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DEPARTMENT OF NATURAL RESOURCES

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Lake Superior Fisheries Management Plan 2023–2033

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Table of Contents

Michigan Department of Natural Resources
Fisheries Report 38, 2024

Lake Superior Management Plan 2023–2033

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Introduction

While Lake Superior and its watershed have the least human-caused disturbance of the Laurentian Great Lakes (hereafter Great Lakes), the fish community has still significantly changed over the past 100 years. As a result of fish stocking and accidental introductions, the fish community contains both native and non-native species. Many of the introduced species have adapted well to the conditions in Lake Superior and its tributaries, resulting in natural reproduction. For many of these species, stocking by management agencies has been greatly reduced or eliminated over the years. The increases in natural reproduction are in part due to gradual improvement in watershed management following the devastating effects of logging that occurred in the late 19th and early 20th century. Corresponding with the gradual improvements to watershed management, water quality in the Lake Superior watershed has also benefited greatly from restrictions of the Clean Water Act and Great Lakes Water Quality Agreement of 1972. This has resulted in many positive benefits as well as some unanticipated changes. While the changes have not been as dramatic in Lake Superior as in the lower Great Lakes, recent monitoring (IJC 2020; Bunnell et al. 2014) has shown that chlorophyll (a measure of productivity) in Lake Superior declined from 1998–2016. A significant decline in total phosphorous (another measure of productivity) has also been documented in Canadian waters (Dove and Chapra, 2015). Based on information available in 2020, it was considered likely that offshore total phosphorous concentrations in Lake Superior were in a range where they were limiting fish production (IJC 2020). However, the large Cisco year class observed in 2022 has managers questioning those findings. Up until 2022, prey fish abundance in Lake Superior was largely deemed to have declined from historic highs in the early 1990s to historic lows in recent years. One thing for certain is that prey fish abundance is variable and year-class strength is difficult to predict. Since there is a significant relationship between prey fish biomass and predator (Lake Trout) biomass over time, the relative abundance of prey fish will either limit or increase predator abundance (bottom-up control). While the relationship was documented for Lake Trout, it follows that other piscivorous predators may also be affected, even if their diet is more diverse and extends beyond fish.

While some trends are apparent, climate change has introduced complexity regarding how the Great Lakes, and particularly Lake Superior, will respond. As one example, Lake Superior is predicted to have less ice cover (Andresen et al. 2012), which has the potential to negatively affect Lake Whitefish recruitment given that ice cover can improve egg survival by protecting deposited eggs from wind and waves (Freeberg et al. 1990). In contrast, primary productivity (as determined from sediment cores) on Lake Superior has increased over the last century due to increasing surface water temperatures and longer stratification that resulted from longer ice-free periods (O'Beirne et al. 2017). Predictions are that increased productivity will continue (Winkler et al. 2014), which may benefit fish populations. This prediction is in direct contrast to the previously mentioned drivers such as reduced nutrient inputs that have resulted from improved watershed management and handling of municipal wastewater. This uncertainty about how the fish community in Lake Superior will respond to various stressors in the coming years suggests that resiliency will be increasingly important. In that regard, species diversity, to some extent, allows for greater adaptive capacity and ability to respond to perturbation (Ives et al. 2019; Rooney et al. 2006). However, the potential resiliency gained from a diverse fish community does not imply that all species are welcome and beneficial. It is still our primary goal to prioritize native species management, with naturalized, non-native species occupying a minor component of the fish community.

Given the inherent limits to productivity in Lake Superior, it is increasingly important to monitor fish populations for changes while simultaneously paying close attention to the number of fish stocked and their contributions to fisheries. We will continue to monitor the fish community via fishery-independent surveys as well as surveys of anglers. Given recent changes in creel survey methods along with periods when certain ports were not surveyed, it will be best to evaluate trends using the index ports of Keweenaw/Traverse Bays, Marquette/Au Train, and Munising/Grand Marais. While we will continue to stock fish in Lake Superior to supplement populations and create local fisheries, it is our primary intent with this plan to protect self-sustaining native and naturalized species. A useful tool for visualizing fish stocking efforts by the various management agencies on Lake Superior is provided by the Great Lakes Fishery Commission website (http://fsis.glfc.org).

This plan will guide fisheries management by the Michigan Department of Natural Resources (MDNR) on Michigan waters of Lake Superior and its tributaries for the next ten years. The plan aligns with Fisheries Division's Strategic Plan while providing more detail relative to Lake Superior. Objectives and actions described in the plan are not intended to encompass all the responsibilities of Fisheries Division but rather will concentrate on regulations, fish stocking, research,

monitoring, and priority habitat restoration. The plan does not duplicate nor supersede management frameworks or obligations described in court-ordered Consent Decrees, Decrees, or informal agreements with Tribal governments. Similarly, the plan recognizes the co-management of fisheries resources on Lake Superior with neighboring States, Canada, and Tribal governments via the Joint Strategic Plan that is administered under the auspices of the Great Lakes Fishery Commission. To that point, this plan is guided by existing fish community objectives established by the Lake Superior Committee (Horns et al. 2003). The overall fishery management goal for Lake Superior that was adopted by the agencies making up the Lake Superior Committee is "To rehabilitate and maintain a diverse, healthy, and self-regulating fish community, dominated by indigenous species and supporting sustainable fisheries." The Lake Superior Committee also adopted numerous principles to guide the formation of management policies and fish community objectives, such as: the importance of protecting fish habitat, recognizing that productivity is limited, acknowledging that non-indigenous naturalized species are part of the ecosystem, maintaining genetic diversity of fish populations, committing to coordinated management among agencies that is supported by science, and finally that preservation of indigenous species is of the highest concern.

While this plan identifies goals and objectives for individual species, it is done with consideration for species interactions and thus incorporates an ecosystem approach to management. An overarching goal is to seek healthy aquatic ecosystem function. For some species, we are aware of and have documented, how one species may have a negative effect on or compete with another. Other potential interactions are suspected but not proven through rigorous research. Therefore, in the plan, we identify threats to fisheries resources in Lake Superior and recommend ways to mitigate their effects or, at a minimum, learn more about them. This plan does not detail actions to prevent or address aquatic invasive species (AIS). For more information related to AIS, we direct the reader to Michigan's Aquatic Invasive Species State Management Plan (MDEQ, Water Resources Division 2013), the Lake Superior Lake-wide Action and Management Plan (ECCC and USEPA 2022) and Focus Area 2 of the Great Lakes Restoration Initiative Action Plan III (USEPA 2019). These documents detail strategies to manage AIS based on a generalized invasion curve that includes prevention, early detection, and response. For Lake Superior, prevention of new AIS is a high priority. This plan does not address contaminants in fish, although it is a high priority for MDNR Fisheries Division to work with the Michigan Department of Environment, Great Lakes, and Energy (EGLE) and other partners to identify and remediate contaminant sources. Additionally, we continue to assist in the collection of fish for contaminant testing as well as the dissemination of consumption advisories to resource users.

Sections of this plan are intended to briefly summarize recent management history, identify the population status, and to set strategic goals for the next 10 years, with particular emphasis on the primary methods (e.g., stocking, regulations) that are available to the MDNR. Creel survey data used for recent trends were limited to the 30-year period from 1990–2019. Although drafting of the report started in 2021, creel survey data from 2020 were omitted given the global pandemic interrupted both hiring staff for creel surveys and the number of months that were surveyed. When using creel survey data, catch per unit effort (CPUE) would ideally be used as an index of relative abundance. However, CPUE is influenced by factors unrelated to fish abundance, such as location, depth, season, target species, and fishing method (Su and He 2013). For example, the catch rate of Brown Trout by anglers targeting Lake Trout would not be indicative of the relative abundance of Brown Trout. Additionally, during angler interviews on Lake Superior, many anglers respond that they are fishing for "anything" or "trout and salmon". Thus, for the purposes of characterizing general trends in the fishery, we used harvest for most species. Throughout the document, we use the term "significant" to denote where there was a statistically significant relationship or trend. For readers interested in the statistical methods or level of significance, please contact the authors.

In administering this management plan, we recognize that staff time and financial resources available to the MDNR are finite and must be utilized as efficiently as possible. Where feasible, it is our hope to work with partners to accomplish goals identified in the plan.

Summary of Public Survey

To inform the development of this management plan, we implemented an open, non-random survey to gauge opinions on key issues (Appendix A). The survey was available on the MDNR website from April 19 through May 31, 2021 (43 days), was advertised via a press release, and was provided to various angler groups and citizen advisory committees. Responses were limited to one per IP address.

A total of 1,807 stakeholders responded to the survey (Appendix B). While responses came from a variety of locations throughout the United States (Figure 1), most responses came from Michigan zip codes and specifically population centers in the Upper Peninsula of Michigan (Figure 2). Most (91%) responses came from those who consider fishing as their most important or one of their more important recreational activities. While responses indicated varying levels of avidity, the majority (61%) of responses came from anglers who indicated they fish 20 or more times per year. The survey indicated that more than a third (36%) of respondents did not fish Lake Superior in the past 12 months; however, this was likely because the survey occurred amid a global pandemic and in 2020 there were mandates that likely affected fishing effort. Still, we believe the survey adequately reached avid Lake Superior anglers and their responses are valid for informing our Management Plan. Anglers fished Lake Superior using a variety of methods with the most popular being personal motorboat (57%), followed by shore/wading (21%), and breakwall/pier (13%). Anglers targeted numerous species on Lake Superior with Lake Trout (31%), Coho and Chinook salmon (25%), and Rainbow Trout (steelhead, 14%) being targeted most often. Like responses related to fishing Lake Superior, respondents indicated that a high proportion (32%) of people did not fish Lake Superior tributaries in the past 12 months. Anglers fished tributaries using a variety of methods with the most popular being wading (56%), followed by dock/bank/shore (24%), and personal motorboat (13%). The most often targeted species on tributaries were Brook Trout (35%), Steelhead (32%), and Walleye (9%). Overall, most respondents (63%) believed that fisheries management should seek a balance between native species and non-native species, although 33% indicated that fisheries management should prioritize native species. When asked to rank management actions based on how important they are to improving fishing and overall angler satisfaction respondents ranked habitat restoration as the highest priority, followed by fish stocking, regulatory measures, and law enforcement.

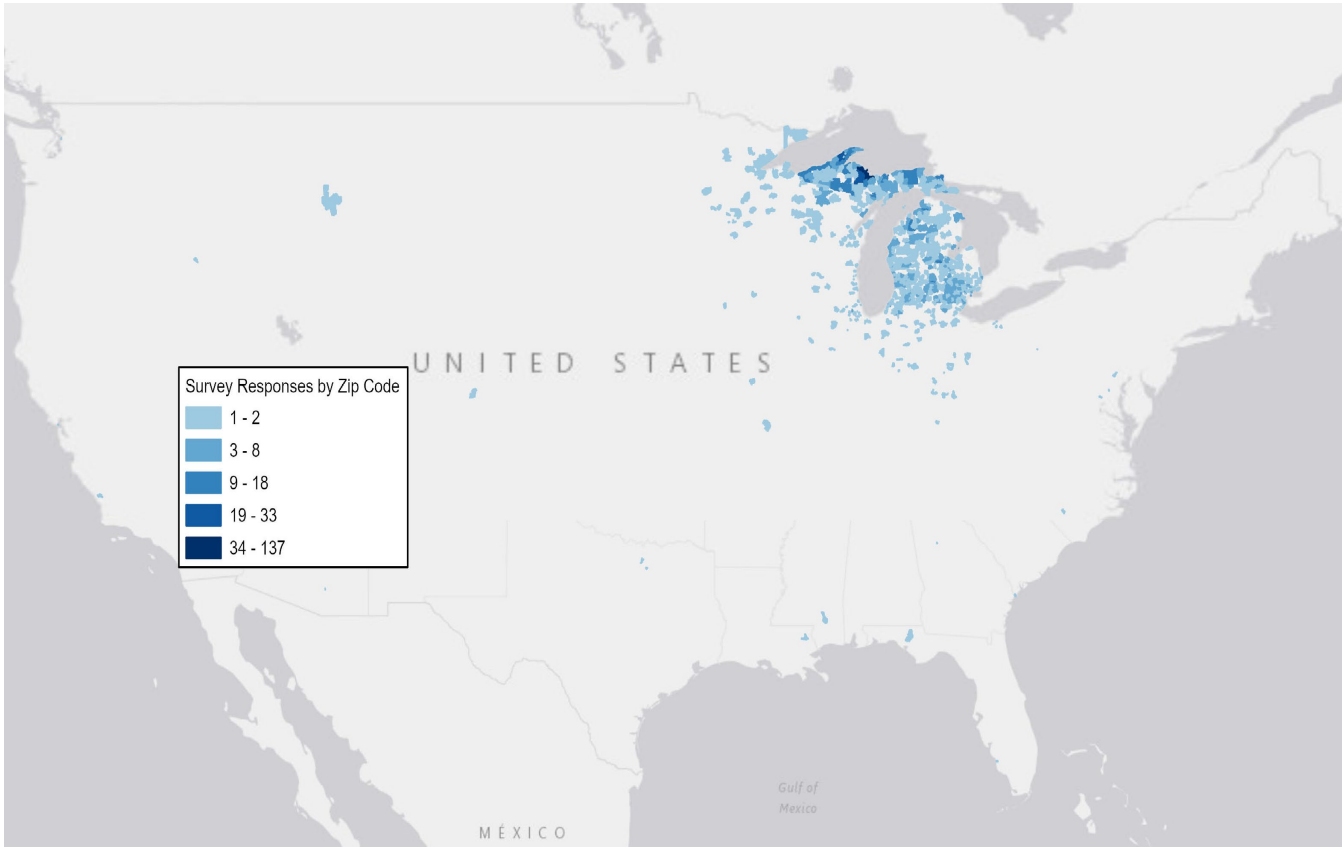

Figure 1. Geographical representation of all survey responses by zip code.

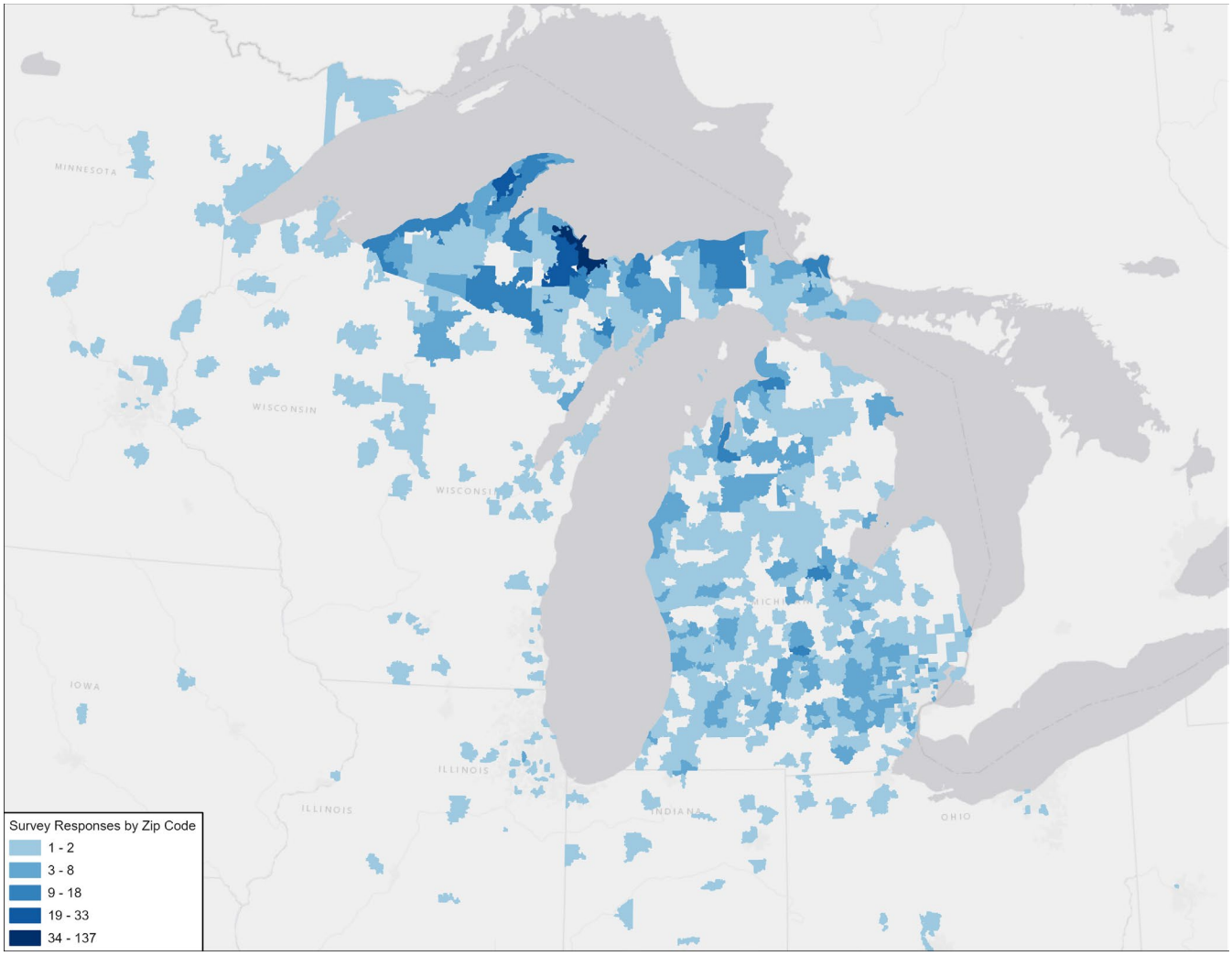

Figure 2. Geographical representation of survey responses by zip code, specific to Michigan and surrounding states.

Comments (N=625) provided as part of the public survey were categorized and enumerated to determine recurring themes (Table 1.). A single comment often conveyed several ideas; thus, the total number of responses for all categories (1,014) is greater than the number of individual comments. Angler opinions varied widely, although some common themes were evident. The most frequent theme in comments from the public survey concerned Native American fishing. It is important that anglers understand Native American fishing in Lake Superior, so we offer brief comment here. Several Federally recognized Tribes have a treaty-reserved right to harvest fish in Lake Superior for both commercial and subsistence purposes. The State of Michigan co-manages fisheries resources on Lake Superior with these sovereign Tribal governments. As partners in fisheries management, Tribal governments conduct both fishery-independent surveys to assess the health of fish populations as well as surveys and sampling of their licensed fishers. Several Tribes are also involved in fish stocking in Lake Superior. The State and the Tribes have many shared management goals such as the sustainability of fish populations and restoration of degraded habitats. We are committed to working with Tribal governments to ensure the long-term viability of Lake Superior and will continue to support biological management and adequate law enforcement.

Table 1. Summary of comments from the public survey.

Categorized comments from public survey	Count	%
Comments concerning Native American commercial fishing (harvest, net entanglement)	82	8.1%
Comments in favor of more restrictive fishing regulations	67	6.6%
Comments in favor of more (generally) or stocking Chinook salmon	60	5.9%
Comments in favor of prioritizing habitat protection, restoration, or fish passage	59	5.8%
Comments in favor of trophy Brook Trout and/or coaster Brook Trout regulations, stocking, or refuges	58	5.7%
Comments thanking or recognizing Fisheries Division/DNR	57	5.6%
Comments in favor of more (generally) or stocking Coho salmon	53	5.2%
Comments in favor of more (generally) or stocking Brown Trout	46	4.5%
Comments in favor of prioritizing management for native species	40	3.9%
Comments in favor of more (generally) or stocking Steelhead	33	3.3%
Comments in favor of maintaining and improving access	31	3.1%
Comments in favor of more (generally) or stocking Splake	30	3.0%
Comments in favor of increased law enforcement	29	2.9%
Comments in favor or invasive species prevention, remediation, or incentives for harvesting	24	2.4%
Comments in favor of less restrictive fishing regulations	22	2.2%
Comments in favor of catch and release fishing regulations	22	2.2%
Comments in favor of predator-prey balance and/or reduced fish stocking	21	2.1%
Comments in favor of increased education and outreach	20	2.0%
Comments in favor of protecting spawning and/or trophy Lake Trout	17	1.7%
Comments in favor of more restrictive size limits for trout in rivers	15	1.5%
Comments in opposition to restrictive Brook Trout size limits	15	1.5%
Comments in favor of general expansion of fishing opportunities or stocking in general	15	1.5%
Comments in favor of limiting commercial and/or charter harvest	14	1.4%
Comments in opposition to non-native fish stocking	11	1.1%
Comments indicating concern over reduced Steelhead abundance	10	1.0%
Comments in favor of artificial lures or flies-only regulations	8	0.8%
Comments questioning timing of survey related to pandemic restrictions	8	0.8%
Comments indicating concern over increasing non-native salmonids in Brook Trout streams	7	0.7%
Comments in favor of Yellow Perch fishing opportunities and/or evaluating decline in Yellow Perch	6	0.6%
Comments supporting management based on biology and/or science	6	0.6%
Comment indicating concern over agricultural or mining pollution affecting waterbodies	6	0.6%
Comments in opposition to concentrating management efforts toward Lake Trout	5	0.5%
Comments concerning effects of harvest on Brook Trout	5	0.5%
Comments in favor of managing for non-native species	5	0.5%
Comments in favor of managing for or stocking Walleye in Lake Superior	5	0.5%
Comments suggesting use of local brood sources, rearing fish in-stream, or fry stocking	5	0.5%
Comments indicating concern over predation by cormorants	4	0.4%
Comments in favor of 10 (or more) Brook Trout possession limit	4	0.4%
Comments in favor of Arctic Grayling restoration	4	0.4%
Comments in favor of efforts to increase smelt population and/or baitfish stocking	4	0.4%
Comments unrelated to Lake Superior basin or Fisheries Division	3	0.3%
Comments in favor of protected slot limits for Northern Pike or Walleye	3	0.3%
Comments in favor or evaluating regulations and seasons given changing climate	3	0.3%
Comments in favor of liberalizing Round Whitefish (Menominee) regulations	3	0.3%

Table 1. cont.

