Management Plan for Walleye in Michigan's Inland Waters

Michigan Department of Natural Resources

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Introduction

Walleye (*Sander vitreus*) is a high priority species for management in Michigan because of its ecological, social, and cultural significance. Walleye play a significant ecological role as a top predator and provide fishing opportunities for anglers. There are many emerging threats to Walleye populations in Michigan, and there will be increasing management challenges related to the protection and conservation of this native species. To formalize management and prepare for emerging threats to Walleye populations in Michigan, the Michigan Department of Natural Resources (MDNR) – Fisheries Division, hereafter Fisheries Division, has developed this plan to guide management efforts. The overarching goal of this plan is to protect, conserve, and adaptively manage Walleye populations to maximize ecological benefits and angler satisfaction derived from healthy Walleye populations and fisheries. Management actions to achieve this high-level goal will be implemented in a manner that considers the potential limitations associated with operational costs, available funding, fisheries management priorities, and the best available science. The focus of this plan are Walleye populations in inland waters, primarily inland lakes, because Great Lakes populations are mainly addressed in other existing management or rehabilitation plans (e.g., *Lake Erie Walleye Management Plan 2015-2019* (Lake Erie Committee 2015)*; Strategy and options for completing the recovery of Walleye in Saginaw Bay* (Fielder and Baker 2004), *Michigan*; *Walleye management strategy for Little Bay de Noc, Lake Michigan* (Michigan DNR Fisheries Division 2012)) and robust resident riverine populations that are not directly connected to Great Lakes waters are fairly limited. Management strategies for inland Walleye have also been previously published and still contain relevant information (e.g., *Walleye management guidelines for the Northern Lake Michigan Management Unit 2011-2016* (Michigan DNR Fisheries Division 2011); *Ecology, management, and status of Walleye, Sauger, and Yellow Perch in Michigan* (Schneider et al. 2007)), but Fisheries Division believes it is prudent to update goals, objectives, and strategies to guide statewide Walleye management in future years.

The State of Michigan recognizes several treaties between the United States government and tribes residing in Michigan. Tribal governments' signatory to the 1836 and 1842 treaties retained hunting, fishing, and gathering rights for tribal members. Tribal governments and the State often co-manage Walleye fisheries and populations in inland waters. State management of waters within these treaty areas may deviate from concepts described within this plan as differences in treaty waters may reflect special needs, unique sources of information (i.e., Traditional Ecological Knowledge), or different strategies and objectives stemming from the co-management process.

Status of Inland Walleye Populations

Distribution

Walleye have a wide distribution throughout the state, but their prevalence is higher in lakes in northern latitudes because those lakes typically have habitat characteristics that are more suitable for Walleye. Walleye are also distributed in southern portions of Michigan's Lower Peninsula, despite marginal habitat suitability, because of previous extensive stocking efforts to create fishing opportunities for this recreationally popular species. In 2002, the Fisheries Division compiled a list of waters where Walleye occur using stocking records (1995-1999), Fisheries Division biological survey records (1980-2002), and a questionnaire sent to biologists in each Fisheries Management Unit (FMU). The previously compiled list is documented in Schneider et al. (2007). As part of the development of this plan, Fisheries Division created an updated list of inland lakes where Walleye occur that is based on stocking records and biological survey records from 2000 to 2019, and a questionnaire sent to biologists in each FMU in 2019 to assess the

Walleye populations based on reproductive characteristics (i.e., sustained natural recruitment or dependent on stocking). Appendix A contains the updated list of inland lakes managed for Walleye and is categorized by FMU because Fisheries Division manages fisheries resources based on those units, which are geographic units delineated by the watersheds that drain to each of the Great Lakes (Figure 1). That information was used to create a nearly complete list of inland lakes where Walleye are likely present, regardless of the lake's predicted habitat suitability for Walleye. The list contains approximately 375 inland lakes where strategic actions described throughout this plan are most likely to achieve the desired goals in a cost-effective manner.

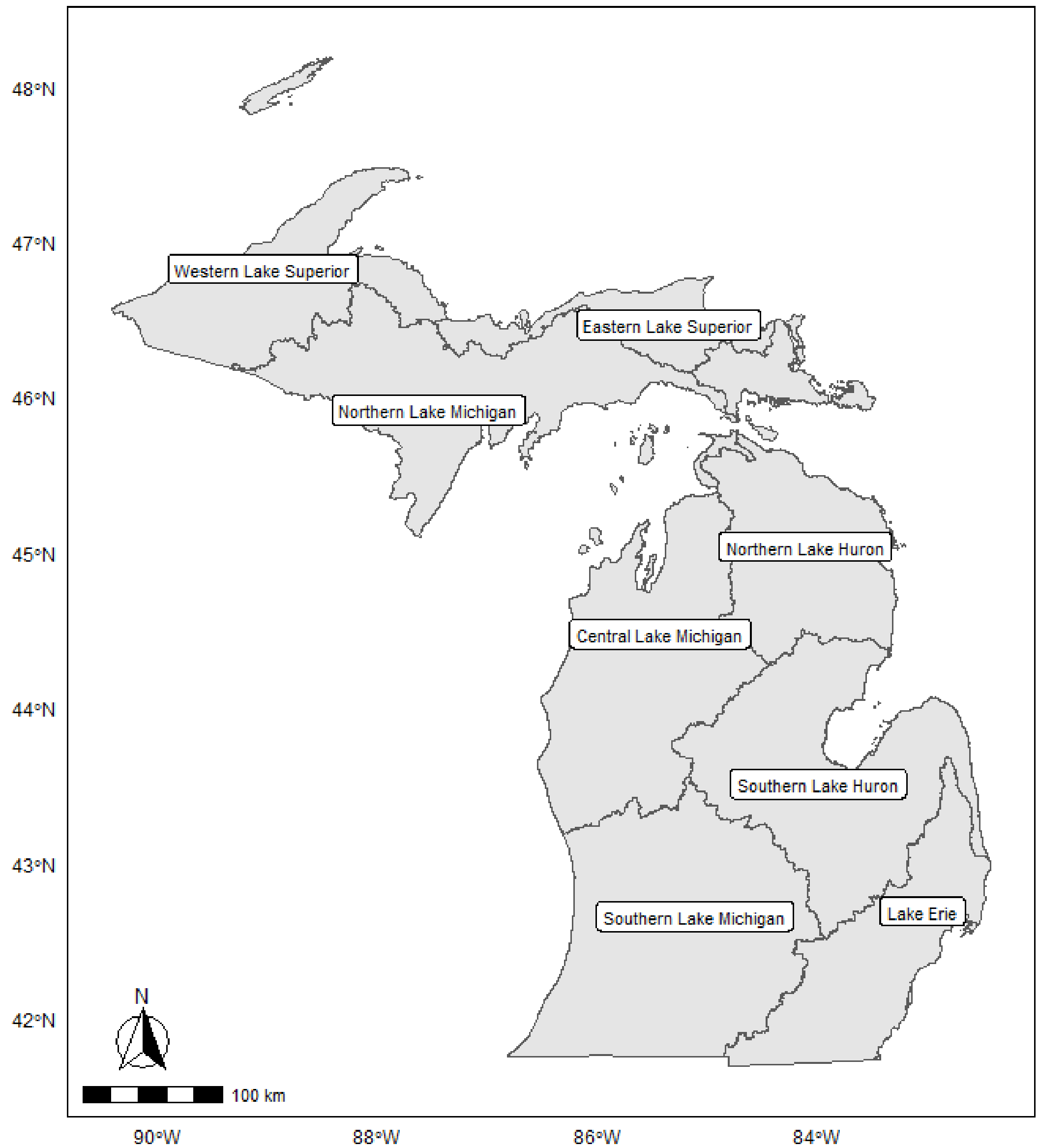

Figure 1. Map with names and boundaries of Fisheries Management Units (FMUs) that are used by the Fisheries Division to manage Michigan's fish populations. The boundaries are based on major watersheds that drain to each of the Great Lakes.

Reproduction

Walleye populations differ greatly in their reproductive capabilities throughout the state. Specifically, approximately 26% of Walleye populations statewide have consistent natural reproduction and are rarely stocked, 33% have inconsistent natural reproduction and are frequently stocked, and the remainder (41%) have no natural reproduction and are maintained exclusively by stocking (Figure 2). The reproductive categories were defined in the following manner: consistent = population persists and provides fishery without history of stocking or persists despite discontinued stocking activities; variable = population produces a year class of natural reproduced Walleye too infrequently to maintain a population without stocking, although a residual Walleye population may be maintained and provide a marginal fishery; and no natural reproduction = persistence of population and fishery are solely dependent on routine stocking. These categorizations are important because management costs are substantially higher when stocking is required to maintain a fishery, and therefore populations with natural reproduction are highly desirable and represent high return per cost opportunities for fisheries managers.

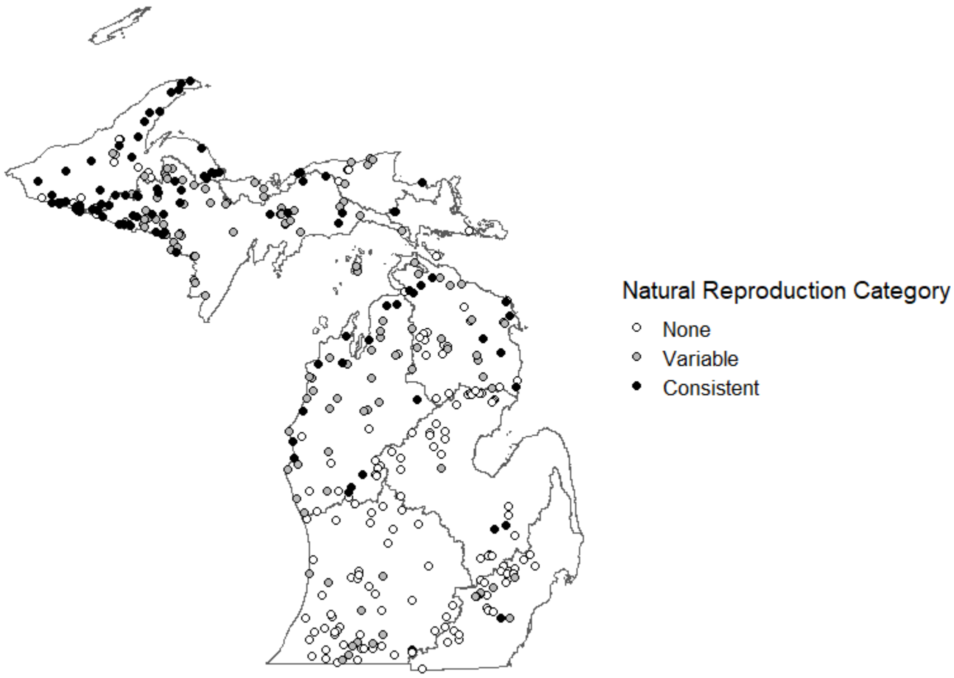

Figure 2. Distribution of inland lakes managed for Walleye in Michigan having consistent, variable, or no natural reproduction based on fisheries assessments and the professional judgement of Fisheries Division biologists at the time this plan was developed.

The number of lakes and natural reproduction status of Walleye populations in those lakes varies considerably across FMUs (Figure 3), which is important because those differences have direct implications on where and what types of actions are needed to achieve desired management goals for populations in specific waters and regions. For example, consistent stocking might be more frequently recommended within FMUs with lakes that contain suitable adult habitat and available prey resources, but that have variable or no natural reproduction because of limited spawning habitat or low survival during the early life stages.

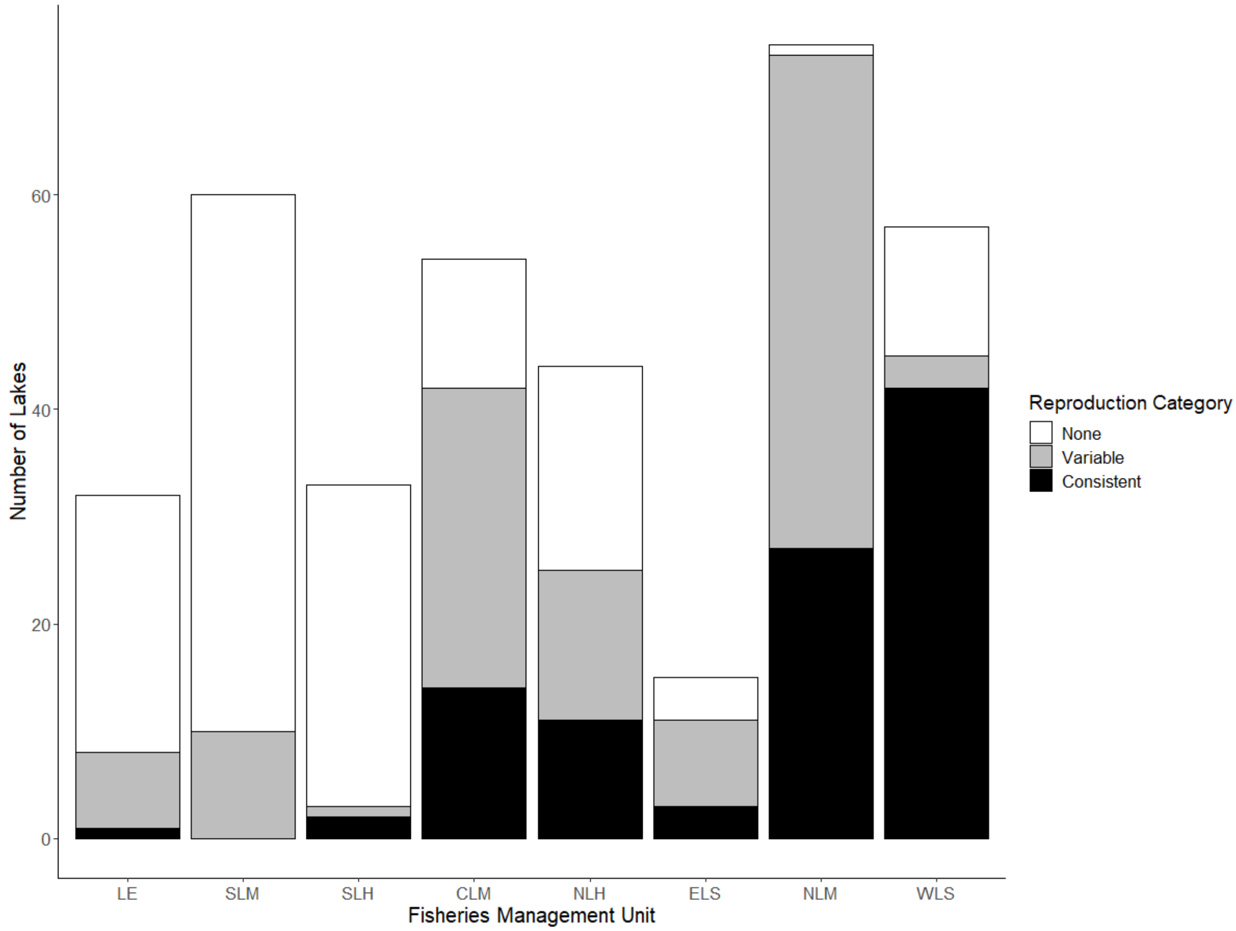

Figure 3. Number of lakes where Walleye occur that are classified as having consistent, variable, or no natural reproduction within each Fisheries Management Unit (FMU). FMUs are ordered south to north going left to right on the x-axis and abbreviations are as follows: Western Lake Superior = WLS, Eastern Lake Superior = ELS, Northern Lake Michigan = NLM, Central Lake Michigan = CLM, Southern Lake Michigan = SLM, Northern Lake Huron = NLH, Southern Lake Huron = SLH, Lake Erie = LE. For lake specific details see Appendix A.

Habitat Suitability

Walleye require sufficient habitat (including physical, chemical, and biological characteristics of lakes) to complete each stage in their life history. In Michigan's inland lakes, Walleye habitat suitability is best explained by relatively large lake surface area, water clarity characteristics, dissolved oxygen levels, thermal characteristics, and the presence of sufficient suitable spawning habitat (Lester et al. 2004; Wehrly et al. 2012; Hansen et al. 2017; Raabe et al. 2020). Walleye populations are typically more robust in larger lakes that have relatively short growing seasons and that contain cool- and well-oxygenated water in the epilimnion. Wehrly et al. (2012) classified Michigan lakes based on fish species assemblage patterns and identified six lake classifications that were primarily explained by differences in lake size and thermal regime. This classification system provides a useful framework for understanding the spatial distribution of Walleye populations and can be helpful for informing management strategies and setting realistic expectations for Walleye fisheries at a statewide level. It is important to recognize, however, that many of the key variables included in this classification system are dynamic and will likely be influenced by rapid land use changes such as large-scale shoreline development and climate change. It can be expected that these key variables will influence a lake's suitability for Walleye, and therefore management for this species will have to be adaptive to account for anticipated changes. Lake habitat changes linked with climate change have already been observed in Wisconsin where lakes that were historically dominated by Walleye have transitioned and are now dominated primarily by Largemouth (*Micropterus salmoides*) and Smallmouth Bass (*Micropterus dolomieu*). The species community shifts in Wisconsin waterbodies are partially associated with climate induced Walleye recruitment declines and habitats that are now more favorable for Largemouth and Smallmouth Bass (Hansen et al. 2015; Hansen et al. 2017).

The Michigan lake classification system consists of six classes that differ in habitat characteristics and fish assemblages (Table 1; Wehrly et al. 2012). This plan will focus on five of the classes because they are most relevant to achieving the goals described in this plan in a cost-conscious manner. Although all lake classifications may support some level of Walleye populations, Class 3 lakes contain the most suitable Walleye habitat and have more Walleye populations with consistent natural reproduction (Figure 4; Wehrly et al. 2012). Additionally, these lakes are predicted to be the most resilient to climate change effects related to projected increases in water temperature. In comparison, the lakes categorized as Class 1 generally will not be prioritized for Walleye management. Class 1 lakes have the lowest habitat suitability, relatively poor levels of natural reproduction, have historically been maintained mostly through stocking, and are predicted to be highly vulnerable to climate change. Therefore, aside from some documented exceptions, Walleye management goals are expected to be more challenging to achieve and efforts will typically be more cost-ineffective in Class 1 lakes. It is important to recognize that lakes with marginal habitat suitability might have previously received stocking, but many of these lakes have yielded low returns on investment (i.e., created no or very limited fishery) and should be a lower priority for future efforts directed specifically at Walleye management.

Table 1: Habitat description of the lake classifications prioritized for Walleye management actions described within this plan. Degree days were calculated (from a base of 32°F) as the product of the duration of the ice-free period and mean water temperature during the ice-free period. This table was amended from Wehrly et al. (2012).

