3 - CURRENT FOREST CONDITIONS AND TRENDS

3.1 Introduction

The state forest satisfies many uses for the people of Michigan that can be divided into ecological, social and economic categories. Ecological uses or services include conservation of genetic diversity and wildlife habitat, regulation of water flow and quality, protection of soil quality and protection from erosion, air quality, climate modification and carbon sequestration. Social used include a feeling of spirituality or well-being associated with forests; consumptive uses such as hunting, fishing, gathering and harvesting of forest products; and non-consumptive uses including nature appreciation, camping and trail related activities (hiking, bicycles, off-road vehicles and horseback riding). Economic uses range from local community support through tourism and forest harvesting to oil and natural gas production and mining.

The eastern Upper Peninsula has relatively flat topography with large expanses of open peat-lands and forested lowland swamps. Elevations range from 600 feet above sea level along the Great Lakes to 1,300 feet inland. The major land forms are a product of the glaciers that covered the region over 10,000 years ago. Within the eastern Upper Peninsula the climate is cooler and more variable than the northern Lower Peninsula and is influenced by its close proximity to the Great Lakes. The eastern Upper Peninsula is the only region in the state that is bordered by three of the Great Lakes: Huron, Michigan and Superior.

The forests of the eastern Upper Peninsula have been recovering from the past harvesting practices and extensive and intensive fires of the late 19th Century and early 20th Century. The present second growth forest of the region is a legacy of natural vegetative succession and post-settlement practices. The intensive logging that began with white pine, red pine and hemlock in the late 1800s was followed by harvesting of northern hardwoods for charcoal and other uses and has resulted in changes in forest types and forest composition in the eastern Upper Peninsula. The current landscape was also influenced by large-scale wildfires and the subsequent attempt to exclude fire from the landscape.

This section describes the current conditions and trends for the eastern Upper Peninsula from the perspective of the state forest resources, forest health concerns, wildlife habitat, fisheries and aquatic communities and socio-economic conditions within the region.

3.2 Climate Change Impacts

Climate is as fundamental to forest communities as soil or hydrology. Since the 1980s the climate has been changing faster than it has in recorded history. The best available climate science indicates that past trends will continue. Some impacts of these trends are very likely or virtually certain (Handler et al., In Press):

- Ecosystems will change across the landscape – this may include changes in location and/or changes in composition;
- Boreal and sub-boreal species are likely to be extirpated or increasingly isolated in cool lake-effect microclimates;
- Forest succession will likely change, making future trajectories increasingly unclear;
- Forest productivity will change, driven by changes in CO_2 fertilization, water and nutrient availability, local disturbances and species migration;
- Seasonal distribution of keystone species such as deer and wolves will change with decreasing snow fall and increased midwinter snow melt events;
- Exacerbation of existing threats and new interactions between threats are likely to be the most obvious effects of climate change; and
- Many current management objectives and practices will face substantial challenges.

Current (Observed) Climate Trends

Throughout the Midwest the average annual temperature has been increasing. The rate of that change has doubled since 1950 (Andresen et al., 2012). Winter and spring are warming faster than summer and fall; nighttime temperatures are warming faster than daytime temperatures (Andresen et al., 2012). Extreme heat events are more common (Andresen et al., 2012). Precipitation has also increased. The increase in recent years (1981-2010) has included a greater increase in winter and spring precipitation than summer and fall precipitation decreased. Both the frequencies of extreme precipitation events as well as the number of merely wet days have increased (Andresen et al., 2012).

Predicted Climate Trends

For the Midwest as a whole, there have been consistent projections for an increase in mean annual temperature and an increase in extreme heat events. Seasonal temperature projects are less consistent (Winkler et al., 2012). Projections for the eastern Upper Peninsula suggest a greater increase in winter than summer (Handler et al., In Press, Swanston, 2011). However, overall temperature increases will likely be moderated by proximity to a Great Lake (Swanston, 2011).

Contrary to temperature projections, the precipitation projections are more consistent for seasonal patterns, but it is unknown if the average annual amount of precipitation will be an increase or decrease. Throughout Michigan the most consistent precipitation projections are for more winter precipitation, more rain instead of snow and more heavy precipitation events in every season (Winkler et al., 2012). For the eastern Upper Peninsula there are differences between projections, depending on whether a low emissions scenario or a high emissions scenario is used in the models (Handler et al., In Press). The Michigan Forest Ecosystem Vulnerability Assessment and Synthesis (Handler et al., In Press) describes sub-regional differences. However, there is a consistent projection for decreased snowfall outside of lake-effect areas and overall a change to more winter precipitation coming as rain (Hayhoe, 2010). Due to changes in the timing and volume of precipitation, all regions of Michigan will likely see significant changes in hydrologic regimes.

An additional trend expected in the short-term for the eastern Upper Peninsula is an increase in soil frost depth due to reduced snowfall. However, in the long-term, the lack of snowfall will likely be off-set by warmer air temperatures and ultimately soils are projected to be frozen for shorter periods in winter (Handler et al., In Press).

Potential Impacts to Forest Communities

Potential Impacts can be broken into categories, including ‘Direct Impacts’ (where change in a climatic variable has a direct effect on a species or ecosystem), ‘Indirect Impacts’ (where change in a climatic variable has an effect on some other factors that affects an species or ecosystem, typically by altering a disturbance regime); and ‘Combined Impacts’ (where changes in climatic variables cause complex interactions between factors that are already threats to the species or ecosystem).

Potential Direct Impacts:

- Increased temperatures resulting in reduced growth for some species and increased growth for others (Vose et al., 2012); for those with potential to increase growth, this gain may be off-set by negative effects resulting from lack of synchronicity with other ecosystem or climatic variables (Swanston, 2011);
- Low soil moisture resulting in stress/mortality and affecting regeneration of trees and wetland wildlife (Vose et al., 2012);
- Extreme weather events resulting in stress/mortality, including longer dry seasons and more extreme floods (Vose et al., 2012);
- Increased atmospheric carbon dioxide and nitrogen deposition resulting in altered physiological function; much variation between species in response is expected (Vose et al., 2012);
- Changes in seasonal climatic factors resulting in longer growing seasons (Vose et al., 2012);
- Changes in multiple climatic factors resulting in reduced suitable habitat (spatial extent and/or quality) for some species; particularly for species associated with boreal forest systems, including quaking aspen, paper birch, tamarack, jack pine and black spruce (Handler et al., In Press); and
- Changes in multiple climatic factors resulting in increased suitable habitat (spatial extent and/or quality) for some species; particularly for species with ranges that currently extend to the south, including American basswood, black cherry and white oak (Handler et al., In Press).

Potential Indirect Impacts:

- Pests, Disease and Invasive Species:
    - Increased temperatures causing some pests and diseases to become more active; examples include beech bard disease, white pine blister rust, spruce budworm, tamarack sawfly, jack pine budworm, *Scleroderris*, white pine shoot weevil and red pine shoot blight (Handler et al., In Press);
    - Changes in multiple climatic factors causing some pests to expand in to new areas, particularly into areas with increased disturbance and dry forest ecosystems (Vose et al., 2012); examples include Asian longhorn beetle and western bark beetle (Handler et al., In Press); and

    - Changes in multiple climatic factors causing some invasive plants to increase and/or expand into new areas, with impacts particularly on regeneration; examples include buckthorn, honeysuckle, garlic mustard, reed canary grass, Japanese barberry, leafy spurge, spotted knapweed and St. John'swort (Handler et al., In Press).
- Moisture, Drought and Wildfire:
    - Decreased snow cover causing even lower soil moisture (Vose et al., 2012);
    - Changes in multiple climatic factors causing increased drought and moisture stress, particularly late in the growing season (Handler et al., In Press, Swanston et al., 2011);
    - Changes in multiple climatic factors causing increased drought and wildfire, resulting in overall changes to structure and function of forest ecosystems (Vose et al., 2012);
    - Shifts in winter precipitation and temperature causing an advance in the timing of snowmelt runoff, resulting in changes to seasonal soil moisture and potentially increasing fire risk, depending on infiltration rates and soil frost (Handler et al., In Press); and
    - Increased temperatures causing accelerated decomposition of litter layers, resulting in lower water-holding capacity and greater moisture stress; this could prompt a move to barrens in some systems (Handler et al., In Press).
- Snowfall and Soil Frost:
    - Changes in snowfall causing changes in soil frost that in turn affect water infiltration rates, nutrient cycling and tree growth (Handler et al., In Press); while short-term increases in soil frost depth due to decreases in snowfall may occur, long-term predictions suggest air temperatures will ultimately increase enough to off-set decreased snowfall and cause a decrease in soil frost depth; and
    - More variable winter weather causing an increase in the number of freeze/thaw cycles per year, resulting in increased root damage of frost-intolerant tree species and affecting the timing of nutrient release in forest soils; northern hardwood species (like sugar maple) are most likely to be negatively affected by this kind of root damage (Handler et al., In Press).
- Growing Season and Productivity:
    - Longer growing season and warmer temps will result in increases in productivity for deciduous forest types (Handler et al., In Press) as long as there are enough water and nutrients available (Swanston, 2011); and
    - Likely a general increase in forest productivity in eastern Upper Peninsula, but could be affected by CO2 fertilization effects and likely limited by moisture availability (Handler et al., In Press).
- Species and Habitat:
    - Increased temperatures causing increased deer populations, resulting in increased herbivory and/or competitive advantage for those species not eaten (Handler et al., In Press);
    - Changes in multiple climatic factors causing drying of ephemeral ponds, resulting in increased stress on dependent species (Swanston, 2011); and
    - Changes in multiple climatic factors causing changes in hydrology of lowland systems, resulting in increased stress on dependent species (Handler et al., In Press).

Potential Combined Impacts:

- Increased invasive species and pest stress exacerbating existing stress complexes, including current land use activities (Vose et al., 2012);
- Increased drought exacerbating existing stress complexes, resulting in higher tree mortality, slow regeneration in some species and altered species assemblages (Vose et al., 2012);
- Decreased snow cover, causing even more reduced soil moisture, resulting in decreased tree vigor and increased forest susceptibility to insects and pathogens that will likely be increased due to climatic factors alone (Vose et al., 2012);
- Increased disturbance causing even greater fragmentation in landscapes that are already highly fragmented, resulting in even more decreased habitat connectivity and corridors for species movement (Vose et al., 2012);
- Decreased moisture and increased temperatures causing weakened trees (from moisture and heat stress), resulting in even greater damage from pests and diseases; examples include hypoxylon canker, forest tent caterpillar, gypsy moth, oak wilt and oak decline (Handler et al., In Press);

- Earthworm activity causing forest stands to have increased susceptibility to drought, resulting in drought-stressed trees that are even more susceptible to pests and disease that will likely be increased due to climatic factors alone (Handler et al., In Press); and
- Increased pests and diseases and increased extreme weather events causing increased mortality, resulting in increased fuel loads and even greater wildfire risk that will likely be heightened due to climatic changes alone (Handler et al., In Press).

The ability of a forest community to cope with potential impacts will also be affected by many additional factors. For example, communities with greater species diversity and structural complexity and those that are more tolerant of disturbance will tend to be better able to adapt to climatic changes. Whereas, forest communities within highly fragmented landscapes or that are very limited to certain spatial areas due to specific abiotic requirements will tend to be less able to adapt. The Michigan Forest Ecosystem Vulnerability Assessment and Synthesis (Handler et al., In Press) includes a much more detailed assessment of eastern Upper Peninsula forest type adaptive capacity.

Potential Impacts to Forest Management Activities (Handler et al., In Press):

- Increased occurrence of intense precipitation events causing increased soil erosion and potential effects on forest infrastructure, affecting access to forests for management activities; roads and bridges are of particular concern;
- Increased disturbance events causing increased tree mortality, resulting in increased salvage cuts;
- Changes to and greater variability in winter weather (increased freeze/thaw cycles, increased air temps, increased rainfall, fewer days of soil frost in the long-term, less snow to protect soils), resulting in more limited access to stands for management activities and increased soil erosion and sedimentation from use by trucks; and
- Decreased soil moisture (particularly later in the growing season and during prolonged droughts), resulting in increased access to stands in typically wetter areas for management activities in summer.

Key Vulnerabilities [to the Forestry Sector] across the Midwest Region (Handler et al., 2012):

- Climate change will amplify many **existing stressors** to forest ecosystems, such as invasive species, insect pests and pathogens and disturbance regimes (very likely);
- Climate change will result in **ecosystem shifts and conversions** (likely);
- Many tree species will have **insufficient migration** rates to keep pace with climate change (likely);
- Climate change will amplify existing stressors to **urban forests** (very likely);
- Forests will be less able to provide a consistent supply of some **forest products** (likely);
- Climate change impacts on forests will impair the ability of many forested watersheds to produce reliable supplies of **clean water** (possible);
- Climate change will result in a widespread decline in **carbon storage** in forest ecosystems across the region (very unlikely);
- Many contemporary and iconic forms of **recreation** within forest ecosystems will change in extent and timing due to climate change (very likely); and
- Climate change will alter many traditional and modern **cultural connections** to forest ecosystems (likely).

