Monterey Bay Aquarium Seafood Watch®

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

Salvelinus namaycush, Coregonus clupeaformis, Osmerus mordax, Sander vitreus, Perca flavescens

©New York State Dept. of Environmental Conservation

Canada and U.S. (Lake Huron)

Set gillnets, Barriers, fences, weirs, corrals, etc.

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Jeremiah Johnson, Whitney Conard, Bailey Keeler, Joseph Krieger, Ellen Spooner

Seafood Watch Standard used in this assessment: Standard for Fisheries vF2

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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 wildcatch 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 over time. 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-twentieth century, which have continued to evolve and expand. Because of these efforts, the current Great Lakes fishery more closely resembles the fishery of the early 1900s than it has in the past 75 years. Today's commercial fisheries are a mixture of recovered native species that have long 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 dominant top predator in all of 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 served to drive lake trout populations into steep decline during the middle of the 20th century. By 1960, lake trout were nearly extirpated 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 are not allowed to be harvested by commercial fishermen and any lake trout that show up at a market are not allowed to be sold. Furthermore, commercial fisheries that do accidentally catch lake trout are required to return them to the lake alive and 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 are considered a '**Good Alternative**'.

Lake trout in Michigan waters of Lake Superior are a "**Good Alternative**" because populations are in recovery. Lake trout in Wisconsin waters of Lake Superior are "**Avoid**" primarily due to lack of available data. Lake trout in Minnesota waters of Lake Superior are "**Best Choice**" because of stable populations and well managed harvest. Lake trout in Canadian waters of Lake Superior are "**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 some increases in recent years. There is no commercial fishery for lake trout in Lake Ontario.

Lake trout in Lake Michigan waters are considered a "**Good Alternative**". Lake trout populations throughout the lake are still heavily maintained through stocking with little natural reproduction being 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 wide 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 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 are still in recovery following a dramatic decline during the 1990's.

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 middle of the 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 for all the Great Lakes. In recent years, 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 trapnets within Pennsylvania or New York waters and "**Good Alternativ**e" if caught in trapnets within Ohio waters or gillnets within Ontario waters.

In Lake Superior Canadian waters, yellow perch were over harvested and the fishery was closed in 2004. They are currently in recovery but have the recommendation of "**Good Alternative**" because of restrictions to harvest which allow for recovery. Lake Superior Michigan waters are "**good alternative**" because of stable populations and low harvest.

Yellow perch have a "**Good Alternative**" recommendation for Lake Huron. Yellow perch populations are still in a state of recovery following lake-wide declines in the 1980's to 1990's. Additionally, several years of poor year-class strength and recruitment have resulted in uncertain population status for yellow perch in US 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 Trapnet 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 tonnes. In New York waters yellow perch received a "**Best Choice**" ranking because it is a small fishery and Yellow Perch have comprised >95% of the fishery since 2004, so its impacts on other species is minimal. In addition, effective management is in place, and the fisheries impacts on habitat, the target stock, and other species is low to moderate.

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

4. Lake whitefish *(Coregonnus clupeaformis)*: Lake whitefish have 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 are 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 middle of the 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, as 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 exotic 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 utilizing alternate prey, including zebra mussels. In spite of decreased condition 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 lake whitefish from Lake Erie are "**Good Alternative**".

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

Lake Whitefish in Lake Huron are also given a "**Good Alternative**" recommendation. Lake whitefish represent the largest and most valuable fishery in Lake Huron but concerns in regards to 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 are **"Avoid**" primarily due to a lack of available data. Lake Whitefish in Canadian waters in Lake Superior are "**Good Alternative**" because of unlicensed fishing in portions of their waters.

With the exception of individuals harvest with trapnets from Wisconsin waters, the Lake Whitefish recommendations for Lake Michigan are "**Good Alternative**". Those taken with trapents from Wisconsin waters are 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 as they 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 like Rainbow Smelt and Alewife; to support increased recreational fishing; and to aid in the recovery of lake trout populations. The first two of these 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 in feeding the predator community that now support highly lucrative recreational fisheries. Smelt had also become a favored prey of recovering native predators such as lake trout. At the same time, Smelt began to support a substantial commercial fishery. In the latter part of the 20th century, Rainbow Smelt stocks entered a period of highly variable recruitment, possibly as a response to excessive predation pressure and reduction of food availability in the water column associated with 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 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 rainbow smelt in Lake Erie is "**Best Choice**".

Rainbow smelt are "**Good alternative**" in Michigan waters of Lake Superior because they are an invasive species. In Lake Superior Wisconsin waters they are "**Good Alternative**" because of a lack of available data. In Canadian waters of Lake Superior they are considered a "**Good Alternative**" because of unlicensed fishing in a portion of their waters. They are **"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.

Final Seafood Recommendations

SPECIES/FISHERY	CRITERION 1: IMPACTS ON THE SPECIES	CRITERION 2: IMPACTS ON OTHER SPECIES	CRITERION 3: MANAGEMENT EFFECTIVENESS	CRITERION 4: HABITAT AND ECOSYSTEM	OVERALL RECOMMENDATION
Lake trout United States of America Lake Huron, Set gillnets, United States of America	Yellow (2.644)	Red (2.159)	Yellow (3.000)	Green (3.464)	**Good Alternative (2.775)**
Lake trout Canada Lake Huron, Set gillnets, Canada	Yellow (2.644)	Yellow (2.644)	Yellow (3.000)	Green (3.464)	**Good Alternative (2.919)**
Lake trout United States of America Lake Huron, Barriers, fences, weirs, corrals, etc., United States of America	Yellow (2.644)	Red (2.159)	Yellow (3.000)	Green (3.464)	**Good Alternative (2.775)**
Lake trout Canada Lake Huron, Barriers, fences, weirs, corrals, etc., Canada	Yellow (2.644)	Yellow (2.644)	Yellow (3.000)	Green (3.464)	**Good Alternative (2.919)**
Lake whitefish United States of America Lake Huron, Set gillnets, United States of America	Red (2.159)	Yellow (2.644)	Yellow (3.000)	Green (3.464)	**Good Alternative (2.775)**
Lake whitefish Canada Lake Huron, Set gillnets, Canada	Yellow (2.644)	Yellow (2.644)	Yellow (3.000)	Green (3.464)	**Good Alternative (2.919)**
Lake whitefish United States of America Lake Huron, Barriers, fences, weirs, corrals, etc., United States of America	Red (2.159)	Yellow (2.644)	Yellow (3.000)	Green (3.464)	**Good Alternative (2.775)**
Lake whitefish Canada Lake Huron, Barriers, fences, weirs, corrals, etc., Canada	Yellow (2.644)	Yellow (2.644)	Yellow (3.000)	Green (3.464)	**Good Alternative (2.919)**
Rainbow smelt Canada Lake Huron, Barriers, fences, weirs, corrals, etc., Canada	Green (5.000)	Yellow (2.644)	Yellow (3.000)	Green (3.464)	**Best Choice (3.423)**
Walleye United States of America Lake Huron, Set gillnets, United States of America	Yellow (2.644)	Red (2.159)	Yellow (3.000)	Green (3.464)	**Good Alternative (2.775)**

Walleye Canada Lake Huron, Set gillnets, Canada	Green (3.318)	Yellow (2.644)	Yellow (3.000)	Green (3.464)	**Good Alternative (3.090)**
Walleye United States of America Lake Huron, Barriers, fences, weirs, corrals, etc., United States of America	Yellow (2.644)	Red (2.159)	Yellow (3.000)	Green (3.464)	**Good Alternative (2.775)**
Walleye Canada Lake Huron, Barriers, fences, weirs, corrals, etc., Canada	Green (3.318)	Yellow (2.644)	Yellow (3.000)	Green (3.464)	**Good Alternative (3.090)**
Yellow perch Canada Lake Huron, Set gillnets, Canada	Green (3.318)	Yellow (2.644)	Yellow (3.000)	Green (3.464)	**Good Alternative (3.090)**
Yellow perch United States of America Lake Huron, Barriers, fences, weirs, corrals, etc., United States of America	Yellow (2.644)	Red (2.159)	Yellow (3.000)	Green (3.464)	**Good Alternative (2.775)**
Yellow perch Canada Lake Huron, Barriers, fences, weirs, corrals, etc., Canada	Green (3.318)	Yellow (2.644)	Yellow (3.000)	Green (3.464)	**Good Alternative (3.090)**

Summary

Walleye and yellow perch harvested from Lake Huron are considered a GOOD ALTERNATIVE, due in part their impact on other species, most notably lake trout, a species of special concern. Concerns with the stock status of yellow perch and walleye also contribute to their score.

Lake Trout and lake whitefish taken from Lake Huron are ranked as a GOOD ALTERNATIVE due to concerns in the stock status of the species, the absence or population status information and concerns about future sustainability of the fishery.

Rainbow smelt harvest from Canadian waters in Lake Huron are all considered BEST CHOICE.

Eco-Certification Information

No elements of the fisheries considered here are eco-certified or part of fisheries improvemetnt projects (FIPs).

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.

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[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).

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) is also evaluated.

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

Species Overview

Lake trout are 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 depths of 100-200 ft waters during the summer and winter. Lake trout are the largest of the charr (a sub-grouping within Salmonidae), reaching lengths of up to 50 inches, and typically weighing 15 to 40 lbs (Froese & Pauly 2012). Once in the dominant predator in Lake Huron, introduction of sea lamprey, habitat alterations, and overfishing have resulted in dramatic declines of this once economically valuable fish.
Lake whitefish (member of the family Salmonidae) are found inland lakes throughout Canada, Alaska, and the northern part of the United States. Lake whitefish are schooling fish, which prefer cool waters at depths of up to 200 ft. Lake whitefish typically achieve lengths of 20-30 inches and weigh upwards of 20 lbs. Lake whitefish represent the highest commercial yield of any fishery in the Great Lakes (Froese & Pauly 2012).

Yellow perch are found throughout freshwater lakes in North America. Yellow perch are utilized as both a food fish and a game fish making them a source of great value. Yellow perch prefer water temperatures of 66-70°F and are generally taken at depths of > 45 ft (Froese & Pauly 2012). They average 4-10 inches in length and achieve weights of 4-10 oz (Froese & Pauly 2012).

Walleye (the largest member of the perch family) are also utilized as both a food fish and a game fish. They are found throughout most of Canada and the Northern United States. Walleye are veracious near shore predators, reaching lengths of 20-30 inches and weighing up to 20 lbs. They prefer temperatures of 55-68°F and are seldom found at depths of >50 ft (Froese & Pauly 2012).

Rainbow smelt are native to the Atlantic Coast and throughout the Northern portions of the Atlantic Ocean and Arctic Ocean. They were introduced into inland lakes, escaped, and made their way into the Great Lakes in the early 1900's. The rainbow smelt is slender and cylindrical, achieving lengths of 7 to 9 inches and weighs of ~3 oz. The commercial fishery for rainbow smelt has greatly declined in Lake Huron where they are now currently caught only as bycatch with other, more valuable species (Froese & Pauly 2012).

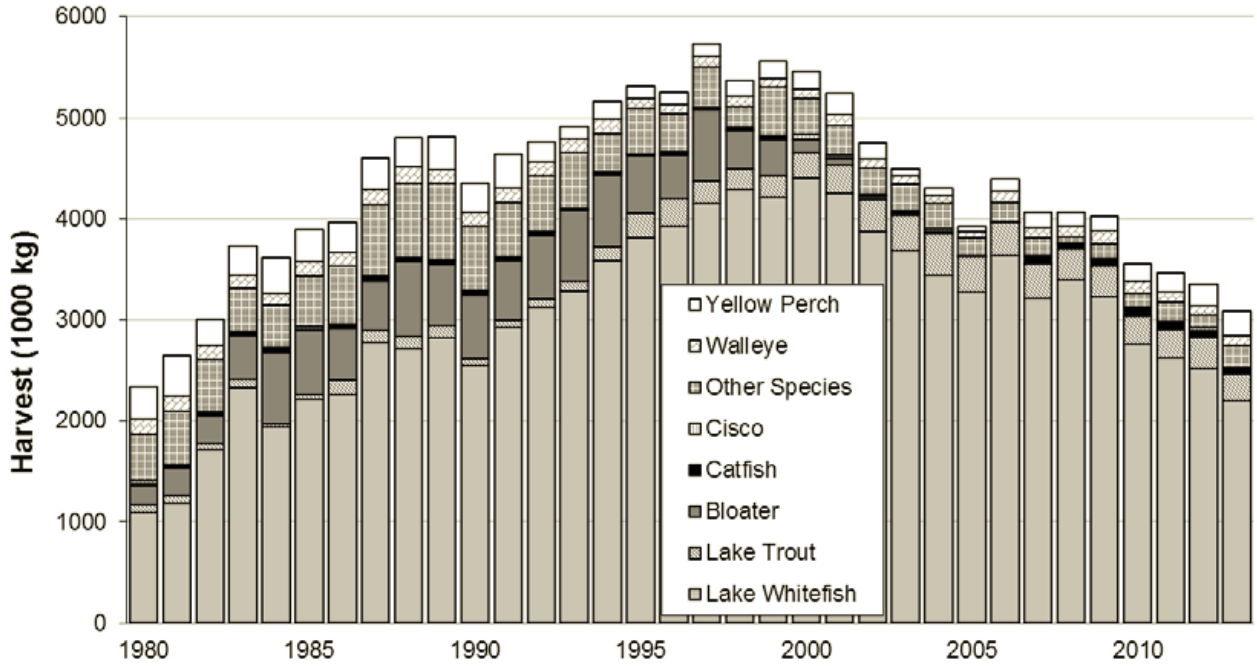
The Lake Huron fishery has been active since the early 19th century, when settlements were established and local fish trading became common. Since then, Lake Huron has supported the 3rd largest commercial fishery in the Great Lakes, primarily through Canadian fisheries in Georgian Bay, the North Channel, and the open lake and US fisheries in the open lake and in Saginaw Bay. The fishery targeted lake trout, lake whitefish, walleye,

sauger, and ciscoes, with nearly constant production until the late 1930s when sea lamprey predation began to affect catches of lake trout and whitefish. This caused a continuing decline in commercial catches of these valuable species through the 1960s, and a concurrent increase in catches of lower value species such as yellow perch and chubs. Total production of all species in Lake Huron dropped from 6,600 tons to 3,800 tons between 1940 and 1966, with lake trout disappearing from US commercial catches by 1946 and from Canadian catches in 1955 (Berst & Spangler 1973). Only Parry Sound and Iroquois Bay continued to support small remnant lake trout populations, likely because there were few sea lampreys in these areas. By the early 1970s, commercial fishing in Lake Huron was in an overall depressed state, with sea lamprey predation having had the single largest effect on species composition by decimating stocks of both lake trout and lake whitefish, species that had supported both major fisheries and high trophic level species. In addition, eutrophication had caused the loss of *Hexagenia* mayflies in Saginaw Bay in the 1960s, affecting food supplies for fish.

