



Monterey Bay Aquarium Seafood Watch®

Walleye, Lake whitefish, Northern pike, and Yellow perch

Sander vitreum, Coregonus clupeaformis, Esox lucius, and Perca flavescens



(Image courtesy New York State Department of Environmental Conservation)

Lake Manitoba, Lake Winnipeg, and Lake Winnipegosis

Midwater Gillnet

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Disclaimer

Seafood Watch® strives to have all Seafood Reports reviewed for accuracy and completeness by external scientists with expertise in ecology, fisheries science and aquaculture. Scientific review, however, does not constitute an endorsement of the Seafood Watch® program or its recommendations on the part of the reviewing scientists. Seafood Watch® is solely responsible for the conclusions reached in this report.

About Seafood Watch®

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

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

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

Guiding Principles

Seafood Watch defines sustainable seafood as originating from sources, whether fished¹ or farmed, that can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems.

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

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

Each criterion includes:

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

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

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

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

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

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

Summary

This report provides recommendations for walleye (*Sander vitreum*), lake whitefish (*Coregonus clupeaformis*), northern pike (*Esox lucius*), and yellow perch (*Perca flavescens*) caught in gillnet fisheries that take place on Lake Manitoba, Lake Winnipeg, and Lake Winnipegosis.

For Criterion 1, Seafood Watch places a priority on stock status and fishing mortality information. There is a paucity of this information for the four Criterion 1 species, so conservative scores have been assigned to these species for Criterion 1. Except for Lake Winnipeg walleye (which are at high levels of abundance relative to historic levels) and Lake Winnipegosis walleye (which are collapsed), few definitive statements can be made about the status and fishing mortality of the Criterion 1 stocks.

Similarly, the Criterion 2 analysis was challenged by this lack of information. A number of non-targeted species are caught and often discarded in these fisheries, but there is scant information available to support an analysis of fishery-specific discarding. Sauger, a species that has been an important commercial species in the past, is included in this report under Criterion 2 due to its current status as a minor component of commercial landings.

The management system that is in place for target species is characterized by a general opacity in regard to the manner in which information influences management decisions. Although data are collected (for example, via index net sampling), there is no apparent process by which these data inform management decisions. Furthermore, there are no apparent reference points or pre-determined harvest control rules that are triggered by reference points; the lack of these harvest control tools contributes to the lack of clarity regarding harvest decisions. For bycatch species, a primary concern is the apparent lack of a mechanism by which management addresses potentially widespread discarding.

Because these fisheries use gillnets, the Seafood Watch criteria assign relatively low concern to the issue of gear impacts on substrate. Conversely, these fisheries' catches of "keystone" piscivores, and the apparent lack of scientific or management effort to evaluate and account for the ecological effects of the fisheries, warrant a score of "high concern" for the food web impacts of these fisheries.

Ultimately, the four assessed species receive overall "Avoid" recommendations. The fundamental issue that precludes higher scores is a pervasive lack of stock status and fishing mortality information, and a secondary contributor is an apparent lack of reference points and harvest control rules.

Table of Conservation Concerns and Overall Recommendations

Stock / Fishery	Impacts on the Stock	Impacts on other Spp.	Management	Habitat and Ecosystem	Overall Recommendation
Yellow perch Manitoba Lake Manitoba - Gillnet, Midwater	Yellow (2.64)	Red (0.90)	Red (1.00)	Yellow (2.45)	Avoid (1.554)

Lake whitefish Manitoba Lake Winnipeg - Gillnet, Midwater	Yellow (2.64)	Red (1.80)	Red (1.00)	Yellow (2.45)	Avoid (1.848)
Pike Manitoba Lake Manitoba - Gillnet, Midwater	Red (2.00)	Red (0.90)	Red (1.00)	Yellow (2.45)	Avoid (1.449)
Pike Manitoba Lake Winnipeg - Gillnet, Midwater	Yellow (2.64)	Red (1.80)	Red (1.00)	Yellow (2.45)	Avoid (1.848)
Pike Manitoba Lake Winnipegosis - Gillnet, Midwater	Red (1.00)	Red (0.90)	Red (1.00)	Yellow (2.45)	Avoid (1.219)
Walleye Manitoba Lake Manitoba - Gillnet, Midwater	Red (1.00)	Red (1.37)	Red (1.00)	Yellow (2.45)	Avoid (1.354)
Walleye Manitoba Lake Winnipeg - Gillnet, Midwater	Red (2.00)	Yellow (2.38)	Red (1.00)	Yellow (2.45)	Avoid (1.848)
Walleye Manitoba Lake Winnipegosis - Gillnet, Midwater	Red (1.00)	Red (0.90)	Red (1.00)	Yellow (2.45)	Avoid (1.219)

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 ≤2.2, **or** either Harvest Strategy (Factor 3.1) or Bycatch Management Strategy (Factor 3.2) is Very High Concern **or** two or more Red Criteria, **or** one or more Critical scores.

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

Table of Contents

About Seafood Watch®	2
Guiding Principles	3
Summary	4
Introduction	7
Assessment	11
Criterion 1: Stock for which you want a recommendation.....	11
Criterion 2: Impacts on Other Species	26
Criterion 3: Management effectiveness	34
Criterion 4: Impacts on the habitat and ecosystem.....	45
Acknowledgements.....	49

Introduction

Scope of the analysis and ensuing recommendation

This report provides recommendations for walleye (*Sander vitreum*), lake whitefish (*Coregonus clupeaformis*), northern pike (*Esox lucius*), and yellow perch (*Perca flavescens*) caught in gillnet fisheries that take place on Lake Manitoba, Lake Winnipeg, and Lake Winnipegosis, as shown in Table 1. The proportion of each species' total catch across all Manitoba lakes that is covered by these recommendations is shown in Figures 1–4.

Table 1. Fisheries addressed in this report.

Lake Name	Species			
	Lake Whitefish	Northern Pike	Walleye	Yellow Perch
Lake Manitoba		X	X	X
Lake Winnipeg	X	X	X	
Lake Winnipegosis		X	X	

Overview of the species and management bodies

Though commercial fishing may occur on approximately 300 lakes in the province (MCWS 2013), the four species addressed in this assessment are primarily caught in Lakes Manitoba, Winnipeg, and Winnipegosis (Figures 1–4).

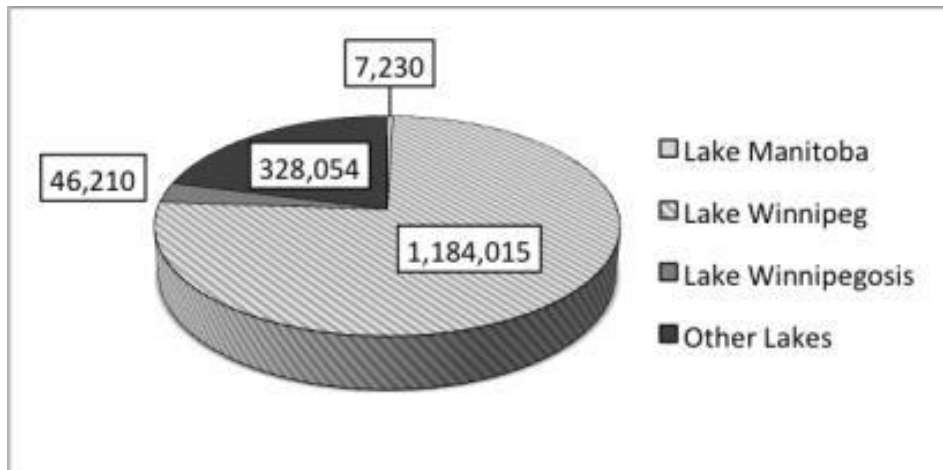


Figure 1. Lake whitefish catch (kg) by lake, 2011–2012, and coverage of this report's recommendations, depicted by white crosshatching. Data from MCWS 2013.

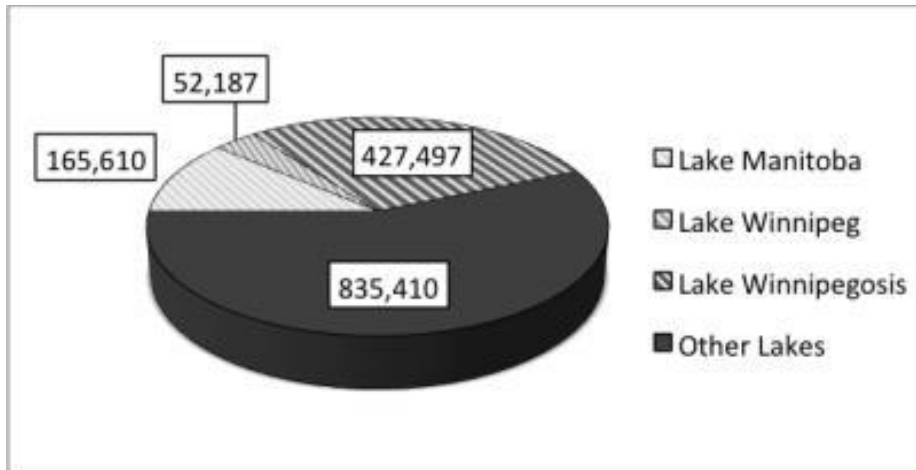


Figure 2. Northern pike catch (kg) by lake, 2011–2012, and coverage of this report’s recommendations, depicted by white crosshatching. Data from MCWS 2013.

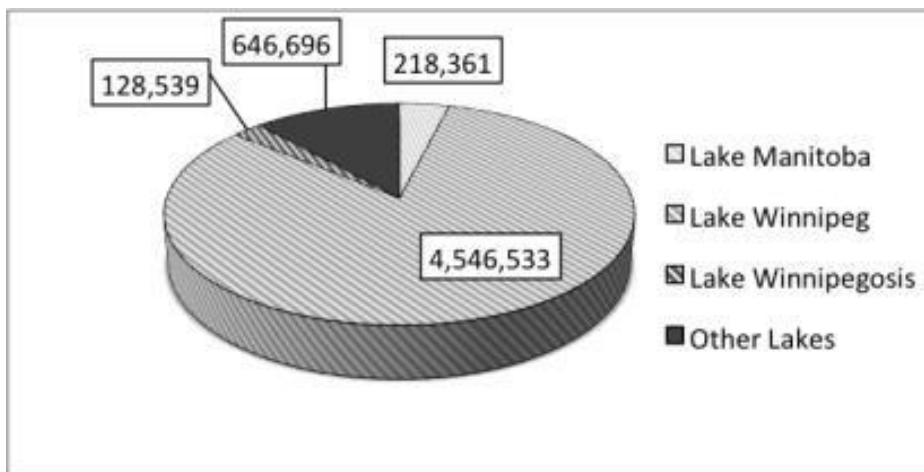


Figure 3. Walleye catch (kg) by lake, 2011–2012, and coverage of this report’s recommendations, depicted by white crosshatching. Data from MCWS 2013.

