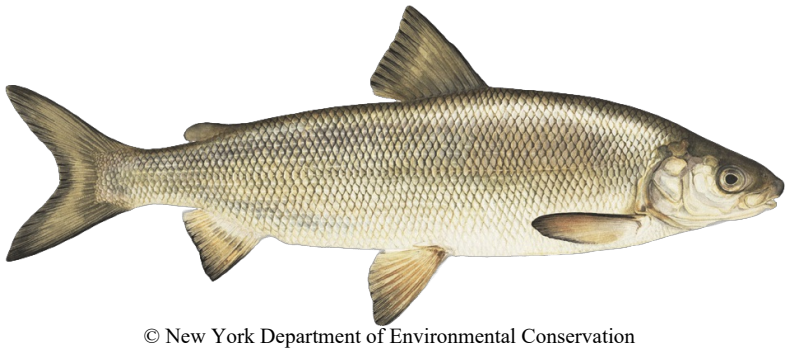
Monterey Bay Aquarium
Seafood Watch

Draft Assessment for Review
November 2024

Freshwater Fish, Lake Huron

Salvelinus namaycush, Coregonus clupeaformis, Sander vitreus, Perca flavescens



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America, North - Inland Waters

Stationary uncovered pound nets, Set gillnets

Report ID 27856

Seafood Watch Standard used in this assessment: Fisheries Standard v4

Disclaimer

All Seafood Watch fishery assessments are reviewed for accuracy by external experts in ecology, fisheries science, and aquaculture. Scientific review does not constitute an endorsement of the Seafood Watch program or its ratings on the part of the reviewing scientists. Seafood Watch is solely responsible for the conclusions reached in this assessment.

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About Seafood Watch

Monterey Bay Aquarium's Seafood Watch program evaluates the environmental 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. 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.

Seafood Watch's science-based ratings are available at www.SeafoodWatch.org. Each rating is supported by a Seafood Watch assessment, in which the fishery or aquaculture operation is evaluated using the Seafood Watch standard.

Seafood Watch standards are built on our guiding principles, which outline the necessary environmental sustainability elements for fisheries and aquaculture operations. The guiding principles differ across standards, reflecting the different impacts of fisheries and aquaculture.

- Seafood rated Best Choice comes from sources that operate in a manner that's consistent with our guiding principles. The seafood is caught or farmed in ways that cause little or no harm to other wildlife or the environment.

- Seafood rated Good Alternative comes from sources that align with most of our guiding principles. However, one issue needs substantial improvement, or there's significant uncertainty about the impacts on wildlife or the environment.

- Seafood rated Avoid comes from sources that don't align with our guiding principles. The seafood is caught or farmed in ways that have a high risk of causing harm to wildlife or the environment. There's a critical conservation concern or many issues need substantial improvement.

Each assessment follows an eight-step process, which prioritizes rigor, impartiality, transparency and accessibility. They are conducted by Seafood Watch scientists, in collaboration with scientific, government, industry and conservation experts and are open for public comment prior to publication. Conditions in wild capture fisheries and aquaculture operations can change over time; as such assessments and ratings are updated regularly to reflect current practice.

More information on Seafood Watch guiding principles, standards, assessments and ratings are available at www.SeafoodWatch.org.

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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.

The following guiding principles illustrate the qualities that fisheries must possess to be considered sustainable by the Seafood Watch program (these are explained further in the Seafood Watch Standard for Fisheries):

- Follow the principles of ecosystem-based fisheries management.
- Ensure all affected stocks are healthy and abundant.
- Fish all affected stocks at sustainable levels.
- Minimize bycatch.
- Have no more than a negligible impact on any threatened, endangered, or protected species.
- Managed to sustain the long-term productivity of all affected species.
- Avoid negative impacts on the structure, function, or associated biota of aquatic habitats where fishing occurs.
- Maintain the trophic role of all aquatic life.
- Do not result in harmful ecological changes such as reduction of dependent predator populations, trophic cascades, or phase shifts.
- Ensure that any enhancement activities and fishing activities on enhanced stocks do not negatively affect the diversity, abundance, productivity, or genetic integrity of wild stocks.

These guiding principles are operationalized in the four criteria in this standard.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, Seafood Watch develops an overall recommendation. Criteria ratings and the overall recommendation are color coded to correspond to the categories on the Seafood Watch pocket guides and online guide:

Best Choice/Green: Buy first; they're well managed and caught or farmed responsibly.

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

Avoid/Red: Take a pass on these for now; they're caught or farmed in ways that harm other marine life or the environment.

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

Summary

This report provides ratings for lake trout (*Salvelinus namaycush*), lake whitefish (*Coregonus clupeaformis*), walleye (*Sander vitreus*), and yellow perch (*Perca flavescens*) caught in Lake Huron by United States (encompassing Michigan state-licensed and tribal-licensed fisheries) and Canadian fisheries (encompassing provincial and First Nations fisheries). The assessment is divided based on management region (Michigan, USA state waters, Michigan 1836 Treaty waters, and Ontario, Canada), gear type (including set gillnets and trap nets or stationary uncovered pound nets), and species.

In the Ontario gillnet and trap net fisheries, the targeted species were lake whitefish, lake trout, walleye and yellow perch. Abundance of lake trout was considered a moderate concern as stocks were above the target reference point in only Northern Lake Huron, and stocks in > 70% of the management units were a moderate concern. In the case of lake whitefish and yellow perch, there were no reference levels for abundance, and both species were found to have high vulnerability, so abundance was scored a high concern. Contrastingly, there were no reference points for abundance of walleye, but the species was found to have medium vulnerability and was scored a moderate concern. Although there were quotas in place for all the species, and in the case of lake whitefish there was a reference level for exploitation rate, fishing mortality was scored a moderate concern as there was uncertainty regarding the appropriateness of the quotas for all the species and the reference level in the case of lake whitefish. In the case of gillnets, as management effectiveness is unknown, and it is likely that gillnets are having a serious negative impact on the retained populations of lake whitefish and yellow perch (as both Criterion 1 and 2 have been scored red), management strategy and implementation was considered as ineffective. Therefore the gillnet fishery in Ontario has received a red rating. In the case of trap nets that targeted lake trout, lake whitefish and walleye, management effectiveness is considered as moderately effective, and hence these trap net fisheries received a yellow rating. Contrastingly, in the yellow perch trap net fishery, management effectiveness is unknown as it is likely that trap nets are having a serious negative impact on retained populations of lake whitefish and yellow perch (as both Criterion 1 and 2 have been scored a red), so management strategy and implementation was considered as ineffective; therefore the yellow perch trap net fishery in Ontario received a red rating.

The state licensed trap net fishery targets lake whitefish and yellow perch. There are no reference points for abundance of lake whitefish and yellow perch, and both species have high vulnerability, so they were considered a high concern for abundance. Further, fishing mortality reference points are unknown for lake whitefish so the factor was considered a moderate concern. For yellow perch, there are no quotas for the commercial fishery, but a newly developed and adopted recreational fishery management plan for the Saginaw Bay population of yellow perch, mentions one reference point for commercial yield in the bay, which is not being achieved, due to the depressed status of the yellow perch population, and recruitment overfishing; hence fishing mortality is considered as a high concern. Lake whitefish is the main targeted retained species in the fishery, and management effectiveness of this species is unknown, and it is likely that the fishery is having a serious negative impact on the retained lake whitefish population (as Criterion 1 has been scored red); therefore, management strategy and implementation was considered ineffective. Hence the state licensed Michigan fishery has received a red rating.

In 1836 Treaty-ceded waters of Michigan, the tribal trap net fishery targets lake whitefish, whereas the tribal gillnet fishery targets lake whitefish, lake trout and walleye. In the case of lake whitefish, there is uncertainty with the abundance reference levels, and lake whitefish has high vulnerability, hence abundance is considered a high concern. Although fishing mortality for lake whitefish is below the reference point, it was considered a

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moderate concern because there was uncertainty in the appropriateness of the reference point. For lake trout, stock abundance was above the reference level, so it was considered a low concern; although lake trout fishing mortality was within the quota, the appropriateness of the quota was uncertain, so fishing mortality is considered a moderate concern. In the case of walleye, there are no reference points for abundance and the species has medium vulnerability, so abundance was considered a moderate concern. As there were no quotas in place for walleye, fishing mortality was considered a moderate concern. Since > 70% of the main targeted and retained stocks in the gillnet fishery have measures in place that are expected to be effective, but there is a potential need for increased precaution (including setting appropriate fishing mortality reference levels for lake whitefish and appropriate quotas for walleye, and setting reference levels for abundance of walleye), management strategy and implementation was considered moderately effective. In the case of tribal trap nets, lake whitefish is a high concern for abundance as the species is highly vulnerable, and a moderate concern for fishing mortality due to uncertainty with regards to the reference points and there are no appropriate quotas in place. Since there are no appropriate quotas or harvest limits in place based on appropriate biological reference levels, the effectiveness of the HRG used is unknown, and it is likely that the fishery is having serious negative impacts on lake whitefish populations due to concerns with the status of the population; hence management is considered as ineffective. Overall, the tribal trap net and gillnet fisheries in 1836 Treaty ceded Michigan waters received a red and a yellow rating respectively.

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Final Seafood Recommendations

SPECIES | FISHERY	C 1 TARGET SPECIES	C 2 OTHER SPECIES	C 3 MANAGEMENT	C 4 HABITAT	OVERALL	VOLUME (MT) YEAR
Lake trout | Lake Huron | America, North - Inland Waters | Canada | Ontario | Set gillnets	2.644	1.732	1.000	3.000	**Avoid (1.925)**	Unknown
Lake trout | Lake Huron | America, North - Inland Waters | Canada | Ontario | Stationary uncovered pound nets	2.644	1.732	3.000	3.000	**Good Alternative (2.534)**	Unknown
Lake trout | Lake Huron | America, North - Inland Waters | United States | Michigan | Set gillnets | Tribal large mesh fishery	3.318	1.732	3.000	3.000	**Good Alternative (2.682)**	Unknown
Lake whitefish | Lake Huron | America, North - Inland Waters | Canada | Ontario | Set gillnets	1.732	1.732	1.000	3.000	**Avoid (1.732)**	Unknown
Lake whitefish | Lake Huron | America, North - Inland Waters | Canada | Ontario | Stationary uncovered pound nets	1.732	2.236	3.000	3.000	**Good Alternative (2.430)**	Unknown
Lake whitefish | Lake Huron | America, North - Inland Waters | United States | Michigan | Set gillnets | Tribal large mesh fishery	1.732	2.644	3.000	3.000	**Good Alternative (2.534)**	Unknown
Lake whitefish | Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | Tribal fishery	1.732	5.000	1.000	3.000	**Avoid (2.258)**	Unknown
Lake whitefish | Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | State Fishery	1.732	2.644	1.000	3.000	**Avoid (1.925)**	Unknown
Walleye | Lake Huron | America, North - Inland Waters | Canada | Ontario | Set gillnets	2.644	1.732	1.000	3.000	**Avoid (1.925)**	Unknown
Walleye | Lake Huron | America, North - Inland Waters | Canada | Ontario | Stationary uncovered pound nets	2.644	1.732	3.000	3.000	**Good Alternative (2.534)**	Unknown
Walleye | Lake Huron | America, North - Inland Waters | United States | Michigan | Set gillnets | Tribal large mesh fishery	2.644	1.732	3.000	3.000	**Good Alternative (2.534)**	Unknown
Yellow perch | Lake Huron | America, North - Inland Waters | Canada | Ontario | Set gillnets	1.732	1.732	1.000	3.000	**Avoid (1.732)**	Unknown
Yellow perch | Lake Huron | America, North - Inland Waters | Canada | Ontario | Stationary uncovered pound nets	1.732	1.732	3.000	3.000	**Avoid (2.279)**	Unknown
Yellow perch | Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | State Fishery	1.000	1.732	1.000	3.000	**Avoid (1.510)**	Unknown

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Production volumes by specific gear type are not available for all fisheries in Lake Huron.

In 2020, approximately 214 MT of lake trout was harvested from Lake Huron, of which approximately 136 MT was from Ontario waters, and 79 MT was from Michigan tribal gillnet fishery (GLFC 2022). Similarly in 2020, a total of approximately 989 MT of lake whitefish was harvested from Lake Huron, where approximately 521 MT was from Ontario waters, and 468 MT was from the state and tribal Michigan fisheries combined (ibid). In 2020, overall 110 MT of walleye was produced from Lake Huron, of which approximately 94 MT was from Ontario waters and 15 MT was from the Michigan tribal gillnet fishery (ibid). In 2020, a total of 123 MT of yellow perch was produced in Lake Huron, of which 110 MT was from Ontario waters, and 13 MT was from the Michigan state and tribal fisheries combined (ibid)

Summary

Overall, the Ontario gillnet lake trout, lake whitefish, yellow perch and walleye fisheries have been rated red, because of the high concern stock status of lake trout, lake whitefish, and yellow perch, and ineffective management. Ontario lake trout, lake whitefish, and walleye trap net fisheries have been rated yellow, due to the moderate stock status and moderately effective management, whereas the Ontario yellow perch trap net fishery has been rated a red due to a high concern stock status and status of other species in the catch.

The Michigan state licensed commercial lake whitefish and yellow perch trap net fisheries have been rated red, because of the high concern stock status of lake whitefish and yellow perch and the ineffective management.

The tribal lake whitefish, lake trout, and walleye gillnet fishery and the lake whitefish fishery operating in 1836 Michigan waters has been rated yellow. This is because the stock abundance of walleye was a moderate concern, whereas the stock abundance of lake trout was a low concern; fishing mortality of lake trout, lake whitefish and walleye were a moderate concern, and management effectiveness was moderately effective. Contrastingly, lake whitefish targeted in the tribal trap net fishery has been rated red, due to the status of the stock and ineffective management.

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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 provides ratings for lake trout (*Salvelinus namaycush*), lake whitefish (*Coregonus clupeaformis*), walleye (*Sander vitreus*), and yellow perch (*Perca flavescens*) caught in Lake Huron by United States (encompassing Michigan state-licensed and tribal-licensed fisheries) and Canadian fisheries (encompassing provincial and First Nation fisheries). The assessment is divided based on management region (Michigan, USA state waters, 1836 Treaty Michigan waters, and Ontario, Canada), gear type, including set gillnets and trap nets (also referred to as stationary uncovered pound nets), and species.

Species Overview

Lake whitefish are temperate (8-14°C) freshwater and brackish salmonids distributed in North America throughout Canada, Alaska, New England, the Great Lakes, and central Minnesota, USA (depth 8-128 m) {Froese & Pauly 2023a}. Lake whitefish can reach 100 cm total length (TL) (commonly 54 cm TL) and 19 kg total weight and the maximum reported age is 50 years (ibid). They are annual open water/substratum egg scatterers in the southern portion of their range but reproduce every two to three years in the northern sub-arctic and arctic regions (ibid). As adults they feed on aquatic insect larvae, mollusks, amphipods, fishes and fish eggs (ibid).

Lake trout are temperate (4-13°C) freshwater salmonids present in North America in Atlantic, Arctic and Pacific basins from northern Canada and Alaska south to New England the Great Lakes and northern Montana, USA {Froese & Pauly 2023b}. They are benthopelagic occurring from 3-61 m depth (commonly 18-53 m, ibid). Lake trout can reach 150 cm TL (commonly 50 cm), 32.7 kg and 50 years of age (ibid). They are open water/substratum egg scatterers reaching maturity at 42-50 cm in length (ibid). They feed on invertebrates (freshwater sponges, crustaceans, insects), fishes and small mammals (ibid).

Walleye are temperate (1-20.6°C) freshwater and rarely brackish perciform fish present in the Great Lakes, Arctic, and Mississippi River basins distributed in North America from Quebec and the Northwest Territories in Canada, to Alabama and Arkansas in the USA (depth 0-27 m, widely introduced to most USA regions) {Froese & Pauly 2023d}(Scott and Crossman 1973). Walleye can reach 107 cm TL (commonly 57 cm TL) and 11 kg total weight, and the maximum reported age is 29 years (ibid). They are broadcast spawners reaching reproductive maturity at 36-43 cm (ibid). Adults feed primarily on insects and fishes, but will also consume crayfish, snails, frogs, mudpuppies, and small mammals (ibid).

Yellow perch are temperate(8-24 °C) (Scott and Crossman 1973). They are freshwater and brackish perciform fish present in Great Lakes, Atlantic, Arctic, and Mississippi River basins in North America from Nova Scotia and the Northwest Territories in Canada, to Ohio, Illinois, Nebraska, and Georgia in the USA (depth 0-56 m, typically < 9 m) {Froese & Pauly 2023e}. Yellow perch can reach 50 cm TL (commonly 19 cm TL) and 1.9 kg total weight, and the maximum reported age is 11 years (ibid). They are annual nonobligatory plant spawners reaching reproductive maturity at 19.2 cm TL (ibid). Adults feed on insects, fishes and fish eggs (ibid).

Lake Huron is bordered by Michigan, USA and Ontario, Canada (Figure 1) {Riley & Ebner 2020}. It is the second largest of the Laurentian Great Lakes (59,565 km^2 water surface area, average depth 59 m, max depth 229 m) comprised of an oligotrophic deep main basin (inclusive of the shallower Saginaw Bay which is eutrophic along the inner bay and oligotrophic or mesotrophic along the outer bay) and two semi-isolated

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basins which include Georgian Bay (oligotrophic) and the North Channel (mesotrophic) {Riley & Ebner 2020} (Michigan Sea Grant 2023). Aquatic community shifts have occurred historically due to habitat degradation, invasive species introduction, and environmental disturbances (lower tropic-level upheavals, water-level fluctuations and declining ice-cover days) (ibid).

In particular, Lake Huron's food web has undergone a paradigm shift in 2003 that has in turn lead to profound changes to the fish community. It began with the invasion and colonization of dreissenid mussels with a cascading effect up the food chain (Barbiero et al. 2011)(Bunnell et al. 2014) reducing planktonic food for the planktivore community such as alewives. Simultaneously the predator population was very high in the early 2000s also contributing to pressure on the prey base {He et al. 2015}. Together these forces caused the collapse of the alewife prey base (Riley et al. 2008) (Riley and Roseman 2013). In the absence of alewives, native predator reproduction (chiefly of walleye and lake trout) increased significantly (Fielder et al. 2007) (Lenart et al. 2018). The food web shift, however, did not benefit lake whitefish (Ebner et al. 2021), with the decline of essential spring plankton blooms. Collectively, these changes have heavily impacted the trends in key commercial species for the decades since.

Several management bodies manage the fisheries in Lake Huron, including state, provincial, federal and tribal bodies, such as the Michigan Department of Natural Resources, the Ontario Ministry of Natural Resources, and the Chippewa-Ottawa Resource Authority (CORA). Additionally, a coordinated cooperative management arrangement exists under the auspices of the Great Lakes Fishery Commission (GLFC), which facilitates and maintains working relationships among the parties as described in the Joint Strategic Plan (JSP). For further information on the overarching management of fisheries in Lake Huron, refer to the C3 summary.

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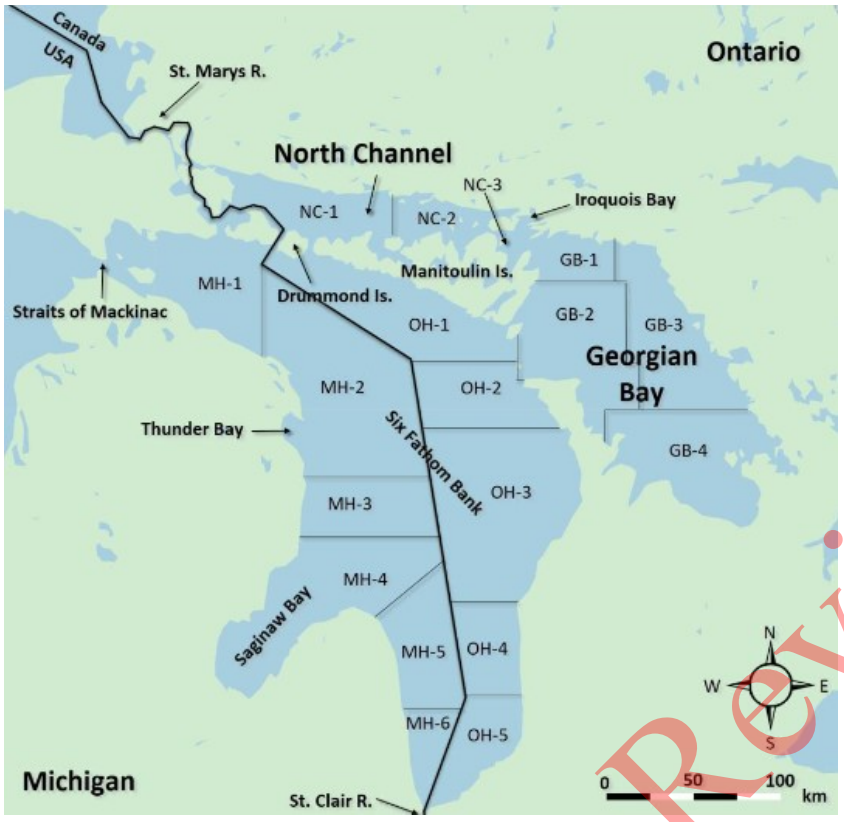

Figure 1: Map of Lake Huron showing major geographical features and statistical districts. The main basin of Lake Huron is waters outside of the North Channel and Georgian Bay {Riley & Ebner 2020}.

Production Statistics

Commercial fisheries in Lake Huron are comprised of state, provincial and indigenous fisheries with 84% of yield harvested in the main basin, 10% in Georgian Bay and 6% in the North Channel {Riley & Ebner 2020}. In particular, Saginaw Bay (which is part of the main basin) has the highest concentration of state-licensed commercial fisheries in Michigan waters (Fielder 2024, pers comm). Ontario commercial fisheries harvest 60% of lake-wide yield (ibid).

Lake trout

In 2020, the lake-wide yield of lake trout in commercial fisheries was 471,000 pounds (298,000 pounds in Ontario, Canada and 173,00 pounds in Michigan, United States) a 21% decrease from 2019 harvest (Figure 2)(GLFC 2022).

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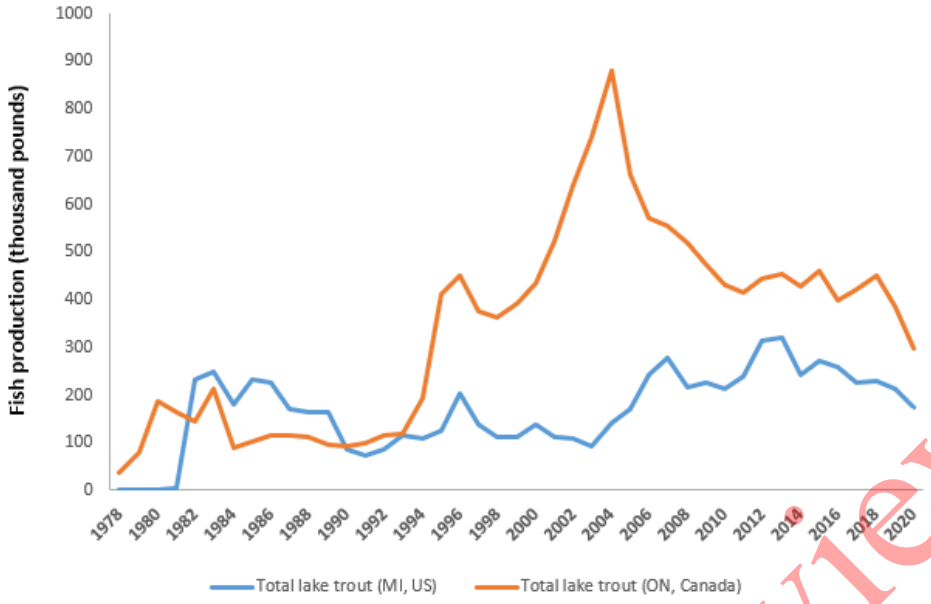

Figure 2: Lake Huron commercial fishery harvest for lake trout (GLFC 2022).

Lake whitefish

The lake whitefish fishery is the largest commercial fishery in Lake Huron (GLFC 2022). Lake whitefish harvest has declined since peaking in 2000 at 9.76 million pounds (lake-wide) with harvest in 2020 at 2.18 million pounds (1.15 million pounds in Canadian waters and 1.03 million pounds in US waters) (Figure 3) (ibid). The decline in yield is attributed to a combination of reduced recruitment and reduced fisheries effort {Riley & Ebner 2020}(Ebner et al. 2021).

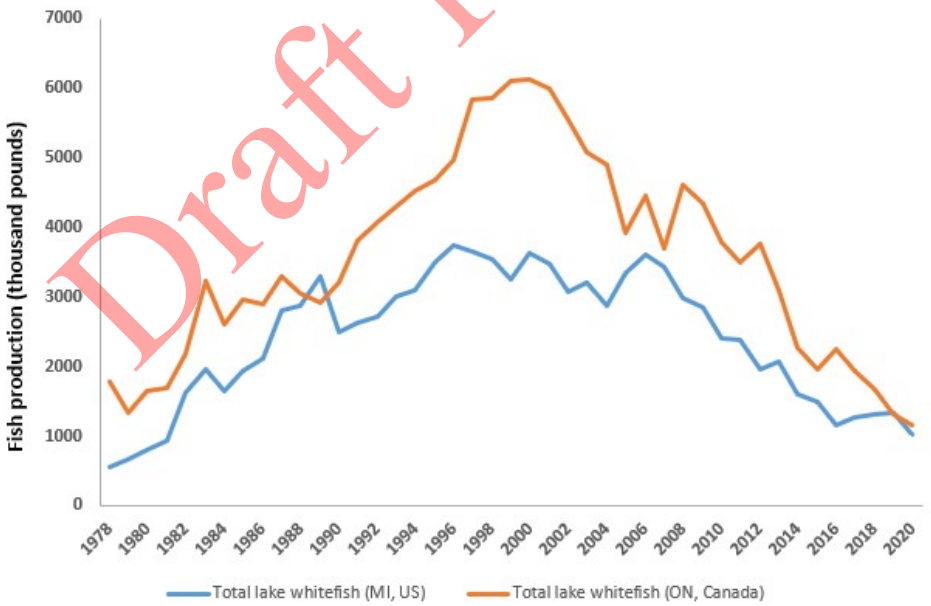

Figure 3: Lake Huron commercial fishery harvest for lake whitefish (GLFC 2022).

Walleye

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In 2020, 241,000 pounds of walleye were harvested lake-wide by commercial fisheries with the majority (86%) harvested in Canadian waters (Figure 4)(GLFC 2022). Lake-wide yield has been low but stable in recent decades relative to historical levels but stable in recent decades (ibid). Historical commercial fisheries for walleye included large yields from state-licensed fisheries but those collapsed in the mid-1940s and were formally closed in 1970 (Fielder and Baker 2019). Since then walleye have been principally allocated to recreational fisheries by the state and only commercial harvest in state waters has been by Native American tribes in the 1836 Treaty waters of northern Lake Huron.