The fisheries targeting the species mentioned above are managed by state, provincial and tribal organizations. They work together with the help of the Great Lakes Fishery Commission (GLFC) under the Joint Strategic Plan for Management of Great Lakes Fisheries, which was originally enacted in 1981. It was reviewed in 1986 and amended in 1997 in an effort to adopt practices to better coordinate fishery and environmental management issues. During this time tribal fisherman (CORA and GLIFWC) and USGS representatives were offered seats on the Council of Lake Committees (GLFC 2007).

Production Statistics

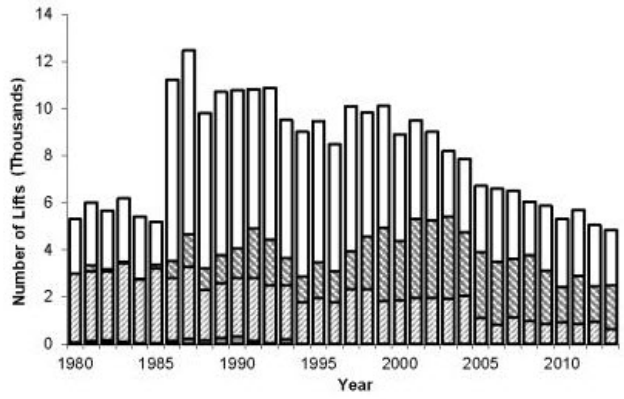
None of the species evaluated in this report are considered important on a global scale. Most of the harvest remains on the continent and is insignificant compared to global landings of other fish in other fisheries. Lake whitefish yields are the largest with an estimated 9, 494 tonnes reported as harvested globally (FAO 2014). In Lake Huron, landings of lake trout have increased over the last 30 years, likely a result of increased re-stocking efforts throughout the Great Lakes. Landings of yellow perch are also higher than their 30 year historic average. Landings of lake whitefish and walleye have decreased over the same period of time. Harvest of lake whitefish showed a peak during the early 2000's and has since begun to decline. This peak represents and all time historic high for lake whitefish harvest in Lake Huron which had never before or since been seen. Harvest of the other 3 species has fluctuated over the last 30 years but appear to remain relatively constant



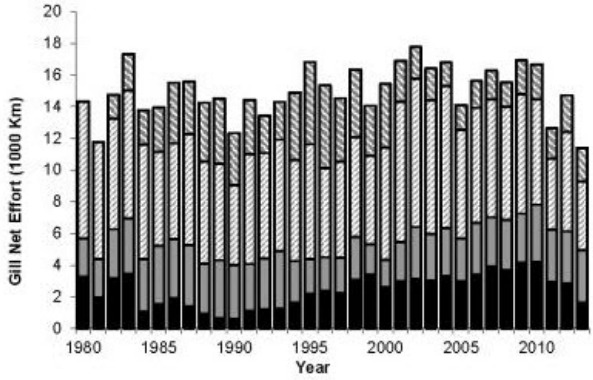
Total lake-wide commercial harvest for all species caught in Lake Huron, 1910-2013. Image from Mohr et al. 2014.

Rainbow smelt landings for 2012 were only 130 lbs, representing a very small fraction of the entire fishing industry. Trend data for rainbow smelt harvest is currently not assessed.

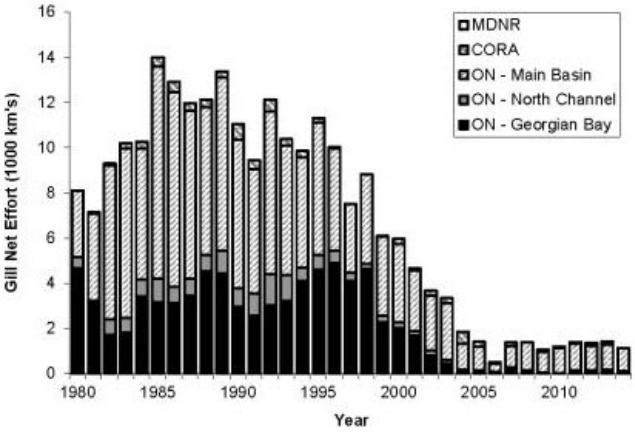
For the Lake Huron Fisheries discussed in this report, the breakdown of gear type effort is given in figure 10



Trapnets



Large Mesh Gillnets



Small Mesh Gillnets

Total lake-wide commercial fishing effort by managment agency and lake basin for Lake Huron. Image from Mohr et al. 2014.

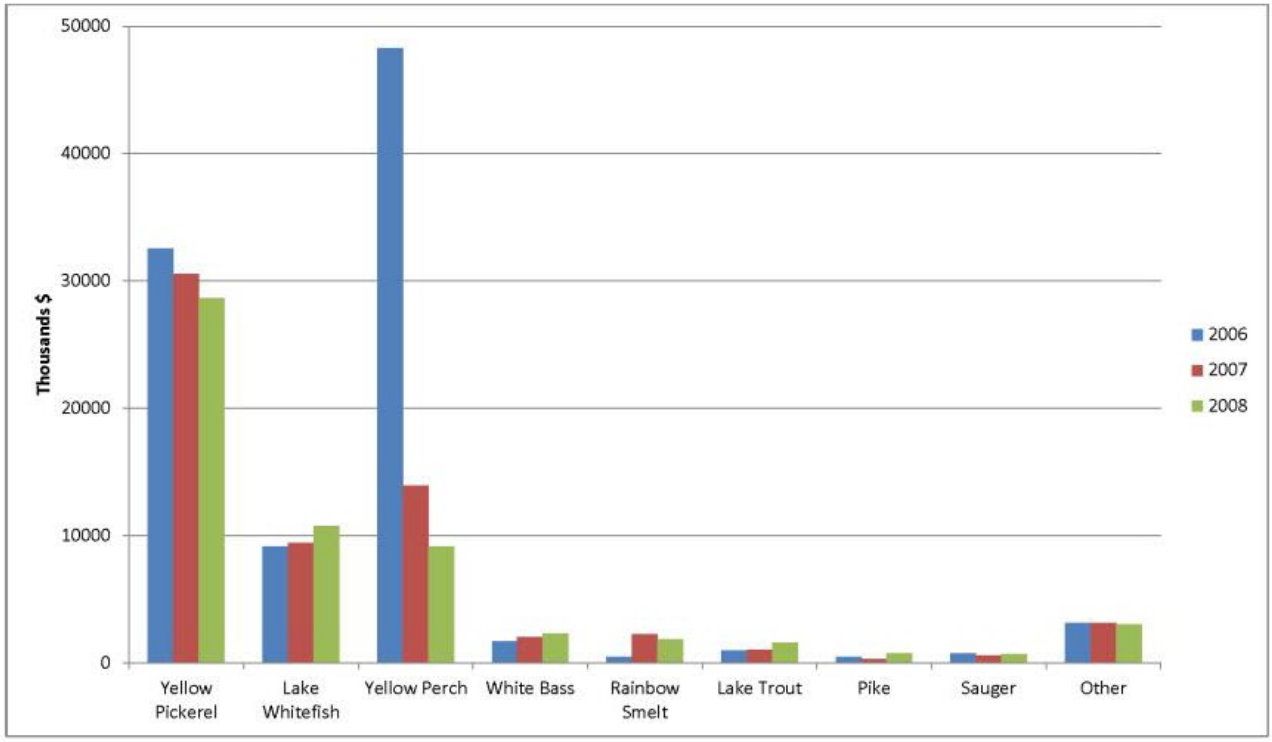
Lake	Fishery	Species	Landings (tonnes)	Gear
Lake Huron	Canadian	Walleye	44.63	Trapnet
Lake Huron	Canadian	Walleye	52.13	Gillnet
Lake Huron	Tribal (US)	Walleye	10.1	Gillnet/Trapnet
Lake Huron	Canadian	Lake Trout	10.64	Trapnet
Lake Huron	Canadian	Lake Trout	165.45	Gillnet
Lake Huron	Tribal (US)	Lake Trout	130.7	Gillnet/Trapnet
Lake Huron	Canadian	Lake Whitefish	49.72	Trapnet
Lake Huron	Canadian	Lake Whitefish	1828.5	Gillnet
Lake Huron	Michigan (State-Licensed)	Lake Whitefish	531.16	Trapnet
Lake Huron	Tribal (US)	Lake Whitefish	365.47	Gillnet/Trapnet
Lake Huron	Canadian	Yellow Perch	4.73	Trapnet
Lake Huron	Canadian	Yellow Perch	192.99	Gillnet
Lake Huron	Michigan (State-Licensed)	Yellow Perch	42.78	Trapnet
Lake Huron	Tribal (US)	Yellow Perch	0.033	Gillnet/Trapnet
Lake Huron	Canadian	Rainbow Smelt	130 lbs	Gillnet

Lake Huron Landings Summary

Importance to the US/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 US 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, and is the recently most valuable in terms of price per pound



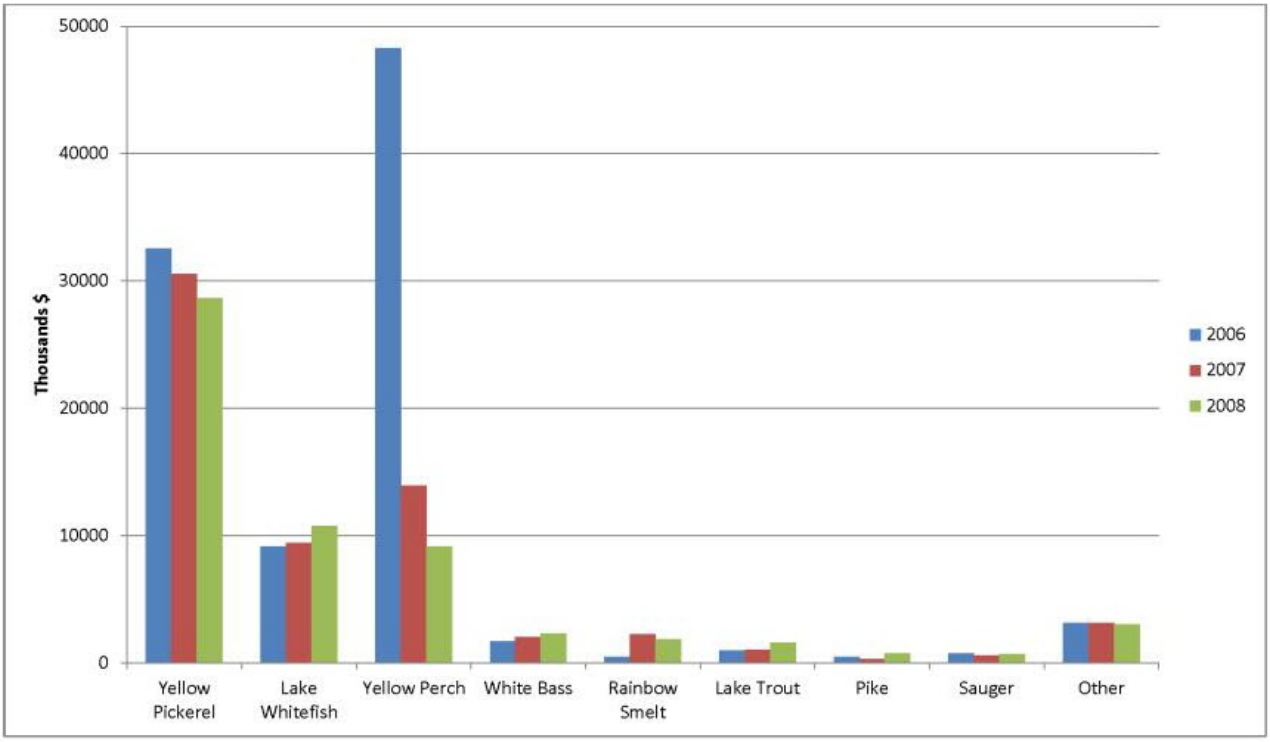
Commercial landing values of Canadian Freshwater Fisheries.

The US 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 about 50-100 million pounds annually (Hinshaw 2006). Currently, close to two million pounds are commercially harvested within the US, primarily from Ohio waters of Lake Erie. Nearly twice that, just under four million pounds, is imported, nearly all of it from Canadian commercial Great Lakes fisheries operating in Ontario ((Hinshaw 2006),(Baldwin et al. 2009),(DFO 2011)).

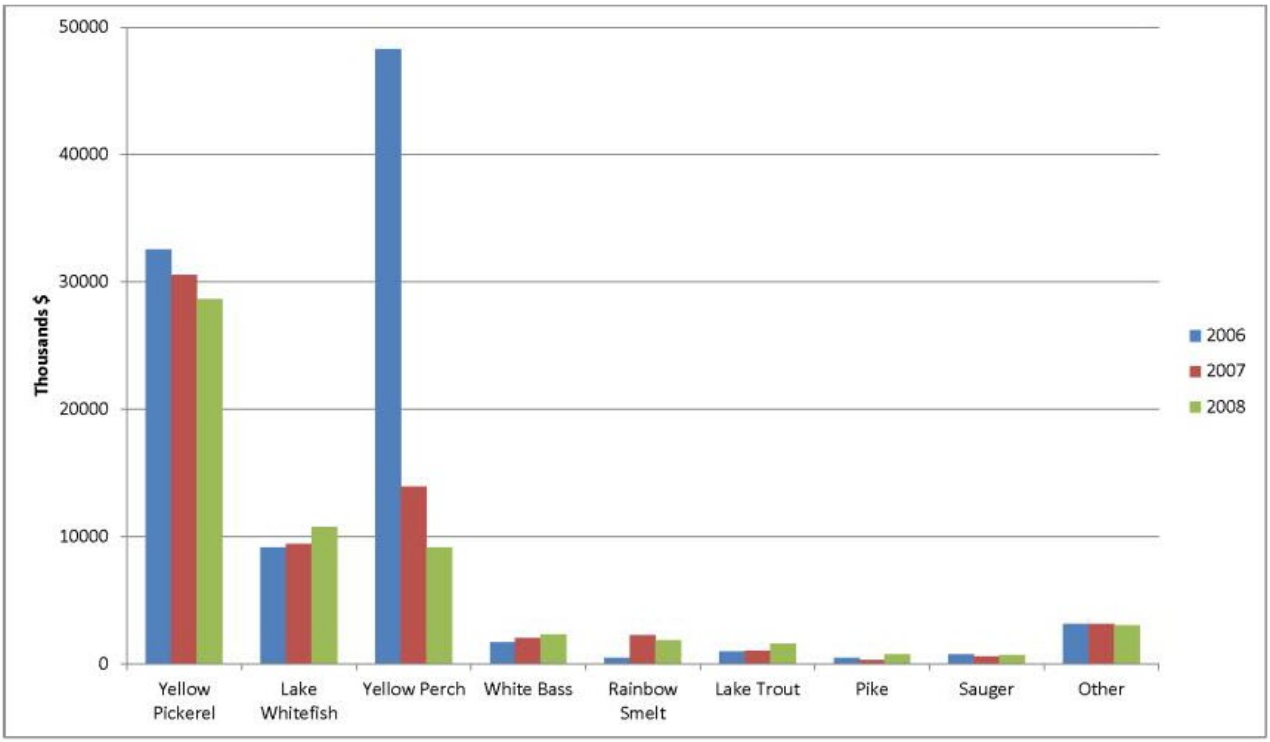
The largest exports of whitefish from Canada are from the Northwest Territories, Manitoba, Saskatchewan, and Alberta. Great Lakes catches traditionally focused on domestic wholesale markets but competition from Canadian wholesalers from northwest regions of Canada are influencing prices and increasing competition with Great Lakes fish. Partly as a result of this competition and also because of declining quota and the need to get greater return from 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



Commercial landing values of Canadian Freshwater Fisheries.