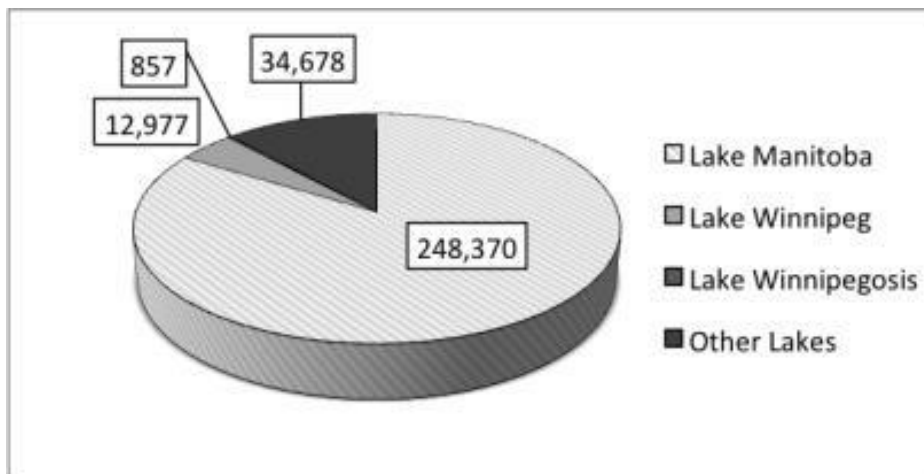


Figure 4. Yellow perch catch (kg) by lake, 2011–2012, and coverage of this report’s recommendations, depicted by white crosshatching. Data from MCWS 2013.

Production Statistics

In 2011–2012, the total production of walleye, lake whitefish, northern pike, and yellow perch from all Manitoba lakes was over 8,830 t, with walleye accounting for approximately 62.4% of this total (Table 5 in (MCWS 2013)). Over the past decade, total payments for all deliveries in the province have ranged from \$25.1 to \$33.4 million, with walleye accounting for approximately 66% of annual payments (p. 18 in (FWFMC 2013); Figure 5).

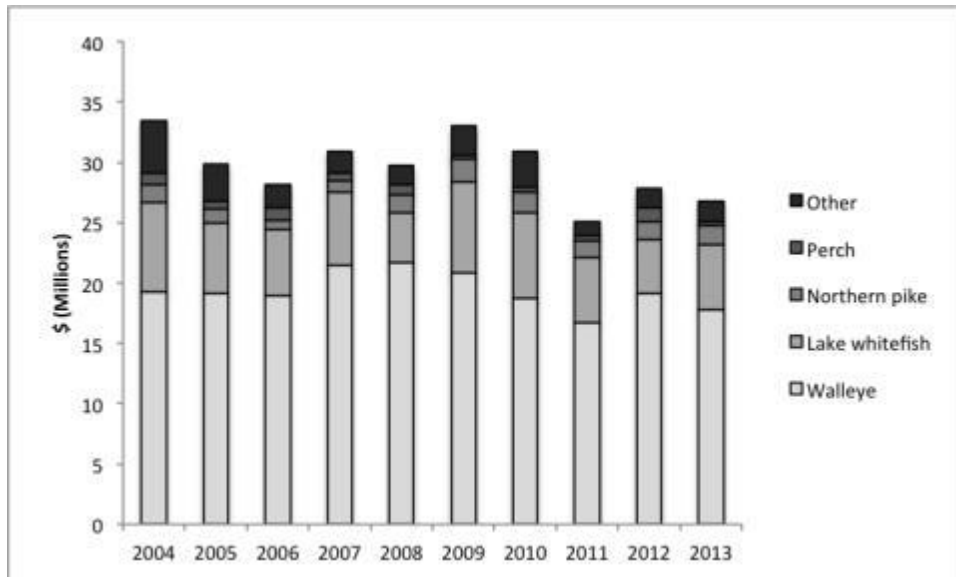


Figure 5. Total payments for deliveries, 2004–2013. Data from FWFMC 2013.

Importance to the U.S./North American market

Canada and the U.S. are important markets for Manitoba-caught walleye and lake whitefish. Walleye markets include Canada, several European countries, and the northern states of the U.S. Midwest, from Michigan to Montana and south to Nebraska (FWFMC 2013). France is the most important market for northern pike, but there is also a market in Canada (FWFMC 2013). Yellow perch fillets have recently been introduced to a market in Wisconsin (FWFMC 2013).

Common and market names

In Canada, walleye are sometimes colloquially known as pickerel; however, the name is somewhat misleading and the species should not be confused with true pickerels (e.g., the chain pickerel, *Esox niger*). Northern pike may be called “jackfish.” In the U.S., the allowable market names for walleye, northern pike, lake whitefish, and yellow perch are walleye, pike, whitefish, and yellow or lake perch, respectively (FDA 2015).

Primary product forms

Walleye are sold whole, filleted, and portioned (FWFMC 2015). Northern pike products include boneless portions, minced products, and caviar (FWFMC 2013). Yellow perch are sold as individually quick-frozen fillets in Wisconsin (FWFMC 2013).

Assessment

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

Criterion 1: Stock for which you want a recommendation

This criterion evaluates the impact of fishing mortality on the species, given its current abundance. The inherent vulnerability to fishing rating influences how abundance is scored, when abundance is unknown. The final Criterion 1 score is determined by taking the geometric mean of the abundance and fishing mortality scores. The Criterion 1 rating is determined as follows:

- Score >3.2=Green or Low Concern
 - Score >2.2 and <=3.2=Yellow or Moderate Concern
 - Score <=2.2=Red or High Concern
- Rating is Critical if Factor 1.3 (Fishing Mortality) is Critical.

Criterion 1 Summary

LAKE WHITEFISH				
Region / Method	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
Manitoba Lake Winnipeg Gillnet, Midwater	2.00:Medium	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.644)

PIKE				
Region / Method	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
Manitoba Lake Manitoba Gillnet, Midwater	2.00:Medium	4.00:Low Concern	1.00:High Concern	Red (2.000)
Manitoba Lake Winnipeg Gillnet, Midwater	2.00:Medium	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.644)
Manitoba Lake Winnipegosis Gillnet, Midwater	2.00:Medium	1.00:Very High Concern	1.00:High Concern	Red (1.000)

WALLEYE				
Region / Method	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
Manitoba Lake Manitoba Gillnet, Midwater	2.00:Medium	1.00:Very High Concern	1.00:High Concern	Red (1.000)
Manitoba Lake Winnipeg Gillnet, Midwater	2.00:Medium	4.00:Low Concern	1.00:High Concern	Red (2.000)

Manitoba Lake Winnipegosis Gillnet, Midwater	2.00:Medium	1.00:Very High Concern	1.00:High Concern	Red (1.000)
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YELLOW PERCH				
Region / Method	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
Manitoba Lake Manitoba Gillnet, Midwater	3.00:Low	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.644)

For Criterion 1, Seafood Watch places a priority on stock status and fishing mortality information. There is a paucity of this information for the four Criterion 1 species, so conservative scores have been assigned to these species for Criterion 1. Except for Lake Winnipeg walleye (which are at high levels of abundance relative to historic levels) and Lake Winnipegosis walleye (which are collapsed), few definitive statements can be made about the status and fishing mortality of the Criterion 1 stocks.

Criterion 1 Assessment

Factor 1.1 - Inherent Vulnerability

Scoring Guidelines

- *Low—The FishBase vulnerability score for species is 0-35, OR species exhibits life history characteristics that make it resilient to fishing, (e.g., early maturing (*
- *Medium—The FishBase vulnerability score for species is 36-55, OR species exhibits life history characteristics that make it neither particularly vulnerable nor resilient to fishing, (e.g., moderate age at sexual maturity (5-15 years), moderate maximum age (10-25 years), moderate maximum size, and middle of food chain).*
- *High—The FishBase vulnerability score for species is 56-100, OR species exhibits life history characteristics that make is particularly vulnerable to fishing, (e.g., long-lived (>25 years), late maturing (>15 years), low reproduction rate, large body size, and top-predator).*
Note: The FishBase vulnerability scores is an index of the inherent vulnerability of marine fishes to fishing based on life history parameters: maximum length, age at first maturity, longevity, growth rate, natural mortality rate, fecundity, spatial behaviors (e.g., schooling, aggregating for breeding, or consistently returning to the same sites for feeding or reproduction) and geographic range.

Factor 1.2 - Stock Status

Scoring Guidelines

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

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

Factor 1.3 - Fishing Mortality

Scoring Guidelines

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

LAKE WHITEFISH

Factor 1.1 - Inherent Vulnerability

Manitoba Lake Winnipeg, Gillnet, Midwater

Medium

The FishBase vulnerability score for lake whitefish is 48. Lake whitefish vulnerability is therefore scored as “medium.”

Factor 1.2 - Stock Status

Manitoba Lake Winnipeg, Gillnet, Midwater

Moderate Concern

Lake whitefish survey catch per unit effort (CPUE) declined in the 1980s and remained at relatively low levels into the early 2000s; recent survey-based abundance indices have been relatively steady. There are no reference points for the stock. A relatively recent expert review suggested that the stock may be in the Healthy or Cautious zones, but notes that there is considerable uncertainty and there are limited data for this stock. Stock status of lake whitefish in Lake Winnipeg is scored as “moderate concern.”

Rationale:

For lake whitefish in Lake Winnipeg, index netting CPUE data for the period 1979–2003 show a decline through the 1980s and sustained, relatively low CPUE thereafter (Figure IV.12 in (Lake Winnipeg Quota Review Task Force 2011)). More recently, abundance indices derived from standard gang index gillnets were relatively steady for 2008–2010 (Table 2). The authors of the Technical Assessment suggest that this stock could be in DFO’s Healthy or Cautious zones (see (DFO 2009) for explanation of zones); however, the authors also note that there is a high degree of uncertainty and there are limited data available for the Lake Winnipeg lake whitefish stock (Lake Winnipeg Quota Review Task Force 2011).

		2008			2009			2010		
		R.A. (%)	CPUE (fish/10 0 m/24 h) {S.D}	BPUE (g/100 m/24 h) {S.D.}	R.A. (%)	CPUE (fish/10 0 m/24 h) {S.D}	BPUE (g/100 m/24 h) {S.D.}	R.A. (%)	CPUE (fish/10 0 m/24 h) {S.D}	BPUE (g/100 m/24 h) {S.D.}
Lake Winnipeg	Sturgeon Bay	4.12	2.08 {3.24}	2,418 {4,001 }	-	- -	- -	0.2 2	0.13 {0.41}	120 {378}
	Grand Rapids	0.14	0.14 {0.46}	158 {499}	3.31	4.27 {4.83}	4,639 {5,245 }	3.4 0	3.28 {4.56}	3,286 {4,580 }
	Mossy Bay	2.68	1.27 {1.73}	923 {1,499 }	2.15	1.00 {1.68}	854 {1,294 }	3.4 1	1.92 {2.59}	658 {780}

Table 2. Lake whitefish abundance indices (relative abundance, catch per unit effort, and biomass per unit effort) from standard gang index gillnet surveys in Lake Winnipeg 2008–2010. (Source: Tables 9.6–5, 7, 9 in (North/South Consultants Inc. 2014) (North/South Consultants Inc. 2014c); Tables 9.6–3, 7, 9 in (North/South Consultants Inc. 2014b).)