Categorized comments from public survey	Count	%
Comments in favor of more (generally) or stocking muskellunge	3	0.3%
Comments in favor of maintaining 5-fish possession limit for Brook Trout	3	0.3%
Comments in favor of maintaining existing Lake Trout regulations	3	0.3%
Comments disparaging Fisheries Division/DNR	3	0.3%
Comments in favor of possession limits for Burbot	3	0.3%
Comments related to perceived better fishing regulations in Canada	2	0.2%
Comments in favor of stocking Brook Trout in inland lakes	2	0.2%
Comments in favor of lower size limit on Northern Pike	2	0.2%
Comments in favor of liberalizing Lake Trout regulations	2	0.2%
Comments recognizing need for commercial fishing and/or opposing over-regulation of commercial fishers	2	0.2%
Comments in opposition to Arctic Grayling reintroduction efforts	2	0.2%
Comments in opposition to Walleye stocking	2	0.2%
Comments in favor of simplified fishing regulations	2	0.2%
Comments in favor of increasing license fees	2	0.2%
Comments indicating concern over contaminants in fish	2	0.2%
Comments in favor of closing rivers to fishing on a rotation	2	0.2%
Comments in favor of reducing Lake Trout possession limits	2	0.2%
Comment regarding stocking fish at appropriate time	1	0.1%
Comment in favor of citizen-based science/data collection	1	0.1%
Comment in favor of closing Ontonagon River to fishing until May 15	1	0.1%
Comment requesting information on Brook Trout fishing opportunities	1	0.1%
Comment in support of single hook regulation on Sturgeon River below Prickett Dam	1	0.1%
Comment regarding low water levels in Au Train basin	1	0.1%
Comment in favor of more (generally) or stocking Lake Trout	1	0.1%
Comment in favor of year-round Walleye harvest on Lake Superior	1	0.1%
Comment expressing concern on price of non-resident license	1	0.1%
Comment in favor of Smallmouth Bass management	1	0.1%
Comment in favor of closing commercial fishing for Cisco	1	0.1%
Comment expressing that fish in Lake Superior have values other than fishing	1	0.1%
Comment in favor of dedicating research and management toward shallow, nearshore areas	1	0.1%
Comment in favor of eliminating harvest of Steelhead in headwaters/spawning areas	1	0.1%
Comment in favor of allowing harvest of one Lake Sturgeon greater than 60"	1	0.1%
Comment indicating concern over fish ladder not functioning at Otter Lake	1	0.1%
Comment in favor of more attention being given to inland lakes	1	0.1%
Comment in favor of 1-year moratorium on fishing for endangered species	1	0.1%
Comment in favor of researching ways to reduce hooking mortality	1	0.1%
Comment in opposition to resources being spent on Lake Sturgeon rehabilitation	1	0.1%
Comment in opposition to allowing oil pipelines in the lakes	1	0.1%
Comment in favor of remediating encroaching stamp sands on reefs	1	0.1%
Comment in favor or evaluating possession limits and size limits every 5 years	1	0.1%
Comment in favor of increased grants and partnerships	1	0.1%
Comment opposing resources spent on remediation of stamp sands	1	0.1%
Comment in favor of promoting aquaculture on Lake Superior	1	0.1%
Comment indicating concern over low staffing at DNR office	1	0.1%
Total	1,014	100%

Another common theme pertained to fish stocking as 22% of comments indicated the respondent was in favor of stocking more of some species. It is important to note that new or increased fish stocking does not necessarily result in higher catch rates as both the survival of stocked fish and subsequent catch by anglers are affected by many factors. In this plan we stress the need to assess natural reproduction and the suitability of stocking prior to initiating any new efforts or expanding existing ones. By doing so, fish stocking will have the greatest chance of success which will result in meaningful return to anglers. Further analyses of responses related to a given species are provided in associated chapters of this plan.

Lean Lake Trout

There are four ecotypes of Lake Trout in Lake Superior, and the most familiar and socio-economically important form is the lean Lake Trout, which inhabits shallow (< 50 m) waters (Muir et al. 2014; Jasonowicz et al. 2022). Lake Trout are the keystone predator in Lake Superior and have been socially and economically important to humans for centuries. Intense commercial fishing combined with the invasion of Sea Lampreys in the middle part of the 20th century caused near extinction of Lake Trout in Lake Superior (Hansen 1999). Recreational fisheries target lean Lake Trout whereas commercial fisheries generally harvest Lake Trout as bycatch while targeting Lake Whitefish. Commercial harvest of Lake Trout is prohibited in state-licensed fisheries, and Tribal commercial fisheries target Lake Whitefish due to its higher market value and bycatch Lake Trout. The 2023 Decree mandates that stock assessment models be run every three years in 1836 Treaty-ceded waters (MI-5, MI-6, MI-7, Figure 3) to determine current population abundance and mortality rates, which are then used in a projection model to estimate annual harvest limits for the next three-year period. Model generated quantities are used to guide management, which is based on maintaining total annual mortality rates at or below 42% on age classes most vulnerable to fishing (Technical Fisheries Committee 2023, unpublished report).

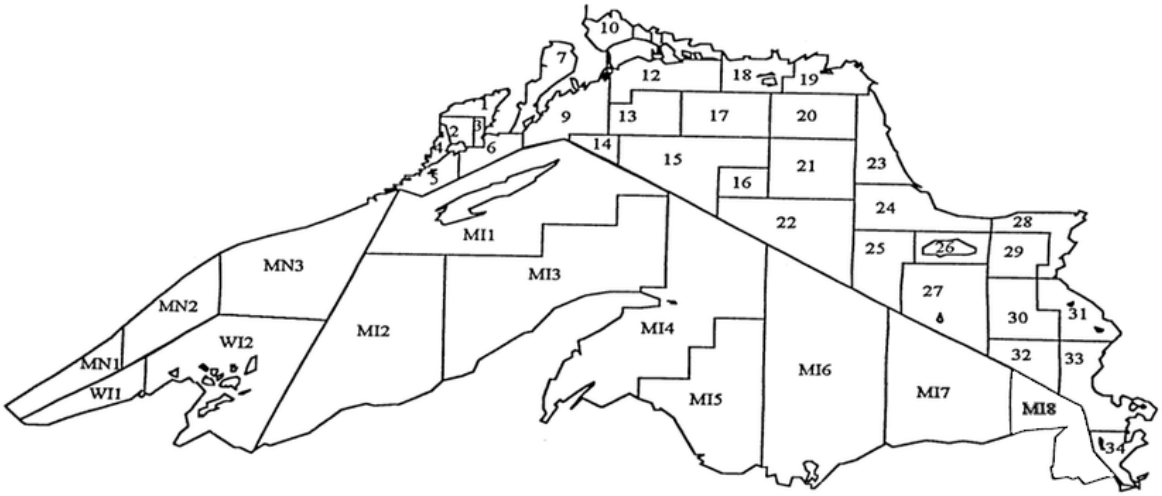

Figure 3. Lake Superior Lake Trout Management Units.

The status of lean Lake Trout populations is described extensively in Sitar (2021) and in the annual status of the stocks report for 1836 Treaty-ceded waters authored by the Modeling Subcommittee of the Technical Fisheries Committee (2020). A summary of those reports is provided here. Lean Lake Trout populations are wild and self-sustaining in all Michigan waters of Lake Superior (Sitar 2021); however, the status of the Lake Trout population in MI-8 is unknown. In MI-8, Lake Trout stocking ceased in the mid-1990s and harvest by Tribes signatory to the 1836 Treaty averaged 46,920 pounds from 1990–2019, ranging from a low of 20,140 pounds to a high of 95,345 pounds. Given that Lake Trout were last stocked in MI-8 in 1996, it is likely that current harvest is largely wild fish. Commercial harvest in Ontario waters of MI-8 is unknown. Offshore populations at Isle Royale (MI-1) and Stannard Rock (MI-5) are in good health with stable age distributions (Sitar 2023 and unpublished data), and Big Reef (MI-6) is presumed have a similar status although it has not been surveyed (Figure 3). There is some concern about high fishing mortality on populations west of the Keweenaw Peninsula (MI-2, MI-3) given their truncated length structure and relatively low abundance. Similar concerns exist for management unit MI-8, where Lake Trout recovery was deferred in the 2000 Consent Decree of the 1836 Treaty of Washington. It will be important to continue monitoring these populations by sampling the commercial and recreational fisheries as well as through fishery-independent surveys. Another concern requiring continued monitoring is

Sea Lamprey mortality. Wounding rates on Lake Trout are above target levels (≤5 wounds/100 fish) in management units MI-6 and MI-7 and have been for over 20 years (Figure 3; Ebener and Pratt 2021). In most management units, Sea Lamprey kill more Lake Trout than either commercial or recreational fisheries.

The recreational fishery comprises both charter and non-charter fishers. Most Lake Trout are harvested from small vessels during the open water season although some are caught in ice fisheries mainly in Keweenaw and Munising bays. Lake Trout are the most harvested species in Michigan's recreational fisheries on Lake Superior with highest harvest levels at Isle Royale (MI-1), Keweenaw Bay (MI-4), and Marquette (MI-5). Combined, lean and Siscowet Lake Trout accounted for 65% of the total lake-wide (Michigan waters) trout and salmon fishery harvest from 1990 to 2019.

Although there is historic knowledge of where lean Lake Trout spawning reefs are located (Goodyear et al. 1982), for the most part the quantity and quality of substrate has not been surveyed (e.g., excellent, suitable, degraded). Habitat surveys to obtain such information would be extremely valuable for understanding reproductive potential of populations and recruitment as well as for potentially prioritizing habitat protections and restorations. One threat that requires significant attention is the inundation of important spawning habitat by mining waste known as stamp sands. While stamp sands were deposited in numerous locations around the Keweenaw Peninsula, it is primarily a threat on the east side of the Keweenaw Peninsula where stamp sands deposited in Lake Superior near the town of Gay have migrated southward by wind and waves and are now encroaching on an 89 km^2 spawning area known as Buffalo Reef. In 2023 a remediation plan was developed by the Buffalo Reef Task Force; however, funding such a massive endeavor will be difficult and could take decades.

In Michigan waters of Lake Superior, recent recreational harvest (not including charter harvest) of lean and Siscowet Lake Trout averaged 36,600 fish annually (2012–2021) whereas non-native Pacific salmonine harvest averaged 14,600 fish annually. Targeted recreational effort for salmon and trout averaged 156,200 angler hours annually during the same period. Lake Superior anglers are opportunistic and generally target both Lake Trout and non-native Pacific salmonines to optimize harvest. Lake Superior has high abundance of self-sustaining wild Lake Trout populations and production of non-native salmonines is limited, which is reflected in the recreational harvest. Recreational harvest of Lake Trout at offshore areas is disproportionately higher than nearshore areas due to the concentration of populations in small areas. For example, Stannard Rock is likely the premiere recreational destination for Lake Trout in the Great Lakes with the highest catch rates measured in Lake Superior, but populations are vulnerable because of the small area (36.4 km^2) and high catchability of the fishery. Although the status of Stannard Rock lean Lake Trout is healthy, a modest increase in mortality could threaten sustainability (Sitar 2023). Progressive anglers have voiced an interest in developing protective measures for offshore Lake Trout and establishing a special status for these sites would be logical.

The online questionnaire targeting Lake Superior anglers administered to inform this management plan revealed some useful information about angler preferences for Lake Trout. Lake Trout or Siscowet were species that respondents targeted most often on Lake Superior at 31% (Appendix A, question 9); however, when respondents were asked to identify all the species they targeted when fishing on Lake Superior, Lake Trout or Siscowet (66%) were targeted by a comparable number of respondents as Chinook and Coho Salmon (69%). This suggests that a larger number of anglers may target salmon species, although overall they do not dedicate as much effort toward them as they do for Lake Trout. When anglers were fishing for Lake Trout or Siscowet on Lake Superior, 73% indicated their primary intent was to harvest fish while 27% indicated their primary intent was to catch and release. It would be useful to know if this intent differs between lean Lake Trout and Siscowet, although in preparing the survey we were not confident that the average angler could distinguish between the two ecotypes with a high degree of accuracy thus the questionnaire had a singular choice of "Lake Trout or Siscowet." Of those that targeted Lake Trout, anglers preferred to harvest Lake Trout between 20–25 inches (62%), followed by 15–20 inches (25%), 25–30-inches (11%), and 30+ inches (2%). Given the evidence of high catch-and-release mortality on Lake Trout (Sitar et al. 2017) and the ineffectiveness of size limits in reducing harvest because of that mortality, Fisheries Division wanted to know whether anglers would prefer reduced daily possession limits or a shortened harvest season if harvest reductions were required to maintain Lake Trout sustainability. About half of the respondents (51%) favored reduced possession limits and 49% favored shortened harvest seasons, which indicates that either regulation could be used. Further survey of anglers and local public meetings would be used to determine the most acceptable policy should the need arise. Additionally, creel and

charter data will be used to determine the effectiveness of each regulation option to reduce harvest. Finally, when respondents were asked whether they would support more restrictive Lake Trout harvest regulations (for example, reduced daily possession limits) on offshore reefs such as Stannard Rock and Big Reef, anglers overwhelmingly (79%) supported the concept. Although the public online questionnaire revealed some angler preferences in the Lake Trout fishery, a more rigorous survey in the future will improve our understanding of angler values and preferences.

Goal

Maintain genetically diverse wild, self-sustaining Lake Trout populations capable of supporting appropriate levels of exploitation.

Objectives

1. Maintain total annual mortality rates less than 42% on age classes selected by fisheries.
2. Maintain Sea Lamprey wounding rates less than 5 wounds per 100 fish.
3. Maintain populations of Lake Trout that support high-quality recreational fisheries at Stannard Rock, Big Reef, and Isle Royale.

Management Actions and Evaluations

1. Conduct status of stocks review for MI-2, MI-3, and MI-8 to identify population-level threats.
2. Conduct creel surveys in MI-2 (annually) and in MI-1 (quinquennially) to assess effectiveness of regulations and management objectives. Conduct evaluation to assess if creel survey is necessary in MI-3.
3. Enhance Sea Lamprey control to achieve target of <5 % wounding on Lake Trout in MI-6, MI-7 by 2030.
4. Continue evaluation of negative effects of stamp sands related to fish reproduction and recruitment and seek funding for appropriate remediation of Buffalo Reef.
5. Conduct and complete spawning habitat mapping/quantification surveys in nearshore and offshore areas of Lake Superior.
6. Continue to survey and assess status of offshore Lake Trout populations (Isle Royale, Stannard Rock, Big Reef, and Klondike Reef-Caribou Island complex).
7. Work with anglers and citizen advisory committees to develop appropriate regulations to achieve population objectives.
8. Continue to conduct human dimensions research to assess demographics, values, and preferences of Lake Superior anglers.

Siscowet Lake Trout

Siscowet are the deepwater Lake Trout ecotype that live long and prosper in offshore waters (≥ 80 m) of Lake Superior. Siscowets are the most abundant and broadly distributed ecotype in the lake (Ebener 1995; Bronte and Sitar 2008) and has some sympatry with lean Lake Trout populations, due to its extensive movement behavior, and can be found at depths as shallow as 40 m (Jasonowicz et al. 2022). Although fisheries tend to target lean Lake Trout, Siscowets are mixed in fishery harvest because they are not easily distinguished from lean Lake Trout. Siscowets were highly prized in the distant history of Lake Superior and were described as more preferred and valued over lean Lake Trout when salted and reconstituted (Goode 1888), which was due to their high intramuscular fat compared to lean Lake Trout (Sitar et al. 2020). During the middle of the 20th century, Siscowet abundance declined due to commercial fishing prior to the invasion of Sea Lampreys, indicating that they are likely more vulnerable to sustained fishery exploitation than lean Lake Trout populations (Bronte and Sitar 2008). During the mid-1980s, a limited gill net fishery for Siscowets in deep water was permitted in Michigan (unpublished data, Marquette Fisheries Research Station, MDNR) but permits were ceased because of high contaminant levels measured in the fillets. More recently, there was renewed interest in harvesting Siscowets for the omega-3 supplement industry; however, uncertainty in the sustainability of the fishery lead to a loss of

interest in the concept. Siscowets are harvested in some quantity in recreational fisheries due to unawareness or misidentification of ecotypes, but targeted effort toward them is believed to be low. In terms of management, there has been no direct management of Siscowets or any ecotypes other than lean Lake Trout. Based on research conducted in the last 20 years, it is apparent that Siscowets are a species with life history strategies (e.g., spring and fall spawning, slow growth and maturation, high levels of skipped spawning, and long lifespans) that facilitate life in highly unproductive, cold, and deep environments that can only endure low mortality and limited disturbance.

Siscowet Lake Trout populations are abundant in all deep (>80 m) water in all management units except MI-2 and likely MI-8 (due to limited deep water in these units; Figure 3). They are also abundant around offshore seamounts such as Stannard Rock and Big Reef as well as around Isle Royale. Very little is known about Siscowet spawning except that most populations spawn in the fall with some populations spawning in the spring. Historic reports indicate spawning throughout the summer (Goodyear et al. 1982). Sea Lamprey wounding rates on Siscowets is higher than lean Lake Trout. Furthermore, it is thought that Siscowets may have a buffering effect on overall Sea Lamprey mortality on lean Lake Trout as they can absorb relatively high levels of attacks with lower lethality compared to lean Lake Trout (Moody et al. 2011). While estimates of total annual mortality for Siscowets are rare, it was estimated to be 15.8% for Siscowets sampled at Stannard Rock during the period from 2011 to 2015 (Sitar 2023). There has been concern among anglers and some managers that Siscowets are competing with lean Lake Trout because they have been captured in similar locations. Recent research on diet, spatial distributions and results from gill net surveys indicate that although diets are ecologically similar, there is little competition because the ecotypes are distributed among differing habitats in Lake Superior with limited overlap of adults (Sitar et al. 2020; Otte 2021; Edwards 2023). The highest relative abundance for Siscowets is generally at depths greater than 150 meters (Seider et al. 2021), and relative abundance of Siscowets in spring surveys targeting lean Lake Trout are very low. The juveniles of both lean Lake Trout and Siscowets are sympatric but have self-regulating mechanisms against competition (Otte 2021; Gerig et al. 2024).

Goal

Maintain genetically diverse, wild Siscowet Lake Trout populations that help maintain ecosystem integrity.

Objectives

1. Maintain total annual mortality rates less than 30%.
2. Maintain Sea Lamprey wounding rates at appropriate levels to achieve management goal.
3. Manage fisheries to maintain appropriate spawning stock to achieve management goal.

Management Actions and Evaluations

1. Conduct and complete spawning habitat mapping/quantification studies in offshore areas of Lake Superior.
2. Continue to survey and assess status of Siscowet Lake Trout populations at Isle Royale, Stannard Rock, Big Reef, and Klondike Reef-Caribou Island complex.
3. Continue to conduct human dimensions research to assess demographics, values, and preferences of Lake Superior anglers, especially as they relate to differences among Lake Trout ecotypes.
4. Develop population models to determine Siscowet abundance levels, mortality rates, and sustainability to complement ongoing nearshore lean Lake Trout stock assessments.

Lake Whitefish

Lake Whitefish inhabit nearshore (<90 m depth) waters of Lake Superior (Gorman et al. 2012) where they feed mostly on benthic invertebrates and serve as prey for native piscivores, such as lean and Siscowet Lake Trout and Burbot (Gamble et al. 2011a). Historically, Lake Whitefish was the most culturally important and economically valuable fish species in Lake Superior. Prior to European settlement, populations along the southern shore of the lake were targeted by Native American subsistence fisheries (Lawrie and Rahrer 1973).

Harvests increased following European settlement as more efficient, large-scale commercial fisheries began targeting the same populations (Koelz 1926). Localized extirpations occurred by the late 1800s and were attributed to sequential overfishing of discrete stocks and degradation of nearshore and riverine spawning areas, which was caused by sawdust deposits from intensive logging that suffocated Lake Whitefish eggs (Milner 1874). High market demand and more efficient gears increased commercial fishing pressure until the mid-1950s when overfishing and predation from newly-established Sea Lamprey caused the collapse of most remaining Lake Whitefish stocks (Lawrie and Rahrer 1973). Reduced commercial fishing pressure and effective Sea Lamprey control allowed Lake Whitefish to recover after the 1960s (Smith and Tibbles 1980). Commercial harvests steadily increased and reached near record levels in Michigan waters of Lake Superior during the late 1980s and early 1990s but have declined since 2015 (Figure 4).

