage of anticipated need for the decade. Information necessary to select these treatments at a stand level is not included or evaluated in the SFMP model. The implementation process of spatial allocation will likely not "select" the right stands to receive these harvests. It is expected that the proportion of these types of treatments will be prescribed across the cover types in the management areas in the decade.

Management actions

Implementation of projected harvests is driven by cover type-specific goals for each management area, but those goals are implemented through FRD administrative units. Forest Management Units are each responsible for identifying eligible stands through forest inventory and prescribing a subset of those stands for treatments that align with and implement the goals of the SFMP. The spatial allocation of the Period 1 harvests helps to guide harvest levels ensuring that forest and habitat conditions are moving from current conditions toward desired future conditions.

Implementation guidance is provided at annual compartment review meetings, beginning with a harvest projection at the pre-inventory meeting. This projected harvest schedule allows stand examiners to evaluate potential candidates to receive treatments in both even-aged and uneven-aged systems. Harvest targets provided at the pre-inventory meeting help establish annual regeneration goals for each even-aged cover type, ensuring that annual harvests result in a new age class that contributes to a desired age class distribution. These regeneration harvest goals should be closely followed on an annual basis. Significant deviations should be avoided unless anomalies are documented to justify a change. Partial harvest projections for selection and thinning treatments are meant to be a higher-level expected level of harvest, and treatments should be applied to stands based on inventoried basal area observations and needs.

Pre-review meetings will be used to evaluate prescribed treatments and compare them with projected harvest levels in each cover type and management area. Deviations from projected harvest levels will be recorded and used in subsequent years to adjust harvest levels up or down as necessary. An overall effort should be made to reach decade-level harvest objectives, contributing to the achievement of the desired age and basal area class distributions and associated habitat elements.

The following tables and graphs summarize the annual projected harvest prescriptions to be made across the state forest. Actual acres prepared for harvest will likely average about 3 to 10 percent less than prescribed acres due to several contributing factors. The continued establishment of within-stand retention areas (required by forest certification standards) results in a reduction of 3 to 10 % of most even-aged regeneration harvests. These areas are often used to protect hydrologic features, wildlife habitat elements or recreation influences. They are also frequently used for visual management or aesthetics. Stands prescribed with a soft limiting factor such as survey needed, road needed, portable

bridge needed, also are included in these projections. They do not always get accomplished in the given year of entry, but usually within the decade. Other reductions in areas prepared for treatment can simply be a refinement of stand boundaries. This occurs once field work is completed and stand boundaries are verified on the ground.

Table 1. Annual harvest projections by silvicultural regime.

Year of Entry	Clearcut	Selection	Thinning	Shelterwood	Group Selection	Salvage Clearcut	Salvage Thinning	Total
2025	26,733	10,336	6,249	1,589	987	11,238	2,611	**59,743**
2026	26,699	12,035	6,317	1,442	296	7,492	2,611	**56,892**
2027	24,597	11,972	8,083	1,596	684	2,341	2,611	**51,884**
2028	21,992	12,516	6,425	1,255	495	936	2,089	**45,709**
2029	21,880	9,287	5,920	1,202	624	468	2,089	**41,470**
2030	21,021	8,038	6,493	1,513	294	234	3,655	**41,248**
2031	22,460	6,187	4,578	1,291	798	234	4,700	**40,249**
2032	19,024	8,732	5,662	1,388	769	234	4,439	**40,249**
2033	22,030	7,707	6,492	1,388	1,138	234	1,305	**40,295**
2034	30,226	14,065	7,419	1,567	1,438	-	-	**54,715**
Total	**236,663**	**100,876**	**63,637**	**14,231**	**7,524**	**23,412**	**26,109**	**472,452**

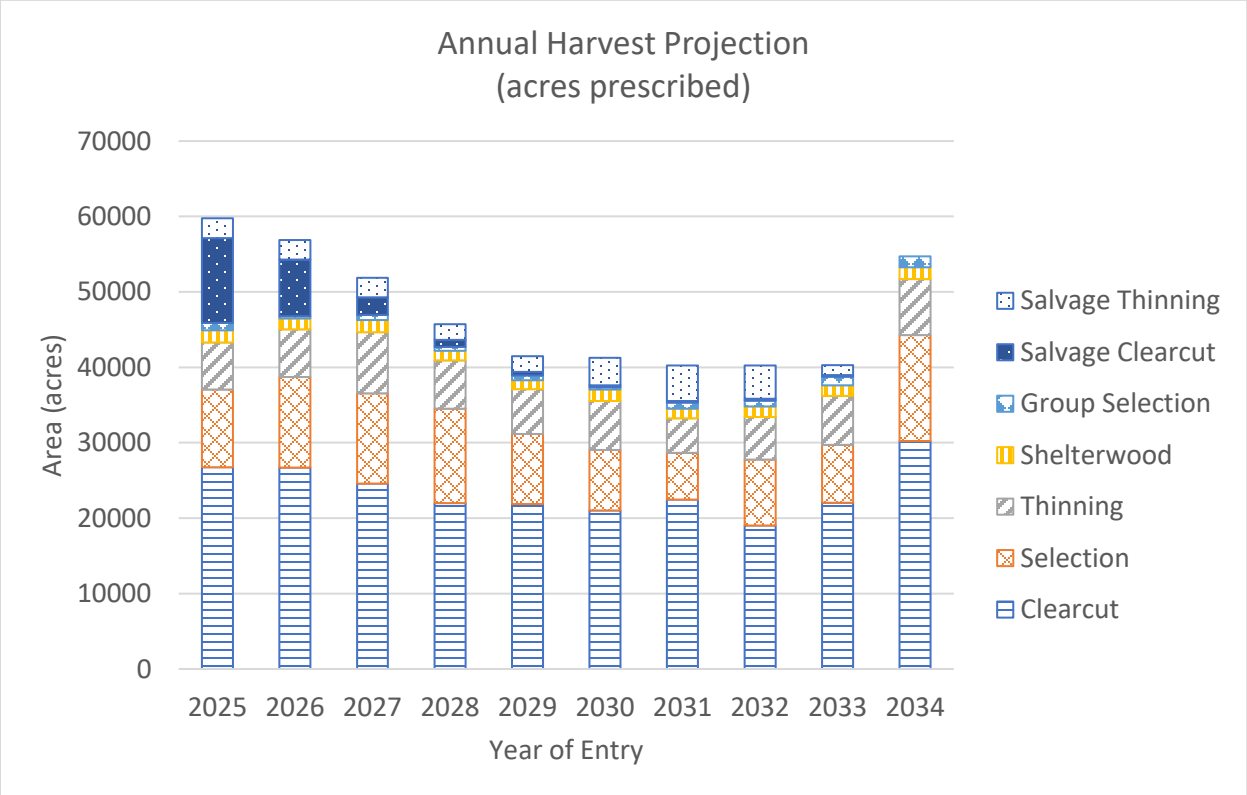


Figure 1. Annual harvest projections by silvicultural regime.

Table 2. 10-year Harvest projections by cover type and silvicultural regime.

Cover type	Clearcut	Selection	Thinning	Group Selection	Shelterwood	Salvage Clearcut	Salvage Thinning	Total
Northern hardwood	1,718	97,277	-	6,604	1,320	6,020	15,571	**128,509**
Aspen	111,480	-	-	-	-	6,115	-	**117,595**
Planted red pine	11,565	-	51,753	-	-	5,054	8,243	**76,615**
Mixed upland deciduous	16,257	2,694	-	-	1,770	249	-	**20,969**
Natural jack pine	15,297	-	-	-	-	2,336	-	**17,633**
Planted jack pine	9,654	-	-	-	-	3,057	-	**12,710**
Lowland conifers	9,624	-	-	-	-	-	-	**9,624**
Northern red oak	7,152	-	343	720	114	290	724	**9,344**
Upland mixed forest	9,064	-	-	-	-	171	-	**9,236**
Lowland aspen	9,139	-	-	-	-	-	-	**9,139**
Natural mixed pines	-	-	3,241	-	3,971	-	754	**7,965**
Black-red hybrid oak	6,957	-	630	-	332	33	-	**7,952**
Upland conifers	6,454	-	9	-	1,168	-	-	**7,631**
Lowland deciduous	4,697	448	-	168	1,655	-	-	**6,967**
Lowland spruce/fir	6,481	-	-	-	-	-	-	**6,481**
Natural white pine	-	-	2,039	-	2,400	-	505	**4,944**
Oak mix	4,142	-	380	-	48	88	-	**4,657**
Planted white pine	472	-	3,198	-	-	-	-	**3,670**
Lowland mixed forest	2,976	-	-	-	-	-	-	**2,976**
Natural red pine	-	-	1,154	-	1,454	-	312	**2,921**
Upland spruce fir	2,507	-	-	-	-	-	-	**2,507**
Planted mixed pine	103	-	890	-	-	-	-	**992**
Tamarack	839	-	-	-	-	-	-	**839**
Hemlock	-	459	-	-	-	-	-	**459**
Cedar	84	-	-	32	-	-	-	**116**
Total	**236,663**	**100,876**	**63,637**	**7,524**	**14,231**	**23,412**	**26,109**	**472,452**

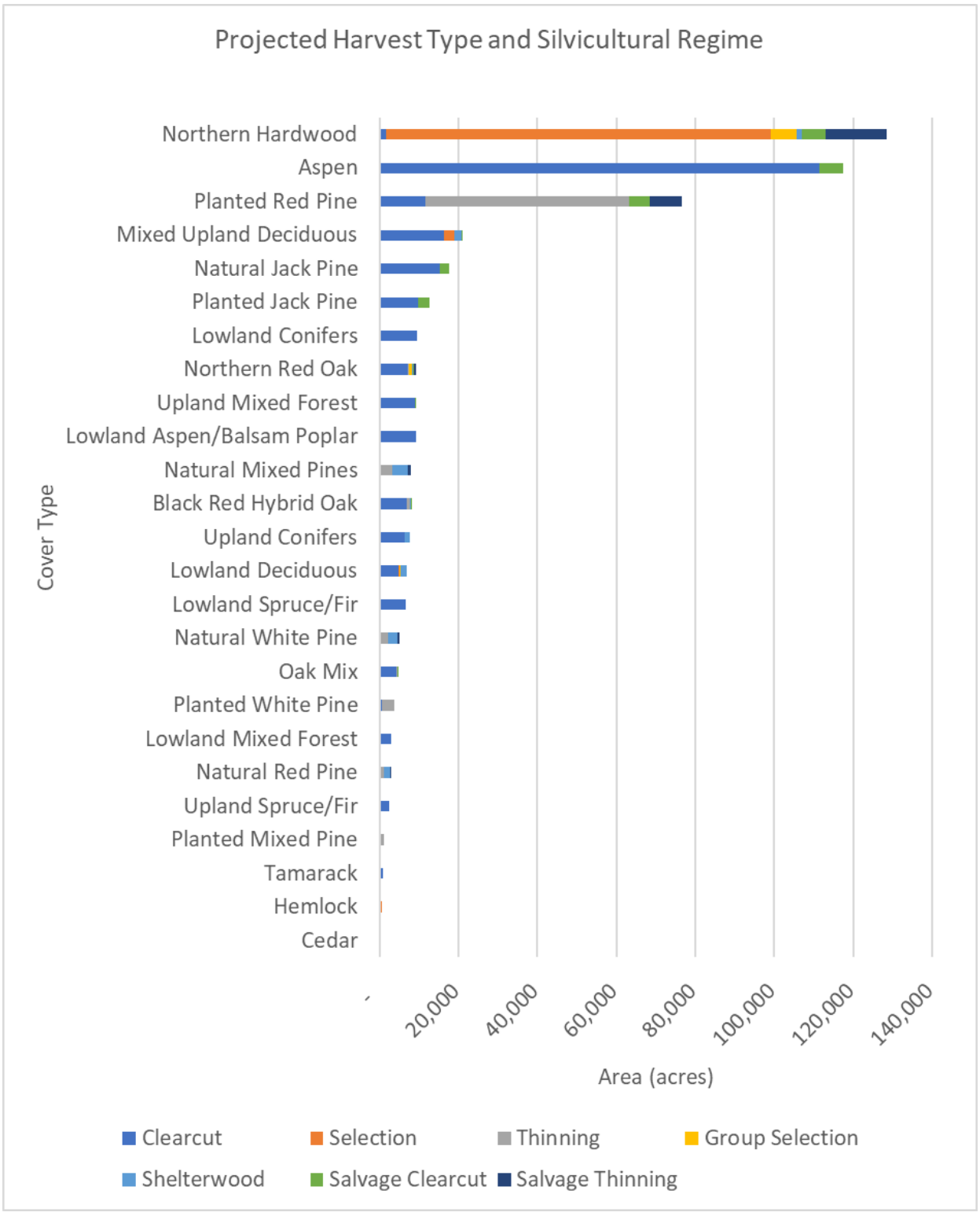


Figure 2. 10-year harvest projections by cover type and silvicultural regime.

Table 3. 10-year harvest projection by district and forest management unit (FMU).

District / FMU	Clearcut	Selection	Thinning	Shelterwood	Group Selection	Salvage Clearcut	Salvage Thinning	Grand Total
ELP Subtotal	**45,171**	**2,245**	**21,394**	**2,507**	**1,319**	**23,412**	**26,109**	**122,158**
Atlanta	18,802	893	4,713	821	260	4,079	3,991	**33,559**
Gaylord	9,957	943	10,159	206	882	8,256	14,822	**45,225**
Grayling	12,486	265	4,664	792	177	8,319	5,131	**31,833**
Pigeon River Country	3,927	144	1,859	689	--	2,758	2,165	**11,541**
EUP Subtotal	**54,396**	**29,115**	**8,812**	**3,683**	**3,845**	**--**	**--**	**99,851**
Newberry	19,920	9,026	2,766	2,428	765	--		**34,904**
Sault Ste. Marie	18,734	9,394	2,615	231	189	--	--	**31,164**
Shingleton	15,742	10,695	3,431	1,025	2,891	--	--	**33,783**
WLP Subtotal	**81,867**	**19,358**	**31,062**	**6,593**	**2,071**	**--**	**--**	**140,950**
Cadillac	20,196	4,133	7,819	919	1,043	--	--	**34,110**
Gladwin	15,795	474	2,905	2,525	207	--	--	**21,907**
Roscommon	25,578	698	4,351	1,632	10	--	--	**32,270**
Traverse City	20,298	14,053	15,986	1,516	811	--	--	**52,664**
WUP Subtotal	**55,229**	**50,159**	**2,370**	**1,447**	**289**	**--**	**--**	**109,493**
Baraga	10,105	23,301	410	296		--	--	**34,112**
Escanaba	26,905	15,029	1,528	616	169	--	--	**44,247**
Gwinn	18,219	11,829	432	535	119	--	--	**31,134**
Grand Total	**236,663**	**100,876**	**63,637**	**14,231**	**7,524**	**23,412**	**26,109**	**472,452**

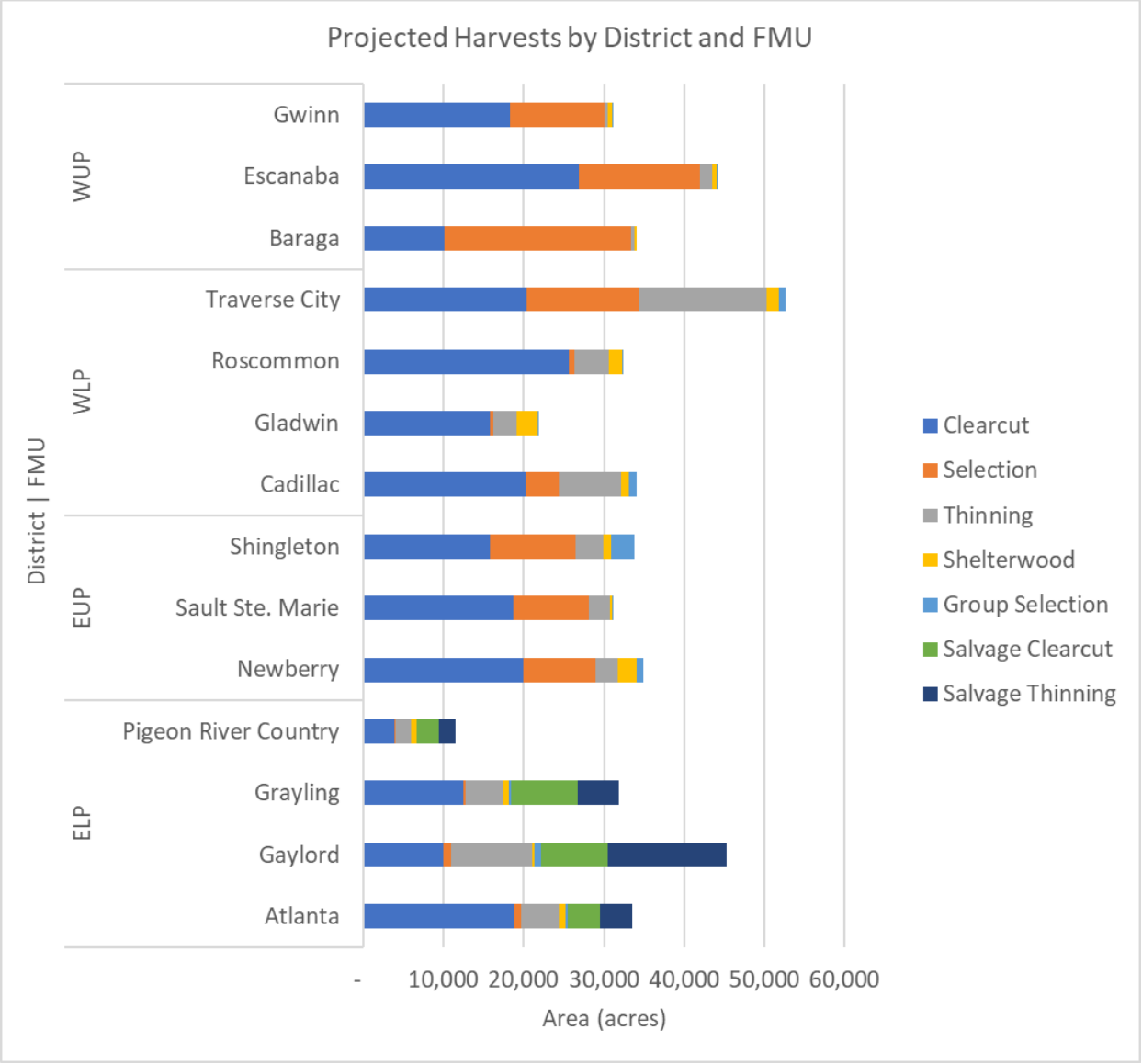


Figure 3. 10-year harvest projection by district and forest management unit (FMU).

Monitoring, Review and Revision

Introduction

The State Forest Management Plan is founded upon the principles of sustainable forest management, as defined by the Montreal Process, through the Michigan Department of Natural Resources forest sustainability planning framework. One of the tenets of the Montreal Process is a "common framework to monitor, assess and report on trends in forest conditions with response to the full range of forest values and, in turn, on the progress toward sustainable forest management."

Monitoring is assured within the DNR sustainability framework through the identification of metrics for each management priority at the statewide and regional scales. The metrics were chosen to be realistic, achievable and within the scope of DNR operations and capacity. These metrics were carried through at the management area and special analysis unit scales, where applicable.

Monitoring, with assessment and reporting, occur across geographic scales and program operations. It is intended to identify the current status or condition of forest values, determine progress toward desired future forest conditions and determine the social, economic and ecological effects of management activities.

Basic monitoring, assessment and reporting requirements inherent to plan implementation are part of a responsible agency resource management program. These include:

- The DNR budget process.
- Special purpose funding such as federal grants.
- The DNR compartment review process.
- Timber sale preparation and inspection process.
- Forest regeneration surveying.
- Resource damage reporting.
- The forest health monitoring program.
- Wildfire detection.
- Sustainable Forestry Initiative and Forest Stewardship Council certification protocols.
- Public reporting – as required by the certification standards.

These, and others, are achieved through different types of monitoring, some of which the DNR currently undertakes and others which the department will strive for within the sustainability framework (Table 1). These are:

- **Baseline monitoring – inventory**: A list of elements of interest on a site or landscape that represents what is known to be the present condition.
- **Baseline monitoring – surveillance**: Repeated inventory completed to established standards and can indicate change over time, though not the cause for change.
- **Implementation (compliance) monitoring:** Collection of data to determine if stated actions were completed.

- **Effectiveness monitoring**: Collection of data to determine if the chosen methods resulted in the desired outcomes, and measures progress toward management objectives or desired future conditions.
- **Validation monitoring**: Verifies assumptions and causal pathways underlying conceptual models of system function and is typically restricted to research projects.

Table 1. Examples of the types of monitoring the DNR employs on state forest land.

Baseline Monitoring – Inventory	Baseline Monitoring – Surveillance	Implementation (Compliance) Monitoring	Effectiveness Monitoring
State forest infrastructure (roads, trails, campgrounds)	Michigan Forest Inventory system (MiFI)	Internal DNR forest audit	Management area analysis toward desired future condition
State forest features (ecological reference areas, deer wintering complexes, etc.)	Forest health monitoring	Forest certification audits	Forest regeneration surveys
--	Wildfire surveillance	Law enforcement	Pesticide use evaluation report
--	Fish and wildlife surveys	--	--

Validation monitoring was not included in the table because research does not represent a large part of DNR operations and is typically conducted through external partnerships. Recent examples of research in the state forest include the Northern Hardwoods Project (Walters et al. 2020), Cedar Research Project (Chimner et al. 2022), and the Predator Prey Project (Sitar and Roell 2021).

Monitoring management plan implementation

The monitoring efforts undertaken by the DNR continue to be employed in the State Forest Management Plan implementation. The difference with this plan is that while most of the data for each of the management priorities has been available as part of DNR inventory systems, metrics for most of them hadn't been defined to track changes over time or toward the desired future conditions in a state forest sustainability context. In some cases, metrics were identified that may require new monitoring, analysis and reporting efforts. This is particularly true for metrics identified for featured species and landscape habitat conditions, described in more detail below.

To assist with these new monitoring needs, the following steps will be completed by the implementation team upon approval of this plan:

1) Compilation of all the management priority objectives and management actions to be sorted by completion date with identified task owners (implementation and compliance monitoring).
2) Compilation of all the management priority metrics sorted by monitoring type and inventory system (inventory and surveillance monitoring).
3) Evaluation of current assessment and reporting systems to determine what gaps need to be filled and in what ways to ensure new metrics are monitored over time.

4) Establishment of a monitoring schedule so that metrics are routinely monitored according to the required frequency.

Featured species and landscape habitat condition monitoring

At present, little monitoring is done in relation to featured species or landscape habitat conditions on the state forest in general, much less in a forest sustainability context. This is a challenging endeavor, because wildlife is difficult and expensive to survey, habitat is species-specific, wildlife habitat can take decades to establish, and because DNR Wildlife Division staff time and resources are limited with state forest management being only part of what they do. Most of the inventory, monitoring and reporting systems established for the state forest were developed by the DNR Forest Resources Division to achieve its mission, mandates and goals pertaining to forest cover type management. The data collected describes forest conditions relevant to silvicultural applications; however, often these do not adequately capture the forest condition attributes relevant to wildlife habitat. There is a long-standing gap between the limiting wildlife habitat stand attributes described in peer-reviewed literature that represent management priorities and forest stand inventory data.

This is problematic for several reasons. It means that wildlife biologists currently have only coarse forest descriptors (e.g., cover type, age, basal area) to evaluate landscape habitat availability, and it also means that these coarse descriptors are the only attributes available to incorporate wildlife habitat into the State Forest Management Plan model. The model provides the DNR with the ability to passively track featured species habitat over time, to integrate featured species habitat goals into forest harvest planning and to evaluate different featured species management scenarios. Without a dataset that better describes important wildlife habitat attributes, and that is collected and monitored over time, any advances this forest harvest modeling platform offers will go unrealized and wildlife habitat management will continue to be hindered.

Metrics identified for featured species and landscape habitat conditions management priorities begin to address this. Similar to the situation described above, many of these are newly identified metrics that rely on currently available inventory data out of necessity and in acknowledgement of the current data gaps for wildlife habitat attributes. However, some are new metrics that will require new monitoring approaches. To address the suite of new monitoring needs generated by both management plan metrics and to better model wildlife habitat, a featured species and landscape habitat conditions monitoring framework was developed (Table 2).

While the plan implementation team will be responsible for implementation and monitoring oversight, they will be largely focused on annual management area and special analysis unit compliance and effectiveness monitoring. It will be the responsibility of DNR division representatives (for Forest Resources, Wildlife, Parks and Recreation and Fisheries divisions). on the team to ensure compliance and other types of monitoring occur regarding their management priority objectives and metrics For featured species and landscape habitat conditions, Wildlife Division staff on the implementation team along with several other division employees formed a wildlife-specific team. The team will ensure identified metrics are captured in a monitoring system and address long-standing wildlife habitat monitoring needs. This team will periodically require the help of species specialists and field staff to

enact various monitoring efforts, and partners will be essential in expanding monitoring capacity. Some species specialists and field staff may also be asked to help develop an approach to incorporating featured species habitat goals into the next iteration of the model. As these monitoring efforts grow, so will data storage, management and assessment needs. Those may be addressed through partnerships, but as this is a recognized limitation for the Wildlife Division, there are efforts underway to address data needs in a larger context.