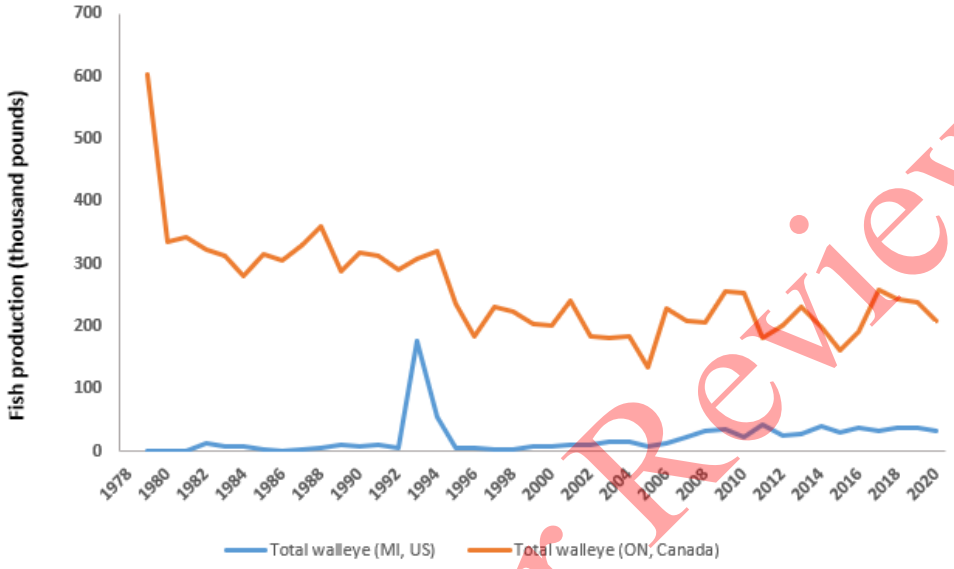

Figure 4: Lake Huron commercial fishery harvest for walleye (GLFC 2022).

Yellow perch

Commercial fisheries yield for yellow perch are reduced relative to historic levels {Riley & Ebner 2020}. In 2020, 273,000 pounds of yellow perch were harvested lake-wide by commercial fisheries with the majority (90%) harvested in Canadian waters (Figure 5)(GLFC 2022). A state-licensed commercial fishery exists for yellow perch in Saginaw Bay and constitutes most of the commercial yield in the Michigan waters of the lake.

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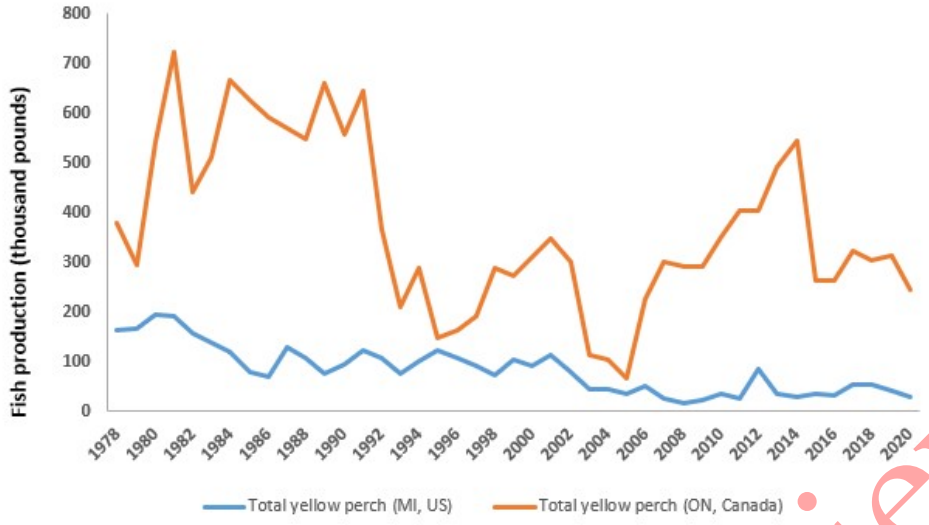

Figure 5: Lake Huron commercial fishery harvest for yellow perch (GLFC 2022).

Importance to the US/North American market.

None of the species evaluated in this report are considered important from the perspective of global trade (Jescovitch et al. 2022). The majority of fish harvested in the Great Lakes region is sold to the local market (within 60 miles) either as fish (46.5%) or processed product (68%), which may include value-added items such as filets, smoking, and fish dips (ibid). A lower percentage of fish harvested in the Great Lakes region is sold regionally, at 37.9% and 25.4% for fish and processed products, and nationally, at 12.7% and 5.1%, respectively (ibid). Only a small proportion, specifically 2.9% for fish and 1.5% for processed product, is sold in international markets (ibid).

Common and market names.

Lake whitefish (*Coregonus clupeaformis*): acceptable market name whitefish, common name lake whitefish (FDA 2022), and is also known as dikameg/adikameg (Anishinaabe/Ojibwe) (Livesay and Nichols 2021), Sault whitefish, whitefish, eastern whitefish, Great Lakes whitefish, inland whitefish, gizzard fish, grande coregone (French), and Attikumaig (Chippewa)..

Lake trout (*Salvelinus namaycush*): acceptable market name lake trout, common name trout (FDA 2022), Great Lakes trout, laker, namaycush/namegos (Anishinaabe/Ojibwe) (Livesay and Nichols 2021), togue, grey trout, mountain trout, mackinaw, lake char/charr, touladi, and salmon trout.

Walleye (*Sander vitreus*): acceptable market name and common name walleye (FDA 2022), and is also known as is also known as ogaa (Anishinaabe/Ojibwe) (Livesay and Nichols 2021), yellow pickerel, pickerel (Canada), yellow pike, yellow walleye, and dore (France, Canada).

Yellow perch (*Perca flavescens*): acceptable market name perch, lake or yellow, common name yellow perch (FDA 2022), and is also known as river perch, striped perch, ringed perch, American perch, common perch (WDNR 2008) and asaawe/asaawens (Livesay and Nichols 2021).

Primary product forms

Lake whitefish: Fresh and frozen whole (dressed), fillets, steaks, and as value added smoked (head-on;

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fillets), roe (Seafood Handbook 2022).

Lake trout: Lake trout may be marketed as fresh, frozen, or smoked fish. A substantial portion of the larger lean lake trout is sold as a smoked product. Smaller lean lake trout are primarily marketed as fresh, frozen, or as whole dressed fish.

Walleye: Fresh whole (round), headless and dressed, fillets (skinless/skin-on) and frozen IQF fillets & IQF fingers.

Yellow perch: Fresh and frozen skin-on fillets & whole, and as value added breaded/battered fillets.

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Assessment

This section assesses the sustainability of the fishery(s) relative to the Seafood Watch Standard for Fisheries, available at www.seafoodwatch.org. The specific standard used is referenced on the title page of all Seafood Watch assessments.

Criterion 1: Impacts on the species under assessment

This criterion evaluates the impact of fishing mortality on the species, given its current abundance. When abundance is unknown, abundance is scored based on the species' inherent vulnerability, which is calculated using a Productivity-Susceptibility Analysis. 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.

Guiding principles

- *Ensure all affected stocks are healthy and abundant.*
- *Fish all affected stocks at sustainable level*

Criterion 1 Summary

LAKE TROUT			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Lake Huron | America, North - Inland Waters | Canada | Ontario | Set gillnets	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Lake Huron | America, North - Inland Waters | Canada | Ontario | Stationary uncovered pound nets	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Lake Huron | America, North - Inland Waters | United States | Michigan | Set gillnets | Tribal large mesh fishery	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)

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LAKE WHITEFISH			
REGION / METHOD	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Lake Huron | America, North - Inland Waters | Canada | Ontario | Set gillnets	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Lake Huron | America, North - Inland Waters | Canada | Ontario | Stationary uncovered pound nets	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Lake Huron | America, North - Inland Waters | United States | Michigan | Set gillnets | Tribal large mesh fishery	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | Tribal fishery	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | State Fishery	1.000: High Concern	3.000: Moderate Concern	Red (1.732)

WALLEYE			
REGION / METHOD	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Lake Huron | America, North - Inland Waters | Canada | Ontario | Set gillnets	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Lake Huron | America, North - Inland Waters | Canada | Ontario | Stationary uncovered pound nets	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Lake Huron | America, North - Inland Waters | United States | Michigan | Set gillnets | Tribal large mesh fishery	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

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YELLOW PERCH			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Lake Huron | America, North - Inland Waters | Canada | Ontario | Set gillnets	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Lake Huron | America, North - Inland Waters | Canada | Ontario | Stationary uncovered pound nets	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | State Fishery	1.000: High Concern	1.000: High Concern	Red (1.000)

Criterion 1 Assessments

SCORING GUIDELINES

Factor 1.1 - Abundance
Goal: Stock abundance and size structure of native species is maintained at a level that does not impair recruitment or productivity.

- *5 (Very Low Concern) — Strong evidence exists that the population is above an appropriate target abundance level (given the species' ecological role), or near virgin biomass.*
- *3.67 (Low Concern) — Population may be below target abundance level, but is at least 75% of the target level, OR data-limited assessments suggest population is healthy and species is not highly vulnerable.*
- *2.33 (Moderate Concern) — Population is not overfished but may be below 75% of the target abundance level, OR abundance is unknown and the species is not highly vulnerable.*
- *1 (High Concern) — Population is considered overfished/depleted, a species of concern, threatened or endangered, OR abundance is unknown and species is highly vulnerable.*

Factor 1.2 - Fishing Mortality
Goal: Fishing mortality is appropriate for current state of the stock.

- *5 (Low Concern) — Probable (>50%) that fishing mortality from all sources is at or below a sustainable level, given the species ecological role, OR fishery does not target species and fishing mortality is low enough to not adversely affect its population.*
- *3 (Moderate Concern) — Fishing mortality is fluctuating around sustainable levels, OR fishing mortality relative to a sustainable level is uncertain.*
- *1 (High Concern) — Probable that fishing mortality from all source is above a sustainable level.*

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Lake trout (Salvelinus namaycush)

Factor 1.1 - Abundance

Lake Huron | America, North - Inland Waters | Canada | Ontario | Set gillnets
Lake Huron | America, North - Inland Waters | Canada | Ontario | Stationary uncovered pound nets

Moderate Concern

Abundance of lake trout in the Canadian waters of Lake Huron is assessed through data-limited assessments (Riley and Ebner 2020). Management utilizes statistical catch-at-age (SCAA) models informed by fisheries-dependent catch and biological data of hatchery-reared and wild-origin lake trout to provide estimates of abundance, biomass, and mortality across broad spatial scales in the main basin (He 2023). There are two SCAA models used for the stock assessment of lake trout in Lake Huron's main basin, which are divided by region: Northern Lake Huron (NLH in statistical districts MH1 and MH2 encompassing the tribal fishery in Michigan waters and statistical districts OH-1 and OH-2, encompassing the commercial fishery in Ontario waters, see map in figure 11, from (He et al. 2022)) and Southern Lake Huron (SLH in statistical districts MH-3, MH-4, MH-5 and MH-6 in Michigan waters, and statistical districts OH-3, OH-4 and OH-5 in Ontario waters as shown in the map presented in figure 11 from (He et al. 2022))(He 2023, pers comm). In NLH, stock biomass has been increasing since the early 1990s and more rapidly since the early 2000s, following the alewife population collapse, with an increase in wild populations (Figure 6, ibid). The NLH SSBR_Current (2.79) and SSBR_BASE (13.80, with natural mortality only) are above the SSBR_target (0.69) (He 2023, pers comm). NLH's survey CPUE has been stable but reduced relative to the previous decade since 2010 coincident with older age distributions of harvest, likely due to both increases in older age groups and decreases in recruitment (abundance of younger age classes) (Figure 7, (He 2023)). In SLH, stock biomass has been decreasing since the early 2000s overall and although there was an increase in wild populations in 2013, they have since been decreasing (Figure 6, ibid). SLH's, commercial catch has been declining since the early 2000s and coincident with older age distributions of harvest likely due to reduced recruitment and availability of younger age classes (Figure 8, ibid). Nevertheless, lake trout stocking was reduced by 50% in MH-1 & MH-2 and eliminated in MH-3, 4, 5, and 6 resulting in a total reduction of approximately 65% in Michigan's waters of Lake Huron (Riley and Ebner 2020); the recent declines in SLH year class strength and ensuing abundance are hence a product of this management action.

Data limited stock assessments are also conducted in Georgian Bay (GB) and the North Channel (NC) (James 2023, pers comm). In the NC, the average spawner age is considered as an indicator of abundance, and an average age one year older than the age of first maturity is considered as the target level (see figure 10 below)(James 2024, unpublished data). Commercial catch rate has declined in GB from 50 $kg \cdot km^{-1}$ in 2002 to < 10 $kg \cdot km^{-1}$ in 2010 and levels have been low but stable through 2017 (Figure 9, (Riley and Ebner 2020)), where the minimum CPUE is considered to be 17 $kg \cdot km^{-1}$ (James 2023, pers comm). In the NC, commercial catch rate is low relative to the other Lake Huron basins, but has been stable since 2005 (Riley and Ebner 2020).

Although there is natural recruitment, it is considered insufficient to sustain the stock, especially in the

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southern basin, and stocks are still maintained through hatchery stocking and sea lamprey control (Riley and Ebner 2020). The data-limited assessment conducted indicates that the stocks are above the target reference points in NLH (with the region also encompassing US waters), however, reference points are unknown for SLH, and there is uncertainty with regards to the appropriateness of the reference levels in NC and GB. Further, annual recruitment fluctuations exist with constant recruitment considered a key factor for the success of lake trout rehabilitation (He et al. 2020). Since reference points are unknown for SLH, and the appropriateness of the reference points in GB and NC is uncertain, a Productivity Susceptibility Analysis was conducted to determine abundance in these three management or statistical units; results of the PSA conducted indicate that lake trout has medium vulnerability (PSA score = 3.18) in GB, NC and SLH. As abundance of the lake trout stocks in > 70% of the management or statistical units is a moderate concern, this factor is considered a moderate concern.

Justification:

Longitudinal year-class strength (YCS) estimates were also used to assess population abundance, informed by catch-at-age data from fisheries-independent surveys and fisheries monitoring data (He et al. 2023b). Reconstruction of lake trout YCS in the main basin showed similar results to the SCAA models with adult abundance increasing in the late 1990s through early 2000s, followed by decline particularly in southern Lake Huron (ibid).

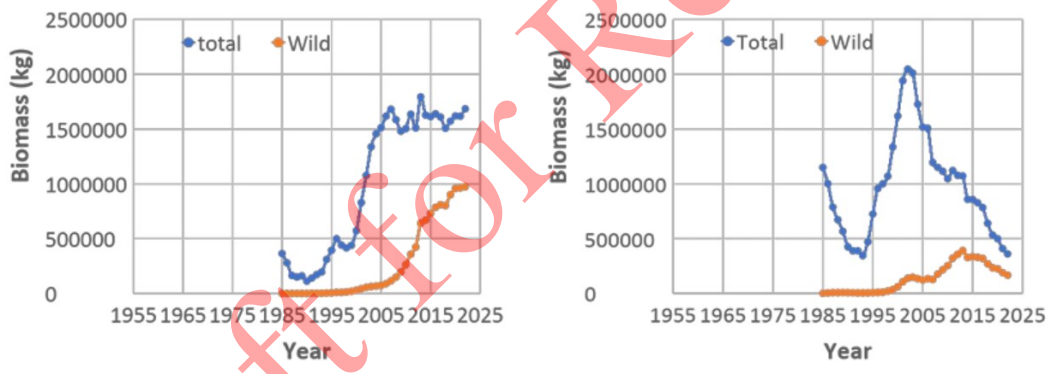

Figure 6: Lake trout stock biomass based on SCAA models for Northern Lake Huron (NLH including MH1, MH2, and QMA OH-1 and OH-2) and Southern Lake Huron (SLH including MH3, MH4, MH5, MH6, and QMA OH-3, OH-4 and OH-5) (He 2023).

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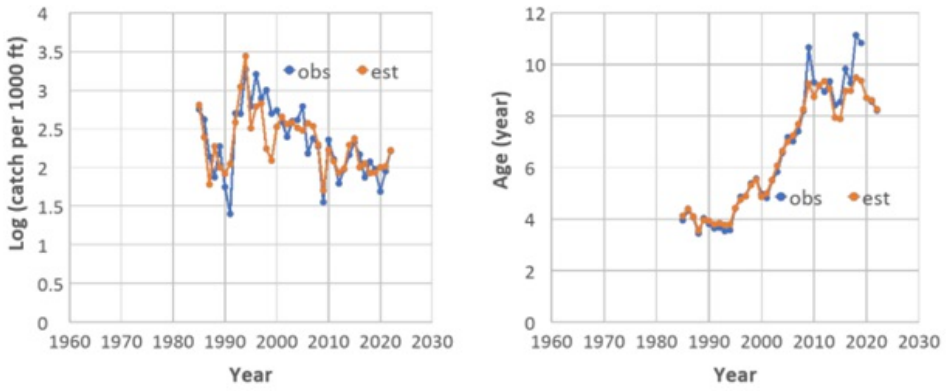

Figure 7: Lake trout survey CPUE and mean age in Northern Lake Huron (MH1, MH2 and QMA OH-1 and OH-2) (He 2023).

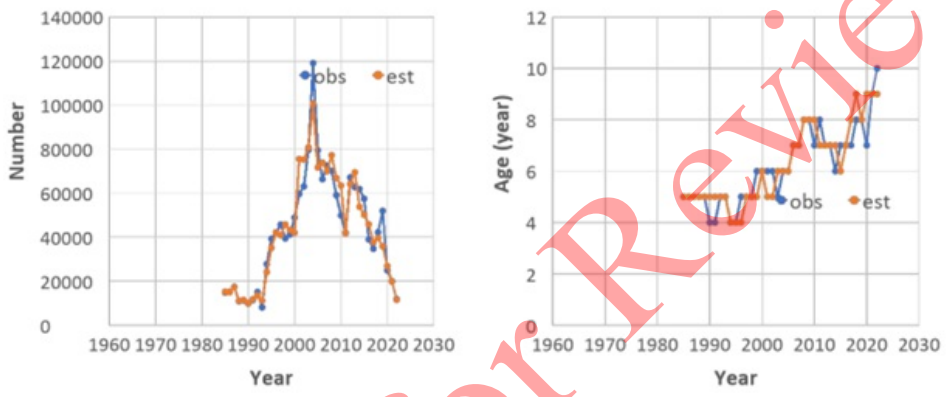

Figure 8: Commercial catch and mean age of lake trout in Southern Lake Huron (MH3, MH4, MH5, MH6, QMA OH-3, OH-4 and OH-5) (He 2023).

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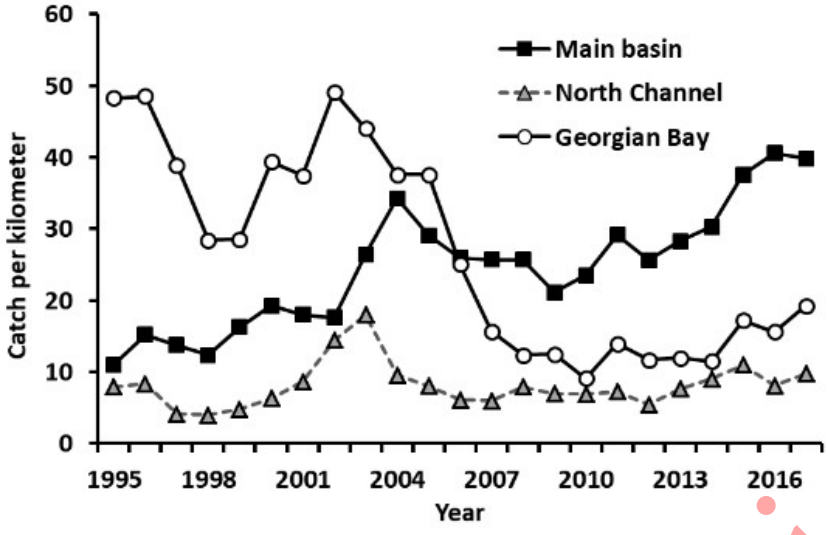

Figure 9: The number of lake trout caught per kilometer of gillnet in Ontario commercial fisheries of the main basin, North Channel, and Georgian Bay during 1979-2017 (Riley and Ebner 2020).

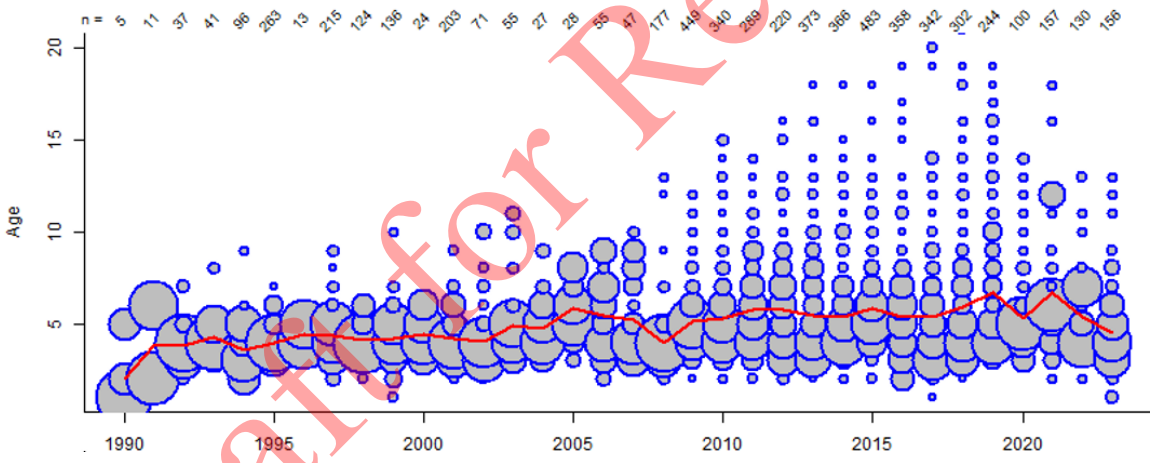

Figure 10: Abundance of lake trout in North Channel, Ontario, measured in terms of average spawner age (James 2024, unpublished data).

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Productivity-Susceptibility Analysis: This species has a medium vulnerability (V = 3.18 = $\sqrt{(1.5^2 + 2.8^2)}$).

Table 1

Productivity	Relevant Information	Score
Average age at maturity	5-6 years	2
Von Bertalanffy Growth Coefficient (K)	>0.25	1
Fecundity	approx 18,000-20,000 eggs per year	2
Average maximum size	50 cm	1
Average size at maturity	51 cm	2
Reproductive Strategy	broadcast spawners	1

References for productivity table (P = 2 + 1 + 2 + 1 +2 + 1 /6) = score 1.5): (Froese and Pauly 2023b) (Madenjian et al. 1998) (USFWS 2024).

Table 2

Susceptibility	Relevant Information	Score
Areal overlap	default score	3
Vertical overlap	default score	3
Seasonal availability	default score	3
Selectivity of fishery	Species in incidentally caught, but is not likely to escape the gear	2
Post-capture mortality	Retained species	3

References for susceptibility table (S = (3 + 3 + 3 + 2 + 2) / 5 = score 2.8).

Lake Huron | America, North - Inland Waters | United States | Michigan | Set gillnets | Tribal large mesh fishery

Low Concern

The lake trout population in Lake Huron was extirpated in the mid 1900s (due to overfishing and lamprey predation) and reestablished through hatchery stocking and control of sea-lamprey which began in the 1970s (Riley and Ebner 2020)(He and Bence 2023). Lake-wide recruitment of wild populations began in the early 2000s (ibid). There was a decline in lake trout length-at-age between 1977–1997 and 1998–2019, coinciding with a decline in prey-fish biomass (ibid). The effect of growth declines have been offset by reductions in mortality (both in lamprey induced mortality and in fishing pressure due to the implementation of harvest quota and no-fishing zones) (He et al. 2020). Despite ecosystem changes, current lake trout production, a mix of hatchery-stocked and wild fish, in the Michigan state waters of Lake Huron is considered healthy (ibid). Lake trout stocking was reduced by 50% in MH-1 and MH-2 beginning in 2018 (see figure 11)(Riley and Ebner 2020). There is no difference in adult mortality of wild vs. hatchery reared lake trout, however, recruitment of wild lake trout is not adequate to compensate fully for declines (post 2003) in hatchery-stocked lake trout (He et al. 2023). Stock assessors have cautioned management against ceasing lake trout stocking programs in Lake Huron as the food web is still undergoing dynamic change and lake trout recruitment is uncertain (He et al. 2020).

A data-limited stock assessment, utilizing statistical catch-at-age models informed by both fishery-dependent and fishery-independent data is conducted annually in 1836 Treaty-ceded waters of Lake Huron for lake trout (MH-1 and MH-2, Northern and North-central Lake Huron) (MSC 2022). In 2022, the total biomass (>3.5 million lbs) and the female spawning stock biomass (>1 million lbs) remained stable (since the mid-2000s) (see figure 12 below, ibid). Total abundance is estimated to be >800k fish (ibid). Recruitment has high interannual variability with a recent 10-year average of 242,943 age-3 fish per year (see figure 13 below, ibid). Current SSBR for MH-1 and MH2 combined is 6.70 lbs, which is above the SSBR at target mortality (1.51 lb for MH-1 and 2.02 lb for MH-2, ibid).

As the data-limited assessment conducted indicates that the stocks are above the target reference points in both management units, abundance of lake trout in 1836 Lake Huron waters is considered a low concern.

Justification:

Longitudinal year-class strength (YCS) estimates were also used to assess population abundance,

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informed by catch-at-age data from fisheries-independent surveys and fisheries monitoring data (He et al. 2023b). Reconstruction of lake trout YCS in the main basin showed similar results to the SCAA models with adult abundance increasing in the late 1990s through early 2000s, followed by decline particularly in southern Lake Huron (ibid).

