

**INDICATOR: WALLEYE HARVEST IN INLAND LAKES**

STRATEGIC DIRECTION: Enhance Resilience

TARGET: N/A

THEME: Conservation Response – Sustainable Management

Background Information:

In 2010, 1.2 million licenced anglers contributed \$2.26 billion to the Ontario economy (OMNRF 2014a). Sustaining these economic and societal benefits relies on the effective management of the fish populations and aquatic ecosystems that support Ontario's fisheries. Ontario has a strong framework of legislation, regulations and policies that support a diversity of high quality, sustainable fisheries targeting a variety of species. Ongoing assessment and an adaptive management approach provide mechanisms to respond to fisheries status changes and ensure sustainability.

In 2004, Ontario introduced an Ecological Framework for Fisheries Management. The framework aims to manage healthy fisheries for the future through simplified regulations over larger, ecologically-based Fisheries Management Zones and providing more public involvement. In support of the framework, a Broad-Scale Monitoring Program of lakes (BSM) was established in 2008 to assess the current state of fishes and other aquatic resources, identify stresses on these resources, and report on changes over time. The program monitors a subset of lakes across the province on 5-year cycles to provide information critical to effective fisheries management.

This indicator uses information on Walleye populations from the Broad-Scale Monitoring Program to assess the level of fishing stress on Walleye across Ontario as an indicator of sustainable management. Walleye are widespread in Ontario and are one of the most sought after species and the most frequently captured species by Ontario anglers (OMNRF 2014a). Information on estimated recreational Walleye harvest and fishing intensity from the 2010 Survey of Recreational Fishing in Canada is used to supplement the data from the Broad-Scale Monitoring Program in this indicator. Together, these measures provide an index of the level of fishing pressure on Ontario's Walleye populations. This is the first time this indicator has been assessed. Future assessments will allow an analysis of trends as both the Broad-Scale Monitoring and Survey of Recreational Fishing are repeated every 5 years. Further details regarding the development of this indicator are available in a separate technical report (Dextrase et al. 2016).

Data Analysis:

Stress associated with fishing mortality – Estimates of Walleye fishing mortality were derived from the first cycle of BSM (2008-2012). Information to estimate mortality was available for 8% of Ontario's 4,242 known inland Walleye lakes greater than 50 ha in size (Table 1). Total adult mortality rate per year for each population was estimated from the number of individuals in each age class (OMNRF 2014b). Estimates of natural mortality for each population were calculated using climate information (Growing Degree Days > 5 °C) and estimates of length at maturity (Lester et al. 2014). Fishing mortality for each Walleye population was calculated as the total adult mortality minus natural



mortality. The level of fishing stress was then assessed by comparing estimated fishing and natural mortalities – Walleye populations with estimated fishing mortality equal to or greater than estimated natural mortality were assessed as having a high level of fishing stress (Kolding and van Zwieten 2014). Such levels of fishing mortality are likely to be higher than the value that maximizes sustainable yield (Lester et al. 2014). For each inland Fisheries Management Zone with sufficient data, the percentage of sampled Walleye lakes with high fishing stress was calculated and mapped (Figure 1). Fishing mortality estimates include all types of fishing – recreational, commercial and subsistence.

Table 1. Sample size of inland Walleye lakes from Broad-Scale Monitoring used to estimate mortality in each Fisheries Management Zone (FMZ) compared with number of known Walleye populations in lakes > 50 ha.

FMZ	Sample size	Known Walleye populations	% of known lakes sampled
1	3	5	60
2	12	570	2
3	0	26	0
4	82	829	10
5	79	674	12
6	55	325	17
7	31	472	7
8	32	496	6
10	19	282	7
11	22	151	15
12	3	6	50
15	12	222	5
16	7	31	23
17	8	37	22
18	9	116	8
Total	374	4242	8

Harvest and fishing intensity – Estimates of recreational Walleye harvest and fishing intensity were based on Ontario respondents to the 2010 Survey of Recreational Fishing in Canada. Responses were received from 39.6% of 29,892 licenced anglers who received the mail-based survey (OMNRF 2014c). A follow-up phone survey of 10% of non-respondents was conducted to account for non-response bias. Estimates of the number of Walleye harvested in lakes in each of Ontario’s inland Fisheries Management Zones were developed by applying appropriate weighting to geographically referenced responses (OMNRF 2014c). A standard measure of Walleye harvest for lakes in each Fisheries Management Zone (kg/hectare) was derived by multiplying the estimated number of harvested fish by 0.748 kg (mean weight of Walleye from historical creel survey data in Ontario) and dividing by the area of known Walleye lakes (Figure 2). Fishing intensity (person-hours of effort/hectare) for lakes in each inland Fisheries Management Zone was measured in a similar fashion based on survey responses (Figure 2). Fishing intensity is reported for all species combined as several respondents targeted multiple species or did not specify target species (OMNRF 2014c). In the north (i.e., FMZ’s 2-12), Walleye is the most sought after and frequently captured fish species and therefore total fishing effort is a reliable index of Walleye



fishing intensity. In the more southern Fisheries Management Zones (FMZ's 15-18), a greater proportion of the total fishing effort is directed at other species such as Smallmouth Bass and Largemouth Bass.

