# MANAGEMENT PLAN FOR NORTHERN PIKE IN MICHIGAN


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**Michigan Department of Natural Resources and Environment**

**Fisheries Division Special Report: Draft**

# MANAGEMENT PLAN FOR NORTHERN PIKE IN MICHIGAN

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## Introduction and Background

This plan focuses on the ecology and management of northern pike *Esox lucius* from the family Esocidae. Esocidae includes two of the more popular game fishes in the Midwest, the northern pike and muskellunge *Esox masquinongy*, as well as one rarely caught and irregularly distributed esocid, the grass pickerel *Esox americanus*. All three of these species share some biological characteristics, yet have unique features of their ecology that affect fishery management. Of the three species, northern pike are by far the most common, in terms of both their distribution and their abundance in harvest by anglers. The purpose of this document is to review the biology and ecology of northern pike, and then to use this information in understanding the fisheries, management of these fisheries, and the potential impact recreational fishing has on those resources.

## Biology

Northern pike are one of the most common game fishes throughout the state of Michigan. They are present in virtually all watersheds within the state and common in most inland lakes. They provide an important amount of fishing activity within the state, particularly for winter ice fisheries. In 2006, a total of 226,000 anglers (resident and nonresident) fished 2,909,000 days for northern pike and muskellunge in Michigan (USFWS 2008). Their populations naturally occurred throughout most of Michigan, although introductions to isolated lakes and streams have occurred sporadically as well. While northern pike occupying large rivers and streams may provide a significant fishery, their main population abundances and fisheries occur in inland

lakes. Northern pike are also common in embayments of the Great Lakes and the connecting waters (St. Marys River, St. Clair River, and Detroit River). While some genetic differences may exist between various northern pike populations in Michigan, for management purposes there are no recognized sub-species or varieties.

Northern pike are primarily piscivorous and tend to be more opportunistic than selective. Most research has shown that esocids will tend to utilize the most abundant prey species present in a body of water. As such, they provide a unique characteristic as a predatory control means in many lakes. Fish communities occurring in the presence of northern pike often differ significantly from those occurring in their absence (Ryder and Kerr 1978). While northern pike forage predominantly on yellow perch *Perca flavescens* and various minnows (Seaburg and Moyle 1964, Diana 1979), the distribution of many minnow species is commonly limited by northern pike abundance (Tonn and Magnuson 1982). Northern pike begin foraging on other fishes at only a couple of weeks of age and depend mainly on fishes throughout their life history. As they mature and grow, their forage shifts to larger prey species, and often the size and abundance of available prey species may limit their growth (Diana 1979). The characteristics of lake systems that contain many large sized pike include abundant deep water habitat and intermediate-size prey species, such as small ciscos *Coregonus artedi*, white suckers *Catastomus commersoni*, or other fishes of an appropriate size (Chapman and Mackay 1984, Jacobson 1993). Such lakes are quite different from lakes that maintain large abundances of smaller northern pike and have extensive spawning and rearing habitat to allow for high levels of reproduction (Jacobson 1993). In such lakes, often shallow and weedy with no temperature stratification, northern pike populations often become stunted.

Habitat is a key factor in determining northern pike population dynamics in inland waters, and ultimately the status of the fisheries those populations can support. Since lands

surrounding most of our lakes, particularly in the southeastern part of the state, are developed, loss of wetlands adjacent to the lake and loss of spawning grounds on lakeshores have had a historical change in the geographic distribution and status of northern pike. Settlement of the southern lower peninsula of Michigan brought development that transformed fish populations with most of the biomass of current fish assemblages in many lakes not consisting of the primary food for northern pike that existed prior to extensive settlement of the area. This settlement and anthropogenic influences on the habitat for northern pike has brought about an ecosystem shift to the region and changed fish communities. The ditching and blocking of marshlands has occurred on large numbers of lakes where all lakeshores have been subjected to intensive development; this is spreading in the north as well. Future management of northern pike resources will be to successfully preserve habitat by some means of reservation of critical habitat.