Table 2. Featured species and landscape habitat condition monitoring framework this planning period.

Implementation (Compliance) Monitoring Definition: Did the DNR do what it said it was going to do?	**Habitat Variable Monitoring and Modeling** Definition: Bridging the gap between MiFI variables and important habitat attributes to prioritize for management, monitoring and modeling.	**Effectiveness Monitoring** Definition: Is the DNR effectively moving toward the desired habitat future conditions? Is there a positive or desired featured species response?
Objective 1: Beginning in Year Of Entry 2027, ensure State Forest Management Plan habitat goals at various spatial scales are enacted through compartment review. • Track annual landscape habitat condition acres relative to model projections. • Track annual special analysis unit harvest targets relative to model projections and are meeting species plan habitat objectives. • Track annual model featured species habitat acres relative to model projections.	Objective 1: Within five years, develop and implement an integrated monitoring system for wildlife habitat attributes not captured in MiFI to better inform the next forest plan model. • Identify priority habitat variables for featured species that aren't captured in MiFI. • Identify feasible monitoring tools, such as remote sensing, to address some monitoring needs. • Work with partners to develop and implement routine monitoring for selected habitat attributes. • Develop crosswalk between habitat variables and model inputs.	Objective 1: Beginning in 2028, sample stands in various stages post-treatment to monitor for planned stand level habitat objectives. • Work with partners to develop and implement monitoring, and to find funding sources if necessary.

Implementation (Compliance) Monitoring Definition: Did the DNR do what it said it was going to do?	**Habitat Variable Monitoring and Modeling** Definition: Bridging the gap between MiFI variables and important habitat attributes to prioritize for management, monitoring and modeling.	**Effectiveness Monitoring** Definition: Is the DNR effectively moving toward the desired habitat future conditions? Is there a positive or desired featured species response?
Objective 2: Beginning in YOE 2027, ensure the habitat goals agreed on at compartment reviews are reflected accurately in timber sale contracts. • Annually conduct a randomized review of a subsample of timber sale contracts and vet them against compartment review sign-off documents.	Objective 2: Within five years, develop habitat goals for all featured species to be incorporated in the next State Forest Management Plan model. • Evaluate featured species habitat needs. • Develop an approach to incorporate featured species habitat needs into the State Forest Management Plan model.	Objective 2: Beginning in 2029, sample the same stands as Objective 1 for targeted featured species response. • Work with partners to develop and implement monitoring, and to find funding sources if necessary. • Evaluate the potential to link featured species monitoring in important state forest sites with larger coordinated survey efforts, such as breeding bird atlases and breeding bird surveys.
Objective 3: Beginning in YOE 2027, ensure habitat goals in timber sale contracts are implemented accurately at the harvest site. • Annually visit a subsample of newly completed timber sales to assess how well timber sale contract specifications were applied.	--	--

Implementation (Compliance) Monitoring Definition: Did the DNR do what it said it was going to do?	**Habitat Variable Monitoring and Modeling** Definition: Bridging the gap between MiFI variables and important habitat attributes to prioritize for management, monitoring and modeling.	**Effectiveness Monitoring** Definition: Is the DNR effectively moving toward the desired habitat future conditions? Is there a positive or desired featured species response?
Objective 4: By the end of 2025, create a backup system outside of the MiFI environment to house stand treatment history. • Work with the DNR Forest Resources Division and the Michigan Department of Technology, Management and Budget to determine the best approach, funding needs and commitments, and training for staff.	--	--
Objective 5: By the end of 2025, develop an automated database to track featured species habitat and landscape habitat conditions treatments in real time for annual reporting purposes. • With division partners, develop a Power BI or other real-time database to automate featured species and habitat treatment tracking.	--	--

Review and revision of the State Forest Management Plan

The planning horizon for the State Forest Management Plan is 10 years. At that time, the plan and model will be reviewed and revised or updated, with public engagement, provided that no major changes occur in the interim. However, sometimes unforeseen and unavoidable changes in environmental conditions, forest or wildlife health, timber markets or recreation demands may result in a necessary change in management direction. Likewise, if plan monitoring over time indicates that some management objectives are no longer valid or are not being achieved, that may necessitate revisiting the management objectives or methods. Depending on the extent and impact of the proposed changes, a public review of

the changes may be initiated, and notifications sent out as appropriate. Changes that amount to minor refinements based on new data will be considered as normal business and adjustments will be made without public review.

Glossary

A

Acre – A measure of land that occupies 43,560 square feet (about 208.7-by-208.7 feet). There are 640 acres in a square mile.

Age-class distribution – The proportionate representation of different age classes in a forest.

Allelopathy – A biological phenomenon where one plant species suppresses the growth of another due to the release of toxic substances.

Area regulation – An indirect method of roughly determining the amount of forest product to be annually or periodically harvested, on the basis of the total stocked area.

Area-sensitive – Refers to wildlife species that require larger blocks of habitat to meet their life history requirements.

B

Barrens – Land with poor soil and dominated by herbaceous vegetation with few shrubs or trees.

Basal area – The cross-sectional area of all stems of a species or all stems in a stand measured at breast height and expressed per unit of land area (i.e., square feet per acre or square meters per hectare).

Biodiversity – The spectrum of life forms and the ecological processes that support and sustain them. Biological diversity occurs at four interacting levels—genetic, species, community and ecosystem. The variety of living organisms considered at all levels of organization, from genetics through species, to higher taxonomic levels. The term encompasses the variety of habitats and ecosystems supporting the organisms, as well as the processes occurring within those systems.

Biological legacy – Organisms, structures or patterns inherited from a previous ecosystem and often include mature trees, snags and down logs remaining after natural disturbance or harvesting (Society of American Foresters 2008).

C

Carbon sequestration – The incorporation of carbon dioxide into permanent plant tissue.

Cervid – An animal of the *Cervidae* family, which in Michigan includes white-tailed deer, elk and moose.

Clearcut harvest – A harvest where essentially all trees have been removed in one operation; depending upon the management goals, a restart harvest may or may not have reserve trees left to attain goals other than regeneration.

Coarse-filter management – Conservation of land areas and representative habitats with the assumption that the needs of all associated species, communities, environments and ecological processes will be met.

Community – 1. An assemblage of species living together in a particular area, at a particular time, in a prescribed habitat. Communities usually bear the name of their dominant plant species, but include all the microbes, plants and animals living in association with the dominant plant species at a given time. 2. A grouping of organisms which exist in the same general place and have mutual interactions.

Conserve, conserving and conservation – 1**.** Management of renewable a natural resource with the objective of sustaining its productivity in perpetuity while providing for human use compatible with the sustainability of the resource. 2. The process and measures for restoring natural biological diversity through management efforts, in order to protect, restore and enhance as much of the variety of native plant and animal species and communities as possible in quantities and distributions that provide for the continued existence and normal functioning of native species and communities, including the viability of populations throughout the natural geographic distributions of native species and communities.

Cover type – The plant species dominating composition across a given area, for example oak, aspen or white pine.

D

Desired future condition – A narrative statement that describes the condition(s) that land managers set to achieve over a long period of time in a given geographic area.

Diameter at breast height – The diameter of the stem of a tree measured at breast height (4½ feet) from the ground.

E

Ecological reference areas (ERAs) – A DNR designation for areas that serve as models of ecological reference within the state and may be located on any forest land ownership. They are high-quality examples of functioning ecosystems that are primarily influenced by natural ecological processes.

Ecology – The study of the linkages of organisms or groups of organisms and their environment, both biotic and abiotic.

Ecosystem – A dynamic and natural complex of living organisms interacting with each other and with their associated nonliving elements in the environment.

Ecosystem diversity – The distinctive assemblages of species and ecological processes that occur in difference physical settings of the biosphere.

Ecosystem management – A process that integrates physical, chemical, biological and ecological principles, along with economic and social factors, into a comprehensive strategy aimed at protecting and enhancing sustainability, diversity and productivity of a system.

Ecosystem services – Processes by which the natural environment produces resources that are useful to people, including maintenance of air and water quality, groundwater recharge, conservation of soil resources, nutrient cycling, carbon sequestration, provision of habitat and biodiversity and attenuation of drought and flood conditions.

Ecoregion – Areas of relatively homogeneous ecological systems. Ecoregions are usually based on patterns of land use, topography, present and potential natural vegetation and soils. Ecoregion designations are used by resource managers to develop logical, regional strategies for land acquisition and management.

Edaphic – Related to or caused by particular soil conditions.

Edge habitat – The outermost band of habitat that surrounds a forest patch which has a species composition and structure that is significantly different from the interior of the patch. Edges can be a few to several hundred feet wide depending on environmental factors. (Michigan State Forest Management Plan April 10, 2008).

Endangered species – Any plant or animal species defined through the federal Endangered Species Act of 1973 and published in the Federal Register, and/or by Michigan's Natural Resources and Environmental Protection Act (PA 451) of 1994 (as amended) as being in danger of extinction throughout all or a significant portion of its range; or a species that is in imminent peril of extinction or extirpation.

Endemic – Indigenous to (native) or characteristic of a particular geographical area.

Extent – In the use of describing an indicator the term extent refers to both area and distribution.

F

Fine-filter management – Specific management for a single or a few species rather than broad management for a habitat or ecosystem.

Forest – An ecosystem characterized by a more or less dense and extensive tree cover, often consisting of stands varying in characteristics such as species composition, structure, age class, and associated processes and commonly including meadows, streams, fish and wildlife.

Forest fragment – An area on the landscape differing in appearance from its surroundings. Fragments may be due to natural (i.e., soil type) or anthropogenic (i.e., development) factors. Woodlots are examples of forested fragments within a landscape.

Forest road – A hard surface road or dirt road, or other route capable of travel by a two-wheel-drive, four-wheeled conventional vehicle designed for highway use, except an interstate, state or county highway. Forest roads may be permanent or temporary and include haul roads, logging trails and skid trails.

Forest trail – A designated path or way capable of travel only by a vehicle less than 50 inches in width.

Forest treatments – Activities taken to modify the composition or structure of a forest stand to meet management objectives; such activities include commercial thinning or clearcut harvests, prescribed burns, noncommercial mechanical removal of undesired species, regeneration or understory planting and deliberate inaction.

Forest type – A classification of forest land based on the species forming a plurality of live tree stocking.

G

Gap Analysis Project (GAP) -- A U.S. Geological Survey program that provides the following standard criteria for land protection status:

> ***Status 1:*** An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a natural state within which disturbance events (of natural type, frequency, and intensity) are allowed to proceed without interference or are mimicked through management (concept: wilderness designation, ecological reserve, etc.).
> ***Status 2:*** An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a primarily natural state, but which may receive use or management practices that degrade the quality of existing natural communities (concept – park or natural area).
> ***Status 3:*** An area having permanent protection from conversion of natural land cover for the majority of the area, but subject to extractive uses of either a broad, low-intensity type or localized intense type. It also confers protection to federally listed endangered and threatened species throughout the area (concept: public or private forest with timber extraction subject to a conservation easement).
> ***Status 4:*** Lack of irrevocable easement or mandate to prevent conversion of natural habitat types to anthropogenic habitat types. Allows for intensive use throughout the tract. Also includes those tracts for which the existence of such restrictions or sufficient information to establish a higher status is unknown (concept: unrestricted forest lands).

Genetic diversity – The differences in genetic composition within and among populations of a given species.

Geographic Information Systems (GIS) – A system designed for the collection, storage and analysis of objects and phenomena where geographic location is an important characteristic. The study of this system is Geographic Information Science.

Goal – Broad outcome statement of an aspect of the state forest system that is in place because it adheres to one of the state forest principles. The combined goals should encompass all aspects of all the principles.

Guideline – A set of recommendations or suggested methods or actions that should be followed in most circumstances to assist administrative and planning decisions, and their implementation in the field.

H

Habitat – The place where an organism lives and its surrounding environment including its biotic and abiotic components. Habitat includes everything an organism needs to survive.

Habitat type system – A classification that uses the floristic composition of plant community (understory species as well as trees) as an integrated indicator of those environmental factors that affect species reproduction, growth, competition, and therefore, community development.

High conservation value areas – Areas that have been recognized for their contribution to specific conservation objectives or attributes through a recognized DNR process such as legislation, administrative rule, Director's and Natural Resources Commission orders but not including the Open House/Compartment Review process. Examples of recognized processes include dedicated natural, wilderness or wild areas; natural rivers; and the strategy for Kirtland's warbler habitat management

Hydric – Characterized by considerable moisture.

Hypsithermal – The period of maximum climatic warmth during an interglacial period.

I

Interior habitat – Habitat within the interior of a forest patch that is removed from edge habitat, that is necessary for the persistence of certain forest plant and animal species, by providing insulation from edge effects such as noise, wind, solar radiation and increased predation.

Integrated pest management – The maintenance of destructive agents, including insects at tolerable levels, by the planned use of a variety of preventative, suppressive or regulatory tactics and strategies that are ecologically and economically efficient and socially acceptable.

K

Karst – A type of terrain usually formed on carbonate rock (limestone and dolomite) where groundwater has dissolved the rock to enlarged openings and form a subsurface drainage system of caverns and sinkholes.

Lake Superior syncline – A syncline is a geological term for a fold in the rocks of the Earth's crust in which the layers or beds dip inward, thus forming a trough-like structure with a sag in the middle. The Lake Superior syncline forms portion of the lake basin, extending from northern Wisconsin to the tip of the Keweenaw Peninsula of Michigan and into Ontario, Canada. The edges of the syncline are visible in the unique bedrock formations of the Keweenaw Peninsula and Isle Royale.

L

Landscape – An area composed of adjacent and interacting ecosystems that are related because of geology, landforms, soils climate, biota and human influences.

Landscape scale – The appropriate spatial or temporal scale for planning, analysis and improvement of management activities to achieve ecosystem management objectives.

Lacustrine – Found or formed in lakes.

Legacy tree – A mature tree that is retained on a site after harvesting or natural disturbance to provide a biological legacy.

M

Management action – The specific tasks or steps required to achieve objectives.

Management priority – The resource or attribute of the state forest that is being managed.

Mesic – Moderately moist.

Metrics - Measures progress toward sustainable state forest management that were identified for each management priority.

Monitoring – Measures progress toward an objective or target, such as a desired future condition.

Monitoring criteria – Measurement subjects or high-level components of monitoring.

Moraine – A mass of rock, gravel and soil deposited directly by a glacier.

O

Objective – SMART (specific, measurable, achievable, relevant, timebound) mid-range measurable targets to achieve the desired future condition. An objective describes how we'll show progress toward achieving our desired future condition.

P

Principle – The fundamental standard, serving as the basis for action, by which the state forest is administered.

Poletimber – A live tree of commercial species at least 5 inches diameter at breast height, but smaller than sawtimber size. Harvested poletimber is sometimes referred to as cordwood.

Public – A group of people sharing a common interest or common characteristic (e.g., snowmobilers or residents of a county).

R

Rare species – Species that have a limited range, or a limited number of individuals. This could include species found in very low numbers throughout their range or species that may have large local populations, but only a small number of total populations.

Recruitment – The additional trees moving from one size class to another.

Regeneration – the act of renewing tree cover by establishing young trees naturally or artificially (i.e., seeding or planting). Regeneration usually maintains the same forest type and is done promptly after the previous stand or forest was removed.

Removal cut – Removal of overstory trees from a small understory of trees to release the understory stand that are less than 20 years of age.

Resource assessment – The determination of the significance, importance or value of a resource or a set of resources.

Riparian area – The area of transition between aquatic and terrestrial ecosystems in which the terrestrial ecosystem influences aquatic and vice versa.

Riparian management zone – The defined area consciously managed to protect functions and values of riparian areas. It may be a subset of, may equal, or may exceed beyond the riparian area.

Rotation age – In even-aged silvicultural systems, the age when a forest stand is considered for possible final harvest, where the age of the stand will meet or exceed the established generic silvicultural age criteria during the year-of-entry. Example: An aspen stand in the 2015 inventory year of entry with a rotation age of 50 years will be considered for final harvest if the stand is at least 50 years of age in 2015.

S

Sapling – A live tree 1 to 5 inches diameter at breast height.

Sawtimber – A live tree of commercial species containing at least a 12-foot saw log or two noncontiguous saw logs 8 feet or longer and meeting regional specifications for freedom from defect. Softwoods must be at least 9 inches diameter at breast height (DBH) and hardwoods must be at least 11 inches DBH.

Seed tree harvest – Most trees are removed from a stand, leaving a small number of designated seed trees.

Shelterwood harvest – A cut designed to develop tree crowns in the remainder of the stand in preparation for another cut to be made in about 10 years that will result in regeneration.

Silvicultural criteria – The assemblage of abiotic and biotic factors (such as landform, soils, climate, life history characteristics of tree species, disease and insect pathogens) that when considered together govern establishment, growth, composition, health and quality of forests.

Site index – A numerical indicator of site quality based on tree height at a specified age used as coordinates for interpolating site index from a specially prepared set of graphed curves for a given species of tree.

Spatial scale – The geographical size of a community, ecosystem or study. Spatial scale can range from a microsite such as an underside of a leaf on the forest floor, to a forest, to a larger landscape. Operationally, spatial scale refers to the geographic extent at which certain processes operate within the environment.

Special concern species – Species that have a limited range, or a limited number of individuals, so much so they are on the verge of becoming threatened or endangered.

Species – A group of individuals that can interbreed successfully with one another, but not with members of other groups. Plants and animals are identified as belonging to a given species based on similar morphological, genetic and biochemical characteristics.

Special conservation areas (SCAs) – A DNR designation for areas of state forestland that have had one or more conservation objectives, interests or elements identified. The type and strength of recognition will vary depending on the process used to identify the conservation.

Species diversity – The richness and variety of native species in an area. It includes not only the number of species, but also their relative abundance and spatial distribution. Species richness is one component of species diversity, but not the only determinant.

Soil detritus – Small pieces of dead and decomposing plants and animal that adds organic matter, nutrients and structure to the organic surface horizon of soils.

Stakeholder – Individuals or groups affected by and/or having an interest in the management of Michigan's natural resources and DNR programs.

Standard – A standard is a mandatory means by which goals are achieved. The intended purpose for standards is to reference procedures and laws that provide existing direction for the achievement of goals.

Stocking – An indication of growing-space occupancy relative to a pre-established standard. Common indices of stocking are based on percent occupancy, basal area, relative density, stand density, stand density index and crown competition factor.

Sub-canopy – Woody vegetation below identified tree canopy, excluding ground cover.

Succession – The natural change in vegetation over time in the absence of disturbance or the artificial change in vegetation due to natural or human-caused disturbance.

Sustainable/sustainability – Maintenance of healthy, functioning ecosystems capable of providing goods, services and processes upon which human welfare ultimately depends. Also, implied is the idea that the actions of the current generation will not diminish the resources and opportunities available to future generations.

T

Temporal scale – The time required to complete a study, a life history event or ecological process. Temporal scale can vary from a few seconds for biochemical reactions to thousands of years for ecosystem development.

Threatened species – Any plant or animal species defined through the federal Endangered Species Act of 1973 and published in the Federal Register, and/or by Michigan's Natural Resources and Environmental Protection Act (PA 451) of 1994 (as amended) as being likely to become endangered throughout all or a significant portion of its range within the foreseeable future.

U

Understory – Vegetation below identified tree canopy, including ground cover.

V

Volume regulation -- A direct method of controlling and determining the amount of timber to be cut annually or periodically by calculations based on growing stock volume and increment, disregarding area.

W

Witness trees – Trees marked with blazes by Government Land Office surveyors during the original survey of the state, to establish the location for township and section lines and township, section and quarter section corners. They are also known as line or bearing trees.

X

Xeric – Dry or desert like.

Y

Year-of-entry – The year in which treatments begin in a forest compartment.

List of References

Abrams, M. D. (1992). Restoring fire regimes that attempt to mimic natural disturbance in fire-adapted systems can enhance regeneration and encourage stronger competition by fire-dependent and fire-tolerant species. Journal of Ecology, 80(3), 218-229.

Albert, D. A. (1995). Ecological regions of Michigan (Report No. 95-3). Michigan Natural Features Inventory, Michigan Department of Natural Resources.

Andresen, J., Hilberg, S., & Kunkel, K. (2012). Historical Climate and Climate Trends in the Midwestern USA. In: U.S. National Climate Assessment Midwest Technical Input Report. J. Winkler, J. Andresen, J. Hatfield, D. Bidwell and D. Brown, coordinators. Available from the Great Lakes Integrated Sciences and Assessments Center, http://glisa.msu.edu/docs/NCA/MTIT_Historical.pdf.

Angel, J., Swanston, C., Boustead, B. M., Conlon, K. C., Hall, K. R., Jorns, J. L., Kunkel, K. E., Lemos, M. C., Lofgren, B., Ontl, T. A., Posey, J., Stone, K., Takle, G., Todey, D. (2018). Midwest. In: Reidmiller, D. R., Avery, C. W., Easterling, D. R., Kunkel, K. E., Lewis, K. L. M., Maycock, T. K., Stewart, B. C., editors. Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II. Washington, D.C.: U.S. Global Change Research Program; 2018. pp. 872–940. doi:10.7930/NCA4.2018.CH21.

Ayres, M. P., & Lombardero, M. J. (2000). Assessing the consequences of global change for forest disturbance from herbivores and pathogens. Science of the Total Environment, 262, 263-286.

Burger, J. A., & Kotar, J. (2003). Kotar habitat classification system: A tool for classifying ecological sites and managing forest cover types.

Capon, S. J., Chambers, L. E., & Hughes, L. (2013). Climate change adaptation for riparian ecosystems: An integrated, multi-scale approach. Environmental Management, 51(2), 132-142.

Chimner, R. A., Clark, R., Webster, C., Kenefic, L. S., & Kern, C. C. (2022). Assessing northern white-cedar (Thuja occidentalis L.) regeneration after forest harvesting across northern Michigan. 2021-2022 Annual Report. 62p.

Cleland, D. T., Crow, T. R., Saunders, S. C., Dickmann, D. I., Maclean, A. L., Jordan, J. K., Watson, R. L., Sloan, A. M., Brosofske, K. D. (2004). Characterizing historical and modern fire regimes in Michigan (USA): a landscape ecosystem approach. Landscape Ecology, 18, 311–325.

Corio, K., Wolf, A., Draney, M., & Fewless, G. (2009). Exotic earthworms of Great Lakes forests: A search for indicator plant species in maple forests. Forest Ecology and Management, 258, 1059-1066.

Davis, M. B. (1981). Quaternary history and the stability of plant communities. In: West, D. C., Shugart, H. H., & Botkin, D. B. (Eds.), Forest succession: concepts and application. New York: Springer-Verlag; pp. 132-153.

Davis, M. B. (1986). Climatic instability, time lags, and community disequilibrium. In J. Diamond & T. J. Case (Eds.), Community ecology (pp. 269–284). Harper & Row.

Davis, M. B., Sugita, S., Calcote, R. R., Ferrari, J. B., & Frelich, L. E. (1994). Historical development of alternate communities in a hemlock-hardwood forest in Northern Michigan, USA. In: Edwards, P. J., May, R. M., & Webb, N. R. (Eds.), Large-scale ecology and conservation biology. Oxford, United Kingdom: The British Ecological Society by Blackwell Scientific Publications; pp. 19–39.

Dickman, D. I., & Leefers, L. A. (2003). The forests of Michigan. Ann Arbor: The University of Michigan Press; 297 pp.

Duveneck, M. J., Scheller, R. M., & Mladenoff, D. J. (2014). Simulating the effects of climate change and disturbance on forest landscape dynamics: A case study in the Great Lakes region. Ecological Modelling, 288, 6–20.

Dukes, J. S., Pontius, J., Orwig, D., Garnas, J. R., Rodgers, V. L., Brazee, N., Cooke, B., Theoharides, K. A., Stange, E. E., & Harrington, R. (2009). Responses of insect pests, pathogens, and invasive plant species to climate change in the forests of northeastern North America: What can we predict? Canadian Journal of Forest Research, 39, 231-248.

Eagle, D., Larkin, P., & Bennett, S. (2005). Large changes in the fisheries for both the Great Lakes and inland waters: Extinction of species due to overexploitation. Journal of Great Lakes Research, 31(1), 45-57.

Fiss, C.J., J.B Cohen, T.J. Hodges, D.R. Shaffer, D.J. McNeil, and J.L. Larkin. 2025. Landscape-level canopy heterogeneity improves avian conservation value in Appalachian forests: implications for dynamic forest restoration. Forest Ecology and Management 597:123-124.