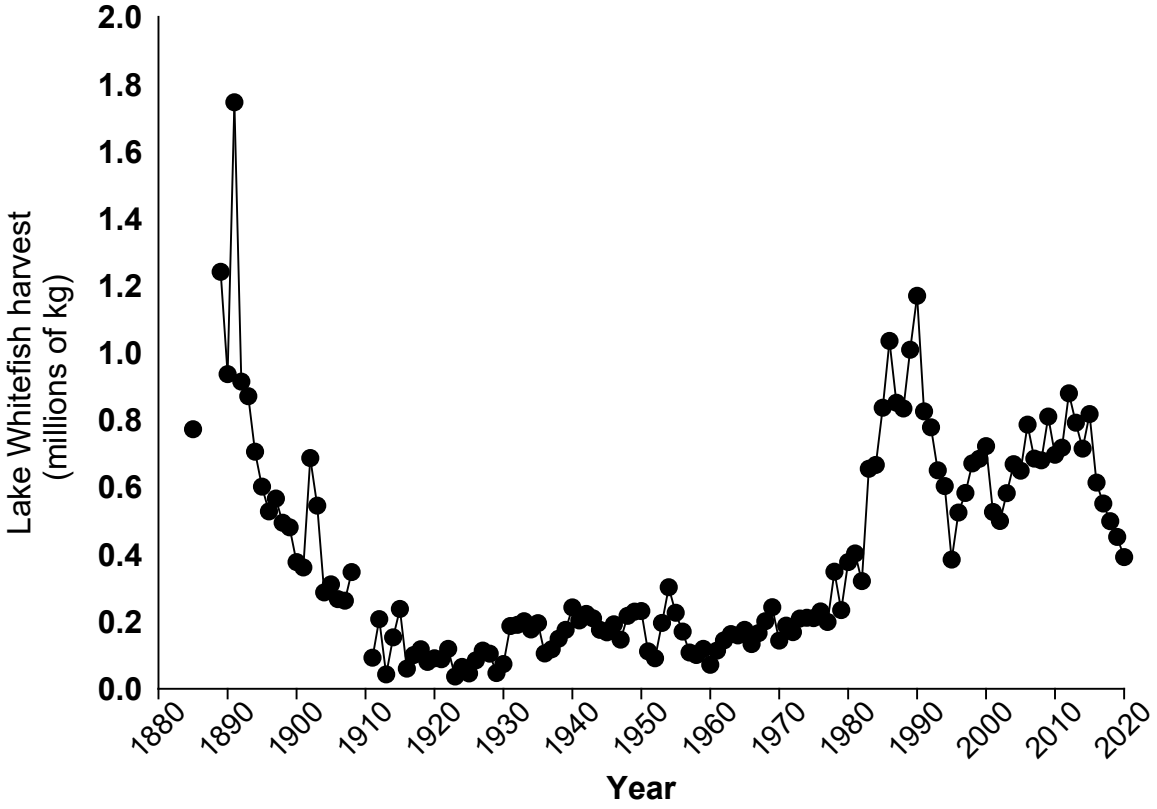

Figure 4. Total annual commercial Lake Whitefish harvest in Michigan waters of Lake Superior during 1880–2020 (GLFC 2022a).

Naturally-reproducing Lake Whitefish populations currently support commercial, recreational, and subsistence fisheries across Michigan waters of Lake Superior. The 2023 Decree mandates that stock assessment models be run every three years in 1836 Treaty-ceded waters to determine current population abundance and mortality rates, which are then used in a projection model to estimate annual harvest limits for the next three-year period. Model generated quantities are used to guide management, which is based on maintaining total annual mortality rates at or below 55% on age-classes most vulnerable to fishing (Technical Fisheries Committee 2023, unpublished report). Similar stock assessment models are being developed for 1842 Treaty-ceded waters and although no official management guidelines exist for commercial fisheries in these areas, if future conditions necessitate reductions in mortality, state and Tribal resource agencies may base future harvest limits on biological reference points. Both recreational and subsistence fisheries harvest relatively few Lake Whitefish compared to commercial fisheries. Recreational fisheries are concentrated in shallow-water areas adjacent to major population centers, such as Sault Ste. Marie, Munising, Marquette, and Houghton-Hancock, where anglers use hook-and-line

during the open water season and spears or hook-and-line for ice fishing (Schorfhaar and Schneeberger 1997). There is no closed season for the recreational Lake Whitefish fishery in Michigan waters of Lake Superior and the daily possession limit is 10 total fish, which includes any combination of Cisco, Lake Whitefish, and Round Whitefish (MDNR 2023). Tribal subsistence fisheries target Lake Whitefish with gill nets and harvests are generally regulated by individual Tribal resource agencies within the previously described harvest limit framework (MSC, TFC 2012).

Lake Superior has largely avoided the environmental and ecological issues afflicting the other Great Lakes, such as Dreissenid mussel proliferation, severe declines in productivity, and changes in zooplankton community structure and abundance, all of which have limited recruitment of Lake Whitefish (Ebener et al. 2021). As a result, Lake Whitefish populations in Michigan waters of Lake Superior are relatively stable compared to most other populations in the Great Lakes. However, changes in population biomass and growth/condition have occurred in some Lake Whitefish management units (MSC, TFC 2022). During the last two decades, average total annual mortality rates for age-8 Lake Whitefish in 1836 Treaty-ceded waters were consistently lower in western units (27% in WFS-04 and 35% in WFS-05) than in eastern units (57% in WFS-07 and 75% in WFS-08). Despite similar levels of recruitment variation within each unit, total biomass increased in WFS-04 and WFS-05 but decreased in WFS-07 and WFS-08. During the same period, the average weight of age-8 Lake Whitefish decreased in WFS-04, was stable in WFS-05 and WFS-07 and increased in WFS-08. Commercial fisheries for Lake Whitefish are too small and sporadic to inform stock assessment models in WFS-06 (MSC, TFC 2022). Preliminary stock assessment models for 1842 Treaty-ceded waters suggest relatively low total annual mortality rates in other units (WFS-01, WFS-02, and WFS-03) but these models have not been updated in nearly a decade and the status of Lake Whitefish populations could have changed more recently. Creel surveys conducted during the last two decades suggest the average weight of Lake Whitefish harvested in recreational fisheries was stable at Keweenaw Bay but declined significantly at Munising and Grand Marais. At Munising, average size over the period declined from around 0.8 pounds to 0.6 pounds. At Grand Marais, average size declined from around 1.1 pounds to 0.6 pounds. Sample sizes at other locations were insufficient to evaluate changes in weight. Based on data collected from commercial harvests, growth of adult Lake Whitefish has declined in these units over the past 20 years. Fishing mortality also declined over the same period, which suggests the trends observed at Munising and Grand Marais are likely due to increases in total biomass or changing ecological conditions rather than harvest.

Despite relative stability compared to other populations in the Great Lakes, sporadic recruitment still drives Lake Whitefish populations in Michigan waters of Lake Superior (MSC, TFC 2022), and recruitment cannot be controlled by resource agencies (Ebener et al. 2021). Therefore, limiting total annual mortality to conserve adult spawning stocks is a primary management objective. Fishing and Sea Lamprey mortality are the only sources of mortality that can be controlled, and both should be maintained at reasonable levels to promote stable, self-sustaining Lake Whitefish populations capable of supporting commercial, recreational, and subsistence fisheries. Management guidelines already exist for commercial fisheries in 1836 Treaty-ceded waters (e.g., maximum total annual mortality rate of 55%), and these should be updated as required by law (e.g., within the framework of a new Consent Decree) or when deemed biologically necessary (e.g., to prevent population collapse in the face of changing environmental and ecological conditions). Total biomass trends during the last two decades suggest that total annual mortality rates like those in WFS-04 and WFS-05 (<55%) may promote population growth, whereas total annual mortality rates like those in WFS-08 (>55%) may cause population declines. During the last decade, total annual mortality rates were consistently below the target level of 55% in WFS-04 and WFS-05 but regularly exceeded the target level in WFS-07 and WFS-08 (MSC, TFC 2022). The most recent (2020) total annual mortality estimates for WFS-07 (51%) and WFS-08 (59%) were the lowest on record since 2013 (MSC, TFC 2022) and state and Tribal resource agencies should continue to work together to maintain future rates at or below the 55% management target. State and Tribal resource agencies are working to develop stock assessment models for 1842 Treaty-ceded waters and discussing management guidelines that promote sustainability in these areas. Although no specific fish community objectives related to Sea Lamprey and Lake Whitefish exist for Lake Superior (Horns et al. 2003), Sea Lamprey abundance (average = 20,000 adults) and wounding rates on lean Lake Trout (average = 6.3 marks per 100 fish) were above target levels (10,000 adult lampreys and 5.0 marks per 100 fish) in Lake Superior during 2019–2021 (GLFC 2022b). Sea Lamprey feed

mostly on lean Lake Trout but a substantial number also feed on Lake Whitefish. For example, Harvey et al. (2008) found that most parasitic phase Sea Lamprey captured in Lake Superior were attached to either lean Lake Trout (35%), Lake Whitefish (25%), or Cisco (25%). Maintaining Sea Lamprey abundance and wounding rates on lean Lake Trout below established target levels for Lake Superior will also benefit Lake Whitefish and state resource agencies should continue to support bi-national Sea Lamprey control efforts.

The public survey administered to inform this management plan indicated that 34% of anglers targeted the Cisco, Lake Whitefish, and Round Whitefish species group when fishing in Lake Superior. When anglers targeted this species group, 69% intended to harvest fish, presumably for human consumption. Therefore, an additional management objective for Lake Whitefish populations in Michigan waters of Lake Superior is to maintain unique, high-quality recreational fishing opportunities adjacent to major population centers. Limiting total annual mortality rates as previously described will ensure that greater numbers of older, larger fish are accessible to anglers.

Goal

Maintain stable, self-sustaining Lake Whitefish populations capable of supporting commercial, recreational, and subsistence fisheries.

Objectives

1. Maintain total annual mortality rates for age-classes most vulnerable to commercial fishing gears at less than 55%.
2. Maintain Sea Lamprey abundance (<10,000 adults) and wounding rates (5.0 wounds per 100 fish) on lean Lake Trout below established target levels for Lake Superior to limit Sea Lamprey-induced mortality on Lake Whitefish.
3. Maintain high-quality recreational fishing opportunities adjacent to major population centers across Michigan waters of Lake Superior, such as Sault Ste. Marie, Munising, Marquette, and Houghton-Hancock.

Management Actions and Evaluations

1. Continue to work with Tribal resource agencies to update biological and harvest data and conduct status of stocks reviews for all Lake Whitefish management units with stock assessment models in 1836 Treaty-ceded waters to identify population-level threats.
2. Continue to work with Tribal resource agencies to maintain total annual mortality rates in WFS-07 and WFS-08 below the target level of 55%.
3. Continue to work with Tribal resource agencies to develop stock assessment models for 1842 Treaty-ceded waters and establish management guidelines that promote sustainability in these areas.
4. Support bi-national efforts to reduce and maintain adult Sea Lamprey abundance in Lake Superior at or below target levels (<10,000 adult lampreys).
5. Conduct annual creel surveys and work with anglers and citizen advisory committees to assess trends in recreational catches on a 5-year basis.
6. Continue to conduct human dimensions research to assess demographics, values, and preferences of Lake Superior anglers.

Brook Trout

Stream spawning runs of lake-dwelling or adfluvial Brook Trout(hereafter, adfluvial Brook Trout), commonly referred to as “coasters”, historically occurred in tributaries around the Great Lakes. Lake Superior had up to 118 seasonal spawning runs of Brook Trout exhibiting this distinctive life history characteristic (Newman et al. 2003). Many populations around Lake Superior were highly vulnerable to exploitation by anglers during the 1800s (Peterson 2018), with the most accessible populations likely being extirpated shortly thereafter. For example, Roosevelt (1865) noted that “Streams within 30 miles of Marquette were fished out”. Since the mid

1800's, Great Lakes adfluvial Brook Trout stocks consisted of a few scattered populations, mostly within the Lake Superior drainage (Hansen 1994). Exotic species and habitat alteration likely had adverse effects on some stocks as well (Schreiner et al. 2008; Zorn et al. 2020).

Rehabilitation or restoration of adfluvial Brook Trout is a priority of MDNR Fisheries Division (Zorn et al. 2018), other state, Tribal and federal jurisdictions in the Lake Superior basin (Newman et al. 2003), and coldwater conservation and angling groups. Attempts to restore adfluvial or adfluvial Brook Trout populations by stocking offspring from remnant adfluvial strains did not lead to spawning runs and stocking-based restoration efforts were abandoned in some jurisdictions, including Michigan (Carlson 2003; Schreiner et al. 2006).

Adfluvial Brook Trout populations are documented in three Michigan locations. 1) Salmon-Trout River in Marquette County (Huckins and Baker 2008); 2) Pilgrim River in Houghton County (Adams 2020); and 3) Isle Royale and adjacent waters of Lake Superior (Boone et al. 2021). Estimates of adult Brook Trout population size are unavailable for each location, although numbers are likely small. Adult fish for each waterbody may number fewer than 500 in any population with numbers for some areas potentially being much smaller. Legal harvest of Brook Trout in the Salmon-Trout River, Pilgrim River (and its receiving waters, Portage-Torch Lake), and Lake Superior is likely minimal due to the 20-inch minimum size limit. Catch-and-release regulations for Brook Trout occur on Isle Royale and Lake Superior waters within 4.5 miles of Isle Royale.

Studies have been unable to genetically distinguish between sympatric stream-resident and adfluvial Brook Trout, which suggests that adfluvial Brook Trout do not represent a genetically distinct strain of Brook Trout (Stimmell 2006; D'Amelio and Wilson 2008; Huckins and Baker 2008; Scribner et al. 2012). Instead, research suggests that the adfluvial and resident Brook Trout life histories co-occur within a stream population, with stream populations showing both life histories being labeled as exhibiting "partial migration" (Robillard et al. 2011a; 2011b; 2014).

Studies in the Great Lake region (Ward 2009; Bobrowski et al. 2011) and Quebec (Thériault et al. 2008) suggest fishing mortality in stream or lake environments may limit expression of the migratory life history in Brook Trout. In 1997, the Minnesota Department of Natural Resources embarked on an adfluvial Brook Trout rehabilitation program in lower reaches of its Lake Superior tributaries applying more protective stream fishing regulations for Brook Trout (20-inch minimum size limit and one fish daily possession). After 10 years, they documented increased abundance of larger and older (i.e., age-4+) Brook Trout in stream assessment surveys (Ward 2009). Their survey data is corroborated by angler reports of notable catches of large Brook Trout in Lake Superior tributary and river mouth habitats in the fall (D. Schreiner, Minnesota DNR, personal communication). Genetic analysis of samples from Brook Trout collected in Minnesota tributaries from this study indicated that the larger, older Brook Trout were genetically assigned to native, resident Minnesota strain, rather than adfluvial Brook Trout strains which had been stocked in prior years (Miller et al. 2016). The genetic results suggest that the capacity to produce the adfluvial Brook Trout life history currently resides within existing Brook Trout populations. Such results are particularly encouraging to fishery managers because population increases occurred despite sizeable populations of Pacific salmonids in streams, a robust Lake Trout population near shore, and anthropogenic alteration of watersheds and stream habitat. Similar Brook Trout population responses were noted in Lake Nipigon waters after more restrictive regulations were enacted by the Ontario Ministry of Natural Resources (Bobrowski et al. 2011). Such studies and other regulation-based evaluations of Great Lakes basin fish populations suggest a long-term approach is needed, since it may take several generations of Brook Trout before effects of regulations are evident in fish population assessment data (e.g., Clark 1981; Schneider 2001; Pierce 2010).

If the adfluvial Brook Trout life history can be expressed under favorable conditions, one may hypothesize that factors causing excessive mortality on adfluvial Brook Trout populations may prevent (or limit) expression of the adfluvial Brook Trout trait. In Michigan, existing populations of adfluvial Brook Trout occur in waters that are relatively inaccessible, and thus sheltered from heavy exploitation; the Salmon-Trout River is largely private and Isle Royale relatively isolated. If adfluvial Brook Trout largely enter spawning rivers in mid-summer as

occurs in the Salmon-Trout River (Huckins and Baker 2008) and Ontario's Lake Superior tributaries (Bobrowski et al. 2011), then rehabilitation of adfluvial Brook Trout runs may be hampered by Michigan's minimum size limit (typically 7 inches), daily possession limit of 5 fish, and the aggressiveness of Brook Trout. Seventy-two percent of respondents to the Lake Superior Angler Survey targeted Brook Trout in tributaries, and 40% of respondents indicated their primary intent was to harvest Brook Trout. Still, the survey indicated stronger support for a 10-inch minimum size limit for Brook Trout over the existing 7-inch minimum size limit, even if it meant fewer fish would likely be harvested. This indicates some willingness to forego harvest to increase abundance of larger Brook Trout.

In 2015, MDNR applied restrictive fishing regulations on eight experimental stream reaches as part of a long-term (10+ year) study to determine if they could contribute to rehabilitation of adfluvial Brook Trout spawning runs (Zorn 2013). These experimental stream reaches, known as Brook Trout Restoration Areas, were highly supported (87%) based on the survey used to inform this Management Plan, and some anglers and interest groups (e.g., Trout Unlimited) support use of these regulations on lower portions of other streams. Interestingly, a collaborative Brook Trout movement study that occurred concurrently with MDNR's regulations study confirmed partial migration (i.e., adfluvial Brook Trout occurrence) in the Brook Trout population of one study stream, the Pilgrim River (Adams 2020).

MDNR fishery managers lack information and tools for adfluvial Brook Trout rehabilitation in Lake Superior tributaries. These include: 1) non-lethal techniques to assessing prior Lake Superior residency in stream-captured Brook Trout; 2) knowledge of stream physical attributes, Brook Trout population characteristics (e.g., fish growth trajectories, densities, etc.), and fisheries management approaches (fishing regulations, closures, etc.) that favor the adfluvial Brook Trout life history; 3) information on population characteristics (e.g., fish growth and mortality rates) and age- and size-specific migratory patterns for existing adfluvial Brook Trout populations; 4) assessment of interactions and effects of other species on Brook Trout in Lake Superior and Lake Superior accessible stream habitats. Current research activities with partners are working to address some of these.

Goal

To increase the number of streams hosting adfluvial Brook Trout populations and the magnitude of existing adfluvial populations.

Objectives

1. Maintain or increase abundance of existing adfluvial populations. Spawning runs should include age-6 or older Brook Trout.
2. Identify and/or establish new Brook Trout populations showing partial migration.
3. Experiment with new or proven techniques to rehabilitate reduced or establish new populations.

Management Actions and Evaluations

1. Conduct evaluations of Brook Trout population dynamics to better understand factors influencing migrations between stream and Lake Superior habitats.
2. Assess occurrence of adfluvial component in Brook Trout populations in Lake Superior tributaries.
3. For existing Brook Trout populations with an adfluvial component, annually document population density and vital rates (e.g., age-specific growth and mortality), determine age- and size-specific migratory rates to lake habitats, and estimate angler exploitation, where feasible.
4. Develop non-lethal analytical techniques (e.g., maxilla microchemistry, stable isotopes) for assessing prior lake residency in stream-captured Brook Trout.
5. Monitor catch rates of Brook Trout by Lake Superior anglers using the Statewide Angler Survey Program, specialized surveys of adfluvial Brook Trout anglers, and via collaborations with partners (e.g., Isle Royale Boaters Association and National Park Service) to provide an index of adfluvial Brook Trout abundance in different areas of Lake Superior and adfluvial Brook Trout-producing tributaries.

6. Collaborate with partners to determine sources of sediment in the Salmon-Trout watershed that may be impairing Brook Trout recruitment and work toward remediating priority sites.
7. Assess angler values for tributaries that could potentially support adfluvial runs, particularly with respect to Brook Trout harvest preference and interest in adfluvial Brook Trout rehabilitation.
8. Evaluate the effectiveness and angler acceptance of Brook Trout Restoration Areas following at least 10 years of implementation.
9. Consider expanding use of protective regulations (i.e., Brook Trout Restoration Areas) if proven successful in stream reaches with adfluvial Brook Trout potential and public support.
10. Engage in outreach and improved signage to educate anglers about Brook Trout Restoration Areas.

