Lake trout, Lake whitefish, Rainbow smelt, Walleye, Yellow perch

Image © New York State Department of Environmental Conservation

Lake Superior

Bottom gillnet, Trap net, Pound net

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About Seafood Watch®

Monterey Bay Aquarium's Seafood Watch® program evaluates the ecological sustainability of wild-caught and farmed seafood commonly found in the United States marketplace. Seafood Watch® defines sustainable seafood as originating from sources, whether wild-caught or farmed, which can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems. Seafood Watch® makes its science-based recommendations available to the public in the form of regional pocket guides that can be downloaded from www.seafoodwatch.org. The program's goals are to raise awareness of important ocean conservation issues and empower seafood consumers and businesses to make choices for healthy oceans.

Each sustainability recommendation on the regional pocket guides is supported by a Seafood Report. Each report synthesizes and analyzes the most current ecological, fisheries and ecosystem science on a species, then evaluates this information against the program's conservation ethic to arrive at a recommendation of "Best Choices," "Good Alternatives" or "Avoid." The detailed evaluation methodology is available upon request. In producing the Seafood Reports, Seafood Watch® seeks out research published in academic, peer-reviewed journals whenever possible. Other sources of information include government technical publications, fishery management plans and supporting documents, and other scientific reviews of ecological sustainability. Seafood Watch® Research Analysts also communicate regularly with ecologists, fisheries and aquaculture scientists, and members of industry and conservation organizations when evaluating fisheries and aquaculture practices. Capture fisheries and aquaculture practices are highly dynamic; as the scientific information on each species changes, Seafood Watch®'s sustainability recommendations and the underlying Seafood Reports will be updated to reflect these changes.

Parties interested in capture fisheries, aquaculture practices and the sustainability of ocean ecosystems are welcome to use Seafood Reports in any way they find useful. For more information about Seafood Watch® and Seafood Reports, please contact the Seafood Watch® program at Monterey Bay Aquarium by calling 1-877-229-9990.

Guiding Principles

Seafood Watch defines sustainable seafood as originating from sources, whether fished[1] or farmed, that can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems.

Based on this principle, Seafood Watch had developed four sustainability **criteria** for evaluating wild-catch fisheries for consumers and businesses. These criteria are:

- How does fishing affect the species under assessment?
- How does the fishing affect other, target and non-target species?
- How effective is the fishery's management?
- How does the fishing affect habitats and the stability of the ecosystem?

Each criterion includes:

- Factors to evaluate and score
- Guidelines for integrating these factors to produce a numerical score and **rating**

Once a rating has been assigned to each criterion, we develop an overall recommendation. Criteria ratings and the overall recommendation are color-coded to correspond to the categories on the Seafood Watch pocket guide and online guide:

Best Choice/Green: Are well managed and caught in ways that cause little harm to habitats or other wildlife.

Good Alternative/Yellow: Buy, but be aware there are concerns with how they're caught.

Avoid/Red: Take a pass on these for now. These items are overfished or caught in ways that harm other marine life or the environment.

1 "Fish" is used throughout this document to refer to finfish, shellfish and other invertebrates.

Summary

The following Seafood Watch report provides recommendations for lake trout (*Salvelinus namaycush*), lake whitefish (*Coregonus clupeaformis*), walleye (*Sander vitreus*), yellow perch (*Perca flavescens*), and rainbow smelt (*Osmerus mordax*) caught throughout the Great Lakes of North America by U.S., Canadian, and tribal fisheries. Since commercial fishing began in the Great Lakes in the 1800s, the profile of commercially targeted and caught species has undergone dramatic changes in response to a suite of anthropogenic pressures. Particularly substantial declines in target species biomass occurred during the first half of the 20th century due to a combination of overfishing, habitat loss, chemical contamination, and the proliferation of invasive species that followed urban, agricultural, and industrial expansion throughout the Great Lakes region. In response to these dramatic declines, new management and assessment regimes were put into place in the mid-20th century, and these have continued to evolve and expand. Because of these efforts, the Great Lakes fishery now more closely resembles the fishery of the early 1900s than in the past 75 years. Today's commercial fisheries are a mixture of recovered native species that have been mainstays of the Great Lakes (e.g., lake trout, yellow perch, walleye, and lake whitefish) and non-native forage species (e.g., rainbow smelt).

1. Lake trout (*Salvelinus namaycush*): This long-lived species was once the top predator in all the Great Lakes, and a main target of the commercial fishery. Although it is moderately resilient to fishing pressure, the combined stress of overfishing and high levels of predation by the exotic sea lamprey drove lake trout populations into steep decline during the mid-20th century. By 1960, lake trout populations were nearly obliterated in all lakes except Lake Superior. At present, only Lake Superior has self-sustaining populations able to support a targeted commercial fishery for wild-caught lake trout. Restoration of lake trout populations remains a major management goal throughout the Great Lakes.

In Lake Erie, lake trout is not allowed to be harvested by commercial fishermen, and any lake trout that shows up at a market is not allowed to be sold. Furthermore, commercial fisheries that do accidentally catch lake trout are required to return them to the lake alive, though this number is unreported.

In Lake Huron, stock status is considered poor, but rehabilitation efforts are in place and ongoing. Spawning and recruitment have been somewhat successful, and the abundance of spawning adults is increasing. Lake trout from Lake Huron is considered a "**Good Alternative**."

Lake trout in Michigan waters of Lake Superior is a "**Good Alternative**" because populations are in recovery. Lake trout in Wisconsin waters of Lake Superior is "**Avoid**" primarily due to lack of available data. Lake trout in Minnesota waters of Lake Superior is a "**Best Choice**" because of stable populations and well-managed harvest. Lake trout in Canadian waters of Lake Superior is a "**Good Alternative**" because of unlicensed fishing in a portion of those waters.

Lake trout populations in Lake Ontario hit a low point in 2005 after a significant decline in the 1990s. Mainly due to hatchery stocking program problems, lake trout populations have seen only some increases in recent years. There is no commercial fishery for lake trout in Lake Ontario.

Lake trout in Lake Michigan waters is considered a "**Good Alternative**." Lake trout populations throughout the lake are still heavily maintained through stocking, with little natural reproduction evident.

2. Walleye (*Sander vitreus*): This dominant near-shore predator has been a target of Great Lakes commercial fisheries since the late 19th century. It is resilient to fishing pressure and tolerant of a variety of environmental conditions. This has allowed walleye populations to recover quickly from environmental degradation, and the species has remained dominant in the commercial fishery.

The walleye recommendation for Lake Superior in Canada and Michigan is "**Good Alternative**" because populations are in recovery. In Wisconsin it is "**Avoid**" primarily due to lack of data.

The recommendation for Lake Huron is "**Good Alternative**." Commercial harvest of walleye is restricted throughout much of the lake in an effort to aid in stock recovery.

Today, walleye harvested by commercial fisheries are caught only in Canadian waters using gillnets. Walleye populations began to recover in Lake Erie as soon as nutrient abatement programs went into effect in the 1970s; however, after a period of recovery from the 1970s to 1990s, walleye populations underwent a second period of decline in the 1990s due to highly variable recruitment. At present, populations are still recovering and a better understanding is needed of what species-specific and environmental characteristics affect year-class strength. Primarily due to this poor recruitment, walleye is recommended as a "**Good Alternative**."

There is a small gillnet and trap net fishery for walleye in Canadian waters of Lake Ontario. This comprised 8% of the total commercial catch in 2012, and both are given "**Good Alternative**" recommendations because impacts of the fishery on the target stock is very low, effective management is in place, and impacts on other species is moderate to low.

The walleye recommendation for Lake Michigan is "**Good Alternative**." Walleye in Lake Michigan is still in recovery following a dramatic decline during the 1990s.

3. Yellow perch (*Perca flavescens*): This near-shore species has an intermediate position in the aquatic food web and is often found in the same environments as walleye. It is broadly distributed in the Great Lakes and resilient to fishing pressure. Yellow perch abundance has been highly variable since the mid-20th century due to the effects of habitat loss, interactions with invasive species, and overfishing, but has recovered quickly when stresses have been removed. The 1980s were a period of record productivity for the yellow perch fisheries throughout the Great Lakes, including Lake Michigan's Green Bay, but yellow perch entered a new period of decline in the 1990s. Currently, yellow perch population status is widely uncertain and variable, and populations are not at levels seen before their decline.

Lake Erie has the largest fishery for yellow perch of all the Great Lakes. In recent years, the yellow perch commercial harvest has been showing a generally increasing trend. Overall, increasing populations (as

evidenced by increased catch per unit effort throughout most of Lake Erie), an effective management regime, and inherently resilient life history characteristics make yellow perch caught in Lake Erie a "**Best Choice**" if caught in trap nets within Pennsylvania or New York waters and "**Good Alternativ**e" if caught in trap nets within Ohio waters or gillnets within Ontario waters.

In Lake Superior Canadian waters, yellow perch was over-harvested and the fishery was closed in 2004. Yellow perch is currently in recovery but has the recommendation of "**Good Alternative**" because of restrictions to harvest that allow for recovery. Yellow perch from Lake Superior Michigan waters is a "**Good Alternative**" because of stable populations and low harvest.

Yellow perch has a "**Good Alternative**" recommendation for Lake Huron. Yellow perch populations are still in a state of recovery following lake-wide declines in the 1980s to 1990s. Additionally, several years of poor year-class strength and recruitment have resulted in uncertain population status for yellow perch in U.S. waters.

In Canadian waters of Lake Ontario, yellow perch is one of the two main targeted species, along with lake whitefish. Yellow perch in Canadian waters for both gillnet and trap net fisheries receive a "**Good Alternative**" because the fishery impacts on stocks, impacts on other species, and effects on habitats and ecosystems are all moderate to low. Furthermore, effective management is in place.

In New York waters of Lake Ontario, yellow perch is the main target species with a catch of 27.21 MT. In New York waters yellow perch received a "**Best Choice**" ranking because it is a small fishery and yellow perch have made up >95% of the fishery since 2004, so its impacts on other species is minimal. In addition, effective management is in place, and the fishery impacts on habitat, the target stock, and other species is low to moderate.

In Lake Michigan, the yellow perch recommendation is "**Good Alternative**" because stocks are still in a period of recovery following dramatic declines in harvest yield.

4. Lake whitefish (*Coregonnus clupeaformis*): Lake whitefish has been a longtime target of the Great Lakes commercial fishery. As an epibenthic fish, this species occupies deep, cold waters rather than near-shore environments. Lake whitefish is a schooling fish caught primarily from Lake Michigan and Lake Huron, and the patchy distribution of its intermingling stocks complicates stock assessment and management. Like other deepwater fish, lake whitefish underwent substantial population declines in the mid-19th century, but was able to recover quickly after nutrient abatement and sea lamprey control measures were put in place in the 1970s. Stocks in Lake Huron and Lake Superior are deemed moderate or low concern. Lake whitefish is currently the dominant deepwater benthic fish in the Great Lakes, because other native fish, such as the cisco, have not recovered as successfully. Their condition, growth, and catch rates became highly variable in the 1990s when their preferred prey, the amphipod *Diporeia*, disappeared in many lake areas in an apparent response to the proliferation of invasive zebra mussels. Lake whitefish have adjusted to these food web changes, first by changing their distribution to areas where *Diporeia* persisted, and more recently by changing their diets and consuming alternate prey, including zebra mussels. In spite of decreased conditions and changing catch rates, populations remain

large, management is effective, and impacts of bycatch are low due to effort, placement, and size restrictions on gear.

In Lake Erie, there is no evidence of year-of-young or yearling whitefish in 2012 lake-wide surveys and assessments. Recruitment appears to be sparse, which is thought to lead to continuing population declines. The recommendation for lake whitefish from Lake Erie is "**Good Alternative**."

Lake Ontario lake whitefish is a "**Good Alternative**." Lake whitefish is only targeted in Canadian waters of Lake Ontario where it is a main target species. Impacts on other species, mainly lake trout, are the main concern.

Lake whitefish in Lake Huron is also given a "**Good Alternative**" recommendation. Lake whitefish represents the largest and most valuable fishery in Lake Huron, but concerns about bycatch (mainly lake trout, and potentially lake sturgeon) result in the score awarded.

The lake whitefish recommendation is "**Good Alternative**" for Lake Superior Michigan waters because of historically stable populations. Lake whitefish in Lake Superior Wisconsin waters is **"Avoid**" primarily due to a lack of available data. Lake whitefish in Canadian waters in Lake Superior is a "**Good Alternative**" because of unlicensed fishing in portions of their waters.

Except for individuals harvest with trap nets from Wisconsin waters, the lake whitefish recommendations for Lake Michigan are "**Good Alternative**." Lake whitefish taken with trap nets from Wisconsin waters is considered a "**Best Choice**."

5. Rainbow smelt (*Osmerus mordax*): This non-native forage species first arrived in the Great Lakes in the 1930s, and was seen as a nuisance because it had no commercial value, clogged nets, and competed with native species. In the mid-1960s, salmonine stocking programs were instituted with a number of motivations: to control non-native species such as rainbow smelt and alewife, to support increased recreational fishing, and to aid in the recovery of lake trout populations. The first two goals were met successfully, but resulted in complications for rainbow smelt management: introduced predators were now successfully controlling forage fish populations, but this forage was essential for feeding the predator community that now supports highly lucrative recreational fisheries. Also, smelt had become a favored prey of recovering native predators such as lake trout, and smelt began to support a substantial commercial fishery. In the latter 20th century, rainbow smelt stocks entered a period of highly variable recruitment, possibly in response to excessive predation pressure and the reduction of food availability in the water column associated with the proliferation of zebra and quagga mussels. However, rainbow smelt is an invasive species that has negative impacts on native forage fish by competing for food and preying on juvenile fish.

Currently, the outlook for rainbow smelt stocks is unclear, though management recognizes the inherent difficulty and complicated nature of managing rainbow smelt populations. This results in high uncertainty about stock status and fishery impacts. Overall, management recognizes that restoring the

native predator-prey balance to the Great Lakes is important, but the recreational fisheries that are made possible in part by rainbow smelt presence in the Great Lakes are also highly valued.

In Lake Erie, rainbow smelt has become an important forage species, and in recent years, surveys are performed to determine their abundance. Rainbow smelt abundances reached their historic highs in 2012. In Lake Erie, the only fishery that targets rainbow smelt is a trawling fishery located in Ontario waters. The recommendation for rainbow smelt in Lake Erie is "**Best Choice**."

Rainbow smelt is a "**Good Alternative**" in Michigan waters of Lake Superior because it is an invasive species. In Lake Superior Wisconsin waters it is a "**Good Alternative**" because of a lack of available data. In Canadian waters of Lake Superior it is considered a "**Good Alternative**" because of unlicensed fishing in a portion of their waters. It is a **"Best Choice**" in Minnesota because they are invasive and have minimal impacts on other species.

Rainbow smelt in Lake Huron is deemed a **"Good Alternative**," primarily due to concerns with bycatch. However, rainbow smelt is not a targeted species and has little commercial value.

There are no rainbow smelt commercial fisheries in Lake Ontario or Lake Michigan.

Table of Conservation Concerns and Overall Recommendations

Stock / Fishery	Impacts on the Stock	Impacts on other Spp.	Management	Habitat and Ecosystem	Overall Recommendation
Lake whitefish Michigan Lake Superior - Trap net	Yellow (2.64)	Red (2.16)	Yellow (3.00)	Green (3.61)	**Good Alternative (2.803)**
Lake whitefish Wisconsin Lake Superior - Trap net	Red (1.73)	Red (1.73)	Yellow (3.00)	Green (3.61)	**Avoid (2.387)**
Lake whitefish Michigan Lake Superior - Gillnet, Bottom	Yellow (2.64)	Red (2.16)	Yellow (3.00)	Green (3.61)	**Good Alternative (2.803)**
Lake whitefish Wisconsin Lake Superior - Gillnet, Bottom	Red (1.73)	Red (1.73)	Yellow (3.00)	Green (3.61)	**Avoid (2.387)**
Lake whitefish Canada Lake Superior - Gillnet, Bottom	Green (3.32)	Red (1.73)	Yellow (3.00)	Green (3.61)	**Good Alternative (2.808)**
Yellow perch Michigan Lake Superior - Gillnet, Bottom	Green (3.87)	Red (2.16)	Yellow (3.00)	Green (3.61)	**Good Alternative (3.084)**
Yellow perch Canada Lake Superior - Gillnet, Bottom	Green (3.32)	Red (1.73)	Yellow (3.00)	Green (3.61)	**Good Alternative (2.808)**
Lake trout	Green (3.32)	Red (2.16)	Yellow (3.00)	Green (3.61)	**Good Alternative**

Michigan Lake Superior - Trap net					**(2.967)**
Lake trout Wisconsin Lake Superior - Trap net	Red (1.73)	Red (1.73)	Yellow (3.00)	Green (3.61)	**Avoid (2.387)**
Lake trout Minnesota Lake Superior - Trap net	Green (3.32)	Green (5.00)	Yellow (3.00)	Green (3.61)	**Best Choice (3.660)**
Lake trout Michigan Lake Superior - Gillnet, Bottom	Green (3.32)	Red (2.16)	Yellow (3.00)	Green (3.61)	**Good Alternative (2.967)**
Lake trout Wisconsin Lake Superior - Gillnet, Bottom	Red (1.73)	Red (1.73)	Yellow (3.00)	Green (3.61)	**Avoid (2.387)**
Lake trout Minnesota Lake Superior - Gillnet, Bottom	Green (3.32)	Green (3.32)	Yellow (3.00)	Green (3.61)	**Best Choice (3.304)**
Lake trout Canada Lake Superior - Gillnet, Bottom	Red (1.73)	Yellow (2.71)	Yellow (3.00)	Green (3.61)	**Good Alternative (2.669)**
Rainbow smelt Michigan Lake Superior - Gillnet, Bottom	Green (5.00)	Red (2.16)	Yellow (3.00)	Green (3.61)	**Good Alternative (3.287)**
Rainbow smelt Wisconsin Lake Superior - Gillnet, Bottom	Green (5.00)	Red (1.73)	Yellow (3.00)	Green (3.61)	**Good Alternative (3.111)**
Rainbow smelt Canada Lake Superior - Gillnet, Bottom	Green (5.00)	Red (1.73)	Yellow (3.00)	Green (3.61)	**Good Alternative (3.111)**
Rainbow smelt Minnesota Lake Superior - Pound Net	Green (5.00)	Green (5.00)	Yellow (3.00)	Green (3.61)	**Best Choice (4.055)**
Walleye Canada Lake Superior - Gillnet, Bottom	Yellow (2.71)	Red (1.73)	Yellow (3.00)	Green (3.61)	**Good Alternative (2.669)**
Walleye Michigan Lake Superior - Gillnet, Bottom	Red (2.16)	Yellow (2.64)	Yellow (3.00)	Green (3.61)	**Good Alternative (2.803)**
Rainbow smelt Wisconsin Lake Superior - Pound Net	Green (5.00)	Green (5.00)	Yellow (3.00)	Green (3.61)	**Best Choice (4.055)**
Walleye Wisconsin Lake Superior - Gillnet, Bottom	Red (2.16)	Red (1.73)	Yellow (3.00)	Green (3.61)	**Avoid (2.522)**
Walleye Michigan Lake Superior - Trap net	Red (2.16)	Yellow (2.64)	Yellow (3.00)	Green (3.61)	**Good Alternative (2.803)**

Scoring Guide

Scores range from zero to five where zero indicates very poor performance and five indicates the fishing operations have no significant impact.

Final Score = geometric mean of the four Scores (Criterion 1, Criterion 2, Criterion 3, Criterion 4).

- **Best Choice/Green** = Final Score >3.2, **and** no Red Criteria, **and** no Critical scores

- **Good Alternative/Yellow** = Final score >2.2-3.2, **and** neither Harvest Strategy (Factor 3.1) nor Bycatch Management Strategy (Factor 3.2) are Very High Concern[2], **and** no more than one Red Criterion, **and** no Critical scores
- **Avoid/Red** = Final Score <=2.2, **or** either Harvest Strategy (Factor 3.1) or Bycatch Management Strategy (Factor 3.2) is Very High Concern **or** two or more Red Criteria, **or** one or more Critical scores.

[2] Because effective management is an essential component of sustainable fisheries, Seafood Watch issues an Avoid recommendation for any fishery scored as a Very High Concern for either factor under Management (Criterion 3).

Table of Contents

Introduction

Scope of the analysis and ensuing recommendation

This report evaluated the commercial harvest of lake whitefish (*Coregonus clupeaformis*), lake trout (*Salvelinus namaycush*), yellow perch (*Perca flavescens*), walleye (*Sander vitreus*), and rainbow smelt (*Osmerus mordax*) in the Laurentian Great Lakes.