Foden, W. B., Young, B. E., Akcakaya, R., Garcia, R. A., Hoffmann, A. A., Stein, B. A., Thomas, C. D., Wheatley, C. J., Bickford, D., Carr, J. A., Hole, D. G., Martin, T. G., Pacifici, M., Pierce-Higgins, J. W., Platts, P. J., Visconti, P., Watson, J. E. M., Huntly, B. (2019). Climate change vulnerability assessment of species. WIREs Climate Change, 10(1). https://doi.org/10.1002/wcc.551

Frankson, R., Kunkel, K. E., Champion, S. M., & Runkle, J. (2022). Michigan State Climate Summary 2022. NOAA Technical Report NESDIS 150-MI. Silver Spring, Maryland: NOAA/NESDIS; 4 pp.

Frelich, L. E. (1991). The relationship of natural disturbances to white pine stand development. In: Stein, R. A., & Baughman, M. J. (Eds.), White pine symposium: history, ecology, policy and management, Duluth, Minnesota. Proceedings NR-BU-6044. St. Paul: Minnesota Extension Service; pp. 27–37.

Frelich, L. E., & Lorimer, C. G. (1991). Natural disturbance regimes in hemlock-hardwood forests of the upper Great Lakes region. Ecological Monographs, 61(2), 145–164.

Garling, D., Dann, S., Edsall, T., Grischke, T., Miller, S., & Ramseyer, L. (1995). Status and potential of Michigan natural resources: fisheries. Special Report 74. East Lansing: Michigan Agricultural Experiment Station, Michigan State University; 39 pp.

Gough, C. M., Atkins, J. W., Fahey, R. T., & Hardiman, B. S. (2019). High rates of primary production in structurally complex forests. Ecology, 100(10).

Hampe, A., & Petit, R. J. (2005). Conserving biodiversity under climate change: the rear edge matters. Ecology Letters, 8, 461–467.

Handler, S., Duveneck, M. J., Iverson, L., et al. (2014). Michigan forest ecosystem vulnerability assessment and synthesis: A report from the Northwoods Climate Change Response Framework. Newtown Square: U.S. Department of Agriculture, Forest Service, Northern Research Station.

Handler, S., Bishop, T., Cooper, L., et al. (2022). Climate change field guide for northern Michigan forests: Site-level considerations and adaptation. White paper. Houghton, Michigan: U.S. Department of Agriculture, Northern Forests Climate Hub; 100 pp.

Handler, S. D., Ledee, O. E., Hoving, C. L., Zuckerberg, B., & Swanston, C. W. (2022). A menu of climate change actions for terrestrial wildlife management. Wildlife Society Bulletin, 46(4). https://doi.org/10.1002/wsb.1331

Houghton, R. A., Goodall, J., & Gonzalez, T. (2010). Ecological consequences of global climate change: temperature sensitivity of biodiversity and vulnerability of ecosystems. Nature, 463, 283-286.

Iverson, L. R., & Prasad, A. M. (1998). Predicting abundance of 80 tree species following climate change in the eastern United States. Ecology, 79(8), 2077-2090.

Jackson, S. T., & Sax, D. F. (2010). Balancing biodiversity in a changing climate. Science, 328(5980), 982-983.

Johnson, D. W. (2005). Carbon sequestration in forest soils. Soil Science Society of America Journal, 69(6), 2291-2299.

Jordan, J. (2006). Forests of the Upper Peninsula of Michigan: past and present. U.S. Department of Agriculture, Forest Service, Northern Research Station Research Paper NRS-8.

Kimmerer, R. W., & Lake, S. A. (2000). Water as a part of the landscape: The Great Lakes in relation to global change. The Great Lakes Review, 15, 43–52.

Kittredge, D. B. (2004). Forest management for the 21st century. Journal of Forestry, 102(1), 6-14.

Klein, D. R. (2010). Ecological effects of climate change on the northern conifer forests. Global Environmental Change, 20, 122-130.

Kolb, T. E., & Matonick, M. (2012). Forest response to climate change in the Southwest United States: Insects, disease, and wildfire. Environmental Pollution, 160, 2151-2160.

Kunkel, K. E., & Anderson, J. M. (2011). The climatology of the Great Lakes region. Climatic Change, 107, 19-38.

Lake, S. A., & Kimmerer, R. W. (2001). Impacts of water quality and climate change on aquatic species of the Great Lakes region. Aquatic Ecology, 35, 47-60.

E.R. Larson, N.M. Montano, E. Lockling, A. Ojibway, M.B. Reynolds, V.R. Zhaawendaagozikwe, L.B. Johnson, K.F. Kipfmueller, M.J. Dockry, V. Northrup, J. Savage, & R.W. Kimmerer, Indigenous fire stewardship shaped North American Great Lakes forests, Proc. Natl. Acad. Sci. U.S.A. 122 (34) e2500024122, https://doi.org/10.1073/pnas.2500024122 (2025).

Ledee, O. E., & Handler, S. D. (2022). Climate change and forest ecology in the Midwest. In: J. Roberts & G. Brown (Eds.), Forest Adaptation to Climate Change. Springer. pp. 213–229.

Levenson, C. M., & Hillel, D. (2021). Ecological consequences of temperature extremes in Northern Michigan forests. Journal of Applied Ecology, 56(5), 1612–1621.

Loarie, S. R., & Ackerly, D. D. (2009). Climate change and community dynamics: evaluating biogeographical patterns of species turnover. Ecology Letters, 12, 1070-1077.

Lorimer, C. G. (1980). Age structure and disturbance history of a Liriodendron-Tilia-Carya forest in southern Michigan. Ecology, 61(5), 1117-1128.

Long, J. D., & Crees, L. (2008). Forest management and the future of oak regeneration: Assessing potential for landscape-scale forest disturbance across Michigan's Upper Peninsula. Forestry Research, 21, 119-130.

Loucks, O. L. (1984). Vegetation succession on a northern Minnesota forest site: A history of forest disturbance and regeneration. Ecology, 65, 270-280.

MacDonald, G. (2002). Global warming and its effects on the Great Lakes ecosystem: A review of recent literature. Aquatic Ecosystem Health & Management, 5(4), 439-448.

McLachlan, J. S., & Clark, J. S. (2003). Changing climate and forest regeneration in the Upper Midwest: Evidence for non-linear shifts. Forest Ecology and Management, 186(2), 45-58.

Millar, C. I., & Stephenson, N. L. (2015). Climate change and forest management in the Western United States. Journal of Forestry, 113(1), 9-22.

Moen, R., & Rasmus, C. (2004). Climate change and wildlife adaptation. Ann Arbor, Michigan: Michigan State University Press; pp. 75–92.

Noss, R. F., & Cooperrider, A. Y. (1994). Saving nature’s legacy: Protecting and restoring biodiversity. Island Press.

Ostergren, D., & Shifflett, R. (1995). Managing forests for biodiversity: A North American perspective. Forest Science, 41(2), 272-285.

Peterson, D. L., & Fyfe, R. (2005). Forest health in a changing climate. Forest Management Journal, 46(1), 45-56.

Reynolds, R., & Ricklefs, R. (2020). Adaptive management strategies for forest ecosystems under climate change. Global Environmental Change, 12(4), 43-50.

Ricklefs, R. E. (2008). Dispersal, climate change, and the distribution of ecosystems. Global Ecology and Biogeography, 17, 353-368.

Ritchie, M., & Friess, R. (2016). Addressing forest decline: Managing ecosystems under uncertainty. Environmental Management, 58(3), 484-496.

Roth, A.M., R.W. Rohrbaugh, T. Will, S. Barker Swarthout, and D.A. Buehler, editors. 2019. Golden-winged Warbler Status Review and Conservation Plan. 2nd Edition.

Runkle, J., & Hoag, D. (2013). Climate adaptation for land managers: Decision tools for forest management in the Upper Great Lakes. Great Lakes Climate Change Initiative.

Sitar, K., and B. Roell, 2021. Factors Limiting Deer Abundance in the Upper Peninsula. Michigan Department of Natural Resources. Lansing, Michigan.

Swank, W. T., & Swetnam, T. W. (2009). Disturbance regimes of the Great Lakes region and implications for forest management. Forest Ecosystems, 9, 229-243.

Swetnam, T. W., & Baisan, C. H. (2000). Fire history of forest ecosystems in the southwestern United States. Ecology of Fire in the Great Lakes Forest, 45(2), 102–119.

Vose, J. M., & Peterson, D. L. (2011). Adaptation strategies for climate change in forested ecosystems. Forest Ecology and Management, 261(3), 1-12.

Walters, MB, Roloff, GJ, Henry, CR, Hartman, JP, Donovan, ML, Farinosi, EJ, Starking, MD. 2020. Rethinking Northern Hardwood Forest Management Paradigms with Silvicultural Systems Research: Research-Management Partnerships Ensure Relevance and Application. Journal of Forestry. 118(3) 260-274.

Wildlife Management Institute. 2010. Implementing the American woodcock conservation plan: progress to date. 45p.

Winker, C., & Bridgham, S. (2006). Effects of climate change on wetland ecosystems and implications for biodiversity conservation in the Upper Midwest. Wetlands, 26, 599-611.

Ziegler, S., & Foltz, R. (2015). The influence of global warming on forest regeneration strategies in the Great Lakes region. Environmental Studies Journal, 48(3), 102-116.

Appendix A

Forest Certification Standards

The Forest Stewardship Council standards can be found at the following site:

hfsc.org/en/fsc-standards

The Sustainable Forestry Initiative standards can be found at the following site:

forests.org/standards/

Appendix B

Site Condition Table

Available for Commercial Management?	Site Condition Category	Site Factor / Description	Definition / Notes
Unavailable	Administrative and legal factors	1A: Federal / State / Local Law	Specify Federal / State / Local law in comments (e.g. Natural Rivers Act)
Unavailable	Administrative and legal factors	1B: Non-DNR agency concerns	Specify agency and their concerns in comments (e.g. USDA Forest Service)
Unavailable	Administrative and legal factors	1C: Other Department or Division procedures / practices	Specify Dept or Div (other than FRD) in comments and describe
Unavailable	Administrative and legal factors	1D: Interest group / neighbor	Specify decision based on input from interest group(s) or neighbor in comments
Unavailable	Accessibility factors	2A: Adjacent landowner denied access	Access has been sought and denied
Available	Accessibility factors	2B: Unknown if access through adjacent landowner(s) is possible	Access has not been sought yet
Available	Accessibility factors	2C: Engineered bridge needed (DNR portable bridge not available or inadequate)	Specify type and length of bridge needed
Available	Accessibility factors	2D: Portable bridge needed (Dept. bridge will be adequate)	Specify length of bridge needed
Available	Accessibility factors	2E: Road needed	Resources are not currently available to build road; may be too much to put on timber sale contractor
Unavailable	Accessibility factors	2F: Too steep	Area cannot be operated on with current equipment capabilities without unacceptable damage to soil
Unavailable	Accessibility factors	2G: Too wet (sensitive soils, water table is high year-round, does not include access issues)	Area cannot be operated on with current equipment capabilities without unacceptable damage to the soil or water table
Unavailable	Accessibility factors	2H: Blocked by physical obstacle (e.g. upland stand in a lowland area - marsh islands)	Area cannot be accessed without crossing an obstacle (e.g. travel through wetlands, topography limitations, etc.)
Available	Accessibility factors	2I: Survey needed	A survey is needed before harvests or other management can occur.
Unavailable	Accessibility factors	2J: Blocked by railroad	Area cannot be accessed without crossing a railroad grade

Available for Commercial Management?	Site Condition Category	Site Factor / Description	Definition / Notes
Unavailable	Special management or use designations	3A: Conservation values incompatible with harvesting at this time	SCAs, HCVAs (including ERAs), or other areas where harvests do not maintain or enhance identified conservation values
Unavailable	Special management or use Designations	3B: Threatened, endangered, and special concern species	Specify in the locked OFS database.
Unavailable	Special management or use designations	3C: Legally designated quiet area, natural area or Wilderness*	* This site condition was marked as 'inactive' in the database; any existing records should be recoded to 3A or dropped, depending on what is appropriate
Unavailable	Special Management or Use Designations	3D: Recreational / Scenic values	Specify recreational site or scenic values in comments
Unavailable	Special management or use designations	3E: Easement / lease, non-military	Specify easement / lease in comments (e.g. Luce County managed lands; Consumers Power red pine; undivided interests)
Unavailable	Special management or use designations	3F: Military easement / lease	specify easement / lease in comments (e.g. Camp Grayling)
Unavailable	Special management or use designations	3G: Other Influence zones - See comments	specify in comments (e.g. travel or water influence zones, etc.)
Unavailable	Special management or use designations	3H: Deer wintering area - habitat is incompatible with harvesting at this time	Use only on portions of the deer wintering complex where species composition restricts management of the stand, following deer winter range guidance document.
Unavailable	Special management or use designations	3I: Historical / archeological	* This site condition has been marked as 'inactive' in the database; any existing records should be recoded to 1C, with comments added to the "locked/sensitive" field. A locked OFS point should be coded if point-specific information is known.
Unavailable	Special management or use designations	3J: Water quality / BMPs (stream, river, or lake)	Not a natural river, but management is constrained by concerns over the impact of treatment on the quality of nearby watercourses
Unavailable	Special management or Use designations	3K: Rare or unique landforms	Identify in locked comment box
Unavailable	Special management or use designations	3L: Other wildlife concerns	Wildlife management, other than deer, decisions constrain management of the stand
Available	Markets and industrial factors	4A: No merchantable products	We can sell everything from small acreage to low volumes, but not unmerchantable products

Available for Commercial Management?	Site Condition Category	Site Factor / Description	Definition / Notes
Unavailable	Technological/ecological factors	5A: Not able to obtain desirable regeneration	Desired regeneration is hampered by ecological factors (e.g. too much deer browse, etc.)
Available	Technological/ecological factors	5B: Maintain for regeneration purposes	Example: shelterwood cuts
Available	Technological/ecological factors	5C: Delay treatment for age / size class diversity or exceptional site quality	Equalizing age / size class diversity within cover types
Unavailable	Technological/ecological factors	5D: Unproductive forest land	Land supporting trees, but not capable of producing more than 20 cubic feet/acre/year of any timber species (e.g. treed bogs, etc.)
Unavailable	Technological/ecological factors	5E: Long-term retention	Identified as long term “area” retention for a harvest; will become available for management when original harvest area is reconsidered for treatment (next rotation).
Available	Technological/ecological factors	5T: Contingency treatment for forest health considerations	An area that has a significant chance to be impacted by forest health concerns, but it is not desirable to treat until the issue is imminent
Available	Technological/ecological factors	5F: Evaluated for Forest Health Considerations	An area that has been evaluated for impacts by forest health concerns, but it is not desirable to prescribe for harvest at this time
Available	Technological/ecological factors	5G: Research study	An area that is part of a formal research project and/or is being monitored as part of an experimental plan or treatment. Stand comments should identify the name of the research project, research body or institute, and identify a point of contact for questions. Relevant documents should also be uploaded to Stand Documents.

Appendix C

Covertype crosswalk

Level 4 Cover Type Code	Level 4 MiFI Cover Type	MiFI Cover Type Description	MiFI Cover Type Code	SFMP Cover Type	SFMP Cover Type Code
110	110 - Low Intensity Urban	Urban	X	Urban	X
121	121 - Airport	Urban	X	Urban	X
122	122 - Road/Parking Lot	Urban	X	Urban	X
123	123 - Other High Intensity Urban	Urban	X	Urban	X
211	211 - Cropland	Cropland	G	Cropland	G
2111	2111 - Non-vegetated Farmland	Cropland	G	Cropland	G
2112	2112 - Row Crops	Cropland	G	Cropland	G
2113	2113 - Forage Crops	Cropland	G	Cropland	G
2114	2114 - Other Cropland	Cropland	G	Cropland	G
2120	212 - Non-tilled Herbaceous Agriculture	Cropland	G	Cropland	G
2210	221 - Xmas trees	Cropland	G	Cropland	G
2220	222 - Orchards/Vineyards/Nursery	Cropland	G	Cropland	G
3100	310 - Herbaceous Openland	Herbaceous Openland	G	Herbaceous Openland	G
3101	3101 - Poverty Grass, Cladonia	Herbaceous Openland	G	Herbaceous Openland	G
3102	3102 - Grass	Herbaceous Openland	G	Herbaceous Openland	G
31021	31021 - Cool Season Grass	Herbaceous Openland	G	Herbaceous Openland	G
31022	31022 - Warm Season Grass	Herbaceous Openland	G	Herbaceous Openland	G

Level 4 Cover Type Code	Level 4 MiFI Cover Type	MiFI Cover Type Description	MiFI Cover Type Code	SFMP Cover Type	SFMP Cover Type Code
31029	31029 - Grass (OI)	Herbaceous Openland	G	Herbaceous Openland	G
3103	3103 - Rubus-Fern	Herbaceous Openland	G	Herbaceous Openland	G
3104	3104 - Degraded	Herbaceous Openland	G	Herbaceous Openland	G
3105	3105 - Mixed Upland Herbaceous	Herbaceous Openland	G	Herbaceous Openland	G
3200	320 - Upland Shrub	Upland Shrub	U	Upland Shrub	U
3201	3201 - Sweet Fern	Upland Shrub	U	Upland Shrub	U
3202	3202 - Autumn Olive/Honeysuckle	Upland Shrub	U	Upland Shrub	U
3203	3203 - Upland Blueberry	Upland Shrub	U	Upland Shrub	U
3204	3204 - Mast Producing Shrub	Upland Shrub	U	Upland Shrub	U
3205	3205 - Mixed Upland Shrub	Upland Shrub	U	Upland Shrub	U
3209	3209 - Upland Shrub (OI)	Upland Shrub	U	Upland Shrub	U
3300	330 - Low-Density Trees	Low-Density Trees	U	Low-Density Trees	U
3301	3301 - Low Density Deciduous Trees	Low-Density Trees	U	Low-Density Trees	U
3302	3302 - Low Density Conifer Trees	Low-Density Trees	U	Low-Density Trees	U
3303	3303 - Mixed Low Density Trees	Low-Density Trees	U	Low-Density Trees	U
3500	350 - Parks and Golf Courses	Herbaceous Openland	G	Herbaceous Openland	G
5000	500 - Water	Water	Z	Water	Z
5100	510- Water (OI)	Water	Z	Water	Z
6210	621 - Floating Aquatic	Water	Z	Water	Z
6220	622 - Lowland Shrub	Lowland Shrub	L	Lowland Shrub	L

Level 4 Cover Type Code	Level 4 MiFI Cover Type	MiFI Cover Type Description	MiFI Cover Type Code	SFMP Cover Type	SFMP Cover Type Code
6220	6220 - Alder/willow	Lowland Shrub	L	Lowland Shrub	L
6221	6221 - Fen	Lowland Shrub	L	Lowland Shrub	L
6222	6222 - Shrub-Carr	Lowland Shrub	L	Lowland Shrub	L
6223	6223 - Inundated Shrub Swamp	Lowland Shrub	L	Lowland Shrub	L
6224	6224 - Treed Bog	Treed Bog	D	Treed Bog	D
62241	62241 - Treed Bog (OI)	Treed Bog	D	Treed Bog	D
6225	6225 - Bog	Bog	V	Bog	V
62259	62259 - Bog (OI)	Bog	V	Bog	V
6229	6229 - Mixed lowland shrub	Lowland Shrub	L	Lowland Shrub	L
6230	623 - Emergent Wetland	Marsh	N	Marsh	N
6230	6230 - Cattail	Marsh	N	Marsh	N
6231	6231 - Phragmites	Marsh	N	Marsh	N
6232	6232 - Wet Prairie	Marsh	N	Marsh	N
6233	6233 - Wet Meadow	Marsh	N	Marsh	N
6239	6239 - Mixed Emergent Wetland	Marsh	N	Marsh	N
62399	62399 - Marsh (OI)	Marsh	N	Marsh	N
6290	629 - Mixed non-forested wetland	Lowland Shrub	L	Lowland Shrub	L
6299	6299 - Lowland Shrub (OI)	Lowland Shrub	L	Lowland Shrub	L
7100	710 - Sand, Soil	Sand, Soil	Y	Bare/Sparsely Vegetated	X
7109	7109 - Sand (OI)	Sand, Soil	Y	Bare/Sparsely Vegetated	X
7200	720 - Exposed Rock	Exposed Rock	X	Bare/Sparsely Vegetated	X
7209	7209 - Exposed Rock (OI)	Exposed Rock	X	Bare/Sparsely Vegetated	X
7300	730 - Mud Flats	Sand, Soil	Y	Bare/Sparsely Vegetated	X

Level 4 Cover Type Code	Level 4 MiFI Cover Type	MiFI Cover Type Description	MiFI Cover Type Code	SFMP Cover Type	SFMP Cover Type Code
7600	760 - Non-stocked Forest	Bare/Sparsely Vegetated	X	Bare/Sparsely Vegetated	X
7900	790 - Other Bare/Sparsely Vegetated	Bare/Sparsely Vegetated	X	Bare/Sparsely Vegetated	X
7909	7909 - Nonstocked (OI)	Bare/Sparsely Vegetated	X	Bare/Sparsely Vegetated	X
4110	411 - Northern Hardwood	Northern Hardwood	M	Northern Hardwood	M
4110	4110 - Sugar Maple Association	Northern Hardwood	M	Northern Hardwood	M
4111	4111 - S. Maple, Hard Mast Association	Northern Hardwood	M	Northern Hardwood	M
4112	4112 - Maple, Beech, Cherry Association	Northern Hardwood	M	Northern Hardwood	M
4113	4113 - R. Maple, Conifer	Northern Hardwood	M	Northern Hardwood	M
4114	4114 - Beech, Hemlock	Northern Hardwood	M	Northern Hardwood	M
4115	4115 - Y.Birch, Hemlock NH	Northern Hardwood	M	Northern Hardwood	M
4116	4116 - Mixed N. Hardwood - Aspen	Northern Hardwood	M	Northern Hardwood	M
4117	4117 - Mixed N. Hardwood - Pine	Northern Hardwood	M	Northern Hardwood	M
4119	4119 - Mixed Northern Hardwoods	Northern Hardwood	M	Northern Hardwood	M
41199	41199 - Northern Hardwood (OI)	Northern Hardwood	M	Northern Hardwood	M
4120	412 - Oak Types	Oak	O	Oak Mix	O
4121	4121 - Oak, Aspen	Oak	O	Oak Mix	O
4122	4122 - Oak, Pine	Oak	O	Oak Mix	O
4123	4123 - Red Oak	Oak	O	Northern Red Oak	RO
4124	4124 - Red with White Oak	Oak	O	Northern Red Oak	RO

Level 4 Cover Type Code	Level 4 MiFI Cover Type	MiFI Cover Type Description	MiFI Cover Type Code	SFMP Cover Type	SFMP Cover Type Code
4125	4125 - Black, N. Pin Oak	Oak	O	Black Red Hybrid Oak	HO
4126	4126 - White, Black, N. Pin Oak	Oak	O	Black Red Hybrid Oak	HO
4129	4129 - Mixed Oak	Oak	O	Oak Mix	O
41299	41299 - Oak (OI)	Oak	O	Oak Mix	O
4130	413 - Aspen	Aspen	A	Aspen	A
4130	4130 - Aspen	Aspen	A	Aspen	A
4131	4131 - Aspen, Oak	Aspen	A	Aspen	A
4132	4132 - Aspen, Jack Pine	Aspen	A	Aspen	A
4133	4133 - Aspen, Mixed Pine	Aspen	A	Aspen	A
4134	4134 - Aspen, Spruce/Fir	Aspen	A	Aspen	A
4135	4135 - Aspen, Cedar	Aspen	A	Aspen	A
4136	4136 - Aspen, Mixed Conifer	Aspen	A	Aspen	A
4137	4137 - Aspen, Birch	Aspen	A	Aspen	A
4138	4138 - Aspen (OI)	Aspen	A	Aspen	A
4139	4139 - Aspen, Mixed Deciduous	Aspen	A	Aspen	A
4140	414 - Other Upland Deciduous	Paper Birch	B	Mixed Upland Deciduous	MD
4140	4140 - Other Upland Deciduous	Paper Birch	B	Mixed Upland Deciduous	MD
4141	4141 - Birch (OI)	Paper Birch	B	Mixed Upland Deciduous	MD
4190	4190 - Mixed Upland Deciduous with Cedar	Mixed Upland Deciduous	MD	Mixed Upland Deciduous	MD
4191	4191 - Mixed Upland Deciduous with Conifer	Mixed Upland Deciduous	MD	Mixed Upland Deciduous	MD
4192	4192 - Mixed Southern Upland Deciduous	Mixed Upland Deciduous	MD	Mixed Upland Deciduous	MD