Burbot

Burbot are a benthic predator in Lake Superior that inhabit all depths from nearshore shallow areas <5 meters deep to the maximum extent of the Great Lakes at just over 400 meters deep. Burbot are known to be potamodromous but also presumed to be lake-spawning in Lake Superior. While there is little data on river runs, recent winter netting efforts caught over 300 Burbot in some Lake Superior tributaries (Jill Leonard, Northern Michigan University, personal communication). Prior to Sea Lamprey control and Lake Trout population recovery, Burbot populations were reduced by lamprey predation. During the 1970s, Burbot populations rebounded but declined again in the 1980s due to the recovery of and predation by lean and Siscowet Lake Trout. Burbot are a key prey resource for adult Lake Trout ecotypes in Lake Superior (Gorman and Sitar 2013; Sitar et al. 2020; Edwards 2023). Fisheries surveys conducted in Lake Superior since the 1980s indicate a highly truncated length distribution with low numbers of large Burbot (Gorman and Sitar 2013). Historically, fisheries targeting Burbot have been limited in Lake Superior, although fishing with hoop nets is allowed in the Sturgeon and Au Train Rivers during winter months. In the past, Burbot were often considered undesirable and discarded by anglers because of misperceptions about their palatability. Recently, interest has increased in targeted recreational fishing for Burbot likely resulting from expanding outdoor-themed social media that has demonstrated technologies such as portable underwater cameras and sonars that allow anglers to observe and track fish. Online videos of Burbot angling and culinary preparation techniques, along with social media showing underwater footage of Burbot have likely fueled the increased recreational value of this species. Understanding this fishery in terms of human dimensions could help the MDNR engage new anglers and reactivate interest from traditional anglers. However, little is known regarding Burbot population dynamics and ecology in Lake Superior and much research is needed to better manage this species.

Goal

Maintain genetically diverse, wild Burbot populations that can endure sustainable levels of fishery exploitation.

Objective

1. Manage recreational and permitted hoop net fisheries to maintain current or higher levels of Burbot abundance.

Management Actions and Evaluations

1. Assess river spawning populations, including estimates of growth, mortality, and abundance, where feasible.
2. Assess lake-spawning populations, including estimates of growth, mortality, and abundance, where feasible.
3. Assess movement dynamics through mark-recapture studies.
4. Review and analyze existing hoop net fishery, recreational fishery, and commercial harvest data to assess appropriate harvest policies.
5. Conduct human dimensions research to measure angler awareness, values, and preferences for Burbot.
6. Monitor Lake Trout consumption of Burbot.
7. Determine reproductive and bathythermal habitat requirements.

Lake Sturgeon

Lake Sturgeon are native to Lake Superior and unique among Michigan fish due to life history characteristics that include attaining large size, extreme longevity, late maturation, and intermittent spawning. Lake Sturgeon can live over 100 years, grow to more than 7 feet long, and weigh over 300 pounds. Lake Sturgeon reach sexual maturity at 15–20 years of age; mature females spawn once every 3–5 years and males spawn annually or every other year. Lake Sturgeon were historically very abundant in all the Great Lakes, although abundance was greatest in the more productive lower lakes, particularly Lake Erie. Lake Sturgeon abundance declined precipitously during the late 1800s and the species is now listed as threatened in Michigan and throughout much of its native range. The decline of Lake Sturgeon was due to several anthropogenic factors that included commercial overharvest and widespread habitat changes, primarily dam construction on spawning rivers. Commercial Lake Sturgeon harvest has been prohibited since 1929 in Michigan's Great Lakes waters. Recreational harvest in Michigan's Great Lakes has been prohibited since 2000, except for the connecting waters of the St. Clair River and Lake St. Clair.

In Michigan waters of the Lake Superior basin the only remnant Lake Sturgeon population spawns in the Sturgeon River (Baraga County). The population is currently considered large (estimated adult abundance of 1,808 in 2012) and stable (Hayes and Caroffino 2012) and the current management goal for the Sturgeon River population is to protect it from overexploitation and other threats so the population can continue to thrive and expand. The Sturgeon River population already shows signs of expanding on its own without the need for stocking.

There is a reintroduced Lake Sturgeon population in the Ontonagon River which is known to have supported a large Lake Sturgeon population prior to extensive European settlement of the region. After surveys conducted in the late-1990s failed to capture sturgeon the population was considered extirpated (locally extinct). Beginning in 1998 Fisheries Division started stocking Lake Sturgeon in the Ontonagon River with the goal of reestablishing a self-sustaining population. The stocking effort is continuing and will likely be ongoing for several more years. The Sturgeon River population (Baraga County) is the source population for gamete collections which makes protecting the Sturgeon River Lake Sturgeon critically important. Surveys in and around the Ontonagon River have shown stocked fish are surviving and healthy and some fish have been observed returning to the river. In fact, netting surveys conducted in the vicinity of Ontonagon in 2021 collected over 80 Lake Sturgeon and the catch per unit effort met the fish community objective for age 4–8 sturgeon. Similarly, in 2021 ten Lake Sturgeon were reported as being caught and released in June and July based on interviews of anglers in Ontonagon. One angler reported catching three in one trip. The fish being caught by anglers are generally between 20 and 30 inches in length. While estimates of the total annual number of released Lake Sturgeon are not generated, it is likely that these observations represent many more being caught throughout the season. While stocked Lake Sturgeon are clearly surviving in the Ontonagon River, natural reproduction has yet to be documented.

The Tahquamenon River is another Lake Superior tributary known to have historically supported a Lake Sturgeon spawning run. However, surveys of the river in the late 1990s failed to capture Lake Sturgeon and the population was determined to be extirpated. Although there has not been a stocking program initiated in Tahquamenon River, it is a high priority river for future Lake Sturgeon restoration.

Goal

Rehabilitate Lake Sturgeon to the point of removal from the threatened species list and to levels that provide productive and unique fishery opportunities.

Objectives

1. Sturgeon River - Enact management practices that will result in population expansion, to include; prohibiting harvest, managing river flows at hydropower facilities to minimize unnatural flow patterns, enhancing habitat where appropriate, providing fish passage where appropriate, and educating the public about Lake Sturgeon.

2. Ontonagon River - Reintroduce Lake Sturgeon and enact management practices that will result in a self-sustaining population. Stocking should be a sustained effort that lasts for a Lake Sturgeon generation (20–25 years) and should strive to maximize genetic diversity of stocked fish.
3. Tahquamenon River - When feasible, reintroduce Lake Sturgeon and enact management practices that will result in a self-sustaining population. Stocking should be a sustained effort that lasts for a Lake Sturgeon generation (20–25 years) and should strive to maximize genetic diversity of stocked fish.

Management Actions and Evaluations

1. Continue to survey the Sturgeon River population annually in the spring when gametes are collected.
2. Work with the U.S. Fish and Wildlife Service to conduct gillnet surveys at index sites on Lake Superior near the Montreal River, Ontonagon, North Entry, South Entry, and the Tahquamenon River.
3. Work with partner agencies to assess the extent of Lake Sturgeon spawning activity in the Ontonagon River as well as the production of larval Lake Sturgeon.
4. Assess the contribution of stocked Lake Sturgeon in the Ontonagon River.
5. Monitor creel survey data to assess trends in the catch of Lake Sturgeon across Lake Superior ports.
6. Work with MDNR Law Enforcement Division and the public to educate anglers about proper catch-and-immediate-release practices for Lake Sturgeon.

Walleye, Muskellunge, Northern Pike, and Other Species

Walleye

Walleye populations in Michigan waters of Lake Superior are relatively small and patchy. Total harvest based on creel survey estimates is generally less than 2,000 Walleyes in recent years, with higher annual harvest estimates in years when creel surveys included the upper St. Mary's River or Ontonagon River. The fish community objective for Walleye in Lake Superior established by the Lake Superior Committee is to "Maintain, enhance, and rehabilitate self-sustaining populations of Walleye and their habitat over their historical range" (Horns et al. 2003). Hoff (2002) identified objectives for rehabilitation in selected areas, which included creating or maintaining spawning and nursery habitats, enhancing fish passage, improving water quality, reducing sedimentation, and reducing contaminants. Rehabilitation strategies for walleye habitats in Michigan waters of Lake Superior include improvement of land use, water use, and habitat-management practices.

Stocking is an important component of Walleye fisheries in Michigan waters of Lake Superior, with larger fisheries in the Ontonagon, Keweenaw-Huron bays, Whitefish Bay, and Upper St. Mary's River areas all receiving stocked fish. Since 2000, Walleye stocked in Michigan waters of Lake Superior have largely been from the Bay de Noc brood source in Lake Michigan; however, other sources have included Portage Lake, St. Mary's River, and Back/Waiska Bay. Protocols outlined in Michigan's Management Plan for Walleye in Michigan's Inland Waters (Herbst et al. 2022) allow for Walleye strains to be stocked across Great Lakes basins as long as they are not in the vicinity of brood source locations that have been determined to be genetically different. Common stocking locations have been Waiska Bay, Huron Bay, Ontonagon River, and Tahquamenon River, with a few other locations stocked periodically (e.g., Grand Marais-West Bay). Estimated annual harvest of Walleyes by non-charter anglers for Michigan waters of Lake Superior sampled by the statewide angler survey program typically totals less than 2,000 fish (Figure 5). Charter reporting on Lake Superior since 2000 shows an annual average harvest of 19 Walleye and an annual average catch of 70 Walleye.

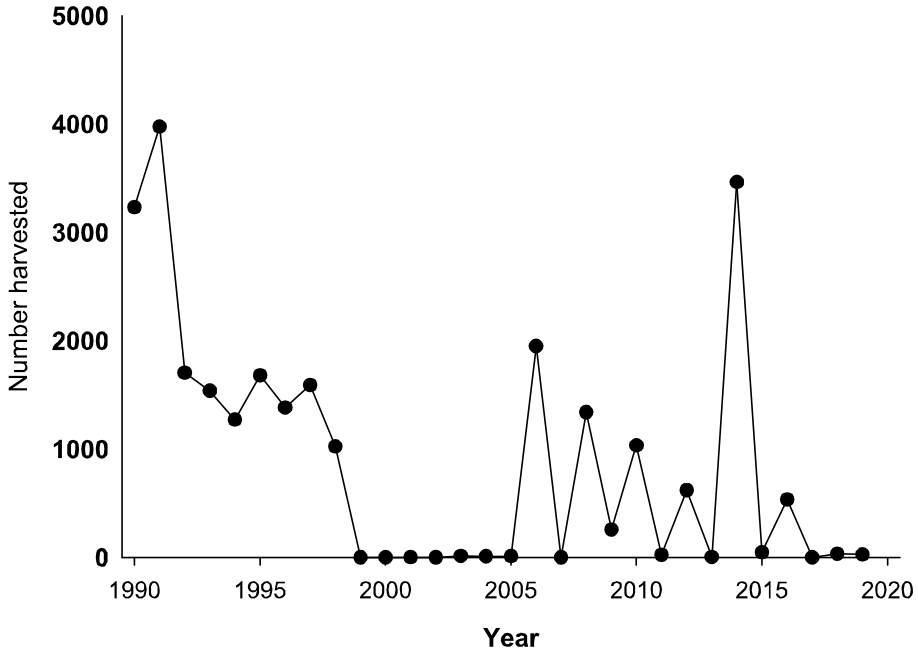

Figure 5. Estimated recreational Walleye harvest from Michigan waters of Lakes Superior from 1990–2019.

Fish communities in Keweenaw, Huron, Munising and West (Grand Marais) bays have been assessed on a 3-year rotation by MDNR since 2015. Average catch rates of walleyes per 320 ft of experimental mesh gill net (Zorn and Kramer 2022) during 2015–2022 in these waters (Keweenaw Bay=0.6; Huron Bay=2.1; Munising Bay = <0.1; West Bay=1.2) reflect their lower productivity relative to catch rates from comparable surveys in Lake Michigan's Little Bay de Noc (4.7 Walleyes per 320 ft of gill net) and Big Bay de Noc (1.5 Walleyes per 320 ft of gill net). Cold, unproductive water makes much of Michigan's portion of Lake Superior less suitable to Walleye as they prefer warmer, more productive environments.

Muskellunge

Muskellunge populations in Lake Superior are comprised primarily of the native Great Lakes strain; however, some populations may have some introgression from inland sources which have been stocked in a few locations (i.e., St. Louis River, MN and Tahquamenon River, MI; Turnquist et al. 2017). Besides some inland stocking of tiger muskellunge (Northern Pike x Muskellunge hybrid) between 1970 and 1990 and some limited northern strain Muskellunge, no muskellunge have been stocked in Michigan waters of Lake Superior. Genetic integrity is important to maintain in Michigan Muskellunge populations (Smith et al. 2016). A clear understanding of the genetic composition of the Muskellunge populations in Lake Superior is needed to consider stocking for rehabilitation and restoration purposes.

Schrouder (1973) suggests that Muskellunge populations were historically abundant in near-shore areas and tributaries across the Great Lakes region and even supported limited commercial fisheries. There is one reported commercial harvest of 8,600 pounds of Muskellunge from the St. Mary's River in 1885 (Michigan Fish Commission 7th Biennial Report), but further commercial harvest of Muskellunge has not been significant for nearly 125 years on the Great Lakes. No targeted commercial Muskellunge fishing efforts take place today on Lake Superior. Muskellunge populations are in low abundance across Lake Superior but remain as an important apex predator supporting localized recreational fisheries. Muskellunge rarely appear in the recreational creel surveys conducted on Lake Superior (<14 fish caught per year since 2006 in the non-charter recreational fishery).

The majority of Muskellunge anglers practice catch and release, resulting in low exploitation of populations. Since 2006, no Muskellunge have been reported as harvested in the recreational creel from Michigan waters of Lake Superior.

Northern Pike

Low-abundance Northern Pike populations are widespread in Lake Superior. Popular periodicals refer to Northern Pike in Lake Superior as "lunkers" and probably the biggest Northern Pike produced in the Great Lakes. There is high potential for Northern Pike to grow to large sizes in Lake Superior because of low mortality and plentiful soft-rayed forage fishes. However, Northern Pike growth in its cold unproductive waters is slow, increasing the time it takes for Northern Pike to achieve trophy size (40 in).

Lake Superior is mostly known for its rocky shorelines and littoral zones. Ideal spawning habitat for Northern Pike is flooded vegetation and marshes. These habitats may be limited when low water conditions persist and reduced by sediment inputs sourced from shoreline erosion and large flood events. Bays with vegetated backwater areas and shoreline marsh complexes should be considered for protection when opportunities arise with the intention of preserving Northern Pike spawning and nursery habitats. Stocking does not occur for Northern Pike in Lake Superior as the population is self-sustaining and should continue to be managed as such. Estimated annual harvest of Northern Pike in the non-charter recreational fishery in Michigan waters of Lake Superior typically is <1,000 fish.

Fish communities in Keweenaw, Huron, Munising and West (Grand Marais) bays have been assessed on a 3-year rotation by MDNR since 2015. Average catch rates of Northern Pike per 320 ft of gill net (Zorn and Kramer 2022) during 2015–2022 in these waters (Keweenaw Bay=0.5; Huron Bay=0.3; Munising Bay=0.3; West Bay=1.4) are about half those in Lake Michigan's Little Bay de Noc (1.0) and Big Bay de Noc (0.9).

Other species

There are other species not covered in this plan that add to the richness of the fish community in Lake Superior. Many of these species are of uncertain status because little effort has been expended to assess trends in their lake-wide distribution or population status. As prey and predators, they act as energy vectors and provide balance and stability (Horns et al. 2003). The current fish community objective (Horns et al. 2003) that addresses the majority of these other species is: "*Protect and sustain the diverse community of indigenous fish species not specifically mentioned earlier (burbot, minnows, Yellow Perch, Northern Pike and suckers). These species add to the richness of the fish community and should be recognized for their ecological importance and cultural, social, and economic value*."

Goal

Self-sustaining populations, and stocked populations supported by judicious stocking, that provide recreational fishing opportunities in Lake Superior bays and tributaries.

Objectives

1. At a minimum, maintain Walleye, Northern Pike, and Yellow Perch as a component of the catch in the annual recreational creel survey.
2. Maintain or enhance Walleye populations where fisheries currently exist, while exploring possible locations for establishing a new Walleye fishery.
3. Maintain and rehabilitate Walleye, Northern Pike, and Muskellunge populations and fisheries as appropriate with appropriate genetic strains.

Management Actions and Evaluations

1. Assess whether development of a Lake Superior strain of Walleye for future stocking is appropriate and feasible given past stocking practices and current genetics.
2. Partner with constituent groups to meet Walleye rearing needs for the Lake Superior basin.

3. Evaluate the need for less/more restrictive minimum length limits for Northern Pike to ensure appropriate harvest protections are in place.
4. Assess feasibility and public acceptance of Muskellunge restoration at various locations in the Lake Superior basin.
5. Continue to address habitat degradation issues in key tributaries that support natural recruitment by removing fish barriers (i.e., road stream crossings and dams).
6. Monitor nearshore game species, non-game fishes, fish species richness, and diversity through standardized sampling efforts of nearshore areas.

Chinook, Coho, and Pink Salmon

Salmon have been part of the fish community in Lake Superior since the 1950s. Species stocked by various management agencies have included Atlantic Salmon, Chinook Salmon, Coho Salmon, and Pink Salmon, however, the current community consists largely of Chinook, Coho, and Pink Salmon. Atlantic Salmon are occasionally reported in angler catches, although they are not currently stocked by any management agencies and their migration from the St. Marys River or Lake Huron is unlikely since they would have to migrate through the shipping locks in Sault Sainte Marie. It is probable that fish identified in recent years as Atlantic Salmon are instead Brown Trout. At the time of writing this report, movement of salmon from Lake Huron or the St. Marys River to Lake Superior (based on coded wire tags) has not been documented (M. Kornis, U.S. Fish and Wildlife Service, personal communication).

Pacific salmon species have adapted well to Lake Superior and its tributaries. Natural reproduction was identified in the 1980s and gradually increased (Hannuksela 1975; Peck et al. 1999). As the contribution of stocked fish declined, management agencies reduced stocking. For example, Coho Salmon stocking in Lake Superior has not occurred by any management agency since the MDNR stopped in 2007. All management agencies on Lake Superior except the Ontario Ministry of Natural Resources and Forestry (OMNRF) ceased stocking Chinook Salmon due to the presence of natural reproduction and poor contribution of stocked fish to the fishery (Goldsworthy et al. 2017; Schreiner et al. 2019). The current stocking plan for Ontario allows for up to 120,000 Chinook Salmon to be stocked yearly (OMNRF 2019), although stocking is largely driven by public interest as unmarked (presumably wild) Chinook Salmon comprise 98% to 99% of the fish caught in Black and Thunder bays (OMNRF 2019). Cessation of Chinook Salmon stocking by MDNR in 2016 was due to poor returns (over 99% of angler-caught fish were from natural reproduction) and high cost of fish returned to creel (range $1,543–$4,558 per fish over 4 years). Pink Salmon were first stocked into the Current River in Ontario in 1956 (Nunan 1967), became naturalized, and are currently not stocked by any management agencies.

Annual lake-wide harvest from the charter and recreational fisheries in Michigan waters of Lake Superior averaged 2,369 Chinook Salmon, 10,619 Coho Salmon, and 1,565 Pink Salmon from 1990–2019. Combined, these salmon species accounted for 28% of the total lake-wide trout and salmon harvest from 1990–2019. Although there appears to be a slight decline in Chinook Salmon harvest over the period (Figure 6), the decline was not statistically significant. When harvest was examined by ports, there was only a weak negative trend for the Marquette/Au Train/Munising area, although it was highly influenced by the relatively high harvest in the 1990s. When the data range was limited to the past 20 years, there was no trend. None the less, given the termination of stocking in 2017, it will be prudent to monitor harvest in the future. The average percentage of Chinook Salmon harvested by age from 2000–2019 was 10.1%, 35.0%, 41.0%, 12.3%, and 1.6% for ages 1–5, respectively. Since a given cohort will contribute to the fishery for 4 years, and since it is prudent to evaluate at least 5 years without stocking, a thorough evaluation of the termination in Chinook Salmon stocking should not occur until at least 2025. For Coho and Pink Salmon, there was no significant trend in harvest from 1990–2019, although Coho Salmon harvest significantly increased from 2000–2019 (Figure 7). Pink Salmon harvest is very sporadic (Figure 8), which is largely because they usually mature, spawn, and die in their second year of life.

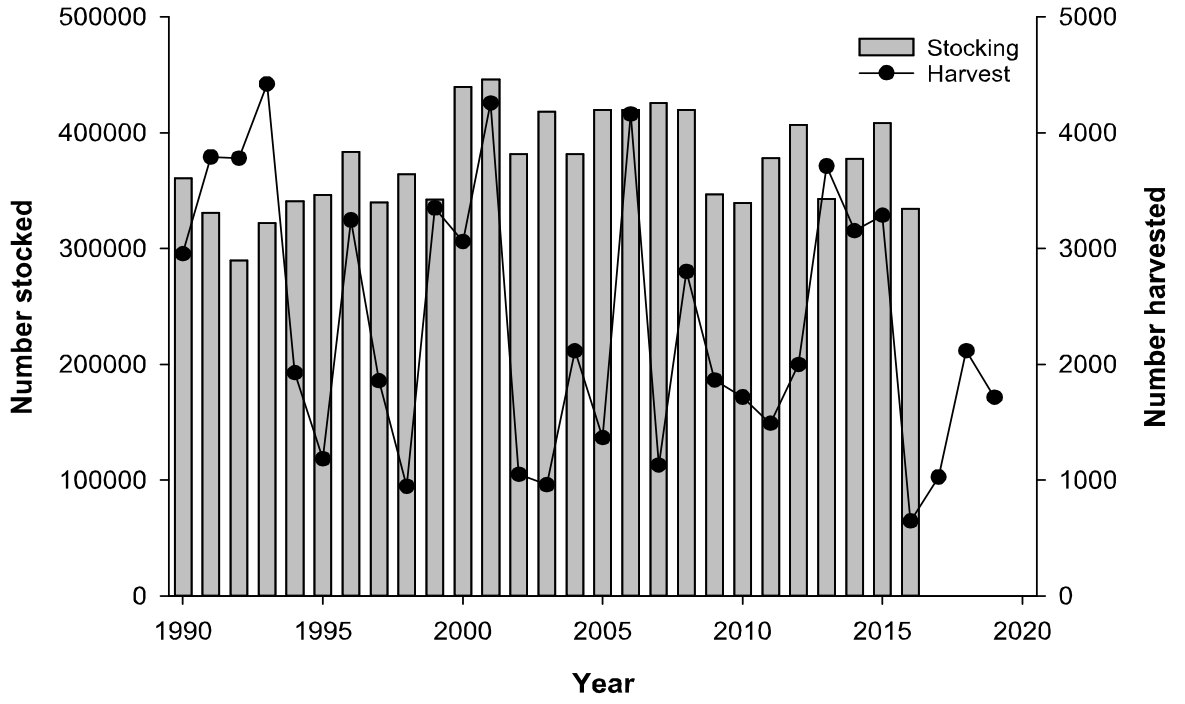

Figure 6. Number of spring fingerling Chinook Salmon stocked in Lake Superior and harvest from Michigan waters of Lake Superior from 1990–2019.

