International Efforts to Study and Understand the Great Lakes Ecosystem:

Lake Ontario

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Satellite image of the Great Lakes. *Image credit GLERL*

The Challenge of Studying the Great Lakes

The Great Lakes are some of the most important freshwater systems in the world. They contribute significantly to the economy and culture of the region, supporting a variety of wildlife, recreational and commercial fisheries, food resources, and opportunities for boating, tourism, energy production, maritime shipping, and more. The Great Lakes are extremely large, spanning approximately 750 miles east to west and 500 miles north to south. Combined, the five Great Lakes cover nearly 100,000 square miles with over 10,000 miles of shoreline. This complex system has many biotic (biological) and abiotic (physical and chemical) differences. Some of these differences include:

- Within lakes: different depths, habitats, temperatures, bottom types, and light conditions;
- Across lakes: different weather conditions, fish and invertebrate communities, and nutrients;
- Through time: all of the factors mentioned above can change within and across the lakes over time.

It is imperative that we understand the Great Lakes to protect, maintain, and enhance the ecological services they provide. However, their size and complexity make it challenging to conduct comprehensive research and monitoring efforts, even within a single lake. In addition, there are essentially endless "moving parts" for scientists to study in the Great Lakes.

Highlights

- Scientists have been learning about the Great Lakes for decades.
- In 2002 the US and Canada agreed to join forces to study the Great Lakes in more detail.
- The effort called the Cooperative Science and Monitoring Initiative (CSMI) visits each Great Lake every five years.
- The approach of CSMI is to combine the commendable efforts of scientists to gain even more information from their efforts.
- CSMI is intended to help develop Lakewide Action and Management Plans in each of the Great Lakes.
- In 2013 the focus was Lake Ontario's nutrients, fish, productivity, and food web.

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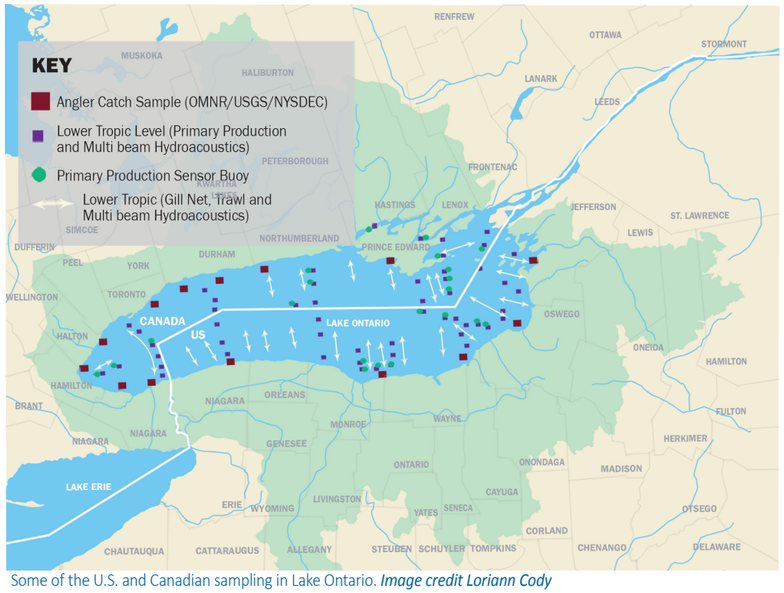
Cooperative Science and Monitoring Initiative
Fact Sheet # 1 of 4

Meeting the Challenge

Scientists have learned a lot about the Great Lakes over the past several decades by doing high quality, long-term studies and monitoring. To get even more value out of these outstanding efforts, in 2002, the United States and Canada committed to a collaborative, binational scientific effort in the Great Lakes. The effort is known as the Cooperative Science and Monitoring Initiative (CSMI). CSMI rotates from lake to lake on a 5-year cycle, and aims to promote, organize, and unify different research and monitoring efforts by local, state, provincial, federal, First Nations, academic, and non-governmental groups. This will help to develop Lakewide Action and Management Plans (LAMPs) under the Great Lakes Water Quality Agreement.



