



STATE OF ONTARIO'S PROTECTED AREAS

Aquatic Ecosystems

2021

State of Ontario's Protected Areas Indicator Report

Aquatic Ecosystems

This indicator describes the health of predator-prey relationships in aquatic ecosystems of provincial parks and conservation reserves.

Status



Status: Fair



Trend (Long-range): Undetermined

Why it's important

Provincial parks and conservation reserves protect 10.6% of the surface area of Ontario's inland lakes and rivers. These aquatic ecosystems provide a wealth of benefits, such as:

- Habitats for a variety of species, including fish, amphibians, reptiles, birds, mammals, invertebrates and plants, many of which are species at risk
- Critical nursery, breeding, feeding and staging areas for fish, waterfowl and other wildlife
- Ecosystem services, such as clean water, recreational opportunities and carbon sequestration
- Economic activities, including tourism and recreational fisheries
- Culturally and historically significant sites
- Places for people to relax and enjoy the restorative power of nature

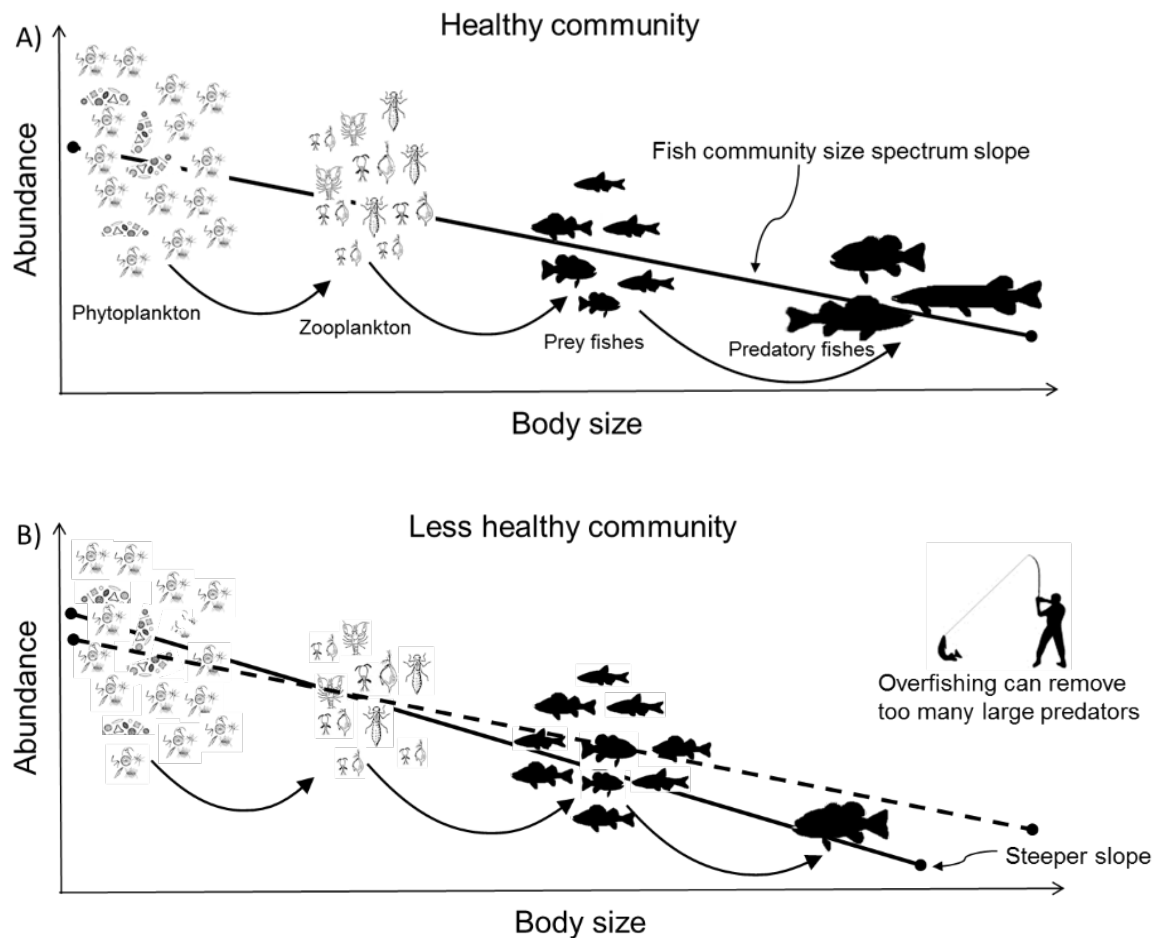
Freshwater aquatic ecosystems are globally imperiled from threats such as pollution, water regulation, and invasive species. Provincial parks and conservation reserves provide protection from many activities that threaten aquatic ecosystems outside their boundaries. Understanding the health of these ecosystems helps us assess the effectiveness of protection and to identify management actions to maintain or restore their ecological integrity.

