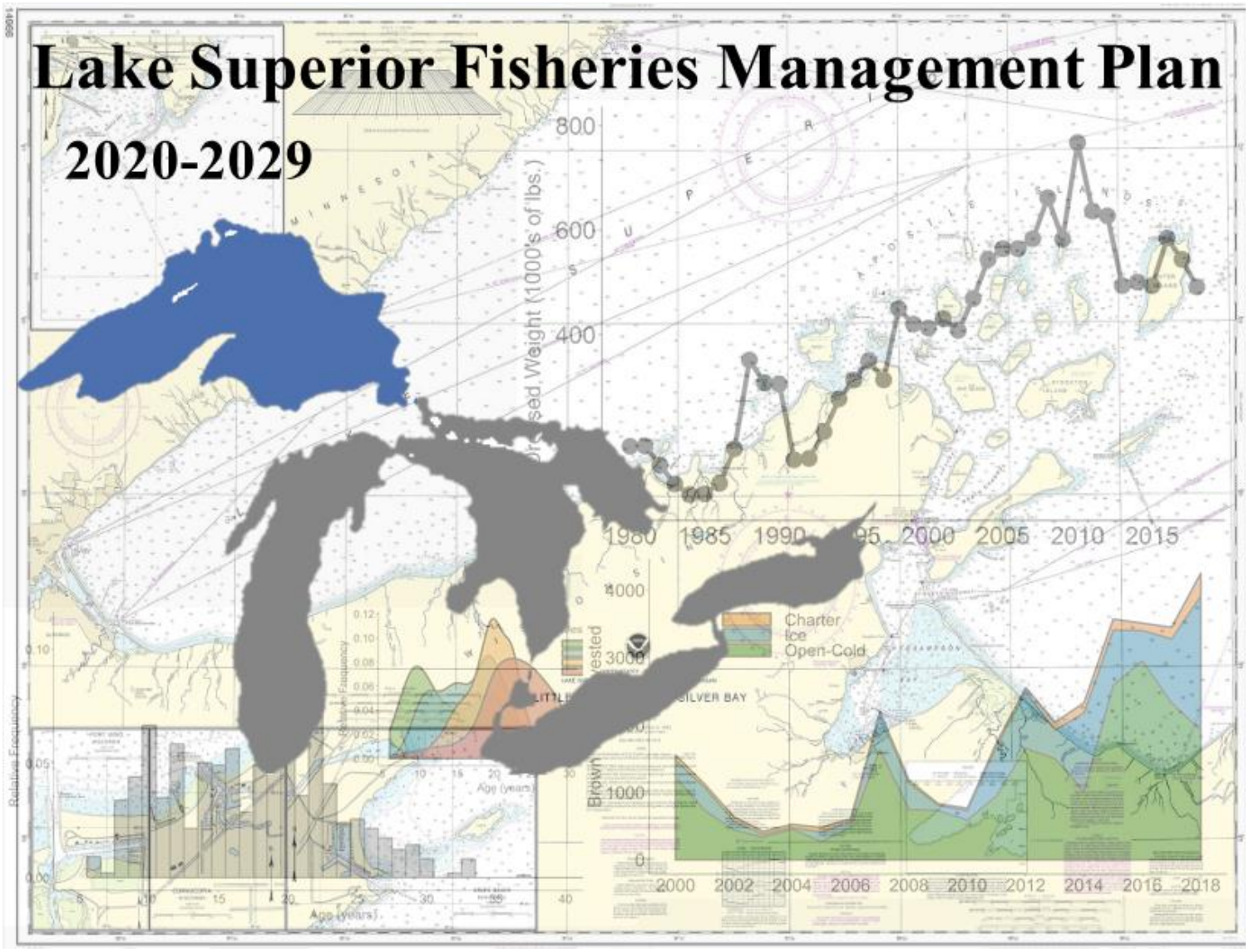
Lake Superior Fisheries Management Plan

2020-2029



Administrative Report No. X

Lake Superior Fisheries Team

Bureau of Fisheries Management

Wisconsin Department of Natural Resources

Table of Contents

INTRODUCTION

Overview - Fisheries management programs, along with state and Federal pollution prevention and habitat protection initiatives, have made huge strides in protecting and restoring fish populations in Lake Superior. World-class fisheries now exist where pollution, habitat degradation, invasive species and unrestricted harvest of native species had once contributed to the collapse of fish populations and ecosystem decay. However, even today, invasive species are continuously introduced, habitats are repeatedly altered, and unforeseen changes still pose a threat to Lake Superior fisheries and limit Lake Superior from reaching its full sport and commercial fishing potential.

This Lake Superior Fisheries Management Plan ("the Plan") guides management of sport and commercial fisheries management in Wisconsin's Lake Superior waters for the next ten years (2020-2029). This Plan presents an ambitious agenda of work that will test the energy and resources of the Lake Superior Fisheries Team over the next five biennial budgeting and planning cycles.

Purpose - The Lake Superior Fisheries Management Plan was prepared by the Wisconsin Department of Natural Resources ("the Department") to define management direction pertaining to sport and commercial fisheries in Lake Superior and its tributaries for the coming decade. The goals and objectives established in the Plan will guide practical management of Wisconsin's Lake Superior fisheries to benefit the state's citizens within the productive capacity of the resources. The public participated extensively in the making of the Plan to ensure that the Plan would reflect a balanced approach to the type of management desired by all stakeholders for Lake Superior and its tributaries.

As the Plan is put into action, it will promote more efficient, consistent fisheries management and will fully inform all resource users what they can expect from Lake Superior and from the Department.

Scope - The Plan covers the ten years from 2020 through 2029, after which it will be reevaluated and revised. Should drastic changes occur in Lake Superior that are not accounted for by the Plan, the Department will, with public input, develop appropriate actions.

Mandate - The Department manages fisheries resources under Wisconsin statute Sections 23.09 and 29.041 and Wisconsin Administrative Code Chapter NR 1, as follows:

- *23.09: Conservation. (1) PURPOSES. The purpose of this section is to provide an adequate and flexible system for the protection, development, and use of forests, fish and game, lakes, streams, plant life, flowers, and other outdoor resources in this state. (2) DEPARTMENTAL RULES; SURVEYS; SERVICES; POWERS; LONG-RANGE PLANNING. The department may promulgate such rules, inaugurate such studies, investigations and surveys, and establish such services as it deems necessary to carry out*

the provisions and purposes of this section. The department shall establish long-range plans, projects, and priorities for conservation.

- *29.041: Department to regulate hunting and fishing in interstate waters. The department may regulate hunting and fishing on and in all interstate boundary waters, and outlying waters.*

- *NR 1.01: Management of fisheries and aquatic resources. (1) To meet its responsibilities established by statute, department programs shall be based on scientific management principles which emphasize the protection, perpetuation, development, and use of all desirable aquatic species. (2) The goal of fish management is to provide opportunities for the optimum use and enjoyment of Wisconsin's aquatic resources, both sport and commercial. A healthy and diverse environment is essential to meet this goal and shall be promoted through management programs. (3) Aquatic resources include both non-game and game species of fish, other aquatic animals and their habitats. Endangered and threatened species form a special group that will be managed according to ch. NR 27 and s. 29.604, Stats. (4) To assure its effectiveness, the management program shall be based upon a close working relationship among all functions of the department, other governmental agencies, federally recognized Indian tribes, and the public. The department will keep interested parties informed of policies, plans and management. To anticipate change and meet future demand, the department shall engage in long-range planning of management programs. (5) Financing the department's fish and aquatic resource management program through, in large part, user fees, particularly license fees and excise taxes on selected equipment purchased by sport and commercial fishers, is an established principle. Although user fees collected for a specific purpose are targeted at that purpose, they provide significant indirect benefits for a wide range of wildlife and users. When beneficiaries are a broader or different segment of the public, other funding sources will be sought. (6) Wisconsin law enunciates a trust doctrine which secures the right of all Wisconsin citizens to quality, non-polluted waters and holds that waters are the common property of all citizens. Fish management programs will vigorously uphold the doctrine that citizens have a right to use in common the waters of the state and these waters shall be maintained free of pollution. (7) With access to Wisconsin's lakes and streams a prerequisite for their use by the public, the acquisition and development of public access to waters should be accelerated, particularly in the more populous areas of the state. (8) Wild and wilderness lakes and streams are a special and limited resource providing unique settings for enjoyment of fishing and other outdoor activities. Additional efforts are required to designate lakes and streams for this status. Special management methods that increase fishing quality shall be encouraged on these waters. Such methods may include trophy fishing, regulated harvest, special seasons, and controlled entry. (9) Sport fishing shall be managed in such a way that all have an equal opportunity to safely enjoy the aquatic resources, regulated to the extent that: (a) Fish and other aquatic resources are protected and enhanced; (b) Fishing effort does not exceed the capabilities of the resource to sustain desirable, quality fish populations; (c) The social, biological and economic values associated with all sport fishing, competitive and non-competitive, are recognized; (d) A sense of responsibility for the resource is inherent in all who participate and enjoy fishing; (e) User conflicts are minimized; and*

(f) Aesthetic and cultural values associated with fishing are held in trust for future generations.

- *NR 1.04 Great Lakes fisheries management. The board endorses a flexible management system for the protection, development, and utilization of the waters and fish populations of the Great Lakes for the maximum public benefit. (1) Management of the Great Lakes is of intrastate, interstate, federal and international interest; therefore, cooperation with management agencies shall be sought in developing management objectives and measures for fish stocks of common concern. (2) The Great Lakes fisheries are to be considered part of a diverse community. The department shall promote efforts to maintain and enhance the quality of this community and its environment. (3) Management of the fishery resources shall be based on a sound understanding of the dynamics of interacting fish stocks. The department shall conduct research and resource base inventories and collect harvest and utilization statistics on which to base sound management decisions. (4) The fishery resources of the Great Lakes, though renewable, experience dynamic changes and are limited. The resources will be managed in accordance with sound management principles to attain optimum sustainable utilization. Management measures may include but are not limited to seasons, bag and harvest limits, limitations on the type and amount of fishing gear, limitation as to participation in the fisheries and allocation of allowable harvest among various users and the establishment of restricted areas.*

In addition to state statutes and code, the Department maintains commitments within the Joint Strategic Plan for Management of Great Lakes Fisheries (SGLFMP; Great Lakes Fishery Commission 2007), a basin-wide agreement facilitated through the Great Lakes Fishery Commission. The agreement binds Wisconsin, seven other Great Lakes states, the Chippewa-Ottawa Treaty Fishery Management Authority (re-constituted as CORA, the Chippewa-Ottawa Resource Authority), the Great Lakes Indian Fish and Wildlife Commission, the U.S. Fish and Wildlife Service, the U.S. Geological Survey, the Ontario Ministry of Natural Resources, and the Canada Department of Fisheries and Oceans to a protocol for coordinating activities and resolving conflicts. Through the Joint Strategic Plan, the Department accepts the following common goal for Great Lakes fishery agencies:

To secure fish communities, based on foundations of stable self-sustaining stocks supplemented by judicious plantings of hatchery-reared fish, and provide from these communities an optimum contribution of fish, fishing opportunities and associated benefits to meet needs identified by society for wholesome food, recreation, employment and income, and a healthy human environment.