Class	Description
1	High degree-days (4,415), high mean temperature (61.2 °F), small surface area (163 acres), and intermediate depth (16.6 ft); these lakes are predominately located in the Lower Peninsula. These lakes are considered a low priority for Walleye management efforts because of their low habitat suitability and high vulnerability to climate change.
2	High degree-days (4,315), intermediate mean temperature (59.9 °F), large surface area (1,572 acres), and deep (22.7 ft); these lakes are found primarily in the Lower Peninsula. Expected to be resilient to climate change because of their large surface area and relatively deep depths.
3	Low degree-days (3,293), low mean temperature (57.7 °F), large surface area (2,363 acres), and deep (24.7 ft); these lakes are concentrated in the western Upper Peninsula, with limited distribution in the northern Lower Peninsula. Currently most suitable for Walleye and expected to be resilient to climate change because of their large surface area and relatively deep depths.
4	Low degree-days (3,441), intermediate mean temperature (59.9 °F), small surface area (94 acres), and intermediate depth (14.7 ft); these lakes are very common in the Upper Peninsula and northern Lower Peninsula. Expected to be the most vulnerable to climate change because of their relatively small surface area, shallow depths, and predicted temperature increases in northern regions where these lakes are located.
5	Intermediate degree-days (3,719), intermediate mean temperature (60.1 °F), intermediate surface area (616 acres), and intermediate depth (14.4 ft); these lakes are found in the Upper Peninsula and northern Lower Peninsula. Expected to have variable response to climate change, which will primarily be determined by surface area, depth, and latitude with lakes within this classification being more resilient in northern latitudes.
6	Low degree-days (3,304), intermediate mean temperature (59.7 °F), intermediate surface area (1,258 acres), and shallow (10.3 ft); these lakes are found primarily in the Upper Peninsula. Expected to have variable response to climate change, which will primarily be determined by surface area and depth with larger and deeper lakes within this classification being more resilient.

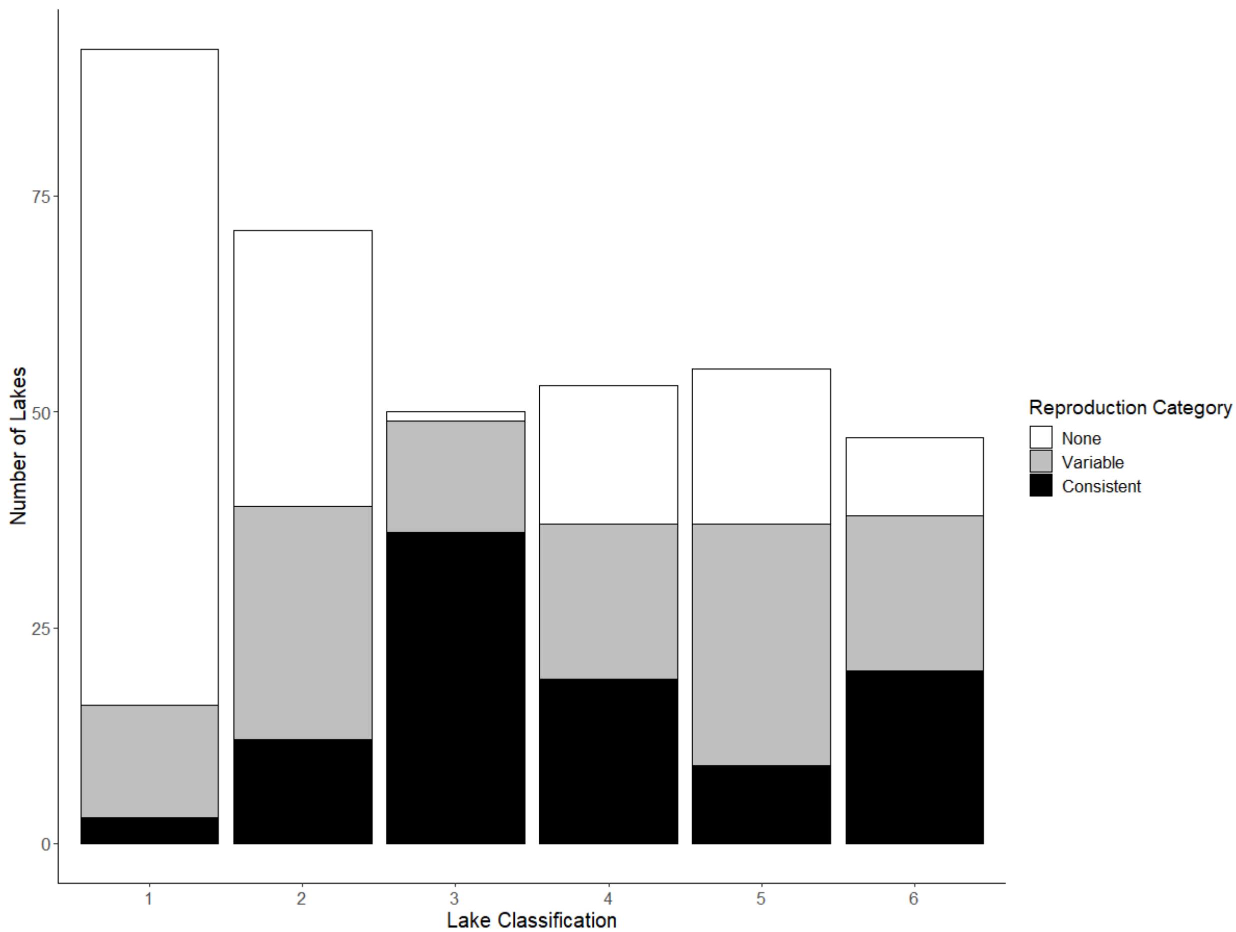

Figure 4. Number of inland lakes managed for Walleye, as identified by Fisheries Division survey data and biologist's professional expertise, having consistent, variable, or no natural reproduction in each lake classification (Wehrly et al. 2012). See Table 1 for habitat descriptions of the different lake classifications.

The lakes with the highest habitat suitability for Walleye, Class 3 lakes, are relatively large and deep lakes that have a low number of degree days and an abundance of cool water in the epilimnion (Wehrly et al. 2012). Class 3 lakes are expected to be among the most resilient to climate change because their depth and large surface are predicted to minimize temperature increases that are expected for lakes with smaller surface area and shallower depths. There are approximately fifty inland lakes managed for Walleye that are classified as Class 3 and the majority of those lakes support consistent natural reproduction (Figure 4). These lakes represent some of the most robust Walleye populations and inland Walleye fisheries in Michigan and they occur primarily in the western Upper Peninsula and a few in the northern Lower Peninsula such as Houghton Lake, Burt Lake, Elk Lake, Lake Charlevoix, and Lake Leelanau.

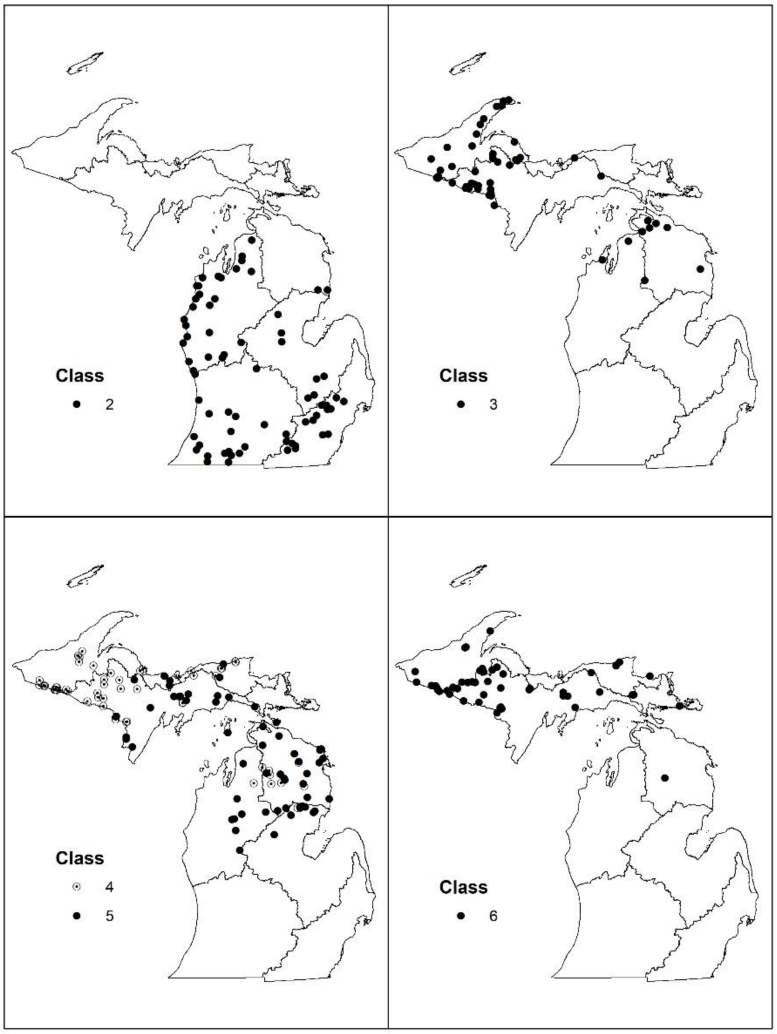

Figure 5. Distribution of inland lakes that are managed for Walleye, as identified by Fisheries Division survey data and staff professional expertise, for each lake class emphasized in this plan. See Table 1 for habitat descriptions for each lake class.

Lakes in Classes 4, 5 and 6 tend to be smaller and shallower and have relatively intermediate-to-warmer mean temperatures in the epilimnion compared to lakes in Class 3. However, lakes in Classes 4, 5, and 6 are found primarily in the northern portion of the state where the cooler climate results in a relatively low number of degree days, making them moderately suitable for Walleye. These lake classes are also expected to have variable responses to climate change (Table 1). Despite the relatively marginal habitat suitability based on lake size and depth, natural reproduction does occur in several lakes within these classes, with Classes 4 and 6 having similar levels of consistent and variable natural reproduction (Figure 5). The majority of lakes in Class 5 do not support consistent natural reproduction, but instead primarily have variable or no Walleye natural reproduction. Class 4, 5, and 6 lakes are distributed across the Upper Peninsula, with Class 5 also being common in the higher elevation region of the Northern Lower Peninsula (Figure 5). Warmwater species such as Largemouth Bass and Bluegill (*Lepomis macrochirus*) are common in these lakes and predation or competition will likely affect the success of Walleye management efforts, such as stocking to enhance Walleye populations. Additionally, managers will also need to consider that Walleye stocking efforts in these lakes could also negatively influence the established fish community.

Lakes in Class 2 have a larger surface area (> 400 acres) which results in slightly cooler mean temperatures in the epilimnion. Lakes within Class 2 are expected to be resilient to climate change because of their large surface area and relatively deep depths. Similar to Class 6, lakes in Class 2 are primarily maintained through inconsistent natural reproduction and stocking because the majority of these waters are unable to annually support reliable natural reproduction (Figure 4). Lakes in Class 2 are dominated by warmwater species such as Largemouth Bass and Bluegill, but often also support cool-water species such as Yellow Perch (*Perca flavescens*), Northern Pike (*Esox lucius*), Rock Bass (*Ambloplites rupestris*), and Smallmouth Bass (Wehrly et al. 2012). Fisheries managers will have to critically consider the habitat types and diversity of the fish community when making management decisions for lakes within this classification because all these factors add complexities that influence the likelihood of achieving desired management goals. Despite those complexities, the larger size and cooler temperatures of these lakes, relative to other lakes in similar latitudes, can also provide unique Walleye fishing opportunities in southern Michigan where those fisheries are relatively limited.

Abundance

Walleye populations show substantial variation in abundance across lakes. Catch rates (number of fish per net lift) of all Walleye in trap nets and fyke nets from Fisheries Division's Status and Trends surveys conducted during the months of May and June from 2003 to 2019 were used as a relative index of Walleye abundance. This survey type was used for comparison because it implements a consistent and random sampling design that provides representative results for each lake sampled throughout the state. Additionally, estimating abundance requires labor intensive population estimate surveys that are relatively limited throughout the state, so this plan instead focuses on comparing populations using measures of relative abundance and not estimates of Walleye per acre. Walleye relative abundance was highest in the Western Lake Superior FMU (1.17), intermediate in Northern Lake Michigan (0.88) and Northern Lake Huron FMUs (0.83), and uniformly lower in the remaining FMUs (Figure 6). This pattern reflects the spatial distribution of lake classifications with a relatively large number of highly suitable lakes that support Walleye natural reproduction occurring in the FMUs located in the western half of the Upper Peninsula and the Northern Lake Huron FMU, and a predominance of less suitable inland lakes for Walleye populations in the eastern Upper Peninsula and the southern portion of the Lower Peninsula.

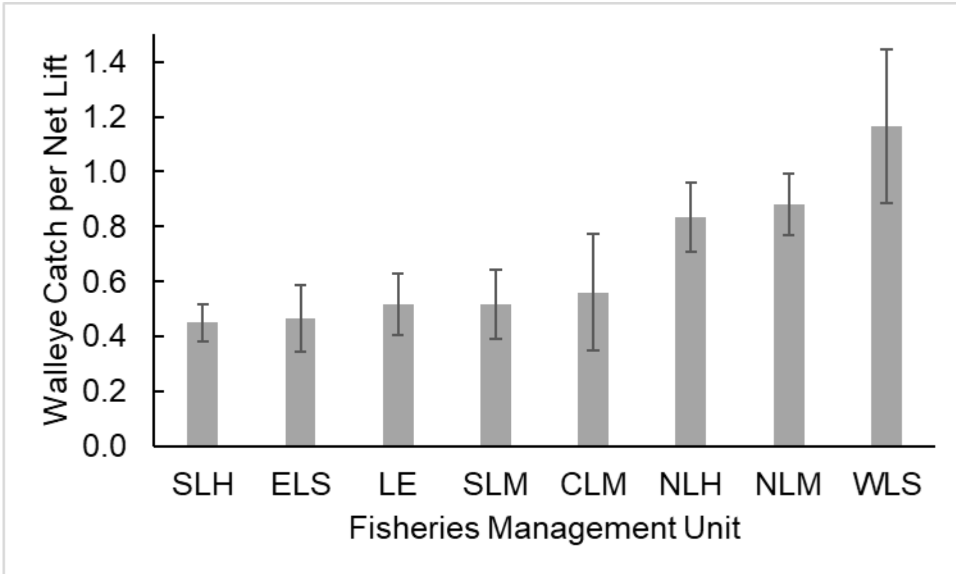

Figure 6. Mean Walleye catch rates in trap and fyke nets used in Status and Trends surveys conducted from 2002-2019 for each Fisheries Management Unit (FMU). Error bars represent 1 standard error. FMU abbreviations are as follows: Western Lake Superior = WLS, Eastern Lake Superior = ELS, Northern Lake Michigan = NLM, Central Lake Michigan = CLM, Southern Lake Michigan = SLM, Northern Lake Huron = NLH, Southern Lake Huron = SLH, Lake Erie = LE.

Growth and Size Structure

Mean length-at-age and length data from inland lake Status and Trends surveys 2002-2019 were used to characterize patterns of Walleye growth and size structure. Walleye growth rates were primarily associated with latitude, which influences water temperature and duration of the growing season. The slowest growth occurs in northern latitudes where the temperatures are typically lower, and duration of the growing season is shorter. As such, populations in the Upper Peninsula exhibited the slowest growth with intermediate growth in the northern Lower Peninsula, and highest growth in the southern Lower Peninsula (Figure 7). The same general pattern exists for overall size structure with larger fish on average in southern portions of the state and smaller fish on average in northern latitudes (Figure 7).

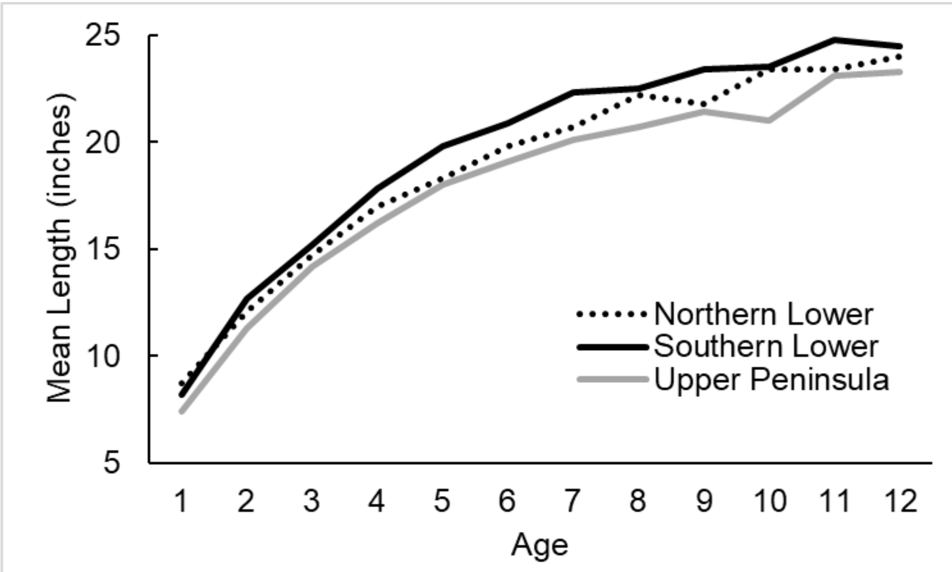

Figure 7. Mean length-at-age of Walleye by region based on biological data from Walleye collected in all gear types used during Fisheries Division Status and Trends surveys in May and June during 2003-2019. The three regions were defined using the spatial coverage of the different Fisheries Management Units (FMUs; Figure 1). Specifically, the Northern Lower consisted of Central Lake Michigan and Northern Lake Huron FMUs, the Southern Lower consisted of Southern Lake Michigan, Southern Lake Huron, and the Lake Erie FMUs, and Upper Peninsula included Northern Lake Michigan, and the Eastern and Western Lake Superior FMUs.

The majority of Walleye in the southern Lower Peninsula and the Central Lake Michigan FMU reached the standard statewide minimum size for harvest of 15 inches by age 3. However, Walleye in the Upper Peninsula and the Northern Lake Huron FMU grew more slowly and typically do not reach the statewide minimum size limit until age 4. These growth patterns are likely to persist in Michigan because of latitudinal temperature patterns, differing levels of productivity associated with land use and geology, and because in lakes with higher Walleye abundance (i.e., northern lakes), the growth rates are frequently reduced due to density dependent effects (Hanchin 2017). This means there may be fewer prey resources available per individual Walleye. Fisheries Division survey data suggests a density-dependent effect on Walleye growth in the Western Lake Superior, Northern Lake Michigan, and Northern Lake Huron FMUs (Figure 8). These growth and size structure patterns are meaningful for informing management decisions because they provide realistic expectations for Walleye growth, specific to each FMU that can be used as a baseline metric to determine when strategic actions identified in this plan are warranted. These baseline metrics should also be used to evaluate the effectiveness of strategic actions that are implemented, such as regulatory changes or stocking.