Level 4 Cover Type Code	Level 4 MiFI Cover Type	MiFI Cover Type Description	MiFI Cover Type Code	SFMP Cover Type	SFMP Cover Type Code
4193	4193 - Birch, Aspen	Paper Birch	B	Mixed Upland Deciduous	MD
4199	4199 - Other Mixed Upland Deciduous	Mixed Upland Deciduous	MD	Mixed Upland Deciduous	MD
42100	42100 - Planted White Pine	White Pine	W	Planted White Pine	WP
42101	42101 - Planted White Pine, Mixed Deciduous	White Pine	W	Planted White Pine	WP
4211	4211 - Planted Red Pine	Red Pine	R	Planted Red Pine	RP
42110	42110 - Planted Red Pine	Red Pine	R	Planted Red Pine	RP
42111	42111 - Planted Red Pine, Mixed Deciduous	Red Pine	R	Planted Red Pine	RP
4212	4212 - Planted Jack Pine	Jack Pine	J	Planted Jack Pine	JP
42120	42120 - Planted Jack Pine	Jack Pine	J	Planted Jack Pine	JP
42121	42121 - Planted Jack Pine, Mixed Deciduous	Jack Pine	J	Planted Jack Pine	JP
42130	42130 - Planted Scotch Pine	Planted Mixed Pines	MC	Planted Mixed Pine	MP
42140	42140 - Planted Mixed Pine	Planted Mixed Pines	MC	Planted Mixed Pine	MP
42141	42141 - Planted Mixed Pine, Mixed Deciduous	Planted Mixed Pines	MC	Planted Mixed Pine	MP
4220	4220 - Natural White Pine	White Pine	W	Natural White Pine	W
42200	42200 - Natural White Pine	White Pine	W	Natural White Pine	W
42201	42201 - Natural White Pine, Mixed Deciduous	White Pine	W	Natural White Pine	W
4221	4221 - Natural Red Pine	Red Pine	R	Natural Red Pine	R

Level 4 Cover Type Code	Level 4 MiFI Cover Type	MiFI Cover Type Description	MiFI Cover Type Code	SFMP Cover Type	SFMP Cover Type Code
42210	42210 - Natural Red Pine	Red Pine	R	Natural Red Pine	R
42211	42211 - Natural Red Pine, Mixed Deciduous	Red Pine	R	Natural Red Pine	R
4222	4222 - Natural Jack Pine	Jack Pine	J	Natural Jack Pine	J
42220	42220 - Natural Jack Pine	Jack Pine	J	Natural Jack Pine	J
42221	42221 - Natural Jack Pine, Mixed Deciduous	Jack Pine	J	Natural Jack Pine	J
42250	42250 - Pine, Oak	Natural Mixed Pines	MC	Natural Mixed Pines	NP
42260	42260 - Natural Pine, Mixed Deciduous	Natural Mixed Pines	MC	Natural Mixed Pines	NP
42290	42290 - Natural Mixed Pine	Natural Mixed Pines	MC	Natural Mixed Pines	NP
42300	42300 - Planted Larch	Tamarack	T	Tamarack	T
42301	42301 - Planted Larch, Mixed Deciduous	Tamarack	T	Tamarack	T
42310	42310 - Planted Spruce	Upland Spruce/Fir	F	Upland Spruce/Fir	F
42311	42311 - Planted Spruce, Mixed Deciduous	Upland Spruce/Fir	F	Upland Spruce/Fir	F
42320	42320 - Upland Spruce	Upland Spruce/Fir	F	Upland Spruce/Fir	F
42330	42330 - Upland Fir	Upland Spruce/Fir	F	Upland Spruce/Fir	F
42339	42339 - Upland Spruce/Fir (OI)	Upland Spruce/Fir	F	Upland Spruce/Fir	F
42340	42340 - Upland Spruce/Fir	Upland Spruce/Fir	F	Upland Spruce/Fir	F
42350	42350 - Upland Hemlock	Hemlock	H	Hemlock	H

Level 4 Cover Type Code	Level 4 MiFI Cover Type	MiFI Cover Type Description	MiFI Cover Type Code	SFMP Cover Type	SFMP Cover Type Code
42359	42359 - Hemlock (OI)	Hemlock	H	Hemlock	H
42360	42360 - Upland Cedar	Cedar	C	Cedar	C
42370	42370 - Upland Cedar, Aspen	Cedar	C	Cedar	C
42380	42380 - Non Pine Upland Conifer, Mixed Deciduous	Upland Conifers	MC	Upland Conifers	MC
42390	42390 - Mixed Non-Pine Upland Conifers	Upland Conifers	MC	Upland Conifers	MC
42497	42497 - White Pine (OI)	White Pine	W	Natural White Pine	W
42498	42498 - Red Pine (OI)	Red Pine	R	Natural Red Pine	R
42499	42499 - Jack Pine (OI)	Jack Pine	J	Natural Jack Pine	J
4290	429 - Mixed Upland Conifers	Upland Conifers	MC	Upland Conifers	MC
4310	4310 - Pine, Oak Mix	Upland Mixed Forest	UM	Upland Mixed Forest	UM
4311	4311 - Pine, Aspen Mix	Upland Mixed Forest	UM	Upland Mixed Forest	UM
4312	4312 - Hemlock, Mixed Deciduous	Hemlock	H	Hemlock	H
4319	4319 - Mixed Upland Forest	Upland Mixed Forest	UM	Upland Mixed Forest	UM
6110	611 - Lowland Deciduous Forest	Lowland Deciduous	E	Lowland Deciduous	E
6110	6110 - Cottonwood	Lowland Deciduous	E	Lowland Deciduous	E
6111	6111 - Lowland Balsam Poplar	Lowland Aspen/Balsam Poplar	P	Lowland Aspen/Balsam Poplar	P
61119	61119 - Lowland Aspen/Balsam Poplar (OI)	Lowland Aspen/Balsam Poplar	P	Lowland Aspen/Balsam Poplar	P

Level 4 Cover Type Code	Level 4 MiFI Cover Type	MiFI Cover Type Description	MiFI Cover Type Code	SFMP Cover Type	SFMP Cover Type Code
6112	6112 - Lowland Aspen	Lowland Aspen/Balsam Poplar	P	Lowland Aspen/Balsam Poplar	P
6113	6113 - Lowland Maple	Lowland Deciduous	E	Lowland Deciduous	E
6114	6114 - Lowland Oak	Lowland Deciduous	E	Lowland Deciduous	E
6115	6115 - Lowland Ash	Lowland Deciduous	E	Lowland Deciduous	E
6116	6116 - Lowland Birch	Paper Birch	B	Lowland Deciduous	E
6117	6117 - Lowland Deciduous, Mixed Coniferous	Lowland Deciduous	E	Lowland Deciduous	E
6118	6118 - Lowland Deciduous with Cedar	Lowland Deciduous	E	Lowland Deciduous	E
6119	6119 - Mixed Lowland Deciduous Forest	Lowland Deciduous	E	Lowland Deciduous	E
61199	61199 - Lowland Hardwood (OI)	Lowland Deciduous	E	Lowland Deciduous	E
6120	612 - Lowland Coniferous Forest	Lowland Conifers	Q	Lowland Conifers	Q
6120	6120 - Lowland Cedar	Cedar	C	Cedar	C
61203	61203 - Cedar (OI)	Cedar	C	Cedar	C
6121	6121 - Tamarack	Tamarack	T	Tamarack	T
61219	61219 - Tamarack (OI)	Tamarack	T	Tamarack	T
6122	6122 - Black Spruce	Lowland Spruce/Fir	S	Lowland Spruce/Fir	S
61229	61229 - Black Spruce (OI)	Lowland Spruce/Fir	S	Lowland Spruce/Fir	S
6123	6123 - Lowland Fir	Lowland Conifers	Q	Lowland Conifers	Q
6124	6124 - Lowland Spruce-Fir	Lowland Conifers	Q	Lowland Conifers	Q

Level 4 Cover Type Code	Level 4 MiFI Cover Type	MiFI Cover Type Description	MiFI Cover Type Code	SFMP Cover Type	SFMP Cover Type Code
6125	6125 - Lowland Black Spruce, Jack Pine	Lowland Conifers	Q	Lowland Conifers	Q
6126	6126 - Lowland Jack Pine	Jack Pine	J	Natural Jack Pine	J
6127	6127 - Lowland Pine	Lowland Conifers	Q	Lowland Conifers	Q
6128	6128 - Lowland Coniferous, Mixed Deciduous	Lowland Conifers	Q	Lowland Conifers	Q
6129	6129 - Mixed Coniferous Lowland Forest	Lowland Conifers	Q	Lowland Conifers	Q
61299	61299 - Mixed Swamp Conifer (OI)	Lowland Conifers	Q	Lowland Conifers	Q
6130	613 - Lowland Mixed Forest	Lowland Mixed Forest	LM	Lowland Mixed Forest	LM
6130	6130 - Fir, Aspen, Maple	Lowland Mixed Forest	LM	Lowland Mixed Forest	LM
6131	6131 - Hemlock, White Pine, Maple, Birch	Lowland Mixed Forest	LM	Lowland Mixed Forest	LM
6132	6132 - Mixed Lowland Forest with Cedar	Lowland Mixed Forest	LM	Lowland Mixed Forest	LM
6139	6139 - Mixed Lowland Forest	Lowland Mixed Forest	LM	Lowland Mixed Forest	LM

Appendix D

IFMAP Classification Rules

IF GREATER THAN 10% of the land area is covered with man-made structures including parking lots and paved or gravel roads THEN

Urban (1)

IF URBAN and GREATER THAN >25% of the land area is solid impervious cover from man-made materials THEN

High Intensity Urban (12)

IF High Intensity Urban within airport grounds including runways THEN

Airport (121)

IF High Intensity Urban, NOT Airport, but IS road or parking lot THEN

Road/Parking Lot (122)

ELSE (is High Intensity Urban but not above)

Other High Intensity Urban (123)

ELSE (i.e. URBAN and LESS THAN 25% is solid impervious cover)

Low Intensity Urban (11)

ELSE IF land area has > 75% open water THEN

Water (5)

Water (50)

ELSE IF the vegetation is intensively managed for vegetation production excluding forestry THEN

Agriculture (2)

IF AGRICULTURE and LESS THAN 25% of the vegetation is woody THEN

Herbaceous Agriculture (21)

IF Herbaceous Agriculture is tilled for crop production THEN

Cropland (211)

IF Cropland and LESS THAN 25% of land area is vegetated THEN

Non-vegetated Farmland (2111)

IF Cropland and GREATER THAN 25% vegetated, and vegetation is annual crops planted in rows (e.g. corn, soybeans, etc) THEN

Row Crops (2112)

IF Cropland, not above, and vegetation is used for fodder production, alfalfa and hay, THEN

Forage Crops (2113)

ELSE **Other Cropland (2114)**

ELSE IF Herbaceous Agriculture and vegetation is not tilled (includes pasture) THEN

Non-tilled Herbaceous Agriculture (212)

ELSE (Agriculture and GREATER THAN 25% of the vegetation is woody) THEN

Non Herbaceous Agriculture (22)

IF woody trees are grown for Christmas tree production THEN

Christmas trees (221)

ELSE **Orchards/Vineyards/Nursery (222)**

ELSE IF the ground area is LESS THAN 25% vegetated THEN

IF formed from sand or bare soil THEN

Sand, Soil (710)

ELSE IF formed from solid rock THEN

Exposed Rock (720)

ELSE IF periodically flooded THEN

Mud Flats (730)

ELSE **Other Bare/Sparsely Vegetated (790)**

ELSE IF LESS THAN 25% of the ground is covered by tree canopy AND there is no evidence of flooding during the past 5 years AND NOT supporting lowland indicator plants THEN

Upland Openland (3)

IF maintained for recreational purposes THEN

Parks and Golf Courses (350)

ELSE IF GREATER THAN 15% of the ground is covered by tree canopy then
Low-Density Trees (330)
IF AT LEAST 60% tree canopy is in Deciduous species THEN
Low Density Deciduous Trees (3301)
ELSE IF AT LEAST 60% tree canopy is in Coniferous species then
Low Density Coniferous Trees (3302)
ELSE IF low density trees but not above THEN
Mixed Low Density Trees (3303)

ELSE IF the combination of woody shrubs/trees total GREATER THAN 25% of the canopy THEN
Upland Shrub (320)
IF AT LEAST 25% of the ground is covered by sweet fern THEN
Sweet Fern (3210)
ELSE IF AT LEAST 50% of the ground is covered by autumn olive/honeysuckle THEN
Autumn Olive/Honeysuckle (3202)
ELSE IF AT LEAST 50% of the ground is covered by blueberry THEN
Upland Blueberry (3203)
ELSE IF AT LEAST 25% of the ground is covered by mast producing shrubs (cherry spp., juneberry, hazel, dogwood, hawthorn, wild plum) THEN
Mast Producing Shrub (3204)
ELSE **Mixed Upland Shrub (3205)**

ELSE IF LESS THAN OR EQUAL TO 25% of the canopy is in woody shrubs or trees THEN
Herbaceous Openland (310)
IF the ground cover is AT LEAST 60% poverty grass, sweet fern, blueberry, and/or cladonia THEN **Poverty Grass, Cladonia (3101)**
ELSE IF AT LEAST 60% of the herbaceous cover is grass THEN
Grass (3102)
IF AT LEAST 60% of the herbaceous cover is cool season grass/ legume (orchard grass, fescue, timothy, clover, vetch) THEN
Cool Season Grass (31021)
ELSE **Warm Season Grass (31022)**
ELSE IF AT LEAST 60% of the herbaceous cover is bracken fern, strawberry, or raspberry/blackberry then
Rubus-Fern (3103)
ELSE IF AT LEAST 60% of the ground cover is exposed gravel or sand, spotted knapweed, St John's-wort, or other invasive exotics THEN
Degraded (3104)
ELSE **Mixed Upland Herbaceous (3105)**

ELSE IF LESS THAN 25% of the ground is covered by tree canopy AND either there IS evidence of flooding during the past 5 years OR supporting lowland indicator plants THEN
Non-forested Wetlands (62)
IF AT LEAST 60% of the non-water ground cover is floating aquatic vegetation THEN
Floating Aquatic (621)

ELSE IF AT LEAST 60% of the non-water ground cover is shrub THEN
Lowland Shrub (622)
IF AT LEAST 60% of the cover is Alder (*alnus*) or Willow (*salix*) THEN
Alder/Willow (6220)
ELSE IF AT LEAST 60% is Shrubby cinquefoil (*Potentilla fruticosa*), Dogwood (*Cornus*), Willow (*Salix*), Sedge (*Carex*) and/or Sphagnum/Peat moss (*Sphagnum*) then
Fen (6221)
ELSE IF AT LEAST 30% is Dogwood (*Cornus*) and/or Michigan Holly (*Ilex verticillata*) THEN
Shrub-Carr (6222)
ELSE IF AT LEAST 30% Button bush (*Cepalanthus*), Water Plantain (*Alisma*), Smartweed (*Polygonum*), Cattail (*Typha*) THEN
Inundated Shrub Swamp (6223)
ELSE IF AT LEAST 30% is evergreen shrubs, Sphagnum/Peat moss (*Sphagnum*) THEN bog
IF AT LEAST 10% of the cover is trees THEN
Treed Bog (6224)
ELSE

Bog (6225)

ELSE **Mixed Lowland Shrub (6229)**

ELSE IF AT LEAST 60% of the non-water ground cover is non-woody vegetation THEN
Emergent Wetland (623)
IF AT LEAST 60% of the cover is cattail (*typha spp*) THEN
Cattail (6230)
ELSE IF AT LEAST 60% *Phragmites* THEN
Phragmites (6231)
ELSE IF AT LEAST 30% native warm season grasses including Big bluestem, Little bluestem, Broom sedge (*Andropogon spp.*), Indian grass (*Sorgastrum nutans*) THEN
Wet Prairie (6232)
ELSE IF AT LEAST 60% is sedges and grasses including Sedge (*Carex*), Bulrush (*Scirpus*), Reed grass (*Calamagrostis*), Reed canary grass (*Phalaris arundinaceae*), native warm season grasses (see above) THEN
Wet Meadow (6233)
ELSE **Mixed Emergent Wetland (6239)**

ELSE **Mixed Non-Forest Wetland (629)**

ELSE IF AT LEAST 25% of the ground is covered by tree crowns - FOREST
IF NO evidence of flooding during the past 5 years AND not supporting lowland indicator plants THEN
Upland Forest (4)
IF AT LEAST 60% of the tree canopy is deciduous THEN
Upland Deciduous Forest (41)
IF AT LEAST 60% is Maple + Beech + Basswood + White Ash + Cherry + Yellow Birch THEN
Northern Hardwood (411)
IF AT LEAST 80% is Sugar Maple + Basswood + White Ash + Cherry THEN
Sugar Maple Association (4110)
ELSE IF AT LEAST 60% is (Sugar Maple + Basswood) AND AT LEAST 10% is (Beech + Oak) THEN
Sugar Maple, Hard Mast Association (4111)
ELSE IF AT LEAST 80% is Maple spp + Beech + Cherry THEN
Maple Association (4112)
ELSE IF AT LEAST 60% is Beech + Hemlock THEN
Beech, Hemlock (4114)
ELSE IF AT LEAST 20% is Yellow Birch + Hemlock THEN
Yellow Birch, Hemlock (4115)
ELSE IF AT LEAST 50% is Red Maple AND AT LEAST 20% is Conifer THEN
Red Maple, Conifer (4113)
ELSE IF AT LEAST 20% is Pine THEN
Mixed Northern Hardwood-Pine (4117)
ELSE IF AT LEAST 20% Aspen spp. THEN
Mixed Northern Hardwood-Aspen (4116)
ELSE **Mixed Northern Hardwoods (4119)**

ELSE IF AT LEAST 60% Oak THEN
Oak Type (412)
IF AT LEAST 15% Hickory THEN
Oak, Hickory (4120)
ELSE IF AT LEAST 30% Pine THEN
Oak, Pine (4122)
ELSE IF AT LEAST 30% Aspen spp. THEN
Oak, Aspen (4121)
ELSE IF AT LEAST 40% Red Oak THEN Red Oak types
IF AT LEAST 20% White Oak THEN
Red with White Oak (4124)
ELSE
Red Oak (4123)
ELSE IF AT LEAST 40% Northern Pin Oak + White Oak + Black Oak THEN Other Oaks

IF AT LEAST 20% White Oak THEN
White, Black, Northern Pin Oak (4126)
ELSE
Black, Northern Pin Oak (4125)
ELSE **Mixed Oak (4129)**

ELSE IF AT LEAST 40% Aspen Species THEN
Aspen Type (413)
IF AT LEAST 20% Conifer THEN Aspen, Conifer
IF AT LEAST 20% Cedar THEN
Aspen, Cedar (4135)
ELSE IF AT LEAST 20% Spruce or Fir THEN
Aspen, Spruce/Fir (4134)
ELSE IF AT LEAST 20% Pine THEN Aspen, Pine
IF Jack Pine IS GREATER THAN OR EQUAL TO White Pine + Red Pine THEN
Aspen, Jack Pine (4132)
ELSE
Aspen, Mixed Pine (4133)
ELSE
Aspen, Mixed Conifer (4136)
ELSE IF AT LEAST 20% Oak THEN
Aspen, Mixed Oak (4131)
ELSE IF AT LEAST 60% Aspen THEN
Aspen (4130)
ELSE IF AT LEAST 20% Birch spp. THEN
Aspen, Birch (4137)
ELSE **Aspen, Mixed Deciduous (4139)**

ELSE IF AT LEAST 60% any other single species (like paper birch) THEN
Other Upland Deciduous (4140)
ELSE **Mixed Upland Deciduous (419)**
ELSE IF AT LEAST 20% Northen White Cedar THEN
Mixed Upland Deciduous with Cedar (4190)
ELSE IF AT LEAST 20% Coniferous THEN
Mixed Upland Deciduous with Conifer (4191)
ELSE IF primarily southern michigan species THEN
Mixed Southern Upland Deciduous (4192)
EISE IF AT LEAST 60% aspen spp. and paper birch THEN
Birch, Aspen (4193)
ELSE **Other Mixed Upland Deciduous (4199)**

ELSE IF AT LEAST 60% of the tree canopy is coniferous THEN
Upland Coniferous Forest (42)
IF AT LEAST 60% of the tree canopy is Pine THEN Pines
IF Plantation THEN
Planted Pine (421)
IF AT LEAST 60% is White Pine THEN
Planted White Pine
IF AT LEAST 20% Deciduous THEN
Planted White Pine, Mixed Deciduous (42101)
ELSE **Planted White Pine (42100)**
ELSE IF AT LEAST 60% Red Pine THEN
Planted Red Pine
IF AT LEAST 20% Deciduous THEN
Planted Red Pine, Mixed Deciduous (42111)
ELSE **Planted Red Pine (42110)**
ELSE IF AT LEAST 60% Jack Pine THEN
Planted Jack Pine
IF AT LEAST 20% Deciduous THEN
Planted Jack Pine, Mixed Deciduous (42121)
ELSE **Planted Jack Pine (42120)**
ELSE IF AT LEAST 60% Scotch Pine THEN
Planted Scotch Pine (42130)
IF AT LEAST 20% Deciduous THEN
Planted Mixed Pine, Mixed Deciduous (42141)

ELSE **Planted Mixed Pine (42140)**

ELSE non-planted THEN
Natural Pine (422)
IF AT LEAST 30% Oak THEN
Pine-Oak (42250)
ELSE IF AT LEAST 60% White Pine THEN
Natural White Pine
IF AT LEAST 30% Deciduous THEN
Natural White Pine, Mixed Deciduous (42201)
ELSE **Natural White Pine (42200)**
ELSE IF AT LEAST 60% Red Pine THEN
Natural Red Pine
IF AT LEAST 30% Deciduous THEN
Natural Red Pine, Mixed Deciduous (42211)
ELSE **Natural Red Pine (42210)**
ELSE IF AT LEAST 60% Jack Pine THEN
Natural Jack Pine
IF AT LEAST 30% Deciduous THEN
Natural Jack Pine, Mixed Deciduous (42221)
ELSE **Natural Jack Pine (42220)**
IF AT LEAST 30% Deciduous THEN
Natural Mixed Pine, Mixed Deciduous (42260)
ELSE **Natural Mixed Pine (42290)**

ELSE IF AT LEAST 60% Non-Pine (Other) Upland Conifers THEN
Non-Pine (Other) Upland Conifers (423)
IF Plantation THEN
IF AT LEAST 60% Larch THEN
Planted Larch
IF AT LEAST 20% Deciduous THEN
Planted Larch, Mixed Deciduous (42301)
ELSE **Planted Larch (42300)**
ELSE IF AT LEAST 60% Spruce THEN
Planted Spruce
IF AT LEAST 20% Deciduous THEN
Planted Spruce Mixed Deciduous (42311)
ELSE **Planted Spruce (42310)**

ELSE non-planted THEN
IF AT LEAST 50% Hemlock THEN
Upland Hemlock (42350)
ELSE IF AT LEAST 60% Spruce THEN
Upland Spruce (42320)
ELSE IF AT LEAST 60% Fir THEN
Upland Fir (42330)
ELSE IF AT LEAST 60% Spruce + Fir THEN
Upland Spruce/Fir (42340)
ELSE IF AT LEAST 60% Cedar THEN UPLAND CEDAR
IF AT LEAST 20% Aspen spp. THEN
Upland Cedar, Aspen (42370)
ELSE **Upland Cedar (42360)**
ELSE IF AT LEAST 30% Deciduous THEN
Non-Pine Upland Conifer, Mxd Deciduous (42380)
ELSE **Mixed Non-Pine Upland Conifers (42390)**

ELSE **Mixed Upland Conifers (429)**

ELSE **Upland Mixed Forest (43)**
ELSE If AT LEASE 70% Pine and Oak species THEN
Pine, Oak Mix (4310)
ELSE If AT LEASE 70% Pine and Aspen species THEN
Pine, Aspen Mix (4311)
ELSE If AT LEASE 40% Hemlock THEN
Hemlock, Mixed Deciduous (4312)
ELSE **Mixed Upland Forest (4319)**

ELSE IF evidence of flooding during the past 5 years OR supporting lowland indicator plants THEN
Lowland Forest (61)

IF AT LEAST 60% of the tree canopy is deciduous THEN

Lowland Deciduous Forest (611)

IF AT LEAST 20% Cedar THEN

Lowland Deciduous with Cedar (6118)

ELSE IF AT LEAST 20% Coniferous THEN

Lowland Deciduous, Mixed Coniferous (6117)

ELSE IF AT LEAST 60% Maple spp. THEN

Lowland Maple (6113)

ELSE IF AT LEAST 60% Oak spp. THEN

Lowland Oak (6114)

ELSE IF AT LEAST 60% Ash spp THEN

Lowland Ash (6115)

ELSE IF AT LEAST 60% Cottonwood THEN

Cottonwood (6110)

ELSE IF AT LEAST 60% Birch spp. THEN

Lowland Birch (6116)

ELSE IF AT LEAST 40% Aspen + Balsam Poplar THEN

Lowland Aspen/Balsam Poplar

IF Aspen spp % IS GREATER THAN Balsam Poplar % THEN

Lowland Aspen (6112)

ELSE **Lowland Balsam Poplar (6111)**

ELSE **Mixed Lowland Deciduous Forest (6119)**

ELSE IF AT LEAST 60% of the tree canopy is coniferous THEN

Lowland Coniferous Forest (612)