How we monitor

Size spectra analysis is a way to assess the health of ecosystems based on the relationship between the sizes and abundances of their prey and predators. In inland lakes, prey such as zooplankton and small fish are typically more abundant than larger top predators (Figure 1 A). The balance of prey and predators can be upset by pressures like over-fishing or invasive species (Figure 1 B).

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Figure 1. Example size spectrum slopes for: A) a healthy fish community, and; B) a less healthy community.



The size spectrum slope for each lake is calculated using data from the Ministry of Natural Resources and Forestry's Broad-scale Monitoring Program for Inland Lakes. This program samples a selection of lakes from each fisheries management zone to collect information on water quality, invertebrates and fishes. Fisheries management zones are the units used for fisheries management in the province. Hundreds of lakes are sampled within a 5-year monitoring cycle. Cycle 1 was completed from 2008 to 2012 and Cycle 2 in 2013 to 2017.

Average size spectrum slopes are compared among fisheries management zones and between monitoring cycles:

- More negative slopes suggest that the predator-prey balance is disrupted compared to lakes with less negative slopes.
- Changes in the slopes of lakes between monitoring cycles may mean that the predator-prey balance is improving if the slope becomes less negative, or declining if the slope becomes more negative.

For each fisheries management zone, the average fish community size spectrum slope was calculated for:

- Lakes inside a provincial park or conservation reserve ($\geq 51\%$ of lake area within a provincial park or conservation reserve)
- Lakes outside a provincial park or conservation reserve (0 to $< 51\%$ of lake area within a provincial park or conservation reserve)