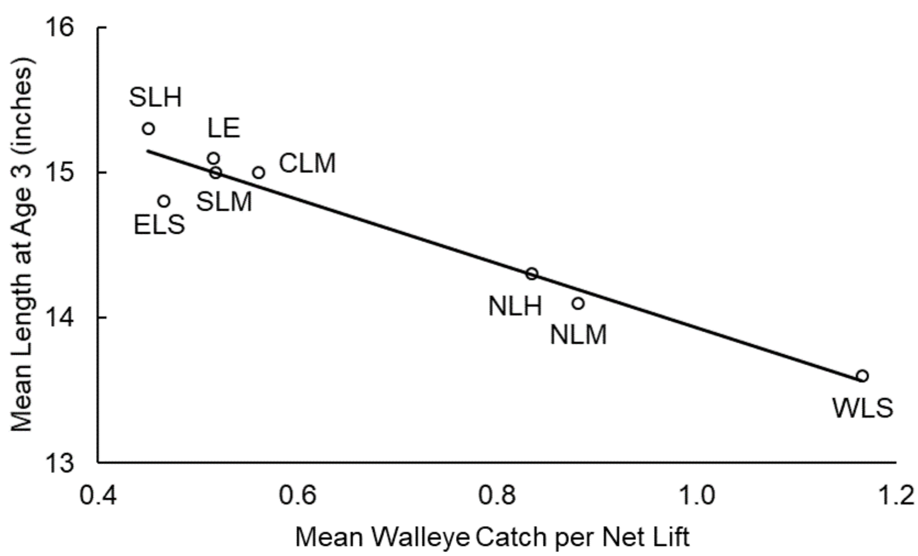

Figure 8. Relationship between Walleye relative abundance and mean length-at-age 3. Walleye catch per net lift and mean length-at-age 3 is based on data collected from each Fisheries Management Unit (FMUs) using Status and Trends fish population surveys conducted in May and June during 2003-2019.

Community role

Adult Walleye are a top predator, with a flexible feeding strategy (summarized by Chipps and Graeb 2011), allowing them to feed on a wide variety of prey organisms across various habitats. In addition to foraging on small fishes, Walleye are also known to feed on crayfishes and aquatic invertebrates (e.g., Herbst et al. 2016). As such, management efforts taken to maintain or enhance Walleye populations have the capacity to alter the density and size structure of panfish such as Yellow Perch, Bluegill and other panfish, forage fish including minnows and shad, and non-native prey such as Rainbow Smelt (*Osmerus mordax*) and Round Goby (*Neogobius melanostomus*) (Schneider 1995; Schneider and Lockwood 1997; Krueger and Hrabik 2005). Their effect on prey fishes further has the potential to cause changes that cascade through the different trophic levels in lakes, leading to alterations to the base of the food web (e.g., zooplankton and algal communities) within lakes (Krueger and Hrabik 2005).

Walleye are also affected by lower trophic levels. For example, newly hatched Walleye (i.e., fry) depend on abundant zooplankton resources for early growth and survival. Many factors affect zooplankton abundance and size structure, but basic limnological productivity is a critical determinant. The introduction and proliferation of Zebra (*Dreissena polymorpha*) and Quagga mussels (*Dreissena bugensis*) in Michigan's inland lakes has emerged as a contributing factor that limits zooplankton abundance, and therefore has the potential to reduce natural recruitment of Walleye (MacWilliams 2013, Fisheries Division unpublished data). The pattern of reduced recruitment resulting from aquatic invasive species (AIS) establishments is not unique to Michigan. Walleye populations in other Great Lakes states and provinces have also been negatively influenced (Chu et al. 2004; Hansen et al. 2020). As such, Walleye management needs to account for limitations imposed by aquatic invasive species and potential benefits resulting from prevention and control efforts.

Angler Behavior and Perceptions

Angler behaviors and perceptions are important considerations when making fisheries management decisions. The Fisheries Division has relied on two survey types of licensed anglers to collect this information: (1) a long-term (2008 to 2018) mail survey distributed monthly to a random sample of all licensed anglers, and (2) an internet survey conducted in 2019 of licensed anglers that provided their email address to the MDNR. These surveys were used to provide representative information from Michigan anglers. In addition to these surveys, the Fisheries Division also gathers information through various stakeholder groups and committees along with feedback provided by individual anglers when considering management issues.

Long-term mail survey

The long-term mail survey provided information on fishing activities and angler behaviors over the past 12 months as well as details about an angler's most recent fishing trip. Not all surveyed anglers fished in the past 12 months (~5% had not fished), so information from anglers that did fish was used to summarize angler behavior for the purpose of informing management strategies in this plan. Of active anglers, 47% of licensed anglers indicated they targeted Walleye at least one time in the previous 12 months and 15% of anglers targeted Walleye on their most recent fishing trip. Of these, 74% were to lakes (inland and Great Lakes) and 26% were to rivers, with most trips occurring between late Spring and early Fall (~85% from April to October). Anglers targeted Walleye at approximately 465 unique lakes in Michigan. Of those lakes, eight lakes accounted for 25% of Walleye trips, 15 lakes accounted for 36% of trips

(Table 2), and 108 lakes accounted for roughly 75% of overall trips targeting Walleye. The remaining 25% of trips were distributed across over 350 lakes.

Table 2. Top 15 lakes in Michigan ranked by their share (% of total trips) of inland lake angling trips targeting Walleye. Rank is based on data collected from long-term mail survey of licensed anglers. FMU represents the Fisheries Division's Fisheries Management Unit.

Lake Name	FMU	County	% of Total Trips
Houghton Lake	CLM	Roscommon	8
Burt Lake	NLH	Cheboygan	3
Muskegon Lake	CLM	Muskegon	3
Lake Leelanau	CLM	Leelanau	2
Lake Gogebic	WLS	Ontonagon	2
Mullett Lake	NLH	Cheboygan	2
Big Manistique Lake	NLM	Mackinac	2
Hubbard Lake	NLH	Alcona	2
Grand Lake	NLH	Presque Isle	2
Lake Charlevoix	CLM	Charlevoix	2
Black Lake	NLH	Cheboygan	2
Long Lake	NLH	Alpena	2
Lake Missaukee	CLM	Missaukee	2
Hamlin Lake	CLM	Mason	1
Brevoort Lake	NLM	Mackinac	1

During trips targeting Walleye anglers used numerous fishing methods including natural bait (77%), artificial bait (70%), trolling (49%), casting from boat (59%), casting from shore/pier (43%), and ice fishing (25%). These responses were not mutually exclusive, meaning that an individual angler could have used multiple methods within the period covered by the survey. The survey results also indicated that inland lake anglers targeting Walleye, on average, travelled further than anglers targeting other species (89.2 vs. 57.2 miles one-way per trip, respectively). This is presumably because the prevalence of Walleye populations in inland lakes is greater in northern Michigan, and therefore the premier inland fishing opportunities for this species are concentrated relatively far from the major population centers in southern Michigan. These overall survey results confirmed that Walleye fishing is valuable, popular among anglers, and that Walleye populations provide anglers with a diversity of fishing opportunities in Michigan.

Internet Survey

The internet survey of anglers provided additional information related to angler behaviors and perceptions that provided the Fisheries Division with insights into potential management goals, strategies, and regulatory options. The questionnaire is included as Appendix E of this plan, and each question was independently developed to address different management questions, and therefore results should be viewed as unique for each question. This survey was marketed as a Walleye angler survey that was meant to inform the development of this species-specific plan, and therefore is likely less representative of all Michigan anglers, and instead more representative of active or dedicated Walleye anglers that provided their email addresses to the MDNR. This presumption was corroborated by responses that indicated the majority (89%) of respondents fished for Walleye in the last 12 months and 57% indicated Walleye fishing was their most important fishing activity, which was greater than responses for the long-term and more representative mail survey.

The internet survey provided angler perceptions on characteristics of "successful" Walleye angling trips that can be used as metrics to evaluate management actions. Specifically, the internet survey indicated that approximately 66% of anglers mostly or always harvest the legal sized Walleye that they catch. In addition, approximately 45% of anglers responded that a successful inland Walleye fishing trip meant catching three or more fish, while roughly 19% indicated that five or more fish would need to be caught to be considered a successful trip. In addition, when considering a successful trip based solely on the size of fish caught, about 41% of anglers said a successful trip would be catching Walleye with an average size of 17 inches, whereas lesser percentages (23 and 4%) indicated a greater average size (19 and 22 inches) would be required for a successful trip. Finally, to help gauge success of Walleye management, the Fisheries Division commonly seeks angler feedback regarding their satisfaction. The internet survey illustrated that the level of satisfaction with Michigan Walleye opportunities was relatively balanced with most anglers indicating neutral satisfaction and about the same levels of satisfaction as dissatisfaction.

Management goals in this plan are diverse and understanding public perceptions on how to achieve those goals with angler support is essential. The internet survey provided useful information for fisheries managers that will be used to inform the strategic actions described within this plan. For example, the survey indicated that if "trophy" management is the goal then strategies need to produce 25-inch Walleye in inland waters to align with angler perceptions for trophy management. Alternatively, and likely more plausible, communications strategies would need to be implemented to educate anglers, so expectations align more appropriately with realistic growth and size structure metrics for Walleye populations in inland waters. Additionally, when considering other Walleye management goals, the internet survey indicated that about 75% of anglers were somewhat or strongly supportive of restrictive Walleye regulations in locations where Walleye are stocked as a predatory biocontrol to promote panfish size structure. Similarly, 75% of respondents supported restrictive regulations to protect naturally reproducing Walleye populations. Furthermore, the internet survey provided useful results of what anglers generally prefer in terms of angling experiences and regulations. Specifically, anglers were asked to rank four specific regulatory scenarios that were linked with unique trip characteristics (Figure 9) and the rankings revealed a clear preference (63.1% of respondents) for the existing statewide regulation (i.e., 15-inch min. size limit and five fish daily possession limit), followed by 20.5% of respondents that selected using protected slot limits as their most preferred regulatory option. There was little preference (6.1%) for imposing catch and release to improve catch rates and the potential to catch a trophy sized fish, which is likely driven by overall angler preference for harvesting legal size Walleye.

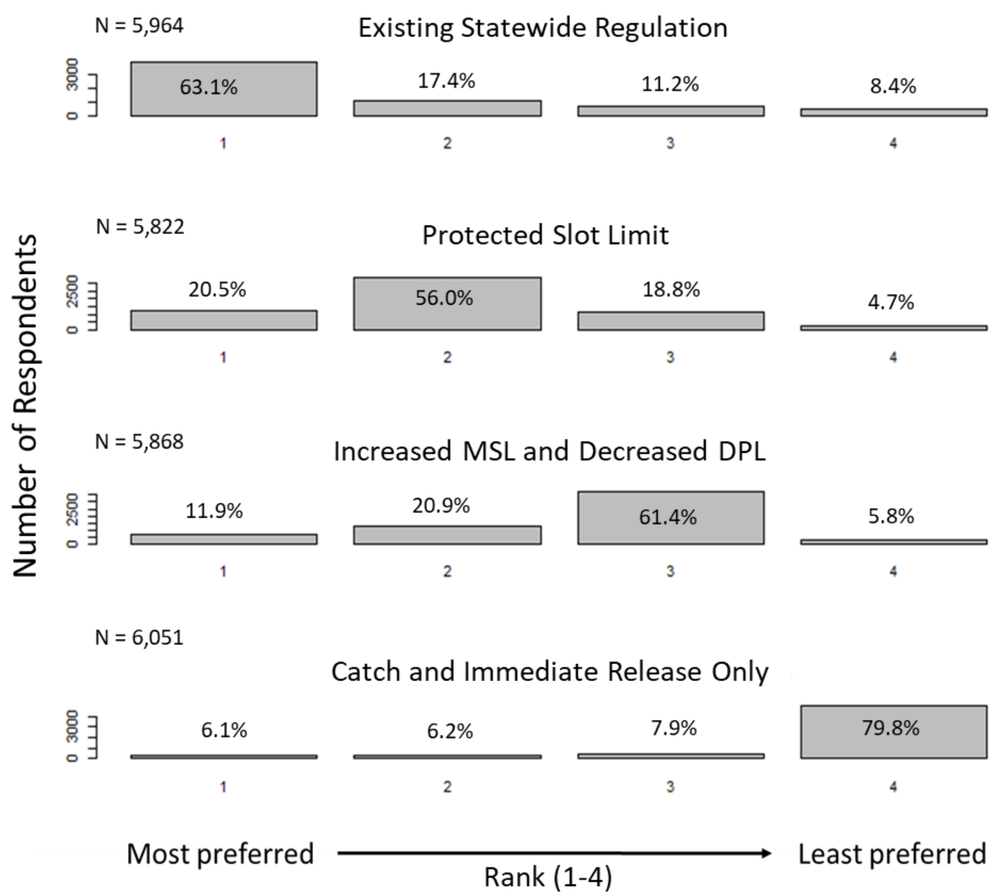

Figure 9. Ranked angler preference (percent of total respondents) for four regulatory and presumed angling scenarios. Respondents were asked to individually rank each scenario 1-4, with 1 being the most preferred scenario. The four scenarios were 1) existing statewide

regulation: Fishing where there is a 15 inch minimum size limit and a daily possession limit of 5 Walleye, which results in a good chance for harvesting up to 5 fish above 15 inches, but rarely catching a Walleye above 20 inches; 2) Protected Slot Limits: fishing where there is a protected slot limit for Walleye (e.g., no harvest of fish 18-22 inches), resulting in a lower chance of harvesting up to 5 Walleye above 15 inches, but increasing your chances of catching a Walleye above 20 inches; 3) Fishing where there is a higher minimum size limit and more restrictive Walleye harvest limit (20 inch minimum, 2 fish per day limit), resulting in higher catch rates and an above average chance of catching a trophy, but would limit your ability to harvest many Walleye; and 4) Fishing where there is a catch-and-release only regulation for Walleye, resulting in highest possible catch rates and highest chance of catching a trophy, but prohibiting your ability to keep fish for eating or to mount as a trophy. MSL = minimum size limit and DPL = daily possession limit. N represents the total number of angler responses received for each scenario from an internet survey conducted by the Fisheries Division in 2019.

History of Walleye Management in Michigan

Biological assessments

Walleye are an actively managed fish species in Michigan because of their popularity among recreational anglers, as a food source for tribal fishers, and because of their role as a top predator. As such, many types of biological assessments are implemented to assess Walleye populations and inform management in Michigan. These surveys are conducted to collect information on population demographics to address various management goals, and those survey types are described in more detail below.

Population estimates

Spring mark-recapture surveys are conducted to quantify abundance, growth rate, mortality rate, and size structure of adult Walleye populations. Data collected using this protocol when combined with a creel survey, or angler tag returns if fish were marked with a uniquely identifiable tag, can also be used to estimate angler exploitation rates. Surveys conducted using these standardized protocols provide a robust means to assess the status of Walleye populations in individual waterbodies and allows for population level comparisons among lakes.

Recruitment surveys

Fall shoreline electrofishing surveys are used to index juvenile Walleye year-class strength and to determine the primary recruitment source of populations (i.e., stocked vs. natural reproduction). Age-0 (i.e., young-of-year (YOY)) and age-1 (i.e., yearlings) Walleye are collected at night during the fall using an electrofishing boat because Walleye are more likely to be concentrated near shore during this timeframe. The number of age-0 and age-1 Walleye collected per mile of electrofishing is used as an index of relative abundance. Measures of relative abundance from individual lakes can then be compared to reference points to predict year class strength (Ziegler and Schneider 2000), but the relationship between year class strength and juvenile catch rates is often variable or weakly related, and therefore can be uninformative. This is an area of research that could result in determining new methods to better predict year class strength, which would inform management decisions related to stocking. Primary recruitment source can also be determined by sampling juvenile Walleye in non-stocked years or by using a distinguishable and permanent mark (i.e., oxytetracycline or OTC) that is applied to Walleye fry during stocked years. Fall electrofishing surveys can be used to evaluate stocking efforts and determine occurrence and relative contribution of natural reproduction. Results from these efforts can then be used to adjust stocking rates, determine stocking priorities, inform co-management decisions in the ceded territories, and evaluate the effects of environmental and habitat conditions on Walleye recruitment.

Large lake surveys

A survey program of large (>1,000 acres) lakes was initiated by the Fisheries Division in 2001 to address data gaps on large lakes that stemmed from the logistical challenges associated with appropriately sampling large lakes with staff from a single FMU. A primary goal of the large lakes survey program was to develop and refine an assessment and monitoring program for highly valued game fish species in these large lakes. Twenty-two lakes were surveyed from 2001–2010 targeting Walleye, Northern Pike, Smallmouth Bass, and Muskellunge (*Esox masquinongy*). The main objectives of the program were to estimate abundance, growth, mortality and harvest of these species in each of these lakes, and to compare various methods for estimating abundance and exploitation. Individual reports were published for each lake and a final report synthesized results from the first 10 years of study (Hanchin 2017). The final report provided recommendations on methods for estimating Walleye abundance and provided useful insights on angler behavior, exploitation, and regulations for many of the large and frequently fished lakes in Michigan.

Status and Trends surveys

Fisheries Division started to implement the Inland Lake Status and Trends Program (ILSTP) in 2002 (Hayes et al. 2003). The objectives of the ILSTP are to 1) maintain a comparable inventory of inland habitat and fish community characteristics statewide; 2) develop reference points for local, regional, and statewide management needs; and 3) to assess the status of, and detect changes to, aquatic habitats and fish communities across Michigan. The ILSTP surveys aquatic habitats and fish communities using standardized methods (Wehrly et al., Fisheries Division unpublished report) in randomly selected lakes that are representative of the broad range of waters found in Michigan. ILSTP fish surveys are conducted in early summer and can be used to evaluate relative abundance (catch per unit effort), growth rate, and size structure of adult Walleye populations. Limnology surveys are conducted in late summer and can be used to evaluate chemical, physical, and biological habitat characteristics. Walleye population and habitat characteristics collected using ILSTP methods from an individual lake can be compared to statewide and FMU reference points summarized in Wehrly et al. (2015) to determine if management efforts are achieving desired outcomes.

Stocking

Walleye stocking has been used as a management tool in Michigan since 1882, and stocking continues to be a significant aspect of current Walleye management strategies to create new fisheries, rehabilitate populations, enhance low density populations, and as a predatory control for abundant and slow-growing panfish populations. Walleye production, on average over the past decade, has provided approximately 10.5 million Walleye annually for stocking efforts at an average annual cost of approximately $330,600. These estimates include the stocking of all life stages in lakes and rivers by Fisheries Division, but excludes those waters stocked exclusively under private permit or by tribal co-managers.