The Department works with the Michigan DNR, the Minnesota DNR, the Ontario Ministry of Natural Resources and Forestry, the 1854 Treaty Authority, the Chippewa-Ottawa Resource Authority, and the Great Lakes Indian Fish and Wildlife Commission to address issues of common concern on Lake Superior. Lake-wide fisheries management policies are developed by these seven agencies through the Lake Superior Committee (LSC). The LSC has adopted Fish Community Objectives (Horns et al. 2003) to guide the seven agencies in their management of Lake Superior fisheries. Additionally, the LSC adapted rehabilitation plans for Lake Trout,

Walleye, Lake Sturgeon, and Brook Trout that are used to help direct fisheries management in Lake Superior.

Finally, the Department has maintained a Lake Superior Fishing Agreement with the Red Cliff and Bad River bands of Lake Superior Chippewas. This agreement guides harvest, designated refuges, restrictive use areas, and open fishing zones. Lake trout quotas are established with a Statistical Catch at Age (SCAA) model. The resulting estimate of total allowable catch (TAC) is used to recommend a safe harvest limit in WI-2 waters of Lake Superior. The TAC is divided between the State and the Tribes based on the agreement between the parties and used to set total allowable gill net effort in WI-2. The TAC in WI-1 waters is established as a static quota and divided between the parties based on the agreement. Seasons, tagging, lake trout stocking, walleye quotas, enforcement, home-use fishing, and information exchange are described in the agreement. The current agreement was recently renegotiated and terminates on November 27, 2028 if not reaffirmed or renegotiated. The Lake Superior Fishing Agreement can be found at https://dnr.wi.gov/topic/Fishing/lakesuperior/LakeSuperiorFisheryAgreement.html.

Planning for work on Lake Superior is conducted within the framework of A Fisheries, Wildlife, and Habitat Management Plan for Wisconsin (WDNR 2013), which describes how the Department will implement its mission and its strategic plan in the programs that work with fish, wildlife, and their habitants.

DESCRIPTION OF THE RESOURCE AND FISHERIES

Physical Setting and Management Jurisdiction

By surface area, Lake Superior is the largest freshwater lake in the world. It is the deepest of the five Great Lakes and lowest in primary productivity due to its low elemental nutrient concentrations such as nitrogen and phosphorus. Lake Superior jurisdiction is shared among the states of Minnesota and Michigan and the province of Ontario, Canada. Specifically, Wisconsin's management area comprises 1.305 million acres of water and 325 miles of shoreline.

Hundreds of tributaries drain to Lake Superior from the three states and Ontario, all of which contribute to Lake Superior's fisheries resources. The St. Louis River constitutes the border between Wisconsin and Minnesota, whereas the Montreal River is the border between Wisconsin and Michigan. Thus, these tributaries are jointly managed between the respective states. All other tributaries in Wisconsin are managed solely by Wisconsin. Wisconsin's Lake Superior tributaries drain sand and clay soil types, which strongly influence the physical attributes of Wisconsin's Lake Superior shoreline and nearshore water characteristics.

Fisheries History

Commercial Fishery - The first fishermen on the Wisconsin waters of Lake Superior were Native Americans that subsisted on the lake's native species prior to the early 1800's, at which time, organized commercial fishing began around the lake. LaPointe, on Madeline Island, was the center of the Lake Superior fishing industry of the American Fur Company. Lake whitefish, lean

lake trout, and siscowet lake trout were harvested, salted, packed in barrels, and shipped via schooner to Sault St. Marie. By 1840, available markets for the fishery disappeared. The American Fur Company dissolved in 1842, and little commercial fishing occurred on the lake for over a decade. Fishing resumed when European settlers arrived in the Bayfield area, and by 1879, Bayfield had 130 people employed in the fishing industry and nearly twice that number a year later (Nute 1944). Gill nets, pound nets, and seines were the primary gears used.

Lake whitefish, lean lake trout, and lake herring (cisco) were commercially harvested off Superior harbor during the late 1850's and early 1860's. Concurrently, walleye, lake sturgeon, and northern pike were heavily harvested in the St. Louis River up to the lower falls during spring spawning runs (Nute 1944). In the 1870's, brook trout were harvested from the Bois Brule River during the winter months and taken to Duluth, MN and Ashland, WI (Sweet 1880). By 1870, the commercial fishery off Superior had declined, as noted by the Superior Times in its November 19, 1870, edition, "The lake fisheries in this vicinity have not been very profitable this season; the catch has been barely sufficient to pay expenses."

Around the turn of the 20th century, the fishery became more efficient due to the transition from small sailing vessels to wooden steamers and the use of automatic gill net lifters (Downs 1976). Linen gill nets were replaced with cotton nets around 1928, followed by nylon nets around the 1970's. During the open water season, commercial fish camps were common on many of the islands and at river mouths along the main shore.

In 1940, approximately 90 percent of the total lake trout harvest was by state-licensed commercial fishers, with the remainder taken by sport anglers. At that time, there were approximately 70 commercial licenses with many part-time fishers. Between 1952 and 1961, the lake trout stocks that remained after years of overharvest, were further depleted by significant sea lamprey predation. When the sea lamprey impact was at its peak in 1963, only 40,000 pounds of lake trout were commercially harvested. To begin regulating lake trout harvest in Wisconsin waters, the commercial fishery was switched to a limited-entry style fishery in 1967. Additionally, stocking of lake trout supplemented what little natural reproduction occurred in the early 1960's, which created a lake trout population mainly composed of hatchery-reared fish through 1970. As a result of lake trout rehabilitation efforts, the annual harvest rose to approximately 70,000 pounds, of which 40,000 pounds were taken by state-licensed commercial fishers. After the Gurnoe Decision in 1972, the Lake Superior Chippewas regained treaty fishing rights and were allocated 50 percent of the safe harvest limits. During the 1970's, the number of state commercial fishing licenses dropped considerably, and approximately 21 tribal commercial ("big boat") licenses entered the fishery.

In 1997 the state of Wisconsin bought out 11 of the 21 remaining state commercial fishing licenses, leaving 10 state licenses and approximately 16 tribal big boat licenses in the current fishery. The present commercial fishery operates from ports along the main shoreline, where harvest is predominantly lake whitefish and cisco using both gill nets and trap nets. The 10-year average (2008-2017) lake whitefish harvest in Wisconsin waters of Lake Superior was 1,157,262 dressed pounds which amounted to 47% of the total harvest in Wisconsin waters. By 2009, an unprecedented market for cisco roe caused a large increase in commercial harvest, with the cisco harvest averaging 989,899 dressed pounds, or 40% of the commercial harvest over the past 10

years compared to 268,532 dressed pounds the previous 10 years. Lean lake trout accounted for 6% of the total harvest (155,416 dressed pounds) and siscowet accounted for an additional 4% (107,569 dressed pounds) over the past 10 years. Most of the remaining harvest was chub species (e.g., *hoyi*, *kiyi*; 2%) at a 10-year average of 49,414 dressed pounds.

Sport Fishery – Records of Lake Superior sport fishing range from occasional Lake Superior references to relatively routine newspaper reports for the tributaries. Many references mention the popularity of "deep-sea" trolling for lake trout and stream fishing for brook trout. Walleye, yellow perch, and northern pike fishing also drew sport anglers to Chequamegon Bay, where large catches were taken through the 1950's. These and other species in the St. Louis River, however, were often unpalatable due to water pollution. Stocks were relatively unexploited until the early 1980's following several years of water quality improvements under the Federal Clean Water Act of 1972. Elsewhere in Wisconsin's Lake Superior waters, walleye stocks declined throughout the 1960's and 1970's. In 1912, rainbow smelt were intentionally introduced into a small lake connected via river to Lake Michigan in the hopes that the rainbow smelt would begin to move into Lake Michigan once the population grew. By 1923, rainbow smelt were detected in Lake Michigan and by the late 1950's were abundant in Lake Superior where they have since provided a spring dip-net and seine fishery. Rainbow trout and brown trout were introduced in the late 1800's through the early 1900's as a part of the era of global homogenization efforts by the U.S. Bureau of Fisheries and to offset the loss of the lake trout and brook trout fisheries during and after the logging era. Coho salmon and Chinook salmon were also introduced by the Michigan DNR in the 1960's and 1970's. These introduced salmonids adapted to Lake Superior and its tributaries and have provided a popular nearshore and tributary sport fishery.

Wisconsin waters of Lake Superior, its embayments, and tributaries offer diverse sport fishing opportunities. Lake trout is a primary target species, particularly as lake ice thickens during the winter and anglers turn to popular deep water "bobbing." Ice fishing is also popular for lake whitefish, brown trout, and yellow perch. Excellent trolling for salmon and trout occurs from Superior to Saxon Harbor beginning in May as the ice dissipates. The summer season drives the fishing effort to deeper water, reached using downriggers, primarily targeting lake trout. When the lake trout season closes, effort returns to brown trout, coho salmon, and Chinook salmon during their migrations toward the spawning tributaries. Numerous charter opportunities focused on lake trout exist during the latter part of the summer. Nearshore embayments such as Chequamegon Bay host a popular year-round coolwater fishery for smallmouth bass, walleye, northern pike, and yellow perch; fishing pressure is typically highest during spring. Walleye and muskellunge are among the more common species sought in the St. Louis River.

Stream fishing for potamodromous and resident salmonids is concentrated on five major Lake Superior tributaries: Bois Brule River, Sioux River, Flag River, Cranberry River, and Fish Creek. The Bois Brule River receives the most pressure, primarily on lake-run spawning populations; the Sioux River is a distant second relative to fishing pressure. In these tributaries, rainbow trout, or steelhead, is the primary target species in the spring, while rainbow trout, brown trout, and coho salmon constitute much of the migratory fishery in late-summer and early fall.

Forage - Historically, cisco was the major forage fish for lake trout, which sustained an annual lake trout harvest of more than 400,000 pounds. Rainbow smelt entered the Wisconsin waters of

Lake Superior in the 1930's and reached significant abundance in the mid-1950's. By the late 1960's, cisco were replaced by rainbow smelt as the major forage fish in both lake trout and the nearshore salmonid diets. In the late 1970's and early 1980's, rainbow smelt abundance began to decline, concomitant with stronger year classes of cisco. Since the 1990's, however, very few measurable year classes of cisco have been observed and rainbow smelt have remained an important part of the prey base.

The forage base will dictate the amount of trout and salmon that the lake can sustain. Rainbow smelt are relatively nearshore inhabitants, whereas cisco utilize all or most of the lake. Cisco can convert more of the lake's zooplankton into forage for top-order predators. A return of abundant cisco stocks will allow the lake to support more top-level predators for both sport and commercial enterprises.

Management - Wisconsin's Management of Lake Superior and tributaries dates to the late-1800's, primarily beginning with the institution of stocking by federal and state authorities. The U.S. Bureau of Fisheries introduced rainbow trout in Lake Superior in 1895. The Bayfield State Fish Hatchery was built in 1897 and provided lake trout for Lake Superior. Brook trout were stocked in the Sioux River in 1890 and in the Bois Brule River in 1891, and rainbow trout were introduced in 1916 in the Bois Brule River, Whittlesey Creek, Onion River, Bark River, and many other streams. Although stocking was a common management tool that continued through subsequent decades, concerns grew over high fishing pressure, which fueled a conservation ethic among public officials and the public. This prompted the hiring of a warden in 1879 and the establishment of fishing regulations in the late 1800's. Aside from stocking, early fisheries management included regulations on commercial fishing through size limits, mesh restrictions, and seasons. Monthly commercial catch reports have been required since 1936. The first fish manager assigned to Lake Superior in 1951 concentrated first on monitoring fish stocks and then on sea lamprey control. Managers responsible for the tributaries at the time implemented season, size, and bag limits.