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Data

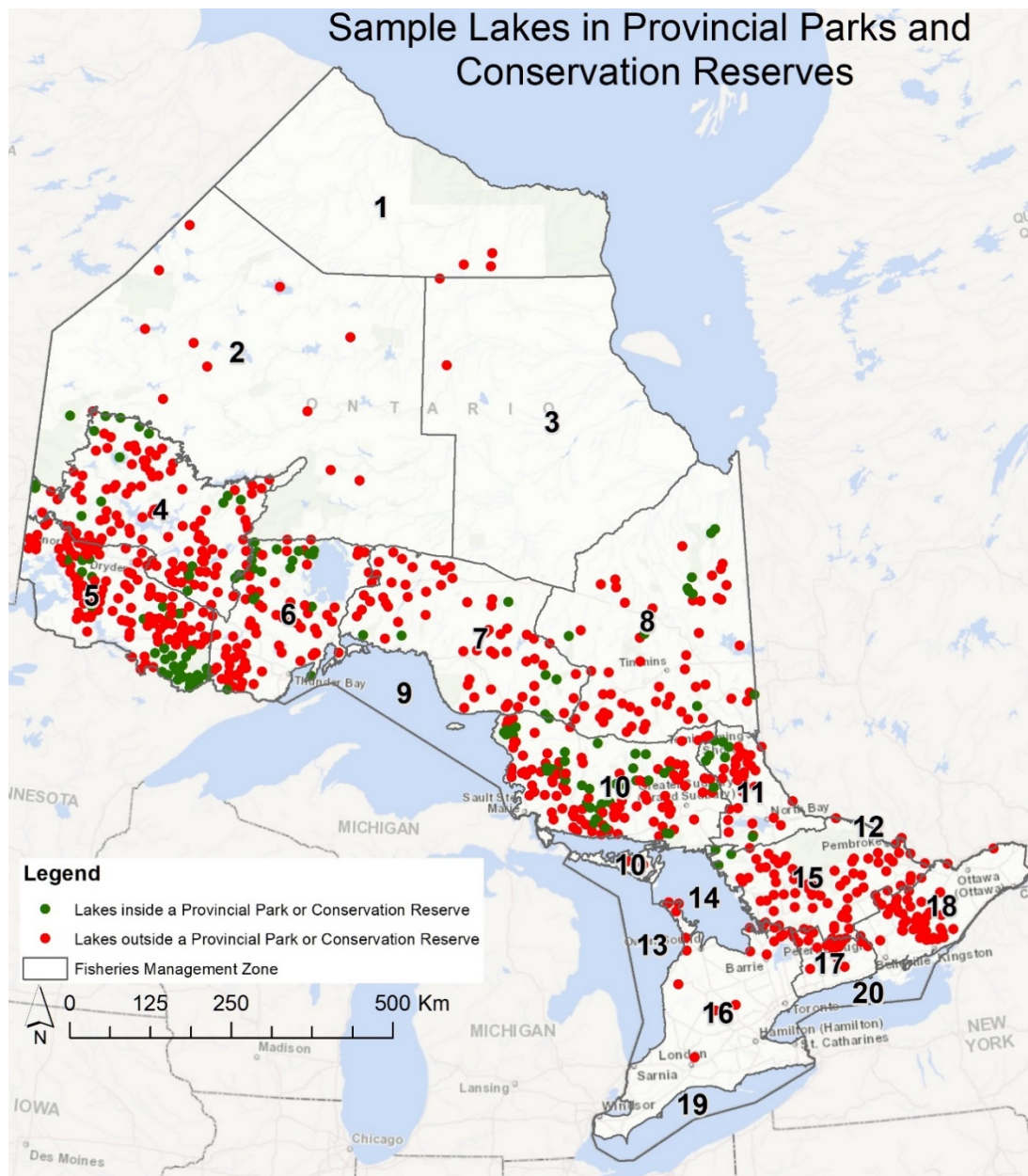
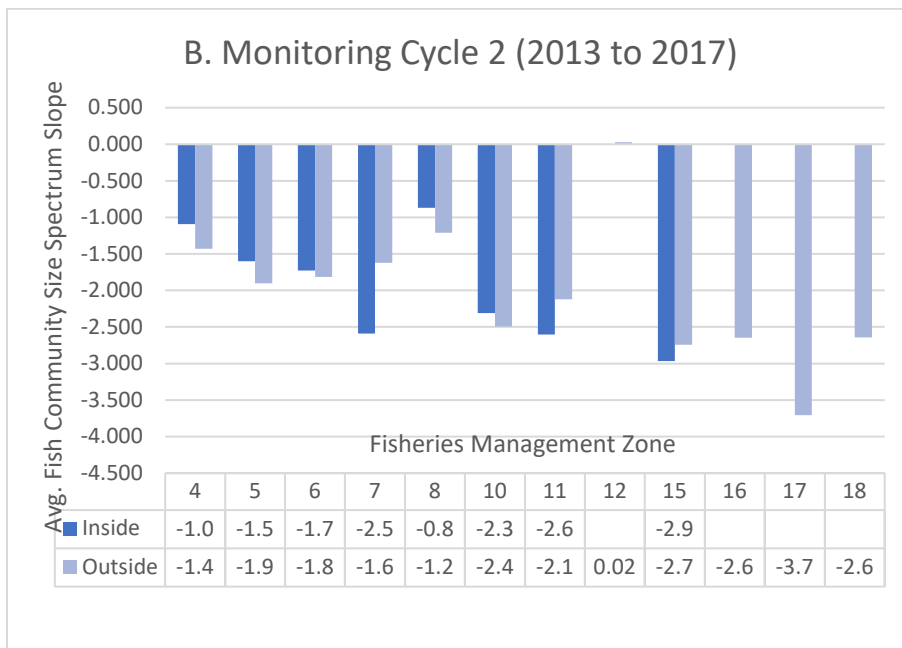
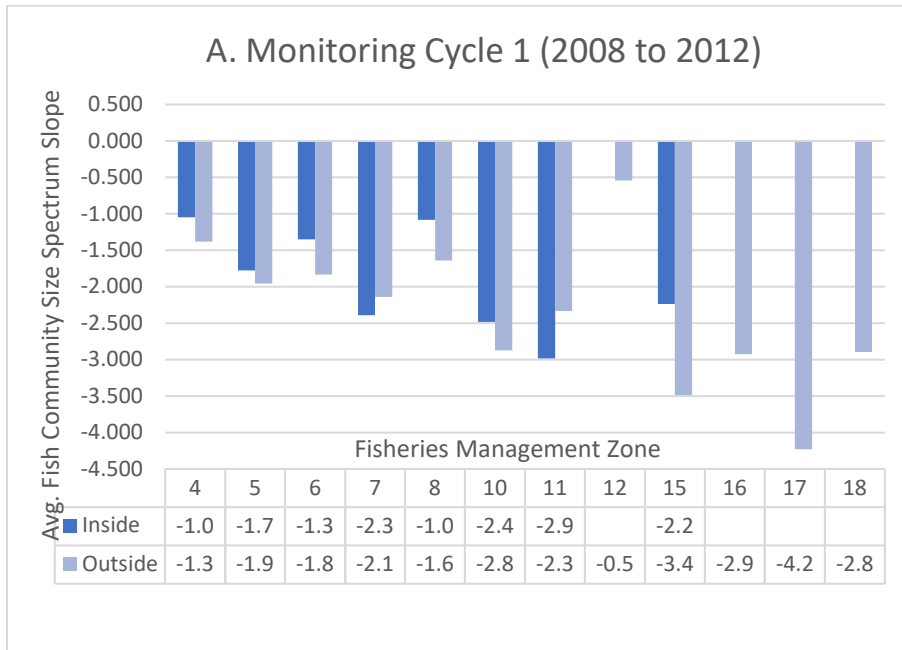


