LAKE
PARTNER
PROGRAM

Report Card 2015

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What This Report Tells You

Ontario's inland lakes are among the province's most valuable resources. By working together, we can improve our understanding of Ontario's beautiful lakes, thereby helping to protect them for future generations.

Since 1996, the Ministry of the Environment and Climate Change (MOECC) has been delivering the Lake Partner Program, which enables citizen scientists to monitor total phosphorus (TP), calcium, and water clarity in Ontario's inland lakes. Working in partnership with the Federation of Ontario Cottagers' Associations (FOCA), the water quality data are reported back to the public annually on the web. The 2015 Lake Partner Program Report Card examines the health of the lakes, sampled by volunteers, over the most recent five years (2010 to 2014), and is designed to serve as a resource for program participants, lake managers, and the general public across the province.

This report consists of the following three key components:

1	Background information on Ontario's Inland Lakes and the Lake Partner Program
2	A description and summary of each of the three water quality indicators measured as part of the Lake Partner Program: Total Phosphorus, Calcium, and Water Clarity. Together, they provide a snapshot of the state of Ontario's lakes.
3	Access to useful tools and other web-based information for citizen scientists and lake stewards.

The complex and dynamic nature of inland lakes requires continued monitoring and research to better inform management actions and, ultimately, to protect these lakes for our enjoyment and the many benefits lakes provide.

Ontario's Lakes

Ontario has over 200,000 lakes, and the majority of them are situated within the Canadian Shield (Fig. 1). The lakes and watersheds of the Canadian Shield are underlain by Precambrian granitic bedrock. This means that the shallow, acidic soils tend to be naturally low in nutrients.

About half of Ontario's inland lakes are considered to be "small" (under 10 hectares in surface area). Roughly 95% of Ontario's lakes are smaller than 100 ha in surface area, with Lake Nipigon being the largest inland lake in Ontario (excluding the Great Lakes; Fig. 2). An estimated 17% of Canada's freshwater is located in Ontario[1], yet only a small fraction of lakes are monitored for water quality (an estimated 1-2%).

The water quality and ecology of Ontario's inland lakes reflect watershed geology and vegetation, but human settlement, land-use change, climate, invasive species, and chemical pollutants modify these influences.

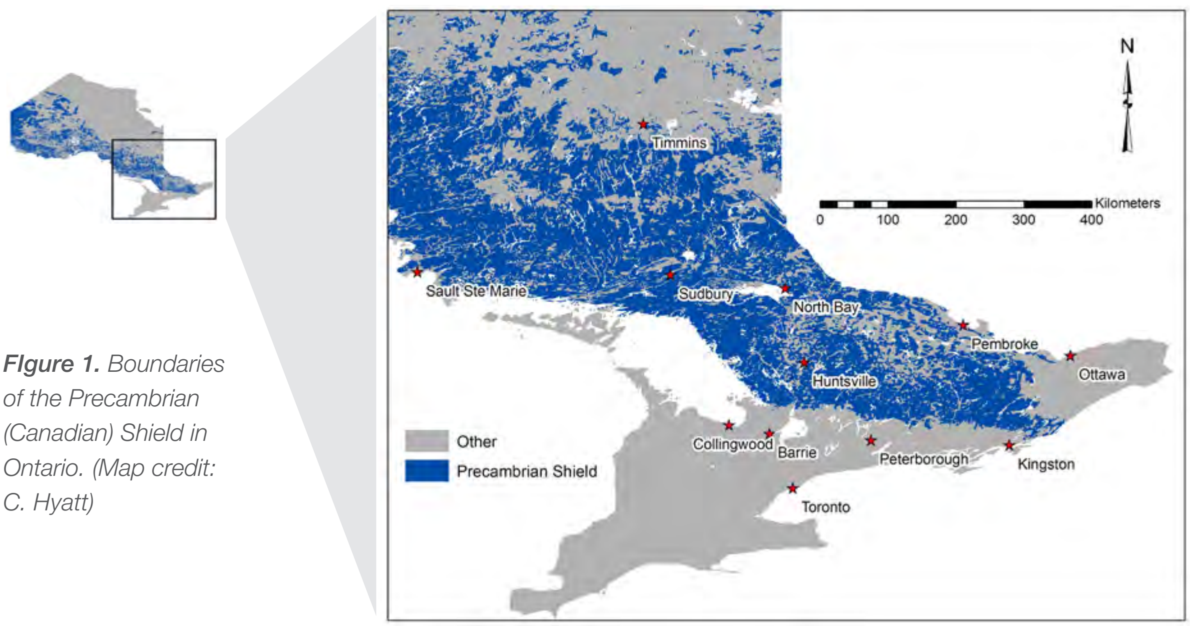
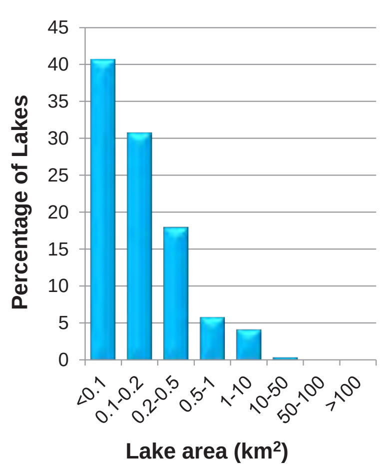