Temperature is an important environmental factor affecting this cool water fish (Casselman 1978). The maximum average temperature tolerance of northern pike is 82 $^{o}$F. The distribution of northern pike in Michigan is limited to those waters where physiological stress is low and temperatures are favorable for growth and survival. At the onset of summer thermal stratification, fish move from inshore to offshore locations that are frequently associated with macrophytes or bottom structures such as submerged logs. Dissolved oxygen concentrations can also affect the activity and vertical distribution of northern pike within a lake. When lake surface temperatures exceed 77 $^{o}$F, fish are found in the coolest available water with dissolved oxygen concentrations of at least 3.0 mg/L, and they are restricted to this stratum for two to three months (Headrick and Carline 1993). Depending on temperature, the upper range of the lower incipient lethal oxygen concentration is 0.5 to 1.5 mg/L (Casselman 1978). Habitat for northern pike within a lake is constricted when water temperatures increase and dissolved oxygen concentrations decrease to suboptimal conditions.

Margenau et al. (1998) examined 19 small Wisconsin lakes and identified multiple factors as potentially limiting northern pike growth and size structure. Growth was negatively related to density, water transparency, and abundance of small bluegills. Extensive littoral areas, water temperatures greater than 70°F during the growing season, and low dissolved oxygen levels in both summer and winter also limited northern pike growth and size structure in those small northern lakes. Pierce and Tomcko (2005) examined 16 lakes of diverse morphometric and biotic characteristics. Lake morphometry was identified as a key factor in determining northern pike density, which has important effects on growth rates, production, and population size structure. Greater numbers and mass of northern pike larger than 14 inches were found in lakes with more littoral habitat area and higher optimal thermal habitat. Percent littoral area was the most important variable explaining density differences, exceeding the effects of other ecological factors such as water productivity, exploitation, or prey fish abundance. Densities of large northern pike (greater than 20 inches) were higher in lakes with larger total area and shoreline length.

Northern pike spawn early in the spring at water temperatures from 46 to 54 $^{o}$F, often when the ice is still on lakes, in shallow vegetated areas, or in rivers or floodings adjacent to a lake. The fish may show significant migrations to spawning areas, and males tend to predominate in the early spawning migration and remain within the spawning habitat for a much longer time than females. Pike broadcast their eggs over shallow vegetation, and the eggs, which are sticky, remain attached to the vegetation and out of the sediments (Diana 1995). These eggs develop quickly over a couple of weeks and hatch early in the spring. The fish progress rapidly from foraging on invertebrates to other fishes, but tend to remain in shallow vegetated habitat throughout their first year of life. Surveys of pike populations often have difficulty collecting young-of-year pike compared to older age classes, indicating that younger pike utilize different

habitats and are probably behaviorally different from adult fish. Spawning success can be excessive, resulting in stunting in pike populations in extremely shallow and weedy lakes. In lakes with lesser amounts of submergent and emergent vegetation, spawning may only occur in certain habitats, and limit the overall production and abundance of pike in a lake. For many locations, particularly in southern Michigan, shoreline development, coupled with filling or draining of nearshore wetland areas and removal of vegetation, have resulted in limited spawning habitat of northern pike and often dramatically reduced pike populations. In many of these lakes, pike have only managed to persist by stocking of fish periodically to replenish the adult population. These human-induced changes, including removal of vegetation, as well as removal of access to flooded areas near water bodies, are a major problem in maintaining pike populations in areas with much human development.

Northern pike are considered a long lived species in their more northern range. Recent standardized sampling of inland lakes in Michigan has revealed that the average life span of northern pike to be six to eight years with ten to twelve age classes observed rarely (DNRE unpublished data). Information from other studies on northern pike age structure appears similar (Margenau et al. 1998). Variation in longevity is not clear but recent information suggests that high natural mortality resulting in low survival of older fish, high exploitation of larger individuals and environmental and habitat factors might be reasons that explain the shorter life span observed in current Michigan populations compared to populations of pike reported in Canadian populations.

Maturity often occurs at age three to four for males, and ages four to five for females, depending on local conditions (Diana 1983). However, in situations with high exploitation rates and high natural mortality rates, males mature at age two, and females at age three. This change in maturation is believed to be due to selective pressure by angling and removal of large northern

pike, resulting in the change in the reproductive life history of the fish. In this situation, fast growing and early maturing pike are more common in the population (Diana 1995). A similar early maturation condition occurs in stunted lakes, except that growth rate in these lakes is very limited. Often in stunted lakes, the fish may mature at the end of their first or second year of life, in spite of their very small size. This shift in reproductive status is believed to be a result of the low likelihood of survival to an older age (similar to the mechanism for high exploitation by anglers) selectively favoring a fish that matures early (Diana 1995). Earlier maturation results in energy being shunted from growth into reproduction, so that ultimate growth rate is reduced by early age at maturation (Diana 1987).