Walleye stocking was a common practice statewide in the early stages of Fisheries Division (pre-1950). In fact, fry stocking occurred at many lakes during this period because originally the state had relatively few inland waters with Walleye populations. As time progressed and scientific knowledge increased, so did the Michigan stocking program. The Fisheries Division began to enhance capacity by working with partners to build and maintain state and privately-owned Walleye rearing ponds to satisfy the growing desire for Walleye stocking among Michigan's anglers.

Interest in Walleye stocking surged in the 1970s through 1990s as spring fingerling production was improved. Stocking was conducted using a trial-and-error approach for many waterbodies during this period and this continued for many years. Although these efforts sometimes created naturally reproducing populations, many stocking efforts failed to create a fishery. As additional information was gained on the effectiveness of Walleye stocking efforts, the Fisheries Division Walleye stocking strategies have been refined to maximize the return on investment and the likelihood of achieving the management goal associated with any given Walleye stocking effort. For example, stocking densities have been refined over the years based on results indicating that increased stocking densities have not resulted in proportional increases in relative Walleye abundance (Figure 10). Additionally, stocking has been eliminated on many waters after several attempts that did not result in creating a sustainable fishery. In addition, in more recent years Fisheries Division has needed to be more strategic by accounting for the tradeoffs between the cost of increased stocking rates and the expected contribution to a fishery because reduced budgets no longer allow for the extensive stocking activities that were historically common. Mechanisms describing historic stocking failures in Michigan waters were not always evaluated, but there is now robust information that provides guidance and criteria for how to increase the likelihood of stocking success (e.g., Raabe et al. 2020). During the creation of this plan, Fisheries Division updated Walleye stocking guidelines to incorporate the current knowledge base related to how to maximize the success of stocking efforts and that guidance is further described in Appendix B.

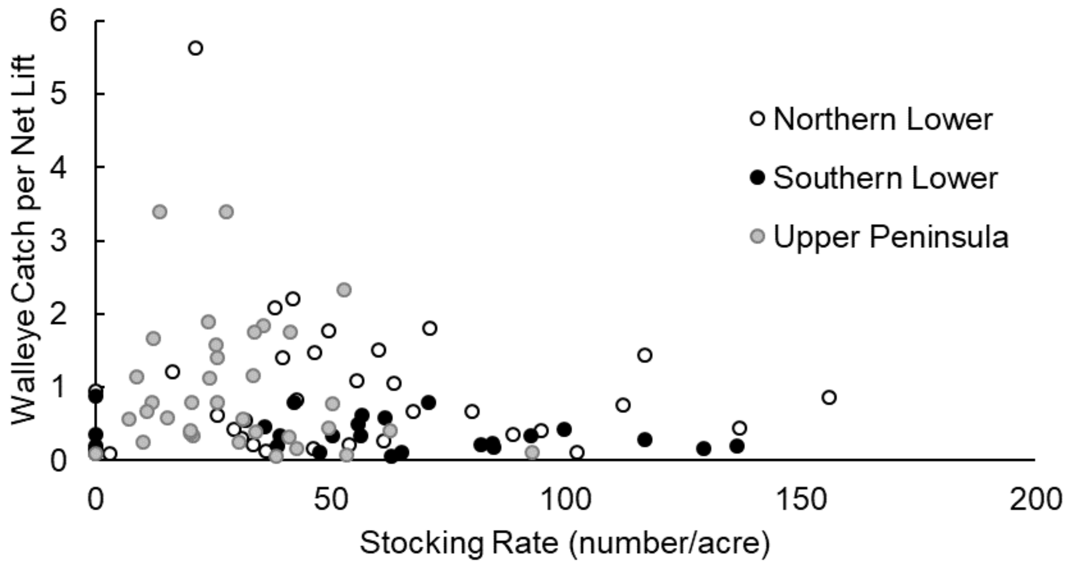

Figure 10. Index of Walleye relative abundance over a gradient of stocking rates of Walleye spring fingerlings in Michigan lakes. Stocking rates for a lake were computed as the average of all spring stocking events within a 6-year window prior to a netting survey on that lake. Walleye abundance was computed as the catch per net lift of Walleye captured in trap and fyke nets during Status and Trends surveys from 2003 to 2019. The three regions were defined using the spatial coverage of the different FMUs (Figure 1). Specifically, the Northern Lower consisted of Central Lake Michigan and Northern Lake Huron FMUs, the Southern Lower consisted of Southern Lake Michigan, Southern Lake Huron, and the Lake Erie FMUs, and Upper Peninsula included Northern Lake Michigan, and the Eastern and Western Lake Superior FMUs.

Walleye production remains a high priority for Fisheries Division to achieve management goals, and that production is derived using a multifaceted approach that provides multiple life stages for statewide stocking efforts. Presently, the Fisheries Division stocks fry (<1 in.), spring fingerlings (1-5 in.), and fall fingerlings (>5 in.). However, most waters are stocked with spring fingerlings because that life stage is typically easy to produce in large quantities and are relatively cost-effective after considering desired stocking densities and post-stocking survival rates. Stocking data by stage of development, year, and location can be accessed using the Fish Stocking Database that is accessible on the Fisheries Division's website (*www.michgian.gov/fishing*).

Annual Walleye production begins with egg-take operations that result in eggs being obtained from wild populations in the Muskegon River and Little Bay de Noc. These locations were selected for egg-take to sustain production and genetic integrity because they represent genetically distinct populations that are viewed as being representative of populations inhabiting the different peninsulas (see Appendix C). Additionally, these locations were selected for egg-take operations because of high relative abundance and large size structure, which allows for efficient gamete collection. Walleye egg-take occurs in early spring as returning adults congregate on spawning grounds. The collected eggs are then sent to one of the three fish hatcheries with cool-water programs (i.e., Thompson State Fish Hatchery, Wolf Lake State Fish Hatchery, and Platte River State Fish Hatchery) to further develop prior to stocking. After the fry emerge in the hatcheries, they are then stocked into ponds to grow to the desired stocking size. FMUs are responsible for operating their own Walleye rearing ponds or share those duties with other FMUs. In addition, there are many Walleye ponds owned by external groups with rearing being a collaborative effort between the public and Fisheries Division.

Walleye produced in these rearing ponds are shared across FMUs as a statewide resource and are stocked in accordance with Fisheries Division's Fish Stocking Guidelines, described in an approved stocking prescription per Fisheries Division Policy 02.02.019, and with consideration of the *Development of Fish Stocking Recommendations*, and the *Strategy for Stocking Walleyes from Various Brood Source Locations* (Appendix C). In most instances, Walleye from the rearing ponds are stocked into inland lakes or rivers as spring fingerlings in late May or June. Several ponds are also used to produce fall fingerlings, which have recently had increased interest from managers because fall fingerlings are larger and have an ability to evade higher predation rates, and lower stocking densities are required because this life stage typically has higher post-stocking survival rates (Raabe et al. 2020). The relatively high cost and space needed for raising fall fingerlings compared to the other life stages has resulted in a lower number of fall fingerlings being available each year, and therefore stocking this life stage is currently relatively rare in Michigan. Recently, Fisheries Division received legislative funding to address space limitations for Walleye production. In 2020, this funding was used to construct rearing ponds at Thompson State Fish Hatchery that are estimated to annually produce approximately 250,000 Walleye spring fingerlings. The new rearing ponds will be a reliable state-owned resource that will accommodate additional Walleye production and will assist with meeting the demands for statewide Walleye stocking efforts beginning in 2021.

Regulations

A primary mechanism for protecting and conserving Walleye populations in Michigan is the use of regulations to limit harvest. Regulatory actions have primarily been implemented to attempt to protect aggregations of spawning fish, influence population size structure, distribute harvest equitably, and promote sportsmanship (Schneider et al. 2007). Regulations have evolved considerably over the last 150 years in response to increases in fishing effort, real or perceived depletion of fish stocks, gains in science-based information, and changing angler values through time (Schneider et al. 2007). The effectiveness of any fishing regulation is linked to compliance, overall angler effort and harvest dynamics, and the habitat and productivity of a specific water. Therefore, Walleye populations throughout the state are expected to respond in a variable manner to different regulation types based on these factors.

Walleye populations in Michigan have historically been managed using a range of regulatory frameworks. Current regulations prohibit the state-licensed commercial harvest of Walleye in all Michigan waters, meaning that Walleye is a species regulated solely as a recreational and subsistence fishery. Fisheries Division manages the Walleye recreational fishery through consistent, statewide regulations that varies between Michigan's peninsulas only for the opening date of the possession season. It should be noted that a relatively few regulatory exemptions to the statewide norm exist, but those are critically reviewed, supported by biological and/or social science rationale, and approved by the Natural Resources Commission. The current statewide regulation for Walleye dates to 1976 and consists of a five fish daily possession limit and a 15-inch minimum size limit (Schneider et al. 2007). The biological justification for this regulation is associated with the desire to protect juvenile Walleye from harvest prior to maturity and allow for harvest opportunities of adults that aligns with perceived sustainable mortality rates, recognizing that there may be exceptions where some populations or subsets of populations (i.e., young, fast-growing females that reach 15 inches prior to maturity) throughout the state require additional protections. In addition, the statewide regulations consist of a closed possession season in both peninsulas to provide protection from harvest during most, if not the entire spawning season when the species is typically aggregated and vulnerable to harvest. Prior to 1987, the opening possession season date for fishing inland waters for Walleye in both the Lower and Upper Peninsulas of Michigan was May 15. This was changed to the last Saturday in April for the Lower Peninsula in 1987 by the Fisheries Division since it was believed that the delayed possession season was overly restrictive for most Lower Peninsula inland waters. This regulation remains in place today for the Lower Peninsula, and past Walleye surveys have shown that most Walleye populations are done spawning by the end of April. Fisheries Division also protects Walleye in spawning tributaries by using gear restrictions that limit the use of certain types of fishing tackle to reduce the likelihood of foul-hooking. For extra protection, some vulnerable spawning Walleye populations in the northern Lower Peninsula have historically had an opening fishing date of May 15. Additional population protections during the spawning period can be adopted using regulatory spawning closures that prohibit fishing activity in rivers with documented spawning activity. Catch-and-immediate-release fishing for Walleye outside of the possession season is not permitted and predominately lacks support from anglers (Figure 9). Statewide regulations in the Lower and Upper Peninsula have been perceived to be sufficiently conservative to protect most Walleye populations from overfishing based on available data and angler reports received by Fisheries Division staff. However, recommendations of other regulatory options that achieve the various management goals in this plan could be warranted when sufficient data is available to justify an alteration, and when resources are available to implement robust evaluations to determine if desired outcomes are being achieved. Therefore, as part of this plan a regulatory toolbox (Appendix D) was created to provide fisheries managers with a suite of regulatory options that can help achieve a variety of management objectives.

Co-management with Tribes

The State of Michigan is responsible for co-managing inland Walleye fisheries with tribal governments within treaty-ceded areas associated with the 1836 Treaty of Washington and 1842 Treaty of La Pointe (Figure 11). Co-management within the 1836 ceded territory was formalized with the adoption of the 2007 Consent Decree (United States v. Michigan, 2007), which describes the agreed upon management approaches for inland waters within that territory. As part of inland fisheries co-management and to help with implementation of the 2007 Consent Decree, the Inland Fisheries Committee (IFC) was formed to facilitate information sharing and working relationships amongst the signatory agencies. The IFC is comprised of biologists from each 1836 tribe and the Fisheries Division's Tribal Coordination Unit, and it has agreed upon protocols for Walleye population estimates and fall recruitment surveys. Although not governed by a formal agreement, the 1842 Fisheries Working Group (FWG) is comprised of biologists and staff from 1842 signatory tribes, Great Lakes Indian Fish & Wildlife Commission (GLIFWC), and Fisheries Division, and it is the venue for information sharing between governments. Both the IFC and FWG collaborate on surveys, share assessment and stocking data, and work together to set safe harvest limits for Walleye lakes in the respective treaty areas.

The harvest limits for tribal fishers, or quotas, are based on estimates of Walleye population size. The estimates of population size rely on implementing a labor-intensive mark-recapture (M-R) survey in the spring during the Walleye spawning season. It is not feasible to annually estimate population size using M-R surveys for all lakes in the 1836 ceded territory because of the large number of lakes and the substantial effort required, so when those estimates of population size are unavailable the population size is predicted using a statistical model that accounts for lake size and the reproductive status (i.e., natural reproduction or stocked) of a population for each lake within the 1836 ceded territory. To address similar constraints in the Michigan portion of the 1842 ceded territory, the tribal fishery agencies (GLIFWC) and Fisheries Division have established a rotation to complete population estimates on priority lakes once every five years. The highest priority lakes for routine surveys are lakes that have relatively high harvest and fishing pressure. Based on an agreement described within the 2007 Inland Consent Decree, Walleye harvest limits in lakes in the 1836 ceded territory typically are set at or below 35% of the estimated adult Walleye population size for each lake or system of interconnected lakes. Though the tribes can declare intent to harvest up to 50% of the safe harvest level (i.e., 17.5% of the adult Walleye population), this has not occurred. Tribal harvest limits have been set at 5 or 10% of the adult Walleye population since the signing of the 2007 Decree. In the 1842 ceded territory, the tribal harvest declaration is currently set at 10% of the estimated adult Walleye population. Though the details of co-management differ in the 1836 and 1842 ceded territories, the overall goal in both areas is to monitor and manage Walleye populations that support both the exercise of treaty-reserved rights by tribal members and recreational fishing by state-licensed anglers.

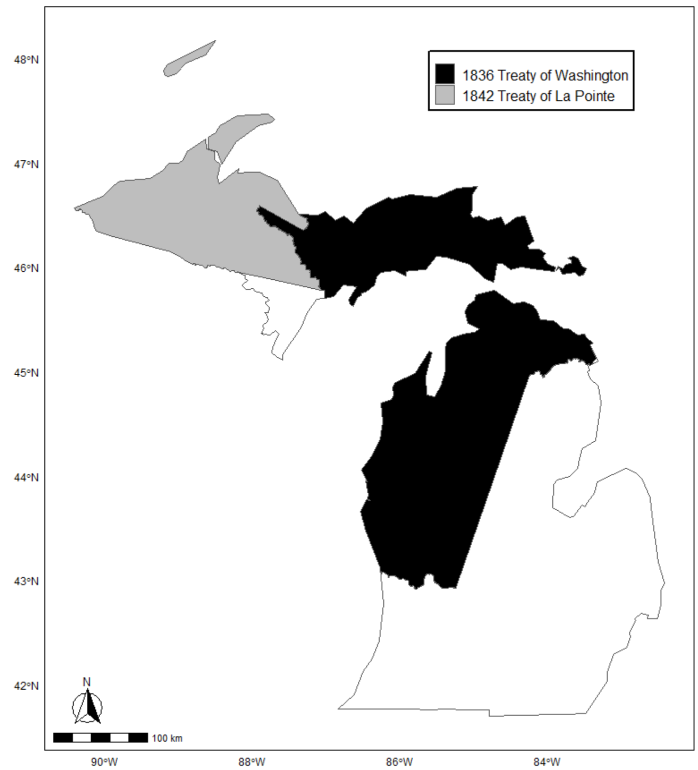

Figure 11. A map delineating the treaty boundaries where Fisheries Division and tribal agencies co-manage Walleye populations.

Management Goals and Objectives:

The overarching goal of this plan is to protect, conserve, and adaptively manage Walleye populations to maximize ecological benefits and angler satisfaction derived from healthy Walleye populations and fisheries. As stated in the introduction, Fisheries Division has developed a set of specific goals to achieve this high-level goal. The goals are not mutually exclusive nor ordered by priority and will be considered in a holistic manner when making management decisions. Under each specific goal, there are objectives that are intended to provide concrete statements of desired outcomes. Fisheries Division has also developed a set of recommended strategic actions intended to guide management activities toward achievement of these objectives. The implementation of the strategic actions described within this plan will be prioritized and coordinated by Fisheries Division's Walleye Committee with assistance from each section within Fisheries Division (i.e., Fish Production, Fisheries Management Units, Research Section, Tribal Coordination Unit, and Program Support). These strategic actions should be implemented using an adaptive management framework, meaning they are continually evaluated, refined and prioritized, within the fiscal and personnel limitations placed upon the Fisheries Division.

Goal 1: Protect, restore, or enhance habitats supporting Walleye populations

Habitat determines Walleye distribution and abundance, and as such the purpose of this goal is to maintain and increase habitat required to support sustainable Walleye populations that provide harvest opportunities. Threats to achieving this goal include point-source and non-point-source nutrient inputs, aquatic vegetation management, aquatic invasive species, climate change, landscape and shoreline development, and fish passage barriers including dams, lake-level-control structures, and culverts. The tools for managing Walleye habitat include nutrient and sediment management such as land acquisition/conservation easements, watershed and AIS best-management practices, replacing leaking septic tanks, increasing or maintaining natural shorelines, conducting environmental permit reviews, and removing barriers that limit accessibility to preferred spawning habitats. Most of these habitat management actions require participation by private landowners. Consequently, the development of partnerships will be key to the successful maintenance, rehabilitation, and protection of Walleye habitat.

To achieve this goal, the Fisheries Division will pursue the following objectives:

- Objective 1.1: Maintain and rehabilitate habitat to achieve suitable dissolved oxygen levels and temperature ranges that are required to support Walleye populations.
- Objective 1.2: Maintain and restore connectivity of waters, including connections with the Great Lakes that support Walleye populations.
- Objective 1.3: Prioritize and protect high quality inland lakes that are managed for Walleye (e.g., Class 3 lakes) with a variety of measures to minimize eutrophication, such as conservation easements or septic management and increased prevention of aquatic invasive species introductions.
- Objective 1.4: Review permits submitted to EGLE and provide guidance to limit negative effects of aquatic vegetation management and other habitat manipulations on all life stages of Walleye.

The following management strategies are recommended to achieve this goal:

- Strategy 1.1: Identify and implement watershed and riparian best management practices to reduce sedimentation and nutrient inputs. Prioritize lakes in Classes 2 and 3 for protection and habitat rehabilitation because they tend to have the highest suitability based on lake size and thermal regime. Evaluate whether lake size and thermal regime may be limiting Walleye populations in Classes 5 and 6 before considering habitat rehabilitation.
- Strategy 1.2: Implement AIS best management practices to reduce the likelihood of introduction and spread as well as limit the ecological impacts of AIS establishments.

- Strategy 1.3: Participate in the environmental permit review process administered through the Department of Environment, Great Lakes, and Energy (EGLE), which includes reviewing chemical treatment permits for invasive and nuisance aquatic vegetation, and other EGLE issued permits in adherence with Parts 301 (inland lakes and streams), 315 (dam safety), 303 (wetlands), 319 (non-point source pollution), and 307 (legal lake level) of Public Act 451 of 1994, referred to as the Natural Resources and Environmental Protection Act.
- Strategy 1.4: Develop partnerships with citizen science programs such as the Cooperative Lakes Monitoring Program to assess and monitor habitats in lakes managed for Walleye.
- Strategy 1.5: Seek external funding and prioritize internal opportunities (e.g., Fisheries Habitat Grant program) to implement projects that result in Walleye habitat enhancements.

