INDICATOR: Water Quality in Inland Lakes

Startegic Direction: Reduce Threats

Target: N/A

Theme: Pressures on Ontario's Biodiversity — Pollution

Previous version: Water Quality in Inland Lakes 2015

Background Information

Lakes and streams have a very important role in sustaining biodiversity (Environment Canada 2008). Along with aquatic species, many terrestrial amphibians, birds and invertebrates depend on freshwater bodies at some point in their life-cycle. Ontario has more than 225,000 lakes greater than 1 hectare in area (Cox 1978). Most of these lakes are found in relatively natural settings and their water chemistry reflects the geology of the surrounding landscape and inputs from inflowing streams. Pollution alters the water quality of lakes directly from point sources (industrial waste, wastewater from urban and suburban development), non-point sources (runoff) and indirectly from airborne pollution deposits. In 1991, the Canada-United States Air quality agreement was signed to address transboundary air pollution leading to acid rain, affecting water quality and both countries continue to monitor acid deposition and ambient levels of ground-level ozone (ECCC 2020).

Water samples from inland lakes are collected as part of Ontario's Broad-Scale Monitoring Program. This program assesses the current state of fishes and other aquatic resources in Ontario lakes, identifying stresses on these resources, and reporting on changes over time. The program monitors lakes (20 - 250,000 ha in size) across the province on 5-year cycles to provide information critical to effective fisheries management, including water quality.

This indicator provides an assessment of water quality in Ontario's inland lakes by examining three parameters that have a strong influence on aquatic biodiversity — pH, and concentrations of calcium and total phosphorus. This assessment of lake water quality sampled in Broad-Scale Monitoring cycle 1 and 2 compares measured levels to those that can impact biodiversity (Table 1). Trends will be assessed and compared in this indicator every 5 years through the results of the Broad-Scale Monitoring.

Table 1. Lake water quality parameters used in indicator assessment.

Parameter	Relevance to biodiversity[1]
pH	pH is a measure of the concentration of hydrogen ions in the water. Acidic water below pH 6.5 and basic water above 8.5 can cause problems for aquatic life (MOEE 1994). pH levels can be affected by industrial effluents and runoff or atmospheric deposition (acid rain).
Calcium	Calcium is a mineral that organisms require to survive. Low levels of calcium (< 1.5 mg/L) can cause problems for small planktonic crustaceans and affect the food chain. There is evidence of widespread calcium declines in many lakes including in Ontario (Jeziorski 2008, OMOE 2013). Calcium rich lakes (> 20 mg/L) with high pH (> 7.4) are most vulnerable to invasion by Zebra Mussel (Neary and Leach 1992).
Total Phosphorus	Phosphorus is an important nutrient in lakes. However, too much phosphorus can lead to blue-green algal blooms and excessive plant growth that reduces oxygen levels in lakes. These impacts are generally avoided when total phosphorus levels are below 20 µg/L (MOEE 1994).

[1]some lakes may naturally have water quality values that are beyond the threshold levels that can have impacts on biodiversity (e.g., low pH, high phosphorus).

Data Analysis

During the first 5-year cycle of Broad-Scale Monitoring of lakes (2008-2012), water quality samples were collected from 827 lakes across Ontario using a standard protocol (unpublished, modified from Ingram et al. 2011). In cycle 2, 680 lakes were sampled using the same method. The majority of sampled lakes were in the Ontario Shield Ecozone (632 lakes or 93%) which was a similar percentage as the previous cycle (768 lakes or 93%). During cycle 2, no lakes were sampled from the Hudson Bay Lowlands Ecozone, while in cycle 1 (2008-2012) 5 lakes from that area were sampled. Sampled lakes include only those greater than 5 hectares in area, so the more numerous smaller lakes are not represented in the indicator.