Northern pike have a relatively high natural mortality rate, which is also related to fish size. Small fish are vulnerable not only to more predators, but also to cannibalism by adult northern pike. In fact, Grimm (1981) and LeCren (1987) suggest that the numbers of small northern pike are regulated by numbers of large individuals through cannibalism. If this is the case in a lake, then the abundance of large northern pike can influence stunting and, in turn, can be influenced by fishing. Causes of stunting are not entirely clear, but include warm temperatures during the growing season, lack of appropriately sized prey, overproduction of young fish, and possibly harvest of large fish (Diana 1987).

Northern pike abundance and size at age appear to be influenced by local lake conditions as much as regional differences like geology and climate. In fact, a common biological characteristic in many Michigan lakes is large numbers of small, slow growing northern pike. These populations, from a fisheries management viewpoint, are difficult to alter because they arise from some combination of over-harvest of large fish, a lack of appropriate-sized prey fish, and habitat characteristics that are not suitable for good growth. Maintaining an appropriate balance of large northern pike, with increasing fishing pressure, may be a key problem for

managing pike populations as the natural habitat characteristics that have been found to directly influence these growth rates cannot be altered.

Densities of large northern pike are comparatively low, with fish over 24 inches averaging only about 0.6 individuals per acre compared to densities averaging 9.3 individuals per acre for fish 14 inches and larger (Pierce and Tomcko 2005). The productive capacity from this study showed that large fish can easily be over-exploited. This is because the productive capacity of northern pike declines rapidly as they get to larger sizes and older ages, yet recreational fishing by all methods tends to select for larger pike that are the least productive part of the population. Pierce and Tomcko (2003) found that in north-central Minnesota lakes, production of fish age six and older was estimated to average only 0.1 pounds per acre per year.

**Fishing Regulations**

Fishing regulations for northern pike have changed dramatically over time. In the late 1800s the state Fish Commissioners in Michigan advocated a "policy of extermination" for pike, referring to them as the "freshwater devil fish" (Williams 1952). There was no minimum size limit and no bag limit from 1865 to 1915. The Department of Natural Resources and Environment has the authority to regulate the northern pike fishery through the use of no minimum size limits. As angler's views on pike changed and they became targeted by anglers, special regulations were developed (Diana and Smith 2008). From 1916 to 1929, there was a ten-inch minimum size limit and a ten-fish bag limit. From 1930 to 1958, there was a 14-inch minimum size limit and a five-fish bag limit. From 1959-1993, there was a 20-inch minimum size limit and a five-fish bag limit. Latta (1971) reported that an increase in the size limit from 20 inches to 22 inches would result in a decrease in yield with a further gain in number of spawners. Latta further found that a decrease in the size limit to 16 inches would result in the highest yield, but would reduce the spawning stock below the status necessary to maintain the

population. From 1993 to 2001, the size limit was raised to 24 inches with a bag limit of five fish. During this time it was believed that an increase in the size limit would provide a general improvement in the northern pike population size structure, the regulation would produce more fish of quality size, and provide more numbers of fish predators to control their prey. Schnieder (1997, results at a Fisheries Division Inservice Training) compared growth indices between slow, average, and fast growth northern pike populations. Preliminary results from this analysis suggested that the 24-inch minimum size limit increased the percentage of fish larger than 24 inches within the fast growth lakes but not in the slow or average growth populations. In 2002, the daily bag limit was further reduced to a maximum of 2 pike within a combined total five fish limit including black bass and walleye. These changes in size and possession limits indicated concerns about the sustainability of some northern pike populations, especially where angling pressure had increased dramatically during these time periods.

In addition to these statewide limits, fisheries managers agreed to liberalize catch and keep regulations for waters that have abundant populations of small northern pike. In 2002, Fisheries Division allowed anglers to keep five fish with no minimum size limit on lakes with northern pike growing below state average. Opportunities for catching large pike were also developed by allowing for a slightly higher size limit on select lakes that have a known capability of growing large pike. This regulation allowed anglers to keep two fish with a 30 inch minimum size limit. These special regulations were implemented because research and computer modeling provided insight that changing size limits has been the most effective tool to achieve an improvement in the fishery.

Management of northern pike is usually to sustain a harvestable fishery. Currently, there is interest in northern pike management to redistribute exploitation rates, increase growth rates,

and improve production of larger fish to provide for a quality fishery in certain key lakes, while in most situations management is still geared toward allowing for a sustainable harvest.