Due to the nature of a currently thriving commercial (state and tribal licensed) fishery and ever-growing popular sport fisheries, Wisconsin waters require a wide array of management tools and regulation to continue providing these opportunities. Since the mid-1900's, fisheries management has focused less heavily on stocking, choosing to use this management tool only in specific scenarios. Population models are used to determine safe harvest limits to properly appropriate harvest among all tribal, commercial, and sportfishing interests. Two large refuges surrounding important spawning shoals ensure asylum from all fishing operations, and several restricted-use areas provide refuge from high-efficiency gears and lessen commercial-sport fishing conflict. Additionally, fishing seasons, bag limits, length limits, footage allotments, and other tools are used to maintain population abundance and size structure in several commercial and sport fisheries. Creel surveys, mandatory reporting, and onboard monitoring are used to track fisheries harvest annually, and the Department and partners conduct numerous fishery-independent surveys annually to independently assess population dynamics. Lastly, management efforts include Department staff hosting public meetings and attending club and board meetings to ascertain public interests and ensure public participation in the fishery management process.

FISHERIES MANAGEMENT AND PUBLIC PARTICIPATION

Although the Department retains management authority within Wisconsin waters of the Great Lakes, fisheries management is conducted in partnership with others, as reflected in SGLFMP. We also rely on the advice, cooperation, and assistance of the citizens of Wisconsin. In addition, our partners include the Red Cliff and Bad River Bands of Lake Superior Chippewa, two other states bordering Lake Superior, Ontario, the Great Lakes Indian Fish and Wildlife Commission, the U.S. Fish and Wildlife Service, and the U.S. Geological Survey. Among the international agreements and federal statutes that define the roles of other governments and agencies are the following:

The Convention on Great Lakes Fisheries, between the United States and Canada, established the Great Lakes Fishery Commission in 1954 with two major responsibilities: 1) To develop coordinated programs of research in the Great Lakes and, on the basis of the findings, recommend measures which will permit the maximum sustained productivity of stocks of fish of common concern and 2) To formulate and implement a program to eradicate or minimize sea lamprey populations in the Great Lakes.

The Great Lakes Water Quality Agreement of 1972, amended in 1987 and 2012, between the United States and Canada sets out objectives, programs, powers and responsibilities to restore and maintain the chemical, biological, and physical integrity of the Great Lakes ecosystem. Programs currently being developed under authority of this agreement include Lakewide Action Management Plans (LAMPs) and Remedial Action Plans (RAPs), including surveillance and monitoring activities and the development of ecosystem health indicators for the Great Lakes.

The Great Lakes Fish and Wildlife Restoration Act of 1990 enhances the role of the U.S. Fish and Wildlife Service in the Great Lakes by establishing offices on the Great Lakes. We have two Fish and Wildlife Conservation Offices in Wisconsin (Ashland and Green Bay) “to provide assistance to the Great Lakes Fishery Commission, the States, Tribes, and other interested entities . . .” and by requiring a “comprehensive study of the status, and the assessment, management, and restoration needs, of the fishery resources of the Great Lakes Basin.”

We cultivate partnerships with the public by encouraging Department biologists and technicians to interact with the public, fishing clubs, and commercial fishing groups. Fishing clubs and individual commercial fishers have actively supported Department activities in a variety of ways. Two statutorily defined groups, the Wisconsin Conservation Congress and the Lake Superior Commercial Fishing Board, provide advice to the Department regarding Lake Superior Fisheries.

As previously discussed in the introduction, the Department is required to establish long-range fisheries management plans that: 1) provide for both sport and commercial fisheries; 2) manage for maximum public benefit; and 3) coordinate with other states and federal agencies.

The ecological realities governing bodies of water such as Lake Superior call for compromise among the lake's users: 1) Lake Superior's productive capacity is limited; in fact, it is the least productive of all the Great Lakes; 2) all of Lake Superior's fisheries components interact with one another; and 3) while diversity of community structure and function is the key to overall fishery stability, the Lake Superior ecosystem is not controllable, and variability should be expected.

Natural resource agencies can provide technical advice as to how many fish Lake Superior can produce, but biologists need to know what kind of fishery people want. The Plan provides a means for citizens to make their needs known and to participate in decision making.

For example, the forage fish (cisco, rainbow smelt, emerald shiners, sculpin, etc.) in Lake Superior can provide food for a certain number of predator fish. Historically, this forage went into lake trout and siscowet populations. Today some of that forage is being utilized by Chinook salmon, steelhead, coho salmon, and brown trout. Decisions need to be made as to what portion of the forage base should be allocated to the various species. Some of the objectives in the Plan may be mutually exclusive at higher levels, so it was important for the Department to assist the public in selecting realistic objectives that maximized public benefit yet fell within Lake Superior's biological capabilities.

PLAN DEVELOPMENT

In the 1980's, the Department recognized the need for a comprehensive management plan to address Lake Superior's diverse, multi-use fish community and developed a ten-year (1988-1998) fisheries management plan for Wisconsin waters of Lake Superior. The plan addressed relevant issues at the time, several of which continue to be relevant today. However, the fish community and its environment are dynamic and require adaptive management through updated monitoring and assessment goals and objectives that reflect public input and fisheries science.

In June 2017, Department fisheries biologists held a public meeting in Ashland to gage interest in the development of the new plan. They presented information on the objectives from the 1988-1998 Lake Superior Fisheries Management Plan and asked for input on preferences of the public moving forward with a new plan. It was decided that the best course of action for the Plan development was to establish an Advisory Panel to help develop the vision, goals, objectives, and tactics for this Plan.

Department fisheries biologists developed a list of 40 organizations and individuals and invited them to join the Advisory Panel along with offering interested stakeholders an opportunity to become part of the Advisory Panel. Additionally, information about the Advisory Panel was continuously updated on the DNR webpage for others to be involved in the process. A total of 26 individuals joined the Advisory Panel representing diverse stakeholders including sport,

commercial, and tribal fisheries, conservation groups, academia, tourism, and land and water conservation.

Six public Advisory Panel meetings were held in Ashland between September 7, 2017, and March 5, 2018. During these meetings the Advisory Panel determined the overall desired future condition for Wisconsin waters of Lake Superior, the Plan's "Vision". The panel also gave crucial input to the development of the goals, objectives, and tactics laid out in the Plan. Additionally, written comments received during the development stage were incorporated into the Plan. Agenda, presentations and information from the meetings can be found on our Lake Superior website - https://dnr.wi.gov/topic/Fishing/lakesuperior/LakeSuperiorFishManagementPlan.html

In late summer of 2019 the first draft of the Plan was sent to the Advisory Panel and public meetings were held in Ashland and Superior to present the Plan and solicit feedback and suggestions.

The Department believes the Lake Superior Fisheries Management Plan reasonably addresses the needs of all parties and benefits all fish stocks. Its framework allows the Department to implement existing effective management strategies and to direct future adaptive management strategies for Lake Superior. The Plan will be reviewed regularly throughout its term to accommodate the changing ecology of Lake Superior and needs of its users. Any revisions of the Plan will be made with public input and coordinated through the Department.

STAFFING AND PROJECTS

Most of Wisconsin's fisheries work on Lake Superior and its tributaries is recurring to maintain essential databases, monitor trends in fish populations and harvest, propagate various trout species, and monitor and enhance instream trout and salmon habitat. The base program is summarized here relative to permanent staffing, fish propagation costs (including facility maintenance, rearing, and stocking), and base field surveys for management. These programs consume most of the available funds. Additional work may only be accomplished through external grants or through partnerships.

Table 1. Permanent staff supporting the Lake Superior fisheries program. An asterisk (*) denotes individuals whose time is only partly devoted to Lake Superior fisheries work.

LOCATION	STAFF
Bayfield Work Unit	one team supervisor, one biologist, two technicians, one boat captain, one project biologist (funded through March 2021)
Superior Work Unit	one biologist, one technician

Les Voigt State Fish Hatchery	one hatchery supervisor*, three technicians*
Brule River State Fish Hatchery	two technicians*
Governor Thompson State Fish Hatchery	one hatchery supervisor*, seven technicians*
Great Lakes District Office (Milwaukee)	one district supervisor*
Central Office (Madison)	one Great Lakes Specialist/Coordinator*, two Fish Health Veterinarians*, one Fish Contaminant and Toxicology Program Coordinator*

The core program operates with permanent field biologists, technicians, hatchery personnel, supervisors, and miscellaneous central office staff described in Table 1. Permanent staff salaries are primarily funded from license revenues, whereas smaller fund amounts are allocated from salmon stamp (Great Lakes) revenues. The work of the staff listed here is complemented and supported by other Departmental programs including Law Enforcement, Office of Great Waters, Watershed Management, Legal Services, and other programs.

The Lake Superior fisheries program administers the following core work for the term of the Plan. Other projects are pursued as funds allow.

- Boat and Equipment Maintenance
    - Research Vessel (R/V) Hack Noyes.
    - Workboats, nets, electrofishing gear.
- Fish Stocking
    - Lake trout: Collect gametes and stock in WI-1 waters until populations meet restored criteria of Hansen 1996.
    - Splake: support a nearshore recreational fishery
    - Brown trout: support a nearshore recreational fishery.
    - Walleye: support a recreational fishery in Chequamegon Bay.
    - Other species: evaluate stocking feasibility.
- Fish Population Monitoring and Assessment
    - Lake Superior lake trout.
    - Commercial and sport fishes including lake whitefish, cisco, chub, siscowet, and burbot.
    - St. Louis River and Chequamegon Bay walleye, northern pike, muskellunge, lake sturgeon, yellow perch, and smallmouth bass populations.
    - Tributary and main lake brown trout, rainbow trout, brook trout, and coho salmon populations.
- Commercial and Sport Harvest Monitoring and Regulation
    - Commercial catch data collection and maintenance of associated database.
    - Commercial harvest limit review and revision.
    - On-board commercial monitoring to determine age and size structure of fish harvested.

    - Angler creel surveys in Lake Superior and tributaries.
    - Charter boat effort and harvest data collection and database maintenance.
    - Salmon and trout harvest estimates from all creel and charter sport fishing surveys.
    - Recreational fishing regulation review and revision.
- Fish Contaminant Monitoring
    - Biennial fish collection for statewide advisory review and revision.
- Fish Habitat
    - In-channel aquatic habitat monitoring and enhancement.
    - Landowner collaboration on upland land management.
- State-Owned Land Management within the Lake Superior Fishery Area.
- Reporting
    - Annual reports on all projects.
    - Technical reports, as necessary.

MANAGEMENT PLAN

Management Vision:

VISION STATEMENT: A diverse fishery and ecosystem that balances the ecological, cultural, social, and economic needs of Wisconsin's Lake Superior basin region.

Science-based management is crucial to this vision, and it focuses on maintaining professional credentials of staff, maintaining appropriate research technology, using science to fill information gaps, and incorporating scientific findings in management. This approach to management requires developing strong partnerships with other agencies and with sport and commercial fishers, communicating findings and policies to the public, and encouraging research by other partners that would help achieve management goals. This collaborative and science-based management strategy will ultimately lead to better ecosystem-based management which recognizes the complex interactions within an ecosystem, including fishers, rather than isolated issues or species populations. This approach will not be possible without an adaptive management style mindset, which will help staff manage the dynamic nature of the Lake Superior ecosystem in the face of uncertainty using predetermined processes for monitoring and assessing management actions. The Plan continually calls for this adaptive framework (monitor, evaluate, adjust) while also accounting for socioeconomic concerns.