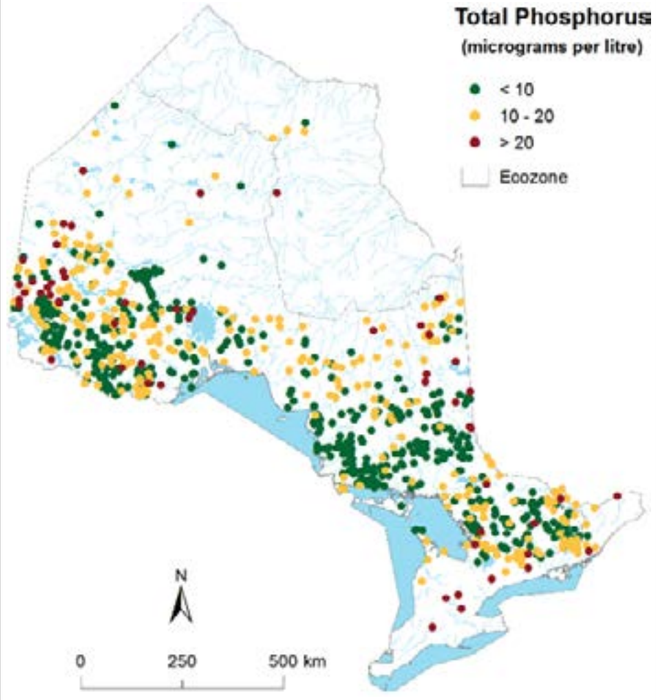
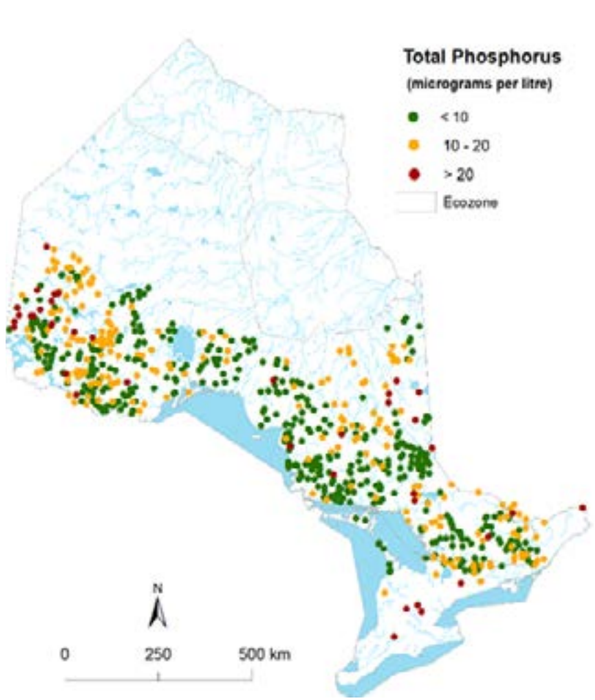
Lakes were mapped for each water quality parameter — pH, calcium and total phosphorus, showing their status with respect to levels that can have impacts on aquatic biodiversity (Figures 1, 2, and 3). In addition to mapping the status of the water quality parameters for each lake, the status of lakes was summarized by ecozone (Figures 1,2, and 3).

It is important to note that some lakes may naturally have water quality values that are beyond the threshold levels that can have impacts on biodiversity (e.g., low pH, high phosphorus). It will be important to assess the trends in these key water quality parameters as successive 5-year cycles of the Broad-Scale Monitoring Program are completed. Additional information of the water quality of Ontario's inland lakes is available from sampling conducted by the Ministry of the Environment, Conservation and Parks and its Lake Partner Program, as well as the Ontario Geological Survey.

- Download Broad-Scale Monitoring lake water quality data (summaries by ecozone, individual lakes)

Results

Trend:No change **Data Confidence:** High **Geographic Extent:** Provincial

Total Phosphorus	
Broad Scale Monitoring Cycle 1 (2008–2012)	Broad Scale Monitoring Cycle 2 (2013–2017)
	