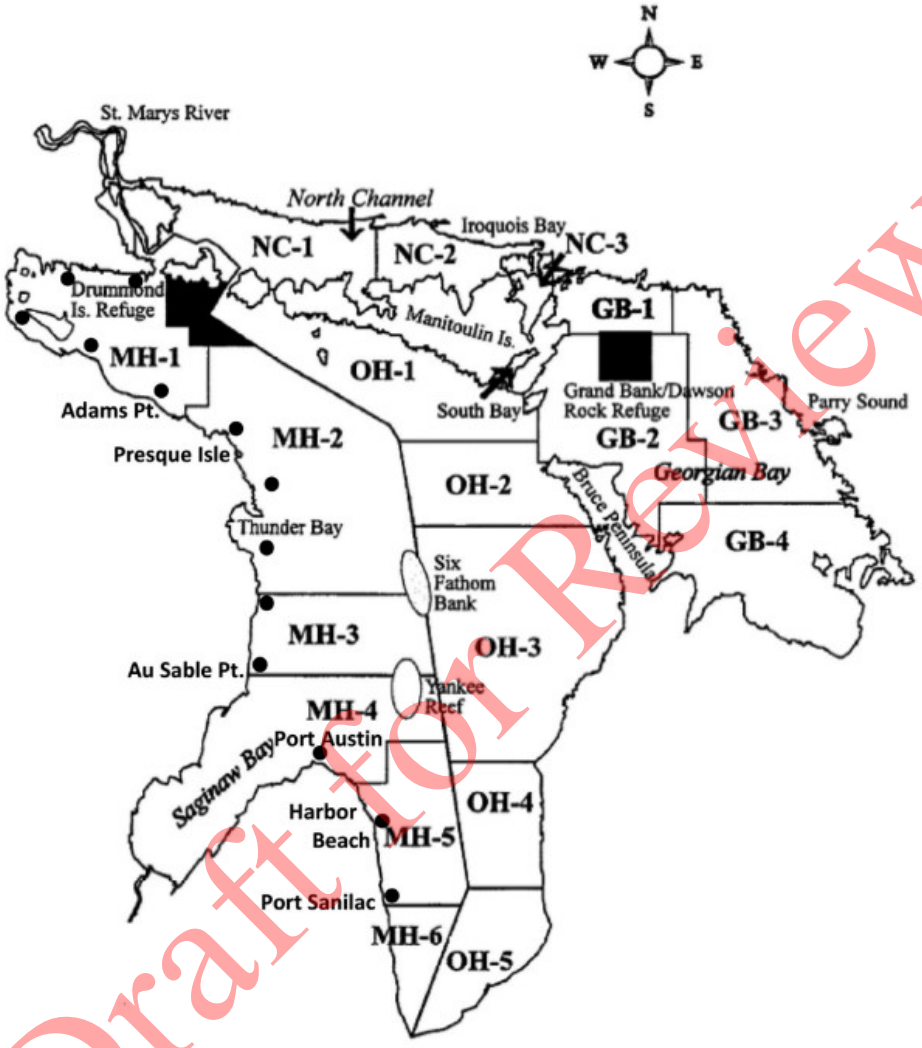

Figure 11: Statistical districts for fisheries management in Lake Huron with the boundary between statistical districts of OH-2 and OH-3, stretching across international boundary to Thunder Bay North Point, suggested to be the boundary between MH-2 and MH-3, and between northern and southern Lake Huron (He et al. 2022).

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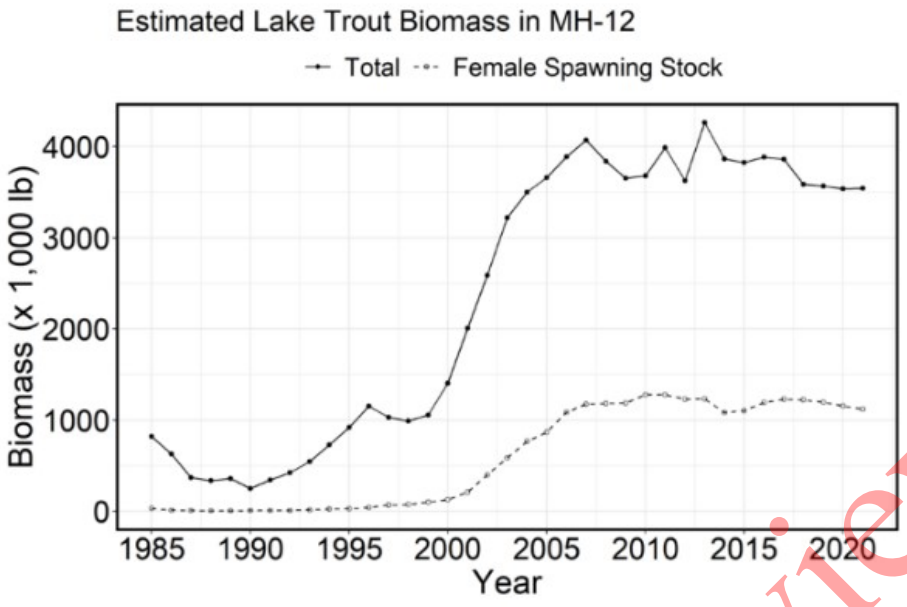

Figure 12: Lake trout biomass (both total and female) in management units MH1 & MH2 combined (MSC 2022).

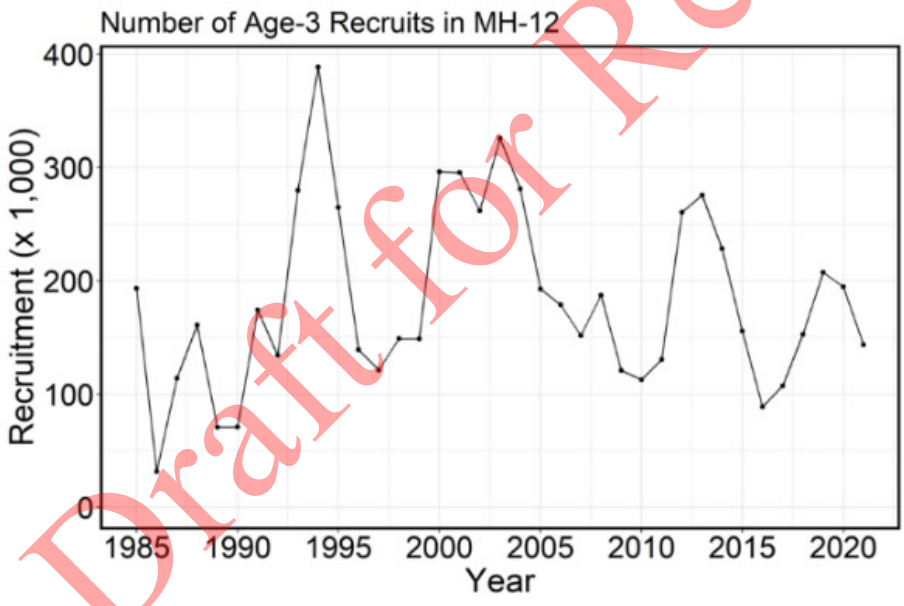

Figure 13: Lake trout age-3 recruits in MH-1 & MH-2 combined (MSC 2022).

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Factor 1.2 - Fishing Mortality

Lake Huron | America, North - Inland Waters | Canada | Ontario | Set gillnets
Lake Huron | America, North - Inland Waters | Canada | Ontario | Stationary uncovered pound nets

Moderate Concern

Commercial fishery yields from Ontario waters have ranged between ~300-550 k pounds since 2007 (GLFC 2022). The annual mortality rate has remained below the target mortality rate (where the target

annual mortality rate A = 0.45,) in Northern Lake Huron (NLH, statistical district MH-1, MH-2,OH-1 and OH-2) since the early 2000s and in Southern Lake Huron (SLH, statistical district MH-3, MH-4, MH-5, MH-6, OH-3, OH-4 & OH-5) for the past decade (see figures 14 and 15, (He 2023)(He 2023, pers comm)). The target rate however is based on an expectation of stable recruitment that is not supported by current lake trout recruitment dynamics (He et al. 2023). Despite remaining below the target, current mortality rates in the south may be unsustainable as stock biomass is decreasing in that region, suggesting a need to re-evaluate the total mortality target as a stand-alone management tool in the south (Riley and Ebner 2020). In NC the annual mortality of lake trout is just below the target reference level of 40% (see figure 17 below)(James 2024, unpublished data), whereas in GB, there is no fishing mortality estimate. The annual quotas established in Ontario waters have not been exceeded from 2006-2022 (Figure 16) (MNRF 2023). As fishing mortality is below the target reference point, but with uncertainty regarding the appropriateness of the target reference point in three of four of the management or statistical units, and fishing mortality is unknown in one management or statistical unit, and further, since it is unknown if the quotas set in Ontario waters are appropriate, this factor is considered a moderate concern.

Justification:

Total mortality was also estimated via catch curve regression informed by data on return rates of coded wire tagged lake trout (He et al. 2022). Estimates of mortality from catch curves were similar to those from the SCAA models despite having different assumptions (see figure 16, ibid).

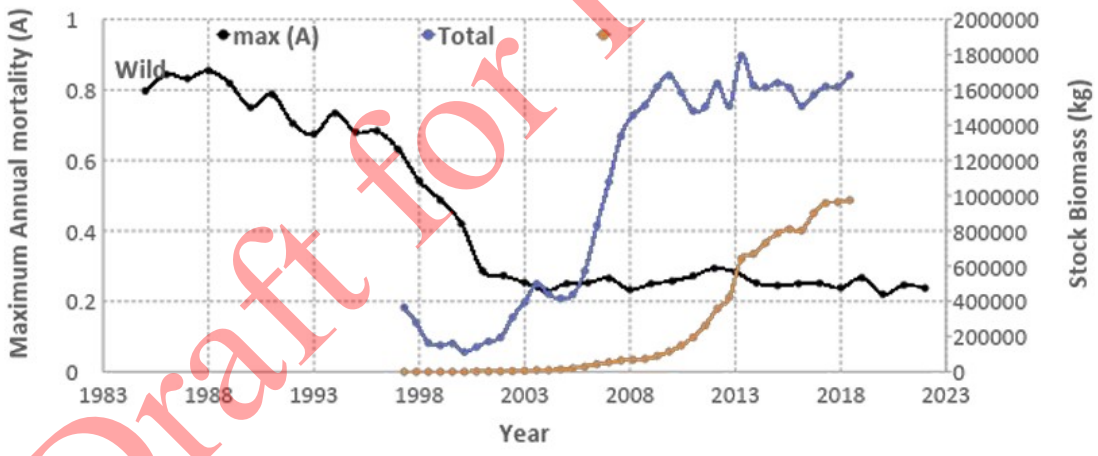

Figure 14: Lake trout annual mortality and stock biomass in Northern Lake Huron, where the black line represents maximum annual mortality (A), the blue line represents total lake trout stock biomass (in kg), and the orange line represents the total wild caught lake trout biomass (in kg) (He 2023).

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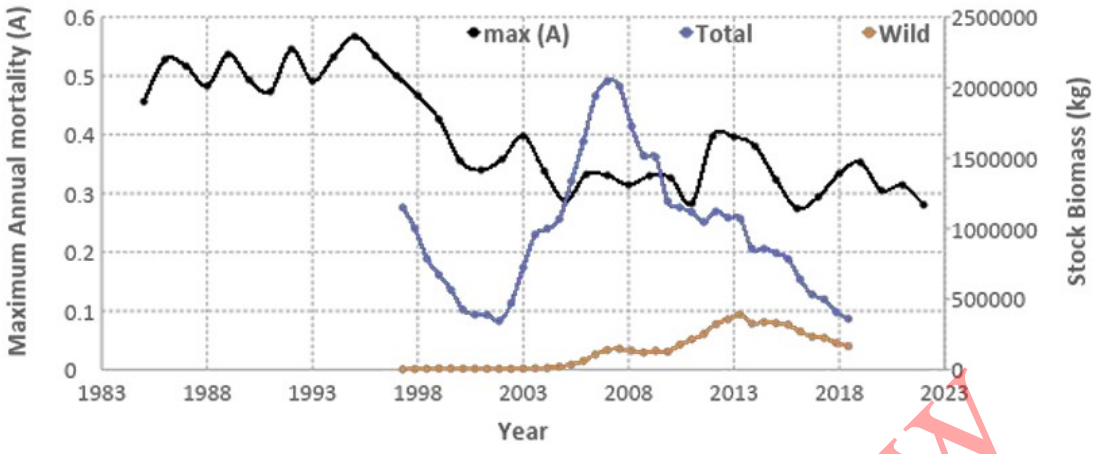

Figure 15: Lake trout annual mortality and stock biomass in Southern Lake Huron, Lake trout annual mortality and stock biomass in Northern Lake Huron, where the black line represents maximum annual mortality (A), the blue line represents total lake trout stock biomass (in kg), and the orange line represents the total wild caught lake trout biomass (in kg) (He 2023).

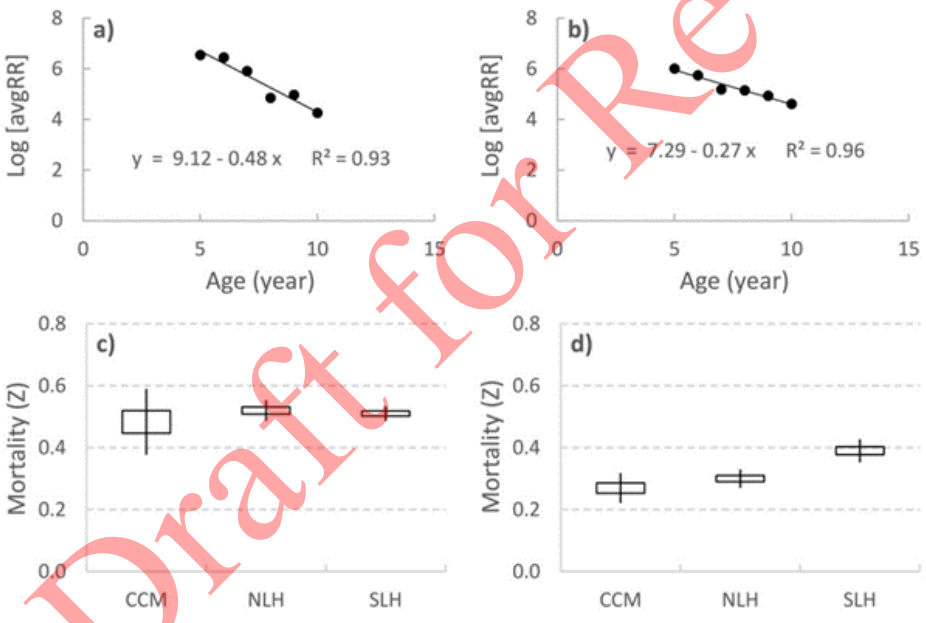

Figure 16: Catch-curve mortality based on relative return rate compared with averages of age 5-10 mortalities estimated from statistical catch-at-age assessments for lake trout in northern Lake Huron (NLH) and southern Lake Huron (SLH) (He et al. 2022). (a) The catch-curve regression for 1991-1995 year classes (b) The catch-curve regression for 1996-2009 year classes. (c) Comparisons of three mortality estimates for the late 1990s through the early 2000s. The boxes are 50% confidence intervals and the bars are 95% confidence intervals. (d) Comparisons of three mortality estimates for the post-2000 period. Boxes and bars are as for panel c.

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Figure 17: Fishing mortality in terms of annual mortality of lake trout in the NC waters of Lake Huron, with a target reference level of 40% (James 2024, unpublished data).

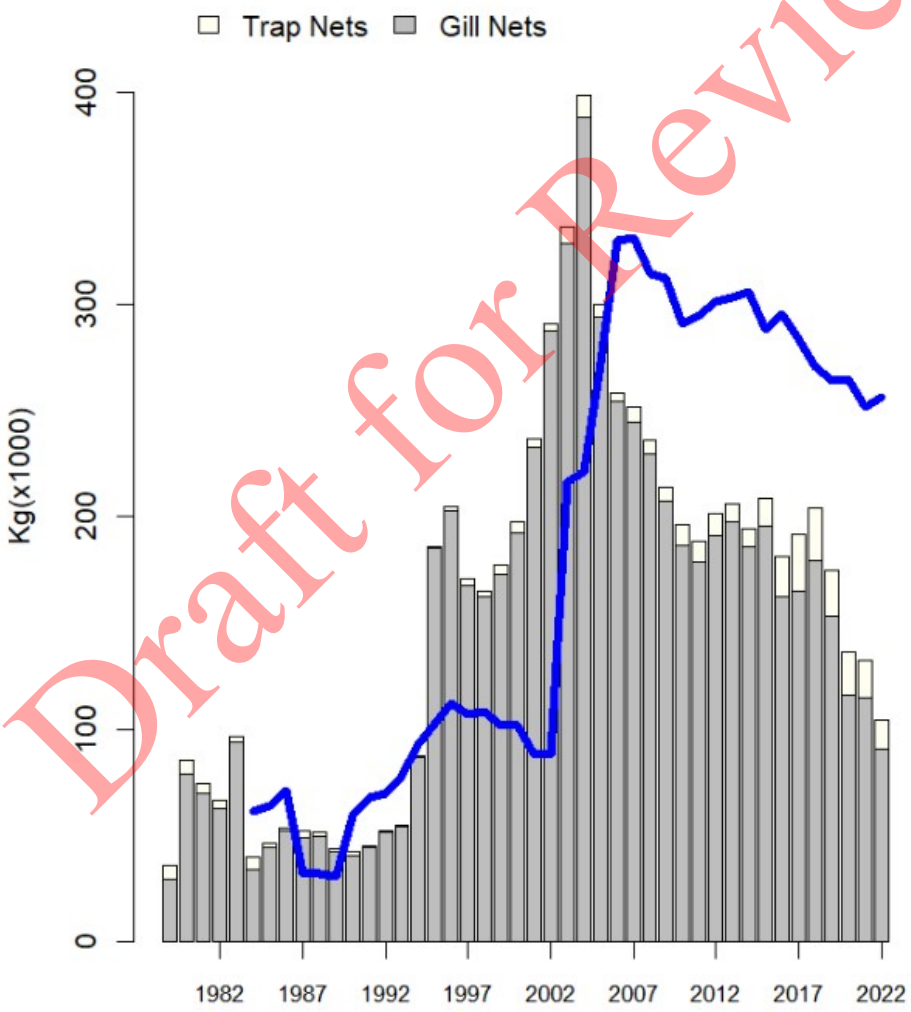

Figure 18: Lake trout quota (line) and harvest (bars) for Ontario waters of Lake Huron (MNRF 2023).

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Lake Huron | America, North - Inland Waters | United States | Michigan | Set gillnets | Tribal large mesh fishery

Moderate Concern

Commercial fishery yields from 1836 Treaty-ceded waters (MH12) have ranged between 200-300K pounds since 2007 (MSC 2022). Lake trout management includes quota control and lake trout protection zones which include no fishing and no-commercial fishing zones that cover 40% of northern Lake Huron lake trout habitat (He 2019). The 2022 data-limited stock assessment, in MH12, indicated that commercial fishing mortality (averaged from 2017 – 2019) was 0.09 y^{-1} (ibid). Maximum allowable annual mortality rate (Z = 0.27y^{-1}) remains below the management target of total annual mortality (Z (instantaneous mortality rate) = 0.5978, A (annual mortality rate) = 0.45), the target rate however is based on an expectation of stable recruitment that is not supported by current lake trout recruitment dynamics (He et al. 2023). Continued effective control of sea lamprey abundance and reduction of sea lamprey predation mortality will be critical to survival of lake trout (He et al. 2022). Nevertheless, lake trout harvests are within the specified harvest limits (see figure 19 below) (Caroffino 2024, pers comm). As fishing mortality is below the target reference point and harvests are within the harvest limits, but there is uncertainty regarding the appropriateness of the fishing mortality target reference point, this factor is considered a moderate concern.

Justification:

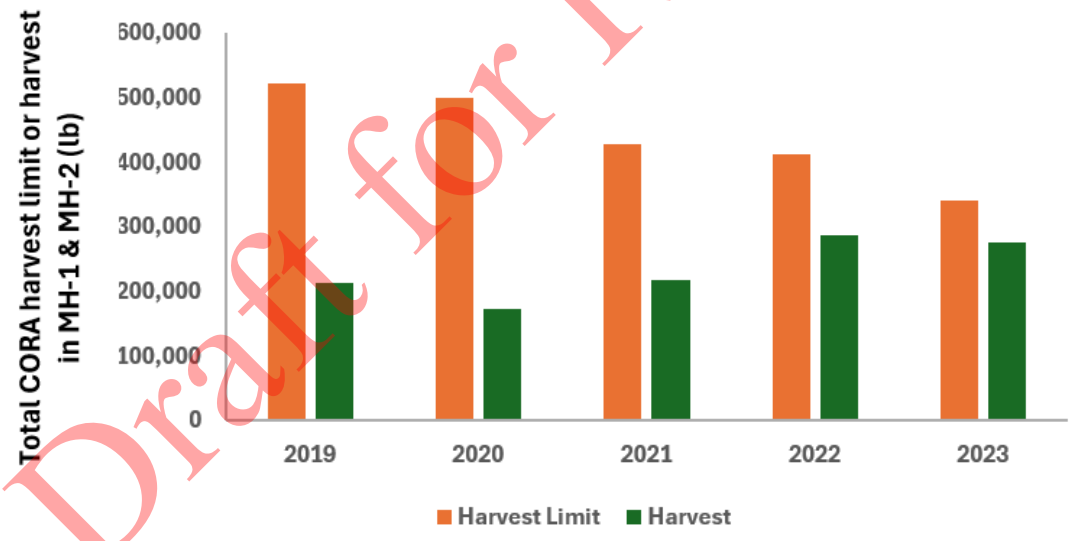

Figure 19: Total tribal harvest limits and harvests (in lb) of lake trout in 1836 Treaty Michigan waters (Caroffino 2024, pers comm).

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Lake whitefish (Coregonus clupeaformis)

Factor 1.1 - Abundance

Lake Huron | America, North - Inland Waters | Canada | Ontario | Set gillnets
Lake Huron | America, North - Inland Waters | Canada | Ontario | Stationary uncovered pound nets
Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | State Fishery

High Concern

Data-limited assessments of lake whitefish in Michigan state-licensed waters and Ontario provincial-licensed waters of Lake Huron are developed utilizing commercial fishery harvest and effort data from fishery-dependent surveys (Lenart et al. 2018). Prior to 2018, spawning stock biomass (SSB) of northern stocks (in both Michigan and Ontario) were at or near historic lows having declined since the late 2000s, while the central and southern main basins show moderate declines in the same time frame and Georgian Bay and the North Channel model estimates of SSB have been relatively stable (ibid). Recruitment estimates (based on age-5 fish) were near record lows for northern stocks, stable for central and southern main basin stocks, and stable but at low levels in Georgian Bay (ibid). Across the Ontario management units, SCAA models were conducted, and the results across all management units indicate that biomass is increasing, after having previously declined, and in 2021, recruits were higher than the recruitment target reference level (approximately 2.8 x 10^6three-year olds)(see figures below) (James 2023, pers comm)(James 2024, unpublished data), but the appropriateness of the reference level is unknown. Declining abundance was likely attributed to a multitude of factors including recruitment declines (ibid). Pre-recruit indices post-2001 in Georgian Bay and post-2003 in the central main basin were below the long term average with several year classes not observed (Riley and Ebner 2020). There are no target or limit reference points used to assess abundance in Michigan state-licensed waters and Ontario provincial-licensed waters of Lake Huron. As the data-limited assessments conducted either have no reference levels or there is uncertainty regarding the appropriateness of the recruitment reference level, a Productivity-Susceptibility Analysis was conducted (see Justification section, V = 3.44) indicating that the species is of high vulnerability; hence abundance is considered a high concern.

Justification:

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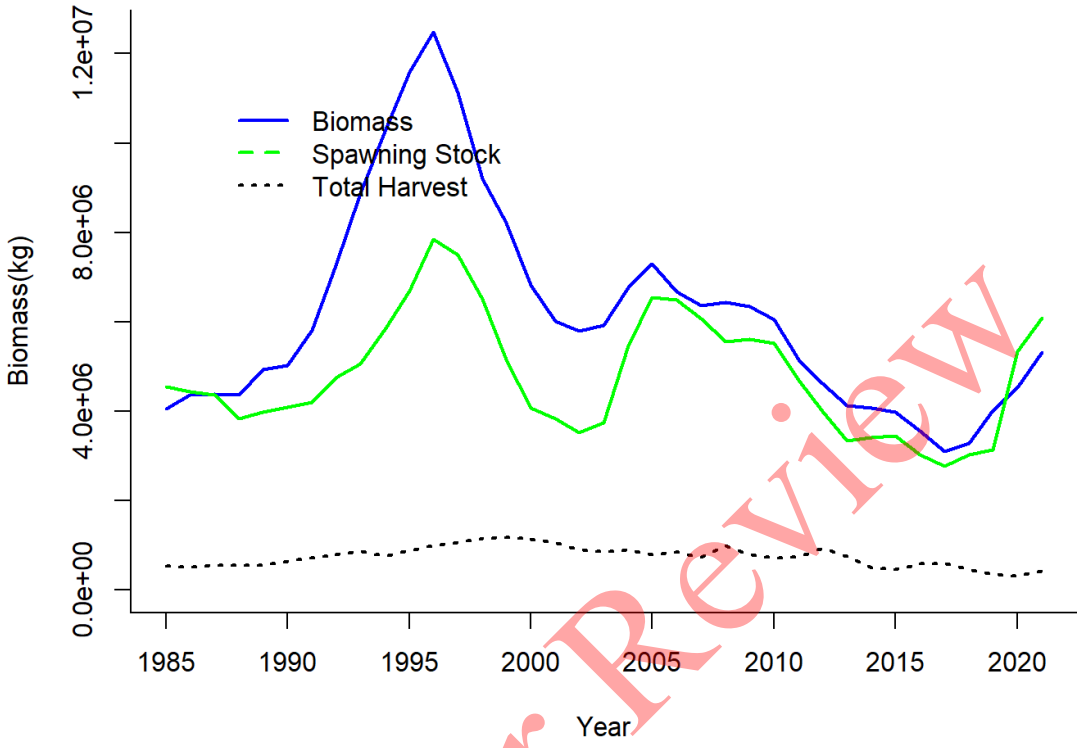

Figure 20: Lake whitefish abundance in terms of biomass (in kg) in Ontario waters of Lake Huron (James 2024, unpublished data).

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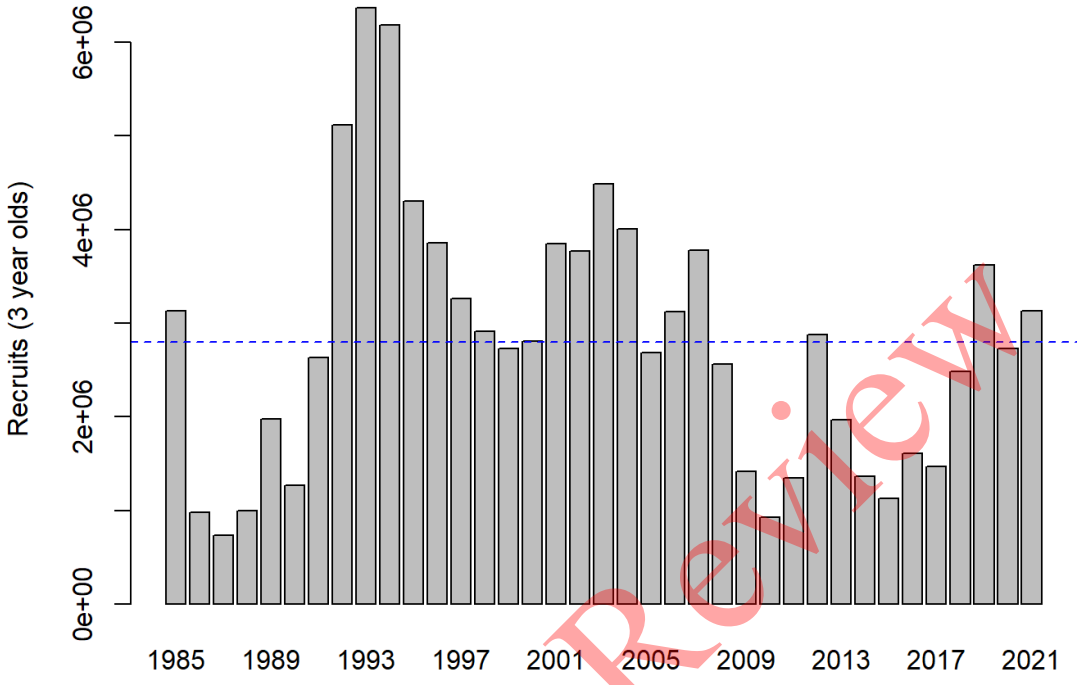

Figure 21: Abundance of lake whitefish in terms of recruits (3-year-olds) in Ontario waters of Lake Huron (James 2024, unpublished data).