Figure 1. *Boundaries of the Precambrian (Canadian) Shield in Ontario. (Map credit: C. Hyatt)*

Figure 2. *The size distribution of 218,000 of Ontario's lakes, grouped by lake area[2,3].*



1 *Natural Resources Canada. 2005. Land and freshwater area by province and territory.* ***www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/phys01-eng.htm****. Accessed 09/28/2015.*

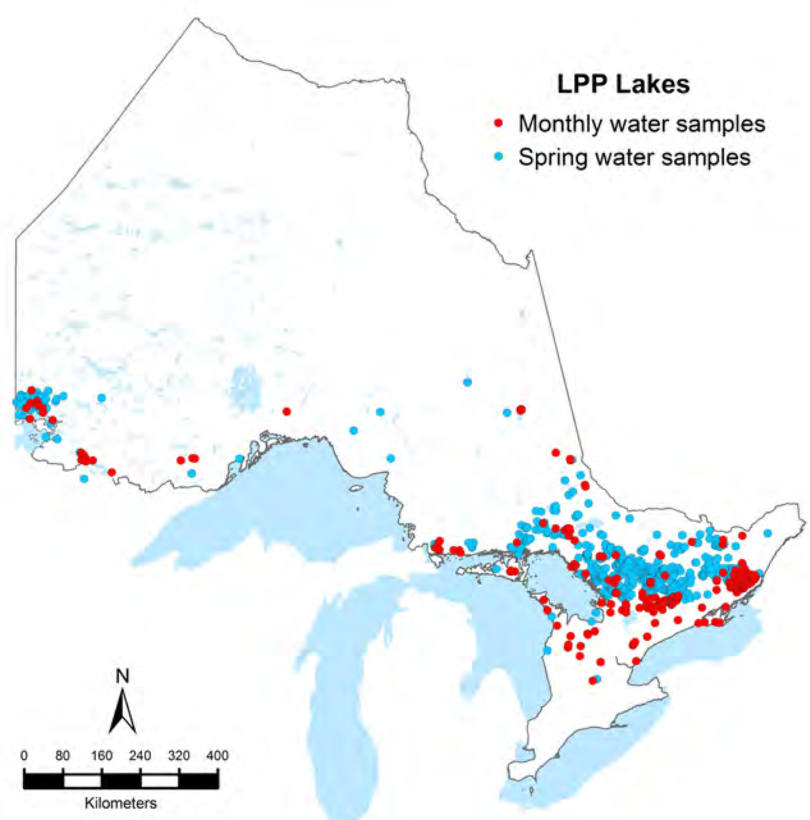
2 *Cox E.T.1978. Counts and measurements of Ontario lake. Fisheries Branch, Ontario Ministry of Natural Resources. 114pp.*

3 *Minns C.K., Moore J.E., Shuter B.J. & Mandrak N.E. 2008. A preliminary analysis of some key characteristics of Canadian Lakes. Can. J. Fish. Aquat. Sci. 65: 1763-1778.*

What is the Lake Partner Program?

The Lake Partner Program (LPP) is Ontario's volunteer inland lakes monitoring program. Each year, approximately 600 volunteers (i.e., lake stewards or citizen scientists) monitor nearly 550 inland lakes at over 800 sampling locations (including lakes with multiple basins; Fig. 3). About 85% of the volunteers sample lakes on the Canadian Shield and these volunteers collect one water sample in the spring each year. The remaining volunteers sample once a month during the ice-free season for lakes that are predominantly off the Canadian Shield. These water samples are used to measure nutrient concentrations (total phosphorus, TP, and calcium, Ca) for Ontario's inland lakes. Volunteers are also asked to make a minimum of six (roughly monthly) water clarity observations using a Secchi disk.