To manage and develop a fishery and ecosystem that balances the ecological, cultural, social, and economic needs of Wisconsin's Lake Superior basin region, this Plan incorporates habitat protection, native species restoration and management, and nuisance species prevention and control. Control of sea lamprey remains one of the most important management activities that

supports today's sport and commercial fisheries. Sea lamprey control is carried out on Lake Superior by the Great Lakes Fishery Commission through its agents, the U.S. Fish and Wildlife Service and Fisheries and Oceans, Canada. In this Plan we propose to continue to work with partners to support these efforts. This Plan also addresses habitat protection and restoration for native nearshore species (e.g., walleye, smallmouth bass, muskellunge, and northern pike) and for desirable naturalized trout and salmon species. We emphasize the effects of land use practices and in-water activities on aquatic habitats. We intend to continue to work on lake trout, brook trout, and lake sturgeon population restoration and to also work with our partner agencies to investigate rehabilitation of cisco.

Sport fishing in Lake Superior and its associated tributaries has historically been an important aspect for the cultural, social, and economic needs of the area and will continue to be in the future. This Plan continues to have a focus on maintaining and improving nearshore, offshore, and tributary sport fishing opportunities. Lake Superior recreational fisheries management is built on a combination of harvest regulation (e.g., annual harvest limits [lake trout], daily bag limits, size restrictions, season restrictions) and supplemental stocking. This Plan emphasizes continuously evaluating harvest regulations and stocking strategies, improving population assessments and monitoring, and implementing activities for both sustaining and promoting these fisheries.

Over the past 25 years Wisconsin has moved toward a smaller and better-regulated commercial fishery targeting four species – lake whitefish, cisco, lake trout, and chubs. Today the lake whitefish and cisco fisheries comprise the majority of the catch and value of the Lake Superior commercial fishery in Wisconsin waters. Wisconsin commercial fishing management is built on three principles –annual harvest limits, limited entry, and individual transferable quotas. Harvest regulation is our primary day-to-day tool for protecting and enhancing commercial fish populations. In this Plan we emphasize improving the commercial fishery, improving population assessments and models, exploring alternative harvest limit systems, and addressing some of the conflicts between sport and commercial fishers including harvest allocation and physical gear conflicts.

While concentrating on science-based management, the Plan also recognizes the cultural, social, and economic importance of the Lake Superior fishery and the many viewpoints therein. The plan addresses ways in which these aspects of the fishery can be maintained or enhanced by using further economic research, better communication, and inclusion of all stakeholders in the adaptive management framework (e.g., Advisory Panel).

The Plan consists of five primary goals, each of which was developed with input from the Advisory Panel. The tactics listed will guide the Department in meeting the objectives established to reach the goals and the overall desired future conditions. These goals and their associated objectives and tactics are outlined below:

Goal 1: Protect, restore and rehabilitate diversity and connectivity of tributary, coastal, and main lake habitats to maximize productive capacity of Lake Superior's fish community.

Goal 2: Identify and implement strategies that protect, support, and enhance the diversity, sustainability, and viability of state and tribal sport, commercial, and subsistence fishing.

Goal 3: Enhance research and monitoring to better understand ecology of Lake Superior fish populations and communities.

Goal 4: Develop, evaluate, and implement strategies to maximize the resiliency of Lake Superior fisheries by controlling, managing, or mitigating existing problems and future threats.

Goal 5: Develop, evaluate, and implement strategies to maintain the social value of Lake Superior.

Management Goals

Goal 1: Protect, restore and rehabilitate diversity and connectivity of tributary, coastal, and main lake habitats to maximize productive capacity of Lake Superior's fish community.

Maintaining diverse aquatic habitats and implementing proper habitat management practices is critical for sustaining the resilient and healthy fish community desired in Lake Superior by all stakeholders. Furthermore, the connectivity among tributary, coastal, and main lake habitats is crucial for numerous fish species for various life stage development, spawning, thermal refugia, and countless other complex ecosystem processes that are important for sustaining fisheries. It is the goal of the Plan to maintain fish refuges and restricted-use areas, enhance spawning and rearing habitats, and minimize the effects of pollution and waterway alterations to provide the habitat required for sustainable fisheries in Wisconsin waters of Lake Superior.

Objective 1: Maintain existing refuges and restricted areas within the bounds of the Lake Superior Fishing Agreement that provide relief from harvest and protection of spawning and nursery grounds.

The formation of the Gull Island Refuge (GIS) in 1976 and the Devils Island Refuge (DIS) in 1981 were a main driver for the resurgence of lake trout not only in Wisconsin, but all of Lake Superior. Prohibiting harvest of lake trout near the spawning habitat allowed for lake trout to naturally reproduce and increase in abundance.

Currently there are 10 areas that have some form of restriction to commercial fishing based on the Lake Superior Fishing Agreement. These areas are likely serving as sanctuaries and should be maintained to ensure sustainability of the fisheries. Restricting high-efficiency gears in certain areas provides sanctuary for fish and helps mitigate commercial-sport fishing conflicts. Most of these restricted areas are nearshore areas that host a diversity of fishes. Some areas are near spawning tributaries important for lake sturgeon and coastal brook trout. Other areas occur in unique habitats that are important for coolwater fish communities. These selected areas should be protected from high-efficiency gears to maintain the progress made in the restoration of Lake Superior fisheries.

Examining population trends inside and outside of the refuges and restricted areas could lead to an understanding of how these areas are playing a crucial role in the protection of the main commercial species as well as other nearshore species.

Tactic 1: Develop a clearer understanding of the role refuges and restricted areas play in protecting fish populations. Key species are lake trout, lake whitefish, cisco, and walleye.

Objective 2: Identify, evaluate, restore and/or enhance spawning and nursery habitat for game and non-game species, including habitat connectivity.

Spawning and nursery habitats are widely distributed throughout the lake and tributaries and vary according to species. Lake trout and whitefish rely on reefs and rocky shoals within the lake for spawning, whereas brook trout primarily use the gravel, cobble, and sand substrates of tributaries, particularly the headwater reaches. Walleye and lake sturgeon seek the rocky substrates of the St. Louis River near the Fond du Lac Dam and will occasionally use the lower reaches of other tributaries (e.g., Kakagon River). Muskellunge and northern pike occupy the vegetative wetland areas along the lake shoreline and the St. Louis River. Non-game fishes such as minnows, sculpins, redhorse, catfish, rainbow smelt, and dozens of others persist throughout the lake and its associated tributaries and wetlands.

Spawning and nursery habitats are occupied at different times of the year among some species, although usage often overlaps. For example, young-of-year coho salmon, brown trout, rainbow trout, and brook trout are frequently observed together throughout the various habitats within tributaries.

Over the years, habitat management projects such as reef installations and wild rice plantings have been implemented in the lake, and selective wood removals have been implemented in several tributaries to enhance spawning and nursery areas. Habitat connectivity is critical to maintaining habitat availability, particularly in the tributaries and wetland complexes near their confluences with the lake.

Tactic 1: Work with partners to inventory instream, riparian and upland habitats of tributaries, evaluate environmental characteristics necessary to support game and non-game species, and use this information to inform systematic restoration that addresses key priorities.

Tactic 2: Work with partners to inventory available wetland and nearshore habitats (reefs, wild rice/marsh areas), evaluate environmental characteristics necessary to support game and non-game species, and use this information to inform systematic restoration that addresses key priorities.

Tactic 3: Provide expertise to partners to develop and implement strategies to enhance resilience of shoreline nursery habitats to fluctuations in water levels.

Tactic 4: Provide expertise to partners to maximize improvements to key fish habitats and take advantage of existing basin level initiatives (e.g., Areas of Concern, SuperFund, etc.).

Tactic 5: Encourage and collaborate with partners to create a geo-referenced system (map) of environmental attributes to systematically prioritize protection, conservation, and management actions.

Objective 3: Minimize point and non-point sources of pollution and land use change impacts to fish in tributaries, estuaries, and embayments.

The conditions and availability of habitats for all life stages of all fishes are dynamic and respond to in-lake and in-stream processes that are often influenced by land and water management practices. Many activities are regulated through State, Federal, and local units of government under the authority of the Federal Clean Water Act, particularly sections 401 (Water Quality Certification), 402 (National Pollutant Discharge Elimination System), and 404 (Dredge and Fill). Some activities are regulated under general permits and exempt landowners from actions otherwise required through individual permits. Best management practices guidance documents are available, yet often require ongoing updates relative to current research. Best management practices most applicable to Lake Superior and tributaries generally focus on soil erosion controls, as soil erosion from upland and riparian areas contributes to the overall sediment and nutrient loads to the lake and tributaries during rain and snowmelt events.

Uplands and riparian zones are managed through various State, Federal, and local programs. Although conservation easements offer land protection, they require strong partnerships to maintain in perpetuity. Partnerships are also paramount to understanding the effects of legacy contamination and atmospheric deposition, as these typically require detailed study and discussion. The Department maintains master plans for its properties, including the South Shore Lake Superior Fishery Area. The plans consist of numerous

goals and objectives for land and water management and include conservation easements. The master plans provide an important reference for this objective.

Tactic 1: Encourage Best Management Practices across the landscape to reduce pollution and sediment loads to Lake Superior (e.g., Tribal, Non-governmental organizations, Environmental Protection Agency, US Forest Service, Natural Resources Conservation Service, Wastewater Districts).

Tactic 2: Work with partners to protect key riparian areas through conservation easements.

Tactic 3: Assist in studies and projects that will result in evaluation of impacts, remediation, restoration, and removal of contaminated sediments or reduction of atmospheric deposition in watershed, tributaries, and nearshore waters.

Objective 4: Minimize impacts of dams and other waterway alterations on the movement of fish in tributaries and coastal habitats to restore connections between habitats while limiting available habitat to undesirable non-native species.

The tributaries and coastal sloughs are integral to the life histories of Lake Superior's many game and non-game fishes. Recreationally important species such as muskellunge, northern pike, walleye, brook trout, rainbow trout, brown trout, and coho salmon exhibit seasonal migrations to and from spawning areas within these waterbodies. Fish passage in and through the sloughs can be affected by berms and causeways, whereas fish passage in and through the tributaries is affected by permanent dams, ephemeral dams, and road-stream crossings. The Fond du Lac Dam on the St. Louis River is a permanent barrier that blocks upstream migration of lake sturgeon, walleye, and other fishes that use the St. Louis River. However, spawning and nursery habitats are available downstream. Fish passage in the Middle River, Bois Brule River, and Iron River is deliberately obstructed as a component of the sea lamprey control program. The Bois Brule River barrier, however, features a companion fish ladder that permits passage of desirable species such as brook trout, rainbow trout, brown trout, and coho salmon, while minimizing sea lamprey passage. These constructed barriers are actively maintained for optimal efficiency. Log jams and beaver dams are very common in the tributaries, due primarily to the forested uplands that often contain woody species preferred by beaver. The timing and magnitude of these barriers often dictate their effects on fish passage. Although various road-stream crossing inventories have been conducted over the years, a need exists to maintain the inventories and identify data gaps to minimize fish passage impediments.

Tactic 1: Utilize GLFC decision support tool, the WDNR Fish Passage at Dams Strategic Analysis, and other tools to help inform decisions on barriers (e.g., remove, maintain or modify).

Tactic 2: Assimilate existing road-stream crossing data to help guide and complete assessments where data gaps exist.

Tactic 3: Explore partnership opportunities to incorporate project designs that enhance fish passage (e.g., Department of Transportation, Federal Energy Regulatory Commission, WDNR Road Liaisons, WDNR Forestry, USDA Animal and Plant Health Inspection Service, US Forest Service, County Forestry, Land Conservation, local townships, and county road commissions).

