



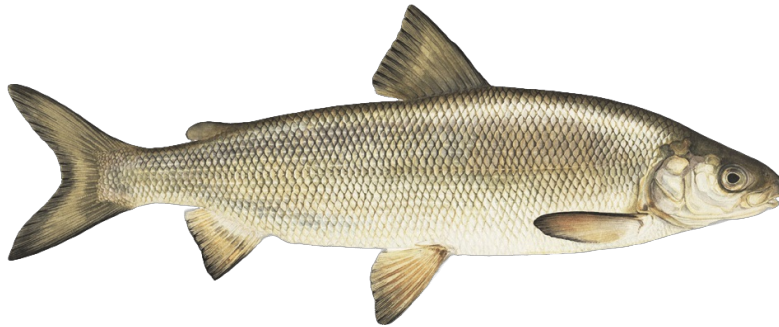
Monterey Bay Aquarium Seafood Watch

Draft Assessment for Review

April 2024

Freshwater Fish, Lake Superior

Coregonus clupeaformis, Salvelinus namaycush, Coregonus artedi, Sander vitreus



America, North - Inland Waters

Stationary uncovered pound nets, Set gillnets, Drift gillnets

Report ID 27857

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.

Guiding Principles

Seafood Watch defines sustainable seafood as originating from sources, whether fished¹ 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.

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

Summary

This report includes recommendations for lean lake trout (*Salvelinus namaycush*), lake whitefish (*Coregonus clupeaformis*), lake herring or cisco (*Coregonus artedii*), and walleye (*Sander vitreus*) caught in Lake Superior, in the Minnesota, Wisconsin and Michigan waters of the United States and the Ontario waters of Canada. Whereas lake trout and lake whitefish may be caught using either large-mesh bottom-set gillnets or stationary uncovered pound nets (or trap nets) depending on the region, walleye is caught using bottom-set gillnets and lake herring is caught using suspended gillnets.

In the Minnesota state- and tribal-licensed lake trout fisheries, fishing mortality is effectively controlled and is well within the TAC set, and hence has been scored a “low concern”. Additionally, the large-mesh bottom-set gillnets used are highly selective, so bycatch is low and there are no main species. Therefore both these fisheries earned a “Green” rating. Similarly, in the Minnesota state- and tribal-licensed suspended gillnet lake herring fisheries, an exploitation rate of 10-15% on adult female ciscoes is considered an appropriate TAC, harvests are within the limit of the TAC, and a Management Strategy Evaluation has been conducted to ensure that the TAC is appropriate. Hence fishing mortality was scored a “low concern”. Suspended gillnets are also a highly selective gear type, and bycatch is low, so there are no main species. Hence both the state- and tribal-licensed Minnesota lake herring fisheries received a “Green” rating.

Both the Wisconsin state and tribal-licensed fisheries use large-mesh bottom-set gillnets and trap nets to harvest lake whitefish and lake trout. Although fishing mortality of lake whitefish is limited by the amount of gillnet footage, which is determined by lake trout catch rates, a recently conducted stock assessment of lake whitefish in Wisconsin waters showed that instantaneous mortality estimates of lake whitefish fishing mortality was 40% since 2015, which is below the target total annual mortality of 55%, and so fishing mortality of the state and tribal-licensed lake whitefish and bottom-set gillnet and trap net fisheries has been scored as a “low concern”. In the case of lake trout caught in bottom-set gillnets and trap nets in the tribal and state-licensed fisheries, fishing mortality is effectively controlled as harvests are within the TAC specified, and has been scored as a “low concern”. Whereas the state and tribal-licensed trap net fisheries are highly selective, and have no main species, bottom-set gillnets of both state and tribal fisheries have lake whitefish, lake trout and lake sturgeon as the main species. Nevertheless, the Bycatch Strategy of both trap nets and gillnets that target lake whitefish and lake trout in Wisconsin waters was scored as “highly effective”. Although management of lake trout is effective, as there are no thresholds set for abundance of lake whitefish and lake trout, Management Strategy and Implementation has been scored as a “moderately effective.” Taken together, the state- and tribal-licensed lake whitefish bottom-set gillnet and trap net fisheries earned a “Green” rating, and the state- and tribal licensed lake trout bottom-set gillnet and trap net fisheries also earned a “Green” rating in Wisconsin. In the Wisconsin state- and tribal-licensed lake herring suspended gillnet fisheries, the 2023 age-1 density data indicate that the lake herring the stock is healthy, and abundance has been scored as a “low concern”; however, fishing mortality has been scored a “moderate concern,” because although harvests are within the TAC specified, given that lake herring is a forage species, the appropriateness of the TAC is unknown as a Management Strategy Evaluation has not been conducted. Due to this reason, it is also unknown if Management Strategy and Implementation in place is adequate, and so the factor has been scored as “moderately effective.” The suspended gillnets used in the lake herring fisheries are a highly selective gear type and the fisheries have no main species, so Bycatch Strategy has been scored as “highly effective.” Taken together, the state and tribal lake herring fisheries in Wisconsin have earned a “Green” rating.

In the 1836 Treaty-ceded Michigan waters, state-licensed fishers use only trap nets to target lake whitefish. In

management units where state-licensed fishers operate, abundance is above the target reference point, and fishing mortality is below the target reference point; hence both these factors were scored a “low concern.” Although lake trout is considered as a main species in this fishery, Bycatch Strategy has been scored as “highly effective” as post-release survival of lake trout from trap nets is high. Similarly as the management of lake whitefish in these regions has been effective in maintaining the stock abundance and controlling fishing mortality of both lake whitefish and lake trout, Management Strategy and Implementation has been scored as “highly effective.” Therefore the state-licensed trap net lake whitefish fishery in 1836 Treaty-ceded Michigan waters has earned a “Green” rating. Tribal-licensed fishers use both trap nets and bottom-set gillnets to harvest lake whitefish and lake trout in 1836 Treaty-ceded Michigan waters. As abundance of lake whitefish in 50% and 60% of the management units in tribal gillnet and trap net fisheries respectively are above the reference points, and fishing mortality of lake whitefish in 50% and 60% of the management units in tribal gillnet and trap net fisheries respectively are below the target reference point, both these factors were scored as a “moderate concern”. As abundance of lake trout in these fisheries is above the target reference point, and fishing mortality is below the target reference point, both these factors have been scored as a “low concern”. In the case of the tribal bottom-set gillnet fishery, both lake whitefish and lake trout are considered as main species, but in the tribal trap net fishery, only lake whitefish is a main species. Bycatch strategy was scored as “highly effective” in both the tribal gillnet and trap fisheries; trap nets were considered as highly selective gear types and gillnets had specific mitigation strategies in place. Although management strategies have been effective in maintaining stock abundance and controlling fishing mortality of lake trout, since management of lake whitefish in some management units needs to be improved, Management Strategy and Implementation was scored as “moderately effective.” Taken together, tribal fisheries that target lake whitefish using bottom-set gillnets and trap nets in 1836 Treaty waters of Michigan received a “Yellow” rating, whereas tribal fisheries that target lake trout using bottom-set gillnets and trap nets in 1836 Treaty waters of Michigan have earned a “Green” rating.

In the 1842 Treaty-ceded waters of Michigan, state-licensed fishers use only trap nets to target lake whitefish. As abundance of lake whitefish in >70% of management units is above the target reference point and fishing mortality in >70% of management units is below the target reference point, both these factors have been scored a “low concern.” There were no main species in this fishery, and the gear type was highly selective, so Bycatch Strategy was scored as “highly effective.” Further, as stock assessment models and data are in the process of being updated and only informal harvest control rules exist, Management Strategy and Implementation were scored as “moderately effective.” Overall the state-licensed lake whitefish trap net fishery in 1842 Michigan waters earned a “Green” rating. Lake whitefish and lake trout are also harvested by tribal fishers using bottom-set gillnets in 1842 Treaty-ceded waters of Michigan. In the case of the lake whitefish fishery, as abundance in >70% of management units is above the target reference point and fishing mortality in >70% of management units is below the target reference point, both factors have been scored as a “low concern.” In the case of the lake trout fishery, as stock abundance in >70% the management units is either above the target reference level or >75% of the target reference level, abundance has been scored as a “low concern”; as fishing mortality in <70% but >50% of management units is below the target reference point, it has been scored as a “moderate concern.” Lake trout and lake whitefish were both added as main species in the tribal bottom-set gillnet fishery, and since the gear type was highly selective, Bycatch Strategy was scored as “highly effective.” As there is no TAC or quota for lake whitefish, Harvest Control Rules are informal, both the lake whitefish and lake trout fishery were scored as “moderately effective” for Management Strategy and Implementation. Together, both the lake whitefish and lake trout tribal bottom-set gillnet fisheries in 1842 waters were given a “Green” rating.

In the Ontario waters of Lake Superior, lake trout, lake whitefish and walleye are targeted using bottom-set

gillnets, whereas lake herring is targeted using suspended gillnets in state- and tribal-licensed fisheries, which have been combined. Abundance of lake trout, lake whitefish and walleye was a “moderate concern” following a PSA conducted in each instance. Fishing mortality of lake whitefish and lake trout in the bottom-set gillnet fishery is within the quotas for each species, and well below the established reference level for the lake, and hence has been scored a “low concern”; for walleye however, although commercial harvests across management units have been within the allotted quota, it is unclear if the quotas are appropriate, hence fishing mortality is considered as a “moderate concern”. Bycatch data for the bottom-set gillnet fishery showed that lake sturgeon, lake trout, suckers, and lake whitefish were identified as main species. As the set-gillnets are not highly selective, and ETP species are found in the catch, Bycatch Strategy has been scored as “moderately effective”. Further, as there were no biological reference points for abundance in the Ontario set-gillnet fishery and stock assessments are not conducted, Management Strategy and Implementation was scored as “moderately effective.” Taken together, the lake trout, lake whitefish and walleye bottom-set gillnet fisheries were given a “Yellow” rating. In the case of lake herring caught in the suspended gillnet fishery in Ontario, fishing mortality was scored a “low concern” as harvests were within the quota and a Management Strategy Evaluation has been conducted to ensure that a constant exploitation rate of 10% is appropriate. As Management Strategy and Implementation was considered adequate, it was scored as “highly effective”. There were no main species in the fishery and the suspended gillnets used are highly selective, so Bycatch Strategy was scored as “highly effective”. Overall the suspended gillnet lake herring fishery in Ontario received a “Green” rating.

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Final Seafood Recommendations

SPECIES FISHERY	C 1	C 2	C 3	C 4	OVERALL	VOLUME (MT) YEAR
	TARGET SPECIES	OTHER SPECIES	MANAGEMENT	HABITAT		
Lake herring Lake Superior America, North - Inland Waters Canada Ontario Gillnets and entangling nets	4.284	5.000	4.000	3.873	Best Choice (4.268)	Unknown
Lake herring Lake Superior America, North - Inland Waters United States Minnesota Gillnets and entangling nets	4.284	5.000	4.000	3.873	Best Choice (4.268)	Unknown
Lake herring Lake Superior America, North - Inland Waters United States Minnesota Gillnets and entangling nets Tribal fishery	4.284	5.000	3.000	3.873	Best Choice (3.972)	Unknown
Lake herring Lake Superior America, North - Inland Waters United States Wisconsin Gillnets and entangling nets	3.318	5.000	3.000	3.873	Best Choice (3.726)	Unknown
Lake herring Lake Superior America, North - Inland Waters United States Wisconsin Gillnets and entangling nets Tribal fishery	3.318	5.000	3.000	3.873	Best Choice (3.726)	Unknown
Lake trout Lake Superior America, North - Inland Waters Canada Ontario Set gillnets	3.413	2.236	3.000	3.464	Good Alternative (2.984)	Unknown
Lake trout Lake Superior America, North - Inland Waters United States Minnesota Set gillnets	3.413	5.000	3.000	3.464	Best Choice (3.649)	Unknown
Lake trout Lake Superior America, North - Inland Waters United States Minnesota Set gillnets Tribal fishery	3.413	5.000	3.000	3.000	Best Choice (3.520)	Unknown
Lake trout Lake Superior America, North - Inland Waters United States Wisconsin Set gillnets	3.413	3.413	3.000	3.742	Best Choice (3.382)	Unknown
Lake trout Lake Superior America, North - Inland Waters United States Wisconsin Set gillnets Tribal fishery	3.413	3.413	3.000	3.742	Best Choice (3.382)	Unknown
Lake trout Lake Superior America, North - Inland Waters United States Michigan Set gillnets 1842 Treaty Waters Tribal fishery	3.318	4.284	3.000	3.000	Best Choice (3.363)	Unknown
Lake trout Lake Superior America, North - Inland Waters United States Michigan Set gillnets 1836 Treaty Waters Tribal fishery	4.284	2.644	3.000	3.464	Best Choice (3.294)	Unknown

Lake trout Lake Superior America, North - Inland Waters United States Michigan Stationary uncovered pound nets 1836 Treaty Waters Tribal fishery	4.284	5.000	3.000	3.464	Best Choice (3.863)	Unknown
Lake trout Lake Superior America, North - Inland Waters United States Wisconsin Stationary uncovered pound nets	3.413	5.000	3.000	3.742	Best Choice (3.720)	Unknown
Lake trout Lake Superior America, North - Inland Waters United States Wisconsin Stationary uncovered pound nets Tribal fishery	3.413	5.000	3.000	3.742	Best Choice (3.720)	Unknown
Lake whitefish Lake Superior America, North - Inland Waters Canada Ontario Set gillnets	3.413	2.236	3.000	3.464	Good Alternative (2.984)	Unknown
Lake whitefish Lake Superior America, North - Inland Waters United States Wisconsin Set gillnets	3.413	3.413	3.000	3.742	Best Choice (3.382)	Unknown
Lake whitefish Lake Superior America, North - Inland Waters United States Wisconsin Set gillnets Tribal fishery	3.413	3.413	3.000	3.742	Best Choice (3.382)	Unknown
Lake whitefish Lake Superior America, North - Inland Waters United States Michigan Set gillnets 1842 Treaty Waters Tribal fishery	4.284	3.318	3.000	3.000	Best Choice (3.363)	Unknown
Lake whitefish Lake Superior America, North - Inland Waters United States Michigan Set gillnets 1836 Treaty Waters Tribal fishery	2.644	4.284	3.000	3.464	Good Alternative (3.294)	Unknown
Lake whitefish Lake Superior America, North - Inland Waters United States Michigan Stationary uncovered pound nets 1836 Treaty Waters State Fishery	4.284	4.284	4.000	3.464	Best Choice (3.993)	Unknown
Lake whitefish Lake Superior America, North - Inland Waters United States Michigan Stationary uncovered pound nets 1842 Treaty Waters State Fishery	4.284	5.000	3.000	3.000	Best Choice (3.726)	Unknown
Lake whitefish Lake Superior America, North - Inland Waters United States Wisconsin Stationary uncovered pound nets	3.413	5.000	3.000	3.742	Best Choice (3.720)	Unknown
Lake whitefish Lake Superior America, North - Inland Waters United States Wisconsin Stationary uncovered pound nets Tribal fishery	3.413	5.000	3.000	3.742	Best Choice (3.720)	Unknown
Lake whitefish Lake Superior America, North - Inland Waters United States Michigan Stationary uncovered pound nets 1836 Treaty Waters Tribal fishery	2.644	5.000	3.000	3.464	Good Alternative (3.424)	Unknown

Walleye Lake Superior America, North - Inland Waters Canada Ontario Set gillnets	2.644	2.236	3.000	3.464	Good Alternative (2.800)	Unknown
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Summary

Overall, the Minnesota state- and tribal-licensed lake trout bottom-set gillnet fisheries and the suspended gillnet have been rated “Green” because of low impact on the species and the highly selective gear type.

In Wisconsin the lake trout and lake whitefish state-and tribal licensed bottom-set gillnet fisheries received a “Green” rating because of the low impact on the species and the "highly effective" bycatch strategy used; the state- and tribal licensed lake whitefish and lake trout trap net fisheries also received a “Green” rating because of the low impact of the fishery on lake trout and the highly selective gear type. The state- and tribal-licensed lake herring suspended gillnet fisheries in Wisconsin also earned a “Green” rating because of the high abundance of lake herring and highly selective gear type.

In the 1836 Treaty-ceded Michigan waters, the state-licensed trap net fishery earned a “Green” rating, due to the low impact of the fishery on the species, on bycatch, and the effective management of the fishery. The tribal bottom-set gillnet and trap net fisheries that target lake whitefish in 1836 Treaty Michigan waters received a “Yellow” rating because of the moderate impact on the species, and the need for improved management in some management units. Tribal fisheries that target lake trout using bottom-set gillnets and trap nets in 1836 Treaty Michigan waters earned a “Green” rating because of the low impact on the species and on bycatch species.

Overall both the state- and tribal-licensed fisheries in 1842 Michigan waters received a “Green” rating, because of the low to moderate impact on the species and the highly effective bycatch mitigation strategy.

In Ontario waters, the lake whitefish lake trout and walleye bottom-set gillnet fisheries received a “Yellow” rating because of the moderate impact of the fishery on the bycatch species, and the "moderately effective" Management Strategy and Implementation score. The lake herring suspended gillnet fishery received a “Green” rating because of the low impact of the fishery on the species, and the highly selective gear type.

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 Concern², and no more than one Red Criterion, and no Critical scores

Avoid/Red = Final Score \leq 2.2, or either Harvest Strategy (Factor 3.1) or Bycatch Management Strategy (Factor 3.2) is Very High Concern or two or more Red Criteria, or one or more Critical scores.

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

Introduction

Scope of the analysis and ensuing recommendation

This report evaluated the commercial harvest of lake whitefish (*Coregonus clupeaformis*), lake trout (*Salvelinus namaycush*), walleye (*Sander vitreus*), and lake herring (*Coregonus artedii*) in Lake Superior. Following the FAO definitions, fishing gears examined in this region include bottom-set gillnets (also referred to as gillnets), stationary uncovered pound nets (henceforth trap nets), and entangling nets (also referred to as suspended gillnets) utilized by commercial state- and tribal-licensed fishers from Michigan, Wisconsin, Minnesota, and the Canadian Province of Ontario.

Various gear types are used to commercially harvest lake trout, lake whitefish, lake herring and walleye in different parts of the lake. In Minnesota, bottom-set gillnets are used to catch lake trout, whereas suspended gillnets are used to catch lake herring, both in state- and tribal-licensed fisheries. Similarly in Wisconsin, suspended gillnets are used to catch lake herring, whereas large-mesh bottom-set gillnets and trap nets are used to catch lake trout and lake whitefish in both state- and tribal-licensed fisheries. In the 1836 and 1842 treaty-ceded Michigan waters of Lake Superior, state-licensed fishers are permitted to harvest only lake whitefish using trap nets. In 1836 Michigan waters, tribal-licensed fishers may use both set gillnets and trap nets to catch lake trout and lake whitefish, whereas in 1842 Michigan waters, tribal-licensed fishers use primarily set gillnets to harvest lake trout and lake whitefish. In 2021 there was one tribal-licensed fisher who started using trap nets in 1842 Michigan waters, and occasionally there has been reported catch from hook and line fishers; however these gear types contributed towards <5% of the annual catch when they have occurred, and as such are not considered in this assessment. In the Ontario waters of Lake Superior, set gillnets are used by state- and tribal- licensed fishers to harvest lake trout, lake whitefish and walleye, whereas suspended gillnets are used to harvest lake herring.

Species Overview

Lake trout are found in the northern parts of North America, principally in Canada, throughout Alaska, and in the Laurentian Great Lakes, preferring cool water temperatures of 32-59 °F (Jasonowicz et al. 2022)(Sitar et al. in review). In Lake Superior, lake trout may be found at depths from the surface to >152m with the median depth inhabited around 20m (Jasonowicz et al. 2022). Lake trout are the largest of the charr (a sub-grouping within Salmonidae), reaching lengths of up to 130cm, with the average length ranging from 20cm to 66cm (Muir et al. 2021) and weights up to 27-32kgs. Once the dominant predator in Lake Superior, the invasion of sea lamprey and habitat alterations has resulted in dramatic declines of this once economically valuable fish (GLFC 2024a). Nevertheless, efforts to control lamprey in Lake Superior have been successful and the lake trout population has since rebounded (Sitar 2021).

Lake whitefish (member of the family Salmonidae) are found in inland lakes throughout Canada, Alaska, and the northern part of the United States (Froese and Pauly 2023h). Lake whitefish are schooling fish and prefer cool waters at depths of 8- 91m (ibid). Lake whitefish typically achieve lengths of 51-76cms and weigh upwards of 9kgs (ibid). Similar to lake trout, lake whitefish were also impacted by the invasion of sea lamprey in Lake Superior.

Walleye (the largest member of the perch family) are also utilized as both a food fish and a game fish. They are found throughout most of Canada and the Northern United States (Froese and Pauly 2023i). Walleye are voracious near shore predators, reaching lengths of 51-76cms and weighing up to 11kgs (ibid). They prefer temperatures of 34-84 °F (ibid) and inhabit shallow embayments, generally <24m.

Lake herring, also known as cisco, is an important commercial fish species, in addition to being a forage fish (Michigan Sea Grant 2023b). The species matures at a size of 23-30cm, when it is 2-4 years of age (ibid). They are found at temperatures between 32-78 °F (Froese and Pauly 2022a), and spawn at around 40 °F (Michigan Sea Grant 2023b). Although Lake herring in the Great Lakes tend to occupy nearshore regions, the form of lake herring in Lake Superior utilize the entire surface area; juveniles are predominant in nearshore waters at bathymetric depths <80m, whereas adult lake herring can be found in nearshore and deep waters (> 80m depth) (Yule et al. 2013)(Eschenroder et al. 2016). The species is distributed all over North America, from the Atlantic to the Arctic basins, across Canada, the Great Lakes, and the upper Mississippi basins in northern Ohio, Illinois and Minnesota in the USA (Michigan Sea Grant 2023b).

The Lake Superior commercial fishery has been active since the early 19th century, when settlements were established and local fish trading increased substantially from pre-European colonization levels. The initial fish composition was dominated by lake trout, lake whitefish, lake herring (cisco), and several species of deep water cisco. Excessive, highly extractive fisheries and predation by sea lampreys in the 1950's caused the collapse of lake trout, lake whitefish, lake herring and deep water cisco populations. Rehabilitation of lake trout stocks have been fairly successful with the stocking of lake trout and the use of lampricide to control sea lamprey and regulations on commercial fishing. Due to increased abundance and expanded fisheries, lake whitefish populations support greater commercial harvest than they have previously.

There are several management bodies that manage the fisheries in Lake Superior which include state, provincial, federal and tribal bodies and they are the Michigan Department of Natural Resources, the Minnesota Department of Natural Resources, the Wisconsin Department of Natural Resources, the Ontario Ministry of Natural Resources, the Chippewa-Ottawa Resource Authority (CORA), and the member tribes of the Great Lakes Indian Fish and Wildlife Commission (GLIFWC) including the Red Cliff Band of Lake Superior Chippewa, and the 1854 Treaty Authority; the fisheries targeting the species mentioned above are managed by these management bodies. However, a coordinated cooperative management arrangement exists under the auspices of the Great Lakes Fishery Commission (GLFC), which oversees sea lamprey control and facilitates this process by maintaining working relationships among the parties as described in the Joint Strategic Plan (JSP). The convention charges the commission with five major duties: to develop a binational research program (GLFC 2024b) aimed at sustaining Great Lakes fish stocks; to coordinate or conduct research consistent with that program; to recommend measures to governments that protect and improve the fishery; to formulate and implement a comprehensive sea lamprey control program (GLFC 2024a); and to publish or authorize publication of scientific and other information critical to sustaining the fishery (GLFC 2024c) (GLFC 2024d). For further information on the overarching management of fisheries Lake Superior, refer to the C3 summary.

Production Statistics

The commercial harvest of lake trout in Lake Superior was approximately four million lbs from 1920 to 1950, and declined abruptly in the 1950s as lake trout stocks collapsed due to overfishing, sea lamprey (*Petromyzon marinus*) predation and habitat degradation (Figure 1) (Hansen 1996)(Hansen and Bronte 2019). From 1953 to 1962, management agencies closed commercial fisheries of lake trout and hence harvests declined by more than 90% (Hansen 1996). During this time, intense stocking of hatchery-reared lake trout and chemical control of sea lamprey were conducted, as lake trout was expected to recover due to these measures along with the closure of the fishery (ibid). Through the 1960s abundance of lake trout increased in Wisconsin and

Michigan due to high stocking rates, but this increase was slower in Ontario waters (where stocking was lower) and in Minnesota (where stocking began much later) (ibid). In the 1980s and 1990s, increased fishery exploitation, sea lamprey predation and reduced stocking affected lake trout restoration (ibid). In 1986 and 1996, the lake trout restoration plan was developed and revised, changing from a plan that focused on stocking to one that focused on improving management of wild lake trout stocks (ibid). A key aspect of the successful restoration of self-sustaining populations of lake trout in Lake Superior was the interjurisdictional management framework, which involved state, provincial, federal and tribal agencies (Hansen and Bronte 2019). Additionally, the refuge complexes in Wisconsin waters played an important role in the restoration of Lake Trout in Lake Superior (Akins et al. 2015) (Schram et al. 1995). Thus, lake trout have recovered from near extirpation in the 1960s to population sizes that now fluctuate around a stable equilibrium, as indicated by density-dependent responses in somatic growth and recruitment (Hansen et al. 1995)(Pratt et al. 2016)(Sitar et al. in review); in general, the population has been stable in all jurisdictions in US and Canada waters since 1993 (Sitar 2021)(Sitar et al. in review).

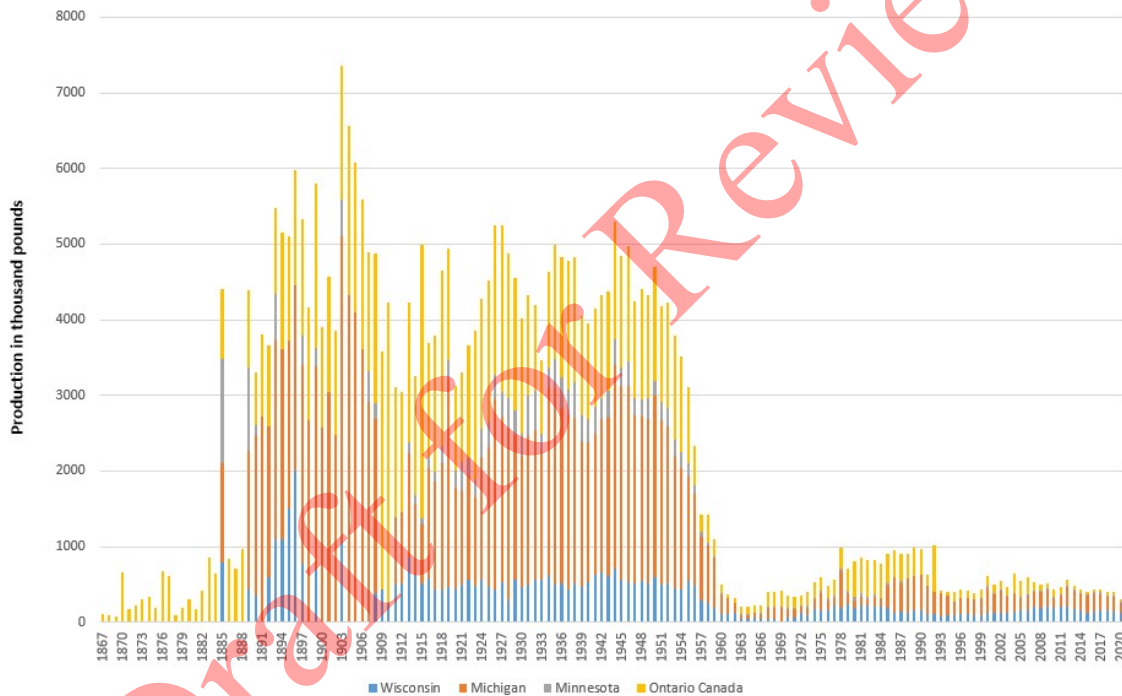


Figure 1: Production of lake trout in Lake Superior from 1867 to 2020, by region (GLFC 2023e). Units are given in thousand pounds.

Although lake whitefish production peaked during late 1800s, high harvests and low regulations on effort resulted in much lower yields by the early 1900s (Figure 2) (Michaels and Gorman 2021). Thereafter commercial yields remained low, increasing slightly through the mid-1900s, and then decreasing again in the 1950s, along with the increase in sea lamprey (ibid). Subsequently commercial yields increased again through the late 1990s, and have stabilized at approximately 1,500 metric tons (or 3300 thousand lb) (ibid). It is likely that yields will increase further due to successful recruitment events of lake whitefish after 2020 (Vinson et al. 2023b).

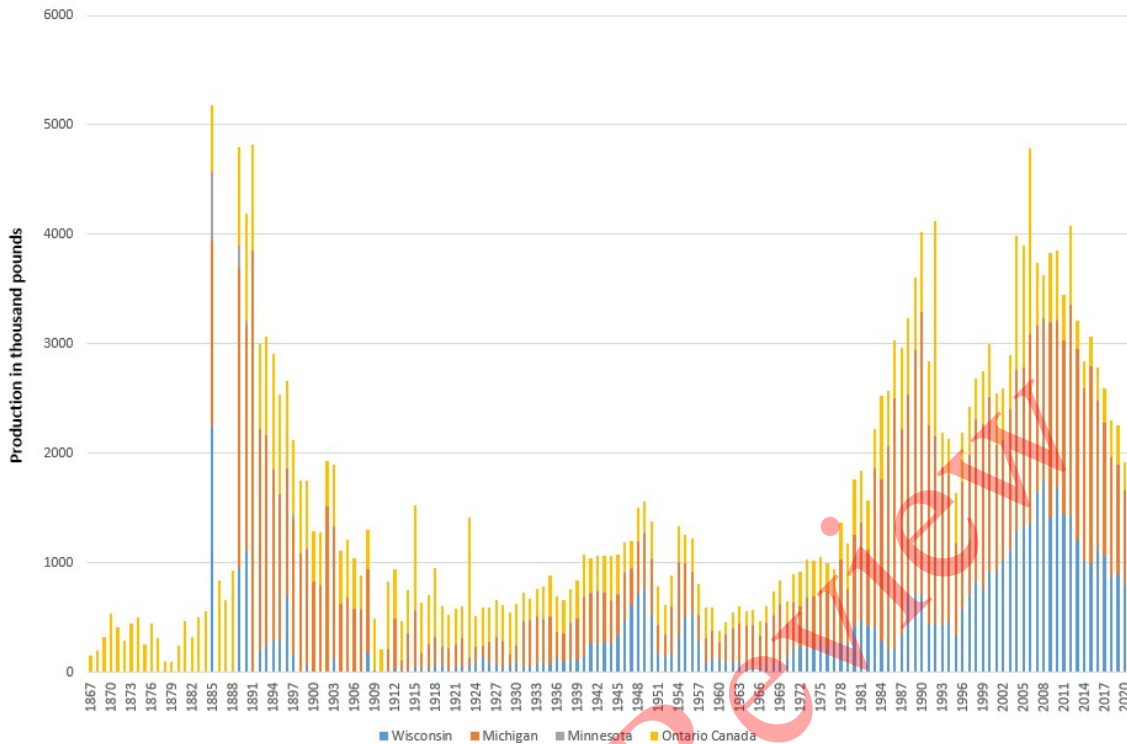


Figure 2: Production of lake whitefish in Lake Superior from 1867 to 2020, by region (GLFC 2023e). Units are given in thousand pounds.

Lake herring (an important forage species) were once the most dominant commercial species harvested from Lake Superior, making up 80% of the total commercial yield, with mean annual landings of approximately six million kg/year (or 13,228 thousand lb/year) (Cox and Kitchell 2004)(Stockwell et al. 2009). However, during the 1960s most lake herring stocks in Lake Superior collapsed due to overfishing (Figure 3), habitat destruction and invasive species (ibid). In the subsequent decades, lake herring did not show a sustained recovery, mainly due to poor recruitment (Cox and Kitchell 2004). Ecological factors that likely contributed to this poor recruitment include: , (1) Increased predation pressure due to stocking of lake trout, during the 1960s through the 1990s and subsequent recovery of native lake trout and siscowet lake trout populations due to harvest management and sea lamprey control, (2) the invasion of rainbow smelt (*Osmerus mordax*) in Lake Superior during the 1940s, which is also a prey species and competes with lake herring for food, but also predated on juvenile lake herring, eggs and larvae, affecting feeding, growth and recruitment (ibid), and (3) to a lesser extent the increase in lake whitefish may have impacted lake herring recruitment as lake whitefish are known to feed on lake herring during the early stages (Cox and Kitchell 2004), although the two species have co-evolved to occupy different niches. More recently, lake herring partially recovered in the 1980s and 1990s, likely due to increased commercial fishery regulations and a few strong year-classes during this period but declined thereafter (Rook et al. 2020)(Goldsworthy and Yule 2021). It is hypothesized that eutrophication during the historical period supported greater recruitment and adult abundance of lake herring and contemporary re-oligotrophication may be limiting full recovery (Rook et al. 2020). Nevertheless, in spring of 2023, USGS surveys confirmed record age-1 abundance estimates of lake herring, with the strongest year-class seen in Lake Superior since the 1970s (Vinson et al. 2023b)(pers comm Goldsworthy, C. 2023).