**Status of the Fisheries**

Northern pike were historically an important commercial fish, but contributed only a small percentage of the total commercial harvest according to Michigan's early records (MDOC, 5th Biennial Report). The total commercial harvest of "Grass Pike" in Michigan waters of the Great Lakes in 1928 was 39,775 lbs. for $4,773, which represents a value of 12 cents per pound. In 1929 the harvest was 68,408 lbs. for $8,208.96. These values correspond to annual values ranging from $59,232 to $101,871 when converted to 2009 dollars. According to Michigan Department of Conservation records the total commercial harvest in 1930 and 1931 increased from the previous two years, but the value decreased to only 10 cents per pound in 1930 and 9 cents per pound in 1931 (MDOC, 6th Biennial Report). Currently, there is no legal commercial harvest of northern pike by non-tribal members in Michigan.

Several treaties exist between the United States government and tribes residing in Michigan. Tribal governments' signatory to two of the treaties retained fishing rights for tribal members. Tribal governments' are sovereign nations and have their own Code of Regulation for fishing matters. The Treaty of Washington, signed in 1836, covers the eastern Upper Peninsula and the northern Lower Peninsula of Michigan and in 2007, the state of Michigan, the Little River Band of Ottawa Indians, the Grand Traverse Band of Ottawa and Chippewa Indians, the Little Traverse Bay Bands of Odawa Indians, the Sault Tribe of Chippewa Indians, the Bay Mills Indian Community and the Unites States government signed a Consent Decree which defines the extent of Tribes inland treaty rights. The Treaty of La Pointe, signed in 1842, covers the western Upper Peninsula and areas of northern Wisconsin and there is no formal agreement which

defines the extent of 1842 Treaty rights within Michigan. However, the 1842 Treaty rights have been adjudicated in Wisconsin and Tribal fishers of the Lac Vieux Desert Band of Lake Superior Chippewa Indians and the Keweenaw Bay Indian Community exercise their rights in the 1842 area of Michigan following tribal regulations consistent with the Wisconsin court cases. Within the 1842 Treaty area there is no season limit, bag limit, or size limit for northern pike for open water hook and line fishing. Spearing of northern pike is allowed under a valid spearing permit that allows for a bag limit of 10 fish per day and no size or season limit. Within the 1836 Treaty area, Tribes residing in Michigan shall prohibit or restrict spearing of northern pike in a manner that is no less restrictive than 2006 State spearing restrictions. The Tribes shall also regulate their members' fishing activities through the use of daily bag limits, possession limits, size limits, and season limits in accordance with Paragraph 11.2 and 11.3 of the 2007 Consent Decree, including northern pike. Except when waters are targeted for complete fish eradication, there is no legal commercial harvest of northern pike by tribal members in Michigan.

Michigan anglers seek northern pike for both their hard fighting qualities on hook and line and also for food. The recreational fishery is diverse; open water angling techniques include casting and trolling lures, still-fishing with live baits, and fly fishing. During the winter considerable effort occurs with hook-and-line, spears, and tip-ups, even on southern Michigan lakes where winter ice conditions can be limited. In northern Michigan, northern pike are targeted during both the open water and ice season, but effort and harvest is likely greater for the ice fishery than for the open water fishery on many northern lakes. Clark et al. (2004) reported the ice fishery accounted for 82% of the northern pike harvested from Houghton Lake.

Recreational fishing in Michigan has had historical influences on northern pike populations. Recreational fishing is highly selective for large pike. Creel surveys from large inland lakes in Michigan have shown fish over 24 inches are seldom released and comprise a

large proportion of the harvest. These surveys also indicate that people harvest pike as small as 16 inches, but 20 inches is typically the minimum size that people will harvest. An intensive survey of seven north-central Minnesota lakes showed that annual exploitation rates are as high as 46% of the northern pike longer than 20 inches (Pierce and Tomcko 2003). Creel surveys from Minnesota also show that people harvested pike as small as nine inches, although 14 inches was typically considered the minimum size that anglers harvested. Pierce and Cook (2000) reported that large (>24 in) northern pike are heavily exploited and that both angling and spearing are responsible. They also reported that darkhouse anglers harvest large northern pike at a rate similar to summer and winter anglers who target northern pike. A result of this size selectivity and the continual increase in size regulations is that sizes of fish have suffered from historical increases in fishing effort and fewer memorable size pike are caught today.