Productivity-Susceptibility Analysis: This species has a high vulnerability (V = 3.44 = $\sqrt{(2^2 + 2.8^2)}$).

Table 3

Productivity	Relevant Information	Score
Average age at maturity	3-6 years	2
Von Bertalanffy Growth Coefficient (K)	0.08	3
Fecundity	6,000-120,000 eggs per year	2
Average maximum size	100 cm	2
Average size at maturity	41-54 cm	2
Reproductive Strategy	broadcast spawner	1

References for productivity table (P = 2 + 3 + 2 + 2 +2 + 1 /6) = score 2.0): (Wang et al. 2008)(Chu & Koops 2007){Froese & Pauly 2023a}.

Table 4

Susceptibility	Relevant Information	Score
Areal overlap	default score	3
Vertical overlap	default score	3
Seasonal availability	default score	3
Selectivity of fishery	default score	2
Post-capture mortality	retained species	3

References for susceptibility table (S = (3 + 3 + 3 + 3 + 3) / 5 = score 2.8)

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Lake Huron | America, North - Inland Waters | United States | Michigan | Set gillnets | Tribal large mesh fishery
Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | Tribal fishery

High Concern

Stock assessments on lake whitefish in 1836 Treaty Waters have been performed annually using SCAA models informed by tribal and state-licensed commercial fishery catch and effort data and biological sampling (Ebener et al. 2005)(Truesdell & Bence 2016). Lake whitefish biomass in 1836 Treaty Waters (WFH-01 - WFH-04, see figure 22 below for map of lake whitefish management zones) has been declining since the mid-1990s (see estimated biomass in figure 23 below) and adult abundance in 2020 (~800 k fish) is estimated to be the lowest since 1986 (currently ~10% of peak levels) (MSC 2022). The number of age-4 recruits decreased dramatically since the early 2000s but has remained stable at low levels over the last few years (150 k recruits per year) from 2019-2020 (see figure 24, ibid). Current spawning-stock biomass per recruit (SSBR, 0.84 lb) is above the SSBR at target mortality (0.36 lb, ibid). Nevertheless, the target mortality rate is non-binding on tribal fishers in 1836 waters of Lake Huron as the management units are not shared with the State (United States v. State of Michigan 2023); hence there is some uncertainty with regards to whether the modelled reference level is the actual reference level maintained in WFH-01 - WFH-04.

In Alpena, Michigan (WFH-05) the SCAA model has not been updated since 2018 (based on 2016 data) (MSC 2022). Since 2007, fishery catch per unit effort (and total catch) has reduced with low levels for catch rates and catch in recent years (see figure 25 below for yield and effort of commercial fisheries in WFH-05, ibid). Effort is underway to collect data to inform and update the 2018 SCAA model (ibid).

As there is uncertainty with the reference level in North Huron (WFH-01-WFH-04), and abundance in Alpena (WFH-05), a Productivity-Susceptibility Analysis was conducted (see Justification section, V = 3.44) indicating that the species is of high vulnerability; hence abundance is considered a high concern.

Justification:

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Figure 22: Map showing lake whitefish management units in 1836 Treaty Michigan waters in Lake Huron (MSC 2022).

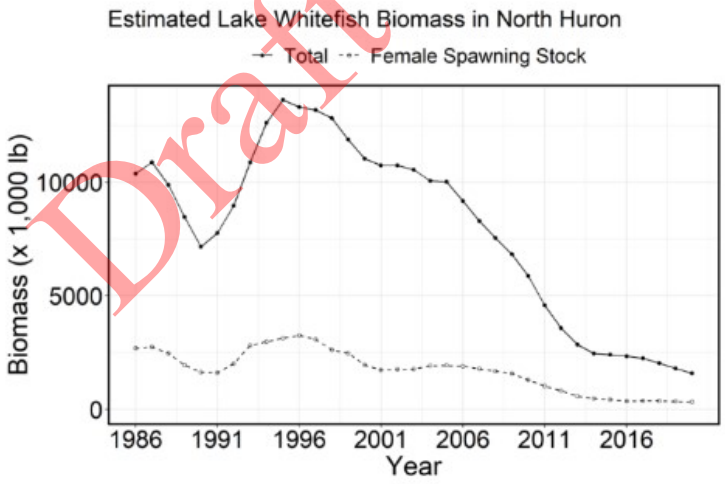

Figure 23: Estimated lake whitefish biomass in North Huron (Michigan 1836 Treaty waters, which includes WFH-01-WFH-04) (MSC 2022).

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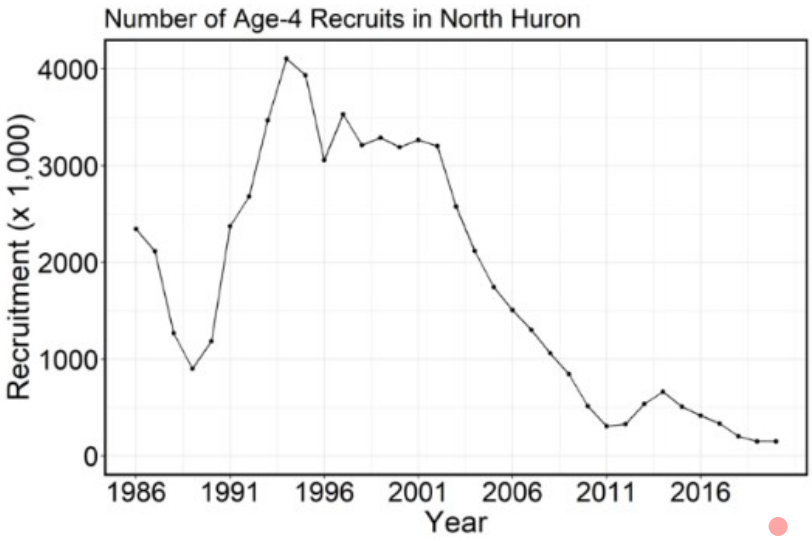

Figure 24: Number of age-4 recruits in North Lake Huron (Michigan 1836 Treaty waters, which includes WFH-01-WFH-04) (MSC 2022).

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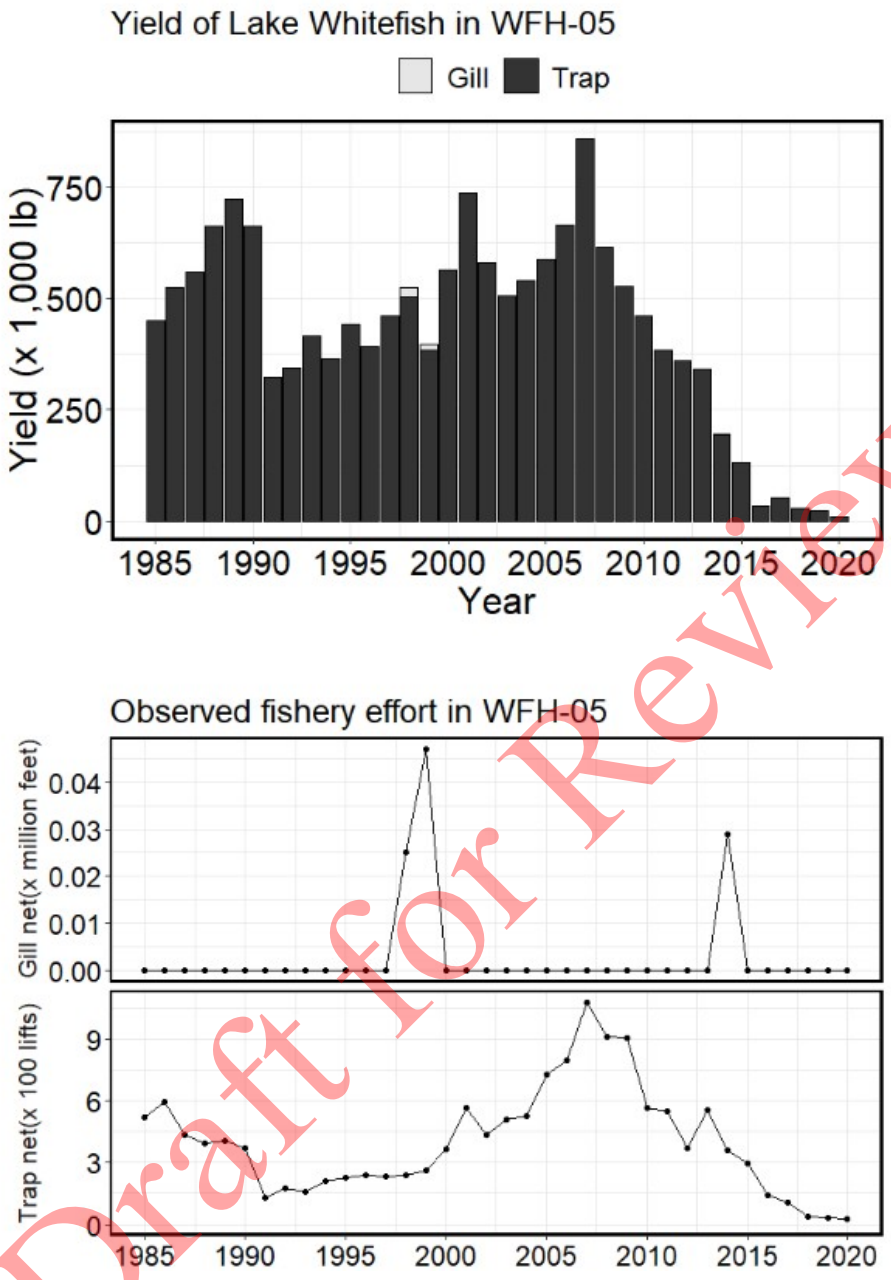

Figure 25: Commercial fishery yield and effort for lake whitefish in Alpena, Michigan (WFH-05) (MSC 2022).

Productivity-Susceptibility Analysis: This species has a high vulnerability (V = 3.44 = $\sqrt{(2^2 + 2.8^2)}$).

Table 5

Productivity	Relevant Information	Score
Average age at maturity	3-6 years	2
Von Bertalanffy Growth Coefficient (K)	0.08	3
Fecundity	6,000-120,000 eggs per year	2
Average maximum size	100 cm	2
Average size at maturity	41-54 cm	2
Reproductive Strategy	broadcast spawner	1

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References for productivity table (P = 2 + 3 + 2 + 2 +2 + 1 /6) = score 2.0): (Wang et al. 2008)(Chu & Koops 2007){Froese & Pauly 2023a}.

Table 6

Susceptibility	Relevant Information	Score
Areal overlap	default score	3
Vertical overlap	default score	3
Seasonal availability	default score	3
Selectivity of fishery	default score	2
Post-capture mortality	retained species	3

References for susceptibility table (S = (3 + 3 + 3 + 3 + 3) / 5 = score 2.8)

Factor 1.2 - Fishing Mortality

Lake Huron | America, North - Inland Waters | Canada | Ontario | Set gillnets
Lake Huron | America, North - Inland Waters | Canada | Ontario | Stationary uncovered pound nets

Moderate Concern

Fishing mortality of lake whitefish in the Ontario waters of Lake Huron is managed by setting an annual quota, made up of Individual Transferable Quotas (ITQs) that are area specific (Quota Management Areas, QMAs) (MNRF 2023). The ITQs are adjusted annually based on stock status (ibid). Quotas have been decreasing in the last decade in response to population and CPUE decline (ibid). Commercial harvest of lake whitefish across management units has been within the allotted quota from 1998 to 2022 (see figure 27, ibid), and the exploitation rate has been below the reference level of 35% (see figure 26 below)(James 2024, unpublished data). However, but the appropriateness of the quotas and the exploitation rate reference level is unknown; hence fishing mortality is considered a moderate concern.

Justification:

In Southern Lake Huron, F:M = 0.345 (James 2023, pers comm), and it is generally accepted that the target value of F/M <1 in a sustainable fishery; nevertheless, here fishing mortality has been scored based on all the management units.

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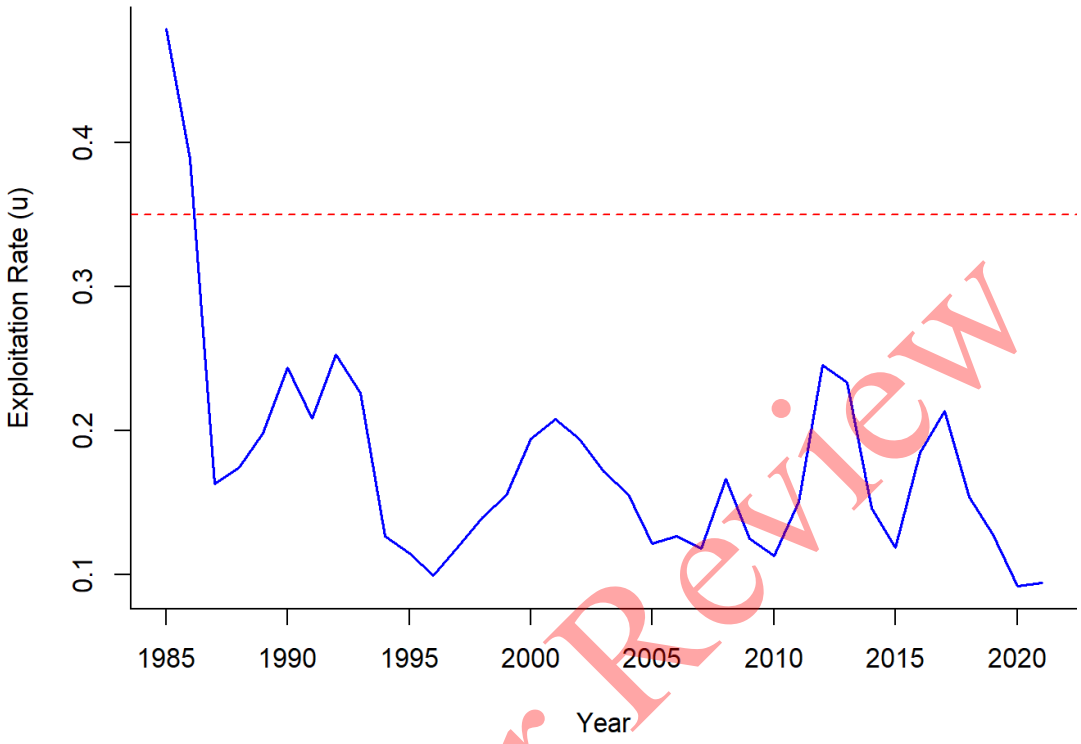

Figure 26: Fishing mortality of lake whitefish in Ontario waters of Lake Huron, in terms of exploitation rate, where the reference level is 0.35 (James 2024, unpublished data).

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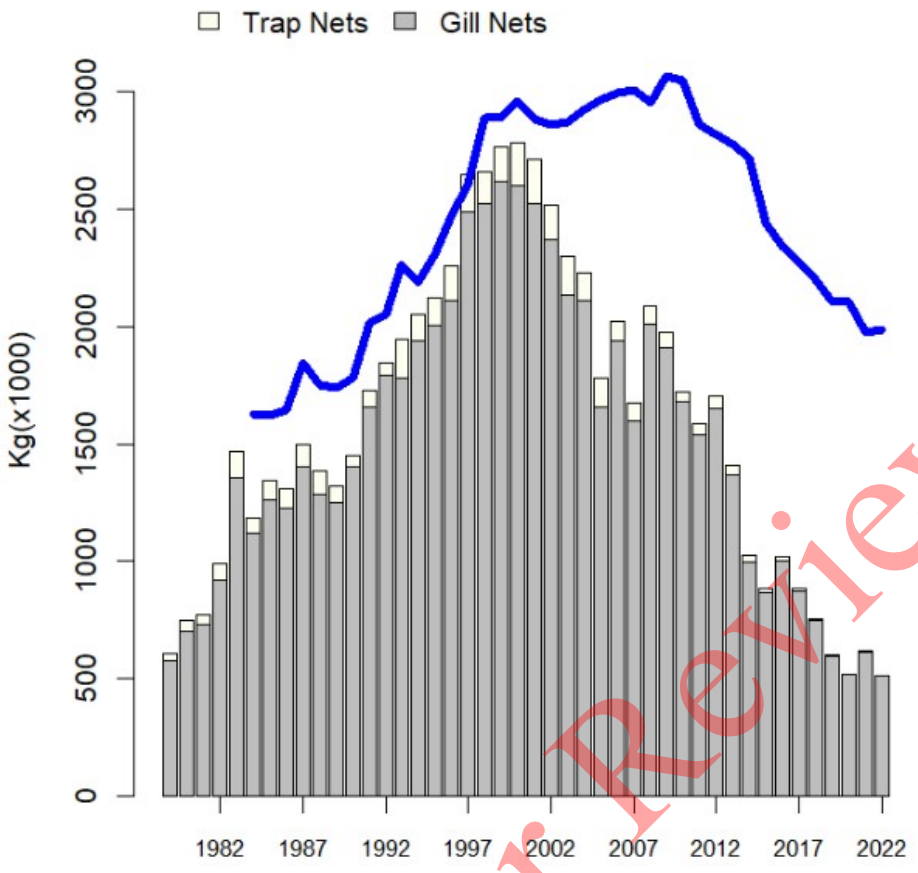

Figure 27: Lake whitefish quota (line) and harvest (bars) for Lake Huron (MNRF 2023).

Lake Huron | America, North - Inland Waters | United States | Michigan | Set gillnets | Tribal large mesh fishery
Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | Tribal fishery

Moderate Concern

Lake whitefish are harvested in Michigan waters of Lake Huron by both tribal gillnet and trap net commercial fisheries in 1836 waters. The 2022 data-limited stock assessment, of lake whitefish in 1836 Michigan waters of Lake Huron, indicated that commercial fishing mortality (averaged from 2018 – 2020, WFH-01 – WFH-04) was 0.07 y^{-1} for trap net fisheries and 0.06 y^{-1} for gill net fisheries (MSC 2022). Maximum mortality rates have declined since 2017 and remain below the management target rate of 65% annual mortality (MSC 2022). The target rate, however, which assumes constant natural mortality and is based on research from 1975 (Deroba & Bence 2012), has been questioned as an appropriate reference point in light of the changing ecosystem (Rook et al. 2022). Despite remaining well below the management target (annual average total annual mortality rate 2011-2018 = 51%) lake whitefish stocks have continued to decline (ibid). To conserve mixed-stocks, in circumstances of low productivity, a target morality rate of 35-55% has been proposed (Molton et al. 2013) (Ebner et al. 2021)(Rook et al. 2022). Under current environmental and ecological conditions even low levels of harvest are likely to have negative effects on lake whitefish stocks (ibid). In 2020, the harvest

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recommendation (304,900 lbs) was reduced relative to the previous year (512,100 lbs) based on a maximum rate of 59% at SPR 0.2 and the current model projecting recommended harvest is considered to be a more accurate reflection of current stock size and structure (MSC 2022). As fishing mortality is below the target reference point (figure 28), but with uncertainty regarding the appropriateness of the target reference point, it is considered a moderate concern.

Justification:

Following the 2023 Great Lakes Decree (USDCWM 2023), the target mortality rate for lake whitefish in the 1836 Treaty waters of Lake Huron is 55%, which has been incorporated into the 2024 quotas (Caroffino 2024, pers comm). This rate will by reviewed by the Decree parties every 6 years, and during that review each party will be able to offer their opinion on an appropriate mortality rate, along with a biological justification (ibid). As the target mortality rates were reduced in 2024, fishing mortality has been scored based on prior target mortality rates, per the rationale provided above.

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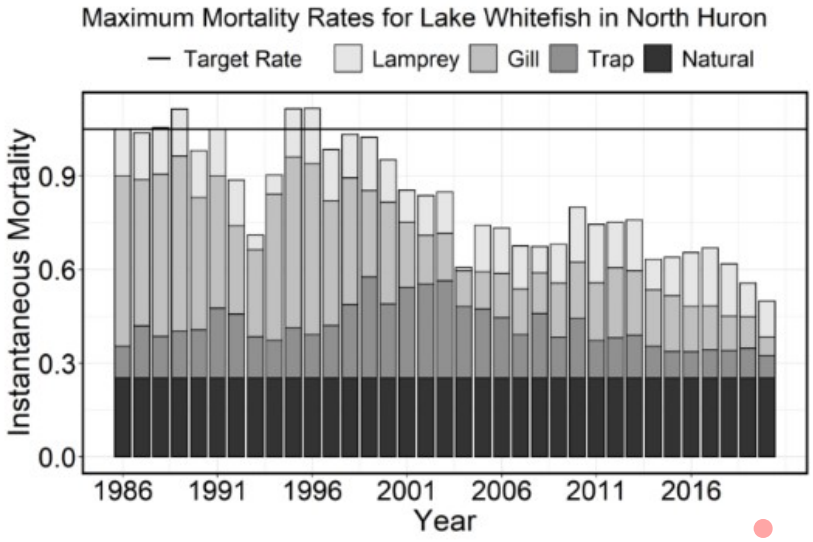

Parameter	Value
Base SSBR	2.22 lb
Current SSBR	0.84 lb
SSBR at target mortality	0.36 lb
Current SPR	0.38
M	0.25 y^{-1}
F, trap net (2018-2020)	0.07 y^{-1}
F, gill net (2018-2020)	0.06 y^{-1}
Z (2020)	0.43 y^{-1}
Sea Lamprey Mort (2018-2020)	0.08 y^{-1}
2022 Actual Harvest Limit	303,900
Model Rating	Medium

Mortality rates represent averages for Lake Whitefish ages 6-11.

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Figure 28: Lake whitefish maximum mortality rates in north Huron (1836 Michigan waters) and 2022 assessment parameters and values (MSC 2022).

Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | State Fishery

Moderate Concern

Annual commercial fisheries lake-wide yield of lake whitefish has declined since the early 2000s (see figure 29 below) (Riley and Ebner 2020). The decline is in part due to reduced abundance from substantial declines in recruitment and in part due to reduced fisheries' effort for gillnet and trap net fisheries (ibid). A recent analysis of fishing mortality using a linear mixed model for catch-curve

regression, and catch- at-age data collected from 2005-2023 estimated instantaneous total mortality to range from 0.21-0.31, which is considered as low, compared to other estimates (He et al. in review). Nevertheless, as fishing mortality relative to limit reference points for lake whitefish are unknown in the Michigan state-licensed fishery of Lake Huron, it is considered a moderate concern.

Justification:

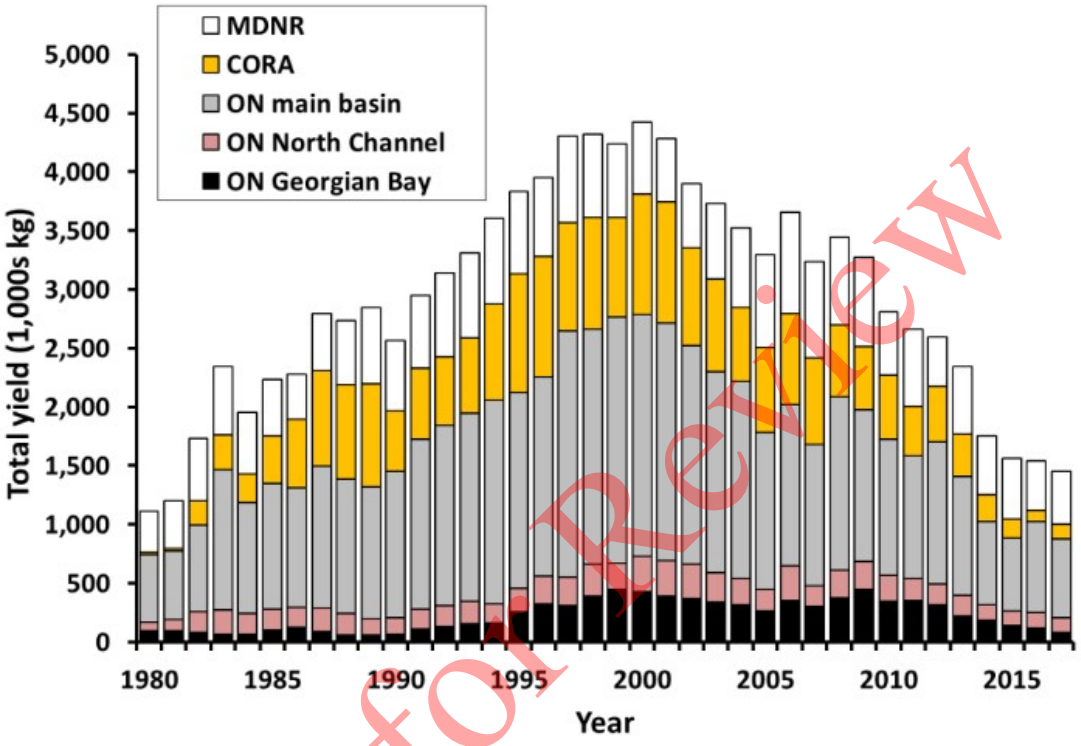

Figure 29: Total annual commercial yield of Lake Whitefish reported by each management agency in the three basins of Lake Huron during 1980-2017 {Riley & Ebner 2020}. MDNR is the Michigan DNR, CORA is the Chippewa Ottawa Resource Authority, and ON is the Ontario Ministry of Natural Resources and Forestry (ibid).

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Walleye (Sander vitreus)

Factor 1.1 - Abundance

Lake Huron | America, North - Inland Waters | Canada | Ontario | Set gillnets
Lake Huron | America, North - Inland Waters | Canada | Ontario | Stationary uncovered pound nets
Lake Huron | America, North - Inland Waters | United States | Michigan | Set gillnets | Tribal large mesh fishery

Moderate Concern

Data-limited assessments of walleye stocks are performed routinely in Ontario and Michigan waters of Lake Huron, where several walleye populations (>37) are most likely natal to their spawning tributaries

although spawning structure is uncertain (Fielder et al. 2010). Despite localized production in various tributaries, it is believed that the Saginaw Bay stock of walleyes is the principal source stock for main basin fisheries in the Michigan waters of Lake Huron and the Ontario waters of the southern main basin (Fielder and Bence 2014) (Hayden et al. 2014). Since the collapse of the invasive alewife in Lake Huron in 2003, reproductive success of walleye (as indicated by age-0 fall catch rate in a trawling survey) in Saginaw Bay has increased over 2000% (from 1986-2002 vs- 2003-2011) (Fielder and Thomas 2014). The Saginaw Bay walleye population formally attained its recovery targets in 2009 (Fielder and Baker 2004)(Fielder and Thomas 2014). In 2023, the Saginaw Bay walleye population was assessed with a SCAA model and was estimated to number over 12 million age-2 and older fish (Fielder 2024, pers comm). Outside of Saginaw Bay, including most of the walleye reproductive stocks of Georgina Bay and North Channel, populations are considered depressed (due to invasive species, river barriers, habitat degradation, and overfishing) (Fielder et al. 2010). In Ontario waters, recruitment of walleye is considered poor relative to other Great Lakes and max age and diversity of age are lower than the other lakes (ibid). Historically larger populations in Georgian Bay and the North Channel are currently in poor condition with low density, intermittent and sparse recruitment and not many older fish (ibid). In the Southern Main Basin the long-term average is considered stable (ibid).