__Figure 3.__ Ontario's Lake Partner Program incorporates inland lakes across Ontario, and some isolated bays of the Great Lakes, such as Georgian Bay. This map shows all of the 233 monthly and 535 spring sites that were actively sampled by volunteers on lakes in Ontario in 2014.



Water samples are sent to the water chemistry laboratory at the MOECC's Dorset Environmental Science Centre (DESC; **www.desc.ca**) for analysis using state-of-the-art methods. The chemical and Secchi-disk results are used by members of the public, partner agencies, government and academic researchers to assess and report on water quality in lakes across Ontario. The three parameters monitored by the Lake Partner Program (TP concentrations, Ca concentrations, and water clarity) are described in the following pages.

A Chemistry Technician at the MOECC's Dorset Environmental Science Centre performs total phosphorus analyses on Lake Partner Program water samples

Photo Credit: P. Sutey

Total Phosphorus

Phosphorus is an essential element for aquatic systems and the organisms that inhabit them. Phosphorus also controls the growth of algae in most Ontario lakes. Increases in phosphorus may stimulate algal growth, resulting in decreased water clarity, reduced deep-water oxygen concentrations, and, in extreme cases, cause algal blooms that may produce toxins, affect the aesthetics of the lake, and/or cause taste and odour problems in the water.

In Ontario, we frequently manage our lakes based on total phosphorus (TP). TP concentrations are used to infer a lake's capacity for algal growth, which is called the nutrient (or trophic) status. Many limnologists (scientists who study aquatic environments) place lakes into three broad categories with respect to nutrient status (Fig. 4). Lakes with less than 10 µg/L of TP are considered oligotrophic. These dilute, unproductive lakes rarely experience nuisance algal blooms, and are considered excellent recreational lakes that are highly valued and may support a cold-water fishery, such as lake trout.

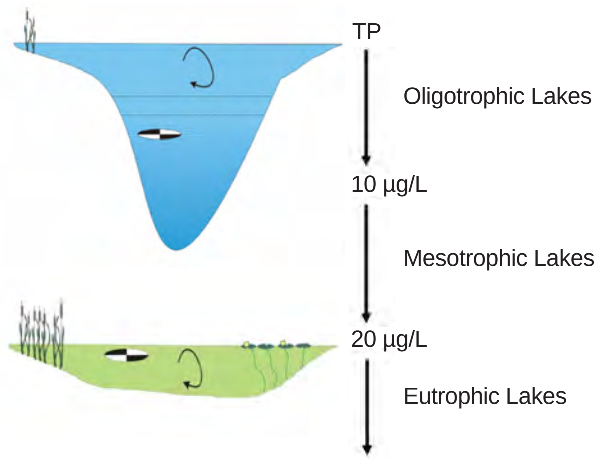
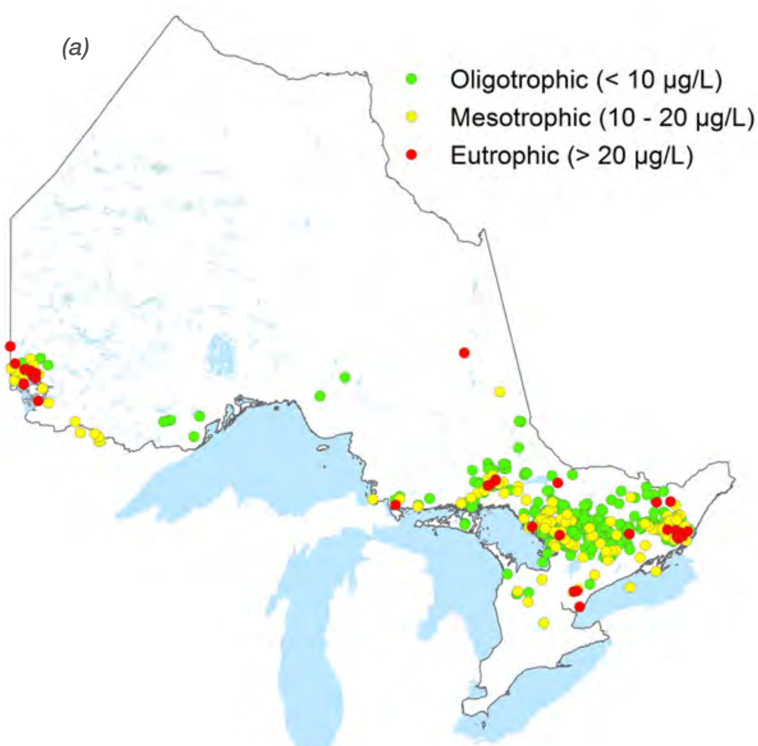
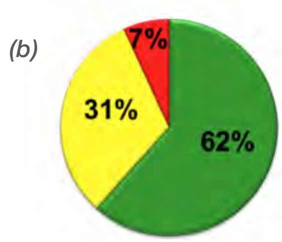