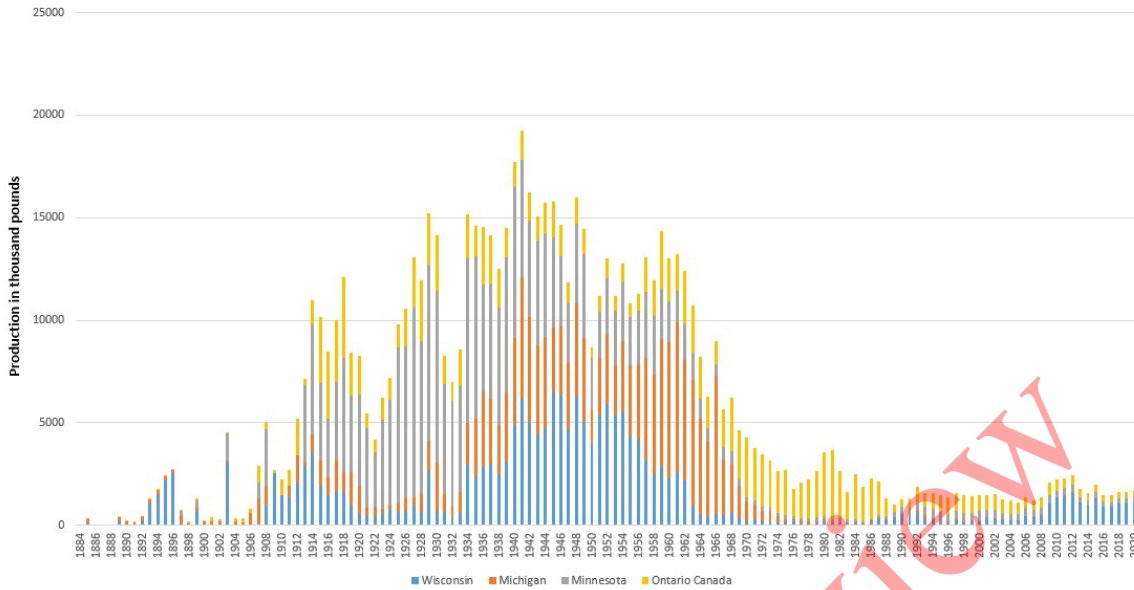


Figure 3: Production of lake herring in Lake Superior from 1867 to 2020, by region (GLFC 2023e). Units are given in thousand pounds.

Although walleye was widely harvested in commercial fisheries in both U.S. and Canadian waters of Lake Superior, Canadian commercial harvests peaked in 1966, whereas the maximum harvests from US waters were in 1885 (Figure 4)(Schram et al. 2010). Declines in walleye abundance throughout Lake Superior were due to overfishing, loss of connectivity with tributary spawning habitat due to dams, habitat degradation, poor watershed practices, and pollution (Schram et al. 2010)(Hoff 2001). Currently yields of walleye in Lake Superior are low, and only limited commercial and recreational fisheries exist (Schram et al. 2010). In 2001 a rehabilitation plan for walleye populations in Lake Superior was developed (Hoff 2001). Further rehabilitation strategies were considered in 2010 (Schram et al. 2010). Over the last 20 years, there has been substantial progress in the recovery of the walleye population in Black Bay, Canada (pers comm James, S. 2023).

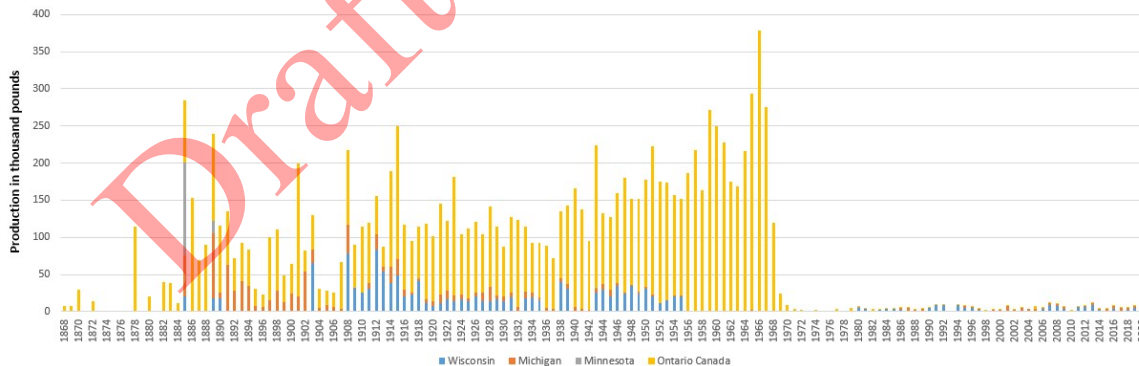


Figure 4: Production of lake walleye in Lake Superior from 1868 to 2020, by region (GLFC 2023e). Units are given in thousand pounds.

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). Most of the fish produced remains in the region (i.e. from Canada and the United

States) (FAO 2022), and is insignificant compared to global landings of other fish in other fisheries. A majority of the fish caught in the Great Lakes region is sold in the local market, either as fish (46.5%), or as a processed product (68%) (ibid). Similarly, a smaller proportion of fish and processed product is sold regionally (37.9% and 25.4% respectively), and nationally (12.7% and 5.1% respectively) (ibid). Only a small proportion of fish and processed fish representing 2.9% and 1.5% respectively is sold internationally (ibid). In particular, much of the lake herring fishery targets this international market. Additionally, most of the lake herring and a small amount of lake whitefish roe are sold internationally, in the Scandinavian market.

Common and market names.

Lake trout, *Salvelinus namaycush*, is also known as Great Lakes trout, laker, namaycush /namegos (Anishinaabe/ Ojibwe) (Blankenheim 2022) (Livesay and Nichols 2021), togue, grey trout, mountain trout, mackinaw, lake char/charr, touladi, and salmon trout.

Walleye, *Sander vitreus*, is also known as oгаа (Anishinaabe/ Ojibwe) (Livesay and Nichols 2021), yellow pickerel, pickerel (Canada), yellow pike, yellow walleye, and dore (France, Canada).

Lake whitefish, *Coregonus clupeaformis*, is also known as common whitefish, 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 herring, *Coregonus artedii*, is also known as cisco, tullibee, bluefin, kewis (Ojibwe) and odoonibiins (Anishinaabe/ Ojibwe)(Livesay and Nichols 2021) (SGUW, NOAA and UW-M 2017).

Primary product forms

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

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

Lake whitefish is available fresh or frozen as whole dressed fish or fillets. New value-added products growing in market share include frozen vacuum-packed fillets and prepared foods such as spreads. Lake whitefish roe is also successfully marketed as “golden caviar” or “sikrom”(SGUW, NOAA and UW-M 2023). Canadian whitefish catches from outside the Great Lakes are marketed by the Freshwater Fish Marketing Corporation (FFMC), which produces three main lake whitefish products: minced block, whole fresh, and whole frozen whitefish.

Lake herring or cisco is sold in fresh, frozen and smoked forms (SGUW, NOAA and UW-M 2017). Cisco eggs also known as roe are also sold as “bluefin caviar” or “løjrom” (SGUW, NOAA and UW-M 2017)(SGUW, NOAA and UW-M 2023). Other forms of cisco include fish cakes, and it may be ground and mixed with other ingredients and sold as “gefilte fish” (SGUW, NOAA and UW-M 2017).

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 HERRING			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Lake Superior America, North - Inland Waters Canada Ontario Gillnets and entangling nets	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Lake Superior America, North - Inland Waters United States Minnesota Gillnets and entangling nets	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Lake Superior America, North - Inland Waters United States Minnesota Gillnets and entangling nets Tribal fishery	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Lake Superior America, North - Inland Waters United States Wisconsin Gillnets and entangling nets	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Lake Superior America, North - Inland Waters United States Wisconsin Gillnets and entangling nets Tribal fishery	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)

LAKE TROUT			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Lake Superior America, North - Inland Waters Canada Ontario Set gillnets	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Lake Superior America, North - Inland Waters United States Minnesota Set gillnets	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Lake Superior America, North - Inland Waters United States Minnesota Set gillnets Tribal fishery	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Lake Superior America, North - Inland Waters United States Wisconsin Set gillnets	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Lake Superior America, North - Inland Waters United States Wisconsin Set gillnets Tribal fishery	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Lake Superior America, North - Inland Waters United States Michigan Set gillnets 1842 Treaty Waters Tribal fishery	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Lake Superior America, North - Inland Waters United States Michigan Set gillnets 1836 Treaty Waters Tribal fishery	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Lake Superior America, North - Inland Waters United States Michigan Stationary uncovered pound nets 1836 Treaty Waters Tribal fishery	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Lake Superior America, North - Inland Waters United States Wisconsin Stationary uncovered pound nets	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Lake Superior America, North - Inland Waters United States Wisconsin Stationary uncovered pound nets Tribal fishery	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)

LAKE WHITEFISH			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Lake Superior America, North - Inland Waters Canada Ontario Set gillnets	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Lake Superior America, North - Inland Waters United States Wisconsin Set gillnets	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Lake Superior America, North - Inland Waters United States Wisconsin Set gillnets Tribal fishery	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Lake Superior America, North - Inland Waters United States Michigan Set gillnets 1842 Treaty Waters Tribal fishery	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Lake Superior America, North - Inland Waters United States Michigan Set gillnets 1836 Treaty Waters Tribal fishery	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Lake Superior America, North - Inland Waters United States Michigan Stationary uncovered pound nets 1836 Treaty Waters State Fishery	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Lake Superior America, North - Inland Waters United States Michigan Stationary uncovered pound nets 1842 Treaty Waters State Fishery	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Lake Superior America, North - Inland Waters United States Wisconsin Stationary uncovered pound nets	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Lake Superior America, North - Inland Waters United States Wisconsin Stationary uncovered pound nets Tribal fishery	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Lake Superior America, North - Inland Waters United States Michigan Stationary uncovered pound nets 1836 Treaty Waters Tribal fishery	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

WALLEYE			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Lake Superior America, North - Inland Waters Canada Ontario Set gillnets	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

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.*

Lake herring

Factor 1.1 - Abundance

Lake Superior | America, North - Inland Waters | Canada | Ontario | Gillnets and entangling nets

Lake Superior | America, North - Inland Waters | United States | Minnesota | Gillnets and entangling nets

Lake Superior | America, North - Inland Waters | United States | Minnesota | Gillnets and entangling nets | Tribal fishery

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Gillnets and entangling nets

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Gillnets and entangling nets | Tribal fishery

Low Concern

Per the most recent data-limited stock assessment summary in the State of Lake Superior report, the lakewide biomass of lake herring declined from 2012-2016 (Goldsworthy and Yule 2021). In particular, the annual commercial yield of lake herring from 2012-2016 declined in Minnesota and Ontario by 18% and 19% when compared to the previous 5-year average (ibid) (see Figure 5 below). Further, in Wisconsin waters, although the average harvest of lake herring increased by 42% from 2012-2016 compared to the previous reporting period, harvest declined from 800 MT in 2012 to 500 MT in 2016 (ibid) (see Figure 5 below). Data through 2022 indicate that abundance of lake herring in Lake Superior overall and in Minnesota waters was declining (see Figures 6,7 and 8 below) (Blankenheim 2022)(pers comm Goldsworthy, C. 2023). Data on the average index of year-class strength for the 2017-2021 reporting period is 2.22 individuals/ha, which is below the target catch rate of 4.17 individuals/ha (see Figure 9 below) (pers comm Goldsworthy, C. 2023). However, shorter term data from assessment surveys indicate that adult lake herring biomass is either stable or increasing (see Figure 10 below) (pers comm Goldsworthy, C. 2023). In 2022, *Coregonus* larval density estimates in USGS trawl surveys were high (see Figure 11 below)(Vinson et al. 2023a), and in 2023, age-1 abundance estimates for lake herring in USGS bottom trawl surveys were 1019 fish/ha, and were the highest seen since the 1970s (pers comm Goldsworthy, C. 2023) (see Figure 6 below)(Vinson et al. 2023b), indicating that abundance of lake herring in Lake Superior is currently healthy. Since the 2023 age-1 density data indicate that the lake herring stock is healthy, abundance of cisco in Lake Superior has been scored as a "low concern".

Justification:

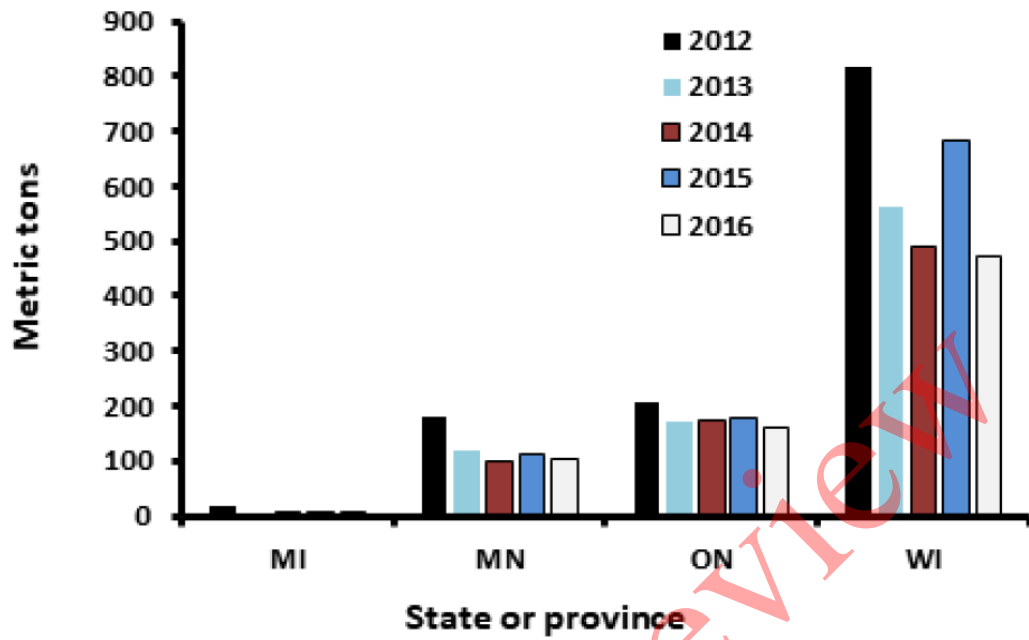


Figure 5: Annual commercial fishery yield of lake herring from Lake Superior (Goldsworthy and Yule 2021).

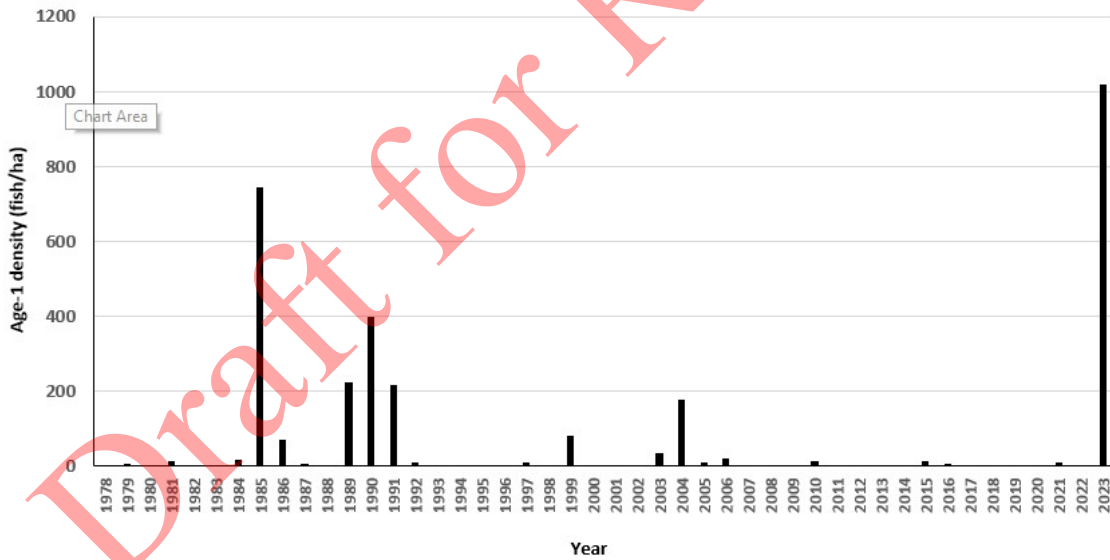


Figure 6: Lake herring age-1 density (fish/ha) in Lake Superior from 1978-2022, from USGS bottom trawl surveys (Vinson et al. 2023a)(Vinson et al. 2023b).

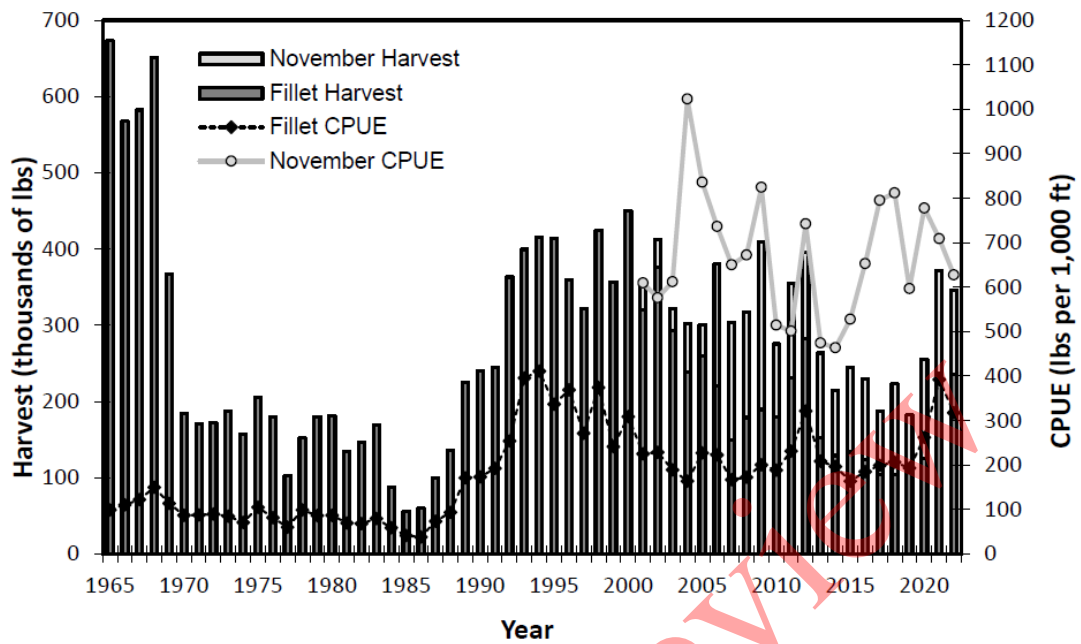


Figure 7: Lake herring harvest and catch per unit effort (CPUE) in the commercial gillnet fishery, in Minnesota waters of Lake Superior from 1965-2022(Blankenheim 2022).



Figure 8: Lake herring biomass from 2015-2022 in Minnesota waters in millions of pounds (pers comm Goldsworthy, C. 2023).

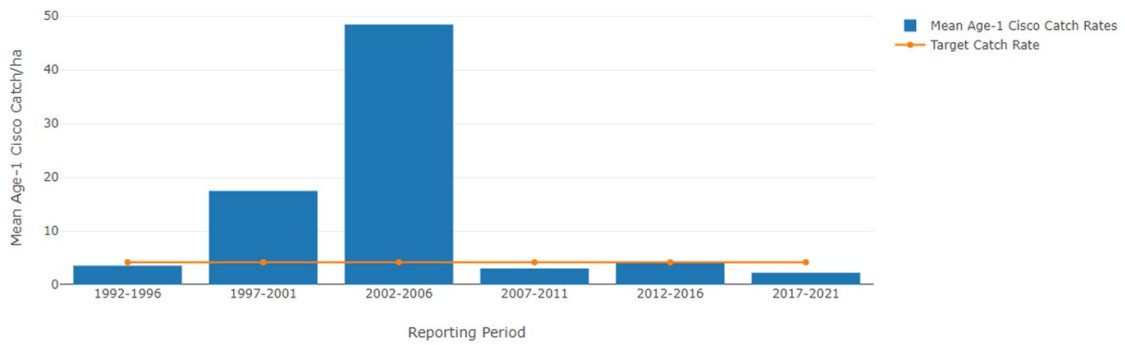


Figure 9: Mean index of lake herring (cisco) year-class strength by 5-year reporting period. Horizontal line indicates the 50th percentile. Note: year ranges indicate year classes, not sample years (pers comm Goldsworthy, C. 2023).

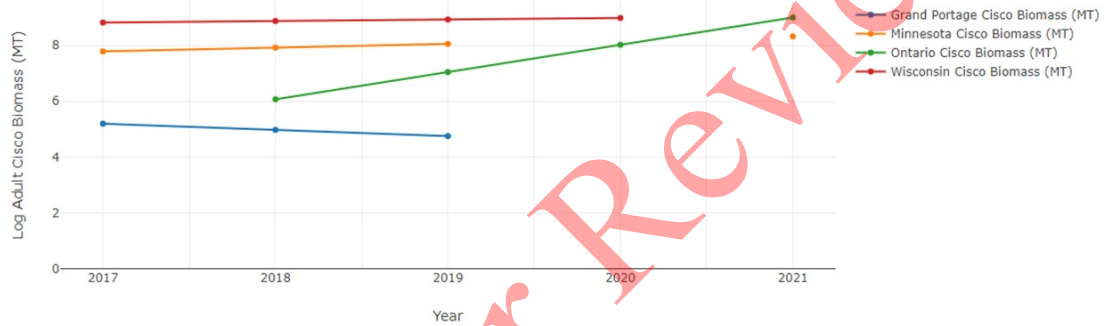


Figure 10: Adult lake herring (cisco) biomass estimates (MT) by Jurisdiction (pers comm Goldsworthy, C. 2023).

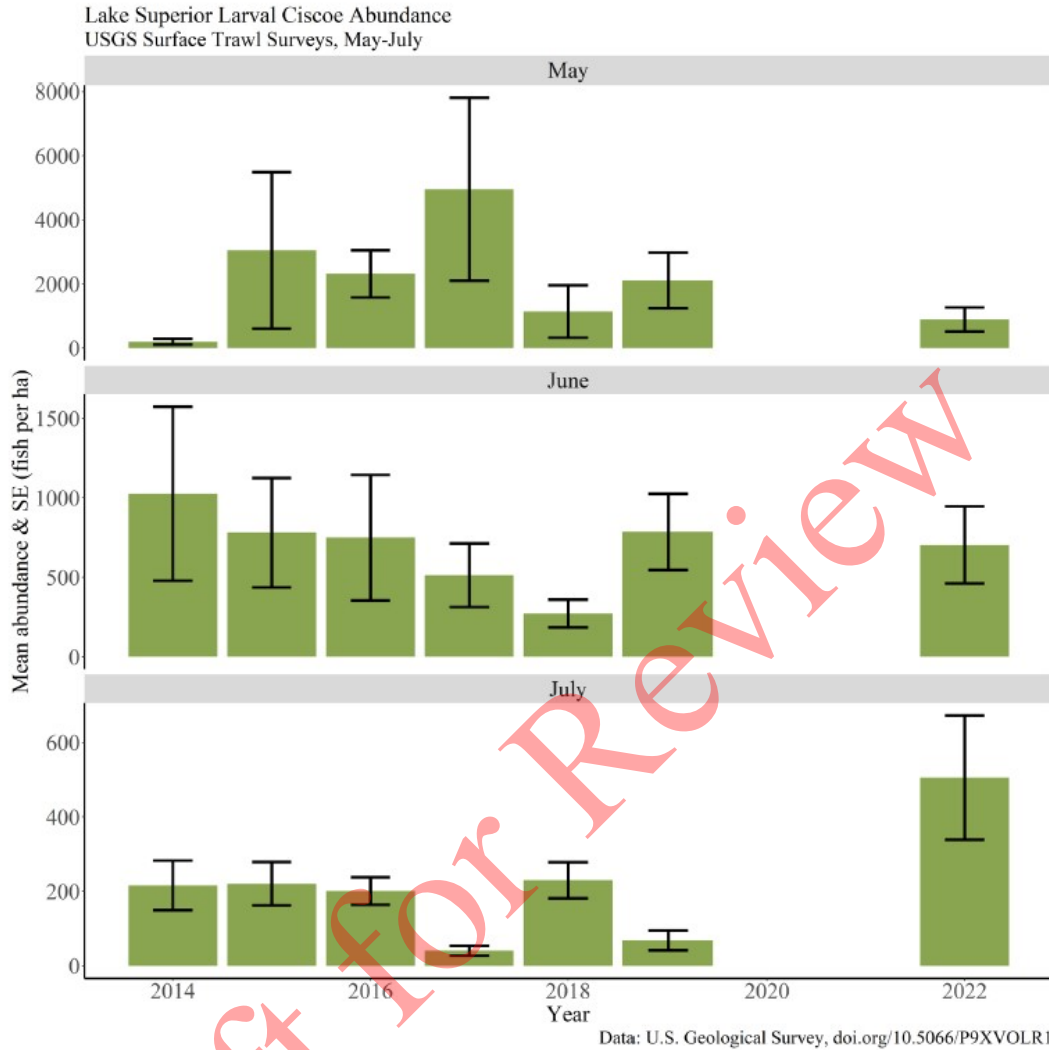


Figure 11: Larval density in 2022 from USGS trawl surveys conducted from May-July (Vinson et al. 2023a).

Factor 1.2 - Fishing Mortality

Lake Superior | America, North - Inland Waters | Canada | Ontario | Gillnets and entangling nets

Low Concern

In the Ontario waters of Lake Superior, fishing mortality on lake herring is controlled by setting a harvest control rule, with a constant exploitation rate of 10% (Fisch et al. 2019). Quotas are managed relatively and incrementally, primarily based on stock status; stock status (and hence quotas) are informed by a suite of assessments including hydroacoustics, USGS trawl surveys, commercial catch sampling and harvest reporting, as well as independent fisheries community assessments (pers comm James, S. 2023). In practice, fishing mortality is often below the exploitation limit of 10% (ibid). Thus, the harvest strategy accounts for volatility of the stock. Further, a robust Management Strategy Evaluation (MSE) has been conducted, showing that an exploitation level of 10% is appropriate and sustainable; the MSE conducted showed that at a constant exploitation rate of 10%, the spawning biomass over a 50-year time period was stable, at a median estimate of 1500 MT, with the median final spawning biomass

between 37% and 64% of the unfished level for the 4-year and 7-year scenarios, respectively (Fisch et al. 2019). As lake herring harvests have been within the limits of the quota (Figure 12), and an MSE has been conducted to ensure that a constant exploitation rate of 10% is appropriate, given that lake herring is a forage species, the fishery in Ontario waters is not considered to be experiencing overfishing, and fishing mortality has been scored as a “low concern”.

Justification:

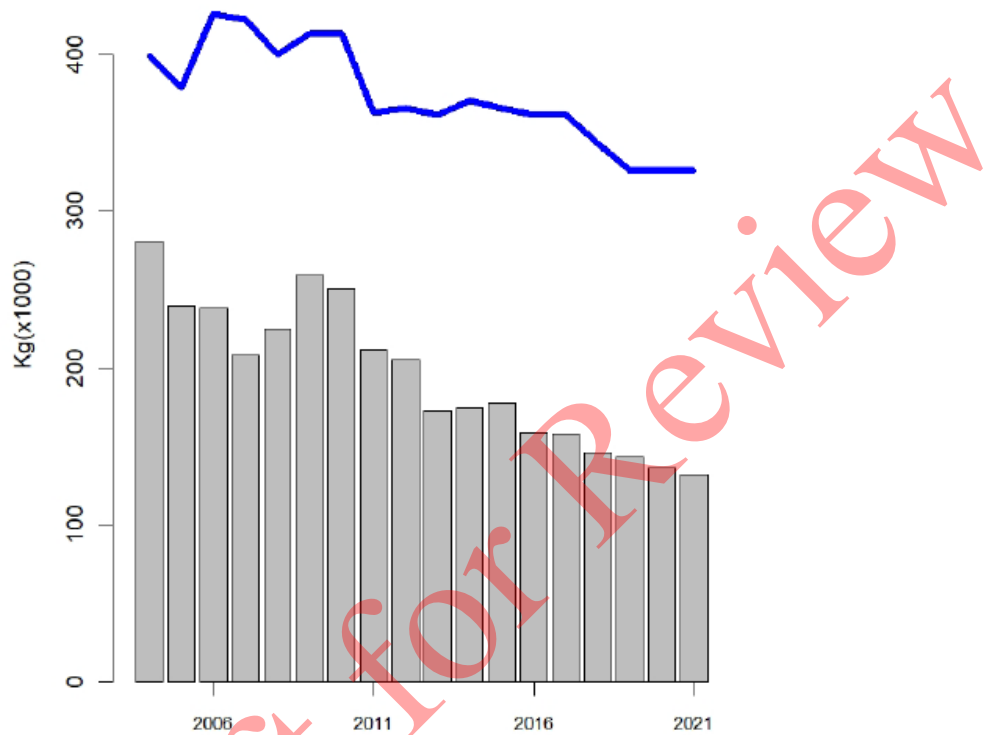


Figure 12: Lake herring or cisco harvest (shown as bars) and quota (shown as a blue line) for the Ontario waters of Lake Superior. Taken from MNRF 2022.

Lake Superior | America, North - Inland Waters | United States | Minnesota | Gillnets and entangling nets

Low Concern

In the Minnesota waters of Lake Superior, lake herring harvests are controlled by setting an annual TAC, based on hydroacoustic survey estimates of the spawning stock biomass, which is conducted in October each year (pers comm Goldsworthy, C. 2023). An exploitation rate of 10-15% on adult female ciscoes (lake herring) is considered appropriate (Stockwell et al. 2009)(pers comm Goldsworthy, C. 2023). Thus the harvest strategy accounts for volatility in the stock. Further, a robust Management Strategy Evaluation has been conducted, showing that an exploitation level of 10-15% is appropriate (see figure 13 below) (pers comm Rook, B. 2023)(Rook et al. 2020). As recent lake herring harvests have been well within the limits of the TAC (Blankenheim 2022), and a Management Strategy Evaluation has been conducted to ensure that a TAC of 10-15% is appropriate given that lake herring is a forage species (see Figure 13 below), the fishery in Minnesota waters is not considered to be experiencing

overfishing, and fishing mortality has been scored as a “low concern”.

Justification:

Note: Lake herring is considered as a forage species by Seafood Watch; hence per the standard, for the TAC to be considered appropriate, the harvest strategy needs to account for volatility in the stock, and harvest strategy outcomes need to be based on a robust Management Strategy Evaluation framework.

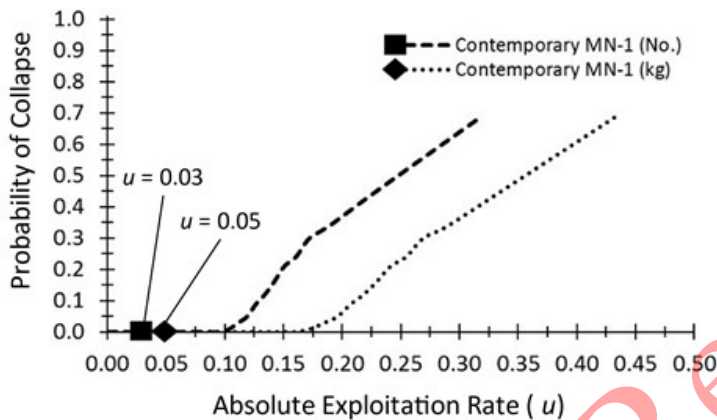


Figure 13: Modelling of absolute exploitation rate of lake herring and probability of collapse in Minnesota waters, showing that the average exploitation rate of 5% of the biomass, was below the TAC of 10-15% of the biomass, and an exploitation rate of 17.5% of the biomass showed no probability of collapse (pers comm Rook, B. 2023).

Lake Superior | America, North - Inland Waters | United States | Minnesota | Gillnets and entangling nets | Tribal fishery

Low Concern

In the Grand Portage zone of the Minnesota waters of Lake Superior, lake herring harvests are controlled by setting an annual TAC based on hydroacoustic survey estimates of the spawning stock biomass, which is conducted in fall each year (pers comm Isaac, E. J. 2023). An exploitation rate of 10% on adult female ciscoes (lake herring) is considered appropriate (ibid)(Stockwell et al. 2009). Lake herring harvests have ranged from 40,000-100,000 lb annually (from 2008-2022, over a 15-year time period), the TAC is sometimes met and in some years it is slightly exceeded (pers comm Isaac, E. J. 2023). The harvest strategy used accounts for volatility in the stock. Further, a robust Management Strategy Evaluation has been conducted for lake herring harvests in Minnesota waters, showing that an exploitation level of 10-15% is appropriate (see figure 13) (pers comm Rook, B. 2023)(Rook et al. 2020). As the lake herring TAC set in the Grand Portage zone is conservative, and lake herring harvests are within the TAC of 10-15%, which is considered appropriate given that lake herring is a forage species, and overall harvests in Minnesota waters are well within the exploitation limit (see Figure 13) (pers comm Rook, B. 2023), fishing mortality has been scored as a “low concern”.

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Gillnets and entangling nets

Moderate Concern

In the Wisconsin waters of Lake Superior, lake herring harvests in the State-licensed fishery are controlled by setting an annual TAC, and a commercial fishing quota (Sapper and Carl 2022). The TAC is set based on hydroacoustic survey estimates of the spawning stock biomass (ibid). An exploitation rate of 10-15% on adult female biomass has been set (Stockwell et al. 2009)(pers comm Ray, B. 2023). Thus the harvest strategy accounts for volatility in the stock. However, a Management Strategy Evaluation for lake herring in Wisconsin waters has not been conducted. Hence given that lake herring is a forage species, the appropriateness of the TAC is unknown, so even though harvests are within the TAC (see Figure 14), fishing mortality has been scored as a “moderate concern”.