In addition, impacts of the commercial fishery on the non-target, state, and provincially listed threatened species lake sturgeon (*Acipenser fulvescens*) are also evaluated.

Fishing gears examined in this region include gillnets and trap nets utilized by commercially licensed fishermen from Michigan, Wisconsin, Minnesota, Illinois, Indiana, Ohio, Pennsylvania, New York, the Canadian Province of Ontario, and tribal fishermen.

Overview of the species and management bodies

Lake trout is found in the northern parts of North America, principally in Canada, throughout Alaska, and in the Laurentian Great Lakes, preferring cool water temperatures of 45–55 °F (Froese & Pauly 2012). During the spring and fall, lake trout may be found at depths of 10 to 15 ft but move to 100–200 ft during the summer and winter. Lake trout is the largest of the charr (a sub-group of Salmonidae), reaching lengths of 50 in., and typically weighing 15 to 40 lbs (Froese & Pauly 2012). Lake trout was once the dominant predator in Lake Huron, but introduction of the sea lamprey, habitat alterations, and overfishing have resulted in dramatic declines of this once economically valuable fish.

Lake whitefish (member of the family Salmonidae) is found in inland lakes throughout Canada, Alaska, and the northern part of the United States. Lake whitefish is a schooling fish that prefers cool waters at depths up to 200 ft. Lake whitefish typically achieves lengths of 20–30 in. and weights of up to 20 lbs. Lake whitefish represents the highest commercial yield of any fishery in the Great Lakes (Froese & Pauly 2012).

Yellow perch is found throughout freshwater lakes in North America. Yellow perch is utilized as both a food fish and a game fish, making it a source of great value. Yellow perch prefers water temperatures of 66–70 °F and is generally taken at depths >45 ft (Froese & Pauly 2012). It averages lengths of 4–10 in. and weights of 4–10 oz (Froese & Pauly 2012).

Walleye (the largest member of the perch family) is also utilized as both a food fish and a game fish. It is found throughout most of Canada and the northern United States. Walleye is a voracious near-shore predator and reaches lengths of 20–30 in. and weights of up to 20 lbs. It prefers temperatures of 55-68°F and are seldom found at depths of >50 ft (Froese & Pauly 2012).

Rainbow smelt is native to the Atlantic Coast and throughout the northern portions of the Atlantic Ocean and Arctic Ocean. It was introduced into inland lakes, escaped, and made its way into the Great Lakes in the early 1900s. The rainbow smelt is slender and cylindrical, 7 to 9 inches long, and weighs ~3 oz. The commercial fishery for rainbow smelt has greatly declined in Lake Superior (Froese & Pauly 2012).

The Lake Superior fishery has been active since the early 19th century, when settlements were established and local fish trading became common. The initial fish composition was dominated by lake trout, lake whitefish, lake herring, and several species of deepwater cisco. Unmanaged fishing and predation by sea lampreys in the 1950s caused the collapse of lake trout, lake herring, and deepwater cisco populations. Rehabilitation efforts of lake trout stocks have been fairly successful, with the stocking of lake trout, the use of lampricide to control sea lamprey, and regulations on commercial fishing. Due to increased abundance and expanded fisheries, lake whitefish populations support greater commercial harvest than they have previously.

There are several management bodies that manage the fisheries in Lake Superior. These include state, provincial, and tribal bodies: the Michigan Department of Natural Resources, the Minnesota Department of Natural Resources, the Wisconsin Department of Natural Resources, the Ontario Ministry of Natural Resources, the Chippewa-Ottawa Resource Authority (CORA), the Great Lakes Indian Fish and Wildlife Commission (GLIFWC), and the 1854 Treaty Authority.

The fisheries targeting the species mentioned above are managed by the Great Lakes Fishery Commission (GLFC) under the Joint Strategic Plan for Management of Great Lakes Fisheries, which was enacted in 1981. It was reviewed in 1986 and amended in 1997 in an effort to adopt practices that would better coordinate fishery and environmental management issues. During this time tribal fishermen (CORA and GLIFWC) and U.S. Geological Survey (USGS) representatives were offered seats on the Council of Lake Committees (GLFC 2007).

Production Statistics

None of the species evaluated in this report is considered important on a global scale. Most of the harvest remains in the region and is insignificant compared to global landings of other fish in other fisheries. Lake whitefish yields are the largest, with an estimated 9,494 MT reported as harvested globally (FAO 2014).

Importance to the U.S./North American market

Commercial fisheries for lake trout in the Great Lakes are generally small and restricted for the most part to Lake Superior, Lake Huron, and Lake Michigan. Although some lake trout are caught in Canadian waters of Lake Superior, this species is not a primary freshwater export for Canada.

The majority of walleye sold in the United States comes from Canadian sources, primarily from Lake Erie. Walleye is one of Canada's largest freshwater fish exports, together with yellow perch and lake whitefish. Lake whitefish has the highest value out of all Canadian harvested species (Upper Great Lakes Management Unit 2011).

The United States imports about 6.6 million pounds of fresh and frozen walleye annually from Canada, primarily as frozen fillets, but also as fresh whole fish, fresh fillets, and frozen block (DFO 2011). Approximately 90% is from Great Lakes sources, with about 87% coming from Lake Erie and about 3% from Lake Huron.

The largest market for yellow perch in the United States is in the Great Lakes region, where fresh perch fillets can attain the highest price per pound. US demand for yellow perch makes it one of Canada's largest and most valuable freshwater fishery exports, together with walleye and lake whitefish.

The demand for yellow perch in the Great Lakes region has been estimated to reach 50 to 100 million lbs annually (Hinshaw 2006). Currently, close to 2 million lbs are commercially harvested within the U.S., primarily from Ohio waters of Lake Erie. Almost twice that—just under 4 million lbs—is imported, nearly all of it from Canadian commercial Great Lakes fisheries operating in Ontario (Hinshaw 2006), (Baldwin et al. 2009), (DFO 2011).

The largest exports of whitefish from Canada are from the Northwest Territories, Manitoba, Saskatchewan, and Alberta. Great Lakes catches traditionally focused on domestic wholesale markets, but Canadian wholesalers in northwest regions of Canada are influencing prices and increasing competition with Great Lakes fisheries. Partly because of this competition as well as a declining quota and the need for a greater return from a less available product, the lake whitefish market is currently exploring better branding and value-added products. Lake whitefish is one of the three largest freshwater exports, by both weight and value, from Canada. These fish are primarily sold in U.S. markets.

Great Lakes rainbow smelt are the fifth-largest Canadian freshwater fish export by value. The majority of Canadian-caught freshwater smelt are exported frozen to Japan, with some going to the United States. A portion of the Lake Erie catch is also exported fresh to the U.S.

Common and market names

Lake trout, *Salvelinus namaycush*, is also known as Great Lakes trout, laker, namaycush, togue, grey trout, mountain trout, mackinaw, lake char/charr, touladi, and salmon trout.

Walleye, *Sander vitreus*, is also known as yellow pickerel, pickerel (Canada), yellow pike, yellow walleye, and dore (France, Canada).

Yellow perch, *Perca flavescens*, is also known as lake perch, ringed perch, raccoon perch, Ned, yellow Ned, redfin, and redfin perch.

Lake whitefish, *Coregonnus clupeaformis*, is also known as common whitefish, Sault whitefish, whitefish, eastern whitefish, Great Lakes whitefish, inland whitefish, gizzard fish, grande coregone (French), and Attikumaig (Chippewa).

Rainbow smelt, *Osmerus mordax*, is also known as American smelt, leefish, freshwater smelt, and frost fish.

Primary product forms

Lake trout may be marketed fresh, frozen, or smoked. Though “smoked lake trout” is typically siscowet, or oily lake trout, a substantial portion of the larger lean lake trout that is sold is also smoked. Smaller fish are primarily marketed fresh or frozen, as whole dressed fish.

Walleye is available fresh as whole fish (head on or off, dressed) or fillets (skin on or off), and frozen as fillets or fingers (7–12 cm strips).

Yellow perch can be found fresh or frozen, sold primarily as scaled, skin-on fillets.

Whitefish is available fresh or frozen as whole dressed fish or fillets. New value-added products growing in market share include frozen vacuum-packed fillets and prepared foods such as spreads. Lake whitefish roe is also successfully marketed as “golden caviar.” Canadian whitefish catches from outside the Great Lakes are marketed by the Freshwater Fish Marketing Corporation (FFMC), which produces three main whitefish products: minced block, whole fresh, and whole frozen whitefish.

Rainbow smelt can be found on the U.S. market as fresh or frozen whole fish.

Assessment

This section assesses the sustainability of the fishery(s) relative to the Seafood Watch Criteria for Fisheries, available at http://www.seafoodwatch.org.

Criterion 1: Impacts on the species under assessment

This criterion evaluates the impact of fishing mortality on the species, given its current abundance. The inherent vulnerability to fishing rating influences how abundance is scored, when abundance is unknown.

The final Criterion 1 score is determined by taking the geometric mean of the abundance and fishing mortality scores. The Criterion 1 rating is determined as follows:

- *Score >3.2=Green or Low Concern*
- *Score >2.2 and <=3.2=Yellow or Moderate Concern*
- *Score <=2.2=Red or High Concern*

Rating is Critical if Factor 1.3 (Fishing Mortality) is Critical.

Criterion 1 Summary

LAKE TROUT				
Region / Method	**Inherent Vulnerability**	**Stock Status**	**Fishing Mortality**	**Subscore**
Canada Lake Superior Gillnet, Bottom	1.00:High	3.00:Moderate Concern	1.00:High Concern	**Red (1.732)**
Michigan Lake Superior Gillnet, Bottom	1.00:High	3.00:Moderate Concern	3.67:Low Concern	**Green (3.318)**
Michigan Lake Superior Trap net	1.00:High	3.00:Moderate Concern	3.67:Low Concern	**Green (3.318)**
Minnesota Lake Superior Gillnet, Bottom	1.00:High	3.00:Moderate Concern	3.67:Low Concern	**Green (3.318)**
Minnesota Lake Superior Trap net	1.00:High	3.00:Moderate Concern	3.67:Low Concern	**Green (3.318)**
Wisconsin Lake Superior Gillnet, Bottom	1.00:High	3.00:Moderate Concern	1.00:High Concern	**Red (1.732)**
Wisconsin Lake Superior Trap net	1.00:High	3.00:Moderate Concern	1.00:High Concern	**Red (1.732)**

LAKE WHITEFISH				
Region / Method	**Inherent Vulnerability**	**Stock Status**	**Fishing Mortality**	**Subscore**
Canada Lake Superior Gillnet, Bottom	2.00:Medium	3.00:Moderate Concern	3.67:Low Concern	**Green (3.318)**
Michigan Lake Superior	2.00:Medium	3.00:Moderate	2.33:Moderate	**Yellow (2.644)**

Gillnet, Bottom		Concern	Concern	
Michigan Lake Superior Trap net	2.00:Medium	3.00:Moderate Concern	2.33:Moderate Concern	**Yellow (2.644)**
Wisconsin Lake Superior Gillnet, Bottom	2.00:Medium	3.00:Moderate Concern	1.00:High Concern	**Red (1.732)**
Wisconsin Lake Superior Trap net	2.00:Medium	3.00:Moderate Concern	1.00:High Concern	**Red (1.732)**

RAINBOW SMELT				
Region / Method	**Inherent Vulnerability**	**Stock Status**	**Fishing Mortality**	**Subscore**
Canada Lake Superior Gillnet, Bottom	2.00:Medium	5.00:Very Low Concern	5.00:Very Low Concern	**Green (5.000)**
Michigan Lake Superior Gillnet, Bottom	2.00:Medium	5.00:Very Low Concern	5.00:Very Low Concern	**Green (5.000)**
Minnesota Lake Superior Pound Net	2.00:Medium	5.00:Very Low Concern	5.00:Very Low Concern	**Green (5.000)**
Wisconsin Lake Superior Gillnet, Bottom	2.00:Medium	5.00:Very Low Concern	5.00:Very Low Concern	**Green (5.000)**
Wisconsin Lake Superior Pound Net	2.00:Medium	5.00:Very Low Concern	5.00:Very Low Concern	**Green (5.000)**

WALLEYE				
Region / Method	**Inherent Vulnerability**	**Stock Status**	**Fishing Mortality**	**Subscore**
Canada Lake Superior Gillnet, Bottom	2.00:Medium	2.00:High Concern	3.67:Low Concern	**Yellow (2.709)**
Michigan Lake Superior Gillnet, Bottom	2.00:Medium	2.00:High Concern	2.33:Moderate Concern	**Red (2.159)**
Michigan Lake Superior Trap net	2.00:Medium	2.00:High Concern	2.33:Moderate Concern	**Red (2.159)**
Wisconsin Lake Superior Gillnet, Bottom	2.00:Medium	2.00:High Concern	2.33:Moderate Concern	**Red (2.159)**

YELLOW PERCH				
Region / Method	**Inherent Vulnerability**	**Stock Status**	**Fishing Mortality**	**Subscore**
Canada Lake Superior Gillnet, Bottom	3.00:Low	3.00:Moderate Concern	3.67:Low Concern	**Green (3.318)**
Michigan Lake Superior Gillnet, Bottom	3.00:Low	3.00:Moderate Concern	5.00:Very Low Concern	**Green (3.873)**

The species in Lake Superior are not necessarily distinct biological stocks and genetically separate, but many have specific and different spawning areas local to their home base. That is partly why a species in one state or province may have different rankings than the same species in another state. Further, each state or province has a portion of the lake that it manages, so even though portions are similarly managed, they have differences, including different harvest rates.

Inherent vulnerability scores are derived from the "vulnerability" score provided on FishBase, which is based on several inherent biological characteristics of the species (e.g., age at maturity, maximum age, and fecundity). The FishBase vulnerability score is derived from Cheung et al. (2005) and is found at www.fishbase.org on the species' page. This score is used to determine a risk-based score for Factor 1.2 (abundance of the stock) only in cases where the abundance is otherwise unknown. Attributes that affect susceptibility of the species to the fishery, e.g., its attraction to fishing gear and spatial overlap with the fishery, are germane to the degree of fishing mortality experienced by the species and therefore are considered under Factor 1.3 (fishing mortality) in cases where fishing mortality is unknown and a risk-based score is needed.

Criterion 1 Assessment

Factor 1.1 - Inherent Vulnerability

Scoring Guidelines

- *Low— FishBase vulnerability score for species 0-35 OR species exhibits life history characteristics that make it resilient to fishing, e.g., early maturing (<5 years), short lived (< 10 years), small maximum size, and low on food chain.*
- *Medium— FishBase vulnerability score for species 36-55 OR life history characteristics that make it neither particularly vulnerable or resilient to fishing, e.g. moderate age at sexual maturity (5-15 years), moderate maximum age (10-25 years), moderate maximum size, and middle of food chain.*
- *High— FishBase vulnerability score for species 56-100 OR life history characteristics that make is particularly vulnerable to fishing, e.g. long-lived (>25 years), late maturing (>15 years), low reproduction rate, large body size, and top-predator.*

Note: The FishBase vulnerability scores is an index of the inherent vulnerability of marine fishes to fishing based on life history parameters: maximum length, age at first maturity, longevity, growth rate, natural mortality rate, fecundity, spatial behaviors (e.g. schooling, aggregating for breeding, or consistently returning to the same sites for feeding or reproduction) and geographic range.

Factor 1.2 - Abundance

Scoring Guidelines

- *5 (Very Low Concern)—Strong evidence exists that the population is above target abundance level (e.g., biomass at maximum sustainable yield, BMSY) or near virgin biomass.*

- *4 (Low Concern)—Population may be below target abundance level, but it is considered not overfished*
- *3 (Moderate Concern) —Abundance level is unknown and the species has a low or medium inherent vulnerability to fishing.*
- *2 (High Concern)—Population is overfished, depleted, or a species of concern, OR abundance is unknown and the species has a high inherent vulnerability to fishing.*
- *1 (Very High Concern)—Population is listed as threatened or endangered.*

Factor 1.3 - Fishing Mortality
Scoring Guidelines

- *5 (Very Low Concern)—Highly likely that fishing mortality is below a sustainable level (e.g., below fishing mortality at maximum sustainable yield, FMSY), OR fishery does not target species and its contribution to the mortality of species is negligible (≤ 5% of a sustainable level of fishing mortality).*
- *3.67 (Low Concern)—Probable (>50%) chance that fishing mortality is at or below a sustainable level, but some uncertainty exists, OR fishery does not target species and does not adversely affect species, but its contribution to mortality is not negligible, OR fishing mortality is unknown, but the population is healthy and the species has a low susceptibility to the fishery (low chance of being caught).*
- *2.33 (Moderate Concern)—Fishing mortality is fluctuating around sustainable levels, OR fishing mortality is unknown and species has a moderate-high susceptibility to the fishery and, if species is depleted, reasonable management is in place.*
- *1 (High Concern)—Overfishing is occurring, but management is in place to curtail overfishing, OR fishing mortality is unknown, species is depleted, and no management is in place.*
- *0 (Critical)—Overfishing is known to be occurring and no reasonable management is in place to curtail overfishing.*

LAKE TROUT

Factor 1.1 - Inherent Vulnerability

Canada Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Trap net

Minnesota Lake Superior, Gillnet, Bottom

Minnesota Lake Superior, Trap net

Wisconsin Lake Superior, Gillnet, Bottom

Wisconsin Lake Superior, Trap net

High

The lake trout is the largest trout native to the Great Lakes and other Michigan lake waters, where it is considered the top native predator. They have relatively long lives (>25 years) and become sexually mature at 6 or 7 years of age. Like many members of Salmonidae, lake trout are broadcast spawners and return each fall to use the same spawning beds.

The FishBase vulnerability score for lake trout is 72 (Froese & Pauly 2012).

Factor 1.2 - Abundance

Michigan Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Trap net

Moderate Concern

In the Michigan waters of Lake Superior, there are eight management units for Lake Trout. The fishery is regulated through yield and effort limits established through maximum lake trout mortality rates, which differ by management unit. There is a modeling subcommittee that developed and fit statistical catch-at-age models to estimate age-specific and year-specific rates of population abundance and mortality. These estimates were combined with growth and maturity data for each management unit to project recommended yield levels. The maximum allowable mortality rate was 45% for lake trout. Total mortality remains below target levels in management units MI-5, MI-6, and throughout Lake Superior.

Models from 2012 estimate the lake trout biomass in the management unit MI-5 Marquette area to be 1.9 million lbs, which is a decrease from its peak in the 1990s when the biomass was 5.6 million lbs. The average biomass of age 4+ lake trout in the MI-5 unit from 2002–2011 is 2,376,400 lbs, so the current biomass is below the last 9 years' average.

Models from 2012 estimate the lake trout average biomass from 2002–2011 in the management unit MI-6 Au Train area to be 1.8 million lbs and 2001 biomass was around 1.5 million lbs, which is below the average.

Models from 2012 estimate the lake trout biomass in management unit MI-7 Grand Marais area in 2011 to be around 700,000 lbs and the average biomass from 2002–2011 is 691,330 lbs, so it is above the last 9 years' average. Confidence in this model has been rated as low because of the strong assumptions necessary to generate stock quantities—mainly relying on a population scaling parameter from the adjacent stock (MI-5 Marquette).

Relative abundance of ages 4 and 5 lake trout in the summer pre-recruit survey done by the management bodies has declined by 50% since 2002, and growth rates continue to be depressed due to density-dependent effects.

This rates “moderate concern” because the total annual mortality is below the target level but the population is still in recovery from a major decline in the mid-20th century.

Rationale:
Apart from background natural mortality, sea lamprey-induced mortality has been the dominant mortality source since 1975, although it declined to low levels in the mid-1990s (Caroffino, D.C., Lenart, S.J. 2012).

In Lake Superior, lake trout are a self-sustaining population.

Minnesota Lake Superior, Gillnet, Bottom

Minnesota Lake Superior, Trap net

Moderate Concern

Minnesota has three management units in Lake Superior. Trends in populations are monitored by a tri-annual lake-wide gillnet assessment. Population dynamics are also monitored by analyzing commercial fishing records, hydroacoustic surveys, and Minnesota Department of Natural Resources (MNDNR) assessment netting. In 2005 the MNDNR also developed a statistical catch-at-age model to assess the status of lake trout stocks and help determine commercial harvest levels, and it is presently in use. Lake trout annual mortality and spawning stock biomass are parameters estimated in the model. The maximum acceptable mortality is 45%, which was shown to prevent lake trout population from declining and prevent spawner abundance from decreasing. Total annual mortality in MN-1 was closest to the maximum target mortality but all other units are below this. The relative CPUE of all lake trout has decreased since the extremely high levels of the 1980s but it has been slightly increasing for the past several years. In 1980 the percent of wild trout found in surveys done by the Minnesota DNR was 4%, and in 2012 the percent wild was 96%, so the population is recovering. In general, lake trout restoration in Minnesota waters has proceeded well (Cory A. Goldsworthy and Donald R. Schreiner 2012).