In general, many of the walleye populations or source stocks in Lake Huron are under studied, and management is premised on data-limited assessments, with no limit and target reference points for abundance. Hence a PSA was performed indicating that the species has medium vulnerability (V = 3.10; see Justification section), and abundance is considered a moderate concern.

Justification:
In Ontario waters, data to support estimations of population abundance are gathered from assessment surveys including the Spring Walleye Index Netting (SWIN), End of Spring Trap Netting (ESTN), Broad-scale Monitoring (BsM) of Nearshore Assessment Zones through multi-mesh summer gillnetting and Fall Walleye Index Netting (FWIN) surveys (Davis 2023).

In Michigan waters, the Saginaw Bay walleye population is the subject of an annual trawling and gillnet fishery-independent netting survey conducted annually since 1971 (Fielder 2024, pers comm). Additionally, the SCAA model is informed by fishery reporting for extractions in the Ontario southern main basin waters gillnet and trap net fisheries, tribal fisheries in northern Lake Huron and creel surveys of the recreational fisheries in the bay and the Michigan waters of the main basin (ibid). The walleye population of the St. Marys River (the connecting channel between Lakes Superior and Huron) is believed sizable and may be an additional source population (ibid). It is assessed by a joint international netting survey and creel survey every five years (Chong et al. 2015).

Productivity Susceptibility Analysis of walleye in Lake Huron:

Table 7

Productivity Attribute	**Relevant Information**	**Score (1= high productivity, 2= medium productivity, 3= low productivity)**
Average age at maturity	3-5 years (Fielder and Thomas 2006)	1

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Von Bertalanffy growth coefficient (K)	K = 0.4 (0.23-.55 specific to Lake Huron) {Froese & Pauly 2023d}	1
Fecundity	22 k – 615 k {Froese & Pauly 2023d}	1
Average maximum size	Lmax = 107 cm TL {Froese & Pauly 2023d}	2
Average size at maturity	Lm = 42.5 cm {Froese & Pauly 2023d}	2
Reproductive strategy	Broadcast spawner	1
Productivity score (P)		1.333

Table 8

Susceptibility Attribute	Relevant Information	Score (1= high susceptibility, 2= medium susceptibility, 3= high susceptibility)
Areal overlap	default score used	3
Vertical overlap	default score used	3
Seasonal availability	default score used	3
Selectivity of the fishery	default score used	2
post-capture mortality	retained species so default score used	3
Susceptibility score (S)		2.8

Vulnerability=$\sqrt{\square\square^2 + \square\square^2}$

$= \sqrt{1.333^2 + 2.8^2}$

$= 3.10$

Factor 1.2 - Fishing Mortality

Lake Huron | America, North - Inland Waters | Canada | Ontario | Set gillnets
Lake Huron | America, North - Inland Waters | Canada | Ontario | Stationary uncovered pound nets

Moderate Concern

The Saginaw Bay stock of walleyes in Lake Huron, considered the single largest source supplying most of the main basin, has averaged a total annual mortality rate of 33% (age 4+) since attaining recovery targets in 2009 (see figure 30 below)(Fielder 2024, unpublished data). The rate has fallen further in recent years as the population continues to expand. The majority of the total annual mortality is from the recreational fishery, and the fishing mortality for the overall population in each commercial fishery is believed low. Nevertheless, there are no biological reference levels set for fishing mortality.

In Ontario waters, most walleye commercial harvest is from the Southern Main Basin (80%, 166 k lbs in 2020), followed by the North Channel (17%, 35 k lbs in 2020) and Georgian Bay (3%, 6 k lbs in 2020, (GLFC 2022)). Harvest is from mixed-stocks with uncertain origins (Fielder et al. 2010). Several of the potential single stocks, which could contribute to fishery harvest, have the potential to be overexploited (ibid). Walleye harvest has not exceeded the quota in Ontario commercial fisheries since the quotas were established in the 1980s (see figure 31) (MNRF 2023). Nevertheless, as there is uncertainty regarding the appropriateness of the quotas, and there is no reference level set for total annual mortality of the Saginaw Bay stock, fishing mortality is considered a moderate concern.

Justification:

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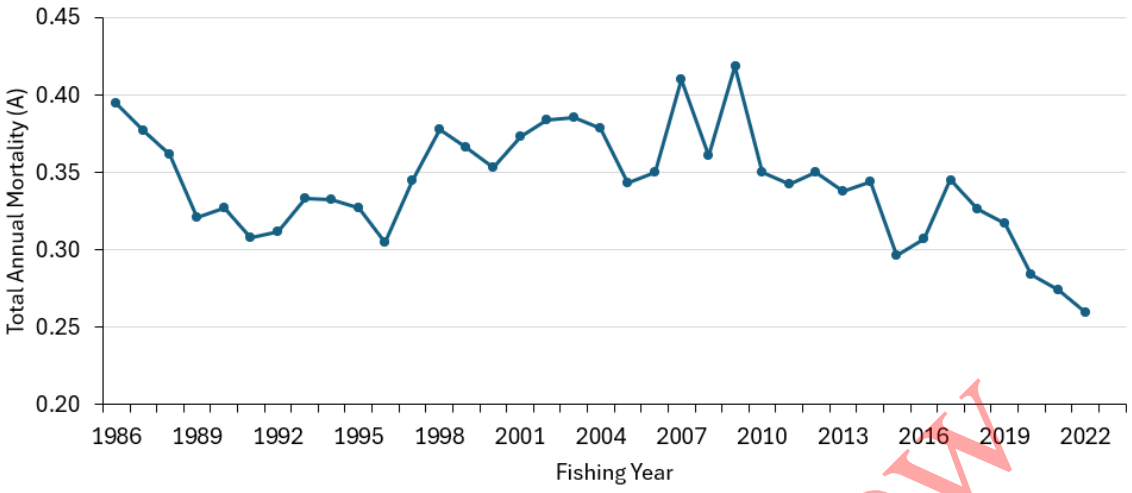

Figure 30: Total annual mortality of walleye in Lake Huron (Fielder 2024, unpublished data).

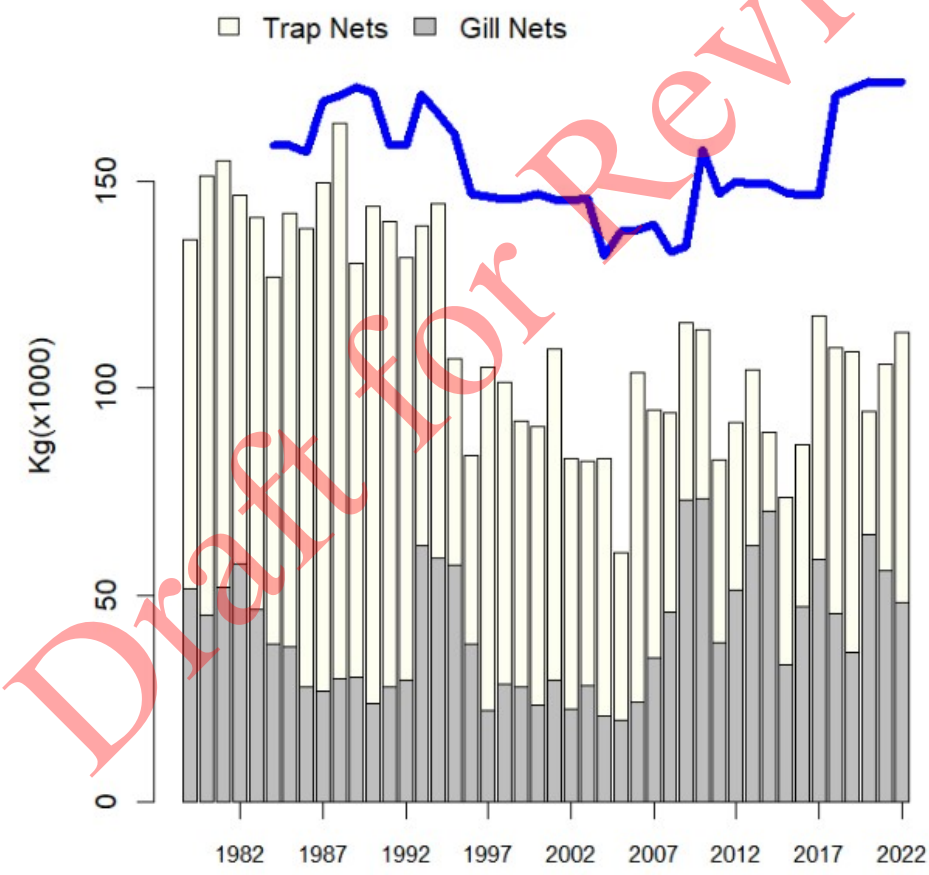

Figure 31: Walleye quota (line) and harvest (bars) for Ontario waters of Lake Huron (MNRF 2023).

Lake Huron | America, North - Inland Waters | United States | Michigan | Set gillnets | Tribal large mesh fishery

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Moderate Concern

Commercial walleye harvest in the Michigan waters of Lake Huron is prohibited by state-licensed fisheries and taken solely by tribal fisheries (Herbst et al. 2021). Harvest is from mixed-stocks with uncertain origins (Fielder et al. 2010). Several of the potential single stocks, which could contribute to fishery harvest, have the potential to be overexploited (ibid). Nevertheless, previous research has indicated that most of the walleyes in the 1836 Treaty waters of northern Lake Huron likely emanate from the Saginaw Bay stocks that make seasonal migrations to that region during the open water months (Fielder and Bence 2014)(Hayden et al. 2014). Consequently it is unclear how to measure potential quotas, and there has been no attempt to manage the stock by allocation of the Saginaw Bay stock of walleyes (Fielder 2024, pers comm). Hence, as fishing mortality is unknown, this factor is considered a moderate concern.

Yellow perch (Perca flavescens)

Factor 1.1 - Abundance

Lake Huron | America, North - Inland Waters | Canada | Ontario | Set gillnets
Lake Huron | America, North - Inland Waters | Canada | Ontario | Stationary uncovered pound nets
Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | State Fishery

High Concern

There is no quantitative stock assessment for yellow perch, however, stock health is assessed through examining trends in abundance using fishery-dependent data as well as fishery-independent data in both Canadian and US waters of Lake Huron (Fielder et al. 2020)(United States v. State of Michigan 2023). Historically, the largest population of yellow perch in Lake Huron was in Saginaw Bay, Michigan but abundance has been low since the 1990s (Fielder et al. 2020). Yellow perch abundance is monitored by the fishery-independent Saginaw Bay fish community assessment (est. 1971) which performs annual gillnetting and trawling surveys in September to evaluate population diversity and abundance (Fielder et al. 2022). Abundance of yellow perch in recent years remains low and, although reproductive success was high, population growth is limited by low recruitment due to high annual natural mortality (averaging 76%, primarily due to walleye predation) between age 0 and 1 (ibid). Mean age-specific CPUE for age >1 has been low since 2003 when the non-native alewife populations collapsed (see figure 32 below, ibid). Alewives were believed to have previously provided a predation buffer on yellow perch and likely the native cisco (also extirpated from Saginaw Bay) played that same buffer role historically (ibid). Fisheries catch has also declined with a 96% decline in harvest of recreational fisheries in 2017 relative to 1987 and a 82% in decline in commercial yield when comparing post 2003 yields to the 1972-1984 average (ibid).

In Ontario, based on catch in small-fish surveys in 2017, yellow perch relative abundance declined in the main basin and Georgian Bay but was relatively stable in the North Channel (Fielder et al. 2020). Yellow perch (primarily juveniles and young adults) was the most frequently caught species in walleye index netting surveys in 2017 in Georgian Bay and the North Channel (ibid). There are no abundance reference points relative to these surveys for yellow perch.

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Yellow perch yield (averaging 0.18 million kg annual harvest lake-wide from 2010-2020, (GLFC 2022)) remains below the Fisheries Community Objective for yellow perch (est. 1995), a yield-based reference point (to maintain yellow perch as the dominant nearshore omnivore while sustaining a harvestable annual surplus of 0.5 million kg, (Fielder et al. 2020)) considered a measure of stock productivity and sustainable harvest, but there are no appropriate biological reference points to directly assess yellow perch abundance (DesJardine 1995)(Fielder et al. 2020). As an appropriate reference point has not been established and yellow perch have high vulnerability (V = 3.26, see PSA below) abundance is considered a high concern.

Justification:

Survey year	Age 0	1	2	3	4	5	6	7	8	9	10	All ages	Age 1 and older
1986	117.6	132.8	125.9	128.4	21.2	3.0	0.7	0.5	0.0	0.0	0.0	530.0	412.4
1987	258.0	61.0	98.6	66.8	37.6	6.6	1.8	0.4	0.0	0.0	0.0	530.9	272.9
1988	458.9	263.8	248.6	309.4	171.6	56.8	13.5	1.7	0.9	0.0	0.0	1,525.3	1,066.4
1989	280.2	168.7	180.3	128.0	81.1	33.3	12.9	4.4	0.3	0.3	0.0	889.6	609.4
1990	34.0	37.8	20.2	20.5	12.6	6.1	2.8	0.9	0.3	0.1	0.1	135.3	101.3
1991	102.6	15.6	29.3	19.2	13.5	8.6	2.5	0.4	0.0	0.0	0.0	191.8	89.1
1992	7.7	44.5	8.5	6.6	4.0	2.5	0.7	0.3	0.0	0.0	0.0	74.9	67.2
1993	0.5	2.2	20.7	7.6	4.4	1.9	0.3	0.1	0.2	0.0	0.0	37.8	37.3
1994	3.5	1.4	2.8	10.1	2.5	1.0	0.2	0.1	0.0	0.0	0.0	21.7	18.2
1995	100.6	12.0	2.6	3.5	5.2	1.1	0.6	0.1	0.1	0.0	0.0	125.8	25.2
1996	37.9	30.9	5.9	3.7	2.7	3.2	0.8	0.0	0.0	0.0	0.0	85.0	47.1
1997	89.1	11.3	16.9	2.9	0.5	0.5	0.4	0.2	0.0	0.0	0.0	122.0	32.8
1998	74.4	54.1	11.7	6.6	1.7	0.4	0.3	0.1	0.0	0.0	0.0	149.2	74.8
1999	19.5	28.1	25.3	10.7	4.7	1.2	0.2	0.2	0.0	0.0	0.0	89.7	70.3
2000	9.4	4.0	11.6	8.3	4.3	1.0	0.5	0.2	0.0	0.0	0.0	39.2	29.8
2001	134.0	3.2	3.8	11.3	4.2	0.7	0.1	0.1	0.0	0.0	0.0	157.2	23.3
2002	36.7	28.1	1.1	1.6	2.0	0.5	0.2	0.1	0.0	0.0	0.0	70.3	33.6
2003	2,450.3	4.6	11.1	1.1	0.5	0.8	0.3	0.1	0.0	0.0	0.0	2,468.7	18.4
2004	461.8	22.9	2.0	2.8	0.5	0.4	0.3	0.0	0.0	0.1	0.0	490.7	28.9
2005	233.7	20.7	5.7	0.5	0.2	0.1	0.0	0.0	0.0	0.0	0.0	260.8	27.2
2006	84.9	6.5	3.0	1.6	0.2	0.1	0.1	0.0	0.0	0.0	0.0	96.4	11.4
2007	89.8	6.1	1.5	1.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	98.9	9.1
2008	214.4	20.1	1.0	0.5	0.1	0.2	0.0	0.0	0.0	0.0	0.0	236.2	21.8
2009	313.9	25.9	1.4	0.5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	341.8	27.8
2010	203.0	30.8	1.7	0.7	0.1	0.1	0.0	0.0	0.0	0.0	0.0	236.2	33.2
2011	153.3	46.3	4.2	0.5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	204.3	51.0
2012	118.0	17.5	6.7	0.7	0.2	0.0	0.0	0.0	0.0	0.0	0.0	143.0	25.0
2013	155.0	7.5	1.5	0.7	0.1	0.1	0.0	0.0	0.0	0.0	0.0	164.9	9.9
2014	50.8	20.1	2.0	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	73.3	22.5
2015	160.5	33.7	2.1	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	196.8	36.3
2016	116.4	28.0	5.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	149.7	33.3
2017	158.2	19.3	8.5	1.7	0.2	0.0	0.0	0.0	0.0	0.0	0.0	187.9	29.7
Grand mean													
All years	210.3	37.8	27.2	23.7	11.8	4.1	1.2	0.3	0.1	0.0	0.0	316.4	106.1
2012–2017	126.5	21.0	4.3	0.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	152.6	26.1
2003–2017[a]	330.9	20.7	3.8	0.9	0.2	0.1	0.0	0.0	0.0	0.0	0.0	356.6	25.7

[a] Post-Alewife crash

Figure 32: Mean catch per unit effort (number of fish per 10-minute tow), by age, of yellow perch collected from fall trawl samples in Saginaw Bay, 1986–2017 (Fielder et al. 2022). Grand means are provided for the entire time series, the current reporting period (2012–2017) and the post-Alewife collapse period (2003–2017) (ibid).

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Productivity-Susceptibility Analysis: This species has a high vulnerability (V = 3.26 = $\sqrt{(1.67^2 + 2.8^2)}$).

Table 9

Productivity	Relevant Information	Score
Average age at maturity	1-2 yrs	1
Von Bertalanffy (Brody) Growth Coefficient (K)	.1-1.1	3
Fecundity	3,000 - 61,000 eggs	2
Average maximum size	50 cm	1
Average size at maturity	19.2 cm	1
Reproductive Strategy	Nonobligatory plant spawner	2

P = (1 + 3 + 2 + 1 + 1 + 2) / 6 = 1.67. References for productivity table: {Froese & Pauly 2023e}.

Table 10

Susceptibility	Relevant Information	Score
Areal overlap	default score	3
Vertical overlap	default score	3
Seasonal availability	default score	3
Selectivity of fishery	targeted species, conditions under high risk do not apply	2
Post-capture mortality	retained species	3

S = (3 + 3 + 3 + 2 + 3) / 5 = 2.8

Factor 1.2 - Fishing Mortality

Lake Huron | America, North - Inland Waters | Canada | Ontario | Set gillnets
Lake Huron | America, North - Inland Waters | Canada | Ontario | Stationary uncovered pound nets

Moderate Concern

From 2010-2020 Ontario gillnet and trap net fisheries harvested 90% of the lake-wide yield of yellow perch (274 k lbs in 2020) with 89% harvested from Huron Proper (GLFC 2022). Yellow perch harvest has not exceeded quota in Ontario commercial fisheries since the quotas were established in the 1980s (see figure 33, (MNRF 2023)). As commercial harvest has been within the allotted quota, but the appropriateness of the quotas are uncertain, fishing mortality is considered a moderate concern.

Justification:

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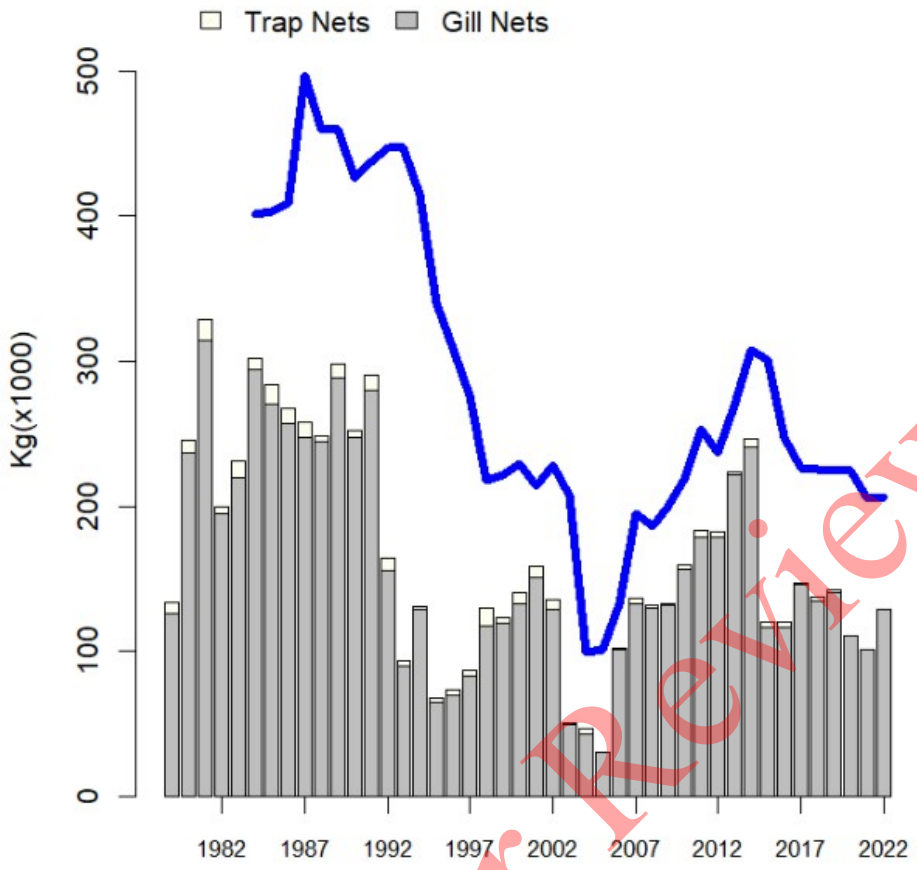

Figure 33: Yellow perch quota (line) and harvest (bars) for Ontario waters of Lake Huron (MNRF 2023).

Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | State Fishery

High Concern

From 2010-2020 Michigan state-licensed fisheries harvested 9% of the lake-wide yield of yellow perch with 27k lbs harvested in Saginaw Bay in 2020 (GLFC 2022). Both the recreational and commercial yellow perch fisheries are virtually collapsed relative to historic levels (recreational year-round harvest in 2017 at 221 k fish, a 96% decline from their high in 1987; and the commercial yield averaging 16 kg since 2003, an 82% decline from the 1972–1984 average) (Fielder et al. 2022). The decline is most likely due to poor early life survival (age-0 and age-1) caused by walleye and cormorant predation (Fielder et al. 2014). There are no quotas for yellow perch for Michigan state-licensed commercial fisheries, but a newly developed recreational fishery management plan for the Saginaw Bay population of yellow perch has been developed and adopted (Jolley et al. 2024), including one reference point for commercial yield in the bay (ibid). Presently the reference point is not being achieved, due to the depressed status of the yellow perch population, and recruitment overfishing is taking place (Fielder 2024, pers comm). Since recruitment overfishing is occurring, fishing mortality is considered as a high concern.

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Criterion 2: Impacts on Other Species

All main retained and bycatch species in the fishery are evaluated under Criterion 2. 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. Species are evaluated using the same guidelines as in Criterion 1. When information on other species caught in the fishery is unavailable, the fishery's potential impacts on other species is scored according to the Unknown Bycatch Matrices, which are based on a synthesis of peer-reviewed literature and expert opinion on the bycatch impacts of each gear type. The fishery is also scored for the amount of non-retained catch (discards) and bait use relative to the retained catch. To determine the final Criterion 2 score, the score for the lowest scoring retained/bycatch species is multiplied by the discard/bait 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 is Critical if Factor 2.3 (Fishing Mortality) is Crtitical

Guiding principles

- *Ensure all affected stocks are healthy and abundant.*
- *Fish all affected stocks at sustainable level.*
- *Minimize bycatch.*

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Criterion 2 Summary

Criterion 2 score(s) overview

This table(s) provides an overview of the Criterion 2 subscore, discards+bait modifier, and final Criterion 2 score for each fishery. A separate table is provided for each species/stock that we want an overall rating for.

LAKE TROUT			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Lake Huron | America, North - Inland Waters | Canada | Ontario | Set gillnets	1.732	1.000: < 100%	Red (1.732)
Lake Huron | America, North - Inland Waters | Canada | Ontario | Stationary uncovered pound nets	1.732	1.000: < 100%	Red (1.732)
Lake Huron | America, North - Inland Waters | United States | Michigan | Set gillnets | Tribal large mesh fishery	1.732	1.000: < 100%	Red (1.732)

LAKE WHITEFISH			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Lake Huron | America, North - Inland Waters | Canada | Ontario | Set gillnets	1.732	1.000: < 100%	Red (1.732)
Lake Huron | America, North - Inland Waters | Canada | Ontario | Stationary uncovered pound nets	2.236	1.000: < 100%	Yellow (2.236)
Lake Huron | America, North - Inland Waters | United States | Michigan | Set gillnets | Tribal large mesh fishery	2.644	1.000: < 100%	Yellow (2.644)
Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | Tribal fishery	5.000	1.000: < 100%	Green (5.000)
Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | State Fishery	2.644	1.000: < 100%	Yellow (2.644)

WALLEYE			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Lake Huron | America, North - Inland Waters | Canada | Ontario | Set gillnets	1.732	1.000: < 100%	Red (1.732)
Lake Huron | America, North - Inland Waters | Canada | Ontario | Stationary uncovered pound nets	1.732	1.000: < 100%	Red (1.732)
Lake Huron | America, North - Inland Waters | United States | Michigan | Set gillnets | Tribal large mesh fishery	1.732	1.000: < 100%	Red (1.732)

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YELLOW PERCH			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Lake Huron | America, North - Inland Waters | Canada | Ontario | Set gillnets	1.732	1.000: < 100%	Red (1.732)
Lake Huron | America, North - Inland Waters | Canada | Ontario | Stationary uncovered pound nets	1.732	1.000: < 100%	Red (1.732)
Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | State Fishery	1.732	1.000: < 100%	Red (1.732)

Criterion 2 main assessed species/stocks table(s)

This table(s) provides a list of all species/stocks included in this assessment for each 'fishery' (as defined by a region/method combination). The text following this table(s) provides an explanation of the reasons the listed species were selected for inclusion in the assessment.

LAKE HURON | AMERICA, NORTH - INLAND WATERS | CANADA | ONTARIO | SET GILLNETS			
SUB SCORE: 1.732	DISCARD RATE: 1.000	SCORE: 1.732	
SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Lake whitefish	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Yellow perch	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Lake sturgeon	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Lake trout	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Walleye	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

LAKE HURON | AMERICA, NORTH - INLAND WATERS | CANADA | ONTARIO | STATIONARY UNCOVERED POUND NETS			
SUB SCORE: 1.732	DISCARD RATE: 1.000	SCORE: 1.732	
SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Lake whitefish	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Yellow perch	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Lake sturgeon	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Lake trout	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Walleye	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

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LAKE HURON | AMERICA, NORTH - INLAND WATERS | UNITED STATES | MICHIGAN | SET GILLNETS | TRIBAL LARGE MESH FISHERY			
SUB SCORE: 1.732	DISCARD RATE: 1.000		SCORE: 1.732
SPECIES	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Lake whitefish	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Walleye	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Lake trout	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Chinook salmon	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

LAKE HURON | AMERICA, NORTH - INLAND WATERS | UNITED STATES | MICHIGAN | STATIONARY UNCOVERED POUND NETS | STATE FISHERY			
SUB SCORE: 2.644	DISCARD RATE: 1.000		SCORE: 2.644
SPECIES	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Yellow perch	1.000: High Concern	1.000: High Concern	Red (1.000)
Lake whitefish	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Lake trout	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Walleye	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)

LAKE HURON | AMERICA, NORTH - INLAND WATERS | UNITED STATES | MICHIGAN | STATIONARY UNCOVERED POUND NETS | TRIBAL FISHERY			
SUB SCORE: 5.000	DISCARD RATE: 1.000		SCORE: 5.000
SPECIES	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Lake whitefish	1.000: High Concern	3.000: Moderate Concern	Red (1.732)

Commercial fisheries that target lake trout, lake whitefish, walleye and yellow perch in Lake Huron typically catch some amounts of non-target species (GLFC 2022)(MDNR 2023b)(MDNR 2023c)(MNRF 2023).