In general, Michigan sport fishing regulations for northern pike have become increasingly restrictive over the last 20 years. This trend reflects management efforts to decrease fishing mortality and increase production of larger northern pike, thus increasing top-down predatory control of non-game fish and sucker populations. Currently, northern pike fisheries in Michigan are regulated with a combination of seasons, size limits, and daily bag limits with some regional differences. Table 1 provides the 2010 general sport fishing regulations for northern pike in inland waters. In addition to the general regulations, there are special regulations on some waters including: lakes with no size limit and daily harvest limit of 5 fish (97 water bodies), lakes with 30” minimum size limit (10 water bodies), lakes with northern pike season from the last Saturday in April to November 30 (19 water bodies), lakes closed to spearing (44 water bodies), and lakes closed to harvest but open for catch and release fishing (17 water bodies).

Public concerns about the health effects of eating large predatory fish such as northern pike may be a factor in establishing fishing opportunities for northern pike in Michigan. The

Michigan Department of Community Health (MDCH) issues advisories for consumption of sport-caught fish (MDCH 2008). A statewide advisory for consumption of northern pike, based on elevated levels of mercury, recommends that women of child-bearing age and children eat no more than one meal of muskellunge per month, while the rest of the human population should restrict consumption to one meal per week. Additional advisories recommending restricted consumption of northern pike, due to PCB or Dioxin contamination, exist for some specific waters in the state of Michigan (MDCH 2008).

# MICHIGAN'S NORTHERN PIKE MANAGEMENT PLAN

***Purpose***: To improve the quality of fishing opportunities by protecting and enhancing existing stocks and the environmental conditions upon which they depend, and by improving technical information and outreach, in full partnership with the anglers of the state.

Our goal is to improve angling opportunities of large northern pike, while also providing a fishery to harvest northern pike. We propose that northern pike populations should be managed to provide a stable fishery harvest and to increase population size structure through regulations that reallocate exploitation of certain size classes. The management objectives for northern pike should reflect the guiding mission statements for both the Department of Natural Resources and Environment (DNRE) and Fisheries Division. The DNRE is committed to the conservation, protection, management, use, and enjoyment of the State's natural resources for current and future generations. It is the mission of Fisheries Division to protect and enhance fish environments, habitat, populations, and other forms of aquatic life and promote optimum use of these resources for the benefit of the people of Michigan.

**Goals, Issues, and Objectives**

This plan identifies current issues that prevent attainment of the goals and provides suggestions on how to address these issues for future management.

**Goal I. Protect, restore, and enhance habitat on Michigan Waters.**

Issues

- Michigan lakes exhibit a high diversity in chemical and physical characteristics across the state's large area. These differences need to be understood to successfully manage and protect northern pike populations.
- The simplification or loss of littoral and riparian habitat (e.g., seawalls, loss of large woody cover, conversion of vegetated littoral zones to sandy beaches, etc.), including

incompatible aquatic plant management, is a major threat to the state's northern pike fisheries.

- Riparian land uses impact fisheries habitat, yet enforcement of existing rules and development of more appropriate measures to protect near-shore habitat is lacking.
- Fisheries Division has no regulatory authority for human activities affecting the littoral and riparian habitat required by self-sustaining northern pike spawning habitat.
- Michigan does not have a regulatory authority to prevent mechanical aquatic plant harvesting that would alter juvenile northern pike habitat and habitat for forage species.
- Education of lakeshore property owners on the importance of habitat to fisheries is not consistent across the state.
- Sedimentation, due largely to non-point source runoff, impacts many of Michigan's waters.
- Barriers to fish passage including dams, lake level control structures, poorly designed stream crossings for roads, etc., can restrict northern pike spawning movements and reduce available spawning and nursery habitat.

Objectives and Strategies

- Locate, document, and protect existing functional littoral and riparian habitat through joint local, federal and state efforts.
- Ensure that local concerns for the fishery are incorporated into decisions on proposed habitat alterations. Evaluate the current waterway, wetland, riparian and aquatic plant management permitting procedures and ensure that the fisheries biologists and angling-interests are included in the process.

- Review/develop educational material on the value of aquatic habitats for lake property owners associations and identify opportunities for interaction/input. O'Neal and Souillere (2006) is an excellent resource that should be useful in this effort.
- Ensure that effective, cost-efficient habitat protection, restoration, and enhancement procedures are documented and used consistently throughout the state.
- When requested by WRD-Land and Water Management Division, Fisheries Division biologists should provide comments on proposed habitat alterations that reflect the established Fisheries Division Policies for such activities.
- Improve enforcement of existing habitat protection regulations.