IF AT LEAST 50% Cedar THEN

Lowland Cedar (6120)

ELSE IF AT LEAST 50% Tamarack THEN

Tamarack (6121)

ELSE IF AT LEAST 50% Black Spruce THEN

Black Spruce (6122)

ELSE IF AT LEAST 50% Fir THEN

Lowland Fir (6123)

ELSE IF AT LEAST 50% Spruce + Fir THEN

Lowland Spruce/Fir (6124)

ELSE IF AT LEAST 50% Jack Pine THEN

Lowland Jack Pine (6126)

ELSE IF AT LEAST 50% Black Spruce + Jack Pine THEN

Lowland Black Spruce, Jack Pine (6125)

ELSE IF AT LEAST 50% Pine THEN

Lowland Pine (6127)

ELSE IF AT LEAST 20% Deciduous THEN

Lowland Coniferous, Mixed Deciduous (6128)

ELSE **Mixed Coniferous Lowland Forest (6129)**

ELSE **Lowland Mixed Forest (613)**

IF AT LEAST 20% Cedar THEN

Mixed Lowland Forest with Cedar (6132)

ELSE IF AT LEAST 60% Fir + Aspen +Balsam Poplar + Maple THEN

Fir, Aspen, Maple (6130)

ELSE IF A LEAST 60% Hemlock + White Pine + Maple + Birch THEN

Hemlock, White Pine, Maple, Birch (6131)

ELSE **Mixed Lowland Forest (6139)**

IFMAP Classification List

6 Urban

- 11 Low Intensity Urban

- 12 High Intensity Urban
    - 121 Airport
    - 122 Roads/Parking Lot
    - 123 Other High Intensity Urban

2 Agricultural

- 21 Herbaceous Agriculture
    - 211 Cropland
        - 2111 Non-vegetated Farmland
        - 2112 Row Crop
        - 2113 Forage Crop
        - 2114 Other Cropland

- 212 Non-tilled Herbaceous Agriculture

- 22 Non Herbaceous Agriculture
    - 221 Christmas tree plantation
    - 222 Orchard/Vineyard/Nursery

3 Upland Openland

- 310 Herbaceous Openland
    - 3101 Poverty Grass, Cladonia
    - 3102 Grass
        - 31021 Cool Season Grass
        - 31022 Warm Season Grass
    - 3103 Rubus, Fern
    - 3104 Degraded
    - 3105 Mixed Upland Herbaceous

- 320 Upland Shrub
    - 3201 Sweet Fern
    - 3202 Autumn Olive/Honeysuckle
    - 3203 Upland Blueberry
    - 3204 Mast Producing Shrub
    - 3205 Mixed Upland Shrub

- 330 Low Density Trees
    - 3301 Low Density Deciduous Trees
    - 3302 Low Density Conifer Trees
    - 3303 Mixed Low Density Trees

- 350 Parks/Golf Courses

4 Upland Forest

- 41 Upland Deciduous Forest
    - 411 Northern Hardwood
    - 4110 Sugar Maple Association
    - 4111 Sugar Maple, Hard Mast Association
    - 4112 Maple Association
    - 4113 Red Maple, Conifer
    - 4114 Beech, Hemlock
    - 4115 Yellow Birch, Hemlock
    - 4116 Mixed Northern Hardwood – Aspen
    - 4117 Mixed Northern Hardwood – Pine
    - 4119 Mixed Northern Hardwoods

- 412 Oak
    - 4120 Oak, Hickory
    - 4121 Oak, Aspen
    - 4122 Oak, Pine
    - 4123 Red Oak
    - 4124 Red with White Oak
    - 4125 Black, Northern Pin Oak
    - 4126 White, Black, Northern Pin Oak
    - 4129 Mixed Oak

- 413 Aspen
    - 4130 Aspen
    - 4131 Aspen, Oak
    - 4132 Aspen, Jack Pine
    - 4133 Aspen, Mixed Pine
    - 4134 Aspen, Spruce/Fir
    - 4135 Aspen, Cedar
    - 4136 Aspen, Mixed Conifer
    - 4137 Aspen, Birch
    - 4139 Aspen, Mixed Deciduous

- 414 Other Upland Deciduous
    - 4140 Paper Birch
    - 414X Other Single Spp. (refer to database for details)

- 419 Mixed Upland Deciduous
    - 4190 Mixed Upland Deciduous with Cedar
    - 4191 Mixed Upland Deciduous with Conifer
    - 4192 Mixed Southern Upland Deciduous
    - 4193 Birch, Aspen
    - 4199 Other Mixed Upland Deciduous

421 Upland Coniferous Forest

- 4210 Planted White Pine types

- 42100 Planted White Pine
- 42101 Planted White Pine, Mixed Deciduous

- 4211 Planted Red Pine types
  - 42110 Planted Red Pine
  - 42111 Planted Red Pine, Mixed Deciduous

- 4212 Planted Jack Pine
  - 42120 Planted Jack Pine
  - 42121 Planted Jack Pine, Mixed Deciduous

- 4213 Planted Scotch Pine types
  - 42130 Planted Scotch Pine

- 4214 Planted Mixed Pine types
  - 42140 Planted Mixed Pine
  - 42141 Planted Mixed Pine, Mixed Deciduous

- 422 Natural Pines
  - 4220 Natural White Pine types
    - 42200 Natural White Pine
    - 42201 Natural White Pine, Mixed Deciduous
  - 4221 Natural Red Pine Types
    - 42210 Natural Red Pine
    - 42211 Natural Red Pine, Mixed Deciduous
  - 4222 Natural Jack Pine types
    - 42220 Natural Jack Pine
    - 42221 Natural Jack Pine, Mixed Deciduous
  - 4226 Natural Mixed Pine Types
    - 42290 Natural Mixed Pine
    - 42250 Natural Pine, Oak
    - 42260 Natural Mixed Pine, Mixed Deciduous

423 Other (Non-Pine) Upland Conifers

- Planted Upland Conifers
  - 42300 Planted Larch, Mixed Deciduous
  - 42301 Planted Larch
  - 42310 Planted Spruce
  - 42311 Planted Spruce, Mixed Deciduous

- Non-planted Upland Conifers
  - 42320 Upland Spruce
  - 42330 Upland Fir
  - 42340 Upland Spruce/Fir
  - 42350 Upland Hemlock
  - 42360 Upland Cedar
  - 42370 Upland Cedar, Aspen

    - 42380 Non-Pine Upland Conifer, Mxd Deciduous
    - 42390 Mixed Non-Pine Upland Conifers
- 429 Mixed Upland Conifers
- 43 Upland Mixed Forest
- 4310 Pine, Oak Mix 4311 Pine, Aspen Mix
- 4312 Hemlock, Mixed Deciduous
- 4319 Mixed Upland Forest

5 Water

- 50 Water

6 Wetlands

- 61 Lowland Forest
    - 611 Lowland Deciduous Forest 6110 Cottonwood
        - 6111 Lowland Balsam Poplar 6112 Lowland Aspen
        - 6113 Lowland Maple
        - 6114 Lowland Oak
        - 6115 Lowland Ash
        - 6116 Lowland Birch
        - 6117 Lowland Deciduous, Mixed Coniferous
        - 6118 Lowland Deciduous with Cedar
        - 6119 Mixed Lowland Deciduous Forest
    - 612 Lowland Coniferous Forest
        - 6120 Lowland Cedar
        - 6121 Tamarack
        - 6122 Black Spruce
        - 6123 Lowland Fir
        - 6124 Lowland Spruce-Fir
        - 6125 Lowland Black Spruce, Jack Pine
        - 6126 Lowland Jack Pine
        - 6127 Lowland Pine
        - 6128 Lowland Coniferous, Mixed Deciduous
        - 6129 Mixed Coniferous Lowland Forest
    - 613 Lowland Mixed Forest
        - 6130 Fir, Aspen, Maple
        - 6131 Hemlock, White Pine, Maple, Birch
        - 6132 Mixed Lowland Forest with Cedar
        - 6139 Mixed Lowland Forest
- 62 Nonforested Wetlands
    - 621 Floating Aquatic
    - 622 Lowland Shrub
        - 6220 Alder/Willow
        - 6221 Fen
        - 6222 Shrub-Carr
        - 6223 Inundated Shrub Swamp 6224 Treed Bog
        - 6225 Bog
        - 6229 Mixed Lowland Shrub
    - 623 Emergent Wetland
        - 6230 Cattail
        - 6231 Phragmites
        - 6232 Wet Prairie
        - 6233 Wet Meadow
        - 6239 Mixed Emergent Wetland

- 629 Mixed Non-forest Wetland

7 Bare/Sparsely Vegetated

- 710 Sand,Soil
- 720 Exposed Rock
- 730 Mud Flats
- 790 Other Bare/Sparsely Vegetated

FMAP / OI cross-inventory cover type summary

Note: For a detailed cross-walk see the second tab of this workbook

Cross-Inventory Cover Type	OI Cross-over code	Category
Purpose: Used in tabular reporting and analysis of IFMAP or IFMAP/OI Combined cover types.	Purpose: Used for map labels, generic silvicultural critieria determination, and to provide a	
Aspen	A	Forested
Paper Birch	B	Forested
Cedar	C	Forested
Lowland Deciduous	E	Forested
Upland Spruce/Fir	F	Forested
Hemlock	H	Forested
Jack Pine	J	Forested
Lowland Mixed Forest	LM	Forested
Northern Hardwood	M	Forested
Natural Mixed Pines	MC	Forested
Planted Mixed Pines	MC	Forested
Upland Conifers	MC	Forested
Mixed Upland Deciduous	MD	Forested
Oak	O	Forested
Lowland Aspen/Balsam Poplar	P	Forested
Lowland Conifers	Q	Forested
Red Pine	R	Forested
Lowland Spruce/Fir	S	Forested
Tamarack	T	Forested
Upland Mixed Forest	UM	Forested
White Pine	W	Forested
Treed Bog	D	Nonforested
Cropland	G	Nonforested
Herbaceous Openland	G	Nonforested
Exposed Rock	K	Nonforested
Lowland Shrub	L	Nonforested
Marsh	N	Nonforested
Upland Shrub	U	Nonforested
Low-Density Trees	U	Nonforested
Bog	V	Nonforested
Urban	X	Nonforested
Bare/Sparsely Vegetated	X	Nonforested
Sand, Soil	Y	Nonforested
Water	Z	Nonforested
Local Name	I	N/A *(only exists in OI)*

Appendix E

Silvicultural Methods

- Even-aged systems: Regenerate and maintain the stand with primarily one age class, though harvests "with reserves" will have retention that enhance or maintain characteristics of a two-aged or all-aged stand.
    - Clearcut group
        - Clearcut: Cutting essentially all trees, producing a fully exposed microclimate for development of a new age class. Regeneration is from stump sprouts, root suckers, natural seeding, direct seeding, planting, or advanced reproduction. Residual basal area (BA) generally runs from 0-10 square feet per acre (sq ft/acre).
        - Seed tree: Cutting all trees except for a small number of widely dispersed trees retained for seed production and to produce a new age class in a fully exposed microclimate. Residual trees generally average 6-8 per acre.
    - Shelterwood group
        - Shelterwood: Cutting most trees, leaving those needed to produce sufficient shade to produce a new age class in a moderated microenvironment. Can be done uniformly throughout the stand or in groups or strips, in one or more subsequent harvests. Residual BA is generally from 30-50 square feet per acre, but residual BA can go down as far as 10 square feet per acre if the crowns are large enough to achieve 25% canopy cover. Residual trees are removed after regeneration is established.
        - Overstory removal: Removal of all overstory trees, leaving established regeneration. This is often done after a shelterwood harvest once regeneration has become established.

- Intermediate systems: Done for reasons other than regeneration, in stands usually treated with even or two-aged systems.
    - Thinning
        - Systematic thinning: Removal of trees in rows, strips, or by using fixed spacing intervals to control stand spacing and favor desired trees without regard to crown position. Not a regeneration harvest. Residual BA can vary, but it is generally no less than one half (more often two-thirds) of the original BA.
        - Crown thinning: Removal of trees from dominant and codominant crown classes. Residual BA generally runs from 50 to 110 square feet per acre.

- Uneven-aged systems: Regenerate and maintain the stand with a multi-aged structure by removing some trees in all size classes.
    - Selection
        - Single-tree selection and small group selection: Individual trees within each size class are removed throughout the stand to promote growth of remaining trees and to provide space for regeneration. Gaps ranging from a 50-foot to 100-foot radius are installed across approximately 10 to 20% of the stand. Residual BA in the remainder of the stand is generally 60 to 90 square feet per acre.

- Group selection
  - Large group selection (systematic re-entry): All trees are generally removed in groups larger than a 100-foot radius. This is sometime referred to as a patch clear-cut when the groups are on the larger scale of up to 2 acres in size. In extreme cases the DNR inventory system would allow groups/patches to occur up to 4.5 acres in size because this is threshold of scale for the definition of a stand. The remainder of the stand is often left unthinned and the stand is restarted over a period of 3 to 4 entries. When thinning and retention are incorporated this method can also be called an irregular shelterwood.

Appendix F

SFMP Model - Technical design summary

Introduction

The Michigan Department of Natural Resources (DNR) invested in an industry-standard modeling platform to support the revision of the State Forest Management Plan. The software is a suite of applications called the Woodstock Optimization Studio® developed by the Remsoft® corporation. Woodstock, as it's commonly referred to, is the key component to an integrated optimization modeling platform that allows users to build custom models to represent different forest management strategies and evaluate the results. The Michigan DNR also invested in training for several staff and hired a consultant, Mason Bruce & Gerard, to help build various components of the Woodstock model. The Woodstock model is used to create and evaluate various forest management scenarios and ultimately helps determine a preferred scenario that adds confidence in harvest sustainability while achieving desired future conditions both in terms of landscape-level forest composition and wildlife habitat.

Woodstock is an optimization model that uses linear programming to select from among various scenario characteristics. It finds the mathematically optimal solution for a given scenario based on an objective function (e.g., maximize harvest acres) and a set of forest management goals and constraints. Each scenario or forestwide management alternative can contain unique model sections and can be compared side by side with other scenarios. The modeling platform uses the following model sections to define the characteristics of each scenario:

- **Constants**: Used to establish names (e.g., scenario name) and declare values of constants referred to in other sections.
- **Control**: Defines how Woodstock should process input files and establishes planning horizon.
- **Landscape**: Contains the themes (e.g., forest type, age, etc.) that classify the landscape being modeled from a Geographic Information System (GIS) shape file.
- **Lifespan:** The Lifespan section contains the declaration that indicates the maximum age a development type may reach before it is assumed to die or be replaced by another development type through succession.
- **Area**: Individual forest and non-forest stands are aggregated into "development types" based on common attributes and are contained in this section.
- **Yields**: This section contains both simple and complex yield tables which contain coefficients of specific attributes of the forest in terms of volume, value, weight, trees per acre, etc.
- **Actions**: This section is where the events or activities (e.g., harvesting, planting, etc.) are described that manipulate the condition of a development type.
- **Transitions**: This section is where the outcomes of particular actions and resulting changes are defined, such as the development type age being reset to zero or cover type conversion occurring when a clearcut happens.
- **Outputs**: This section contains the declaration of various yield table values or inventory values (e.g., Trees per acre, basal area per acre, volume per acre) that are contributing to a metric that needs to be evaluated or controlled.
- **Graphics**: This section contains the code for each custom graphic used to quickly evaluate outputs.
- **Optimization**: This section is where the formulation for the model occurs using an objective function (e.g., maximize net present value) and controls such as goals and constraints (e.g., aspen acres in age class 0-9 should be >= 16% of all available aspen acres).
- **Schedule**: This section is produced once a model is executed or run and contains a multi-period harvest schedule for a given scenario.
- **Reports**: This section is where the user controls what content, format and types of files that get created to summarize outputs generated in a model run.

- **Maps**: This is a GIS display of the shapefile that can be generated for different attributes with different harvest schedules assigned to the GIS polygons and other spatial optimization routines performed.

Each of these sections contains Woodstock code that helps define how the model interacts with inventory data, which objective is used, what the limitations of a solution are, and what outputs are created after a scenario is executed and a Woodstock solution is generated.

Strategic modeling approach

The strategic forest management approach used by the DNR is technically called area regulation. This approach to forest management can be directly modeled using Woodstock. This general concept of management has been applied on Michigan state forests and forests around the world for decades, and managers feel it is well suited for managing multiple resource values of a public forest owned by the people of Michigan. In simple terms “area regulation” or “area control” is the approach taken when managers seek to achieve the desired amount of area (acres) in specific age or density (basal area) categories across a geographic area over time.

The State Forest Management Planning (SFMP) approach uses three distinct silvicultural systems, each with its own silvicultural methods, to model the management the state forest:

1. Even-aged systems
    a. Clearcut / seedtree
    b. Intermediate thinning
2. Two-aged systems
    a. Shelterwood
    b. Overstory removal
3. Uneven-aged systems
    a. Selection
    b. Group Section

Cover types such as jack pine and aspen managed with even-aged systems primarily rely on clearcut and seed-tree harvests as the primary silvicultural method for resetting ages, but managers can also choose to include intermediate thinning to maintain basal area goals prior to a clearcut. Cover types such as northern hardwoods that are managed with uneven-aged systems primarily rely on selection and group selection harvests to maintain basal area targets achieving optimal stand densities and diameter distributions. These approaches to management are handled in different ways in the SFMP model by embedding the treatment regimes in the yield tables or using goals and constraints that rely on inventory attributes such as age classes.

The even-aged area regulation approach calls for setting specific age class goals in each planning period. The DNR used 10-year planning periods along with 10-year age classes for even-aged management, which makes creation of desired age class levels straightforward. Harvesting and regenerating a specific amount of a given cover type over a 10-year planning period will result in establishment of an age class. That process is then repeated during each future planning period, resulting in establishment of desired age class distribution over time. These age class goals are created using a combination of specific outputs and goals discussed in the outputs and optimization sections below.

Both even-aged system and uneven-aged systems use area regulation with respect to achieving desired stand density distributions of cover types across an area over time. The processes are similar but accomplished with different harvesting techniques that change stand densities rather than resetting ages. A desired basal area distribution is defined by setting basal area thresholds in the timber yield tables that focus on maintaining stands in a condition that sustains optimal growth and stand structure. For example, the northern hardwood cover type is typically managed according to a bell-shaped curve of basal area distribution ranging from 70 square feet of basal area per acre on the low end to 120 square feet of basal are per acre on the high end. Stands are eligible for a selection harvest when they reach the higher density and are thinned to the lower target density allowing for more growth on desirable residual stems. There are

many variations of this general thinning approach that favor other management goals like regeneration and recruitment or different diameter distributions, but the basic principle is important to have represented in the yield tables of the SFMP model.

The uneven-aged group selection silvicultural method is a smaller scale approach to area regulation done within a stand. Smaller patches are clearcut in each stand and additional patches are harvested each decade resulting in an uneven-aged stand that can be perpetually managed in this condition. Again, with this approach there are many variations of the system used to achieve desired results based on patch size, re-entry period and the cycle completion period. This approach is represented in the SFMP model through a series of constraints, actions and outputs that simulate a standard group selection system. The process used was to remove 20 percent of the volume of a development type and account for 20 percent of the acres harvested if a group selection action was initiated. The group selection constraints then locked the development type into group selection regime once it was initiated so that each period that same action would happen until the entire development type was treated over five-decade periods. The stand then transitions to an average age and basal area class representative of the five age cohorts created across the stand.

Wildlife habitat management considerations are incorporated into the model by creating custom outputs that add up acres of a specific condition representing a particular habitat. Goals and constraints are then used to reference those habitat outputs when a certain threshold or trend is desired. The outputs are also used to evaluate effects of various model changes and are helpful in determining the preferred scenario.

Evaluation of model capabilities and usefulness: Pilot area testing

A pilot area was identified in the early stages of development of the new state forest management plan to test the efficacy of the Woodstock model to represent the management of state forest land. Most forest management goals that were to be represented in the model are set at the management area (MA) scale. There are XX management areas across the state. Within management areas, individual cover types have unique age-class goals and silvilcultural regime goals. The pilot area was in the northern Lower Peninsula and consisted of two management areas: the Wolverine Moraines and the Presque Isle Lake and Till Plain. Both management areas had a good representation of diverse cover types with varying age class goals and silvicultural regimes to be tested.

Two unique features of the pilot area were that there was already a few defined forest management and habitat goals related to the Pigeon River Country's "Concept of Management" and to the Elk Management Plan. These plans contained 2 goals that could be directly incorporated into the model as soft or hard constraints:

1. Maintain the 0-9 age class of a subset of even-aged cover types at 7% to 8% of the entire Pigeon River Country forest.
2. Maintain 27% of the Pigeon River Country forest in the aspen cover type.

Because the Elk Management Plan was for an area that did not align with either the forest management unit boundaries or the management area boundaries, it was necessary to come up with an additional geographical unit for these goals. The term Special Analysis Unit or SAU for short, was adopted to describe any geographic area that needed to have specific goals assigned to it if it did not align with an already existing feature.

Forest composition and structure goals, in conjunction with habitat-related goals, were set for each MA. These goals guided the resulting harvest outputs and schedule in the model. Those harvests are implemented through the administrative units of the Forest Resources Division, known as forest management units (FMUs). The FMUs are largely aligned with counties and do not align with the management areas in most cases. The pilot area offered an ideal test for implementing the harvest schedule derived from management area goals in each FMU. The pilot area consisted of the entire Pigeon River Country FMU as well as parts of the Gaylord and Atlanta forest management units.

The pilot model testing was useful in quickly identifying numerous challenges that needed to be overcome through various modeling strategies and different approaches. The relatively small landscape offered quick Woodstock solve times during the execution model, enabling a quick turnaround to analyze the results after a change in the model was made. After several months of testing, it was determined that the *Woodstock Optimization Studio*® was an excellent fit

for the Michigan DNR to use for determining a long-term sustainable management scenario resulting in desired future conditions.

Supplying the woodstock model with forest inventory data

The SFMP model needed the best representation of the forest Inventory that could provide a starting point. There are about 5 years of treatments on state forests already prescribed and approved at various stages of implementation/completion in the inventory any time a snapshot (copy) of the database is made. The inventory snapshot that would feed the model would need to reflect what those stands would be like after the prescribed treatments take place. This resulted in a need to "increment" or advance the inventory forward five years (the time it takes for a typical treatment to go from prescription to completed and updated inventory) to best represent what the inventory will look like at the beginning of the upcoming, first planning period.

The following steps were taken to accomplish this:

1. Stands with no entry in the basal area field were assigned a typical BA class based on cover type and age (fit to a curve).
2. Stands not prescribed for a regeneration harvest were advanced in age 5 years (6-year-old stand (0-9 age class) became 11 years old (10-19 age class).
3. Any non-forested stand or 0-9 age class forested stand, with a "forested objective" was converted to that cover type and stayed in 0-9 age class.
4. Stands that were not prescribed for a partial harvest were candidates for an advancement to the next BA class. BA classes span 30 to 50 square feet of basal area, and the exact BA for particular stands is unknown. Therefore, a systematic random method was used to determine which stands advance and which do not. Because some covertypes typically grow faster than others, and stands grow different at different basal areas, an ingrowth % were assigned to each covertype and BA combination based on existing growth and yield data derived from FIA data on state forest lands. The following steps were used to accomplish this:
    a. Ingrowth % was assigned for each cover type and BA range combination based on growth and yield data. This is the typical percentage of stands within a specific current BA class that will likely graduate to the next BA class in the next 10 years (keeping in mind the "current" BA class would have been recorded up to 10 years ago, the last time the stand was inventoried (figure 1).
    b. A random number between 0.0 and 1.0 was generated for each stand.
    c. If the random number assigned was less than or equal to the % of ingrowth, then the BA advanced to the next highest class, otherwise it remained the same. (e.g. 66 % (0.66) of NH stands at 81-110 advance, so a random number of .54 would advance that stand to 111-140) This was done only one time and applied to a snapshot of the inventory data that informed the SFMP model.

Table 1. Graphic representing the analysis tool created to set and modify incremented growth percentages.