Differences that May Affect Eastern Upper Peninsula Forest Community Response to Climate Change:

- This region has less fragmentation than some other regions of Michigan: Application of climate change adaptation strategies across landscapes may be easier; migration may be easier for species;
- This region has more lake-effect areas than some other regions of Michigan: Communities with specific climate requirements, such as lake-effect areas, may be highly vulnerable to climatic changes; lake-effect areas may be especially vulnerable due to dependency on complex relationships including lake water temperature, lake water level, air temperature and precipitation;
- This region has more consolidated blocks of public land ownership (federal and state) than other regions of Michigan: Application of climate change adaptation strategies across landscapes may be easier;
- This region has more rare species than some other regions of Michigan: Rare species will likely be very vulnerable to climatic changes, as these become additive stresses on top of those already making the species rare;

- This region is less reliant on planting for regeneration of forest communities than some other regions of Michigan, natural regeneration generally works well: Fewer opportunities for assisted migration may occur; species may experience less stress from climatic changes that affect regeneration;
- This region has more non-forested/open communities and lowland communities than other regions of Michigan: The kinds of communities are more adapted to disturbance than other types and may be better able to adapt to climatic changes and resulting impacts; lowland communities are often associated with specific hydrologic regimes and may be less able to adapt to changes in hydrology;
- This region has a greater diversity of forest community types than other regions of Michigan: Landscapes with greater diversity will likely have greater ability to adapt to climatic changes and resulting impacts;
- This region has more potential 'reference areas' or 'refugia' (particularly for boreal forest communities) than some other regions of Michigan: Refugia are likely to be less affected by climatic changes than other places on the landscape and may provide safe harbor for vulnerable species and communities; boreal forests are likely more vulnerable to climate change than many other forest communities;
- This region has a higher wildfire risk than other regions of Michigan: Migration may be more difficult for species due to greater potential for increased fragmentation; forest communities may be at greater risk for structural and functional changes, including conversion to barrens or grasslands; many existing forest communities are already adapted to wildfire; and
- This region is more isolated and may have less exposure to species invasions and new migrants than other regions of Michigan: Fewer additional stresses from new invasive species and competition from new migrants may help make forest communities less vulnerable to climatic changes.

Summaries of 'Winners' and 'Losers'

The Michigan Forest Ecosystem Vulnerability Assessment and Synthesis (Handler et al., In Press) used the Tree Atlas and LANDIS-II models to predict future trends in tree species for the eastern Upper Peninsula. Detailed information about the models, differences between the models and model results are available in the publication. 'Declining' or 'increasing' refers to the overall general existence of the species in Michigan forests and may include spatial changes in suitable habitat availability, productivity and general health of the species or some combination of these outcomes.

RESULTS CONSISTENT BETWEEN MODELS		**RESULTS INCONSISTENT BETWEEN MODELS**	
Declining Overall, with Greater Declines Under Higher Emission Scenario		**More Declining than Increasing**	
Balsam fir	Jack pine	Eastern hemlock	Red pine
Balsam poplar	Northern white-cedar	Quaking aspen	Yellow birch
Black ash	Paper birch	Red maple	
Black spruce	White spruce		
Eastern hemlock			
Stable or Increasing Under Lower Emission Scenario, Decreasing Under Higher Emission Scenario		**Really Mixed Results**	
American beech	Eastern white pine	American basswood	Northern pin oak
Bigtooth aspen	Northern red oak	Black oak	Sugar maple
Black cherry	Red maple	Green ash	
Increasing Under Both Emission Scenarios		**More Increasing than Declining**	
American elm	White ash	White oak	

The Michigan Forest Ecosystem Vulnerability Assessment and Synthesis (Handler et al., In Press) used modeling results, literature review and expert opinion to assess potential impacts and ability to adapt to climatic changes for forest

communities eastern Upper Peninsula and develop overall assessments of vulnerability to climate change for those forest communities. Detailed information about the assessment and synthesis process, as well as results, are available in the publication.

Vulnerability	Forest System
High	**Upland spruce-fir**
High-Moderate	**Jack pine (including pine-oak)** **Lowland conifers** **Red pine-white pine**
Moderate	**Aspen-birch** **Lowland-riparian hardwoods** **Northern hardwoods**
Low-Moderate	**Barrens** **Oak associations**

3.3 – Region-wide Forest Resource Base Conditions and Trends

There are 1,064,927 acres of state forest land in the eastern Upper Peninsula, covering more than 25% of the region. It represents 26% of Michigan's 4.09 million acre state forest system. Within the eastern Upper Peninsula there are three state forest management units: Shingleton (380,169 acres), Newberry (352,918 acres) and Sault Ste. Marie (332,285 acres) (Figure 3.1).

Over 75% of the state forest land in the eastern Upper Peninsula is forested (805,073 acres), with 24% (259,854 acres) being non-forested (Table 3.1). The forest is dominated by northern hardwood (11%); aspen (11%), cedar (11%), jack pine (9%) red pine (7%) and lowland conifer (7%) (Table 3.1 and Figure 3.2).

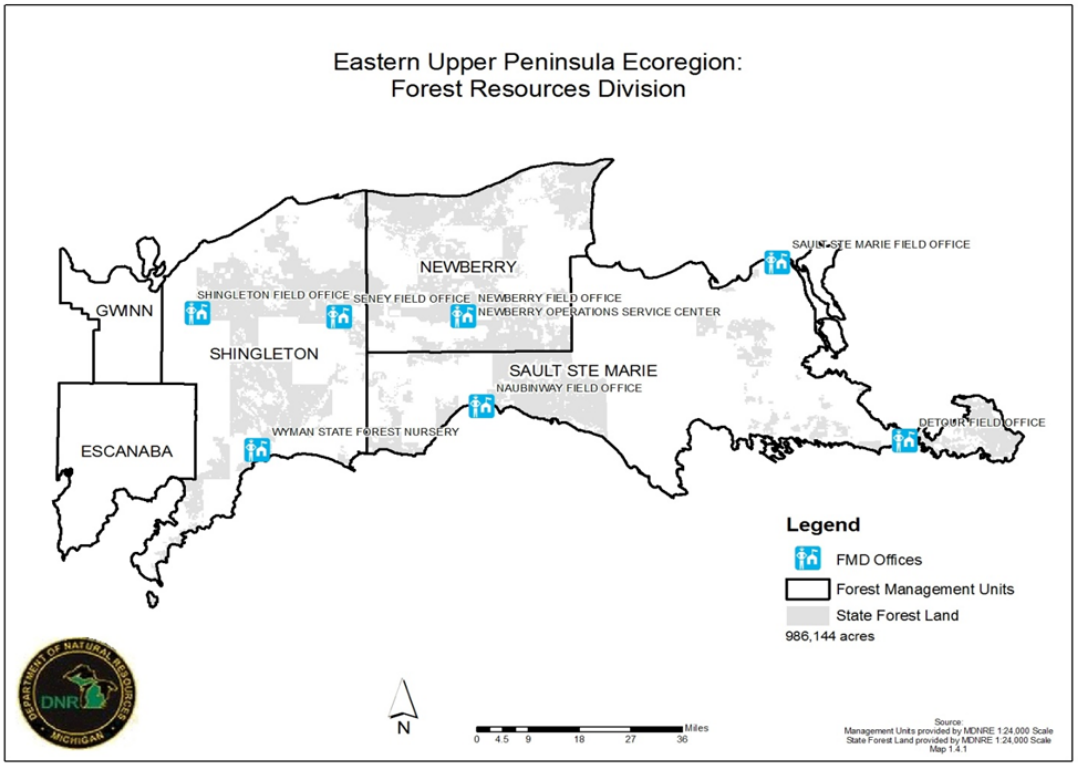

Figure 3.1. Map of the eastern Upper Peninsula ecoregion showing the forest management units and the state forest land.

Table 3.1. Extent of current cover types for the eastern Upper Peninsula ecoregion state forest land (2013 Department of Natural Resources inventory data).

Category/Cover Type	State Forest Land Area (Acres)	Percent of Total Area in Category
Northern Hardwood	123,444	12%
Aspen	117,222	11%
Cedar	112,721	11%
Jack Pine	99,341	9%
Red Pine	76,278	7%
Lowland Conifers	71,264	7%
Lowland Spruce/Fir	37,079	3%
White Pine	30,569	3%
Lowland Deciduous	28,640	3%
Lowland Aspen/Balsam Poplar	16,269	2%
Upland Spruce/Fir	13,861	1%
Upland Conifers	11,043	1%
Upland Mixed Forest	10,843	1%
Paper Birch	10,425	1%
Tamarack	9,580	1%
Natural Mixed Pines	9,523	1%
Lowland Mixed Forest	9,001	1%
Mixed Upland Deciduous	8,952	1%
Hemlock	6,936	1%
Oak	3,690	0%
Planted Mixed Pines	464	0%
Lowland Open/Semi-Open Lands	197,964	19%
Upland Open/Semi-Open Lands	43,040	4%
Misc Other (Water, Local, Urban)	20,807	2%
Total State Forest Area	**1,068,956**	**100%**
Forested Total	**807,145**	**76%**
Non-Forest Total	**261,811**	**24%**

Approximately 522,591 acres (65%) of the state forest land in the eastern Upper Peninsula is productive upland forest cover types and about 284,555 acres (35%) are less-productive lowland forest cover types. These numbers are approximate, as some cover types in the eastern Upper Peninsula are found on both upland and lowland sites. The remaining 261,811 acres (24%) of eastern Upper Peninsula state forest land is non-forested cover types including: non-forested wetlands, upland open lands, water, sand and rock.

The forest is dominated by conifer tree species (46%) and upland site conditions (50%) (Figure 3.3). Deciduous uplands comprise 25% of the forest, upland conifers 25%, lowland conifers 21% and lowland deciduous tree species comprise 5% of the forest land (Figure 3.3).

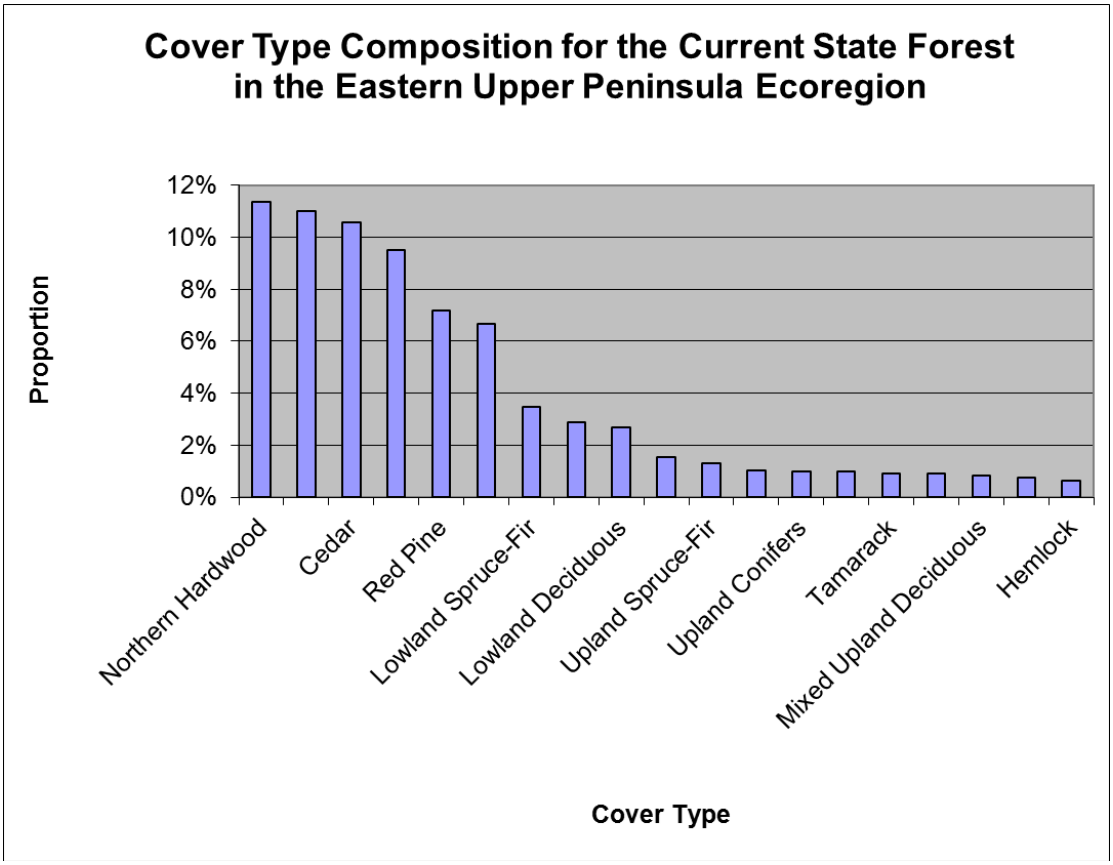

Figure 3.2. Current state forest cover type composition for the eastern Upper Peninsula ecoregion (2013 Department of Natural Resources inventory data).

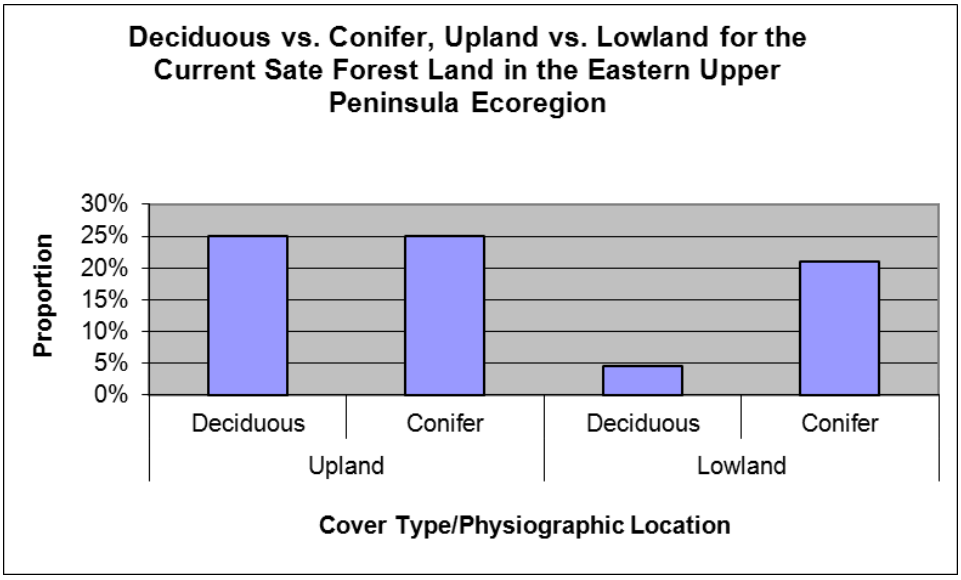

Figure 3.3. Upland and lowland cover types for the current state forest in the eastern Upper Peninsula ecoregion (2013 Department of Natural Resources inventory data).