Justification:

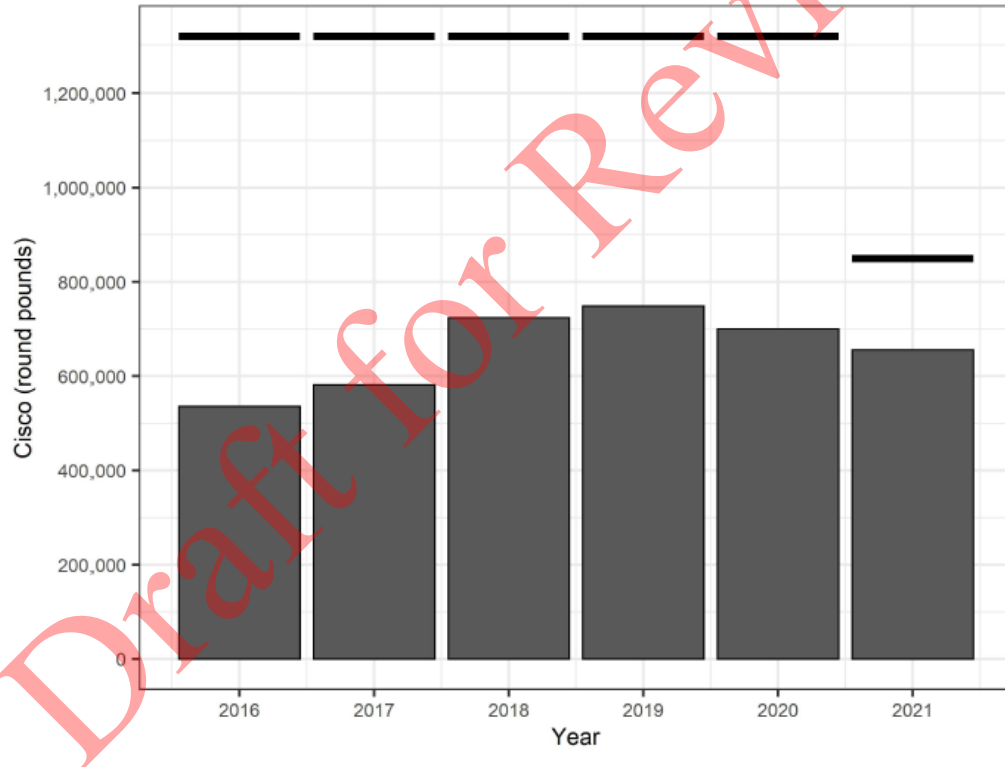


Figure 14: Total commercial harvest of lake herring (cisco) during the lake herring season (October to December) in Wisconsin waters of Lake Superior from 2016-2021 (Sapper and Carl 2022). Harvest is expressed as round pounds of lake herring. Black lines represent the quota allotted to the commercial fishery in a given year in round pounds.

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Gillnets and entangling nets | Tribal fishery

Moderate Concern

In the Wisconsin waters of Lake Superior, lake herring harvests in the tribal-licensed fishery are controlled by setting an annual TAC, and a commercial fishing quota. The quota for the Red Cliff Band for 2021-2023 is set at 448,500 lbs and was not reached in 2021 or 2022 (pers comm, Harding, I. 2023); the lake herring quota is a three-party quota, implemented by the Tribes and the State, and is subject to evaluation every three years (BRBLSTCI, WIDNR and RCBLSC 2018). An exploitation rate of 10-15% on adult female biomass has been set (Stockwell et al. 2009)(pers comm Ray, B. 2023). Thus the harvest strategy accounts for volatility in the stock. However, a Management Strategy Evaluation for lake herring in Wisconsin waters has not been conducted. Hence given that lake herring is a forage species, the appropriateness of the TAC is unknown, so even though harvests are within the TAC, fishing mortality has been scored as a “moderate concern”.

Lake trout

Factor 1.1 - Abundance

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

Moderate Concern

According to the most recent data-limited stock assessment summary in the State of Lake Superior report, on average, relative abundance of adult wild lake trout increased in western Ontario and decreased in eastern Ontario from 2012-2016, when compared to the previous reporting period from 2007-2011 (Sitar 2021) (see panels representing management units ON-W and ON-E in the Figure 18). In general, abundance of lake trout in Lake Superior is healthy in all jurisdictions in US and Canada waters since 1993, except for eastern Lake Superior (Sitar et al. in review). As there were no limit and target reference points set for relative abundance of lake trout, a Productivity Susceptibility Analysis (PSA) was conducted. The results showed that the PSA score of lake trout in the Canadian set gillnet fishery was 3.18, with “medium vulnerability”. Hence abundance has been assigned a score of “moderate concern”.

Justification:

The Productivity Susceptibility of lake trout in the Ontario waters of Lake Superior, for the set gillnet fishery is as follows:

Productivity Attribute	Relevant Information	Score (1= high productivity, 2= medium productivity, 3= low productivity)
Average age at maturity	6-8 years	2
Von Bertalanffy growth coefficient (K)	K= 0.214 (Burnham-Curtis and Bronte 1996) (Froese and Pauly 2022b)	2
Fecundity	1,000-18,000 per season (Eschmeyer 1964)	2
Average maximum size	Lmax = 150 cm TL (Froese and Pauly 2022c)	2
Average size at maturity	Lm = 51.6 cm (Froese and Pauly 2022c)	2
Reproductive strategy	Broadcast spawners (Froese and Pauly 2022d)	1
Productivity score (P)		1.833

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	Fisheries overlap with species for approximately 3-6 months in the year (pers comm James, S. 2023)	2
Selectivity of the fishery	default score used	2
post-capture mortality	retained species, so default score used	3
Susceptibility score (S)		2.6

$$\text{Vulnerability} = \sqrt{p^2 + s^2}$$

$$= \sqrt{(1.833)^2 + 2.6^2}$$

$$= 3.18$$

Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1836 Treaty Waters | Tribal fishery

Low Concern

Per the most recent 2021-2022 data-limited stock assessment of lake trout conducted in the 1836 treaty Michigan waters of Lake Superior, the total biomass and female biomass may be viewed in Figure 15 (Sitar 2022a). Current SSBR (in 2020) in management units MI-5 (Marquette), MI-6 (Munising), and MI-7 (Grand Marais) was 1.77 lb, 1.68 lb, and 1.31 lb respectively, which was well above the SSBR at target mortality for each management unit of 0.22 lb, 0.41 lb, and 0.64 respectively (ibid). Similarly, current SPR (in 2020) in MI-5, MI-6 and MI-7 was 0.39, 0.38 and 0.47 respectively. As there is confidence that the stocks in >70% of the management units are healthy, abundance has been scored a “low concern”.

Justification:



Figure 15: Estimated lake trout biomass in (a) MI-5 (Marquette), (b) MI-6 (Munising) and (c) MI-7 (Grand Marais) (Sitar 2022a).

Lake Superior | America, North - Inland Waters | United States | Michigan | Set gillnets | 1842 Treaty Waters | Tribal fishery

Low Concern

Per the most recent data-limited stock assessment of lake trout conducted in the 1842 treaty Michigan waters of Lake Superior, the total biomass and female biomass may be viewed in Figure 16 (Caroffino 2023a)(Caroffino 2023b)(Caroffino 2023c). Current SSBR (in 2015) in management units WI-2 and MI-2 (which represents the combined abundance from eastern Wisconsin waters and the western side of the Keweenaw Peninsula in Michigan), MI-3 (also the western side of the Keweenaw Peninsula in Michigan), and MI-4 (Keweenaw Bay) was 0.27 lb, 0.51 lb, and 0.25 lb respectively. In the case of management unit WI-2 and MI-2 the SSBR at target mortality was 0.33 lb, and hence current SSBR was

>75% of the target reference level; however SSBR at target mortality in MI-3 and MI-4 was 0.08 lb, and 0.06 respectively where current SSBR was above the target level. As stock abundance in >70% the management units are either above the target reference level or are >75% of the target reference level, abundance has been scored as a “low concern”.

Justification:

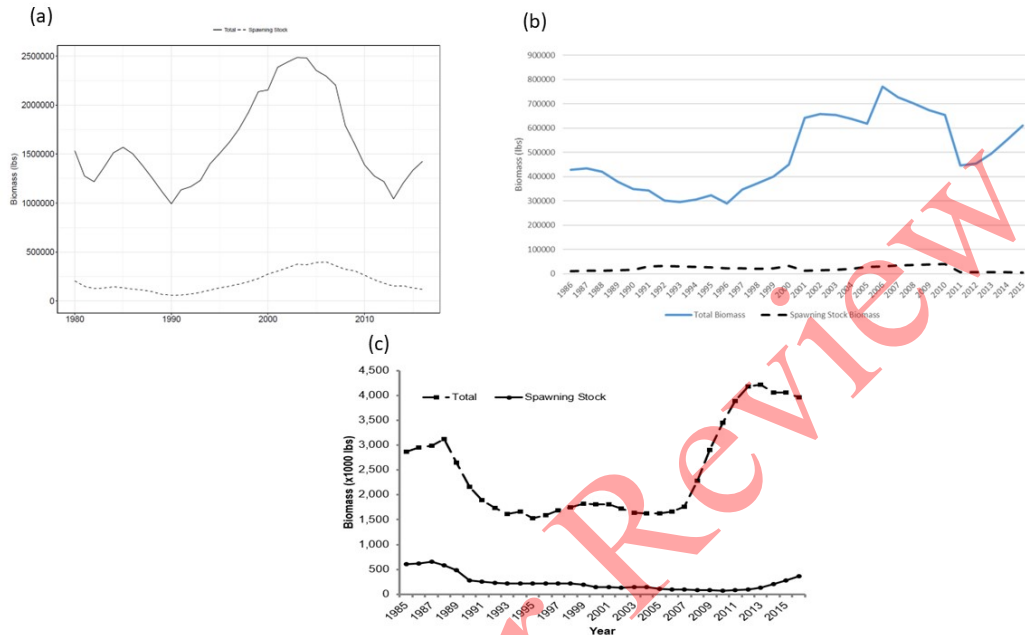


Figure 16: Lake trout biomass and spawning stock biomass from (a) WI-2 & MI-2 (western side of the Keweenaw Peninsula), (b) MI-3 (western side of the Keweenaw Peninsula), and (c) MI-4 (Keweenaw Bay) (Caroffino 2023a) (Caroffino 2023b) (Caroffino 2023c).

**Lake Superior | America, North - Inland Waters | United States | Minnesota | Set gillnets
 Lake Superior | America, North - Inland Waters | United States | Minnesota | Set gillnets | Tribal fishery**

Moderate Concern

According to the most recent data-limited stock assessment summary in the State of Lake Superior report, relative abundance of adult wild lake trout populations in Minnesota increased during the reporting period from 2012-2016, when compared to the average abundance from 1993-2016 (Sitar 2021) (see panels representing management units MN-1, MN-2 and MN-3 in Figure 17). As there were no limit and target reference points set for relative abundance of lake trout, a Productivity Susceptibility Analysis (PSA) was conducted. The results showed that the PSA score of lake trout in the Minnesota set gillnet state- and tribal-licensed fisheries was 3.18, with "medium vulnerability". Hence abundance has been assigned a score of “moderate concern.”

Justification:

The Productivity Susceptibility of Lake trout in the Minnesota state and tribal-licensed set gillnet fisheries in Lake Superior is as follows:

Productivity Attribute	Relevant Information	Score (1= high productivity, 2= medium productivity, 3= low productivity)
Average age at maturity	6-8 years	2
Von Bertalanffy growth coefficient (K)	K= 0.214 (Burnham-Curtis and Bronte 1996) (Froese and Pauly 2022b)	2
Fecundity	1000-18000 per season (Eschmeyer 1964)	2
Average maximum size	Lmax = 150 cm TL (Froese and Pauly 2022c)	2
Average size at maturity	Lm = 51.6 cm (Froese and Pauly 2022c)	2
Reproductive strategy	Broadcast spawners (Froese and Pauly 2022d)	1
Productivity score (P)		1.833

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	Fisheries overlap with species for 3-6 months in the year (pers comm Goldsworthy, C. 2023) and (pers comm Isaac, E. J. 2023).	2
Selectivity of the fishery	default score used	2
post-capture mortality	retained species so default score used	3
Susceptibility score (S)		2.6

$$\text{Vulnerability} = \sqrt{P^2 + S^2}$$

$$= \sqrt{1.833^2 + 2.6^2}$$

$$= 3.18$$

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Set gillnets
Lake Superior | America, North - Inland Waters | United States | Wisconsin | Set gillnets | Tribal fishery
Lake Superior | America, North - Inland Waters | United States | Wisconsin | Stationary uncovered pound nets
Lake Superior | America, North - Inland Waters | United States | Wisconsin | Stationary uncovered pound nets | Tribal fishery

Moderate Concern

According to the most recent data-limited stock assessment summary in the State of Lake Superior report, relative abundance of adult wild lake trout populations in Wisconsin increased during the reporting period from 2012-2016, when compared to the average abundance from 1993-2016 (Sitar 2021) (see panels representing management units WI-1 and WI-2 in Figure 17 below). The Wisconsin Department of Natural Resources monitors the lake trout population in the Wisconsin waters of Lake Superior three times a year - in Spring, Summer and Fall (see justification section for more information on the surveys)(Carl 2021a)(Carl 2021b)(Carl 2022a)(Carl 2022b). Relative abundance in terms of geometric mean catch per unit effort (GMCPE) of wild lake trout from the Spring survey from 1981 to 2021, in WI-1 and WI-2 has increased through the time series and has become stable in recent years, reaching approximately 15 fish/ km of net in 2020 in each region (See Figure 18 below) (Carl 2021a). Results of the recently updated SCAA model (conducted for management unit WI-2) showed a steady increase in abundance in terms of catch per effort (CPE) from 2011 to 2022 (BC 2023a). Since there are no biological reference points specified, but trends indicate that abundance is healthy, this factor has been scored as a “moderate concern”.

Justification:

The relative adult abundance of lake trout, expressed as the geometric mean catch-per-unit effort in the various management unit of Lake Superior from 1993-2016 is shown in the figure below.

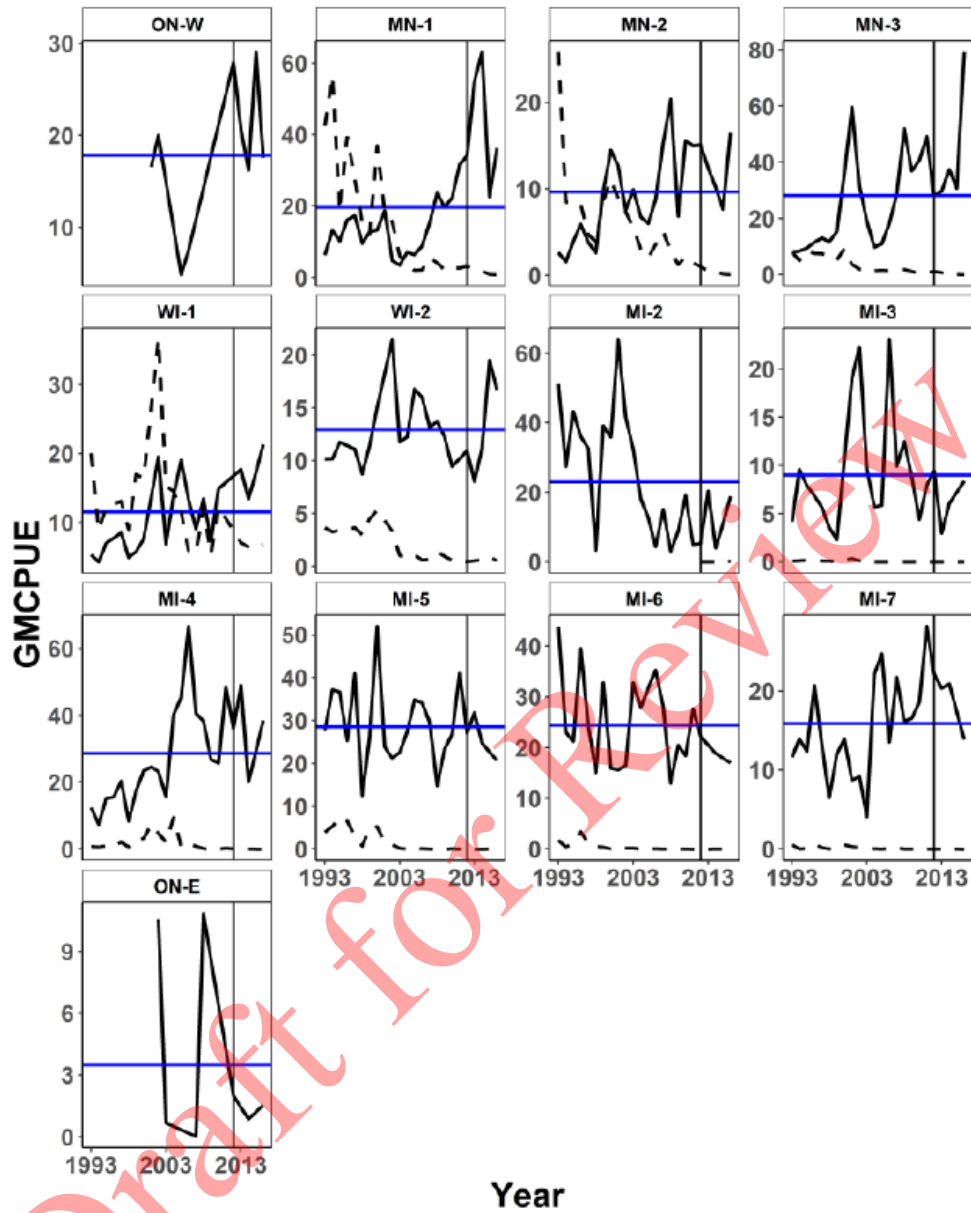


Figure 17: Relative abundance of adult wild (solid black line) and hatchery reared (dashed black line) lake trout as the geometric mean catch-per-unit effort (GMCPUE, fish/km/night) in management units of Lake Superior from 1993-2016. The horizontal blue line represents the average GMCPUE from 1993-2016 for wild fish. The vertical line represents 2012 (Sitar 2021).

Relative adult abundance of lake trout, expressed as the geometric mean catch-per-unit effort from the Spring survey from 1981 to 2021 is shown in the figure below.

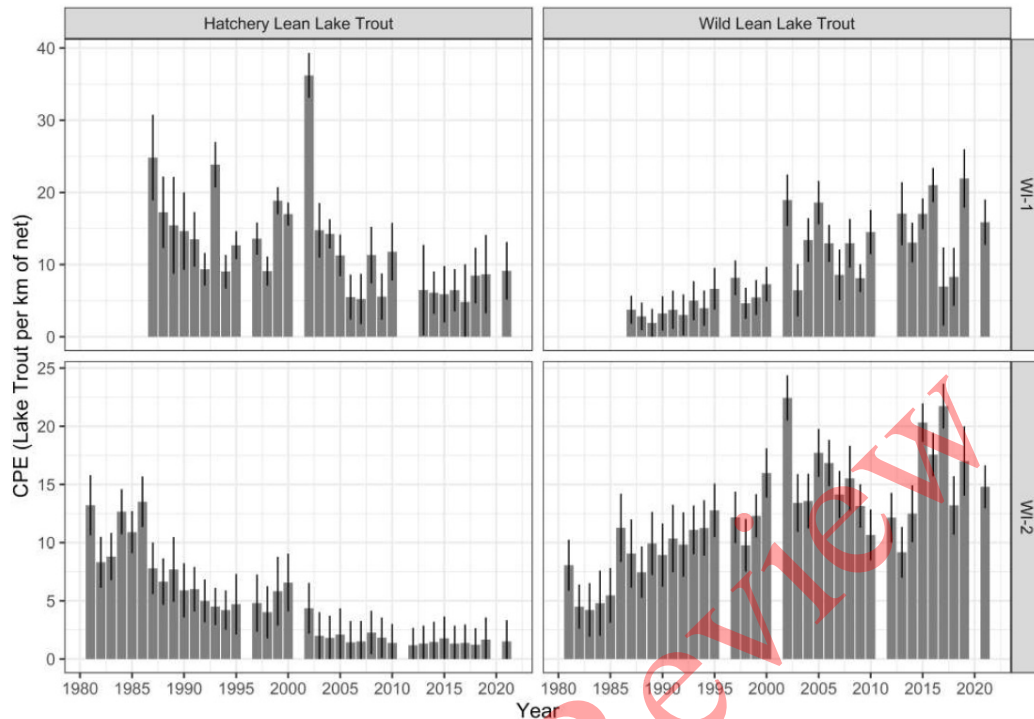


Figure 18: Geometric mean CPE +1 (+/- one standard deviation) of wild lean lake trout in WI-1 and WI-2 waters of Lake Superior from the Spring survey, from 1981 to 2021. CPE is total catch per kilometer of gill net and is standard for set duration (Carl 2021a).

Note that the Summer survey is used to monitor recruitment of lake trout; although relative abundance in terms of GMCPE for juvenile lean lake trout in 2020 for region WI-2 was approximately 12.5 fish/ km of net, which was near average for the previous decade, GMCPE for juvenile lean lake trout in 2021 for region WI-1 was much lower at 3 fish/ km of net (Carl 2021b)(Carl 2022b). Given that only one data point for recruitment was below the accepted average, it was not considered in the scoring of abundance. However, recruitment and abundance must be closely watched to rule out a potential downward trend in subsequent years.

Factor 1.2 - Fishing Mortality

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

Low Concern

Fishing mortality of wild lake trout in the Ontario waters of Lake Superior is controlled by setting an annual quota, and is made up of Individual Transferable Quotas (ITQs), based on stock assessments in 12 management areas (pers comm James, S. 2023)(Sitar et al. in review). These ITQs have been established in Ontario waters of Lake Superior since 1984, and are based on past performance of the fishery at that time (ibid). Since then, the ITQs have been adjusted annually based on the status of each stock (ibid). Following published literature, it is recommended that maximum total annual mortality of lake trout in Lake Superior should not exceed 45% (Akins et al. 2015) (Hansen 1996) (Nieland et al. 2008); in Ontario waters, since 2016, annual mortality of lake trout across management areas has been <20% (pers comm James, S. 2023). As the commercial harvest of lean lake trout across management units has been well within the allotted quota from 2004 to 2021 (see Figure 19 below)(MNRF 2022),

fishing mortality is considered as a “low concern”.

Justification:

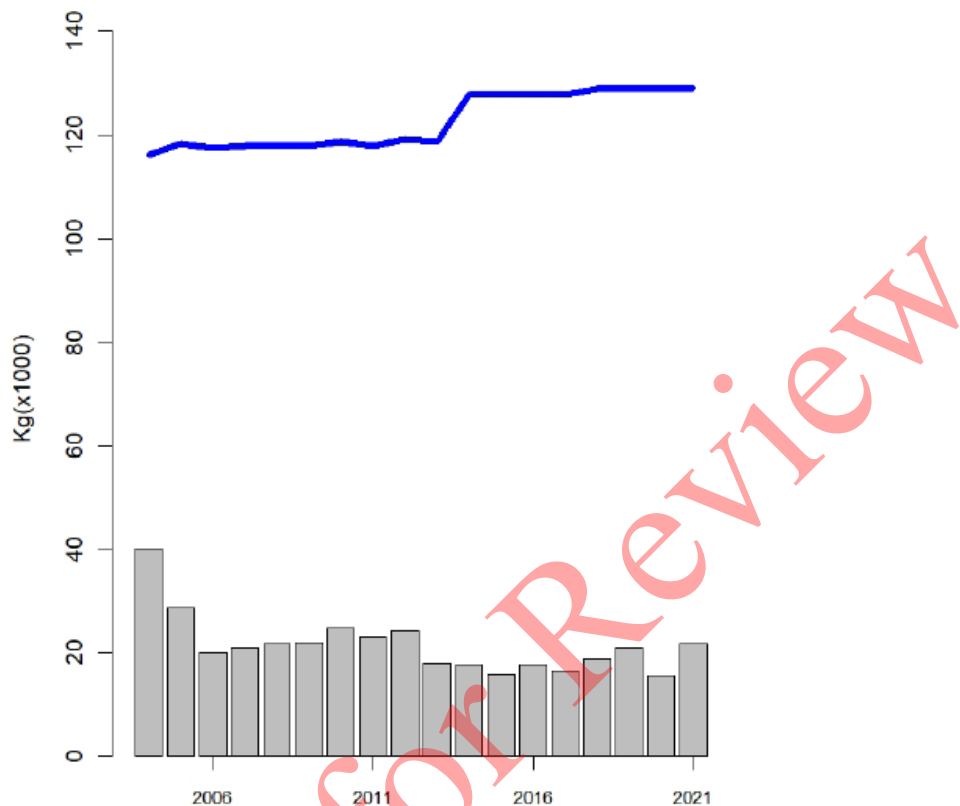


Figure 19: Lake trout quota (blue line) and harvest (bars) for the Ontario waters of Lake Superior (MNRF 2022).

Lake Superior | America, North - Inland Waters | United States | Michigan | Set gillnets | 1836 Treaty Waters | Tribal fishery

Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1836 Treaty Waters | Tribal fishery

Low Concern

Following the most recent data-limited stock assessment from 2022 conducted in Michigan waters of Lake Superior, data averaged from 2019-2021 indicates that commercial fishing mortality in management units MI-05 (Marquette), MI-06 (Munising) and MI-07 (Grand Marais) was <0.01/y, 0.02/y and 0.01/y respectively (Sitar 2022a). Although only gillnets are mentioned in Figure 22 below, fishing mortality estimates consider both gillnets and trap nets (pers comm Caroffino, D. 2023). The 2021 total mortality (Z) estimate in management unit MI-05 and MI-06 was 0.22/y and 0.27/y respectively, whereas the 2019 Z estimate in MI-07 was 0.22/y; these estimates were below the target reference points set for those management units (see Figure 20)(ibid). As >70% of the stocks (in management units MI-05, MI-06 and MI-07) are well below the target reference point, fishing mortality has been collectively scored as a “low concern”.

Justification:

Per the draft Lake Superior Fisheries Management Plan 2023-2033 (pers comm Hanchin, P. 2023), total annual mortality on lake trout in Michigan waters will henceforth be maintained at 42% on age classes selected by fisheries; however, since this change is in the process of being implemented, it was not considered in the scoring of lake trout fishing mortality.

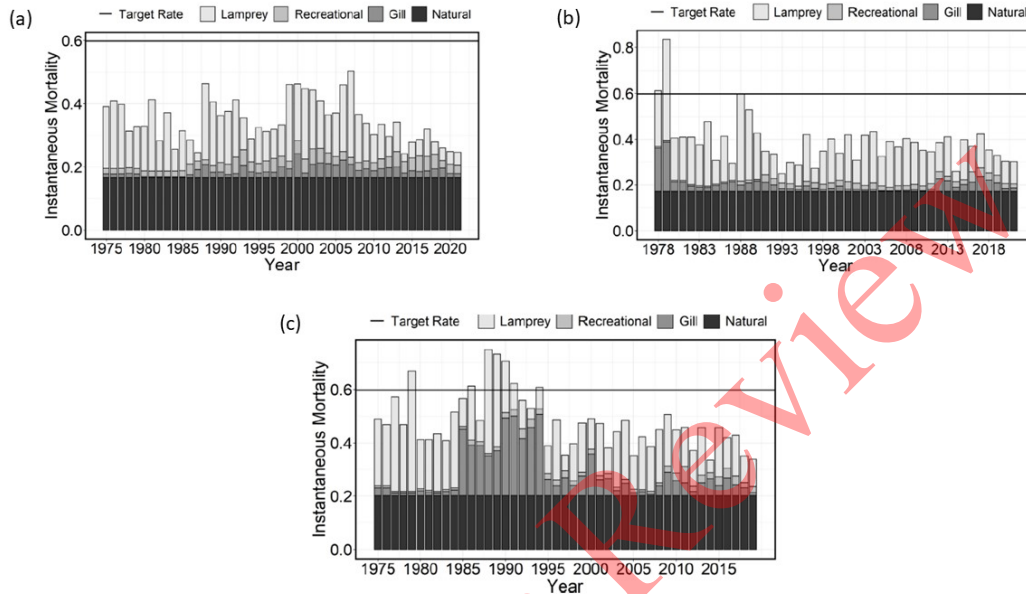


Figure 20: Maximum mortality rates for lake trout in Michigan waters of Lake Superior, where management units are: (a) MI-05 (Marquette), (b) MI-06 (Munising), and (c) MI-07 (Grand Marais)(Sitar 2022a).

Lake Superior | America, North - Inland Waters | United States | Michigan | Set gillnets | 1842 Treaty Waters | Tribal fishery

Moderate Concern

Following the most recent data-limited stock assessment conducted in 1842 treaty Michigan waters of Lake Superior, data averaged from 2015/2016 indicate that total fishing mortality in management units WI-2 & MI-2 (eastern waters of Wisconsin and western side of the Keweenaw Peninsula in Michigan combined for this stock assessment), MI-3 (western side of the Keweenaw Peninsula in Michigan) and MI-4 (Keweenaw Bay) was 0.63/y, 0.32/y and 0.26/y respectively (Caroffino 2023a) (Caroffino 2023b) (Caroffino 2023c), where the target Z is 0.6 in each management unit (on an instantaneous scale, which equates to 45% annual mortality). Hence fishing mortality in WI-2 & MI-2 was above the target reference level, but in MI-3 and MI-4 it was below the target reference level (Figure 21). As the stocks in >50% but <70% of the management units meet the target reference level, fishing mortality has been scored a "moderate concern".

Justification:

Per the draft Lake Superior Fisheries Management Plan 2023-2033 (pers comm Hanchin, P. 2023), total annual mortality on lake trout in Michigan waters will henceforth be maintained at 42% on age classes selected by fisheries; however, since this change is in the process of being implemented, it was

not considered in the scoring of lake trout fishing mortality.

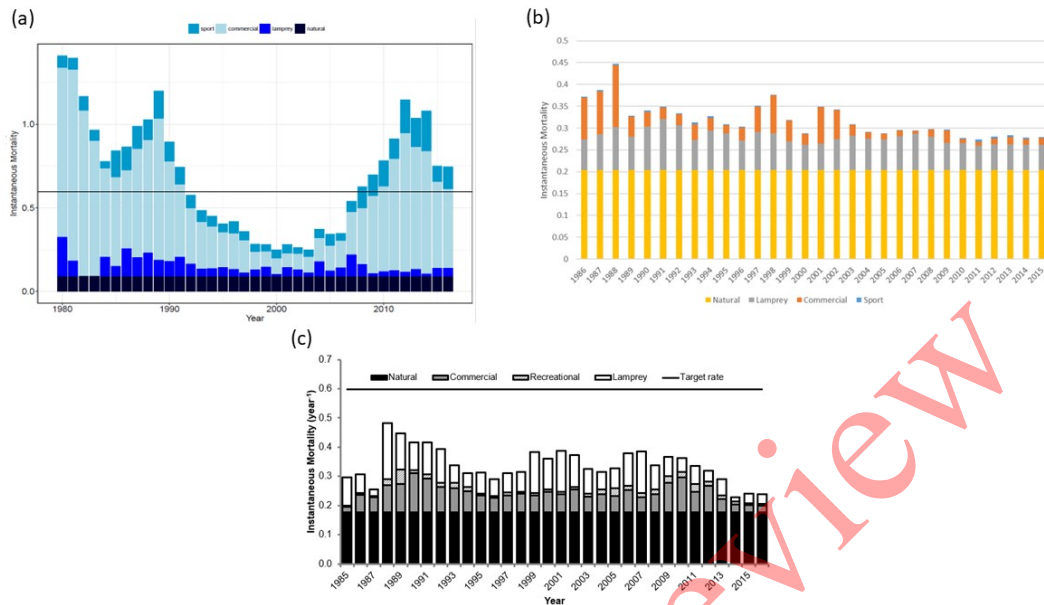


Figure 21: Maximum instantaneous mortality rates across all ages, along with the target reference level in (a) WI-2 & MI-2 (eastern waters of Wisconsin and western side of the Keweenaw Peninsula in Michigan), (b) MI-3 (western side of the Keweenaw Peninsula in Michigan) and (c) MI-4 (Keweenaw Bay) (Caroffino 2023a) (Caroffino 2023b) (Caroffino 2023c).

**Lake Superior | America, North - Inland Waters | United States | Minnesota | Set gillnets
Lake Superior | America, North - Inland Waters | United States | Minnesota | Set gillnets | Tribal fishery**

Low Concern

Fishing mortality of lake trout in Minnesota waters of Lake Superior is controlled by setting an annual TAC in the state-licensed commercial fishery, in all three management units (MN-1, MN-2 and MN-3) (pers comm Goldsworthy, C. 2023). The total annual mortality is set conservatively to approximately 40% (including fishing mortality and sea lamprey mortality) (pers comm Goldsworthy, C. 2023), and is based on a statistical catch at age model and on simulated fishing mortality rates that result in total annual mortality rates near 42%, as this is the rate at which total fishing mortality is considered to be sustainable (Nieland et al. 2008). The TAC for MN-1 is 700 fish, MN-2 is 2000 fish and MN-3 is 3000 fish. Fishing mortality of wild lake trout in the Grand Portage zone of the Minnesota waters of Lake Superior is controlled by setting an annual TAC of 27,000 lb in the tribal commercial fishery (pers comm Isaac, E. J. 2023). Only 30% of the TAC is harvested, at an average of approximately 5000 lb annually (ibid). Fishing effort in both the state- and tribal-licensed fisheries is also limited by restricting the number of lake trout tags given to commercial fishers; all lake trout caught must be tagged and have a locking strap number before they are landed at the dock (pers comm Goldsworthy, C. 2023)(pers comm Isaac, E. J. 2023). As the commercial harvest of lean lake trout in both the state-licensed and tribal fisheries is well within the allotted TAC, which is considered as appropriate, fishing mortality is considered as a “low concern”.

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Set gillnets | Tribal fishery

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

Low Concern

Fishing mortality of lake trout in the Wisconsin waters of Lake Superior is controlled by setting a total allowable catch (TAC) annually in both management units (WI-1 and WI-2); this TAC represents the maximum number of lake trout that can be harvested by all fisheries (commercial, recreational, home-use and assessment) (Sapper and Carl 2022), and is within the simulated fishing mortality rates that resulted in total annual mortality rates near 42%, as this is the rate at which total fishing mortality is considered to be sustainable (Nieland et al. 2008). From 2021-2023 in the tribal-licensed fishery, the TAC for the Red Cliff Band of commercial fishers was set at 1,500 fish in WI-1 and 20,000 fish in WI-2 (pers comm, Harding, I. 2023). During this period, the TAC was not exceeded in any of the years (ibid). As the tribal-licensed commercial harvest of lake trout in both management units is within the allotted quota for each fishery, and the quota for each fishery is considered as appropriate, fishing mortality is considered as a “low concern”.

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Set gillnets

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Stationary uncovered pound nets

Low Concern

Fishing mortality of wild lake trout in the Wisconsin waters of Lake Superior is controlled by setting a total allowable catch (TAC) annually in both management units (WI-1 and WI-2); this TAC represents the maximum number of lake trout that can be harvested by all fisheries (commercial, recreational, home-use and assessment) (Sapper and Carl 2022). With regards the state-licensed fishery, in WI-1, the TAC is fixed, whereas in WI-2, the TAC is set based on a statistical catch at age model (Carl 2021a) and on simulated fishing mortality rates that resulted in total annual mortality rates near 42%, as this is the rate at which total fishing mortality is considered to be sustainable (Nieland et al. 2008). Fishing effort is also limited by allowing fishers to operate a total of ten trap nets at a time, and restricting the amount of large-mesh gillnet footage annually, based on catch rates observed by onboard commercial monitoring (Sapper and Carl 2022). For the 2018, 2019 and 2020 fishing seasons, the lake trout quota for state-licensed fishers (including for commercial, recreational and assessment use) was set to 12,500 fish for WI-1, and 26,500 fish for WI-2 (BRBLSTCI, WIDNR and RCBLSC 2018). As the state-licensed commercial harvest of lake trout in both management units is within the allotted quota for each fishery (see Figure 22), fishing mortality is considered as a “low concern”.