Figure 4. *Gradient of lake nutrient (or trophic) status categories (oligotrophic, 0-10 µg/L; mesotrophic, 10-20 µg/L; eutrophic, >20 µg/L) based on total phosphorus (TP) concentrations.*

Figure 5. *Distribution of lake trophic status based on total phosphorus (TP) concentrations, a) across Ontario, and b) by percentage. Data represent 466 Ontario lakes monitored for spring TP concentrations for at least 3 years between 2010-14.*





Lakes with TP concentrations between 10 and 20 µg/L are mesotrophic and are in the middle with respect to trophic status. These lakes show a broad range of characteristics and can be clear and unproductive at the bottom end of the scale or susceptible to moderate algal blooms at concentrations near 20 µg/L. Mesotrophic lakes also tend to support warm-water fish species and have a more diverse shoreline habitat. Lakes over 20 µg/L are classified as eutrophic. These lakes tend to have naturally higher TP concentrations, and may exhibit persistent, nuisance algal blooms.

It is important to note that many lakes in Ontario are "tea stained" and have moderate to high levels of dissolved organic carbon (DOC). These lakes are called dystrophic lakes, and do not share the algal/TP relationships described above. The chemistry of these lakes is quite complex.

Most of the lakes in Ontario's LPP are oligotrophic (62%), and tend to be located on the Canadian Shield (Fig. 5). 31% are mesotrophic, and the remaining 7% are eutrophic, and tend to be located off the Canadian Shield bedrock (Fig. 5). In general, almost three-quarters of LPP lakes have TP concentrations between 4-12 µg/L (Fig. 6). You can find out the TP concentration for your lake by visiting the LPP Interactive Online Mapping tool at **www.ontario.ca/environment-and-energy/map-lake-partner**

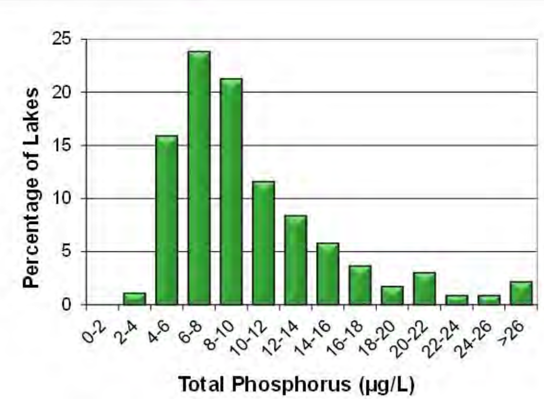


Figure 6. *Current distribution of lake total phosphorus (TP) concentrations across Ontario. Data represent 466 Ontario lakes monitored for spring TP concentrations for at least 3 years between 2010-14.*

Phosphorus is an essential element for aquatic systems and the organisms that inhabit them.

Fig. 7 compares the 10-year mean distribution of TP in lakes across the province for 2005 to 2009 and 2010 to 2014. This graph does not show a significant change in lake TP concentrations between these two time periods. If TP in the lakes had increased over the 10 year interval, the blue curve would be shifted to the right of the red curve. This trend of no change in the overall distribution of TP over the last 10 years is one that has been observed across other datasets from lakes in Ontario. The MOECC will continue to monitor and report on trends through time in the LPP dataset.

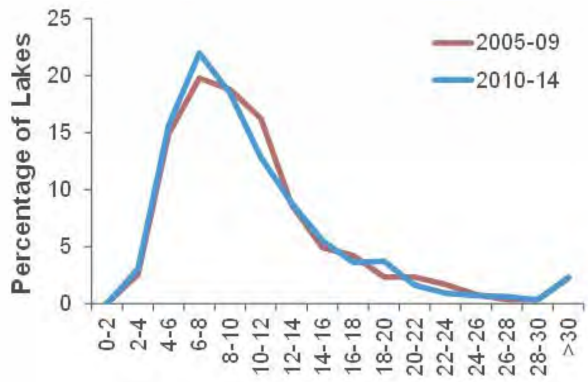


Figure 7. Distribution of mean total phosphorus concentrations for Lake Partner Program Lakes from two time periods, 2005-09 (n=900) and 2010-14 (n=997).