Approximately 31% of the state forest is made up of late successional forest types, less than a quarter (16%) is in mid-successional forest types and the remainder (29%) is comprised of early successional types (Figure 3.4).

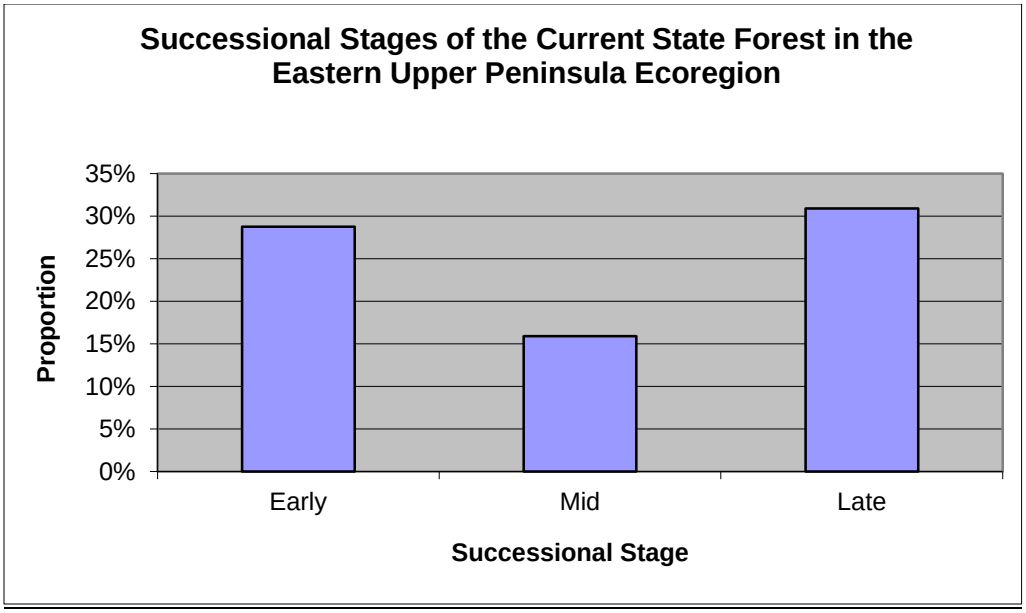

Figure 3.4. Successional stages of the state forest in the eastern Upper Peninsula ecoregion (2013 Department of Natural Resources inventory data).

Northern Hardwood

Northern or upland hardwoods represent the largest forested cover type in the eastern Upper Peninsula (121,046 acres, 11%). They are normally managed under a regulated all-aged/uneven-aged selective harvest system and generally are selectively thinned every 20 years. Basal area is normally used as a selection criterion for managed hardwood forests. Under a well-regulated and managed silvicultural system, basal area will be maintained between 80 and 100 square-feet per acre. Even-aged management of hardwoods may occur on some of the poor-quality sites.

Many of the hardwood stands in the eastern Upper Peninsula were designated for long-term management under the DNR's Forest Development Fund. During the 1970s and 1980s silvicultural treatment of many hardwood stands was deferred due to a lack of labor resources. Additional DNR field staff hired in 1994, combined with increased contract timber marking in the late 1990s, allowed for a greatly expanded harvest of northern hardwoods in the eastern Upper Peninsula. As a result, these hardwood stands will show reduced basal area during upcoming inventory cycles.

Northern hardwoods in the eastern Upper Peninsula have remained relatively stable in acreage, except for some conversion to aspen. Stand quality varies throughout the eastern Upper Peninsula. Hardwood stands along the Mackinaw/Luce County line and in central Alger County are on very productive, high-quality sites. Sandy outwash plains in Alger and Luce counties have hardwood stands of much poorer quality. Hardwoods on state forest land surrounding the Seney Wildlife Refuge are mainly found along the major rivers and drainages and fall within forest riparian management zones and are subject to special management prescriptions.

The major trend that will affect most upland hardwood forests in the eastern Upper Peninsula will be the advancing killing fronts of beech bark disease and emerald ash borer. This will cause an increase in salvage sales in the short term, and may decrease the opportunities to enter some of these stands on the normal 20-year cycle.

The Michigan Forest Ecosystem Vulnerability Assessment and Synthesis (Handler et al., In Press) for the eastern Upper Peninsula summarized potential impacts, vulnerabilities and ability to adapt to projected future climate changes for tree species and forest types. This forest type has diverse tree species and can exist on a range of soil types and landforms, so there are many potential future trajectories, although they may include a different mix of species than is currently characteristic for northern hardwoods. Sugar maple is currently a key tree species in Michigan's northern hardwoods – unfortunately, model results have been mixed for this species and it is difficult to predict any future trends at this time. This species is shade tolerant and has fewer disease and insect pests relative to other species, so it may be able to adapt to climatic changes and continue to persist in many areas where it currently exists. However, sugar maple is also often limited to soils rich in nutrients like calcium, which may limit its future habitat opportunities. Overall, the northern hardwoods type is less adapted to widespread, more frequent disturbance events than others, which could limit its ability

to adapt to climatic changes and resulting impacts. It is intolerant of frequent soil freeze/thaw cycles, which are predicted to increase. It could also potentially lose the ephemeral pond component of the ecosystem. Northern hardwoods may not do as well where it occurs in simplified stands with low species diversity.

Aspen

At 117,273 acres (11%), aspen is the second largest forested cover type in the eastern Upper Peninsula. The type includes both large-tooth and quaking aspen. Approximately 49% of the aspen in the eastern Upper Peninsula is found in the Sault, with 27% in the Shingleton and 24% in the Newberry forest management units.

Traditionally, aspen was a minor cover type in the northern half of the eastern Upper Peninsula. The state forest goal in the late 1980s was to increase aspen for wildlife habitat. Overall a 5,658 acre increase (2%) was achieved from conversion of white birch, upland hardwood, spruce, fir and upland non-stocked cover types. Aspen sites within the northern eastern Upper Peninsula are of poor quality, and the trend will be toward less conversion to aspen in the future. Some of the aspen on the least accessible, poorest sites will be allowed to succeed to other types.

Aspen is the dominant species in the southern half of the eastern Upper Peninsula and has been actively managed for timber production and wildlife habitat. Special wildlife management areas, such as the Strickler management area in Mackinac County and Drummond Island in Chippewa County, have been targeted for mixed-age aspen management. Due to poor aspen markets, a disproportionate amount of aspen in 1988 was in the 50-69 year-old age classes. Market demand increased with the expansion of the pulp mill in Escanaba and the more recently built Louisiana Pacific mill in Newberry, both of which use aspen. Subsequent harvesting has resulted in a large proportion of the current eastern Upper Peninsula aspen cover type to be in the 20-30 year age class. These trees will not be mature for another 20 years. Harvesting of stands younger than the rotation age is being considered in order to start balancing the age classes.

The Michigan Forest Ecosystem Vulnerability Assessment and Synthesis (Handler et al., In Press) for the eastern Upper Peninsula summarized potential impacts, vulnerabilities and ability to adapt to projected future climate changes for tree species and forest types. Both species of aspen (trembling and large-tooth) are predicted to decline, particularly under a higher emission future. Overall, the aspen forest type is adapted to disturbance events and exists on a wide range of sites, which could improve its ability to adapt to climatic changes and resulting impacts. However, it has a low species diversity, which may limit options for future trajectories and reduce its ability to adapt to climatic changes. Drought and forest pests are of significant concern for aspen species – both of which are expected to increase over time.

Cedar

Cedar covers 112,705 acres (11%) and is the third-largest forested cover type on state forest land in the eastern Upper Peninsula. Approximately 54% of the cedar is within the Sault forest management unit; 28% in the Shingleton forest management unit; and 18% in the Newberry Management forest management unit. The cedar cover type on state forest land in the eastern Upper Peninsula has received very few silvicultural treatments over recent years. In some areas where cedar harvesting did occur, the stands have regenerated with a different composition of tree species.

Due to more intensive inventory efforts, many mixed lowland conifer stands have been reclassified as cedar stands. In addition, as markets for aspen increased, the aspen overstory was removed from many stands on Drummond Island and the cedar understory was left following the harvest. This resulted in some stands being reclassified from aspen to cedar stands. On some inaccessible, poor quality, lowland wet sites, the die off of lowland poplar, fir and paper birch has exposed the understory cedar. These stands were also reclassified as cedar during subsequent forest inventory. Also, since 2005 the DNR Natural Resource Commission has emphasized purchasing cedar stands for deer range. All of these factors have contributed to an increase in cedar acreage over the last 20 years.

Many of the cedar stands in the eastern Upper Peninsula are identified as special conservation areas for winter deer yards, and are not managed for timber production. Most cedar stands contain creeks and drainages making logging difficult. In some parts of the eastern Upper Peninsula, cedar regeneration is very difficult, due to low snow depths, and high winter deer population. Limited access, the need for winter deer habitat and difficulty in the regenerating cedar has greatly restricted management activities in this cover type.

As there has been little harvesting of cedar, the age-class distribution of cedar stands in the eastern Upper Peninsula is heavily skewed to older age classes, with most of the stands being over 70 years old.

The Michigan Forest Ecosystem Vulnerability Assessment and Synthesis (Handler et al., In Press) for the eastern Upper Peninsula summarized potential impacts, vulnerabilities and ability to adapt to projected future climate changes. Northern white cedar is a key species in lowland coniferous forests and is predicted to decline under all future emission scenarios. Increases in pests and deer herbivory are of particular concern. The lowland coniferous forest type has a limited tolerance for changes in water table, which may make it more vulnerable to climatic changes. It is also closely associated with sphagnum moss, which will likely be limited by future increases in temperature.

Jack Pine

There are 101,086 acres of jack pine on state forest land in the eastern Upper Peninsula. While it is only 9% of the total forested acreage, it is the largest cover type in the northern half of the ecoregion, particularly in the Deer Park and Danaher Kingston management areas. The Newberry forest management unit has approximately 57%, and the Shingleton forest management unit has 42% of the jack pine acres in the eastern Upper Peninsula.

Even though there are many jack pine plantations, the majority of jack pine stands are of natural origin. Historically, fire played a major role in determining species composition, successional stage, forest structure and configuration. Disease, insects and other pathogens also impact the composition of jack pine communities. With altered natural fire regimes, successful cultivation techniques have replaced fire as the main tool for perpetuating jack pine. While natural regeneration (scarification or prescribed burning) is normally used for jack pine regeneration in the eastern Upper Peninsula, seeding and planting are sometimes used.

Over the eastern Upper Peninsula, jack pine has the most balanced age-class distribution of all cover types because of the stability of the markets and the accessibility of the timber. The 2012 Duck Lake Fire that burned approximately 9,500 acres of jack pine changed the age class distribution, moving these acres into the 0-9 year age class.

The Michigan Forest Ecosystem Vulnerability Assessment and Synthesis (Handler et al., In Press) for the eastern Upper Peninsula summarized potential impacts, vulnerabilities and ability to adapt to projected future climate changes for tree species and forest types. Jack pine is predicted to decline under all future emission climate scenarios. In northern Wisconsin, a decline in abundance is predicted, even though there may be some expansion of spatial distribution (limited by soils). The jack pine forest type has a low species diversity which may limit options for future trajectories and could potentially limit the ability of this forest type to adapt to climatic changes and resulting impacts. However, it is also disturbance adapted and could expand with increased widespread disturbance or it could convert to barrens, if disturbance is too great. Jack pine may face increased competition from hardwoods and greater pest and disease threats and may also be physiologically limited by increased temperatures.

Red Pine

There are 76,475 acres of red pine in the eastern Upper Peninsula. While only occurring on 7% of the eastern Upper Peninsula acreage, it is one of the more commercially valuable timber species. The Shingleton forest management unit has approximately 46% of the red pine acres in the eastern Upper Peninsula, Newberry forest management unit has 34% and the Sault forest management unit has 20%.

In the southern half of the eastern Upper Peninsula most of the red pine is of plantation origin. Many of these stands were planted by the Civilian Conservation Corps in the 1930s. These stands are located on good soil with easy access and have been managed intensively, yielding high-quality products. As these stands are nearing economic maturity, many will be final harvested and re-planted to red pine. Some sites will require prescribed burning to prepare the site before planting.

During the 1950s and 1960s, red pine was planted on state land in the large, stump-field openings that were created after turn of the century logging and subsequent fires. Most of these plantings, north of M-28, had mixed results in terms of success as they were on very dry sites with low site indices. Many of these resulted in poorly stocked stands with short, branchy trees of low market value. The red pine project of 2006-07 resulted in several of these lower quality stands in the Danaher Kingston Outwash management area being final harvested. The sites were then evaluated to determine if they should be replanted to red pine, jack pine or left as wildlife openings. Some red pine plantations were shifted to higher quality sites in different locations, given the objective of no net loss of red pine acreage in the management area.

Along Lake Superior in Luce County, red pine acreage has increased due to the cutting of mixed jack and red pine stands that were previously classified as jack pine. Decadent jack pine was removed from these mixed stands and the residual cover type classification was changed to red pine. Natural regeneration in these stands after logging is often a mix of jack, red and white pine; therefore, the cover type may change again in the future.

Natural red pine stands throughout the eastern Upper Peninsula are normally regenerated using shelterwood and seed tree harvests to promote natural reproduction. Many natural red pine stands are mixed with white pine and shelterwood harvesting results in mixed red and white pine regeneration. Red pine displays inconsistent seed production, with a good crop occurring only every 7-10 years. It has been demonstrated that prescribed burning and scarification can help with natural regeneration of red pine. Where natural regeneration does not occur, natural red pine stands are regenerated through planting.

The Michigan Forest Ecosystem Vulnerability Assessment and Synthesis (Handler et al., In Press) for the eastern Upper Peninsula summarized potential impacts, vulnerabilities and ability to adapt to projected future climate changes for tree species and forest types. Red pine is predicted to decline under all future climate scenarios and may be physiologically limited by increased temperatures. Of particular concern are pest and disease threats, as well as novel interactions between stresses. The red pine-white pine forest type has a low species diversity which may limit future trajectories.