Objective 5: Minimize impacts to fish and aquatic habitats from construction and maintenance of in-water structures, lake-bed/stream-bed modifications (e.g., dredging, filling), and filling behind bulkhead lines; and restore habitat previously degraded from these activities.

The conditions and availability of habitats for all life stages of all fishes are dynamic and respond to in-lake and in-stream processes that are often influenced by land and water management decisions. Department regulatory programs review permit applications for consistency with state water quality standards and other environmental statutes. Department fisheries personnel contribute regularly to the review process by determining consistency with Fisheries program goals, particularly along the Lake Superior shoreline and on coldwater streams classified as trout waters. Fisheries staff serve technical advisory roles by providing verbal and written communications and participating in meetings and conference calls. Some of the most common permit applications for Lake Superior and the tributaries are lakefront dock installations, road-stream crossing repairs, and stream channel modifications.

Tactic 1: Advise WDNR regulatory programs on projects that may impact fish habitat.

Goal 2: Identify and implement strategies that protect, support, and enhance the diversity, sustainability, and viability of state and tribal sport, commercial, and subsistence fishing.

Lake Superior is home to a truly diverse and unique fish community and supports several quality sport, commercial (both tribal and state-licensed), and subsistence fisheries. Therefore, it is the goal of the Plan to ensure that all native and desirable non-indigenous species comprising the offshore (coldwater), nearshore (coolwater), and tributary fisheries are fished sustainably for future generations, while also supporting vibrant fishing opportunities today. Fishery-dependent

(e.g., creel, commercial monitoring, etc.) and independent surveys (e.g., standardized gill netting, hydroacoustics, etc.), fishery models, and stakeholder input will all aid in science-based management decisions and regulations to achieve these goals.

Objective 1: Restore and maintain self-sustaining lean and siscowet lake trout populations to levels that support sport, commercial, and subsistence fisheries and maintain ecosystem function.

Lake trout abundance declined from the early 2000's to 2013 but has been gradually increasing since 2014. The recent increase in lake trout abundance is due to a reduction in sport and commercial fishing mortality and an apparent influx of younger fish. Reducing the total allowable catch (TAC) for lake trout resulted in lower sport and commercial effort and has allowed the population to begin to recover from its lowest point in over 20 years. Although abundance is increasing due to greater recruitment in recent years, spawning biomass remains lower than in the early 2000's.

Lean lake trout TAC is set with a statistical catch-at-age (SCAA) model in WI-2 and a static quota in WI-1. The quota for each management area is divided between state and tribal users based on the Lake Superior Fishing Agreement. The SCAA model is used to estimate fishery harvest, abundance, recruitment, mortality, gear selectivity, catchability, and fishery-independent assessment catch per unit effort for wild lake trout of ages 4 to 15+. To calculate a TAC recommendation for each fishing season, lake trout abundance is projected forward using average values from the most recent years for age-4 abundance, natural mortality, sea lamprey mortality, recreational fishing mortality, and commercial fishing selectivity. The TAC is based on an annual mortality of 40% on the age of maximum commercial selectivity. An annual mortality rate of 40% is likely sustainable, assuming adequate spawner biomass is also maintained (Nieland et al. 2008) and has been used as a harvest criterion in other areas of Lake Superior. The recommended TAC is the average total harvest (sport and commercial) predicted for the years being projected, based on assumed mortality rates and projected lake trout abundance.

For continued success in maintaining lake trout populations, effort should be given to the continued evaluation of the SCAA model used in WI-2, a thorough evaluation of the static quota used in WI-1, and adaptive management strategies for each area.

Tactic 1: Develop and evaluate thresholds to inform safe harvest limits within the confines of the Lake Superior Fishing Agreement.

Tactic 2: Enhance outreach and communication about how the current lake trout model functions, how harvest limits are set, and justification for management actions.

Tactic 3: Improve methods of assessment and modeling by including sensitivity analyses, additional sources of mortality (e.g., hooking mortality), and forecasting population responses to changing environmental conditions.

Objective 2: Maintain self-sustaining lake whitefish population to levels that support sport, commercial, and subsistence fisheries.

Lake whitefish are the primary target of the commercial industry in Wisconsin waters, and there is a growing sport fishery targeting them. The commercial fishery is largely regulated through allowable lake trout harvest in terms of total amount of gill net footage allowed. The observed lake trout catch in commercial gillnets is combined with the lake trout population estimate from the SCAA to determine the amount of gill net effort that can be set each year. This process has worked to increase and stabilize lake whitefish harvest since implementation in 1992 and harvest has been around one million pounds annually since the early 2000's. Throughout the 1980's and 1990's lake whitefish abundance increased considerably, however, this increase in abundance has been followed by a decrease in growth rates throughout the 2000's. Development of stock assessment models and other population information should help disentangle the mechanisms driving lake whitefish population dynamics. As recreational fisheries increasingly target lake whitefish, it will be imperative to both commercial and recreational fisheries to continually monitor, evaluate, and potentially adjust harvest limits to ensure sustainability.

Tactic 1: Initiate a stock assessment model for lake whitefish and collaborate with partners to fully develop it.
Tactic 2: Develop and evaluate thresholds to inform safe harvest limits within the confines of the Lake Superior Fishing Agreement.
Tactic 3: Evaluate lake whitefish in Chequamegon Bay.
Tactic 4: Utilize information from our Lake Superior Creel Survey to characterize the lake whitefish sport fishery.

Objective 3: Maintain self-sustaining cisco (lake herring) populations to levels that support predator populations and sport, commercial, and subsistence fisheries.

Harvest management policies for cisco in Lake Superior range from bycatch allowances to 15% of the hydroacoustic-derived spawning stock biomass estimates within jurisdictions. From 2012 to 2016, average harvest in Wisconsin waters increased 42% compared to the previous five-year average. In all jurisdictions annual harvest declined from 2012 to 2016 due in part to cisco caviar supply exceeding market demand; however, current low market demand should not be viewed as an effective tool to ensure sustainability of cisco stocks given the continued lack of strong recruitment events. In Wisconsin, the 2009 year-class comprised approximately half of the total harvest in 2014. Based on the USGS year-class strength index, density of the 2005 and 2009 year-classes were similar; however, contribution of the 2005 year-class to the 2014 roe fishery was only 1% in Wisconsin, indicating longevity of year-classes of similar magnitude may be relatively short given current levels of exploitation. As recruitment continues to be low

and sporadic, working with partners to develop better understanding of the importance of cisco to Lake Superior will be crucial.

Tactic 1: Initiate the development of a cisco stock assessment model and collaborate with partners to improve understanding of lake-wide recruitment and population dynamics through data sharing, collaborative efforts to assess population dynamics.

Tactic 2: Provide expertise and data to researchers to assess interactions between cisco and lake whitefish.

Tactic 3: Provide data and sampling assistance to partners to assess lake trout consumptive demand for cisco relative to other prey species.

Objective 4: Maintain and restore self-sustaining populations of native species that support fisheries while recognizing their roles within diverse fish communities.

Lake Superior hosts a diverse native fish community that includes popular recreational fish species, many of which are managed independent of how management affects the entire native fish community. Native fishes face ongoing human-induced challenges such as modified habitat, altered water quality conditions, non-indigenous species invasions, and overfishing. Through time, these stressors have threatened the natural reproduction and recruitment necessary to sustain sport fisheries. Restoration and maintenance of native populations within the framework of known food web dynamics will help provide future sport fishing opportunities, promote fish community diversity, and contribute toward ecosystem stability in Lake Superior.

Objective 4a: Muskellunge and northern pike (Esocids)

Lake Superior Esocids generally inhabit embayments, estuaries, and wetlands where they serve important recreational and ecological components of the fishery. In Wisconsin waters of Lake Superior, muskellunge are most prevalent in the St. Louis River Estuary where they are a management focal species for the states of Wisconsin and Minnesota. The existing population developed, in part, through a bi-state stocking program from 1983 through 2005. Wisconsin DNR stocked Chippewa River (Wisconsin strain) from 1983 to 2004, and Minnesota DNR stocked Shoepack and Leech Lake (Minnesota strains) from 1985 to 2005. Recent population assessments have documented relatively strong natural reproduction and some hybridization between the two previously stocked strains. The St. Louis River muskellunge population is currently managed as a trophy fishery. Recent acoustic tagging studies have shown muskellunge frequently migrate between the St. Louis River and Lake Superior, particularly during the early summer months; Leech Lake strain exhibited more frequent migration than Chippewa River strain. Any future stocking by the Department would utilize Great Lake Spotted strain muskellunge, rather than Chippewa River strain due to statewide policy changes aimed to

restore native strains. However, hatchery capacity of Great Lake Spotted strain muskellunge is limited and if stocking is pursued, hatchery production would need to be increased. Additionally, the Green Bay Great Lakes Spotted Musky Management Plan 2012 can serve as guidance for management decisions in the St. Louis River. Muskellunge fishing regulations vary between the St. Louis River and Lake Superior, with seasonal consistency between the states of Wisconsin and Minnesota, but different minimum lengths. For instance, the minimum length for the St. Louis River is 50 inches, whereas that for Lake Superior is 40 inches (consistent with Wisconsin's inland regulation).

Northern pike exist in both the St. Louis River Estuary and Chequamegon Bay, with low-density populations along the south shore such as the Bark Bay Sloughs. The St. Louis River population was initially jump-started, in part, through Minnesota DNR's stocking program from 1989 through 1993. Although quantitative population estimates were not computed for northern pike, Lake Superior fisheries managers in 1995 implemented more conservative harvest regulations for the species following an early 1990's statewide initiative to improve population size structure throughout the state.

Northern pike and muskellunge management would benefit from enhanced data collection and sharing to evaluate population dynamics (i.e., recruitment, growth, and mortality), harvest regulations, movement patterns, and potential supplemental stocking opportunities.

Tactic 1: Improve understanding of status and trends of northern pike and muskellunge to inform development of regulations that maintain excellent fisheries.

Objective 4b: Walleye and yellow perch (Percids)

Lake Superior Percids include walleye and yellow perch, which persist along the south shore bays, estuaries, and wetlands, and serve important recreational and ecological roles within the fish community. For the purposes of this Plan, the St. Louis River and Chequamegon Bay are the most productive and relevant areas for both species. The St. Louis River supports the largest self-sustaining walleye fishery in the Lake Superior basin. The current walleye population was established in part through agency stocking from the late-1980's through mid-2000's and from water quality improvements through the Clean Water Act. Since the St. Louis walleye fishery is self-sustaining through natural recruitment, harvest regulations are the primary management tool for ensuring sustainability of this stock, and large-scale population assessments are regularly conducted (Olson et al. 2016). The walleye fishery provides both catch-and-release and harvest opportunities, including a 5,000-pound harvest quota tribal commercial fishery in a small zone west of Bark Point. Olson et al. 2016 suggested the St. Louis River population is currently being exploited near maximum sustainable yield, primarily through sport harvest. Additional walleye monitoring and assessments are needed relative to population dynamics, movement, and exploitation.

In Chequamegon Bay, walleye populations were historically maintained by production from the Kakagon River and sloughs. Since 1980, however, the population has been supplemented and sustained with fingerling and fry stocking by the Department and the Bad River Natural Resources Department. Stocking was initiated by the Department from the Ashland shoreline to create a localized sport fishery and to decrease abundance of suspected stunted yellow perch via predation mortality, thus improving yellow perch size structure. Despite a presumed dependence on stocking, walleye are still the main predator species in Chequamegon Bay, accounting for almost 75% of total prey consumption (Devine et al. 2005). Therefore, estimates of relative contribution of stocking vs. natural recruitment to the population would be informative for future management of the entire Chequamegon Bay fish community.