Factor 1.3 - Fishing Mortality

Manitoba Lake Winnipeg, Gillnet, Midwater

Moderate Concern

There are no estimates of current fishing mortality for lake whitefish in Lake Winnipeg. Deliveries (i.e., recorded landings) in recent years have been high relative to levels in the second half of the 20th

century, and may be underrepresenting total fishing mortality, due to unreported discarding. Fishing mortality is scored as “moderate” concern.

Rationale:

For lake whitefish in Lake Winnipeg, the estimated total mortality rate at maximum sustainable yield (MSY) is 45% (pers. comm., G. Klein, 2015). However, the current mortality rate is not known.

During 1977–2007, commercial deliveries of Lake Winnipeg whitefish varied between approximately 851 t and 1,877 t (Appendix III.b in (Lake Winnipeg Quota Review Task Force 2011)), but the authors of the recent Technical Assessment suggest that catches may be higher than landings due to unreported discarding of whitefish (p. 76 in (Lake Winnipeg Quota Review Task Force 2011)). There is a long history of the economic discarding of unwanted fish on Lake Winnipeg (Heuring, L. 1993), and lake whitefish are discarded in unknown but potentially significant amounts. This is due to a perverse economic incentive: whitefish are managed with a three-species cumulative quota, along with the much more valuable walleye and sauger, so fishers have an incentive to discard (“bush”) lake whitefish in order to maximize the economic value of their three-species quota (Change the Normal: Redirecting Fish Waste 2012). A lake whitefish optimization program was introduced in 2008; this program has provided an average of 354,525 kg of additional lake whitefish quota in an effort to encourage deliveries of lake whitefish and reduce bushing (pers. comm., B. Parker, 2015).

Since the 1940s, only one decade (the 1980s) had a higher mean annual commercial catch of lake whitefish than did the first decade of the 21st century (Table IV.2 in (Lake Winnipeg Quota Review Task Force 2011)). The authors of the Lake Winnipeg Technical Assessment suggest a lake whitefish Recommended Allowable Harvest (RAH) of 1.63 million kg (Lake Winnipeg Quota Review Task Force 2011); this value is based on whitefish landings in recent years, so recent catches have been similar to this proposed RAH. Since the early 1970s, lake whitefish catch, effort, and CPUE have generally varied together (Figure IV.17 in (Lake Winnipeg Quota Review Task Force 2011)).

PIKE

Factor 1.1 - Inherent Vulnerability

Manitoba Lake Manitoba, Gillnet, Midwater

Manitoba Lake Winnipeg, Gillnet, Midwater

Manitoba Lake Winnipegosis, Gillnet, Midwater

Medium

The FishBase vulnerability score for northern pike is 69. But when the species’ productivity attributes (see below) are evaluated with the Seafood Watch criteria, it warrants a score of “medium” inherent

vulnerability.

Rationale:

Northern pike productivity attributes, and associated Seafood Watch scores, are evaluated as follows.

Productivity Attribute	Data	Source	Seafood Watch Score
Average age at maturity	Approximately 2 years	(Malette, M.D. and Morgan, G.E. 2005)	3
Average maximum age	7	(Harvey, B. 2009)	3
Fecundity	>100 eggs/year	(Harvey, B. 2009)	NA
Average maximum size	Can exceed 100 cm	(Froese, R. and Pauly, D. Eds. 2015)	2
Average size at maturity	42 cm (male) 46 cm (female)	(Malette, M.D. and Morgan, G.E. 2005)	2
Reproductive strategy	Broadcast spawn	(Harvey, B. 2009)	3
Trophic level	4.1 (± 0.4)	(Froese, R. and Pauly, D. Eds. 2015)	1
<i>Average</i>			<i>2.33 (Medium)</i>

Factor 1.2 - Stock Status

Manitoba Lake Manitoba, Gillnet, Midwater

Low Concern

In the past 6 years (2009–2014), northern pike CPUE in index netting data increased from below the population objective (10 fish per net) to more than double the objective (pers. comm., G. Klein, 2015). For Lake Manitoba, northern pike stock status is scored as “low” concern; the lack of a quantitative stock assessment precludes a score of “very low” concern.

Manitoba Lake Winnipeg, Gillnet, Midwater

Moderate Concern

There is no information regarding the northern pike stock status relative to reference points for Lake Winnipeg. Pike abundance indices, derived from index surveys, do not demonstrate consistent trends for 2008–2010: while the indices gradually increased for the Sturgeon Bay site during this period, they largely declined for the other two sites (Table 3). The lack of information regarding stock status combined with the species’ “medium” inherent vulnerability compel a stock status score of “moderate” concern.

Rationale:

		2008			2009			2010		
		R.A. (%)	CPUE (fish/100 m/24 h) {S.D.}	BPUE (g/100 m/24 h) {S.D.}	R.A. (%)	CPUE (fish/100 m/24 h) {S.D.}	BPUE (g/100 m/24 h) {S.D.}	R.A. (%)	CPUE (fish/100 m/24 h) {S.D.}	BPUE (g/100 m/24 h) {S.D.}
Lake Winnipeg	Sturgeon Bay	6.45	3.45 {2.21}	3,352 {2,200}	8.90	4.22 {4.24}	1,596 {2,021}	13.6 1	7.18 {6.10}	5,777 {4,929}
	Grand Rapids	1.55	1.37 {1.44}	2,924 {3,415}	0.25	0.33 {0.66}	1,296 {2,880}	0.38	0.46 {0.63}	574 {799}
	Mossy Bay	1.37	1.40 {2.51}	4,055 {7,402}	-	-	-	0.26	0.16 {0.35}	429 {1,135}

Table 3. Northern pike abundance indices (relative abundance, catch per unit effort, and biomass per unit effort) from standard gang index gillnet surveys in Lake Winnipeg, 2008–2010. (Source: Tables 9.6–5, 7, 9 in (North/South Consultants Inc. 2014) (North/South Consultants Inc. 2014c); Tables 9.6–3, 7, 9 in (North/South Consultants Inc. 2014b).)

Manitoba Lake Winnipegosis, Gillnet, Midwater**Very High Concern**

Index net abundance indicators and commercial CPUE data indicate that northern pike abundance was reduced in the mid-2000s, relative to previous decades. More recently, abundance indices from surveys conducted in 2008–2010 do not indicate increasing abundance. The stock status of Lake Winnipegosis northern pike is therefore scored as “very high” concern.

Rationale:

Pike CPUE declined sharply in the early 1970s and then continued to decline in subsequent years, reaching a low point in the early 1990s before increasing somewhat through the early 2000s (Figure 64 in (Lysack, W. 2006)). An index of Lake Winnipegosis pike abundance, derived from index net sampling, is available for 1990–2005 (Figure 9 in (Lysack, W. 2006)). The mean abundance for 2005 was the lowest in the series, and the 2005 median abundance was similar to the lowest levels in the series. Most recently, abundance indices from gillnet surveys taken in 2008–2010 do not show a strong indication of increasing abundance (Table 4).

	2008			2009			2010		
	R.A. (%)	CPUE (fish/100 m/24 h) {S.D.}	BPUE (g/100 m/24 h) {S.D.}	R.A. (%)	CPUE (fish/100 m/24 h) {S.D.}	BPUE (g/100 m/24 h) {S.D.}	R.A. (%)	CPUE (fish/100 m/24 h) {S.D.}	BPUE (g/100 m/24 h) {S.D.}
Lake Winnipegosis	12.01	5.94 {6.02}	9,349 {9,185}	5.98	2.45 {2.23}	3,482 {3,231}	8.00	5.76 {5.81}	9,389 {8,455}

Table 4. Northern pike abundance indices (relative abundance, catch per unit effort, and biomass per unit effort) from standard gang index gillnet surveys in Lake Winnipegosis, 2008–2010. (Source: Tables 9.6–3, 7, 9 in (North/South Consultants Inc. 2014) (North/South Consultants Inc. 2014b) (North/South Consultants Inc. 2014c).)

Factor 1.3 - Fishing Mortality

Manitoba Lake Manitoba, Gillnet, Midwater

High Concern

Commercial deliveries of northern pike have increased over the past several years, and 2013 deliveries were at their highest level since the early 1980s; these increased deliveries are likely a result of increased abundance (see Factor 1.2). Although there is an estimate of MSY for Lake Manitoba northern pike, there is no recent estimate of fishing mortality, and management is not considered to be effective (see Criterion 3.1). Fishing mortality of Lake Manitoba northern pike is scored as “high” concern.

Rationale:

Lake Manitoba northern pike natural mortality is estimated to be approximately 0.3 (pers. comm., G. Klein, 2015). The MSY for this stock is considered to be approximately 60% of this mortality rate (pers. comm., G. Klein, 2015). But presently, there is no estimate for recent fishing mortality rates.

Northern pike commercial deliveries declined during the 1980s and remained low, relative to walleye and perch, through the 1990s and 2000s (Figure 6). But since 2010, deliveries have sharply increased, and in 2013 northern pike deliveries were the highest of the four main species and were at their highest point since the early 1980s (Figure 6). This is likely due to recent flooding, which has increased spawning habitat and led to a sharp increase in stock status (see Factor 1.2).

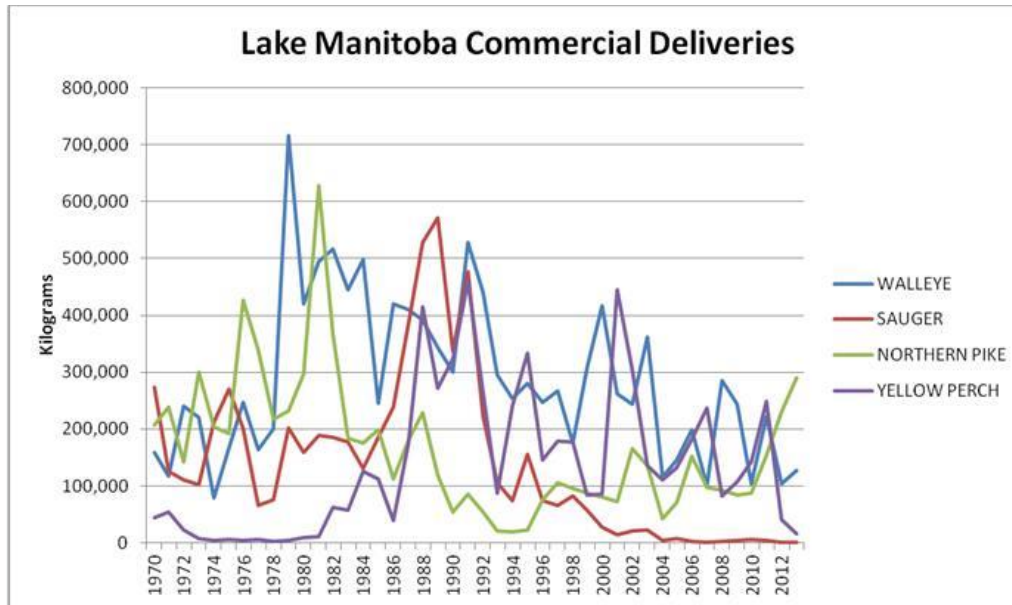


Figure 6. Lake Manitoba commercial deliveries (pers. comm., G. Klein, 2014).