However, it is adapted to drought and disturbance, which may increase its ability to adapt to climatic changes. This forest type is wildfire adapted and could expand with increased occurrence of wildfire or it could convert to barrens with too much wildfire. Dependence on planting for regeneration of red pine could be a limiting factor, as planting and regeneration success may be highly affected by a predicted shift to wetter springs and drier summers.

Lowland Conifers

Lowland conifer stands are found on 71,105 acres making up 7% of state forest land in the eastern Upper Peninsula. Approximately 46% of the lowland conifer stands are in the Newberry forest management unit, with 29% in the Shingleton forest management unit and 25% in the Sault forest management unit.

Tree species commonly found in this type include balsam fir, black spruce, tamarack, birch and red maple. Cedar is frequently a component of these stands and also occurs as separate stands closely associated with lowland conifer types (See above for more information regarding cedar).

Lowland conifer stands across the eastern Upper Peninsula are challenging to manage. They are frequently too wet to harvest except when frozen during the coldest part of winter. Many of these stands are not accessible by roads, contain seeps and streams or are isolated by wetlands. On poor sites, lowland conifers often don't reach marketable size until they are 80-100 years old.

Lowland conifers stands in the southern part of the eastern Upper Peninsula are often on shallow limestone soils. These stands are prone to drought, windthrow and other disturbances such as spruce budworm. These disturbances can reduce the volumes to levels that are not marketable.

Many of the lowland conifer stands are affected by "limiting factors." Limiting factors are site-specific constraints that restrict the opportunities to harvest stands that would otherwise meet silvicultural criteria for harvest. In most cases, the factors include one or more of the following: excessive soil moisture, accessibility and watershed or wildlife management concerns. Because of these factors, very little management has occurred within the lowland conifer cover type. As most of the lowland conifer stands in the eastern Upper Peninsula are at or near rotation age, it will be necessary to work around these limiting factors to harvest these stands and diversify the age classes of this cover type, while continuing to provide adequate habitat for wildlife species that use this cover type.

Lowland Open/Semi-Open Lands

Lowland open/semi-open lands occur on 198,274 acres (19%) of all state forest land in the eastern Upper Peninsula. This is the largest cover type in the eastern Upper Peninsula; including both forested and non-forested types. This category includes bogs, treed bogs, marshes and lowland shrub thickets. Approximately 40% of these wetland cover types are in the Shingleton forest management unit 39% in the Newberry forest management unit and 21% in the Sault forest management unit.

In general, these non-forested lowland types are associated with major streams and watercourses. Little or no management occurs in the non-forested lowland types. All categories of non-forested lowlands contribute to the functional diversity and ecosystem services of the eastern Upper Peninsula watersheds and provide habitat for numerous types of wildlife.

Restrictions on Timber Harvesting

Any discussion of forest cover types and the availability of timber for harvest must consider that basis of forest land that is actually suitable for timber production. There are five categories of state forest acres which are mostly unavailable for timber harvests:

- Forest land that is leased to other governmental agencies or private corporations for other uses;
- Non-forested lands (bogs, grasslands, sand dunes, water, etc.);
- Forest land that is withdrawn from timber production (with a legal basis) for ecological purposed (high conservation value areas and ecological reference areas);
- Forest land that is not physically suited for timber production (many lowland forests and physically inaccessible lands); and
- Forest land that is not appropriate for timber production (administratively removed lands that are used for other purposes, such as roads and campgrounds).

These categories can overlap on any given acre of the state forest, so this analysis accounts for overlap to provide an accurate estimate of forest land that is suitable for timber production. This analysis also accounts for many factors that constrain or limit the prescription of stands that meet a silvicultural criterion and are otherwise ready for harvest. Treatment limiting factors are used to record constraints on the availability of a stand for harvest, reasons that harvest cannot occur. There currently are five categories of limiting factors (Appendix C): (1) Administrative and legal factors; (2) Accessibility factors; (3) Special management or use designation; (4) Markets and industrial factors; and (5) Technological/ecological factors.

The accounting framework for a current estimate of state forest land that is suitable for timber production starts with the approximately 1,073,000 acres of state forest in the eastern Upper Peninsula ecoregion (Table 3.2). Of this total there are 6,531 acres that are leased to Luce County or for mineral production. An additional 268,532 acres are non-forested, which include rock, water, marshes, grass and brush lands. These lands provide wildlife habitat and are important recreational and biological components of the landscape, but they are not part of a working timber base. After accounting for leased and non-forested lands, the estimate of actual forest land in the eastern Upper Peninsula ecoregion is about 798,000 acres (Table 3.2).

Lands that are withdrawn from timber production for ecological purposes (high conservation value areas, and ecological reference areas) total 26,241 acres of state forest in the eastern Upper Peninsula ecoregion. Lands which are not physically suited for timber production (due to wetness, with water quality concerns, physical inaccessibility or steep slopes) total 25,364 acres. After accounting for these two categories, there are an estimated 746,000 acres of state forest land that is tentatively suitable for timber production (Table 3.2).

There are 35,676 acres of lands that have been administratively removed from timber production for other purposes and uses (including recreational uses, non-dedicated natural areas, Type 1 and 2 old growth, deer winter habitat and forest roads). Accounting for these areas yields an estimated 710,000 acres of state forest land that is suitable for timber production in the eastern Upper Peninsula ecoregion (Table 3.2).

This analysis does not account for temporary treatment limiting factors that can also constrain or limit the prescription of stands that meet a silvicultural criterion and are otherwise ready for harvest. Stands with temporary limiting factors will be harvested once the factors have been satisfied (longer rotation age) or are eliminated (need for a bridge).

Table 3.2 State forest lands suitable for timber production for the eastern Upper Peninsula ecoregion (2013 Department of Natural Resources inventory data).

Major Categories	Acres [1]	Acres	Definitions
		1,072,817	**Total DNR State Forest Land**
Leased Lands	-6,531		This category includes lands that are leased to the Department of Military Affairs, Luce County, and to corporations for mineral, oil and gas extraction facilities.
Non-forest Land	-268,532		This category is comprised of non-stocked acres: bogs, muskeg, grasslands, rock, lowland and upland brush, marsh, sand dunes, and water.
		797,754	**= Forest Land**
Forest Land Withdrawn from Timber Production	-26,241		This category is comprised of areas that are legally or otherwise dedicated to other uses that preclude timber production: Dedicated Natural Areas, Natural River Buffers, Ecological Reference Areas, Critical Dunes, Designated Critical Habitat (Piping Plover), and Coastal Environmental Areas.
Forest Land not Physically Suited for Timber Production	-25,364		This category is comprised of areas that have site conditions where timber production would cause resource damage to soils, productivity, or watershed conditions: being too steep (Code 2F), too wet (Code 2G), blocked by physical obstacle (Code 2H), Influence Zones (Code 3G), and water quality/BMPs (Code 3J).
		746,149	**= Forest Land Tentatively Suitable for Timber Production**
Forest Land not Appropriate for Timber Production	-35,676		This category is comprised of areas that are administratively removed for other resource values and management uses: Recreation Areas (SF Campgrounds, Motorized Trails, and Scramble Areas), Scenic Values (Code 3D), Proposed and Nominated Natural Areas, Possible and Verified Type 1 and 2 Old Growth Areas, Potential Old Growth (Code 3A), Deer Wintering Areas (Code 3H), TE&SC Species (Code 3B), other wildlife concerns (Code 3L), Archeological Sites (Code 3I), Rare Landforms (Code 3K), Non-Military Easements (Code 3E), Forest Roads, and Other Administrative/Legal Factors (Codes 1A, 1B, 1C, and 1D).
		710,472	**= Forest Land Suitable for Timber Production**

[1] Acres have been adjusted to eliminate duplicate accounting where multiple designations occur for any given area. Absolute acres are higher for any given category.

3.4 Forest Health Conditions and Trends

The eastern Upper Peninsula faces several major forest health concerns. The introduction of non-native plants, insects and diseases are a serious threat to the health and plant species composition of the state's forest ecosystems, although population cycles of endemic, native insects also cause periodic disturbance and can have a significant impact at a localized level.

Native insects and diseases periodically kill weakened and/or older trees. While outbreaks of some native insects and diseases periodically cause unacceptable growth loss and tree mortality, they also contribute to the process of forest regeneration, growth and renewal. Areas with large outbreaks, anticipated or ongoing, often have timber harvest operations to salvage the usable fiber.

Unlike native insects and diseases, non-native species have not evolved with and are not integral parts of our forest ecosystems. These organisms cause new and sometimes devastating effects that disrupt natural functions and processes and have major consequences on the vegetative composition, structure, productivity and health of native forests.

Due to a continually emerging global economy, there is an ever-present threat of the introduction of new non-native invasive plants, insects and diseases. Recently introduced non-native species include the emerald ash borer, beech bark disease and the hemlock woolly adelgid. Introduced pests pose a major threat to U.S. forests, as well as those in Michigan. Some of these pests are transported inadvertently by movement of firewood, wood products and nursery stock. Quarantines and other types of restrictions try to curb the movement and introduction into other parts of the state and neighboring states.

The long-term ecological consequences of threats to forest health may not be fully apparent or immediately understood. To address this, Michigan participates in the national Forest Health Monitoring program to evaluate the extent, severity and causes of changes in forest health. There is also ongoing research by various agencies, including the DNR.

A number of forest insects and diseases are present or may threaten forest conditions in the eastern Upper Peninsula ecoregion (Table 3.3), the most significant insects being emerald ash borer, beech bark scale, spruce budworm, jack pine budworm, red-headed pine sawfly, eastern larch beetle, larch casebearer, hemlock looper and hemlock woolly adelgid. All of these pests are present in Michigan now although the hemlock woolly adelgid has only been found and eradicated in a few very isolated spots on ornamental trees in the Lower Peninsula. The forest pests present by management area in eastern Upper Peninsula ecoregion are shown in Table 3.4. The most commonly found pests are beech bark disease, oak wilt, *Hypoxylon* canker, white trunk rot of aspen, *Scleroderris* canker of pine, white pine blister rust and *Armillaria* root rot. There are two management areas with 10 forest health concerns, (Hiawatha Moraine and Seney Manistique Swamp management areas), four with nine and three with eight. All of these pests pose a threat to the sustainable use of our forest resources. As such, their presence needs to be recorded, and when detected, appropriate management responses formulated.

Table 3.3. Forest pests, host species, origin, threat severity, incidence and trends for the eastern Upper Peninsula ecoregion.

Pest	**Host Species**	**Origin**	**Severity of Threat**	**Incidence in EUP**	**Trend**
Emerald Ash Borer	Ash	Non-Native	High/Extreme	Moderate, Extensive	Increasing
Beech Bark Disease	Beech	Non-Native	High/Extreme	High, Extensive	Increasing
Hypoxylon Canker	Aspen	Native	Medium	High, Extensive	Stable
White Trunk Rot	Aspen	Native	Medium	High, Extensive	Stable
Oak Wilt	Oak	Non-Native	High/Extreme	Low	Increasing
Eastern Larch Beetle	Larch, Tamarack	Native	Medium	Low	Stable
Larch Casebearer	Larch, Tamarack	Native	Low	High	Stable
Pine Engraver	White, Red, and Jack Pine	Native	Low	Moderate	Stable
White Pine Blister Rust	White Pine	Non-Native	Medium	Moderate	Stable
Jack Pine Budworm	Jack Pine	Native	Medium	Medium	Stable
Spruce Budworm	Balsam Fir, White Spruce	Native	Medium	Medium	Periodic
Scleroderris Canker	Red and Jack Pine	Native	Low	Low	Stable
White Grub	Red and Jack Pine Seedlings	Native	Medium	Low	Periodic
Hemlock Looper	Eastern Hemlock	Native	Medium	Low	Periodic

Table 3.4. Forest pests present by management area for the eastern Upper Peninsula ecoregion.

Management Area		Forest Pest Occurrence Within a Management Area														
		Emerald Ash Borer	Beech Bark Disease	Hypoxylon Canker	White Trunk Rot	Oak Wilt	Eastern Larch Beetle	Larch Casebearer	Pine Engraver	Red-Headed Pine Sawfly	White Pine Blister Rust	Jack Pine Budworm	Spruce Budworm	Scleroderris Canker	White Grubs	Total
MA-1	8 Mile Corner		X	X	X		X	X	X		X		X			8
MA-2	Battydoe Deer Yard		X	X	X		X	X					X			6
MA-3	Bullock Ranch								X			X		X		3
MA-4	Carp River		X	X	X				X	X						5
MA-5	Charcoal Grade	X	X	X	X		X	X					X			7
MA-6	County Line Hardwoods		X	X	X		X	X	X				X			7
MA-7	Cusino Complex		X	X	X		X	X					X			6
MA-8	Danaher Kingston Outwash								X	X		X		X	X	5
MA-9	Deer Park		X	X	X				X	X	X	X			X	8
MA-10	Drummond Island		X	X	X		X	X					X			6
MA-11	Fox River Complex		X	X	X				X	X				X		6
MA-12	Garden Thompson Plains	X	X	X	X		X	X	X	X			X			9
MA-13	Gogomain	X	X				X	X					X			5
MA-14	Summer Islands		X													1
MA-15	Hiawatha Moraine		X	X	X		X	X	X	X	X	X	X			10
MA-16	Huron Patterned Outcrop		X	X	X		X	X					X			6
MA-17	Kincheloe Highlands		X	X	X	X			X	X						6
MA-18	Kinross Bog			X	X		X	X					X			5
MA-19	Lake Michigan Shoreline		X	X	X								X			4
MA-20	Mackinac Mix	X	X	X	X		X	X	X	X			X			9
MA-21	Maxton Plains	X	X	X	X		X	X					X			7
MA-22	Milakokia Lake	X	X	X	X		X	X					X			7
MA-23	Munuscong Bay															0
MA-24	North Rudyard	X	X	X	X											4
MA-25	Pictured Rocks Buffer		X						X		X	X		X	X	6
MA-26	Sage Truck Trail		X	X	X		X	X					X			6
MA-27	Seney Manistique Swamp		X	X	X		X	X	X	X		X	X	X		10
MA-28	Strickler Aspen		X	X	X		X	X	X	X			X	X		9
MA-29	Tahquamenon River Basin Wetlands	X		X	X		X	X					X			6
MA-30	Tahquamenon River Patterned Fens						X	X	X			X	X			5
MA-31	Two Hearted Headwaters		X				X	X	X	X		X	X	X	X	9
MA-32	Whaishkey Bay	X		X	X								X			4
MA-33	Whitefish Vermillion Point						X	X	X	X		X	X	X	X	8
	Total	9	25	24	24	1	21	21	17	12	4	9	23	8	5	

Invasive Plant Species

Invasive species are a serious threat to biodiversity and ecosystem function. Invasive species are those that are non-native to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health (National Invasive Species Council, 1999). Invasive species disrupt complex interactions among native species and hence ecosystem functions. Invasive species may displace native species, disrupt critical components of food chains (particularly invertebrates), be unpalatable or toxic, disrupt mutualistic relationships and/or diminish recreational opportunities (Higman and Campbell, 2009).