**Goal II. Ensure that adequate technical information is available for Michigan's northern pike fisheries.**

Issues

- There is often insufficient information on northern pike populations and angler use to make informed management decisions.
- Current Status and Trends surveys do not capture sufficient numbers of northern pike to assess population parameters.

Objectives and Strategies

- Develop a statewide strategy to insure sufficient information is available on northern pike fisheries.
    - Support the Lake Status and Trends Program for systematic monitoring and assessment of the fish communities in Michigan's inland waters, while

recognizing the need for additional sampling to effectively monitor northern pike population parameters.

- Endorse the collection of northern pike population information within the Large Lakes Monitoring Program.
- Survey Michigan anglers to determine demand for various types of northern pike fishing opportunities and be able to evaluate trends in northern pike fisheries.
- Adopt a standard northern pike survey protocol for Michigan inland waters (See Appendix A)
- Support the statewide creel survey program for inland waters and develop targeted effort estimates to evaluate northern pike fishing success.

- Maintain a standing Esocid Committee within Fisheries Division to foster continued attention to Esocid management issues.

**Goal III. Protect and maintain Michigan's self-sustained northern pike fisheries and associated fish assemblages and aquatic communities.**

Issues

- Stocking of northern pike occurs to a limited degree by the Department, mainly for the reestablishment of populations lost to fish kills, rehabilitation, low reproduction, loss of spawning habitat, etc.
- Northern pike are a large native predator species that should be preserved as part of a balanced fish community.

Objectives and Strategies

- Maintain and optimize Michigan's existing self-sustained northern pike populations. Natural reproduction is not a limiting factor in many lakes, but there are a few lakes where habitat has been destroyed and stocking could be used for maintaining northern pike populations. DNRE, Fisheries Division northern pike stocking guidelines should also be considered when supplemental stocking is necessary (Dexter and O'Neal 2004).
- Prevent collapse of a population because of excessive harvest to the point where adequate spawning numbers or biomass, reproduction, and recruitment cannot be sustained.
- Determine the risks for disease transmission and influences on population levels.

**Goal IV. Communicate with anglers and promote the recreational value of Michigan's northern pike fisheries**.

Issues

- The public is poorly informed of the reasons behind management actions.
- Ecological differences between waterbodies necessitate having a variety of management options available for appropriately managing the northern pike fisheries in individual water bodies.
- Stakeholder groups and individual anglers can have conflicting values for northern pike fisheries.
- Identification of northern pike and muskellunge can be problematic for some anglers.
- Anglers may not recognize the relative rarity of large northern pike in Michigan waters and the impact that even low levels of exploitation can have on the size structure of northern pike populations.

Objectives and Strategies

- Develop a working stakeholders committee to accomplish the following:
    - Increase awareness of the importance of large northern pike to maintaining balance in many aquatic systems.
    - Obtain information on the economic value of northern pike fisheries to increase public awareness of the importance of quality northern pike fisheries to Michigan's economy.
    - Educate anglers on the differing potential of Michigan lake types for supporting northern pike populations.
    - Increase education efforts on the identification, biology, and management of northern pike in Michigan.

**Goal V. Provide a variety of northern pike fishing opportunities within a science based management system.**

Issues

- The current statewide regulations do not adequately address management needs for northern pike populations characterized by the variation of growth potential across Michigan.
- Many inland waters are not achieving their potential for producing large pike
- Fishing regulations are getting too complicated and there are too many exceptions to statewide regulations.
- Conflicts exist between various user groups.
- It is impractical to obtain sufficient information to manage every northern pike fishery on a lake-by-lake basis.

Objectives and Strategies

- Assess a variety of regulations and develop a group of standard regulations for managers to choose from for addressing the management goals (Table 2).
- Manage waters with high growth potential to prevent overfishing and to produce larger pike. Exploitation rates should not exceed a level where the numbers of larger fish decline because losses from mortality and harvest exceed gains from growth.
- Maintain the current season structure to recognize the associated seasons for black bass, muskellunge, and walleye.
- Manage northern pike populations to increase the numbers of fish older than age 8 and larger than 28 inches, or to reach their potential ultimate sizes where this objective may not be achieved.
- Manage northern pike populations to provide a stable fishery yield (by numbers), where growth rates do not achieve state averages.
- Manage northern pike populations to control or utilize their influence in the management of other fish species.