Manitoba Lake Winnipegosis, Gillnet, Midwater

High Concern

Lake Winnipegosis northern pike have been overexploited for decades. Fishing mortality of Lake Winnipegosis northern pike is therefore scored as “high” concern.

Rationale:

As of 2006, Lysack stated that Lake Winnipegosis pike were continuously overexploited (Lysack, W. 2006). An estimate of total mortality (Z) from 1990 through 2001 shows substantial variation, but indicates an overall increasing trend, with high mortality rates ($Z > 1.0$) for many years (Figure 28 in (Lysack, W. 2006)). Most pike sampled during 1990–2005 were between 40 and 60 cm in length, with few exceeding 60 cm (Figure 22 in (Lysack, W. 2006)). Age composition data for pike sampled between 1990 and 2001 show a relatively consistent age structure, with ages 2–4 dominating (Figure 21 in (Lysack, W. 2006)). Index net samples have found that the majority of pike are mature by age 3; at that age, pike are approximately 53 cm (Figure 26 in (Lysack, W. 2006)).

Manitoba Lake Winnipeg, Gillnet, Midwater

Moderate Concern

In 2007 and 2008 (the most recent years for which data are available), northern pike deliveries from Lake Winnipeg were approximately 64.7 t and 102.1 t, respectively; these values were well below the 1972–2008 average (289.8 t) and were similar to the lowest values recorded for during 1972–2008

(Appendix III in (Lake Winnipeg Quota Review Task Force 2011)). Though there is no estimate of sustainable mortality for northern pike in Lake Winnipeg, the relatively low deliveries in recent years mitigates concern. Fishing mortality is scored as “moderate” concern for Lake Winnipeg northern pike.

WALLEYE

Factor 1.1 - Inherent Vulnerability

Manitoba Lake Manitoba, Gillnet, Midwater

Manitoba Lake Winnipeg, Gillnet, Midwater

Manitoba Lake Winnipegosis, Gillnet, Midwater

Medium

The FishBase vulnerability score for walleye is 40. Walleye inherent vulnerability is therefore scored as “medium.”

Factor 1.2 - Stock Status

Manitoba Lake Manitoba, Gillnet, Midwater

Very High Concern

Recent monitoring has “confirmed the depressed status” of walleye in Lake Manitoba (MCWS 2014). The stock status of Lake Manitoba walleye is thus scored as “very high” concern.

Manitoba Lake Winnipeg, Gillnet, Midwater

Low Concern

Recent indicators of walleye abundance are positive, and abundance may be near record levels. But the long-term stability of the abundance increase is not known. That concern, along with a lack of reference points, precludes a score of “very low” concern; the stock status of Lake Winnipeg walleye is therefore scored as “low” concern.

Rationale:

In recent years, the walleye stock in Lake Winnipeg has increased due to strong year classes, which have benefited from feeding on recently introduced rainbow smelt (Ministry of Water Stewardship 2009).

Index netting CPUE for Lake Winnipeg walleye shows a sharp increase from the mid-1990s through the mid-2000s, and CPUE data from a revised index-netting program indicate increases from 2006–2009 (Figure 7; note that a change in sampling protocols prevents direct comparison between the two sets of CPUE data). The brief 2006–2009 time series of index netting data shows relative stability in the ratio of walleye CPUE to sauger CPUE (Table IV.4. in (Lake Winnipeg Quota Review Task Force 2011)). Most recently, indices of walleye abundance (derived from standard gang index gillnet surveys taken in three locations in Lake Winnipeg) indicate increasing abundance from 2008–2010 (Table 5). The authors of the Technical Assessment suggest that Lake Winnipeg walleye are likely rated in DFO’s “Healthy Zone” (i.e., above 80% of B_{MSY} (DFO 2009)), despite the lack of reference points (Lake Winnipeg Quota Review Task Force 2011).

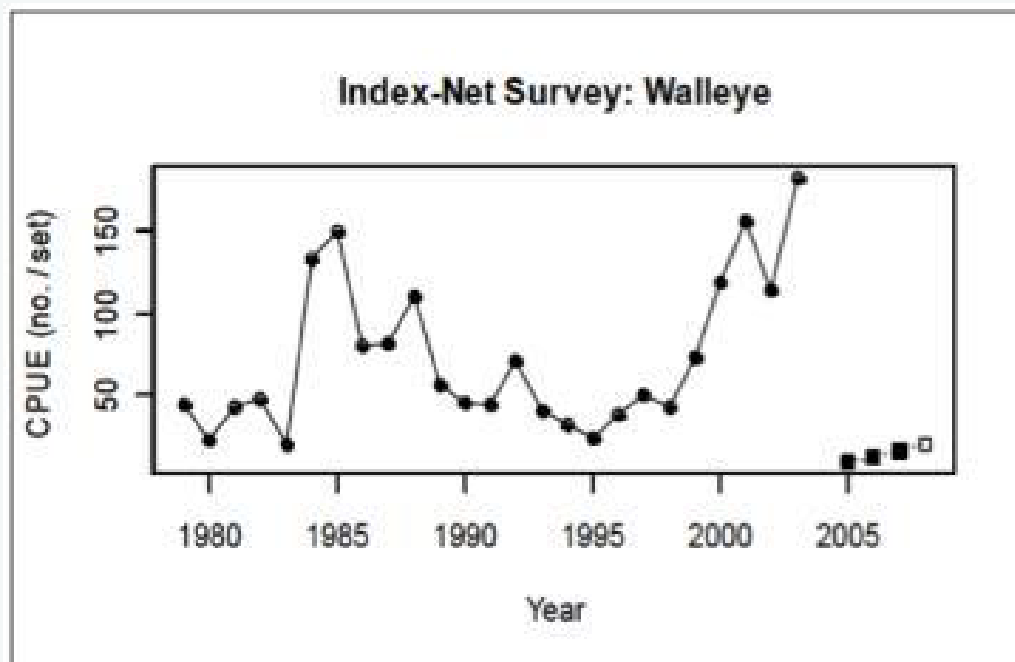


Figure 7. Lake Winnipeg walleye index net. Figure from Lake Winnipeg Quota Review Task Force, 2011.

		2008			2009			2010		
		R.A. (%)	CPUE (fish/100 m/24 h) {S.D.}	BPUE (g/100 m/24 h) {S.D.}	R.A. (%)	CPUE (fish/100 m/24 h) {S.D.}	BPUE (g/100 m/24 h) {S.D.}	R.A. (%)	CPUE (fish/100 m/24 h) {S.D.}	BPUE (g/100 m/24 h) {S.D.}
Lake Winnipeg	Sturgeon Bay	1.43	0.73 {1.40}	843 {1,832}	48.04	22.34 {14.14}	11,537 {7,854}	43.20	19.84 {19.51}	12,618 {13,634}
	Grand Rapids	46.47	39.91 {0.61}	30,784 {20,294}	35.21	41.81 {12.23}	25,238 {7,796}	75.28	105.99 {102.25}	66,330 {62,459}
	Mossy Bay	17.57	16.11 {21.99}	12,229 {10,080}	43.92	35.97 {27.26}	35,622 {27,111}	20.63	14.79 {15.74}	13,349 {13,839}

Table 5. Walleye abundance indices (relative abundance, catch per unit effort, and biomass per unit effort) from standard gang index gillnet surveys in Lake Winnipeg, 2008–2010. (Source: Tables 9.6–5, 7, 9 in (North/South Consultants Inc. 2014) (North/South Consultants Inc. 2014c); Tables 9.6–3, 7, 9 in (North/South Consultants Inc. 2014b).)

Manitoba Lake Winnipegosis, Gillnet, Midwater

Very High Concern

Available information indicates that Lake Winnipegosis walleye are collapsed and have not increased in abundance in recent years. Lake Winnipegosis walleye stock status is therefore scored “very high” concern.

Rationale:

The walleye stock in Lake Winnipegosis is collapsed (Lysack, W. 2006) (Ministry of Water Stewardship 2009). Trends in walleye abundance, derived from index net sampling, indicate that walleye abundance declined to very low levels for the first half of the 1990s and again in the early 2000s. The mean and median abundances displayed different trends for 2004 and 2005 (the last two years in the series), with median abundance sharply declining and mean abundance increasing (Figure 8 in (Lysack, W. 2006)). Walleye catch per unit effort (CPUE) was very low from the late 1980s through the late 1990s, but increased somewhat during the late 1990s and early 2000s (Figure 64 in (Lysack, W. 2006)). Recruitment is “sporadic and is declining over the long term” (Lysack, W. 2006). Most recently, various indices of abundance, derived from standard gang index gillnet surveys in Lake Winnipegosis, do not indicate that abundance increased during 2008–2010 (Table 6).

	2008			2009			2010		
	R.A. (%)	CPUE (fish/10 0 m/24 h) {S.D}	BPUE (g/100 m/24 h) {S.D.}	R.A. (%)	CPUE (fish/10 0 m/24 h) {S.D}	BPUE (g/100 m/24 h) {S.D.}	R.A. (%)	CPUE (fish/10 0 m/24 h) {S.D}	BPUE (g/100 m/24 h) {S.D.}
Lake Winnipegosis	22.6 4	11.36 {13.62}	9,041 {13,270 }	16.3 2	6.56 {5.80}	3,990 {2,656 }	10.7 9	7.94 {5.98}	6,708 {5,591 }

Table 6. Walleye abundance indices (relative abundance, catch per unit effort, and biomass per unit effort) from standard gang index gillnet surveys in Lake Winnipegosis, 2008–2010. (Source: Tables 9.6–5, 7, 9 in (North/South Consultants Inc. 2014) (North/South Consultants Inc. 2014c); Tables 9.6–3, 7, 9 in (North/South Consultants Inc. 2014b).)

Factor 1.3 - Fishing Mortality

Scoring Guidelines

Manitoba Lake Manitoba, Gillnet, Midwater

High Concern

Lake Manitoba walleye deliveries have generally declined since the late 1970s, but mortality is estimated to be above a safe level. Fishing mortality of Lake Manitoba walleye is scored as “high” concern.

Rationale:

For Lake Manitoba, walleye catches are managed via a two-species combined quota of 907,200 kg for walleye and sauger (CFSV 2014). Since sauger landings are essentially none (see Figure 6), all the two-species quota is essentially available for walleye, although walleye landings have not approached that level since the late 1970s (Figure 6). Since the late 1970s, Lake Manitoba walleye landings have generally trended downward, with several periods of high catches (Figure 6). Catches in 2012 and 2013 were among the lowest since 1974 (Figure 6). Current mortality rate estimates are approximately 57% and 65% in the North and South Basins, respectively, while the estimated safe mortality rate is 42% (pers. comm., B. Parker, 2015).