The potential threat of an invasive species is based on how fast it spreads, how quickly it will displace native vegetation and how difficult it is to control. There are several invasive species that present the highest threat to the state's forest systems that are not yet well established and for which local control and eradication is possible (Table 3.5). Tables 3.5 and 3.6 represent the best of our knowledge about invasive plant species; however, the database is incomplete – occurrences are more widespread than we know. These data can be supplemented by continuing to map the presence of

invasive plant species as part of the compartment review process. This list, in conjunction with an early detection and rapid response system, will be used to help focus and prioritize prevention, monitoring and control activities.

Table 3.6 shows the presence of invasive plant species by management area and buffer zone for the management areas in the eastern Upper Peninsula ecoregion. Glossy buckthorn is the most commonly found invasive plant in the eastern Upper Peninsula management areas with 8 occurrences in four management areas and it also represents the largest threat as there are 32 occurrences in four buffer areas. The Fox River Complex management area has eight occurrences of one invasive species and the County Line Hardwoods management area has six occurrences of three invasive species. Thirty management areas have no occurrences recorded.

Some eradication efforts have started on invasive species. Scots pine (*Pinus sylvestris*) is systematically being removed from state forest lands. Glossy buckthorn (*Rhamnus frangula)* plagues many areas of the state and it is being removed as opportunities occur. Garlic mustard (*Alliaria petiolata*) monitoring, management and eradication projects are gaining momentum in Michigan. Public and private organizations are co-operating in efforts to remove and keep garlic mustard from establishing in new areas of the eastern Upper Peninsula. Purple loosestrife (*Lythrum salicaria*) has been reduced to isolated areas by an introduced exotic leaf beetle (*Galareucella sp*.). There are also several other invasive plants of concern which have been detected. Invasive plant management is a new arena and training sessions for DNR personnel that include plant identification, reporting protocols, and management strategies were conducted and will be repeated periodically.

Table 3.5. Non-established invasive plants for eastern Upper Peninsula ecoregion state forest lands.

Invasive species for the Eastern Upper Peninsula ecoregion.				
Common Name	Scientific Name(s)	Wetland/Riparian	Forest Understory/Edge	Open/Grassland
Black and Pale Swallow-worts	*Cunanchum louiseae, syn. - Vincetaoxicum nigrum and C. rossicum, syn. - V. rossicum*	X	X	X
Common Buckthorn	*Rhamnus cathartica*		X	X
Garlic Mustard	*Alliaria petiolata*	X	X	X
Glossy Buckthorn	*Rhamnus frangula*	X	X	X
Japanese and Giant Knotweeds	*Fallopia japonica and F. sachalinensis*	X	X	X
Japanese Barberry	*Berberis thinbergii*		X	
Leafy Spurge	*Euphorbia esula*			X
Phragmites	*Phragmites australis*	X		
Oriental Bittersweet	*Celastrus orbiculatus*		X	
Narrow-leaf Cat-tail	*Typha angustifolia*	X		
Amur Honeysuckle	*Lonicera maackii*		X	X
Tartarian Honeysuckle	*Lonicera tatarica*		X	X
Spotted Knapweed	*Centaurea stoebe and C. maculosa*			X
Wild Parsnip	*Pastinaca sativa*			X
Reed Canary Grass	*Phalaris arundinacea*	X		
Purple Loosestrife	*Lythrum salicaria*	X		

Table 3.6. Invasive plant species present in management areas and buffers for the eastern Upper Peninsula ecoregion.

		Occurrences of Invasive Species Within the Managagment Area or Five Mile Buffer																					
		Phragmites		Common Buckthorn		Garlic Mustard		Glossy Buckthorn		Japanese/Giant Knotweeds		Leafy Spurge		Spotted Knapweed		Wild Parsnip		Purple Loosestrife		Reed Canary Grass		Totals	
Management Area		MA	Buffer	MA	Buffer	MA	Buffer	MA	Buffer	MA	Buffer	MA	Buffer	MA	Buffer	MA	Buffer	MA	Buffer	MA	Buffer	MA	Buffer
MA-1	8 Mile Corner											0	1									0	1
MA-2	Battydoe Deer Yard					0	4															0	4
MA-3	Bullock Ranch							0	12													0	12
MA-4	Carp River																					0	0
MA-5	Charcoal Grade					0	1															0	1
MA-6	County Line Hardwoods													2	0	2	0	0	1	2	0	6	1
MA-7	Cusino Complex																					0	0
MA-8	Danaher Kingston Outwash											0	1									0	1
MA-9	Deer Park																					0	0
MA-10	Drummond Island																					0	0
MA-11	Fox River Complex							8	4			0	2			0	1	0	1	0	1	8	9
MA-12	Garden Thompson Plains	0	1							0	1											0	2
MA-13	Gogomain											0	2	0	1							0	3
MA-14	Summer Islands																					0	0
MA-15	Hiawatha Moraine																					0	0
MA-16	Huron Patterned Outcrop																					0	0
MA-17	Kincheloe Highlands																					0	0
MA-18	Kinross Bog									0	1	0	2			0	1					0	4
MA-19	Lake Michigan Shoreline					0	2			0	2											0	4
MA-20	Mackinac Mix																					0	0
MA-21	Maxton Plains																					0	0
MA-22	Milakokia Lake					4	0	0	12			0	1					0	1			4	14
MA-23	Munuscong Bay																					0	0
MA-24	North Rudyard																	0	1			0	1
MA-25	Pictured Rocks Buffer																					0	0
MA-26	Sage Truck Trail																					0	0
MA-27	Seney Manistique Swamp							0	4	0	1	0	1									0	6
MA-28	Strickler Aspen																					0	0
MA-29	Tahquamenon River Basin Wetlands											0	1	0	2					0	2	0	5
MA-30	Tahquamenon River Patterned Fens																					0	0
MA-31	Two Hearted Headwaters																					0	0
MA-32	Whaishkey Bay			0	2					0	4					0	1	0	1			0	8
MA-33	Whitefish Vermillion Point					0	1			0	1											0	2
	Total	0	1	0	2	4	8	8	32	0	10	0	11	2	3	2	3	0	5	2	3	18	78

3.5 Featured Wildlife Species

The DNR Wildlife Division has a public trust responsibility for the restoration, conservation, management and enhancement of wildlife and the provisions for the public use of these resources. This responsibility is codified in Public Act 451 of 1994 and reinforced in the division's mission statement and strategic plan. In practice, this responsibility is carried out by: 1) Managing/co-managing state-administered land; 2) Advocating/facilitating wildlife-appropriate management on other lands; and 3) Informing decisions on the regulations that affect the method and manner of take of game species. Goals for land management that affect wildlife distribution and abundance focus on providing sufficient habitat to maintain viable wildlife populations. Additional goals include providing sufficient recreational opportunities for viewing, hunting and trapping. Recognizing that resources are limited and often restricted to types of use, Wildlife Division has employed a featured species approach to prioritize land management actions.

Featured species include highly valued game species, threatened and endangered, species of greatest conservation need and umbrella wildlife species with an identified habitat requirement and for which a practical habitat-related solution exists. Table 3.7 lists the featured wildlife species by management area for the eastern Upper Peninsula ecoregion. This plan addresses those featured species for which state forest provides a significant opportunity to address these habitat conditions. Within the context of ecoregional state forest planning, featured species will:

- Help to identify and focus the discussion regarding current habitat conditions and threats within the eco-region;
- Help to more effectively prioritize and articulate a desired future condition for state forest lands within and across the eco-regions during this planning cycle and into the future; and
- Provide the habitat requirements of the featured species, helping an assemblage of other wildlife species meet their life requisites.

There are approximately 280 wildlife species (200 birds, 52 mammals and 28 reptiles and amphibians) that commonly inhabit the eastern Upper Peninsula. Of these, 23 "featured species" were selected to better focus our limited resources. Featured species were selected using a multi-step process which was informed by U.S. Fish and Wildlife Service Strategic Habitat Conservation (http://www.fws.gov/landscape-conservation/). Species were initially nominated by Wildlife Division staff and vetted through a public review process and through individuals and teams within the Wildlife Division and the department. Habitat guidance for each species was developed by the Wildlife Division staff with species-specific knowledge.

The featured species concept does not preclude the management for other wildlife species within a particular management area, but is an attempt to help prioritize where we are emphasizing habitat management for that species in particular.

For lands purchased with Pittman-Robertson Act or Game and Fish Funds, the primary objective of vegetative management must be for wildlife restoration.

Many existing departmental guidance documents are adequate for addressing wildlife habitat needs. These will be used as appropriate. Where these documents do not adequately provide for the habitat needs of featured species, more specific direction is provided in Section 4. In addition to the featured species guidance included in this plan, numerous Wildlife Division strategic management plans exists (e.g., deer, wolves, elk and bear) that help guide the population management of these species, yet do not provide habitat direction at a finer scale (e.g., management area) or direction on timber management or timber management mitigation for a given species.

Table 3.7. Featured wildlife species by management area for the eastern Upper Peninsula ecoregion.

EUP Management Area	American Bittern	American Marten	American Woodcock	Beaver	Black Bear	Blackburnian Warbler	Eastern Bluebird	Gray Jay	Kirtland's Warbler	Mallard	Moose	Pileated Woodpecker	Piping Plover	Northern Goshawk	Red Crossbill	Red-Shouldered Hawk	Ruffed Grouse	Sharptail Grouse	Snowshoe Hare	Spruce Grouse	Upland Sandpiper	Whitetail Deer	Wild Turkey	Number of Species Selected
MA 1 8 Mile Corner						X						X					X					X		4
MA 2 BattyDoe Deeryard																X	X		X			X		4
MA 3 Bullock Ranch				X				X										X						3
MA 4 Carp River Red Pine						X										X	X		X					4
MA 5 Charcoal Grade		X			X						X						X			X				4
MA 6 County Line Hardwoods					X									X		X	X		X			X		6
MA 7 Cusino Complex		X			X			X			X			X			X					X		6
MA 8 Danaher-Kingston Outwash							X		X						X			X		X	X			6
MA 9 Deer Park		X							X				X		X									4
MA 10 Drummond Island					X									X			X	X	X			X		6
MA 11 Fox River Complex					X									X					X	X		X		5
MA 12 Garden Thompson Plain			X														X					X	X	4
MA 13 Gogomain					X														X			X		3
MA 14 Summer Islands																								0
MA 15 Hiawatha Moraine			X														X	X				X		4
MA 16 Huron Patterned Outcrop												X					X		X			X		4
MA 17 Kincheloe Highlands					X										X		X							3
MA 18 Kinross Bog	X			X	X														X					4
MA 19 Lake Michigan Shoreline													X									X		2
MA 20 Mackinac Mix					X							X					X		X			X		5
MA 21 Maxton Plains					X													X			X			3
MA 22 Milakokia Lake			X			X										X						X		4
MA 23 Munuscong Bay	X		X							X								X				X		4
MA 24 North Rudyard			X													X	X					X		4
MA 25 Pictured Rocks Buffer		X				X						X		X										4
MA 26 Sage Truck Trail		X			X												X		X			X		5
MA 27 Seney Manistique Swamp				X							X						X	X	X			X		5
MA 28 Stickler Aspen			X														X		X			X		4
MA 29 Tahquamenon River Basin Wetlands					X			X											X			X		4
MA 30 Tahquamenon River Patterned Fens					X	X					X				X				X	X				6
MA 31 Two Hearted Headwaters		X			X	X						X												4
MA 32 Waishkey Bay	X							X				X												3
MA 33 Whitefish Point											X		X		X					X				4
Total	**3**	**6**	**6**	**3**	**14**	**6**	**1**	**4**	**2**	**1**	**5**	**6**	**3**	**5**	**5**	**5**	**13**	**6**	**14**	**5**	**2**	**19**	**1**	

Featured Species Summaries

This section contains information on each of the eastern Upper Peninsula featured species including: special listings, conservation history, habitat need, threats, as well as the specific wildlife management issue that will be addressed with this plan. Refer to Section 4 (Desired Future Condition) of this document for specific detail regarding goals and recommended practices for featured species by management areas within the species' priority landscape.

American Bittern

The American bittern is listed as a species of greatest conservation need and a priority species by the Upper Mississippi River and Great Lakes Region Joint Venture. The Breeding Bird Survey has documented an average decline of 5.1% per year between 1966 and 2007 in Michigan, with the loss and degradation of wetlands suitable for nesting being the major factor in these declines. Breeding habitat for bitterns is primarily shallow wetlands with open water in the center and adjacent upland grasslands. Suitable wetlands are between 10 and 450 acres in size, with wetlands greater than 25 acres being used more frequently than smaller wetlands. Protecting and maintaining wetlands and surrounding open grasslands complexes greater than 50 acres in size is particularly important for bitterns.

American bittern is moderately vulnerable to climate change in Michigan and future populations will depend on both climate shifts and forest habitat (Hoving et al., 2013).