Some of the U.S. and Canadian sampling in Lake Ontario. *Image credit Loriann Cody*

CSMI 2013 in Lake Ontario

In 2013 the CSMI focused on Lake Ontario. Lake Ontario has gone through significant changes over the past two centuries, experiencing shifts in the factors listed below and more. Because of the complexity and size of Lake Ontario, no one group can be expected to keep track of all these factors continuously and simultaneously across the entirety of Lake Ontario.

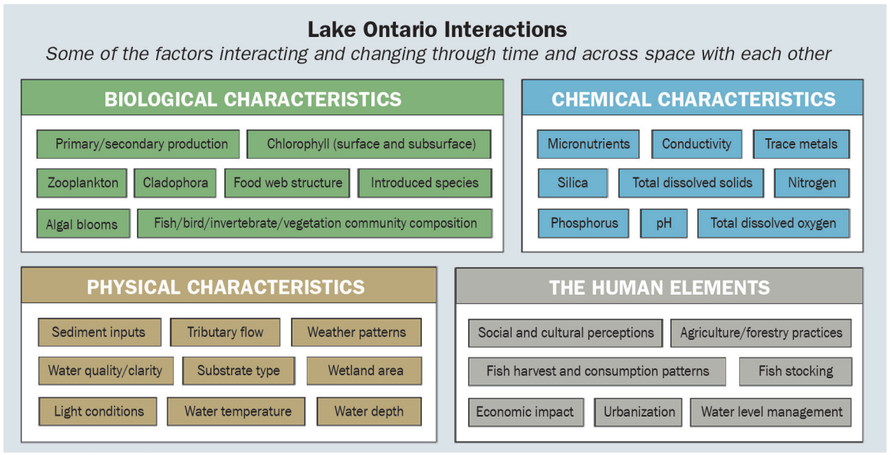


Image credit Loriann Cody

In 2013, more than 25 groups joined together to gain a broader and deeper understanding of Lake Ontario. One of the most important tools they use is the ***Research Vessel Lake Guardian*** that samples all five Great Lakes.

The *R/V Lake Guardian. Image credit Michael Milligan, SUNY Fredonia*

The 2013 effort focused on four themes:

- Nutrient loading and fate;
- Fish abundance, distribution, and diet;
- Spatial distribution of primary and secondary production;
- Trophic transfer and food web mass balance modeling.

These factors and many others work together to form what Lake Ontario looks like today. As factors change over time, Lake Ontario responds in ways that can be observed and measured. The CSMI scientists use old, new, simple, and sophisticated technologies and methods to monitor and sample different components of Lake Ontario to characterize these responses. From centuries-old seining to the complex rosette sampler, scientists use a variety of techniques to learn more about Lake Ontario.

Left: During a 2008 New York Sea Grant-led Lake Ontario teacher training, NYSG Coastal Education Specialist Helen Domske and State University of New York Environmental Science and Forestry's investigator Dr. Greg Boyer use a Secchi disk to determine water turbidity, a measure of clarity. *Image credit Lauren Makeyenko*

Right: From water samples drawn using a rosette sampler, scientists learn about surface temperature, dissolved oxygen, pH and fluorescence, a measure of algae abundance. *Image credit Paul Focazio*

Left: Sea Grant scholar Brent Boscarino collects Mysis, also known as possum shrimp because of this crustacean's brood pouch. *Image credit Brent Boscarino*

Right: Seining the Niagara River. Seining is a simple, yet effective sampling tool. *Image credit Paul Focazio*

Information to Change the Future: Forecasting and Management

So how does coordinating scientific efforts and collecting all of this information help? The truth is, most ecosystems are too complex to fully understand. To make things easier, scientists use data they collect to make models (or simplifications) of ecosystems that help them "forecast." In other words, scientists use information from the past and present to understand (or forecast) how the Lake Ontario system might respond to changes in the future. For example, in the past algal blooms were observed in Lake Ontario when nutrient inputs were higher than today. Knowing this, one might expect (or forecast) that algal blooms might be observed again if nutrient inputs returned to what was observed in the past. That is essentially how models are built. The next step is for managers to use these models to help them make decisions and adjust their actions to best prepare for the future.