These fish are primarily sold in US markets.

Great Lakes rainbow smelt are the fifth largest Canadian freshwater fish export by value.



Commercial landing values of Canadian Freshwater Fisheries.

The majority of Canadian-caught freshwater smelt are exported frozen to Japan, with some going to the US.

A portion of the Lake Erie catch is also exported fresh to the US.

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 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 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 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 US 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**	**Abundance**	**Fishing Mortality**	**Score**
United States of America/Lake Huron Set gillnets | United States of America	1.00: High	3.00: Moderate Concern	2.33: Moderate Concern	Yellow (2.64)
Canada/Lake Huron Set gillnets | Canada	1.00: High	3.00: Moderate Concern	2.33: Moderate Concern	Yellow (2.64)
United States of America/Lake Huron Barriers, fences, weirs, corrals, etc. | United States of America	1.00: High	3.00: Moderate Concern	2.33: Moderate Concern	Yellow (2.64)
Canada/Lake Huron Barriers, fences, weirs, corrals, etc. | Canada	1.00: High	3.00: Moderate Concern	2.33: Moderate Concern	Yellow (2.64)

LAKE WHITEFISH				
Region | Method	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Score**
United States of America/Lake Huron Set gillnets | United States of America	2.00: Medium	2.00: High Concern	2.33: Moderate Concern	Red (2.16)

Canada/Lake Huron Set gillnets | Canada	2.00: Medium	3.00: Moderate Concern	2.33: Moderate Concern	Yellow (2.64)
United States of America/Lake Huron Barriers, fences, weirs, corrals, etc. | United States of America	2.00: Medium	2.00: High Concern	2.33: Moderate Concern	Red (2.16)
Canada/Lake Huron Barriers, fences, weirs, corrals, etc. | Canada	2.00: Medium	3.00: Moderate Concern	2.33: Moderate Concern	Yellow (2.64)

RAINBOW SMELT

Region | Method	Inherent Vulnerability	Abundance	Fishing Mortality	Score
Canada/Lake Huron Barriers, fences, weirs, corrals, etc. | Canada	2.00: Medium	5.00: Very Low Concern	5.00: Very Low Concern	Green (5.00)

WALLEYE

Region | Method	Inherent Vulnerability	Abundance	Fishing Mortality	Score
United States of America/Lake Huron Set gillnets | United States of America	2.00: Medium	3.00: Moderate Concern	2.33: Moderate Concern	Yellow (2.64)
Canada/Lake Huron Set gillnets | Canada	2.00: Medium	3.00: Moderate Concern	3.67: Low Concern	Green (3.32)
United States of America/Lake Huron Barriers, fences, weirs, corrals, etc. | United States of America	2.00: Medium	3.00: Moderate Concern	2.33: Moderate Concern	Yellow (2.64)
Canada/Lake Huron Barriers, fences, weirs, corrals, etc. | Canada	2.00: Medium	3.00: Moderate Concern	3.67: Low Concern	Green (3.32)

YELLOW PERCH				
Region | Method	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Score**
Canada/Lake Huron Set gillnets | Canada	3.00: Low	3.00: Moderate Concern	3.67: Low Concern	Green (3.32)
United States of America/Lake Huron Barriers, fences, weirs, corrals, etc. | United States of America	3.00: Low	3.00: Moderate Concern	2.33: Moderate Concern	Yellow (2.64)
Canada/Lake Huron Barriers, fences, weirs, corrals, etc. | Canada	3.00: Low	3.00: Moderate Concern	3.67: Low Concern	Green (3.32)

Species were evaluated as separate stocks belonging to either Canadian or US/Tribal commercial fishing stocks. Fishermen from each organization operate within designated areas established by each parent country. While some fishing can and inevitably does occur across national boundaries, the species evaluated are primarily taken from stocks located within a single jurisdiction. As such, as species within this report are evaluated as belonging to 1 of 2 main stocks, Canadian or United States.

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, fecundity, etc.). 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

SCORING GUIDELINES

Factor 1.1 - Inherent Vulnerability

- *Low—The FishBase vulnerability score for species is 0-35, OR species exhibits life history characteristics that make it resilient to fishing, (e.g., early maturing).*
- *Medium—The FishBase vulnerability score for species is 36-55, OR species exhibits life history characteristics that make it neither particularly vulnerable nor 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—The FishBase vulnerability score for species is 56-100, OR species exhibits 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

- *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

- *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

UNITED STATES OF AMERICA/LAKE HURON, SET GILLNETS, UNITED STATES OF AMERICA
CANADA/LAKE HURON, SET GILLNETS, CANADA
UNITED STATES OF AMERICA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., UNITED STATES OF AMERICA
CANADA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., CANADA

High

Fishbase vulnerability score is 72 out of 100 (Froese & Pauly 2012).

The lake trout is the largest trout native to the Great lakes and other Michigan lake waters, where they are 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, preferring cobble and gravel substrate on which to spawn.

Factor 1.2 - Abundance

UNITED STATES OF AMERICA/LAKE HURON, SET GILLNETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., UNITED STATES OF AMERICA

Moderate Concern

Lake trout stocks throughout Lake Huron are scored a "moderate concern" since they are a species of special concern (Ebener 1998) and it is probable that the stocks are below the point where recruitment is impaired, but evidence of recent stock improvement is apparent and widespread. Lake trout stock biomass of age 4+ in US waters of Lake Huron is estimated at 1619.3 tonnes (Caroffino & Lenart 2012). 130.7 tonnes of lake trout was harvested from US waters in 2012, representing only 50.5% of the established TAC (Caroffino & Lenart 2012).
Spawning stock biomass is estimated at 328.1 tonnes. Lake trout stock biomass is maintained through the stocking of lake trout in Lake Huron in both US and Canadian waters. In 2011, 1,188,312 lake trout were stock in US waters of Lake Huron (Caroffino & Lenart 2012).

Lake trout in the Canadian waters of Lake Huron are currently in the process of being rehabilitated. These efforts are focused in 16 lake trout rehabilitation zones located throughout Lake Huron on both the USA and Canadian sides (OMNR 2012). Due to these efforts, lake trout are considered an incidental catch species throughout Canadian waters. However, stocks in Lake Huron are currently in transition from stocking-dependence to being able to self-sustain through natural reproduction. Rates of natural reproduction have even improved to the point of management officials considering making lake trout a production (or target) species in the Lake Huron fishery (pers. comm. OMNR).

Justification:

While lake trout stocks in Lake Huron have shown signs of recent improvement, and rates of natural reproduction continue to increase, the abundance of natural reproducing individuals is not known to be at a level where population growth would continue without stocking efforts. This is suggested by Sitar and He (2006), who discuss Lake Superior lake trout wild stock abundance (which have a much higher abundance of adults) as still being lower than hatchery-reared individuals. These findings were then applied to Lake Huron in He et al. (2012) which states "Given the current relative abundance of lake trout adults in Lake Huron and delayed recruitment, a potential hatchery-to wild transition as described by Sitar and He (2006) could take much longer in Lake Huron than in Lake Superior.".

CANADA/LAKE HURON, SET GILLNETS, CANADA
CANADA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., CANADA

Moderate Concern

Lake trout stocks throughout Lake Huron are scored a "moderate concern" since they are a species of special concern (Ebener 1998) and it is probable that the stocks are below the point where recruitment is impaired, but evidence of recent stock improvement is apparent and widespread.
Lakewide biomass estimates for lake trout in the Canadian waters of Lake Huron either do not exist or could not be obtained. Lake trout are stocked throughout Lake Huron, and only a few populations have shown evidence of natural reproduction in Canadian waters (OMNR 2012). As such, CPUE data may not be a sufficient indicator of abundance since the species is only incidentally caught. Populations fluctuate based on yearly stocking rates.

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Factor 1.3 - Fishing Mortality

UNITED STATES OF AMERICA/LAKE HURON, SET GILLNETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., UNITED STATES OF AMERICA

Moderate Concern

Fishing mortality for lake trout harvested in the US waters of Lake Huron scored as a "moderate concern" as % mortality attributed to fishing is minimal and catch rates are below established TAC restrictions but data was not available to evaluate how fishing mortalities compared to a sustainable level of harvest. Additionally, lake trout stocks are partially maintained by stocking, contributing to the "moderate concern" ranking.

TAC's are established annually by estimating population abundance-at-age at the start of the year and then adjusting fishing mortality either to meet mortality targets or to follow guidelines established in the Consent Decree for phasing in the targets. The resulting projection of yield or effort associated with the fishing mortality then form the basis for the TAC recommendation (Caroffino & Lenart 2012). Based on this we believe that they are an appropriate alternative to MSY. Additionally, TAC's are adjusted to achieve target mortality rates and account for current population abundance estimates, resulting in flexible TAC levels reflective of current population status.

Commercial fishing mortality is estimated at 0.131 and 0.005 for the two management units in Lake Huron where lake trout is harvested. These rates represent 38.87 and 1.73 % of the total mortality, respectively (Caroffino & Lenart 2012).

Justification:

In 2012, 130.7 tonnes of lake trout was harvested from US waters, representing only 50.5% of the established TAC (Caroffino & Lenart 2012).

CANADA/LAKE HURON, SET GILLNETS, CANADA
CANADA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., CANADA

Moderate Concern

Fishing mortality for lake trout harvested in the Canadian waters of Lake Huron scored as a "moderate concern" as % mortality attributed to fishing is minimal and catch rates are below established quota restrictions but data was not available to evaluate how fishing mortalities compared to a sustainable level of harvest. Additionally, lake trout stocks are partially maintained by stocking, contributing to the "moderate concern" ranking.

In 2012, 200.9 tonnes of lake trout was harvested, representing only 61.7% of the established quota for lake trout (OMNR 2013).

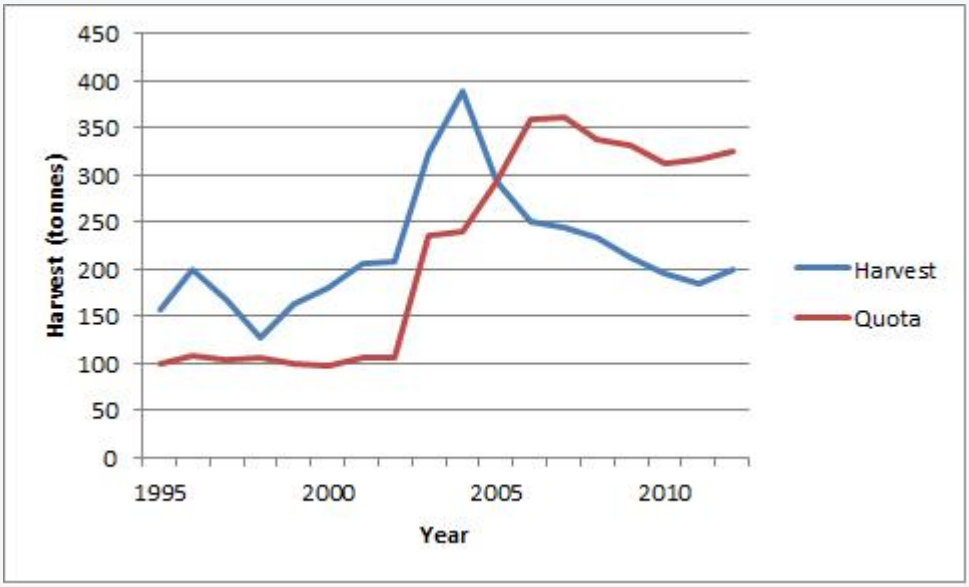
Gillnet CPUE for lake trout harvested in Canadian waters in 2012 was reported as 19.99 kg/km. This is lower than the historic average (1985 to present) which is 23.67 kg/km (OMNR 2013).
Trapnet harvest was only responsible for 10.6 tonnes of Canadian lake trout harvest in 2012 (OMNR 2013). CPUE was not estimated for trapnets.

Quotas for lake trout are established using Individual Transferable Quotas assigned to each Quota Management Area. Quotas are defined using trends in reported harvest, catch-per-unit-effort, and percent quota harvested, as indicators of stock status.

Fmsy is not available or not calculated for Canadian lake trout. However, based on trends in harvest vs. quota it is believed that commercial fishing is having a minor impact on the stock.

Justification:

Percent of harvested quota taken in 2012 (61.7%) is nearly half of the historic quota taken (123.05%). Early in the historical period, established lake trout quotas were much less then present values. During this time, incidental catch rates were higher than these quotas resulting in higher than desired harvest (OMNR 2013). Percent of taken quota has shown a steady, downward trend the last 8 years even though allowable quotas are at all-time highs indicating an increase in stock abundance (OMNR 2013). These quotas have increased as a result of increased stocking efforts and a perceived increase in levels of natural reproduction within lake trout stocks in Lake Huron.



Lake trout trends in harvest rates and allowable quotas in Canadian water.

LAKE WHITEFISH

Factor 1.1 - Inherent Vulnerability

UNITED STATES OF AMERICA/LAKE HURON, SET GILLNETS, UNITED STATES OF AMERICA
CANADA/LAKE HURON, SET GILLNETS, CANADA
UNITED STATES OF AMERICA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., UNITED STATES OF AMERICA
CANADA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., CANADA

Medium

Fishbase vulnerability score is 48 out of 100 (Froese & Pauly 2012).

The lake whitefish, a member of the family Salmonidae, has long comprised the mainstay of the commercial catch in the Great Lakes. This schooling, planktivorous fish can live >25 years, and reaches sexual maturity at ~ 3-6 years of age. Lake whitefish are characteristic broadcast spawners.