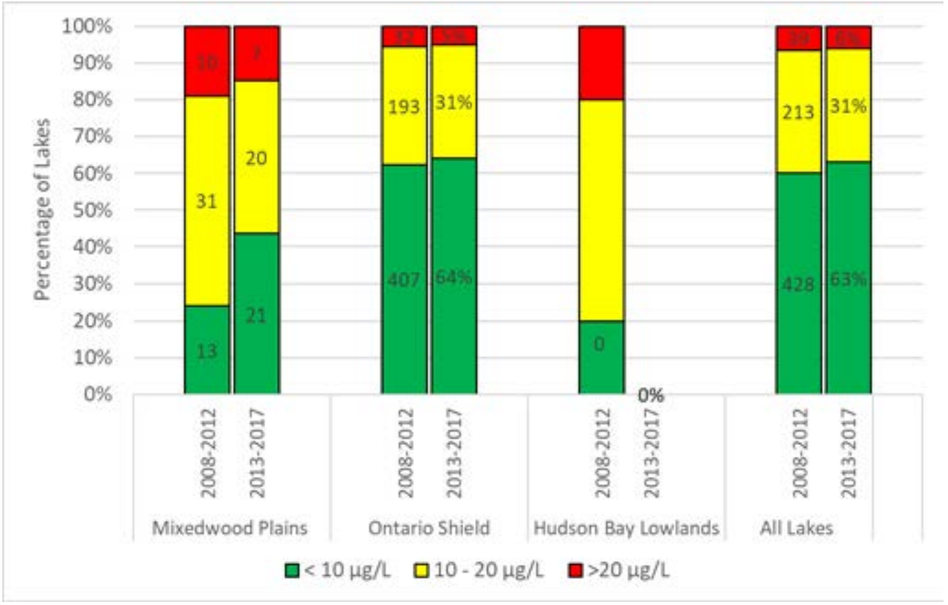
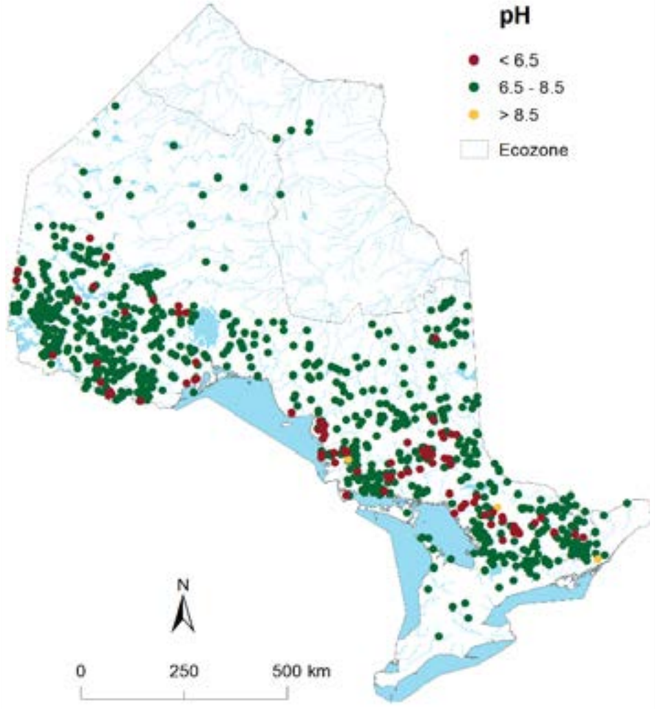
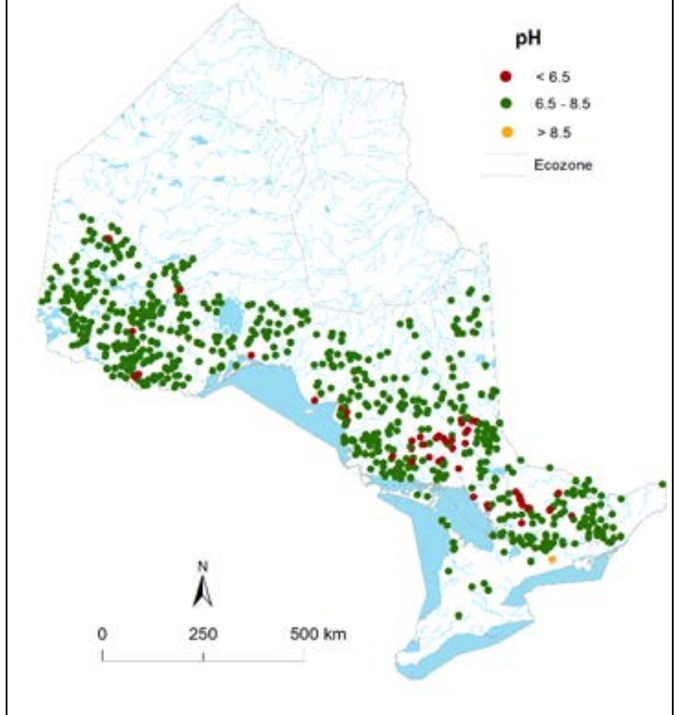


Figure 1. Status of total phosphorus levels in Ontario lakes sampled during cycle 1 (n=827) cycle 2 (n= 680), and percentage of lakes by ecoregion.

pH levels	
Broad Scale Monitoring Cycle 1 (2008–2012)	Broad Scale Monitoring Cycle 2 (2013–2017)
	

