INDICATOR: WATER QUALITY IN INLAND LAKES

STRATEGIC DIRECTION: Reduce Threats

TARGET: N/A

THEME: Pressures on Ontario's Biodiversity – Pollution

Background Information:

Lakes and streams have a very important role in sustaining biodiversity (Environment Canada 2008). Along with aquatic species, many birds, amphibians 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 2008, Ontario initiated the Broad-Scale Monitoring Program of lakes 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 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 initial assessment of lake water quality, based on the first 5-year cycle of sampling, compares measured levels to those that can impact biodiversity (Table 1). Trends will be assessed in this indicator after subsequent cycles of Broad-Scale Monitoring have been completed.

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 recent 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). All samples were analyzed at the Ministry of the Environment and Climate Change laboratory in Dorset, Ontario. The majority of sampled lakes were in the Ontario Shield Ecozone (768 lakes or 93%). Only 5 lakes from the Hudson Bay Lowlands Ecozone were sampled. Sampled Lakes include only lakes greater than 5 hectares in area, so the more numerous smaller lakes are not represented in the indicator.

Three water quality parameters that have a strong influence on biodiversity in Ontario's lakes were included in this indicator – pH, calcium and total phosphorus. For each water quality parameter, lakes were mapped showing their status with respect to levels that can have impacts on aquatic biodiversity (Figure 1). In addition to mapping the status of the water quality parameters for each lake, the status of lakes was summarized by ecozone (Figure 1).

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 Environment and Climate Change and its Lake Partner Program, as well as the Ontario Geological Survey.

- download BSM lake water quality data (summaries by ecozone, individual lakes)

Results:

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

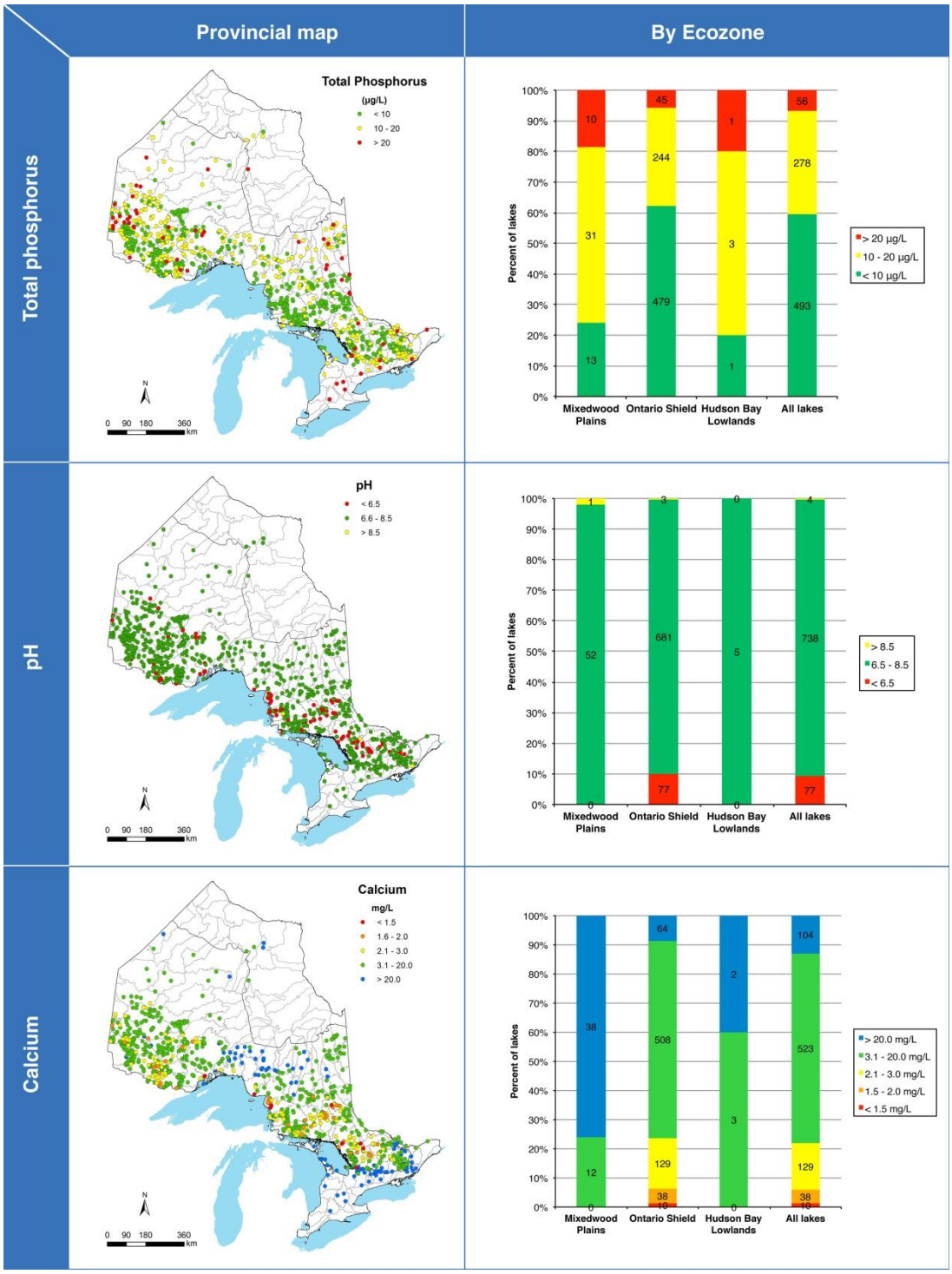

Figure 1. Status of total phosphorus, pH and calcium levels in Ontario lakes sampled from 2008-2012 (*n* = 827).

Status:

- More than 90% of sampled lakes are below the recommended level of 20 µg/L for total phosphorus above which algal blooms and excessive plant growth can occur. The majority of sampled lakes in the Ontario Shield Ecozone (62%) have low levels of total phosphorus (< 10 µg/L).
- More than 90% of sampled lakes had pH values within the 6.5-8.5 range recommended for the protection of aquatic life. All 77 lakes with low pH (< 6.5) are found in the Ontario Shield Ecozone.
- Only 10 of the sampled lakes (1%) had critically low calcium levels (< 1.5 mg/L), but 21% 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.
- Most lakes in the Mixedwood Plains Ecozone (76%) are calcium rich (> 20 mg/L) and are therefore more vulnerable to Zebra Mussel invasion. Calcium rich lakes also occur in the northern part of the Ontario Shield Ecozone and the Hudson Bay Lowlands Ecozone. All but three of the 102 calcium rich lakes also have pH values (>7.4) conducive to supporting Zebra Mussel.

Links:

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

Related Themes: N/A

Web Links :

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

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

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

References:

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Citation
Ontario Biodiversity Council. 2015. State of Ontario's Biodiversity [web application]. Ontario Biodiversity Council, Peterborough, Ontario. [Available at: **http://ontariobiodiversitycouncil.ca/sobr** (Date Accessed: May 19, 2015)].