Factor 1.2 - Abundance

UNITED STATES OF AMERICA/LAKE HURON, SET GILLNETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., UNITED STATES OF AMERICA

High Concern

The United States Lake Huron lake whitefish population had an estimated stock biomass of 14.359kt which is only 7% of the SSB_{MSY} (spawning stock biomass at maximum sustainable yield, 186,535mt) (Caroffino & Lenart 2012), thus scoring lake whitefish stock status as "high concern".

Biomass is currently in decline following a period of high productivity and is below the historical average (from 1985 to present).

Justification:

Biomass had increased from 15.982kt in 1985 to 28.799kt in 1995 but has since steadily declined to current levels

Figure 8 Figure 4. Stock biomass trends of Lake Whitefish in US waters of Lake Huron. Data from MDNR.

. Biomass is currently well below the historical average of 20.794kt (Caroffino & Lenart 2012).

A period of reduced growth in lake whitefish has recently become evident following the loss of the lake whitefish's major prey source (Diaporeia). This coupled with a recent lack of recruitment has led to elevated concerns about the state of the lake whitefish fishery (Riley 2013).

CANADA/LAKE HURON, SET GILLNETS, CANADA
CANADA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., CANADA

Moderate Concern

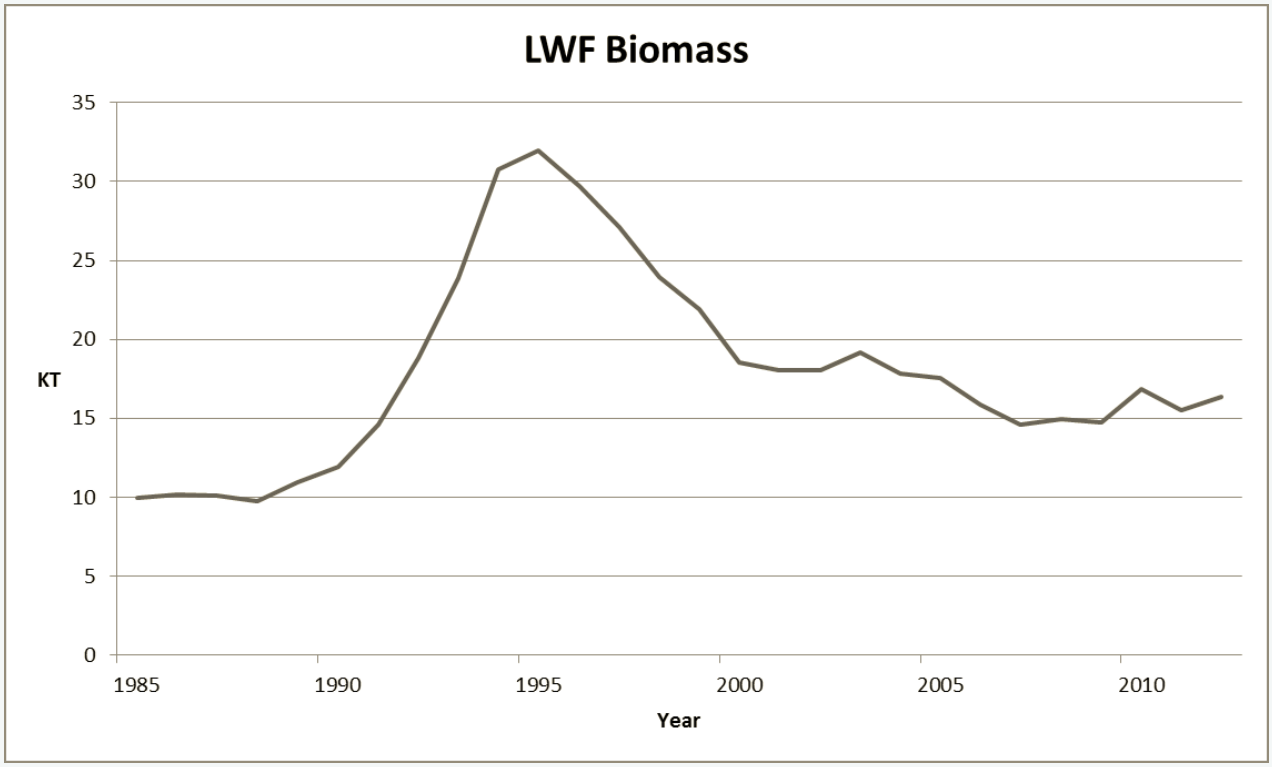
The Canadian Lake Huron lake whitefish population had an estimated stock biomass of 16.349kt (Caroffino & Lenart 2012).

Biomass in relation to biological reference points is unknown, resulting in a score of "moderate concern".

Biomass is currently in decline following a period of high productivity but is above the historical average (from 1979-present).

Justification:

Biomass had increased from 9.988kt in 1985 to 31.954kt in 1995 (Caroffino & Lenart 2012),



Stock biomass trends of Lake Whitefish in Canadian waters of Lake Huron. Data from MDNR.

Biomass is in decline following this period of high productivity but is currently near the historical average (OMNR 2013).

A period of reduced growth in lake whitefish has recently become evident following the loss of the lake whitefish's major prey source (Diaporeia). This couple with a recent lack of recruitment has led to elevated concerns about the state of the lake whitefish fishery (Riley 2013).

Factor 1.3 - Fishing Mortality

UNITED STATES OF AMERICA/LAKE HURON, SET GILLNETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., UNITED STATES OF AMERICA

Moderate Concern

Fishing mortality of 4+ fish is 0.103 (in management units Lake Huron Whitefish (WFH)-01-04) and 0.086 (WFH-05) for trapnet fisheries and 0.087 for all gillnet fisheries. It is unknown whether these values are above or below a sustainable level as biological reference points have not been established. Total mortality for 4+ fish is 0.632 and 0.569 in these management zones, which suggests that the fishery is having a minor impact relative to overall impacts (Caroffino & Lenart 2012). However, fishing mortality in regards to target reference point is either unknown or could not be found resulting in a score of "moderate concern".

The TAC of lake whitefish for these management units was set at 1,219,795 lbs. TAC's are established annually by estimating population abundance-at-age at the start of the year and then adjusting fishing mortality either to meet mortality targets or to follow guidelines established in the Consent Decree for phasing in the targets. The resulting projection of yield or effort associated with the fishing mortality then form the basis for the TAC recommendation (Caroffino & Lenart 2012). Harvest rates (1,298,000) were slightly above the recommended TAC in 2012.

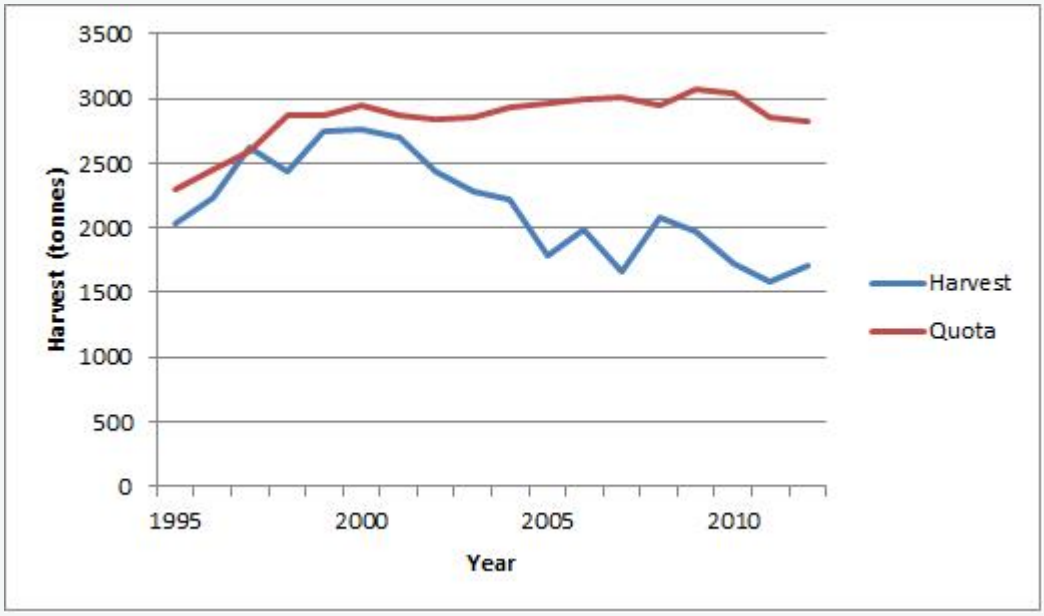
CANADA/LAKE HURON, SET GILLNETS, CANADA
CANADA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., CANADA

Moderate Concern

Harvest totals (1.704 kt) are only 60.4% of the established quota (2.820 kt) for lake whitefish (OMNR 2013). Fish mortality for lake whitefish in Canadian water of Lake Huron scores as a "moderate concern" as harvest is below quota limits but information in how these quotas compare to MSY could not be determined. However, it should be noted that lake whitefish fishing mortalities in Lake Huron are becoming more variable and appear to be approaching established benchmarks (pers. com. OMNR). Quotas are established annually based on previous year's harvest, trends, scientific advice, and consumer demand.

Justification:

Percent of allowable quota taken for 2012 (60.4 %) is much lower than the historic average of 76.7 %. There is an evident, downward trend in % of quota taken from 1995 to present (OMNR 2013).



Lake whitefish trends in harvest rates and allowable quotas in Canadian water.

RAINBOW SMELT

Factor 1.1 - Inherent Vulnerability

CANADA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., CANADA

Medium

Fishbase vulnerability score is 38 out of 100 (Froese & Pauly 2012).

Rainbow smelt are an introduced species in the Great Lakes and serve as forage fish for many native species. Rainbow smelt can live for >7 years and reach maturity in 1-2 years. They are plantivorous fishes, prey on zooplankton, and larvae of other fish species. Spawning is typically initiated shortly after ice out, and takes place in streams and rivers. Rainbow smelt are broadcast spawners.

Factor 1.2 - Abundance

CANADA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., CANADA

Very Low Concern

As of 2011, rainbow smelt stock biomass is estimated at 33.376 kt (Schaeffer et al. 2012) for both Canadian and US waters of Lake Huron. Unfortunately, reference point data (MSY) is currently is not available. However, the current biomass represents an increasing trend over the past 7 years (Schaeffer et al. 2012). Rainbow smelt are a non-native species in the Great Lakes and as such receive a score of "very low concern".

Factor 1.3 - Fishing Mortality

CANADA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., CANADA

Very Low Concern

Established quotas for rainbow smelt harvest could not be found. However, in 2012 only 130 lbs of rainbow was harvested in Canadian waters of Lake Huron (OMNR 2013). With an estimated biomass of 33.376 kt in Lake Huron (Schaeffer et al. 2012), 130 lbs of rainbow smelt harvest does not represent a significant portion of the estimated stock abundance. Low harvest impacts and the species designation as a non-native species results in a score of "very low concern".

WALLEYE

Factor 1.1 - Inherent Vulnerability

UNITED STATES OF AMERICA/LAKE HURON, SET GILLNETS, UNITED STATES OF AMERICA
CANADA/LAKE HURON, SET GILLNETS, CANADA
UNITED STATES OF AMERICA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., UNITED STATES OF AMERICA
CANADA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., CANADA

Medium

Fishbase vulnerability score is 40 out of 100 (Froese & Pauly 2012).

The walleye is the largest member of the perch family, and are 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.

Factor 1.2 - Abundance

UNITED STATES OF AMERICA/LAKE HURON, SET GILLNETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., UNITED STATES OF AMERICA

Moderate Concern

Walleye receive a score of "moderate concern" primarily owing to the basin-wide state of the current stock, and because is unknown whether the abundance is above or below the point where recruitment is impaired. Walleye populations throughout Lake Huron are still in recovery following a period of dramatic decline in the mid-1900's.

Currently, commercial harvest of walleye in US waters of Lake Huron is prohibited to state-licensed fisheries. As such, walleye is considered an incidental catch species and is only kept if harvested by tribal fisheries. The main walleye stock in US waters is located in Saginaw Bay where a substantial recreational fishery for the species exists.

Justification:

The Fish Community Objective (FCO) for Lake Huron walleye calls for a sustainable catch of 771.62 tonnes. The yield in 2012 was below 110 tonnes, and may indicate the inability of the lake to sustain a population of the desired size (DesJardine et al. 1995).

CANADA/LAKE HURON, SET GILLNETS, CANADA
CANADA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., CANADA

Moderate Concern

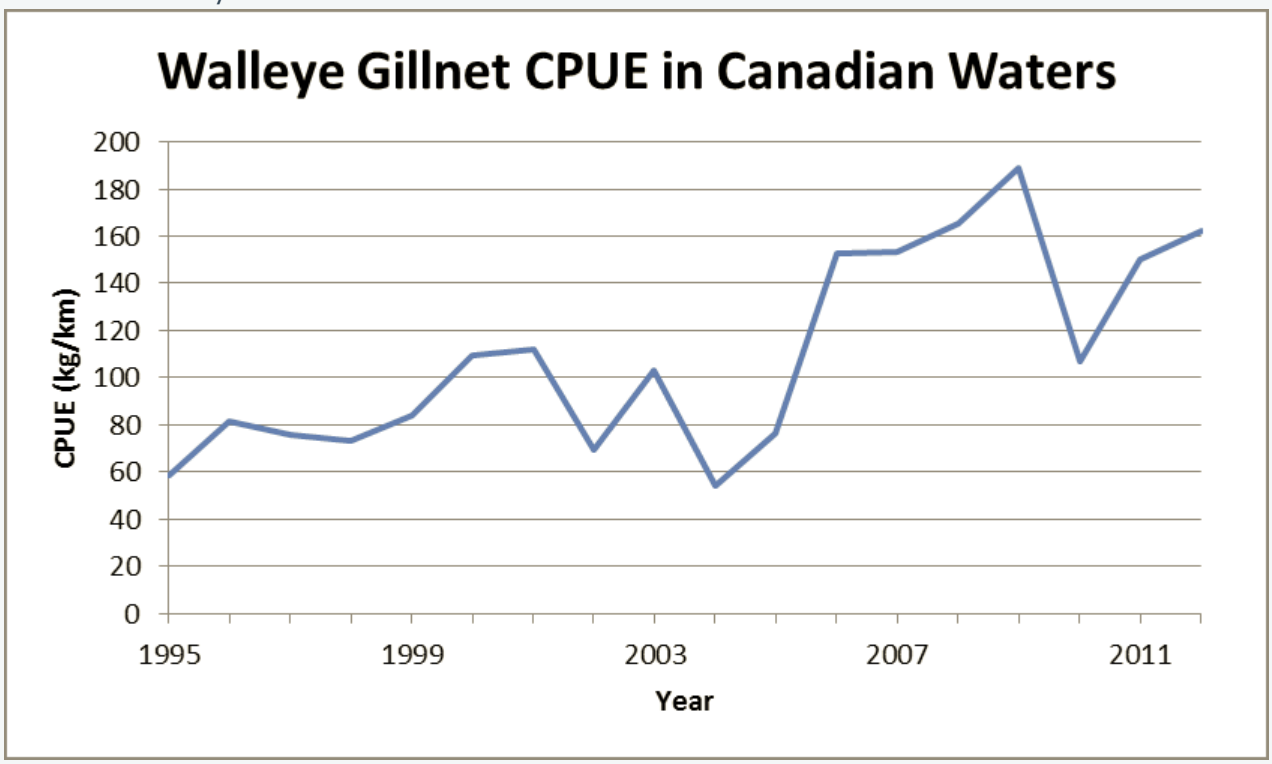
MSY data for walleye in Lake Huron was not available. Gillnet CPUE for walleye in 2012 was reported as 162.51 kg/km. This is higher than the historic average (from 1979-oresent) which is 101.84 kg/km (OMNR 2013). Trapnet CPUE for walleye in 2012 was reported as 56.72 kg/lift. This is also somewhat higher than the historic average which is 53.20 kg/lift (OMNR 2013).