Justification:

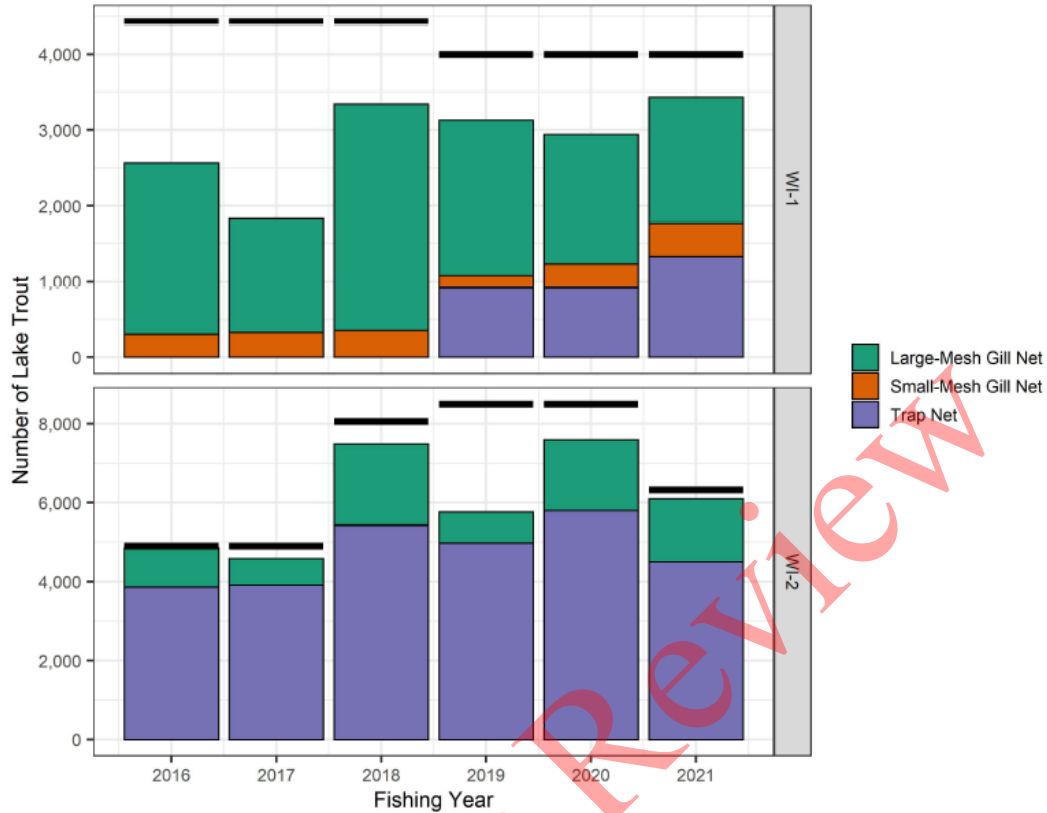


Figure 22: Total reported state-licensed commercial harvest of lake trout in Wisconsin waters of Lake Superior from fishing year 2016 to 2021 within management units WI-1 and WI-2. Harvest is expressed as number of lake trout (Sapper and Carl 2022). Black lines represent the quota allotted to the commercial fishery within each management unit.

Lake whitefish

Factor 1.1 - Abundance

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

Moderate Concern

According to the most recent data-limited stock assessment in the State of Lake Superior report, the commercial yield of lake whitefish in Lake Superior during the reporting period 2012-2016 ranged from 1,300 to 1,700 MT (see Figure 23); however the annual commercial gillnet catch per unit effort overall declined from 150-176 kg per km in 2006-2011 (the previous reporting period) to 101-142 kg per km in 2012-2016, representing a 22% decline in abundance (Michaels and Gorman 2021) (see Figure 24). Similarly the CPUE of lake whitefish captured during surveys in Ontario waters declined by 7% in comparison to the previous reporting period (ibid) (see Figure 24). Nevertheless, overall CPUE from 2012-2016 was still within the target range of 56-136 kg/km, as specified by the fish community objective (FCO) for lake whitefish in Lake Superior (ibid). Since there are no biological reference points specified, but long-term trends show that stock abundance is healthy, this factor been scored as a

“moderate concern”.

Justification:

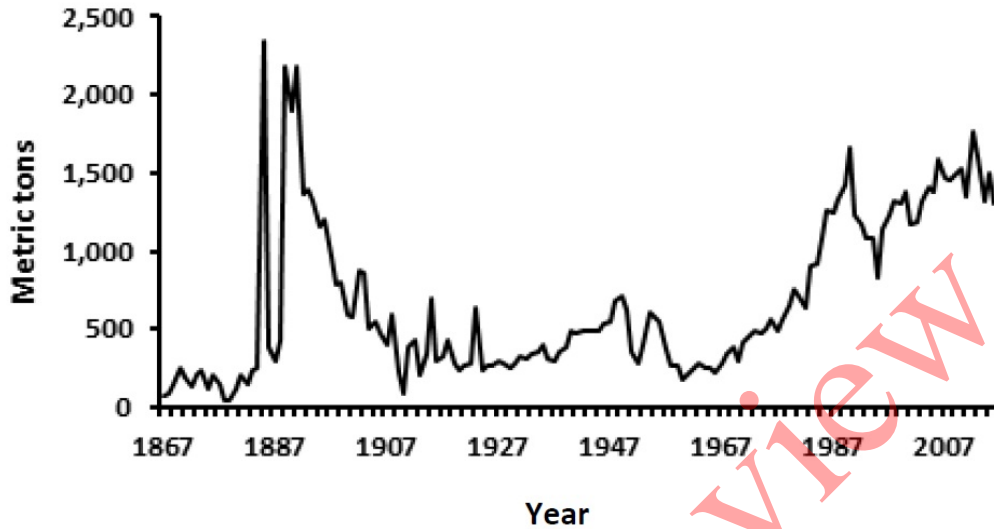


Figure 23: Annual commercial yield of lake whitefish from Lake Superior, 1867-2016 (Michaels and Gorman 2021).

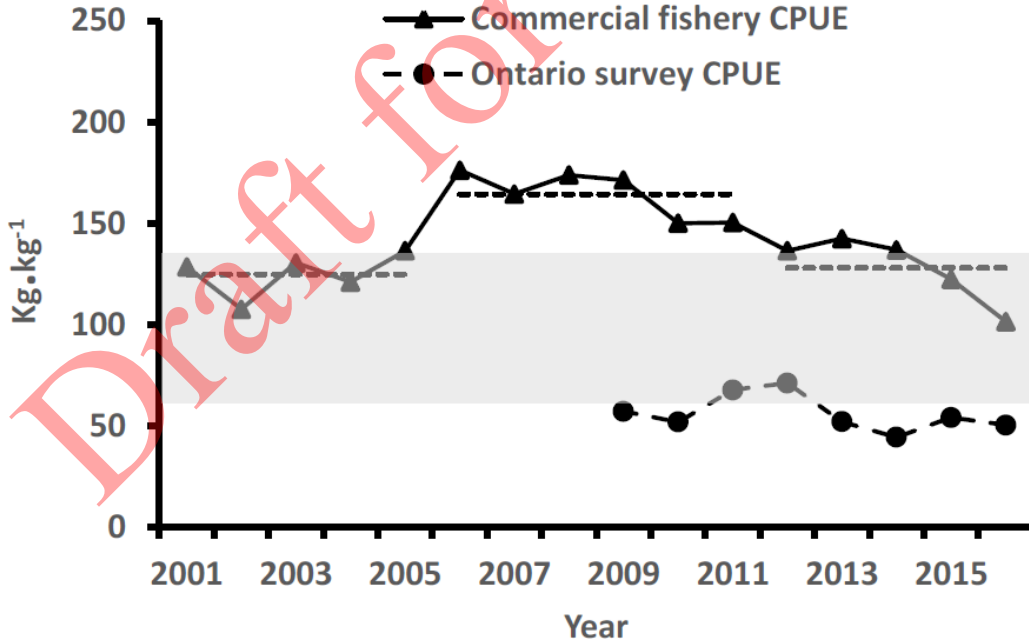


Figure 24: Commercial fishery and survey gillnet catch per unit effort (CPUE) of lake whitefish in Lake Superior, 2001-2016. Horizontal dashed lines represent the average commercial gillnet CPUE, 2002-2005, 2006-2011, and 2012-2016. Shaded area represents the fish community objective relative to abundance level during 1990-1999 (65 to 136 kg per km) (Michaels and Gorman 2021).

**Lake Superior | America, North - Inland Waters | United States | Michigan | Set gillnets | 1836
Treaty Waters | Tribal fishery**

Moderate Concern

Following the most recent data-limited stock assessment from 2022 conducted in 1836 Treaty Michigan waters of Lake Superior where tribal-licensed commercial lake whitefish set gillnet fisheries operate, data from 2020 indicates that current SSBR in management unit WFS-05 (Munising), and WFS-07 (Tahquamenon Bay) is 3.65 lb and 1.19 lb respectively, which is above the SSBR at target mortality of 1.34 lb, and 1.03 lb in each management unit respectively (Figure 27 b and c)(Seider 2022)(Sitar 2022b)(Tuomikoski 2022), indicating that abundance in these management units is healthy. Nevertheless, the current SSBR in management unit WFS-08 (Brimley) is 0.54 lb, which is <75% SSBR at target mortality of 0.77 lb (Figure 27d); further the SPR in WFS-08 is 0.17 (Tuomikoski 2022), which is below the SPR limit reference point of 0.2. There was no stock assessment model for management unit WFS-06 (Grand Marais), due to low effort levels and a lack of fishery monitoring data. As 50% of the stocks (in management units WFS-05 and WFS-07) are above the target reference point, 25% of the stocks (in management unit WFS-08) is below the target reference point, and 25% of the stocks (in management unit WFS-06) has no stock assessment, abundance has been collectively scored as a “moderate concern”.

Justification:

There is a complimentary rule set by the Modeling Subcommittee and Technical Fisheries Committee, that reduces mortality below the target rate in the next fishing season if the SPR is below 0.2 - hence an SPR of 0.2 may be considered as the limit level (Lenart and Smith 2022); however, this complimentary rule was part of the 2000 Decree, and is no longer in use as part of the 2023 Decree.

**Lake Superior | America, North - Inland Waters | United States | Michigan | Set gillnets | 1842
Treaty Waters | Tribal fishery**

**Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered
pound nets | 1842 Treaty Waters | State Fishery**

Low Concern

Following the most recent data-limited stock assessment, conducted in 1842 treaty Michigan waters of Lake Superior, data from 2022 indicate that current SSBR in management units MI2/3 (western side of the Keweenaw Peninsula) and MI-4 (Keweenaw Bay) is 2.614 lb and 2.635 lb respectively, which is above the SSBR at target mortality of 2.428 lb and 1.566 in each management unit respectively (Figure 25)(Rook 2023a) (Rook 2023b) (pers comm Rook, B. 2023), indicating that abundance is healthy. As >70% of the stocks (in management units MI2/3 and MI-4) are above the target reference point, abundance has been collectively scored as a “low concern”.

Justification:

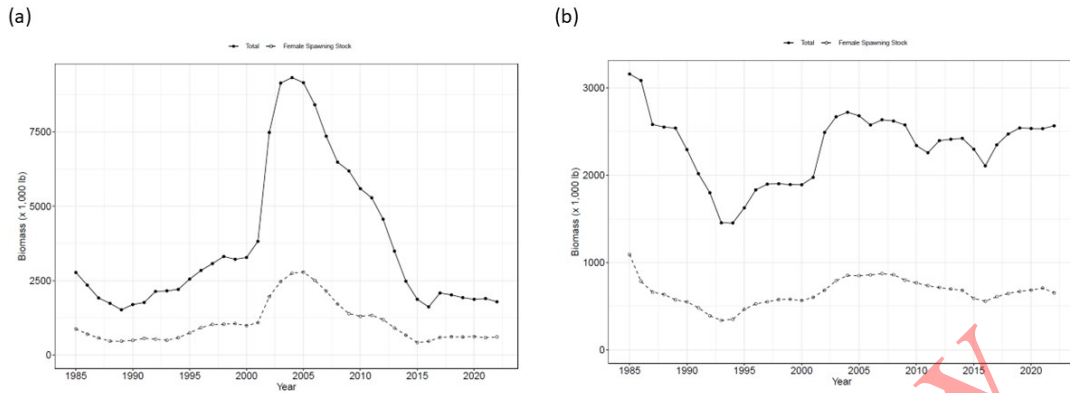


Figure 25: Estimated lake whitefish biomass in 1842 treaty Michigan waters of Lake Superior from 1885 to 2022, where (a) is MI2/3 (western side of the Keweenaw Peninsula), (b) is MI-4 (Keweenaw Bay) (Rook 2023a) (Rook 2023b).

Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1836 Treaty Waters | State Fishery

Low Concern

Following the most recent data-limited stock assessment from 2022 conducted in 1836 treaty Michigan waters of Lake Superior, data from 2020 indicates that current SSBR in management units WFS-04 (Marquette-Big Bay) and WFS-05 (Munising) is 4.58 lb, and 3.65 lb respectively, which is above the SSBR at target mortality of 0.82 lb and 1.34 lb in each management unit respectively (Figure 26)(Seider 2022)(Sitar 2022b), indicating that abundance in these management units is healthy. As >70% of the stocks (in management units WFS-04 and WFS-05 where state-licensed commercial lake whitefish fisheries operate) are above the target reference point, abundance has been collectively scored as a “low concern”.

Justification:

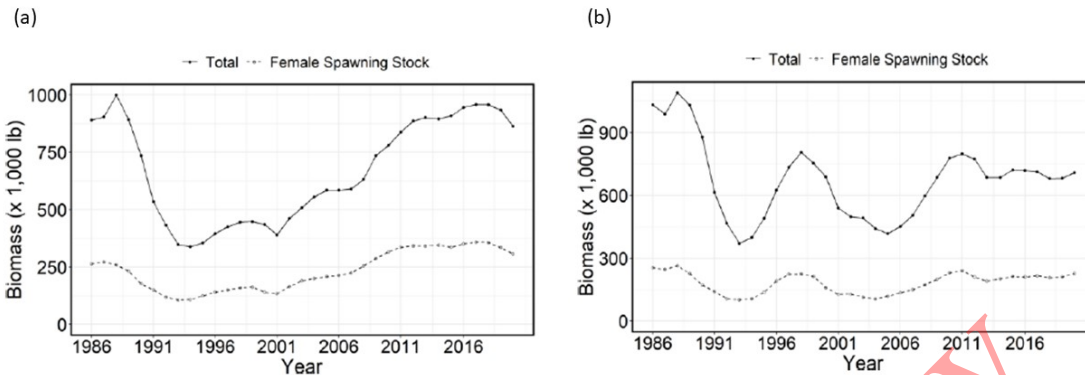


Figure 26: Estimated lake whitefish biomass in Michigan waters of Lake Superior, where (a) is WFS-04 (Marquette-Big Bay), and (b) is WFS-05 (Munising) (Seider 2022)(Sitar 2022b).

Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1836 Treaty Waters | Tribal fishery

Moderate Concern

Following the most recent data-limited stock assessment from 2022 conducted in 1836 treaty Michigan waters of Lake Superior where tribal-licensed commercial lake whitefish trap net fisheries operate, data from 2020 indicate that current SSBR in management units WFS-04 (Marquette-Big Bay), WFS-05 (Munising), and WFS-07 (Tahquamenon Bay) is 4.58 lb, 3.65 lb, and 1.19 lb respectively, which is above the SSBR at target mortality of 0.82 lb, 1.34 lb and 1.03 lb in each management unit respectively (Figure 27) (Seider 2022)(Sitar 2022b)(Tuomikoski 2022), indicating that abundance in these management units is healthy. There was no stock assessment model for WFS-06 (Grand Marais) due to low levels of effort and a lack of fishery monitoring data. The current SSBR in management unit WFS-08 (Brimley) is 0.54 lb, which is <75% of the SSBR at target mortality of 0.77 lb; further the SPR in WFS-08 is 0.17 (Tuomikoski 2022), which is below the limit reference point of 0.2. As 60% of the stocks (in management units WFS-04, WFS-05, and WF-07) are above the target reference point, 20% of the stocks (in management unit WFS-08) is below the target reference point, and 20% of the stocks (in management unit WFS-06) have not been assessed, abundance has been collectively scored as a “moderate concern”.

Justification:

There is a complimentary rule set by the Modeling Subcommittee and the Technical Fisheries Committee, that reduces mortality below the target rate in the next fishing season if the SPR is below 0.2 - hence an SPR of 0.2 may be considered as the limit level (Lenart and Smith 2022); however, this complimentary rule was part of the 2000 Decree, and is no longer in use as part of the 2023 Decree.

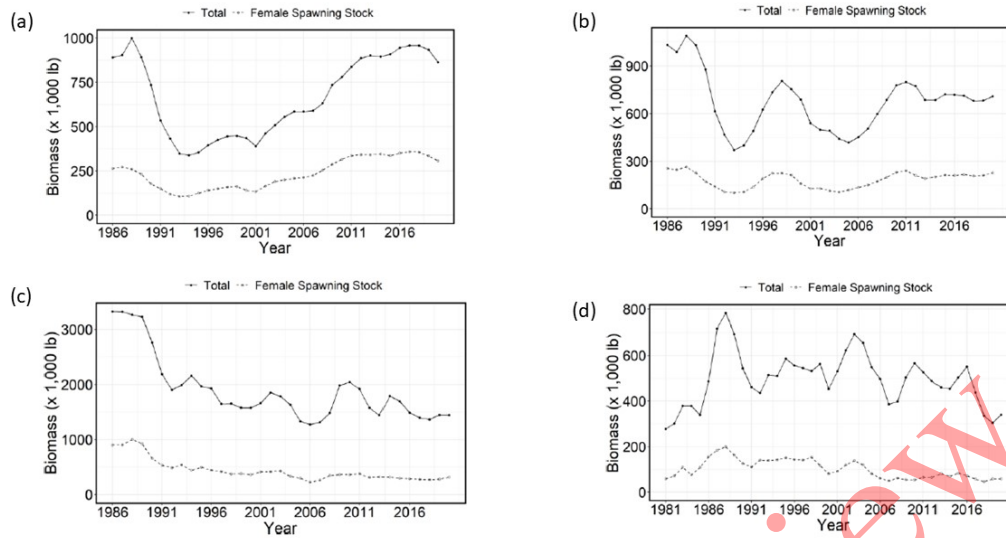


Figure 27: Estimated lake whitefish biomass in Michigan waters of Lake Superior, where (a) is WFS-04 (Marquette-Big Bay), (b) is WFS-05 (Munising), (c) is WFS-07 (Tahquamenon Bay), and (d) is WFS-08 (Brimley)(Seider 2022)(Sitar 2022b) (Tuomikoski 2022).

**Lake Superior | America, North - Inland Waters | United States | Wisconsin | Set gillnets
 Lake Superior | America, North - Inland Waters | United States | Wisconsin | Set gillnets | Tribal fishery**

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Stationary uncovered pound nets

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

Moderate Concern

According to the most recent data-limited stock assessment in the State of Lake Superior report, the commercial yield of lake whitefish in Lake Superior during the reporting period 2012-2016 ranged from 1,300 to 1,700 MT (see Figure 23); however the annual commercial gillnet catch per unit effort declined from 150-176 kg per km in 2006-2011 (which was the previous reporting period) to 101-142 kg per km from 2012-2016, representing a 22% decline in abundance (Michaels and Gorman 2021) (see Figure 24). Nevertheless, CPUE from 2012-2016 was still within the target range of 56-136 kg/km, as specified by the fish community objective (FCO) for lake whitefish in Lake Superior (ibid). Since there are no biological reference points specified, but long-term trends show that abundance is healthy, this factor been scored as a “moderate concern”.

Factor 1.2 - Fishing Mortality

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

Low Concern

Fishing mortality of lake whitefish in the Ontario waters of Lake Superior is controlled by setting an

annual quota, and is made up of Individual Transferable Quotas (ITQs), which are area specific (pers comm James, S. 2023). These ITQs have been established in Ontario waters of Lake Superior since 1984, and are based on past performance of the fishery at that time (ibid). Since then, the ITQs have been adjusted annually based on the status of each stock (ibid). It is recommended that total annual mortality of lake whitefish in Lake Superior should not exceed 65% (pers comm Ray, B. 2023), and more recently, an unpublished stock assessment conducted by the Lake Superior Technical Committee in 1836 Michigan waters, recommended that total annual mortality be maintained at or below 55% (pers comm Hanchin, P. 2023). As the commercial harvest of lake whitefish across management units in Ontario waters has been within the allotted quota from 2004 to 2021 (see Figure 28)(MNRF 2022), and since overall fishing mortality of lake whitefish in Lake Superior for the past 5 years is below 30% (pers comm James, S. 2023) which is well below the established reference level for the lake, fishing mortality is considered as a “low concern”.

Justification:

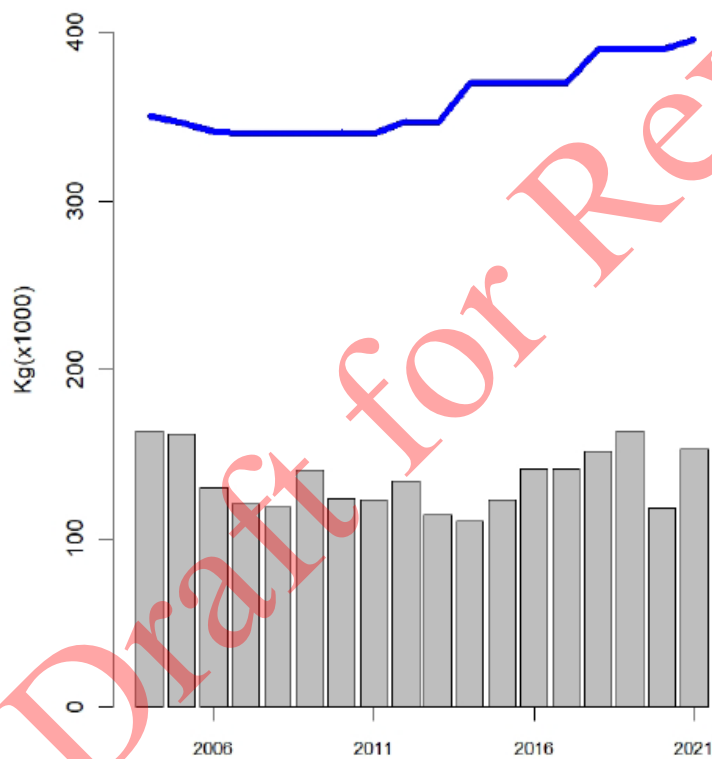


Figure 28: Lake whitefish quota (blue line) and harvest (bars) for the Ontario waters of Lake Superior (MNRF 2022).

Lake Superior | America, North - Inland Waters | United States | Michigan | Set gillnets | 1836 Treaty Waters | Tribal fishery

Moderate Concern

Following the most recent data-limited stock assessment from 2022 conducted in 1836 Treaty Michigan waters of Lake Superior, data averaged from 2018-2020 indicates that gillnet fishing mortality in management units WFS-05 (Munising), and WFS-07 (Tahquamenon Bay) was 0.10/y and 0.37/y

respectively (Sitar 2022b)(Tuomikoski 2022). The 2020 total mortality (Z) in management unit WFS-05 and WFS-07 was 0.26/y and 0.72/y respectively, which was below the target reference points set for those management units (see figure 31 b&c)(ibid). In WFS-08 (Brimley), the average 2018-2020 gillnet fishing mortality was 0.37/y, and the 2020 total mortality (Z) was 0.89/y, which was just below the target reference point; however, total mortality in the years preceding 2020 was above the target reference point due to higher fishing mortality (see figure 31 d)(Tuomikoski 2022). There was no stock assessment model for management unit WFS-06 (Grand Marais), due to low effort levels and a lack of fishery monitoring data. As 50% of the stocks (in management units WFS-05 and WFS-07) are well below the target reference point, 25% of the stocks (in management unit WFS-08) were only recently below the target reference level, and 25% of the stocks (in management unit WFS-06) have no stock assessment, fishing mortality has been collectively scored as a “moderate concern”.

Lake Superior | America, North - Inland Waters | United States | Michigan | Set gillnets | 1842 Treaty Waters | Tribal fishery

Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1842 Treaty Waters | State Fishery

Low Concern

Following the most recent data-limited stock assessment with data up to 2022 conducted in 1842 treaty Michigan waters of Lake Superior, data averaged across ages 4-20 indicate that total fishing mortality in management units MI-2/3 (western side of the Keweenaw Peninsula) and MI-4 (Keweenaw Bay) was 0.1544/y and 0.3034/y respectively (pers comm Rook, B. 2023). The 2022 total mortality (Z) in management unit MI-2/3 and MI-4 was 0.3344/y and 0.4827/y respectively, which was below the target reference points set for those management units (Rook 2023a)(Rook 2023b)(see Figure 29). As >70% of the stocks (in management units MI-2/3 and MI-4) are well below the target reference point, fishing mortality has been collectively scored as a “low concern”.

Justification:

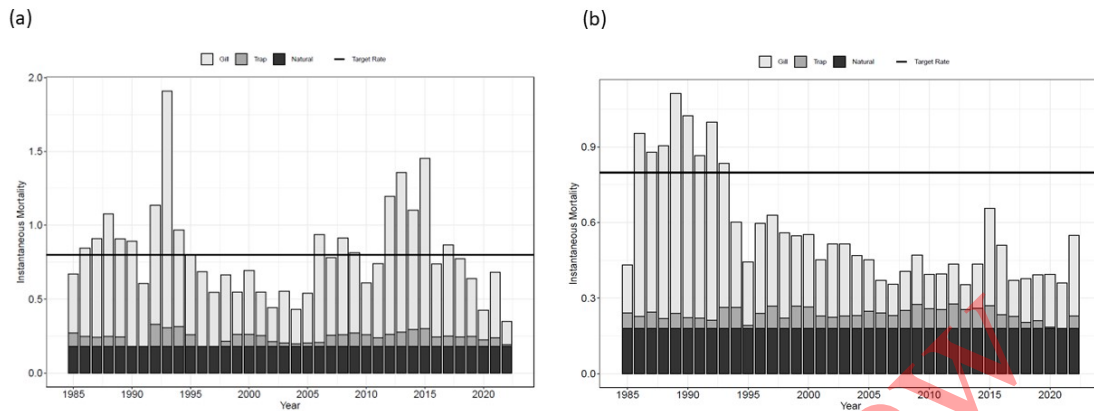


Figure 29: Maximum mortality rates for lake whitefish in 1842 treaty Michigan waters of Lake Superior from 1985-2022, where management units are: (a) MI-2/3 (western side of the Keweenaw Peninsula) and (b) MI-4 (Keweenaw Bay) (Rook 2023a) (Rook 2023b).

Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1836 Treaty Waters | State Fishery

Low Concern

Following the most recent data-limited stock assessment from 2022 conducted in 1836 treaty Michigan waters of Lake Superior, data averaged from 2018-2020 indicate that trap net fishing mortality in management units WFS-04 (Marquette-Big Bay) and WFS-05 (Munising) was 0.12/y and 0.07/y respectively (Seider 2022)(Sitar 2022b). The 2020 total mortality (Z) in management unit WFS-04 and WFS-05 was 0.3/y and 0.26/y respectively, which was below the target reference points set for those management units (see Figure 30)(ibid). As >70%% of the stocks (in management units WFS-04 and WFS-05) are well below the target reference point, fishing mortality has been collectively scored as a “low concern”.

Justification:

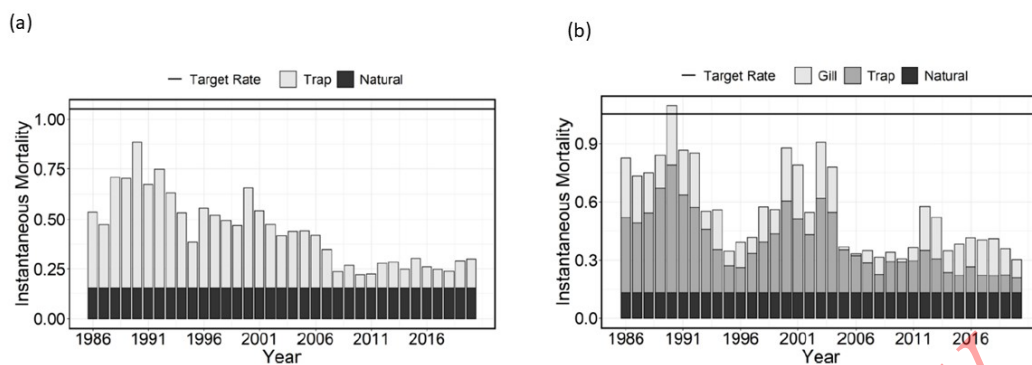


Figure 30: Maximum mortality rates for lake whitefish in Michigan waters of Lake Superior, where management units are: (a) WFS-04 (Marquette-Big Bay) and (b) WFS-05 (Munising) (Seider 2022) (Sitar 2022b).

Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1836 Treaty Waters | Tribal fishery

Moderate Concern

Following the most recent data-limited stock assessment from 2022 conducted in 1836 treaty Michigan waters of Lake Superior, data averaged from 2018-2020 indicates that trap net fishing mortality in management units WFS-04 (Marquette-Big Bay), WFS-05 (Munising), and WFS-07 (Tahquamenon Bay) was 0.12/y, 0.07/y and 0.24/y respectively (Seider 2022)(Sitar 2022b)(Tuomikoski 2022). The 2020 total mortality (Z) in management unit WFS-04, WFS-05 and WFS-07 was 0.3/y, 0.26/y and 0.72/y respectively, which was below the target reference points set for those management units (see figure 31 a,b and c below)(ibid). In WFS-08 (Brimley), the average 2018-2020 trap net fishing mortality was 0.78/y, and the 2020 total mortality (Z) was 0.89/y, which was just below the target reference point; however, total mortality in the years preceding 2020 was above the target reference point due to higher fishing mortality (see figure 31 d below)(Tuomikoski 2022). There was no stock assessment model for management unit WFS-06 (Grand Marais), due to low effort levels and a lack of fishery monitoring data. As 60% of the stocks (in management units WFS-04, WFS-05 and WFS-07) are well below the target reference point, 20% of the stocks (in management unit WFS-08) are only recently just below the target reference level, and there was no stock assessment conducted in 20% of the stocks (in management unit WFS-06), fishing mortality has been collectively scored as a “moderate concern”.

Justification:

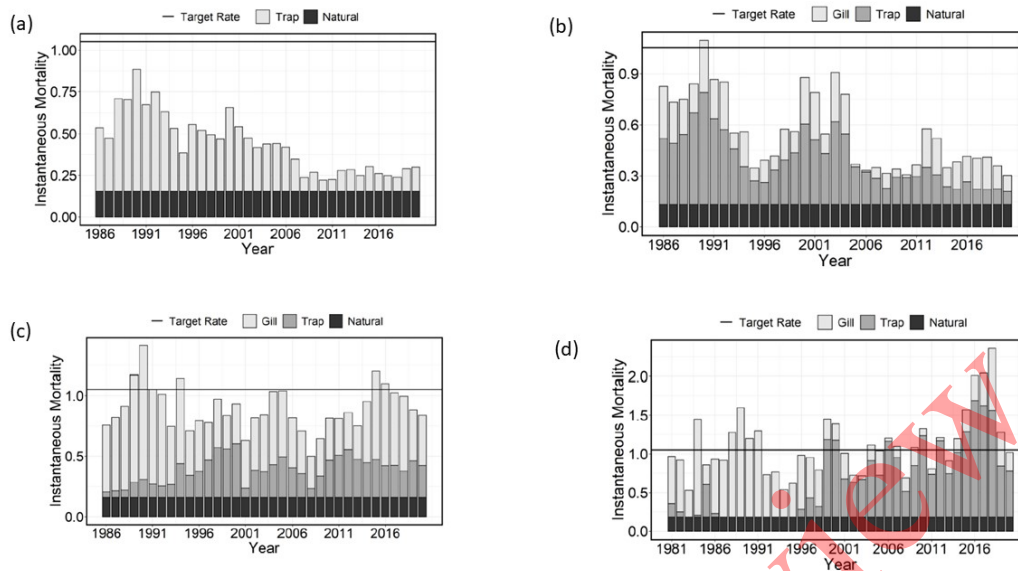


Figure 31: Maximum mortality rates for lake whitefish in Michigan waters of Lake Superior, where management units are: (a) WFS-04 (Marquette-Big Bay), (b) WFS-05 (Munising), (c) WFS-07 (Tahquamenon Bay), and (d) WFS-08 (Brimley) (Seider 2022) (Sitar 2022b) (Tuomikoski 2022).

**Lake Superior | America, North - Inland Waters | United States | Wisconsin | Set gillnets
 Lake Superior | America, North - Inland Waters | United States | Wisconsin | Set gillnets | Tribal fishery**

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Stationary uncovered pound nets

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

Low Concern

In the case of gillnets, fishing mortality of lake whitefish is limited by the amount of gillnet footage that fishers are allowed to set annually, which in turn is determined by lake trout catch rates observed by onboard commercial monitoring (Sapper and Carl 2022); more lake trout means less gillnet footage is allowed in following years and creates an upper limit to gillnet harvest of lake whitefish as well (ibid). For both gillnets and trap nets, lake whitefish data show increasing or stable abundance and there is no indication that overharvest is occurring (pers comm Ray, B. 2023). It is recommended that total annual mortality of lake whitefish in Lake Superior should not exceed 65% (pers comm Ray, B. 2023), and more recently, an unpublished stock assessment conducted by the Lake Superior Technical Committee in 1836 Michigan waters, recommended that total annual mortality be maintained at or below 55% (pers comm Hanchin, P. 2023). Recent results of the whitefish stock assessment showed that instantaneous mortality estimates on lake whitefish in Wisconsin waters have remained below 40% since 2015 and were 35% in 2022 {pers comm, Ray, B. 2023}{BC 2023b). Additionally, overall fishing mortality of lake whitefish in Lake Superior for the past 5 years is below 30% (pers comm James, S. 2023) which is well below the established reference level for the lake. Taken together, this factor has been scored as a “low concern”.