- [download Walleye fishing stress, Walleye harvest and fishing intensity data](#)

Results:

Trend: Baseline **Data Confidence:** Medium **Geographic Extent:** Provincial

Stress Associated With Fishing Mortality

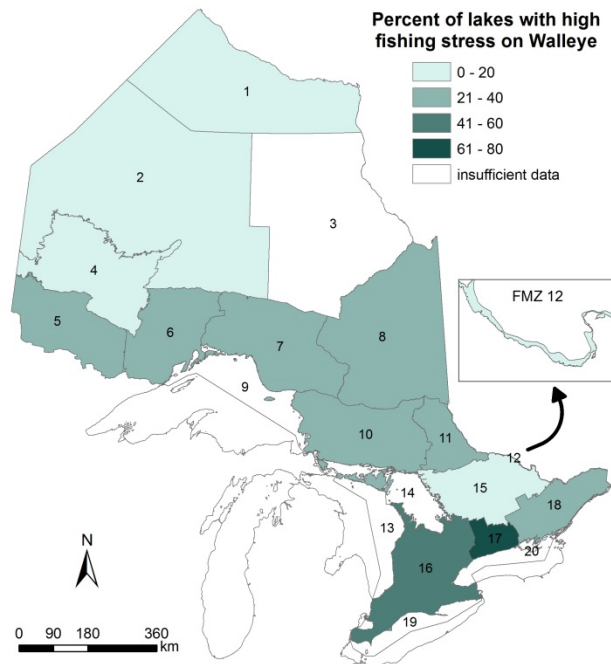


Figure 1. Proportion of sampled Walleye lakes in each inland Fisheries Management Zone with high fishing stress based on first 5-year cycle of Broad-scale Monitoring (Lakes with estimated Walleye fishing mortality equal to or greater than natural mortality were assessed as having high fishing stress on Walleye).

Status:

- Ninety-six of 374 Walleye lakes (26%) sampled in the first 5-year cycle of Ontario's Broad-scale Monitoring Program (2008-2012) were assessed as having high fishing stress on their Walleye populations based on estimates of fishing mortality.
- Fisheries Management Zones 17 in southern Ontario's Mixedwood Plains Ecozone has the greatest proportion of sampled lakes with high fishing stress on Walleye (63% of sampled lakes).
- Fisheries Management Zones in the Ontario Shield and Hudson Bay Lowlands ecozones have a relatively small proportion of sampled lakes with high fishing stress on walleye (all < 34%). None of



the sampled lakes from Fisheries Management Zones 1 and 2 in the Far North and Zone 12 in the southern Ontario Shield Ecozone were assessed as having high fishing stress on Walleye.