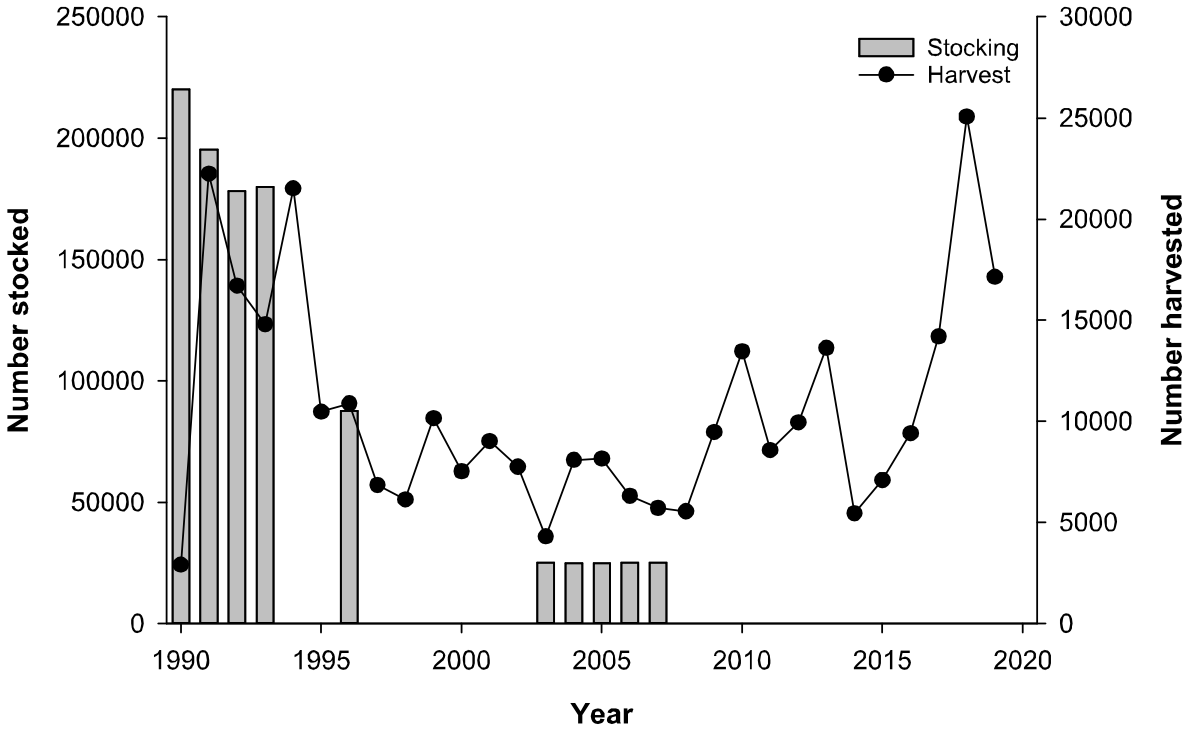

Figure 7. Number of yearling Coho Salmon stocked in Lake Superior and harvest from Michigan waters of Lake Superior from 1990–2019.

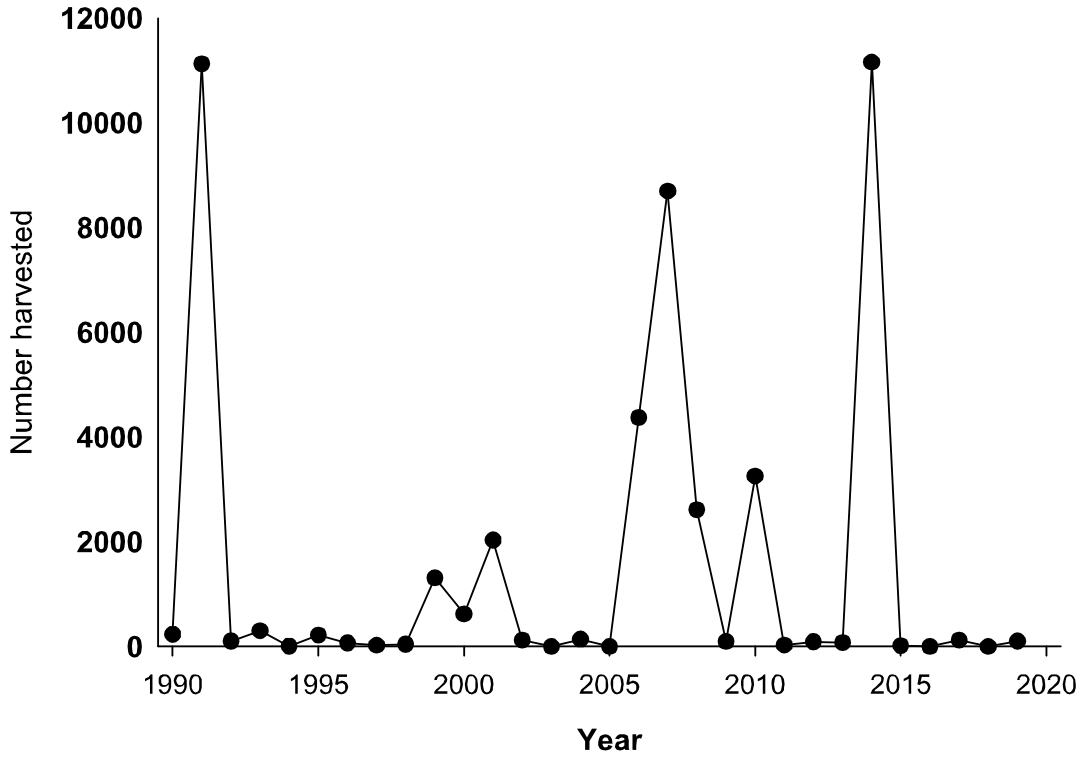

Figure 8. Number of Pink Salmon harvested from Michigan waters of Lake Superior from 1990–2019.

In addition to metrics related to angler returns, there are other important considerations for stocking Pacific salmonids in Lake Superior. Since the abundance of fish predators is largely determined by the abundance of prey fish (bottom-up control), stocking on top of natural reproduction could potentially upset predator-prey balance. In fact, there is evidence that predators may be near carrying capacity in Lake Superior (Kitchell et al. 2000). In Lake Michigan (Dettmers et al. 2012) and Lake Huron (Bence et al. 2008) the stocking of Chinook Salmon was implicated in the reduction of forage bases. Given the status of Cisco in Lake Superior, (see chapter in this plan on Ciscoes and Rainbow Smelt) stocking salmon at this time has the potential to negatively impact valuable prey resources. Additionally, wild Chinook and Coho Salmon in Lake Superior have adapted to the environmental conditions of the lake with different growth and maturation rates. The stocking of either Chinook or Coho Salmon from Lake Michigan (the State's primary egg take location) into Lake Superior could negatively impact naturalized populations. Given the potential threats of stocking Chinook Salmon in Lake Superior, Schreiner et al. (2019) suggested that all management agencies should critically review stocking, especially given the minimal return to the fishery. A management direction that does not include stocking salmon is not a new concept for Lake Superior. The MDNR suggested that stocking Steelhead and Coho Salmon was a limited management option in Lake Superior given poor returns and suggested that agencies should concentrate on habitat protection and enhancement for maintenance of populations (Peck 1992, 2001). While the naturalization of Chinook Salmon in Lake Superior is viewed as a success by managers, some anglers believe that stocking is needed. Numerous responses from the public survey and group meetings indicated a perceived decrease in tributary runs following the termination of stocking. While it is possible that the termination of stocking may marginally reduce the fall return fishery at some locations, the overall contribution of stocked fish has been too low to support continued stocking. Additionally, it is not feasible to assess run sizes on tributaries given the inherent difficulty and cost. In the future, it is anticipated that the fishery will vary annually depending on year-class strength. This is especially true since Chinook Salmon are relatively short lived and at times only supported by one strong year class.

Goal

Self-sustaining Chinook, Coho, and Pink Salmon populations that provide recreational fishing opportunities in Lake Superior and its tributaries.

Objectives

1. Maintain angler catch and harvest in proportion to productivity of the Lake Superior ecosystem.

Management Actions and Evaluations

1. Monitor harvest of salmon species in Lake Superior using the Statewide Angler Survey Program.
2. Monitor harvest of salmon species in Lake Superior tributaries using occasional creel surveys or via angler diaries.
3. Evaluate Chinook Salmon harvest trends before and after cessation of stocking.
4. Work with partners to identify and restore degraded spawning habitat in tributaries.
5. Seek to enhance natural reproduction of adfluvial salmonids by removing dams where feasible and prudent.
6. Monitor salmon production to gain insight into natural reproduction and potential contribution to lake-wide fishery.

Rainbow Trout

Rainbow Trout were introduced to Lake Superior in the late 1800s in Ontario waters. The source for these fish was the McCloud River system in California. Additional introductions of west-coast origin Rainbow Trout occurred in Wisconsin and Minnesota waters through 1920 (MacCrimmon and Gots 1972). The earliest Rainbow Trout stocking in Michigan waters of Lake Superior was 1895 in Townline Creek (Ontonagon) and the Pilgrim River (Houghton). Rainbow Trout were first reported in Lake Superior in 1895 and 1896 by commercial fishers when individual fish were captured during operations (Whitaker et al. 1897). In 1909, the Michigan Fish Commission introduced the first Michigan strain Rainbow Trout (steelhead) to Lake Superior, sourced from progeny of the McCloud River strain reared domestically in Michigan hatcheries. Experimentation with Rainbow Trout continued through 1910, with more routine stocking in Michigan waters of Lake Superior starting in the 1930s. Collectively among the natural resource agencies surrounding Lake Superior, around 23 strains of Rainbow Trout have been stocked with differing management objectives. Michigan DNR currently utilizes the Michigan strain Steelhead whose source is the Little Manistee River in Lake Michigan. Steelhead have adapted quite well to the conditions in Lake Superior and its tributaries and are now naturalized in many streams.

Rainbow Trout management in Michigan waters of Lake Superior and its tributaries has focused on supplementing naturalized wild stocks with hatchery fish (Hansen and Stauffer 1971; Wagner and Stauffer 1978; and Peck 1992). By the 1950s most tributaries had naturally-reproducing Steelhead populations creating popular fisheries. With the increased abundance of Sea Lamprey in the 1950s, Steelhead and other salmonine populations declined throughout Lake Superior and its tributaries (Smith and Tibbles 1980). Control measures initiated by the Great Lakes Fishery Commission in collaboration with the Michigan Department of Conservation (today MDNR) in the 1960s, including lampricide treatments and electric barriers, led to reduced Sea Lamprey populations and allowed for an increase in salmonine populations. As a result, in the late 1960s, Steelhead spawning runs improved as survival and adult abundance increased (Dahl and McDonald 1980). Coinciding with Sea Lamprey control measures, size of yearling Steelhead in hatcheries increased and fisheries managers made appropriate changes in stocking strategies. Using late-spring yearlings (average length 6.7–7.5 in), survival of stocked smolts was expected to increase and provide acceptable returns (Seelbach 1987).

At the time of completion of this report, there are active management prescriptions for 94,000 Michigan strain yearling Steelhead to be stocked in five tributaries and one Lake Superior port, annually. From 1990–2019, annual Steelhead stocking has averaged 88,000 yearlings (range 55,880–130,401 yearlings, Figure 9). Over this period, other Rainbow Trout strains (e.g., Arlee, Eagle Lake, Kamloops, Shasta, and Wytheville) have either been directly stocked into Lake Superior or stocked in tributaries with open access to Lake Superior. Management

prescriptions for these Rainbow Trout strains are no longer active although some stocking has occurred under a private stocking permit. Fall fingerling Michigan strain Steelhead, a byproduct of the rearing process for yearling Steelhead, are stocked when available. From 1990–2019, fall fingerling Steelhead stocking has averaged 147,446 annually (range 30,000–480,000).

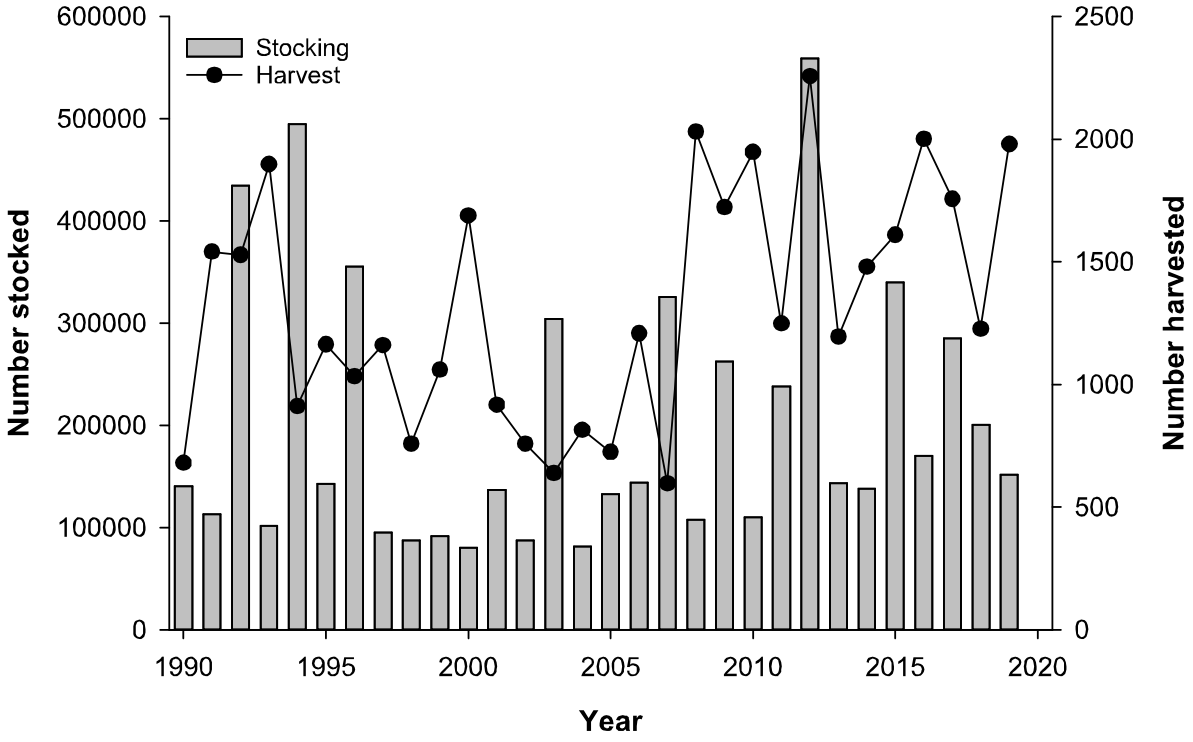

Figure 9. Number of yearling Steelhead stocked in Lake Superior and its tributaries and charter and recreational fishery harvest from Michigan waters of Lake Superior from 1990–2019.

Annual lake-wide harvest from charter and recreational fisheries in Michigan waters of Lake Superior averaged 1,318 Steelhead (Figure 9) from 1990–2019. There was a significant increase in harvest of Steelhead over the period. When considering number of stocked yearlings and Steelhead harvested per hour 3 years later (when mature), there was no significant relationship indicating that the number of stocked fish likely did not influence the harvest rate for Steelhead. Naturally-produced progeny from wild Steelhead are known to have higher survival than progeny of stocked Steelhead (Chilcote et al. 1986). Due to changes in environmental conditions such as increase in water levels and habitat improvements, it is possible that a higher proportion of the harvest is coming from naturally-produced Steelhead in the tributaries. Additional monitoring should be continued for the next several years to determine whether wild Steelhead are contributing to this trend.

Early regulations for trout in the Great Lakes typically relied on size limits with relatively liberal daily possession limits compared to those of recent times. From 1926–1945, 15 Rainbow Trout were allowed in the daily possession limit for Lake Superior. From the late 1960s to 1988, the daily possession limit was reduced to 5 fish per day. From 1989–1999, the daily possession limit for trout was reduced to 5 fish per day (no more than 3 of any species) on the Great Lakes and 10 fish per day on inland streams with no more than 3 fish 16 inches or greater. Since 2000, Rainbow Trout in Lake Superior have been regulated under a 10-inch minimum size limit and a daily possession limit of 3 fish, while inland streams have been regulated by stream “types” carrying various season closures for fishing and harvest. Rainbow Trout in all stream types have a 10-inch minimum size limit and a 5 fish daily possession limit, with no more than 3 fish 15 inches or greater.

Understanding the contribution of stocked and wild Steelhead to the fishery has been a continuous challenge for fisheries managers. Efforts to characterize lake and stream Steelhead fisheries should continue using existing and new tagging technology as well as novel angler data collection methods. Given the lack of funding traditionally available for river creel surveys, consideration should be made to characterize river Steelhead fisheries by alternate means, such as angler diaries, trail camera deployment, and mobile device technology. Additionally, it has been suggested that Michigan fisheries managers should consider use of a local wild stock for Steelhead in Lake Superior (Seelbach and Miller 1993; Peck 1994). While this may be the ideal scenario biologically, a feral egg take is an onerous endeavor given requirements for fish health testing, the appropriate number of adults needed to meet genetic goals, and staffing limitations. A logical first step would be to evaluate the genetic health of wild Steelhead in Lake Superior, including assessment of the contribution from various Rainbow Trout strains that have been stocked.

While Zorn et al. (2020) demonstrated that non-native salmonids can have a negative effect on resident Brook Trout populations, researchers should continue to evaluate interactions between Steelhead and Brook Trout in streams where management strategies have been established for both species. Additionally, understanding the diet composition and overlap with other native and non-native salmonids will be important in establishing management recommendations and research needs for Steelhead lake-wide (Vasquez et al. 2021).

Goal

Self-sustaining Steelhead populations supported by judicious stocking in key tributaries that provide recreational fishing opportunities in Lake Superior and its tributaries.

Objectives

1. Maintain angler catch and harvest in proportion to productivity of the Lake Superior ecosystem.
2. Improve wild Steelhead production, where possible, to reduce reliance on stocking.

Management Actions and Evaluations

1. Continue to address habitat degradation issues in tributaries that support natural recruitment, including barrier removals, fish passage, and conservation of spawning substrates.
2. Evaluate contribution from stocking (various life stages) and natural recruitment to the recreational fishery.
3. Evaluate genetic health of wild Steelhead, including assessment of the contribution from various Rainbow Trout strains stocked in Lake Superior.
4. Identify if a local genetic stock from Lake Superior could enhance spawning runs, therefore protecting the genetic integrity of the wild population.
5. Continue to pursue access for angling along tributaries and shorelines utilizing conservation easements and land acquisitions, where feasible.
6. Conduct river creel surveys during the spring spawning run and late fall early migration, where feasible.
7. Evaluate the appropriateness and acceptance of the current harvest regulations for Steelhead on Lake Superior and tributaries.
8. Evaluate extent of resident Rainbow Trout populations in streams.

Brown Trout

Historically, Brown Trout in Lake Superior have been a minor component of the fishery. Great Lakes Brown Trout are a shallow-water species that perform best in nearshore waters that are generally warmer and more productive, often inhabited by Rainbow Smelt and other prey fish. They prefer temperatures from 50 to 65 degrees Fahrenheit (Coutant 1977) but can tolerate temperatures in the 70s. In Michigan waters of Lake Superior, the cold and relatively unproductive nearshore water may not allow for the same stocking survival as realized in other areas such as Chequamegon Bay and the Apostle Islands (Wisconsin). From 1990–2019, harvest from Michigan waters of Lake Superior averaged 874 fish. River harvest has not been assessed frequently, although Peck (1992) reported an average annual harvest of 144 and 128 fish in the Carp and Chocolay rivers, respectively from 1984–1987. Resident and migratory Brown Trout populations are known to exist in numerous Lake Superior tributaries (Hannuksela 1969; Juetten 1973) where they are supported by low levels of natural reproduction. While stocking has contributed to the fishery in some locations, overall returns have been low. Peck (1992) reported that hatchery Brown Trout made up 40% of the Brown Trout catch in the Marquette area of Lake Superior and 4–50% of the catch in three tributaries that were monitored from 1984–1987. While this evaluation proved that stocked fish survived and contributed to the fishery, the average annual Brown Trout catch from the Marquette area of Lake Superior was only 273 fish, while the average catch from the tributaries was 272 fish, an overall return to creel of <1%. Over the 1990s and 2000s Brown Trout stocking continued at several Michigan ports on Lake Superior to diversify the fishery; however, returns >1% were never realized.