Goal 2: Maintain self-sustaining Walleye populations

In 2018, Fisheries Division released *Charting the Course: Fisheries Division's Framework for Managing Aquatic Resources*, which is the strategic plan for managing Michigan's Fisheries into the future. One of the goals identified was "Ensure Healthy Aquatic Ecosystems and Sustainable Fisheries" with the objective to "conserve and manage aquatic species and their habitats". The strategy to achieve the goal was to focus on protecting and enhancing natural reproduction of native and desirable naturalized aquatic species. Maintaining self-sustaining Walleye populations falls within this strategy and is the most economical and ecologically appropriate approach to manage Walleye populations. The Fisheries Division emphasizes the importance of maintaining self-sustaining Walleye populations because doing so maintains genetic integrity of a healthy population and reduces stocking costs while still providing ecological benefits and desirable fisheries.

Obstacles to achieving the goal of self-sustaining Walleye populations are overharvest, habitat degradation or unsuitable habitat, and proliferation of aquatic invasive species. However, there are many opportunities to overcome these obstacles. These include identifying, maintaining, and increasing spawning and nursery habitats, maintaining natural shorelines to reduce sedimentation of suitable spawning substrates, and keeping total annual mortality at sustainable levels.

To achieve this goal, the Fisheries Division will pursue the following objective:

- Objective 2.1: Identify and maintain self-sustaining Walleye populations.

The following management strategies are recommended to achieve this goal:

- Strategy 2.1: Conduct statewide and targeted monitoring programs of self-sustaining Walleye populations to determine persistence of natural reproduction. Management actions should be implemented in an adaptive manner to identify mechanisms and address concerning population trends when they are identified.
- Strategy 2.2: Utilize regulations statewide, and collaborate with tribal co-managers in treaty-ceded waters, to limit harvest to ensure sustainable populations.
- Strategy 2.3: Implement and evaluate habitat protection or enhancement projects on the relevant landscape scale (i.e., watershed, lake, and/or river) to maintain or enhance naturally reproducing Walleye populations. Specifically, restoring

connectivity with streams that serve as corridors for migration to spawning habitat should be prioritized. This strategy should also be addressed collaboratively with the Midwest Glacial Lakes Partnership and the Great Lakes Basin Fish Habitat Partnership.

- Strategy 2.4: Do not recommend or prescribe stocking Walleye in waters where Walleye are already known to be consistently naturally reproducing and supporting a viable fishery, based on available survey data or professional expertise of the managing Fisheries Management Unit.

Goal 3: Maintain and further develop relations with tribal governments and stakeholders

The intent of this goal is to ensure open communication, regular engagement, and positive relationships that will lead to improved transparency and more successful Walleye management. To properly represent the differences in Fisheries Division's relationships with tribal governments and stakeholders, this goal is divided into subsections.

Tribal governments

Tribal governments are sovereign entities, and those within the 1836 and 1842 Treaty-ceded territories have equal co-management authority with the State of Michigan. This means different governments each have their own authority to manage the same bodies of water. If governments are not working together and sharing information, successful management will be unlikely. At its core, the government-to-government relationship that exists has a goal of monitoring and managing Walleye populations that support both the exercise of treaty-reserved rights by tribal members and recreational fishing by state-licensed anglers. For this to be realized, collaboration must occur on multiple levels and open communication among professionals and policy makers within each government is imperative. Management strategies must be pursued together, and changes agreed to by consensus.

Stakeholders

While the framework is already in place to collaborate with tribal governments, further work needs to be done to maintain and enhance relations with stakeholder groups, citizen advisory committees, and anglers that are not part of an organized group. Currently, the Fisheries Division has formal and informal avenues to interact with stakeholders about Walleye management. One formal venue for interacting with stakeholders about Walleye management is the Fisheries Division's Warmwater Resources Steering Committee, which is a committee that consists of several external stakeholder groups and independent anglers actively engaged in the management of Michigan's warm- and coolwater fish species. While these interactions have been effective, Walleye anglers are generally not organized into formal angling groups which can be a challenge to efficient communication. As such, biologists also frequently attempt to increase interactions with individual anglers, angler groups, and lake associations that are not represented on the Warmwater Resources Steering Committee. This plan is expected to provide benefits because it will be used as a communication tool to enhance clarity and transparency regarding Walleye management goals and strategies with stakeholders at all levels of engagement.

To achieve this goal, the Fisheries Division will pursue the following objectives:

- Objective 3.1: Actively partner with tribal governments to regularly assess and collaboratively manage Walleye populations within the various treaty-ceded territories (e.g., Walleye abundance estimates, recruitment evaluations, stocking contribution evaluations, investigate early life history issues, determine harvest management strategies).
- Objective 3.2. Garner support for initiatives and management concerns by engaging with anglers, lake associations, citizen advisory groups, tournament directors, steering committees, and stakeholder groups (*e.g., Northern Inland Lakes Citizens Advisory Committee, Warmwater Resources Steering Committee, Western Upper Peninsula Citizens Advisory Committee, Walleyes for Tomorrow*).
- Objective 3.3: Develop, maintain, and enhance new partnerships related to habitat projects, stocking efforts, and regulation proposals (e.g., Walleye rearing pond management, private stocking proposals, special regulation proposals, etc.).

The following management strategies are recommended to achieve this goal:

- Strategy 3.1: Annually meet with tribal co-managers to share work plans, stocking plans, survey data, and to discuss proposed changes to management of Walleye populations.
- Strategy 3.2: Maintain and enhance a statewide database of Walleye population estimates, stocking, and recruitment data with tribal co-managers.
- Strategy 3.3: Develop communication tools and promote stakeholder input related to Walleye management issues and regulatory proposals. Examples could include social media posts, videos, brochures, webinars, etc.

- Strategy 3.4: Regularly promote management efforts, such as population and habitat assessments, regulatory proposals and review, Walleye egg-takes, and stocking efforts to communities and stakeholders.
- Strategy 3.5. Develop education and outreach materials that provides anglers with information on when, where, and how to effectively target Walleye.
- Strategy 3.6: Maintain relationships with conservation groups to provide direction and professional advice for effective operation of cooperative Walleye rearing ponds.

Goal 4: Provide production capacity for Walleye stocking

The intent of this goal is to maintain and enhance a network of Walleye rearing ponds distributed throughout the state where certified disease-free Walleye can be produced to annually fulfill stocking requests at target levels. Artificial propagation of Walleye is a high priority for Fisheries Division because several goals described within this plan require the use of stocking.

To achieve this goal, the Fisheries Division will pursue the following objectives:

- Objective 4.1: Optimize survival per cost of stocked Walleye to increase the number available for harvest annually and in future years.
- Objective 4.2: Maintain the genetic integrity of Walleye populations that source the annual egg-take operations.
- Objective 4.3: Produce Walleye that are certified disease-free prior to stocking.
- Objective 4.4: Maintain and enhance opportunities for private groups and tribal governments seeking to help produce, stock, and evaluate Walleye stocking efforts that are focused on achieving management goals described within this plan.

The following management strategies are recommended to achieve this goal:

- Strategy 4.1: Develop pond-specific Walleye rearing protocols and routinely evaluate to determine if refinements are necessary to achieve desired overall numbers produced, survival rates, and costs of production and maintenance.
- Strategy 4.2: Develop protocols for evaluating stocking efforts that includes characteristics of life stage of Walleye stocked, stocking densities, evaluation period, lake habitat characteristics, existing fish assemblage, and other evaluation parameters.
- Strategy 4.3: Update Fisheries Division's Fish Stocking Guidelines as needed to incorporate findings from stocking evaluations.
- Strategy 4.4: Implement disinfection procedures, biosecurity measures, and disease testing regimes to remain vigilant in raising disease certified and healthy stocks of Walleye.
- Strategy 4.5: Maintain and foster relationships with university staff to enhance and maintain genetic testing capacity to inform actions needed to maintain diverse and robust wild broodstock populations.
- Strategy 4.6: Annually meet with peers and partners to share information on how to maximize Walleye production to increase annual output of a high-quality product.
- Strategy 4.7: Evaluate tribal and private partnerships to ensure that stocking efforts are critically reviewed, are certified as disease free, and have a high likelihood of contributing to a fishery.

Goal 5: Provide diverse opportunities for Walleye fishing

The majority of higher-quality inland Walleye populations are in the northern portion of the state, thereby requiring increased travel costs for much of the angling populace. Efforts to create and maintain quality Walleye angling opportunities throughout the state are designed to better serve all anglers. Although this plan is focused on inland waters, Great Lakes, connecting waters, and seasonal riverine fishing opportunities need be considered because those waters provide some of the most desirable and diverse Walleye fisheries in Michigan. Challenges faced in achieving this goal include natural variability in abiotic and biotic factors that influence the ability of lakes to support self-sustaining or stocked Walleye populations, as well as the threat that invasive species and climate change pose to populations that are currently self-supporting. A primary tool for creating or enhancing Walleye fishing opportunities is stocking, which entails a cost to the Fisheries Division, and for which the return on investment needs to be considered when making management decisions. In addition, adjusting fishing regulations is a management tool that can be implemented to achieve population characteristics that align with diverse Walleye fisheries, but biological and social science elements need to be reviewed when regulatory modifications are considered and recommended to the Natural Resource Commission for approval.

To achieve this goal, the Fisheries Division will pursue the following objectives

- Objective 5.1: Maintain and when feasible create Walleye populations to provide fishing opportunities in such a manner that may reduce an angler’s need for long distance travel to target Walleye.

- Objective 5.2: Provide and promote multiple fishery access types (boat, shore, ice) for Walleye fisheries distributed throughout Michigan's diverse assortment of inland waters (rivers and lakes).
- Objective 5.3: Maintain unique Walleye fisheries that already exist within the state (e.g., lakes with particular aesthetics, notably high catch rates)

The following management strategies are recommended to achieve this goal:

- Strategy 5.1: Use stocking, following guidance provided in Appendix B and consideration for most suitable early life stage to stock based on habitat and existing fish community, to develop or enhance Walleye populations. The waters selected for stocking and the stage stocked (i.e., fry, spring fingerling, fall fingerling) should be chosen based on suitability of habitat conditions to support adult Walleye, proximity to population centers, and availability of nearby Walleye fishing opportunities. Efforts to develop or enhance Walleye populations should be prioritized in lakes with suitable habitat (i.e., Classes 2, 3, 4, 5, and 6) or a history of stocking success, characterized as having variable or no natural reproduction, and should have a stocking evaluation plan developed.
- Strategy 5.2: In consultation with anglers and tribal governments, identify Walleye fisheries that are unique and of unusually high value, and prioritize management actions at these locations to maintain and protect the characteristics that make them desirable.
- Strategy 5.3: Recommend pertinent regulatory options (see Appendix D) that align with desired management objectives to maintain or enhance diverse Walleye fisheries throughout the state.

Goal 6: Manage Walleye populations to achieve desirable fish community characteristics

The intent of this goal is to achieve ecosystem balance by using Walleye to bio-manipulate the existing fish community. Walleye rank as one of the top predators used in biological control programs across North America (Wiley and Wydoski 1993), and there is a long history of stocking and adjusting regulations for Walleye to structure fish communities, much of it based on research conducted in Michigan (e.g., Schneider 1997; Schneider and Lockwood 1997; O'Neal 2017). Goals of these management actions often include controlling some aspect of panfish population dynamics (Wiley and Wydoski 1993; Dexter and O'Neal 2004). For example, predator stocking has been shown to successfully alter Bluegill population attributes (Schneider 1975; Forsythe and Wrenn 1979; Santucci and Wahl 1993; O'Neal 2017), and there is evidence for the importance of predation by and on percids (e.g., Walleye, Yellow Perch, darter species) in determining structure and function of fish communities (MacLean and Magnuson 1977).

Mixed results have been documented when using Walleye stocking to structure or manipulate fish communities. Increasing predation rates through Walleye stocking may make an ecosystem more resistant and resilient to the effects of aquatic invasive species (Fielder 2004; Krueger and Hrabik 2005). For example, Walleye stocking that results in robust adult populations has contributed to suppressing populations of introduced non-native species, such as Rainbow Smelt (Cwalinski 2010; Krueger and Hrabik 2005). In contrast, undesirable effects of Walleye stocking can include the reduction in other stocked or native fish populations, especially when alternate prey is scarce (Johnson et al. 2007). These potential outcomes are important to consider, especially after recognizing that in Michigan Walleye are the most common species stocked by the public under permit from the state. Therefore, it is important that private stocking programs be coordinated with fisheries managers to comprehensively weigh possible long-term negative impacts against intended benefits.

To achieve this goal, the Fisheries Division will pursue the following objectives:

- Objective 6.1: Retain Walleye stocking as a biocontrol option for improving growth rates and size structure of panfish populations, but only in lakes that have suitable habitat for adult Walleye.
- Objective 6.2: Adopt an adaptive management approach for using Walleye to control invasive or undesirable aquatic species (e.g., Round Goby, Rainbow Smelt, Gizzard Shad (*Dorosoma cepedianum*), etc.).
- Objective 6.3: Limit Walleye stocking efforts when there is the potential to negatively impact other desirable fisheries or populations of species of concern (e.g., Yellow Perch, Cisco (*Coregonus artedi*), salmonids).

The following management strategies are recommended to achieve this goal:

- Strategy 6.1: Inventory waters and seek angler feedback to determine waters where panfish management is desired (i.e., systems with sub-optimal panfish populations, including Yellow Perch), and where Walleye stocking would be an appropriate or inappropriate management tool to achieve goals for panfish populations. Waters identified for Walleye stocking should not include locations where natural Walleye reproduction occurs consistently.

- Strategy 6.2: Identify waters where Walleye stocking could be used to control invasive or undesirable aquatic species. These waters should not include locations where natural Walleye reproduction occurs consistently.
- Strategy 6.3: Develop a list of waters where Walleye stocking would be appropriate because of suitable Walleye habitat. Furthermore, evaluate and refine stocking strategies based on factors that influence stocking success to develop criteria for increasing efficacy of future stocking efforts.
- Strategy 6.4: Develop materials to facilitate education of private groups as to the potential advantages and disadvantages of Walleye stocking, and to the guidelines being used by Fisheries Division to evaluate requests for private stocking.

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Appendices

Appendix A: Michigan's Inland Lakes Managed For Walleye

Table A-1. List of inland lakes managed for Walleye that are classified based on stocking records, results of fisheries surveys (2000-2019), and questionnaires completed by fisheries biologists from each Fisheries Management Unit (FMU). FMU label abbreviations are as follows: Western Lake Superior = WLS, Eastern Lake Superior = ELS, Northern Lake Michigan = NLM, Central Lake Michigan = CLM, Southern Lake Michigan = SLM, Northern Lake Huron = NLH, Southern Lake Huron = SLH, Lake Erie = LE. Natural reproduction categories 1 and 2 were defined as consistent natural reproduction meaning a population persists and provides fishery without history of stocking or persists despite discontinued stocking; 3 and 4 were defined as variable natural reproduction meaning a population produces a year class of natural reproduced Walleye too infrequently to maintain a population without stocking, although a residual Walleye population may be maintained and provide a marginal fishery; and 5 was defined as no natural reproduction meaning persistence of a population and fishery is solely dependent on routine stocking. Lake Class refers to the six lake types in Michigan identified by Wehrly et al. (2012) based on fish assemblages, lake size, and thermal regime. Predicted suitability of each lake ranged from 0 (lowest) to 1 (highest) and was based on a model estimating the presence-absence of adult Walleye in each lake using landscape-based predictors (Wehrly, unpublished data). Natural reproduction categories and habitat suitability are significantly influenced by annual variations in biotic and abiotic conditions and by long-term climatic conditions. Therefore, values for those factors provided in this table are expected to be dynamic and will likely vary following the publication of this plan. Missing information indicates model estimates or other data were not available for that waterbody.

FMU	County	Name	Surface area (acres)	Natural Reproduction	Lake Class	Suitability	Latitude	Longitude
LE	Hillsdale	Lake Diane	266	5	1	0.39	41.71011	-84.65307
LE	Jackson	Clark Lake	576	5	2	0.62	42.12054	-84.32648
LE	Jackson	Vineyard Lake	541	5	2	0.59	42.08249	-84.20981
LE	Lenawee	Devils Lake	1,312	5	2		41.97916	-84.30773
LE	Lenawee	Lake Erin	565	5	2	0.61	42.00071	-84.13902
LE	Lenawee	Sand Lake	546	5	2	0.61	42.04721	-84.13731
LE	Livingston	Base Line Lake	244	3	1	0.40	42.42555	-83.89343
LE	Livingston	Kent Lake	1,015	3	2	0.74	42.51305	-83.67593
LE	Livingston	Strawberry Lake	261	3	1	0.66	42.44916	-83.84148
LE	Livingston	Whitmore Lake	576	5	2	0.62	42.43677	-83.75036
LE	Livingston	Woodland Lake	258	5	1		42.55527	-83.78398
LE	Livingston	Zukey Lake	149	3	1	0.32	42.45999	-83.8462
LE	Macomb	Stoney Creek Pond	584	5	2	0.61	42.71891	-83.08994
LE	Oakland	Big Lake	213	5	1	0.47	42.72277	-83.51982
LE	Oakland	Big Seven Lake	158	5	1	0.39	42.81876	-83.67895
LE	Oakland	Cass Lake	1,279	3	2	0.62	42.6086	-83.36676
LE	Oakland	Crescent Lake	91	5	1		42.64332	-83.38676
LE	Oakland	Lakeville Lake	430	5	1	0.59	42.8286	-83.15009
LE	Oakland	Long Lake	166	5	1	0.36	42.6111	-83.45676
LE	Oakland	Oakland Lake	304	5	1	0.46	42.70027	-83.36065