American Marten

The American marten was eliminated from much of Michigan in the early 1900s as a result of removal of large tracts of mature conifer forest and unregulated marten harvest. Recovery efforts since that time have been successful in relatively unfragmented landscapes where reintroductions have occurred and restoration of this species in the Upper Peninsula has been successful to allow a sustainable harvest. Mature conifer stands provide the structure sought by marten which are rarely found outside the forest canopy and avoid stands with less than 30% canopy cover. Marten depend on live-tree dens, snags and coarse woody debris for resting and denning sites. Dead and declining trees play an important role in marten reproduction and in the habitat requirements of their prey. The role of coarse woody debris in almost all aspects of marten ecology warrants special consideration of this element in management practices. In addition, marten need corridors between populations in order to maintain population vigor. The American marten has been identified in Michigan as a species of greatest conservation need.

American marten is moderately vulnerable to climate change in Michigan and future populations will depend on both climate shifts and forest habitat (Hoving et al., 2013).

American Woodcock

The American woodcock is a valued game bird with a strong contingent of stakeholders. For example, in 2010, 36,000 hunters spent 213,000 days pursuing American woodcock in Michigan. The American woodcock is listed as both a species of greatest conservation need and a U.S. Fish and Wildlife Service, Upper Mississippi and Great Lakes Region Joint Venture focal species. Michigan is among the top woodcock producing states, but since the late 1960s, woodcock numbers have declined by 2-3% each year. Woodcock populations across time will benefit from a balanced aspen age-class distribution and provision of display, feeding, nesting and brood-rearing habitat via upland brush, opening and poorly stocked stand management.

American woodcock is likely to Increase due to climate change in Michigan and future populations are likely to respond positively to forest habitat management (Hoving et al., 2013).

Beaver

Beaver is a valued furbearer species and in 2010 1,300 trappers spent nearly 30,000 days afield trapping Michigan beaver. Beavers modify their environment, and the progression from pond creation, to senescence, abandonment and eventual re-vegetation in a unique cyclic disturbance regime. Beaver ponds and abandoned pond meadows provide essential conditions for many wildlife species including waterfowl, otters, warblers and woodcock. Beaver activity also promotes the maintenance of diverse wetland and riparian communities. Beavers prefer relatively narrow, low gradient streams of less that 15% slope with emergent vegetation and abundant alder, aspen, birch, maple or willow. Reduction in beaver abundance can result in a decrease in this disturbance regime and a suite of associated wildlife. The beaver population in the eastern Upper Peninsula appears to be healthy and timber management specifically designed to benefit beaver does not appear necessary in most places. Beaver prefer to forage within 100 feet of streams.

The population of beaver is presumed stable due to climate change and large changes positive or negative impacts due to climate change are not expected (Hoving et al., 2013).

Black Bear

The black bear is a highly valued big game species throughout northern Michigan. In 2010, 37,000 hunters applied for 12,000 available bear licenses and hunters spent more than 55,000 days afield hunting. There are at least seven well-established stakeholder groups supporting bear management. In addition, viewing bears is valued by hunters and non-hunters alike. In 2011 the department recommended stabilizing the bear population in the eastern Upper Peninsula at current population levels. Hard mast is critical for bears during the fall months to achieve adequate weight gains before denning. Black bear benefit from small forest clearings and both hard and soft mast.

The population of black bear is presumed stable due to climate change and large changes positive or negative impacts due to climate change are not expected (Hoving et al., 2013).

Blackburnian Warbler

The blackburnian warbler is listed as both a species of greatest conservation need and a Partners in Flight stewardship species. Blackburnian warbler abundance declines when forests become fragmented. Blackburnian warblers build nests almost exclusively in conifers (hemlock, white pine, white spruce, balsam fir or natural stands of red pine) and nest densities increase with increased percentage of conifers and are most abundant in mature forests. Thus, the primary habitat concern is the continuing decline in the percentage of conifers in the region and the continuing decline in the amount of mature conifers. Blackburnian warblers prefer diverse, unfragmented stands of mature forest with a conifer component.

Blackburnian warbler is moderately vulnerable to climate change in Michigan and future populations will depend on both climate shifts and forest habitat (Hoving et al., 2013).

Eastern Bluebird

The eastern bluebird is one of the eastern Upper Peninsula most easily recognized and valued songbirds. Although Michigan's bluebirds have been generally increasing at an average rate of 5.9% per year between 1966 and 2007, bluebird abundance in the eastern Upper Peninsula bluebirds has been declining at an average rate of greater than 1.5 % per year over the same period. Declines are thought to result from changes in land-use practices including open lands reverting back to forest and lack of snags in open lands for nesting.

The population of eastern bluebird is presumed stable due to climate change and large changes positive or negative impacts due to climate change are not expected (Hoving et al., 2013).

Gray Jay

The gray jay is listed as a species of greatest conservation need and this species is at the southern edge of its range in the Upper Peninsula where it is considered an uncommon to common local resident of conifer dominated habitats, particularly those containing spruce. Evidence suggests that abundance is declining at the southern edge of their range (including the Upper Peninsula), possibly in response to climate change and the resulting degradation of the perishable food stores used for late-winter nesting. Winter habitat needs (especially old black spruce) may be critical to persistence of local populations. Gray jays also serve as an umbrella species for other wildlife using boreal forest cover types (e.g., white spruce, balsam fir, tamarack, white cedar, paper birch and aspen). Gray jays benefit from older age classes of boreal forest and retention of spruce and fir and scattered individual trees for food caching.

The population of gray jay is presumed stable (elsewhere) due to climate change, but the population is likely to shift out of Michigan. Future populations of gray jay are more likely to respond to climate trends rather than forest habitat management (Hoving et al., 2013).

Kirtland's Warbler

Kirtland's warbler, the rarest neotropical migrant in North America, is a federal and state listed endangered species, a species of greatest conservation need and a Joint Venture land bird species. It is considered a conservation-reliant species meaning that managing jack pine in large patches with relatively high stem densities is necessary to sustain a viable population. Since the early 1990s, Kirtland's warbler has been found in suitable Upper Peninsula jack pine habitat as the species expands beyond the core northern Lower Peninsula range. Primary or core nesting habitat may expand

and or shift northward as a result of future climate change especially with the provision of suitable habitat (e.g., large blocks of 300-500 acres with appropriate structural and compositional diversity).

Kirtland's warbler is likely to increase due to climate change in Michigan and future populations are likely to respond positively to forest habitat management (Hoving et al., 2013).

Mallard

Mallards are a highly valued game species in Michigan and represent approximately 47% of the state's annual duck harvest. There has been a long-term decline in the estimated number of Michigan's breeding mallards; down from 567,000 in 1998 to 259,000 in 2009. The loss or degradation of Michigan's emergent wetlands is the primary habitat concern. The goal is to maintain 420,000 breeding mallards in Michigan, when Great Lakes water levels are near their long-term average. Protection of existing wetland types used by mallards and maintenance of wildlife management areas with suitable habitat are priority issues for Wildlife Division.

The population of mallard is presumed stable due to climate change and large changes positive or negative impacts due to climate change are not expected (Hoving et al., 2013).

Moose

Moose are highly valued by Michigan's citizens, wildlife enthusiasts and hunters. Recently the legislature passed a bill to allow moose hunting in Michigan, yet at the time this was written, the Natural Resource Commission has not taken action to implement a season. The eastern Upper Peninsula moose population continues to grow at a slow rate. The reasons for the slow population growth are unclear and may be related to habitat limitations and increasing temperatures making the animals less fit. Moose in the Upper Peninsula are at the southern edge of their range, are easily heat stressed and climate change projections suggest conditions in Michigan may be unsuitable for moose by the end of this century.

The two most important habitat issues for moose in the eastern Upper Peninsula are adequate supplies of mesic conifer (thermal cover) and balanced age-class distribution of aspen (forage). Moose require wetlands, particularly those interspersed with forested uplands, to provide submerged aquatic plants and to stay cool in the summer months; mesic conifers, hemlock being most important (including white pine, spruce and hemlock) to provide shelter in winter and shade in summer; and early successional aspen and birch stands for forage. Willow is an important browse species, as are submergent and emergent aquatic vegetation associated with summer feeding areas. Buffers along riparian and wetland edges would help to protect this food source.

Moose is highly vulnerable to climate change in Michigan. The long-term sustainability moose will depend on more on climate shifts than on forest habitat (Hoving et al., 2013).

Northern Goshawk

The northern goshawk is a U.S. Forest Service regional forest sensitive species, a species of greatest conservation need and is impacted by alteration of forest structure required for both nesting and post-fledging use. These same alterations also influence the abundance and vulnerability of northern goshawk prey species and can enhance populations of goshawk predators and competitors. Some forest treatments have resulted in reduced proportions of mature upland hardwoods that contain large diameter trees, standing dead and down trees, cull trees, multiple vegetation layers and high tree species diversity, including conifers. A goshawk will occupy a nesting area for 1-8 years, with an average of 3.8 years.

In addition to following the *Interim Management Guidance for Red-Shouldered Hawks and Northern Goshawk on State Forest Lands*, goshawk benefit from: large (300-600 acre) blocks of unfragmented mature hardwood or mixed forest (single or multiple stands in close proximity), large populations of snowshoe hare, ruffed grouse and other small prey that are dependent upon coarse woody debris. In addition, aspen stands in the 60-70 year-old age category with large diameter trees (>18 inches in diameter at breast height) trees for nesting especially multi-crotched trees high in the canopy are important habitat features for northern goshawk.

The population of northern goshawk is presumed stable (elsewhere) due to climate change, but the population is likely to shift out of Michigan. Future populations of northern goshawk are more likely to respond to climate trends rather than forest habitat management (Hoving et al., 2013).

Pileated Woodpecker

The pileated woodpecker creates large cavities for nesting. They do not reuse nest sites, so the cavities become available for other cavity-dependent animals which cannot excavate their own cavities (secondary cavity nesters). There is strong competition both within and between species of secondary cavity nesters for the limited supply of pileated woodpecker nests, including wood duck, common goldeneye, bufflehead, hooded merganser, common merganser, merlin, kestrel, screech-owl, saw-wet owl, barred owl, fisher and American marten. Only large-diameter trees have sufficient girth for nest and roost cavities. Thus, there is concern for populations of this woodpecker and species dependent upon it when late-successional forests are converted to younger habitat conditions or not allowed to mature. Mature forest including large diameter living and dead standing trees (for cavities) are important habitat requirements for this species.

The population of pileated woodpecker is presumed stable due to climate change and large changes positive or negative impacts due to climate change are not expected (Hoving et al., 2013).

Piping Plover

Piping plover is a state and federally listed endangered species that nest and forage in open, sparsely vegetated sandy coastal habitats. The U.S. Fish and Wildlife Service has designated critical habitat for this species along portions of eastern Upper Peninsula Great Lakes shorelines. Plovers use both the beach and fore-dune areas and wetlands between the dunes. These areas have significant biodiversity value and provide habitat for many species of Great Lakes endemic and rare plants such as Houghton's goldenrod, Pitcher's thistle, Lake Huron tansy and the rare insect the Lake Huron locust. Other species of note sharing the beach with piping plover include Caspian terns, spotted sandpiper, bald eagle and numerous migrating shorebirds and waterfowl. The protection of shoreline areas and enforcement of off-road vehicle laws is critical to maintain piping plover habitat.

Piping plover is moderately vulnerable to climate change in Michigan and future populations of will depend on both climate shifts and forest habitat (Hoving et al., 2013).

Red Crossbill

The red crossbill is a species of greatest conservation need and has a nearly exclusive diet of conifer seeds which influences its seasonal distribution and habitat selection. Red crossbills are an umbrella species for other species dependent upon mature hemlock, white spruce and red and white pine forests. Declines in red crossbills have been associated with declines in the availability of conifer seeds (Table 3.8); mostly a result of decreases in conifer across the landscape and a shortening of rotation periods for remaining conifer stands relative to when seed is produced and the mean pathological age (Table 3.8)(Benkman,1993). This species is closely associated with conifer forests throughout the year. In Michigan, savannah-like stands of mature red pine are preferred cover types (Evers, 2011). The provision of older age classes of conifer cover types in appropriate cover types and stands within select landscapes is necessary to meet red crossbill life requisites.

The population of red crossbill is presumed stable due to climate change and large changes positive or negative impacts due to climate change are not expected (Hoving et al., 2013).

Table 3.8. Comparison of Department of Natural Resources suggested rotations ages with mean pathological age, maximum known age, and minimum seed bearing age (Bonner and Karrfalt, 2008).

	Minimum seed bearing age	DNR 'Generic Silvicultural Criteria'	Mean Pathological Age	Maximum Known Age
Eastern Hemlock	20-30 years	150	400	988
Red Pine	20-25 years	80	150	360
White Pine	5-10 years	100	160	460
White Spruce	30 years	54	160	637

Red-shouldered Hawk

The red-shouldered hawk is a U.S. Forest Service regional forest sensitive species, a state-threatened species and a species of greatest conservation need. Additionally, it is a U.S. Fish and Wildlife Service, Region 3, conservation priority as a rare/declining species. In the early 1900s, red-shouldered hawk numbers decreased along with declines in mature lowland deciduous forests habitat. Although Michigan red-shouldered hawk populations are currently believed to be

stable, they are sensitive to decreases in suitable forest cover and preferred nest trees and increased forest fragmentation. Goshawks prefer hardwood forest stands greater than 385 acres in size with some large (18-25 inches in diameter at breast height) diameter trees.

The population of red-shouldered hawk is presumed stable due to climate change and large changes positive or negative impacts due to climate change are not expected (Hoving et al., 2013).

Ruffed grouse

The ruffed grouse is an important game bird in Michigan with approximately 85,000 hunters spending 616,000 days hunting grouse in 2010. Michigan and the eastern Upper Peninsula are both nationally recognized for grouse production and hunting opportunity. Compared to other ecoregions, the eastern Upper Peninsula state forest contains lower proportions of aspen cover types than any other ecoregion. Although ruffed grouse use many different cover types, aspen support the highest densities of grouse. Optimum habitat includes young (6-15 year old), even-aged deciduous stands that typically support 8-10,000 woody stems per acre. A balanced aspen age-class distribution and provision of soft browse should provide long-term sustainable ruffed grouse populations.