Lake trout in Minnesota is “moderate concern” because CPUE is above the recent historical average but it is still in recovery.

Canada Lake Superior, Gillnet, Bottom

Moderate Concern

Lake trout populations are currently in recovery and the quota is a bycatch quota, which allows fishermen to target other species yet retain lake trout. There are 34 quota zones on the Canadian side of Lake Superior and each quota zone has its own species-specific quota by weight. The total quota for each zone is shared on a percent basis between commercial fishing licenses and tribal commercial fishermen. In 2011 the highest CPUEs were in quota zones 1–3 (Thunder Bay) and quota zone 11 (eastern Nipigon Bay). In the eastern quota zones the 2011 reported commercial fishing effort was too low to calculate CPUE in all quota zones, except for quota zones 31 and 33. The average CPUE across all reported management units in 2011 was 34 kg/km, which is lower than the historic average across all management units from 1993–2011 (44.2 kg/km). Many of the management units show declines in CPUE from 1993–2011 (Upper Great Lakes Management Unit 2011).

Abundance of lake trout in Lake Superior is a “moderate concern” because the CPUE is recorded annually as a stock assessment tool but there is little evidence if the stock is at or above the point where recruitment would be impaired, and the population is still in recovery.

Rationale:
Lake trout populations were believed to have been stable during 1929–43 with an average annual yield of 4 million lbs. In the 1950s lake trout populations declined dramatically because of overfishing and sea lamprey predation. Harvest dropped over 90%. The population began to recover in the 1960s because of stocking efforts and less harvest. Yet once populations began to recover, the commercial fishing resumed and the population dropped again in the 1980s, due to reduced stocking effort. Fisheries management has re-evaluated those problems and now relies more on managing for wild lake trout populations instead of stocking, and has seen more wild trout. The objective for lake trout restoration in Lake Superior is to restore self-sustaining stocks that are able to yield those historical amounts.

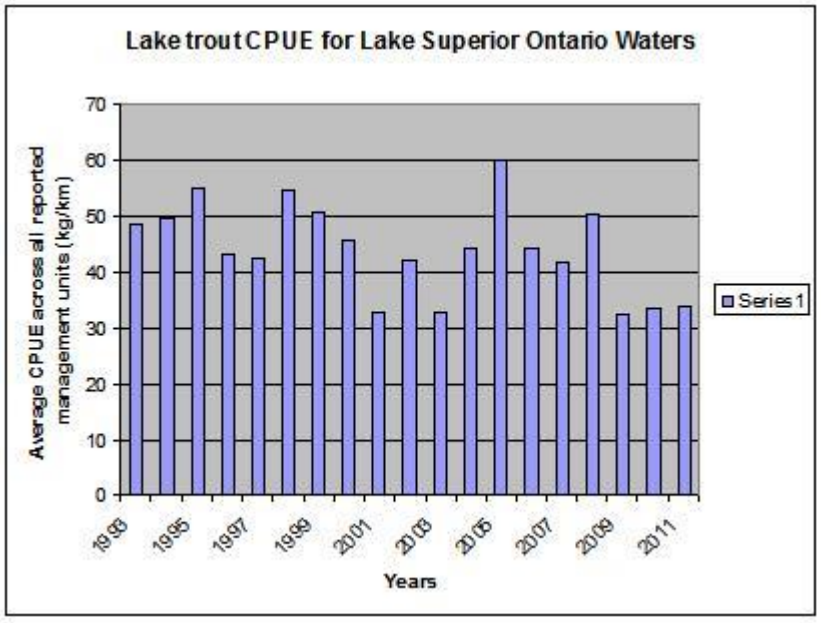

Figure 1. Average CPUE for lake trout in Ontario waters across all reported management units per year.

Wisconsin Lake Superior, Gillnet, Bottom

Wisconsin Lake Superior, Trap net

Moderate Concern

The Apostle Islands is where almost all the commercial fishing occurs. Lake trout were nearly obliterated in Lake Superior during the 1950s due to overfishing and sea lamprey predation. Sea lamprey control, reduction of commercial fishing, and established refuges have contributed to the increase in lake trout abundance in Wisconsin waters. However, lake trout populations are still recovering and overfishing may still be an issue (Seider 2010). Though a catch-at-age model is used to estimate abundance of the species, the current data were not available for legal reasons.

Factor 1.3 - Fishing Mortality

Michigan Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Trap net

Low Concern

Quotas are determined annually based on modeled projections of total fish mortality. A total annual mortality of 45% has been determined as necessary to allow for sustained population growth (Caroffino, D.C., Lenart, S.J. 2012). When determining allowable commercial fishing mortalities (i.e., quotas), mortality due to natural causes and sea lamprey predation are combined to determine total mortality. Quota limits are then adjusted based on the increase or decrease in mortality from other sources. In the management unit MI-5, the commercial fishing mortality is 15%. In the management unit MI-6, the commercial fishing mortality is 10%. In the management unit MI-7, the commercial fishing mortality is 11%. The target total annual mortality rate is 45%, so all management units are below the target rate. Total mortality rates have declined since 2007 because of management efforts, and recreational harvest has been steady recently. There is a total annual mortality average of 21%.

Minnesota Lake Superior, Gillnet, Bottom

Minnesota Lake Superior, Trap net

Low Concern

The maximum target mortality level was set at 45% because models indicated the abundance of spawning lake trout declined when mortality exceeded 45%. According to Figure 5.6 in (Schreiner, et al. 2006), reported fishing makes up a small portion of total mortality of lake trout in Minnesota. Their

models show that total mortality in management units MN-2 and MN-3 is below 45%; however, management unit MN-1 is approaching 45%.

Canada Lake Superior, Gillnet, Bottom

High Concern

In 2011 21,962 kg of lake trout were harvested, which equals 18.4% of the quota (Upper Great Lakes Management Unit 2011). The harvest in 2012 was 24,490 kg.

Lake trout is caught as bycatch from the targeted commercial fish (lake whitefish, cisco, chub, and yellow perch) but still landed and sold. The quotas are kept at low levels to facilitate the recovery of wild self-sustaining lake trout populations while still allowing commercial fishing. The 2011 licensed commercial lake trout harvest in all Lake Superior quota zones remained well below quotas. However, the harvest by unlicensed First Nation fisheries in eastern Lake Superior exceeded the quota for all inshore quota zones combined (Figure 81). The estimated unlicensed commercial harvest of lake trout in eastern Lake Superior peaked in 2000 with over 60,000 kg harvested (>30 times the proposed First Nation allocation) and has since shown a fairly steady downward trend (Upper Great Lakes Management Unit 2011).

Due to the unlicensed First Nation overfishing in the eastern portion of Lake Superior, this is rated “high concern.”

Wisconsin Lake Superior, Gillnet, Bottom

Wisconsin Lake Superior, Trap net

High Concern

Current harvest values are unavailable because of legal reasons. The Natural Resources Board suggested a reduction in the harvest limit for lake trout because the welfare of recreational, commercial, and tribal fisheries are at risk with declining lake trout populations in the Apostle Island vicinity. The decline was confirmed through surveys done by the Wisconsin Department of Natural Resources since the early 2000s. The Wisconsin Department of Natural Resources, in agreement with the Red Cliff Band and Bad River Bands of Lake Superior, determined the harvest limit and recommended a reduction in overall harvest (Stepp 2013).

Lake trout in Wisconsin waters is rated “high concern” for fishing mortality, because there were no current data but it is thought that overfishing may be occurring.

LAKE WHITEFISH

Factor 1.1 - Inherent Vulnerability

Canada Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Trap net

Wisconsin Lake Superior, Gillnet, Bottom

Wisconsin Lake Superior, Trap net

Medium

The lake whitefish, a member of the family Salmonidae, has long formed the mainstay of the commercial catch in the Great Lakes. This schooling, planktivorous fish can live >25 years, and reaches sexual maturity at about 2 years of age. Lake whitefish is a characteristic broadcast spawner.

The FishBase vulnerability score for lake whitefish is 48 (Froese & Pauly 2012). Therefore, Lake whitefish inherent vulnerability is listed as “medium.”

Factor 1.2 - Abundance

Michigan Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Trap net

Moderate Concern

Models in 2012 for the management unit WFS-04 estimated fishable biomass at 488,000 lbs in 2010. The average biomass for age 3+ lake whitefish is 515,600 lbs. Though the 2010 estimate is below the average biomass, estimates have remained relatively stable since the mid-1990s (Caroffino, D.C., Lenart, S.J. 2012).

Models in 2012 for the management unit WFS-05 estimated fishable biomass in 2010 at 1.08 million lbs. Biomass estimates have generally trended upward over the past decade. The average biomass from 200–-2010 was 902,800 lbs (Caroffino, D.C., Lenart, S.J. 2012).

A 2012 model estimate was not done for management unit WFS-06 because there has been little fishing

effort in the unit and no biological data have been collected since 2004. The 2004 model estimated the biomass to be 551,000 lbs in 2002, down from its peak of 673,000 lbs in 1988. Since a slight drop in 1992, the population appears to be stable.

A 2012 model for the management unit WFS-07 estimated the 2010 biomass as 1.34 million lbs. Fishable biomass of age 4 and older lake whitefish peaked at 3.5 million lbs in 1988 and has been declining ever since.

Canada Lake Superior, Gillnet, Bottom

Moderate Concern

The majority of commercial fishing occurs in Thunder Bay and the next highest amount is in Black Bay (Upper Great Lakes Management Unit 2011). The Upper Great Lakes Management Unit does not currently model the biomass of this stock, but it records the CPUE. The lake whitefish CPUE in quota zones 1–3 has been relatively stable over the past decade, yet quota zone 7 in Black Bay has declined over the past decade. The 2011 CPUE for lake whitefish in management unit 1–3 (Thunder Bay) was 216 kg/km, and the average from 1993–2011 is 248.9 kg/km. The CPUE is reported by management zone, with different management zones showing various trends over time. After averaging all management units within each year from 1993–2011, the 2011 average CPUE for all management units was 113 kg/km. The average of all management units from 1993–2011 was 140.76. Figure 2 depicting the averaged CPUE across management units per year shows a steady trend.

In eastern Lake Superior there is unlicensed First Nation commercial fishing of lake whitefish. The population has been overfished in these areas, which make up zones 31, 33, and 34. Populations in that part of the lake are declining due to this overfishing. The lack of fishing effort and location information make it impossible to assess the spatial distribution of the harvest or any trends in relative abundance of lake whitefish in this part of the lake.

Although the majority of commercial harvests in Ontario waters have been historically steady, the First Nation overfishing in the eastern portion of the lake rates this as “moderate concern.”

Rationale:

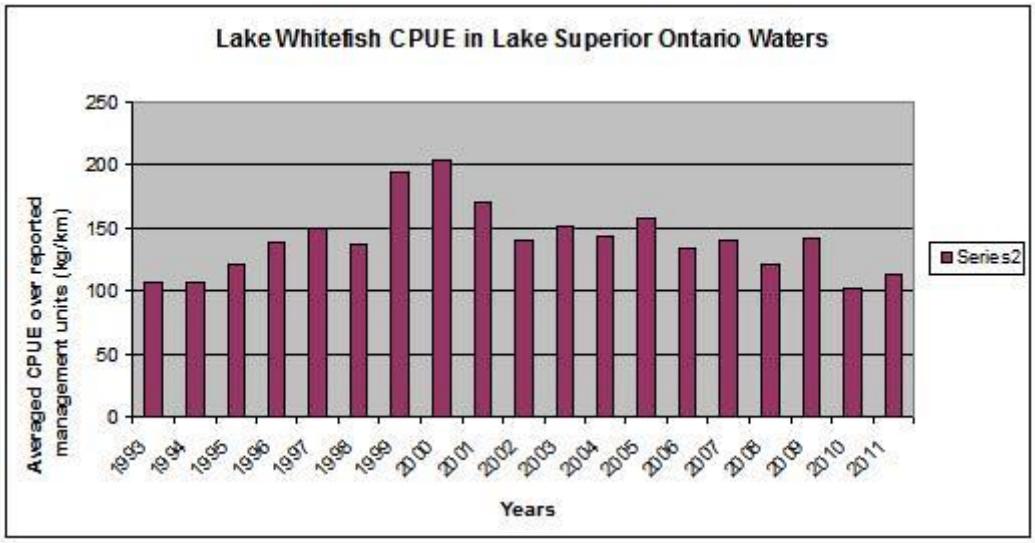

Figure 2. Averaged CPUE across all reported management units in Ontario Waters in Lake Superior per year from 1993–2011.

Wisconsin Lake Superior, Gillnet, Bottom

Wisconsin Lake Superior, Trap net

Moderate Concern

For more than a century, lake whitefish has shown trends similar to many other species in Lake Superior. Harvest was high in the 19th century and declined in the mid-20th century because of sea lamprey predation. In 1903, harvest was less than 100,000 kg, and in 2006 commercial harvest was over 600,000 kg. Commercial harvest and fishery independent surveys both indicated that whitefish abundance has increased dramatically since 1970 (Michael Seider and Stephen Schram 2009).

Lake whitefish scores “moderate concern” because the population compared to the reference point that would impair recruitment is unknown or unable to be obtained.

Factor 1.3 - Fishing Mortality

Canada Lake Superior, Gillnet, Bottom

Low Concern

In 2012 the lake whitefish harvest was 121,994 kg. In 2011 the lake whitefish harvest was 115,991 kg, so 33.4% of the quota was taken (Upper Great Lakes Management Unit 2011).

Rationale:

Thunder Bay accounts for the majority of the lake whitefish harvested in the western Ontario waters of Lake Superior (west of the Pic River). There are unlicensed fishermen in the eastern portion of Lake Superior targeting lake whitefish. The unlicensed fishermen's harvest has been declining and is less than 40% of the 1998–2010 average, and this harvest is included in the calculation of the percent of quota taken (Upper Great Lakes Management Unit 2011). Ontario requires licensing of all fisheries including those created under treaty rights of tribal peoples. There are three types of licenses issued and the majority of the tribal communities fish under these agreements/licenses. However, in the case of eastern Lake Superior, one tribal band refuses to fish under a license/agreement and therefore does not accept the quotas or the requirement for reporting, but they have the right to fish (pers. comm., OMNR).

Michigan Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Trap net

Moderate Concern

All management units in Michigan waters in Lake Superior had lake whitefish yields below the total allowable catch (TAC). The TAC is set using a proxy of spawning potential reduction (SPR) equal to 0.2. SPR was calculated by dividing the spawning stock biomass per recruit (with a fishing mortality rate of 65%(by the spawning stock biomass per recruit (assuming only natural mortality). If SPR was less than 0.2, fishing mortality was decreased until SPR was equal to 0.2. This approach represents a more aggressive harvest strategy compared with the approach used for other species (Caroffino, D.C., Lenart, S.J. 2012). As a result, the TACs may be less conservative than F_{MSY}, so catch is a "moderate concern" even though catch is less than the TAC.

Rationale:
In 2010, commercial yield of lake whitefish from trap nets was 22,031 lbs in management unit WFS-04. The trap net fishing mortality from 2008–2010 of age 4+ was 0.060/yr. In 2010, commercial yield of lake whitefish from trap nets was 56,974 lbs in management unit WFS-05. The trap net fishing mortality from 2008–2010 of age 4+ was 0.057/yr. In 2010, there was no trap net fishing in management unit WFS-06. In 2010, commercial yield of lake whitefish from trap nets was 204,000 lbs in management unit WFS-07. The trap net fishing mortality from 2008–2010 of age 4+ was 0.20/yr. The trap net fishing mortality from 2008–2010 of age 4+ was 0.38/yr (Caroffino, D.C., Lenart, S.J. 2012). In 2010, commercial yield of lake whitefish from gill nets was 21,887 lbs in management unit WFS-04. The gill net fishing mortality from 2008–2010 of age 4+ was 0.076/yr. In 2010, commercial yield of lake whitefish from gill nets was 5,220 lbs in management unit WFS-05. The gill net fishing mortality from 2008–2010 of age 4+ was 0.0160/y. In 2010, commercial yield of lake whitefish from gill nets was 3,600 lbs in management unit WFS-06. In 2010, commercial yield of lake whitefish from gill nets was 232,000 lbs in management unit WFS-07. The gill net fishing mortality from 2008–2010 of age 4+ was 0.22/yr. The gill net fishing mortality from 2008–2010 of age 4+ was 0.067/yr. All whitefish yields in these management units were below the total

allowable catch or TAC (Caroffino, D.C., Lenart, S.J. 2012).

The Consent Decree outlines a specific lake trout management regime that regulates the fishery through yield and effort limits established through maximum lake trout mortality rates, which differ by management unit. In non-shared units, in which the tribes exclusively have the commercial fishing opportunities, harvest regulation guidelines (HRGs) are set based upon a number of factors, including characteristics of the fishery and the population. A Modeling Subcommittee (MSC) of the Technical Fisheries Committee (TFC) was established and charged with developing the annual yield and effort limits required by the Consent Decree. Recommended yield limits were obtained by either limiting mortality to a maximum rate or achieving a minimum spawning potential reduction. The maximum allowable mortality rate on whitefish was 65%. In Lake Superior, commercial harvest of lake whitefish has generally declined over time in the western units as a result of declining effort. Yield has declined less dramatically in the eight eastern units (WFS-07 and WFS-08), but is still generally below peak yield from the late 1980s and early 1990s (Caroffino, D.C., Lenart, S.J. 2012).

Wisconsin Lake Superior, Gillnet, Bottom

Wisconsin Lake Superior, Trap net

High Concern

The sustainability of the current harvest of whitefish is a management concern. Commercial harvest of whitefish was variable but generally increased from 1970 to 2006. Harvest ranged from 59,422 kg in 1970 to 630,388 kg in 2005. During the 1980s and in 1997, the commercial harvest exceeded the highest values recorded since 1903. Data suggest that growth and condition of whitefish may be beginning to decline. It is likely that this decline is due to a density dependence issue. The commercial harvest peaked in 2003 at 8 fish/1000 m of net and in 2006 dropped back down to 2 fish/1000 m of net (Michael Seider and Stephen Schram 2009)

This is “high concern” because of the unavailable data on commercial harvest combined with the data suggesting that the stock may be declining.

Rationale:
Because of legal reasons, more recent data were not available, so this rated as “high concern.”

RAINBOW SMELT

Factor 1.1 - Inherent Vulnerability

Canada Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Gillnet, Bottom

Minnesota Lake Superior, Pound Net

Wisconsin Lake Superior, Gillnet, Bottom

Wisconsin Lake Superior, Pound Net

Medium

Rainbow smelt is an introduced species in the Great Lakes and serves as forage fish for many native species. Rainbow smelt reaches maturity in 1–2 years and can live for >7 years. It is a plantivorous fish that preys on zooplankton, as well as larvae of other fish species. Spawning is typically initiated shortly after ice out, and takes place in streams and rivers. Rainbow smelt is a broadcast spawner.

The FishBase vulnerability score for rainbow smelt is 38 (Froese & Pauley 2012). Therefore, rainbow smelt inherent vulnerability is classified as “medium.”

Factor 1.2 -Abundance

Canada Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Gillnet, Bottom

Minnesota Lake Superior, Pound Net

Wisconsin Lake Superior, Gillnet, Bottom

Wisconsin Lake Superior, Pound Net

Very Low Concern

Lakewide mean biomass for rainbow smelt was 0.53 kg/ha in 2013. This was less than the longer-term average of 1.22 kg/ha. Density of age-1 fish was 142.9 fish/ha in 2013, which was similar to the long-term average of 165.15 fish/ha (Mark R. Vinson, Lori M. Evrard, Owen T. Gorman, Daniel L. Yule 2013).

This is ranked as “very low concern” because it is a non-native species.

Factor 1.3 - Fishing Mortality

Canada Lake Superior, Gillnet, Bottom

Very Low Concern

Rainbow smelt is a non-native species in Lake Superior. In 2012 there was 5,437 kg of rainbow smelt harvested in Ontario waters. This is significantly lower than the historic average from 1995 to 2012 of 1,851.42 kg. The peak of rainbow smelt harvest was in 2001 and it rapidly declined from then on (Lloyd Mohr 2014).

This is ranked “very low concern” because it is a non-native species.

Minnesota Lake Superior, Pound Net

Very Low Concern

61,900 pounds of rainbow smelt was the total harvest in 2011 (Cory A. Goldsworthy and Donald R. Schreiner 2012). The commercial harvest of rainbow smelt increased 53% in 2012, but CPUE decreased 40% compared to 2011 (Cory Goldsworthy 2012).

Rainbow smelt is a non-native species so it is a “very low concern.”