You can find out the TP concentration for your lake by visiting the LPP Interactive Online Mapping tool.

Calcium

Figure 8. *Image of a calcium-rich Daphnia (Photo credit: Dr. Derek J. Taylor)*

Calcium is a nutrient that is required by all living organisms. For example, *Daphnia*, (Fig. 8), which are tiny organisms called zooplankton and are a primary food for many fish, are very sensitive to declining calcium levels. *Daphnia* use calcium in the water to form their calcium-rich body coverings. There are many other aquatic animals that need calcium, such as mollusks, clams, amphipods, and crayfish.

Calcium concentrations in Canadian Shield lakes are decreasing (Fig. 9). Laboratory and field studies by partners working at DESC have shown that calcium loss is an important stressor for many aquatic species, especially when less calcium is combined with lower food availability and the warmer temperatures that are predicted in future climate change scenarios. Decades of acid loading, coupled with logging, have depleted watershed stores of calcium, and further decreases are predicted in many lakes.

Laboratory experiments have shown that the reproduction of most *Daphnia* species is jeopardized at lake calcium concentrations below 1.5 mg/L. In nature, where organisms must cope with multiple stressors, this limiting or threshold calcium concentration may actually be higher.

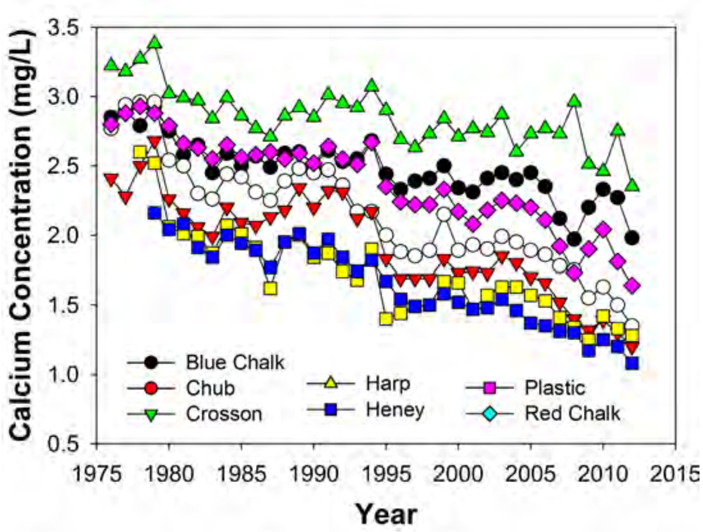


Figure 9. *Declines in calcium concentrations over the last 35 years in 7 intensively-studied lakes in south-central Ontario (MOECC, unpublished data).*

Calcium is a nutrient that is required by all living organisms.

The LPP began monitoring calcium concentrations in 2008. The majority (74%) of lakes monitored through the LPP have moderate-to-high levels of calcium concentrations, and 97% are above the 1.5 mg/L threshold considered to limit reproduction of large zooplankton (Figs. 10 & 11). This means that 3% of lakes have very low calcium. The lakes with low-moderate calcium concentrations tend to be located on the hard, poorly-weathered, granitic bedrock of the Canadian Shield (Fig. 10). Continuing work will examine trends in data and possible correlations to total phosphorus concentrations.