The population of ruffed grouse is presumed stable (elsewhere) due to climate change, but the population is likely to shift out of Michigan. Future populations of ruffed grouse are more likely to respond to climate trends rather than forest habitat management (Hoving et al., 2013).

Sharp-tailed Grouse

Sharp-tailed grouse historically were widely distributed in the Upper Peninsula and Northern Lower Peninsula during the 1950s, but their range has since declined, primarily due to changes in openland cover types. The sharp-tailed grouse is listed as a species of greatest conservation need. There is a desire for increased recreational opportunities associated with hunting and viewing and a limited hunting season was reopened in 2010 in the eastern Upper Peninsula after being closed since 1997. Strong local partnerships exist for this species and guidelines for managing large opening complexes in the eastern Upper Peninsula have been developed by a multi-agency workgroup. Distribution and abundance of sharp-tailed grouse is tied to their habitat needs including relatively large blocks of herbaceous openlands, including upland herbaceous openings, sedge meadows, other herbaceous wetland types and upland pine barrens.

The population of sharp-tailed grouse is presumed stable (elsewhere) due to climate change, but the population is likely to shift out of Michigan. Future populations of sharp-tailed grouse are more likely to respond to climate trends rather than forest habitat management (Hoving et al., 2013).

Snowshoe Hare

The snowshoe hare is a valued game species in across the northern part of the state and during 2010, 15,000 hunters spent about 103,000 days in the field hunting this species. Snowshoe hare are an important prey species for many eastern Upper Peninsula furbearers including pine marten, fisher, bobcat and other medium size carnivores. Today there is a low relative abundance of hare throughout the southern extent of its range which includes northern lower and upper Michigan. Declines likely result from a reduction in habitat quality (young forest with regenerating mesic conifer); however, climate change may also play a role. Hare populations do best in areas of dense, young forest and shrub communities; alder and coniferous swamps are preferred. Dense understory cover is the primary limiting factor; escape and thermal cover is more important than food availability. Priority habitat needs include maintaining early successional forest (jack pine, mixed swamp conifer, tag alder and aspen), especially in areas adjacent to lowlands, promotion of retaining and restoring the mesic conifer component within stands, and maintenance or enhancement of leaving coarse woody debris following harvest.

Snowshoe hare is highly vulnerable to climate change in Michigan. The long-term sustainability of snowshoe hare will depend on more on climate shifts than on forest habitat (Hoving et al., 2013).

Spruce Grouse

Spruce grouse is a U.S. Forest Service regional forest sensitive species, a species of greatest conservation need and a permanent resident that provides recreation for birdwatchers and photographers throughout the year. This species is characteristic of mature stands of short-needled conifers (e.g., jack pine, black and white spruce and tamarack) interspersed with small openings. Ideal habitat in Michigan occurs where black spruce and jack pine mix with scattered small openings amongst decaying logs and stumps. Since this bird does not disperse long distances, forest treatments that create large open clear-cuts and subsequent single species plantations (e.g., red/ jack pine plantations with little

understory) reduces populations locally and often eliminates them entirely. Populations appear to fluctuate over time, primarily in response to the degree of maturation of post fire regrowth and secondarily to predation pressure. Management in the eastern Upper Peninsula will focus on early successional forest (jack pine, mixed swamp conifer, tag alder and aspen), maintaining adequate coarse woody debris and encouraging conifer (e.g., jack pine and mixed swamp conifer) understory component.

Spruce grouse is moderately vulnerable to climate change in Michigan and future populations will depend on both climate shifts and forest habitat (Hoving et al., 2013).

Upland Sandpiper

The upland sandpiper is listed as a species of greatest conservation need in Michigan and a U.S. Fish and Wildlife Service, Upper Mississippi and Great Lakes Region Joint Venture focal species. This bird relies on relatively large (greater than 125 acres) contiguous and sparsely vegetated opening complexes. Abundance has declined statewide on average 1.6% per year between 1966 and 2007. These declines are likely the result of forest encroachment on openings, decreases in patch size and decreases in the size of timber harvests and increased fire suppression. Priority habitat issues for this species will focus on maintaining large opening complexes and scheduling jack-pine harvests associated with permanent openings on a sustainable rotation and harvests adjacent to burns or similarly aged jack pine treatments in close proximity to one another.

Upland sandpiper is likely to Increase due to climate change in Michigan and future populations are likely to respond positively to forest habitat management (Hoving et al., 2013).

White-tailed Deer

White-tailed deer are the most highly valued game species in the state and deer hunting contributes significantly to local economies. Deer are a keystone species and can have significant impacts (positive and negative) on vegetative communities. In 2010, 656,500 hunters spent 9.6 million days afield in Michigan hunting deer with the largest number of participants and stakeholder groups of any game species.

In the Upper Peninsula, the strongest limiting factor is overwinter survival, and mortality has exceeded 30% of the population in severe winters. A high proportion of the population (60-90%) migrates from summer range to wintering complexes; most of these areas are conifer-dominated stands with >50% canopy closure, adjacent to hardwood browse. Nutritious spring forage, particularly adjacent to wintering complexes, is critical to recovery from winter stress.

White-tailed deer statewide are not likely to increase or decrease due to climate change. However, the patterns of habitat use by white-tailed deer in northern Michigan are likely to shift as snowfall patterns change. Snowfall is a major driver of deer migratory behavior and their restriction to wintering complexes of mature conifers. Current trends toward more winter precipitation and less lake ice have resulted in significant increases in snowfall over the past 30 years, even as temperatures have increased. Thus, deer wintering complexes of mature conifers remain important. At some point, increasing temperatures will cause more snow to fall as rain, winter severity will decrease and the importance of deer wintering complexes will decrease. When deer become less restricted to wintering complexes, the spatial impact of deer browse will change. The timing of this shift is highly uncertain.

Wild Turkey

The wild turkey is a highly valued game bird. During the 2009 spring season, 120,000 hunters spent 450,000 days afield in Michigan pursuing turkeys. As a result of successful introduction efforts and winter feeding programs over the past half century, turkeys are now present in almost all eastern Upper Peninsula counties, in low numbers. Provision of natural winter food, maintaining and regenerating the oak component within stands, and maintaining brood-rearing openings will improve turkey brood-production and winter survival.

Wild turkey is likely to increase due to climate change in Michigan and future populations of are likely to respond positively to forest habitat management (Hoving et al., 2013).

Summary of Priority Habitat Elements

The priority habitat issues are listed in Table 3.9 by featured species.

As the summaries above indicate, there is a high degree of overlap in the conservation/habitat needs of many of the featured species. These needs can be categorized into broad categories that include:

- Coarse woody debris: Maintain and encourage coarse woody debris in harvested stands for wildlife species dependent upon such conditions.
- Early successional forest: Maintain aspen, balsam poplar, jack pine, upland brush and openings in appropriate locations, and strive to balance aspen acreage. Increase species diversity in harvested stands by retaining a variety of tree species and legacy patches.
- Habitat fragmentation: Provide wildlife movement corridors across the landscape, especially along riparian systems or where habitat fragmentation is a problem. This is the second most common habitat issue shared amongst the selected eastern Upper Peninsula featured species.
- Large open land complexes: Create and maintain large openings and savanna in appropriate areas.
- Large living and dead standing trees: Maintain and encourage large living and dead trees in harvested stands for wildlife species dependent upon such conditions.
- Late successional forest: Provide mature forest for species that require this habitat condition, particularly in areas subject to intensive timber management. This is habitat issue is shared with more eastern Upper Peninsula featured species than any other.
- Mast: Maintain and expand mast-producing species such as red oak, beech and fruit-bearing shrubs, focusing on areas where disease is threatening sustainability of these resources.
- Mesic conifer: Encourage expansion of natural stands of white pine, white spruce, balsam fir and hemlock and components of these species in other forest types. This is the third most common habitat issue shared amongst the selected eastern Upper Peninsula featured species.

Featured Species	Coarse Woody Debris	Early Succes-sional Forest	Habitat Fragmen-tation	Large Oepnland Complexes	Large, Living and Dead Standing	Late Succes-sional Forest	Mast	Mesic Conifer
American Bittern								
American Marten	X		X		X	X		X
American Woodcock		X						
Beaver		X						
Black Bear			X				X	
Blackburnian Warbler			X			X		X
Eastern Bluebird				X				
Gray Jay						X		X
Kirtland's Warbler		X	X					
Mallard								
Moose		X						X
Northern Goshawk	X		X			X		
Pileated Woodpecker					X	X		
Piping Plover								
Red Crossbill						X		X
Red-shouldered Hawk			X			X		
Ruffed Grouse		X					X	
Sharp-tailed Grouse				X				
Snowshoe Hare	X	X						X
Spruce Grouse	X					X		
Upland Sandpiper			X	X				
White-tailed Deer						X		X
Wild Turkey							X	

Table 3.9. Priority wildlife habitat elements for each featured species in the eastern Upper Peninsula ecoregion.

3.6 Water Quality and Fisheries

The majority of Michigan's watersheds were historically forested, and most watersheds in the eastern Upper Peninsula have had relatively low levels of deforestation. The watershed deforestation that did occur has been a result of human development for agriculture, residential and urban use. Watershed scale deforestation in lower Michigan has been shown to affect the hydrology of streams and lakes, changing flow patterns, channel characteristics and various habitat components including water quality (Wang et al., 2008). Fisheries Division studies have found that the level of forest cover shading the stream channel is one of three important factors influencing water temperatures in Michigan streams, the other two being channel morphology and ground water inputs (Wehrly et al., 1998). More current research has suggested a more complex picture suggesting that stream temperatures are influenced by a much broader suite of factors (Wehrly et al., 2006). Regardless, maintaining and restoring riparian forests are important components of maintaining stream temperatures and hence stream biota (Wehrly et al., 1998).

The relationship between the proportion of a watershed that is harvested (temporary deforestation), as part of forest management operations and when stream temperatures begin to rise is complex and has not been well documented. Also, there has been little work in the area of determining resilience – how long is the period of time that it takes for stream temperature to return to normal levels as the harvested forest regenerates, or what is the proportion of the watershed that can be maintained in a deforested state without impacting stream temperature (recognizing that the spatial distribution of temporarily deforested harvest areas move around the landscape). As a result there are no guidelines for use in forest management planning or implementation that relate to the proportion of a watershed that can be harvested without having a negative impact on stream temperature. It is known that stream temperature, stream flow and water quality can be impacted by forest operations within what is called a riparian or riparian management zone adjacent to the stream channel.

Riparian areas of lakes and streams provide critical benefits for aquatic resources, including:

- Protection from sunlight and cold that helps maintain natural water temperatures during winter and summer;
- Maintaining natural cycles of water infiltration and evapotranspiration;
- Natural shoreline vegetation for stabilizing stream banks and lake shorelines against unnatural erosion, critical amphibian and reptile habitat, and provision of terrestrial litter and insects into surface waters for direct food sources and aquatic food webs; and
- Attenuating floods and runoff to help maintain water quality.

The DNR uses riparian cover management guidelines, often referred to a best management practices, as described in IC4011 *Sustainable Soil and Water Quality Management Practices on Forest Land* (DNR and DEQ, 2009) to protect riparian management zones on lakes and streams. The riparian management zone is a strip on each side of perennial or intermittent streams or around the perimeter of water bodies (e.g., open water wetlands, ponds and lakes). The riparian management zone is not a "no cut buffer;" it is a zone where extra precaution will be used in harvesting timber or where such related activities as log landings, road construction, stream crossings or site preparation are not permitted or minimized.

Status and Trends of Inland Streams

Historically, many eastern Upper Peninsula streams have been altered by the effects of logging and road crossings. The removal of timber, the increased erosion (and subsequent deposition of sediments), the use of check dams and the resultant channel changing flow surges, has impacted nearly all rivers in the region. Compared to the Lower Peninsula, most of the area affected by historic logging operations has recovered and additionally, few artificial impoundments exist within the eastern Upper Peninsula. Most dams, however, are located in the areas of highest gradient, impounding the best spawning areas for many species, making them unavailable to migrating fish species. Though dams inhibit reproduction of desirable species, they also limit the range and production of invasive exotic species such as sea lamprey. Streams with good spawning habitat not blocked by dams, such as the Carp, Sucker and Two Hearted, are chemically treated for sea lamprey ammocetes or have had electrical lamprey barriers installed to prevent lamprey from accessing the most suitable spawning habitat.

Dams (including those constructed by beaver) can also affect the temperature and flow of a stream, often to the point of where they impact the downstream aquatic community and stream's ability to sustain an acceptable natural trout population. Dams also affect stream ecology by interrupting the transport of sediments, and large woody material.

DNR Policy and Procedure 39.21-20 – Beaver Management addresses high priority trout streams (Appendix F) where beaver have the potential to cause unacceptable degradation of cold water stream quality.

Trout require clean, cold, well-oxygenated water that flows over gravel in order to spawn successfully. Trout are migratory in terms of spawning behavior and seasonally seek thermal refuge (cold water); thus, they require unobstructed passage to headwater areas. The best trout producing streams have cold summer temperatures with sufficient gravel or cobble for spawning. Generally, waters in the eastern Upper Peninsula support diverse aquatic communities and are commonly found to have good-to-excellent water quality (Wolf and Wuycheck, 2004),

Most streams in the eastern Upper Peninsula are small and are bordered with tag alder. They typically have sand, mud and occasionally gravel substrate. Even so, many small headwater streams draining coarse glacial outwash are cold and relatively stable trout waters. Cold summer temperatures with sufficient gravel or cobble for spawning substrate make those streams good trout producers. Other streams, including the lower sections of some of the better trout streams, provide for coolwater habitat for species such as walleye, smallmouth bass and northern pike.

In contrast, the small streams in the central Manistique River watershed, central Tahquamenon River watershed and much of Chippewa County are located in relatively impervious soils producing unstable flows. Many of the larger river systems such as the Manistique, Tahquamenon, Waishkey and Munuscong are designated cool water systems, providing angling opportunities for walleye, smallmouth bass, yellow perch and northern pike.