Walleye

Factor 1.1 - Abundance

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

Moderate Concern

Per the latest report on the Status of Lake Superior in 2017 (which was published in 2021), the population of walleye is associated with shallow embayments in Lake Superior (Bergland 2021). During the reporting period from 2012-2016, the Ontario Ministry of Natural Resources and Forestry conducted fall walleye index netting surveys in Black Bay, and captured an average of 2.3 kg/net/night compared with only 0.1 kg/net/night in 2002 (Figure 32)(ibid). Recruitment of walleye in Black Bay had also improved after 2012 (ibid). During this same period, the walleye population in Thunder Bay was also considered to be small but healthy, with evidence of recruitment (ibid). Nevertheless, as there were no biological reference points, a Productivity Susceptibility Analysis (PSA) was conducted. The PSA score of walleye caught using gillnets in the Ontario waters of Lake Superior was 2.92, indicating that the species has medium vulnerability. Hence abundance has been scored as a “moderate concern”.

Justification:

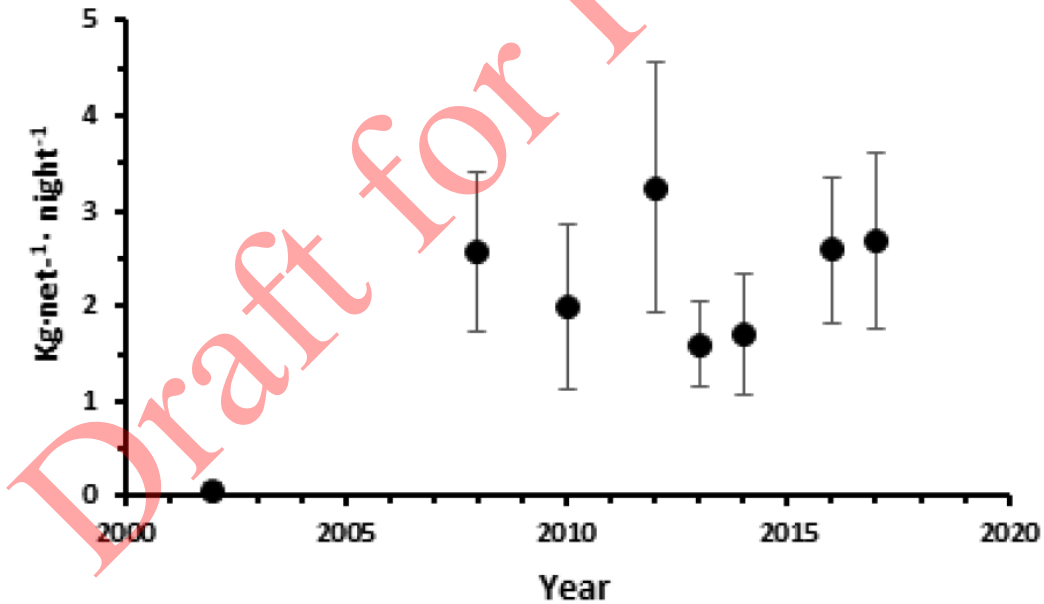


Figure 32: Walleye caught per net night (block dot) and 95% confidence interval about the mean (vertical bars) during fall walleye index netting in Black Bay, Ontario, Lake Superior. Data is from 2002 and 2008-2016 (Bergland 2021).

The Productivity Susceptibility Analysis of walleye in the Ontario waters of Lake Superior is as follows:

Productivity Attribute	Relevant Information	Score (1= high productivity, 2= medium productivity, 3= low productivity)

Average age at maturity	males mature at 2-3 years and females mature at 4-5 years (WDNR 2008)	1
Von Bertalanffy growth coefficient (K)	K = 0.4 (Froese and Pauly 2023a)	1
Fecundity	> 50,000 eggs during a spawning period (WDNR 2008)	1
Average maximum size	Lmax = 107 cm TL (Froese and Pauly 2023b)	2
Average size at maturity	Lm = 42.5 cm (Froese and Pauly 2023b)	2
Reproductive strategy	Broadcast spawner	1
Productivity score (P)		1.333

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	Fisheries overlap with species for 8 months in the year (pers comm James, S. 2023)	2
Selectivity of the fishery	default score used	2
post-capture mortality	retained species so default score used	3
Susceptibility score (S)		2.6

$$\text{Vulnerability} = \sqrt{P^2 + V^2}$$

$$= \sqrt{1.333^2 + 2.6^2}$$

$$= 2.92$$

Factor 1.2 - Fishing Mortality

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

Moderate Concern

Fishing mortality of walleye in the Ontario waters of Lake Superior is controlled by setting an annual quota, and is made up of Individual Transferable Quotas (ITQs), which are area specific (pers comm James, S. 2023). These ITQs have been established in Ontario waters of Lake Superior since 1984, and are based on past performance of the fishery at that time (ibid). Since then, the ITQs have been adjusted annually based on the status of each stock (ibid). Even though the commercial harvest of walleye across management units has been within the allotted quota from 2004 to 2021 (see Figure 33) (MNRF 2022), as it is unclear if the ITQ is appropriate, fishing mortality is considered as a “moderate concern”.

Justification:

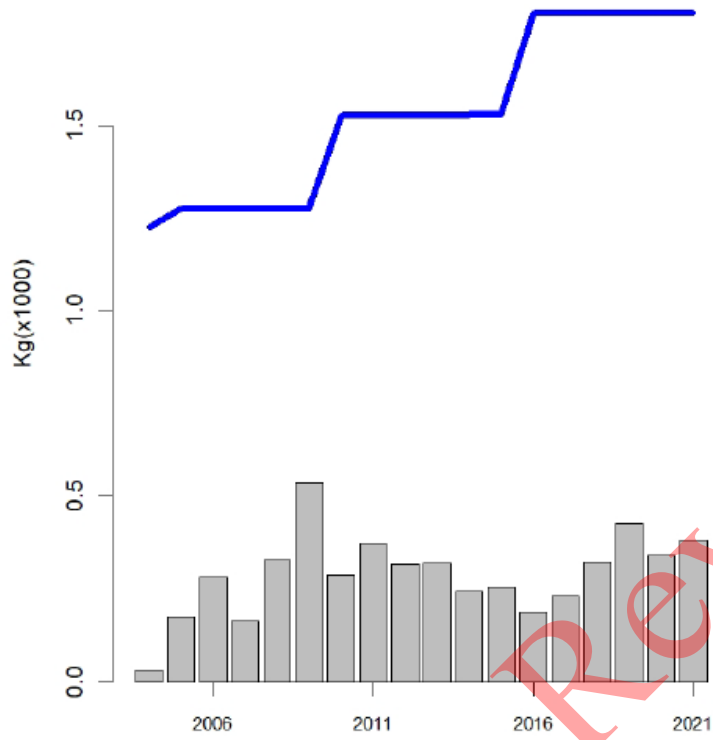


Figure 33: Walleye quota (blue line) and harvest (bars for Ontario, Lake Superior. Taken from MNRF 2022.

Draft for Review

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 Critical

Guiding principles

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

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 HERRING			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Lake Superior America, North - Inland Waters Canada Ontario Gillnets and entangling nets	5.000	1.000: < 100%	Green (5.000)
Lake Superior America, North - Inland Waters United States Minnesota Gillnets and entangling nets	5.000	1.000: < 100%	Green (5.000)
Lake Superior America, North - Inland Waters United States Minnesota Gillnets and entangling nets Tribal fishery	5.000	1.000: < 100%	Green (5.000)
Lake Superior America, North - Inland Waters United States Wisconsin Gillnets and entangling nets	5.000	1.000: < 100%	Green (5.000)
Lake Superior America, North - Inland Waters United States Wisconsin Gillnets and entangling nets Tribal fishery	5.000	1.000: < 100%	Green (5.000)

LAKE TROUT			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Lake Superior America, North - Inland Waters Canada Ontario Set gillnets	2.236	1.000: < 100%	Yellow (2.236)
Lake Superior America, North - Inland Waters United States Minnesota Set gillnets	5.000	1.000: < 100%	Green (5.000)
Lake Superior America, North - Inland Waters United States Minnesota Set gillnets Tribal fishery	5.000	1.000: < 100%	Green (5.000)
Lake Superior America, North - Inland Waters United States Wisconsin Set gillnets	3.413	1.000: < 100%	Green (3.413)
Lake Superior America, North - Inland Waters United States Wisconsin Set gillnets Tribal fishery	3.413	1.000: < 100%	Green (3.413)
Lake Superior America, North - Inland Waters United States Michigan Set gillnets 1842 Treaty Waters Tribal fishery	4.284	1.000: < 100%	Green (4.284)
Lake Superior America, North - Inland Waters United States Michigan Set gillnets 1836 Treaty Waters Tribal fishery	2.644	1.000: < 100%	Yellow (2.644)
Lake Superior America, North - Inland Waters United States Michigan Stationary uncovered pound nets 1836 Treaty Waters Tribal fishery	5.000	1.000: < 100%	Green (5.000)
Lake Superior America, North - Inland Waters United States Wisconsin Stationary uncovered pound nets	5.000	1.000: < 100%	Green (5.000)
Lake Superior America, North - Inland Waters United States Wisconsin Stationary uncovered pound nets Tribal fishery	5.000	1.000: < 100%	Green (5.000)

LAKE WHITEFISH			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Lake Superior America, North - Inland Waters Canada Ontario Set gillnets	2.236	1.000: < 100%	Yellow (2.236)
Lake Superior America, North - Inland Waters United States Wisconsin Set gillnets	3.413	1.000: < 100%	Green (3.413)
Lake Superior America, North - Inland Waters United States Wisconsin Set gillnets Tribal fishery	3.413	1.000: < 100%	Green (3.413)
Lake Superior America, North - Inland Waters United States Michigan Set gillnets 1842 Treaty Waters Tribal fishery	3.318	1.000: < 100%	Green (3.318)
Lake Superior America, North - Inland Waters United States Michigan Set gillnets 1836 Treaty Waters Tribal fishery	4.284	1.000: < 100%	Green (4.284)
Lake Superior America, North - Inland Waters United States Michigan Stationary uncovered pound nets 1836 Treaty Waters State Fishery	4.284	1.000: < 100%	Green (4.284)
Lake Superior America, North - Inland Waters United States Michigan Stationary uncovered pound nets 1842 Treaty Waters State Fishery	5.000	1.000: < 100%	Green (5.000)
Lake Superior America, North - Inland Waters United States Wisconsin Stationary uncovered pound nets	5.000	1.000: < 100%	Green (5.000)
Lake Superior America, North - Inland Waters United States Wisconsin Stationary uncovered pound nets Tribal fishery	5.000	1.000: < 100%	Green (5.000)
Lake Superior America, North - Inland Waters United States Michigan Stationary uncovered pound nets 1836 Treaty Waters Tribal fishery	5.000	1.000: < 100%	Green (5.000)

WALLEYE			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Lake Superior America, North - Inland Waters Canada Ontario Set gillnets	2.236	1.000: < 100%	Yellow (2.236)

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 SUPERIOR AMERICA, NORTH - INLAND WATERS CANADA ONTARIO GILLNETS AND ENTANGLING NETS			
SUB SCORE: 5.000		DISCARD RATE: 1.000	SCORE: 5.000
SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Lake herring	3.670: Low Concern	5.000: Low Concern	Green (4.284)

LAKE SUPERIOR AMERICA, NORTH - INLAND WATERS CANADA ONTARIO SET GILLNETS			
SUB SCORE: 2.236		DISCARD RATE: 1.000	SCORE: 2.236
SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Lake sturgeon	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Suckers (unknown)	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Walleye	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Lake trout	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Lake whitefish	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)

LAKE SUPERIOR AMERICA, NORTH - INLAND WATERS UNITED STATES MICHIGAN SET GILLNETS 1836 TREATY WATERS TRIBAL FISHERY			
SUB SCORE: 2.644		DISCARD RATE: 1.000	SCORE: 2.644
SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Lake whitefish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Lake trout	3.670: Low Concern	5.000: Low Concern	Green (4.284)

LAKE SUPERIOR AMERICA, NORTH - INLAND WATERS UNITED STATES MICHIGAN SET GILLNETS 1842 TREATY WATERS TRIBAL FISHERY			
SUB SCORE: 4.284		DISCARD RATE: 1.000	SCORE: 4.284
SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Lake trout	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Lake whitefish	3.670: Low Concern	5.000: Low Concern	Green (4.284)

LAKE SUPERIOR AMERICA, NORTH - INLAND WATERS UNITED STATES MICHIGAN STATIONARY UNCOVERED POUND NETS 1836 TREATY WATERS STATE FISHERY			
SUB SCORE: 4.284		DISCARD RATE: 1.000	SCORE: 4.284
SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Lake trout	3.670: Low Concern	5.000:	Green (4.284)
Lake whitefish	3.670: Low Concern	5.000: Low Concern	Green (4.284)

LAKE SUPERIOR | AMERICA, NORTH - INLAND WATERS | UNITED STATES | MICHIGAN | STATIONARY UNCOVERED POUND NETS | 1836 TREATY WATERS | TRIBAL FISHERY

SUB SCORE: 5.000		DISCARD RATE: 1.000	SCORE: 5.000
SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Lake whitefish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Lake trout	3.670: Low Concern	5.000: Low Concern	Green (4.284)

LAKE SUPERIOR | AMERICA, NORTH - INLAND WATERS | UNITED STATES | MICHIGAN | STATIONARY UNCOVERED POUND NETS | 1842 TREATY WATERS | STATE FISHERY

SUB SCORE: 5.000		DISCARD RATE: 1.000	SCORE: 5.000
SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Lake whitefish	3.670: Low Concern	5.000: Low Concern	Green (4.284)

LAKE SUPERIOR | AMERICA, NORTH - INLAND WATERS | UNITED STATES | MINNESOTA | GILLNETS AND ENTANGLING NETS

SUB SCORE: 5.000		DISCARD RATE: 1.000	SCORE: 5.000
SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Lake herring	3.670: Low Concern	5.000: Low Concern	Green (4.284)

LAKE SUPERIOR | AMERICA, NORTH - INLAND WATERS | UNITED STATES | MINNESOTA | GILLNETS AND ENTANGLING NETS | TRIBAL FISHERY

SUB SCORE: 5.000		DISCARD RATE: 1.000	SCORE: 5.000
SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Lake herring	3.670: Low Concern	5.000: Low Concern	Green (4.284)

LAKE SUPERIOR | AMERICA, NORTH - INLAND WATERS | UNITED STATES | MINNESOTA | SET GILLNETS

SUB SCORE: 5.000		DISCARD RATE: 1.000	SCORE: 5.000
SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Lake trout	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)

LAKE SUPERIOR | AMERICA, NORTH - INLAND WATERS | UNITED STATES | MINNESOTA | SET GILLNETS | TRIBAL FISHERY

SUB SCORE: 5.000		DISCARD RATE: 1.000	SCORE: 5.000
SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Lake trout	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)

LAKE SUPERIOR | AMERICA, NORTH - INLAND WATERS | UNITED STATES | WISCONSIN | GILLNETS AND ENTANGLING NETS

SUB SCORE: 5.000		DISCARD RATE: 1.000	SCORE: 5.000
SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Lake herring	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)

LAKE SUPERIOR | AMERICA, NORTH - INLAND WATERS | UNITED STATES | WISCONSIN | GILLNETS AND ENTANGLING NETS | TRIBAL FISHERY

SUB SCORE: 5.000		DISCARD RATE: 1.000	SCORE: 5.000
SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Lake herring	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)

LAKE SUPERIOR | AMERICA, NORTH - INLAND WATERS | UNITED STATES | WISCONSIN | SET GILLNETS

SUB SCORE: 3.413		DISCARD RATE: 1.000	SCORE: 3.413
SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Lake sturgeon	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Lake trout	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Lake whitefish	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)

LAKE SUPERIOR | AMERICA, NORTH - INLAND WATERS | UNITED STATES | WISCONSIN | SET GILLNETS | TRIBAL FISHERY

SUB SCORE: 3.413		DISCARD RATE: 1.000	SCORE: 3.413
SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Lake sturgeon	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Lake trout	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Lake whitefish	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)

LAKE SUPERIOR AMERICA, NORTH - INLAND WATERS UNITED STATES WISCONSIN STATIONARY UNCOVERED POUND NETS			
SUB SCORE: 5.000		DISCARD RATE: 1.000	SCORE: 5.000
SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Lake trout	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Lake whitefish	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)

LAKE SUPERIOR AMERICA, NORTH - INLAND WATERS UNITED STATES WISCONSIN STATIONARY UNCOVERED POUND NETS TRIBAL FISHERY			
SUB SCORE: 5.000		DISCARD RATE: 1.000	SCORE: 5.000
SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Lake trout	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Lake whitefish	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)

Commercial fisheries that target lake herring (cisco) in drift gillnets, and those that target lake trout, lake whitefish and walleye in bottom-set gillnets in Lake Superior typically catch low amounts of nontarget species. For instance, in state-licensed commercial fisheries in Minnesota waters, from 2018-2022, small-mesh drift gillnets that target lake herring caught <1% of lake trout on average (MNDNR 2023a), hence we consider drift gillnets that target lake herring in the state commercial fishery in Minnesota to have no main species. Similarly, large-mesh bottom-set 4.5" stretch measure monofilament and nylon filament gillnets that are used to target lake trout are highly selective and have approximately <3% bycatch of lake whitefish (pers comm Blankenheim, J. 2023); hence large-mesh bottom-set gillnets have no main species (MNDNR 2023a). Although small-mesh 2.75" drift gillnets and 3" bottom-set gillnets that catch >99% of lake herring, and >97% of round whitefish respectively (ibid) also catch lake trout, these gear types catch only approximately <1% and <3% of the total lake trout respectively, in Minnesota waters; hence small-mesh drift and small-mesh bottom-set gillnets were not considered in the lake trout fishery in this assessment. Since no catch composition data were available for the tribal fishery, we assumed that bycatch would be similar to the state licensed commercial fishery; hence no main species were added to the tribal small-mesh gillnet fishery that target lake herring in Minnesota, and there were no main species added in the tribal lake trout gillnet fishery in Minnesota.

Similarly in Wisconsin waters, data from both commercial state-licensed and commercial tribal fisheries from 2011-2023 showed that small-mesh drift gillnets targeting lake herring had <2% of bycatch (WDNR 2023), hence we consider the Wisconsin gillnet lake herring fishery to have no main species. Contrastingly, large-mesh bottom-set gillnets targeting lake trout and lake whitefish caught approximately 74% of lake whitefish and 13% of lake trout (ibid); since both lake whitefish and lake trout form more than 5% of the catch, following the Seafood Watch standard, both lake whitefish and lake trout were added as main species in the large-mesh bottom-set gillnet fishery. In addition, per the SFW Fisheries standard, as more than 5% of the sustainable limit of lake sturgeon (where the sustainable limit is 3.1% of the population, following (Schloesser and Quinlan 2019)) was caught in large-mesh bottom-set gillnets (WDNR 2023), it was added as a main species in that fishery. In both the state-licensed and tribal large-mesh bottom-set gillnet fisheries, lake sturgeon limits the C2

score due to its threatened status. In the Wisconsin state-licensed and tribal trap net fisheries that target both lake trout and lake whitefish, approximately 96% of the catch comprised lake whitefish (WDNR 2023); hence it was added as a main species to those fisheries. In both the state-licensed and the tribal Wisconsin trap net fisheries, lake whitefish limits the C2 score because fishing mortality in trap nets is unknown.

In the Ontario waters of Lake Superior, catch composition data of the suspended gillnet fishery indicated that 99% of the catch comprised lake herring or cisco (MNRF 2024); hence no main species were added in this fishery. In the bottom-set gillnet fishery, since lake sturgeon is globally and regionally categorized as Endangered by the IUCN and COSSARO respectively, and is caught in that fishery (MNRF 2024), it was added as a main species. In addition, lake trout, lake whitefish and suckers also qualified as main species in the bottom-set gillnet fishery, as they comprised more than 5% of the catch. Lake sturgeon limits the C2 score of bottom-set gillnet Ontario fisheries in Lake Superior, due to its threatened status.

In the 1836 treaty Michigan waters of Lake Superior, harvest data from the state-licensed commercial trap fishery showed that lake trout comprised >20% of the catch that predominantly targeted lake whitefish (M-DNR 2023a). Hence lake trout was added as a main species in the lake whitefish fishery. According to tribal commercial fishery data from 2017-2022, from the 1836 treaty Michigan waters of Lake Superior, large-mesh bottom-set gillnets were used to target lake whitefish and lake trout, whereas trap nets were used to target lake whitefish (M-DNR 2023b). As 99% of the tribal trap net fish harvested comprised of lake whitefish, no main species were added to this fishery. In the large-mesh bottom-set gillnet tribal fishery, 75% of the catch harvested comprised of lake whitefish, and 19% of the harvest comprised of lake trout, hence both species were added as a main species in the tribal bottom-set gillnet fishery. The C2 score of the tribal large-mesh bottom-set gillnet fishery was limited by lake whitefish as only 50% of the stocks had abundance above the limit reference point, and fishing mortality of only 50% of the stocks was below the target reference point. Note that no bycatch release data from the tribal fishery was provided.

In the 1842 treaty Michigan waters of Lake Superior, harvest data collected from 2001-2022 from the state-licensed commercial trap fishery showed that lake whitefish comprised approximately 97% of the catch (Rook 2023d); hence no main species were added in the lake whitefish commercial trap net fishery. According to tribal commercial gillnet fishery data from 2000 to 2021, from the 1842 treaty Michigan waters of Lake Superior, 82% of the harvests comprised lake whitefish, whereas 15% comprised lake trout (Mattes 2023); hence lake whitefish and lake trout were both added as main species in the bottom-set gillnet fishery.

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

Draft for Review

Lake herring

Factor 2.3 - Discard Rate/Landings

Lake Superior | America, North - Inland Waters | Canada | Ontario | Gillnets and entangling nets
< 100%

Data from 2021 indicate that the ratio of released or discarded catch to landings was 12.23% (MNRF 2022). Hence this factor has been scored as <100%.

Lake Superior | America, North - Inland Waters | United States | Minnesota | Gillnets and entangling nets

Lake Superior | America, North - Inland Waters | United States | Minnesota | Gillnets and entangling nets | Tribal fishery

< 100%

Data from 2018-2022 indicate that bycatch was <1% (MNDNR 2023a) and hence the ratio of discards to landings is assumed to be low. Therefore this factor has been scored as <100%.

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Gillnets and entangling nets

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Gillnets and entangling nets | Tribal fishery

< 100%

Data from 2011-2023 indicate that bycatch was <2% (WDNR 2023); of these species 0.19% were released or discarded, so the ratio of discards to landings is assumed to be low. Therefore this factor has been scored as <100%.

Lake sturgeon

Factor 2.1 - Abundance

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

High Concern

According to the most recent IUCN assessment, published in 2022, the lake sturgeon *Acipenser fulvescens* is globally Endangered (Haxton and Bruch 2022). Current and extirpated populations of lake sturgeon in Lake Superior may be viewed in the Figure 34 below (Schloesser et al. 2014). 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 has been scored as a “high concern.”

Justification:

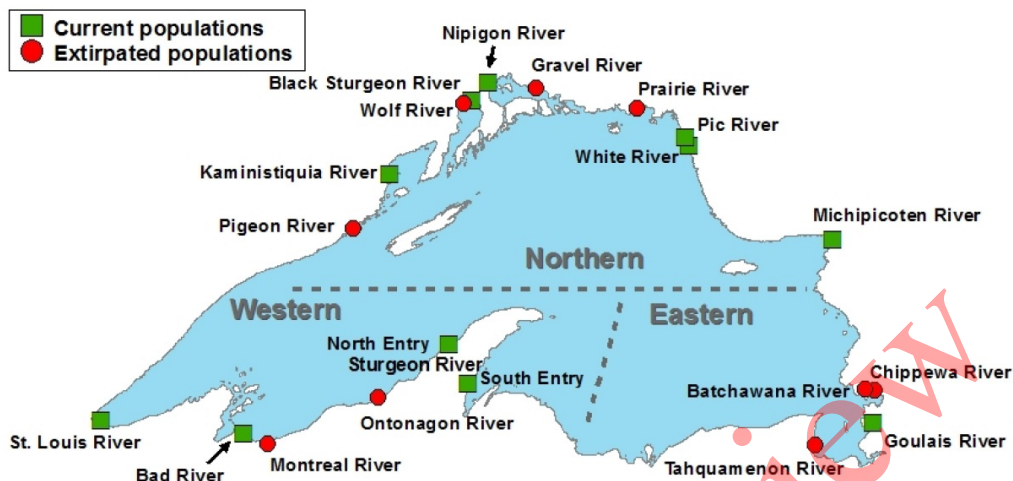


Figure 34: Current and extirpated populations of lake sturgeon in the tributeries of Lake Superior, that were sampled during the 2011 Lake Superior Lake Sturgeon Index Survey (Schloeser et al. 2014).

**Lake Superior | America, North - Inland Waters | United States | Wisconsin | Set gillnets
 Lake Superior | America, North - Inland Waters | United States | Wisconsin | Set gillnets | Tribal fishery**

Moderate Concern

According to the most recent IUCN assessment, published in 2022, the lake sturgeon *Acipenser fulvescens* is globally Endangered (Haxton and Bruch 2022). Current and extirpated populations of lake sturgeon in Lake Superior may be viewed in Figure 34 above (Schloeser et al. 2014). Currently the state of Wisconsin has categorized lake sturgeon as “S3” or “Vulnerable” due to a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats or other factors (WDNR 2021)(WDNR 2022). A recent study in Wisconsin waters conservatively estimates that the Bad and White River population of lake sturgeon is approximately 2308 individuals, as it meets the FCO of 1500 mature adults, and may be considered to be rehabilitated (Schloeser and Quinlan 2019) (Ebener and Pratt 2021). Contrastingly, the St. Louis population, which is shared by Wisconsin and Minnesota show signs of progression towards recovery, but has not yet met the FCO goal (Ebener and Pratt 2021). As the appropriateness of the reference level is unknown, a PSA was conducted for lake sturgeon, with a score of 3.12 at “medium vulnerability”. Hence abundance was scored a “moderate concern”.

Justification:

The Productivity Susceptibility Analysis of lake sturgeon in the Wisconsin waters of Lake Superior is as follows:

Productivity Attribute	Relevant Information	Score (1= high productivity, 2= medium productivity, 3= low productivity)

Average age at maturity	>15 years (WDNR 2024)	3
Von Bertalanffy growth coefficient (K)	K <0.15 (Froese and Pauly 2024)	3
Fecundity	> 20,000 eggs (Froese and Pauly 2024)	1
Average maximum size	Lmax = 274 cm (Froese and Pauly 2024)	2
Average size at maturity	Lm = 40-200 cm cm (Froese and Pauly 2024)	2
Reproductive strategy	Broadcast spawner (WDNR 2024)	1
Productivity score (P)		2.0

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	Majority of captured individuals released (pers comm Ray, B. 2023)	1
Susceptibility score (S)		2.4

$$\text{Vulnerability} = \sqrt{P^2 + V^2}$$

$$= \sqrt{2.0^2 + 2.4^2}$$

$$= 3.12$$

Factor 2.2 - Fishing Mortality

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

Low Concern

Catch composition data indicate that in 2021, 1297kg of lake sturgeon were caught as bycatch in gillnets in the Ontario waters of Lake Superior (MNRF 2022). Of this amount 21kg were harvested and the remaining 1276kg were released or discarded (ibid). Although there is no information on fisheries-related post-release survival of lake sturgeon from Ontario, in Wisconsin waters, all the lake sturgeon caught as bycatch in commercial fisheries are released alive, and post-release survival is likely to be high, as they are tagged and are frequently recaptured (pers comm Ray, B. 2023). Hence in Ontario as well, the commercial fishery is not considered to be a substantial contributor to fishing mortality, and this factor has been scored as a “low concern”.

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Set gillnets

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Set gillnets | Tribal fishery

Low Concern

The recommended exploitation rate to maintain a self-sustaining population of lake sturgeon is 3.1% of the Bad and White River population (Schloesser and Quinlan 2019). Bycatch of lake sturgeon in large-mesh gillnets (that target lake trout and lake whitefish) in 2022 was approximately 1.17% of the population if it is assumed that all the individuals caught as bycatch were in fact from the Bad and White River population. However, all individuals caught as bycatch did not belong to the Bad and White River population, so fishing mortality is unknown (pers comm Ray, B. 2023). Nevertheless, all the lake sturgeon caught as bycatch in commercial fisheries are released alive, and post-release survival is likely to be high, as they tagged and frequently recaptured (pers comm Ray, B. 2023) and hence the commercial fishery is not considered to be a substantial contributor to fishing mortality. Further, recreational angling and tribal subsistence fishing, which is permitted is likely a substantial contributor to fishing mortality of lake sturgeon in Wisconsin waters (Schloesser and Quinlan 2019). Because of these

reasons, fishing mortality in commercial fisheries has been scored a “low concern”.

Lake trout

Factor 2.3 - Discard Rate/Landings

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

< 100%

Data from 2021 indicate that the ratio of released or discarded catch to landings was 12.23% (MNRF 2022). Hence this factor has been scored as <100%.

Lake Superior | America, North - Inland Waters | United States | Michigan | Set gillnets | 1842 Treaty Waters | Tribal fishery

Lake Superior | America, North - Inland Waters | United States | Michigan | Set gillnets | 1836 Treaty Waters | Tribal fishery

Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1836 Treaty Waters | Tribal fishery

< 100%

Discards are very low for all gear types in the Michigan waters of Lake Superior (pers comm Caroffino, D. 2023). Hence we consider the ratio of discards to landings to be <100%.

Lake Superior | America, North - Inland Waters | United States | Minnesota | Set gillnets

Lake Superior | America, North - Inland Waters | United States | Minnesota | Set gillnets | Tribal fishery

< 100%

Data collected from 2018-2022 indicate that 2.75" and 3" gillnets catch >99% of cisco and >97% of round whitefish respectively, that are harvested (MNDNR 2023a). A total of 5700 lake trout are harvested and the remaining are released (pers comm Goldworthy, C.) or discarded. As we expect that the ratio of discards to landings will comprise <1% of the catch in the case of the 2.75" mesh gillnets and <3% in the case of the 3.00" mesh gillnets, discards are likely to be low. Hence we have scored this factor as <100%.

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Set gillnets

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Set gillnets | Tribal fishery

< 100%

Data from 2011 to 2022 indicate that the ratio of released or discarded catch to landings is 0.43% (WDNR 2023), which is low. Hence this factor has been scored as <100%.

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Stationary uncovered pound nets

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Stationary

uncovered pound nets | Tribal fishery

< 100%

Data from 2011 to 2022 indicate that the ratio of released or discards to landings was 0.13% (WDNR 2023), which was very low. Hence this factor has been rated as <100%.

Lake whitefish

Factor 2.3 - Discard Rate/Landings

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

< 100%

Data from 2021 indicate that the ratio of released or discarded catch to landings was 12.23% (MNRF 2022). Hence this factor has been scored as <100%.

Lake Superior | America, North - Inland Waters | United States | Michigan | Set gillnets | 1842 Treaty Waters | Tribal fishery

Lake Superior | America, North - Inland Waters | United States | Michigan | Set gillnets | 1836 Treaty Waters | Tribal fishery

Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1836 Treaty Waters | Tribal fishery

< 100%

Discards are very low for all gear types in the Michigan waters of Lake Superior (pers comm Caroffino, D. 2023). Hence we consider the ratio of discards to landings to be <100%.

Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1836 Treaty Waters | State Fishery

< 100%

Data from 2018-2022 indicate that the ratio of discards to landings ranged from 8.5% to 43.32% (M-DNR 2023a). Therefore this factor has been scored as <100%.

Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1842 Treaty Waters | State Fishery

< 100%

As harvest data from 2002-2022 showed that discards comprised only approximately 10% of the catch on average (Rook 2023d), the ratio of discards to landings was scored as <100%.

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Set gillnets

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Set gillnets | Tribal fishery

< 100%

Data from 2011 to 2022 indicate that the ratio of released or discarded catch to landings is 0.43%

(WDNR 2023), which is low. Hence this factor has been scored as <100%.

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Stationary uncovered pound nets

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

< 100%

Data from 2011 to 2022 indicate that the ratio of released or discards to landings was 0.13% (WDNR 2023), which was very low. Hence this factor has been rated as <100%.

Suckers (unknown)

Factor 2.1 - Abundance

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

Moderate Concern

As the longnose sucker *Catostomus catostomus* (which is commonly found in the Great Lakes) is a "Least Concern" on the IUCN Red List of Threatened Species (Bogutskaya 2021), abundance of suckers has been scored as a "moderate concern".

Factor 2.2 - Fishing Mortality

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

Moderate Concern

As suckers are not targeted, stock assessments are not conducted on them, and fishing mortality is unknown; hence this factor has been scored a "moderate concern".

Walleye

Factor 2.3 - Discard Rate/Landings

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

< 100%

Data from 2021 indicate that the ratio of released or discarded catch to landings was 12.23% (MNRF 2022). Hence this factor has been scored as <100%.

Factor 2.3 - Discard Rate/Landings

Lake Superior | America, North - Inland Waters | Canada | Ontario | Gillnets and entangling nets
Lake Superior | America, North - Inland Waters | Canada | Ontario | Set gillnets

< 100%

Data from 2021 indicate that the ratio of released or discarded catch to landings was 12.23% (MNRF 2022). Hence this factor has been scored as <100%.

Lake Superior | America, North - Inland Waters | United States | Michigan | Set gillnets | 1842 Treaty Waters | Tribal fishery

Lake Superior | America, North - Inland Waters | United States | Michigan | Set gillnets | 1836 Treaty Waters | Tribal fishery

Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1836 Treaty Waters | Tribal fishery

< 100%

Discards are very low for all gear types in the Michigan waters of Lake Superior (pers comm Caroffino, D. 2023). Hence we consider the ratio of discards to landings to be <100%.

Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1836 Treaty Waters | State Fishery

< 100%

Data from 2018-2022 indicate that the ratio of discards to landings ranged from 8.5% to 43.32% (M-DNR 2023a). Therefore this factor has been scored as <100%.

Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1842 Treaty Waters | State Fishery

< 100%

As harvest data from 2002-2022 showed that discards comprised only approximately 10% of the catch on average (Rook 2023d), the ratio of discards to landings was scored as <100%.

Lake Superior | America, North - Inland Waters | United States | Minnesota | Gillnets and entangling nets

Lake Superior | America, North - Inland Waters | United States | Minnesota | Gillnets and entangling nets | Tribal fishery

< 100%

Data from 2018-2022 indicate that bycatch was <1% (MNDNR 2023a) and hence the ratio of discards to landings is assumed to be low. Therefore this factor has been scored as <100%.

Lake Superior | America, North - Inland Waters | United States | Minnesota | Set gillnets

Lake Superior | America, North - Inland Waters | United States | Minnesota | Set gillnets | Tribal fishery

< 100%

Data collected from 2018-2022 indicate that 2.75" and 3" gillnets catch >99% of cisco and >97% of round whitefish respectively, that are harvested (MNDNR 2023a). A total of 5700 lake trout are harvested and the remaining are released (pers comm Goldworthy, C.) or discarded. As we expect that the ratio of discards to landings will comprise <1% of the catch in the case of the 2.75" mesh gillnets and <3% in the case of the 3.00" mesh gillnets, discards are likely to be low. Hence we have scored this factor as <100%.

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Gillnets and entangling nets

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Gillnets and entangling nets | Tribal fishery

< 100%

Data from 2011-2023 indicate that bycatch was <2% (WDNR 2023); of these species 0.19% were released or discarded, so the ratio of discards to landings is assumed to be low. Therefore this factor has been scored as <100%.

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Set gillnets

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Set gillnets | Tribal fishery

< 100%

Data from 2011 to 2022 indicate that the ratio of released or discarded catch to landings is 0.43% (WDNR 2023), which is low. Hence this factor has been scored as <100%.

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Stationary uncovered pound nets

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

< 100%

Data from 2011 to 2022 indicate that the ratio of released or discards to landings was 0.13% (WDNR 2023), which was very low. Hence this factor has been rated as <100%.

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 Superior America, North - Inland Waters Canada Ontario Gillnets and entangling nets	Highly effective	Highly effective	Moderately Effective	Highly effective	Highly effective	Green (4.000)
Lake Superior America, North - Inland Waters Canada Ontario Set gillnets	Moderately Effective	Moderately Effective	Moderately Effective	Highly effective	Highly effective	Yellow (3.000)

Lake Superior America, North - Inland Waters United States Michigan Set gillnets 1836 Treaty Waters Tribal fishery	Moderately Effective	Highly effective	Moderately Effective	Highly effective	Highly effective	Yellow (3.000)
Lake Superior America, North - Inland Waters United States Michigan Set gillnets 1842 Treaty Waters Tribal fishery	Moderately Effective	Highly effective	Moderately Effective	Highly effective	Highly effective	Yellow (3.000)
Lake Superior America, North - Inland Waters United States Michigan Stationary uncovered pound nets 1836 Treaty Waters State Fishery	Highly effective	Highly effective	Moderately Effective	Highly effective	Highly effective	Green (4.000)
Lake Superior America, North - Inland Waters United States Michigan Stationary uncovered pound nets 1836 Treaty Waters Tribal fishery	Moderately Effective	Highly effective	Moderately Effective	Highly effective	Highly effective	Yellow (3.000)
Lake Superior America, North - Inland Waters United States Michigan Stationary uncovered pound nets 1842 Treaty Waters State Fishery	Moderately Effective	Highly effective	Moderately Effective	Highly effective	Highly effective	Yellow (3.000)
Lake Superior America, North - Inland Waters United States Minnesota Gillnets and entangling nets	Highly effective	Highly effective	Moderately Effective	Highly effective	Highly effective	Green (4.000)
Lake Superior America, North - Inland Waters United States Minnesota Gillnets and entangling nets Tribal fishery	Moderately Effective	Highly effective	Moderately Effective	Moderately Effective	Highly effective	Yellow (3.000)
Lake Superior America, North - Inland Waters United States Minnesota Set gillnets	Moderately Effective	Highly effective	Moderately Effective	Highly effective	Highly effective	Yellow (3.000)
Lake Superior America, North - Inland Waters United States Minnesota Set gillnets Tribal fishery	Moderately Effective	Highly effective	Moderately Effective	Moderately Effective	Highly effective	Yellow (3.000)
Lake Superior America, North - Inland Waters United States Wisconsin Gillnets and entangling nets	Moderately Effective	Highly effective	Moderately Effective	Highly effective	Highly effective	Yellow (3.000)
Lake Superior America, North - Inland Waters United States Wisconsin Gillnets and entangling nets Tribal fishery	Moderately Effective	Highly effective	Moderately Effective	Highly effective	Highly effective	Yellow (3.000)
Lake Superior America, North - Inland Waters United States Wisconsin Set gillnets	Moderately Effective	Highly effective	Moderately Effective	Highly effective	Highly effective	Yellow (3.000)

Lake Superior America, North - Inland Waters United States Wisconsin Set gillnets Tribal fishery	Moderately Effective	Highly effective	Highly effective	Highly effective	Highly effective	Yellow (3.000)
Lake Superior America, North - Inland Waters United States Wisconsin Stationary uncovered pound nets	Moderately Effective	Highly effective	Highly effective	Highly effective	Highly effective	Yellow (3.000)
Lake Superior America, North - Inland Waters United States Wisconsin Stationary uncovered pound nets Tribal fishery	Moderately Effective	Highly effective	Highly effective	Highly effective	Highly effective	Yellow (3.000)

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 Superior (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 2023c). 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 40). 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 (Busiahn 1990)(Horns et al. 2003) (GLFC 2023a)(GLFC 2023c). 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 2023c).

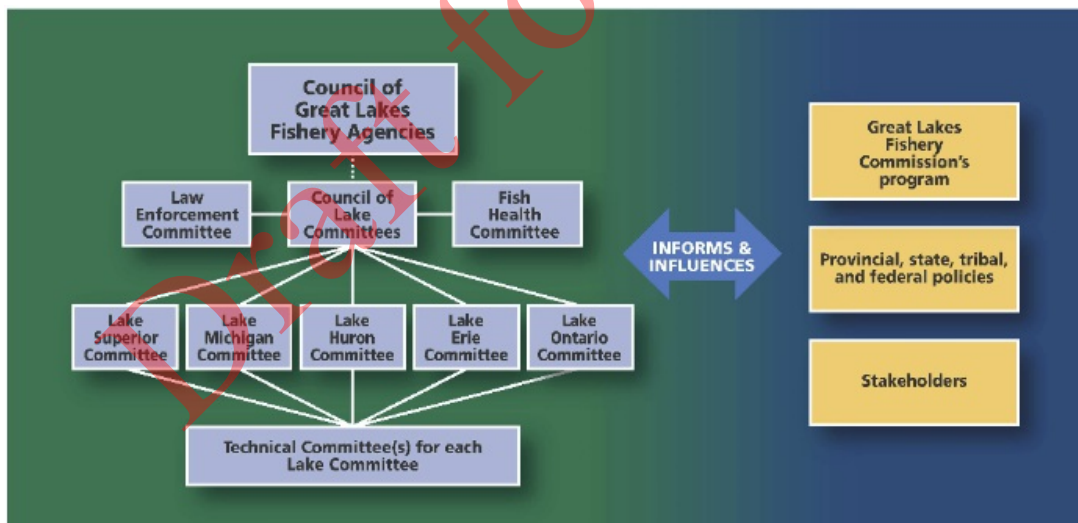


Figure 40: Organizational structure of management bodies in the Great Lakes (GLFC 2023c).

The Lake Superior Committee comprises senior staff members from the Michigan Department of Natural Resources, Minnesota Department of Natural Resources, Ontario Ministry of Natural Resources and Forestry, Wisconsin Department of Natural Resources, the Chippewa-Ottawa Resource Authority (CORA), the Great Lakes Indian Fish and Wildlife Commission (GLIFWC), the 1854 Treaty Authority and the Red Cliff Band of Lake Superior Chippewa (GLFC 2023b). The Lake Superior 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 Superior Technical Committee comprises fishery biologists from Michigan Department of Natural Resources, Minnesota Department of Natural Resources, Ontario Ministry of Natural Resources and Forestry, Wisconsin Department of Natural Resources, CORA, GLIFWC, the 1854 Treaty Authority, Fisheries and Oceans Canada, U.S Fish and Wildlife Service, and U.S. Geological Survey (ibid). The Technical Committee is responsible for: (1) providing the Lake Superior Committee with technical information on the status of stocks including management alternatives and guidelines in making and evaluating fisheries management decisions, (2) reviewing proposed work assignments and providing technical approval for assignments to be carried out, (3) providing resource persons to assist members when required, (4) advising the Committee Chairman of additional funding or other requirements, and (5) drafting the semi-annual, annual and state of the lake reports for use by the Committee (ibid).

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 2022)(GLFC 2023d). 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).

In 1836 and 1842, 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 the 1842 Treaty (GoUS and GoOCI 1836)(GoUS and GoCI 1842), and shown in the map below (Figure 41). As such, the Grand Portage, Red Cliff and Bad River Bands of Lake Superior Chippewa and the Keweenaw Bay Indian Community have the right to fish in 1842 Treaty-ceded waters, whereas five tribes i.e. 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 Superior (Moen et al. 2022).



Figure 41: Map of Lake Superior, showing the 1836 and the 1842 Treaty-ceded territories (Falck et al. 2015).

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 managers 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 is a mechanism to effectively address user conflicts.

Draft for Review

Factor 3.1 - Management Strategy And Implementation

Lake Superior | America, North - Inland Waters | Canada | Ontario | Gillnets and entangling nets

Highly effective

As lake herring (cisco) is the targeted species in suspended gillnets (referred to as gillnets and entangling nets) in the Ontario waters of Lake Superior, management strategy and implementation of each of the species is considered in this section (MNRF 2022). Management is based on the following main strategies: (1) limited licensing – there are 49 licensed commercial fishers, including five Indigenous Community licenses, (2) an annual harvest limit or quota (with Individual Transferable Quotas that are allocated to each licensed fisher or Indigenous Community for each quota managed species), (3) fishing seasons (which usually extends from May-December) , and (4) daily requirements to report on effort, catch and harvest information as a licensing condition (ibid).

To determine safe harvest limits in the cisco fishery, stock status (and hence quotas) are informed by a suite of assessments including hydroacoustics, USGS trawl surveys, commercial catch sampling and harvest reporting, as well as independent fisheries community assessments (pers comm James, S. 2023) and the TAC is set to 10% of the spawning stock biomass (Fisch et al. 2019) estimated during the annual hydroacoustic survey, based on an established harvest control rule and TAC. The appropriateness of TAC has been tested through a Management Strategy Evaluation (see section C1.2). As the strategies in place effectively manage the lake herring stock in Ontario waters, Management Strategy and Implementation has been scored as “highly effective”.

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

Moderately Effective

As lake whitefish, lake trout and walleye comprise the main targeted and retained species in set gillnets in the Ontario waters of Lake Superior, management strategy and implementation of each of these species is considered in this section (MNRF 2022). Management is based on the following main strategies: (1) limited licensing – there are 49 licensed commercial fishers, including five Indigenous Community licenses, (2) an annual harvest limit or quota (with Individual Transferable Quotas that are allocated to each licensed fisher or Indigenous Community for each quota managed species), (3) fishing seasons (which usually extends from May-December) , and (4) Ddaily requirements to report on effort, catch and harvest information as a licensing condition (ibid).

To determine safe harvest limits in each fishery, relative abundance is monitored through a variety of fisheries assessments annually (pers comm James, S. 2023). 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 and Forestry 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, which can be thought of as the total quota of all licenses in each area for each species (ibid). These TACs have been established in Ontario waters of Lake Superior since 1984, based on past performance of the fishery at the time (ibid). Subsequently, they have been adjusted relatively based on the status of each fish stock by species and area, but by no more than 10-15% (ibid), and may be considered as a harvest control rule.

Although the existing management strategies have been effective in ensuring that harvests of the main targeted retained species remain within the specified TAC, stock assessments are not conducted, and there were no biological reference points set for abundance. Therefore, Management Strategy and Implementation has been scored as “moderately effective”.

Lake Superior | America, North - Inland Waters | United States | Michigan | Set gillnets | 1836 Treaty Waters | Tribal fishery

Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1836 Treaty Waters | Tribal fishery

Moderately Effective

The Management Strategy and Implementation of both lake trout and lake whitefish caught in the tribal gillnet and trap net fisheries is considered in this section as both species are targeted and retained in both gear types (M-DNR 2023b). Management is based on the following main strategies: (1) limited entry, (2) establishment of commercial fishing zones, and zones closed to commercial fishing including depth restrictions, (3) gear restrictions (such as limiting the number of feet of gillnet used or number of traps per fisher) and controlling gear markings, (4) establishment of seasonal spawning closures, and (5) setting harvest limits for each management unit (with allocations between tribal- and state-licensed fishers where applicable), and target annual mortality rates based on scientific data (BMIC, GTBOCI, LRBOI, LTBOI and SSMTCI 2022)(USDCWM 2023)(Lenart and Smith 2022).

To determine safe harvest limits in the lake trout and lake whitefish fisheries, the status of stocks across management units is regularly reviewed, to assess effectiveness of regulations and management effectiveness (Lenart and Smith 2022). Reference levels for abundance and fishing mortality of both lake trout and lake whitefish have been clearly defined (ibid). Following the updated Decree of 2023 (USDCWM 2023) and the draft Lake Superior Fisheries Management plan 2023-2033 (henceforth Michigan FMP), total annual mortality rates of lake trout will be maintained at less than 42% on age classes selected by fisheries, and of lake whitefish will be maintained at less than 55% (pers comm Hanchin, P. 2023), which represents a reduction in total annual mortality rates from their current levels. Further, the Biological Services Division (BSD) of CORA establishes, evaluates and adjusts benchmark harvest levels for fish stocks and these are referred to as “Harvest Regulation Guidelines” (HRGs), in consultation with tribal biologists and consultants (BMIC, GTBOCI, LRBOI, LTBOI and SSMTCI 2022). Specifically for lake whitefish in management units not shared with the State, and lake trout in management unit MI-8, these HRGs are established, evaluated and adjusted (ibid). 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 (CORA 2000)(pers comm Gorenflo, T. 2023)(USDCWM 2023).

Although existing management strategies have been effective in maintaining stock abundance and controlling fishing mortality of lake trout, fishing mortality of lake whitefish in WFS-08 has been below the target reference level only in the most recent year (2021), and no stock assessment has been conducted in WFS-06. Due to this reason, Management Strategy and Implementation has been scored as “moderately effective”.

Lake Superior | America, North - Inland Waters | United States | Michigan | Set gillnets | 1842 Treaty Waters | Tribal fishery

Moderately Effective

The Management Strategy and Implementation of lake whitefish and lake trout caught in tribal gillnet fisheries in 1842 Treaty Michigan waters of Lake Superior is considered in this section, as both species are targeted and retained in the gillnets (Mattes 2023). Management of lake whitefish and lake trout is based on the following main strategies (Mattes 2021): (1) Limited entry (there are thirteen licenses in total; seven belonging to small boats and six to large boats), (2) establishment of seven closed seasonal refuges and spawning closures for lake trout, (3) TAC established quotas for lake trout (followed by the Bad River Band and the Red Cliff Band; the Keweenaw Bay follows their fishery management plan), (4) limits to gillnet effort and harvest by setting target effort and harvest levels, and (5) mandatory bi-weekly commercial catch and effort reporting.

To determine safe harvest limits in the lake whitefish fisheries, the status of lake whitefish stocks across management units has been reviewed (Rook 2023a) (Rook 2023b) (Rook 2023c), to ensure management effectiveness. Reference levels for abundance and fishing mortality of lake whitefish have also been clearly defined (ibid). Similarly, to determine safe harvest limits in the lake trout fisheries, the status of lake trout stocks across management units has been assessed, and biological reference levels for abundance and fishing mortality have been clearly defined (Caroffino 2023a) (Caroffino 2023b) (Caroffino 2023c). Harvest and effort of lake whitefish and lake trout have typically been within the target levels specified (Mattes 2021). Although there is a fishing mortality limit for lake whitefish and lake trout, which will henceforth be maintained at 55% and 42% respectively across all fisheries selected age classes, there is an informal Harvest Control Rule that is followed by the Tribes (pers comm Caroffino, D. 2023).

Despite the fact that harvests of lake whitefish in 1842 Michigan waters have been within the target harvest level, there is no TAC or quota set for lake whitefish in these waters based on biological models, and the Harvest Control Rules are informal. In the case of lake trout, although there is a TAC in place, fishing mortality in some management units is above the target reference levels (Caroffino 2023a). Hence, Management Strategy and Implementation for both lake whitefish and lake trout has been scored as “moderately effective”.

Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1836 Treaty Waters | State Fishery

Highly effective

As the state-licensed trap net fishery targets only lake whitefish in 1836 Treaty Michigan waters of Lake Superior, management strategy and implementation of only lake whitefish is considered in this section. Management is based on the following main strategies: (1) establishment of commercial fishing zones, and zones closed to commercial fishing, (2) gear restrictions and markings, (3) establishment of seasonal spawning closures, and (4) setting harvest limits for each management unit (with allocations between tribal- and state-licensed fishers where applicable), and target annual mortality rates based on scientific data (USDCWM 2023)(Lenart and Smith 2022). Further, state-licensed commercial fishers are not permitted to retain lake trout (USDCWM 2023).

To determine safe harvest limits in the lake whitefish fishery, the status of stocks across management units is regularly reviewed, to assess effectiveness of regulations and management effectiveness (Lenart and Smith 2022). Reference levels for abundance and fishing mortality of both lake whitefish

have been clearly defined (ibid). Per the draft Lake Superior Fisheries Management plan 2023-2033 (henceforth Michigan FMP), Michigan Department of Natural Resources (MDNR) plans to maintain total annual mortality rates of lake whitefish at less than 55% on age classes selected by fisheries (pers comm Hanchin, P. 2023), which represents a reduction in total annual mortality rates from their current levels. A harvest control rule exists, to manage these fishing mortality limits (USDCWM 2023). The Michigan FMP also aims to limit sea lamprey-induced mortality on lake whitefish (ibid).

As management of lake whitefish has been effective in maintaining stock abundance and controlling fishing mortality of lake whitefish, in the state-licensed commercial fishery, Management Strategy and Implementation has been scored as “highly effective”.

Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1842 Treaty Waters | State Fishery

Moderately Effective

As the state-licensed trap net fishery targets mostly lake whitefish in 1842 Treaty-ceded Michigan waters of Lake Superior, only the management strategy and implementation of lake whitefish is considered in this section. Management is based on the following main strategies: (1) limited licensing (with two commercial fishing operators only) (M-DNR 2023c), (2) gear restrictions and markings (ibid), and (3) effort restrictions (only a set number of nets per license may be used) (pers comm Caroffino, D. 2023). Although preliminary stock assessment models for 1842 Treaty-ceded waters indicate that total annual mortality rates in this region are low, the models used are in the process of being updated and outputs are in the process of being updated with new data (pers comm Hanchin, P. 2023)(pers comm Caroffino, D. 2023). An informal Harvest Control Rule exists to maintain fishing mortality within the limit of 55% on all age classes selected by fisheries (pers comm Caroffino, D. 2023).

Even though some management strategies do exist, stock assessment models and data are in the process of being updated. Further, although a Harvest Control Rule exists, it is informal. Due to these reasons, Management Strategy and Implementation has been scored as “moderately effective”.

Lake Superior | America, North - Inland Waters | United States | Minnesota | Gillnets and entangling nets

Highly effective

Small-mesh suspended gillnets mainly target lake herring (MNDNR 2023a), and hence only the management strategy and implementation of lake herring is considered here. Overall Minnesota follows the Fish Community Objectives defined by the GLFC (Horns et al. 2003). However, following the Minnesota FMP (Goldsworthy et al. 2017), management of the commercial fishery is based on the following main strategies: (1) limited entry (to a maximum of 25 residents), (2) annual harvest limits (with a TAC and individual quotas, restrictions on gillnet footage set to a maximum of 300,000 feet of net overall for suspended gillnets, and restrictions on the maximum amount of gillnet per licensee set to 6,000 feet for suspended gillnets), and (3) an established harvest control rule (Goldsworthy and Yule 2021).

To determine safe harvest limits in the cisco fishery, annual hydroacoustic surveys are conducted in October in Minnesota waters and the TAC is set to 10-15% of the spawning stock biomass estimated

during the annual hydroacoustic survey, based on an established harvest control rule and TAC (pers comm Goldsworthy, C. 2023)(Goldsworthy and Yule 2021). The appropriateness of TAC has been tested through a Management Strategy Evaluation (see section C1.2). As the strategies in place effectively manage the lake herring stock in Minnesota waters, Management Strategy and Implementation has been scored as “highly effective”.

Lake Superior | America, North - Inland Waters | United States | Minnesota | Gillnets and entangling nets | Tribal fishery

Moderately Effective

Small-mesh suspended gillnets are typically used to target lake herring (MNDNR 2023a), and hence only the management strategy and implementation of lake herring is considered here. Overall the tribal Minnesota fisheries management follows the Fish Community Objectives defined by the GLFC (Horns et al. 2003). However, management of the commercial fishery is based on the following main strategies: (1) limited number of fishers (5 for the cisco fishery), (2) annual harvest limits (with a TAC), (3) an established harvest control rule (Goldsworthy and Yule 2021) (pers comm Isaac, E. J. 2023), and (4) a Tribal code that outlines regulations for fishing (pers comm Isaac, E. J. 2023).

To determine safe harvest limits in the cisco fishery, annual hydroacoustic surveys are conducted in October in Minnesota waters and the TAC is set to 10% of the spawning stock biomass estimated during the annual hydroacoustic survey (pers comm Isaac, E. J. 2023), based on an established harvest control rule. As there are strategies in place to manage the lake herring stock in Minnesota Grand Portage waters, but the TAC is sometimes met and sometimes exceeded, Management Strategy and Implementation has been scored as “moderately effective”.

**Lake Superior | America, North - Inland Waters | United States | Minnesota | Set gillnets
Lake Superior | America, North - Inland Waters | United States | Minnesota | Set gillnets | Tribal fishery**

Moderately Effective

Large-mesh gillnets in Minnesota waters are mainly used to target lake trout (MNDNR 2023a), and hence only the management strategy and implementation of lake trout is considered here. Overall, the Minnesota Department of Natural Resources and the Grand Portage Band of Lake Superior Chippewa follow the Fish Community Objectives defined by the GLFC (Horns et al. 2003). Following the Minnesota FMP (Goldsworthy et al. 2017), management of the state-licensed commercial fishery is based on the following main strategies: (1) limited entry (to a maximum of 25 residents), (2) annual harvest limits (with TACs and individual quotas, restrictions on gillnet footage set to a maximum of 300,000 feet of net each for bottom set gillnets, restrictions on the maximum amount of gillnet per licensee set to 25,000 feet for bottom set gillnets, and a limited expanded open season), (3) fishing seasons and spawning closures, (4) establishing refuges from all fishing operations where lake trout spawn, and (5) controlling sea lamprey wounding rates to below 5%. Management of the tribal-licensed fishery is based on the following management strategies: (1) limited number of fishers (2 for the lake trout fishery), (2) annual harvest limits (with a TAC of 27,000 lbs and the use of lake trout tags), and (3) the Grand Portage Hunting and Fishing code that outlines regulations for fishing (pers comm Isaac, E. J. 2023).

To determine safe harvest limits in the lake trout fishery, population models are used, and fishery-

independent surveys are conducted annually to assess population dynamics (Goldsworthy et al. 2017). A Statistical-Catch-at-Age (SCAA) model is used to assess lake trout populations, with total annual mortality, which is the sum of natural mortality, fishing mortality and sea lamprey induced mortality (ibid). In the state-licensed fishery, the TAC is set based on a total annual mortality threshold of 40% for the state-licensed commercial fishery (ibid). Per the Minnesota Expanded Harvest statute, the Minnesota Department of Natural Resources has been authorized to expand the taking and sale of lake trout by licensed commercial operators in MN-3 and MN-2, with a TAC of 3,000 and 2,000 respectively in an open season from June 1 to September 30 (State of Minnesota 2009). The Minnesota FMP also aims to locate and protect areas where lake trout spawn successfully, and to maintain a spawning closure during the lake trout spawning season to limit fishing mortality of lake trout (Goldsworthy et al. 2017). Fishing effort is also limited by restricting the number of lake trout tags given to commercial fishers; all lake trout caught must be tagged and have a locking strap number before they are landed at the dock (pers comm Goldsworthy, C. 2023). Harvest Control Rules are also in place to ensure that fishing mortality of lake trout in Minnesota waters is controlled (MNDNR 2016). Finally, in the event of a catastrophic environmental event such as a disease outbreak or a new invasive species that decimates the lake trout population, stocking for the purpose of rehabilitation will be conducted once the event is controlled, with due consideration given to the ecosystem impacts of stocking and to the forage base (ibid). Within the Grand Portage Zone, annual Spring survey assessments are conducted to measure lake trout relative abundance (pers comm Isaac, E. J. 2023). The Department of Biology and Environment of the Grand Portage Band of Chippewa has an agreement with the Minnesota Department of Natural Resources and set their annual harvest limit of lake trout at 27,000 lbs (ibid). This limit may be considered as a harvest control rule. Further, tribal commercial fishers are given a fixed number of tags and are required to tag all lake trout that are caught and sold, thus limiting the harvest of lake trout (ibid).

Although there are many strategies in place to effectively manage the lake trout stock in the state- and tribal licensed fisheries in Minnesota waters, there are no biological reference points set for abundance of lake trout; hence Management Strategy and Implementation has been scored as “moderately effective”.

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Gillnets and entangling nets

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Gillnets and entangling nets | Tribal fishery

Moderately Effective

The main targeted and retained species in small-mesh suspended gillnets is lake herring (WDNR 2023), and so management strategy and implementation of the species is considered in this section. Management is based on four main strategies: (1) limited entry – ten state commercial fishing licenses and 16 tribal big boat licenses are given out in the commercial fishery, (2) annual harvest limits (with quotas and allocations), (3) individual transferable quotas, and (4) establishing large refuges from all fishing operations (including the Gull Island Refuge and the Devils Island Refuge)(WDNR 2020).

To determine safe harvest limits in the lake herring fishery, an annual quota (or TAC) is set to 15% of the hydroacoustic derived spawning stock biomass estimates within jurisdictions (ibid), and this is considered as the harvest control rule (Goldsworthy and Yule 2021). Based on peer reviewed

recommendations, an exploitation rate of 15% is considered appropriate to manage the fishery (Stockwell et al. 2009). Per the Lake Superior Fishing Agreement, the Tribes have agreed to participate in the evaluation of the cisco quota, and the State and the Tribes have agreed to implement the result of this process as a three-party quota, with the possibility of recalculating or revising the quota in the future (BRBLSTCI, WIDNR and RCBLSC 2018).

Although the existing management strategies have been effective and a harvest control rule has been developed to manage the lake herring fishery, as lake herring is a forage species, no Management Strategy Evaluation has been conducted, so following the Seafood Watch standard, the appropriateness of the exploitation rate level is unknown. Therefore, Management Strategy and Implementation has been scored a “moderately effective”.

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Set gillnets
Lake Superior | America, North - Inland Waters | United States | Wisconsin | Set gillnets | Tribal fishery
Lake Superior | America, North - Inland Waters | United States | Wisconsin | Stationary uncovered pound nets
Lake Superior | America, North - Inland Waters | United States | Wisconsin | Stationary uncovered pound nets | Tribal fishery

Moderately Effective

As the main targeted and retained species in large-mesh gillnets and trap nets is comprised of lake whitefish and lake trout (WDNR 2023), and since management strategy and implementation of both lake whitefish and lake trout are inextricably linked, both the species are considered in this section. Management is based on five main strategies: (1) limited entry – ten state commercial fishing licenses and 16 tribal big boat licenses are given out in the commercial fishery, (2) annual harvest limits (with quotas and allocations) and effort limits in the case of set gillnets, (3) individual transferable quotas, (4) fishing seasons and periods (including 3 periods extending from November 28-March 31, April 1 to May 31, and June 1 to September 30), and (5) establishing large refuges from all fishing operations (including the Gull Island Refuge and the Devils Island Refuge) (WDNR 2020). As such, harvest control rules have been set on catch, effort and fishing mortality {pers comm, Ray, B. 2023}.

To determine safe harvest limits in the lake trout fishery, population models are used, and numerous fishery-independent surveys are conducted annually to assess population dynamics (ibid). A Statistical-Catch-at-Age (SCAA) model is used to estimate fishery harvest, abundance, recruitment, mortality, gear selectivity, catchability, and fishery independent catch-per-unit effort for lean lake trout of ages 4-15+(ibid). The total allowable catch (TAC) is based on an annual mortality of 42% on the age of maximum commercial selectivity, as this annual mortality rate is considered sustainable (Nieland et al. 2008). The TAC of lake trout is set with the SCAA model in WI-2, and a static quota in WI-1 (BRBLSTCI, WIDNR and RCBLSC 2018). As the TAC of lake trout has been reduced, commercial effort has been reduced; this strategy has allowed the lake trout population to recover in Wisconsin waters over the past 20 years (WDNR 2020). The allocation of the lake trout quota between the State and the Tribes (including the Red Cliff Tribe and the Bad River Tribe) are given in Figure 35 below (BRBLSTCI, WIDNR and RCBLSC 2018). Limits are set on lake trout harvest by allocating a fixed number of lake trout tags (ibid). Only lake trout that has been appropriately tagged may be docked in Wisconsin (pers comm Ray, B. 2023). Large-mesh gillnet effort in waters less than 330 feet is also

controlled by setting limits on the maximum gillnet footage based on lake trout tag allocations (BRBLSTCI, WIDNR and RCBLSC 2018). Trap net restrictions such as mesh size, depth restrictions, number of pots per fisher etc., also serve to control effort using this gear type (ibid).

Per the Wisconsin FMP, the lake whitefish fishery is regulated through a harvest limit based on allowable lake trout harvest in terms of total amount of gillnet footage allowed (WDNR 2020). By using this method, lake whitefish harvest has been stabilized since 1992 (ibid). More recently a lake whitefish stock assessment model was developed, which will inform stock status and management of lake whitefish in Wisconsin waters (BC 2023b); WDNR intends to maintain the maximum annual mortality under the target level of 55% for the state of Wisconsin, and this goal is currently being met.

Although there are many management strategies in place, there are no biological limits set for abundance of lake trout and lake whitefish. Taken together, management strategy and implementation has been scored a “moderately effective”.

Justification:

	WI-1			WI-2		
	State	Bad River	Red Cliff	State	Bad River	Red Cliff
Initial Allocation	7,000	3,500	3,500	36,500	18,250	18,250
WI-1/WI-2 Tag Swap	+5,000	-3,000	-2,000	-5,000	+3,000	+2,000
Allocation Adjustment for WI-2	N/A	N/A	N/A	-6,000	+3,000	+3,000
Total Allocation:	12,000	500	1,500	25,500	24,250	23,250
	<i>WI-1 TAC: 14,000</i>			<i>WI-2 TAC: 73,000</i>		
Assessment Tags	500	0	0	1,000	500	500
	Total WI-1 Assessment Tags: 500			Total WI-2 Assessment Tags: 2,000		
Total Quotas:	WI-1 Total: 14,500			WI-2 Total: 75,000		
	<i>Combined Totals: 89,500</i>					

Figure 1: Figure 35: Lake trout quota and allocation between the State, the Bad River Band Tribe and the Red Cliff Tribe, for the seasons 2018, 2019 and 2020 (WDNR 2020).

Factor 3.2 - Bycatch Strategy

Lake Superior | America, North - Inland Waters | Canada | Ontario | Gillnets and entangling nets

Highly effective

As the suspended gillnet fishery or the gillnet and entangling net fishery that targets lake herring in Ontario waters catches 99% of lake herring, it is considered as a “highly selective” gear type, and bycatch strategy is scored as "highly effective".

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

Moderately Effective

Although the gillnets used are not highly selective per the SFW definition, they do minimize bycatch to an extent due to their selectivity (MNR 2022). Commercial fishers are required to report all of their catch on a daily basis, including bycatch (pers comm James, S. 2023). The Ministry monitors all

commercial fishing activities including bycatch, but there is no observer coverage (ibid). If the catch of target species is higher than the quota, it is released (MNRF 2022). Similarly, if non-target species (including brook trout, brown trout, burbot, chinook salmon, common carp, lake sturgeon, muskellunge, Pacific salmon, pink salmon, rainbow smelt, rainbow trout, round whitefish, sea lamprey, suckers and white bass) are caught in gillnets, they are required to be released; if a proportion is harvested, it is reported (ibid). Nevertheless, lake sturgeon, which is an ETP species, is required to be released when captured, and if killed are required to be reported; however no post-release survival studies have been done for lake sturgeon in Ontario waters. Taken together, as the set-gillnets are not highly selective, and ETP species are found in the catch, this factor has been scored as “moderately effective”.

Lake Superior | America, North - Inland Waters | United States | Michigan | Set gillnets | 1836 Treaty Waters | Tribal fishery

Highly effective

Both lake whitefish and lake trout are considered as targeted species in the large-mesh gillnet tribal fishery in 1836 Treaty Michigan waters. Other species that are caught comprise 5.6% of the catch, and may or may not be retained. Per the Tribal Plan, the Tribes are responsible for management of species such as bloater chubs, walleye, yellow perch that form a small proportion of the catch, and may develop HRGs for them (BMIC, GTBOCI, LRBOI, LTBBOI and SSMTCI 2022). Further, per the Consent Decree of 2000 and the updated Decree of 2023, retaining > 25 lbs. 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 (USDCWDMSD 2000) (USDCWM 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 is prohibited, and these species if caught must be returned to the water alive, or if dead, they need to be turned over to the BSD tribal staff (ibid). Taken together, Bycatch Strategy of the tribal large-mesh gillnet fishery is scored as "highly effective".