## Summary and Prioritized Action Items

This document provides a review of the biology and ecology of northern pike, compiles the available knowledge of the northern pike fisheries in Michigan, and proposes a strategy for the future management of northern pike in Michigan. We propose that northern pike populations should be managed to improve angling opportunities for large northern pike through regulations that reallocate exploitation of certain size classes, while still providing a stable fishery harvest. Goals addressing the areas of habitat, technical knowledge, fish populations, and stakeholders are presented in this plan. Issues representing impediments to the achievement of those goals are

identified and objectives and strategies to address those issues are included. A prioritized list of some of the strategies and objectives is presented here as action items.

- Maintain a standing Esocid Committee within Fisheries Division to foster continued attention to northern pike management issues. (Goal II- Tech. Information)
- Assess a variety of regulations and develop a group of standard regulations for managers to choose from for addressing the management goals (Goal V-Fishing Opportunities)
- Adopt a standard northern pike survey protocol for Michigan inland waters. (Goal II – Tech. Information)
- Survey Michigan anglers to determine demand for various types of fishing opportunities for northern pike. This survey could be part of a statewide angler survey with specific questions targeting northern pike anglers. (Goal II – Tech. Information)
- Support the statewide inland waters creel survey program and explore options for improving the estimates of northern pike fishery targeted effort, harvest, and catch when northern pike waters are creel surveyed. (Goal II – Tech. Information)
- Facilitate communication between interest groups with various values for northern pike fisheries in Michigan (spearing interest versus no-kill proponents for example). (Goal IV – Communicate with anglers)
- Ensure that local concerns for the fishery are incorporated into decisions on proposed habitat alterations. Evaluate the current waterway, wetland, riparian and aquatic plant management permitting procedures and ensure that fisheries biologists and angling-interests are included in the process. (Goal I – Habitat)
- Develop criteria that group northern pike populations based on habitat, growth, or population density, and that facilitate management needs (Goal II- Tech. Information)

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Table 1. General recreational fishing regulations for northern pike in Michigan's inland waters, 2010.

| Gear | Region | Season | Minimum size | Daily limit[note] |
|---|---|---|---|---|
| Hook/line | Upper Peninsula | May 15 to March 15 | 24" | 2 |
| Hook/line | Lower Peninsula | Last Sat. in April to March 15 | 24" | 2 |
| Spear | Statewide | December 1 to March 15 | 24" | 2 |

Note: The daily bag limit is two fish which are included in a total bag limit of 5 fish for walleye, smallmouth bass, largemouth bass, northern pike, and flathead catfish combined.

Table 2. Proposed regulations to be assessed by simulation modeling and yield-recruitment models. msl = minimum size limit; slot is a protected no harvest within length range.

| Regulation | Goal |
|---|---|
| No msl, bag 5 | Maximize sustainable harvest |
| 24" msl, bag 2 | Maintain current structure for fast growth populations |
| Protected Slot 24-34, bag 2 | fish immediately released between 24-34 inches, to improve population size structure |
| 26 or 30" msl | Reduced harvest |

## Appendix A

### Sampling Protocol and Population Assessment

Management opportunities are often limited by the inconsistent collection of data for detailed population dynamics. The ability to sample populations needs to be improved so that management can be based on quantitative analysis. Baseline assessment and monitoring for pike has not been implemented in Michigan. Recently developed Lake Status and Trends Program sampling protocols, employed during late spring and early summer, generally assess fish composition statewide where information on northern pike may be collected, but catch of pike can be highly variable and may not provide enough information to estimate population characteristics. Existing survey methodologies need to be examined or modified to evaluate newly proposed quantitative objectives for management and to estimate the parameters of proposed biological reference points. This section outlines techniques for assessment and a call for future research and evaluation.

Standard fisheries sampling techniques and monitoring methods need to provide adequate information on pike population characteristics, primarily these parameters: population abundance, catch at age, growth, and size structure. Early spring impoundment gear assessments are regionally accepted as the primary means of collecting population information. Enough nets should be set to collect fish from spawning habitat and most of the available habitat within the lake. Data should be recorded separately for each net set. Spring population densities of northern pike should be estimated by use of Chapman's modification of the Peterson estimator for single recapture runs, and the modified Schnabel estimator for multiple recapture runs in closed systems (Ricker 1975).

Early spring surveys of northern pike are critical in developing biological information because during this period, sex can be determined; sexual dimorphism is large in this species, and therefore appropriate biological analysis can be calculated from these surveys. Available information within the statewide database indicates that trap nets and large mesh fyke nets with similar selectivity (generally with conventional 1.5-inch mesh pots) are efficient at capturing adult northern pike and muskellunge from age 3 and older. Northern pike inch groups between 16 to 24 inches are the highest proportion of sizes captured by these types of gear.