The stock status of walleye in Canadian waters of Lake Huron is scored as a “moderate concern” as it is unknown whether the abundance is above or below a point where recruitment is impaired. Walleye populations are still in a recovery period following dramatic declines in the mid-1900’s. While CPUE has shown a steady increase in recent decades, total yield values have remained below historic averages (OMNR 2013). This is likely a result of a drop off in the number of fisherman targeting walleye. Walleye are only targeted as a production species in the Southern Basin of Lake Huron, and is considered an incidental catch species throughout the rest of the Canadian water (pers. comm. OMNR). In the North Basin Small pockets of walleye existing in Georgian Bay and the North Channel are believed to be in low abundance and may rate a higher level of concern pers. comm. OMNR).

Justification:

Walleye gillnet effort in Lake Huron increased from 236.6 km in 2011 to 306.8 km in 2012. However, effort in

2012 is still below the historic average of 339 km. Gillnet CPUE for walleye appears to show a varying trend over the last 10 + years of the record



Trends in walleye CPUE in Canadian waters. Data from OMNR 2013.

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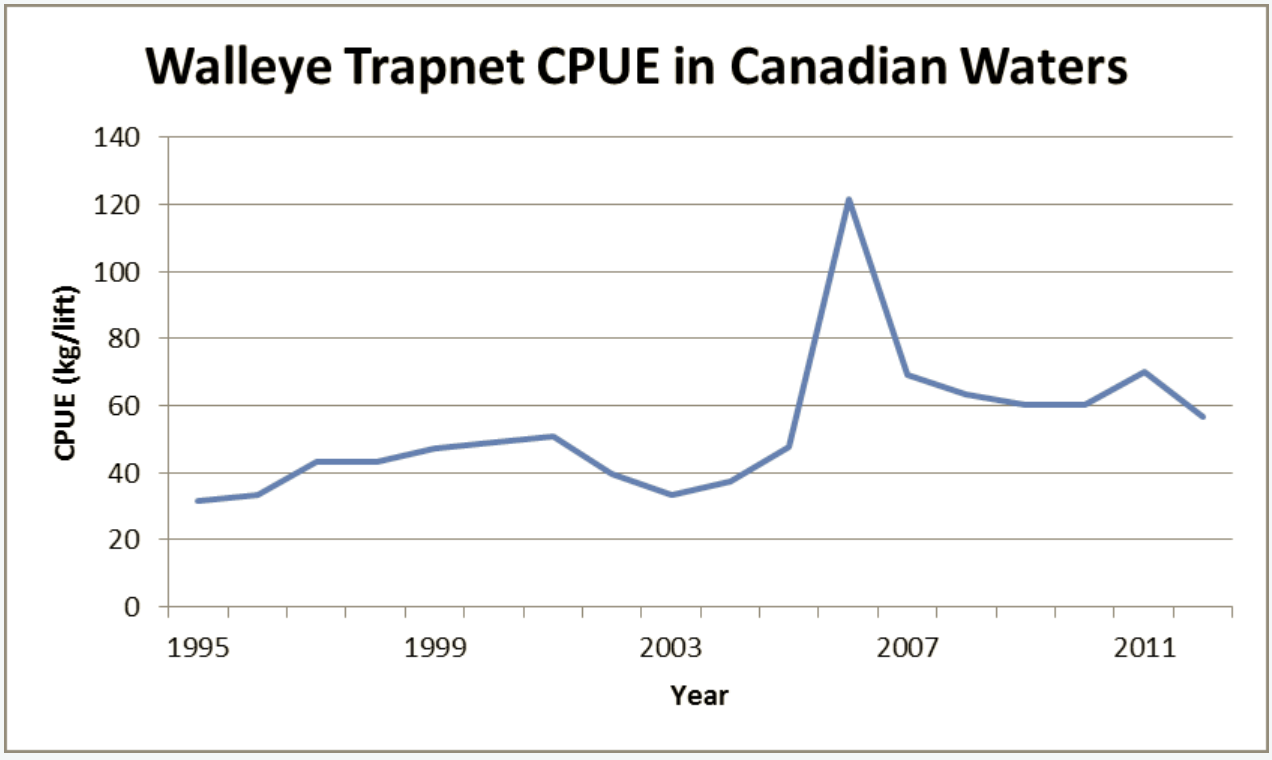
Walleye trapnet effort in Lake Huron increased from 630 lifts in 2011 to 713 lifts in 2012 yet the CPUE decreased from 70.24 in 2011 to 56.78 in 2012. CPUE has mainly remained constant following a record effort in 2006



Trends in walleye CPUE in Canadian waters. Data from OMNR 2013. Effort in 2012 is

well below the historic average of 1,197 lifts (OMNR 2013).

Factor 1.3 - Fishing Mortality

UNITED STATES OF AMERICA/LAKE HURON, SET GILLNETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., UNITED STATES OF AMERICA

Moderate Concern

A score of "moderate concern" was given primarily due to lack of data on commercial fisheries impacts.

Commercial harvest of walleye in US waters of Lake Huron is limited to US tribal fisherman and is believed to be minimal. As such, a lakewide assessment of fishery induced mortality does not exist. A study on trapnet bycatch mortality rates in Saginaw Bay, Michigan found that mortality rates may be as high as 42% for incidentally caught walleye (MacMillan & Roth 2012). However, new management actions require reduced soak times for fishing gears which is aimed at addressing this issue (pers. comm. MDNR).

Justification:

Saginaw Bay is believed to harbor one of the largest stocks of walleye in US waters and as such data on mortality rates for this stock drive this recommendation (Riley 2013). A potential gear-induced mortality rate of >40% for an incidental species is a cause for potential concern.

While commercial fishing is limited to US tribal fisherman in the Saginaw Bay area, a substantial recreational fishery exists, which has consistently harvested in excess of 50,000 fish per year (Fielder et al. 2007).

In 2012, 10.1 tonnes of walleye was harvested from US waters representing only 10.4% of the total walleye harvest from Lake Huron (Mohr et al. 2014). Both trapnets and gillnets are utilized in the harvest of walleye but information on gear-type breakdown was unavailable.

CANADA/LAKE HURON, SET GILLNETS, CANADA
CANADA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., CANADA

Low Concern

This answer scores as “low concern” as annual harvest values are well below established quotas.
91.6 tonnes of walleye was harvested from Canadian waters of Lake Huron in 2012, representing 60.5% of the available quota (OMNR 2013). Of this, 55.4% (50.8 tonnes) was harvested with gillnets, with the remaining 44.6% (40.5 tonnes) coming from trapnets. Harvest rates for 2012 were somewhat lower than the historic average (from 1979-present) taken from Lake Huron (90.3 tonnes)(OMNR 2013).

Quotas are believed to be set at appropriate levels to maintain stock function. Quotas are established using past harvest trends and scientific advice.

Justification:

Walleye quotas for the Canadian waters of Lake Huron are managed in two ways: as production quotas and as incidental quotas. Production quota areas are those with self-sustaining populations large enough to allow targeted harvesting. These include Quota Management Areas (QMA) 4-5, 5-1, 5-2, 5-7, and 6-1, which represent 98.8% of the total harvest in 2012 (OMNR 2013). Commercial fishing in Canadian waters are managed within discrete areas called Quota Management Areas. Fishing within each QMA is monitored and area specific quotas and regulations are enforced. Walleye harvest from Canadian waters is almost exclusively collected with gillnets, the exception being QMA 4-5, where trapnets are also used. Since 1995, trapnet harvests have decreased 30% in Lake Huron. QMA 4-5 is located in the southern basin of Lake Huron and in 2012 84.9% of total Canadian walleye catch was collected from this area (OMNR 2013).

YELLOW PERCH

Factor 1.1 - Inherent Vulnerability

CANADA/LAKE HURON, SET GILLNETS, CANADA
UNITED STATES OF AMERICA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., UNITED STATES OF AMERICA
CANADA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., CANADA

Low

Fishbase vulnerability score is 31 out of 100 (Froese & Pauly 2012).

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

Factor 1.2 - Abundance

CANADA/LAKE HURON, SET GILLNETS, CANADA
CANADA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., CANADA

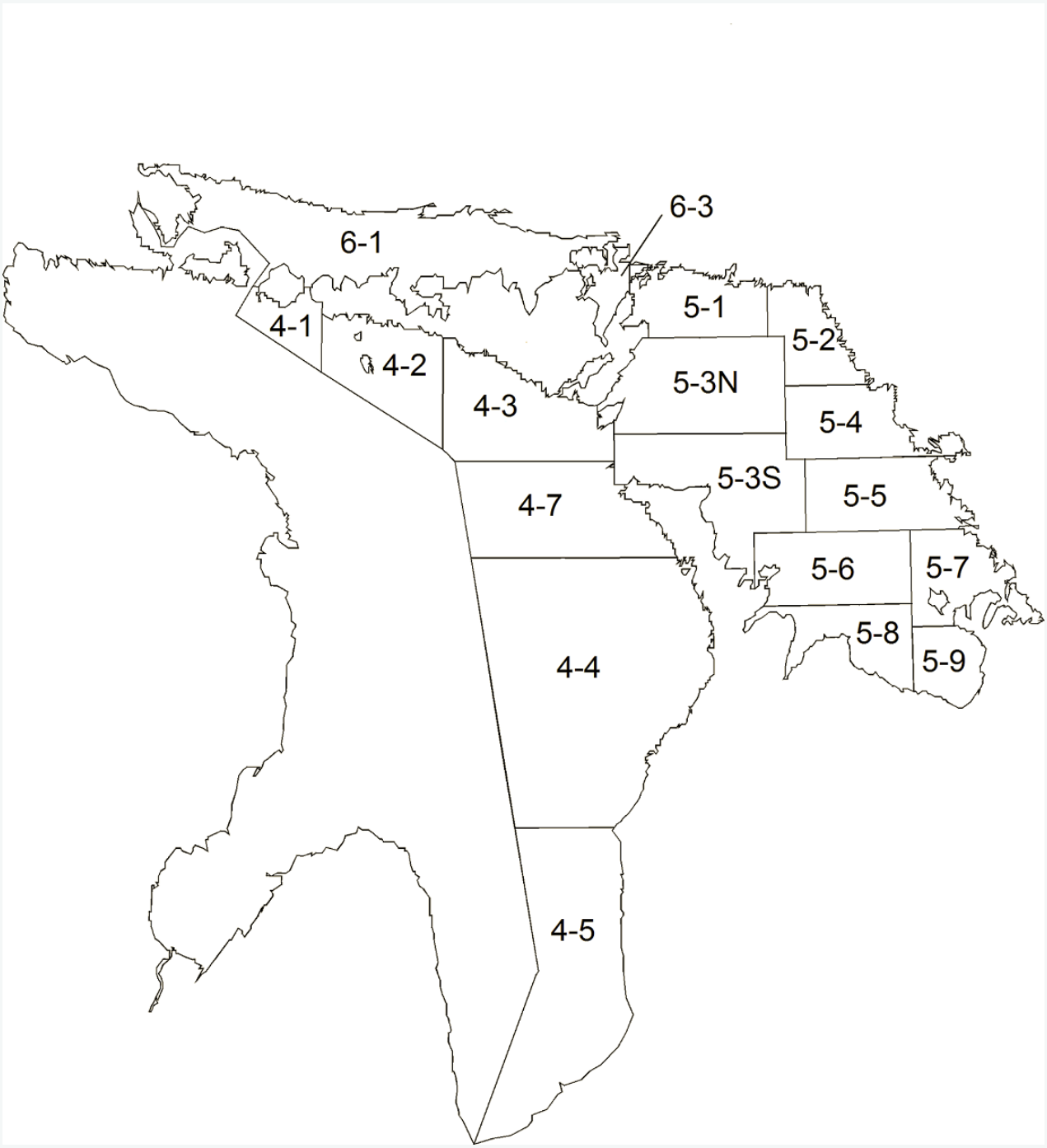
Moderate Concern

This answer is scored as a "moderate concern" since evidence of stock status compared to target reference point is not available.

Gillnet CPUE (kg/km) has increased from 32.9 in 1995 to 160 in 2012 (OMNR 2013). Commercial fishing in Canadian waters are managed in areas called Quota Management Areas (QMA). Fishing within each QMA is monitored and area specific quotas and regulations are enforced. QMA 4-5 represents the only area where trapnets are used in commercial yellow perch harvesting. CPUE of trapnet fishing as increased from 11.9 (lifts/km) in 1995 to 29 in 2012 and is above the historic average of 20.2 (OMNR 2013).

Justification:

QMAs 4-5, 5-7, and 6-1 represent 99.8% of the total harvest in 2012, with 98.9% coming from QMA 4-5 alone ((OMNR 2013),



Quota Management Areas (QMAs) defined for managing commercial fish species in Lake Huron. Basins defined in this report include the Main Basin (4-1 to 4-7), Georgian Bay (5-1 to 5-9, and the North Channel (6-1 and 6-3). Image from OMNR2013.

Yellow perch harvest from Canadian waters is almost exclusively collected with gillnets (responsible for

97.6% of total harvest), the exception being QMA 4-5, where some trapnets are also used.

Abundance is believed to be a low concern in the Southern Basin of Canadian waters, where 98% if the commercial fishing occurs, as reflected by the gradual increase in CPUE over the past 2 decades and based on the assessment of provincial fisheries managers (pers. comm. OMNR). However, the abundance of yellow perch in the North Channel may be considered a high concern as CPUE has decreased and qualitative observations suggest the population may be in a state of poor growth (pers. comm. OMNR).

UNITED STATES OF AMERICA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., UNITED STATES OF AMERICA

Moderate Concern

Yellow perch stock status scores as a "moderate concern" as evidence to suggest stock is above or below target reference points is not available.