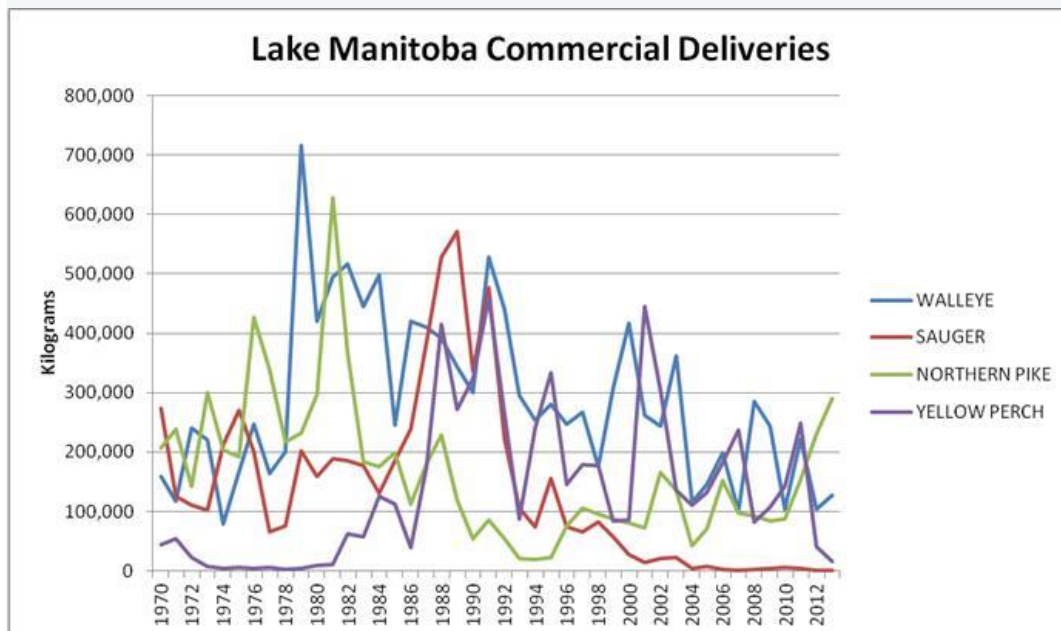


Figure 6. Lake Manitoba commercial deliveries (pers. comm., G. Klein, 2014).

Manitoba Lake Winnipeg, Gillnet, Midwater

High Concern

In the past several years, catches of walleye in Lake Winnipeg rose sharply to levels not seen before in the fishery. Mean walleye catches during the 2000s were 3,914 t; the decade with the next highest mean was the 1940s (1,998 t) (Table IV.2. in (Lake Winnipeg Quota Review Task Force 2011)). Fishing mortality of Lake Manitoba walleye is scored as “high” concern.

Manitoba Lake Winnipegosis, Gillnet, Midwater

High Concern

Lake Winnipegosis walleye yields have been estimated to have exceeded MSY for most years from the late 1930s through the early 1960s. Although yields have not exceeded the estimated MSY in the decades since, it has been asserted that the species is overexploited in two dimensions: growth and recruitment (Lysack, W. 2006). Age composition data indicate that few fish caught in index nets are older than 4 years (Figure 40 in (Lysack, W. 2006)); at ages less than 4, fewer than 50% of females are mature (Lysack, W. 2006). Lysack states, “Overexploitation is both the original cause of the walleye collapse and the single major factor that currently maintains walleyes and several other fish species in a depressed state” (Lysack, W. 2006). The fishing mortality of Lake Winnipegosis walleye is scored as “high” concern.

Rationale:

Lysack stated that Lake Winnipegosis walleye fishery has been characterized by continuous overexploitation (Lysack, W. 2006). An estimate of total mortality (Z) for 1990–2005 was characterized by substantial variation from year to year, but was generally high ($Z > 1.0$ for all but 3 years in the period) and showed an increasing trend overall (Figure 43 in (Lysack, W. 2006)). Lake Winnipegosis walleye yields are estimated to have exceeded an estimate of MSY for most years between the early 1930s and the early 1960s (Figure 63 in (Lysack, W. 2006)). Catches have approached the estimated MSY at some points in the years since, but have not exceeded it or the walleye quota (Figure 63 in (Lysack, W. 2006)). Recent yields have been well below the estimated 450,000 kg of walleye that should be produced by a rehabilitated Lake Winnipegosis (Ministry of Water Stewardship 2009) and below two different estimates of MSY (Figure 8).

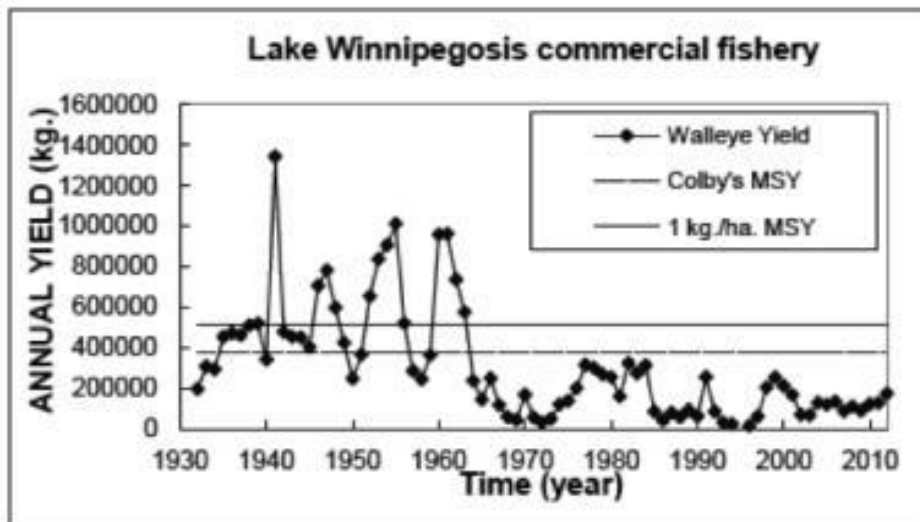


Figure 8. Lake Winnipegosis walleye yield vs. estimates of MSY, 1930–2012. Source: MCWS 2014.

YELLOW PERCH

Factor 1.1 - Inherent Vulnerability

Manitoba Lake Manitoba, Gillnet, Midwater

Low

The FishBase vulnerability score for yellow perch is 31. Yellow perch inherent vulnerability is therefore scored as “low.”

Factor 1.2 - Stock Status

Manitoba Lake Manitoba, Gillnet, Midwater

Moderate Concern

There is no information for yellow perch stock status in Lake Manitoba. Because yellow perch stock status is unknown and the species does not have high inherent vulnerability, it is scored as “moderate” concern.

Factor 1.3 - Fishing Mortality

Scoring Guidelines

Manitoba Lake Manitoba, Gillnet, Midwater

Moderate Concern

For 2011 and 2012, commercial deliveries of Lake Manitoba yellow perch were at their lowest levels since the early 1980s. There is no estimate of sustainable mortality of yellow perch. Fishing mortality is therefore scored as “moderate” concern.

Rationale:

Commercial deliveries of yellow perch caught in Lake Manitoba were minimal until the early 1980s, but increased sharply through the 1980s to levels comparable to those of walleye and sauger (Figure 6). The increase in the 1980s was due to a reduction in the minimum mesh size from 96 mm stretched to 76 mm stretched; this change resulted in increased catches of the small-bodied yellow perch (pers. comm., G. Klein, 2015). Deliveries varied without an apparent trend from the late 1990s until 2010, but deliveries in 2011 and 2012 were the lowest since the 1980s (Figure 6).

Criterion 2: Impacts on Other Species

All main retained and bycatch species in the fishery are evaluated in the same way as the species under assessment were evaluated in Criterion 1. Seafood Watch® defines bycatch as all fisheries-related mortality or injury to species other than the retained catch. Examples include discards, endangered or threatened species catch, and ghostfishing. To determine the final Criterion 2 score, the score for the lowest scoring retained/bycatch species is multiplied by the discard rate score (ranges from 0-1), which evaluates the amount of non-retained catch (discards) and bait use relative to the retained catch. The Criterion 2 rating is determined as follows:

- Score >3.2=Green or Low Concern
 - Score >2.2 and <=3.2=Yellow or Moderate Concern
 - Score <=2.2=Red or High Concern
- Rating is Critical if Factor 2.3 (Fishing Mortality) is Critical.

Criterion 2 Summary

Lake whitefish: Manitoba Lake Winnipeg, Gillnet, Midwater

Subscore:: 2.000 Discard Rate: 0.90 C2 Rate: 1.800

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
WALLEYE	Medium	4.00: Low Concern	1.00: High Concern	2.000
FINFISH	Medium	3.00: Moderate Concern	2.33: Moderate Concern	2.644
LAKE WHITEFISH	Medium	3.00: Moderate Concern	2.33: Moderate Concern	2.644
PIKE	Medium	3.00: Moderate Concern	2.33: Moderate Concern	2.644
SAUGER	Medium	3.00: Moderate Concern	2.33: Moderate Concern	2.644

Pike: Manitoba Lake Manitoba, Gillnet, Midwater

Subscore:: 1.000 Discard Rate: 0.90 C2 Rate: 0.900

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
WALLEYE	Medium	1.00: Very	1.00: High	1.000

		High Concern	Concern	
SAUGER	Medium	1.00: Very High Concern	2.33: Moderate Concern	1.526
PIKE	Medium	4.00: Low Concern	1.00: High Concern	2.000
FINFISH	Medium	3.00: Moderate Concern	2.33: Moderate Concern	2.644
YELLOW PERCH	Low	3.00: Moderate Concern	2.33: Moderate Concern	2.644

Pike: Manitoba Lake Winnipeg, Gillnet, Midwater

Subscore:: **2.000** Discard Rate: **0.90** C2 Rate: **1.800**

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
WALLEYE	Medium	4.00: Low Concern	1.00: High Concern	2.000
FINFISH	Medium	3.00: Moderate Concern	2.33: Moderate Concern	2.644
LAKE WHITEFISH	Medium	3.00: Moderate Concern	2.33: Moderate Concern	2.644
PIKE	Medium	3.00: Moderate Concern	2.33: Moderate Concern	2.644
SAUGER	Medium	3.00: Moderate Concern	2.33: Moderate Concern	2.644

Pike: Manitoba Lake Winnipegosis, Gillnet, Midwater

Subscore:: **1.000** Discard Rate: **0.90** C2 Rate: **0.900**

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
PIKE	Medium	1.00: Very High Concern	1.00: High Concern	1.000
SAUGER	Medium	1.00: Very High Concern	1.00: High Concern	1.000
WALLEYE	Medium	1.00: Very High Concern	1.00: High Concern	1.000

FINFISH	Medium	3.00: Moderate Concern	2.33: Moderate Concern	2.644
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Walleye: Manitoba Lake Manitoba, Gillnet, Midwater

Subscore:: 1.526 Discard Rate: 0.90 C2 Rate: 1.373

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
WALLEYE	Medium	1.00: Very High Concern	1.00: High Concern	1.000
SAUGER	Medium	1.00: Very High Concern	2.33: Moderate Concern	1.526
PIKE	Medium	4.00: Low Concern	1.00: High Concern	2.000
FINFISH	Medium	3.00: Moderate Concern	2.33: Moderate Concern	2.644
YELLOW PERCH	Low	3.00: Moderate Concern	2.33: Moderate Concern	2.644