Brown Trout regularly migrate to Michigan from Wisconsin waters as evidenced by fin clips observed in creel surveys. From 2000–2019, Brown Trout originating from Wisconsin waters comprised 16% of the Brown Trout observed in Michigan waters. Most recently, from 2014–2019, the percentage of fish originating from Wisconsin increased from 8% to 29%. In 2018 and 2019, Brown Trout harvest in Michigan waters of Lake Superior increased substantially to 4,462 fish and 6,213 fish, respectively (Figure 10). While we are confident that Brown Trout harvest increased, there is some uncertainty about the magnitude of the increase given the method used to expand harvest to unsampled ports (Lenart and Turschak, in preparation). This increase in harvest was likely due in part to stocking efforts by the Wisconsin DNR, although naturally-produced year classes may have also contributed to an unknown degree. The movement of Brown Trout from Wisconsin waters is not a new development as Peck (1992) reported that 64% of hatchery Brown Trout caught in Lake Superior at Marquette were fish stocked in Wisconsin waters. It is not known why Wisconsin Brown Trout tend to migrate to Michigan waters, but it is possibly related to surface currents that generally flow easterly from Wisconsin (Bennington et al. 2010).

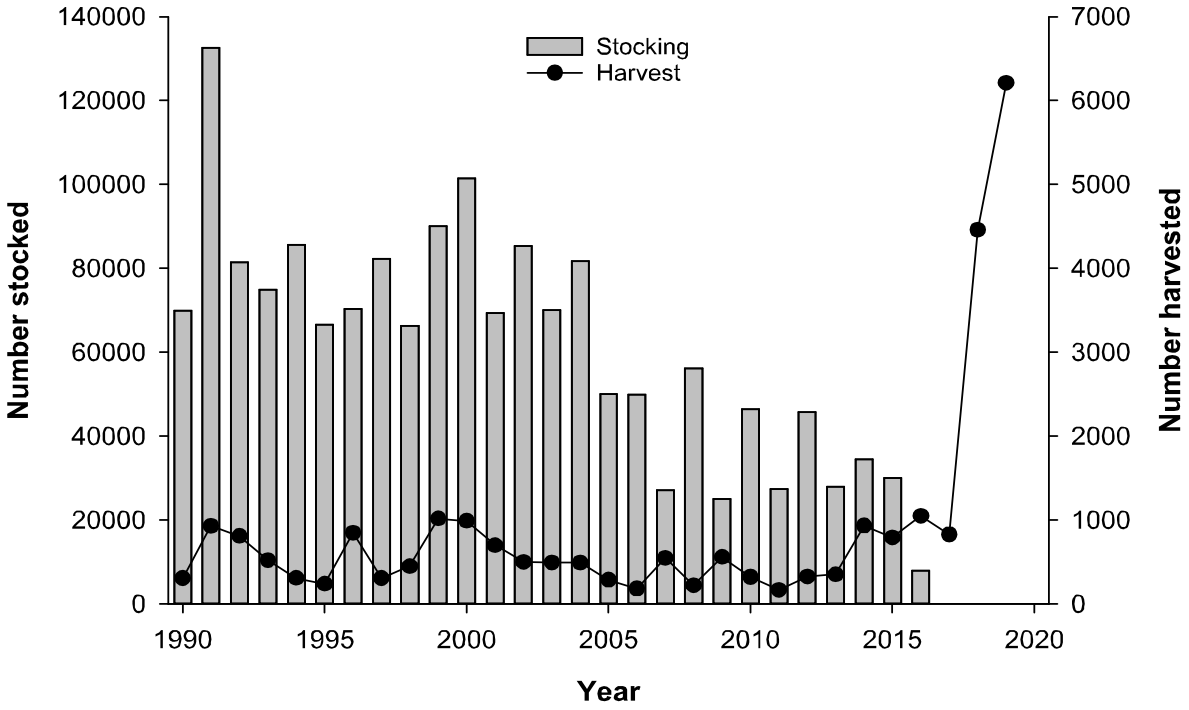

Figure 10. Number of yearling Brown Trout stocked and harvest from Michigan waters of Lakes Superior from 1990–2019.

In Lake Huron, Johnson and Rakoczy (2004) attributed Brown Trout survival to Alewife abundance, whereby the Alewives buffered against predation of stocked trout. Similarly, the Wisconsin DNR attributes some the recent stocking success of Brown Trout to offshore stocking that was employed in Chequamegon Bay to reduce predation on newly stocked fish (B. Ray, Wisconsin DNR, personal communication). Given the apparent relationship between Brown Trout survival and both prey and predator abundance, any efforts to create or enhance fisheries via stocking must consider these potential factors. In Michigan, locations with suitable nearshore habitat (e.g., Ontonagon to North Entry) would provide the best opportunity for stocking success. However, managers must recognize the negative effect that Brown Trout have on native Brook Trout (Zorn 2020). Given the overall priority of native species recognized by the Lake Superior Committee, Brown Trout should be stocked sparingly in Lake Superior and its tributaries.

Goal

Maintain nearshore (e.g., piers, breakwalls, ice fishing, small boats) recreational fishing opportunities for Brown Trout.

Objectives

1. Maintain angler catch and harvest in proportion to productivity of the Lake Superior ecosystem.
2. Minimize potential negative effects of Brown Trout on other native fish species.

Management Actions and Evaluations

1. Supplement naturalized populations of Brown Trout with surplus hatchery fish, when available, in nearshore areas of Lake Superior with a high probability of survival and low probability of interaction with native Brook Trout.
2. Evaluate Brown Trout stocking to determine which factors influence success.
3. Continue to evaluate the extent of natural reproduction of Brown Trout in tributaries.

Splake

Splake are a hybrid between male Brook Trout and female Lake Trout. They were initially stocked in the Great Lakes to create a fishery following the collapse of Lake Trout. While stocking was reduced over the years as Lake Trout took over hatchery space and evaluations found poor Splake returns, stocking has continued at a few sites where significant fisheries were created. From 1981–2013, Splake were primarily stocked in Copper Harbor, Marquette Harbor, and Munising Bay with between 10,000–30,000 yearlings stocked annually at each site. In 2015, fisheries managers developed a method to evaluate the suitability of existing Splake stocking sites using the following criteria: relative public use, Splake return, cost per fish caught, diversity of salmonid fishery, relative importance of Splake, and seasonality of the fishery. As a result of the site evaluation tool, Marquette was eliminated as a suitable stocking site with the last stocking occurring in 2016. Similarly, a method was established to evaluate new stocking sites using the following criteria: feasibility of ice fishery and/or small-boat fishery, habitat and forage suitability, value Splake may add to existing fishery, evaluation potential, cost, and risk to native fish species. In an evaluation completed in 2016, Keweenaw Bay ranked the highest of six sites evaluated. While surplus Splake had occasionally been stocked in Keweenaw Bay as early as 2013 when hatchery production exceeded amounts prescribed for existing sites, in 2021, Keweenaw Bay was established as an annual stocking site for Splake.

Given their tendency to occupy nearshore habitats, Splake are rarely caught in standardized spring and summer surveys which are largely used to assess Lake Trout and Lake Whitefish populations. Therefore, creel surveys have generally been used to assess relative abundance. Estimated harvest of Splake from Michigan waters of Lake Superior averaged 1,502 fish from 1990–2019, with a range of 292–3,434 fish. Over that period harvest gradually increased (Figure 11) which is largely attributed to increased survival resulting from an increase in the size of Splake stocked.

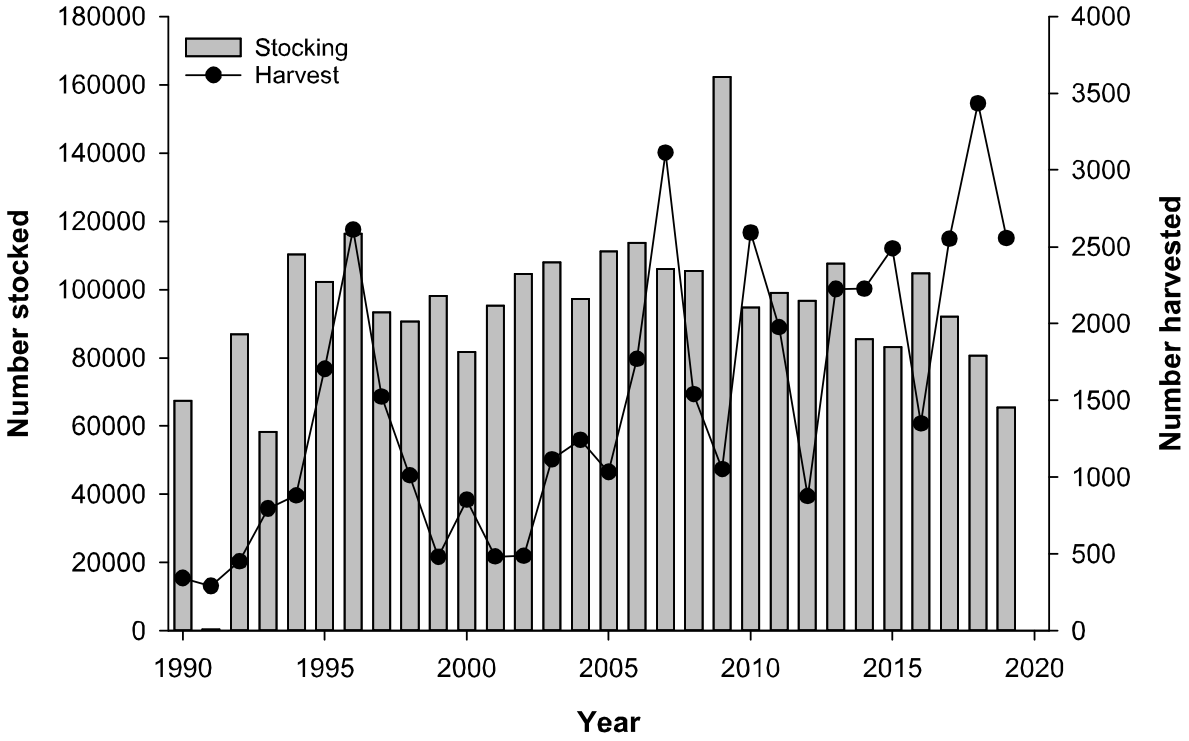

Figure 11. Number of yearling Splake stocked and harvest from Michigan waters of Lakes Superior from 1990–2019.

Estimates of return to creel vary when calculated for catch versus harvest, as well as when catch/harvest from adjacent sites is evaluated to determine if stocking is a prudent management action at a given site. Generally, return based on catch (harvest and release combined) ranges from 4–7% annually across sites, whereas return based on harvest ranges from 1–5% annually at various sites. Return to creel is an imperfect metric as harvest from non-surveyed months is missed. For example, the open-water creel period is from April through October and the ice-cover creel period is generally February and March on Lake Superior. Thus, harvest that occurs in November, December, and January is not estimated. Splake returns to the creel can occasionally be remarkable. In 1985, Splake return in Lake Superior was estimated at 13%, the highest for any salmonid in the study (Peck 1992). The fishery for Splake is seasonal, with angler catch being highest in the winter, early spring, and fall. Splake stocking sites have varying ice-cover periods with Munising generally having the longest, followed by Keweenaw Bay, and Copper Harbor which in some years only has 3–4 weeks of ice cover. The extent of ice cover each year likely has a positive effect on annual harvest.

While Splake provide a unique and popular fishery for many anglers in Lake Superior, they are not without controversy. Given that Splake can be fertile, there has been concern about introgression, or the transfer of genetic information from one species to another, in this case introgression between native Brook Trout and Lake Trout. Introgression is a concern as it could reduce the fitness of native species, including reduced ability to adapt to changes. Stott (2008) documented introgression of Splake in both Lake Trout and Brook Trout; however, the geographic extent of introgression among populations has not been investigated. Additionally, the difficulty in differentiating Splake from both parental species has resulted in challenges for regulations. In the past, anglers have suggested that Lake Trout in their possession were Splake and therefore fell under different size or possession limits. Given that accurate identification requires counting the internal pyloric caeca, enforcement is difficult. Seasons and size limits were aligned over the years, but possession limits still vary between Splake and Lake Trout, and size limits differ between Splake and Brook Trout. Several areas of Lake Superior have a 20-inch minimum size limit for Brook Trout whereas Splake and Lake Trout have a 15-inch minimum size limit. If the Splake minimum size limit were increased to match Brook Trout, it would result in a greatly reduced return to creel. Since the Splake size limit was increased to 15 inches in 2011, 70% of fish harvested have been between 15–20 inches.

Under the structure of the Great Lakes Fishery Commission, the Lake Superior Technical Committee recently highlighted many of the concerns about stocking Splake in Lake Superior (LSTC 2022). While all the potential negative effects associated with Splake stocking are not repeated here, we highlighted some of the research needs by incorporating them into this Management Plan.

Goal

Create limited nearshore (e.g., pier, breakwall, ice fishing, small boat) recreational fishing opportunities for Splake.

Objectives

1. Maximize return to creel by producing and stocking high-quality hatchery Splake.
2. Minimize potential negative effects of Splake on other native fish species.

Management Actions and Evaluations

1. Monitor catch and harvest of Splake using angler surveys, charter boat reporting, and potentially angler diaries.
2. Monitor growth and condition of Splake and adjust stocking rates as necessary.
3. Assess the potential for angler catch/harvest that is missed due to non-surveyed periods and consider occasional expansion of creel to capture periods when anglers are targeting Splake.
4. Mark stocked Splake to improve identification and accuracy of harvest estimates. Partner with angler groups to mark Splake.
5. Work with angler groups to deter avian predation on stocked Splake.
6. Assess movement of Splake from stocking sites using angler survey and netting surveys.
7. Monitor the extent of Splake presence with spawning aggregations of Lake Trout and Brook Trout.

8. Assess extent of Splake diet overlap with native species.
9. Assess the fertility and/or gamete viability of mature Splake caught in the wild.
10. Assess the potential for and/or determine the extent of genetic introgression of Splake with Lake Trout and Brook Trout populations in Lake Superior and tributaries.
11. Work with partner agencies to assess gamete viability via production of F2 Splake - Brook Trout and/or Lake Trout hybrids.
12. Investigate feasibility of producing triploid Splake, including hatchery constraints, success in producing sterile Splake, and relative survival of triploid versus diploid Splake.
13. Propose combining the daily possession limit for Lake Trout and Splake to avoid identification issues and increase harvest opportunities in some areas where Splake are stocked.

Ciscoes and Rainbow Smelt

The prey fish assemblage in Lake Superior includes a variety of species, such as Cisco, Bloater, Kiyi, Shortjaw Cisco, Pygmy Whitefish, Rainbow Smelt, and multiple stickleback, sucker, and sculpin species (Ebener and Pratt 2021), all of which are at least seasonally important diet items for both native and non-native piscivores (Conner et al. 1993; Gamble et al. 2011a, 2011b; Ray et al. 2007; Vasquez et al. 2021). Prey fish populations are generally controlled by sporadic recruitment driven by large-scale environmental factors (e.g., coregonines) and/or predation from lean and Siscowet Lake Trout (e.g., Rainbow Smelt) that regulates species-specific abundances and age-distributions (Ebener and Pratt 2021). As a result, most prey fish species in Michigan waters of Lake Superior cannot be effectively managed. Notable exceptions include Cisco and potentially Rainbow Smelt. Harvests of both species are only loosely regulated, and their management and status are described below.

Cisco are pelagic and inhabit both nearshore (<90 m depth) and offshore (≥90 m depth) waters of Lake Superior (Gorman et al. 2012) where they feed mostly on large crustacean zooplankton and serve as prey for lean and Siscowet Lake Trout, Burbot, and non-native Pacific salmon (Conner et al. 1993; Gamble et al. 2011a, 2011b; Ray et al. 2007; Vasquez et al. 2021). Historically, Cisco was likely the single most abundant fish species in each of the Great Lakes, including Lake Superior (Smith 1995). Prior to European settlement, populations along the southern shore of the lake were targeted by Native American subsistence fisheries, although the larger Lake Whitefish was generally preferred over Cisco (Lawrie and Rahrer 1973). Harvests of Cisco increased following European settlement as more efficient, large-scale commercial fisheries began targeting the same populations around 1900 (Koelz 1926). Cisco fisheries collapsed by the mid-1900s (Lawrie and Rahrer 1973) due to sequential overfishing of discrete stocks (Selgeby 1982) and interactions with non-native Rainbow Smelt (Anderson and Smith 1971). Increased commercial fishery regulation (MacCallum and Selgeby 1987), recovering Lake Trout stocks that suppressed Rainbow Smelt populations (Gorman 2012), and a few strong recruitment events during the 1980s and 1990s (Bronte et al. 2003) allowed Cisco to partially recover in Lake Superior, but as recently as 2020, the species had not fully recovered. For example, during the last 20 years for which data are available (2001–2020), commercial harvests of Cisco in Michigan waters of Lake Superior were only 0.5% of those during the 20-year period prior to collapse (1947–1966; Figure 12). Re-oligotrophication since the mid-1900s (Dove and Chapra 2015; Reavie et al. 2014; Shaw-Chraibi et al. 2014) was suspected of limiting full recovery to observed historical levels, possibly due to environmental conditions that are less suitable for age-1 recruitment (Rook et al. 2021). However, the large 2022 Cisco year-class, observed as age-0 fish in the fall of 2022 and again as age-1 fish in the spring of 2023, has managers questioning this theory. Whether or not this large Cisco year-class persists as adults will determine any changes in management direction for this species, likely over the next 20-year period.

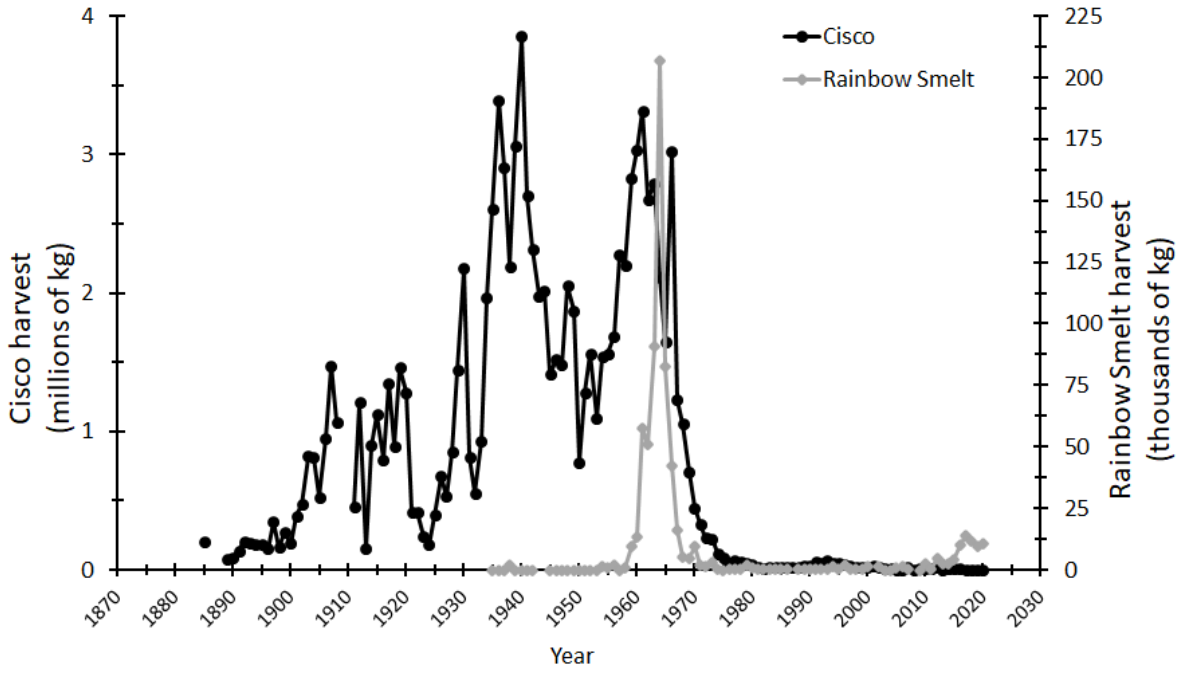

Figure 12. Total annual commercial Cisco and Rainbow Smelt harvest in Michigan waters of Lake Superior during 1880–2020 (GLFC 2022a).