% of a current BA Class that will grow into next higher BA class	1-50	51-80	81-110	111-140	141-170	171-200	200+
Cover type	2	7	8	3	4	5	6
Northern Hardwood	40%	66%	66%	66%	33%	25%	0%
Natural White Pine	40%	75%	75%	75%	75%	66%	0%
Natural Red Pine	40%	75%	75%	75%	75%	66%	0%
Natural Mixed Pines	40%	75%	75%	75%	75%	66%	0%
Northern Red Oak	40%	75%	75%	75%	75%	66%	0%
Oak Mix	40%	50%	50%	50%	50%	40%	0%
Lowland Deciduous	40%	50%	50%	50%	50%	40%	0%
Mixed Upland Deciduous	40%	66%	66%	66%	66%	50%	0%
Upland Mixed Forest	40%	66%	66%	66%	66%	50%	0%
Aspen	40%	66%	66%	66%	66%	50%	0%
Planted Red Pine	40%	90%	90%	90%	90%	90%	0%
Planted White Pine	40%	80%	80%	80%	80%	80%	0%
Planted Mixed Pine	40%	75%	75%	75%	75%	75%	0%
Planted Jack Pine	20%	30%	30%	30%	30%	30%	0%
Natural Jack Pine	20%	30%	30%	30%	30%	30%	0%
Black Red Hybrid Oak	40%	50%	50%	50%	50%	40%	0%
Lowland Aspen/Balsam Poplar	40%	50%	50%	50%	50%	50%	0%
Lowland Spruce/Fir	40%	33%	33%	33%	33%	25%	0%
Upland Spruce/Fir	40%	66%	66%	66%	66%	50%	0%
Upland Conifers	40%	66%	66%	66%	66%	50%	0%
Lowland Conifers	40%	33%	33%	33%	33%	25%	0%
Lowland Mixed Forest	40%	33%	33%	33%	33%	25%	0%
Hemlock	20%	25%	25%	25%	25%	25%	0%
Cedar	20%	25%	25%	25%	25%	25%	0%
Tamarack	40%	50%	50%	50%	50%	40%	0%

5. Stands prescribed for a harvest had their BA class reset based on the combination of covertype and treatment method applied (Table 2).

Table 2. Incremented Basal area class values for stands prescribed for treatment, by covertype.

Residual Basal Area	Single Tree Selection	Group Selection	Crown Thinning	Systematic Thinning	Low Thinning	Clearcut	Clearcut with Retention	Seed Tree	Seed Tree with Retention	Shelterwood	Shelterwood with Retention	Overstory Removal	Strip/Patch/ Gap Cut (Femelschlag)	Salvage	Other	Other - Specify
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Northern Hardwood	51-80	51-80	51-80	51-80	51-80	1-50	1-50	1-50	1-50	1-50	1-50	1-50	51-80	1-50	51-80	51-80
Natural White Pine	81-110	81-110	81-110	81-110	81-110	1-50	1-50	1-50	1-50	1-50	1-50	1-50	51-80	1-50	51-80	51-80
Natural Red Pine	81-110	81-110	81-110	81-110	81-110	1-50	1-50	1-50	1-50	1-50	1-50	1-50	51-80	1-50	51-80	51-80
Natural Mixed Pines	81-110	81-110	81-110	81-110	81-110	1-50	1-50	1-50	1-50	1-50	1-50	1-50	51-80	1-50	51-80	51-80
Northern Red Oak	51-80	51-80	51-80	51-80	51-80	1-50	1-50	1-50	1-50	1-50	1-50	1-50	51-80	1-50	51-80	51-80
Oak Mix	51-80	51-80	51-80	51-80	51-80	1-50	1-50	1-50	1-50	1-50	1-50	1-50	51-80	1-50	51-80	51-80
Lowland Deciduous	51-80	51-80	51-80	51-80	51-80	1-50	1-50	1-50	1-50	1-50	1-50	1-50	51-80	1-50	51-80	51-80
Mixed Upland Deciduous	51-80	51-80	51-80	51-80	51-80	1-50	1-50	1-50	1-50	1-50	1-50	1-50	51-80	1-50	51-80	51-80
Upland Mixed Forest	51-80	51-80	51-80	51-80	51-80	1-50	1-50	1-50	1-50	1-50	1-50	1-50	51-80	1-50	51-80	51-80
Aspen	51-80	51-80	51-80	51-80	51-80	1-50	1-50	1-50	1-50	1-50	1-50	1-50	51-80	1-50	51-80	51-80
Planted Red Pine	81-110	81-110	111-140	111-140	111-140	1-50	1-50	1-50	1-50	1-50	1-50	1-50	51-80	1-50	51-80	51-80
Planted White Pine	81-110	81-110	111-140	111-140	111-140	1-50	1-50	1-50	1-50	1-50	1-50	1-50	51-80	1-50	51-80	51-80
Planted Mixed Pine	81-110	81-110	111-140	111-140	111-140	1-50	1-50	1-50	1-50	1-50	1-50	1-50	51-80	1-50	51-80	51-80
Planted Jack Pine	81-110	81-110	111-140	111-140	111-140	1-50	1-50	1-50	1-50	1-50	1-50	1-50	51-80	1-50	51-80	51-80
Natural Jack Pine	81-110	81-110	111-140	111-140	111-140	1-50	1-50	1-50	1-50	1-50	1-50	1-50	51-80	1-50	51-80	51-80
Black Red Hybrid Oak	51-80	51-80	51-80	51-80	51-80	1-50	1-50	1-50	1-50	1-50	1-50	1-50	51-80	1-50	51-80	51-80
Lowland Aspen/Balsam Poplar	51-80	51-80	51-80	51-80	51-80	1-50	1-50	1-50	1-50	1-50	1-50	1-50	51-80	1-50	51-80	51-80
Lowland Spruce/Fir	51-80	51-80	51-80	51-80	51-80	1-50	1-50	1-50	1-50	1-50	1-50	1-50	51-80	1-50	51-80	51-80
Upland Spruce/Fir	51-80	51-80	51-80	51-80	51-80	1-50	1-50	1-50	1-50	1-50	1-50	1-50	51-80	1-50	51-80	51-80
Upland Conifers	51-80	51-80	51-80	51-80	51-80	1-50	1-50	1-50	1-50	1-50	1-50	1-50	51-80	1-50	51-80	51-80
Lowland Conifers	51-80	51-80	51-80	51-80	51-80	1-50	1-50	1-50	1-50	1-50	1-50	1-50	51-80	1-50	51-80	51-80
Lowland Mixed Forest	51-80	51-80	51-80	51-80	51-80	1-50	1-50	1-50	1-50	1-50	1-50	1-50	51-80	1-50	51-80	51-80
Hemlock	81-110	81-110	81-110	81-110	81-110	1-50	1-50	1-50	1-50	1-50	1-50	1-50	51-80	1-50	51-80	51-80
Cedar	111-140	111-140	111-140	111-140	111-140	1-50	1-50	1-50	1-50	1-50	1-50	1-50	51-80	1-50	51-80	51-80
Tamarack	81-110	81-110	81-110	81-110	81-110	1-50	1-50	1-50	1-50	1-50	1-50	1-50	51-80	1-50	51-80	51-80

6. Stands prescribed for a regeneration harvest had their age class reset to 0-9 and the new covertype was based on the treatment management objective.

It is important to note that this method likely resulted in an artificially inflated 0-9 age class, especially in the planted red pine cover type. The reestablishment of the planted red pine cover type takes a long time to get from a prescribed stand in the treatments database to an established forested stand (3 feet tall at 25% tree canopy) captured in the inventory. A typical timeline from prescription to a reestablished stand will likely resemble the following timeline:

- Prescription made and approved during inventory in 2020
- Timber sale prepped in 2022 (year of entry)
- Timber sale sold in 2023
- To be harvested in 2026
- To be trenched in 2028
- Herbicide application scheduled in 2029
- To be planted in 2030
- 3 –foot-tall forested stand in 2033

This timeline spans beyond the decade-long planning period, but the incrementation process assumes that all stands that were currently prescribed for a clearcut and replant to red pine would become planted red pine cover type within the planning period. It is likely that a significant portion of the incremented 0-9 will actually end up as either 0-9 in the next planning period or be 10-19 in this planning period, depending on where that particular stand was in its implementation phase when the snapshot was taken. The compensatory approach used during the last planning period did call for a significant increase in 0-9 age class acres when there was a deficit in the “current” 0-9 and 10-19 age classes, meaning it is not all from the method of incrementation described above.

The impact of this exaggerated 0-9 age class has little effect on the model solution for projecting harvest levels of current merchantable timber and regenerating that to build a new 0-9 age class in this upcoming planning period. The impact is more noticeable in projected future age class distributions once that age class is part of the merchantable and available pool of acres that can receive a treatment. While we are paying attention to long-term harvest sustainability, we are not relying on this model run to set up a treatment plan 50+ years into the future. The projected future age class distributions would look slightly different if this exaggeration was not present and more spread out over two age classes. The model will be periodically updated with new inventory information and reexecuted for each new planning period at a minimum, and likely more often than that as we adapt our management to changing conditions.

Model design summary by section

The Woodstock model contains 14 sections that each serve a specific purpose in model design and control. All of these sections work together to represent the preferred scenario providing a projected harvest level that supplies a sustainable level of harvest and meets the habitat needs of numerous featured species. The following sections will be described in the order in which they are scanned when executing a model scenario.

a) Constants
b) Control
c) Landscape
d) Lifespan
e) Areas
f) Yields
g) Actions
h) Transitions
i) Outputs
j) Graphics
k) Optimize
l) Schedule
m) Reports
n) Maps

Constants

The Constants section is used to declare values that will be used in more than one section of the model. The SFMP model uses several harvest removal fractions to help represent the amount of volume removed from a grow-only yield value when various actions are performed. The following Harvest Removal fractions are applied in the SFMP model:

CC_Fraction 1.00 (100% for clearcut)
SW_Fraction 0.60 (60% for shelterwood)
OR_Fraction 0.30 (30% for other removals)
GS_Fraction 0.20 (20% for group selection harvest)
Sel_Fraction 0.25 (25% for selection harvest)

Other constants are used to assign abbreviated values to full names of themes found in the Landscape Section as seen in these examples shown below for MA names:

cAvery_Hills	AveryH
cBois_Blanc_Island	BoisBl
cBrule_River	BruleR
cCadillac_Moraines	Cadill
cCamp_Grayling	CampGr

Control

The Control section is used to declare how Woodstock should process model input files and the length of the planning horizon. The SFMP model uses 10-year periods, and the length of the model run is 15 periods, providing a 150-year planning horizon (Figure 1).

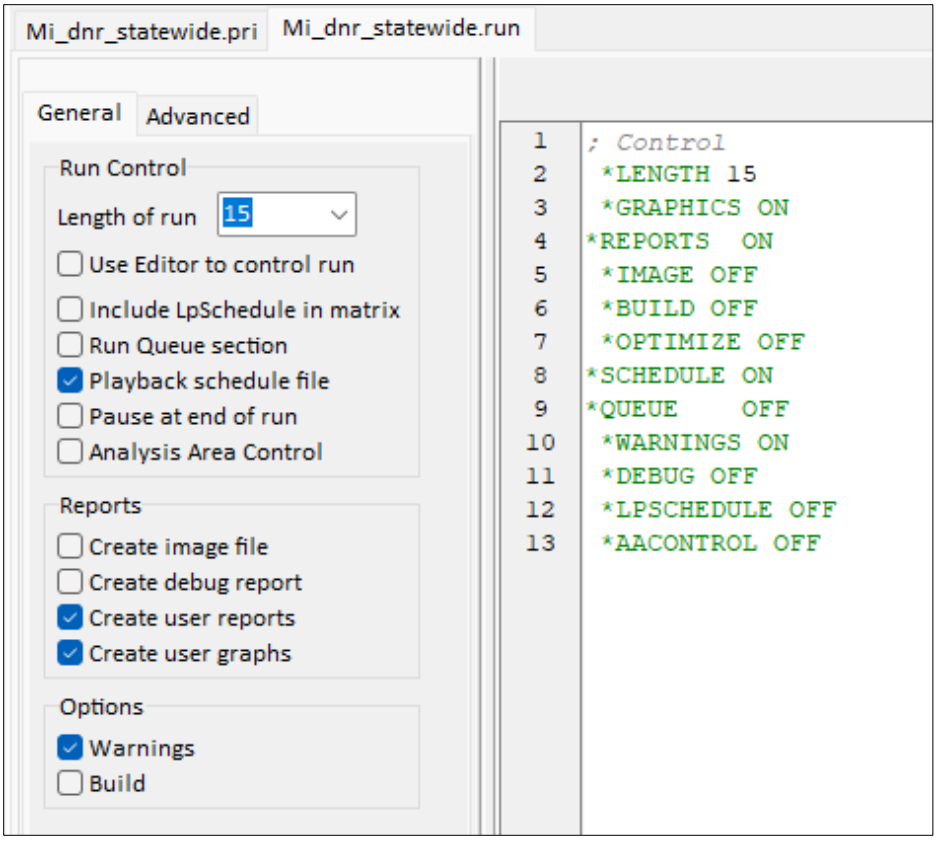


Figure 1. Screenshot of the control section of the SFMP Model in Woodstock.

Landscape

The Landscape section contains the themes to describe the land classification scheme in the SFMP model– similar to the fields containing attributes in a database file used in a GIS environment. The Woodstock model contains the following themes and attribute options (aggregates of individual attributes are not shown):

*THEME *{1}* Eco-Region
EUP *; Eastern Upper Peninsula Eco-Region*
WUP *; Western Upper Peninsula Eco-Region*
NLP *; Northern Lower Peninsula Eco-Region*
ALL *; All Eco-Regions*

*THEME *{2}* District
ELP *; Eastern Lower Peninsula District*
EUP *; Eastern Upper Peninsula District*
WLP *; Western Lower Peninsula District*
WUP *; Western Upper Peninsula District*
ALL *; All Districts*

*THEME *{3}* **Forest** Management Unit
Atlanta
Baraga
Cadillac
Crystal_Falls
Escanaba
Gaylord
Gladwin

Grayling
Gwinn
Newberry
Pigeon_River_Country
Roscommon
Sault_Ste_Marie
Shingleton
Traverse_City
ALL

*THEME *{4}* Management Area
Avery_Hills
Beaver_Island
Bois_Blanc_Island
Brule_River
Cadillac_Moraines
Camp_Grayling
Cassidy_Creek
Drummond_Island
Emmet_Moraines
Escanaba_Lake_and_Till_Pl
Gladwin_Lake_Plain
Grand_Marais_Moraine_Comp
Grand_Traverse_Moraine
Green_Bay
High_Sand_Plains
Houghton_Hardwoods
Huron_Sandy_Lake_Plain
Kalkaska_Sandy_Moraines
Keewenaw
Keweenaw_Bay
Lake_County_Outwash
Menominee-Marquette
Michigamme_Highlands
Presque_Isle_Lake_and_Til
Ralph_Moraine
Rudyard_Silty_Lake_Plain
Seney_Lake_Plain
St_Ignace_Lake_Plain
Suomi_Till_and_Outwash_Pl
WayDam_Complex
Wolverine_Moraines

*THEME *{5}* Compartment (Note: Details not presented due to number of compartments (# total)
ALL *; all compartments*
; 11001 ; compartment number = FMU/compartment

*THEME *{6}* Stand ID (Note: Details not presented due to number of stands (158,871 total)
ALL *; all stands*

; 11001001 ; Stand ID = FMU/compartment/stand (FFCCCSSS)

*THEME *{7}* Yield ID (Note: Details not presented due to number of yield tables: *There are 750 Unique Yield Table Ids)*
ALL
1
3
6
*THEME *{8}* Cover Type
Aspen
Bare_Sparsely_Vegetated
Black_Red_Hybrid_Oak
Bog
Cedar
Cropland
Hemlock
Herbaceous_Openland
Low_Density_Trees
Lowland_Aspen_Balsam_Popl
Lowland_Conifers
Lowland_Deciduous
Lowland_Mixed_Forest
Lowland_Shrub
Lowland_Spruce_Fir
Marsh
Mixed_Upland_Deciduous
Natural_Jack_Pine
Natural_Mixed_Pines
Natural_Red_Pine
Natural_White_Pine
Northern_Hardwood
Northern_Red_Oak
Oak_Mix
Planted_Jack_Pine
Planted_Mixed_Pine
Planted_Red_Pine
Planted_White_Pine
Tamarack
Treed_Bog
Upland_Conifers
Upland_Mixed_Forest
Upland_Shrub
Upland_Spruce_Fir
Urban
Water

*THEME *{9}* Age Class (Note: 10 years per age class)
ALL *; All age classes*
0-9
10-19

20-29
30-39
40-49
50-59
60-69
70-79
80-89
90-99
100-109
110-119
120-129
130-139
140-149
150+
NF
*THEME *{10}* BA Range
ALL *; All ranges of basal area*
1-50 *; 1-50 Sq. Ft. Basal Area*
51-80 *; 51-80 Sq. Ft. Basal Area*
81-110 *; 81-110 Sq. Ft. Basal Area*
111-140 *; 111-140 Sq. Ft. Basal Area*
141-170 *; 141-170 Sq. Ft. Basal Area*
171-200 *; 171-200 Sq. Ft. Basal Area*
201+ *; 201 and above Sq. Ft. Basal Area*
NF

*THEME *{11}* Availability
Avail *; Available Lands for Harvest*
UnAvail *; Unavailable Lands for Harvest*

*THEME *{12}* Special Analysis Units (DWC =Deer Wintering Complex, etc.
DWC-Arnold-Ford_River
DWC-Cusino
DWC-Dead_Horse-North_Perk
DWC-Deerfoot_Lodge
DWC-Gulliver_Scott_Point_
DWC-Hulbert_Hendrie_Sage_
DWC-Indian_Lake
DWC-Iron-Floodwood
DWC-McMillan_Ten_Curves
ELK
GEM-Backus_Creek
GEM-Bill_Rollo_Memorial_G
GEM-Cedar_River
GEM-Drummond
GEM-Garden_Grade
GEM-Greasy_Creek
GEM-Halifax
GEM-Hazel_Swamp

GEM-Lame_Duck_Foot_Access
GEM-LeeGrande_Ranch
GEM-Little_Betsie
GEM-Mark_Knee_Memorial_GE
GEM-Melstrand
GEM-Ralph
SAU-KW
None
ALL *; not in use*

*THEME *{13}* Purchased Land
Y
N
ALL

*THEME *{14}* Treatment Sequence Completed
None *; initial existing condition*
XXXX *; immediately after regeneration harvest*
SEL1 *; 1st selection entry*
SEL2 *; 2nd selection entry*
SEL3 *; 3rd selection entry*
SEL4 *; 4th selection entry*
SEL5 *; 5th selection entry*
SEL6 *; 6th selection entry*
SEL7 *; 7th selection entry*
SEL8 *; 8th selection entry*
SEL9 *; 9th selection entry*
SEL10 *; 10th selection entry*
GRP1 *; 1st group selection entry*
GRP2 *; 2nd group selection entry*
GRP3 *; 3rd group selection entry*
GRP4 *; 4th group selection entry*
GRP5 *; 5th group selection entry*
Thin1 *; 1st thin*
Thin2 *; 2nd thin*
Thin3 *; 3rd thin*
Thin4 *; 4th thin*
Thin5 *; 5th thin*
Thin6 *; 6th thin*
OVSTR1 *; 1st rotation OR*
OVSTR2 *; 2nd rotation OR*
OVSTR3 *; 3rd rotation OR*
OVSTR4 *; 4th rotation OR*
OVSTR5 *; 5th rotation OR*
PCT *; pre-commercial thin in existing PJP*

*THEME *{15}* Rotation Status
None *; Existing stand starting conditions*
REGEN1 *; 1st rotation CC*

REGEN2 *; 2nd rotation CC*
REGEN3 *; 3rd rotation CC*
REGEN4 *; 4th rotation CC*
REGEN5 *; 5th rotation CC*
REPCT1 *; 1st rotation CC+PCT in KW PJP*
REPCT2 *; 2nd rotation CC+PCT in KW PJP*
REPCT3 *; 3rd rotation CC+PCT in KW PJP*
REPCT4 *; 4th rotation CC+PCT in KW PJP*
REPCT5 *; 5th rotation CC+PCT in KW PJP*
SHELT1 *; 1st rotation SW*
SHELT2 *; 2nd rotation SW*
SHELT3 *; 3rd rotation SW*
SHELT4 *; 4th rotation SW*
SHELT5 *; 5th rotation SW*
SHELT6 *; 6th rotation SW*
GRP7 *; Group Selection starting @ age 7*
GRP8 *; Group Selection starting @ age 8*
GRP9 *; Group Selection starting @ age 9*
GRP10 *; Group Selection starting @ age 10*
GRP11 *; Group Selection starting @ age 11*
GRP12 *; Group Selection starting @ age 12*
GRP13 *; Group Selection starting @ age 13*
GRP14 *; Group Selection starting @ age 14*
GRP15 *; Group Selection starting @ age 15*
DEATH *; acres reaching lifespan*

*THEME *{16}* Treatment Type
NIU *; not in use (yet) initial condition*
EA *; even aged regime*
UE *; uneven aged regime*

*THEME *{17}* Year of Entry
ALL
;2013
;2014
;2015
;2016
;2017
;2018
;2019
;2020
;2021
;2022

*THEME *{18}* Regime
GrowOnly
RegimeA
RegimeB
RegimeC

RegimeD
RegimeE

*THEME *{19}* Stand Origin
EX
RE

Lifespan

The Lifespan section contains the declaration that indicates the maximum age a development type may reach before it is assumed to die or be replaced by another development type through succession. The SFMP model has the following short lived covertypes senescing if they are marked as unavailable for commercial timber harvest in the forest inventory system and exceed the age shown in 10-year increments (21 = 210 years). The biological rotation age for each covertype was used to define when death is represented in the model:

? ? ? ? ? ? ? Northern_Red_Oak ? ? Unavail ? ? ? ? ? ? ? ?	21
? ? ? ? ? ? ? Black_Red_Hybrid_Oak ? ? Unavail ? ? ? ? ? ? ? ?	16
? ? ? ? ? ? ? Oak_Mix ? ? Unavail ? ? ? ? ? ? ? ?	16
? ? ? ? ? ? ? Aspen ? ? Unavail ? ? ? ? ? ? ? ?	13
? ? ? ? ? ? ? Planted_Jack_Pine ? ? Unavail ? ? ? ? ? ? ? ?	13
? ? ? ? ? ? ? Natural_Jack_Pine ? ? Unavail ? ? ? ? ? ? ? ?	13
? ? ? ? ? ? ? Lowland_Aspen_Balsam_Popl ? ? Unavail ? ? ? ? ? ? ? ?	13

The masking above indicates the covertype and the availability of the development type in order to undergo the "_Death" action. These covertypes have all been assigned a more mid to late successional covertype to transition into and is defined in the transitions section.

Area

The Area section is where the forest area included in the scenario or model run is defined and where the development type structure is initialized using the themes listed in the Landscape section. The SFMP model shape file contains 155,092 polygons that total 3,999,054 acres (including Beaver Island which was excluded from all scenarios as Wildlife Division is now the Land administering Division and it is no longer part of the State Forest). The following is an example of the code representing individual development types (individual polygons with the same attributes are aggregated into development types) in the area section and values represented are:

Eco-region, district, forest management unit, management area, compartment #(not used), Stand # (not used), yield table identification, cover type, age class, basal area class, availability for commercial harvest, special analysis unit, purchased land flag, treatment sequence, space holder (NIU), year of entry (all), regime, stand origin, age (in 10-year periods), acres of the development type.

;*A Th1 Th2 Th3 Th4 Th5 Th6 Th7 Th8 Th9 Th10 Th11 Th12 Th13 Th14 Th15 Th16 Th17 Th18 Th19 Age Area
*A EUP EUP Newberry Grand_Marais_Moraine_Comp ALL ALL 1000 Lowland_Spruce_Fir 80-89 51-80 Avail None N None None NIU ALL GrowOnly EX 9 18.1(Acres)

The Area section also contains all future development types of the forest representing future conditions once actions and transitions have occurred. The SFMP model has 653,347 total development types (current and future combined).

Key attributes from the forest inventory system were captured and represented as themes in the Landscape section and eventual attributes Area section. Administrative designations like "Forest Management Unit" combined with planning designations like "Management Area" help to build a crosswalk for implementing harvest goals created at the planning level with resources assigned to the administrative units.

Site condition data were used to determine “Availability”, which is the area eligible to receive a harvest once other criteria are met like age and basal area for certain silvicultural treatments. This was a key attribute in determining sustainable harvest flow in the SFMP model because it defines the portion of the state forest that can be actively managed over the long term.

The combination of each cover type, age class and basal area class also represented key components that are used in determining operable areas and treatments each unique combination was eligible to receive.

Yields

The Yields section is the part of the Woodstock model for including per acre stand volumes, basal area estimates, cultivation costs, species-product stumpage prices, and revenues associated with the development types.

The forest inventory data collected by the Michigan DNR is qualitative in nature and provides a great deal of valuable information about the state forest, but it does not contain the quantitative data necessary to produce growth and yield tables. The variables necessary to represent the current condition of various cover types in different conditions are, however, contained in the USDA Forest Service’s Forest Inventory and Analysis (FIA) data. The key attributes from the Michigan Forest Inventory (MiFI) data that were necessary to create yield tables for individual representative stratum were cover type, age class, and basal area class. These three attributes could also be calculated for a collection of FIA plots that contained the necessary volumetric data to be used in the generation of growth and yield tables. FIA plots located on state forest land were included in an analysis that used individual tree canopy percentage, size class, and species data to calculate a MiFI cover type using the same cover type rules as are in the MiFI system. Other fields in the FIA data were used to determine the basal area class and age class of each plot.