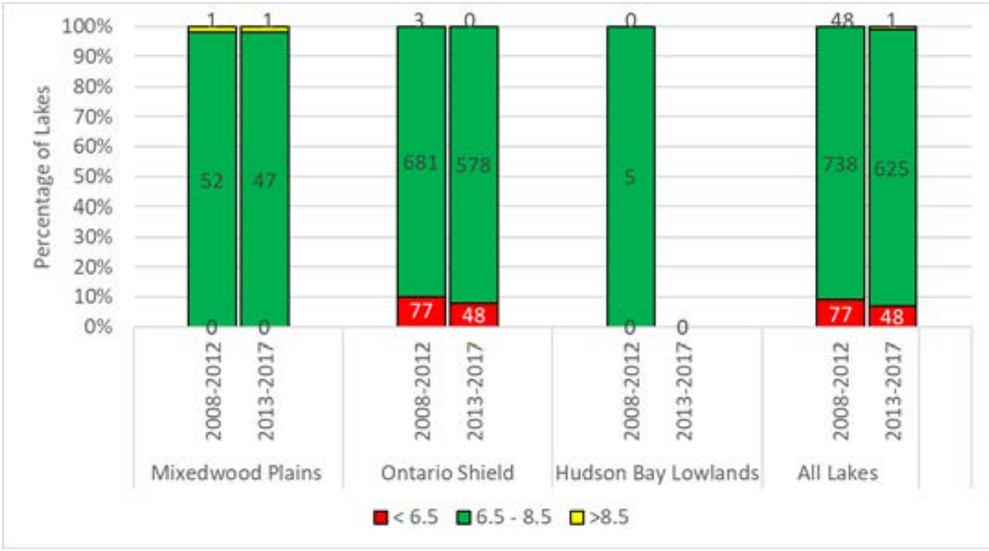
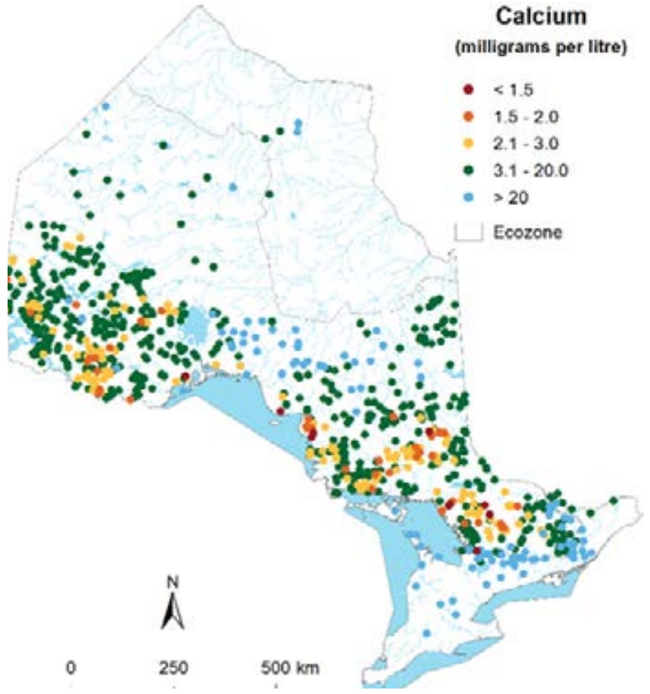
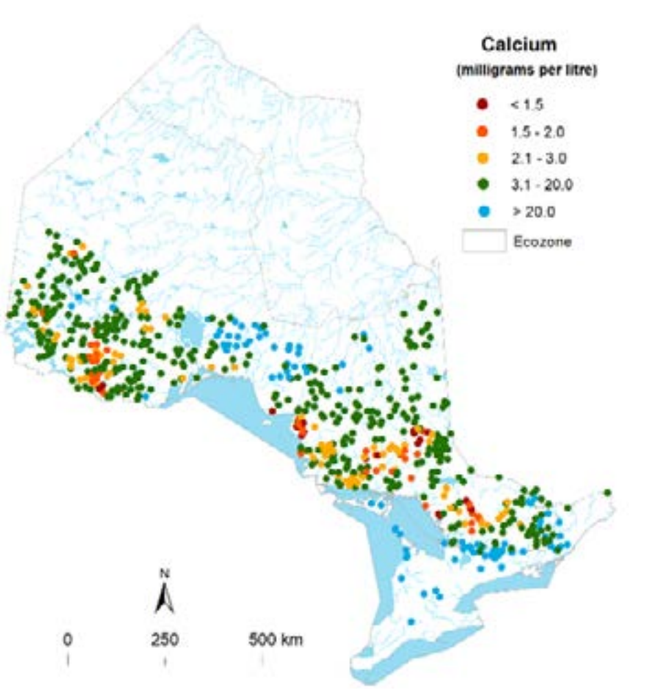


Figure 2. Status of total pH levels in Ontario lakes sampled during cycle 1 (n=827), cycle 2 (n=674) and a percentage of lakes by ecoregion.