Yellow perch CPUE in US waters of Lake Huron have increased in certain yellow perch stocks from 13.1 fish per lift to 50.3 fish per lift (Riley 2013). However, evidence of poor survival of age-0 yellow perch (as high as 99%) in Saginaw Bay is a cause for concern (Riley 2013). Saginaw Bay has historically been an area of high yellow perch yields and successful recruitment of individuals into this stock is necessary for the long-term sustainability of the fishery.

Factor 1.3 - Fishing Mortality

CANADA/LAKE HURON, SET GILLNETS, CANADA
CANADA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., CANADA

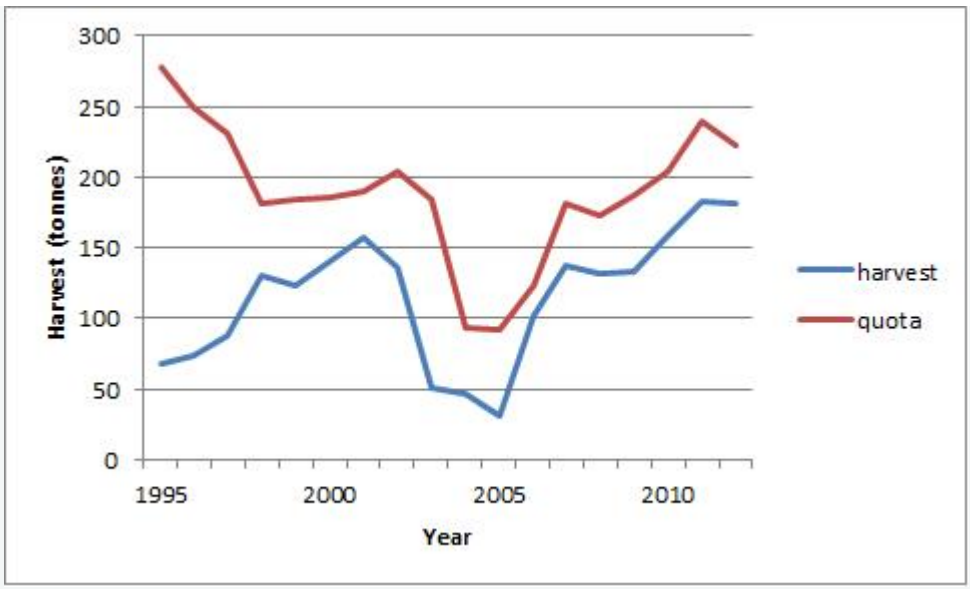
Low Concern

This answer scores as “low concern” as annual harvest values are well below established quotas.

182.8 tonnes of yellow perch was harvested from Canadian waters of Lake Huron in 2012, representing 72.4% of the available quota (OMNR 2013).

Quotas are believed to be set at appropriate levels to maintain stock function. Quotas are established using past harvest trends and scientific advice.

Justification:



Yellow perch trends in harvest rates and allowable quotas in Canadian water.

UNITED STATES OF AMERICA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., UNITED STATES OF AMERICA

Moderate Concern

Lake Huron specific fishing mortality studies could not be identified. Fishing mortality associated with trapnets in Lake Erie estimated annual mortality at 0.19. Annual survival rate is estimated at 0.55 (Thomas & Haas 2000). Trapnets fisheries are considered to have a moderate impact on yellow perch fish stocks.

Justification:

Yellow perch harvest from Lake Huron accounted for only 8% of the entire yellow perch yield in the Great Lakes (Riley 2013). Of this yield only 17.8% came from US waters. Management of yellow perch for recreational fishing receives the highest priority in Lake Huron, where angler pressure has remained high (Riley 2013).

US yellow perch harvest represents only 17.8% of the total harvest from Lake Huron (Mohr et al. 2014). This harvest is almost exclusively from trapnet fisheries (>99%). The Fishery Community Objective (FCO) calls for an annual sustainable harvest of 551.2 tonnes of yellow perch from Lake Huron waters. In 2012, annual lakewide harvest of only 225.61 tonnes. This may indicate the inability of current lake conditions to sustain desired population sizes.

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 Crtitical

Criterion 2 Summary

Only the lowest scoring main species is/are listed in the table and text in this Criterion 2 section; a full list and assessment of the main species can be found in Appendix A.

LAKE TROUT - CANADA/LAKE HURON - BARRIERS, FENCES, WEIRS, CORRALS, ETC. - CANADA					
Subscore:	**2.644**	**Discard Rate:**	**1.00**	**C2 Rate:**	**2.644**
Species	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Subscore**	
Lake whitefish	2.00:Medium	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.644)	
Walleye	2.00:Medium	3.00:Moderate Concern	3.67:Low Concern	Green (3.318)	
Yellow perch	3.00:Low	3.00:Moderate Concern	3.67:Low Concern	Green (3.318)	
Rainbow smelt	2.00:Medium	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.000)	

LAKE TROUT - CANADA/LAKE HURON - SET GILLNETS - CANADA					
Subscore:	**2.644**	**Discard Rate:**	**1.00**	**C2 Rate:**	**2.644**
Species	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Subscore**	
Lake whitefish	2.00:Medium	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.644)	
Walleye	2.00:Medium	3.00:Moderate Concern	3.67:Low Concern	Green (3.318)	

Yellow perch	3.00:Low	3.00:Moderate Concern	3.67:Low Concern	Green (3.318)

LAKE TROUT - UNITED STATES OF AMERICA/LAKE HURON - BARRIERS, FENCES, WEIRS, CORRALS, ETC. - UNITED STATES OF AMERICA				
Subscore:	**2.159**	**Discard Rate:**	**1.00**	**C2 Rate:**	**2.159**
Species	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Subscore**
Lake whitefish	2.00:Medium	2.00:High Concern	2.33:Moderate Concern	Red (2.159)
Walleye	2.00:Medium	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.644)
Yellow perch	3.00:Low	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.644)

LAKE TROUT - UNITED STATES OF AMERICA/LAKE HURON - SET GILLNETS - UNITED STATES OF AMERICA				
Subscore:	**2.159**	**Discard Rate:**	**1.00**	**C2 Rate:**	**2.159**
Species	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Subscore**
Lake whitefish	2.00:Medium	2.00:High Concern	2.33:Moderate Concern	Red (2.159)
Walleye	2.00:Medium	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.644)

LAKE WHITEFISH - CANADA/LAKE HURON - BARRIERS, FENCES, WEIRS, CORRALS, ETC. - CANADA				
Subscore:	**2.644**	**Discard Rate:**	**1.00**	**C2 Rate:**	**2.644**
Species	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Subscore**
Lake trout	1.00:High	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.644)
Walleye	2.00:Medium	3.00:Moderate Concern	3.67:Low Concern	Green (3.318)
Yellow perch	3.00:Low	3.00:Moderate Concern	3.67:Low Concern	Green (3.318)
Rainbow smelt	2.00:Medium	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.000)

LAKE WHITEFISH - CANADA/LAKE HURON - SET GILLNETS - CANADA					
Subscore:	**2.644**	**Discard Rate:**	**1.00**	**C2 Rate:**	**2.644**
Species	**Inherent Vulnerability**	**Abundance**		**Fishing Mortality**	**Subscore**
Lake trout	1.00:High	3.00:Moderate Concern		2.33:Moderate Concern	Yellow (2.644)
Walleye	2.00:Medium	3.00:Moderate Concern		3.67:Low Concern	Green (3.318)
Yellow perch	3.00:Low	3.00:Moderate Concern		3.67:Low Concern	Green (3.318)

LAKE WHITEFISH - UNITED STATES OF AMERICA/LAKE HURON - BARRIERS, FENCES, WEIRS, CORRALS, ETC. - UNITED STATES OF AMERICA					
Subscore:	**2.644**	**Discard Rate:**	**1.00**	**C2 Rate:**	**2.644**
Species	**Inherent Vulnerability**	**Abundance**		**Fishing Mortality**	**Subscore**
Lake trout	1.00:High	3.00:Moderate Concern		2.33:Moderate Concern	Yellow (2.644)
Walleye	2.00:Medium	3.00:Moderate Concern		2.33:Moderate Concern	Yellow (2.644)
Yellow perch	3.00:Low	3.00:Moderate Concern		2.33:Moderate Concern	Yellow (2.644)

LAKE WHITEFISH - UNITED STATES OF AMERICA/LAKE HURON - SET GILLNETS - UNITED STATES OF AMERICA					
Subscore:	**2.644**	**Discard Rate:**	**1.00**	**C2 Rate:**	**2.644**
Species	**Inherent Vulnerability**	**Abundance**		**Fishing Mortality**	**Subscore**
Lake trout	1.00:High	3.00:Moderate Concern		2.33:Moderate Concern	Yellow (2.644)
Walleye	2.00:Medium	3.00:Moderate Concern		2.33:Moderate Concern	Yellow (2.644)

RAINBOW SMELT - CANADA/LAKE HURON - BARRIERS, FENCES, WEIRS, CORRALS, ETC. - CANADA					
Subscore:	**2.644**	**Discard Rate:**	**1.00**	**C2 Rate:**	**2.644**
Species	**Inherent Vulnerability**	**Abundance**		**Fishing Mortality**	**Subscore**
Lake trout	1.00:High	3.00:Moderate Concern		2.33:Moderate Concern	Yellow (2.644)

Lake whitefish	2.00:Medium	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.644)
Walleye	2.00:Medium	3.00:Moderate Concern	3.67:Low Concern	Green (3.318)
Yellow perch	3.00:Low	3.00:Moderate Concern	3.67:Low Concern	Green (3.318)

WALLEYE - CANADA/LAKE HURON - BARRIERS, FENCES, WEIRS, CORRALS, ETC. - CANADA					
Subscore:	**2.644**	**Discard Rate:**	**1.00**	**C2 Rate:**	**2.644**
Species	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**		**Subscore**
Lake trout	1.00:High	3.00:Moderate Concern	2.33:Moderate Concern		Yellow (2.644)
Lake whitefish	2.00:Medium	3.00:Moderate Concern	2.33:Moderate Concern		Yellow (2.644)
Yellow perch	3.00:Low	3.00:Moderate Concern	3.67:Low Concern		Green (3.318)
Rainbow smelt	2.00:Medium	5.00:Very Low Concern	5.00:Very Low Concern		Green (5.000)

WALLEYE - CANADA/LAKE HURON - SET GILLNETS - CANADA					
Subscore:	**2.644**	**Discard Rate:**	**1.00**	**C2 Rate:**	**2.644**
Species	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**		**Subscore**
Lake trout	1.00:High	3.00:Moderate Concern	2.33:Moderate Concern		Yellow (2.644)
Lake whitefish	2.00:Medium	3.00:Moderate Concern	2.33:Moderate Concern		Yellow (2.644)
Yellow perch	3.00:Low	3.00:Moderate Concern	3.67:Low Concern		Green (3.318)

WALLEYE - UNITED STATES OF AMERICA/LAKE HURON - BARRIERS, FENCES, WEIRS, CORRALS, ETC. - UNITED STATES OF AMERICA					
Subscore:	**2.159**	**Discard Rate:**	**1.00**	**C2 Rate:**	**2.159**
Species	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**		**Subscore**
Lake whitefish	2.00:Medium	2.00:High Concern	2.33:Moderate Concern		Red (2.159)

Lake trout	1.00:High	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.644)
Yellow perch	3.00:Low	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.644)

WALLEYE - UNITED STATES OF AMERICA/LAKE HURON - SET GILLNETS - UNITED STATES OF AMERICA					
Subscore:	**2.159**	**Discard Rate:**	**1.00**	**C2 Rate:**	**2.159**
Species	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Subscore**	
Lake whitefish	2.00:Medium	2.00:High Concern	2.33:Moderate Concern	Red (2.159)	
Lake trout	1.00:High	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.644)	

YELLOW PERCH - CANADA/LAKE HURON - BARRIERS, FENCES, WEIRS, CORRALS, ETC. - CANADA					
Subscore:	**2.644**	**Discard Rate:**	**1.00**	**C2 Rate:**	**2.644**
Species	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Subscore**	
Lake trout	1.00:High	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.644)	
Lake whitefish	2.00:Medium	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.644)	
Walleye	2.00:Medium	3.00:Moderate Concern	3.67:Low Concern	Green (3.318)	
Rainbow smelt	2.00:Medium	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.000)	

YELLOW PERCH - CANADA/LAKE HURON - SET GILLNETS - CANADA					
Subscore:	**2.644**	**Discard Rate:**	**1.00**	**C2 Rate:**	**2.644**
Species	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Subscore**	
Lake trout	1.00:High	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.644)	
Lake whitefish	2.00:Medium	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.644)	
Walleye	2.00:Medium	3.00:Moderate Concern	3.67:Low Concern	Green (3.318)	

YELLOW PERCH - UNITED STATES OF AMERICA/LAKE HURON - BARRIERS, FENCES, WEIRS, CORRALS, ETC. - UNITED STATES OF AMERICA					
Subscore:	**2.159**	**Discard Rate:**	**1.00**	**C2 Rate:**	**2.159**

Species	Inherent Vulnerability	Abundance	Fishing Mortality	Subscore
Lake whitefish	2.00:Medium	2.00:High Concern	2.33:Moderate Concern	Red (2.159)
Lake trout	1.00:High	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.644)
Walleye	2.00:Medium	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.644)

Species included in Criteria 2 include all species composing 5% or more of the total catch by that fishery. Catch composition was determined from data provided in by the Ontario Ministry of Natural Resources (OMNR) and the Michigan Department of Natural Resources (MDNR), and raw data was provided by representatives from both agencies. Lake whitefish is the main species reported in the Lake Huron fishery. Gear types mentioned with catch data include gillnets, and trap nets.
There are no bycatch species in these fisheries that are discarded dead in significant amounts. Most species harvested have commercial value (even if they are not a targeted species) and are thus kept and sold portside. The only exception is lake sturgeon, which are listed as threatened or endangered throughout the region. 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 Huron (gillnets and trapnets) 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).

The capture rates of lake sturgeon in both these fisheries are also extremely low. In Lake Huron, 29.18 tonnes of lake sturgeon was reported as bycatch, caught in either trapnets or gillnets in Canadian water. All individuals captured were discarded. Lake sturgeon caught in these gears are known to have high survival rates (pers. comm. OMNR). In addition, gillnets are often the preferred sampling method for juvenile and adult lake sturgeon by various resource management agencies as well as scientific researchers. This method is utilized because of low mortality rates associated with gear techniques ((Threader and Broussaeu 1986), (Hayes and Caroffino 2012)).Therefore, the Great Lakes fisheries are deemed not to impact lake sturgeon populations, and lake sturgeon are not included in the assessment.