The result was a collection of FIA plots that could be used to determine average beginning conditions of each cover type-age-BA stratum. More common types like aspen and northern hardwoods are represented by hundreds of FIA plots while less common types/conditions may only have one or two plots, and in some cases, there were no FIA plots that represented a specific combination of cover type, age class and BA class. These strata were represented using a nearest neighbor approach where the closest combination of younger age class and lower basal area values were used as the starting condition to represent the null current condition within the cover type. This imputation process resulted in a representative yield table for each combination of cover type, age class and basal area class in twenty, ten-year periods.

Future conditions for each stratum were created to simulate growth by feeding current conditions into the USFS Forest Vegetation Simulator (FVS). Various controls were used (Max BA, growth modifier) to moderate growth and resulting conditions until each set of strata closely resembled timber sale harvest data for equivalent types in terms of basal area and cords per acre.

It is important to note that the yield tables are relatively coarse and represent an average condition of each stratum across a range of soil productivity and spatial distribution. The coarseness of the yield tables can often lead to significant swings in conditions from one period to the next and is often observed in inventory-based outputs using yield table variable thresholds to describe certain conditions (many wildlife outputs use these).

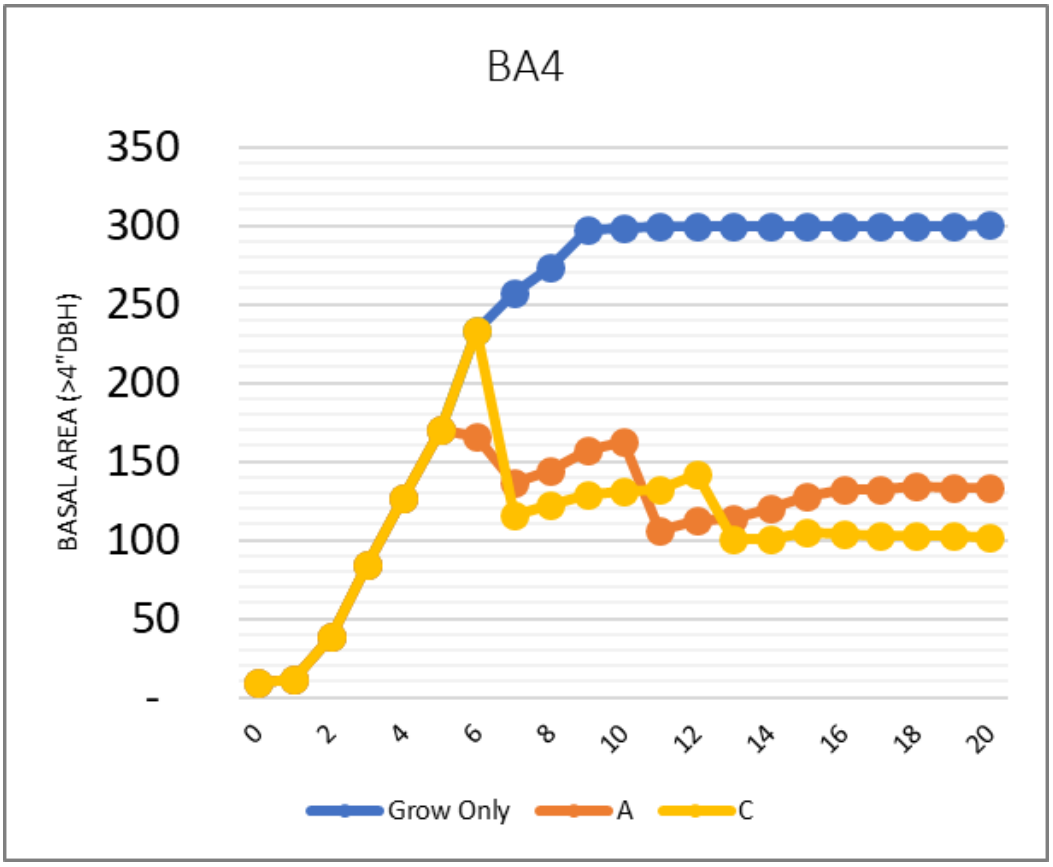


Figure 2. Yield Table showing BA4 values for planted red pine in all 20 periods.

"Grow only" tables were created for all strata to represent current and future conditions of each stratum if no harvesting were to occur. Conversion to other longer-lived or more shade tolerant species can be observed in the yield tables for shorter-lived cover types by examining the volume by individual species product variables.

Various partial harvest regimes were then created in FVS to simulate common thinning regimes (Figure 2) applied to various cover types that are more thoroughly described in the Actions section. The example in Figure 2 shows yields for planted red pine where the model can be referred to the grow only yield table or one of the harvest regimes (A or C) depending on the actions selected for a particular scenario:

Year
Period
Age
Standid
Stocking Class
Cover Type
Age Class
CordsPerAcreChange
a) TPA (Trees per acre)
b) TPA4
c) BA
d) BA4
e) QMD (Quadratic mean diameter)
f) QMD4
g) Total Cords/ac

h) Saw MBF/ac (Thousand board feet per acre of sawtimber)
h) Saw Cords/ac
i) Pulp Cords/ac (Cords per acre of pulpwood)
j) MIXED ASPEN Pulpwood
k) MIXED HARDWOOD Pulpwood
l) RED PINE Pulpwood
m) MIXED OAK Pulpwood
n) JACK PINE Pulpwood
o) WHITE PINE Pulpwood
p) MIXED SPRUCE Pulpwood
q) MIXED SOFTWOOD Pulpwood
r) MIXED ASPEN Sawtimber
s) RED PINE Sawtimber
t) MIXED OAK Sawtimber
u) WHITE PINE Sawtimber
v) BASSWOOD Sawtimber
w) RED OAK Sawtimber
x) WHITE OAK Sawtimber
y) SUGAR MAPLE Sawtimber
z) RED MAPLE Sawtimber
Aboveground Total Carbon Tons/ac
Aboveground Merchantable Carbon Tons/ac
Belowground Live Carbon Tons/ac
Belowground Dead Carbon Tons/ac
Standing Dead Carbon Tons/ac
Percent Canopy Cover
Number of Species Present
Total Harvest Carbon Tons/ac

The simple stumpage value yield table provides an adjustable stumpage price for 17 unique species product combinations. Statewide average stumpage prices were calculated using a 5-year moving average ending in 2022 and can be updated to reflect current prices at any time. Species product prices included in the SFMP model are as follows:

```
;;; Pulpwood harvest volume by species in $/cord
*YT ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ?
 y$AS_P     1    35.78     ; MIXED ASPEN Pulpwood
 y$HW_P     1    49.59     ; MIXED HARDWOOD Pulpwood
 y$JP_P     1    33.91     ; JACK PINE Pulpwood (normal rotation)
 y$OAK_P    1    28.74     ; MIXED OAK Pulpwood
 y$RP_P     1    73.27     ; RED PINE Pulpwood
 y$SOFT_P   1    22.66     ; MIXED SOFTWOOD Pulpwood
 y$SPR_P    1    34.88     ; MIXED SPRUCE Pulpwood
 y$WP_P     1    33.79     ; WHITE PINE Pulpwood

;;; Sawtimber harvest volume by species in $/MBF
*YT ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ?
 y$AS_S     1   121.20     ; MIXED ASPEN Sawtimber
 y$BW_S     1   158.94     ; BASSWOOD Sawtimber
 y$OAK_S    1   216.74     ; MIXED OAK Sawtimber
 y$RM_S     1   165.91     ; RED MAPLE Sawtimber
```

```
y$RO_S     1   292.96    ; RED OAK Sawtimber
y$RP_S     1   163.94    ; RED PINE Sawtimber
y$SM_S     1   448.21    ; SUGAR MAPLE Sawtimber
y$WO_S     1   102.94    ; WHITE OAK Sawtimber
y$WP_S     1    91.11    ; WHITE PINE Sawtimber
```

Some average estimated costs were included in the SFMP model to capture cultivation efforts but are not used in any financial valuation as many costs are not captured and factored into the model. Most costs are incurred at the time of stand establishment. Costs used in the SFMP model are represented in this simple yield table on a per acre basis:

```
y$Herb     1   150.00    ; Herbicide
y$Trench   1    67.00    ; Trenching
y$Plant    1   234.00    ; Planting
y$Seed     1    67.00    ; Seeding
y$Scar_JP  1    86.00    ; Scarification in Jack Pine Covertype
y$Scar_NH  1   292.00    ; Scarification in Northern Hardwood Covertype
y$PCT      1   300.00    ; Pre-Commercial Thinning in KW SAU Jack Pine
y$Masticate 1  300.00    ; Mastication in Jack Pine for KW SAU
```

Actions

The Actions section defines the activities or events that change the dynamics of forest development. The Actions section only describes and defines the actions each development type is eligible for while the Transition section describes what happens to those development types after the action is executed. Five partial harvest regimes were generated as described in the Yields section and eligibility for each of those regimes (A-E) are described below:

i. Harvest regime eligibility: establishes which development types are eligible for various treatment regimes and/or silvicultural methods.

    1. Regime A: thinning is defined in yield tables and starts in period 1 and contains specific regimes for the following cover types:
        a. Northern Hardwood - Selection
        b. Northern Red Oak – Intermediate Thinning
        c. Planted Red Pine – Intermediate Thinning
        d. Planted White Pine – Intermediate Thinning
        e. Planted Mixed Pine – Intermediate Thinning
        f. Natural Red Pine – Intermediate Thinning
        g. Natural White Pine – Intermediate Thinning
        h. Natural Mixed Pine – Intermediate Thinning
        i. Lowland Deciduous – Intermediate Thinning
        j. Upland Conifer – Intermediate Thinning

    2. Regime B: same as above but thins start in period 2 as a second timing choice (allows for more even flow of harvests)
    3. Regime C: Third timing choice for planted and natural pine types
    4. Regime D: Selection harvest for lowland deciduous only
    5. Regime E: Same as D, but provides second timing choice

ii. Silvicultural methods or type of harvest described in the SFMP model are listed below:
    1. aClearcut — Clearcut-only action in regime – resets age to 0
    2. aCC_after_Thin — Clearcut after a thin has occurred, resets age to 0

3. aShelterwood — Shelterwood– remove 80% of volume
4. aOverstoryRem — Overstory removal- 2 periods after shelterwood
5. aThin_b4_CC — Intermediate thinning prior to clearcut
6. aSelect — Selection in NH – regeneration after third entry
7. aGrpSel_Int*x* — Group Selection (x of 5) 20% volume-100% area
8. aGrpSel_Final — Final Group Selection – resets age to 30 yr old

iii. Other parts of the Actions section define if a development type is operable for an Action, for instance:
   1. Aspen Age class >=5 to be eligible for clearcut (40+ years old)
      a. For each existing stand and regenerated stands
   2. Planted Red Pine yTotThn>= 1 in assigned yield table means a thinning is represented in the yield table.
      a. yTotThin is a calculated coefficient in the yield tables, generated by FVS when a beginning stand table is grown forward in periods and specific metrics hit trigger points
      b. Ytotthin is triggered to be set to 1 when Age >= 30 and BA >= 160 for Planted Red Pine
   3. Shelterwood harvest – specific cover types and age requirements
   4. Development types are eligible for Overstory removal after Rotation status is set to "SHELT1" meaning a shelterwood harvest was actioned on that development type.

Transitions

The Transitions section presents outcomes of activities or events declared in the Actions section. Transitions can be as simple as defining what happens to a development type after a simple clearcut action is performed where the age is reset to zero and the development type is now a regenerating type with no other changes. This new development type is then assigned to a new yield table that represents that condition and will stay there if and when another action is performed. Transitions can also describe what happens after a partial harvest occurs assigning the development type to one of the regimes in the yield tables representing that condition.

A key component of this SFMP model is the ability to represent transitions that result in a change in cover type or cover type conversions. This is defined in the Transitions section of the model, and the changes are unique to each cover type in each MA and Special Analysis Unit. Default regional values were used in the transition section if a unique MA value was not requested through the series of local Michigan DNR Desired Future Conditions meetings. Those default values were a representation of current cover type trends or desired trends moving forward. An example code representing a cover type conversion occurring is shown below where existing mixed upland deciduous development types scheduled for a clearcut harvest in the Avery Hills management area are transitioned to regenerating stands. The proportion staying in the mixed upland deciduous cover type is 40%, while 50% is converting to aspen, and 10% is projected to convert to planted red pine and assigned to the regime A yield tables.

```
*SOURCE ? ? ? Avery_Hills ? ? ? Mixed_Upland_Deciduous ? ? ? None ? ? NONE EA ? GrowOnly EX
  *TARGET ? ? ? Avery_Hills ? ? ? Aspen ? ? ? ? ? XXXX REGEN1 EA ? GrowOnly RE          50
  *TARGET ? ? ? Avery_Hills ? ? ? Mixed_Upland_Deciduous ? ? ? ? ? XXXX REGEN1 EA ? GrowOnly RE  40
  *TARGET ? ? ? Avery_Hills ? ? ? Planted_Red_Pine ? ? ? ? ? XXXX REGEN1 EA ? RegimeA RE      10
```

Outputs

The Outputs section includes the values used to exert management control and to evaluate management implementation. The SFMP model contains nearly 1,000 outputs that help to describe values for both timber and wildlife habitat. They can be categorized in the following general types (with examples for each):

Area outputs:

```
        Inventory Area Outputs
*OUTPUT oFMU_Acres(_TH3)  Total Forest Management Unit Acres
```

*SOURCE ? _INVENT _AREA

Harvest Area Outputs
*OUTPUT oCT_HarvestThinAc(_TH8) Thinning Acres by Covertype
*SOURCE ? aThin_b4_CC _AREA

Volume Outputs:

Inventory Volume Outputs
*OUTPUT oTotalInventory Total Inventory in ??? units
*SOURCE ? _INVENT yxInvVol

Harvest Volume Outputs
*OUTPUT oEX_CC_Vol Existing Development Type Clearcut Volume in ??? units
*SOURCE ? EX aClearcut yxInvVol

Graphics

The Graphics section contains the declaration of what outputs are displayed in graphical format in the compiler graphics screen. Graphics that help users evaluate model behavior are especially helpful to build in the graphics section and enable quick analysis of various scenarios based on key outputs. An example of a Woodstock graphic is shown below showing the overall acreage (800,000+) and age-class distribution of aspen across the state forest over 15 periods (Figure 3).

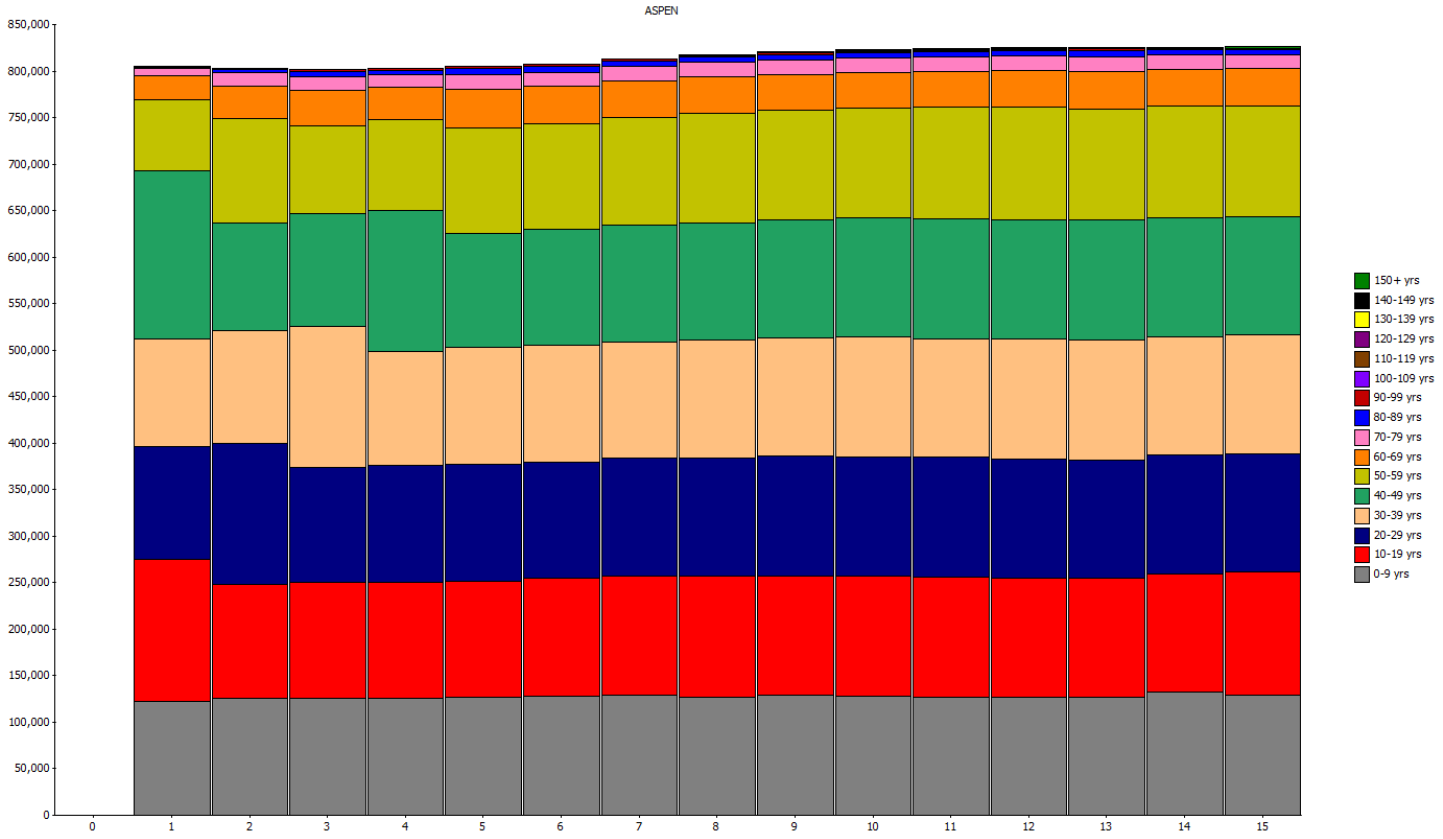


Figure 3. Aspen age class distribution for the entire State Forest in all 15 ten-year periods.

Optimize

The Optimize section formulates the model as a linear programming (LP) model by declaring an objective function and constraints on outputs. This section is key to representing the management strategies used on the forest and provides methods to either control the model through the use of “hard” constraints (e.g., KW jack pine clearcut acres = 3200 in

period 1) or by incentivizing the model through the use of goals (e.g., Aspen age class 1 = 16% of all available acres of aspen in all periods) – not feasible in all periods given the current condition, but the model is incentivized to reach this goal as soon as possible. The objective function is defined here and is used by the LP solution algorithm for finding a mathematically optimal solution. The statewide SFMP model uses an objective function that maximizes harvest acres over 15 decades while penalizing the objective function when goals are not satisfied in each period (e.g., The age class goals of age classes 2, 3, and 4 (age 10-39) cannot be changed because they are too young for harvest in the 1 period, but once they become merchantable in subsequent periods, then the model can allocate harvests to achieve those goals and regenerate a new 0-9 age class that also meets the age class goal).

The following objective function is used in the SFMP Model:

*OBJECTIVE
_MAX oTotalHarvestAc - _PENALTY(_ALL) 1.._LENGTH

Other objective functions (e.g., to minimize costs or maximize other outputs in SAU modeling efforts) have been used for sub-state areas, but the statewide model is best represented with a maximize harvest acres objective function to represent area regulation models. The harvests can only occur on acres available for harvest, XXX of YYY totl forest acres statewide.

Several hard constraints are used to control model behavior and ensure certain constraints are met or to mediate unintended consequences of the objective function that otherwise would result in negative impacts to harvest flow across a specific area or create unfavorable habitat conditions. One example of these is an even-flow constraint that helps provide a relatively stable flow of harvest acres in each 10-year period. In the following example, the total harvest acres output cannot deviate more than 5% in each period:

_EVEN(oTotActHarvAc,5%) 1.._LENGTH

Other examples include constraints that ensure harvest regimes are executed as desired, helping to ensure actions represent management intentions. The following example ensures that group selection continues on a development type once it is first scheduled, resulting in a sequence of five harvests to complete the cycle:

oGrpSel7_GRP2_Ac = oGrpSel7_GRP1_Ac[-1] 2.._LENGTH
oGrpSel7_GRP3_Ac = oGrpSel7_GRP2_Ac[-1] 3.._LENGTH
oGrpSel7_GRP4_Ac = oGrpSel7_GRP3_Ac[-1] 4.._LENGTH
oGrpSel7_GRP5_Ac = oGrpSel7_GRP4_Ac[-1] 5.._LENGTH

The harvest regime goals are a key component of the SFMP model and designate what proportion of eligible silvicultural regimes are applied to each cover type. These controls are set up as goals, sometimes called “soft” constraints, and incentivize the model to achieve these goals by accruing penalty points when not met. These points reduce the value of the objective function which the model is trying to maximize. Hence, the model tries to achieve these goals thereby avoiding the negative points. These goals exist for each MA and cover type that has multiple options for silvicultural regimes. The following goal statement incentivizes the model to allocate 77% of the total harvest acres to the clearcut, 7% to shelterwood, and the remaining 16% to thinning treatment in the black-red hybrid oak cover type in the Cadillac Moraines management area.

oMA_Cadill_CC(Black_Red_Hybrid_Oak) >= 0.77 * oMA_Cadill_HarvAc(Black_Red_Hybrid_Oak) 1.._LENGTH
_GOAL(GR_Cadill_BRH_CC,100)
oMA_Cadill_SW(Black_Red_Hybrid_Oak) >= 0.07 * oMA_Cadill_HarvAc(Black_Red_Hybrid_Oak) 1.._LENGTH
_GOAL(GR_Cadill_BRH_SW,100)
oMA_Cadill_TH(Black_Red_Hybrid_Oak) >= .16 * oMA_Cadill_HarvAc(Black_Red_Hybrid_Oak) 1.._LENGTH
_GOAL(GR_Cadill_BRH_Thn,100)

The age class goals also are one of the most influential sets of goals in the SFMP model. These goals provide incentive for the optimal solution to conform to an area regulation system based on age class goals. There are also several goals related to specific habitat needs of featured species such as elk, Kirtland's warbler, and white-tailed deer (food and shelter). These goals are described in detail in section 5. Special Analysis Units.

Each cover type and MA combination has a unique set of age class goals that define what the ideal age class distribution looks like; in essence they describe the desired future condition of the state forest in terms of age distribution. The penalty points associated with these goals vary depending on the overall abundance of each cover type in each MA. The more significant cover types carry a high goal weight as there is greater opportunity to achieve a desired age class distribution. Smaller populations of cover type acres use a smaller goal weight, resulting in less penalty points accrued against the objective function if goals are not met. Desired age class distributions are not always as attainable in small populations and are less realistic to achieve in an area regulation system. The following example shows a set of age-class goals and corresponding age class distribution in each period for that same cover type and MA, showing the progress toward and achievement of the desired age class distribution in the Cadillac Moraines MA for aspen of approximately 15.2% of the available aspen is contained in the first 6 age classes. The next three oldest age classes have a goal of containing 6%, 1.6%, and .3% of the available population of acres.

oAsp_Age_1_Ac_Av(Cadillac_Moraines) >= 0.152222 * oMA_Asp_Ac_Av(Cadillac_Moraines) 1.._LENGTH _GOAL(ACG_Cadill_Asp_1,25)
oAsp_Age_2_Ac_Av(Cadillac_Moraines) >= 0.152222 * oMA_Asp_Ac_Av(Cadillac_Moraines) 1.._LENGTH _GOAL(ACG_Cadill_Asp_2,25)
oAsp_Age_3_Ac_Av(Cadillac_Moraines) >= 0.152222 * oMA_Asp_Ac_Av(Cadillac_Moraines) 1.._LENGTH _GOAL(ACG_Cadill_Asp_3,25)
oAsp_Age_4_Ac_Av(Cadillac_Moraines) >= 0.152222 * oMA_Asp_Ac_Av(Cadillac_Moraines) 1.._LENGTH _GOAL(ACG_Cadill_Asp_4,25)
oAsp_Age_5_Ac_Av(Cadillac_Moraines) >= 0.152222 * oMA_Asp_Ac_Av(Cadillac_Moraines) 1.._LENGTH _GOAL(ACG_Cadill_Asp_5,25)
oAsp_Age_6_Ac_Av(Cadillac_Moraines) >= 0.152222 * oMA_Asp_Ac_Av(Cadillac_Moraines) 1.._LENGTH _GOAL(ACG_Cadill_Asp_6,25)
oAsp_Age_7_Ac_Av(Cadillac_Moraines) >= 0.066667 * oMA_Asp_Ac_Av(Cadillac_Moraines) 1.._LENGTH _GOAL(ACG_Cadill_Asp_7,25)
oAsp_Age_8_Ac_Av(Cadillac_Moraines) >= 0.016667 * oMA_Asp_Ac_Av(Cadillac_Moraines) 1.._LENGTH _GOAL(ACG_Cadill_Asp_8,25)
oAsp_Age_9_Ac_Av(Cadillac_Moraines) >= 0.003333 * oMA_Asp_Ac_Av(Cadillac_Moraines) 1.._LENGTH _GOAL(ACG_Cadill_Asp_9,25)

The results of these goals are presented in Figure 4.