Rationale:

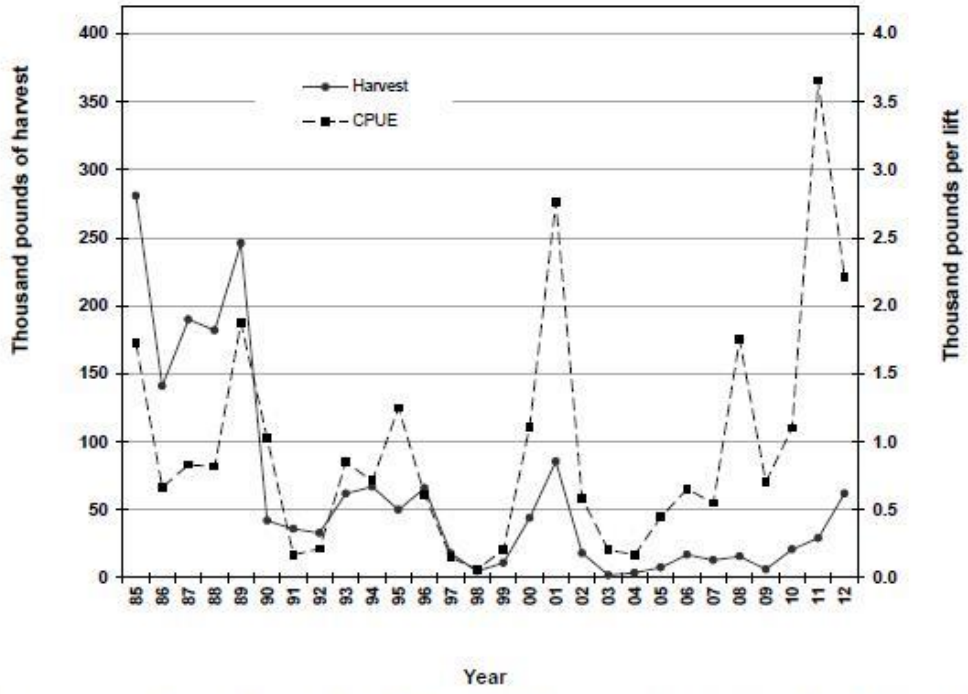

Figure 2. Rainbow smelt harvest and catch per unit effort (CPUE) in the commercial pound net fishery, Minnesota waters of Lake Superior, 1985-2012.

Figure 3. Harvest and Catch per Unit Effort in Minnesota waters of Lake Superior from 1985–2012.

Wisconsin Lake Superior, Pound Net

Very Low Concern

Rainbow smelt is a non-native species in the Great Lakes. Harvest has been decreasing and only 49 lbs were caught by state-licensed commercial fishermen in 2013 (according to an anonymous fisheries biologist in the region). The majority are caught in pound nets but a small portion of this are from gill nets.

This is rated a “very low concern” because it is an invasive species.

Wisconsin Lake Superior, Gillnet, Bottom

Very Low Concern

Rainbow smelt is an invasive species in the Great Lakes. Harvest has been decreasing and only 49 lbs were caught by state-licensed commercial fishermen in 2013 (according to an anonymous fisheries biologist in the region). The majority are caught in pound nets but a small portion of this are from gill nets.

Michigan Lake Superior, Gillnet, Bottom

Very Low Concern

Rainbow smelt is a non-native species in Lake Superior. Rainbow smelt is only harvested in Management unit MI-8 using gillnets. In 2012, 10,769 lbs of rainbow smelt were harvested, which is above the average harvest from 2007–2013 of 3,154 lbs (Dave Caroffino 2013).

This is ranked as a “very low concern” because it is a non-native species.

WALLEYE

Factor 1.1 - Inherent Vulnerability

Canada Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Trap net

Wisconsin Lake Superior, Gillnet, Bottom

Medium

The walleye is the largest member of the perch family, and is considered the dominant near-shore predator. Walleye can live >25 years with males maturing at age 2–4 and females maturing at age 3–6. In the spring, walleye migrate to tributary streams to lay eggs over gravel and rock.

The FishBase vulnerability score for walleye is 40 (Froese & Pauley 2012). Therefore, walleye inherent vulnerability is classified as “medium.”

Factor 1.2 - Abundance

Canada Lake Superior, Gillnet, Bottom

High Concern

Walleye seem to be in an early stage of recovery, but nowhere near their historical abundance (Eric Berglund 2014). Mean age distribution, mortality rates, growth rates, CPUE, and other abundance estimates form the basic population information. The Lake Superior management unit is responsible for collecting, analyzing, and interpreting data (OMNR 2014).

Walleye are “high concern” because they are in recovery but nowhere near their historical abundance.

Michigan Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Trap net

Wisconsin Lake Superior, Gillnet, Bottom

High Concern

There are no stock assessments for walleye in Lake Superior but the Great Lakes Fishery Commission puts out a summary of the walleye population in Lake Superior in their state of the lake report. During 2001–2005, most walleye populations were significantly below historical abundance levels, with the St. Louis River population being the only one at or near historical abundance because of conservation efforts. There is a walleye rehabilitation plan with the goals of maintaining, enhancing, and rehabilitating self-sustaining populations of walleye and their habitat over their historical range. Some of these populations are being augmented by stocking and are highly regulated to restore the population and/or maintain a fishery (Owen T. Gorman, Mark P. Ebener and Mark R. Vinson 2005). There are also no CPUE values for walleye because often they are not a targeted species but caught as bycatch and kept for market.

Factor 1.3 - Fishing Mortality

Canada Lake Superior, Gillnet, Bottom

Low Concern

Walleye is not a targeted fishery but is only caught as bycatch from other targeted fisheries. Black Bay once supported the largest walleye fishery on Lake Superior, but collapsed in 1970 after several years of very high exploitation (a peak of ~135,000 kg/yr in 1966) (Eric Berglund 2014). Mortality seems to be declining (pers. comm., OMNR). An incidental quota is assigned to this species. There are detailed guidelines for setting quotas. Quotas are based on corroborating evidence and trend-through-time. Mean age, age distribution, mortality rates, growth rates, and CPUE will form the basic evidence package. Local quota-setting meetings are held to ensure that local issues are raised. Conservation of the fish stocks will be the priority (OMNR 2014). In 2012, 1,035 kg of walleye were harvested in Ontario waters of Lake Superior. This is above the average harvest from 1995–2012 of 610 kg (Lloyd Mohr 2014). In 2011, 368 kg of walleye were harvested, which was 24.1% of the quota (Upper Great Lakes Management Unit 2011). Walleye in Canadian waters are “low concern” because they are still in recovery but mortality seems to be declining and flexible conservative quotas are put in place.

Wisconsin Lake Superior, Gillnet, Bottom

Moderate Concern

The current harvest of walleye in Lake Superior is significantly lower than historical harvest values. Management has said that total annual mortality should not exceed 45% (Stephen T Schram 2000). The tribes are allowed to catch and sell 5,000 pounds of walleye in WI-1 (i.e., western arm) (according to an anonymous fisheries biologist in the region). It is not known if catches are below allotted limits. Other more recent information on the fishery could not be provided because of legal issues.

Rationale:
Historically, walleye were an important regional fishery, with fish communities in large bays, estuaries, and rivers of Lake Superior, but overharvesting, habitat degradation, and pollution during the late 1800s and early 1900s led to their decline. The walleye rehabilitation plan was put in place in 2001.

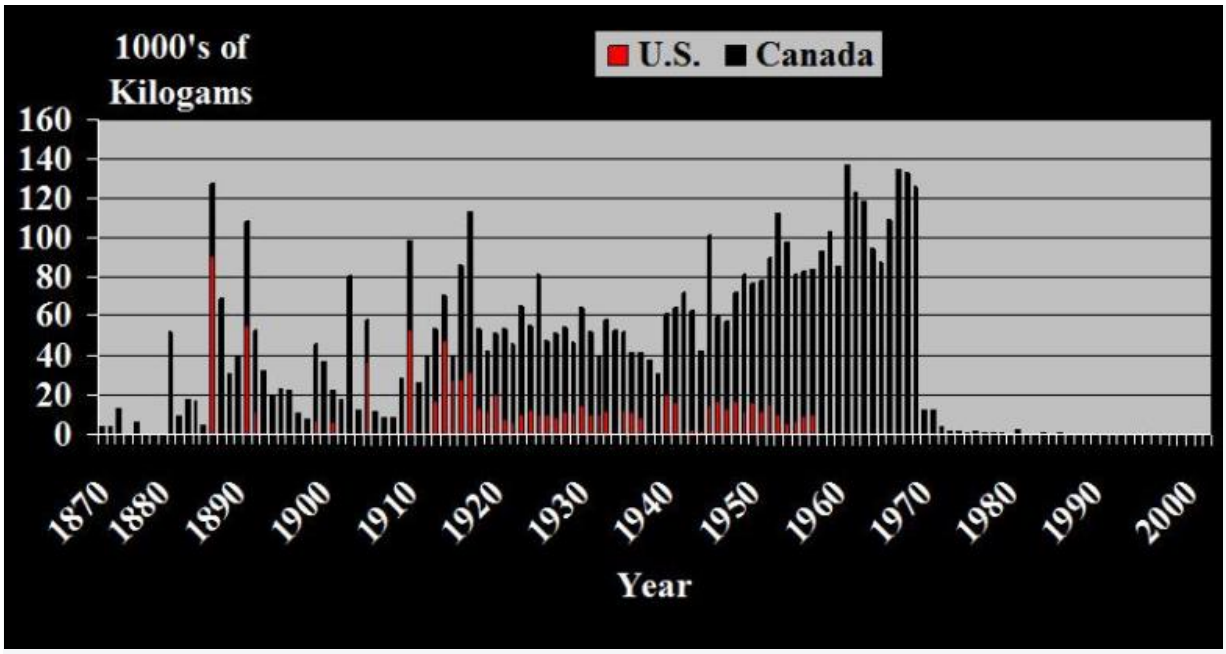

Figure 4. Historical harvest of Walleye in Lake Superior from the U.S. and Canada from 1870–2000.

Michigan Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Trap net

Moderate Concern

In 2012, walleye were only caught in management unit MI-8. In that year, 595 pounds were harvested, which is below the average harvest of 688 lbs across management units from 2007–2013. These numbers are reported and fished by the tribal community (Dave Caroffino 2013). Due to overharvesting, habitat degradation, and pollution during the late 1800s and early 1900s, the population of walleye declined, but soon after, a walleye rehabilitation plan was put in place. The goal is to rehabilitate and support a self-sustaining population. As part of the rehabilitation plan, there is a total annual allowable mortality of 45%. Walleye is not one of the main commercially targeted species, so updates on this species happen less often. But in the 2005, The State of Lake Superior in 2005, total annual mortality was below 45%. In 1972, the Michigan DNR banned the use of small-mesh gillnets, to reduce the mortality of non-target fish species (MDNR website). This was later followed by a ban of large-mesh gillnets except for tribal use.

In 2012. only 599 lbs of walleye were caught (all from management unit MI-8), which is significantly lower than the average harvest from 2007–2013. These numbers are reported by the tribal community (Dave Caroffino 2013).

This is ranked “moderate concern” because there is no quota for walleye by the consent decree parties and no estimates of fishing mortality rates relative to a sustainable level, but the harvest numbers are

low.

YELLOW PERCH

Factor 1.1 - Inherent Vulnerability

Canada Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Gillnet, Bottom

Low

The yellow perch inhabits shallow, near-shore areas where it dines primarily on immature insects, larger invertebrates (such as crayfish), and the eggs and young of other fish. Male perch reach sexual maturity at 3 years of age while females mature at age 4. Yellow perch often live 9 to 10 years. Yellow perch spawn in the spring, laying eggs in gelatinous strings over dense vegetation, roots, and fallen trees.

The FishBase vulnerability score is 31 for yellow perch (Froese & Pauley 2012). Therefore, the yellow perch inherent vulnerability is classified as “low.”

Factor 1.2 - Abundance

Canada Lake Superior, Gillnet, Bottom

Moderate Concern

After 2000, there has been a decline in harvest and relative abundance in management zone 7, which led to the closure of the fishery by 2004. Currently, yellow perch is an incidental catch from other target species. In 2011, the average CPUE across all reported management zones was 69 kg/km, which is above the average CPUE from reported management zones from 1993–2011 of 38.36 kg/km (Upper Great Lakes Management Unit 2011).

This is “moderate concern” because the fishery is closed but the species is still in recovery and caught as bycatch.

Michigan Lake Superior, Gillnet, Bottom

Moderate Concern

There are no biomass estimates for yellow perch in Lake Superior. There are also no CPUE values for

yellow perch because it is not a targeted species, but often caught as bycatch and kept for markets.

Factor 1.3 - Fishing Mortality

Canada Lake Superior, Gillnet, Bottom

Low Concern

In 2012, 485 kg of yellow perch was harvested. This is significantly smaller than the average harvest from 1995–2012 of 7,935 kg (Lloyd Mohr 2014). In 2011, 726 kg of yellow perch was harvested, which was 9.1% of the quota (Upper Great Lakes Management Unit 2011). An incidental quota is assigned to this species. There are detailed guidelines for setting quotas. Quotas are based on corroborating evidence and trend-through-time. Mean age, age distribution, mortality rates, growth rates, and CPUE will form the basic evidence package. Local quota-setting meetings are held to ensure that local issues are raised. Conservation of the fish stocks will be the priority (OMNR 2014).

This is ranked “low concern” because it is still recovering but harvest is extremely low.

Rationale:
Yellow perch is a relatively small component of the Lake Superior commercial fishery in Canadian waters, limited to a few quota zones with suitable habitat.

Michigan Lake Superior, Gillnet, Bottom

Very Low Concern

No yellow perch were caught in Michigan waters in 2012 in any management unit. The average harvest from 2007–2013 was 15 lbs, which is all incidental catch from the targeted species commercial fishery of lake whitefish. These numbers are reported by the tribal community (Dave Caroffino 2013).

Criterion 2: Impacts on other species

All main retained and bycatch species in the fishery are evaluated in the same way as the species under assessment were evaluated in Criterion 1. Seafood Watch® defines bycatch as all fisheries-related mortality or injury to species other than the retained catch. Examples include discards, endangered or threatened species catch, and ghost fishing.

To determine the final Criterion 2 score, the score for the lowest scoring retained/bycatch species is multiplied by the discard rate score (ranges from 0-1), which evaluates the amount of non-retained catch (discards) and bait use relative to the retained catch. The Criterion 2 rating is determined as follows:

- *Score >3.2=Green or Low Concern*
- *Score >2.2 and <=3.2=Yellow or Moderate Concern*
- *Score <=2.2=Red or High Concern*

Rating is Critical if Factor 2.3 (Fishing Mortality) is Critical.

Criterion 2 Summary

Lake trout: Canada Lake Superior, Gillnet, Bottom

Subscore:: 2.709 **Discard Rate: 1.00** **C2 Rate: 2.709**

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
LAKE TROUT	High	3.00: Moderate Concern	1.00: High Concern	**1.732**
WALLEYE	Medium	2.00: High Concern	3.67: Low Concern	**2.709**
LAKE WHITEFISH	Medium	3.00: Moderate Concern	3.67: Low Concern	**3.318**
YELLOW PERCH	Low	3.00: Moderate Concern	3.67: Low Concern	**3.318**
RAINBOW SMELT	Medium	5.00: Very Low Concern	5.00: Very Low Concern	**5.000**

Lake trout: Michigan Lake Superior, Gillnet, Bottom

Subscore:: 2.159 **Discard Rate: 1.00** **C2 Rate: 2.159**

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
WALLEYE	Medium	2.00: High	2.33:	**2.159**

		Concern	Moderate Concern	
LAKE WHITEFISH	Medium	3.00: Moderate Concern	2.33: Moderate Concern	**2.644**
LAKE TROUT	High	3.00: Moderate Concern	3.67: Low Concern	**3.318**
YELLOW PERCH	Low	3.00: Moderate Concern	5.00: Very Low Concern	**3.873**
RAINBOW SMELT	Medium	5.00: Very Low Concern	5.00: Very Low Concern	**5.000**

Lake trout: Michigan Lake Superior, Trap net

Subscore:: **2.159** **Discard Rate:** **1.00** **C2 Rate:** **2.159**

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
WALLEYE	Medium	2.00: High Concern	2.33: Moderate Concern	**2.159**
LAKE WHITEFISH	Medium	3.00: Moderate Concern	2.33: Moderate Concern	**2.644**
LAKE TROUT	High	3.00: Moderate Concern	3.67: Low Concern	**3.318**

Lake trout: Minnesota Lake Superior, Gillnet, Bottom

Subscore:: **3.318** **Discard Rate:** **1.00** **C2 Rate:** **3.318**

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
LAKE HERRING	Medium	3.00: Moderate Concern	3.67: Low Concern	**3.318**
LAKE TROUT	High	3.00: Moderate Concern	3.67: Low Concern	**3.318**

Lake trout: Minnesota Lake Superior, Trap net

Subscore:: **5.000** **Discard Rate:** **1.00** **C2 Rate:** **5.000**

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
LAKE TROUT	High	3.00: Moderate Concern	3.67: Low Concern	**3.318**

Lake trout: Wisconsin Lake Superior, Gillnet, Bottom

Subscore:: **1.732** **Discard Rate:** **1.00** **C2 Rate:** **1.732**

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
LAKE TROUT	High	3.00: Moderate Concern	1.00: High Concern	**1.732**
LAKE WHITEFISH	Medium	3.00: Moderate Concern	1.00: High Concern	**1.732**
WALLEYE	Medium	2.00: High Concern	2.33: Moderate Concern	**2.159**
RAINBOW SMELT	Medium	5.00: Very Low Concern	5.00: Very Low Concern	**5.000**

Lake trout: Wisconsin Lake Superior, Trap net

Subscore:: **1.732** **Discard Rate:** **1.00** **C2 Rate:** **1.732**

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
LAKE TROUT	High	3.00: Moderate Concern	1.00: High Concern	**1.732**
LAKE WHITEFISH	Medium	3.00: Moderate Concern	1.00: High Concern	**1.732**

Lake whitefish: Canada Lake Superior, Gillnet, Bottom

Subscore:: **1.732** **Discard Rate:** **1.00** **C2 Rate:** **1.732**

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
LAKE TROUT	High	3.00: Moderate Concern	1.00: High Concern	**1.732**
WALLEYE	Medium	2.00: High	3.67: Low	**2.709**

		Concern	Concern	
LAKE WHITEFISH	Medium	3.00: Moderate Concern	3.67: Low Concern	**3.318**
YELLOW PERCH	Low	3.00: Moderate Concern	3.67: Low Concern	**3.318**
RAINBOW SMELT	Medium	5.00: Very Low Concern	5.00: Very Low Concern	**5.000**

Lake whitefish: Michigan Lake Superior, Gillnet, Bottom

Subscore:: **2.159** **Discard Rate:** **1.00** **C2 Rate:** **2.159**

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
WALLEYE	Medium	2.00: High Concern	2.33: Moderate Concern	**2.159**
LAKE WHITEFISH	Medium	3.00: Moderate Concern	2.33: Moderate Concern	**2.644**
LAKE TROUT	High	3.00: Moderate Concern	3.67: Low Concern	**3.318**
YELLOW PERCH	Low	3.00: Moderate Concern	5.00: Very Low Concern	**3.873**
RAINBOW SMELT	Medium	5.00: Very Low Concern	5.00: Very Low Concern	**5.000**

Lake whitefish: Michigan Lake Superior, Trap net

Subscore:: **2.159** **Discard Rate:** **1.00** **C2 Rate:** **2.159**

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
WALLEYE	Medium	2.00: High Concern	2.33: Moderate Concern	**2.159**
LAKE WHITEFISH	Medium	3.00: Moderate Concern	2.33: Moderate Concern	**2.644**
LAKE TROUT	High	3.00: Moderate Concern	3.67: Low Concern	**3.318**

Lake whitefish: Wisconsin Lake Superior, Gillnet, Bottom

Subscore:: 1.732 **Discard Rate:** 1.00 **C2 Rate:** 1.732

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
LAKE TROUT	High	3.00: Moderate Concern	1.00: High Concern	**1.732**
LAKE WHITEFISH	Medium	3.00: Moderate Concern	1.00: High Concern	**1.732**
WALLEYE	Medium	2.00: High Concern	2.33: Moderate Concern	**2.159**
RAINBOW SMELT	Medium	5.00: Very Low Concern	5.00: Very Low Concern	**5.000**

Lake whitefish: Wisconsin Lake Superior, Trap net

Subscore:: 1.732 **Discard Rate:** 1.00 **C2 Rate:** 1.732

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
LAKE TROUT	High	3.00: Moderate Concern	1.00: High Concern	**1.732**
LAKE WHITEFISH	Medium	3.00: Moderate Concern	1.00: High Concern	**1.732**