Early summer gill net surveys are encouraged to be used to recapture marked fish in the population, but should not be used during the marking period to prevent violating assumptions of population estimates. We recommend standardizing experimental gill net efforts by the following lake sizes: Lakes 100 to 300 acres would get 9 overnight net sets, lakes 300-600 acres would get 12 overnight net sets, lakes 600 to 1000 acres would get 16 net sets, and lakes over 1,000 acres would follow protocols for the large lake survey.

Electrofishing methods employed in large, slow flowing rivers may be another method useful to assess pike populations. Multiple mark and recapture runs during spring should be conducted to complete mark-recapture sampling. Electrofishing catch rates should be estimated from the number of fish captured during the last run. Electrofishing in lakes should be conducted during spring months to estimate population density from electrofishing catch rates. Electrofishing catch rates were linearly related to population density in spring for northern pike (Schoenebeck and Hansen 2005). Electrofishing to obtain a relative abundance determination for young-of-year (YOY) and yearling fish has been developed and proposed as a possible method (Ziegler and Schneider 2000). Adoption of electrofishing surveys should be included with general surveys and should exclude a standard gear used for assessment by itself. This

technique, however, may be useful in monitoring recruitment (YOY catch rates) of populations where natural reproduction occurs because variation in year classes might be more accurately detected. Coverage of the water to be sampled should be separated by random selection of segments developed by the total area of the water. Segments should be chosen at equally spaced intervals and data recorded separately by each effort within that segment. Research is needed to evaluate spring and fall survey techniques for northern pike in Michigan.

Because of the longevity of northern pike, the use of PIT tags to identify fish is reasonable, but half finclips, elastomer marks, or metal jaw tags should also be considered for short term surveys. The objective should be to approximately mark/tag 10% of the estimated population, if this information is not available prior to the survey then approximately 0.5 northern pike per acre should be captured and marked. Marking more fish may improve the accuracy of the population estimate, but longer sampling effort may be inefficient. Age determination of esocids by cleithrum bones or dorsal fin rays are the most reliable structures and surveys should be standardized using this method for statewide comparisons. A subsample (>12) of adult fish (6 of each sex) that are believed to be representative of that population's size structure can be used for growth determination derived from cleithra, and subsequently limiting the number of mortalities. Dorsal fin rays should be collected from enough fish to establish accurate estimates of age and growth information. This number may include collecting dorsal fin rays from 20 fish per inch group with no less than 10 of each sex within that inch group.

Standardized sampling of northern pike should be developed to evaluate the management objectives and status of the fisheries in Michigan. A stratified random selection of fixed waters should be selected based on growth potential, stocked and natural waters, and other sampling logistics. These waters can be used to monitor abundance, mortality, recruitment, growth

evaluation, and length distribution for adult muskellunge. Currently northern pike regulations are based on ecological groupings and these groupings can be used to establish similar waters to monitor within these groupings.

**Tasks:**

- Compile existing northern pike assessment data in FCS database to describe pike population characteristics.
- Collaborate with and coordinate research studies to assess recruitment, survival, survey techniques, etc.
- Develop northern pike monitoring protocol and survey design.
    - Establish long-term trend waters where adult population estimates can be conducted every 5-10 years.
    - Conduct mail angler surveys and coordinate annual creel surveys between management units.

Goals/objectives:

- Monitoring
    - Establish a network of long-term trends monitoring waters that track northern pike abundance, size-structure, annual mortality, exploitation, and relative abundance of the associated fish community.
    - Conduct frequent mail surveys to track angler attitudes and to evaluate program goals. Pilot an angler diary program for possible local coverage.
    - Variation among lakes and the wide distribution of the species dictate that northern pike populations be monitored for extended periods, and that reference

waters also be monitored to aid interpretation of data and development of meaningful management recommendations.

- Evaluation
    - Develop an index for northern pike populations (e.g., mean size at age 3, mean size at age 4, number of age classes greater than age 2, number of fish larger than 28 inches, etc.).
    - Develop quantitative criteria to define biological reference points.
    - Implement a comprehensive angler survey that represents public performance objectives for fishing regulations that have been evaluated and exploitation rates that have been estimated correctly on select waters. Develop seasonal sample indexes for statewide evaluation and analysis.