FMU	County	Name	Surface area (acres)	Natural Reproduction	Lake Class	Suitability	Latitude	Longitude
LE	Oakland	Orion Lake	482	5	2	0.61	42.78055	-83.2487
LE	Oakland	Oxbow Lake	268	5	1	0.39	42.64582	-83.48065
LE	Oakland	Pontiac Lake	613	5	2	0.67	42.66666	-83.45843
LE	Oakland	Union Lake	467	5	2	0.59	42.60218	-83.44493
LE	Oakland	White Lake	519	5	2	0.60	42.6686	-83.5637
LE	Oakland	Wolverine Lake	269	5	1	0.40	42.55527	-83.49176
LE	Washtenaw	Argo Pond	84	5	1		42.29117	-83.74573
LE	Washtenaw	Barton Pond	192	5	1	0.31	42.30988	-83.75398
LE	Washtenaw	Big Portage Lake	641	3	2	0.62	42.41738	-83.90993
LE	Washtenaw	Ford Lake	958	1	2	0.66	42.2064	-83.56044
LE	Washtenaw	Geddes Pond	195	5	1		42.27105	-83.6716
LE	Wayne	Belleville Lake	1,253	3	2	0.68	42.21436	-83.44178
NLH	Alcona	Alcona Dam Pond	975	2	5	0.76	44.56605	-83.80491
NLH	Alcona	Cedar Lake	1,057	5	5		44.53138	-83.33204
NLH	Alcona	Crooked Lake	96	4	4	0.43	44.73555	-83.86954
NLH	Alcona	Hubbard Lake	8,768	1	3	0.77	44.80416	-83.55954
NLH	Alpena	Beaver Lake	693	2	5	0.75	44.93777	-83.79899
NLH	Alpena	Long Lake	5,342	2	5	0.77	45.16547	-83.43694
NLH	Alpena	Winyah Lake (7 mile)	865	4	5	0.75	45.10243	-83.52047
NLH	Cheboygan	Black Lake	10,113	4	3	0.75	45.46666	-84.26676
NLH	Cheboygan	Burt Lake	17,395	1	3	0.69	45.46666	-84.66676
NLH	Cheboygan	Douglas Lake	3,727	4	3	0.75	45.5811	-84.69704
NLH	Cheboygan	Long Lake	379	3	5	0.69	45.53471	-84.39871
NLH	Cheboygan	Mullett Lake	16,704	1	3	0.69	45.5361	-84.51676
NLH	Chippewa	Caribou Lake	829	5	6	0.70	45.99582	-83.99454
NLH	Chippewa	Carp (Trout) Lake	568	1	6	0.73	46.18332	-85.04177
NLH	Chippewa	Frenchman's Lake	185	4	6	0.61	46.1836	-85.01565
NLH	Crawford	Big Bradford Lake	256	4	1	0.66	44.85702	-84.71193
NLH	Crawford	Big Creek Impoundment	78	5	4		44.79777	-84.37744
NLH	Crawford	Jones Lake	40	5	4	0.40	44.78416	-84.5926
NLH	Emmet	Crooked Lake	2,352	1	3	0.77	45.41082	-84.82593
NLH	Emmet	Pickerel Lake	1,082	1	5	0.77	45.39666	-84.76843
NLH	Emmet	Round Pond	353	5	1	0.70	45.40693	-84.88926

FMU	County	Name	Surface area (acres)	Natural Reproduction	Lake Class	Suitability	Latitude	Longitude
NLH	Iosco	Cooke Pond	1,635	4	2	0.73	44.47257	-83.57251
NLH	Iosco	Five Channels Pond	223	4	1	0.65	44.45588	-83.67721
NLH	Iosco	Van Etten Lake	1,409	2	2	0.75	44.47221	-83.35982
NLH	Mackinac	Twin Lakes	560	5	5		45.7486	-84.45843
NLH	Montmorency	East Twin Lake	820	5	5	0.73	44.86971	-84.30704
NLH	Montmorency	Ess Lake	119	5	4	0.62	45.11249	-83.98343
NLH	Montmorency	Long Lake	279	4	5	0.69	45.12777	-83.97315
NLH	Montmorency	West Twin Lake	1,306	5	6	0.76	44.87749	-84.34954
NLH	Ogemaw	AuSable Lake	272	5	5	0.68	44.42999	-83.92037
NLH	Ogemaw	Clear Lake	204	5	5	0.59	44.40499	-84.28315
NLH	Oscoda	McCollum Lake	219	4	5	0.62	44.77688	-83.89255
NLH	Oscoda	Mio Pond	670	2	5	0.75	44.66044	-84.13419
NLH	Oscoda	Tea Lake	204	4	5	0.60	44.84166	-84.29454
NLH	Otsego	Big Bear Lake	344	4	5	0.70	44.93804	-84.38454
NLH	Otsego	Big Lake	124	5	1	0.64	45.00832	-84.58482
NLH	Otsego	Dixon Lake	78	5	4	0.44	44.99471	-84.63454
NLH	Otsego	Opal Lake	125	5	4	0.64	44.9261	-84.61315
NLH	Otsego	Otsego Lake	2,013	5	5	0.77	44.95554	-84.69232
NLH	Presque Isle	Grand Lake	5,822	1	5	0.77	45.29999	-83.5001
NLH	Presque Isle	Lake Esau	319	5	5	0.69	45.31332	-83.46704
NLH	Presque Isle	Ocqueoc Lake	125	4	1	0.60	45.47419	-84.11389
NLH	Presque Isle	Rainy Lake	202	4	5	0.57	45.24943	-84.06843
NLH	Roscommon	Lake St. Helen	2,416	5	5	0.77	44.36416	-84.46343
SLH	Clare	Budd Lake	174	5	1	0.56	44.02027	-84.79426
SLH	Clare	Eight Point Lake	416	5	1	0.68	43.83999	-85.07343
SLH	Genesee	C. S. Mott Lake	596	1	2	0.64	43.08064	-83.65236
SLH	Genesee	Holloway Reservoir	1,173	1	2	0.66	43.12026	-83.49165
SLH	Genesee	Lake Fenton	867	5	2	0.68	42.83471	-83.71537
SLH	Genesee	Lake Ponemah	410	5	1	0.63	42.81666	-83.74176
SLH	Genesee	Lobdell Lake	546	5	2	0.66	42.79065	-83.84436
SLH	Gladwin	Lake Lancer	688	5	2	0.74	44.10728	-84.45084
SLH	Gladwin	Pratt Lake	188	5	1		44.02499	-84.54704
SLH	Gladwin	Ross Lake	249	5	1	0.60	43.88381	-84.48406

FMU	County	Name	Surface area (acres)	Natural Reproduction	Lake Class	Suitability	Latitude	Longitude
SLH	Gladwin	Secord Lake	400	5	1	0.68	44.04166	-84.34176
SLH	Gladwin	Smallwood Lake	371	5	1	0.68	43.96027	-84.33593
SLH	Gladwin	Wiggins Lake	293	5	5	0.67	43.9961	-84.54371
SLH	Gladwin	Wixom Lake	1,142	5	2		43.817	-84.38478
SLH	Iosco	Indian Lake	214	5	5	0.57	44.34721	-83.64954
SLH	Iosco	Long Lake	486	5	5	0.68	44.41499	-83.85399
SLH	Iosco	Loon Lake	416	4	1	0.67	44.40971	-83.82371
SLH	Iosco	Round Lake	91	5	1		44.33943	-83.6601
SLH	Iosco	Sand Lake	245	5	5	0.65	44.32555	-83.68093
SLH	Isabella	Coldwater Lake	285	4	1	0.61	43.6611	-84.95593
SLH	Isabella	Littlefield Lake	140	5	1		43.77249	-84.94509
SLH	Lapeer	Lake Nepessing	427	5	1	0.64	43.01749	-83.37176
SLH	Lapeer	Otter Lake	67	5	1	0.25	43.2186	-83.46037
SLH	Livingston	Lake Chemung	313	5	1	0.55	42.58221	-83.8487
SLH	Mecosta	Chippewa Lake	791	5	5	0.73	43.75443	-85.29815
SLH	Mecosta	Pretty Lake	116	5	1	0.57	43.6961	-85.23482
SLH	Midland	Sanford Lake	1,402	3	2	0.70	43.67693	-84.38009
SLH	Montcalm	Rock Lake	51	5	1	0.29	43.40832	-84.94287
SLH	Ogemaw	Devoe Lake	118	5	4	0.58	44.40081	-84.0265
SLH	Ogemaw	George Lake	186	5	5	0.58	44.39916	-83.97315
SLH	Ogemaw	Peach Lake	234	5	5	0.68	44.29443	-84.17037
SLH	Ogemaw	Rifle Lake	185	5	5	0.59	44.41193	-83.98037
SLH	Tuscola	Murphy Lake	183	5	1	0.39	43.29999	-83.46176
CLM	Antrim	Bellaire Lake	1,789	3	2	0.74	44.95721	-85.22426
CLM	Antrim	Birch Lake	325	1	1	0.70	44.93554	-85.38204
CLM	Antrim	Intermediate Lake	1,571	3	2	0.74	45.0236	-85.22065
CLM	Antrim	Lake Skegemog	2,766	3	2	0.74	44.82789	-85.35028
CLM	Antrim	Six Mile Lake	369	3	5	0.68	45.11249	-85.20121
CLM	Benzie	Little Lime Lake	35	3	1	0.21	44.75471	-85.93287
CLM	Benzie	Lower Herring Lake	450	4	2	0.68	44.56471	-86.21482
CLM	Benzie	Platte Lake	2,532	2	2	0.75	44.6911	-86.09232
CLM	Benzie	Upper Herring Lake	572	4	2	0.70	44.56193	-86.18176
CLM	Charlevoix	Lake Charlevoix	17,268	2	3	0.77	45.26665	-85.13343

FMU	County	Name	Surface area (acres)	Natural Reproduction	Lake Class	Suitability	Latitude	Longitude
CLM	Charlevoix	Lake Geneserath	480	3	5		45.59804	-85.53899
CLM	Charlevoix	Walloon Lake	4,577	2	2	0.74	45.27499	-85.0001
CLM	Crawford	Lake Margarethe	1,922	4	3	0.69	44.65054	-84.78732
CLM	Emmet	Paradise Lake	1,912	3	5	0.74	45.68749	-84.7501
CLM	Grand Traverse	Boardman Lake	317	1	1	0.87	44.75667	-85.61472
CLM	Grand Traverse	Fife Lake	606	3	5	0.70	44.56029	-85.34403
CLM	Grand Traverse	Long Lake	2,911	1	2	0.74	44.71165	-85.74843
CLM	Grand Traverse	Silver Lake	609	3	2		44.69277	-85.68621
CLM	Kalkaska	Manistee Lake	874	4	2	0.75	44.78249	-85.02065
CLM	Kalkaska	Pickerel Lake	93	5	4	0.37	44.80027	-84.97732
CLM	Lake	Big Star Lake	890	4	2	0.74	43.83277	-85.94454
CLM	Leelanau	Lake Leelanau	8,607	1	3	0.75	44.97456	-85.70915
CLM	Manistee	Bear Lake	1,873	4	2	0.74	44.43332	-86.15287
CLM	Manistee	Manistee Lake	1,051	1	2	0.71	44.23304	-86.29982
CLM	Manistee	Portage Lake	2,116	3	2		44.35999	-86.24037
CLM	Manistee	Tippy Dam Backwaters	1,086	3	2	0.75	44.26047	-85.93595
CLM	Mason	Hackert (Crystal) Lake	120	5	1	0.52	43.98332	-86.32509
CLM	Mason	Hamlin Lake	4,622	3	2	0.71	44.0376	-86.49111
CLM	Mason	Pere Marquette Lake	606	1	2	0.67	43.94304	-86.44787
CLM	Mecosta	Blue Lake	229	5	1	0.63	43.61971	-85.28371
CLM	Mecosta	Horsehead Lake	443	5	2	0.69	43.67721	-85.25815
CLM	Mecosta	Lake Mecosta	312	5	1	0.68	43.61304	-85.29759
CLM	Mecosta	Rogers Impoundment	337	2	1	0.68	43.61388	-85.47926
CLM	Mecosta	School Section Lake	122	5	1	0.55	43.59665	-85.27343
CLM	Missaukee	Lake Missaukee	2,035	4	5	0.75	44.32221	-85.24676
CLM	Muskegon	Big Blue Lake	336	5	1	0.65	43.45388	-86.20426
CLM	Muskegon	Muskegon Lake	4,232	3	2	0.69	43.2361	-86.28315
CLM	Muskegon	White Lake	2,535	3	2	0.71	43.37721	-86.38037
CLM	Muskegon	Wolf Lake	225	5	1	0.45	43.25777	-86.10204
CLM	Newaygo	Baptist Lake	80	5	1	0.34	43.33332	-85.5812
CLM	Newaygo	Croton Pond	1,129	1	2	0.76	43.43749	-85.66398
CLM	Newaygo	Fremont Lake	825	3	2	0.71	43.45054	-85.96482
CLM	Newaygo	Hardy Pond	2,773	1	2	0.75	43.48817	-85.62984

FMU	County	Name	Surface area (acres)	Natural Reproduction	Lake Class	Suitability	Latitude	Longitude
CLM	Newaygo	Nichols Lake	153	5	1	0.50	43.72638	-85.90621
CLM	Newaygo	Pickerel Lake	308	5	1	0.65	43.45665	-85.81232
CLM	Oceana	Hart Lake (impoundment)	236	4	1	0.61	43.71721	-86.37232
CLM	Oceana	Pentwater Lake	482	1	2	0.66	43.76999	-86.42093
CLM	Oceana	Silver Lake	672	4	2	0.71	43.66776	-86.50482
CLM	Osceola	Rose Lake	373	5	5	0.68	44.06471	-85.38176
CLM	Otsego	Lake Twenty Seven	106	3	4	0.39	45.04804	-84.78593
CLM	Roscommon	Houghton Lake	20,075	1	5	0.75	44.34999	-84.7251
CLM	Wexford	Hodenpyl Dam Pond	1,530	3	2	0.76	44.36245	-85.81978
CLM	Wexford	Lake Cadillac	1,172	3	5	0.74	44.249	-85.40948
CLM	Wexford	Lake Mitchell	2,649	3	5	0.69	44.23903	-85.46243
NLM	Baraga	Beaufort Lake	467	4	3	0.79	46.53665	-88.18815
NLM	Baraga	Craig Lake	360	4	3	0.81	46.61082	-88.18621
NLM	Baraga	Ruth Lake	189	4	6	0.69	46.55943	-88.21677
NLM	Baraga	Spruce Lake	70	4	4	0.44	46.50693	-88.17677
NLM	Delta	Camp Seven Lake	52	3	4		46.05749	-86.5526
NLM	Delta	Deep Lake	39	3	4	0.24	46.165	-86.60602
NLM	Delta	Gooseneck Lake	128	3	4	0.57	46.06832	-86.54843
NLM	Delta	Round Lake	442	2	5	0.61	46.16084	-86.74976
NLM	Delta	Skeels Lake	93	3	4	0.38	46.15832	-86.62371
NLM	Dickinson	Big Badwater Lake	308	4	6		45.88526	-88.08176
NLM	Dickinson	Big Quinnesec Falls Flowage	40	2	4		45.78361	-88.0464
NLM	Dickinson	Hamilton Lake	73	4	4	0.36	45.75499	-87.78482
NLM	Dickinson	Island Lake (Pond 1)	175	4	6	0.55	45.97706	-87.99842
NLM	Dickinson	Kingsford Imp (Ford Dam)	408	4	3		45.80755	-88.12634
NLM	Dickinson	Lake Antoine	725	4	5	0.72	45.83749	-88.03288
NLM	Dickinson	Louise Lake	83	4	4		45.75026	-87.80899
NLM	Dickinson	South Lake (Grov. Mine Pd. 4)	346	4	6	0.72	45.95526	-87.98019
NLM	Dickinson	Sturgeon River Impoundment		1			45.75248	-87.86215
NLM	Dickinson	West Lake (Grov. Mine Pd. 2A)	203	4	6	0.56	45.96769	-88.01229
NLM	Iron	Bone Lake	159	1	6	0.68	46.37471	-88.30704
NLM	Iron	Brule Lake	234	1	6	0.75	46.05776	-88.83843
NLM	Iron	Cable Lake	331	1	6	0.76	46.35249	-88.59177

FMU	County	Name	Surface area (acres)	Natural Reproduction	Lake Class	Suitability	Latitude	Longitude
NLM	Iron	Chicagon Lake	1,083	3	3	0.83	46.05693	-88.50593
NLM	Iron	Crystal Falls Pond (Paint)	59	3	4		46.1084	-88.33557
NLM	Iron	Deer Lake	74	3	4	0.46	46.3261	-88.32649
NLM	Iron	Emily Lake	326	4	3	0.80	46.11249	-88.50149
NLM	Iron	Fire Lake	129	4	4	0.71	46.19276	-88.46927
NLM	Iron	Hagerman Lake	565	2	3	0.79	46.05971	-88.77982
NLM	Iron	Indian Lake	197	4	6	0.68	46.04249	-88.49676
NLM	Iron	Iron Lake	390	2	3	0.80	46.14471	-88.65232
NLM	Iron	Lake Mary	270	4	3	0.73	46.05721	-88.22176
NLM	Iron	Lake Ottawa	532	3	3	0.75	46.0861	-88.76204
NLM	Iron	Long Lake	83	1	4	0.50	46.40387	-88.32704
NLM	Iron	Long Lake	60	4	4	0.34	46.12082	-88.44982
NLM	Iron	Michigamme Falls Reservoir	470	4	3	0.71	45.95601	-88.19692
NLM	Iron	Michigamme Reservoir (Way)	4,867	1	3	0.83	46.15992	-88.23498
NLM	Iron	Paint Lake	240	1	6	0.72	46.35221	-88.88927
NLM	Iron	Paint River Pond	708	1	3		45.96402	-88.24468
NLM	Iron	Peavy Pond	2,347	1	3	0.80	45.9911	-88.20871
NLM	Iron	Perch Lake	1,038	3	6	0.81	46.36221	-88.66177
NLM	Iron	Porter Lake	271	1	3	0.73	46.32999	-88.57732
NLM	Iron	Snipe Lake	63	1	4	0.39	46.05221	-88.69426
NLM	Iron	Stager Lake	109	1	4	0.61	45.98415	-88.33149
NLM	Iron	Stanley Lake	319	1	3	0.81	46.05887	-88.70676
NLM	Iron	Sunset Lake	531	1	3	0.79	46.13221	-88.59038
NLM	Iron	Swan Lake	160	1	6	0.67	46.16332	-88.39482
NLM	Iron	Winslow Lake	259	1	6	0.73	46.34582	-88.76454
NLM	Luce	N. Manistique Lake	1,709	3	3	0.72	46.28749	-85.73899
NLM	Mackinac	Big Manistique Lake	10,346	4	6	0.73	46.23332	-85.78343
NLM	Mackinac	Brevoort Lake	4,315	3	5	0.69	45.99999	-84.93343
NLM	Mackinac	Milakokia Lake	2,031	1	5	0.74	46.07915	-85.80427
NLM	Mackinac	Millecoquins Lake	1,123	3	5	0.77	46.1536	-85.51315
NLM	Mackinac	S. Manistique Lake	4,133	1	5	0.73	46.17499	-85.7626
NLM	Marquette	Bass Lake	272	3	6	0.69	46.25888	-87.37093
NLM	Marquette	Fish Lake	152	3	6	0.68	46.49749	-87.9626