Walleye: Manitoba Lake Winnipeg, Gillnet, Midwater

Subscore:: 2.644 Discard Rate: 0.90 C2 Rate: 2.380

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
WALLEYE	Medium	4.00: Low Concern	1.00: High Concern	2.000
FINFISH	Medium	3.00: Moderate Concern	2.33: Moderate Concern	2.644
LAKE WHITEFISH	Medium	3.00: Moderate Concern	2.33: Moderate Concern	2.644
PIKE	Medium	3.00: Moderate Concern	2.33: Moderate Concern	2.644
SAUGER	Medium	3.00: Moderate Concern	2.33: Moderate Concern	2.644

Walleye: Manitoba Lake Winnipegosis, Gillnet, Midwater

Subscore:: **1.000** Discard Rate: **0.90** C2 Rate: **0.900**

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
PIKE	Medium	1.00: Very High Concern	1.00: High Concern	1.000
SAUGER	Medium	1.00: Very High Concern	1.00: High Concern	1.000
WALLEYE	Medium	1.00: Very High Concern	1.00: High Concern	1.000
FINFISH	Medium	3.00: Moderate Concern	2.33: Moderate Concern	2.644

Yellow perch: Manitoba Lake Manitoba, Gillnet, Midwater

Subscore:: **1.000** Discard Rate: **0.90** C2 Rate: **0.900**

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
WALLEYE	Medium	1.00: Very High Concern	1.00: High Concern	1.000
SAUGER	Medium	1.00: Very High Concern	2.33: Moderate Concern	1.526
PIKE	Medium	4.00: Low Concern	1.00: High Concern	2.000
FINFISH	Medium	3.00: Moderate Concern	2.33: Moderate Concern	2.644
YELLOW PERCH	Low	3.00: Moderate Concern	2.33: Moderate Concern	2.644

A number of non-targeted species are caught and often discarded in these fisheries, but there is scant information available to support an analysis of fishery-specific discarding. Sauger, which has been an important commercial species in the past, is included in this report under Criterion 2 due to its current status as a minor component of commercial landings.

Criterion 2 Assessment**FINFISH****Factor 2.1 - Inherent Vulnerability**

Scoring Guidelines (same as Factor 1.1 above)

Manitoba Lake Manitoba, Gillnet, Midwater

Manitoba Lake Winnipeg, Gillnet, Midwater

Manitoba Lake Winnipegosis, Gillnet, Midwater

Medium

Non-targeted species are caught in these fisheries, but there is no species-specific information to demonstrate how much of each non-targeted species is caught in each fishery. Species that are caught in index nets include black bullhead (*Ameiurus melas*, FishBase vulnerability score = 50), burbot (*Lota lota*, 66), channel catfish (*Ictalurus punctatus*, 72), freshwater drum (*Aplodinotus grunniens*, 37), goldeye (*Hiodon alosoides*, 63), cisco (*Coregonus artedi*, 43), quillback sucker (*Carpionodes cyprinus*, 46), rock bass (*Ambloplites rupestris*, 43), shorthead redhorse (*Moxostoma macrolepidotum*, 56), white bass (*Morone chrysops*, 42), and white sucker (*Catostomus commersoni*, 57) (pers. comm., G. Klein, 2015). The average FishBase vulnerability score for those species is 51.4. Inherent vulnerability is therefore scored as “medium” for the generic “finfish” category for Criterion 2. It should be noted that non-targeted species, though often discarded, are sometimes landed (pers. comm., G. Klein, 2015).

Factor 2.2 - Stock Status

Scoring Guidelines (same as Factor 1.2 above)

Manitoba Lake Manitoba, Gillnet, Midwater

Manitoba Lake Winnipeg, Gillnet, Midwater

Manitoba Lake Winnipegosis, Gillnet, Midwater

Moderate Concern

A number of species of non-targeted fish may be caught in the commercial fisheries (see Factor 2.1); however, there is a lack of information regarding the amounts of such fish discarded by the fisheries. As per the Seafood Watch criteria, stock status is scored as “moderate” concern for the generic category of “finfish.”

Factor 2.3 - Fishing Mortality

Scoring Guidelines (same as Factor 1.3 above)

Manitoba Lake Manitoba, Gillnet, Midwater

Manitoba Lake Winnipeg, Gillnet, Midwater

Manitoba Lake Winnipegosis, Gillnet, Midwater

Moderate Concern

Several species of non-targeted fish may be caught in these fisheries (see Factor 2.1). There are no estimates of fishing mortality rates or sustainable mortality rates for these fish species. Fishing mortality is unknown, there is not effective management in place for these species, and the stock status of these species is not known, so fishing mortality is scored as “moderate” concern for unidentified “finfish.”

Factor 2.4 - Discard Rate

Manitoba Lake Manitoba, Gillnet, Midwater

Manitoba Lake Winnipeg, Gillnet, Midwater

Manitoba Lake Winnipegosis, Gillnet, Midwater

40-60%

There are no official estimates of discarded bycatch for Lakes Manitoba, Winnipeg, or Winnipegosis. Although bycatch in the commercial fishery in another Manitoba lake (Waterhen Lake) is believed to be low (Intertek 2014), reports of “bushing” (i.e., unreported discarding of dead fish) of lake whitefish in Lake Winnipeg (Lake Winnipeg Quota Review Task Force 2011) and anecdotal reports of bushing of other unwanted species suggest that discard rates are not low. In lieu of any reliable information on this subject, a discard rate of 40-60% is selected on the assumption that this rate will be conservative.

SAUGER

Factor 2.1 - Inherent Vulnerability

Scoring Guidelines (same as Factor 1.1 above)

Manitoba Lake Winnipeg, Gillnet, Midwater

Manitoba Lake Winnipegosis, Gillnet, Midwater

Medium

The FishBase vulnerability score for sauger is 49. The inherent vulnerability of sauger is therefore scored as “medium.”

Factor 2.2 - Stock Status

Scoring Guidelines (same as Factor 1.2 above)

Manitoba Lake Winnipeg, Gillnet, Midwater

Moderate Concern

Sauger CPUE in index net surveys declined in the late 1980s and remained relatively steady, at a low level, throughout the 1990s. Recent index net CPUE data have likewise been relatively steady. However, the sauger stock in Lake Winnipeg is considered to be “growing” (pers. comm., G. Klein, 2015). In light of this information (steady CPUE indices, assertion of stock growth by an expert, the lack of stock-specific reference points, and the species’ “medium” inherent vulnerability), sauger stock status is scored as “moderate” concern for Lake Winnipeg.

Rationale:

The CPUE of Lake Winnipeg sauger in index net surveys declined in the late 1980s and remained relatively steady during the 1990s (Figure IV.9 in (Lake Winnipeg Quota Review Task Force 2011)). Sauger CPUE data from a more recent index netting program remained stable from 2006–2009 (Table IV.4 in (Lake Winnipeg Quota Review Task Force 2011)). (It is noted that sauger, due to its smaller size, is less susceptible to the larger net panels used in the index nets, while the larger walleye is susceptible to larger panels (Lake Winnipeg Quota Review Task Force 2011).)

Manitoba Lake Winnipegosis, Gillnet, Midwater

Very High Concern

Lysack (2006) presented data that show that sauger “disappeared” from Lake Winnipegosis index gill nets by the late 1990s, and remained essentially missing through at least 2005 (Figure 20 in (Lysack, W. 2006)). Lysack also used the terms “almost disappeared” and “extirpated” to describe the status of sauger in Lake Winnipegosis. Because there is no information to indicate a recovery in the intervening years, sauger stock status is scored as “very high” concern for Lake Winnipegosis.

Factor 2.3 - Fishing Mortality

Scoring Guidelines (same as Factor 1.3 above)

Manitoba Lake Winnipeg, Gillnet, Midwater

Moderate Concern

In recent years, sauger landings have been well below historical levels. These low catches are not a

result of management efforts, because sauger landings continue to be managed with a three-species quota (along with whitefish and walleye). However, the total mortality rate (Z) is estimated to be 0.70, while Z_{MSY} is 0.80 (pers. comm., G. Klein, 2015). Fishing mortality for Lake Winnipeg sauger is scored as “moderate” concern.

Rationale:

There is no estimate of sustainable fishing mortality for Lake Winnipeg sauger. Although sauger has long been a species of commercial importance on Lake Winnipeg, landings have declined in recent years. After declining from the 1940s to the 1950s, average sauger landings stayed relatively stable from the 1950s (1,479 t/year) through the 1990s (1,316 t/year), but declined sharply in the 2000s (450 t/year, on average; Table IV.2 in (Lake Winnipeg Quota Review Task Force 2011)). As a result, sauger’s contribution to total landings declined from 33% in the 1990s to 8% in the 2000s (Table IV.3. in (Lake Winnipeg Quota Review Task Force 2011)).

Manitoba Lake Winnipegosis, Gillnet, Midwater

High Concern

For the most recent year for which data are publicly available, commercial landings of sauger from Lake Winnipegosis were essentially zero (Table 5 in (MCWS 2013)). However, Lysack (2006) stated that sauger are susceptible to fisheries for “most of their life span.” Given the stock’s status, fishing mortality of Lake Winnipegosis sauger is scored as “high” concern.

Factor 2.4 - Discard Rate

Manitoba Lake Winnipeg, Gillnet, Midwater

Manitoba Lake Winnipegosis, Gillnet, Midwater

40-60%

There are no official estimates of discarded bycatch for Lakes Manitoba, Winnipeg, or Winnipegosis. Although bycatch in the commercial fishery in another Manitoba lake (Waterhen Lake) is believed to be low (Intertek 2014), reports of “bushing” (i.e., unreported discarding of dead fish) of lake whitefish in Lake Winnipeg (Lake Winnipeg Quota Review Task Force 2011) and anecdotal reports of bushing of other unwanted species suggest that discard rates are not low. In lieu of any reliable information on this subject, a discard rate of 40-60% is selected on the assumption that this rate will be conservative.

Criterion 3: Management effectiveness

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

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

- *Score >3.2=Green or Low Concern*
- *Score >2.2 and <=3.2=Yellow or Moderate Concern*
- *Score <=2.2 or either the Harvest Strategy (Factor 3.1) or Bycatch Management Strategy (Factor 3.2) is Very High Concern = Red or High Concern*
Rating is Critical if either or both of Harvest Strategy (Factor 3.1) and Bycatch Management Strategy (Factor 3.2) ratings are Critical.