Michigan state-licensed trap net commercial fisheries: According to 2018-2022 trap net catch composition data (MDNR 2023b), lake trout and walleye comprised >5% of the catch and hence are included as Criterion 2 species. Lake whitefish was a Criterion 1 species since it was targeted, and hence were considered as Criterion 2 species in the Michigan state trap fishery that targeted yellow perch (ibid). Small amounts of lake sturgeon were also caught in 2018 (ibid). Lake sturgeon, a state threatened species in Michigan and an endangered species in Canada, has spatial overlap to potentially interact with the assessed fisheries (Hayes and Caroffino 2012)(COSEWIC 2017) (COSSARO 2017); however, based on available data, catch of this species is negligible in the Michigan state-licensed trap fisheries, and hence was excluded as a Criterion 2 species (MDNR 2023b). Lake whitefish limits the Criterion 2 score of Michigan state licensed trap nets, because they are a highly vulnerable species and since there were no reference points for fishing mortality.

Tribal trap net and gillnet commercial fisheries: Tribal fisheries do not report discards but bycatch is

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considered low (MDNR 2023, pers comm); in particular, lake sturgeon is unlikely to be a bycatch species in tribal fisheries in 1836 Michigan waters of Lake Huron (Caroffino 2024, pers comm). Based on harvest data in large mesh gillnets, the yield of Chinook salmon, lake trout, lake whitefish and walleye were >5% the weight of total annual harvest and hence were included as species for Criterion 2 (MDNR 2023c). Both lake whitefish and walleye limit the Criterion 2 score of the tribal gillnet fishery in 1836 Michigan waters, because in the case of lake whitefish abundance is above the reference point only in one management unit, and there is uncertainty with regards to the fishing mortality reference points; in the case of walleye, there were no reference points for abundance and the species had medium vulnerability, whereas there was uncertainty in the appropriateness of the quotas set for fishing mortality. As yellow perch targeted in the small mesh tribal gillnet fishery in 1836 Michigan waters comprised only 3% of the total yellow perch production in Lake Huron, the fishery was excluded from this assessment. No species fit the criteria for inclusion for the tribal trap fishery in Michigan (ibid).

Ontario gillnet and trap net commercial fisheries: In the Ontario waters of Lake Huron, catch and harvest data were available for gillnets and trap nets separately, and included the target species i.e. lake trout, lake whitefish, walleye and yellow perch for each gear type (MNRF 2024). Other than the targeted species assessed in C1, for small-mesh and large-mesh gillnets combined, lake trout, lake whitefish and yellow perch qualified as Criterion 2 species as they comprised >5% of the catch from 2012-2022 (ibid). Lake sturgeon was also found in the catch from 2012-2022 and was added as a Criterion 2 species as it is globally and regionally categorized as Endangered by the IUCN and COSSARO respectively {Haxton & Bruch 2022} (COSSARO 2017) and the level of sustainable harvest of the species in Ontario waters is unknown. In the case of trap nets, lake whitefish, lake trout and walleye qualified as Criterion 2 species as they comprised >5% of the catch from 2012-2022 (MNRF 2024). In the Ontario trap nets as well, lake sturgeon was added as a Criterion 2 species because of its Endangered status and since it comprised >5% of the trap net catch from 2012-2012 (ibid). In the Ontario gillnet fishery, lake whitefish and yellow perch limit the Criterion 2 score, because of their high vulnerability and uncertainty of the appropriateness of their quotas, whereas lake trout limits the Criterion 2 score because <50% of the stocks are above the reference point for abundance and there is uncertainty around the appropriateness of the quotas. For similar reasons, in the Ontario trap net fishery, lake whitefish and lake trout limit the Criterion 2 score. Although we recognize that the catch composition of large and small-mesh gillnets in Ontario waters is different, the breakup of these data were not available for this assessment.

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Criterion 2 Assessment

SCORING GUIDELINES

Factor 2.1 - Abundance
(same as Factor 1.1 above)

Factor 2.2 - Fishing Mortality
(same as Factor 1.2 above)

Factor 2.3 - Modifying Factor: Discards and Bait Use
Goal: Fishery optimizes the utilization of marine and freshwater resources by minimizing post-harvest loss. For fisheries that use bait, bait is used efficiently.

Scoring Guidelines: The discard rate is the sum of all dead discards (i.e. non-retained catch) plus bait use divided by the total retained catch.

Ratio of bait + discards/landings	Factor 2.3 score
<100%	1
>=100	0.75

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Chinook salmon (Oncorhynchus tshawytscha)

Factor 2.1 - Abundance

Lake Huron | America, North - Inland Waters | United States | Michigan | Set gillnets | Tribal large mesh fishery

Very Low Concern

The state of Michigan introduced chinook salmon to Lake Huron through stocking which began in 1968 (Johnson et al. 2007). As non-native species, abundance of chinook salmon is considered a “very low concern.”

Factor 2.2 - Fishing Mortality

Lake Huron | America, North - Inland Waters | United States | Michigan | Set gillnets | Tribal large mesh fishery

Low Concern

As chinook salmon are non-native species (Johnson et al. 2007), fishing mortality is considered a "low concern."

Lake sturgeon (Acipenser fulvescens)

Factor 2.1 - Abundance

Lake Huron | America, North - Inland Waters | Canada | Ontario | Set gillnets
Lake Huron | America, North - Inland Waters | Canada | Ontario | Stationary uncovered pound nets

High Concern

According the most recent IUCN assessment, published in 2022, the lake sturgeon *Acipenser fulvescens* is globally Endangered (Haxton and Bruch 2022). Whereas the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has designated the lake sturgeon population from the Great Lakes region as “Threatened” (COSEWIC 2017), a more regional assessment of the species from Ontario by the Committee on the Status of Species at Risk in Ontario (COSSARO) indicates that the lake sturgeon population from the Great Lakes Designatable Unit has been classified as “Endangered” (COSSARO 2017). Because of these reasons, abundance is considered a “high concern.”

Factor 2.2 - Fishing Mortality

Lake Huron | America, North - Inland Waters | Canada | Ontario | Set gillnets
Lake Huron | America, North - Inland Waters | Canada | Ontario | Stationary uncovered pound nets

Low Concern

Catch composition data indicate that in 2022, 19,998 lbs of lake sturgeon were caught as bycatch (all

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commercial fisheries) in the Ontario waters of Lake Huron (MNRF 2023). None were harvested, all lake sturgeon were released or discarded (ibid). There is no information on what level of fishing mortality is sustainable for lake sturgeon in the Ontario waters of Lake Huron and on fisheries-related post-release survival of lake sturgeon from this region. Nevertheless, as post-release survival of lake sturgeon in other parts of the Great Lakes (for instance Wisconsin waters of Lake Superior) is expected to be high, fishing mortality is considered a “low concern.”

Lake trout (Salvelinus namaycush)

Factor 2.1 - Abundance

Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | State Fishery

Moderate Concern

Although lake trout is not harvested in the state licensed commercial fishery in Lake Huron, a data-limited stock assessment has been conducted in Southern Lake Huron (SLH in statistical districts MH-3, MH-4, MH-5 and MH-6 in Michigan waters, and statistical districts Quota Management Area OH-2, OH-3, OH-4 and OH-5 in Ontario waters) as shown in the map presented in figure 11 from (He et al. 2022))(He 2023, pers comm). In SLH, stock biomass has been decreasing since the early 2000s overall and although there was an increase in wild populations in 2013, they have since been decreasing (Figure 6, ibid). SLH's commercial catch has been declining since the early 2000s and coincident with older age distributions of harvest likely due to reduced recruitment and availability of younger age classes (Figure 7, ibid). Nevertheless, there are no reference points set for abundance in SLH. . Hence a PSA was conducted on lake trout to score abundance (see table below). As the PSA conducted generated a vulnerability score of 3.00 (which is considered as medium vulnerability), abundance is considered a “moderate concern.”

Justification:

Productivity-Susceptibility Analysis: This species has a medium vulnerability (V = 3.00 = $\sqrt{(1.5^2 + 2.6^2)}$).

Table 11

Productivity	Relevant Information	Score
Average age at maturity	5-6 years	2
Von Bertalanffy Growth Coefficient (K)	>0.25	1
Fecundity	approx 18,000-20,000 eggs per year	2
Average maximum size	50 cm	1
Average size at maturity	51 cm	2
Reproductive Strategy	broadcast spawners	1

References for productivity table (P = 2 + 1 + 2 + 1 +2 + 1 /6) = score 1.5): (Froese and Pauly 2023b) (Madenjian et al. 1998) (USFWS 2024).

Table 12

Susceptibility	Relevant Information	Score
Areal overlap	default score	3

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Vertical overlap	default score	3
Seasonal availability	default score	3
Selectivity of fishery	Species in incidentally caught, but is not likely to escape the gear	2
Post-capture mortality	Post-capture survival is 60.8%	2

References for susceptibility table (S = (3 + 3 + 3 + 2 + 2) / 5 =score 2.6); (MDNR 2023b)(MacMillan and Roth 2012).

Factor 2.2 - Fishing Mortality

Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | State Fishery

Moderate Concern

The annual mortality rate has remained below the target mortality rate (where the target annual mortality rate A = 0.45,) in Southern Lake Huron (SLH, statistical district MH-3, MH-4, MH-5, MH-6, OH-2, OH-3, OH-4 & OH-5) for the past decade (see figure 15, (He 2023)(He 2023, pers comm)). The target rate however is based on an expectation of stable recruitment that is not supported by current lake trout recruitment dynamics (He et al. 2023). Despite remaining below the target, current mortality rates in the south may be unsustainable as stock biomass is decreasing in that region, suggesting a need to re-evaluate the total mortality target as a stand-alone management tool in the south (Riley and Ebner 2020). Although a lake trout are caught as bycatch in state licensed commercial trap nets in Saginaw Bay, harvest of the species is not permitted in this fishery (MDNR 2023b). A study conducted in Saginaw Bay indicates that 39.2% of lake trout caught as bycatch in state licensed commercial trap nets were morbid (MacMillan and Roth 2012). As fishing mortality of lake trout is uncertain, but is expected to occur to some extent, this factor is considered a “moderate concern.”

Walleye (Sander vitreus)

Factor 2.1 - Abundance

Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | State Fishery

Low Concern

A recent data-limited stock assessment on walleye, conducted through a statistical catch at age model in Saginaw Bay of Lake Huron (where lake whitefish trap nets are set) indicates that the estimated population size of age-2 and older walleye is >10 million, which is well above the target reference level of >5 million (see figure 34) (Jolley et al. 2024). Further recruitment has recently been high, as the mean age-0 walleye catch per unit effort from bottom trawl surveys conducted in 2022 was >40/10 min tow which is well above the target reference level of >24.4/10 min tow (see figure 35) (ibid). Still further, the unfished spawning stock biomass of the population is considered to be high (ibid). Taken together, abundance of walleye in Saginaw Bay is considered a “low concern.”

Justification:

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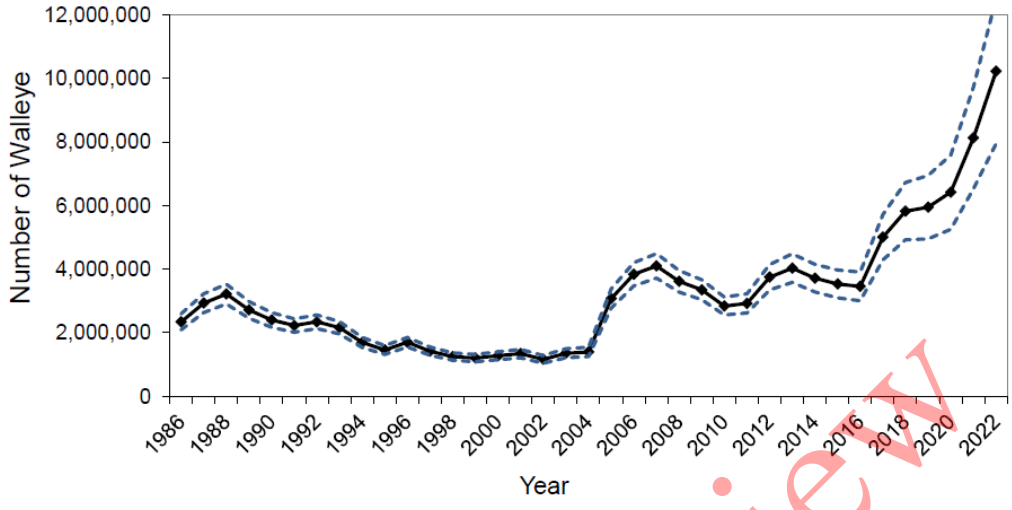

Figure 34: Estimated population (+/- 2 standard errors, dashed lines) of age-2 and older Saginaw Bay walleye, computed from the Michigan Department of Natural Resources statistical catch-at age model (Jolley et al. 2024).

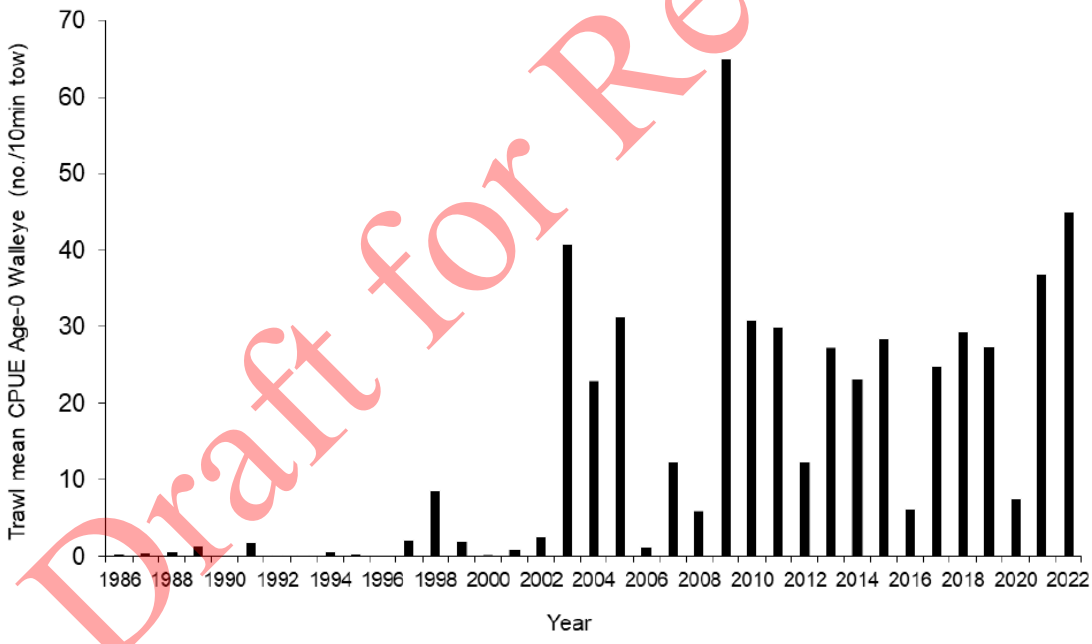

Figure 35: Abundance trends of fall young-of-the-year (age-0) walleye in Saginaw Bay in terms of mean CPUE (number/10 min tow) in bottom trawl surveys from 1986-2022 (Jolley et al. 2024).

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Factor 2.2 - Fishing Mortality

Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | State Fishery

Moderate Concern

Although a high proportion of walleye are caught as bycatch in state licensed commercial trap nets in

Saginaw Bay, harvest of the species is not permitted in this fishery (MDNR 2023b). Nevertheless, a study conducted in Saginaw Bay indicates that 42% of walleye caught as bycatch in state licensed commercial trap nets were morbid (MacMillan and Roth 2012). As fishing mortality of walleye is unknown, but is expected to occur to some extent, this factor is considered a “moderate concern.”

Factor 2.3 - Discard Rate/Landings

Lake Huron | America, North - Inland Waters | Canada | Ontario | Set gillnets
Lake Huron | America, North - Inland Waters | Canada | Ontario | Stationary uncovered pound nets

< 100%

The ratio of discards to landings (5.65%) is <100% for commercial fisheries in Ontario waters of Lake Huron (based on data from 2022, (MNRF 2023)).

Lake Huron | America, North - Inland Waters | United States | Michigan | Set gillnets | Tribal large mesh fishery
Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | Tribal fishery

< 100%

Discards are not reported in tribal fisheries but are considered minimal (MDNR 2023, pers comm).

Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | State Fishery

< 100%

The ratio of discards to landings is <100% for state-licensed trap net fisheries in Michigan waters of Lake Huron (MDNR 2023, pers comm).

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Criterion 3: Management Effectiveness

Five factors are evaluated in Criterion 3: Management Strategy and Implementation, Bycatch Strategy, Scientific Research/Monitoring, Enforcement of Regulations, and Inclusion of Stakeholders. Each is scored as either 'highly effective', 'moderately effective', 'ineffective,' or 'critical'. The final Criterion 3 score is determined as follows:

- *5 (Very Low Concern) — Meets the standards of 'highly effective' for all five factors considered.*
- *4 (Low Concern) — Meets the standards of 'highly effective' for 'management strategy and implementation' and at least 'moderately effective' for all other factors.*
- *3 (Moderate Concern) — Meets the standards for at least 'moderately effective' for all five factors.*
- *2 (High Concern) — At a minimum, meets standards for 'moderately effective' for Management Strategy and Implementation and Bycatch Strategy, but at least one other factor is rated 'ineffective.'*
- *1 (Very High Concern) — Management Strategy and Implementation and/or Bycatch Management are 'ineffective.'*
- *0 (Critical) — Management Strategy and Implementation is 'critical'.*

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 = Red or High Concern***

Rating is Critical if Management Strategy and Implementation is Critical.

Guiding principle

- The fishery is managed to sustain the long-term productivity of all impacted species.

Five factors are evaluated in Criterion 3: Management Strategy and Implementation, Bycatch Strategy, Scientific Research/Monitoring, Enforcement of Regulations, and Inclusion of Stakeholders. Each is scored as either 'highly effective', 'moderately effective', 'ineffective,' or 'critical'. The final Criterion 3 score is determined as follows:

Criterion 3 Summary

FISHERY	MANAGEMENT STRATEGY	BYCATCH STRATEGY	DATA COLLECTION AND ANALYSIS	ENFORCEMENT	INCLUSION	SCORE
Lake Huron | America, North - Inland Waters | Canada | Ontario | Set gillnets	Ineffective	Moderately Effective	Moderately Effective	Highly effective	Highly effective	**Red (1.000)**
Lake Huron | America, North - Inland Waters | Canada | Ontario | Stationary uncovered pound nets	Moderately Effective	Moderately Effective	Moderately Effective	Highly effective	Highly effective	**Yellow (3.000)**

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Lake Huron | America, North - Inland Waters | United States | Michigan | Set gillnets | Tribal large mesh fishery	Moderately Effective	Highly effective	Moderately Effective	Highly effective	Highly effective	**Yellow (3.000)**
Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | State Fishery	Ineffective	Moderately Effective	Moderately Effective	Highly effective	Highly effective	**Red (1.000)**
Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | Tribal fishery	Ineffective	Moderately Effective	Moderately Effective	Highly effective	Highly effective	**Red (1.000)**

The Great Lakes Fishery Commission (GLFC) is an inter-jurisdictional agency comprising eight Commissioners (four from Canada and four from the United States) and one U.S. Alternate Commissioner; it is the main coordinating body of fisheries management for Lake Huron (GLFC 2023a). In 1981, a Joint Strategic Plan for Management of Great Lakes Fisheries was established to facilitate working relationships among parties (GLFC 2007) (GLFC 2023a)(GLFC 2023b). This cooperative fishery management process is guided by four principles: consensus, accountability, information sharing, and ecosystem-based management (ibid). Specific to each lake, “lake committees” are established which comprise state, provincial, and U.S. tribal agencies, and are the primary management jurisdiction on each lake (ibid)(see Figure below). The purpose of the lake committees is to develop strategic management goals called Fish Community Objectives (FCO) and set cooperative harvest-levels, management plans, and rehabilitation plans (DesJardine 1995) (GLFC 2023a)(GLFC 2023b). Each lake committee is comprised of at least one technical committee which is responsible for collecting data, producing and interpreting science, and making recommendations to the lake committee (GLFC 2023a)(GLFC 2023b).

The Lake Huron Committee (LHC) comprises senior staff members from Michigan Department of Natural Resources, Ontario Ministry of Natural Resources and Forestry, and the Chippewa-Ottawa Resource Authority (GLFC 2023c). The Lake Huron Committee is responsible for (1) addressing issues that are pertinent to or have been referred by the Commission, (2) addressing issues of common concern to member management agencies, (3) developing and coordinating joint programs and research projects, and (4) serving as a platform for state, provincial, tribal and federal agencies to operate (ibid).

The Lake Huron Technical Committee (LHTC), appointed by the LHC, comprises fishery biologists from Michigan Department of Natural Resources, Ontario Ministry of Natural Resources and Forestry, the Chippewa-Ottawa Resource Authority, Fisheries and Oceans Canada, U.S. Fish and Wildlife Service, and U.S. Geological Survey (GLFC 2023c). The LHTC's purposes are to (1) provide the LHC with technical information on the status of the stocks, management alternatives and guidelines in evaluating fisheries management decisions, (2) arrange for resource persons to assist the LHC as required, (3) recommend specialized task groups to address issues outside of the scope of the LHTC, (4) advice the LHC chair of additional funding or requirements needed (ibid).

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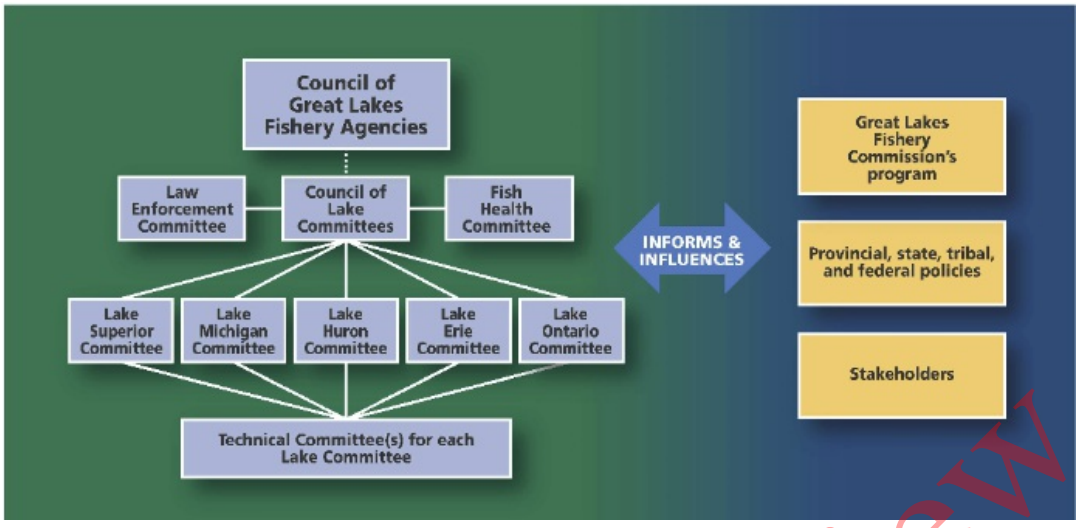

Figure 40: Organizational structure of management bodies in the Great Lakes (GLFC 2023b).

In 1836, the Ottawa and Chippewa nations of Indians ceded their territories to the United States, but reserved their rights to harvest natural resources from their lands, as documented in the 1836 Treaty and shown in the map below (US and OCI 1836) (Falck et al. 2015). As such, five tribes (the Bay Mills Indian Community, Little Traverse Bay Bands of Odawa Indians, Grand Traverse Band of Chippewa Indians, Little River Band of Odawa Indians, and the Sault Ste. Marie Tribe of Chippewa Indians) have the right to fish in 1836 Treaty-ceded-waters of Lake Huron (US and OCI 1836) (Falck et al. 2015) {United States v. Michigan 2023}.

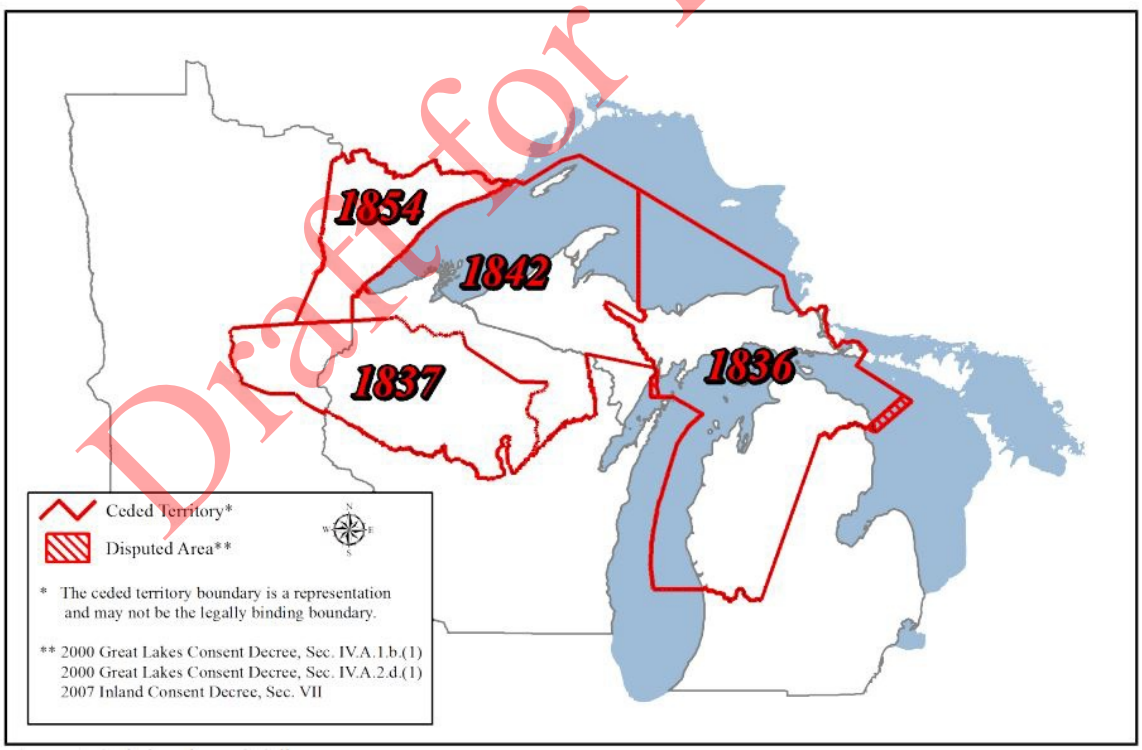

Figure 40: Organizational structure of management bodies in the Great Lakes (GLFC 2023b).