Lake Superior | America, North - Inland Waters | United States | Michigan | Set gillnets | 1842 Treaty Waters | Tribal fishery

Highly effective

Lake whitefish and lake trout caught in bottom-set gillnets together comprise 97% of the catch, and both these species are targeted and retained (Mattes 2023). Since the bottom-set gillnets used catch less than 3% bycatch, they may be considered as a highly selective gear type, following the Seafood Watch Fisheries standard. Hence Bycatch Strategy has been scored as “highly effective”.

Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1836 Treaty Waters | State Fishery

Highly effective

Lake trout comprises the predominant bycatch species in state-licensed trap nets that target lake whitefish in 1836 treaty Michigan waters of Lake Superior (MNDNR 2023a). Although on average the bycatch of lake trout was 20% from 2018-2022, state-licensed fishers are not permitted to retain this species, and they are released alive (MNDNR 2023a)(USDCWM 2023). As post-release survival of lake trout from studies conducted in similar trap net fisheries in Lake Huron indicate that lake trout survival was 87.8% (Johnson et al. 2004.), releasing lake trout from trap nets is considered as a

successful strategy. Hence bycatch strategy has been scored as “highly effective”.

Justification:

Per the updated Decree of 2023, the following species shall not be offered for sale or exchange when caught as bycatch during commercial fishing activities: muskellunge, splake, brown trout, brook trout, rainbow trout, Atlantic salmon, largemouth bass, smallmouth bass and northern Pike (USDCWM 2023). These species are also prohibited from being retained as bycatch species. Further, lake sturgeon, muskellunge and any other species that is listed as threatened or endangered under the Federal Endangered Species Act are prohibited from being taken as bycatch in commercial fisheries and must be returned to the water alive if caught (ibid). If not alive, they must be turned over to the BSD tribal biological staff or the nearest MDNR field office, and are not permitted to be retained (ibid).

Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1836 Treaty Waters | Tribal fishery

Highly effective

Tribal trap nets that target and retain lake whitefish also catch lake trout, which comprises <1% of the catch and is also targeted and retained. Hence, per the Seafood Watch standard these trap nets are considered as a highly selective gear type, and Bycatch Strategy has been scored as “highly effective”.

Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1842 Treaty Waters | State Fishery

Highly effective

As 97% of the catch from state-licensed trap nets in 1842 Treaty Michigan waters comprises lake whitefish, the gear is considered as highly selective, and hence Bycatch Strategy has been scored as “highly effective”.

Lake Superior | America, North - Inland Waters | United States | Minnesota | Gillnets and entangling nets

Lake Superior | America, North - Inland Waters | United States | Minnesota | Gillnets and entangling nets | Tribal fishery

Highly effective

Following the Seafood Watch Standard for Fisheries, suspended gillnets or gillnets and entangling nets that target lake herring in the Minnesota state-licensed fishery catch <1% of bycatch, and hence the gillnets are considered as a highly selective gear type. Since we assume that bycatch in the tribal-licensed lake herring fishery is similar to the State licensed cisco fishery and the gear used is similar, Bycatch Strategy for both the state- and tribal-licensed lake herring fisheries have been scored as “highly effective”.

**Lake Superior | America, North - Inland Waters | United States | Minnesota | Set gillnets
Lake Superior | America, North - Inland Waters | United States | Minnesota | Set gillnets | Tribal fishery**

Highly effective

Both the monofilament and nylon large-mesh gillnets used to target lake trout are highly selective and

catch <3% of lake whitefish, which may also be considered as a target species. Commercial operators get locking numbered tags that are used to tag lake trout caught in Minnesota waters (pers comm Goldsworthy, C. 2023). Lake trout that are not tagged are returned to the water, and post-release survival is expected to be high (ibid), based on post-release studies conducted in other regions of the Great Lakes (Johnson et al. 2004.)(Gallinat et al. 2011). The Minnesota DNR's use of a permitting system for these fisheries allows fisheries managers to determine where commercial operators fish and what types of gear they use, including specifics such as depth, amount set, mesh size etc.; this reduces bycatch considerably compared to other gear types (pers comm Goldsworthy, C. 2023). As tribal-licensed commercial fishers who fish in the Grand Portage zone of Minnesota waters use similar gear to harvest lake trout, they are expected to be highly selective. Taken together, Bycatch Strategy for both the state- and tribal-licensed commercial lake trout fisheries has been scored as “highly effective”.

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Gillnets and entangling nets

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Gillnets and entangling nets | Tribal fishery

Highly effective

Following the Seafood Watch standard for Fisheries, suspended gillnets or gillnets and entangling nets gillnets nets that target cisco catch <2% of bycatch, and are considered as a highly selective gear type. Hence Bycatch Strategy has been scored as “highly effective”.

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Set gillnets

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Set gillnets | Tribal fishery

Highly effective

Although the large-mesh gillnet used is not highly selective per the SFW definition, it does minimize bycatch (WDNR 2023)(WDNR 2019). Onboard bycatch monitoring is conducted, and observer coverage is 7% (BRBLSTCI, WIDNR and RCBLSC 2018) (pers comm Ray, B. 2023). If higher numbers of incidental catch were to be detected, changes to existing regulations would be implemented, to reduce population-level effects on non-target fishes (WDNR 2019).

Excess lake trout and lake whitefish harvest is controlled through effort limitations (BRBLSTCI, WIDNR and RCBLSC 2018). Non-target species (including coho salmon, chinook salmon, brown trout, rainbow trout, brook trout, smallmouth bass, and northern pike) if caught in the gillnets are required to be released (WDNR 2019)(WDNR 2023). Further, the Lake Superior lake sturgeon rehabilitation plan's target of 1500 mature spawning individuals that ascend a common tributary has been met in Wisconsin waters (Auer 2003)(Schloesser and Quinlan 2019). Still further, the issue of ghost gear was addressed through an outreach and education plan to prevent gillnet loss, developed jointly by the University of Wisconsin Sea Grant program, in cooperation with local stakeholders and NOAA (NOAA 2023). This initiative is part of NOAA's Marine Debris Program and focused on guidance for reporting on derelict fishing gear and strategies to encourage behavior change to prevent derelict gear from entering the Lake Superior ecosystem (NOAA 2023). Taken together, the Bycatch Strategy has been scored as “highly effective”.

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Stationary uncovered pound nets

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

Highly effective

As the fishery has <5% of bycatch and discards are 0.13% of the catch, traps that target lake whitefish and lake trout in Wisconsin waters of Lake Superior are considered as a highly selective gear type, and Bycatch Strategy has been scored as “highly effective”.

Factor 3.3 - Scientific Data Collection and Analysis

Lake Superior | America, North - Inland Waters | Canada | Ontario | Gillnets and entangling nets

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

Moderately Effective

A lake-wide data-limited stock assessment of lake trout, lake whitefish, lake herring and walleye is published by the Lake Superior Committee every five years, in the State of Lake Superior report, based on data collected by fisheries scientists belonging to federal and state agencies (Sitar 2021)(Michaels and Gorman 2021)(Goldsworthy and Yule 2021)(Bergland 2021). Further, the Ontario Ministry of Natural Resources and Forestry (MNR) annually monitors relative abundance through a variety of fisheries assessments (pers comm James, S. 2023). The commercial harvest catch rate is measured from daily catch reporting and reported weight per kilometer of gillnet that is set (ibid). MNR also monitors relative abundance through a fishery-independent fish community survey which measures catch rate per standard index net (ibid). Trend information is primarily used for commercial fisheries management (ibid) and full stock assessments are not conducted. Bycatch is also monitored by the MNR through daily reporting requirements (ibid), but there is no independent observer coverage. Further there are no tagging experiments conducted on lake sturgeon to ensure that post-release survival from bottom-set gillnets is high. As lake-wide stock assessments conducted for lake trout, lake whitefish, cisco and walleye are data-limited, there is no independent observer coverage of bycatch, and no post-release survival studies are conducted in lake sturgeon, Scientific Data Collection and Analysis has been scored as “moderately effective”.

Lake Superior | America, North - Inland Waters | United States | Michigan | Set gillnets | 1836 Treaty Waters | Tribal fishery

Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1836 Treaty Waters | Tribal fishery

Moderately Effective

A lake-wide data-limited stock assessment of lake whitefish and lake trout is published by the Lake Superior Committee every five years, in the State of Lake Superior report, based on data collected by fisheries scientists belonging to federal and state agencies (Ebener and Pratt 2021)(Michaels and Gorman 2021). Further, as part of a collaborative the Modeling Subcommittee, Michigan DNR conducts peer reviewed stock assessments on lake whitefish and lake trout in 1836 treaty Michigan waters annually, based on statistical catch-at-age models developed for each management unit, including

information on recommended harvest and effort limits (Lenart and Smith 2022). Although both fishery-independent and fishery-dependent data are used for the lake trout stock assessments, only fishery-dependent data are used for the lake whitefish stock assessments. Per the Decree of 2023, stock assessments will henceforth be conducted once every three years (USDCWM 2023). Further, bycatch in the tribal-licensed commercial lake whitefish and lake trout fisheries in Michigan 1836 treaty waters of Lake Superior is appropriately monitored by the Tribes and the BSD of CORA (MNDNR 2023b)(CORA 2000)(BMIC, GTOCI, LRBOI, LTBOI and SSMTCI 2022). Although stock assessments on lake whitefish and lake trout are regularly conducted and bycatch data are regularly collected, as stock assessments for lake whitefish use only fishery-dependent data and observer coverage when monitoring bycatch is unknown in both the lake trout and lake whitefish fisheries, and it is unknown if data on ghost gear are collected, Scientific Data Collection and Analysis has been scored as “moderately effective”.

Lake Superior | America, North - Inland Waters | United States | Michigan | Set gillnets | 1842 Treaty Waters | Tribal fishery

Moderately Effective

A lake-wide data-limited stock assessment of lake whitefish and lake trout is published by the Lake Superior Committee every five years, in the State of Lake Superior report, based on data collected by fisheries scientists belonging to federal and state agencies (Ebener and Pratt 2021)(Michaels and Gorman 2021). Further, as part of a collaborative the Modeling Subcommittee, Michigan DNR in collaboration with GLIFWC conducts stock assessments on lake whitefish and lake trout in 1842 treaty Michigan waters, based on statistical catch-at-age models developed for each management unit (Caroffino 2023a) (Caroffino 2023b) (Caroffino 2023c) (Rook 2023a) (Rook 2023b) (Rook 2023c). Harvest and effort limits are also recommended by GLIFWC (Mattes 2021). Further, bycatch in the tribal-licensed commercial lake whitefish and lake trout fisheries in Michigan 1842 treaty waters of Lake Superior is appropriately monitored by the Tribes and GLIFWC (Mattes 2023). However, as observer coverage when monitoring bycatch is unknown and ghost gear has not been quantified, Scientific Data Collection and Analysis has been scored as “moderately effective”.

Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1836 Treaty Waters | State Fishery

Moderately Effective

A lake-wide data-limited stock assessment of lake whitefish is published by the Lake Superior Committee every five years, in the State of Lake Superior report, based on data collected by fisheries scientists belonging to federal and state agencies (Ebener and Pratt 2021)(Michaels and Gorman 2021). Further, as part of a collaborative the Modeling Subcommittee, Michigan DNR conducts peer reviewed and independent stock assessments on lake whitefish in 1836 treaty Michigan waters annually, based on a statistical catch-at-age model which utilizes fishery-dependent data only. The stock assessments are developed for each management unit and includes information on recommended harvest and effort limits (Lenart and Smith 2022). Per the new consent decree, stock assessments will henceforth be conducted once every three years (USDCWM 2023). Further, bycatch in the state-licensed commercial lake whitefish trap fishery in Michigan 1836 treaty waters of Lake Superior is appropriately monitored by Michigan DNR (M-DNR 2023a). Although stock assessments on lake whitefish are regularly conducted and bycatch data are regularly collected, as stock assessments are

based on fishery-dependent data only and observer coverage when monitoring bycatch is unknown, Scientific Data Collection and Analysis has been scored as “moderately effective”.

Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1842 Treaty Waters | State Fishery

Moderately Effective

A lake-wide data-limited stock assessment of lake whitefish is published by the Lake Superior Committee every five years, in the State of Lake Superior report, based on data collected by fisheries scientists belonging to federal and state agencies (Ebener and Pratt 2021)(Michaels and Gorman 2021). Further, as part of a collaborative the Modeling Subcommittee, Michigan-DNR has conducted stock assessments on lake whitefish in 1842 Treaty Michigan waters, based on a statistical catch-at-age model, developed for each management unit (Rook 2023a) (Rook 2023b) (Rook 2023c), and the stock assessment models are currently in the process of being updated (pers comm Hanchin, P. 2023). Further, bycatch in the state-licensed commercial lake whitefish trap fishery in Michigan 1842 treaty waters of Lake Superior is appropriately monitored by Michigan DNR (Rook 2023d). Although stock assessments on lake whitefish have been conducted and bycatch data are regularly collected, observer coverage is unknown when monitoring bycatch and ghost gear has not been quantified, Scientific Data Collection and Analysis has been scored as “moderately effective”.

Lake Superior | America, North - Inland Waters | United States | Minnesota | Gillnets and entangling nets

Moderately Effective

A lake-wide data-limited abundance assessment of lake herring is conducted annually by the USGS, where recruitment is measured by the catch of age-1 fish, through bottom-trawl surveys (Goldsworthy and Yule 2021){Vinson et al. 2023}. Further, the Minnesota Department of Natural Resources conducts annual hydroacoustic abundance assessments on lake herring in Minnesota waters (pers comm Goldsworthy, C. 2023). Bycatch is also appropriately monitored by the Minnesota DNR {MNDNR 2023}. Nevertheless, as the stock assessments conducted are data-limited, and observer coverage when monitoring bycatch is unknown, Scientific Data Collection and Analysis has been scored as “moderately effective”.

Lake Superior | America, North - Inland Waters | United States | Minnesota | Gillnets and entangling nets | Tribal fishery

Moderately Effective

A lake-wide data-limited abundance assessment of lake herring is conducted annually by the USGS, where recruitment is measured by the catch of age-1 fish, through bottom-trawl surveys (Goldsworthy and Yule 2021){Vinson et al. 2023}. Further, the Department of Biology and Environment of the Grand Portage Band of Lake Superior Chippewa conducts annual hydroacoustic abundance assessments on lake herring in the Grand Portage Minnesota waters (pers comm Isaac, E. J. 2023). Bycatch is also appropriately monitored by the Minnesota DNR and the Grand Portage Band of Chippewa. Nevertheless, as the stock assessments conducted are data-limited and observer coverage when monitoring bycatch is unknown, Scientific Data Collection and Analysis has been scored as “moderately effective”.

Lake Superior | America, North - Inland Waters | United States | Minnesota | Set gillnets

Moderately Effective

A lake-wide data-limited stock assessment of lake trout is published by the Lake Superior Committee every five years, in the State of Lake Superior report, based on data collected by fisheries scientists belonging to federal and state agencies (Ebener and Pratt 2021)(Sitar 2021). Further, the Minnesota Department of Natural Resources conducts stock assessments based on fishery-dependent and fishery-independent surveys annually on lake trout in Minnesota waters. The assessment uses a SCAA model with total annual mortality (the sum of natural mortality, fishing mortality and sea lamprey induced mortality (Goldsworthy et al. 2017)) which is used to produce an annual commercial fishing summary report (Blankenheim 2022). Bycatch is also appropriately monitored by the Minnesota DNR (pers comm Goldsworthy, C. 2023). Nevertheless, as observer coverage during bycatch monitoring is unknown, and there is no quantification of ghost gear, Scientific Data Collection and Analysis has been scored as “moderately effective”.

Lake Superior | America, North - Inland Waters | United States | Minnesota | Set gillnets | Tribal fishery

Moderately Effective

A lake-wide data-limited stock assessment of lake trout is published by the Lake Superior Committee every five years, in the State of Lake Superior report, based on data collected by fisheries scientists belonging to federal and state agencies (Ebener and Pratt 2021)(Sitar 2021). Further, the Minnesota Department of Natural Resources conducts stock assessments based on fishery dependent data and fishery-independent surveys annually on lake trout in Minnesota waters; the assessment uses a SCAA model with total annual mortality (Goldsworthy et al. 2017). Within the Grand Portage Zone, annual Spring survey assessments are conducted to measure lake trout relative abundance (pers comm Isaac, E. J. 2023). Bycatch is also appropriately monitored by the Minnesota DNR in collaboration with the Grand Portage Band of Chippewa. Nevertheless, as observer coverage during bycatch monitoring is unknown and ghost gear has not been quantified, Scientific Data Collection and Analysis has been scored as “moderately effective”.

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Gillnets and entangling nets

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Gillnets and entangling nets | Tribal fishery

Moderately Effective

A lake-wide data-limited abundance assessment of lake herring is conducted annually by the USGS, where recruitment is measured by the catch of age-1 fish, through bottom-trawl surveys (Goldsworthy and Yule 2021)(Vinson et al. 2023). Further, the Wisconsin Department of Natural Resources conducts annual hydroacoustic abundance assessments on lake herring in Wisconsin waters (Sapper and Carl 2022)(Sapper and Carl 2023). Bycatch is also appropriately monitored by Wisconsin DNR along with the Tribes (WDNR 2023)(BRBLSTCI, WIDNR and RCBLSC 2018), with 7% observer coverage. Nevertheless, as the stock assessments conducted are data-limited, Scientific Data Collection and Analysis has been scored as “moderately effective”.

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Set gillnets

Moderately Effective

A lake-wide data-limited stock assessment of lake whitefish is published by the Lake Superior Committee every five years, in the State of Lake Superior report, based on data collected by fisheries scientists belonging to federal and state agencies (Ebener and Pratt 2021)(Michaels and Gorman 2021). Further, bycatch in Wisconsin waters is appropriately monitored by Wisconsin DNR along with the Tribes (WDNR 2023)(BRBLSTCI, WIDNR and RCBLSC 2018), and observer coverage is 7% (pers comm Ray, B. 2023). Nevertheless, no stock assessments on lake whitefish are conducted in Wisconsin waters, and lake-wide assessments of lake whitefish are data-limited. Hence, Scientific Data Collection and Analysis has been scored as “moderately effective”.

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Set gillnets | Tribal fishery

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Stationary uncovered pound nets

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

Highly effective

A lake-wide data-limited stock assessment of lake whitefish and lake trout is published by the Lake Superior Committee every five years, in the State of Lake Superior report, based on data collected by fisheries scientists belonging to federal and state agencies (Ebener and Pratt 2021)(Michaels and Gorman 2021)(Sitar 2021).

Lake Whitefish

Bycatch in Wisconsin waters is appropriately monitored by Wisconsin DNR along with the Tribes (WDNR 2023)(BRBLSTCI, WIDNR and RCBLSC 2018), and observer coverage is 7% (pers comm Ray, B. 2023). Recently, a lake whitefish stock assessment model has been developed (BC 2023b).

Lake Trout

The Wisconsin Department of Natural Resources conducts peer-reviewed independent stock assessments, based on fishery-dependent data and multiple fishery-independent surveys conducted annually on lake trout in Wisconsin waters; the assessment uses a SCAA model to estimate fishery harvest, abundance, recruitment, mortality, gear selectivity, catchability, and fishery independent catch-per-unit effort for lake trout of ages 4-15+ (WDNR 2020)(Carl 2021a) (Carl 2021b) (Carl 2022a) (Carl 2022b). Bycatch is also appropriately monitored by Wisconsin DNR along with the Tribes (WDNR 2023)(BRBLSTCI, WIDNR and RCBLSC 2018), and independent observer coverage is 7% (pers comm Ray, B. 2023). Although the issue of ghost gear is being addressed, data on ghost gear has not yet been collected.

Under state statute, commercial fishers are required to mark all leads or corks on gillnets and report lost gear; this allows attempts to retrieve and know how much gear is still fishing as ghost nets moving forward (pers comm Ray, B. 2023). If a net is reported as lost and is subsequently retrieved, the markings allow for correct identification (ibid).

Taken together, Scientific Data Collection and Analysis has been scored as “highly effective”.

Factor 3.4 - Enforcement of and Compliance with Management Regulations

Lake Superior | America, North - Inland Waters | Canada | Ontario | Gillnets and entangling nets
Lake Superior | America, North - Inland Waters | Canada | Ontario | Set gillnets

Highly effective

Besides the higher-level enforcement responsibilities of the Great Lakes Law Enforcement Committee (see C3 summary for details), the *Fish and Wildlife Conservation Act, 1997* (FWCA) provides the MNRF with the ability to issue licenses for the purposes of the *Ontario Fishery Regulations, 2007*. Penalties are levied on any person who commits an offence and contravenes any provision of this Act (CanLII 2023). 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 (pers comm James, S. 2023). Fishers are therefore compelled to report on catch information as a condition to their license, but inspections are also conducted by the MNRF and catch is routinely monitored and audited (ibid). As enforcement is in place, and there are seldom any issues with non-compliance, this factor has been scored as “highly effective”.

Lake Superior | America, North - Inland Waters | United States | Michigan | Set gillnets | 1836 Treaty Waters | Tribal fishery

Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1836 Treaty Waters | Tribal fishery

Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1836 Treaty Waters | State Fishery

Highly effective

In addition to the higher-level enforcement responsibilities of the Great Lakes Law Enforcement Committee (see C3 summary for details), within the 1836 Treaty ceded Michigan waters of Lake Superior, state and tribal law enforcement officers are responsible for enforcement of fisheries restrictions and regulations, as per the Consent Decree (USDCWM 2023) and the Tribal Plan (BMIC, GTBOCI, LRBOI, LTBBOI and SSMTCI 2022). The following strategies are used to ensure effective enforcement and compliance:

1. The State and the Tribes provide support and maintain adequately equipped law enforcement personnel and resources to provide for public safety, protection of the fisheries resource, ensure regulatory compliance and prevent harassment and vandalism (USDCWM 2023).
2. Per the updated Decree, the State and the Tribes need to adopt an electronic reporting system to collect, report and share information on commercial fishing harvest (ibid). Commercial fishers are required to submit the following information to their reporting system at the end of each fishing day: fisher license number, weight of species landed, location of fishing by grid, type and amount of fishing gear date and name of the person entering the data. In the case of the Tribes, CORA shall own the tribes' electronic reporting system (ibid). Until the electronic reporting system is implemented, Parties are required to report on their harvest bi-monthly and shall transmit to other Parties an electronic copy of their reports in a timely manner (ibid). The Tribes shall provide the

MDNR with details of commercial fishing licenses, commercial fishing permits and subsistence fishing licenses (ibid). Note that per the Consent Decree of 2000, reporting was required only once a month (USDCWDMSD 2000).

3. The Law Enforcement Committee (LEC) is the primary body for consultation and collaboration on enforcement, and comprises the chief law enforcement officer from each Tribe, and the chief law enforcement officer from the MDNR (USDCWM 2023). The LEC addresses enforcement priorities, public safety issues, standardizes report forms, coordinates shared resources, identifies training needs, protects commercial gear from theft and vandalism, identifies areas of special law enforcement concerns and shares enforcement information (ibid). Each of the Tribes commits one person to participate in team patrols, which takes place at least eight times a year as part of the duties of the LEC (ibid). Further, the LEC investigates and provides recommendations to CORA and MDNR on improvements in markings and identification of fishing gear and equipment (ibid). The LEC also seeks consensus among its members on matters and issues before it, and prepares a report for the Executive Council annually (ibid).
4. Per the updated Decree of 2023, a standard complaint handling mechanism will be established to accept complaints regarding violation of fishing regulations, vandalism, etc. (ibid).
5. Each law enforcement agency enforcing the Tribal Code needs to have written policies and procedures in place to investigate complaints made against enforcement officers (ibid).
6. Conservation officers of the MNDR may enforce the Tribal Code and any other regulations of the Tribes pertaining to fisheries in 1836 waters (USDCWM 2023)(BMIC, GTBOCI, LRBOI, LTBBOI and SSMTCI 2022). However, the courts of the Tribes shall have exclusive jurisdiction over enforcement of Tribal laws or regulations governing tribal fisheries, and the State shall not enforce its fishing laws against tribal citizens (USDCWM 2023). The Tribal Court has the authority to impose civil or criminal penalties, suspend or revoke licenses, issue injunctions and order forfeiture of personal property used in the offense (BMIC, GTBOCI, LRBOI, LTBBOI and SSMTCI 2022).
7. According to the Decree of 2023, the Sault Tribe must dedicate at least 1.5 officers for enforcement of commercial fishing regulations, whereas the Bay Mills Tribe shall dedicate the at least 0.5 full time officers to this effort (USDCWM 2023). However, the number of enforcement officers dedicated to law enforcement is higher than this requirement. In general the proportion of enforcement officers to the number of commercial fishers is high (pers comm Gorenflo, T. 2023).
8. All Tribes are required to maintain their fisheries and regulate their citizens in compliance with the Decree, the Tribal Plan, and the Tribal Code and the decisions of the GLRC and the BSD Director in accordance with the Tribal Plan (BMIC, GTBOCI, LRBOI, LTBBOI and SSMTCI 2022).

Taken together, Enforcement and Compliance with Management Regulations in 1836 Treaty Michigan waters has been scored as “highly effective”.

Justification:

Further to the LEC membership mentioned above, if the Bureau of Indian Affairs provides conservation law enforcement services to any of the Tribes, the Michigan Agency’s chief law enforcement officer shall be a member of the LEC (USDCWM 2023). One or more members from USFWS, the United States coast guard, the United States Department of Justice, the Bureau of Indian Affairs, the Ontario Ministry of Natural Resources and any other law enforcement agency may serve as an ex officio member of the LEC (ibid).

Lake Superior | America, North - Inland Waters | United States | Michigan | Set gillnets | 1842 Treaty Waters | Tribal fishery

Highly effective

Within the 1842 Treaty ceded Michigan waters of Lake Superior, in addition to the higher-level enforcement responsibilities of the Great Lakes Law Enforcement Committee (see C3 summary for details), several tribal and GLIFWC law enforcement officers are responsible for enforcement of fisheries restrictions and regulations (pers comm Mattes, W. 2023), following the intertribal agreement between the Bad River and the Red Cliff Bands, and the fisheries management plan of the Keweenaw Bay Band (Mattes 2021). Taken together, Enforcement and Compliance with Management Regulations in 1842 Treaty Michigan waters has been scored as “highly effective”.

Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1842 Treaty Waters | State Fishery

Highly effective

In addition to the higher-level enforcement responsibilities of the Great Lakes Law Enforcement Committee (see C3 summary for details), within the 1842 Treaty-ceded Michigan waters of Lake Superior, two state conservation officers are responsible for enforcement of fisheries restrictions and regulations (M-DNR 2023d)(pers comm Caroffino, D. 2023). Therefore, Enforcement and Compliance with Management Regulations has been scored as “highly effective”.

Lake Superior | America, North - Inland Waters | United States | Minnesota | Gillnets and entangling nets | Tribal fishery

Lake Superior | America, North - Inland Waters | United States | Minnesota | Set gillnets | Tribal fishery

Moderately Effective

In addition to the higher-level enforcement conducted by the Great Lakes Law Enforcement Committee (see C3 summary for details), the Conservation and Law Department of the Grand Portage Band of Chippewa has Enforcement Conservation Officers whose assigned duties include enforcement of commercial netting regulations (pers comm Isaac, E. J. 2023). In the case of lake trout, Conservation Officers provide tribal commercial fishers with tags, which are used as a tool to ensure that the lake trout harvest is within the specified limits (ibid). Although penalties for fishing infractions do exist, it is a grey area, and the Department is currently discussing ways to have the enforcement mechanism work (ibid). As enforcement currently exists, but its effectiveness is uncertain, this factor has been scored as a “moderately effective”.

Lake Superior | America, North - Inland Waters | United States | Minnesota | Gillnets and entangling nets

Lake Superior | America, North - Inland Waters | United States | Minnesota | Set gillnets

Highly effective

Besides the higher-level enforcement responsibilities of the Great Lakes Law Enforcement Committee (see C3 summary for details), the MNDNR has an Enforcement Division, with Conservation Officers whose assigned duties include enforcement of commercial netting regulations (MNDNR 2023b)(pers comm Miller, M. 2023). According to the Enforcement Division’s Strategic Plan, Minnesota’s waters,

natural lands and diverse fish and wildlife habitats will be conserved and enhanced by: (1) enforcing laws and regulations, (2) protecting Natural Resources and (3) promoting voluntary compliance (MNDNR 2014). All laws and rules pertaining to fish and fisheries are provided in chapters 97A and 97C of the Minnesota statutes 2022 {State of Minnesota 2022}{State of Minnesota. 2022b).

Enforcement activities include proactive patrols, where placement and markings of nets are monitored, as prescribed in each operator's permit, licenses of fishers are checked, and spot checks are conducted for accuracy and completion of records as to amounts and species of fish taken (pers comm Miller, M. 2023). Patrols are conducted in boats on Lake Superior and in trucks between accesses, marinas and fish houses out of which netters operate (ibid). The surveillance of transfer of fish from net to boat and boat to vehicle/sale helps confirm the accuracy of records. If violations are detected, they are handled through coaching, verbal warnings, or criminal citations to be resolved through local courts (ibid). All violations are misdemeanor level crimes (ibid). Citations of such violations usually result in payment of a fine through the local court system (ibid). Convictions of these can also carry license and permit ramifications through internal processes (ibid). Details of penalties and fines for specific offences are provided in the Minnesota statutes 2022, chapter 97A {State of Minnesota 2022}.

Currently there is one Conservation Officer from the MNDNR Enforcement Division who is responsible for enforcement of rules and regulations in the state commercial fishery (pers comm Goldsworthy, C. 2023). The use of lake trout tags with a locking strap number is used as an enforcement tool specifically in the lake trout fishery; fishers cannot dock untagged lake trout (ibid). The Conservation Officer is responsible for the checking of lake trout tags (ibid). In the case of the lake herring November roe fishery, fishers call in weekly to report their catch volumes (ibid). If they are approaching their quota, there are daily calls with the MNDNR (ibid). Hence, reporting and compliance is also voluntary to an extent, and is based on trust (ibid). Taken together, Enforcement and Compliance with Management Regulations has been scored as "highly effective".

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Gillnets and entangling nets

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Gillnets and entangling nets | Tribal fishery

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Set gillnets

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Set gillnets | Tribal fishery

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Stationary uncovered pound nets

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

Highly effective

In addition to the higher-level enforcement responsibilities of the Great Lakes Law Enforcement Committee (see C3 summary for details), within the Wisconsin waters of Lake Superior, state and tribal wardens are responsible for enforcement of fisheries restrictions and regulations, as agreed upon in the Lake Superior Fishing Agreement (henceforth referred to as "Agreement"). The Wisconsin Department of Natural Resources is responsible for enforcing restrictions within the Agreement against non-tribal fishers, and violations are persecuted in state courts; the Tribes are responsible for enforcing

restrictions within the Agreement against tribal fishers, and violations are persecuted in tribal courts (BRBLSTCI, WIDNR and RCBLSC 2018). The following strategies are used to ensure effective enforcement:

1. Identification of fishers - At the start of the fishing year, a list of tribal- and state-licensed fishers and their license numbers is shared by both Parties (ibid). State wardens are authorized to approach and seek identification from tribal fishers on board their vessels, and tribal fishers are obliged to cooperate (ibid).
2. Use of lake trout tags (in the case of the lake trout fishery) – State and tribal lake trout allocation assigned to commercial fishing is enforced using tags that are color coded according to the year; unused tags need to be returned to the authorities at the end of the fishing season (ibid).
3. Inspections and Searches – The Tribes and their wardens have the sole authority to inspect tribal fishers (ibid). The Tribes are required to conduct at least 25 covert inspections per fishing year (ibid). State wardens may conduct searches if they have probable cause to believe that a tribal fishing violation has occurred, and if the tribal fishing authority cannot be contacted within half an hour (ibid). Failure to allow an inspection or search results in penalties and/or a license suspension, and repeat violations result in longer suspensions (ibid).
4. Joint patrols, inspections, and searches - At least seven joint covert inspections and searches where state wardens accompany tribal wardens are conducted at land and sea per year (ibid). Joint patrols including both state and tribal wardens are also held (ibid). Two wardens from the Red Cliff Tribe are available for joint patrolling twice a week and one warden from the Bad River Tribe is available once a week (ibid). Wardens from the Great Lakes Indian Fish and Wildlife Commission (GLIFWC) are authorized by the Bad River Tribe to act on behalf of Bad River wardens (ibid).
5. Seizures – The State may seize tribal fishing gear set in areas closed to tribal fishing (ibid). All evidence of a suspected violation may be seized and handed over to tribal fishing authorities (ibid).
6. Exchange of law enforcement information and reports – Incident reports and information on violations are exchanged by the Parties. Monthly reports are exchanged including law enforcement effort, number of joint law enforcement patrols, the officers involved, offences discovered and a discussion of the joint patrol system (ibid). The enforcement wardens of the Parties and the Biological Committee meet within 20 days of the close of each fishing period, to calculate the actual observed CPE from that period (ibid).

Currently the capacity for enforcement and to ensure compliance in Wisconsin waters is more than adequate; the State has 13 officers with enforcement responsibilities, whereas the Tribes have six wardens (three from Bad River and three from Red Cliff) with similar responsibilities (pers comm Ray, B. 2023). Taken together, Enforcement and Compliance with Management Regulations in Wisconsin waters has been scored as “highly effective”.

Factor 3.5 - Stakeholder Inclusion

**Lake Superior | America, North - Inland Waters | Canada | Ontario | Gillnets and entangling nets
Lake Superior | America, North - Inland Waters | Canada | Ontario | Set gillnets**

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 Ontario Ministry of Natural Resources and Forestry 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 Ontario Ministry of Natural Resources and Forestry has a focus on building partnerships, creating Fisheries Management Zone Councils, encouraging community-based stewardship programs and having agreements with Aboriginal communities (ibid). The Ontario Ministry of Natural Resources and Forestry 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 Ontario Ministry of Natural Resources and Forestry 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 is high participation with a constructive relationship between all stakeholders, and a high transparency in the decision-making process, Stakeholder Inclusion has been scored as "highly effective".