Criterion 3 Summary

Region / Method	Management of Retained Species	Management of Non-Retained Species	Overall Recommendation
Manitoba Lake Manitoba Gillnet, Midwater	1.000	1.000	Red(1.000)
Manitoba Lake Winnipeg Gillnet, Midwater	1.000	1.000	Red(1.000)
Manitoba Lake Winnipegosis Gillnet, Midwater	1.000	1.000	Red(1.000)

Factor 3.1: Harvest Strategy

Scoring Guidelines

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

- *5 (Very Low Concern)—Rated as 'highly effective' for all seven subfactors considered.*
- *4 (Low Concern)—Management Strategy and Recovery of Species of Concern rated 'highly effective' and all other subfactors rated at least 'moderately effective.'*
- *3 (Moderate Concern)—All subfactors rated at least 'moderately effective.'*

- 2 (High Concern)—At minimum, meets standards for ‘moderately effective’ for Management Strategy and Recovery of Species of Concern, but at least one other subfactor rated ‘ineffective.’
- 1 (Very High Concern)—Management exists, but Management Strategy and/or Recovery of Species of Concern rated ‘ineffective.’
- 0 (Critical)—No management exists when there is a clear need for management (i.e., fishery catches threatened, endangered, or high concern species), OR there is a high level of illegal, unregulated, and unreported fishing occurring.

Factor 3.1 Summary

Factor 3.1: Management of fishing impacts on retained species							
Region / Method	Strategy	Recovery	Research	Advice	Enforce	Track	Inclusion
Manitoba Lake Manitoba Gillnet, Midwater	Ineffective	Ineffective	Moderately Effective	Ineffective	Moderately Effective	Ineffective	Highly Effective
Manitoba Lake Manitoba Gillnet, Midwater	Ineffective	Ineffective	Moderately Effective	Ineffective	Moderately Effective	Ineffective	Highly Effective
Manitoba Lake Winnipeg Gillnet, Midwater	Ineffective	N/A	Moderately Effective	Ineffective	Moderately Effective	Moderately Effective	Highly Effective
Manitoba Lake Winnipegosis Gillnet, Midwater	Ineffective	Ineffective	Moderately Effective	Ineffective	Moderately Effective	Ineffective	Highly Effective

Subfactor 3.1.1 – Management Strategy and Implementation

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

Manitoba Lake Manitoba, Gillnet, Midwater

Ineffective

The fishery for Lake Manitoba walleye and sauger is managed with a cumulative quota of 907,200 kg; a seasonal closure that closes the fishery from March 16 until ice or November 1, and thus closes the fishery during walleye spawning; and a minimum mesh size of 95 mm (CFSV 2014). There are no catch limits for northern pike or yellow perch. Annual monitoring occurs, and estimates of MSY are available for walleye but not for pike or yellow perch. Management strategy and implementation is scored as “ineffective” due to the lack of management of pike and yellow perch catches, the lack of references against which to assess abundance indices, and the lack of an obvious mechanism for adjusting allowable walleye catches downward in times of declining abundance.

Rationale:

The following compares the Lake Manitoba fishery's management with the Seafood Watch criteria's requirements for management of data-poor fisheries.

1. Process for monitoring and assessment

There is a monitoring program in place, which has been conducted in its current format for 5 years (MCWS 2014).

2. Strategy for protecting spawning stock

Three estimates of walleye MSY, derived from three different methods, are available for Lake Manitoba (p. 175 in (MCWS 2014)). In addition, this is a winter fishery, so it does not occur during the walleye spawning season. There are no estimates for MSY for northern pike or yellow perch.

3. Allow for adaptive management to adjust for declining stock status

Biomass reference points have not been determined for Lake Manitoba walleye, northern pike, or yellow perch.

4. Have been demonstrated effective

As noted previously, fish production in Lake Manitoba has undergone a "long-term" decline, with walleye stocks "depressed" and sauger stocks "collapsed" (MCWS 2014).

Manitoba Lake Winnipeg, Gillnet, Midwater**Ineffective**

The existing management approach uses a multi-species cumulative quota to manage catch of the three main commercial species (lake whitefish, sauger, and walleye). A recent technical review concluded that this approach was not compatible with the precautionary principle and was not "sound biological practice" (Lake Winnipeg Quota Review Task Force 2011). Though other management measures are in place, the multi-species quota approach allows for the potential overexploitation of target species. Management strategy and implementation is thus scored as "ineffective" for Lake Winnipeg.

Rationale:

Since 1972, the three main commercial species in Lake Winnipeg have been managed with a cumulative quota. In 1985, this quota was increased to 6.5 million kg (Lake Winnipeg Quota Review Task Force 2011). In subsequent years, this quota has been increased several times (by 120,000 kg in 2008; 100,000 kg in 2014, and 100,000 kg in 2015 (pers. comm., B. Parker, 2015)). Additionally, since 2008, approximately 350,000 kg/year of whitefish quota has been made available to fishers via the whitefish optimization program (pers. comm., B. Parker, 2015).

This approach was recently reviewed by the members of the Lake Winnipeg Quota Review Task force and found to be problematic. Specifically, the authors of the Technical Assessment note that the three species have substantially different life histories, and that the cumulative quota approach allows for the potential overexploitation of any one of the three species (Lake Winnipeg Quota Review Task Force 2011). A specific concern with this management approach is the apparent lack of harvest control rules to adjust allowable mortality based on stock status vs. reference points. The authors of the Technical Assessment conclude that the cumulative quota for lake whitefish, sauger, and walleye is not compatible with the precautionary principle, state that it “is not sound biological practice,” and suggest that the current quota be partitioned into species-specific Recommended Allowable Harvests (RAHs) (Lake Winnipeg Quota Review Task Force 2011).

Several other management measures are also used in conjunction with the three-species quota. These include area-based individual fisher quotas, minimum mesh sizes, and protected areas (Lake Winnipeg Quota Review Task Force 2011).

Manitoba Lake Winnipegosis, Gillnet, Midwater

Ineffective

For Lake Winnipegosis, walleye catch in the open water summer fishery is managed with individual Quota Entitlements. Northern pike catch (as well as walleye catch in the winter fishery) is not limited by quotas. Additional management measures include minimum mesh sizes of 102 mm and defined seasons. Index netting data and estimates of walleye MSY are available. Management strategy and implementation is scored as “ineffective” due to the lack of management of pike catches, the lack of references against which to assess abundance indices, and the lack of an obvious mechanism for adjusting allowable walleye catches downward in times of declining abundance.

Rationale:

Walleye catch in the Lake Winnipegosis open water summer fishery is managed with individual quotas, known as Quota Entitlements, which can be bought and sold (MCWS 2013). For 2013–2014, the total walleye quota was 263,320 kg (MCWS 2014). There are no limits on other species, including northern pike, and no limits on walleye catch in the winter fishery. Additional management measures consist of a minimum mesh size of 102 mm and seasonal closures (for walleye: April 1 to July 11, and September 6 to March 31; for other species besides carp and sucker: April 1 to ice or November 1 (CFSV 2014)). Despite these measures, fish production has undergone a long-term decline in Lake Winnipegosis (MCWS 2014).

The following compares the Lake Winnipegosis walleye fishery’s management with the Seafood Watch criteria’s requirements for management of data-poor fisheries.

1. Process for monitoring and assessment

There is an annual index-netting program in place (MCWS 2014).

2. Strategy for protecting spawning stock

Three estimates of walleye MSY, derived from two different methods, are available for Lake Winnipegosis (p. 175 in (MCWS 2014)). There are no estimates of MSY for northern pike.

3. Allow for adaptive management to adjust for declining stock status

Reference levels have not been determined for Lake Winnipegosis walleye or northern pike.

4. Have been demonstrated effective

As noted previously, fish production in Lake Winnipegosis has undergone a “long-term” decline (MCWS 2014).

Subfactor 3.1.2 – Recovery of Species of Concern

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

Manitoba Lake Manitoba, Gillnet, Midwater

Ineffective

There are no apparent measures underway to identify, monitor, and/or develop recovery strategies for stocks of concern for Lake Manitoba. In particular, the lack of evidence of recovery of sauger is a concern; it has been noted that sauger are “collapsed” (MCWS 2014), and sauger catches have been minimal for the past decade (Figure 6) despite the species being managed by a cumulative quota with walleye (thus allowing for harvest). Although this report lists sauger under Criterion 2 (“Other Species”), this is due to the species’ status as a previously important commercial species (but now collapsed). Its lack of apparent recovery necessitates a score of “ineffective” for recovery of stocks of concern.

Manitoba Lake Winnipeg, Gillnet, Midwater

N/A

There are no targeted stocks in Lake Winnipeg that would appear to qualify as overfished, depleted, collapsed, or otherwise of special concern.

Manitoba Lake Winnipegosis, Gillnet, Midwater

Ineffective

Lake Winnipegosis walleye have long been “collapsed” ((Lysack, W. 2006); see Criterion 1), and recovery is not apparent.

Subfactor 3.1.3 – Scientific Research and Monitoring

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

Manitoba Lake Manitoba, Gillnet, Midwater

Moderately Effective

There is an annual monitoring program in place (MCWS 2014), and an assessment of walleye and sauger occurs annually (pers. comm., G. Klein, 2015). This qualifies for a “moderately effective” ranking.

Manitoba Lake Winnipeg, Gillnet, Midwater

Moderately Effective

With the exception of walleye and sauger, for which assessments are available (pers. comm., G. Klein, 2015), there are insufficient data available to assess the status of stocks in Lake Winnipeg (Lake Winnipeg Quota Review Task Force 2011). This qualifies for a score of “moderately effective.”

Manitoba Lake Winnipegosis, Gillnet, Midwater

Moderately Effective

There is an annual monitoring program in place (MCWS 2014), and an assessment of walleye and sauger occurs annually (pers. comm., G. Klein, 2015). This qualifies for a "moderately effective" ranking.

Subfactor 3.1.4 – Management Record of Following Scientific Advice

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

Manitoba Lake Manitoba, Gillnet, Midwater

Manitoba Lake Winnipeg, Gillnet, Midwater

Manitoba Lake Winnipegosis, Gillnet, Midwater

Ineffective

The manner in which management follows science advice is not apparent, because there are no science-based recommendations for allowable harvest for quota or non-quota species.

Subfactor 3.1.5 – Enforcement of Management Regulations

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

Manitoba Lake Manitoba, Gillnet, Midwater

Manitoba Lake Winnipeg, Gillnet, Midwater

Manitoba Lake Winnipegosis, Gillnet, Midwater

Moderately Effective

There is little information regarding the effectiveness of enforcement. There is no mandatory logbook program in place. In recent years, compliance on at least one lake has been declared low: Lysack (2006) states that fishing effort on Lake Winnipeg has essentially been uncontrolled, and that abuse of regulations is rampant. However, natural resource officers (NROs) have recently increased compliance checks of commercial fishers: NROs made 66 such checks in 2010 and 26 in 2011, but made 227 checks in 2012 (Manitoba Conservation 2015).

Subfactor 3.1.6 – Management Track Record

Considerations: Does management have a history of successfully maintaining populations at sustainable levels or a history of failing to maintain populations at sustainable levels? A Highly

Effective rating is given if measures enacted by management have been shown to result in the long-term maintenance of species overtime.

Manitoba Lake Manitoba, Gillnet, Midwater

Ineffective

Due to a pervasive lack of data, the track record of the Lake Manitoba management approach is uncertain. What is known is that the walleye stock is “depressed” and sauger is “collapsed” (MCWS 2014). The Lake Manitoba management approach is thus scored “ineffective” for track record.