Table 1. Number of inland lakes sampled inside and outside provincial parks and conservation reserves during Cycles 1 and 2.

Fisheries Management Zone	Inside	Outside	Total
4	10	65	75
5	19	71	90
6	5	34	39
7	5	44	49
8	5	38	43
10	30	69	99
11	5	25	30
12	0	10	10
15	2	34	36
16	0	18	18
17	0	18	18
18	0	30	30
Total	81	456	537

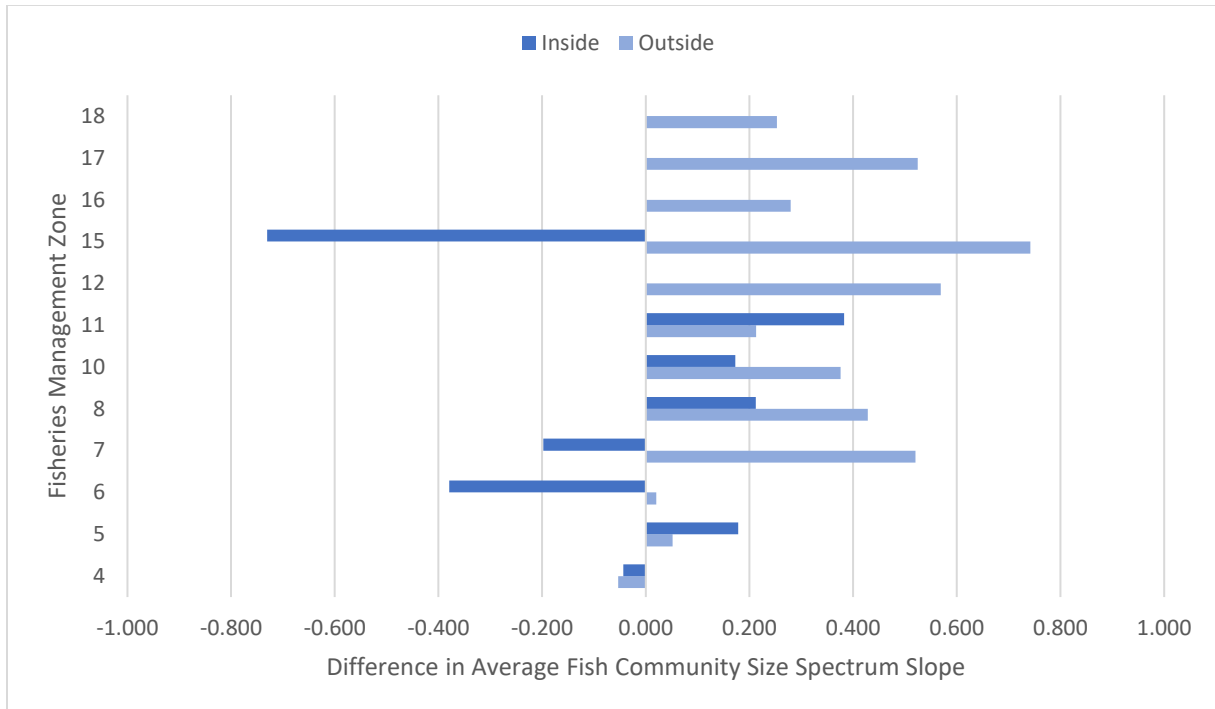
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Figure 2. Average fish community size spectrum slope for inland lakes inside and outside provincial parks and conservation reserves in: A. Monitoring Cycle 1 (2008 to 2012), and B. Monitoring Cycle 2 (2013 to 2017).