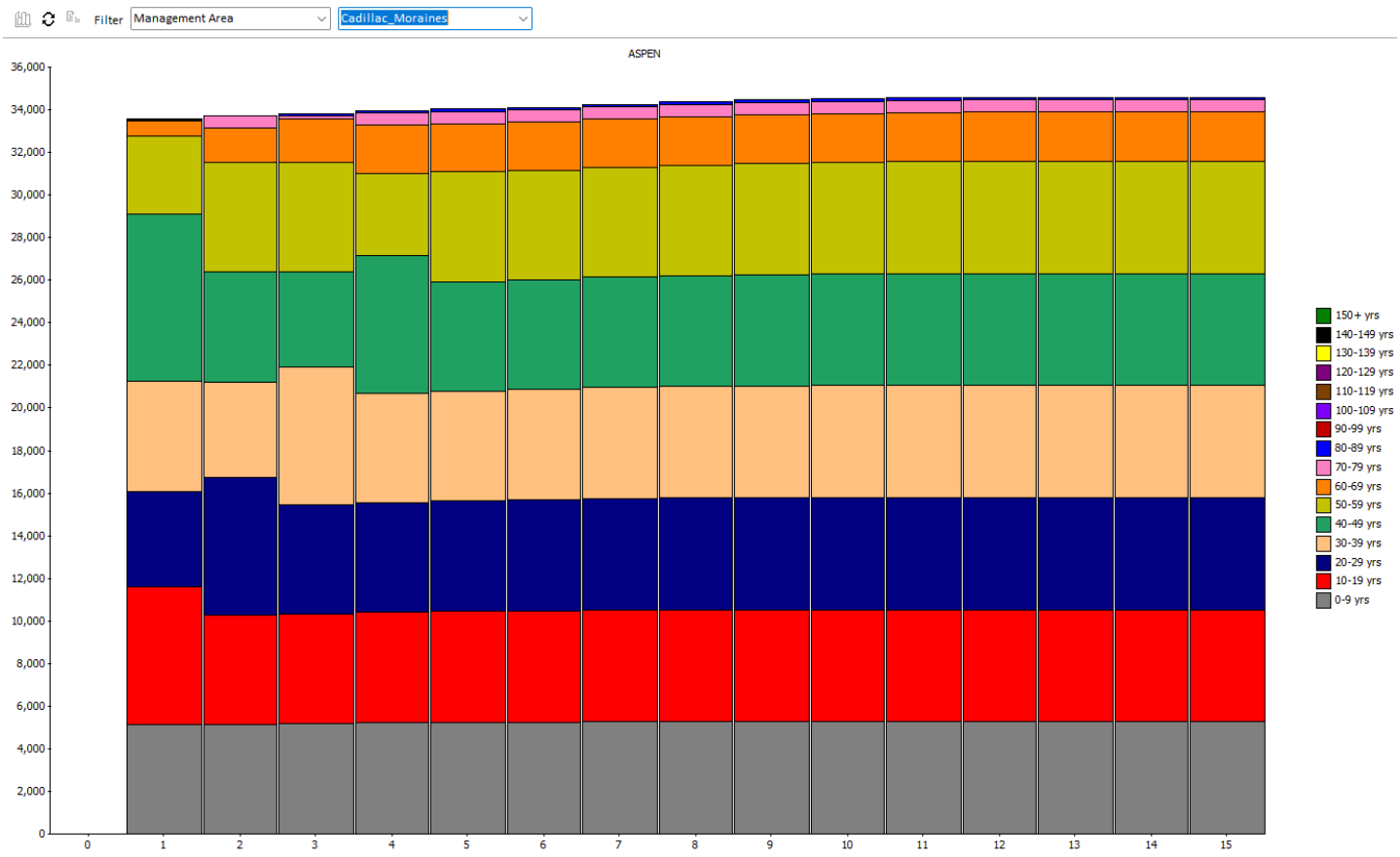


Figure 4. A stacked bar graph of the area of aspen in each age class over the 15-period model run, showing the achievement of desired age class distribution.

Similar age-class goals are also applied in special analysis units (SAUs) where there may be different age-class distribution objectives when compared to the remainder of the MA.

Schedule

The Schedule section is used to generate reports on an optimal solution found by the LP solver used by Woodstock. The resulting harvest schedule contains a comprehensive list of harvest activities that were scheduled on development types for the entire model run. This harvest schedule is an integral part of the implementation process for the SFMP planning process and is further described in the implementation section of the SFMP. Below is an example of the harvest Schedule viewed as a table and showing mixed upland deciduous development types with a selection harvest in the Newberry FMU (Figure 5).

Record	Theme3	Theme4	Theme5	Theme6	Theme7	Theme8	Theme9	Theme10	Theme11
31,366	Newberry	Grand_marais_moraine_comp	All	All	1016	Mixed_upland_deciduous	100-109	111-140	Avail
31,367	Newberry	Grand_marais_moraine_comp	All	All	1022	Mixed_upland_deciduous	100-109	81-110	Avail
31,368	Newberry	Grand_marais_moraine_comp	All	All	1099	Mixed_upland_deciduous	60-69	81-110	Avail
31,369	Newberry	Grand_marais_moraine_comp	All	All	1099	Mixed_upland_deciduous	60-69	81-110	Avail
31,370	Newberry	Grand_marais_moraine_comp	All	All	1100	Mixed_upland_deciduous	70-79	111-140	Avail
31,371	Newberry	Grand_marais_moraine_comp	All	All	1102	Mixed_upland_deciduous	110-119	51-80	Avail

Theme12	Theme13	Theme14	Theme15	Theme16	Theme17	Theme18	Theme19	Age	Area	Action
None	Y	None	None	Ea	All	Growonly	Ex	11	15.96572	Aselect
None	N	None	None	Ea	All	Growonly	Ex	11	71.01213	Aselect
None	N	None	None	Ea	All	Growonly	Ex	7	3.50000	Aselect
None	Y	None	None	Ea	All	Growonly	Ex	7	17.10000	Aselect
None	N	None	None	Ea	All	Growonly	Ex	8	11.47816	Aselect
None	N	None	None	Ea	All	Growonly	Ex	12	3.49512	Aselect

Figure 5. Example of the harvest schedule allocated to development types in the woodstock model.

Reports

The Reports section identifies the outputs to include in report files. The SFMP model contains several custom reports that produce csv file types for thousands of output values for each period. These reports are generally imported into an Excel document and used to support the writing efforts of this plan through various graphs and tables.

Maps

The maps section provides several GIS tools to interact with the spatial data (Figure 6) that was used to create the Area section of the model. There are several tools and options that help to spatially analyze results by spatially assigning the harvest schedule to the polygons creating a potential harvest solution that is spatially represented across state forest lands. This section is heavily used in the implantation process and is described in section 6: Implementation.

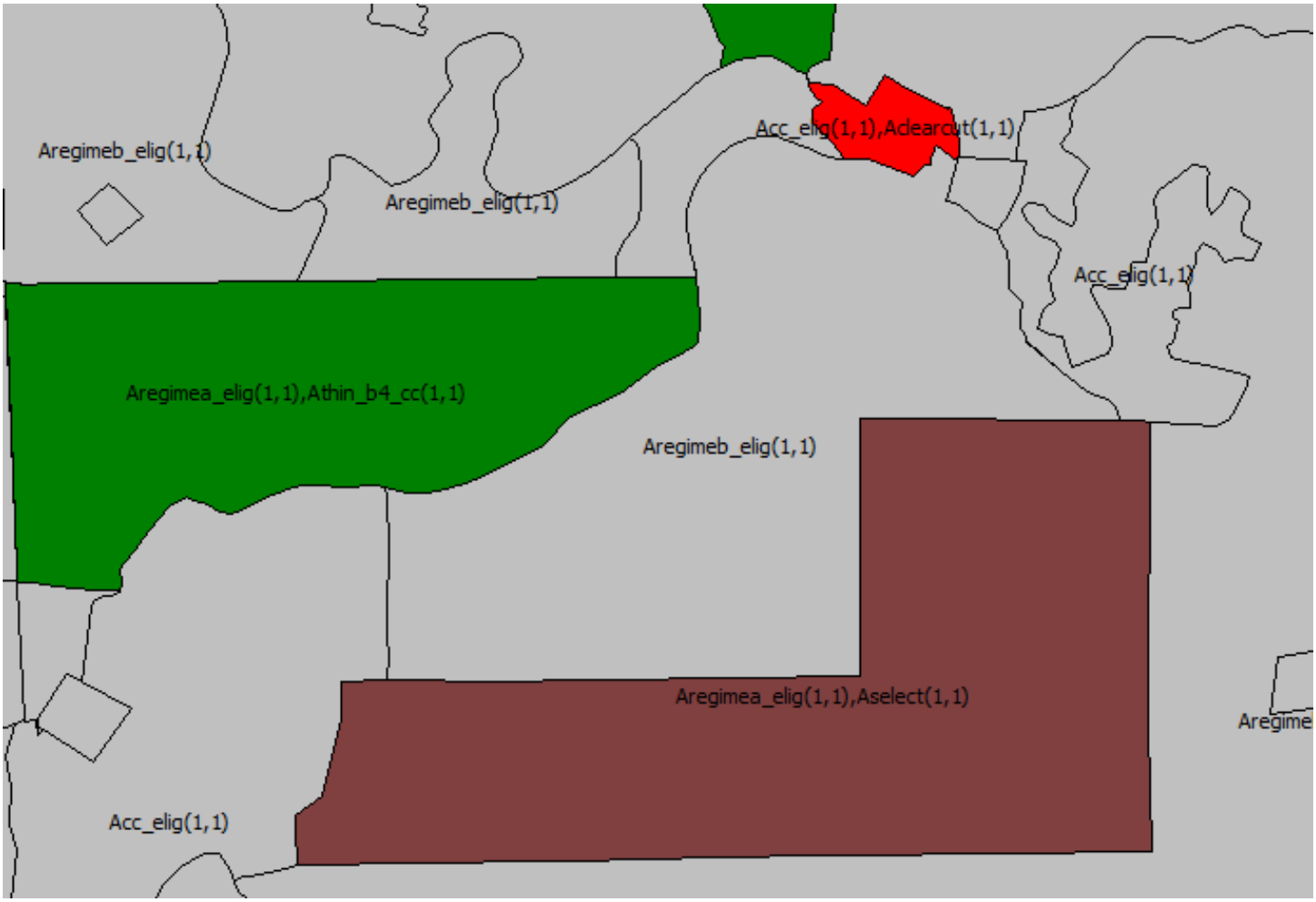


Figure 1. A screen shot of the spatial allocation of treatments from the maps section. Each color represents a different treatment type allocated to the respective polygon; grey polygons received no treatment allocation.

Appendix G

Forest Habitat Type (Kotar) Classifications Systems

Classification systems are needed to effectively manage forest resources. Traditionally, resource classifications have been developed only for specific uses. Forest cover types, for example, traditionally a standard unit for forest management, have serious limitations as an ecological basis for developing management prescriptions. They are based entirely on current dominant and most often successional tree species. Thus, stands of a given cover type encompass a wide range of environmental conditions and therefore have different productivity potentials and respond differently to the same management techniques. Similarly, systems that classify or map landscapes based entirely on physical factors (e.g., physiographic maps or soil surveys) are inadequate for management if they do not include ecological interpretations of communities (e.g., composition, growth, dynamics) that are associated with individual physical landscape units. A system that delineates and explains some basic ecological units is needed to place management on an ecological foundation. This habitat classification system uses natural vegetation (potential as well as current) to recognize ecologically equivalent vegetation communities and landscape units.

The Forest Habitat Type (Kotar) Classification System is a site classification system based on the identification of repeatable patterns in the composition of understory vegetation. It is a system based on the study of floristic composition of vegetation that groups communities and their environments into categories useful for management interpretation. The habitat types are developed independently from the current tree species composition and condition and can be applied to most upland forest stands.

The Kotar classifications for each ecoregion are listed below.

Table 1. Western Upper Peninsula Ecoregion Habitat Types

Habitat Type	Name	Primary Landform and Soils
PVCx/PVDc	White pine/Blueberry – Hairgrass and White pine/Blueberry - Sedge	Excessively drained sandy soils on outwash plains
PQE	White pine – Red Oak/Trailing arbutus	Deep sandy soils on outwash and lacustrine deposits or shallow soils over bedrock
PArV	White Pine – Red maple/Blueberry	Excessively well drained soils of lacustrine deposits
PArV(w)	White Pine – Red maple/Blueberry (Wisconsin variant)	Sands and loamy sands on glacial outwash and moraines
PArVAa	White pine – Red maple/Blueberry – Wild sarsaparilla	Excessively well drained soils of lacustrine deposits

Habitat Type	Name	Primary Landform and Soils
PArVAa(w)	White pine – red maple/blueberry – wild sarsaparilla (Wisconsin variant)	Sand to sandy loam on glacial outwash and moraines
PArV-Co	White pine – red maple/blueberry – bunchberry variant	Excessively well drained sands on lacustrine Northern Lower Peninsula ecoregion habitat types
AArAst	Sugar maple – red maple/large-leaved aster	Sandy soils formed in coarse till and shallow till over bedrock
AArLy	Sugar maple – red maple/stiff club-moss	Loamy soils over deep sands on coarse till deposits and thin till over bedrock
AVVb	Sugar maple/blueberry – maple-leaved viburnum	Well drained sandy loams on rolling moraines and glaciofluvial deposits
AVb	Sugar maple/maple-leaved viburnum	Sandy loams on medium textured end moraines
TMC	Eastern hemlock/wild lily-of-the-valley – goldthread	Somewhat poorly drained soils on a variety of landforms
ATM	Sugar maple-eastern hemlock/wild lily-of-the-valley	Loamy sand and sandy loam soils on end moraines and outwash covered moraines
ATM-Sm	Sugar maple-eastern hemlock/Wild lily-of-the-valley – false solomon's seal variant	Loamy sand and sands on medium and coarse texture tills
ATM-O	Sugar maple-eastern hemlock/wild lily-of-the-valley – sweet cicely variant	Sandy loam soils over clay on clay and lacustrine deposits
ATFAs	Sugar maple-eastern hemlock-American beech/jack-in-the-pulpit	Sandy soils with subsurface clayey, gravelly or cemented layers
ATD	Sugar maple-eastern hemlock/spinulose shield fern	Loamy soils on coarse textured till and loess
ATD-Hp	Sugar maple-eastern hemlock/dpinulose shield fern-sharp-lobed hepatica variant	Sandy soils with subsurface clayey, gravelly or cemented layers on medium textured glacial till

Habitat Type	Name	Primary Landform and Soils
ATD-Ca	Sugar maple-eastern hemlock/spinulose shield fern-blue cohosh variant	Loamy cap soils on clay deposits
AOCa	Sugar maple/Sweet cicely - blue cohosh	Well drained loamy till and loess

Table 2. Eastern Upper Peninsula Ecoregion Habitat Types

Habitat Type	Name	Primary Landforms and Soils
PVE	White pine/blueberry – trailing arbutus	Excessively drained soils on lacustrine deposits of sand and gravel
PArV	White pine - red maple/blueberry	Excessively drained to well drained soils on deep lacustrine deposits of sand and gravel
PArV-Ao	White pine – red maple/blueberry – spreading dogbane variant	Excessively drained to somewhat excessively drained soils on glacial outwash
PArVAa	White pine – red maple/blueberry – wild sarsaparilla	Excessively to well drained sandy soils on deep lacustrine deposits of sand and gravel
ATFD	Sugar maple – eastern hemlock – American beech/spinulose shield fern	Well to moderately well drained deep sands and loamy sands on outwash, lacustrine deposits, glacial till and end moraines
AFPo	Sugar maple – American beech/hairy Solomon's seal	Well to somewhat excessively drained deep sands and loamy sands on a variety of landforms; gravelly, cemented and mottled layers are common
AFOAs	Sugar maple – American beech/sweet cicely – jack-in-the-pulpit	Moderately well to somewhat excessively drained soils on end moraines and till plains; gravelly, cemented and mottled layers are common; als, thin till over bedrock

Table 3. Northern Lower Peninsula Ecoregion Habitat Types

Habitat Type	Name	Primary Landforms and Soils
PVCd	White pine/blueberry – reindeer lichen	Sandy outwash plains, very dry/very poor nutrient
PARVHa	White pine – red maple/blueberry – witch hazel	Level plains and gentle slopes, associated with glacial outwash plains, sandy beach ridges and coarse textured moraines, very dry to dry/poor nutrient
PArVVb	White pine – red maple/blueberry – maple-leaved viburnum	Beach ridges along Lake Huron, dry to dry-mesic/poor to medium nutrient
AFO	Sugar maple – American beech/sweet cicely	Coarse textured end moraines, ground moraines, outwash plains, till plains and undifferentiated end moraine – ground moraine complexes; mesic/medium to rich nutrient
AFOCa	Sugar maple – American beech/sweet cicely – blue cohosh	End moraine, drumlins and ground moraines; mesic/rich to very rich nutrient
PArVCo	White pine – red maple/blueberry – bunchberry	Poorly drained outwash sands; mesic to wet-mesic/poor nutrient

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

INTEROFFICE COMMUNICATION

April 8, 2024

TO: Forest Resources Division District Managers and Unit Managers

FROM: David Price, Forest Planning and Operations Section Manager



SUBJECT: Interim Guidance - Increased Minimum Gap Size and Regeneration Accountability for Uneven-Aged Management

This memo is aimed at communicating interim guidance for two objectives: 1) changes to gap harvesting criteria for northern hardwood management and 2) establishing recruitment and age accountability at the gap scale. This guidance replaces guidance for group selection in the DNR Silvics and Management Guidance Manual (IC4111) and will be incorporated into future revisions of the guidance manual.

The update to gap size is based on research and management experience over the last two decades. The rationale for better accounting of the resource is related to the age imbalance and a lack of a system to track it at a scale smaller than stands. It is critical that we track recruitment efforts closely so that we can begin to develop the structure desired. In many cases, this effort will take more than just monitoring. This communication is broken into categories that provide background for these changes and explanation of their purpose.

Research: In 2007, Forest Resources Division (FRD) began investing in research for northern hardwood management due to a lack of desirable recruitment across the majority of the acreage on the State Forest. The current project that began in 2016 aims to test alternative silvicultural systems, and the minimum gap sizes for the current project were based on the previous research. However, FRD never updated our minimum gap size for operational purposes. Results from the more recent project will continue to inform this guidance.

Silviculture: 1994 FRD guidance suggested that proper implementation of single tree selection would result in regulation 30 years later. As we approach on this anniversary, it has become clear that this was not a practical goal. Furthermore, it is also becoming clear that single-tree selection may not be the most efficient way to convert even-aged stands to uneven-aged structure, even in places with abundant desirable advanced regeneration. The increased gap size outlined in this guidance is a fundamental shift from single tree selection to small group selection. Under this new approach, we will be accountable to recruit the acreage within the gap, as opposed to an even distribution of regeneration across a stand. The latter was a poor metric for developing uneven-aged structure, and thus led to some of the accountability problems.

To maximize natural regeneration outcomes, new gap sizes for northern hardwood management are required to have a minimum radius of 50 ft (0.18 acre) to the bole of trees on the gap edge with a recommended maximum radius of 85 ft. (0.52 acre), or up to 100 ft (0.72 acre) in cases where intolerant species are desirable and can be promoted with available local seed/sprout sources.

In addition to providing an increased likelihood of desirable regeneration in problem areas, creating larger gaps can also be used to promote vigorous growth into small poles in stands where desirable advance regeneration is abundant, but pole timber is lacking. The proportion of a stand to include in gaps will vary based on the age and condition of a stand, but the guidance for a typical log-sized hardwood stand will be **10-20% of the area**, with the remaining 80-90% subject to thinning or no harvesting. Additional guidance on tree selection methods within the remainder of the stand will be provided in an updated version of The Complete Marker (IC 4039).

Forest Certification: Regeneration accountability has surfaced in several forest certification audits, but until recently it has been recognized as an area of improvement rather than a corrective action. A recent internal audit finding specific to natural regeneration has prompted more-timely implementation of this guidance. Additional guidance for even-aged natural regeneration monitoring will follow later. The changes for uneven-aged management outlined in this guidance will be incorporated into revision of Forest Certification Work Instructions.

Timber Sales: Staff will begin implementing the minimum gap size during timber sale preparation. Gap locations will be collected using a point or polygon feature. Within stands, there is considerable latitude regarding gap placement. The only requirement is that gaps should be separated by >75 feet of intact forest. It is encouraged that gaps be located where it makes the most sense; for example, maximizing the proportion of high-risk timber to be harvested, presence of well-stocked advance regeneration of desirable species, placement adjacent to seed-bearing trees of uncommon desirable species, or to optimize other management goals. As a reference, average gap density based on the 10% of stand target is approximately one 50-ft radius gap per two acres or one 75-ft radius gap per four acres, and for the 20% target one 50-ft radius gap per acre or one 75-ft radius gap per two acres. Painting gap boundaries prior to individual tree marking is an approach that should be considered at all scales. This can be efficient, as fewer trees need to be marked at the upper end of the minimum gap size and it eliminates the need to have a device on hand while marking. It also creates an opportunity to more evenly stratify gaps and creates a way to use timber sale specifications (cut all stems >1 inch dbh) to create a uniform flush of sprouts from advanced regeneration that was previously of varying form and size. In the example of a 100-acre treatment, individual tree marking can be reduced by 10-20 acres through use of this tactic.

Timber cruising will not change significantly, but it is important to point out some situations that will become increasingly common. The cruising options generally fall into two categories. The first scenario is when gaps are exclusively being created and the remainder of the stand is NOT being marked. This is becoming increasingly common in larger gaps with artificial regeneration objectives. In gaps larger than the minimum size for natural regeneration the cruiser would increase plot density to a minimum of 2 points per acre and the walk-through method would need to be incorporated. The second scenario is when the remainder of the stand is being marked. In the second scenario, the cruiser would increase the plot density and ignore the gap boundaries when determining cruise plot locations. Cruise plots would include trees from both inside and outside the gaps even if a separate paint color is used to identify gaps.

Treatment Tracking and Inventory: When the timber sale closes point data will be converted into polygons for the creation of monitoring or cultivation treatments in MiFI. Each gap will become its own treatment to provide clarity of scale for contractors and because different gaps within stands may need/not need treatments or may need different treatments.

Plans are being developed to convert regeneration survey data in Inventory Manager to a regeneration status that is specific to each gap. This platform will also provide the space to add other attributes such as age and size once the regeneration surveys are complete. The fundamental shift toward small group selection coincides with an opportunity to explore area regulation as compared to basal area regulation in the next planning cycle. The latter method for determining a sustainable harvest level was more suitable for single tree selection systems.

Cultivation: Achieving desirable regeneration is largely dependent upon having desirable advanced regeneration present before harvest. Unfortunately, a significant portion of the northern hardwood cover type has low advanced regeneration stem densities of desirable species, and often high densities of less desirable competitors, including beech and ironwood. Some of these stands are ideal candidates for conversion to other cover types for the next rotation, where practical. Otherwise, management toward uneven-aged northern hardwoods will continue to be the most common path over the next decade even when undesirable understory conditions dominate. Therefore, novel silvicultural treatments aimed at tipping the balance in favor of desirable well stocked regeneration will be required in many circumstances, including controlling undesirable regeneration with herbicides, scarifying to increase seedling establishment, brush saw release when stocking of desirable regeneration is present, and planting with browse protection when chances of natural establishment are low or have already failed. We have some of these tools at our disposal now and others will develop as funding becomes available for restoration. Gaps larger than the minimum size for natural regeneration are recommended once the decision has been made to use artificial regeneration.

Regeneration Monitoring: Regeneration surveys will continue to be scheduled in MiFI. Gaps requiring artificial regeneration will be scheduled for regeneration monitoring in the first and third growing season similar to how this works at the stand scale. Natural regeneration surveys will be scheduled at 5 growing seasons and 10 growing seasons post-harvest regardless of the re-inventory schedule for the compartment review process. The 5-year regeneration survey window allows for time to install an efficient release treatment if desirable regeneration is becoming established but is overtopped by competing shrubs and/or undesirable tree species. This window also allows for efficient planning of alternative treatments aimed at securing regeneration if desirable natural regeneration is clearly not establishing. The timing of the 10-year survey is intended to assess if desirable regeneration is expected to be well stocked and free-to-grow (i.e. taller than the browse line at >4.5 feet tall and not overtopped by competing vegetation). If the gaps are fully stocked with free-to-grow saplings then monitoring can be discontinued, and the harvest gaps can be considered successfully regenerated.

Regeneration surveys will always follow quantitative methods (installation of plots) because the costs are largely influenced by the need to travel to the site. The detail of the survey methods and the stocking thresholds are being developed through the northern hardwood research and will be incorporated into the Forest Regeneration Survey Manual (IC 4145). Established gaps that meet the minimum gap size requirement and have 5 years of growth can begin to be scheduled for regeneration surveys in the fall of 2024.