Managers are generally interested in how Lake Ontario will respond to two things; 1) management actions like controlling nutrient inputs and changing stocking or fishing regulations, or 2) unplanned events like invasive species introductions or changes in weather conditions. In reality, managers have a relatively limited set of "tools" to manage a system like Lake Ontario, and arguably, "Mother Nature" has more control over the lake than we do. However, managers have used three "tools" successfully:

1) Manipulating fish populations by stocking, altering harvest regulations, and Sea Lamprey control;
2) Altering nutrient loading from the watershed and into the lake directly;
3) Improving habitat with restoration efforts, dam removal, and reducing inputs like contaminants.



Left: One way of manipulating fish populations is by stocking fish like these yearling Lake Trout seen in a de-watering tower before being loaded on to the stocking truck. *Image credit Larry Miller, USFWS*
Center: Altering nutrient loading into Sodus Bay, Lake Ontario, may have prevented this harmful algal bloom. *Image credit Jay Ross, Save our Sodus Association*
Right: Heavy equipment is used to restore pothole habitat in a wetland area used by fish for spawning. *Image credit Ducks Unlimited*

How do We Move Forward? CSMI is Here to Help

Scientists have made commendable strides in the Great Lakes to help us understand how they work with the overall goal of ensuring that the ecosystem remains functional and healthy. We know more now about the Great Lakes than we ever have, but there is always a level of uncertainty about what might happen in the future. This uncertainty can be difficult to address, but the more information we have, the better prepared and responsive we can be.

We are likely to face more challenges in the future like new invasive species introductions, weather conditions that may decrease reproduction or survival of native species, habitat degradation, diseases, and more. However, the United States and Canada are dedicated to learning more about the Great Lakes. In 2003, 2008, and 2013 the CSMI focused on Lake Ontario, and it will return again in 2018. Scientists will apply all that was learned in 2013 and other years to guide their research focus for the 2018 CSMI. This effort combined with ongoing efforts by scientists will help provide managers with more tools and better information to protect the Lake Ontario system and all of its resources.

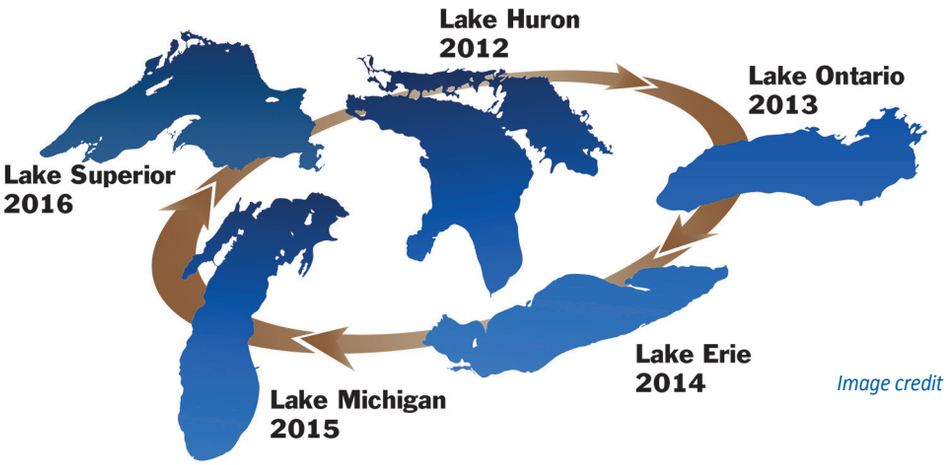


Image credit Loriann Cody

References

More information about the Lake Ontario Cooperative Science and Monitoring initiative can be found at: www.nyseagrant.org/csmi

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