Yellow perch populations in Wisconsin waters of Lake Superior are much less understood than walleye, as quantitative data collection has been limited in recent decades. Netting, electrofishing, and creel surveys are not necessarily directed toward yellow perch and catches in these surveys are more incidental. The species continues to be targeted by some anglers throughout the St. Louis River and Chequamegon Bay. In the St. Louis River, yellow perch recreational catch rates decreased steadily from 1989 through 2015, although the percentages of angling parties remained constant (Varian et. al. 2017). Similarly, in Chequamegon Bay recreational ice fishing, total harvest has remained relatively stable (average of approximately 10,000/year), but catch rates have declined throughout the past 25 years (Zunker 2019). However, this has been coupled with an increase in yellow perch growth over the same period. As with walleye, targeted monitoring and assessments are needed for yellow perch to better understand population dynamics and contribution to the recreational fishery.

Tactic 1: Evaluate the potential for self-sustaining populations of walleye and yellow perch in Chequamegon Bay recognizing that walleye are key predators on yellow perch.

Tactic 2: Improve understanding of status and trends of walleye and yellow perch to inform development of regulations that maintain excellent fisheries.

Tactic 3: Improve understanding of stock structure of walleye populations in Wisconsin tributaries of Lake Superior and assess contributions from locations beyond the St. Louis River and Chequamegon Bay.

Objective 4c: Smallmouth bass, largemouth bass, and panfish (Centrarchids)

Black bass and panfish populations in Lake Superior are generally localized to embayment areas, streams, and other nearshore habitats suitable for their physiological and ecological requirements. As with other sport fishes noted in this Plan, Centrarchids are most common in the St. Louis River and Chequamegon Bay, with some species being abundant and integral components of fish community dynamics and recreational sport fisheries. The Chequamegon Bay smallmouth bass population was once subjected to overfishing in the 1970's and 1980's. However, management shifted in the early 1990's

from relatively liberal to very conservative harvest regulations. Since then, average size of angler-caught smallmouth bass has increased, and Chequamegon Bay commonly produces trophy-size smallmouth bass. A formal evaluation of smallmouth bass population dynamics and effects of the conservative harvest regulations is warranted to ensure protection of this valuable recreational fishery.

Centrarchid populations have experienced recent statewide increases in abundance due to conservative harvest regulations, changing angler behavior, and a changing climate (Hansen et al. 2015). Higher abundances of smallmouth bass in Lake Superior may affect fish community dynamics by influencing growth or recruitment of other native coolwater species such as walleye and yellow perch via interspecific competition or direct predation. Further, relatively little is currently known about other Lake Superior centrarchids (e.g., largemouth bass, rock bass, pumpkinseed, etc.). In the face of a changing climate and warming lakes, population status and trends of these species should also be investigated to evaluate potential effects on food web dynamics and corresponding recreational fisheries.

Tactic 1: Evaluate effects of existing regulations on smallmouth bass populations and potential for smallmouth bass to impact recruitment of other species.

Tactic 2: Improve understanding of status and trends of Centrarchids to inform development of regulations that maintain excellent fisheries.

Objective 4d: Lake sturgeon

Lake sturgeon is an ongoing management focal species for state, federal, and tribal agencies, all of which have contributed to monitoring, stocking, and habitat restoration. The species declined throughout Lake Superior and was extirpated from the St. Louis River following habitat loss and overfishing from the mid-1800's through mid-1900's. Some spawning habitats were lost, modified, or fragmented by the construction of the Fond du Lac Dam in 1924. Lake sturgeon is long-lived (>40 years) and slow-growing (<1 inch per year as adults), and therefore requires long-term management commitments.

Lake sturgeon were stocked in the St. Louis River from 1983 through 2000. Wolf River and Upper Fox River (Lake Winnebago) strains were stocked from 1983 through 1994, then were discontinued following agency concerns over the potential effects of stocking a non-Lake Superior strain in Lake Superior. Stocking resumed in 1998 and continued through 2000 using Sturgeon River (Lake Superior) strain from upper Michigan. Stocking was discontinued after 2000 to evaluate natural reproduction and to minimize the risk of introducing and transmitting Viral Hemorrhagic Septicemia (VHS) virus. Today's population is composed of adults initially stocked as fry and fingerlings in the original stocking program, as well as by other Lake Superior strains (Estep et. al. in review). Lake sturgeon migrate seasonally along Lake Superior's south shore, particularly between the St. Louis River and Chequamegon Bay, and are known to migrate outside of Wisconsin's waters of Lake Superior (Piszczek et. al. 2016). Naturally reproduced young-of-year lake sturgeon have been captured in the St. Louis River,

however their recruitment to ages two through five has been low (Minnesota DNR unpublished survey data). Studies and monitoring are necessary to determine potential recruitment bottlenecks and the efficacy of the initial stocking program. Additional stocking of Sturgeon River or other Lake Superior strains is expected, as interest in native stocks continues to increase.

Habitat use varies by life stage and season. Adults use the rock substrates below the Fond du Lac Dam as a primary spawning area, and larval fish are often found near the spawning area (Fond du Lac Band of Lake Superior Chippewa unpublished survey data). Juveniles and adults inhabit the variable depths of the middle and lower river, as well as the sand flats of the bays and south shore of the lake. Adults are common in Chequamegon Bay, where they are often targeted for harvest. The rock substrate in the Fond du Lac Dam's tailwaters was modified by Minnesota DNR and The Nature Conservancy to increase spawning habitat availability over a wider range of flows. This consisted of large boulder arrays that have been stable since their installation in 2009.

Lake sturgeon is currently managed with two regulations in Wisconsin waters: (1) Catch-and-release only in the St. Louis River system; and (2) One fish over 50 inches per season in Lake Superior (requires a tag and registration). The 50-inch minimum length will increase to 60 inches for the 2020 fishing season. Wisconsin is the only Lake Superior state that has a harvest season for lake sturgeon.

Tactic 1: Develop safe harvest limits for lake sturgeon to reduce the potential for negative affects to populations.

Tactic 2: Collaborate with other agencies to evaluate lake sturgeon habitat use and identify key habitats across life stages.

Tactic 3: Work with partners to evaluate opportunities to enhance sturgeon populations.

Objective 5: Maintain populations of potamodromous salmonids that support fisheries.

Potamodromous salmonids in Lake Superior include brook trout ("coaster" or "coastal"), brown trout, Chinook salmon, coho salmon, pink salmon, and rainbow trout (steelhead). Wisconsin introduced rainbow trout and brown trout during the 1890's and early 1900's to offset the losses of native fishes such as lake trout and brook trout from logging-era land and stream channel changes and to provide additional recreational fishing opportunities. Minnesota and Michigan introduced Chinook, coho, and pink salmon in the 1960's to expand fishing opportunities in their respective jurisdictions; many individuals from those introductions, however, strayed into Wisconsin waters of Lake Superior.

Most introduced salmonids, regardless of where they were introduced, adapted well to the lake and its coldwater tributaries in Wisconsin. Although stocking continued through the years, it diminished as populations began sustaining themselves through natural reproduction. The introduced salmonids are resilient to the dynamic conditions of Lake

Superior and its tributaries, such as the record high and record low lake levels in 1987 and 2007, respectively, and nearly complete ice cover in 1994 and 2013. Moderate to high annual salmonid production is common in the tributaries, particularly the Bois Brule River, Flag River, Cranberry River, Bark River, Pikes Creek, Onion River, Sioux River, Whittlesey Creek, and Fish Creek. The tributaries are primarily sourced by deep coldwater aquifers and have extensive channel networks that range from first to fourth Strahler order. Tributary channels are generally unstable due to excessive and rapid runoff during and after rain and snowmelt events. In addition, channel structure is often influenced and modified by beaver dams. Most tributaries drain remote, mixed-cover lands (e.g., forest, pasture, etc.).

The "coaster" or "coastal" brook trout is the potamodromous form of brook trout that persists in low densities along the south shore and tributaries, including in and near the Bark River, Bois Brule River, Cranberry River, Flag River, North Fish Creek, Sioux River, and Whittlesey Creek. The resident form, however, primarily occupies the headwater reaches of nearly all south shore coldwater tributaries. The headwaters often have less strenuous hydraulic and hydrologic conditions compared to the middle and lower segments and offer less interspecific competition with naturalized game fish species. Past coaster brook trout management sought to increase tributary brook trout abundance toward density-dependent out-migration that would reconnect the stream populations with their Lake Superior coastal habitats (Newman et. al. 2003).

Tactic 1: Continue stocking program with species that provides the best return to sport anglers and maintains sport fishing opportunities for desirable naturalized salmonids in the main lake and tributaries.

Tactic 2: Pursue habitat restoration projects that enhance natural reproduction and increase fisheries productivity.

Tactic 3: Work with partners to identify high priority brook trout populations and habitats and avoid stocking other salmonids of common concern in those areas.

Tactic 4: Revisit the Wisconsin Lake Superior Basin Brook Trout Plan (Wisconsin DNR and U.S. Fish and Wildlife Service 2005) and the Brook Trout Rehabilitation Plan for Lake Superior (Newman et. al. 2003) and work with partners to identify and implement relevant aspects of these plans.

Tactic 5: Maintain consistency with other state management plans, including the beaver management plan, forest management plans, property management plans, and trout management plan.

Goal 3: Enhance research and monitoring to better understand ecology of Lake Superior fish populations and communities.

Science-based management of Lake Superior fisheries is a priority of the Department, as guided by Administrative Code Section NR 1.01. To effectively implement evidence-based management

decisions, research and standardized monitoring protocols are necessary for identifying key mechanisms which drive trends in fisheries through time and space. Numerous research needs and questions are always evolving from new technologies and new results of completed studies. However, the time, funding, and labor resources required for such projects are limited, encouraging the need to work with partners to share data and collaborate with parties with similar research interests. In accordance with lake-wide management objectives, enhanced research and monitoring will ultimately help protect and support the sustainability of all fisheries resources in Lake Superior in an ecosystem-based management context.

Objective 1: Develop a better understanding of factors driving population dynamics of potamodromous salmonids.

Potamodromous salmonids are unique among Lake Superior's aquatic biota in that they inhabit the lake and the tributaries throughout their lives. The environments exhibit diverse and dynamic conditions and pressures that influence the abundances, size structures, reproductive capacities, feeding behaviors, and other attributes of their populations and among the individuals.

Salmonid populations are governed by abiotic factors during each life history stage, from egg to fry to juvenile to adult. It is within the first three stages (i.e., egg, fry, and juvenile) that physical structure of the stream channels plays a significant role in fish production. In general, physically and hydraulically stable stream channels facilitate consistent egg maturation, hatching success, and juvenile refuge. However, few south shore tributaries are considered stable, as logging-era land use changes and contemporary watershed practices have and continue to influence watershed hydrology and consequently in-channel hydraulics and macrohabitats (e.g., pools, riffles, runs, etc.). As these fluctuate, salmonid populations fluctuate. During out-migration, salmonid smolts rely heavily on in-channel water volumes and flow rates to safely navigate to Lake Superior. On arrival in the lake, smolts encounter new physical factors as well as dozens of biological and ecological factors that individually and/or together affect the numbers and conditions of the fish as they live in the lake. As adults mature and return to the tributaries, they are again, albeit in a different life stage, subject to the conditions that affected their livelihoods when they were young.

From sedimentation and erosion in the tributaries to temporal shifts in Lake Superior water levels and ice coverage to interspecific competition with and without these influences, the environmental, biological, and ecological conditions as well as sport and commercial fishing pressures require significant data collection and analyses to aid proper management.