Naturally-reproducing Cisco populations currently support limited commercial, recreational, and subsistence fisheries across Michigan waters of Lake Superior. Most Cisco sold to Michigan-based wholesale fish dealers during 2021–2022 (>14,000 kg annually) were harvested in Wisconsin waters of Lake Superior. In Michigan waters of Lake Superior, commercial Cisco harvests are generally limited to bycatch in "chub" (deepwater cisco) fisheries (Ebener et al. 2008) or small, targeted spawning fisheries (October–December) around Whitefish Bay (<1,000 kg annually during 2021–2022). Recreational fisheries are concentrated in Keweenaw Bay, Huron Bay, near Munising and Grand Marais (Ebener et al. 2008), and along the south shore of Whitefish Bay and the upper St. Marys River, where anglers use hook-and-line to target Cisco through the ice. There is no closed season for the recreational Cisco fishery in Michigan waters of Lake Superior and the daily possession limit is 10 total fish, which includes any combination of Cisco, Lake Whitefish, and Round Whitefish (MDNR 2023). Tribal subsistence fisheries target Cisco with small mesh (2.0–3.0 in. stretch-measure) gill nets and individual fishers are generally limited to 300 ft (91.4 m) of net and 100 pounds (45.4 kg) of fish per day (U.S. v. State of Michigan 2000).

Sporadic recruitment drives Cisco populations in Lake Superior (Vinson et al. 2022), and recruitment cannot be controlled by resource agencies (Stockwell et al. 2009). Therefore, limiting total annual mortality to conserve adult spawning stocks is a primary management objective. Fishing and Sea Lamprey mortality are the only sources of mortality that can be controlled, and both should be maintained at the lowest levels possible to promote Cisco recovery and provide adequate prey for piscivores while still supporting limited commercial, recreational, and subsistence fisheries. Harvey et al. (2008) found that 25% of parasitic phase Sea Lamprey captured in Lake Superior were attached to Cisco. Maintaining Sea Lamprey abundance and wounding rates on lean Lake Trout below established target levels (GLFC 2022b) will also benefit Cisco and state resource agencies should continue to support bi-national Sea Lamprey control efforts. Fishing mortality rates are already low for most Cisco populations in Michigan waters of Lake Superior and should be maintained at or below current levels.

Rainbow Smelt are pelagic and inhabit nearshore (<90 m depth) waters of Lake Superior (Gorman et al. 2012) where they feed mostly on large crustacean zooplankton and serve as prey for lean and Siscowet Lake Trout, Burbot, and non-native Pacific salmon and trout species (Conner et al. 1993; Gamble et al. 2011a, 2011b; Ray et al. 2007; Vasquez et al. 2021). Rainbow Smelt likely entered Lake Superior from Lake Huron through the St. Marys River. The first official specimen was collected from Whitefish Bay in 1930 (Van Oosten 1937). During the following years, Rainbow Smelt quickly spread throughout nearshore waters of the lake (Lawrie and Rahrer 1973) where they replaced Cisco as both the dominant zooplanktivore and prey of Lake Trout (e.g., Dryer

et al. 1965). Rainbow Smelt populations peaked during the late 1950s and early 1960s, a period when Lake Trout abundance was at an all-time low and Cisco abundance was rapidly declining (Gorman 2012). Declines in Rainbow Smelt abundance were observed concurrent with increased Lake Trout stocking during the late 1960s, and further declines occurred as Lake Trout stocks recovered during the 1970s and 1980s (Gorman 2012). More recent U.S. Geological Survey (USGS) prey fish surveys indicate that lake-wide Rainbow Smelt biomass has declined by more than 50% since 1989 (Ebener and Pratt 2021), and reduced Rainbow Smelt populations are thought to be a factor in the partial recovery of Cisco observed during the 1980s and 1990s (Bronte et al. 2003; Gorman 2012). In Michigan waters of Lake Superior, a relatively small commercial fishery for Rainbow Smelt existed during the late 1950s and early 1960s, but this fishery disappeared by the early 1970s, a pattern consistent with the abundance trends described above (Figure 12).

Naturally-reproducing Rainbow Smelt populations currently support limited commercial, recreational, and subsistence fisheries across Michigan waters of Lake Superior. Rainbow Smelt spawn during April–May when they can be found ascending tributaries along the south shore of the lake. There are also anecdotal reports of beach spawning. Commercial Rainbow Smelt harvests are generally limited to small, lake-based fisheries targeting pre- and post-spawn fish in and around Whitefish Bay (~9,000–17,000 kg annually during 2021–2022), although some fish are taken as bycatch in fisheries targeting other species. Recreational fisheries target spawning runs using hand nets and are concentrated in tributaries to Keweenaw Bay, Huron Bay, Whitefish Bay, and near Munising and Grand Marais. Anglers also use hook-and-line to target Rainbow Smelt off tributary mouths, especially just prior to ice-out. Some of the more popular tributaries include those flowing into Keweenaw Bay to the west and the Anna River, Tahquamenon River, and Roxbury Creek to the east. Anecdotal accounts indicate relatively high levels of hand-netting effort during the 1970s and 1980s that has declined in more recent decades. During 2020–2021, average harvest of Rainbow Smelt in the Keweenaw Bay ice fishery was 2,400 fish/year, whereas that near Munising was 2,200 fish/year. There is no closed season for anglers using hook-and-line to target Rainbow Smelt in Michigan waters of Lake Superior, but hand nets can only be used within the lower half mile of tributaries from March 1st to May 31st, and the daily possession limit is 2 gal (MDNR 2023). Tribal subsistence fisheries target Rainbow Smelt with both micro mesh (≤2.0 in. stretch-measure) gill nets in Lake Superior and hand nets in tributaries. Individual fishers are generally limited to 300 ft (91.4 m) of net and 100 pounds (45.4 kg) of fish per day in Lake Superior (U.S. v. State of Michigan 2000). Reporting of tributary catches is not required for subsistence or recreational fisheries (U.S. v. State of Michigan 2007); these catches are unknown and likely highly variable from year-to-year.

Recent studies (e.g., Myers et al. 2009) suggest that predation by juvenile and adult Rainbow Smelt on larval Cisco could impede Cisco recovery and negatively impact the native food web in Lake Superior. However, Rainbow Smelt are also a major diet item for lean Lake Trout, Coho and Chinook Salmon, and Rainbow and Brown Trout (Conner et al. 1993; Ray et al. 2007; Vasquez et al. 2021), all of which are important commercial or sport fish species. Biomass of Rainbow Smelt in Lake Superior is inversely correlated with Lake Trout abundance and was high during the mid-1900s, when Lake Trout stocks were severely depleted, but declined concurrent with Lake Trout recovery since the 1970s, primarily due to selective predation from Lake Trout on larger Rainbow Smelt (Gorman 2012; Ray et al. 2007). The primary management objective for Rainbow Smelt in Michigan waters of Lake Superior is to maintain self-sustaining populations at the lowest levels possible to promote Cisco recovery while still providing adequate prey for piscivores and supporting limited commercial, recreational, and subsistence fisheries. Given that fishery managers cannot directly control Rainbow Smelt abundance, this management objective will likely be accomplished indirectly by maintaining Lake Trout abundance within a range of levels capable of producing the desired outcomes.

Goal

Maintain self-sustaining Cisco and Rainbow Smelt populations capable of providing adequate prey for piscivores and supporting limited commercial, recreational, and subsistence fisheries while still promoting Cisco recovery.

Objectives

1. Maintain total annual mortality rates for Cisco at the lowest levels possible to conserve adult spawning stocks and promote Cisco recovery.

2. Maintain Sea Lamprey abundance (<10,000 adults) and wounding rates (5.0 wounds per 100 fish) on lean Lake Trout below established target levels for Lake Superior to limit Sea Lamprey-induced mortality on Cisco.
3. Maintain current recreational fishing opportunities for Cisco and promote new opportunities if/when abundances permit.
4. Maintain Rainbow Smelt populations at the lowest levels possible to provide adequate prey for piscivores and promote Cisco recovery.
5. Maintain Lake Trout abundance at levels that limit Rainbow Smelt populations and promote Cisco recovery.

Management Actions and Evaluations

1. Continue to monitor annual fish community survey data for changes in Cisco, Rainbow Smelt, and Lake Trout abundances to identify potential management changes, population-level threats, and/or Cisco recovery.
2. Support bi-national efforts to reduce and maintain adult Sea Lamprey abundance in Lake Superior at or below target levels (<10,000 adult lampreys).
3. Continue to work with Tribal resource agencies to monitor Cisco mortality rates.
4. Support inter-agency research efforts aimed at understanding the complex interactions between Cisco, Rainbow Smelt, and Lake Trout in a food web context.
5. Continue to conduct human dimensions research to assess demographics, values, and preferences of Lake Superior anglers.

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Appendix A. Lake Superior Angler Survey

Michigan Department of Natural Resources, Fisheries Division

Lake Superior Angler Survey

This information is requested under authority of Part 435, 1994 PA 451, M.C.L. 324.43539.

The Michigan Department of Natural Resources Fisheries Division is seeking your feedback to help inform the development of a Fisheries Management Plan for Lake Superior and its tributaries. The questions are designed to gather input from anglers about recent angling activity and opinions regarding fisheries management. Some questions will be asked separately with respect to Lake Superior or tributaries (rivers and streams flowing into Lake Superior up to the first barrier such as waterfall or dam). The information obtained in this survey will be used along with biological data to develop a 10-year Management Plan for Lake Superior.

This survey should take about 10-15 minutes to complete. Your answers are strictly confidential and specific data will not be shared with any other parties.

If you have any questions about this survey, please email: Isenhoffd@michigan.gov

1. As a recreational activity, how important is fishing for you compared to other recreational activities (select one)
   - My most important recreational activity
   - One of my more important recreational activities
   - No more important than other recreational activities
   - Not at all important as a recreational activity
   - Less important than most of my recreational activities

2. In the past 12 months, how many times did you go fishing? (select one)

   - Not at all
   - 1 time
   - 2 or 3 times
   - 4 or 5 times
   - 6 to 9 times
   - 10 to 19 times
   - 20 or more times

3. How many years have you fished Lake Superior and its tributaries? (select one)

   - Never
   - Less than 1 year
   - 1-5 years
   - 6-10 years
   - 11-15 years
   - 16-20 years
   - More than 20 years

In the following 2 questions, we are attempting to gauge people's understanding of the fish populations in Lake Superior and its tributaries.

4. Please select all species that are native to Lake Superior from the following list. (select all)
   - Atlantic salmon
   - Brook Trout
   - Brown Trout
   - Cisco
   - Chinook salmon
   - Coho salmon
   - Lake Trout
   - Menominee
   - Northern Pike
   - Pink salmon
   - Rainbow trout (steelhead)
   - Siscowet
   - Smelt
   - Splake
   - Walleye
   - Whitefish

5. Please select the two fish species that are used to create the hybrid fish known as Splake. (select two)
   - Atlantic salmon
   - Brook Trout
   - Brown Trout
   - Cisco
   - Chinook salmon
   - Coho salmon
   - Lake Trout
   - Menominee
   - Northern Pike
   - Pink salmon
   - Rainbow trout (steelhead)
   - Siscowet
   - Smelt
   - Splake
   - Walleye
   - Whitefish

The following questions pertain to fishing on <u>Lake Superior</u> only. Separate questions will be asked regarding fishing on Lake Superior tributaries (rivers and streams) later in the survey.

6. In the past 12 months, how many times did you fish on <u>Lake Superior</u>? (select one)

   - Not at all
   - 1 time
   - 2 or 3 times

4 or 5 times
6 to 9 times
10 to 19 times
20 or more times

7. How do you primarily fish on Lake Superior during the open-water season? (select one)
   Breakwall or pier
   Shore or wading
   Canoe or kayak
   Personal motor boat
   Charter boat

8. What species do you target when fishing on Lake Superior? (select all that apply)
   Brook Trout
   Brown Trout
   Coho and Chinook salmon
   Lake Trout or Siscowet
   Northern Pike
   Rainbow trout (steelhead)
   Smelt
   Splake
   Walleye
   Whitefish, cisco, or menominee
   Other

9. What species do you target most often on Lake Superior? (select one)
   Brook Trout
   Brown Trout
   Coho and Chinook salmon
   Lake Trout or Siscowet
   Northern Pike
   Rainbow trout (steelhead)
   Smelt
   Splake
   Walleye
   Whitefish, cisco, or menominee
   Other

10. When fishing for the following species on Lake Superior, is it your primary intent to harvest or catch and release? (check boxes for harvest vs. catch and release)

    Brook Trout
    Brown Trout
    Coho and Chinook salmon
    Lake Trout or Siscowet
    Northern Pike
    Rainbow trout (steelhead)

Smelt
Splake
Walleye
Whitefish, cisco, or menominee
Other
Question not applicable as I did not fish Lake Superior

11. What is your preferred size Lake Trout to harvest for consumption? (select one)
    15-19.9 inches
    20-24.9 inches
    25-29.9 inches
    Larger than 30 inches

12. Because of high catch-and-release mortality (40%) on Lake Trout, size limits are not as effective as other regulations for reducing harvest. If regulation changes are necessary to maintain Lake Trout sustainability, what type of regulation change would you prefer? (select one)
    Reduced daily possession limit
    Shortened harvest season or spawning closure

13. Would you support more restrictive Lake Trout harvest regulations (for example reduced daily possession limits) on offshore reefs such as Stannard Rock and Big Reef to better protect those populations? (Yes/No)

14. Please rank the fishing methods that you use for Lake Trout, with 1 being the method used most often. (not all methods require a ranking)
    boat: Down rigger
    boat: wire/copper/lead-core line (fishing with wire line without downrigger)
    boat: bobbing/jigging (fishing with rod by hand while drifting or still)
    Shoreline/pier/breakwall
    Ice fishing

The following questions pertain to fishing on <u>tributaries</u> (rivers and streams) to Lake Superior (specifically the reaches that are accessible to fish from Lake Superior).

15. In the past 12 months, how many times did you fish on <u>tributaries</u> to Lake Superior? (select one)

    Not at all
    1 time
    2 or 3 times
    4 or 5 times
    6 to 9 times
    10 to 19 times
    20 or more times

16. When you fish on <u>tributaries</u> to Lake Superior, how do you primarily fish? (select one)
    Dock, bank, or shore
    Wading
    Non-motorized canoe, drift boat, or kayak

Personal motor boat
Charter boat

17. When you fish using hook-and-line on tributaries to Lake Superior, what type of gear do you most often use? (select one)

    Artificial fly
    Artificial lure
    Bait

18. What species do you target on tributaries to Lake Superior? (select all that apply)
    Brook Trout
    Brown Trout
    Coho and Chinook salmon
    Lake Trout or Siscowet
    Northern Pike
    Rainbow trout (steelhead)
    Smelt
    Splake
    Walleye
    Whitefish, cisco, or menominee
    Other

19. What species do you target most often on tributaries to Lake Superior? (select one)
    Brook Trout
    Brown Trout
    Coho and Chinook salmon
    Lake Trout or Siscowet
    Northern Pike
    Rainbow trout (steelhead)
    Smelt
    Splake
    Walleye
    Whitefish, cisco, or menominee
    Other

20. When fishing for the following species on tributaries to Lake Superior, is it your primary intent to harvest or catch and release? (check boxes for harvest vs. catch and release)

    Brook Trout
    Brown Trout
    Coho and Chinook salmon
    Lake Trout or Siscowet
    Northern Pike
    Rainbow trout (steelhead)
    Smelt
    Splake

Walleye
Whitefish, cisco, or menominee
Other
Not applicable

21. Rank the following four scenarios for Brook Trout regulations in tributaries to Lake Superior and provide your preference. (1-preferred option, 2-second choice, 3-third choice, 4-least preferred)

    a. Fishing where there is a 7-inch minimum size limit and a daily possession limit of 5 Brook Trout, which results in a good chance for harvesting up to 5 fish above 7 inches, but rarely catching a Brook Trout larger than 10 inches.
    b. Fishing where there is a 10-inch minimum size limit and a daily possession limit of 5 Brook Trout, resulting in a lower chance of harvesting up to 5 Brook Trout, but increasing your chances of catching a Brook Trout larger than 10 inches.
    c. Fishing where there is a 15-inch minimum size limit and daily possession limit of 3 Brook Trout, resulting in an even lower chance of harvesting up to 3 Brook Trout, but increasing your chances of catching a Brook Trout larger than 15 inches.
    d. Fishing where there is a 20-inch minimum size limit and daily possession limit of 1 Brook Trout, resulting in reduced harvest opportunity, but increasing your chances of catching a Brook Trout larger than 20 inches.

The following questions pertain to overall fisheries management of Lake Superior and its tributaries.

22. Do you believe that fisheries management should prioritize native species such as Brook Trout, cisco, Lake Trout, menominee, and whitefish over non-native species such as Brown Trout, Chinook salmon, Coho salmon, rainbow trout/steelhead, and Splake? (select one)
    Fisheries management should prioritize native species
    Fisheries management should prioritize non-native species
    Fisheries management should seek a balance between native species and non-native species

23. The Michigan Department of Natural Resources has experimental regulations (20-inch minimum size limit, daily possession limit of 1) to rehabilitate lake-run Brook Trout ("Coasters") on 8 rivers and 1 lake system. The experimental regulations have not been in place long enough for evaluation. Do you support these regulations? (select one)
    Yes
    No

24. Please rank the following management actions based on how important you believe they are to improving angling and overall angler satisfaction. (1 = highest)
    Habitat restoration
    Fish stocking
    Regulatory measures (size limits, possession limits, fishing seasons)
    Law enforcement measures (ensuring that regulations are followed)

25. Do you feel you have adequate access to fishing opportunities on Lake Superior and its tributaries?
    Yes
    No

To help group your responses with those from other individuals and to ensure that we have an adequate sample, we would like to know a little about yourself. Please be assured that all the information will remain confidential.

26. What is your highest level of education? (Select one option)

    Less than high school degree
    High school degree or GED
    Some post high school or some college
    Associates degree
    Bachelor's degree
    Graduate degree
    Prefer not to answer

27. Which of the following best describes your annual household income? (Select one option)

    $0 - $24,999
    $25,000 - $49,999
    $50,000 - $74,999
    $75,000 - $99,999
    $100,000 - $149,999
    $150,000 or more
    Prefer not to answer

28. What is your primary ZIP / postal code? (enter value)

29. What is your age? (enter value)

30. What is your gender?
    Male
    Female
    Prefer not to answer

31. Are you a current member of any fishing organizations or fishing associations? (Yes/No)

32. Do you own a fishing vessel capable of operating on Lake Superior? (Yes/No)

33. Are you a charter boat operator? (Yes/No)

34. Please enter any additional comments you have that may help inform fisheries management on Lake Superior and its tributaries. (comment box)

Appendix B. Summary of Public Survey Responses

Q1. As a recreational activity, how important is fishing for you compared to other recreational activities? (Select one option.)		
Responses	**Responses**	**%**
My most important recreational activity	700	38.74%
One of my more important recreational activities	949	52.52%
No more important than other recreational activities	125	6.92%
Not at all important as a recreational activity	10	0.55%
Less important than most of my recreational activities	23	1.27%
Total Responses	**1,807**	

Q2. In the past 12 months, how many times did you go fishing? (Select one option.)		
Responses	**Responses**	**%**
Not at all	70	3.88%
1 time	31	1.72%
2 or 3 times	74	4.10%
4 or 5 times	101	5.60%
6 to 9 times	144	7.98%
10 to 19 times	291	16.12%
20 or more times	1,094	60.61%
Total Responses	**1,805**	

Q3. How many years have you fished Lake Superior and its tributaries? (Select one option.)		
Responses	**Responses**	**%**
Never	178	9.88%
Less than 1 year	108	5.99%
1-5 years	293	16.26%
6-10 years	203	11.27%
11-15 years	119	6.60%
16-20 years	143	7.94%
More than 20 years	758	42.06%
Total Responses	**1,802**	

Q4. Please select all species that are native to Lake Superior from the following list. (Select all that apply.)		
Responses	**Responses**	**%**
Atlantic salmon	185	10.43%
Brook Trout	1,303	73.45%
Brown Trout	587	33.09%
Cisco	900	50.73%
Chinook salmon	262	14.77%

Coho salmon	393	22.15%
Lake Trout	1,619	91.26%
Menominee	971	54.74%
Northern Pike	1,389	78.30%
Pink salmon	179	10.09%
Rainbow trout (steelhead)	714	40.25%
Siscowet	613	34.55%
Smelt	936	52.76%
Splake	337	19.00%
Walleye	1,270	71.59%
Whitefish	1,603	90.36%
Total Responses	**13,261**	
Because multiple answers per participant are possible, the total percentage may exceed 100%.		

Q5. Please select the two fish species that are used to create the hybrid fish known as Splake. (Select two.)		
Responses	**Responses**	**%**
Atlantic salmon	33	1.93%
Brook Trout	1,369	80.25%
Brown Trout	81	4.75%
Cisco	15	0.88%
Chinook salmon	23	1.35%
Coho salmon	44	2.58%
Lake Trout	1,565	91.74%
Menominee	7	0.41%
Northern Pike	29	1.70%
Pink salmon	15	0.88%
Rainbow trout (steelhead)	115	6.74%
Siscowet	24	1.41%
Smelt	25	1.47%
Splake	24	1.41%
Walleye	14	0.82%
Whitefish	29	1.70%
Total Responses	**3,412**	
Because multiple answers per participant are possible, the total percentage may exceed 100%.		