Rainbow smelt: Canada Lake Superior, Gillnet, Bottom

Subscore:: 1.732 **Discard Rate:** 1.00 **C2 Rate:** 1.732

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
LAKE TROUT	High	3.00: Moderate Concern	1.00: High Concern	**1.732**
WALLEYE	Medium	2.00: High Concern	3.67: Low Concern	**2.709**
LAKE WHITEFISH	Medium	3.00: Moderate Concern	3.67: Low Concern	**3.318**
YELLOW PERCH	Low	3.00: Moderate Concern	3.67: Low Concern	**3.318**

RAINBOW SMELT	Medium	5.00: Very Low Concern	5.00: Very Low Concern	**5.000**

Rainbow smelt: Michigan Lake Superior, Gillnet, Bottom

Subscore:: **2.159** **Discard Rate:** **1.00** **C2 Rate:** **2.159**

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
WALLEYE	Medium	2.00: High Concern	2.33: Moderate Concern	**2.159**
LAKE WHITEFISH	Medium	3.00: Moderate Concern	2.33: Moderate Concern	**2.644**
LAKE TROUT	High	3.00: Moderate Concern	3.67: Low Concern	**3.318**
YELLOW PERCH	Low	3.00: Moderate Concern	5.00: Very Low Concern	**3.873**
RAINBOW SMELT	Medium	5.00: Very Low Concern	5.00: Very Low Concern	**5.000**

Rainbow smelt: Minnesota Lake Superior, Pound Net

Subscore:: **5.000** **Discard Rate:** **1.00** **C2 Rate:** **5.000**

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
RAINBOW SMELT	Medium	5.00: Very Low Concern	5.00: Very Low Concern	**5.000**

Rainbow smelt: Wisconsin Lake Superior, Gillnet, Bottom

Subscore:: **1.732** **Discard Rate:** **1.00** **C2 Rate:** **1.732**

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
LAKE TROUT	High	3.00: Moderate Concern	1.00: High Concern	**1.732**
LAKE WHITEFISH	Medium	3.00: Moderate Concern	1.00: High Concern	**1.732**
WALLEYE	Medium	2.00: High Concern	2.33: Moderate	**2.159**

			Concern	
RAINBOW SMELT	Medium	5.00: Very Low Concern	5.00: Very Low Concern	**5.000**

Rainbow smelt: Wisconsin Lake Superior, Pound Net

Subscore:: 5.000 **Discard Rate: 1.00** **C2 Rate: 5.000**

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
RAINBOW SMELT	Medium	5.00: Very Low Concern	5.00: Very Low Concern	**5.000**

Walleye: Canada Lake Superior, Gillnet, Bottom

Subscore:: 1.732 **Discard Rate: 1.00** **C2 Rate: 1.732**

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
LAKE TROUT	High	3.00: Moderate Concern	1.00: High Concern	**1.732**
WALLEYE	Medium	2.00: High Concern	3.67: Low Concern	**2.709**
LAKE WHITEFISH	Medium	3.00: Moderate Concern	3.67: Low Concern	**3.318**
YELLOW PERCH	Low	3.00: Moderate Concern	3.67: Low Concern	**3.318**
RAINBOW SMELT	Medium	5.00: Very Low Concern	5.00: Very Low Concern	**5.000**

Walleye: Michigan Lake Superior, Gillnet, Bottom

Subscore:: 2.644 **Discard Rate: 1.00** **C2 Rate: 2.644**

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
WALLEYE	Medium	2.00: High Concern	2.33: Moderate Concern	**2.159**
LAKE WHITEFISH	Medium	3.00: Moderate Concern	2.33: Moderate Concern	**2.644**
LAKE TROUT	High	3.00: Moderate	3.67: Low Concern	**3.318**

		Concern		
YELLOW PERCH	Low	3.00: Moderate Concern	5.00: Very Low Concern	**3.873**
RAINBOW SMELT	Medium	5.00: Very Low Concern	5.00: Very Low Concern	**5.000**

Walleye: Michigan Lake Superior, Trap net

Subscore:: **2.644** **Discard Rate:** **1.00** **C2 Rate:** **2.644**

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
WALLEYE	Medium	2.00: High Concern	2.33: Moderate Concern	**2.159**
LAKE WHITEFISH	Medium	3.00: Moderate Concern	2.33: Moderate Concern	**2.644**
LAKE TROUT	High	3.00: Moderate Concern	3.67: Low Concern	**3.318**

Walleye: Wisconsin Lake Superior, Gillnet, Bottom

Subscore:: **1.732** **Discard Rate:** **1.00** **C2 Rate:** **1.732**

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
LAKE TROUT	High	3.00: Moderate Concern	1.00: High Concern	**1.732**
LAKE WHITEFISH	Medium	3.00: Moderate Concern	1.00: High Concern	**1.732**
WALLEYE	Medium	2.00: High Concern	2.33: Moderate Concern	**2.159**
RAINBOW SMELT	Medium	5.00: Very Low Concern	5.00: Very Low Concern	**5.000**

Yellow perch: Canada Lake Superior, Gillnet, Bottom

Subscore:: **1.732** **Discard Rate:** **1.00** **C2 Rate:** **1.732**

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore

LAKE TROUT	High	3.00: Moderate Concern	1.00: High Concern	**1.732**
WALLEYE	Medium	2.00: High Concern	3.67: Low Concern	**2.709**
LAKE WHITEFISH	Medium	3.00: Moderate Concern	3.67: Low Concern	**3.318**
YELLOW PERCH	Low	3.00: Moderate Concern	3.67: Low Concern	**3.318**
RAINBOW SMELT	Medium	5.00: Very Low Concern	5.00: Very Low Concern	**5.000**

Yellow perch: Michigan Lake Superior, Gillnet, Bottom

Subscore:: **2.159** **Discard Rate:** **1.00** **C2 Rate:** **2.159**

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
WALLEYE	Medium	2.00: High Concern	2.33: Moderate Concern	**2.159**
LAKE WHITEFISH	Medium	3.00: Moderate Concern	2.33: Moderate Concern	**2.644**
LAKE TROUT	High	3.00: Moderate Concern	3.67: Low Concern	**3.318**
YELLOW PERCH	Low	3.00: Moderate Concern	5.00: Very Low Concern	**3.873**
RAINBOW SMELT	Medium	5.00: Very Low Concern	5.00: Very Low Concern	**5.000**

Species included in Criterion 2 include all species that make up 5% or more of the total catch by that fishery. Catch composition was determined from data provided by reports from the Michigan Department of Natural Resources, Minnesota DNR, Wisconsin DNR, and the Ontario Ministry of Natural Resources.

Lake sturgeon landings are prohibited throughout the Great Lakes, but they are occasionally incidentally captured in gillnets. However, there is a general consensus throughout the fishery community (scientists and fishermen) that gillnets most often do not harm lake sturgeon. Fishing methods utilized in Lake Superior (gillnets and trap nets) are not believed to have significant impacts on lake sturgeon, and most fish that are incidentally caught with such gears are returned to the water alive (Threader and Broussaeu 1986) (Hayes and Caroffino 2012) (pers. comm., MDNR). Ontario has a daily catch reporting

system in which all fish that are caught must be reported, but lake sturgeon are not harvested. They must be returned to their waters, and there is little mortality because soak times are generally short (pers. comm. OMNR). The capture rates of lake sturgeon in both these fisheries are also extremely low. Therefore, the Great Lakes fisheries are deemed not to impact lake sturgeon populations, and lake sturgeon are not included in the assessment.

Criterion 2 Assessment

LAKE HERRING

Factor 2.1 - Inherent Vulnerability

Scoring Guidelines (same as Factor 1.1 above)

Canada Lake Superior, Gillnet, Midwater

Minnesota Lake Superior, Gillnet, Bottom

Medium

Lake herring (*Coregonus artedi*) is a long-lived, large-bodied, deepwater prey fish related to the lake whitefish, which once dominated the diets of native Great Lakes predators such as lake trout. Its life history characteristics, such as high fecundity and moderate population growth rates, impart moderate resilience to fishing pressure. It has persisted throughout the Great Lakes basin despite overfishing and competition with or predation by invasive species (such as alewife) during more than a century of Great Lakes commercial fisheries. But lake herring have some behaviors that increase their vulnerability to fishing pressure, including aggregating in schools—particularly during spawning season in the fall when some populations move to shallower waters (Carla Ng 2008).

The FishBase inherent vulnerability score for lake herring is 43, which is in the “medium” vulnerability range.

Factor 2.2 - Abundance

Scoring Guidelines (same as Factor 1.2 above)

Canada Lake Superior, Gillnet, Midwater

Moderate Concern

Acoustic surveys and midwater trawl surveys are done to estimate abundance annually (Daniel L. Yule, et al., 2009). In 2009, abundance in Thunder Bay (where most fishing occurs) was 6.5 million, and it was 1.12 million in Black Bay. Cisco CPUE for quota zones 1–3, where the largest harvests are fished, have

been increasing since 2002 and have been fairly stable in the past decades. Yet quota zone 7, which is were most of the cisco fishery is targeted, has shown steady declines.

Abundance is “moderate concern” because some quota zones show stable populations while others show decreasing trends.

Minnesota Lake Superior, Gillnet, Bottom

Moderate Concern

Hydro-acoustic sampling and trawl surveys are done to estimate year-class strength and biomass every 3 years (Schreiner, Donald R. et al., 2006). From 1940 to 1985, abundance declined and then increased, yet they exhibit sporadic recruitment (Cory A. Goldsworthy and Donald R. Schreiner 2012).

Abundance is “moderate concern” because the stock abundance is unknown relative to reference points, and the inherent vulnerability is medium.

Factor 2.3 - Fishing Mortality

Scoring Guidelines (same as Factor 1.3 above)

Canada Lake Superior, Gillnet, Midwater

Low Concern

204,189 kg of lake herring were harvested in 2012 (Lloyd Mohr 2014). The fishery is managed so that harvest does not reduce the population’s ability to maximize recruitment. Exploitation fractions have been estimated by dividing estimates of numbers harvested by estimates of abundance from fishery-independent surveys. The Lake Superior technical committee recently recommended an annual harvest level of 10–15% (Daniel L. Yule, Eric Berglund, Lori M. Evrard, Ken I. Cullis, and Gary A. Cholwek 2009). The exploitation fraction was estimated at 7.1%, which is below the recommended maximum harvest of 15% (Upper Great Lakes Management Unit 2011).

Fishing mortality is “low concern” because estimated fishing mortality is below the maximum harvest level.

Minnesota Lake Superior, Gillnet, Bottom

Low Concern

282,066 lbs were harvested in 2012 (Cory A. Goldsworthy and Donald R. Schreiner 2012). Total allowable catch is based on 10% of the lower limit of the estimate of spawning stock biomass determined by hydro-acoustic survey estimates. Harvest was below TAC in all management units in 2012.

Fishing mortality is “low concern” because harvest is below TAC in all management units.

Factor 2.4 - Discard Rate

Canada Lake Superior, Gillnet, Midwater

< 20%

Minnesota Lake Superior, Gillnet, Bottom

< 20%

Although detailed bycatch data from these fisheries could not be obtained, discard rates of lake trout and lake whitefish are minimal (Caroffino & Lenart 2012) (pers. comm., DNR). Though many species harvested in the commercial fishery are retained as incidental catch, they still possess market value and are taken to port.

Criterion 3: Management effectiveness

Management is separated into management of retained species (harvest strategy) and management of non-retained species (bycatch strategy).

The final score for this criterion is the geometric mean of the two scores. The Criterion 3 rating is determined as follows:

- *Score >3.2=Green or Low Concern*
- *Score >2.2 and <=3.2=Yellow or Moderate Concern*
- *Score <=2.2 or either the Harvest Strategy (Factor 3.1) or Bycatch Management Strategy (Factor 3.2) is Very High Concern = Red or High Concern*

Rating is Critical if either or both of Harvest Strategy (Factor 3.1) and Bycatch Management Strategy (Factor 3.2) ratings are Critical.

Criterion 3 Summary

Region / Method	Management of Retained Species	Management of Non-Retained Species	Overall Recommendation
Canada Lake Superior Gillnet, Bottom	3.000	All Species Retained	Yellow(3.000)
Michigan Lake Superior Gillnet, Bottom	3.000	All Species Retained	Yellow(3.000)
Michigan Lake Superior Trap net	3.000	All Species Retained	Yellow(3.000)
Minnesota Lake Superior Gillnet, Bottom	3.000	All Species Retained	Yellow(3.000)
Minnesota Lake Superior Pound Net	3.000	All Species Retained	Yellow(3.000)
Minnesota Lake Superior Trap net	3.000	All Species Retained	Yellow(3.000)
Wisconsin Lake Superior Gillnet, Bottom	3.000	All Species Retained	Yellow(3.000)
Wisconsin Lake Superior Pound Net	3.000	All Species Retained	Yellow(3.000)
Wisconsin Lake Superior Trap net	3.000	All Species Retained	Yellow(3.000)

Factor 3.1: Harvest Strategy

Scoring Guidelines

Seven subfactors are evaluated: Management Strategy, Recovery of Species of Concern, Scientific Research/Monitoring, Following of Scientific Advice, Enforcement of Regulations, Management Track Record, and Inclusion of Stakeholders. Each is rated as 'ineffective,' 'moderately effective,' or 'highly effective.'

- *5 (Very Low Concern)—Rated as 'highly effective' for all seven subfactors considered.*
- *4 (Low Concern)—Management Strategy and Recovery of Species of Concern rated 'highly effective' and all other subfactors rated at least 'moderately effective.'*
- *3 (Moderate Concern)—All subfactors rated at least 'moderately effective.'*
- *2 (High Concern)—At minimum, meets standards for 'moderately effective' for Management Strategy and Recovery of Species of Concern, but at least one other subfactor rated 'ineffective.'*
- *1 (Very High Concern)—Management exists, but Management Strategy and/or Recovery of Species of Concern rated 'ineffective.'*
- *0 (Critical)—No management exists when there is a clear need for management (i.e., fishery catches threatened, endangered, or high concern species), OR there is a high level of Illegal, unregulated, and unreported fishing occurring.*

Factor 3.1 Summary

Factor 3.1: Management of fishing impacts on retained species							
Region / Method	**Strategy**	**Recovery**	**Research**	**Advice**	**Enforce**	**Track**	**Inclusion**
Canada Lake Superior Gillnet, Bottom	Moderately Effective	Moderately Effective	Highly Effective	Highly Effective	Highly Effective	Moderately Effective	Highly Effective
Michigan Lake Superior Gillnet, Bottom	Moderately Effective	Moderately Effective	Highly Effective	Highly Effective	Highly Effective	Moderately Effective	Highly Effective
Michigan Lake Superior Trap net	Moderately Effective	Moderately Effective	Highly Effective	Highly Effective	Highly Effective	Moderately Effective	Highly Effective
Minnesota Lake Superior Gillnet, Bottom	Moderately Effective	Moderately Effective	Highly Effective	Highly Effective	Highly Effective	Moderately Effective	Highly Effective
Minnesota Lake Superior Pound Net	Moderately Effective	Moderately Effective	Highly Effective	Highly Effective	Highly Effective	Moderately Effective	Highly Effective
Minnesota Lake Superior Trap net	Moderately Effective	Moderately Effective	Highly Effective	Highly Effective	Highly Effective	Moderately Effective	Highly Effective
Wisconsin Lake Superior Gillnet, Bottom	Moderately Effective	Moderately Effective	Highly Effective	Highly Effective	Highly Effective	Moderately Effective	Highly Effective
Wisconsin Lake Superior Pound Net	Moderately Effective	Moderately Effective	Highly Effective	Highly Effective	Highly Effective	Moderately Effective	Highly Effective
Wisconsin Lake Superior Trap net	Moderately Effective	Moderately Effective	Highly Effective	Highly Effective	Highly Effective	Moderately Effective	Highly Effective

Subfactor 3.1.1 – Management Strategy and Implementation

Considerations: What type of management measures are in place? Are there appropriate management goals, and is there evidence that management goals are being met? To achieve a highly effective rating, there must be appropriate management goals, and evidence that the measures in place have been successful at maintaining/rebuilding species.

Canada Lake Superior, Gillnet, Bottom

Moderately Effective

The Great Lakes span jurisdictions in two countries, several states, one province, and a number of tribal lands, so management of the shared fishery resources is complex and dynamic. The main coordinating body of fishery management in the region is the Great Lakes Fishery Commission (GLFC), an inter-jurisdictional agency established in 1954 by the governments of the United States and Canada (Beamish 2001). The Commission comprises four Canadian and four American commissioners, who are appointed by their respective governments and supported by a secretariat in Ann Arbor, Michigan. Within the Great Lakes Fishery Commission, each lake has a Lake Committee that undertakes research and makes recommendations on sea lamprey control (the original motivation for the Commission), lake trout rehabilitation, stocking events, and other lake-specific management actions for each of the Great Lakes. Lake Committees are made of members of the actual management bodies for each lake. The GLFC and the Lake Committees do not manage the lakes; rather, they serve as a platform to help bring together the multiple management agencies involved in the Great Lakes fisheries—to better coordinate research, enforcement, stocking, quotas, and other management issues. Tribe-licensed fisheries in the Great Lakes are managed by two management agencies: the Chippewa-Ottawa Resource Authority (CORA) and the Great Lakes Indian Fish and Wildlife Commission (GLIFWC). In 1976 the Michigan Supreme Court reaffirmed that treaties signed in 1836 and 1855 reserved some tribal fishing rights outside state regulation. This finding led to the 1985 Consent Order and the 2000 Consent Decree, now in effect. The Consent Decree establishes biological monitoring and law enforcement within CORA-managed tribal fisheries, with an Executive Council and Technical Fishery Committee comprising state, tribal, and federal biologists. Since the 2000 Consent Decree, these fisheries are managed on a species-specific rather than region-specific basis, with emphasis on restoring lake trout communities (CORA 2007) (GLIFWC 2007). Some fish stock surveys and water quality monitoring in the Great Lakes region is also undertaken by the US Geological Survey's Great Lakes Science Center, NOAA's Great Lakes Environmental Research Laboratory (GLERL), and the U.S. Environmental Protection Agency (EPA). Stock assessments are conducted by the federal, state, and provincial agencies that make up the various Lake Technical Committees (LTCs). Daily catch reports, annual CPUE and harvest trends, and stock condition trends (length-to-weight ratios, size at maturity, and size at harvest) are all monitored and evaluated by the host agencies (DNR, OMNR, etc.) and shared with LTCs. In addition, fisheries-independent research conducted by local agencies and universities, which assess parameters of stock condition and the fishery as a whole, are incorporated into stock assessments. The agencies use these stock assessments to propose and set changes to yearly quotas, which are established for all species of commercial interest.

The commercial fishery in the Ontario waters of Lake Superior is managed by the Ontario Ministry of Natural Resources, Upper Great Lakes quota zone, in cooperation with licensed Ontario and tribal commercial fishermen. They produce an annual report to describe the fishery and how it is managed. They use a quota system with stock assessments being used. Stock assessments are partially done by commercial fishermen who are required to report effort, catch, and harvest information when landing fish. They also perform acoustic surveys of populations. Quota setting in the Canadian waters of Lake Superior has main principles: conservation of the fisheries resources is paramount, and management decisions will be based on the most current data available (mean age, age distribution, mortality rates, growth rates, and CPUE; the Lake Superior Management Unit is responsible for collecting and analyzing this data) (Upper Great Lakes Management Unit 2011). All commercially targeted species have quotas established.

Management Strategies and Implementation for fisheries in Lake Superior receive a score of "moderately effective." Although strategies are in place to effectively manage the fishery, successful implementation has proved a challenge due to both ecological influences (invasive species introduction, lack of self-sustaining lake trout stocks) and anthropogenic influences (varying resource use interests).