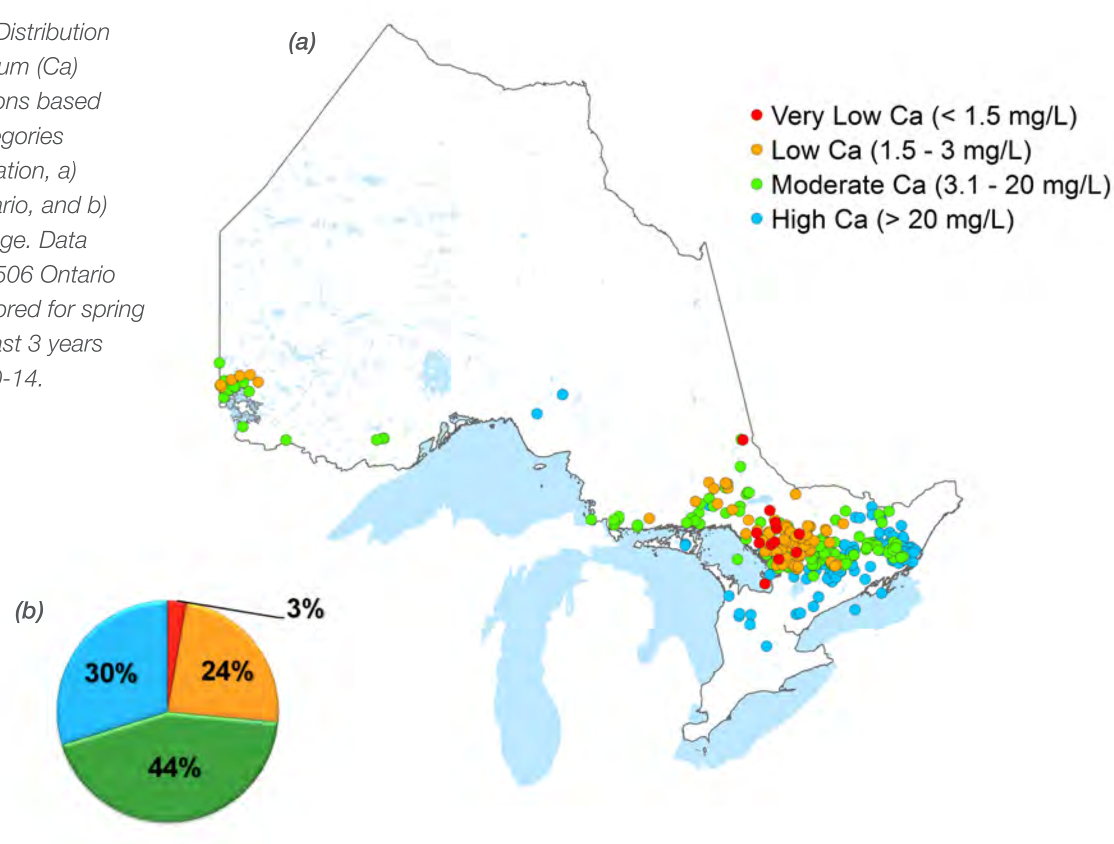


Figure 10. Distribution of lake calcium (Ca) concentrations based on four categories of concentration, a) across Ontario, and b) by percentage. Data represents 506 Ontario lakes monitored for spring Ca for at least 3 years during 2010-14.

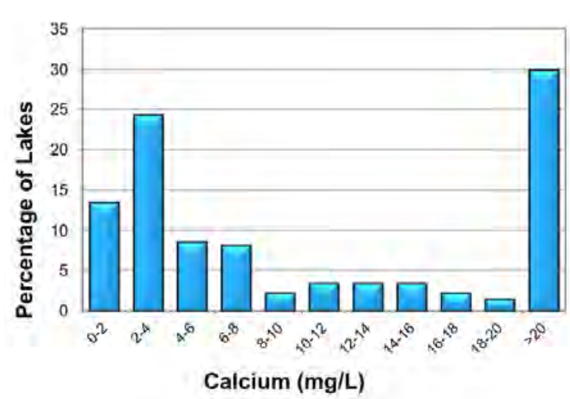


Figure 11. Current distribution of lake calcium (Ca) concentrations across Ontario. Data represent 506 Ontario lakes monitored for spring Ca concentrations for at least 3 years during 2010-14.