Q6. In the past 12 months, how many times did you fish on Lake Superior? (Select one option.)		
Responses	**Responses**	**%**
Not at all	644	35.66%
1 time	152	8.42%
2 or 3 times	247	13.68%
4 or 5 times	151	8.36%
6 to 9 times	142	7.86%
10 to 19 times	166	9.19%

20 or more times	304	16.83%
Total Responses	**1,806**	

Q7. How do you primarily fish on Lake Superior during the open-water season? (Select one option.)		
Responses	**Responses**	**%**
Breakwall or pier	145	12.53%
Shore or wading	240	20.74%
Canoe or kayak	62	5.36%
Personal motor boat	665	57.48%
Charter boat	45	3.89%
Total Responses	**1,157**	

Q8. What species do you target when fishing on Lake Superior? (Select all that apply.)		
Responses	**Responses**	**%**
Brook Trout	285	24.68%
Brown Trout	515	44.59%
Coho and Chinook salmon	798	69.09%
Lake Trout or Siscowet	763	66.06%
Northern Pike	204	17.66%
Rainbow trout (steelhead)	698	60.43%
Smelt	170	14.72%
Splake	403	34.89%
Walleye	301	26.06%
Whitefish, cisco, or menominee	390	33.77%
Other (Please specify)	87	7.53%
Total Responses	**4,614**	
Because multiple answers per participant are possible, the total percentage may exceed 100%.		

Q9. What species do you target most often on Lake Superior? (Select one option.)		
Responses	**Responses**	**%**
Brook Trout	41	3.54%
Brown Trout	29	2.51%
Coho and Chinook salmon	290	25.06%
Lake Trout or Siscowet	357	30.86%
Northern Pike	22	1.90%
Rainbow trout (steelhead)	162	14.00%
Smelt	5	0.43%
Splake	71	6.14%
Walleye	69	5.96%
Whitefish, cisco, or menominee	84	7.26%
Other	27	2.33%
Total Responses	**1,157**	

Q10. When fishing for the following species on Lake Superior, is it your primary intent to harvest or catch and release?

10 (a) : When fishing for the following species on Lake Superior, is it your primary intent to harvest or catch and release?: Brook Trout	

(a).Brook Trout

Answer	Responses	%
Harvest	292	28.27%
Catch and Release	578	55.95%
NA	188	18.20%
Total Responses	**1058**	

Note: Because multiple answers per participant are possible, the total percentage may exceed 100%.

Q10. When fishing for the following species on Lake Superior, is it your primary intent to harvest or catch and release?

10 (b) : When fishing for the following species on Lake Superior, is it your primary intent to harvest or catch and release?: Brown Trout	

(b).Brown Trout

Answer	Responses	%
Harvest	555	53.94%
Catch and Release	394	38.29%
NA	104	10.11%
Total Responses	**1053**	

Note: Because multiple answers per participant are possible, the total percentage may exceed 100%.

Q10. When fishing for the following species on Lake Superior, is it your primary intent to harvest or catch and release?

10 (c) : When fishing for the following species on Lake Superior, is it your primary intent to harvest or catch and release?: Coho and Chinook salmon	

(c).Coho and Chinook salmon

Answer	Responses	%
Harvest	900	83.64%
Catch and Release	150	13.94%
NA	45	4.18%
Total Responses	**1095**	

Note: Because multiple answers per participant are possible, the total percentage may exceed 100%.

Q10. When fishing for the following species on Lake Superior, is it your primary intent to harvest or catch and release?

10 (d) : When fishing for the following species on Lake Superior, is it your primary intent to harvest or catch and release?: Lake Trout or Siscowet	

(d).Lake Trout or Siscowet

Answer	Responses	%
Harvest	759	71.13%
Catch and Release	286	26.80%
NA	67	6.28%
Total Responses	**1112**	

Note: Because multiple answers per participant are possible, the total percentage may exceed 100%.

Q10. When fishing for the following species on Lake Superior, is it your primary intent to harvest or catch and release?

10 (e) : When fishing for the following species on Lake Superior, is it your primary intent to harvest or catch and release?: Rainbow trout (steelhead)	

(e).Rainbow trout (steelhead)

Answer	Responses	%
Harvest	644	60.87%
Catch and Release	396	37.43%
NA	51	4.82%
Total Responses	**1091**	

Note: Because multiple answers per participant are possible, the total percentage may exceed 100%.

Q10. When fishing for the following species on Lake Superior, is it your primary intent to harvest or catch and release?

10 (f) : When fishing for the following species on Lake Superior, is it your primary intent to harvest or catch and release?: Smelt	

(f).Smelt

Answer	Responses	%
Harvest	560	58.39%
Catch and Release	78	8.13%
NA	323	33.68%
Total Responses	**961**	

Note: Because multiple answers per participant are possible, the total percentage may exceed 100%.

Q10. When fishing for the following species on Lake Superior, is it your primary intent to harvest or catch and release?

10 (g) : When fishing for the following species on Lake Superior, is it your primary intent to harvest or catch and release?: Splake	

(g).Splake

Answer	Responses	%
Harvest	589	59.86%
Catch and Release	217	22.05%
NA	198	20.12%
Total Responses	**1004**	

Note: Because multiple answers per participant are possible, the total percentage may exceed 100%.

Q10. When fishing for the following species on Lake Superior, is it your primary intent to harvest or catch and release?

10 (h) : When fishing for the following species on Lake Superior, is it your primary intent to harvest or catch and release?: Walleye	

(h).Walleye

Answer	Responses	%
Harvest	691	69.52%
Catch and Release	131	13.18%
NA	201	20.22%
Total Responses	**1023**	

Note: Because multiple answers per participant are possible, the total percentage may exceed 100%.

Q10. When fishing for the following species on Lake Superior, is it your primary intent to harvest or catch and release?

10 (i) : When fishing for the following species on Lake Superior, is it your primary intent to harvest or catch and release?: Whitefish, cisco, or menominee	

(i).Whitefish, cisco, or menominee

Answer	Responses	%
Harvest	685	69.19%
Catch and Release	104	10.51%
NA	216	21.82%
Total Responses	**1005**	

Note: Because multiple answers per participant are possible, the total percentage may exceed 100%.

Q10. When fishing for the following species on Lake Superior, is it your primary intent to harvest or catch and release?

10 (j) : When fishing for the following species on Lake Superior, is it your primary intent to harvest or catch and release?: Other	

(j).Other

Answer	Responses	%
Harvest	149	22.11%
Catch and Release	169	25.07%
NA	364	54.01%
Total Responses	**682**	

Note: Because multiple answers per participant are possible, the total percentage may exceed 100%.

Q11. What is your preferred size Lake Trout to harvest for consumption? (Select one option.)

Responses	Responses	%
I do not harvest Lake Trout	210	18.28%
15-19.9 inches	238	20.71%
20-24.9 inches	581	50.57%
25-29.9 inches	100	8.70%

Larger than 30 inches	20	1.74%
Total Responses	**1,149**	

Q12. Because of high catch-and-release mortality (40%) on Lake Trout, size limits are not as effective as other regulations for reducing harvest. If regulation changes are necessary to maintain Lake Trout sustainability, what type of regulation change would you prefer? (Select one option.)		
Responses	**Responses**	**%**
Reduced daily possession limit	573	51.21%
Shortened harvest season or spawning closure	546	48.79%
Total Responses	**1,119**	

Q13. Would you support more restrictive Lake Trout harvest regulations (for example, reduced daily possession limits) on offshore reefs such as Stannard Rock and Big Reef to better protect those populations?(Select one option.)		
Responses	**Responses**	**%**
Yes	910	78.92%
No	243	21.08%
Total Responses	**1,153**	

Q14. Please rate how frequently you use the fishing methods that you use for Lake Trout.		
14 (a) : Please rate how frequently you use the fishing methods that you use for Lake Trout.: Boat: down rigger		
(a).Boat: down rigger		
Answer	**Responses**	**%**
Often	480	43.40%
Sometimes	293	26.49%
Never	333	30.11%
Total Responses	**1106**	

Q14. Please rate how frequently you use the fishing methods that you use for Lake Trout.		
14 (b) : Please rate how frequently you use the fishing methods that you use for Lake Trout.: Boat: wire/copper/lead-core line (fishing with wire line without downrigger)		
(b).Boat: wire/copper/lead-core line (fishing with wire line without downrigger)		
Answer	**Responses**	**%**
Often	314	29.57%
Sometimes	285	26.84%
Never	463	43.60%
Total Responses	**1062**	

Q14. Please rate how frequently you use the fishing methods that you use for Lake Trout.		
14 (c) : Please rate how frequently you use the fishing methods that you use for Lake Trout.: Boat: bobbing/jigging (fishing with rod by hand while drifting or still)		
(c).Boat: bobbing/jigging (fishing with rod by hand while drifting or still)		

Answer	Responses	%
Often	273	25.23%
Sometimes	471	43.53%
Never	338	31.24%
Total Responses	**1082**	

Q14. Please rate how frequently you use the fishing methods that you use for Lake Trout.

14 (d) : Please rate how frequently you use the fishing methods that you use for Lake Trout.: Shoreline/pier/breakwall	

(d).Shoreline/pier/breakwall

Answer	Responses	%
Often	202	18.77%
Sometimes	475	44.14%
Never	399	37.08%
Total Responses	**1076**	

Q14. Please rate how frequently you use the fishing methods that you use for Lake Trout.

14 (e) : Please rate how frequently you use the fishing methods that you use for Lake Trout.: Ice fishing	

(e).Ice fishing

Answer	Responses	%
Often	207	19.47%
Sometimes	387	36.41%
Never	469	44.12%
Total Responses	**1063**	

Q15. In the past 12 months, how many times did you fish on tributaries (rivers and streams)to Lake Superior? (Select one option.)

Responses	Responses	%
Not at all	579	32.08%
1 time	118	6.54%
2 or 3 times	256	14.18%
4 or 5 times	248	13.74%
6 to 9 times	167	9.25%
10 to 19 times	162	8.98%
20 or more times	275	15.24%
Total Responses	**1,805**	

Q16. When you fish on tributaries to Lake Superior, how do you primarily fish? (Select one option.)

Responses	Responses	%
Dock, bank, or shore	288	23.51%
Wading	691	56.41%
Non-motorized canoe, drift boat, or kayak	88	7.18%
Personal motor boat	154	12.57%
Charter boat	4	0.33%
Total Responses	**1,225**	

Q17. When you fish using hook-and-line gear on tributaries to Lake Superior, what type of gear do you most often use? (Select one option.)		
Responses	**Responses**	**%**
Artificial fly	315	25.76%
Artificial lure	472	38.59%
Bait	436	35.65%
Total Responses	**1,223**	

Q18. What species do you target on tributaries to Lake Superior? (Select all that apply.)		
Responses	**Responses**	**%**
Brook Trout	878	71.79%
Brown Trout	647	52.90%
Coho and Chinook salmon	457	37.37%
Lake Trout or Siscowet	82	6.70%
Northern Pike	227	18.56%
Rainbow trout (steelhead)	847	69.26%
Smelt	171	13.98%
Splake	130	10.63%
Walleye	299	24.45%
Whitefish, cisco, or menominee	91	7.44%
Other (Please specify)	69	5.64%
Total Responses	**3,898**	
Because multiple answers per participant are possible, the total percentage may exceed 100%.		

Q19. What species do you target most often on tributaries to Lake Superior? (Select one option.)		
Responses	**Responses**	**%**
Brook Trout	424	34.73%
Brown Trout	70	5.73%
Coho and Chinook salmon	86	7.04%
Lake Trout or Siscowet	12	0.98%
Northern Pike	43	3.52%
Rainbow trout (steelhead)	389	31.86%
Smelt	22	1.80%
Splake	8	0.66%
Walleye	113	9.25%
Whitefish, cisco, or menominee	15	1.23%
Other (Please specify)	39	3.19%
Total Responses	**1,221**	

Q20. When fishing for the following species on tributaries to Lake Superior, is it your primary intent to harvest or catch and release?

20 (a) : When fishing for the following species on tributaries to Lake Superior, is it your primary intent to harvest or catch and release?: Brook Trout		
(a).Brook Trout		
Answer	**Responses**	**%**
Harvest	464	39.83%
Catch and Release	662	56.82%
NA	80	6.87%
Total Responses	**1206**	

Note: Because multiple answers per participant are possible, the total percentage may exceed 100%.

Q20. When fishing for the following species on tributaries to Lake Superior, is it your primary intent to harvest or catch and release?

20 (b) : When fishing for the following species on tributaries to Lake Superior, is it your primary intent to harvest or catch and release?: Brown Trout		
(b).Brown Trout		
Answer	**Responses**	**%**
Harvest	446	40.47%
Catch and Release	553	50.18%
NA	131	11.89%
Total Responses	**1130**	

Note: Because multiple answers per participant are possible, the total percentage may exceed 100%.

Q20. When fishing for the following species on tributaries to Lake Superior, is it your primary intent to harvest or catch and release?

20 (c) : When fishing for the following species on tributaries to Lake Superior, is it your primary intent to harvest or catch and release?: Coho and Chinook salmon		
(c).Coho and Chinook salmon		
Answer	**Responses**	**%**
Harvest	622	59.69%
Catch and Release	241	23.13%
NA	207	19.87%
Total Responses	**1070**	

Note: Because multiple answers per participant are possible, the total percentage may exceed 100%.

Q20. When fishing for the following species on tributaries to Lake Superior, is it your primary intent to harvest or catch and release?

20 (d) : When fishing for the following species on tributaries to Lake Superior, is it your primary intent to harvest or catch and release?: Lake Trout or Siscowet		
(d).Lake Trout or Siscowet		
Answer	**Responses**	**%**
Harvest	313	31.58%

Catch and Release	271	27.35%
NA	424	42.79%
Total Responses	**1008**	

Note: Because multiple answers per participant are possible, the total percentage may exceed 100%.

Q20. When fishing for the following species on tributaries to Lake Superior, is it your primary intent to harvest or catch and release?

20 (e) : When fishing for the following species on tributaries to Lake Superior, is it your primary intent to harvest or catch and release?: Rainbow trout (steelhead)	

(e).Rainbow trout (steelhead)

Answer	**Responses**	**%**
Harvest	576	50.39%
Catch and Release	537	46.98%
NA	85	7.44%
Total Responses	**1198**	

Note: Because multiple answers per participant are possible, the total percentage may exceed 100%.

Q20. When fishing for the following species on tributaries to Lake Superior, is it your primary intent to harvest or catch and release?

20 (f) : When fishing for the following species on tributaries to Lake Superior, is it your primary intent to harvest or catch and release?: Smelt	

(f).Smelt

Answer	**Responses**	**%**
Harvest	510	51.41%
Catch and Release	96	9.68%
NA	396	39.92%
Total Responses	**1002**	

Note: Because multiple answers per participant are possible, the total percentage may exceed 100%.

Q20. When fishing for the following species on tributaries to Lake Superior, is it your primary intent to harvest or catch and release?

20 (g) : When fishing for the following species on tributaries to Lake Superior, is it your primary intent to harvest or catch and release?: Splake	

(g).Splake

Answer	**Responses**	**%**
Harvest	362	37.40%
Catch and Release	213	22.00%
NA	412	42.56%
Total Responses	**987**	

Note: Because multiple answers per participant are possible, the total percentage may exceed 100%.

Q20. When fishing for the following species on tributaries to Lake Superior, is it your primary intent to harvest or catch and release?

20 (h) : When fishing for the following species on tributaries to Lake Superior, is it your primary intent to harvest or catch and release?: Walleye	

(h).Walleye

Answer	Responses	%
Harvest	577	56.68%
Catch and Release	146	14.34%
NA	319	31.34%
Total Responses	**1042**	

Note: Because multiple answers per participant are possible, the total percentage may exceed 100%.

Q20. When fishing for the following species on tributaries to Lake Superior, is it your primary intent to harvest or catch and release?

20 (i) : When fishing for the following species on tributaries to Lake Superior, is it your primary intent to harvest or catch and release?: Whitefish, cisco, or menominee	

(i).Whitefish, cisco, or menominee

Answer	Responses	%
Harvest	394	40.29%
Catch and Release	142	14.52%
NA	455	46.52%
Total Responses	**991**	

Note: Because multiple answers per participant are possible, the total percentage may exceed 100%.

Q20. When fishing for the following species on tributaries to Lake Superior, is it your primary intent to harvest or catch and release?

20 (j) : When fishing for the following species on tributaries to Lake Superior, is it your primary intent to harvest or catch and release?: Other	

(j).Other

Answer	Responses	%
Harvest	126	16.56%
Catch and Release	169	22.21%
NA	476	62.55%
Total Responses	**771**	

Note: Because multiple answers per participant are possible, the total percentage may exceed 100%.

Q21. Rank the following four scenarios for Brook Trout regulations in tributaries to Lake Superior and provide your preference. (1-preferred option, 2-second choice, 3-third choice, 4-least preferred)					
Answer	**Rank 1**	**Rank 2**	**Rank 3**	**Rank 4**	**Weighted Rank (Score)**

Fishing where there is a 10-inch minimum size limit and a daily possession limit of five Brook Trout, resulting in a lower chance of harvesting up to five Brook Trout, but increasing your chances of catching a Brook Trout larger than 10 inches.	418	419	321	18	1 (3589)
Fishing where there is a 15-inch minimum size limit and daily possession limit of three Brook Trout, resulting in an even lower chance of harvesting up to three Brook Trout, but increasing your chances of catching a Brook Trout larger than 15 inches.	244	399	491	42	2 (3197)
Fishing where there is a 7-inch minimum size limit and a daily possession limit of five Brook Trout, which results in a good chance for harvesting up to five fish above 7 inches, but rarely catching a Brook Trout larger than 10 inches.	289	238	172	477	3 (2691)
Fishing where there is a 20-inch minimum size limit and daily possession limit of one Brook Trout, resulting in reduced harvest opportunity, but increasing your chances of catching a Brook Trout larger than 20 inches.	225	119	191	641	4 (2280)
Total Responses					**1176**

Q22. Do you believe that fisheries management should prioritize native species such as Brook Trout, cisco, Lake Trout, menominee, and whitefish over non-native species such as Brown Trout, Chinook salmon, Coho salmon, rainbow trout/steelhead, and Splake? (Select one option.)		
Responses	**Responses**	**%**
Fisheries management should prioritize native species	591	32.76%
Fisheries management should prioritize non-native species	73	4.05%
Fisheries management should seek a balance between native species and non-native species	1,140	63.19%
Total Responses	**1,804**	

Q23. The Michigan Department of Natural Resources has experimental regulations (20-inch minimum size limit, daily possession limit of one) to rehabilitate lake-run Brook Trout ("coasters") on eight rivers and one lake system. The experimental regulations have not been in place long enough for evaluation. Do you support these regulations? (Select one option.)		
Responses	**Responses**	**%**
Yes	1,571	87.72%
No	220	12.28%
Total Responses	**1,791**	

Q24. Please rank the following management actions based on how important you believe they are to improving fishing and overall angler satisfaction. (1-highest importance, 2-second choice, 3-third choice, 4-lowest importance)					
Answer	**Rank 1**	**Rank 2**	**Rank 3**	**Rank 4**	**Weighted Rank (Score)**
Habitat restoration	926	451	256	156	1 (5725)
Fish stocking	508	411	376	494	2 (4511)
Regulatory measures (size limits, possession limits, fishing seasons)	236	678	616	259	3 (4469)
Law enforcement measures (ensuring that regulations are followed)	120	250	541	878	4 (3190)
Total Responses					**1789**

Q25. Do you feel you have adequate access to fishing opportunities on Lake Superior and its tributaries?(Select one option.)		
Responses	**Responses**	**%**
Yes	1,578	87.76%
No	220	12.24%
Total Responses	**1,798**	

Q26. What is your highest level of education? (Select one option.)		
Responses	**Responses**	**%**
High school degree or GED	131	7.27%
Some post high School or some college	341	18.93%
Associate degree	222	12.33%
Bachelor's degree	647	35.92%
Graduate degree	460	25.54%
Total Responses	**1,801**	

Q27. Which of the following best describes your annual household income?(Select one option.)		
Responses	**Responses**	**%**
$0-$24,999	81	4.67%
$25,000-$74,999	478	27.55%
$75,000-$99,999	397	22.88%
$100,000-$149,999	466	26.86%
$150,000 or more	313	18.04%
Total Responses	**1,735**	

Q29. What is your gender?(Select one option.)		
Responses	**Responses**	**%**
Male	1,644	91.54%
Female	109	6.07%
Prefer not to answer	43	2.39%
Total Responses	**1,796**	

Q30. Are you a current member of any fishing organization or association? (Select one option.)		
Responses	**Responses**	**%**
Yes	585	32.48%
No	1,216	67.52%
Total Responses	**1,801**	

Q31. Do you own a fishing boat/vessel capable of operating on Lake Superior?(Select one option.)		
Responses	**Responses**	**%**
Yes	1,014	56.30%
No	787	43.70%
Total Responses	**1,801**	

Q32. Are you a charter boat operator?(Select one option.)		
Responses	**Responses**	**%**
Yes	18	1.00%
No	1,781	99.00%
Total Responses	**1,799**	