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Criterion 3 Assessment

SCORING GUIDELINES

Factor 3.1 - 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? Do manages follow scientific advice? To achieve a highly effective rating, there must be appropriately defined management goals, precautionary policies that are based on scientific advice, and evidence that the measures in place have been successful at maintaining/rebuilding species.

Factor 3.2 - Bycatch Strategy

Considerations: What type of management strategy/measures are in place to reduce the impacts of the fishery on bycatch species and when applicable, to minimize ghost fishing? How successful are these management measures? To achieve a Highly Effective rating, the fishery must have no or low bycatch, or if there are bycatch or ghost fishing concerns, there must be effective measures in place to minimize impacts.

Factor 3.3 - Scientific Research and Monitoring

Considerations: How much and what types of data are collected to evaluate the fishery's impact on the species? Is there adequate monitoring of bycatch? To achieve a Highly Effective rating, regular, robust population assessments must be conducted for target or retained species, and an adequate bycatch data collection program must be in place to ensure bycatch management goals are met.

Factor 3.4 - 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.

Factor 3.5 - 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, if high participation by all stakeholders is encouraged, and if there a mechanism to effectively address user conflicts.

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Factor 3.1 - Management Strategy And Implementation

Lake Huron | America, North - Inland Waters | Canada | Ontario | Set gillnets

Ineffective

Management in Ontario's commercial gillnet fisheries in Lake Huron is based on the following main strategies: (1) limited entry (including provincial and indigenous communal licensing), (2) annual harvest limits or quota (with Individual Transferable Quotas that are allocated to each licensed fisher or Indigenous Community for each quota managed species), and (3) daily requirements to report on effort, catch and harvest information as a licensing condition (MSC 2022)(MNRF 2023).

The Lake Huron Committee established Fish Community Objectives (FCOs) to ensure unification in inter-jurisdictional fisheries management strategy (DesJardine 1995). Progress toward FCOs is outlined in the State of Lake Huron reports and as of the most recent publication in 2020, none of the FCOs have currently been achieved for the species assessed herein under Criterion 1 (lake trout, lake whitefish, walleye, and yellow perch) {Riley & Ebner 2000}. Continued ecosystem disruptions, due in part to colonization by non-native species and to declining nutrients and lower-trophic-level productivity, are a challenge to effective fisheries management in Lake Huron (ibid). As the prospect of achieving some of the FCOs is unlikely given current ecosystem dynamics, the Lake Huron Committee considers reevaluation of the existing FCOs to be a priority (ibid).

Abundance is monitored through data-limited fisheries assessments for lake trout and lake whitefish, but there are no biologically based target or limit reference points for abundance and fishing mortality {Riley & Ebner 2020}(MSC 2022). To determine safe harvest limits in each fishery, relative abundance is monitored through a variety of fisheries surveys annually (James 2023, pers comm). The commercial harvest catch rate is measured from daily catch reporting and reported weight per kilometer of gillnet that is set (ibid). The Ontario Ministry of Natural Resourcesalso monitors relative abundance through a fishery independent fish community survey which monitors catch rate per standard index net (ibid). Trend information is primarily used for commercial fisheries management rather than establishing quantitative reference points (ibid). A Total Allowable Catch (TAC) is set (representing the total quota of all licenses in each area for each species) and is adjusted relatively based on the status of each fish stock by species and area (ibid).

Nevertheless, the main targeted and retained species in the gillnet fishery are lake trout, lake whitefish and yellow perch. In the case of lake trout, abundance in only NLH is above the reference level and no reference levels have been set for abundance of lake whitefish and yellow perch, even though these species have high vulnerability. Further, there is uncertainty with respect to the quotas set for lake trout, lake whitefish and yellow perch. Taken together, management effectiveness is unknown, and it is likely that both the gillnetfisheries are having a serious negative impact on the retained populations of lake whitefish and yellow perch (as both Criterion 1 and 2 have been scored red); therefore, management strategy and implementation is considered "ineffective."

Lake Huron | America, North - Inland Waters | Canada | Ontario | Stationary uncovered pound nets

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Moderately Effective

Management in Ontario's commercial trap fishery in Lake Huron is based on the following main strategies: (1) limited entry (including provincial and indigenous communal licensing), (2) annual harvest limits or quota (with Individual Transferable Quotas that are allocated to each licensed fisher or Indigenous Community for each quota managed species), and (3) daily requirements to report on effort, catch and harvest information as a licensing condition (MSC 2022)(MNRF 2023).

The Lake Huron Committee established Fish Community Objectives (FCOs) to ensure unification in inter-jurisdictional fisheries management strategy (DesJardine 1995). Progress toward FCOs is outlined in the State of Lake Huron reports and as of the most recent publication in 2020, none of the FCOs have currently been achieved for the species assessed herein under Criterion 1 (lake trout, lake whitefish, walleye, and yellow perch) {Riley & Ebner 2000}. Continued ecosystem disruptions, due in part to colonization by non-native species and to declining nutrients and lower-trophic-level productivity, are a challenge to effective fisheries management in Lake Huron (ibid). As the prospect of achieving some of the FCOs is unlikely given current ecosystem dynamics, the Lake Huron Committee considers reevaluation of the existing FCOs to be a priority (ibid).

Abundance is monitored through data-limited fisheries assessments for lake trout and lake whitefish, but there are no biologically based target or limit reference points for abundance and fishing mortality {Riley & Ebner 2020}(MSC 2022)(James 2024, unpublished data). To determine safe harvest limits in each fishery, relative abundance is monitored through a variety of fisheries surveys annually (James 2023, pers comm). The commercial harvest catch rate is measured from daily catch reporting and reported weight per kilometer of gillnet that is set (ibid). The Ontario Ministry of Natural Resources also monitors relative abundance through a fishery independent fish community survey which monitors catch rate per standard index net (ibid). Trend information is primarily used for commercial fisheries management rather than establishing quantitative reference points (ibid). A Total Allowable Catch (TAC) is set (representing the total quota of all licenses in each area for each species) and is adjusted relatively based on the status of each fish stock by species and area (ibid).

Nevertheless, the main targeted and retained species in the trap net fishery they are lake trout, lake whitefish, and walleye. In the case of lake trout, abundance in only NLH is above the reference level and no reference levels have been set for abundance of lake whitefish and, even though these species have high vulnerability. Further, there is uncertainty with respect to the quotas set for lake trout, lake whitefish and walleye. Taken together, management is in place, but there is a need for increased precaution; therefore, management strategy and implementation is considered "moderately effective."

Lake Huron | America, North - Inland Waters | United States | Michigan | Set gillnets | Tribal large mesh fishery

Moderately Effective

Management in tribal commercial gillnet fishery is based on the following main strategies: (1) limited entry, (2) gear restrictions (fixed allocation of gear) (3) areas closed to commercial fishing (4) seasonal closures in some regions and (5) effort-based harvest management (CORA 2022a)(CORA 2022b) (United States v. State of Michigan 2000)(United States v. State of Michigan 2023). Overall, CORA establishes, evaluates and adjusts benchmark harvest levels for fish stocks referred to as Harvest Regulation Guidelines (HRGs) which represent a sustainable annual level of harvest, in consultation

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with Tribal biologists and consultants (United States v. State of Michigan 2023). The Tribes acting through the GLRC prepare and adopt regulations governing the exercise of their Treaty fishing rights in the 1836 Treaty waters, and each tribe has a Tribal Code which may be more restrictive than the Decree (ibid). With respect to lake whitefish however, per the current Great Lakes Decree, in Lake Huron, the whitefish Management Units are not shared, and the Tribes manage their commercial lake whitefish fishery by developing and using their own HRGs; the Tribes are obliged to notify the Technical Fisheries Committee of these HRGs within two weeks of their establishment (ibid). In the tribal gillnet fishery, lake trout, lake whitefish, walleye and chinook salmon comprise the main targeted and retained species.

Harvest limits are in place for lake trout (MSC 2022). To determine harvest limits, the status of lake trout stocks across management units is regularly reviewed, to assess effectiveness of regulations and management (ibid). Reference levels for abundance and fishing mortality of lake trout have been clearly defined (ibid). Population models (SCAA) to establish and evaluate harvest limits (for both lake whitefish and lake trout) are developed by the Modeling Subcommittee of the Technical Fisheries Committee with target annual mortality rates used to calculate harvest limits reviewed at minimum every 6 years and harvest limits set for three consecutive years (MSC 2022)(CORA 2022b). Contrastingly, in the case of walleye, there are no reference levels set for abundance, the species has medium vulnerability and there is uncertainty with regards to the appropriateness of the harvest level set. With regards to chinook salmon (a non-native species), the state of Michigan began stocking in 1968 primarily for the recreational fishery (Riley and Ebner 2020). However, in Lake Huron stocking has declined by approximately 80% in 2017, when compared to the chinook salmon stocked in 1990 (ibid). Recent surveys conducted indicate that >85% of chinook salmon sampled were wild caught (ibid). Thus the species appears to be established in Lake Huron.

More than 70% of the main targeted and retained stocks in the gillnet fishery have measures in place that are expected to be effective, but there is a potential need for increased precaution (including setting appropriate fishing mortality reference levels and quotas for lake whitefish, and setting appropriate quotas and abundance reference levels for walleye caught in tribal gillnets). Further, management of chinook salmon has appropriate regulations in place, stocking is conducted by the state of Michigan, and the species is established in Lake Huron. Hence taken together, management strategy and implementation is considered as “moderately effective.”

Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | State Fishery

Ineffective

Management in the state-licensed commercial fisheries is based on the following main strategies: (1) limited entry, (2) gear restrictions (fixed allocation of number of trap nets) (3) minimum size limits for harvest, and (4) areas closed to commercial fishing (Fielder et al. 2014)(MDNR 2023a). There are no quotas in place for harvest (ibid).

The Lake Huron Committee established Fish Community Objectives (FCOs) to ensure unification in inter-jurisdictional fisheries management strategy (DesJardine 1995). Progress toward FCOs is outlined in the State of Lake Huron reports and as of the most recent publication in 2020, none of the FCOs have currently been achieved for the species assessed herein under Criterion 1 (lake trout, lake whitefish, walleye, and yellow perch){Riley & Ebner 2000}. Continued ecosystem disruptions, due in

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part to colonization by non-native species and to declining nutrients and lower-trophic-level productivity, are a challenge to effective fisheries management in Lake Huron (ibid). As the prospect of achieving some of the FCOs is unlikely given current ecosystem dynamics, the Lake Huron Committee considers reevaluation of the existing FCOs to be a priority (ibid).

Management has taken recent actions to aid in recovery of declining yellow perch populations including liberalizing walleye recreational fishery regulations to reduce age-0 and age-1 yellow perch mortality, reducing yellow perch bag limits and shifting commercial fishing licenses (Fielder et al. 2022). Reintroduction of cisco stocking (est. 2018) is also intended to promote yellow perch survival through buffering predation on yellow perch as cisco are an alternate prey for walleye (ibid). A new management plan for Saginaw Bay walleye and yellow perch fisheries has recently been completed (Jolley et al. 2024)(ibid).

Nevertheless, the main targeted and retained species in this fishery is lake whitefish, and there are are no reference points set for abundance or fishing mortality in this fishery, with no quotas in place and the species is considered to be highly vulnerable. Hence management effectiveness is unknown, and it is possible that the fishery is having a serious negative impact on the retained lake whitefish population (as Criterion 1 has been scored red); therefore, management strategy and implementation is considered “ineffective.”

Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | Tribal fishery

Ineffective

Management in tribal commercial trap net fisheries is based on the following main strategies: (1) limited entry, (2) gear restrictions (fixed allocation of gear) (3) areas closed to commercial fishing (4) seasonal closures in some regions and (5) effort-based harvest management (CORA 2022a)(CORA 2022b)(United States v. State of Michigan 2000)(United States v. State of Michigan 2023). Overall, CORA establishes, evaluates and adjusts benchmark harvest levels for fish stocks referred to as Harvest Regulation Guidelines (HRGs) which represent a sustainable annual level of harvest, in consultation with Tribal biologists and consultants (United States v. State of Michigan 2023). The Tribes acting through the GLRC prepare and adopt regulations governing the exercise of their Treaty fishing rights in the 1836 Treaty waters, and each tribe has a Tribal Code which may be more restrictive than the Decree (ibid). With respect to lake whitefish however, per the Current Great Lakes Decree, in Lake Huron, the whitefish Management Units are not shared, and the Tribes manage their commercial lake whitefish fishery by developing and using their own HRGs; the Tribes are obliged to notify the Technical Fisheries Committee of these HRGs within two weeks of their establishment (ibid). In the case of the tribal trap net fishery, lake whitefish comprises the main targeted and retained species.

Population models (SCAA) to establish and evaluate harvest limits for lake whitefish are developed by the Modeling Subcommittee of the Technical Fisheries Committee with target annual mortality rates used to calculate harvest limits reviewed at minimum every 6 years and harvest limits set for three consecutive years (MSC 2022)(CORA 2022b); however, in the case of lake whitefish in Lake Huron, these harvest limits are non-binding (United States v. State of Michigan 2023).

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Lake whitefish, which comprises the main targeted and retained stock in the trap net fishery does not have appropriate quotas or harvest limits in place based on appropriate biological reference levels, the effectiveness of the HRG is unknown, and it is likely that the fishery is having serious negative impacts on lake whitefish populations due to concerns with the status of the population. Hence, management strategy and implementation is considered as “ineffective.”

Factor 3.2 - Bycatch Strategy

Lake Huron | America, North - Inland Waters | Canada | Ontario | Set gillnets
Lake Huron | America, North - Inland Waters | Canada | Ontario | Stationary uncovered pound nets

Moderately Effective

The gillnets used are highly selective (MNRF 2024), but the trap nets used are not highly selective (ibid) per the SFW definition. Nevertheless, the trap nets do minimize bycatch to an extent because of their selectivity (ibid). Commercial fishers are required to report all their catch on a daily basis, including bycatch (MNRF 2023). The Ministry monitors all commercial fishing activities including bycatch (ibid), and there is 5% observer coverage on all commercial fishing trips (James 2023, pers comm). If the catch of target species is higher than the quota, it is released (ibid). Similarly, if nontarget species (including channel catfish, lake herring, deepwater chub, lake sturgeon, northern pike, walleye and yellow perch) are caught in gillnets and trap nets, they are required to be released; if a proportion is harvested, it is reported (MNRF 2023). Nevertheless, lake sturgeon, which is an endangered, threatened, or protected (ETP) species, is required to be released when captured, and if killed, is required to be reported (ibid); however, no post-release survival studies have been done for lake sturgeon in Ontario waters. Since lake sturgeon, an ETP species, is found in the catch in both gillnets and trap nets, and no post release survival studies are conducted on the species in Ontario waters, this factor is considered as “moderately effective.”

Lake Huron | America, North - Inland Waters | United States | Michigan | Set gillnets | Tribal large mesh fishery

Highly effective

Other species that are caught comprise approximately 2% of the landed catch (MDNR 2023c), and may or may not be retained. Bycatch is considered to be low (MDNR 2023, pers comm); species such as lake sturgeon are unlikely to be caught as bycatch in tribal fisheries in 1836 Michigan waters of Lake Huron (Caroffino 2024, pers comm). Per the Tribal Plan, the Tribes are responsible for management of species such as lake herring and yellow perch that form a small proportion of the catch, and may develop HRGs for them (BMIC, GTBOCI, LRBOI, LTBBOI and SSMTCI 2022). Also, per the Consent Decree of 2000 and the updated Great Lakes Decree of 2023, retaining >25 lb round weight of bycatch species such as muskellunge, splake, brown trout, brook trout, rainbow trout, Atlantic salmon, largemouth bass, smallmouth bass, and northern pike is prohibited (United States v. State of Michigan 2000)(United States v. State of Michigan 2023). Further, bycatch of species such as lake sturgeon, muskellunge, and any other species that is listed as “Threatened” or “Endangered” under the federal Endangered Species Act (ESA) is prohibited, and these species, if caught, must be returned

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to the water alive; or if dead, they must be turned over to the BSD tribal staff (United States v. State of Michigan 2000)(United States v. State of Michigan 2023). Taken together, the bycatch strategy of the tribal large-mesh gillnet fishery is considered “highly effective.”

Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | State Fishery

Moderately Effective

In the case of the the State licensed trap net fishery, the gear is not highly selective following the SFW definition. Lake trout and walleye comprise a major proportion of the bycatch (MDNR 2023b) and are released alive, but post release survival studies conducted suggest that 39.2% of lake trout and 42% of walleye released from trap nets were morbid (MacMillan and Roth 2012). Since walleye and lake trout are released alive to reduce bycatch, but the effectiveness of bycatch reduction measure is uncertain, bycatch strategy is considered as “moderately effective.”

Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | Tribal fishery

Moderately Effective

Tribal trap nets in 1836 Treaty waters of Michigan target and retain lake whitefish, which comprises 97.67% of the catch (MDNR 2023c). Following the 2023 Great Lakes Decree, tribal trap net fishers are now allowed to retain lake trout in some areas, but not in others (United States v. State of Michigan 2023). As bycatch data are unavailable, but it is expected that lake trout is retained as bycatch in some areas, but not in others, we assume that the gear is not highly selective, but in the absence of data, the effectiveness of the strategy of retaining lake trout from specific areas only is unknown. Hence, bycatch strategy is considered as “moderately effective.”

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Factor 3.3 - Scientific Data Collection and Analysis

Lake Huron | America, North - Inland Waters | Canada | Ontario | Set gillnets
Lake Huron | America, North - Inland Waters | Canada | Ontario | Stationary uncovered pound nets

Moderately Effective

Data-limited stock assessments of lake trout, lake whitefish, walleye and yellow perch are published by the Lake Huron Committee every five years, in the State of Lake Huron report, based on data analyses by fisheries scientists belonging to federal and state agencies (Riley and Ebner 2020). Further, the Ontario Ministry of Natural Resources (MNR) annually monitors relative abundance through a variety of fisheries assessments (James 2023, pers comm). The commercial harvest catch rate is measured from daily catch reporting and reported weight per kilometer of gillnet that is set (ibid). The commercial catch is sampled for biological data including information on size and age, growth and condition and to inform mortality estimates (ibid). The Ministry also monitors relative abundance through a fishery-independent fish community survey which monitors catch rate per standard index-net (ibid). Trend information is primarily used for commercial fisheries management rather than establishing quantitative reference points, hence stock assessments are data-limited (ibid). Bycatch is also

monitored by the MNRF through daily reporting requirements (ibid). Nevertheless, as there is no observer coverage for bycatch, no post release survival studies conducted on lake sturgeon, no evaluation of ghost fishing impacts, and stock assessments conducted are data-limited, scientific data collection and analysis is considered “moderately effective.”

Lake Huron | America, North - Inland Waters | United States | Michigan | Set gillnets | Tribal large mesh fishery
Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | Tribal fishery

Moderately Effective

Scientific data is collected to inform fisheries management and per the Decree of 2023, biological data necessary for management decisions will be collected {United States v. Michigan 2023}; this includes harvest information (from commercial fishers, subsistence fishers, recreational fishers, and wholesalers), age composition, length/weight composition, maturity/sex ratio, sea lamprey wounding (and other lamprey-related data), agency assessment indexing (such as bycatch per unit of effort), fish stocking activities and plans, and fish diet and health factors (such as disease, contaminants, and nutritional deficiencies) (e.g., thiamine)) (ibid).

The Technical Fisheries Committee utilizes results from the Modeling Subcommittee’s lake whitefish and lake trout data-limited stock assessments to inform the management strategies for the tribal gill and trap net fisheries (MSC 2022)(United States v. State of Michigan 2023). The SCAA models for lake whitefish utilize only commercial fishery-dependent information, which limits the certainty of abundance estimates due to potential mismatches between the biological stocks and the management unit boundaries (ibid). SCAA models, which typically assume a constant stock-recruit relationship, have been modified for northern Lake Huron to increase accuracy as recruitment has been variable in recent years in Lake Huron (ibid). Instead, the annual recruitment value utilized was the product of an estimated time-series average with an estimated annual deviation, with the annual deviations following a white noise pattern (ibid). Despite challenges in estimating abundance and mortality, due to frequent ecological perturbation in Lake Huron, the best available data is utilized across management units (ibid). Management adjusts annual harvest limits based on the best available information (ibid).

The SCAA model for lake trout utilizes both fishery-dependent and fishery-independent information (MSC 2022). All relevant sources of fishing mortality are incorporated into the assessment including recreational, commercial, natural, and sea lamprey mortality (ibid). Lake trout assessments are supported by well-established agency survey indices (ibid). Recommendations for total annual harvest limits are adjusted based on the best available information.

There is no quantitative stock assessment for yellow perch, however, stock health is assessed by examining trends in abundance using fishery-dependent data as well as fishery-independent data in US waters of Lake Huron {Riley & Ebner 2020}.

Data-limited assessments of walleye stocks, informed by fisheries-independent assessment surveys, are performed routinely in Michigan waters of Lake Huron (Fielder et al. 2010). Although bycatch is not reported for the tribal fisheries it is considered minimal {DNR 2023, personal communication}.

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As stock assessments are data-limited, there is a lack of observer coverage or video monitoring to ensure that goals are being met for both bycatch and retained species, and a lack of data on ghost fishing impacts by the fishery, scientific data collection and analysis is considered “moderately effective" for the tribal commercial gill net and trap net fisheries.

Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | State Fishery

Moderately Effective

Commercial fisheries harvest is monitored through direct reports to MDNR by commercial fishermen (Fielder et al. 2014). Data-limited stock assessments are conducted by MDNR on lake whitefish (He et al. in review). Management adjusts annual harvest limits based on the best available information (ibid). For the Michigan lake whitefish state-licensed fishery, bycatch is monitored through discard reporting to the management agency {Goniea 2023, pers comm}, however, there is a lack of observer coverage and a lack of monitoring ghost fishing impacts. There is no quantitative stock assessment for yellow perch, however, stock health is assessed by examining trends in abundance using fishery-dependent data as well as fishery-independent data in US waters of Lake Huron (Fielder et al. 2020). The Saginaw Bay fish community assessment (est. 1971) monitors fish diversity and abundance through annual trawling and gillnetting surveys each September (Fielder et al. 2022).

As some data related to stock abundance and health are collected and analyzed, but data are not sufficient to meet the “highly effective” category (e.g. not including fishery-independent information and uncertainty in monitoring and stock boundaries, there is a lack of observer coverage, and a lack of ghost fishing monitoring), scientific data collection and analysis is considered “moderately effective" for the lake whitefish and yellow perch Michigan state-licensed trap net fisheries.

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Factor 3.4 - Enforcement of and Compliance with Management Regulations

Lake Huron | America, North - Inland Waters | Canada | Ontario | Set gillnets
Lake Huron | America, North - Inland Waters | Canada | Ontario | Stationary uncovered pound nets

Highly effective

The Great Lakes Law Enforcement Committee, comprises one member from each resource agency with enforcement responsibility (including eight U.S. states, three U.S. intertribal agencies, one Canadian province, one Canadian federal agency, and two U.S. federal agencies) (GLFC 2014) (GLFC 2022b)(GLFC 2023f). The Committee's mission is to "protect, enhance and promote the safe and wise use of natural resources in the Great Lakes", and it serves as an intermediary between fishery managers and law enforcement agencies (ibid). As such, the Committee is responsible for: (1) maintaining each jurisdiction's interests in cooperative fishery enforcement activities and decisions, (2) sharing law enforcement information, (3) supporting investigations across jurisdictional lines, (4) developing consistent regulations and penalties among jurisdictions, (5) providing leadership in resolving important enforcement issues to deter illegal activities, (6) developing strategies to communicate law enforcement issues effectively with resource users, (7) providing assistance by

organizing training sessions for Great Lakes officers on specific topics (8) providing guidance to any subcommittees that it appoints, (9) drafting recommendations for consideration by the Council of Lake Committees on policies required to reduce and prevent illegal commercialization in the Great Lakes region, and (10) advising the Council of Lake Committees on matters pertaining to effective law enforcement in the Great Lakes region (ibid).

The *Fish and Wildlife Conservation Act, 1997* (FWCA) provides the MNR with the ability to issue licenses for the purposes of the *Ontario Fishery Regulations, 2007* (CanLII 2023). Penalties are levied on any person who commits an offence and contravenes any provision of this Act (ibid). Commercial fishing licenses in Ontario include many conditions that must be followed including daily catch records of which species were caught, how many were caught, and other specific information related to each net set in the lake (James 2023, pers comm). Fishers are therefore compelled to voluntarily report on catch information as a condition to their license, but inspections are also conducted by the MNR (ibid). On-board observers are present on 5% of all commercial fishing trips and audits are routinely conducted; thus enforcement is active and non-compliance is not tolerated (ibid). MNR also has adequate capacity for enforcement compared to the scale of the fishery (ibid). As enforcement is in place, and is considered effective, this factor is considered as "highly effective."

Lake Huron | America, North - Inland Waters | United States | Michigan | Set gillnets | Tribal large mesh fishery
Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | Tribal fishery
Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | State Fishery

Highly effective

The Great Lakes Law Enforcement Committee was created by the Great Lakes Fishery Commission through the multi-jurisdictional Joint Strategic Plan for Management of Great Lakes Fisheries to protect, enhance, and promote the safe and wise use of natural resources in the Great Lakes (GLFC 2014) (GLFC 2022b) (GLFC 2023f) (GLFC 2023g). The Law Enforcement Committee is comprised of members from all representative state, tribal, and provincial agencies, and serves as a channel between law enforcement agencies and their respective fishery managers (ibid). The Law Enforcement Committee is responsible for a range of issues such as supporting investigations that cross jurisdictional lines, developing consistent regulations and commensurate penalties among jurisdictions, providing necessary leadership to bring resolution to law enforcement issues, providing annual basin updates, and organizing training sessions for Great Lakes officers on everything from invasive species identification to information sharing (ibid). Great Lakes officers, who work through the Law Enforcement Committee, engage in covert operations to protect resources from illegal harvest, invasive species, and other threats (ibid). Tribal, federal, and state law enforcement and conservation officers undergo and utilize various techniques to enforce regulations such as advanced surveillance, forensic fish analysis, joint patrols, tip lines, and stake-outs (GLFC 2014) (GLFC 2022b) (GLFC 2023f) (CORA 2019) {CORA 2023} (MDNR 2019) (MDNR 2020). Commercial fishing vessels can be boarded for harvest and gear inspection (ibid). Portside inspections are used to enforce regulations such as minimum fish sizes, retention of prohibited species, and gear restrictions (ibid). Deployed gear is randomly inspected to examine gear placement, mesh size, and markings (ibid). As regulations are independently verified with the capacity to control and report compliance at a scale appropriate for the fisheries, enforcement and compliance with management regulations is considered

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"highly effective."