Michigan Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Trap net

Moderately Effective

The Great Lakes span jurisdictions in two countries, several states, one province, and a number of tribal lands, so management of the shared fishery resources is complex and dynamic. The main coordinating body of fishery management in the region is the Great Lakes Fishery Commission (GLFC), an inter-jurisdictional agency established in 1954 by the governments of the United States and Canada (Beamish 2001). The Commission comprises four Canadian and four American commissioners, who are appointed by their respective governments and supported by a secretariat in Ann Arbor, Michigan. Within the Great Lakes Fishery Commission, each lake has a Lake Committee that undertakes research and makes recommendations on sea lamprey control (the original motivation for the Commission), lake trout rehabilitation, stocking events, and other lake-specific management actions for each of the Great Lakes. Lake Committees are made of members of the actual management bodies for each lake. The GLFC and the Lake Committees do not manage the lakes; rather, they serve as a platform to help bring together the multiple management agencies involved in the Great Lakes fisheries—to better coordinate research, enforcement, stocking, quotas, and other management issues. Tribe-licensed fisheries in the Great Lakes are managed by two management agencies: the Chippewa-Ottawa Resource Authority (CORA) and the Great Lakes Indian Fish and Wildlife Commission (GLIFWC). In 1976 the Michigan Supreme Court reaffirmed that treaties signed in 1836 and 1855 reserved some tribal fishing rights outside state regulation. This finding led to the 1985 Consent Order and the 2000 Consent Decree, now in effect. The

Consent Decree establishes biological monitoring and law enforcement within CORA-managed tribal fisheries, with an Executive Council and Technical Fishery Committee comprising state, tribal, and federal biologists. Since the 2000 Consent Decree, these fisheries are managed on a species-specific rather than region-specific basis, with emphasis on restoring lake trout communities (CORA 2007) (GLIFWC 2007). Some fish stock surveys and water quality monitoring in the Great Lakes region is also undertaken by the US Geological Survey's Great Lakes Science Center, NOAA's Great Lakes Environmental Research Laboratory (GLERL), and the U.S. Environmental Protection Agency (EPA). Stock assessments are conducted by the federal, state, and provincial agencies that make up the various Lake Technical Committees (LTCs). Daily catch reports, annual CPUE and harvest trends, and stock condition trends (length-to-weight ratios, size at maturity, and size at harvest) are all monitored and evaluated by the host agencies (DNR, OMNR, etc.) and shared with LTCs. In addition, fisheries-independent research conducted by local agencies and universities, which assess parameters of stock condition and the fishery as a whole, are incorporated into stock assessments. The agencies use these stock assessments to propose and set changes to yearly quotas, which are established for all species of commercial interest.

The commercial fishery in Michigan is managed in part by the Michigan Department of Natural Resources. They determine quotas using catch-at-age models. All commercially targeted species have quotas established.

Management Strategies and Implementation for fisheries in Lake Superior receive a score of "moderately effective." Although strategies are in place to effectively manage the fishery, successful implementation has proved a challenge due to both ecological influences (invasive species introduction, lack of self-sustaining lake trout stocks) and anthropogenic influences (varying resource use interests).

Minnesota Lake Superior, Gillnet, Bottom

Minnesota Lake Superior, Pound Net

Minnesota Lake Superior, Trap net

Moderately Effective

The Great Lakes span jurisdictions in two countries, several states, one province, and a number of tribal lands, so management of the shared fishery resources is complex and dynamic. The main coordinating body of fishery management in the region is the Great Lakes Fishery Commission (GLFC), an inter-jurisdictional agency established in 1954 by the governments of the United States and Canada (Beamish 2001). The Commission comprises four Canadian and four American commissioners, who are appointed by their respective governments and supported by a secretariat in Ann Arbor, Michigan. Within the Great Lakes Fishery Commission, each lake has a Lake Committee that undertakes research and makes recommendations on sea lamprey control (the original motivation for the Commission), lake trout

rehabilitation, stocking events, and other lake-specific management actions for each of the Great Lakes. Lake Committees are made of members of the actual management bodies for each lake. The GLFC and the Lake Committees do not manage the lakes; rather, they serve as a platform to help bring together the multiple management agencies involved in the Great Lakes fisheries—to better coordinate research, enforcement, stocking, quotas, and other management issues. Tribe-licensed fisheries in the Great Lakes are managed by two management agencies: the Chippewa-Ottawa Resource Authority (CORA) and the Great Lakes Indian Fish and Wildlife Commission (GLIFWC). In 1976 the Michigan Supreme Court reaffirmed that treaties signed in 1836 and 1855 reserved some tribal fishing rights outside state regulation. This finding led to the 1985 Consent Order and the 2000 Consent Decree, now in effect. The Consent Decree establishes biological monitoring and law enforcement within CORA-managed tribal fisheries, with an Executive Council and Technical Fishery Committee comprising state, tribal, and federal biologists. Since the 2000 Consent Decree, these fisheries are managed on a species-specific rather than region-specific basis, with emphasis on restoring lake trout communities (CORA 2007) (GLIFWC 2007). Some fish stock surveys and water quality monitoring in the Great Lakes region is also undertaken by the US Geological Survey's Great Lakes Science Center, NOAA's Great Lakes Environmental Research Laboratory (GLERL), and the U.S. Environmental Protection Agency (EPA). Stock assessments are conducted by the federal, state, and provincial agencies that make up the various Lake Technical Committees (LTCs). Daily catch reports, annual CPUE and harvest trends, and stock condition trends (length-to-weight ratios, size at maturity, and size at harvest) are all monitored and evaluated by the host agencies (DNR, OMNR, etc.) and shared with LTCs. In addition, fisheries-independent research conducted by local agencies and universities, which assess parameters of stock condition and the fishery as a whole, are incorporated into stock assessments. The agencies use these stock assessments to propose and set changes to yearly quotas, which are established for all species of commercial interest.

The Minnesota Department of Natural Resources Fisheries section is responsible for managing fisheries in Minnesota waters. The long-term goal is to protect the Lake Superior ecosystem, restore its watershed, and manage for a diverse, stable, self-sustaining fish community that provides recreational, commercial, and tribal fishing opportunities. The Department realizes that the effectiveness of Lake Superior management programs must be continually evaluated. It limits the number of commercial operators within Minnesota waters and works with these commercial operators to implement a total allowable catch (TAC) that allocates harvest equally among participants. The Minnesota DNR developed the first Fisheries Management Plan for the Minnesota Waters of Lake Superior, which was a guide to managing the waters. The DNR's mission is to work with citizens to conserve and manage the state's natural resources, to provide outdoor recreation opportunities, and to provide for commercial uses of natural resources in a way that creates a sustainable quality of life (Schreiner, Donald R., et al., 2006). The Minnesota DNR uses a statistical catch-at-age model to determine the harvestable surplus for each management zone every 5 years. It tries to maintain lake trout annual mortality rates below 45% to achieve the desired level of rehabilitation. It also conducts surveys to monitor year-class strength and determine the biomass of rainbow smelt in Minnesota waters of Lake Superior. All commercially targeted species have quotas established.

Management Strategies and Implementation for fisheries in Lake Superior receive a score of

"moderately effective." Although strategies are in place to effectively manage the fishery, successful implementation has proved a challenge due to both ecological influences (invasive species introduction, lack of self-sustaining lake trout stocks) and anthropogenic influences (varying resource use interests).

Wisconsin Lake Superior, Gillnet, Bottom

Wisconsin Lake Superior, Pound Net

Wisconsin Lake Superior, Trap net

Moderately Effective

The Great Lakes span jurisdictions in two countries, several states, one province, and a number of tribal lands, so management of the shared fishery resources is complex and dynamic. The main coordinating body of fishery management in the region is the Great Lakes Fishery Commission (GLFC), an inter-jurisdictional agency established in 1954 by the governments of the United States and Canada (Beamish 2001). The Commission comprises four Canadian and four American commissioners, who are appointed by their respective governments and supported by a secretariat in Ann Arbor, Michigan. Within the Great Lakes Fishery Commission, each lake has a Lake Committee that undertakes research and makes recommendations on sea lamprey control (the original motivation for the Commission), lake trout rehabilitation, stocking events, and other lake-specific management actions for each of the Great Lakes. Lake Committees are made of members of the actual management bodies for each lake. The GLFC and the Lake Committees do not manage the lakes; rather, they serve as a platform to help bring together the multiple management agencies involved in the Great Lakes fisheries—to better coordinate research, enforcement, stocking, quotas, and other management issues. Tribe-licensed fisheries in the Great Lakes are managed by two management agencies: the Chippewa-Ottawa Resource Authority (CORA) and the Great Lakes Indian Fish and Wildlife Commission (GLIFWC). In 1976 the Michigan Supreme Court reaffirmed that treaties signed in 1836 and 1855 reserved some tribal fishing rights outside state regulation. This finding led to the 1985 Consent Order and the 2000 Consent Decree, now in effect. The Consent Decree establishes biological monitoring and law enforcement within CORA-managed tribal fisheries, with an Executive Council and Technical Fishery Committee comprising state, tribal, and federal biologists. Since the 2000 Consent Decree, these fisheries are managed on a species-specific rather than region-specific basis, with emphasis on restoring lake trout communities (CORA 2007) (GLIFWC 2007). Some fish stock surveys and water quality monitoring in the Great Lakes region is also undertaken by the US Geological Survey's Great Lakes Science Center, NOAA's Great Lakes Environmental Research Laboratory (GLERL), and the U.S. Environmental Protection Agency (EPA). Stock assessments are conducted by the federal, state, and provincial agencies that make up the various Lake Technical Committees (LTCs). Daily catch reports, annual CPUE and harvest trends, and stock condition trends (length-to-weight ratios, size at maturity, and size at harvest) are all monitored and evaluated by the host agencies (DNR, OMNR, etc.) and shared with LTCs. In addition, fisheries-independent research conducted by local agencies and universities, which assess parameters of stock condition and the fishery

as a whole, are incorporated into stock assessments. The agencies use these stock assessments to propose and set changes to yearly quotas, which are established for all species of commercial interest.

The Wisconsin Department of Natural Resources (DNR) holds the authority to set harvest limits. The commercial fishing board for Lake Superior is required by statute to recommend species harvest limits; then the DNR is required to give due consideration to those recommendations. Management of commercial fishing in Wisconsin waters has three defining features: harvest limits, limited entry, and individual transferable quotas. Under the limited entry system, the privilege of a commercial license is limited to 10 licensed fishers on Lake Superior. The DNR is also developing statistical catch-at-age models for estimating abundance of several commercial species (Stepp 2013). The Wisconsin Department of Natural Resources, the Bad River Band of Lake Superior Tribe of Chippewa Indians, and the Red Cliff Band of Lake Superior Chippewas agreed to a Comprehensive Plan for the cooperative management of the Lake Superior fishery. The parties agree that the goal of restoring self-sustaining populations at or near carrying capacity is important. All commercially targeted species have quotas established.

Management Strategies and Implementation for fisheries in Lake Superior receive a score of "moderately effective." Although strategies are in place to effectively manage the fishery, successful implementation has proved a challenge due to both ecological influences (invasive species introduction, lack of self-sustaining lake trout stocks) and anthropogenic influences (varying resource use interests).

Subfactor 3.1.2 – Recovery of Species of Concern

Considerations: When needed, are recovery strategies/management measures in place to rebuild overfished/threatened/ endangered species or to limit fishery's impact on these species and what is their likelihood of success? To achieve a rating of Highly Effective, rebuilding strategies that have a high likelihood of success in an appropriate timeframe must be in place when needed, as well as measures to minimize mortality for any overfished/threatened/endangered species.

Canada Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Trap net

Minnesota Lake Superior, Gillnet, Bottom

Minnesota Lake Superior, Pound Net

Minnesota Lake Superior, Trap net

Wisconsin Lake Superior, Gillnet, Bottom

Wisconsin Lake Superior, Pound Net

Wisconsin Lake Superior, Trap net

Moderately Effective

Walleye, lake trout and lake whitefish are in recovery from overharvesting, invasive species predation, and/or habitat loss. Lake trout and lake whitefish are in recovery and no longer considered depleted but walleye are still depleted, especially in eastern Lake Superior on the Canadian side. Effective lampricide treatments, reduced harvest attempts, and vigorous re-stocking attempts have resulted in the partial resurgence of the Lake Superior commercial fishery.

The Lake Superior committee has created a Fish Communities Objective that is meant to provide a framework for future decision making. They adopted the goal of rehabilitating and maintaining a diverse, healthy, and self-regulating fish community, dominated by indigenous species and supporting sustainable fisheries (Horns, W.H. et al., 2003).

Lake whitefish and lake trout have been overfished in the eastern portion of the Canadian side of Lake Superior, causing issues with those populations' recovery (Lloyd Mohr, 2014). Lake whitefish and lake trout in other portions of the lake show signs of strong recovery. Lake trout are currently in recovery from a collapse in the 1950s due to overfishing and sea lamprey predation. Lake trout are caught as bycatch from other targeted fisheries, so their quotas allow commercial fishers to target other species while retaining an incidental catch of lake trout. The quotas are kept at low levels to facilitate the recovery of a wild self-sustaining population while still allowing commercial fishing. The Great Lakes Fishery Commission has made a Lake Trout Restoration Plan for Lake Superior. The goal is to restore lake trout in Lake Superior to a self-sustaining population that can annually yield approximately 2 million kg. Progress is made by prudent regulation of sport and commercial fishery harvest, increased control of the sea lamprey, and stocking of yearling lake trout. But naturally reproducing trout are becoming an increasing proportion of the populations. Prey species abundance is managed to be adequate to provide for the maturation of lake trout. Sea lamprey have been effectively controlled, which has allowed offshore fish communities to begin to return to pre-modern conditions (Hansen 1996).

Walleye are currently in recovery from a decline in their population in the first half of the 20th century. This decline resulted from a combination of overharvesting, habitat degradation, poor land-use practices, river damming, and pollution. The Great Lakes Fishery Commission created a rehabilitation plan for walleye. The goals of this recovery plan are to manage exploitation of non-depleted stocks to maintain a stable, self-sustaining status for walleye, and to achieve no net loss of the productive capacity of habitats supporting Lake Superior fisheries. There is also an outline of how progress will be assessed using absolute abundance of spawners in key areas, and relative abundance of age-0 and age-1 walleye. Their strategy to rehabilitate is through stocking eggs, fry, and/or adults; controlling fish

harvest to reduce annual mortality; and protecting and maintaining remaining habitat (Michael H Hoff 2003).

This factor is considered “moderately effective” because walleye populations that were depleted have strategies and management measures in place to aid their recovery, and other species are showing strong recovery.

Subfactor 3.1.3 – Scientific Research and Monitoring

Considerations: How much and what types of data are collected to evaluate the health of the population and the fishery’s impact on the species? To achieve a Highly Effective rating, population assessments must be conducted regularly and they must be robust enough to reliably determine the population status.

Canada Lake Superior, Gillnet, Bottom

Highly Effective

The Ontario Ministry of Natural Resources, Upper Great Lakes Management Unit, conducts much of the research on fisheries in Lake Superior. They do not model biomass of commercially important fish species but they perform acoustic surveys and index certain species with gillnet surveys. Scientists and biologists from the Ontario Ministry of Natural Resources report annually on the state of Ontario’s Great Lakes fisheries at Great Lakes Fishery Commission meetings. These reports come from routine monitoring of the state of Great Lakes fish and food web, from studies that help understand why changes occur, and from future projections. They also collect information on invasive species and how that will affect species or populations structure and function in an ecosystem. Some information is also collected from the commercial fishermen, so there is fishery-independent and fishery-dependent data (OMNR 2012). The Lake Superior technical committee is charged with providing the Lake Committee with information on the status of stocks, and presenting information annually at the Lake Committee meetings. They also report on invasive species, especially sea lamprey. They also produce the State of Lake Report every 5 years, but because the 2012 report is still being written, the 2005 report is the most current. The report outlines the trends in catch and stock status and makes recommendations based on estimated stock statuses. In addition, they produce a Fish Community Objectives report that describes how the major species are doing and tracks the effect of invasive species on these species. The most recent version of this report was put out in 2003 (Horns, W.H. et al. 2003) (Owen T. Gorman, Mark P. Ebener and Mark R. Vinson 2005). The United States Geological Survey also conducts annual surveys in near-shore and offshore waters of Lake Superior. These provide data for assessment of long-term lake-wide trends in fish occurrence, relative abundance, and biomass. These data have been considered as population indices rather than estimates of absolute abundance and biomass (Mark R. Vinson, Lori M. Evrard, Owen T. Gorman, Daniel L. Yule 2013).

These assessments mainly use CPUE as an indicator of biomass or stock abundance, while target reference points are absent. However, these assessments are long-term and robust, and are coupled with species body-condition and age/weight assessments, so it is likely that they are good indicators of stock status and fish community health.

Research is “highly effective” because the management process uses an independent and up-to-date scientific stock assessment, and these assessments are conducted regularly.

Michigan Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Trap net

Highly Effective

The Michigan DNR conducts surveys and collects data to assess major species populations (MDNR website).

A Modeling Subcommittee of the Technical Fisheries Committee, which was established by the parties to the 2000 Consent Decree, develops annual yield and effort limits. The U.S. Fish and Wildlife Service (USFW) and the Chippewa-Ottawa Resource Authority (CORA) are the remaining parties within the subcommittee. They developed and fitted statistical catch-at-age models to estimate age- and year-specific population abundance and mortality rates for lake whitefish and lake trout. The most recent model is from 2012 (Caroffino, D.C., Lenart, S.J. 2012). The Lake Superior technical committee is charged with providing the Lake Committee with information on the status of stocks, and presenting information annually at the Lake Committee meetings. They also report on invasive species, especially sea lamprey. They also produce the State of Lake Report every 5 years, but because the 2012 report is still being written, the 2005 report is the most current. The report outlines the trends in catch and stock status and makes recommendations based on estimated stock statuses. In addition, they produce a Fish Community Objectives report that describes how the major species are doing and tracks the effect of invasive species on these species. The most recent version of this report was put out in 2003 (Horns, W.H. et al., 2003) (Owen T. Gorman, Mark P. Ebener and Mark R. Vinson 2005). The United States Geological Survey also conducts annual surveys in near-shore and offshore waters of Lake Superior. These provide data for assessment of long-term lake-wide trends in fish occurrence, relative abundance, and biomass. These data have been considered as population indices rather than estimates of absolute abundance and biomass (Mark R. Vinson, Lori M. Evrard, Owen T. Gorman, Daniel L. Yule 2013).

These assessments mainly use CPUE as an indicator of biomass or stock abundance, while target reference points are absent. However, these assessments are long-term and robust, and are coupled with species body-condition and age/weight assessments, so it is likely that they are good indicators of stock status and fish community health.

Research is “highly effective” because the management process uses an independent and up-to-date scientific stock assessment, and these assessments are conducted regularly.

Minnesota Lake Superior, Gillnet, Bottom

Minnesota Lake Superior, Pound Net

Minnesota Lake Superior, Trap net

Highly Effective

The Minnesota Department of Natural Resources, Division of Fish and Wildlife, Section of Fisheries monitors, researches and manages the commercial fishery in Minnesota waters along with tribal agreements. They produce the Completion report for Minnesota Waters of Lake Superior, with the most recent one done in 2012. This report describes how the fish species are assessed and the effects of invasive species. They assess species using gillnet surveys and compare these results with the CPUE gathered from the commercial fishermen. They also produced the Fisheries Management Plan for the Minnesota Waters of Lake Superior, which describes how each species population is doing and what the goals are when managing that species. In addition, they developed a statistical Catch-at-Age model to assess the status of lake trout in Minnesota waters of Lake Superior. They are used to assist in the determination of harvest levels (Cory A. Goldsworthy and Donald R. Schreiner 2012) (Cory Goldsworthy 2012). The Lake Superior technical committee is charged with providing the Lake Committee with information on the status of stocks, and presenting information annually at the Lake Committee meetings. They also report on invasive species, especially sea lamprey. They also produce the State of Lake Report every 5 years, but because the 2012 report is still being written, the 2005 report is the most current. The report outlines the trends in catch and stock status and makes recommendations based on estimated stock statuses. In addition, they produce a Fish Community Objectives report that describes how the major species are doing and tracks the effect of invasive species on these species. The most recent version of this report was put out in 2003 (Horns, W.H. et al. 2003) (Owen T. Gorman, Mark P. Ebener and Mark R. Vinson 2005). The United States Geological Survey also conducts annual surveys in near-shore and offshore waters of Lake Superior. These provide data for assessment of long-term lake-wide trends in fish occurrence, relative abundance, and biomass. These data have been considered as population indices rather than estimates of absolute abundance and biomass (Mark R. Vinson, Lori M. Evrard, Owen T. Gorman, Daniel L. Yule 2013).

These assessments mainly use CPUE as an indicator of biomass or stock abundance, while target reference points are absent. However, these assessments are long-term and robust, and are coupled with species body-condition and age/weight assessments, so it is likely that they are good indicators of stock status and fish community health.

Research is “highly effective” because the management process uses an independent and up-to-date scientific stock assessment, and these assessments are conducted regularly.