2.4 - Discards + Bait / Landings

UNITED STATES OF AMERICA/LAKE HURON, SET GILLNETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/LAKE HURON, SET GILLNETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/LAKE HURON, SET GILLNETS, UNITED STATES OF AMERICA

< 20%

Use of gillnets in US waters of Lake Huron is restricted to tribal fisheries. While detailed bycatch data from these fisheries could not be obtained, discard rates of lake trout (< 3%) and lake whitefish (negligible) 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. Lake trout

collected by US fisherman must be discarded.

CANADA/LAKE HURON, SET GILLNETS, CANADA
CANADA/LAKE HURON, SET GILLNETS, CANADA
CANADA/LAKE HURON, SET GILLNETS, CANADA
CANADA/LAKE HURON, SET GILLNETS, CANADA

< 20%

Discards from Canadian gillnets in Lake Huron are low and do not appear to afflict any one species in a particularly adverse way. The total discard rate for all species in the fishery caught using gillnets (including species that are not included as part of this report) are estimated at 4.12%, while the discard rate for species only included in this report is 1.84% {OMNR 2013}. 26.47 tonnes of lake sturgeon (a threatened species in Michigan and Ontario waters) was also reported as discard.

UNITED STATES OF AMERICA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., UNITED STATES OF AMERICA

< 20%

Discard rates for trapnet fisheries could not be obtained but impact on fish stocks is considered minor. Trap nets collect live catches, and have been shown to have small incidence of bycatch compared to other gears (including gillnets), and relatively high survival rates of bycatch ({Riley 2013},{Siira et al. 2006}). Based on catch data from other fisheries throughout Lake Huron, discard rates of trapnets fisheries in US waters of Lake Huron are believed to be low, with less chance of mortality to any species caught incidentally.

CANADA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., CANADA
CANADA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., CANADA
CANADA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., CANADA
CANADA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., CANADA
CANADA/LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., CANADA

< 20%

Trapnets are responsible for a very minor portion of the total fishery in the Canadian waters of Lake Huron (4.36%, {OMNR 2013}). Total discard rate for trapnets was 0.49%. However. the only species listed as caught in trapnets were the targeted commercial species (walleye, lake whitefish, yellow perch, and lake trout), so discard rates of species with little commercial value are not known but believed to be low. No rainbow smelt or lake sturgeon are believed to have been harvested with trapnets.

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	Harvest Strategy	Bycatch Strategy	Score
Canada / Lake Huron / Barriers, fences, weirs, corrals, etc. / Canada	3.000	0.000	Yellow (3.000)
Canada / Lake Huron / Set gillnets / Canada	3.000	0.000	Yellow (3.000)
United States of America / Lake Huron / Barriers, fences, weirs, corrals, etc. / United States of America	3.000	0.000	Yellow (3.000)
United States of America / Lake Huron / Set gillnets / United States of America	3.000	0.000	Yellow (3.000)

Criterion 3 Assessment

SCORING GUIDELINES

Factor 3.1 - Harvest Strategy

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 Huron / Barriers, fences, weirs, corrals, etc. / Canada	Moderately Effective	Moderately Effective	Highly Effective	Highly Effective	Highly Effective	Moderately Effective	Highly Effective
Canada / Lake Huron / Set gillnets / Canada	Moderately Effective	Moderately Effective	Highly Effective	Highly Effective	Highly Effective	Moderately Effective	Highly Effective
United States of America / Lake Huron / Barriers, fences, weirs, corrals, etc. / United States of America	Moderately Effective	Moderately Effective	Highly Effective	Highly Effective	Highly Effective	Moderately Effective	Highly Effective
United States of America / Lake Huron / Set gillnets / United States of America	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 HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., CANADA
CANADA / LAKE HURON, SET GILLNETS, CANADA
UNITED STATES OF AMERICA / LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., UNITED STATES OF AMERICA
UNITED STATES OF AMERICA / LAKE HURON, SET GILLNETS, UNITED STATES OF AMERICA

Moderately Effective

The Great Lakes span jurisdictions in two countries, several states, one province, and a number of tribal lands. As such, 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 US and Canada (Beamish 2001). The Commission consists of 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 comprised of members of the actual management bodies for each lake. However, the GLFC and the Lake Committees do not manage the lakes, but rather 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.

Tribal-licensed fisheries are managed by two 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 Service's Great Lakes Science Center, NOAA's Great Lakes Environmental Research Laboratory (GLERL), and the US 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 LTC's. In addition, fisheries independent research conducted by local agencies and universities, which assess parameters of stock condition and the fishery as a whole, are also 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.

Gear types utilized in Lake Huron waters are gillnets and trap-nets. Gillnetting is prohibited in the US state-licensed fishery. Trawling is prohibited throughout the entire lake. Lake trout and walleye are not to be targeted or sold by US state-licensed fisherman but tribal and Canadian fisherman may sell them as incidental catch. Size restrictions for lake whitefish are ~19" in length. This is set to allow lake whitefish at least one season in which to breed. Rainbow smelt is not a commercially important species in Lake Huron and as such, it is generally unregulated.

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

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 HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., CANADA
CANADA / LAKE HURON, SET GILLNETS, CANADA
UNITED STATES OF AMERICA / LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., UNITED STATES OF AMERICA
UNITED STATES OF AMERICA / LAKE HURON, SET GILLNETS, UNITED STATES OF AMERICA

Moderately Effective

Lake trout and some stocks of lake whitefish throughout Lake Huron are still in a recovery phase following the dramatic declines experienced after sea lamprey and alewife introductions in the mid 1900's. Effective lampricide treatments, reduced harvest attempts, and vigorous re-stocking attempts have resulted in the partial resurgence of the Lake Huron commercial fishery (Riley 2013).

The Lake Huron Committee has established Fish-Communities Objectives (FCO's) for all relevant fish stocks that are currently harvested as target or incidental catch in Lake Huron (DesJardine et al. 1995). These objectives define target yields and conditions for each species that are believed to represent restored stocks capable of sustaining desired annual harvest demands and/or allowing fish community structures to return to pre-collapse levels (DesJardine et al. 1995).

Efforts to facilitate recovery of fish stocks have included: the prohibiting of gillnet use by US fisherman, changes in the mesh size and placement and effort of gillnets used by tribal and Canadian fishermen, a gradual shift to less lethal trapnets, labeling of vulnerable stocks of walleye and yellow perch as incidental and not commercial harvest, reduced numbers of authorized fishing licenses, and increased restriction on the take of lake trout throughout the basin. As part of these restrictions, only CORA fishermen in northern US waters of Lake Huron are allowed to harvest lake trout. The US state-licensed fishermen are not allowed to harvest lake trout commercially. ((OMNR 2012),(Riley 2013),(Ebener 1998), pers. comm.. DNR, OMNR).

While these restrictions, along with the increased control of invasive sea lamprey predation and improved habitat management have resulted in yields that are nearing and in some cases exceeding historic averages, most FCO's are currently not being met, and some have shown a downward trend in relative progress (Riley 2013). This has caused some discussion as to the ability of Lake Huron to support the desired stock abundance in its current condition. FCO's of several species are currently under review because a new ecological paradigm exists in the lake and it may be difficult to ascertain exactly what "recovery" is or will be. The MNR and other organizations have made strong efforts to facilitate recovery of fish populations but the chronic infusion of invasive species has in some cases swamped management efforts, thus potentially hampering rehabilitation efforts.

One species that is currently undergoing a vigorous recovery attempt in Lake Huron is the lake trout. Lake trout stocks in Lake Huron are the most actively managed and recovery and rehabilitation strategies have been developed and implemented in an effort to restore naturally reproducing stocks throughout the region. Rehabilitation efforts of lake trout are currently managed through the establishment of rehabilitation zones throughout Lake Huron (Ebener 1998) (fig. 1). These zones represent areas of preferred lake trout habitat or in some cases remnant stocks of pre-existing lake trout. These areas are stocked annually with pure strain lake trout and are subject to more restrictive fishing regulations ((OMNR 2012), (Riley 2013)). While evidence of increased natural reproduction has been identified in several stocks of Lake Huron, the fishery is still reliant on annual stocking. The FCO for lake trout in Lake Huron calls for a self-sustaining lake trout population throughout the Lake Huron basin, which does not appear to be likely to occur in the near future (DesJardine et al. 1995). Yet naturally produced lake trout are becoming an increasing proportion of lake trout populations in the main basin of Lake Huron. The Lake Huron Technical Committee has also recommended a procedure to evaluate the feasibility of stopping lake trout stocking (pers. comm. GLFC). .

Recovery of species of concern is considered moderately effective because while many stocks are not meeting the FCO's established by the Lake Huron Committee, there is good evidence of stock status improvement as shown by increased natural reproduction and annual yields of lake trout (a species of concern).

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 HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., CANADA
CANADA / LAKE HURON, SET GILLNETS, CANADA
UNITED STATES OF AMERICA / LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., UNITED STATES OF AMERICA
UNITED STATES OF AMERICA / LAKE HURON, SET GILLNETS, UNITED STATES OF AMERICA

Highly Effective

There is a high level of scientific research and monitoring that occurs throughout the Lake Huron Basin. Such activities include regular stock assessments and discussions of gear modification and impact ((DesJardine et al. 1995),(Riley 2013)). These assessments mainly use CPUE as an indicator of biomass or stock abundance, and target reference points are absent. However, these assessments are long term and robust and are coupled with species body-condition and age/weight assessments, and there is good probability they are good indicators of stock status and fish community health.

Much of this work is carried out by the various state, provincial and tribal agencies that make up the Lake Huron Technical Committee (LHTC), which provides the Lake Huron Lake Committee (LHLC) with technical information, management alternatives, and biological guidelines used in making fishery management decisions. In addition to this committee, a number of independent and academic institutions also conduct research in the region including testing gear modifications, analysis of stock vulnerabilities to various disturbances, and engaging in tagging studies to monitor fish populations ((Beamish 2001),(MacMillan & Roth 2012)). Harvest quotas and fishing restrictions are assessed yearly and changes are made that reflect current pressures on the commercial fishery including previous years landings, new relevant scientific findings, and current economic demand for fishery products ((Beamish 2001),(GLFC 2007),(Riley 2013)). All of this results in a wealth of fishery data available to the LHLC in order to ensure the fishery is managed effectively.

Formalized stock assessments are generated on an annual or semi-annual basis for lake whitefish and lake trout stocks throughout Lake Huron (Caroffino & Lenart 2012). In addition, remnant lake sturgeon stocks are constantly monitored and management efforts are guiding by both government and independent scientific research and suggestions ((Golder Associates Ltd 2011),(Hayes and Caroffino 2012)). Stock status of walleye and yellow perch are also assessed on an annual to semi-annual basis but they are generally given less basin-wide importance (Riley 2013). The Status of Lake Huron report, which is typically generated every 5 years, outlines the trends in catch and stock status and makes recommendations based on estimated stock statuses (Riley 2013).

Rainbow smelt stocks are not followed as vigorously as are other stocks in Lake Huron. Rainbow smelt make

up a very minor portion of the overall catch and are not specifically targeted by any fishery.

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 HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., CANADA
CANADA / LAKE HURON, SET GILLNETS, CANADA
UNITED STATES OF AMERICA / LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., UNITED STATES OF AMERICA
UNITED STATES OF AMERICA / LAKE HURON, SET GILLNETS, UNITED STATES OF AMERICA

Highly Effective

The Great Lakes Fishery Commission takes scientific advice into account when setting 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 both state and provincial agencies and assessed based on proposed ecological impacts to the fishery and surrounding ecosystems (GLFC 2007). Additionally, scientific advice is elicited to help determine stock status on most of the species listed in this report. Serving on each lake technical committee and present at the lake committee technical hearings are representatives from the research divisions of DNR and OMNR agencies whose sole propose is 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 advice 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 HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., CANADA
CANADA / LAKE HURON, SET GILLNETS, CANADA
UNITED STATES OF AMERICA / LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., UNITED STATES OF AMERICA
UNITED STATES OF AMERICA / LAKE HURON, SET GILLNETS, UNITED STATES OF AMERICA

Highly Effective

The Great Lakes Fishery Commission (GLFC) created the International Great Lakes Law Enforcement Committee with the goal to "protect, enhance and promote the safe and wise use of the natural resources in the Great Lakes for present and future generations" (GLFC Website 2014). This committee is comprised of representatives from the fishery management agencies representing all states and provinces bordering the Great Lakes. These management agencies include State Departments of Natural Resources (DNR), the

Department of Environmental Conservation in New York (NYSDEC), the Pennsylvania Fish and Boat Commission, the Ontario Ministry of Natural Resources (OMNR), the United States Coast Guard, and the tribal/ first nation authorities Chippewa Ottawa Resource Authority (CORA) and the Great Lakes Indian Fish & Wildlife Commission (GLIFWC) when applicable.

Specialists from the coast guard and both the OMNR and the states DNR routinely board commercial fishing vessels to inspect harvest and fishing gear to ensure that fisherman are following the required guidelines.

Portside inspections are carried out by DNR and tribal authorities which enforce fisheries legislation including minimum landing sizes, retention of prohibited species, gear restriction, etc. Deployed gears are also randomly inspected by coastguard and conservation officers of the DNR to ensure that gears are properly marked, placed in authorized areas, and are utilizing legal mesh sizes (DNR Website 2005). Patrols and monitoring of illegal fishing are carried out by the U.S. coast guard, conservation officers of the DNR, and tribal authorities.

An agreement was reached between CORA and the US coast guard (the memorandums of agreement) which allows the coast guard to inspect and prosecute tribal fisherman in tribal waters of the Great Lakes (Pickering 2010). Additionally, the Tribal Fisheries Constent Decree of 2000 between the U.S. and CORA allows DNR officials to inspect portside take from tribal fisherman (DNR Website 2005).

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, and sharing of law enforcement intelligence information, and enforcing quota and harvest regulations (GLFC Website 2014).

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 HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., CANADA
CANADA / LAKE HURON, SET GILLNETS, CANADA
UNITED STATES OF AMERICA / LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., UNITED STATES OF AMERICA
UNITED STATES OF AMERICA / LAKE HURON, SET GILLNETS, UNITED STATES OF AMERICA

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 (sea lamprey, alewifes, zebra mussels, etc), and habitat alteration and destruction have resulted in many of the fish stocks becoming greatly diminished or depleted. Comprehensive management of the Great Lakes began during the middle of the 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 in action may interfere with current restoration attempts, as new threats such as invasive species and productivity changes continue to plague the fishery.