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Figure 3. Difference in average fish community size spectrum slopes between monitoring Cycle 1 and Cycle 2 in inland lakes inside and outside provincial parks and conservation reserves. Bars to the right show positive change, while bars to the left show negative change.



What's happening

Eighty-one (15%) of the 537 inland lakes sampled in both Broad-Scale Monitoring cycles were in 51 provincial parks and conservation reserves. Lakes sampled in these protected areas were distributed among 8 fisheries management zones in central and northern Ontario. There were no lakes sampled in provincial parks and conservation reserves in fisheries management zones in southern Ontario (zones 12, 16, 17 and 18). Monitoring did not occur in the far north of the province in zones 1, 2 and 3.

Size spectrum slopes followed a similar pattern for lakes inside and outside provincial parks and conservation reserves, with slopes less steep for lakes in northern Ontario compared to southern Ontario in both cycles. Lakes that have a steep slope (more negative value) are generally less healthy than ones with shallow slopes (less negative value). Slopes can also be influenced by regional environments, with lakes in wet, warm climates normally having steeper slopes compared to those in dry, cool climates (Chu et al. 2016).

Lakes inside provincial parks and conservation reserves had shallower slopes than lakes outside in 6 of 8 fisheries management zones in Cycle 1, and 5 of 8 in Cycle 2 (Figure 2). Slopes are sensitive to impacts from human disturbances, such as degraded water quality and angling pressure (Chu et al. 2018). These results suggest that lakes in provincial parks and conservation reserves in these zones are healthier than those outside; however, there were no statistically significant differences between lakes inside and outside.

Fish community size spectrum slopes were relatively stable in lakes inside provincial parks and conservation reserves between cycles 1 and 2. Slopes improved in fisheries management zones 5, 8, 10 and 11 and declined in zones 4, 6, 7 and 15. Changes were not statistically significant, however, except in zones 5 and 6.

The size spectrum slope of lakes outside provincial parks and conservation reserves improved in 11 of 12 fisheries management zones in cycle 2. Improvements were

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statistically significant in all zones except 5, 6 and 16. There was a statistically significant decline in slope in zone 4.

These patterns in fish community size spectrum slopes suggest that:

- Fish communities are less healthy in lakes in southern Ontario than in northern Ontario.
- Lakes inside provincial parks and conservation reserves may have healthier fish communities and a better predator-prey balance than lakes outside in several fisheries management zones, although results were not statistically significant.
- The health of fish communities was relatively stable in lakes inside provincial parks and conservation reserves between the two monitoring cycles.
- Fish communities improved in lakes outside provincial parks and conservation reserves in most fisheries management zones.

More data are needed to reliably assess trends in this information and understand the changes that we observed. We will be better able to assess trends when more lakes are sampled in provincial parks and conservation reserves and another cycle of Broad-scale Monitoring is completed.

Indicator last updated:

November 2020

Data sources:

- [Broad-scale Monitoring Program for Inland Lakes](#)
- [Land Information Ontario](#)
- Chu, C., N.P. Lester, H.C. Giacomini, B.J. Shuter and D.J. Jackson. 2016. Catch-per-unit-effort and size spectra of lake fish assemblages reflect underlying patterns in ecological conditions and anthropogenic activities across regional and local scales. *Can. J. Fish. Aquat. Sci.* 73: 535-546.
- Chu, C., L. Ellis and D.T. de Kerckhove. 2018. Effectiveness of terrestrial protected areas for conservation of lake fish communities. *Cons. Biol.* 32: 607-618

Related links

N/A