Manitoba Lake Winnipeg, Gillnet, Midwater

Moderately Effective

Due to a pervasive lack of data, the track record of the Lake Winnipeg management approach is uncertain. Though walleye abundance has sharply increased in recent years, this is thought to be due to increased predation on introduced smelt and is not a result of management efforts. The statuses of lake whitefish and sauger are less clearly defined (Lake Winnipeg Quota Review Task Force 2011).

Manitoba Lake Winnipegosis, Gillnet, Midwater

Ineffective

After reviewing available information, Lysack (2006) concluded that Lake Winnipegosis hosted “the most depressed commercial fishery in Manitoba” and that overexploitation has driven the collapse of walleye and the depressed state of several other species. The track record for Lake Winnipegosis is therefore scored as “ineffective.”

Subfactor 3.1.7 – Stakeholder Inclusion

Considerations: Are stakeholders involved/included in the decision-making process?

Stakeholders are individuals/groups/organizations that have an interest in the fishery or that may be affected by the management of the fishery (e.g., fishermen, conservation groups, etc.).

A Highly Effective rating is given if the management process is transparent and includes stakeholder input.

Manitoba Lake Manitoba, Gillnet, Midwater

Manitoba Lake Winnipeg, Gillnet, Midwater

Manitoba Lake Winnipegosis, Gillnet, Midwater

Highly Effective

Available information indicates that the Fisheries Branch endeavors to ensure effective stakeholder inclusion. Regional fisheries managers hold annual meetings with fishers from Lakes Manitoba and Winnipegosis (pers. comm., B. Parker, 2015). In recent years the Branch has developed the Lake Winnipeg Fishery Resource Co-management Board, which is meant to improve stakeholder involvement in management, and has supported eco-certification efforts by fishers on a lake that is not reviewed in this report (Waterhen Lake) (MCWS 2014).

Bycatch Strategy

Factor 3.2: Management of fishing impacts on bycatch species						
Region / Method	All Kept	Critical	Strategy	Research	Advice	Enforce
Manitoba Lake Manitoba Gillnet, Midwater	No	No	Ineffective	Ineffective	Ineffective	Moderately Effective
Manitoba Lake Winnipeg Gillnet, Midwater	No	No	Ineffective	Ineffective	Ineffective	Moderately Effective
Manitoba Lake Winnipegosis Gillnet, Midwater	No	No	Ineffective	Ineffective	Ineffective	Moderately Effective

Subfactor 3.2.1 – Management Strategy and Implementation

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

Manitoba Lake Manitoba, Gillnet, Midwater

Ineffective

Though a number of non-targeted species may be caught in the fishery (see the list for “Finfish, Inherent Vulnerability”), there are no limits on bycatch of non-targeted species in Lake Manitoba (CFSV 2014).

Manitoba Lake Winnipeg, Gillnet, Midwater

Ineffective

With the exception of lake sturgeon (which must be released) and channel catfish (which cannot be sold

on a Special Dealer's License) (pers. comm., G. Klein, 2015), there are no limits on bycatch of non-targeted species in Lake Winnipeg (CFSV 2014).

Manitoba Lake Winnipegosis, Gillnet, Midwater

Ineffective

There are no limits on bycatch of non-targeted species in Lake Winnipegosis (CFSV 2014).

Subfactor 3.2.2 – Scientific Research and Monitoring

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

Manitoba Lake Manitoba, Gillnet, Midwater

Manitoba Lake Winnipeg, Gillnet, Midwater

Manitoba Lake Winnipegosis, Gillnet, Midwater

Ineffective

There is no on-the-water monitoring program in place, and except for one reference for Lake Winnipeg (Heuring, L. 1993), there are no publicly available estimates of discarded bycatch mortality in the commercial fishery.

Subfactor 3.2.3 – Management Record of Following Scientific Advice

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

Manitoba Lake Manitoba, Gillnet, Midwater

Manitoba Lake Winnipeg, Gillnet, Midwater

Manitoba Lake Winnipegosis, Gillnet, Midwater

Ineffective

See Subfactor 3.1.5 under Harvest Strategy Factor 3.1.

Subfactor 3.2.4 – Enforcement of Management Regulations

Considerations: Is there a monitoring/enforcement system in place to ensure fishermen follow management regulations and what is the level of fishermen's compliance with regulations? To achieve a Highly Effective rating, there must be consistent enforcement of regulations and verification of compliance.

Manitoba Lake Manitoba, Gillnet, Midwater

Manitoba Lake Winnipeg, Gillnet, Midwater

Manitoba Lake Winnipegosis, Gillnet, Midwater

Moderately Effective

See Subfactor 3.1.6 under Harvest Strategy Factor 3.1.

Criterion 4: Impacts on the habitat and ecosystem

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

The final score is the geometric mean of the impact of fishing gear on habitat score (plus the mitigation of gear impacts score) and the ecosystem-based fishery management score. The Criterion 2 rating is determined as follows:

- *Score >3.2=Green or Low Concern*
- *Score >2.2 and <=3.2=Yellow or Moderate Concern*
- *Score <=2.2=Red or High Concern*
Rating cannot be Critical for Criterion 4.

Criterion 4 Summary

Region / Method	Gear Type and Substrate	Mitigation of Gear Impacts	EBFM	Overall Recomm.
Manitoba Lake Manitoba Gillnet, Midwater	3.00:Low Concern	0.00:No Effective Mitigation	2.00:High Concern	Yellow (2.450)
Manitoba Lake Winnipeg Gillnet, Midwater	3.00:Low Concern	0.00:No Effective Mitigation	2.00:High Concern	Yellow (2.450)
Manitoba Lake Winnipegosis Gillnet, Midwater	3.00:Low Concern	0.00:No Effective Mitigation	2.00:High Concern	Yellow (2.450)

Because these fisheries use gillnets, the Seafood Watch criteria assign relatively low concern to the issue of gear impacts on substrate. Conversely, these fisheries’ catches of “keystone” piscivores and the apparent lack of scientific or management effort to evaluate and account for the ecological effects of the fisheries warrant a score of “high concern” for the food web impacts of these fisheries.

Justification of Ranking

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

Scoring Guidelines

- *5 (None)—Fishing gear does not contact the bottom*
- *4 (Very Low)—Vertical line gear*

- *3 (Low)—Gears that contacts the bottom, but is not dragged along the bottom (e.g. gillnet, bottom longline, trap) and is not fished on sensitive habitats. Bottom seine on resilient mud/sand habitats. Midwater trawl that is known to contact bottom occasionally (*
- *2 (Moderate)—Bottom dragging gears (dredge, trawl) fished on resilient mud/sand habitats. Gillnet, trap, or bottom longline fished on sensitive boulder or coral reef habitat. Bottom seine except on mud/sand*
- *1 (High)—Hydraulic clam dredge. Dredge or trawl gear fished on moderately sensitive habitats (e.g., cobble or boulder)*
- *0 (Very High)—Dredge or trawl fished on biogenic habitat, (e.g., deep-sea corals, eelgrass and maerl)*

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

Manitoba Lake Manitoba, Gillnet, Midwater

Low Concern

These fisheries use gillnets, so the Seafood Watch criteria suggest a score of “low” concern for impacts of the gear on substrate.

Manitoba Lake Winnipeg, Gillnet, Midwater

Low Concern

Approximately three-quarters of the Lake Winnipeg fishery is conducted using benthic gillnets, and approximately one-quarter is conducted using floating set nets; the latter gear is anchored at both ends, but the leadline does not contact the bottom (pers. comm., G. Klein, 2015). Therefore, the Seafood Watch criteria suggest a score of “low” concern for impacts of the gear on substrate.

Manitoba Lake Winnipegosis, Gillnet, Midwater

Low Concern

These fisheries use gillnets, so the Seafood Watch criteria suggest a score of “low” concern for impacts of the gear on substrate.

Factor 4.2 – Mitigation of Gear Impacts

Scoring Guidelines

- *+1 (Strong Mitigation)—Examples include large proportion of habitat protected from fishing (>50%) with gear, fishing intensity low/limited, gear specifically modified to reduce damage to seafloor and modifications shown to be effective at reducing damage, or an effective combination of ‘moderate’ mitigation measures.*
- *+0.5 (Moderate Mitigation)—20% of habitat protected from fishing with gear or other measures in place to limit fishing effort, fishing intensity, and spatial footprint of damage caused from fishing.*
- *+0.25 (Low Mitigation)—A few measures are in place (e.g., vulnerable habitats protected but other habitats not protected); there are some limits on fishing effort/intensity, but not actively being reduced.*
- *0 (No Mitigation)—No effective measures are in place to limit gear impacts on habitats.*

Manitoba Lake Manitoba, Gillnet, Midwater

Manitoba Lake Winnipeg, Gillnet, Midwater

Manitoba Lake Winnipegosis, Gillnet, Midwater

No Effective Mitigation

There are no measures in place that are specifically meant to mitigate the impact of the gear on substrate.

Factor 4.3 – Ecosystem-Based Fisheries Management

Scoring Guidelines

- *5 (Very Low Concern)—Substantial efforts have been made to protect species’ ecological roles and ensure fishing practices do not have negative ecological effects (e.g., large proportion of fishery area is protected with marine reserves, and abundance is maintained at sufficient levels to provide food to predators).*
- *4 (Low Concern)—Studies are underway to assess the ecological role of species and measures are in place to protect the ecological role of any species that plays an exceptionally large role in the ecosystem. Measures are in place to minimize potentially negative ecological effect if hatchery supplementation or fish aggregating devices (FADs) are used.*
- *3 (Moderate Concern)—Fishery does not catch species that play an exceptionally large role in the ecosystem, or if it does, studies are underway to determine how to protect the ecological role of these species, OR negative ecological effects from hatchery supplementation or FADs are possible and management is not in place to mitigate these impacts.*

- *2 (High Concern)—Fishery catches species that play an exceptionally large role in the ecosystem and no efforts are being made to incorporate their ecological role into management.*
- *1 (Very High Concern)—Use of hatchery supplementation or fish aggregating devices (FADs) in the fishery is having serious negative ecological or genetic consequences, OR fishery has resulted in trophic cascades or other detrimental impacts to the food web.*

Manitoba Lake Manitoba, Gillnet, Midwater

Manitoba Lake Winnipeg, Gillnet, Midwater

Manitoba Lake Winnipegosis, Gillnet, Midwater

High Concern

The fish that are caught by the commercial fisheries of Lakes Manitoba, Winnipeg, and Winnipegosis are important components of the lakes' ecosystems. For example, northern pike is a "keystone" species due to its role as a "voracious" piscivore (Harvey, B. 2009). Yellow perch is a primary prey species for pike, but pike is an opportunistic predator and will eat a variety of other species (Harvey, B. 2009). Similarly, walleye is a top piscivore that is non-selective in its choice of prey species (Hartman, G.F. 2009). The fisheries thus catch species of exceptional ecological importance, and there are no apparent efforts underway to incorporate ecological roles into management. The Seafood Watch criteria thus require a score of "high" concern.

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