Harvest and Fishing Intensity

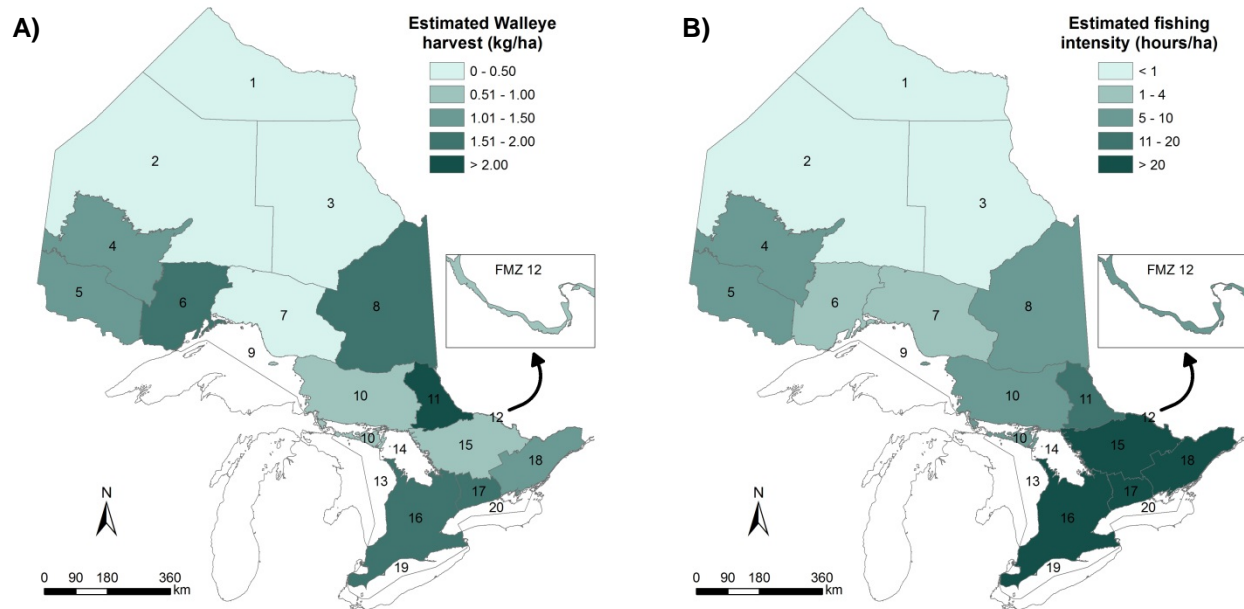


Figure 2. A) Estimated recreational fishing harvest of Walleye standardized by lake area (kg/ha) for lakes in inland Fisheries Management Zones in Ontario; B) Estimated recreational lake fishing intensity (person-hours/ha for all species combined) for lakes in inland Fisheries Management Zones in Ontario (Data for both panels are based on the 2010 Survey of Recreational Fishing in Canada [OMNRF 2014b]).

Status:

- Estimated Walleye harvest by lake area is highest (> 2.0 kg/ha) in Fisheries Management Zone 11 in the Ontario Shield Ecozone. Estimated harvest in Zones 6, 8, 16 and 17 is also relatively high (1.57 – 1.80 kg/ha). Because of a warmer climate, lakes in southern Ontario can generally sustain higher harvest levels than lakes in the north (Lester et al. 2004).
- Recreational fishing intensity is high (> 20 hr/ha) in Fisheries Management Zones 16, 17, and 18 in the Mixedwood Plains Ecozone and in Zone 15 in the southern part of the Ontario Shield Ecozone. A greater proportion of fishing effort in these southern zones is directed at species other than Walleye.
- Fishing intensity decreases moving northward with very low levels of effort (< 1 hr/ha) in Fisheries Management Zones 1, 2 and 3 in the Far North.

Links:

Related Targets: N/A

Related Themes: N/A

**Web Links:**

OMNRF – Management of Fish in Ontario <https://www.ontario.ca/document/provincial-fish-strategy-background>

Fish Ontario – Broad-scale Monitoring of lakes program <https://www.ontario.ca/environment-and-energy/methods-monitoring-fish-populations>

Fisheries and Oceans Canada – Survey of Recreational Fishing in Canada <http://www.dfo-mpo.gc.ca/stats/rec/canada-rec-eng.htm>

References:

Dextrase, A.J., N.P. Lester, H.E. Ball, and K.B. Armstrong. 2016. An assessment of fishing stress on Walleye in Ontario's inland lakes based on mortality estimates from the Broad-scale Monitoring Program, 2008 – 2012. State of Ontario's Biodiversity Technical Report Series, Report #SOBTR-06. Ontario Biodiversity Council, Peterborough, ON.

Kolding, J., and P.A.M. van Zwieten. 2014. Sustainable fishing of inland waters. *Journal of Limnology* 73(Supplement 1):132-148

Lester, N.P., A.J. Dextrase, R.S. Kushneriuk, M.R. Rawson, and P.A. Ryan. 2004. Light and temperature: key factors affecting walleye abundance and production. *Transactions of the American Fisheries Society* 133:588–605.

Lester, N.P., B.J. Shuter, P. Venturelli, and D. Nadeau. 2014. Life-history plasticity and sustainable exploitation: a theory of growth compensation applied to walleye management. *Ecological Applications* 24:38-54.

Ontario Ministry of Natural Resources and Forestry (OMNRF). 2014a. 2010 Survey of recreational fishing in Canada: selected results for Ontario fisheries - Draft. Biodiversity Branch. Ontario Ministry of Natural Resources and Forestry, Peterborough, ON.

Ontario Ministry of Natural Resources and Forestry (OMNRF). 2014b. Guide to lake synopsis: broad-scale monitoring. Science and Research Branch, Ontario Ministry of Natural Resources and Forestry, Peterborough, ON.

Ontario Ministry of Natural Resources and Forestry (OMNRF). 2014c. 2010 Survey of recreational fishing in Canada: results for fisheries management zones of Ontario - Draft. Biodiversity Branch. Ontario Ministry of Natural Resources and Forestry, Peterborough, ON.

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Ontario Biodiversity Council. 2015. State of Ontario's Biodiversity [web application]. Ontario Biodiversity Council, Peterborough, Ontario. [Available at: <http://ontariobiodiversitycouncil.ca/sobr> (Date Accessed: July 22, 2016)].