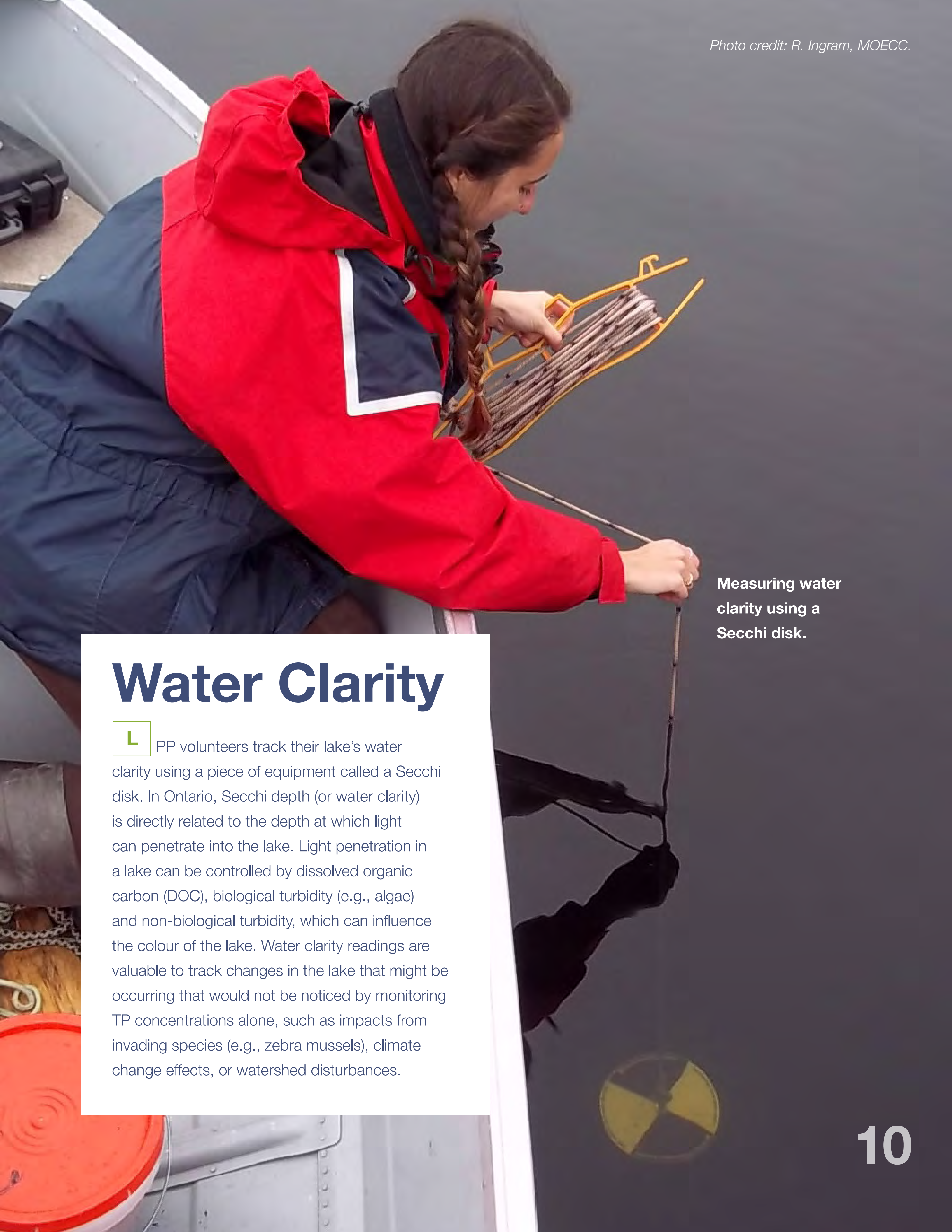


Photo credit: R. Ingram, MOECC.

Measuring water clarity using a Secchi disk.

Water Clarity

LPP volunteers track their lake's water clarity using a piece of equipment called a Secchi disk. In Ontario, Secchi depth (or water clarity) is directly related to the depth at which light can penetrate into the lake. Light penetration in a lake can be controlled by dissolved organic carbon (DOC), biological turbidity (e.g., algae) and non-biological turbidity, which can influence the colour of the lake. Water clarity readings are valuable to track changes in the lake that might be occurring that would not be noticed by monitoring TP concentrations alone, such as impacts from invading species (e.g., zebra mussels), climate change effects, or watershed disturbances.

Water clarity data from LPP lakes across the province show that more than half of the lakes (55%) have high transparency (Secchi depth >4 m; Figs. 12 & 13), while approximately 39% are moderately transparent (Secchi depth 2-4 m), and 6% have low transparency (Secchi depth 0-2 m).