FMU	County	Name	Surface area (acres)	Natural Reproduction	Lake Class	Suitability	Latitude	Longitude
NLM	Marquette	Greenwood Reservoir	1,117	3	3		46.44276	-87.80232
NLM	Marquette	Keewayden Lake	132	3	6	0.69	46.60238	-88.10683
NLM	Marquette	Lake Michigamme	4,292	1	3	0.83	46.48486	-88.07377
NLM	Marquette	Little Lake	460	3	6	0.70	46.27693	-87.34815
NLM	Marquette	Mehl Lake	90	3	4	0.19	46.26471	-87.94982
NLM	Marquette	Michigamme River Basin	43	1	4		46.40165	-87.98565
NLM	Marquette	Pike Lake	90	3	4	0.42	46.26693	-87.57593
NLM	Marquette	Schweitzer Impoundment	245	3	5	0.69	46.41473	-87.64781
NLM	Marquette	Witch Lake	211	1	6	0.73	46.27832	-88.00871
NLM	Menominee	Chalk Hills Impoundment	543	4	5		45.51396	-87.80202
NLM	Menominee	Grand Rapids Impoundment	183	4	5	0.45	45.36246	-87.65631
NLM	Menominee	White Rapids Impoundment	439	4	5		45.48491	-87.7979
NLM	Schoolcraft	Gemini Lake	128	1	4	0.58	46.4886	-86.30343
NLM	Schoolcraft	Indian Lake	8,647	3	6	0.74	45.99165	-86.33343
NLM	Schoolcraft	Petes Lake	194	3	6	0.51	46.22638	-86.60038
NLM	Schoolcraft	Steuben Lake	136	4	5	0.50	46.19971	-86.42121
NLM	Schoolcraft	Thunder Lake	331	3	5	0.64	46.10165	-86.47288
NLM	Schoolcraft	Triangle Lake	172	2	6	0.51	46.16832	-86.50204
SLM	Allegan	Kalamazoo Lake	321	3	1		42.65054	-86.20704
SLM	Allegan	Lake Allegan	1,785	3	2	0.61	42.56114	-85.95343
SLM	Allegan	Osterhout Lake	172	5	1	0.36	42.43499	-86.04009
SLM	Allegan	Selkirk Lake	92	5	1	0.27	42.6086	-85.62898
SLM	Barry	Barlow Lake	181	5	1	0.33	42.66915	-85.51981
SLM	Barry	Fine Lake	324	5	1	0.56	42.44443	-85.29204
SLM	Barry	Gun Lake	2,735	5	2	0.69	42.59146	-85.54095
SLM	Barry	Payne Lake	113	5	1	0.33	42.63721	-85.51926
SLM	Barry	Thornapple Lake	415	3	1	0.58	42.62665	-85.1887
SLM	Barry	Wall Lake	557	5	2	0.63	42.52138	-85.38815
SLM	Berrien	Paw Paw Lake	922	5	2	0.65	42.20749	-86.26315
SLM	Branch	Lake of the Woods (Rose)	334	5	1	0.52	41.84999	-85.04176
SLM	Branch	Matteson Lake	313	5	1	0.50	41.93138	-85.20759
SLM	Branch	Union Lake	544	3	2	0.60	42.04426	-85.20228
SLM	Calhoun	Duck Lake	596	5	2	0.66	42.38582	-84.78593

FMU	County	Name	Surface area (acres)	Natural Reproduction	Lake Class	Suitability	Latitude	Longitude
SLM	Calhoun	Goguac Lake	340	5	1	0.54	42.28888	-85.21037
SLM	Cass	Barron Lake	216	5	1	0.36	41.84388	-86.18342
SLM	Cass	Diamond Lake	1,041	5	2	0.66	41.90249	-85.98065
SLM	Cass	Fish Lake	334	5	1	0.56	42.04915	-85.86037
SLM	Cass	Indian Lake	500	5	2		41.99554	-86.21315
SLM	Cass	Juno Lake	560	5	2		41.81011	-85.98496
SLM	Cass	Long Lake	241	5	1	0.43	41.77527	-85.82009
SLM	Cass	Magician Lake	522	5	2		42.07258	-86.14967
SLM	Gratiot	Rainbow Lake	304	5	1		43.12696	-84.69879
SLM	Hillsdale	Carpenter Lake	36	5	1	0.21	41.88888	-84.7962
SLM	Hillsdale	Hemlock Lake	150	5	1	0.31	41.89554	-84.79204
SLM	Hillsdale	Long Lake	213	5	1	0.35	41.87332	-84.79676
SLM	Ingham	Moore's River Pond	112	5	1		42.72008	-84.56816
SLM	Ionia	Session Lake	139	5	1	0.32	42.944	-85.12609
SLM	Ionia	Woodard Lake	70	5	1	0.28	43.08138	-85.06232
SLM	Jackson	Center Lake	847	5	2	0.74	42.2281	-84.32525
SLM	Jackson	Portage Lake	398	5	1	0.58	42.33832	-84.23481
SLM	Jackson	Round Lake	152	5	1	0.38	42.08832	-84.47259
SLM	Kalamazoo	Morrow Lake	920	3	2	0.65	42.28237	-85.49077
SLM	Kent	Lincoln Lake	417	5	1	0.64	43.24415	-85.36037
SLM	Kent	Wabasis Lake	404	5	1	0.68	43.13804	-85.37732
SLM	Montcalm	Clifford Lake	195	5	1	0.40	43.30832	-85.18954
SLM	Montcalm	Crystal Lake	709	5	2	0.66	43.26193	-84.93148
SLM	Muskegon	Mona Lake	656	5	2	0.64	43.18054	-86.25093
SLM	Newaygo	Bills Lake	200	5	1	0.53	43.39388	-85.66148
SLM	Ottawa	Crockery Lake	104	5	1	0.28	43.1686	-85.85148
SLM	Ottawa	Lake Macatawa	1,881	5	2	0.63	42.77915	-86.16454
SLM	St. Joseph	Clear Lake	233	5	1	0.43	41.94749	-85.73287
SLM	St. Joseph	Constantine Impoundment	206	3	1		41.8481	-85.66856
SLM	St. Joseph	Klinger Lake	835	5	2	0.66	41.80527	-85.54342
SLM	St. Joseph	Lake Templene	869	5	2	0.66	41.90856	-85.48663
SLM	St. Joseph	Long Lake (Colon Twp)	234	5	1	0.43	41.91582	-85.34148
SLM	St. Joseph	Mottville Impoundment	214	3	1		41.8065	-85.74815

FMU	County	Name	Surface area (acres)	Natural Reproduction	Lake Class	Suitability	Latitude	Longitude
SLM	St. Joseph	Palmer Lake	497	5	2	0.60	41.94471	-85.31648
SLM	St. Joseph	Portage Lake	400	5	1	0.59	42.04971	-85.50954
SLM	St. Joseph	Sand Lake	95	5	1	0.28	41.91415	-85.45592
SLM	St. Joseph	Sturgeon Lake	208	3	1	0.35	41.96777	-85.33092
SLM	St. Joseph	Sturgis Impoundment	574	3	2		41.97004	-85.53758
SLM	St. Joseph	Three Rivers Impoundment	491	3	2		41.94118	-85.62411
SLM	Van Buren	Bankson Lake	364	5	1	0.56	42.12221	-85.79648
SLM	Van Buren	Cedar Lake	275	5	1	0.46	42.08832	-85.83009
SLM	Van Buren	Gravel Lake	297	5	1	0.46	42.07665	-85.86731
SLM	Van Buren	Lake Brownwood	125	5	1	0.33	42.24277	-85.91565
SLM	Van Buren	Lake of Woods	301	5	1	0.46	42.11082	-85.99981
SLM	Van Buren	Maple Lake	193	5	1	0.33	42.22471	-85.89287
ELS	Alger	Au Train Lake	845	4	5	0.70	46.40388	-86.83899
ELS	Alger	Beaver Lake	783	1	3	0.71	46.56832	-86.33871
ELS	Alger	AuTrain (Cleveland) Basin	1,489	3	5	0.76	46.33116	-86.8498
ELS	Alger	Deer Lake	266	3	5	0.58	46.47749	-86.96732
ELS	Alger	Kingston Lake	122	5	4	0.70	46.58221	-86.2201
ELS	Alger	Nawakwa Lake	442	1	6	0.62	46.53582	-85.97538
ELS	Chippewa	Monocle Lake	172	1	6	0.56	46.47416	-84.64593
ELS	Luce	Bass Lake	144	4	5	0.52	46.46388	-85.71704
ELS	Luce	Beaverhouse Lake	33	5	4	0.23	46.59888	-85.68066
ELS	Luce	Bodi Lake	275	3	6	0.71	46.70082	-85.32704
ELS	Luce	Culhane Lake	100	5	4	0.46	46.69415	-85.35371
ELS	Luce	Little Lake	87	3	4	0.44	46.71277	-85.36149
ELS	Luce	Muskallonge Lake	762	4	5	0.77	46.66943	-85.63177
ELS	Luce	Pike Lake	286	3	6	0.71	46.64193	-85.40732
ELS	Luce	Pretty Lake	45	5	4	0.33	46.6011	-85.6601
WLS	Baraga	Big Lake	119	5	4	0.71	46.61443	-88.57649
WLS	Baraga	King Lake	502	5	6	0.78	46.52054	-88.4101
WLS	Baraga	Parent Lake	184	5	6	0.70	46.57387	-88.43788
WLS	Baraga	Prickett Backwaters	747	2	3	0.76	46.72398	-88.66696
WLS	Baraga	Vermilac (Worm) Lake	640	3	6	0.80	46.53887	-88.49371
WLS	Gogebic	Allen Lake	78	3	4	0.43	46.22498	-89.17232

FMU	County	Name	Surface area (acres)	Natural Reproduction	Lake Class	Suitability	Latitude	Longitude
WLS	Gogebic	Beatons Lake	324	5	3	0.77	46.32804	-89.36621
WLS	Gogebic	Big African	85	1	4	0.42	46.25163	-89.39812
WLS	Gogebic	Big Lake	733	1	3	0.78	46.20998	-89.44399
WLS	Gogebic	Birch Lake	181	5	6	0.67	46.15582	-89.15538
WLS	Gogebic	Chaney Lake	496	5	6	0.69	46.31665	-89.9126
WLS	Gogebic	Cisco Lake	567	1	6	0.77	46.24165	-89.44593
WLS	Gogebic	Dinner Lake	108	1	4	0.60	46.19998	-89.13565
WLS	Gogebic	Duck Lake	612	2	6	0.76	46.20832	-89.21676
WLS	Gogebic	East Bay Lake	277	2	3	0.72	46.20276	-89.40704
WLS	Gogebic	Elbow Lake	26	2	4	0.16	46.35137	-89.78343
WLS	Gogebic	Fishhawk Lake	77	2	4	0.39	46.21665	-89.41676
WLS	Gogebic	Gaylord Lake	80	2	4	0.43	46.27776	-89.68343
WLS	Gogebic	Indian Lake	129	5	4	0.63	46.2111	-89.38482
WLS	Gogebic	Lac Vieux Desert	4,370	1	3	0.80	46.13679	-89.08121
WLS	Gogebic	Langford Lake	482	5	6	0.79	46.27498	-89.47926
WLS	Gogebic	Lindsley Lake	156	2	6	0.59	46.21804	-89.42788
WLS	Gogebic	Little Oxbow Lake	98	2	4	0.44	46.25721	-89.66649
WLS	Gogebic	Mamie Lake	337	2	6	0.74	46.19165	-89.38899
WLS	Gogebic	Marion Lake	297	2	6	0.72	46.26387	-89.0876
WLS	Gogebic	Moraine Lake	90	2	4	0.41	46.27776	-89.78343
WLS	Gogebic	Morley Lake	59	2	4		46.21387	-89.43343
WLS	Gogebic	Ormes Lake	52	5	4	0.33	46.27082	-89.65313
WLS	Gogebic	Pomeroy Lake	314	2	6	0.77	46.27915	-89.5751
WLS	Gogebic	Poor Lake	106	2	4	0.51	46.21248	-89.40426
WLS	Gogebic	Record Lake	68	2	4	0.35	46.25276	-89.3876
WLS	Gogebic	Sunday Lake	226	2	6	0.78	46.48115	-89.96055
WLS	Gogebic	Tamarack Lake	331	2	6	0.72	46.24739	-88.98586
WLS	Gogebic	Thousand Island	1,009	2	3	0.80	46.22915	-89.4001
WLS	Gogebic	West Bay	362	2	3	0.74	46.20415	-89.42788
WLS	Houghton	Bob Lake	130	5	4	0.56	46.66582	-88.90871
WLS	Houghton	Lake Gerald	356	5	6	0.72	46.89915	-88.83121
WLS	Houghton	Lake Roland	258	5	6	0.66	46.88971	-88.85121
WLS	Houghton	Otter Lake	863	2	3	0.71	46.91332	-88.57371

FMU	County	Name	Surface area (acres)	Natural Reproduction	Lake Class	Suitability	Latitude	Longitude
WLS	Houghton	Pike Lake	83	2	4	0.44	46.83471	-88.84482
WLS	Houghton	Portage Lake	10,808	2	3		47.06637	-88.49704
WLS	Houghton	Rice Lake	656	2	6	0.73	47.1636	-88.28482
WLS	Houghton	Torch Lake	2,401	2	3	0.78	47.15832	-88.4251
WLS	Keweenaw	Gratiot Lake	1,452	1	3	0.78	47.35304	-88.12899
WLS	Keweenaw	Lac LeBelle	1,205	2	3	0.74	47.37443	-88.01177
WLS	Keweenaw	Lake Fanny Hooe	230	2	3	0.66	47.4636	-87.86427
WLS	Keweenaw	Lake Medora	690	1	3	0.76	47.44221	-87.98232
WLS	Marquette	Dead River Storage Basin	2,737	1	3	0.82	46.56471	-87.57093
WLS	Marquette	Deer Lake Basin	906	1	3	0.76	46.53133	-87.66816
WLS	Marquette	Forestville Basin	90	1	4	0.32	46.57406	-87.46221
WLS	Marquette	Lake Independence	2,041	1	3	0.69	46.80554	-87.70454
WLS	Marquette	McClure Basin	118	1	4	0.62	46.55252	-87.52072
WLS	Marquette	Teal Lake	485	1	3	0.70	46.51304	-87.62815
WLS	Ontonagon	Bond Falls Flowage	2,127	1	3	0.81	46.39443	-89.10343
WLS	Ontonagon	Lake Gogebic	13,127	1	3	0.83	46.58269	-89.5889
WLS	Ontonagon	Six Mile Lake	82	4	4		46.76193	-88.9326
WLS	Ontonagon	Sudden Lake	35	5	4	0.35	46.74155	-88.90583
WLS	Ontonagon	Victoria Impoundment	282	1	3	0.71	46.68695	-89.23102

Appendix B: Walleye stocking strategy guidelines

Walleye stocking has been used as a management tool in Michigan since 1882 and this activity continues to be a significant aspect of current Walleye management strategies to create new fisheries, rehabilitate populations, enhance small populations, and as a biocontrol for overly abundant and slow growing panfish populations. Walleye stocking should not be implemented without specific management goals and objectives previously established. The purpose of this document is to complement the Department's existing stocking guidelines, and to provide a decision support framework to help guide fisheries managers through the process of making science-based and cost-conscious stocking decisions for allocation of statewide resources.

The *Michigan Fish Stocking Guidelines II,* developed by the Michigan Department of Natural Resources Fisheries Division in 2004, has been the primary resource for informing Walleye stocking in Michigan in recent years. These guidelines are still relevant and rely on stocking practices that have been implemented and refined to achieve management goals and Walleye population metrics. Specific to inland lakes, managers have classified Walleye populations with more than 2 adults/acre as good to excellent fisheries. Populations with 1 adult/acre or less were ranked from poor to fair. The existing stocking guidelines recommends the target Walleye density of 2/acre to maintain adequate fishing and justify continuation of stocking programs. This population metric is particularly relevant when the management goal is associated with creating, rehabilitating, or enhancing populations for angling opportunities (MI Fish Stocking Guidelines II, 2004). Maintaining or achieving the target Walleye density is significant because angler catch rates are correlated with population densities, meaning increased population densities generally result in greater angler catch rates (Beard et al. 1997).

The Fisheries Division has developed recommendations for Walleye stocking densities in Michigan waters to maximize success of this statewide program (Table B-1). Stocking success is often variable and is dependent on many abiotic and biotic factors, but current stocking guidelines do not provide specific guidance that incorporates these factors. The one exception is the recommendation to stock Walleye fry in turbid waters for greater success (MI Fish Stocking Guidelines II, 2004). To maximize success, the Fisheries Division will use a decision tree that provides recommendations on when Walleye stocking is most appropriate based on a comprehensive synthesis of Walleye populations and stocking success in the Midwestern states (Raabe et al. 2020; Figure B-1). In addition, the Fisheries Division prioritizes the genetic integrity of the feral populations that are used as egg source to produce Walleye stocking in Michigan waters. As such, Fisheries Division developed the *Strategy for Stocking Walleyes from Various Brood Source Locations* (Appendix C), which will be a critical aspect of the comprehensive stocking strategy guidelines provided in this appendix.

Table B-1. Recommended stocking densities that have been slightly modified from those listed in *Michigan Fish Stocking Guidelines II* to account for results from recent stocking evaluations conducted by fisheries biologists.

Life history classification	**Avg. size (inches)**	**Stocking density (fish/acre)**	**Stocking timeframe**
Fry	<1	2,000	Spring following hatch
Spring fingerling	1-5	25-100	May to Sept. 1
Fall fingerling	>5	4-40	After Sept. 1

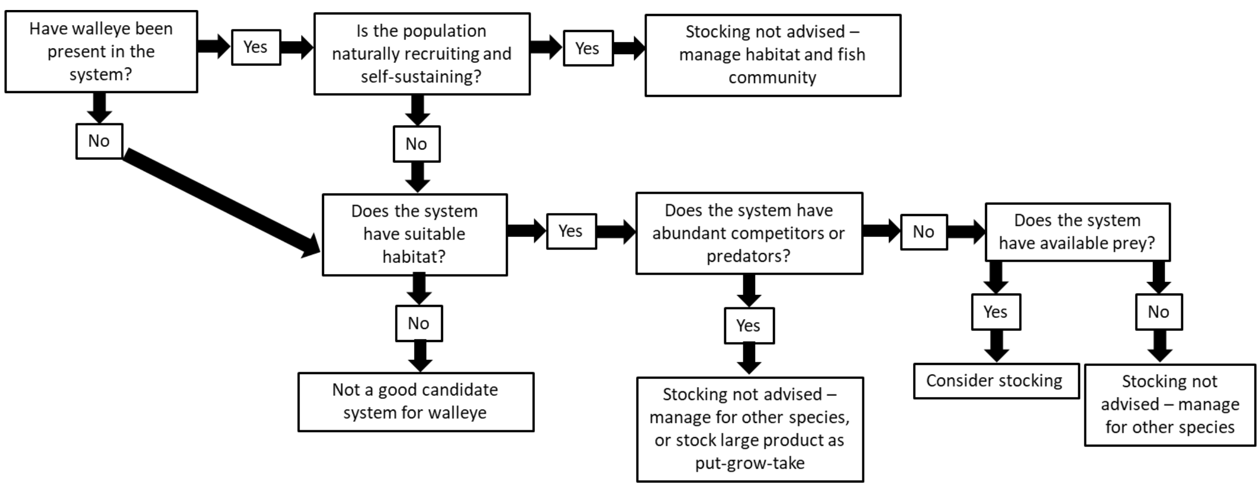

Figure B-1. Decision tree that will be used to inform science-based stocking decisions by Fisheries Division. The diagram was taken from a comprehensive review of Walleye stocking in Midwestern states and the decision tree represents synthesized results that are meant to increase the likelihood of a successful stocking event (Raabe et al. 2020).