Tactic 1: Work with partners to develop linkages across salmonid life stages in streams (e.g., stock-recruitment dynamics, critical spawning areas)

Tactic 2: Provide expertise and data to researchers to determine drivers of variability in key life history stages/traits across habitats.

Tactic 3: Apply knowledge generated to enhance management strategies to improve fisheries productivity.

Objective 2: Quantify coolwater fish population characteristics (key species to investigate include walleye, smallmouth bass, lake sturgeon, northern pike, yellow perch, muskellunge, white perch).

The Lake Superior coolwater (nearshore) fishery has received little attention in relation to the coldwater fishery of the main lake, primarily due to lack of time and labor resources of field staff and alignments with lake-wide management objectives. Additionally, the coolwater fishery has been more resilient to lake-wide stressors (e.g., no or little commercial fishing, less predation by sea lamprey, etc.) and has required less management intervention. In short, little is known about status and trends of much of the coolwater fishery (e.g., Chequamegon Bay), even though the fishery is both recreationally and economically significant to the Wisconsin's south shore. Therefore, it is important that we gather existing data from the coolwater fishery to illuminate past population characteristics, develop standardized sampling strategies to monitor potential changes in the future, summarize findings for use in management directions (e.g., public outreach, harvest regulation, etc.), and employ adequate staff to carry out management objectives for all Wisconsin waters of Lake Superior.

Tactic 1: Develop enhanced sampling protocol of coolwater species to assess population size, size and age structure, and recruitment dynamics.

Tactic 2: Provide expertise and data to researchers to develop a better understanding of variability in key life history stages/traits across habitats.

Tactic 3. Apply knowledge generated to enhance management strategies to improve fisheries productivity.

Objective 3: Pursue research efforts to elucidate food web interactions in tributaries, wetlands, and nearshore embayments.

While it is crucial to monitor population dynamics of fisheries for appropriate management, oftentimes this information is not enough to explain the mechanisms driving trends observed in a population. A more comprehensive knowledge of these ecological processes may provide insight for explanations of historical trends, prediction of potential stressors to the fishery, and ultimately, better management strategies. Food web dynamics and trophic interactions (e.g., predation, competition, cannibalism, etc.) often play a large role in ecosystem dynamics and structuring fish communities, especially in large lake systems. Food web interactions can vary tremendously in space (e.g., among habitats or depths), through time (e.g., seasonally), and across life stages, and may be useful for management when accounting for these differences. Research

focused on these biotic interactions would be valuable for transitioning to more holistic, ecosystem-based management approaches for Lake Superior (Hartig et al. 1998).

Tactic 1: Provide expertise and data to researchers to assess predator-prey interactions of key species to determine "who eats who"?

Tactic 2: Provide expertise and data to researchers to assess species interactions of key species to determine "who competes with who"?

Tactic 3: Work with partners to determine if and how key food web interactions differ across habitats and environment conditions.

Tactic 4: Work with partners to determine how food web interactions of predators and prey differ across multiple life stages.

Tactic 5: Apply knowledge generated to develop multi-species management strategies.

Objective 4: Evaluate stocking as a tool to enhance sport fish populations

Throughout the history of Great Lakes management, managers have used stocking to balance the desires of constituent anglers with preservation of native communities and enhancement of Great Lakes sport fishing opportunities. However, in maintaining this balance, considerations of the feasibility, efficacy, and sustainability of stocking practices must be considered, including stocking efficiency, likelihood of success, and potential risks to other fisheries. In Lake Superior, these risks may include competition for space or food between planted and native or naturalized fishes or introgression with native and naturalized populations or stocks, which may reduce reproductive potential of established sport fish populations. Careful monitoring, re-evaluating, and adjusting of stocking practices are necessary to avoid these risks and maximize stocking success and economic efficiency.

Department stocking in Wisconsin waters of Lake Superior has created new and popular sport fisheries, sustained fisheries with low natural reproduction, and even helped rehabilitate native populations. However, economical and biological constraints warrant constant evaluation of stocking strategies, and stocking may not always be the answer to all management issues. Modified stocking strategies for brown trout in 2009 have resulted in increased survival and a world-class fishery, but proper stocking evaluation and economic analyses are necessary. Splake have also become a popular sport fishery, but low average return rates and concerns of introgression with lake trout and brook trout justify assessment of this stocking practice. Walleye stocking in Chequamegon Bay has helped sustain a once-declining fishery, but little is known about the stocking efficiency or contribution of natural reproduction to this population. Brook trout stocking could be increased by collaborating with Red Cliff. Lastly, stocking was one of the critical steps in rehabilitating lake trout populations in Lake Superior, but stocking strategies in WI-1 should be constantly evaluated under the criteria set forth in the Lake Trout Restoration Plan for Lake Superior (Great Lake Fishery Commission 1996). In addition, new stocking

strategies, locations, and strains will be continuously investigated as necessary to maintain quality fisheries within the productive capacity of Lake Superior.

Tactic 1: Develop an adaptive stocking strategy to evaluate performance of stocking efforts for brook trout and splake.
Tactic 2: Evaluate the walleye stocking program in Chequamegon Bay.
Tactic 3: Evaluate lake trout population demographics to determine if the population meets criteria to cease stocking outlined in the Lake Trout Restoration Plan for Lake Superior (Great Lake Fishery Commission, 1996).
Tactic 4: Develop stocking strategies to minimize risks of introgression and other negative genetic effects to native and naturalized populations of potamodromous salmonids.
Tactic 5: Evaluate current stocking strategies to maximize stocking efficiency, ensure distribution of stocked fish to all Wisconsin waters of Lake Superior, minimize risks to naturalized and native populations, and produce consistent harvest opportunities.
Tactic 6: Explore alternative strains of stocked fish to enhance survival and increase fish available for harvest by sport fishers.

Goal 4: Develop, evaluate, and implement strategies to maximize the resiliency of Lake Superior fisheries by controlling, managing, or mitigating existing problems and future threats.

Although sustaining and improving fish populations are possible by a variety of techniques, ultimately an abundant, diverse, and stable fish community depends on the resiliency of the fisheries to existing and future threats.

Objective 1: Develop, evaluate, and implement strategies to eliminate, control, and manage invasive species and certain nuisance species.

Lake Superior currently contains many invasive species and new invasions and range expansion will inevitably continue. Most are non-indigenous species that were introduced as the unintended result of human activities. Some of these non-indigenous species, such as sea lamprey, are highly invasive and have had large undesirable impacts on the ecosystem. Prevention of further invasions is the best protection for the lake ecosystem. Although invasive species can sometimes be managed and controlled (e.g., sea lamprey have been reduced by the Great Lakes Fishery Commission's control program), most often effective control is not possible once invasive species are established. Even some native species, such as cormorants, have reached historical high levels and are affecting the Lake Superior ecosystem. For such native species, control and management in collaboration with partner agencies are needed to protect the Lake Superior ecosystem.

The Department allocates effort towards regulating one of the top vectors of non-indigenous species transport, ballast water. The Bureau of Water Quality leads Department work in the regulation of ballast discharge and has developed a general WPDES Ballast Water Discharge Permit (WDNR 2015b). The ability of the Lake Superior Fisheries Program to influence some of the issues is limited, but we can provide some leadership in detecting new invasive species and in planning and guiding appropriate Department responses to new arrivals.

Invasive species in the Great Lakes can spread into inland waters and cause deleterious effects on inland ecosystems and sport fish populations. Recreational boats are an important vector for invasive species transport. The Department has adopted rules prohibiting the transport of invasive species attached to or in boats and rules that require boaters to drain all water from boats, trailers, and containers before transporting a boat from one body of water to another.

Tactic 1: Assist partners to monitor populations, investigate impacts to fisheries, and develop management plans for invasive and nuisance species that are currently present in Lake Superior and causing ecological impacts.

Tactic 2: Work with partners to minimize introduction of new invasive species into Lake Superior.

Tactic 3: Work with partners to minimize introduction of invasive species from the Great Lakes to inland waters.

Tactic 4: Encourage partners to implement an early detection program and regularly report status and trends of new and existing invasive and nuisance species.

Tactic 5: Minimize ecosystem effects of new and existing invasive and nuisance species by developing mitigation strategies to reduce the numbers, distributions, and role of invasive and nuisance species in the Lake Superior food web (e.g., development of harvest strategies to reduce populations of invasive and nuisance species).

Objective 2: Develop, evaluate, and implement strategies to improve resilience of Lake Superior fisheries to climate change, including extreme weather events.

Climate change has become an increasing reality when it comes to managing fisheries and developing long-term action plans, particularly regarding salmonids (e.g., Mitro et al. 2011; Wisconsin Inland Trout Management Plan). In Wisconsin, climate change is projected to increase average daily air temperatures, total annual rainfall, and the frequency of heavy precipitation events (Kucharik et al. 2010), and Lake Superior is not immune to these changes. In fact, Lake Superior water temperatures are warming much faster than regional atmospheric temperatures due to a positive ice-albedo feedback (Austin and Colman 2007), and water levels are projected to decrease because of higher evaporation rates (Angel and Kunkel 2010). These environmental changes have begun to

affect the entire Lake Superior ecosystem from algae to fish within the tributaries and main basin. Specifically, warming may potentially alter trophic interactions, population dynamics, and species distributions in the fish community, just to name a few. It is important the Department works with partners to identify and mitigate these potential changes in the Lake Superior fish community while also using adaptive management strategies to conserve and maintain excellent recreational and commercial fishing opportunities for all users.

Tactic 1: Work with partners to evaluate impacts of flooding and erosion events on nearshore environmental conditions (e.g., temperature, water clarity and quality) and fish populations.

Tactic 2: Work with partners to identify and mitigate expected environmental changes resulting from climate change (e.g. increased Lake Superior water temperature) and to monitor actual impacts and forecast potential impacts to fish populations, as well as increases in invasive species, nuisance species and toxic algal blooms.

Tactic 3: Work with internal and external partners on infrastructure development projects to incorporate fisheries management goals.

Objective 3: Develop partnerships to ensure a proactive approach to identify, detect, and communicate risks related to contaminants in Lake Superior fish (e.g. mercury) emerging Chemicals of Mutual Concern (CMC) and Contaminants of Emerging Concern (CEC) identified through the Great Lakes Water Quality Agreement.

The overall water quality of Lake Superior remains at a high standard. The lake is characterized as oligotrophic and has few water quality issues when compared to some of the lower Great Lakes or other large lakes in more populated areas. There are, however, some areas of concern on the lake, such as low levels of some toxic contaminants in fish and impaired water quality of localized nearshore areas. Also, because of the oligotrophic nature of the lake it is probable that small changes in the nutrient input to the lake could result in dramatic changes in the lakes water quality and/or ecology. The fragile nature of this unique and tremendous natural resource dictates the prudent course of a monitoring strategy to detect subtle changes in the lake environment before problems or irreversible impacts occur.

Tactic 1: Work with Office of Great Waters and other partners to assess progress toward environmental goals outlined in Great Lakes Water Quality Agreement.

Tactic 2: Work with partners to identify sources of CMC in the environment and elucidate movement of CMC through food webs to fish populations.

Tactic 3: Work with partners to standardize and improve the effectiveness of communication and contaminant levels in fish (i.e. legacy contaminants such as mercury, as well as other CMCs) and to convey understandable information about safe consumption levels of Lake Superior fish to diverse audiences.

Tactic 4: Work with partners to increase research and understanding of the effects of CECs to the Lake Superior Ecosystem.