Wisconsin Lake Superior, Gillnet, Bottom

Wisconsin Lake Superior, Pound Net

Wisconsin Lake Superior, Trap net

Highly Effective

The Wisconsin Department of Natural Resources conducts summer index assessments intended to monitor various population dynamics of the Lake Superior fisheries and to document potential shifts in the fish community structure. The most up-to-date report available to the public is from 2009, in which 19 stations throughout the Wisconsin waters of Lake Superior were sampled. They are sampled annually using gillnets. The DNR also checks for how the sea lamprey affect these populations. They also calculated geometric mean CPUE for the examination of long-term trends. The Lake Superior technical committee is charged with providing the Lake Committee with information on the status of stocks, and presenting information annually at the Lake Committee meetings. They also report on invasive species, especially sea lamprey. They also produce the State of Lake Report every 5 years, but because the 2012 report is still being written, the 2005 report is the most current. The report outlines the trends in catch and stock status and makes recommendations based on estimated stock statuses. In addition, they produce a Fish Community Objectives report that describes how the major species are doing and tracks the effect of invasive species on these species. The most recent version of this report was put out in 2003 (State of Wisconsin-Tribes 2007). The United States Geological Survey also conducts annual surveys in nearshore and offshore waters in Lake Superior. These provide data for assessment of long-term lake-wide trends in fish occurrence, relative abundance, and biomass. These data have been considered population indices rather than absolute abundance and biomass estimates. (Mark R. Vinson, Lori M. Evrard, Owen T. Gorman, Daniel L. Yule 2013).

These assessments mainly use CPUE as an indicator of biomass or stock abundance, while target reference points are absent. However, these assessments are long-term and robust, and are coupled with species body-condition and age/weight assessments, so it is likely that they are good indicators of stock status and fish community health.

Research is “highly effective” because the management process uses an independent and up-to-date scientific stock assessment, and these assessments are conducted regularly.

Subfactor 3.1.4 – Management Record of Following Scientific Advice

Considerations: How often (always, sometimes, rarely) do managers of the fishery follow scientific recommendations/advice (e.g. do they set catch limits at recommended levels)? A Highly Effective rating is given if managers nearly always follow scientific advice.

Canada Lake Superior, Gillnet, Bottom

Highly Effective

The Upper Great Lakes Management Unit almost always follows scientific advice when developing management strategies. When determining quotas, the previous CPUE and previous harvest data are looked at (Upper Great Lakes Management Unit 2011).

The Great Lakes Fishery Commission takes scientific advice into account when recommending quotas and developing management strategies throughout the Great Lakes. With the enactment of the Joint Strategic Plan for Management of Great Lakes Fisheries, quotas and stock assessments are evaluated by representatives of both state and provincial agencies and assessed based on proposed ecological impacts to the fishery and surrounding ecosystems. Additionally, scientific advice is elicited to help determine stock status on most species listed in this report. Managers serve on each lake committee. Representatives of state, federal, and provincial agencies are present at lake committee technical hearings, whose purposes are to provide information on projected stock status, discuss potential adverse trends afflicting stocks of interest (including spread of VHS and lamprey control efforts), and to advise on future directions. The Great Lakes Fishery Commission is implementing scientific advice on a regular basis (pers. comm., DNR and OMNR officials). Independent research conducted by universities throughout the Great Lakes routinely finds its way to these meetings and significant results are discussed. Owing to the fragile nature of the Great Lakes fishery, which appears to only recently be recovering from a period of low yield and decreased stock abundances, scientific advice is relied upon heavily to ensure the fishery continues to recover.

Michigan Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Trap net

Highly Effective

The Michigan Department of Natural Resources, the Chippewa-Ottawa Resource Authority, and the Great Lakes Indian Fish and Wildlife Commission almost always follow scientific advice when deciding management strategies and setting harvest quotas (Caroffino, D.C., Lenart, S.J. 2012) (William P. Mattes 2013).

The Great Lakes Fishery Commission takes scientific advice into account when recommending quotas

and developing management strategies throughout the Great Lakes. With the enactment of the Joint Strategic Plan for Management of Great Lakes Fisheries, quotas and stock assessments are evaluated by representatives of both state and provincial agencies and assessed based on proposed ecological impacts to the fishery and surrounding ecosystems. Additionally, scientific advice is elicited to help determine stock status on most species listed in this report. Managers serve on each lake committee. Representatives of state, federal, and provincial agencies are present at lake committee technical hearings, whose purposes are to provide information on projected stock status, discuss potential adverse trends afflicting stocks of interest (including spread of VHS and lamprey control efforts), and to advise on future directions. The Great Lakes Fishery Commission is implementing scientific advice on a regular basis (pers. comm., DNR and OMNR officials). Independent research conducted by universities throughout the Great Lakes routinely finds its way to these meetings, and significant results are discussed. Owing to the fragile nature of the Great Lakes fishery, which appears to only recently be recovering from a period of low yield and decreased stock abundances, scientific advice is relied upon heavily to ensure the fishery continues to recover.

Minnesota Lake Superior, Gillnet, Bottom

Minnesota Lake Superior, Pound Net

Minnesota Lake Superior, Trap net

Highly Effective

The Minnesota Department of Natural Resources always follows scientific advice (Cory A. Goldsworthy and Donald R. Schreiner 2012).

The Great Lakes Fishery Commission takes scientific advice into account when recommending quotas and developing management strategies throughout the Great Lakes. With the enactment of the Joint Strategic Plan for Management of Great Lakes Fisheries, quotas and stock assessments are evaluated by representatives of both state and provincial agencies and assessed based on proposed ecological impacts to the fishery and surrounding ecosystems. Additionally, scientific advice is elicited to help determine stock status on most species listed in this report. Managers serve on each lake committee. Representatives of state, federal, and provincial agencies are present at lake committee technical hearings, whose purposes are to provide information on projected stock status, discuss potential adverse trends afflicting stocks of interest (including spread of VHS and lamprey control efforts), and to advise on future directions. The Great Lakes Fishery Commission is implementing scientific advice on a regular basis (pers. comm., DNR and OMNR officials). Independent research conducted by universities throughout the Great Lakes routinely finds its way to these meetings, and significant results are discussed. Owing to the fragile nature of the Great Lakes fishery, which appears to only recently be recovering from a period of low yield and decreased stock abundances, scientific advice is relied upon heavily to ensure the fishery continues to recover.

Wisconsin Lake Superior, Gillnet, Bottom

Wisconsin Lake Superior, Pound Net

Wisconsin Lake Superior, Trap net

Highly Effective

The Wisconsin Department of Natural Resources almost always follows scientific advice (Stepp 2013).

The Great Lakes Fishery Commission takes scientific advice into account when recommending quotas and developing management strategies throughout the Great Lakes. With the enactment of the Joint Strategic Plan for Management of Great Lakes Fisheries, quotas and stock assessments are evaluated by representatives of both state and provincial agencies and assessed based on proposed ecological impacts to the fishery and surrounding ecosystems. Additionally, scientific advice is elicited to help determine stock status on most species listed in this report. Managers serve on each lake committee. Representatives of state, federal, and provincial agencies are present at lake committee technical hearings, whose purposes are to provide information on projected stock status, discuss potential adverse trends afflicting stocks of interest (including spread of VHS and lamprey control efforts), and to advise on future directions. The Great Lakes Fishery Commission is implementing scientific advice on a regular basis (pers. comm., DNR and OMNR officials). Independent research conducted by universities throughout the Great Lakes routinely finds its way to these meetings and significant results are discussed. Owing to the fragile nature of the Great Lakes fishery, which appears to only recently be recovering from a period of low yield and decreased stock abundances, scientific advice is relied upon heavily to ensure the fishery continues to recover.

Subfactor 3.1.5 – Enforcement of Management Regulations

Considerations: Do fishermen comply with regulations, and how is this monitored? To achieve a Highly Effective rating, there must be regular enforcement of regulations and verification of compliance.

Canada Lake Superior, Gillnet, Bottom

Highly Effective

The Ontario Ministry of Natural Resources requires every fishermen to fill out a total catch form before they land so that bycatch is reported. They have officials at ports who check the landings and make sure the logs agree with what is present, and they take samples of the fish to get data on what species, age, and size are getting caught. They also randomly send out officials to board the vessels and observe the fishing and check the logbooks (pers. comm., Lloyd Mohr). The Great Lakes Fishery Commission also has

a Great Lakes Law Enforcement Committee, whose mission is to participate in the management of the fisheries resources by preventing exploitation by unlawful means. They provide a conduit for the transfer of information between fisheries managers and law enforcement, and they identify and evaluate the problems associated with control of illegal fishery activities. The Great Lakes Law Enforcement Committee consists of representatives of each resource agency with enforcement responsibilities in the basin. They annually update the Great Lakes Fishery Commission to ensure that law enforcement information is incorporated into fisheries management decision making. In order to make these reports, they meet annually (Law Enforcement Committee 2012). Actions of the Great Lakes Law Enforcement Committee are guided by policies and recommendations enacted by the governing Council of Lake Committees. These include supporting investigations crossing jurisdiction lines, supporting development and dissemination of information on fisheries forensic sciences, sharing of law enforcement intelligence information, and enforcing quota and harvest regulations.

Michigan Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Trap net

Minnesota Lake Superior, Gillnet, Bottom

Highly Effective

An agreement was reached between Chippewa-Ottawa Resource Authority (CORA) and the U.S. Coast Guard (the memorandums of agreement) that allows the Coast Guard to inspect and prosecute tribal fishermen in tribal waters of the Great Lakes (Pickering 2010). Additionally, the Tribal Fisheries Consent Decree of 2000 between the U.S. and CORA allows DNR officials to inspect portside take from tribal fishermen (DNR Website 2005).

According to the National Indian Law Library, the Red Cliff Band fishermen with licenses shall allow tribal conservation law enforcement officers to inspect nets, vessels, and vehicles used in the fishing operation, and to inspect any fish taken and retained by a licensee, at any reasonable time and place. They also have a joint patrol agreement in which anywhere that a tribal warden decides to board a tribal boat, inspect or seize a tribal catch, or take similar law enforcement action involving tribal members, then state wardens acting under the direction of the tribal warden will also be authorized to participate in conducting boarding, inspection, seizure, or other action, and it shall not be an objection to a subsequent citation or prosecution that state wardens so participated (Native American Rights Fund 2012).

In the Lake Superior Fishing agreement, there is joint monitoring between the tribes and the state that may be conducted by biological or law enforcement staff in Minnesota waters of Lake Superior. The Tribes agree to provide the Department with the daily effort records of individual fishermen on a case-by-case basis, upon a showing of law enforcement need. The parties agree to meet each year to discuss

the implementation of the agreement, including but not limited to the manner in which the joint law enforcement and biological monitoring provisions are accomplished. The law enforcement is allowed to conduct inspections. Inspections include the counting and observation of fish on commercial vessels at dockside by law enforcement personnel (State of Wisconsin-Tribes 2007).

The Great Lakes Fishery Commission also has a Great Lakes Law Enforcement Committee, whose mission is to participate in the management of the fisheries resources by preventing exploitation by unlawful means. They provide a conduit for the transfer of information between fisheries managers and law enforcement, and they identify and evaluate the problems associated with control of illegal fishery activities. The Great Lakes Law Enforcement Committee consists of representatives of each resource agency with enforcement responsibilities in the basin. They annually update the Great Lakes Fishery Commission to ensure that law enforcement information is incorporated into fisheries management decision making. In order to make these reports, they meet annually (Law Enforcement Committee 2012).

Minnesota Lake Superior, Pound Net

Minnesota Lake Superior, Trap net

Highly Effective

According to the National Indian Law Library, the Red Cliff Band fishermen with licenses shall allow tribal conservation law enforcement officers to inspect nets, vessels, and vehicles used in the fishing operation, and to inspect any fish taken and retained by a licensee, at any reasonable time and place. They also have a joint patrol agreement in which anywhere that a tribal warden decides to board a tribal boat, inspect or seize a tribal catch, or take similar law enforcement action involving tribal members, then state wardens acting under the direction of the tribal warden will also be authorized to participate in conducting boarding, inspection, seizure, or other action, and it shall not be an objection to a subsequent citation or prosecution that state wardens so participated (Native American Rights Fund 2012). The Great Lakes Fishery Commission also has a Law Enforcement Committee, whose mission is to participate in the management of the fisheries resources by preventing exploitation by unlawful means. They provide a conduit for the transfer of information between fisheries managers and law enforcement, and they identify and evaluate the problems associated with control of illegal fishery activities. The Law Enforcement committee consists of representatives of each resource agency with enforcement responsibilities in the basin. They annually update the Great Lakes Fishery Commission to ensure that law enforcement information is incorporated into fisheries management decision making. In order to make these reports, they meet annually (Law Enforcement Committee 2012).

Wisconsin Lake Superior, Gillnet, Bottom

Highly Effective

An agreement was reached between Chippewa-Ottawa Resource Authority (CORA) and the U.S. Coast Guard (the memorandums of agreement) that allows the Coast Guard to inspect and prosecute tribal fishermen in tribal waters of the Great Lakes (Pickering 2010). Additionally, the Tribal Fisheries Consent Decree of 2000 between the U.S. and CORA allows DNR officials to inspect portside take from tribal fishermen (DNR Website 2005).

According to the National Indian Law Library, the Red Cliff Band fishermen with licenses shall allow tribal conservation law enforcement officers to inspect nets, vessels, and vehicles used in the fishing operation, and to inspect any fish taken and retained by a licensee, at any reasonable time and place. They also have a joint patrol agreement in which anywhere that a tribal warden decides to board a tribal boat, inspect or seize a tribal catch, or take similar law enforcement action involving tribal members, then state wardens acting under the direction of tribal warden will also be authorized to participate in conducting boarding, inspection, seizure, or other action, and it shall not be an objection to a subsequent citation or prosecution that state wardens so participated (Native American Rights Fund 2012).

In the Lake Superior Fishing agreement, there is joint monitoring between the tribes and the state that may be conducted by biological or law enforcement staff in Minnesota waters of Lake Superior. The Tribes agree to provide the Department with the daily effort records of individual fishermen on a case-by-case basis, upon a showing of law enforcement need. The parties agree to meet each year to discuss the implementation of the agreement, including but not limited to the manner in which the joint law enforcement and biological monitoring provisions are accomplished. The law enforcement is allowed to conduct inspections. Inspections include the counting and observation of fish on commercial vessels at dockside by law enforcement personnel (State of Wisconsin-Tribes 2007).

The Great Lakes Fishery Commission also has a Great Lakes Law Enforcement Committee, whose mission is to participate in the management of the fisheries resources by preventing exploitation by unlawful means. They provide a conduit for the transfer of information between fisheries managers and law enforcement, and they identify and evaluate the problems associated with control of illegal fishery activities. The Great Lakes Law Enforcement Committee consists of representatives of each resource agency with enforcement responsibilities in the basin. They annually update the Great Lakes Fishery Commission to ensure that law enforcement information is incorporated into fisheries management decision making. In order to make these reports, they meet annually (Law Enforcement Committee 2012).

Wisconsin Lake Superior, Pound Net

Wisconsin Lake Superior, Trap net

Highly Effective

In the Lake Superior Fishing agreement, there is joint monitoring between the tribes and the state that may be conducted by biological or law enforcement staff in Wisconsin waters of Lake Superior. The Tribes agree to provide the Department with the daily effort records of individual fishermen on a case-by-case basis, upon a showing of law enforcement need. The parties agree to meet each year to discuss the implementation of the agreement, including but not limited to the manner in which the joint law enforcement and biological monitoring provisions are accomplished. The law enforcement is allowed to conduct inspections. Inspections include the counting and observation of fish on commercial vessels at dockside by law enforcement personnel (State of Wisconsin-Tribes 2007).

The Great Lakes Fishery Commission also has a Great Lakes Law Enforcement Committee, whose mission is to participate in the management of the fisheries resources by preventing exploitation by unlawful means. They provide a conduit for the transfer of information between fisheries managers and law enforcement, and they identify and evaluate the problems associated with control of illegal fishery activities. The Great Lakes Law Enforcement Committee consists of representatives of each resource agency with enforcement responsibilities in the basin. They annually update the Great Lakes Fishery Commission to ensure that law enforcement information is incorporated into fisheries management decision making. In order to make these reports, they meet annually (Law Enforcement Committee 2012).

Subfactor 3.1.6 – Management Track Record

Considerations: Does management have a history of successfully maintaining populations at sustainable levels or a history of failing to maintain populations at sustainable levels? A Highly Effective rating is given if measures enacted by management have been shown to result in the long-term maintenance of species overtime.

Canada Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Trap net

Minnesota Lake Superior, Gillnet, Bottom

Minnesota Lake Superior, Pound Net

Minnesota Lake Superior, Trap net

Wisconsin Lake Superior, Gillnet, Bottom

Wisconsin Lake Superior, Pound Net

Wisconsin Lake Superior, Trap net

Moderately Effective

The fish stocks in the Great Lakes have been subject to fishing pressures for centuries. Historic overfishing, the introduction of non-native species (e.g., sea lamprey, alewife, zebra mussels), and habitat alteration and destruction have greatly diminished or depleted many fish stocks. Comprehensive management of the Great Lakes began during the mid-20th century with the formation of the Great Lakes Fishery Commission (GLFC), after many of the commercially important stocks were already decimated. Implementation of legislation to promote improved conditions throughout the Great Lakes (Great Lake Water Quality Agreement 1972), as well as the development of more effective invasive control efforts, have resulted in the increased stock abundance of many target species. State (DNR), provincial (OMNR), and tribal (CORA) management agencies have made substantial progress in rehabilitation, restoration, and prevention efforts. However, stocks of once commercially valuable lake trout and lake sturgeon are still far below historic levels (though improving), even after rigorous re-stocking and rehabilitation attempts over the last several decades. Additionally, systemic issues that occur between agencies (difference in regional priorities and interests, jurisdictional disputes, etc.) can impede or delay action and response to new threats or obstacles to the fishery. Such delays may interfere with current restoration attempts, as new threats such as invasive species and productivity changes continue to plague the fishery. Although current management strategies have proved effective in halting and in some cases reversing the downward trends in abundance of many stocks throughout the Great Lakes, it is too early to determine whether this management system will prevail in the face of mounting ecological pressures.

Subfactor 3.1.7 – Stakeholder Inclusion

Considerations: Are stakeholders involved/included in the decision-making process? Stakeholders are individuals/groups/organizations that have an interest in the fishery or that may be affected by the management of the fishery (e.g., fishermen, conservation groups, etc.). A Highly Effective rating is given if the management process is transparent and includes stakeholder input.

Canada Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Trap net

Highly Effective

Agencies at the state, federal, and provincial level work with local stakeholders because they are the managing agencies with the delegated authority to invoke management actions (e.g., harvest restrictions, size limits, and stocking). For example, Ontario has formed a provincial system of Fisheries Management Zone councils comprised almost entirely of mixed user groups. These groups meet regularly to hear from the Ontario Ministry of Natural Resources (OMNR), to research elements, and to provide feedback for proposed management decisions. This ground-level engagement is conducted by individual managing agencies, which include U.S. state and federal agencies and Canadian provincial agencies. Bringing together these managing agencies in the Great Lakes region is the Great Lakes Fishery Commission (GLFC). The GLFC comprises representatives from all parties that have a stake in the commercial fishery, including U.S. state and federal agencies, Canadian agencies, and tribal/first nation representatives. The GLFC has a good track record of including stakeholders in the development of legislation, harvest restrictions, and enforcement regulations throughout the Great Lakes fisheries, since there are representatives participating from managing agencies that regularly reach out to their local stakeholders. Furthermore, stakeholders representing recreational fishery interests are also present at local lake committee meetings. The U.S. fishery is largely managed for the benefit of the recreational fishing industry, so their interests are acknowledged and incorporated in Great Lakes management (DesJardine et al. 1995) (Riley 2013). Each lake committee is required to make regular reports to the Council of Lake Committees (CLC). These reports generate the development of new legislation that is made public and given to local, state, provincial, and federal agencies, which are invited to submit comments and suggestions. Findings, reports, and suggested management strategies are made public and opened to criticism, which shows the transparency of the process (GLFC 2007).

Minnesota Lake Superior, Gillnet, Bottom

Minnesota Lake Superior, Pound Net

Minnesota Lake Superior, Trap net

Highly Effective

In the Fisheries Management Plan for the Minnesota Waters of Lake Superior by the Minnesota Department of Natural Resources, citizen participation was very important, especially in the planning process. An advisory group was set up that included fishing clubs, environmental groups, tribal bands, commercial fishermen, county organizations, and individual anglers. This group was involved with early conversations on all issues, solicited input from their organizations, and reviewed and commented on the draft plan. They also had three “Open House” meetings to get feedback on the draft plan from citizens not associated with a representative on the advisory group. These comments were reviewed and considered to be a part of the final draft (Schreiner, Donald R. et al., 2006). The Great Lakes Fishery Commission (GLFC) has a good track record of including stakeholders in the development of legislation, harvest restrictions, and enforcement regulations throughout the Great Lakes fisheries. The GLFC

comprises representatives from all parties that have a stake in the commercial fishery, including U.S. state and federal agencies, Canadian agencies, and tribal/first nation representatives. Furthermore, stakeholders representing recreational fishery interests are also present at local lake committee meetings. The U.S. fishery is largely managed for the benefit of the recreational fishing industry, so their interests are acknowledged and incorporated in Great Lakes management (DesJardine et al. 1995 and Riley 2013). Each lake committee is required to make regular reports to the Council of Lake Committees (CLC). These reports generate the development of new legislation that is made public and given to local, state, provincial, and federal agencies, which are invited to submit comments and suggestions. Findings, reports, and suggested management strategies are made public and opened to criticism, which shows the transparency of the process (GLFC 2007).