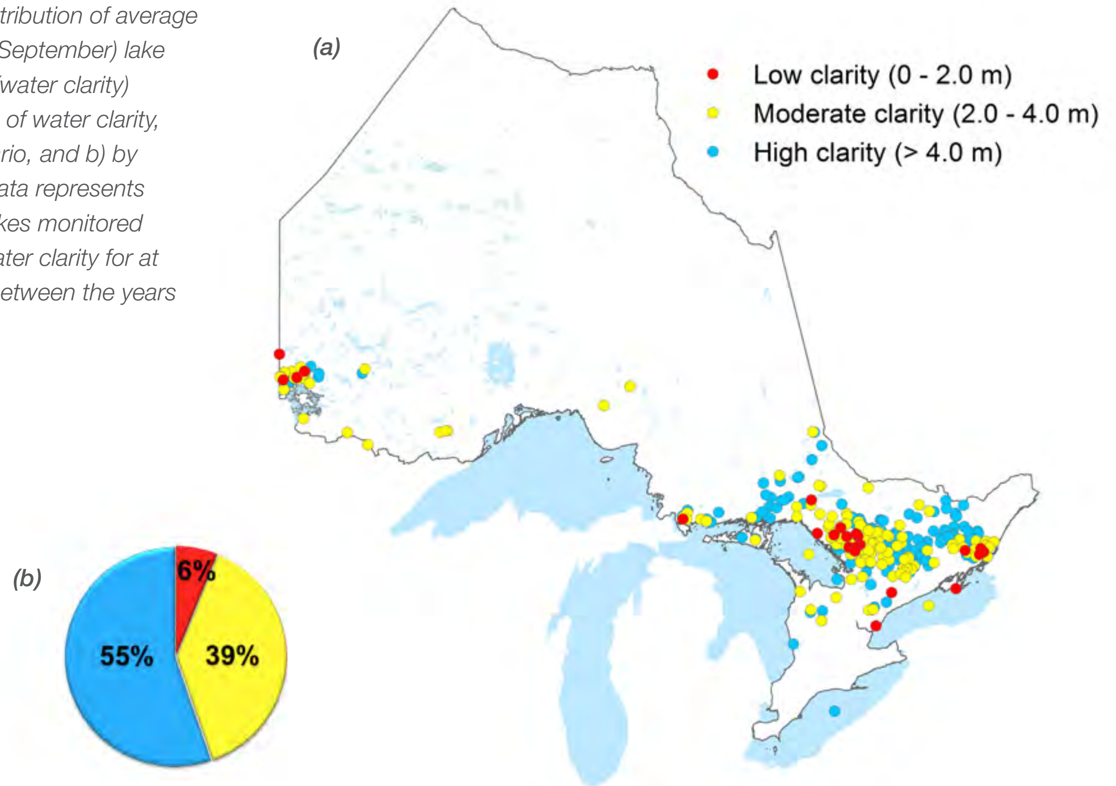


Figure 12. *Distribution of average summer (July-September) lake Secchi depth (water clarity) for three levels of water clarity, a) across Ontario, and b) by percentage. Data represents 376 Ontario lakes monitored for summer water clarity for at least 3 years between the years 2010-14.*

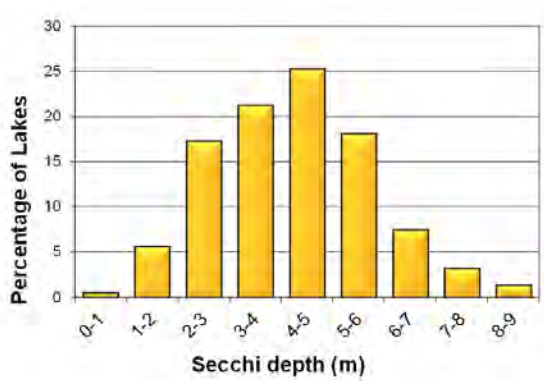


Figure 13. *Current distribution of summer Secchi depth (water clarity) for lakes across Ontario. Data represent 376 Ontario lakes monitored for summer water clarity for at least 3 years between the years 2010-14.*

Moving Forward – What You Can Do

The complex and dynamic nature of inland lakes requires continued monitoring and research to better inform management actions to protect these lakes for our enjoyment and the many benefits lakes provide.

Individuals and communities can work together to help maintain the water quality of Ontario's lakes. To find out more about what you can do to help protect Ontario's lakes, visit FOCA's "Resources" page to access a wealth of information (**www.foca.on.ca/resources/**).

Below: Participants in the Haliburton-Muskoka-Kawartha Children's Water Festival learn about lake water clarity during an interactive demonstration.

Individuals and communities can work together to help maintain good water quality.

Photo credit: R. Ingram, MOECC.

Helpful Resources

1	Visit the MOECC LPP's web-based mapping tool to look at the data or long-term trends for individual lakes (**www.ontario.ca/environment-and-energy/map-lake-partner**.) These data are updated annually. LPP data can also be accessed by visiting **www.ontario.ca/data/ontario-lake-partner**, or at FOCA's website **www.foca.on.ca/lake-partner-program-overview/**
2	Gain insight into interpreting the Lake Partner Program total phosphorus and water clarity data, or learn more about lake calcium decline, by visiting the Dorset Environmental Science Centre webpage: **www.desc.ca/programs/lpp**
3	Contact the MOECC's Lake Partner Program by phone: 1-800-470-8322 or email lakepartner@ontario.ca
4	Contact FOCA by phone: (705) 749-3622 or email info@foca.on.ca
5	Learn more about algal blooms in Ontario at (**www.ontario.ca/page/blue-green-algae**). If you think you see an algal bloom, report it to the MOECC Spills Action Centre (toll free: 1-800-268-6060 TTY: 1-855-515-2759)

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www.desc.ca/programs/lpp