Goal 5: Develop, evaluate, and implement strategies to maintain the social value of Lake Superior.

The Department has the responsibility to manage the Lake Superior sport and commercial fisheries to provide opportunity for all stakeholders. Lake Superior currently has excellent and diverse recreational fishing opportunities and a vibrant commercial fishery which are also important components of the regional culture and economy and is tied to the tourism allure of the region. The diverse sport fishery is dominated by lake trout, but also includes brown and rainbow trout, coho and Chinook salmon, walleye, smallmouth bass, northern pike, lake sturgeon, lake whitefish, yellow perch, and other species. It also includes fishing opportunities in tributaries, from shore and piers, nearshore and on the open lake. Commercial fishing provides fish for many Wisconsin residents who do not fish yet still enjoy eating Wisconsin fish. This goal expresses our desire for continuing these varied sport and commercial fishing opportunities in Lake Superior and acknowledges the limitations of the fisheries due to the limited productive capacity of the ecosystem.

Objective 1: Develop, evaluate, and implement strategies to effectively communicate to internal and external partners.

Good communication is essential for effective fisheries management. Like all Wisconsin fisheries, Lake Superior fisheries are managed for the benefit of the public. For this system to work well, 1) the public should be engaged and informed about fisheries management issues and the capacity and limitations of Lake Superior, 2) fisheries managers should be informed about public desires and experiences, and 3) elected officials should be informed about our management program. In addition, Lake Superior fish resources are shared with three other jurisdictions, so communication with those states, providences, tribes and the Federal government is crucial. Lake Superior is a complex, changing ecosystem that is threatened by many impacts ranging from habitat alteration to invasive species and more. To meet these challenges, we will need the most current knowledge of the lake's ecosystem as well as the most thought-out, science-based, adaptive management techniques. Therefore, it is essential for Department biologists to communicate with other professionals to advance the knowledge and state of the science of Lake Superior.

Tactic 1: Continually improve methods to communicate information to stakeholders and maintain full and open exchange of information and ideas with public.
Tactic 2: Engage stakeholders to determine their fishery preferences, desires, perceptions, and experiences.
Tactic 3: Actively engage stakeholders throughout the research process, including project development, to convey implications of research findings to management and policy development.
Tactic 4: Communicate survey results and management project results with the public and scientific community.
Tactic 5: Coordinate with stakeholders to develop informational brochure that highlights opportunities to take advantage of the diverse resources Lake Superior offers.
Tactic 6: Coordinate with Lakewide Action Management Plan (LAMP) partners on items that require cooperation to enhance and manage fisheries.

Objective 2: Enhance tributary, shore, and nearshore fishing opportunities.

The Lake Superior sport fishery is presently growing, providing a needed economic boost to its coastal communities. Providing access to tributaries and shore fishing is a key to realizing the lake's sport fishing potential. The Department will seek to actively participate in land acquisitions, shoreline development permits and planning (e.g., fishing piers, boat ramps, etc.), nearshore fish habitat construction, and other opportunities as presented to help enhance shoreline and tributary fishing opportunities. In addition, anglers are generally a very responsible cross-section of society and care deeply about protecting and sharing their natural resources. However, over the years certain unethical behaviors have persisted amongst some anglers including using illegal fishing methods, trespassing, littering, and wasting fish. This unethical behavior causes non-anglers to reflect poorly on anglers as a whole and degrades experiences for law-abiding, ethical anglers. The Department should take actions necessary and pursue efforts to discourage these unethical behaviors.

Tactic 1: Evaluate alternatives to improve both quality and quantity of access to shore, nearshore, and tributary fishing opportunities.
Tactic 2: Discourage fish waste and unethical fishing practices.

Objective 3: Develop, evaluate, and incorporate economic metrics into assessment of management alternatives.

The fisheries of Wisconsin's Lake Superior waters and its tributaries provide a variety of recreational and commercial opportunities. Each has different economic impacts on the

coastal region in Wisconsin. The goal of the Plan is to use economic guidelines in developing management opportunities for the use of the limited aquatic resources. There are major groupings of sport anglers, including stream, lake, ice, and charter. In addition, commercial groups include tribal and state licensed fishers. Each of these groups provides varying values to local economies; some complement each other while others compete. The present and potential value that each group contributes to local and regional economies should be analyzed. This will provide public, local, and state authorities direction for maintaining and expanding opportunities for the optimum use and enjoyment of Wisconsin's aquatic resources by all groups. Information on consumer needs and desires, both sport and commercial, will provide coastal businesses with goals and direction in maintaining and/or expanding their investments.

Tactic 1: Coordinate with stakeholders to incorporate economic metrics to evaluate alternative management strategies.

Tactic 2: Work with partners to better understand the economic value of intact habitats to provide incentive for protection.

Objective 4: Identify strategies to coordinate with stakeholders to promote Lake Superior fisheries.

The wide variety of Wisconsin's Lake Superior fisheries supports a diverse collection of stakeholder groups. Thus, it is a goal of the Plan to communicate and keep all stakeholders up-to-date with current knowledge of fishing activities (e.g., regular fishing reports, etc.) on a variety of platforms (e.g., online, verbal, etc.). In addition, we should strive to make sure the Lake Superior recreational angling community is represented during development of mobile apps, tools, or webpages to provide useful tools for Lake Superior fishing and opportunities for the Department to reach out to recreational anglers and promote fishing. Inherently, the diverse stakeholder groups among Lake Superior fisheries oftentimes represent differing views for the role and direction of fisheries management efforts. Implementing strategies to educate the public and mitigate conflict regarding contentious issues among stakeholder groups will be an important aspect of maintaining and improving good communication with stakeholders (e.g., FAQ documents, Advisory Panel, etc.). Likewise, participating in community events and other structured events to educate the public and seek feedback on complex fishery management issues (e.g., Lake Superior Fishing Agreement, Lake Trout TAC, etc.) should help with promotion of the valuable Lake Superior fishery resources.

Tactic 1: Develop reporting protocol to communicate recent observations of fishing activities to stakeholders.

Tactic 2: Engage diverse stakeholder groups on strategies to address contentious issues (e.g., sport-commercial, tribal-state), and develop information document clarifying Frequently Asked Questions (FAQs).

Tactic 3: Continue to participate in community events to educate and communicate to the public key information about the Lake Superior Fisheries.

REFERENCES

Angel, J. R., and K. E. Kunkel. 2010. The response of Great Lakes water levels to future climate scenarios with an emphasis on Lake Michigan-Huron. Journal of Great Lakes Research 36:51-58.

Austin, J. A., and S. M. Colman. 2007. Lake Superior summer water temperatures are increasing more rapidly than regional air temperatures: A positive ice-albedo feedback. Geophysical Research Letters 34.

Devine, J. A., S. T. Schram, and M. J. Hansen. 2005. A food web analysis of the fishery in Chequamegon Bay, Lake Superior. Wisconsin Department of Natural Resources, Bureau of Fisheries Management, Report No. 150.

Downs, W. 1976. Fish of Lake Superior. University of Wisconsin Sea Grant WIS-SG76-124.

Estep, K., J. VanDeHey, J. Raabe, P. Schmalz, D. Wilfond, P. Piszczek, and B. Borkholder. 2019. In review. Genetic Origins and Diversity of Lake Sturgeon in the St. Louis River. Journal of Great Lakes Research.

GLFC (Great Lakes Fishery Commission, Editor). 2007. A joint strategic plan for management of Great Lakes fisheries (adopted in 1997 and supersedes 1981 original). Great Lakes Fish. Comm. Misc. Publ. 2007-01.

Hansen, J. F., G. G. Sass, J. W. Gaeta, G. A. Hansen, D. A. Isermann, J. Lyons, and M. J. VanderZanden. 2015. Largemouth Bass management in Wisconsin: intraspecific and interspecific implications of abundance increases. Pages 193-206 in American Fisheries Society Symposium 82.

Hansen, M.J. [ED.]. 1996. A lake trout restoration plan for Lake Superior. Great Lakes Fish. Comm. 34 p.

Hartig, J. H., M. A. Zarull, N. L. Law. 1998. An ecosystem approach to Great Lakes management: practical steps. Journal of Great Lakes Research 24(3):739-750.

Horns, W.H., C.R. Bronte, T.R. Busiahn, M.P. Ebener, R.L. Eshenroder, T. Gorenflo, N. Kmiecik, W. Mattes, J.W. Peck, M. Petzold, D.R. Schreiner. 2003. Fish-community objectives for Lake Superior. Great Lakes Fish. Comm. Spec. Pub. 03-01. 78 p.

Kucharik, C. J., S. P. Serbin, S. Vavrus, E. J. Hopkins, and M. M. Motew. 2010. Patterns of climate change across Wisconsin from 1950 to 2006. Physical Geography 31: 1−28.

Mitro, M., J. Lyons, and S. Sharma. 2011. Coldwater Fish and Fisheries Working Group Report. Wisconsin Initiative on Climate Change Impacts: Working Group Reports, 31 pages. Available at http://www.wicci.wisc.edu/report/Coldwater-Fish-and-Fisheries.pdf. Accessed December 2018.

Newman, L.E., DuBois, R.B., and T. Halpern. [Eds.]. 2003. A Brook Trout

Rehabilitation Plan for Lake Superior. Great Lakes Fish. Comm. Misc. Publ. 2003-03.

Nute, G.L. 1944. Lake Superior. New York: Bobbs-Merrill Co.

Olson, K., P. Piszczek, J. Hoffman, and T. Margenau. 2016. Population Dynamics, Sport and Commercial Harvest and Management of St. Louis River Walleye (1981-2015). Wisconsin Department of Natural Resources, Bureau of Fisheries Management, Report No. 156.

Piszczek, P., A. Nelson, M. Wedge, A. Varian, and B. Borkholder. 2016. 2015 St. Louis River Lake Sturgeon Survey Summary. Wisconsin DNR Fisheries File Report, Superior Office. 15 pp.

Roseman, E., P. Kocovsky, and C. Vandergoot. 2010. Status of walleye in the Great Lakes: proceedings of the 2006 symposium. Great Lakes Fishery Commission Technical Report 69, Ann Arbor.

Superior Times (November 19, 1870), p.4

Sweet, E. T. 1880. Geology of the western Lake Superior district; climate, soils and timber. In Chamberlin's: Geology of Wisconsin, Vol. 3, pp. 323-329.

Varian, A., D. Hendrickson, K. Olson, and P. Piszczek. 2017. Access Based Creel Survey of the Open Water and Winter Fishery 2015-2016 and Walleye Population Estimate on the St. Louis River Estuary, St. Louis County, Minnesota and Douglas County, Wisconsin. Minnesota Department of Natural Resources Completion Report, F15AF00162, R29G60F29RP32. 42 pp.

Wisconsin Department of Natural Resources. 2013. Fish, Wildlife and Habitat Management Plan: Guidance for fish and wildlife conservation, management and recreation related activities in the Wisconsin Department of Natural Resources funded under the Federal Aid in Sport Fish Restoration Act and the Federal Aid in Wildlife Restoration Act, July 1, 2007 - September 30, 2015 (2013 UPDATE). Madison. http://dnr.wi.gov/topic/fishing/documents/publications/fwhplan.pdf

Wisconsin Department of Natural Resources and U.S. Fish and Wildlife Service. 2005. Wisconsin Lake Superior Basin Brook Trout Plan. Wisconsin DNR Superior office. 47 pp.

Zunker, C. 2019. Wisconsin's 2018 Lake Superior creel survey report. Wisconsin Department of Natural Resources, Bayfield.