Factor 3.5 - Stakeholder Inclusion

Lake Huron | America, North - Inland Waters | Canada | Ontario | Set gillnets
Lake Huron | America, North - Inland Waters | Canada | Ontario | Stationary uncovered pound nets

Highly effective

Through the Joint Strategic Plan, which promotes cooperation, stakeholder inclusion and consensus at a higher level (See C3 summary for details), the MNRF is bound to seven other Great Lakes states, CORA, GLIFWC, the 1854 Treaty Authority, the US Fish and Wildlife Service, USGS, ONMR, DFO Canada and to a protocol for coordinating mutual activities and conflict resolution (GLFC 2007). In particular, bi-national commitments play an important role in the decision-making process used to manage Ontario's fisheries in shared waters between Canada and the United States (MNRF 2011). The Ministry is also committed to fulfilling its constitutional obligations with respect to Aboriginal and Treaty rights including obligations to consult and accommodate First Nations people where required (ibid). As such, the Ministry has a focus on building partnerships, creating Fisheries Management Zone Councils, encouraging community-based stewardship programs and having agreements with Aboriginal communities (ibid). The Ministry is also obliged to consider all sources of traditional knowledge in fisheries resource management decisions, and to collaborate with fishers, Aboriginal communities, academic institutions, and other government agencies in the fisheries assessments and development of appropriate management options (ibid). Similarly in its objective to provide sustainable economic development, the Ministry collaborates with commercial fishers and other interested parties in developing environmental policies and best practices, in developing more efficient and effective licensing and administration of commercial fisheries, while affording appropriate priority allocations where Aboriginal or Treaty rights exist (ibid). To ensure that commercial fisheries contribute to the social and cultural welfare of all the people of Ontario, the needs and interests of all commercial fisheries and fish resources are balanced, such that Aboriginal and Treaty rights are respected (ibid). Further, commercial fishing policies and strategic documents are made available to the public and information on the state of commercially harvested fish resources is readily provided to the people of Ontario (ibid). As all major user groups are involved in management, there appears to be high participation with a constructive relationship between all stakeholders and high transparency in the decision-making process, stakeholder inclusion is considered "highly effective."

Lake Huron | America, North - Inland Waters | United States | Michigan | Set gillnets | Tribal large mesh fishery
Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | Tribal fishery

Highly effective

The GLFC includes stakeholder input in the development of legislation, harvest restrictions, and enforcement regulations (GLFC 2007)(GLFC 2023a) (GLFC 2023d) (GLFC 2023e). The GLFC holds annual meetings where the public can learn about and discuss developments in the Great Lakes

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fishery (GLFC 2023e). Each lake has a representative committee required to make regular reports to the Council of Lake Committees (GLFC 2007) (GLFC 2023a). These reports generate the development of new legislation, which is made public and local, state, provincial, tribal, and federal agencies are invited to submit comments and suggestions (ibid). The lake committees additionally hold annual meetings that are open to the public to review progress toward fishery objectives, as well as a common session to discuss topics of interest to the entire basin (GLFC 2023e). Further, the State established the “Tribal Co-Management Citizen's Fishery Advisory Committee." This group was created in 2024 to promote transparency and dialogue related to State-Tribal co-management issues across Michigan - one of those includes the commercial fishery within the 1836 Treaty waters of Lake Huron (MDNR 2024b).

One of the main goals of the tribes is to maintain and build upon cooperative intergovernmental structures and activities (CORA 2022b). To that end, the Tribes, through CORA, actively participate in all information sharing and consultation entities (ibid). Additionally, CORA and MDNR are integral members of the Lake Huron Committee and the Lake Huron Technical Fisheries Committee (CORA 2022b)(United States v. State of Michigan 2023). Further, the 2023 Great Lakes Decree establishes a mechanism to effectively address user conflicts and encourages high participation in the assessment and management process (United States v. State of Michigan 2023).

As the management process is transparent and includes stakeholder input from major user groups, provides forums to address conflict, and encourages participation in the assessment and management process, with a constructive relationship between management, scientists, and fishers, stakeholder inclusion is considered “highly effective.”

Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | State Fishery

Highly effective

The GLFC includes stakeholder input in the development of legislation, harvest restrictions, and enforcement regulations (GLFC 2007) (GLFC 2023a) (GLFC 2023d) (GLFC 2023e). The GLFC holds annual meetings where the public can learn about and discuss developments in the Great Lakes fishery (GLFC 2023e). Each lake has a representative committee required to make regular reports to the Council of Lake Committees (GLFC 2007) (GLFC 2023a). These reports generate the development of new legislation, which is made public and local, state, provincial, tribal, and federal agencies are invited to submit comments and suggestions (ibid). The lake committees additionally hold annual meetings that are open to the public to review progress toward fishery objectives, as well as a common session to discuss topics of interest to the entire basin (GLFC 2023e). The Lake Huron Committee is made up of members from MNRF, MDNR and CORA, whereas the Lake Huron Technical Committee and Task Groups are comprised of fishery biologists from MDNR, MNRF, CORA, DFO, USWFS and USGS (GLFC 2024). The 2023 Great Lakes Decree establishes a mechanism to effectively address user conflicts and encourages high participation in the assessment and management process (United States v. State of Michigan 2023).

Specific to MDNR Fisheries Division, transparency, collaboration, and communication in decision making are core values of the department (MDNR 2023d). The Lake Huron Citizens Fishery Advisory Committee reviews and provides recommendations and directions into fishery goals, objectives and management plans of MDNR in Lake Huron; committee members are comprised of diverse

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stakeholders with various interests in Lake Huron (MDNR 2024). Meeting details (including the date, time and agenda) are posted on the MDNR website to encourage participation (ibid).

As the management process is transparent and includes stakeholder input from major user groups, provides forums to address conflict, and encourages participation in the assessment and management process, with a constructive relationship between management, scientists, and fishers, stakeholder inclusion is considered “highly effective.”

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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 (factor 4.1 + factor 4.2) and the Ecosystem Based Fishery Management score. The Criterion 4 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***

Guiding principles

- Avoid negative impacts on the structure, function or associated biota of marine habitats where fishing occurs.
- Maintain the trophic role of all aquatic life.
- Do not result in harmful ecological changes such as reduction of dependent predator populations, trophic cascades, or phase shifts.
- Ensure that any enhancement activities and fishing activities on enhanced stocks do not negatively affect the diversity, abundance, productivity, or genetic integrity of wild stocks.
- Follow the principles of ecosystem-based fisheries management.

Rating cannot be Critical for Criterion 4.

Criterion 4 Summary

FISHERY	FISHING GEAR ON THE SUBSTRATE	MITIGATION OF GEAR IMPACTS	ECOSYSTEM-BASED FISHERIES MGMT	FORAGE SPECIES?	SCORE
Lake Huron | America, North - Inland Waters | Canada | Ontario | Set gillnets	Score: 3	Score: 0	Moderate Concern		Yellow (3.000)
Lake Huron | America, North - Inland Waters | Canada | Ontario | Stationary uncovered pound nets	Score: 3	Score: 0	Moderate Concern		Yellow (3.000)
Lake Huron | America, North - Inland Waters | United States | Michigan | Set gillnets | Tribal large mesh fishery	Score: 3	Score: 0	Moderate Concern		Yellow (3.000)
Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | State Fishery	Score: 3	Score: 0	Moderate Concern		Yellow (3.000)
Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | Tribal fishery	Score: 3	Score: 0	Moderate Concern		Yellow (3.000)

The Joint Strategic Plan for Management of the Great Lakes calls for an Ecosystem-Management Strategy in which management agencies address impacts of overlapping activities on fish communities (GLFC 2007).

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Fish community objectives (FCOs) are developed by the Lake Huron Committee to promote ecosystem recovery from disturbances and facilitate a functional food web and healthy ecosystem in Lake Huron {DesJardine et al. 1995}. As of 2017, most existing FCOs remain unmet (ibid). The ecology of Lake Huron has experienced recent fish community shifts due to invasive species, observed post original FCO development in the mid-1990s, including the spiny water flea (*Bythotrephes longimanus*), zebra and quagga mussels (*Dreissena* spp.), and round goby (*Neogobius melanostomus*) {Riley & Ebner 2020}. Due to an ecosystem regime shift, with uncertainty if the lake is in a stable state or a state of current flux, the Lake Huron Technical Committee recommended that FCOs be revisited (ibid).

Following 50 years of stability from the 1940s to 1990s, trophic regime shifts were observed in Lake Huron's food web in 1980-1999 and 2000-2017 through stable isotope analyses (Trumpickas et al. 2022). The food-web shifted to increased reliance on nearshore and benthic energy sources (ibid). This was likely due to the coincident invasion of dreissenid mussels and round goby and declining offshore prey densities (ibid). Dreissenid mussel establishment is a driver of oligotrophication and has affected the productivity of lake whitefish reproductive habitat potentially reducing the carrying capacity (Ebner et al. 2021) and displaced *Diporeia*, a common prey item of lake whitefish, which likely contributed to lake whitefish distribution shifts and declines in recruitment and abundance (Trumpickas et al. 2022).

The collapse of non-native alewife populations in 2003 led to increased predation on age 0-1 yellow perch, mainly attributed to walleye through gut content analyses (Fielder et al. 2022). There is significant yellow perch production but as early mortality remains a bottleneck to population growth managers are working to improve survivorship through modest reductions to the walleye population (by liberalizing fishing restrictions) and provisioning of alternate prey (ibid). It is hypothesized that historically abundant cisco may have been an alternate prey source that provided a buffer to yellow perch predation (ibid). In 2018, a cisco reintroduction stocking study was implemented to reestablish natural cisco reproduction in Lake Huron with the goal of improving yellow perch survival (ibid).

In 2021, the Lake Huron Committee identified environmental priorities, specific actions in critical locations over the next five years, intended to enhance fish production and assist in meeting FCOs (Lake Huron Committee 2021). These include dam management and fish passage restoration, reef restoration (critical spawning and nursery habitat), removal of invasive species and coastal wetland and in-stream habitat restoration (ibid).

Criterion 4 Assessment

SCORING GUIDELINES

Factor 4.1 - Physical Impact of Fishing Gear on the Habitat/Substrate
Goal: The fishery does not adversely impact the physical structure of the ocean habitat, seafloor or associated biological communities.

- *5 - Fishing gear does not contact the bottom*
- *4 - Vertical line gear*
- *3 - 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. Or bottom seine on resilient mud/sand habitats. Or midwater trawl that is known to contact bottom occasionally. Or purse seine known to commonly contact the bottom.*
- *2 - Bottom dragging gears (dredge, trawl) fished on resilient mud/sand habitats. Or gillnet, trap, or*

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bottom longline fished on sensitive boulder or coral reef habitat. Or bottom seine except on mud/sand. Or there is known trampling of coral reef habitat.

- *1 - Hydraulic clam dredge. Or dredge or trawl gear fished on moderately sensitive habitats (e.g., cobble or boulder)*
- *0 - 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 - Modifying Factor: Mitigation of Gear Impacts
Goal: Damage to the seafloor is mitigated through protection of sensitive or vulnerable seafloor habitats, and limits on the spatial footprint of fishing on fishing effort.

- *+1 —>50% of the habitat is protected from fishing with the gear type. Or fishing intensity is very low/limited and for trawled fisheries, expansion of fishery's footprint is prohibited. Or gear is specifically modified to reduce damage to seafloor and modifications have been shown to be effective at reducing damage. Or there is an effective combination of 'moderate' mitigation measures.*
- *+0.5 —At least 20% of all representative habitats are protected from fishing with the gear type and for trawl fisheries, expansion of the fishery's footprint is prohibited. Or gear modification measures or other measures are in place to limit fishing effort, fishing intensity, and spatial footprint of damage caused from fishing that are expected to be effective.*
- *0 —No effective measures are in place to limit gear impacts on habitats or not applicable because gear used is benign and received a score of 5 in factor 4.1*

Factor 4.3 - Ecosystem-Based Fisheries Management
Goal: All stocks are maintained at levels that allow them to fulfill their ecological role and to maintain a functioning ecosystem and food web. Fishing activities should not seriously reduce ecosystem services provided by any retained species or result in harmful changes such as trophic cascades, phase shifts or reduction of genetic diversity. Even non-native species should be considered with respect to ecosystem impacts. If a fishery is managed in order to eradicate a non-native, the potential impacts of that strategy on native species in the ecosystem should be considered and rated below.

- *5 — Policies that have been shown to be effective are in place to protect species' ecological roles and ecosystem functioning (e.g. catch limits that ensure species' abundance is maintained at sufficient levels to provide food to predators) and effective spatial management is used to protect spawning and foraging areas, and prevent localized depletion. Or it has been scientifically demonstrated that fishing practices do not have negative ecological effects.*
- *4 — Policies are in place to protect species' ecological roles and ecosystem functioning but have not proven to be effective and at least some spatial management is used.*
- *3 — Policies are not in place to protect species' ecological roles and ecosystem functioning but detrimental food web impacts are not likely or policies in place may not be sufficient to protect species' ecological roles and ecosystem functioning.*
- *2 — Policies are not in place to protect species' ecological roles and ecosystem functioning and the likelihood of detrimental food impacts are likely (e.g. trophic cascades, alternate stable states, etc.), but conclusive scientific evidence is not available for this fishery.*
- *1 — Scientifically demonstrated trophic cascades, alternate stable states or other detrimental food web impact are resulting from this fishery.*

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

Lake Huron | America, North - Inland Waters | Canada | Ontario | Set gillnets
Lake Huron | America, North - Inland Waters | United States | Michigan | Set gillnets | Tribal large mesh fishery

Score: 3

The use of gill nets is restricted to Canadian and tribal fisheries in Lake Huron. The bottom substrate of Lake Huron comprises of mostly mud (33%), sand (22.5%) and clay (22.1%) with 22% hard substrate (Wang et al. 2015) (USGS & GLAHF 2018)(see map in Figure 37). Per the Seafood Watch Standard for Fisheries, the physical impact of fishing gear on the habitat/substrate for gear types such as gillnets (Figure 36) that are set mostly on soft substrates is given a score of "3."

Justification:

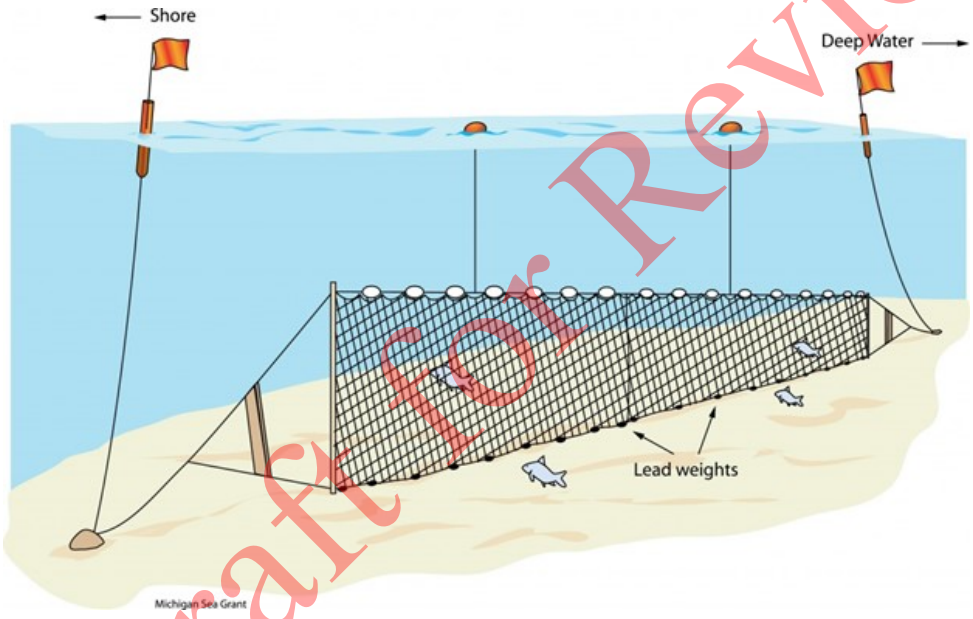

Figure 36: Set gillnets are set perpendicular to shore with floats on the top and weights on the bottom (Michigan Sea Grant 2023b).

Lake Huron | America, North - Inland Waters | Canada | Ontario | Stationary uncovered pound nets
Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | Tribal fishery
Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | State Fishery

Score: 3

The bottom substrate of Lake Huron comprises of mostly mud (33%), sand (22.5%) and clay (22.1%) with 22% hard substrate (Wang et al. 2015) (USGS & GLAHF 2018)(see map in figure 37 below). Per the Seafood Watch Standard for Fisheries, the physical impact of fishing gear on the habitat/substrate

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for gear types such as trap nets (Figure 38) that are set mostly on soft substrates is given a score of "3."

Justification:

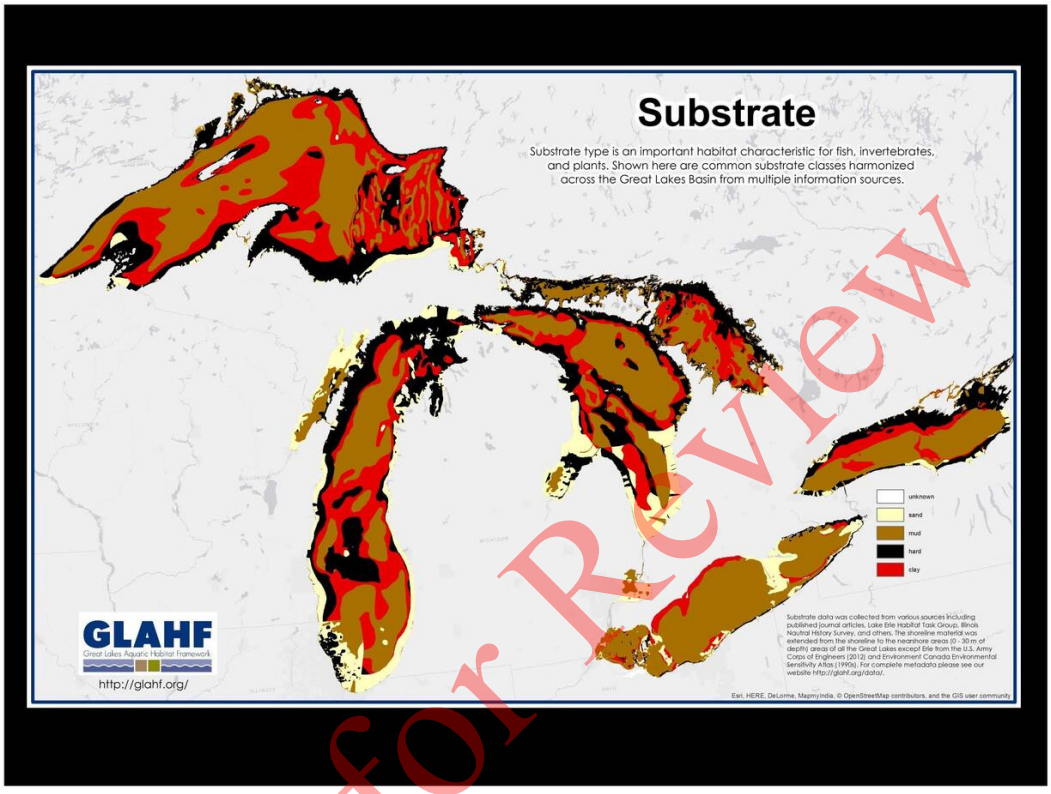

Figure 37: Map of substrate types in the Great Lakes, showing that Lake Huron comprises mostly of mud (USGS & GLAHF 2018).

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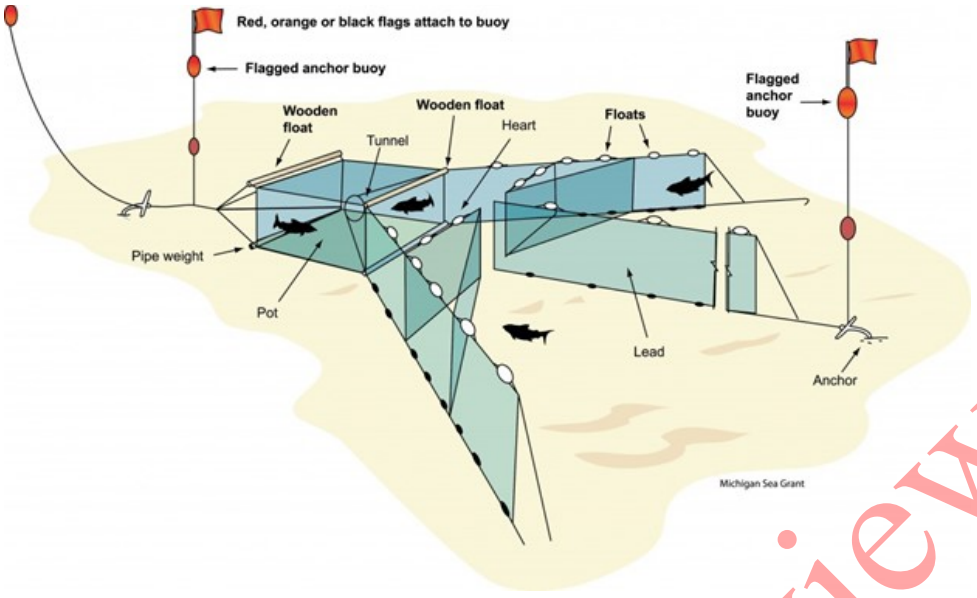

Figure 38: Trap nets divert fishes into an enclosure, through a tunnel into a pot for capture (Michigan Sea Grant 2023b).

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Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

Lake Huron | America, North - Inland Waters | Canada | Ontario | Set gillnets
Lake Huron | America, North - Inland Waters | Canada | Ontario | Stationary uncovered pound nets
Lake Huron | America, North - Inland Waters | United States | Michigan | Set gillnets | Tribal large mesh fishery
Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | Tribal fishery
Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | State Fishery

Score: 0

There are 2,572 km of coastal shoreline protected (at various levels) in Lake Huron (305 km in the US, 2,267 km in Canada) (Parker et al. 2017). There are 15,488 km^2 of in lake protected areas in US waters and 427 km^2 of in lake protected waters in Canada (ibid). The lake's protected area in the United States is inclusive of the largest and oldest marine sanctuary in the Great Lakes, the Thunder Bay National Marine Sanctuary (established in 2000 and expanded in 2014 (11,064 km^2) to protect shipwrecks and preserve maritime history), however, this is not a complete no-take fishing area (NOAA 2023a). In Michigan state waters, areas closed to commercial fishing in Lake Huron include Thunder Bay Area, Tawas Bay Area and Wildfowl Bay Area (see figure 39 below, (DTMB 2015)). There are also two Lake Trout Refuge areas where both recreational and commercial fishing for lake trout are not permitted (ibid), but these protections are seasonal (United States v. State of Michigan 2023). Although some spatial protections are in place, they do not provide sufficient coverage to meet

the requirements to apply a modifying score for mitigation of gear impacts.

Justification:

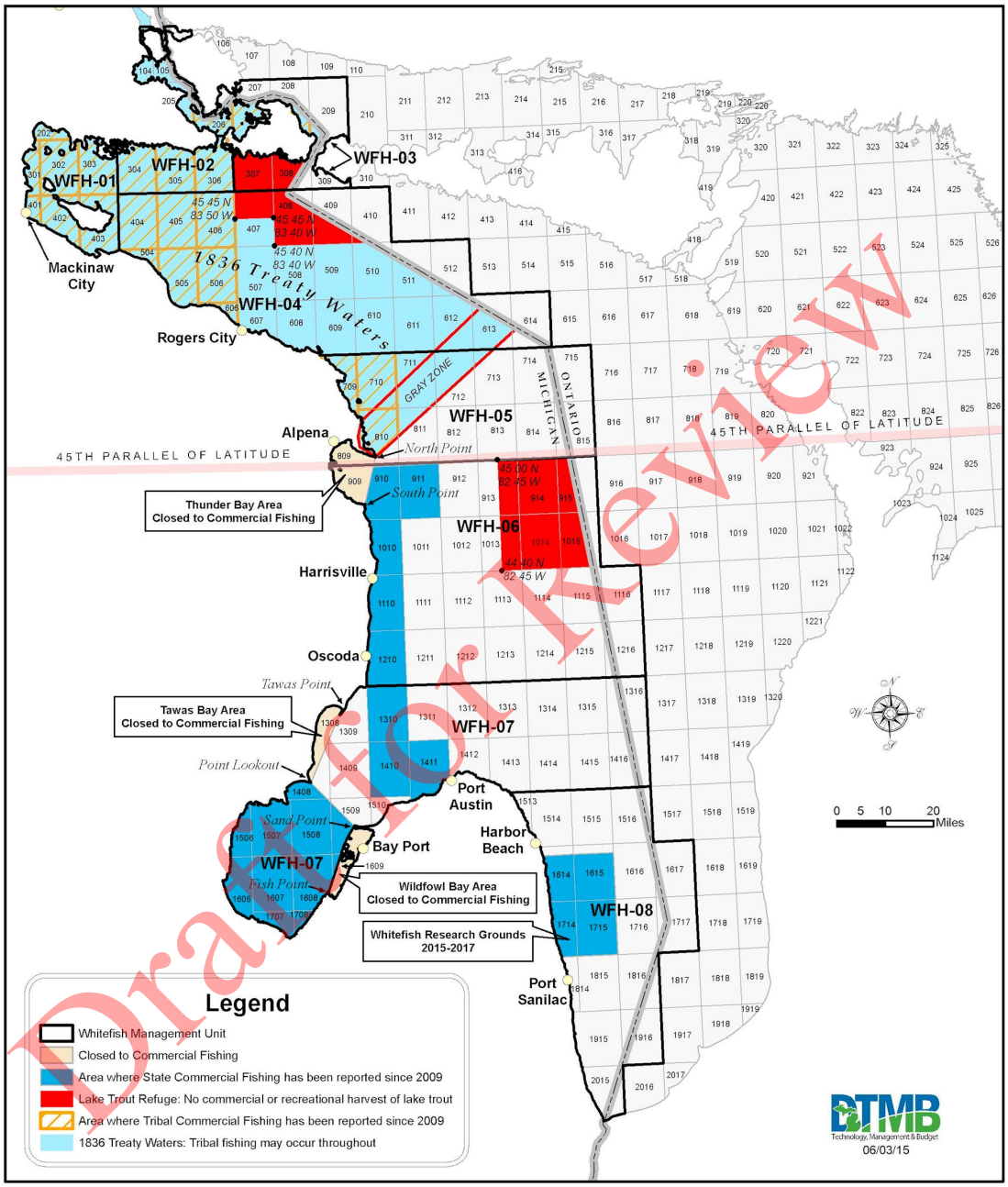

Figure 39: Commercial fishing areas in Michigan state waters of Lake Huron (DTMB 2015).

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Factor 4.3 - Ecosystem-based Fisheries Management

Lake Huron | America, North - Inland Waters | Canada | Ontario | Set gillnets
Lake Huron | America, North - Inland Waters | Canada | Ontario | Stationary uncovered pound nets
Lake Huron | America, North - Inland Waters | United States | Michigan | Set gillnets | Tribal large mesh fishery
Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | Tribal fishery
Lake Huron | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | State Fishery

Moderate Concern

An overview of the ecosystem changes in Lake Huron and the ecosystem based fisheries management adopted in the lake have been summarized in the C4 synthesis section above. Based on the species' ecological roles, detrimental food web impacts are possible (Riley and Ebner 2020) (Ebner et al. 2021) (Fielder et al. 2022) (Trumpickas et al. 2022). Nevertheless, as there is spatial and temporal management in place (DTMB 2015)(Parker et al. 2017) appropriate to the scale of the fishery and ecology of the stocks that is likely to be effective with little scientific controversy, ecosystem-based fisheries management is considered a “moderate concern.”

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Acknowledgements

Scientific reviewdoes 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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