Total Calcium	
Broad Scale Monitoring Cycle 1 (2008–2012)	Broad Scale Monitoring Cycle 2 (2013–2017)
	

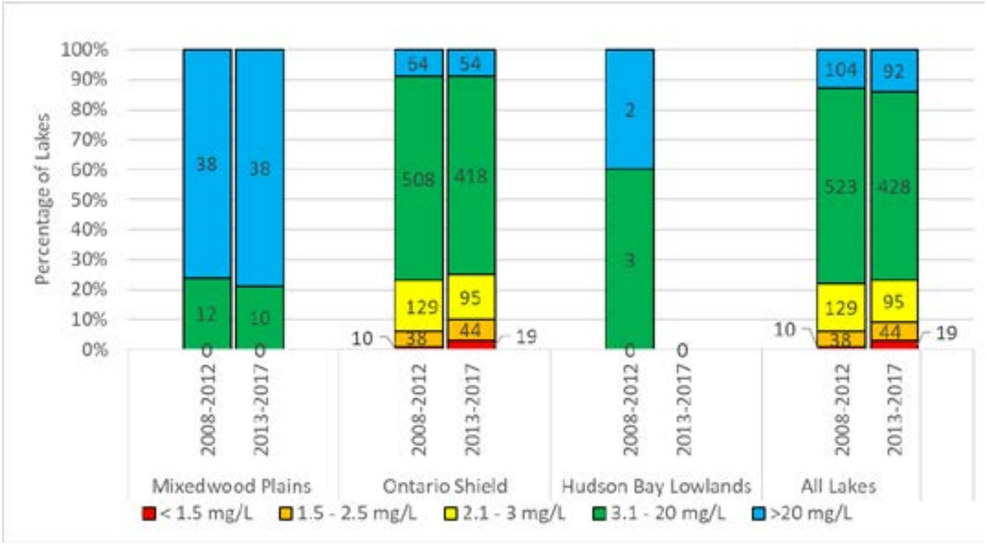


Figure 3. Status of total Calcium levels in Ontario lakes sampled during cycle 1 (n=827), cycle 2 (n=678) and percentage of lakes by ecoregion.

Status

- Between 2013 and 2017, 94% of sampled lakes were below the 20 µg/L threshold for total phosphorus, indicating there is an acceptable level of nutrients. Lakes where phosphorous levels are above 20 µg/L can result in algal blooms and excessive plant growth. The majority of the sampled lakes in the Ontario shield (64%) have low levels of total phosphorus (< 10 µg/L), while those in the mixedwood plains fell between low and medium levels. These results are similar to those reported in 2015.
- More than 90% of sampled lakes had pH values within the 6.5–8.5 range recommended for the protection of aquatic life. All the lakes (48) with low pH (< 6.5) are found in the Ontario Shield Ecozone, with the majority of those lakes falling within FMZ 11 and 15. These results are similar to those reported in 2015.
- A total of 3% of the sampled lakes (19 lakes) had critically low calcium levels (< 1.5 mg/L), which is a rise from 1% previously reported. Twenty-one percent of the lakes sampled had calcium levels close to this threshold (1.5–3.0 mg/L). All of these lakes are in the Ontario Shield Ecozone where calcium levels are naturally low in most areas and there is a concern because of declining calcium levels in soils and aquatic ecosystems.

- A total of 79% of the lakes in the Mixedwood Plains Ecozone were calcium rich (> 20 mg/L) which is an increase from the 76% reported in 2015, making them more vulnerable to Zebra Mussel invasion. Calcium rich lakes also occur in the northern part of the Ontario Shield Ecozone. All of the 93 calcium rich lakes also have pH values (>7.4).

Links

Related Targets: 8. By 2015, the release of pollutants harmful to biodiversity is reduced.

Related Themes: N/A

Web Links

Government of Canada - Canada-United States Air Quality Agreement: overview - Canada.ca

Lake Partner Program http://desc.ca/programs/lpp

MOECC – Dorset Environmental Science Centre http://desc.ca/

Ontario Geological Survey data http://www.geologyontario.mndm.gov.on.ca/

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