Wisconsin Lake Superior, Gillnet, Bottom

Wisconsin Lake Superior, Pound Net

Wisconsin Lake Superior, Trap net

Highly Effective

Agencies at the state, federal, and provincial level work with local stakeholders because they are the managing agencies with the delegated authority to invoke management actions (e.g., harvest restrictions, size limits, and stocking). For example, Ontario has formed a provincial system of Fisheries Management Zone councils comprised almost entirely of mixed user groups. These groups meet regularly to hear from the Ontario Ministry of Natural Resources (OMNR), to research elements, and to provide feedback for proposed management decisions. This ground-level engagement is conducted by individual managing agencies, which include U.S. state and federal agencies and Canadian provincial agencies. Bringing together these managing agencies in the Great Lakes region is the Great Lakes Fishery Commission (GLFC). The GLFC comprises representatives from all parties that have a stake in the commercial fishery, including U.S. state and federal agencies, Canadian agencies, and tribal/first nation representatives. The GLFC has a good track record of including stakeholders in the development of legislation, harvest restrictions, and enforcement regulations throughout the Great Lakes fisheries, since there are representatives participating from managing agencies that regularly reach out to their local stakeholders. Furthermore, stakeholders representing recreational fishery interests are also present at local lake committee meetings. The U.S. fishery is largely managed for the benefit of the recreational fishing industry, so their interests are acknowledged and incorporated in Great Lakes management (DesJardine et al. 1995) (Riley 2013). Each lake committee is required to make regular reports to the Council of Lake Committees (CLC). These reports generate the development of new legislation that is made public and given to local, state, provincial, and federal agencies, which are invited to submit comments and suggestions. Findings, reports, and suggested management strategies are made public and opened to criticism, which shows the transparency of the process (GLFC 2007).

Bycatch Strategy

Factor 3.2: Management of fishing impacts on bycatch species						
Region / Method	**All Kept**	**Critical**	**Strategy**	**Research**	**Advice**	**Enforce**
Canada Lake Superior Gillnet, Bottom	Yes	No	Highly Effective	Highly Effective	Highly Effective	Highly Effective
Michigan Lake Superior Gillnet, Bottom	Yes	No	Highly Effective	Highly Effective	Highly Effective	Highly Effective
Michigan Lake Superior Trap net	Yes	No	Highly Effective	Highly Effective	Highly Effective	Highly Effective
Minnesota Lake Superior Gillnet, Bottom	Yes	No	Highly Effective	Highly Effective	Highly Effective	Highly Effective
Minnesota Lake Superior Pound Net	Yes	No	Highly Effective	Highly Effective	Highly Effective	Highly Effective
Minnesota Lake Superior Trap net	Yes	No	Highly Effective	Highly Effective	Highly Effective	Highly Effective
Wisconsin Lake Superior Gillnet, Bottom	Yes	No	Highly Effective	Highly Effective	Highly Effective	Highly Effective
Wisconsin Lake Superior Pound Net	Yes	No	Highly Effective	Highly Effective	Highly Effective	Highly Effective
Wisconsin Lake Superior Trap net	Yes	No	Highly Effective	Highly Effective	Highly Effective	Highly Effective

Subfactor 3.2.1 – Management Strategy and Implementation

Considerations: What type of management strategy/measures are in place to reduce the impacts of the fishery on bycatch species and how successful are these management measures? To achieve a Highly Effective rating, the primary bycatch species must be known and there must be clear goals and measures in place to minimize the impacts on bycatch species (e.g., catch limits, use of proven mitigation measures, etc.).

Canada Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Trap net

Minnesota Lake Superior, Gillnet, Bottom

Minnesota Lake Superior, Pound Net

Minnesota Lake Superior, Trap net

Wisconsin Lake Superior, Gillnet, Bottom

Wisconsin Lake Superior, Pound Net

Wisconsin Lake Superior, Trap net

Highly Effective

Lake sturgeon is a species of special interest when looking at bycatch of commercial fishing in Lake Superior. Lake sturgeon are not commercially harvested nor are they able to be sold portside, making them of little value to commercial fisherman. Nevertheless, lake sturgeon bycatch records in Canadian waters continue to be effectively monitored, with fishermen understanding the importance of keeping such records and continuing to work cooperatively with the OMNR (pers. comm., OMNR).

Lake sturgeon is listed by Ontario as a zero quota (so none is allowed to be kept) as of 2009, but it is still incidentally caught. Ontario has a daily catch reporting system in which all fish that are caught must be reported, but lake sturgeon are not harvested. They must be returned to their waters, and there is little mortality because soak times are generally short (pers. comm., OMNR).

They are given a "highly effective" score because most species that are still incidentally caught have commercial value and are kept and sold portside.

Subfactor 3.2.2 – Scientific Research and Monitoring

Considerations: Is bycatch in the fishery recorded/documented and is there adequate monitoring of bycatch to measure fishery's impact on bycatch species? To achieve a Highly Effective rating, assessments must be conducted to determine the impact of the fishery on species of concern, and an adequate bycatch data collection program must be in place to ensure bycatch management goals are being met.

Canada Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Trap net

Minnesota Lake Superior, Gillnet, Bottom

Minnesota Lake Superior, Pound Net

Minnesota Lake Superior, Trap net

Wisconsin Lake Superior, Gillnet, Bottom

Wisconsin Lake Superior, Pound Net

Wisconsin Lake Superior, Trap net

Highly Effective

Lake sturgeon populations throughout Lake Superior are closely monitored year-round. Tagging, acoustic telemetry, and year-class life history surveys are routinely conducted in an effort to measure population viability and to forecast future concerns for lake sturgeon lake wide.

This section receives a score of "highly effective" since research and monitoring associated with lake sturgeon is extensive, well-coordinated, and aimed at improving and rehabilitating the lake sturgeon's natural ecological role in the Lake Superior ecosystem.

Subfactor 3.2.3 – Management Record of Following Scientific Advice

Considerations: How often (always, sometimes, rarely) do managers of the fishery follow scientific recommendations/advice (e.g., do they set catch limits at recommended levels)? A Highly Effective rating is given if managers nearly always follow scientific advice.

Canada Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Trap net

Minnesota Lake Superior, Gillnet, Bottom

Minnesota Lake Superior, Pound Net

Minnesota Lake Superior, Trap net

Wisconsin Lake Superior, Gillnet, Bottom

Wisconsin Lake Superior, Pound Net

Wisconsin Lake Superior, Trap net

Highly Effective

See Factor 3.1.4.

Subfactor 3.2.4 – Enforcement of Management Regulations

Considerations: Is there a monitoring/enforcement system in place to ensure fishermen follow management regulations and what is the level of fishermen's compliance with regulations? To

achieve a Highly Effective rating, there must be consistent enforcement of regulations and verification of compliance.

Canada Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Trap net

Minnesota Lake Superior, Gillnet, Bottom

Minnesota Lake Superior, Pound Net

Minnesota Lake Superior, Trap net

Wisconsin Lake Superior, Gillnet, Bottom

Wisconsin Lake Superior, Pound Net

Wisconsin Lake Superior, Trap net

Highly Effective

See Factor 3.1.5.

Criterion 4: Impacts on the habitat and ecosystem

This Criterion assesses the impact of the fishery on seafloor habitats, and increases that base score if there are measures in place to mitigate any impacts. The fishery's overall impact on the ecosystem and food web and the use of ecosystem-based fisheries management (EBFM) principles is also evaluated. Ecosystem Based Fisheries Management aims to consider the interconnections among species and all natural and human stressors on the environment.

The final score is the geometric mean of the impact of fishing gear on habitat score (plus the mitigation of gear impacts score) and the Ecosystem Based Fishery Management score. The Criterion 2 rating is determined as follows:

- *Score >3.2=Green or Low Concern*
- *Score >2.2 and <=3.2=Yellow or Moderate Concern*
- *Score <=2.2=Red or High Concern*

Rating cannot be Critical for Criterion 4.

Criterion 4 Summary

Region / Method	Gear Type and Substrate	Mitigation of Gear Impacts	EBFM	Overall Recomm.
Canada Lake Superior Gillnet, Bottom	3.00:Low Concern	0.25:Minimal Mitigation	4.00:Low Concern	**Green (3.606)**
Michigan Lake Superior Gillnet, Bottom	3.00:Low Concern	0.25:Minimal Mitigation	4.00:Low Concern	**Green (3.606)**
Michigan Lake Superior Trap net	3.00:Low Concern	0.25:Minimal Mitigation	4.00:Low Concern	**Green (3.606)**
Minnesota Lake Superior Gillnet, Bottom	3.00:Low Concern	0.25:Minimal Mitigation	4.00:Low Concern	**Green (3.606)**
Minnesota Lake Superior Pound Net	3.00:Low Concern	0.25:Minimal Mitigation	4.00:Low Concern	**Green (3.606)**
Minnesota Lake Superior Trap net	3.00:Low Concern	0.25:Minimal Mitigation	4.00:Low Concern	**Green (3.606)**
Wisconsin Lake Superior Gillnet, Bottom	3.00:Low Concern	0.25:Minimal Mitigation	4.00:Low Concern	**Green (3.606)**
Wisconsin Lake Superior Pound Net	3.00:Low Concern	0.25:Minimal Mitigation	4.00:Low Concern	**Green (3.606)**
Wisconsin Lake Superior Trap net	3.00:Low Concern	0.25:Minimal Mitigation	4.00:Low Concern	**Green (3.606)**

Justification of Ranking

Factor 4.1 – Impact of Fishing Gear on the Habitat/Substrate

Scoring Guidelines

- *5 (None)—Fishing gear does not contact the bottom*
- *4 (Very Low)—Vertical line gear*
- *3 (Low)—Gears that contacts the bottom, but is not dragged along the bottom (e.g. gillnet, bottom longline, trap) and is not fished on sensitive habitats. Bottom seine on resilient mud/sand habitats. Midwater trawl that is known to contact bottom occasionally (*
- *2 (Moderate)—Bottom dragging gears (dredge, trawl) fished on resilient mud/sand habitats. Gillnet, trap, or bottom longline fished on sensitive boulder or coral reef habitat. Bottom seine except on mud/sand*
- *1 (High)—Hydraulic clam dredge. Dredge or trawl gear fished on moderately sensitive habitats (e.g., cobble or boulder)*
- *0 (Very High)—Dredge or trawl fished on biogenic habitat, (e.g., deep-sea corals, eelgrass and maerl)*

Note: When multiple habitat types are commonly encountered, and/or the habitat classification is uncertain, the score will be based on the most sensitive, plausible habitat type.

Canada Lake Superior, Gillnet, Bottom

Low Concern

Gillnets are the most commonly used fishing method in Canada. Impacts of gillnets on the seabed are expected to be limited to the impact of anchors on the substrate and minimal amounts of scouring during the setting and hauling of nets (Figure 9 and pers. comm., DNR, OMNR). The anchor and the bottom part of the net touch the bottom. Bottom gillnets on Lake Superior do not encounter rocky reefs or coral and thus qualify as a “low concern” (Chuenpagdee et al. 2003).

Michigan Lake Superior, Gillnet, Bottom

Low Concern

It is mainly tribal fisheries that use gillnets. The impacts of gillnets on the lakebed are expected to be limited to the impact of anchors on the substrate and minimal amounts of scouring during the setting and hauling of nets (pers. comm., DNR, OMNR). Bottom gillnets on Lake Superior do not encounter rocky reefs or coral and thus qualify as a “low concern” (Chuenpagdee et al. 2003).

Gillnet fishing throughout the Great Lakes is generally referred to as “bottom gillnets”; they are anchored to the substrate and touch the bottom.

Michigan Lake Superior, Trap net

Low Concern

Trap nets are used lakewide in U.S., tribal, and Canadian waters. Trap net impacts on benthic substrate in Canadian waters are not assessed. However, their impacts are considered negligible in areas where they are utilized (pers. comm., OMNR). Trap nets on Lake Superior do not encounter rocky reefs or coral and thus qualify as a “low concern” (Chuenpagdee et al. 2003).

Minnesota Lake Superior, Gillnet, Bottom

Low Concern

It is mainly tribal fisheries that use gillnets. The impacts of gillnets on the lakebed are expected to be limited to the impact of anchors on the substrate and minimal amounts of scouring during the setting and hauling of nets (pers. comm., DNR, OMNR). Bottom gillnets on Lake Superior do not encounter rocky reefs or coral and thus qualify as a “low concern” (Chuenpagdee et al. 2003).

Gillnet fishing throughout the Great Lakes is generally referred to as “bottom gillnets”; they are anchored to the substrate and touch the bottom.

Minnesota Lake Superior, Pound Net

Low Concern

Pound nets have a similar function as trap nets and are mainly used to capture rainbow smelt. The impact from pound nets may be minimal because there are no coral reefs, and the bottom is either soft or rocky with not much production in most parts because it is too deep. The main impact would be from the stakes that are driven into the ground to hold the net in place (Koelz 1925).

Minnesota Lake Superior, Trap net

Low Concern

Trap nets are used lakewide in U.S., tribal, and Canadian waters. Trap net impacts on benthic substrate in Canadian waters are not assessed. However, their impacts are considered negligible in areas where they are utilized (pers. comm., OMNR). Trap nets on Lake Superior do not encounter rocky reefs or coral and thus qualify as a “low concern” (Chuenpagdee et al. 2003).

Wisconsin Lake Superior, Gillnet, Bottom

Low Concern

It is mainly tribal fisheries that use gillnets. The impacts of gillnets on the lakebed are expected to be limited to the impact of anchors on the substrate and minimal amounts of scouring during the setting and hauling of nets (pers. comm., DNR, OMNR). Bottom gillnets on Lake Superior do not encounter rocky reefs or coral and thus qualify as a "low concern" (Chuenpagdee et al. 2003).

Gillnet fishing throughout the Great Lakes is generally referred to as "bottom gillnets"; they are anchored to the substrate and touch the bottom.

Wisconsin Lake Superior, Pound Net

Low Concern

Pound nets have a similar function as trap nets and are mainly used to capture rainbow smelt. The impact from pound nets may be minimal because there are no coral reefs, and the bottom is either soft or rocky with not much production in most parts because it is too deep. The main impact would be from the stakes that are driven into the ground to hold the net in place (Koelz 1925).

Wisconsin Lake Superior, Trap net

Low Concern

Trap nets are used lakewide in U.S., tribal, and Canadian waters. Trap net impacts on benthic substrate in Canadian waters are not assessed. However, their impacts are considered negligible in areas where they are utilized (pers. comm., OMNR). Trap nets on Lake Superior do not encounter rocky reefs or coral and thus qualify as a "low concern" (Chuenpagdee et al. 2003).

Factor 4.2 – Mitigation of Gear Impacts

Scoring Guidelines

- *+1 (Strong Mitigation)—Examples include large proportion of habitat protected from fishing (>50%) with gear, fishing intensity low/limited, gear specifically modified to reduce damage to seafloor and modifications shown to be effective at reducing damage, or an effective combination of 'moderate' mitigation measures.*
- *+0.5 (Moderate Mitigation)—20% of habitat protected from fishing with gear or other measures in place to limit fishing effort, fishing intensity, and spatial footprint of damage caused from fishing.*

- *+0.25 (Low Mitigation)—A few measures are in place (e.g., vulnerable habitats protected but other habitats not protected); there are some limits on fishing effort/intensity, but not actively being reduced.*
- *0 (No Mitigation)—No effective measures are in place to limit gear impacts on habitats.*

Canada Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Trap net

Minnesota Lake Superior, Gillnet, Bottom

Minnesota Lake Superior, Pound Net

Minnesota Lake Superior, Trap net

Wisconsin Lake Superior, Gillnet, Bottom

Wisconsin Lake Superior, Pound Net

Wisconsin Lake Superior, Trap net

Minimal Mitigation

Impacts of commercial fishing gear on benthic substrate have not been fully assessed in Lake Superior. However, gears utilized in Lake Huron are not believed to significantly impact benthic substrate, so mitigation strategies for negative impacts are non-existent. The benthic substrate of Lake Huron is generally soft substrate and devoid of hard structure that may be damaged by gear placement. In areas deemed spawning or nursery areas (where such hard substrate may exist) fishing gear is rarely, if ever, placed, because such areas are recognized as vital to commercially valuable species such as lake whitefish (pers. comm., OMNR).

Factor 4.3 – Ecosystem-Based Fisheries Management

Scoring Guidelines

- *5 (Very Low Concern)—Substantial efforts have been made to protect species' ecological roles and ensure fishing practices do not have negative ecological effects (e.g., large proportion of fishery area is protected with marine reserves, and abundance is maintained at sufficient levels to provide food to predators).*
- *4 (Low Concern)—Studies are underway to assess the ecological role of species and measures are in place to protect the ecological role of any species that plays an exceptionally large role in the ecosystem. Measures are in place to minimize potentially*

negative ecological effect if hatchery supplementation or fish aggregating devices (FADs) are used.

- *3 (Moderate Concern)—Fishery does not catch species that play an exceptionally large role in the ecosystem, or if it does, studies are underway to determine how to protect the ecological role of these species, OR negative ecological effects from hatchery supplementation or FADs are possible and management is not place to mitigate these impacts.*
- *2 (High Concern)—Fishery catches species that play an exceptionally large role in the ecosystem and no efforts are being made to incorporate their ecological role into management.*
- *1 (Very High Concern)—Use of hatchery supplementation or fish aggregating devices (FADs) in the fishery is having serious negative ecological or genetic consequences, OR fishery has resulted in trophic cascades or other detrimental impacts to the food web.*

Canada Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Gillnet, Bottom

Michigan Lake Superior, Trap net

Minnesota Lake Superior, Gillnet, Bottom

Minnesota Lake Superior, Pound Net

Minnesota Lake Superior, Trap net

Wisconsin Lake Superior, Gillnet, Bottom

Wisconsin Lake Superior, Pound Net

Wisconsin Lake Superior, Trap net

Low Concern

The Great Lakes Fishery Commission (GLFC) currently implements an Ecosystem-Based Fisheries Management (EBFM) strategy (GLFC 2007). The Joint Strategic Plan for Management of the Great Lakes explicitly calls for an Ecosystem Management Strategy as one of four agreed-upon strategies recognized by the GLFC. The policy was adopted for two main reasons: (1) fisheries managers realize that the Great Lakes are interconnected, and if something negatively impacts one, there is a high likelihood that it will affect the others; (2) the Great Lakes commercial fishing industry comprises multiple species of interest, with each currently existing in a different state of conservation concern and requiring different management efforts to recovery. As such, targeted fish stocks and status are continually monitored, and recommendations on harvest restrictions are made to reflect current stock conditions. These restrictions include harvest limits or quotas, seasonal fishing restrictions, and size restrictions (Horns, W.H. et al., 2003). Shifts in community structure, as well as trends in abundance of prey and forage fish

are also closely monitored. The options of the Lake Superior Technical Committee to influence the fish-community structure are to regulate harvests, stock fish, protect and enhance habitat, and suppress nuisance species (sea lamprey in particular).

Lake trout, an “exceptional species” in Lake Superior as a top predator, is also closely monitored, and the ecological interactions of lake trout and its surrounding ecosystem are a subject of great concern and consideration for managers throughout the Great Lakes. A basin-wide rehabilitation effort is currently underway that attempts to fully understand the lake trout ecological role, in an effort to help restore the stocks. In Lake Superior, these rehabilitation efforts include stocking and hatchery programs, sea lamprey control and predation monitoring, assessment and tracking of current stocks, and genetic monitoring and considerations in hatchery operations.

Overall scientific assessment and management efforts that are currently in place take into account the ecological role of all species considered. Exceptional species that may be caught, such as lake trout or lake sturgeon, have protection in place so they can continue to perform the ecological role and entire ecosystem functioning. For example, many of the sturgeon spawning habitats are off-limits to fishing. Many fisheries have hatchery supplementation, and all the potential negative ecological genetic impacts are considered and minimized. With the many non-native species in Lake Superior, there are policies in place to manage for all their adverse effects. For these reasons, the score is of “low concern.”

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Scientific review does not constitute an endorsement of the Seafood Watch® program, or its seafood recommendations, on the part of the reviewing scientists. Seafood Watch® is solely responsible for the conclusions reached in this report.

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