While current management strategies have proven 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 HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., CANADA
CANADA / LAKE HURON, SET GILLNETS, CANADA
UNITED STATES OF AMERICA / LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., UNITED STATES OF AMERICA
UNITED STATES OF AMERICA / LAKE HURON, SET GILLNETS, UNITED STATES OF AMERICA

Highly Effective

Agencies at the state, federal, and provincial level work with local stakeholders since they are the managing agencies with the delegated authority to invoke management actions (e.g. harvest restrictions, size limits, stocking, etc…). 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 Ontario Ministry of Natural Resources (OMNR), research elements, and provide feedback for proposed management decisions. This ground level engagement is conducted by individual managing agencies, which include US state and federal agencies and Canadian provincial agencies.

Bringing together these managing agencies in Great Lakes region is The Great Lakes Fishery Commission (GLFC). The GLFC is comprised of representatives from all parties that have a stake in the commercial fishery including US 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 reach out to their local stakeholders regularly. 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 and as such their interests are acknowledge and incorporating 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 which is made public and to local, state, provincial, and federal agencies who are invited to submit comments and suggestions. Findings, reports, and suggested management strategies are made public and opened to criticism which shows transparency of the process (GLFC 2007).

Factor 3.2 - Bycatch Strategy

SCORING GUIDELINES

Four subfactors are evaluated: Management Strategy and Implementation, Scientific Research and Monitoring, Record of Following Scientific Advice, and Enforcement of Regulations. Each is rated as 'ineffective,' 'moderately effective,' or 'highly effective.' Unless reason exists to rate Scientific Research and Monitoring, Record of Following Scientific Advice, and Enforcement of Regulations differently, these rating are the same as in 3.1.

- *5 (Very Low Concern)—Rated as 'highly effective' for all four subfactors considered*
- *4 (Low Concern)—Management Strategy 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 but some other factors rated 'ineffective.'*
- *1 (Very High Concern)—Management exists, but Management Strategy rated 'ineffective.'*
- *0 (Critical)—No bycatch management even when overfished, depleted, endangered or threatened species are known to be regular components of bycatch and are substatntially impacted by the fishery*

FACTOR 3.2 - BYCATCH STRATEGY

Region / Method	All Kept	Critical	Strategy	Research	Advice	Enforce
Canada / Lake Huron / Barriers, fences, weirs, corrals, etc. / Canada	Yes	All Species Retained				
Canada / Lake Huron / Set gillnets / Canada	Yes	All Species Retained				
United States of America / Lake Huron / Barriers, fences, weirs, corrals, etc. / United States of America	Yes	All Species Retained				
United States of America / Lake Huron / Set gillnets / United States of America	Yes	All Species Retained				

Subfactor 3.2.3 – 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

Subfactor 3.2.4 – 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.

Subfactor 3.2.5 – 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.

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	Score
Canada / Lake Huron / Barriers, fences, weirs, corrals, etc. / Canada	3.00: Low Concern	0.00: No Effective Mitigation	4.00: Low Concern	Green (3.464)
Canada / Lake Huron / Set gillnets / Canada	3.00: Low Concern	0.00: No Effective Mitigation	4.00: Low Concern	Green (3.464)
United States of America / Lake Huron / Barriers, fences, weirs, corrals, etc. / United States of America	3.00: Low Concern	0.00: No Effective Mitigation	4.00: Low Concern	Green (3.464)
United States of America / Lake Huron / Set gillnets / United States of America	3.00: Low Concern	0.00: No Effective Mitigation	4.00: Low Concern	Green (3.464)

Criterion 4 Assessment

SCORING GUIDELINES

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

- *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.*

Factor 4.2 - Mitigation of Gear Impacts

- *+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*

Factor 4.3 - Ecosystem-Based Fisheries Management

- *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.*

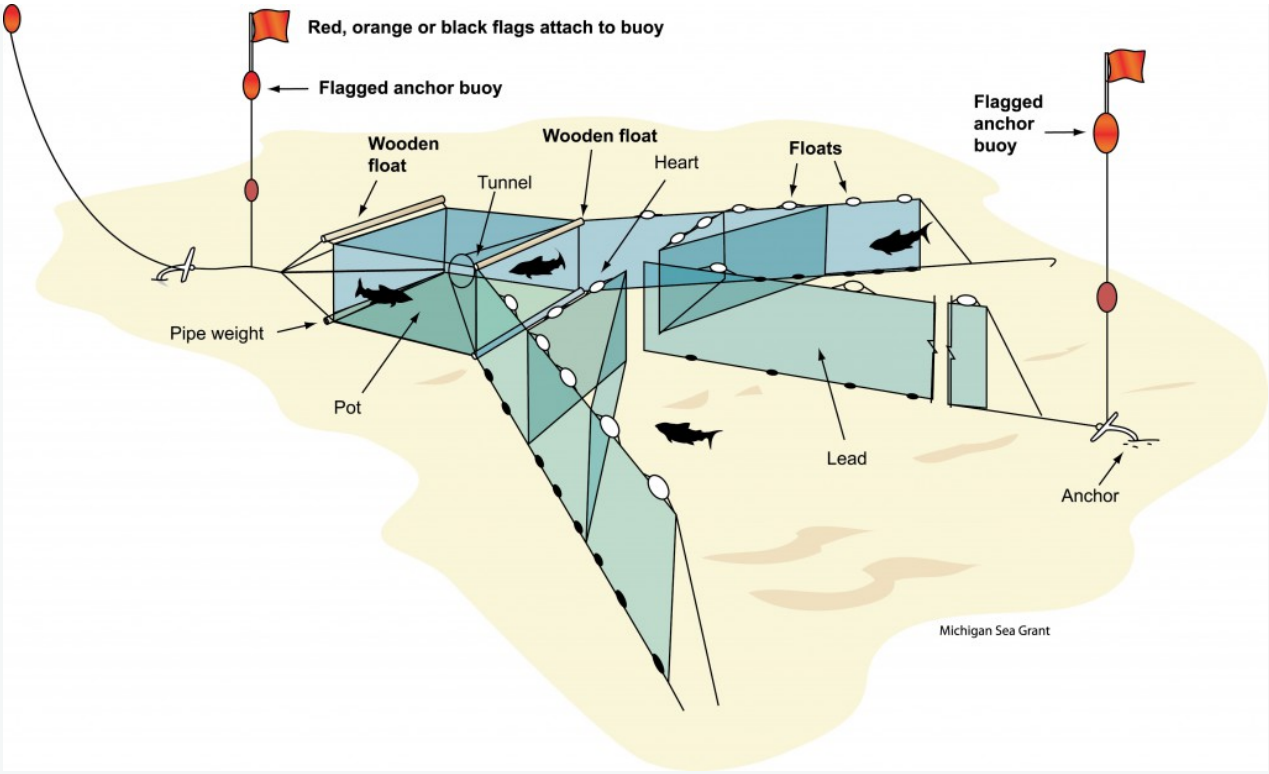
Factor 4.1 - Impact of Fishing Gear on the Habitat/Substrate

CANADA / LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., CANADA
UNITED STATES OF AMERICA / LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., UNITED STATES OF AMERICA

Low Concern

Trapnets are used lakewide in US, Tribal, and Canadian waters. Trapnet 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). The vast majority of Lake Huron substrate is composed of soft, sandy silt and clay which is little affected by fishing gears. Trapnets are set in fixed locations and do not scour the bottom.

Justification:



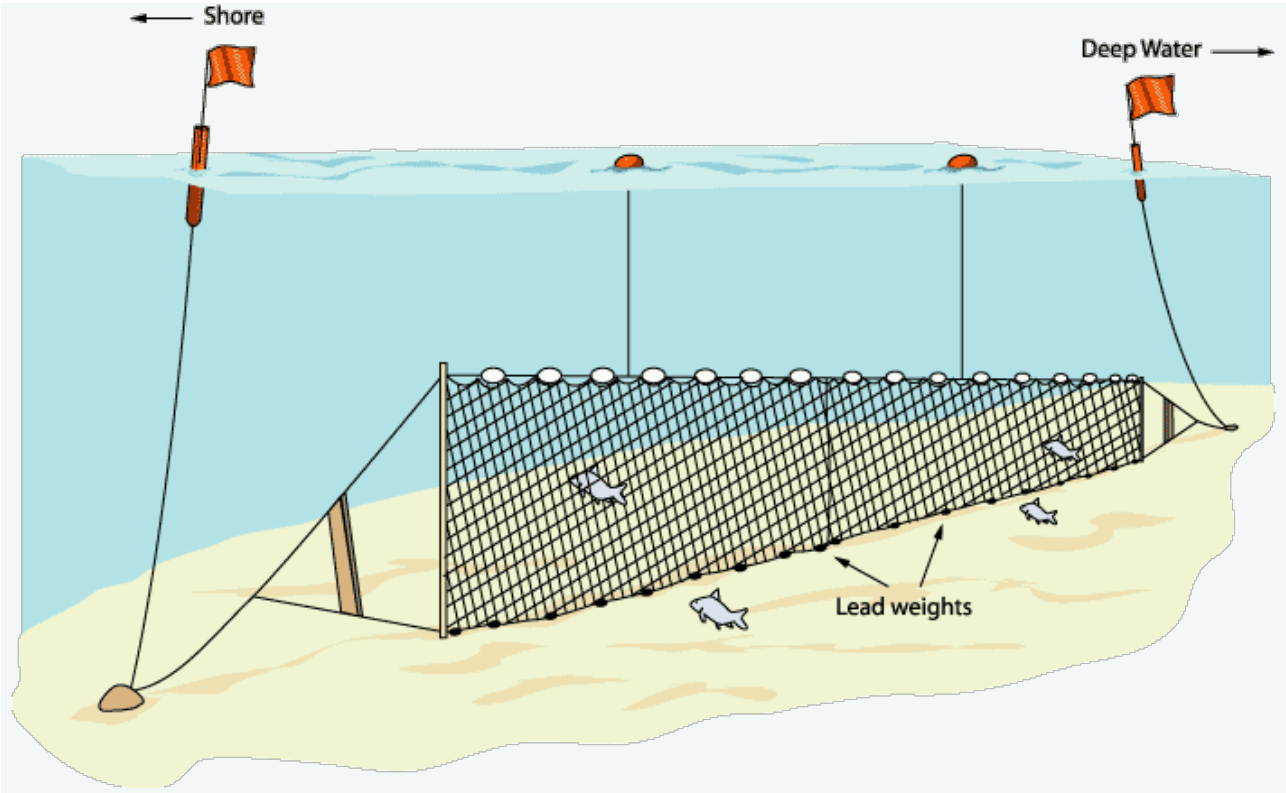
Depiction of trapnets as deployed throughout the Great Lakes. Image from Michigan Seagrant

CANADA / LAKE HURON, SET GILLNETS, CANADA
UNITED STATES OF AMERICA / LAKE HURON, SET GILLNETS, UNITED STATES OF AMERICA

Low Concern

Gillnetting is restricted to Canadian and tribal fisheries in Lake Huron where it is the preferred fishing method. Gillnets are primarily utilized for lake whitefish, yellow perch and walleye fisheries. Lake trout are sometimes taken as incidental harvest. 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 setting and hauling nets (fig. 9, pers. comm., DNR, OMNR). Much of Lake Huron's benthic substrate is composed of soft, sandy silt and clay which is little affected by fishing gears. Additionally, the Niagara escarpment runs through much of the northern half of the lake resulting in many areas of hard, rocky substrate which limits the amount of type of fishing activities in these areas.

Justification:



Depiction of typical gillnet deployment in Great Lakes. Image provided by Michigan Seagrant.

Factor 4.2 - Mitigation of Gear Impacts

CANADA / LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., CANADA
CANADA / LAKE HURON, SET GILLNETS, CANADA
UNITED STATES OF AMERICA / LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., UNITED STATES OF AMERICA
UNITED STATES OF AMERICA / LAKE HURON, SET GILLNETS, UNITED STATES OF AMERICA

No Effective Mitigation

Impacts of commercial fishing gear on benthic substrate has not been fully assessed in Lake Huron. However, gears utilized in Lake Huron are not believed to significantly impact benthic substrate and as such, mitigation strategies for negative impacts are non-existent. The benthic substrate of Lake Huron is generally soft substrate, devoid of hard structure which may be damaged by gear placement. Fishing rarely occurs in areas deemed spawning or nursery areas (where such hard substrate may exist) , although fishing is allowed, because the fishermen recognize these areas as vital to commercially valuable species such as lake whitefish, and because the rugose habitat of these spawning areas could damage gear (pers. comm. OMNR).

Factor 4.3 - Ecosystem-Based Fisheries Management

CANADA / LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., CANADA
CANADA / LAKE HURON, SET GILLNETS, CANADA
UNITED STATES OF AMERICA / LAKE HURON, BARRIERS, FENCES, WEIRS, CORRALS, ETC., UNITED STATES OF AMERICA
UNITED STATES OF AMERICA / LAKE HURON, SET GILLNETS, UNITED STATES OF AMERICA

Low Concern

The EBFM score for the entire Lake Huron fisheries is given a score of "low concern' for the following

reasons:

Scientific assessment and management efforts to account for ecological role are underway.

The fishery catches one "exceptional species": Lake Trout, and policies are in place to protect ecosystem functioning.

For fisheries with hatchery supplementation, practices are designed to minimize or mitigate any potential negative ecological and/or genetic impacts, where applicable (lake trout).

There are no fisheries for non-native species.

Justification:

The 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 4 agreed upon strategies recognized by the GLFC. The policy was adopted for 2 main reasons: 1) Fisheries managers realize that the Great Lakes are all intimately connected and if something negatively impacts ones there is a high likelihood that it will affect the others, 2) the Great Lakes commercial fishing industry is comprised of multi-species of interests 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, size restrictions, and protected areas consisting of no-fish and limited fishing zones ((Caroffino & Lenart 2012), (DesJardine et al. 1995), (OMNR 2013),(Riley 2013)). Shifts in community structure, as well as trends in abundance of prey and forage fish are also closely monitored (DesJardine et al. 1995).

Lake trout are considered an 'exceptional species'. Prior to their collapse, lake trout were the dominant, apex predator in the mid to deep water zones throughout the Great Lakes. Their collapse (which was facilitated by the spread of invasive sea lampreys, and anthropogenic influences such as over harvest and habitat alteration) laid open the Great Lakes to be infiltrated by a host of other invasives such as the alewife and rainbow smelt. The lake trouts role as a keystone species has generated strong support for their restoration ((He et al. 2012),(OMNR 2012)).

As an exceptional species, they are also closely monitoring and the ecological interactions existing between the 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 (see section 3.1.2) which attempts to fully understand the lake trout ecological role in an effort to help restore the dramatically stocks. In Lake Huron, these rehabilitation efforts include the stocking of lake trout in designated stock zones (OMNR 2012). Strains of stocked lake trout are primarily taken from existing populations in Lake Huron in an effort to reduce the introduction of non-native strains and maintain the genetic integrity of the existing stocks ((Ebener 1998),(OMNR 2012)).

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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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