Potential Impacts of Climate Change on Aquatic Ecosystems

Given that the impacts on stream temperature from changes in land cover and land use will be of similar or greater magnitude as from increasing air temperature (Wehrly et al., 2006), global warming has the potential for widespread impact on aquatic ecosystems and biota. There may be a shift of some cold water streams to cool water conditions and cool water systems to warm water systems with a corresponding change in biotic communities.

3.7 Socioeconomic Context

Social and economic values associated with Michigan's forests are both rich and complex. Concurrently with the U.S. Department of Agriculture Forest Service, the DNR held a series of 53 focus group meetings in 1996 for the purpose of gaining information about the public's views, visions, and concerns regarding the management of public lands in the northern Lower Peninsula ecoregion. Participants in these meetings identified the following values and uses as being important for the ecoregion (Tessa Systems, LLC 2006):

- Low population, less traffic, and absence of urban characteristics
- Slower, friendlier lifestyle
- Small town environment
- Beauty and solitude of lakes, rivers, and the natural environment
- Nearness to public lands
- Clean air, open spaces, the four seasons, and the pristine environment
- Hunting, fishing, viewing wildlife and other recreational activities
- Raw materials for manufacturing and good transportation networks.

These uses and values are also likely applicable to the eastern Upper Peninsula ecoregion, and state forest lands in the eastern Upper Peninsula contribute to these values and uses by providing a wide variety of uses, including hunting, fishing, gathering, recreation, tourism, timber production, education and research. The economic contribution of state forest land includes employment opportunities and the production of products and values for the benefit of both the rural and urban population of the state. Wood products, forest-based recreation and tourism are the primary elements of the overall forest-based economy, forming a major economic contribution to the eastern Upper Peninsula.

3.7.1 Timber Production

The forest products industry is one of the oldest industries in the eastern Upper Peninsula. While the Upper Peninsula plays a fairly small role in the overall Michigan economy, it is very important for Michigan's forest product industries. Over half of the Upper Peninsula manufacturing jobs are related to the forest products industry.

From the period of 2000-2009 state forest timber sales in the eastern Upper Peninsula ecoregion totaled 114,574 acres, with a total value of almost $64 million. Over the last 15 years, timber harvest acreage from state forest land in the eastern Upper Peninsula has fluctuated (Figure 3.5). Timber revenue peaked in about 2005 then declined significantly, following

the national economic trends of the same time period. Four cover types (aspen, jack pine, red pine and upland hardwoods) account for about 80% of state forest timber sale acres in the eastern Upper Peninsula. Lowland cover types of spruce, mixed conifers, tamarack, lowland aspen, lowland hardwood and cedar make up the most of the rest of the sale acres.

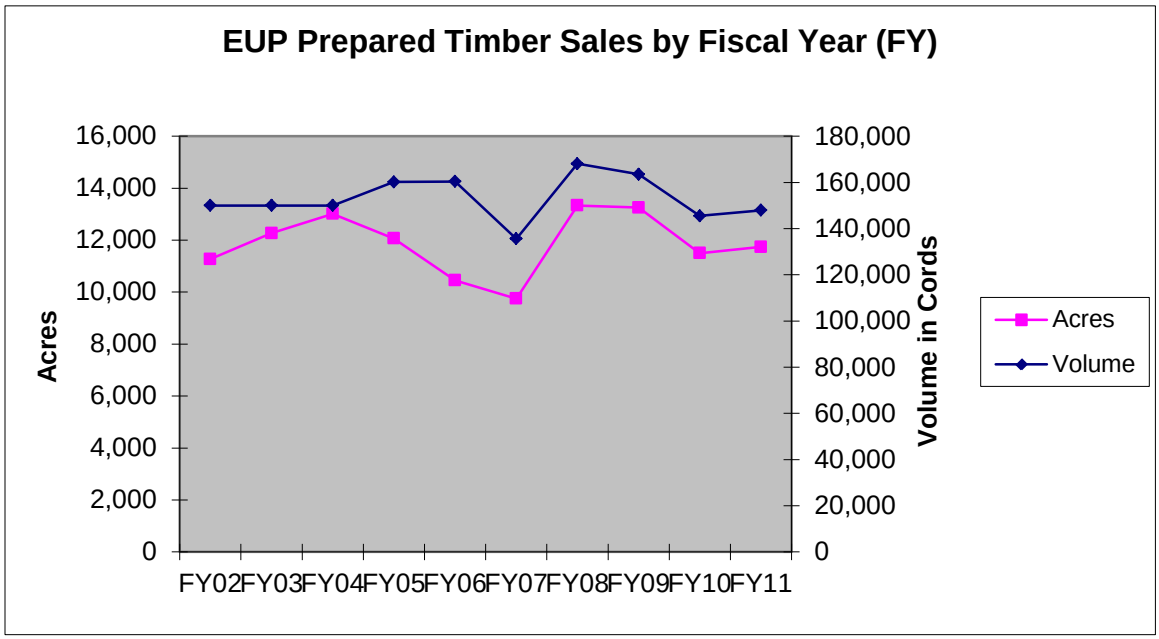

Figure 3.5. Acreage and volume of state forest timber sales in the eastern Upper Peninsula ecoregion (2012 unpublished Department of Natural Resources timber sale data).

Northern hardwoods account for approximately 30% of the state forest timber sales in the eastern Upper Peninsula ecoregion, averaging about 3,700 acres per year over the last 15 years. Sale acres were somewhat higher between 1997 and 2001 as resources became available to mark stands that were prescribed for harvest. Upcoming harvest of upland hardwoods in the eastern Upper Peninsula ecoregion is expected to be slightly lower than average due to the 20-year harvest cycle and the loss of volume to beech bark disease.

Harvest of red pine in the eastern Upper Peninsula ecoregion state forest has averaged about 2,300 acres per year for the last 15 years and is expected to continue on a 2,000+ acre trend. Red pine accounted for 19% of harvests. Jack pine harvests have averaged 2,100 acres per year and are expected to remain relatively stable. Jack pine represented about 18% of the eastern Upper Peninsula state forest timber sales in the last 15 years. Aspen was the fourth largest contributor to eastern Upper Peninsula state forest timber sales, averaging 1,600 acres or 14% of the sales. Aspen sale-acres are expected to remain stable or slightly increase.

Lowland conifers include mixed conifers, spruce, cedar and tamarack. The harvesting of lowland conifers has remained relatively stable over the last 15 years, averaging over 500 acres per year. Acres are expected to increase in upcoming years as more of these stands become merchantable. Lowland conifer cover types often have factors limiting harvest such as lack of legal access, excessive wetness, access impeded by streams or rivers or retention of the stands as deer wintering complexes. Because of these limiting factors, harvesting of lowland conifers is more challenging than harvesting of upland cover types.

3.7.2 Oil, Gas and Mineral Production

There is currently no oil or gas production in the Upper Peninsula While some traces of oil have been encountered in water wells in the eastern Upper Peninsula and in a previously active copper mine in the western Upper Peninsula, oil and gas has not been found in economic quantities despite the drilling of about a dozen test wells.

The eastern Upper Peninsula ecoregion currently has limited metallic mineral potential.

The production of non-metallic minerals from state-owned land continues to be an important source of locally used materials for road and other construction purposes. There are 18 nonmetallic mineral leases for sand and gravel on 1,212 acres of state forest in the eastern Upper Peninsula ecoregion. Expansion beyond these current leases is not expected during this planning period.

3.7.3 Forest Recreation and Tourism

Public lands in Michigan are a very important resource for many types of recreational pursuits. State lands comprise 4.7 million acres of Michigan's total of 36.4 million acres. The state lands thus account for over 13% of Michigan lands. The state of Michigan has the largest landholding, including state forests, state park and recreation areas, state wildlife refuges and state game areas. State forest lands in the eastern Upper Peninsula provide over one million acres of land available for all forms of dispersed recreation. Recreational facilities such as trails and campgrounds on state forest land are now managed by Parks and Recreation Division with support and co-operation from Forest Resources Division staff.

Designated Trails and Natural Beauty/Heritage Routes

There are designated trails on state forest land for snowmobiles, off-road vehicles, all-terrain vehicles, motorcycles, hiking, cross country skiing, mountain biking and horseback riding. There are approximately 206 miles of designated all-terrain vehicles trails (50 inches in width or less), 205 miles of motorcycle only trails, 100 miles of off-road vehicles route (72 inches and wider) and there are 12 non-motorized pathways totaling over 100 miles located on state forest lands in the eastern Upper Peninsula. More than 1,300 miles of snowmobile trails are maintained across all ownerships in the eastern Upper Peninsula. Communities are linked through the trail system to allow riders to enjoy lodging, restaurants and other amenities.

Travel to and from recreational settings has long been recognized as an important part of the recreational experience. Natural beauty roads and heritage routes are identified by the state as a way to identify and preserve transportation routes associated with recreation. The M-123 corridor north of Newberry is a designated scenic heritage route. The Old Seney Road south of Grand Marais has been designated as a natural beauty road. Designated visual management areas on state forest land in the eastern Upper Peninsula include: Cut River Gorge Corridor, Big Knob, the Inland Buffer Zone of Pictured Rocks National Lakeshore, Old Seney Road Natural Beauty Road, M-123 Scenic Heritage Route and Rainey Wildlife Viewing Area.

Campgrounds

Camping continues to be a popular recreational activity across the state especially in the small rustic state forest campground sites. Most are located near lakes or rivers, which is the primary draw for other outdoor recreation pursuits. In the eastern Upper Peninsula, state forest campgrounds accounted for approximately 17,982 camp days in 2011, providing for 27,669 people. As of 2011, there were 39 state forest campgrounds in the eastern Upper Peninsula with 15, 11, and 10 in the Newberry, Shingleton and Sault forest management units, respectively. Currently there are 35 campgrounds with 621 campsites.

Hunting, Fishing, and Trapping

The U.S. Fish and Wildlife Service, in conjunction with the Bureau of Census, conducts a periodic national survey of fishing, hunting and wildlife-related recreation and Michigan-specific reports were developed for the 1996, 2001 and 2006 surveys (U.S. Department of the Interior Fish and Wildlife Service and U.S. Department of Commerce Bureau of the Census, 1998, 2003, 2008). The surveys compiled various types of data on hunter and angler characteristics, participation and expenditures. Over 1.7 million residents and non-residents fished or hunted. Participation in fishing and hunting by Michigan residents declined from 1996 to 2006, while wildlife viewing remained constant. Nevertheless, purchases related to these activities are still a significant revenue source. For 2006, the total expenditures were $1.7 billion for fishing; $916 million for hunting; and $1.6 billion for wildlife watching. It is clear that $4 billion is a significant contribution to Michigan's economy and many of these expenditures are made in northern Michigan.

The DNR's Wildlife Division surveys hunters regarding their effort and success. Overall, though hunter numbers are substantial, the number of paid hunting license holders has declined in recent years (Frawley, 2004). Although there is a downward trend in the number of active firearm deer, small game and waterfowl hunters, the number of turkey hunters and bear hunters has increased significantly in recent years. Overall the number of people hunting deer in Michigan has been on the decline since the late 1990s (Frawley, 2004). Approximately 1.8 million harvest tags were purchased in 2003 compared with 1.6 million in 2009. Statewide, 686,000 deer hunters harvested 444,000 deer in 2009. Of the 10.2 million hunter-days in that year, 260,000 took place in the EUP.

Dispersed Recreation

From the report “The Role of Natural Resources in Community and Regional Economic Stability in the Eastern Upper Peninsula” (Feb. 2007) studies were conducted to examine dispersed recreation activities on forest land in the eastern Upper Peninsula, researchers surveyed two different forest user groups: people who drove to the forest and residents who live adjacent to the public forestland. Picking berries/mushrooms, fishing, deer hunting, grouse/woodcock hunting and other hunting were the top five activities for vehicle-based visitors. The most important activities for adjacent landowners were deer hunting, hiking/walking, snowmobiling, fishing and nature observation.

In the EUP, households were asked to identify their three favorite outdoor activities in which they or some member of the household participated. Most households participated in many outdoor activities including: wildlife viewing (85%); flower gardening (67%); wild berry picking (64%); wildlife feeding (60%); fishing (71%); swimming (66%); boating (65%); hunting (57%); and camping (48%). Skating/sledding (42%); snowmobiling (40%); cross-country skiing (32%); and downhill skiing (14%) were popular winter activities.

3.7.4 Public Research and Education

The Michigan DNR supports a variety of ongoing forestry, wildlife and fisheries research projects that are designed to increase knowledge and to improve methods of sustainable management of Michigan’s public lands. Many of these research projects are accomplished in cooperation with state universities through formal agreements and on an as needed call for proposals for subjects of interest. An example of a formal research agreement is Partnership for Ecosystem Research and Management between Michigan State University and the DNR.

The Michigan DNR’s Forest Certification Work Instruction 5.1, Coordinated Natural Resource Management Research, describes the procedures to report research performed by each division. The research coordinators from each division or bureau must compile a list of research projects, a list of on-line links or contact persons for research projects completed during the previous fiscal year and a summary of internal and external research expenditures during the previous year. This information will be used to prepare an annual research summary to be published by March 1 of each year and for preparation of the Sustainable Forestry Initiative Annual Report. These report summaries can be found on the DNR forest certification website.

Products of research often include educational materials that serve to convey research findings to the public. Since almost 63% of timberland in the state is in private ownership, public education programs are a critical part of encouraging sustainable natural resource management throughout the state. Several examples of educational opportunities offered by the department include: fire prevention programs, hunter safety, off-road vehicle safety education, snowmobile safety education and boating safety courses. In addition, landowner education is facilitated by the DNR’s cooperative forest management specialist. Park Interpreters offer educational and interpretive programs at Tahquamenon State Park, Indian Lake State Park, Brimley State Park and Thompson Fish Hatchery. Programs on fisheries, wildlife and forestry are offered to sportsman’s groups, school districts and other organizations. Public meetings are held on a variety of subjects that pertain to department programs and plans.