Appendix C: Strategy for Stocking Walleyes from Various Brood Source Locations

Adopted by Fisheries Division, April 2019

Background:

Since 2000 there have been 10 brood source locations for walleye stocked in Michigan waters (Table 1). While the standard procedure has been to stock using the closest brood source, walleyes have been stocked across basins regularly. For example, walleye from Muskegon River brood were regularly stocked in Saginaw Bay, walleye from Bay de Noc brood were frequently (1989-2000) stocked in the St. Marys River, and walleye from St. Marys River brood have occasionally (2014 & 2017) been stocked in Bay de Noc. There have been several evaluations of the genetic structure of walleyes in Michigan (Haponski and Stepien 2014, Caroffino et al. 2011; Stepien et al. 2009; Scribner and Filcek 2002; Billington et al. 1998); however, summarizing the results is difficult as sample size and geographic area of interest influence differentiation. The Michigan-based study with the most samples (Scribner and Filcek 2002) suggested that the Muskegon River and Saginaw Bay populations were related; however, Muskegon River, St. Marys River, and Little Bay de Noc were genetically differentiated from one another. Walleye from Lake Gogebic were the most unique and may represent ancestral reef-spawning walleyes from Saginaw Bay (Gary Whelan, Michigan Department of Natural Resources, personal communication).

Table C-1. Recent (since 2000) walleye brood source locations for stocking in Michigan.

Brood source location	Agency	Management Unit
Bay de Noc	Fisheries Division	NLMMU
Cheboygan River	Little Traverse Bay Band	NLHMU
Lac Vieux Desert	Lac Vieux Desert Tribe	WLSMU
Muskegon River	Fisheries Division	CLMMU
Ohio	Private facility	Ohio
Portage Lake	Keweenaw Bay Indian Community	WLSMU
St. Marys River	Sault Tribe	NLHMU
Superior/Back Bay	Sault Tribe	ELSMU
Superior/Chequamenon Bay	Keweenaw Bay Indian Community	Wisconsin
Tittabawassee River	Fisheries Division	SLHMU

Current Fish Stocking Guidelines (Dexter and O'Neal 2004) indicate that efforts should be made by managers to maintain unique local genetic integrity and to avoid releasing multiple strains into the same area if the management goal is to establish or supplement a naturalized population. For walleye specifically, guidelines indicate that if stocking is necessary, introduction of fish from other stocks (even within the Great Lakes basin) is not recommended. There is currently enough information on genetic differences among brood source locations to support protecting their genetic integrity. However, there is currently not enough information on the genetic structure of walleyes in Michigan to adopt a holistic genetic management unit concept. Generally, walleyes are stocked from the closest brood source location (e.g., Muskegon River or Bay de Noc) based on logistics; however, occasionally managers wish to utilize different strains in order to meet objectives.

Recommendation:

We recommend that the stocking of walleye from various brood source locations be based on the relative risk that it presents to a waterbody, basin, and the overall genetic structure of walleyes in Michigan. Therefore, the following options listed below have been developed to help guide managers when determining the best scenario to follow when choosing walleye strains for stocking. Managers should follow these guidelines when reviewing private stocking permit applications as well.

1. Waterbodies with no or highly obstructed connection to the Great Lakes and no natural reproduction may receive walleye from any brood source location.
2. Waterbodies with connection to the Great Lakes and no natural reproduction should receive walleye from the closest brood source within the basin; however, managers are interested in having the ability to occasionally stock alternate strains (or approve private stocking of alternate strains).
3. Waterbodies with documented natural reproduction should use walleye reared from the closest brood source within the basin or the remnant stock. For most waterbodies this will result in using one of the three primary brood sources; however, it allows for use of local gametes (e.g. Little Traverse Bay Band's use of Cheboygan River walleyes). This recommendation assumes that there is a relationship between geographic and genetic separation (Wilson et al. 2007).
4. Because there is evidence of genetic differences among the three primary brood source locations (Muskegon River, Little Bay de Noc, and St. Marys River), connecting waters in the vicinity of these locations should not be stocked with walleyes from other brood source locations. Mixing of these stocks may result in outbreeding depression and lower fitness. Additionally, telemetry studies support relatively strong spawning site fidelity of Great Lakes walleyes indicating that populations are largely segregated during the spawning season. For the purposes of this recommendation, grids adjacent to brood source locations were identified (Figure 1). Walleye stocking in these grids or in tributaries directly connected to these grids should be limited to the local strain.
5. The stocking of fish from brood source locations with unknown genetic structure (e.g. Lac Vieux Desert) should be limited to the source location.

Future Work:

There are several outstanding issues that may potentially require additional information. For example, there is some desire to re-establish a reef-spawning strain in Saginaw Bay. If this occurred, we would need to identify the most appropriate strain. There is some evidence that the Lake Gogebic population was established from reef-spawning walleyes from Saginaw Bay. Similarly, while the current Tittabawassee River/Saginaw Bay population was re-established using largely Muskegon River walleyes, the genetics of these walleye could potentially be monitored in the future to determine if they have diverged from other sources. There may be other examples where additional information would be valuable; thus, further information on the overall genetic structure of walleye in Michigan should be obtained as opportunities arise.

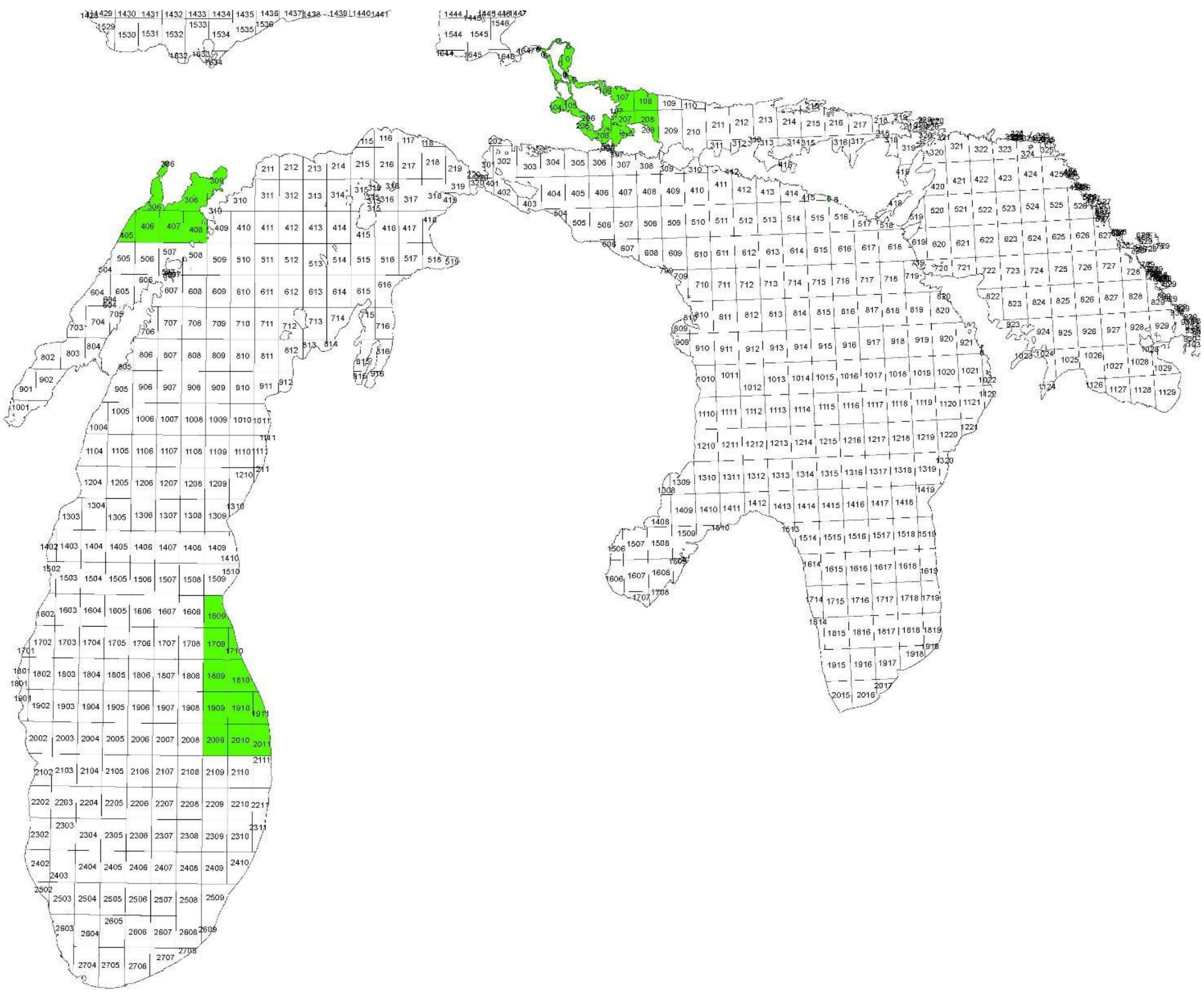

Figure C-1. Primary walleye brood source locations. Highlighted grids represent individual brood source protection areas where walleyes originating from another source may not be stocked.

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Appendix D: Walleye regulations toolbox

Fisheries biologists have limited management tools to influence Walleye populations to achieve desired management goals. Implementing fishing regulations is one such tool that biologists rely on to protect and conserve populations. Regulations are meant to strike a balance between providing angling opportunities and ensuring the conservation of a species.

The statewide regulation for Walleye uses a daily possession limit of five fish and a minimum size limit of 15 inches. The biological justification for this regulation is associated with the desire to protect juvenile Walleye from harvest prior to maturity and allow for harvest opportunities of adults that align with sustainable mortality rates. In addition, the closed possession season in both peninsulas was created to provide protection from harvest during the spawning season when the species is congregated and vulnerable to harvest.

Fisheries Division has identified a desire to provide a diverse set of angling opportunities, as described in objective 2 of *Charting the course: Fisheries Division's Framework for managing aquatic resources*, while also striving for simplistic regulations. Walleye population characteristics and growth potential differs among waters in Michigan and to account for those differences a limited number of diverse regulation options are warranted. Therefore, the set of regulatory options listed below were created to provide managers with options to achieve management goals for the diversity of Walleye fisheries in Michigan. Adopting regulatory options that differ from the widely supported existing statewide regulation (i.e., option 2) should only be considered and recommended by biologists when recent biological and representative social data for that waterbody are available and that information suggests the desired outcome is likely to occur. In addition, the adoption of a new regulation on any waterbody should be accompanied with an evaluation to determine if desired outcomes are achieved.

Regulatory options:

1. **15-inch minimum size limit and daily possession limit of 5**
   Goal: Protect majority of juvenile Walleye from harvest prior to maturity and allow for harvest opportunities of adults that align with sustainable mortality rates.

2. **18-inch minimum size limit and daily possession limit of 2**
   Goal: Reduce harvest for the purpose of population restoration during times when a population is declining or at low abundance. Alternatively, to maximize the trophy potential and catch rate through catch and release of quality sized Walleye within a stable population. Additionally, protect adult Walleye from harvest with the intent of maintaining high density of adult Walleye for predation to improve panfish size structure.

3. **No possession of Walleye**
Goal: Eliminate harvest to achieve population restoration during times when a population is declining or at historically low abundance. Additionally, to protect Walleye from harvest with the intent of using Walleye predation to improve panfish size structure in waters with stunted panfish populations. Furthermore, to maintain public health by preventing human consumption of contaminated fish.

4. **13-inch minimum size limit and daily possession limit of 5+**
Goal: Provide anglers with increased harvest opportunities while attempting to reduce density of consistently slow growing populations that are primarily sexually mature prior to reaching 15 inches.

   Note: In waters with high density Walleye populations that are hindering prey fish populations fisheries managers may also consider a daily possession limit that exceeds five fish.

5. **Experimental Protected Slot Limit**

   Length ranges for restricted harvest and daily possession limits will vary based available data pertaining to population demographics.

   Goal: Reduce the exploitation rate and increase the spawning stock biomass for a population to increase the protection and sustainability of a naturally reproducing population. Additionally, increased size structure may result from reducing harvest on the larger individuals in a population.

   Note: Recommended waters for this regulation type will require survey data that provides information on the population's recruitment and growth dynamics, and an understanding of angling effort based on empirical data. Fisheries Biologists should also document angler perceptions and acceptance associated with this regulation type before implementation. The biological and representative social data will be used as a baseline to evaluate the influence of the protected slot limit on population demographics and angler perceptions.

   Additionally, the implementation of a consistent protected slot limit will provide preferred simplicity to the overall regulatory framework and allow for a more robust evaluation of this regulation type in Michigan.

Appendix E: Internet Survey Questionnaire

Below is the internet survey questionnaire that was used to determine information related to angler behaviors and perceptions that provided the Fisheries Division with insights into potential management goals, strategies, and regulatory options for this plan. Each question was independently developed to address different management questions, and therefore results were not conditional on other questions.

Michigan Department of Natural Resources, Fisheries Division

Opinion Survey for Walleye Fishing on Inland Lakes and Rivers

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 Walleye Management Plan for **inland lakes and rivers**. The questions below are meant to solicit information from licensed anglers in Michigan to better align the biological and social aspects of Walleye management in Michigan.

Please take a few minutes to complete the survey. The Department greatly appreciates your input and interest in Michigan's world-class fisheries.

Question 1. In the past 12 months, how many times did you go fishing in Michigan? (select one option)

1 time   2 or 3 times   4 or 5 times   6 to 9 times   10 to 19 times   20 or more times

Question 2. In the past 12 months, which of the following fishing activities did you participate in? (select all that apply)

Bass fishing

Catfish fishing

Musky fishing

Panfish fishing

Pike fishing

Salmon fishing

Question 2 (cont.)

Trout fishing

Walleye fishing

Bow or spearfishing

Other

Question 3. Which one fishing activity is most important to you? (select one option)

Bass fishing

Catfish fishing

Musky fishing

Panfish fishing

Pike fishing

Salmon fishing

Trout fishing

Walleye fishing

Bow or spearfishing

Other

Question 4. In the past 12 months, how many times did you go <u>walleye</u> fishing in Michigan on inland lakes and rivers? (select one option)

Never   2 or 3 times   4 or 5 times   6 to 9 times   10 to 19 times   20 or more times

Question 5. Do you typically harvest the walleye you catch if they are of legal size? (Select one)

No

Yes, some of the time

Yes, most of the time

Yes, always

Question 6. What do you consider to be a successful inland walleye fishing trip? (Select one for each sub-question)

a. Minimum catch per trip: Not important 1 fish 3 fish 4 fish 5+ fish
b. Average size of fish (inches): Not important 15" 17" 19" 22"+

Question 7. What would you consider the minimum size of a "trophy" size walleye to be? (Select one for each sub-question)

Inland: open field to provide length in inches

Great Lakes: open field to provide length in inches

Question 8. How long would you be willing to travel to fish for walleye given the following circumstances.

a. If you had a reasonable expectation of catching your limit, with fish averaging 15-18 inches? (Select one)

Not interested in Walleye fishing ½ hour 1 hour 1.5 hours 2 hours > 2 hours

b. If you had a reasonable expectation of catching a "trophy fish", but rarely catching your limit (Select one)

Not interested in Walleye fishing ½ hour 1 hour 1.5 hours 2 hours > 2 hours

c. If there was an increased harvest limit (i.e., more than 5 fish) and the minimum size limit was lower than 15" and you had an expectation of catching your limit, but your catch consisted of primarily 13-15" fish (Select one)

Not interested in Walleye fishing ½ hour 1 hour 1.5 hours 2 hours > 2 hours

d. If you had a reasonable expectation of catching 1-2 fish per trip, with about ½ being legal-harvest size. Fishing site is an undeveloped scenic shoreline (Select one)

Not interested in Walleye fishing ½ hour 1 hour 1.5 hours 2 hours > 2 hours

e. If you had a reasonable expectation of catching 1-2 fish per trip, with about ½ being legal-harvest size. Fishing site is a highly-developed shoreline within a suburban setting. (Select one)

Not interested in Walleye fishing ½ hour 1 hour 1.5 hours 2 hours > 2 hours

Question 9. Rank the following four scenarios and provide your preference:

1-Preferred option, 2-second choice, 3-third choice, 4 – least preferred

a. Fishing where there is a 15” minimum size limit and a daily possession limit of 5 walleye, which results in a good chance for harvesting up to 5 fish above 15 inches, but rarely catching a walleye above 20 inches.

b. Fishing where there is a protected slot limit for walleye (e.g., no harvest of fish 18-22 inches), resulting in a lower chance of harvesting up to 5 walleye above 15 inches, but increasing your chances of catching a walleye above 20 inches.

c. Fishing where there is a higher minimum size limit and more restrictive walleye harvest limit (20 inch minimum, 2 fish per day limit), resulting in higher catch rates and an above average chance of catching a trophy, but would limit your ability to harvest many walleye.

d. Fishing where there is a catch-and-release only regulation for walleye, resulting in highest possible catch rates and highest chance of catching a trophy, but prohibiting your ability to keep fish for eating or to mount as a trophy.

Question 10. Would you be supportive of having restrictive walleye harvest regulations on lakes where walleye are stocked primarily to support healthier panfish populations?

No

Yes, somewhat

Yes, strongly

No opinion

Question 11. Would you be supportive of having restrictive walleye size limit regulations on lakes with natural reproduction, even if that limited your ability to keep larger walleye for eating or to mount as a trophy?

No

Yes, somewhat

Yes, strongly

No opinion

Question 12. Do you intentionally fish for walleyes in lakes that are stocked with walleye in preference to other nearby lakes with populations supported solely by natural reproduction?

Yes No

Question 13. How satisfied are you with the walleye fishing opportunities in your local area?

Very Satisfied
Satisfied
Neither satisfied nor dissatisfied
Dissatisfied
Very dissatisfied

If you are dissatisfied, please tell us why: ________________

Question 14. Are you a current member of any fishing organizations or fishing associations?

Yes No

Questions 15. What is your primary ZIP code?

open field to provide ZIP

Appendix F: Fisheries Division's responses to public comments on the draft plan

See external attachment that includes Fisheries Division's responses to public comments received during the external review period. This appendix will be available the Fisheries Division's website for one year following the approval and public distribution of this plan.