Lake Superior | America, North - Inland Waters | United States | Michigan | Set gillnets | 1836 Treaty Waters | Tribal fishery

Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1836 Treaty Waters | Tribal fishery

Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1836 Treaty Waters | State Fishery

Highly effective

Through the Joint Strategic Plan, which promotes cooperation, stakeholder inclusion and consensus at a higher level (See C3 summary for details), the MDNR 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, the Consent Decree of 2023, governs allocation, management and regulation of state and tribal fisheries in 1836 Treaty waters of Michigan, and promotes cooperative management of shared resources, communication, collaboration and sharing of data, scientific information and perspectives in a transparent manner, as well as government to government consultation regarding decisions that may

impact another Party's fishery (USDCWM 2023). Per the Decree, prior to taking any regulatory action, a Party needs to provide written notice to the other Parties of the proposed action (ibid). After completing the action, the Party taking action must provide all the other Parties with a copy of the action within the stipulated time period (ibid). Upon request of a Party to any other Party, government representatives must meet to discuss matters of common concern (ibid). The Tribes, the State, USFWS, USGS and NOAA are also obliged to share information on non-native and invasive species and to cooperate to address issues related to such species under the Federal Nuisance Prevention and Control Act of 1990 and the National Invasive Species Act of 1996 (ibid). Further, all Parties are required to collaborate on research that affects fisheries in 1836 Treaty waters, and to share plans for fisheries work to be conducted including work on assessments, fisheries monitoring, habitat rehabilitation, stocking plans and research project (ibid). The Technical Fisheries Committee and the Executive Council have representatives from each of the Tribes and the MDNR (ibid). There is also a robust dispute resolution mechanism in place if there is any dispute relating to the points stipulated in the Decree (ibid).

Similarly, the CORA Charter and the Tribal Plan govern how stakeholder inclusion takes place between the Tribes (BMIC, GTBOCI, LRBOI, LTBBOI and SSMTCI 2022). The Biological Services Division (BSD) has representation from all of the Tribes and their consultants (ibid). Similarly, the Great Lakes Resource Committee which is responsible for developing management protocols and promulgating regulations in the tribal fisheries consists of board members from each Tribe which is a member of CORA (ibid). The CORA Charter also has a robust dispute resolution mechanism in place to resolve disputes that may arise over decisions made or proposed by the GLRC and the BSD (ibid).

Further, the Citizen Fishery Advisory Committee which is comprised of the Michigan DNR, commercial fishers, and recreational fishers meets three times a year to discuss fisheries issues, including Great Lakes fisheries, regulations, environmental issues, stocking, etc. (pers comm Caroffino, D. 2023). This committee serves as a forum for stakeholder input and inclusion (ibid). The public is also involved in management as stakeholder consultations, surveys, and open public comment periods are routinely followed when drafting management plans and regulations (pers comm Hanchin, P. 2023). Taken together, Stakeholder Inclusion has been scored as "highly effective".

Lake Superior | America, North - Inland Waters | United States | Michigan | Set gillnets | 1842 Treaty Waters | Tribal fishery

Highly effective

Through the Joint Strategic Plan, which promotes cooperation, stakeholder inclusion and consensus at a higher level (See C3 summary for details), GLIFWC, CORA, the 1854 Treaty Authority, all eight Great Lakes states, the US Fish and Wildlife Service, USGS, ONMR, DFO Canada are bound to a protocol for coordinating mutual activities and conflict resolution (GLFC 2007). Further, the Red Cliff, Bad River and the Keweenaw Bay Bands of Lake Superior Chippewa have entered into an intertribal agreement to promote cooperation and inclusion to improve fisheries management (Mattes 2021). Therefore, Stakeholder Inclusion has been scored as "highly effective".

Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1842 Treaty Waters | State Fishery

Highly effective

Through the Joint Strategic Plan, which promotes cooperation, stakeholder inclusion and consensus at a higher level (See C3 summary for details), the MDNR 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). The public is also involved in management as stakeholder consultations, surveys and open public comment periods are routinely followed when drafting management plans and regulations (pers comm Hanchin, P. 2023). The Citizen Fishery Advisory Committee which is comprised of the Michigan DNR, commercial fishers, and recreational fishers meets three times a year to discuss fisheries issues, including Great Lakes fisheries, regulations, environmental issues, stocking, etc. (pers comm Caroffino, D. 2023). This committee serves as a forum for stakeholder input and inclusion (ibid). Taken together, Stakeholder Inclusion has been scored as “highly effective”.

Lake Superior | America, North - Inland Waters | United States | Minnesota | Gillnets and entangling nets | Tribal fishery

Lake Superior | America, North - Inland Waters | United States | Minnesota | Set gillnets | Tribal fishery

Highly effective

Through the Joint Strategic Plan, which promotes cooperation, stakeholder inclusion and consensus at a higher level (See C3 summary for details), the 1854 Treaty Authority is bound to CORA, GLIFWC, all eight Great Lakes states, the US Fish and Wildlife Service, USGS, ONMR, DFO Canada and to a protocol for coordinating mutual activities and conflict resolution (GLFC 2007). In addition, the Department of Biology and Environment of the Grand Portage Band of Chippewa has ongoing partnerships with Minnesota DNR, the U.S. Fish and Wildlife Service, and other tribal, state, federal, and several academic institutions (GPBLSC 2023). Further, the Grand Portage Natural Resources Management program of which the Department of Biology and Environment is a part, is led by the trust lands administrator, and works directly with the Grand Portage Tribal Council, to communicate overall priorities (ibid). Taken together, Stakeholder Inclusion has been scored as “highly effective”.

Lake Superior | America, North - Inland Waters | United States | Minnesota | Gillnets and entangling nets

Lake Superior | America, North - Inland Waters | United States | Minnesota | Set gillnets

Highly effective

Through the Joint Strategic Plan, which promotes cooperation, stakeholder inclusion and consensus at a higher level (See C3 summary for details), the MNDNR is bound to seven other Great Lakes states, CORA, GLIFWC, 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, the MNDNR shares fisheries management responsibility with the states of Wisconsin, Michigan, the Province of Ontario, GLIFWC, CORA, the 1854 Treaty Authority, US Fish and Wildlife Service and USGS (Goldsworthy et al. 2017).

When the MNDNR developed the Fishery Management Plan for the Minnesota waters of Lake Superior (henceforth MNFMP), citizen participation was an important part of the process, and helped stimulate ongoing conversations about the future of fisheries in Minnesota waters to ensure long-term benefits to the resource and its users (ibid). The Lake Superior Advisory Group (LSAG) comprises 26 members

who represent fishing organizations, environmental groups, tribal resource managers, commercial fishing interests, local governments, watershed groups, GLFC advisors, commercial fishing operators and individual anglers; this Advisory Group was instrumental in developing the MNFMP (ibid).

When revisions to the MNFMP began, the Lake Superior Fisheries Conference was organized, which was open to all citizens interested in Lake Superior fisheries management (ibid). The MNDNR invited various Lake Superior fisheries scientists to make presentations at the conference (ibid). Citizens were further engaged in break-out sessions, where they discussed and identified important issues for the MNDNR and the LSAG to address in the revised MNFMP (ibid). Issues identified were subsequently summarized and prioritized based on topics. Thereafter, six meetings were held with the LSAG where the issues were discussed and clarified further (ibid). Each LSAG member was asked to meet with the group that they represented to reply to each of the various issues (ibid). All input was compiled into summaries along with input from the LSAG and distributed to the groups involved (ibid). The summaries were then used to compile a set of recommendations which were used to craft a revised draft of the MNFMP (ibid). The draft was sent to the LSAG for their comments (ibid). These comments were used to modify the draft MNFMP (ibid). This second draft was then distributed to the public for their comment and review (ibid). Additionally, according to the MNFMP, citizen participation is also important to the ongoing fishers management implementation, and compliance is partially voluntary and based on trust (Goldsworthy et al. 2017)(pers comm Goldsworthy, C. 2023). Considering the close involvement of diverse user groups in various aspects of fisheries management, Stakeholder Inclusion has been scored as “highly effective”.

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Gillnets and entangling nets

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Gillnets and entangling nets | Tribal fishery

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Set gillnets

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Set gillnets | Tribal fishery

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Stationary uncovered pound nets

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

Highly effective

Through the Joint Strategic Plan, which promotes cooperation, stakeholder inclusion and consensus at a higher level (See C3 summary for details), the Wisconsin Department of Natural Resources (WDNR) 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)(WDNR 2020). In particular, WDNR regularly partners with the Red Cliff and Bad River Bands of Lake Superior Chippewa, the states of Minnesota and Michigan, MNRF, GLIFWC, the US Fish and Wildlife Service and USGS (WDNR 2020).

When WDNR developed the Lake Superior Fishery Management Plan (henceforth FMP), the public contributed extensively to ensure that the FMP reflected the management interests of all the stakeholders (ibid). During this process, 26 organizations and individuals representing various

stakeholders (including commercial and tribal fishers, conservation groups, academics, tourism professionals, etc.) joined an Advisory Panel to contribute towards the FMP (ibid).

During the fishery management process, WDNR staff host public meetings and attend meetings hosted by fishing clubs and commercial fishing groups, to determine public interests and ensure public participation in the fishery management process (ibid). Per the Wisconsin Lake Superior Fishing Agreement, the State and the Tribes (including the Red Cliff and the Bad River Bands) have established a “Biological Committee”, comprising members from each Party (BRBLSTCI, WIDNR and RCBLSC 2018). This Biological Committee advises both Parties on exchanging information, developing and revising assessment techniques, data collection, calculating quotas, reporting and making science-based recommendations (ibid). Taken together, Stakeholder Inclusion in Wisconsin has been scored as “highly effective”.

Draft for Review

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 Superior America, North - Inland Waters Canada Ontario Gillnets and entangling nets	Score: 5	Score: 0	Moderate Concern	Yes	Green (3.873)
Lake Superior America, North - Inland Waters Canada Ontario Set gillnets	Score: 3	Score: 0	Low Concern		Green (3.464)
Lake Superior America, North - Inland Waters United States Michigan Set gillnets 1836 Treaty Waters Tribal fishery	Score: 3	Score: 0	Low Concern		Green (3.464)
Lake Superior America, North - Inland Waters United States Michigan Set gillnets 1842 Treaty Waters Tribal fishery	Score: 3	Score: 0	Moderate Concern		Yellow (3.000)
Lake Superior America, North - Inland Waters United States Michigan Stationary uncovered pound nets 1836 Treaty Waters State Fishery	Score: 3	Score: 0	Low Concern		Green (3.464)
Lake Superior America, North - Inland Waters United States Michigan Stationary uncovered pound nets 1836 Treaty Waters Tribal fishery	Score: 3	Score: 0	Low Concern		Green (3.464)
Lake Superior America, North - Inland Waters United States Michigan Stationary uncovered pound nets 1842 Treaty Waters State Fishery	Score: 3	Score: 0	Moderate Concern		Yellow (3.000)
Lake Superior America, North - Inland Waters United States Minnesota Gillnets and entangling nets	Score: 5	Score: 0	Moderate Concern	Yes	Green (3.873)
Lake Superior America, North - Inland Waters United States Minnesota Gillnets and entangling nets Tribal fishery	Score: 5	Score: 0	Moderate Concern	Yes	Green (3.873)
Lake Superior America, North - Inland Waters United States Minnesota Set gillnets	Score: 3	Score: 0	Low Concern		Green (3.464)
Lake Superior America, North - Inland Waters United States Minnesota Set gillnets Tribal fishery	Score: 3	Score: 0	Moderate Concern		Yellow (3.000)
Lake Superior America, North - Inland Waters United States Wisconsin Gillnets and entangling nets	Score: 5	Score: 0	Moderate Concern	Yes	Green (3.873)
Lake Superior America, North - Inland Waters United States Wisconsin Gillnets and entangling nets Tribal fishery	Score: 5	Score: 0	Moderate Concern	Yes	Green (3.873)
Lake Superior America, North - Inland Waters United States Wisconsin Set gillnets	Score: 3	+0.5	Low Concern		Green (3.742)
Lake Superior America, North - Inland Waters United States Wisconsin Set gillnets Tribal fishery	Score: 3	+0.5	Low Concern		Green (3.742)
Lake Superior America, North - Inland Waters United States Wisconsin Stationary uncovered pound nets	Score: 3	+0.5	Low Concern		Green (3.742)
Lake Superior America, North - Inland Waters United States Wisconsin Stationary uncovered pound nets Tribal fishery	Score: 3	+0.5	Low Concern		Green (3.742)

In Lake Superior, efforts to restore populations of native species have recognized that an ecosystem-based

fisheries management approach is key to success {Kitchell et al. 2000}{Stockwell et al. 2009}{Zimmerman and Krueger 2009}. Towards the end of the 20th century, fisheries management began to focus on community structure and ecosystem function (Krueger et al. 1995). Ecosystem-based fisheries management began to be recognized due to its importance in lake trout rehabilitation, as lake trout is a top predator and competitor, with multiple linkages in the ecosystem (ibid). To restore lake trout populations, lake herring or cisco, which is their primary prey also needs to be protected from exploitation {Kitchell et al. 2000}. However, the Lake Superior ecosystem also contains an assemblage of exotic species including sea lamprey, rainbow smelt and Pacific salmon (chinook, coho and steelhead), some of which play an important role in sustaining trophic structure (ibid). For instance, invasive sea lamprey is the single largest threat to lake trout fisheries in Lake Superior, and multi-jurisdictional cooperative efforts have been made to re-establish lake trout and suppress sea lamprey populations (Lewandoski and Brenden 2022). Contrastingly, ecosystem modelling shows that the removal of rainbow smelt has a negative effect on the number of juvenile and adult lake trout {Kitchell et al. 2000}. Rehabilitating lake trout in Lake Superior also likely benefitted lake herring recovery though lake trout predation on invasive rainbow smelt populations (Stockwell et al. 2009). In general, in Lake Superior, exotic species show a relatively rapid turnover, whereas native species show a slower turnover {Kitchell et al. 2000}. Therefore even with strong management strategies in place, populations of native species such as lake trout cannot be restored to pre-fishery and pre-lamprey levels (ibid), and recovery should proceed in the context of re-establishment (Zimmerman and Krueger 2009).

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 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.*

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

Lake Superior | America, North - Inland Waters | Canada | Ontario | Gillnets and entangling nets

Lake Superior | America, North - Inland Waters | United States | Minnesota | Gillnets and entangling nets

Lake Superior | America, North - Inland Waters | United States | Minnesota | Gillnets and entangling nets | Tribal fishery

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Gillnets and entangling nets

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Gillnets and entangling nets | Tribal fishery

Score: 5

As lake herring is targeted using suspended gillnets (also referred to in this report as gillnets and entangling nets) that do not come into contact with the bottom habitat, but are anchored to the bottom (SGUW, NOAA and UW-M 2023)(see Figure 36), the physical impact of these nets on the habitat/substrate has been scored as a “5”.

Justification:

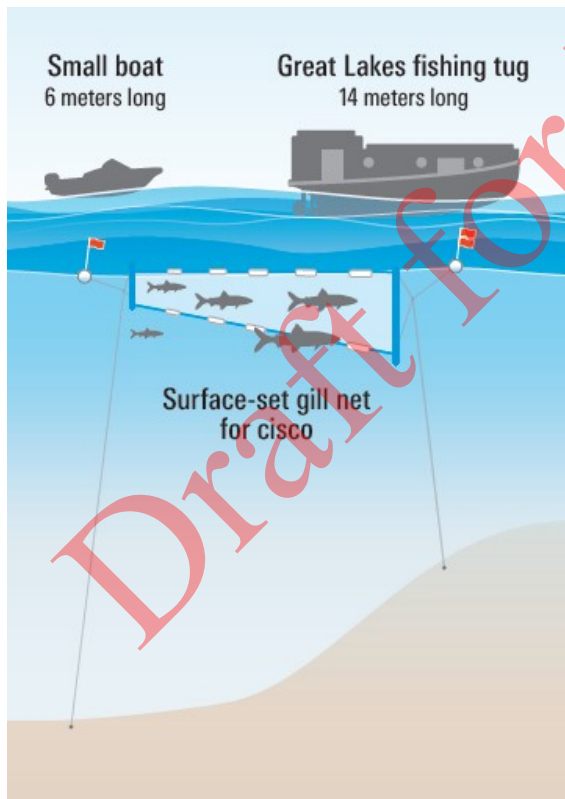


Figure 36: Image of a suspended gillnet that is used to harvest lake herring (cisco) in Lake Superior (SGUW, NOAA and UW-M 2023).

Lake Superior | America, North - Inland Waters | Canada | Ontario | Set gillnets
Lake Superior | America, North - Inland Waters | United States | Minnesota | Set gillnets
Lake Superior | America, North - Inland Waters | United States | Minnesota | Set gillnets | Tribal fishery
Lake Superior | America, North - Inland Waters | United States | Wisconsin | Set gillnets
Lake Superior | America, North - Inland Waters | United States | Wisconsin | Set gillnets | Tribal fishery
Lake Superior | America, North - Inland Waters | United States | Michigan | Set gillnets | 1842 Treaty Waters | Tribal fishery
Lake Superior | America, North - Inland Waters | United States | Michigan | Set gillnets | 1836 Treaty Waters | Tribal fishery
Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1836 Treaty Waters | Tribal fishery
Lake Superior | America, North - Inland Waters | United States | Wisconsin | Stationary uncovered pound nets
Lake Superior | America, North - Inland Waters | United States | Wisconsin | Stationary uncovered pound nets | Tribal fishery
Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1836 Treaty Waters | State Fishery
Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1842 Treaty Waters | State Fishery

Score: 3

The bottom substrate of Lake Superior comprises of mostly mud (41%) and clay (35%), with approximately 16% of 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 bottom set gillnets and trap nets (see Figures 38 and 39 below) that are set mostly on soft substrates is given a score of “3”.

Justification:

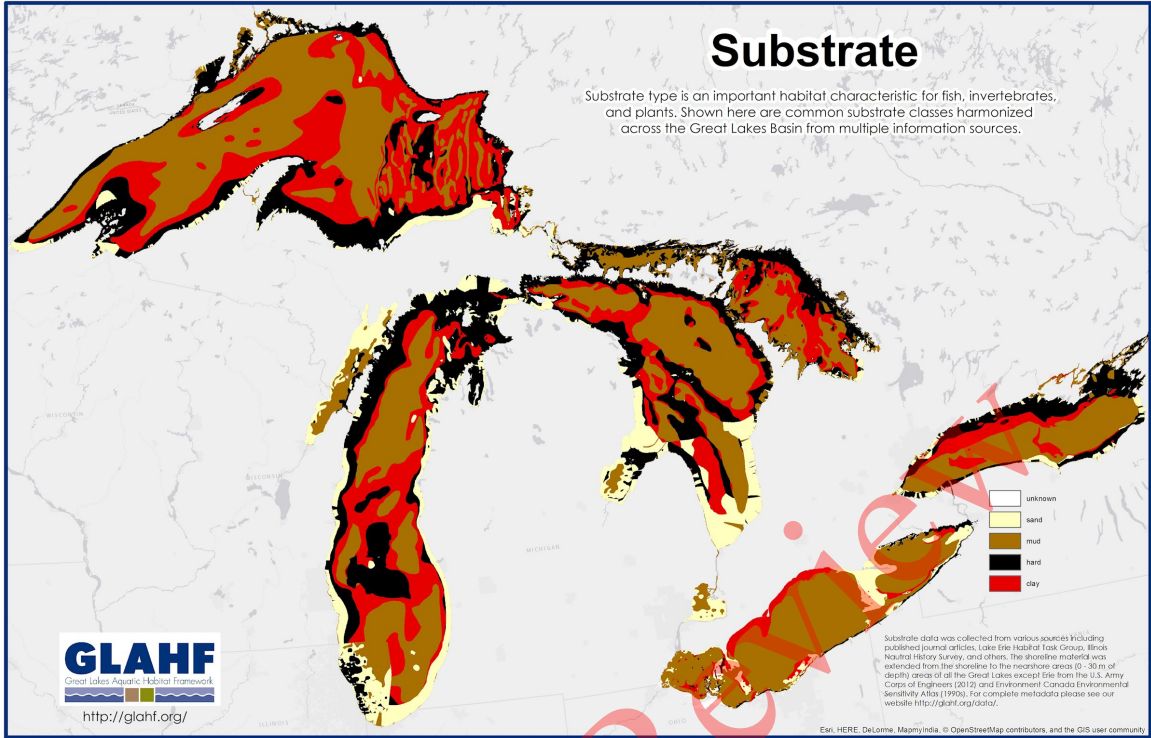


Figure 37: Map of substrate types in the Great Lakes, showing that Lake Superior comprises mostly of clay and mud (USGS & GLAHF 2018).

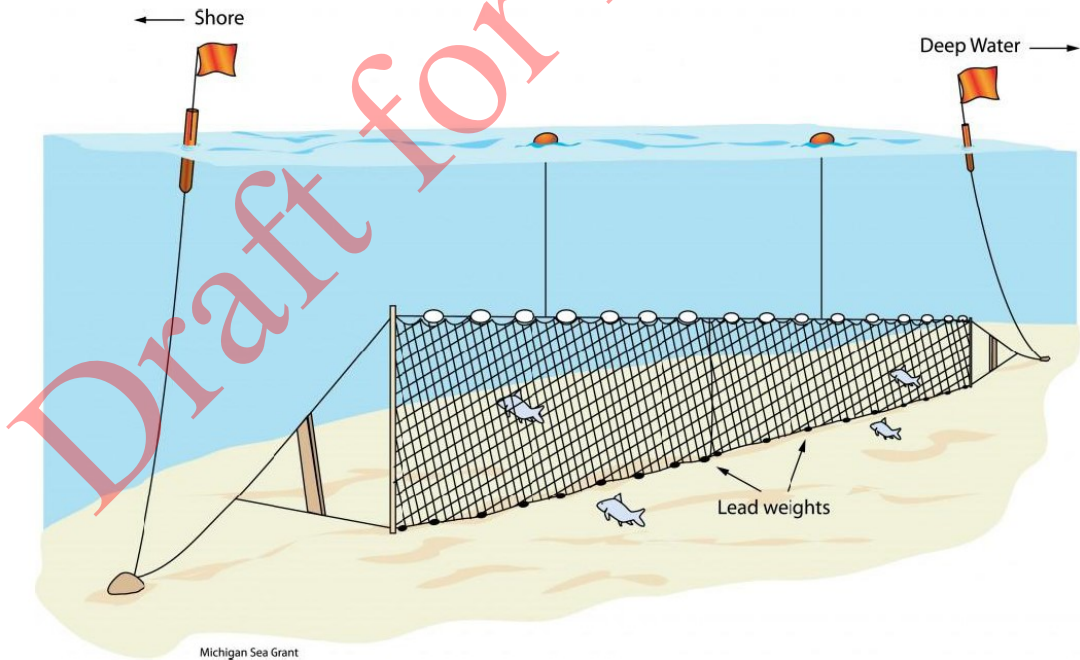


Figure 38: Image of a typical bottom-set gillnet used in Lake Superior (Michigan Sea Grant 2023b).

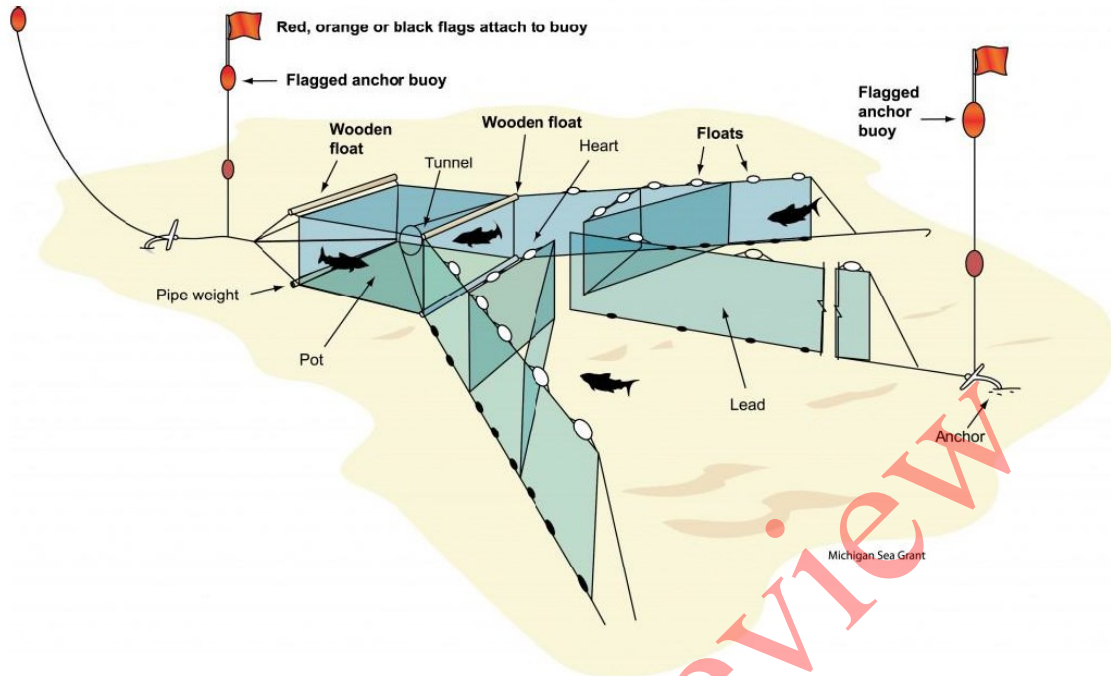


Figure 39: Image of a typical trap net used in Lake Superior (Michigan Sea Grant 2023b).

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

Lake Superior | America, North - Inland Waters | Canada | Ontario | Gillnets and entangling nets

Lake Superior | America, North - Inland Waters | United States | Minnesota | Gillnets and entangling nets

Lake Superior | America, North - Inland Waters | United States | Minnesota | Gillnets and entangling nets | Tribal fishery

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Gillnets and entangling nets

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Gillnets and entangling nets | Tribal fishery

Score: 0

Not applicable because gear used is benign.

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

Score: 0

There are some spatial management strategies in place, including western Nipigon Bay, which is excluded from commercial fishing (pers comm James, S. 2023). Nevertheless, protected habitats do not comprise a substantial proportion in the Ontario waters of Lake Superior, and bottom set gillnets do not have modifications to reduce their impact on the seafloor. Hence Mitigation of Gear Impacts are considered negligible or benign, and has been given a score of "0".

Lake Superior | America, North - Inland Waters | United States | Michigan | Set gillnets | 1842 Treaty Waters | Tribal fishery

Lake Superior | America, North - Inland Waters | United States | Michigan | Set gillnets | 1836 Treaty Waters | Tribal fishery

Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1836 Treaty Waters | Tribal fishery

Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1836 Treaty Waters | State Fishery

Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1842 Treaty Waters | State Fishery

Score: 0

As there are no protected habitats in the Michigan waters of Lake Superior, and gear types such as bottom set gillnets and trap nets do not have modifications to reduce their impact on the seafloor, Mitigation of Gear Impacts has been given a score of "0".

Lake Superior | America, North - Inland Waters | United States | Minnesota | Set gillnets

Lake Superior | America, North - Inland Waters | United States | Minnesota | Set gillnets | Tribal fishery

Score: 0

As there are no protected habitats in the Minnesota waters of Lake Superior, and bottom set gillnets do not have modifications to reduce their impact on the seafloor, Mitigation of Gear Impacts has been given a score of "0".

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Set gillnets

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Set gillnets | Tribal fishery

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Stationary uncovered pound nets

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

+0.5

The Gull Island Refuge and the Devil's Island Refuge comprise 20.1% of Wisconsin's waters {pers comm, Ray, B. 2023}, and hence a substantial proportion of representative habitats are protected from bottom contact. Therefore Mitigation of Gear Impacts has been given a score of "+0.5".

Factor 4.3 - Ecosystem-based Fisheries Management

Lake Superior | America, North - Inland Waters | Canada | Ontario | Gillnets and entangling nets

Moderate Concern

In the Ontario suspended gillnet fishery that targets lake herring, harvest limits are set in the form of TACs which are adjusted based on a HCR relative to the status of each fish stock by species and area, but by no more than 10-15% (pers comm James, S. 2023). Further, there are both temporal and spatial

management strategies used (MNRF 2022)(pers comm James, S. 2023) to protect the ecosystem functioning and account for the capture species' ecological role, and detrimental food webs impacts are not likely. Although there are TACs in place, that are adjusted relative to the status of the stock, as lake herring is a forage species and there is no Management Strategy Evaluation in place, Ecosystem-based Fisheries Management is scored a "moderate concern".

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

Low Concern

In the Ontario bottom-set gillnet fisheries, harvest limits are set in the form of TACs which are adjusted in subsequent years relative to the status of each fish stock by species and area, but by no more than 10-15% (pers comm James, S. 2023). Further, there are both temporal and spatial management strategies used (MNRF 2022)(pers comm James, S. 2023) to protect the ecosystem functioning and account for the capture species' ecological role, and detrimental food webs impacts are not likely. Hence Ecosystem-based Fisheries Management is scored a "low concern".

Lake Superior | America, North - Inland Waters | United States | Michigan | Set gillnets | 1836 Treaty Waters | Tribal fishery

Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1836 Treaty Waters | Tribal fishery

Low Concern

As an HCR is in place to manage the harvest limit of lake whitefish and lake trout, which comprises most of the tribal commercial catch in trap nets and gillnets set in 1836 Treaty-ceded Michigan waters, temporal and spatial closures are in place to protect stocks, and detrimental food web impacts due to harvesting the species are unlikely, Ecosystem-based Fisheries Management has been scored as a "low concern".

Lake Superior | America, North - Inland Waters | United States | Michigan | Set gillnets | 1842 Treaty Waters | Tribal fishery

Moderate Concern

There are seven closed seasonal refuges that are maintained by the Tribes in 1842 Treaty-ceded Michigan waters of Lake Superior that contribute towards the ecosystem based management of the bottom-set gillnet fishery (Mattes 2021). Additionally, an informal Harvest Control Rule following established limits is followed (pers comm Caroffino, D. 2023), which has unknown effectiveness. Nevertheless, detrimental food web impacts are not likely. Hence Ecosystem-based Fisheries Management has been scored as a "moderate concern".

Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1836 Treaty Waters | State Fishery

Low Concern

As an HCR is in place to manage the harvest limit of lake whitefish, which comprises most of the state and tribal commercial catch in trap nets and gillnets set in 1836 Treaty-ceded Michigan waters, temporal and spatial closures are in place to protect stocks, and detrimental food web impacts due to harvesting the species are unlikely, Ecosystem-based Fisheries Management has been scored as a

“low concern”.

Lake Superior | America, North - Inland Waters | United States | Michigan | Stationary uncovered pound nets | 1842 Treaty Waters | State Fishery

Moderate Concern

The state-licensed trap net fishery in 1842 treaty waters has temporal and spatial management strategies (pers comm Caroffino, D. 2023). Although there are no formal HCRs in place, informal HCRs based on established limits are maintained (pers comm Caroffino, D. 2023); nevertheless, detrimental food webs are possible, but not likely. Hence Ecosystem-based Fisheries Management has been scored a “moderate concern”.

Lake Superior | America, North - Inland Waters | United States | Minnesota | Gillnets and entangling nets

Lake Superior | America, North - Inland Waters | United States | Minnesota | Gillnets and entangling nets | Tribal fishery

Moderate Concern

There is an HCR in place in the Minnesota suspended gillnet fisheries that target lake herring Goldsworthy and Yule 2021} with an ecological harvest control rule that is consistent with the Lenfest Fish Task Force Recommendations, and buffers built in to account for the needs of dependent predators (as there is a Management Strategy Evaluation in place and the harvest strategy accounts for volatility of the species). Nevertheless, there are no explicit spatial and temporal management strategies used to protect ecosystem functioning and account for the capture species' ecological role, and detrimental food web impacts are not likely. Hence, Ecosystem-based Fisheries Management has been scored a “moderate concern”.

Justification:

Although there are no spatial and temporal management strategies in place, fishing of lake herring does not take place through the year due to the winter, and the fishing season extends from April-May to mid-November (pers comm Goldsworthy, C. 2023). Additionally, in the case of the state-licensed cisco fishery, the TAC set is conservative and strictly enforced, so to stay within the limits of the TAC, fishers cannot fish throughout the year.

Lake Superior | America, North - Inland Waters | United States | Minnesota | Set gillnets

Low Concern

As there are HCRs in place to ensure that fishing mortality of lake trout in the state-licensed Minnesota fishery is controlled (MNDNR 2016), there are temporal and spatial closures in place to protect spawning lake trout (Goldsworthy et al. 2017), and detrimental food web impacts due to harvesting the species are unlikely, Ecosystem Based Fisheries Management has been scored as a “low concern”.

Lake Superior | America, North - Inland Waters | United States | Minnesota | Set gillnets | Tribal fishery

Moderate Concern

As the lake trout fishery lacks temporal and spatial management strategies, but the harvest limit is

maintained and detrimental food web impacts due to the fishery are unlikely, Ecosystem-based Fisheries Management has been scored as a “moderate concern”.

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Gillnets and entangling nets

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Gillnets and entangling nets | Tribal fishery

Moderate Concern

The main targeted species is lake herring, which is harvested using a conservative HCR of 15%, that takes into account the needs of dependent predators {Kitchell et al. 2000}{Stockwell et al. 2009}. Although an exploitation rate of 10-15% has been found to be appropriate following the literature (Stockwell et al. 2009) and exploitation in Wisconsin is below this limit, as lake herring is a forage species, the effectiveness of this HCR has yet to be proven, as no management strategy evaluation has been conducted. Nevertheless, the Gull Island and Devil’s Island Refuges provide adequate spatial and temporal management of lake trout, lake whitefish and lake herring (Akins et al. 2015)(Zuccarino-Crowe et al. 2016), and detrimental food web impacts due to harvesting the species are unlikely. Taken together, Ecosystem-based Fisheries Management has been scored as a “moderate concern”.

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Set gillnets

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Set gillnets | Tribal fishery

Lake Superior | America, North - Inland Waters | United States | Wisconsin | Stationary uncovered pound nets

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

Low Concern

As there are harvest limits in place for lake trout and lake whitefish, the Gull Island and Devil’s Island Refuges provide adequate spatial and temporal management of both lake trout and lake whitefish (Akins et al. 2015)(Zuccarino-Crowe et al. 2016), and detrimental food web impacts due to harvesting the species are unlikely, Ecosystem-based Fisheries Management has been scored as a “low concern”.

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