International Efforts to Study and Understand the Great Lakes Ecosystem:

Monitoring Change Across Space and Through Time

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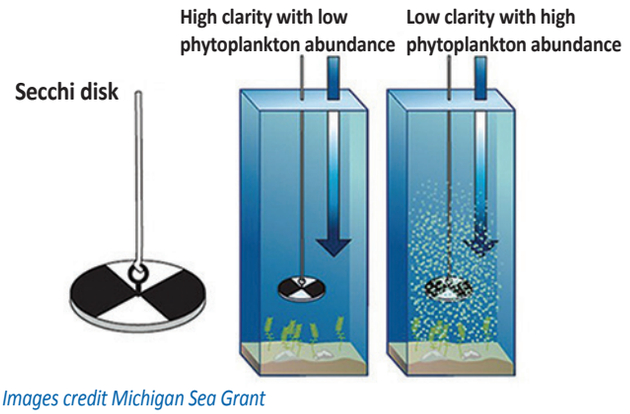
Boaters on Sodus Bay, a popular recreational area of Lake Ontario. *Image credit Diane Kuehn*

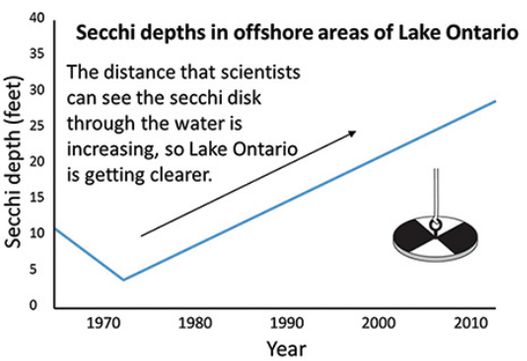
Learning from the Past

The effort known as the Cooperative Science and Monitoring Initiative (CSMI) focused on Lake Ontario in 2013. The international effort in 2013 was built upon previous and ongoing research that dedicated scientists have been conducting for decades. Understanding and learning from the past is a crucial part of forecasting the future. So, how do researchers use current science and monitoring to help forecast the future?

An Example: Water Clarity in Lake Ontario

Since the 1970's and 1980's two important factors have influenced Lake Ontario; 1) regulations have reduced the amount of phosphorus entering the lake, and 2) zebra and quagga mussels have spread throughout the lake. These changes have influenced phytoplankton (the base of the food web), reducing the nutrients they need to grow and reducing their numbers because mussels eat phytoplankton. With fewer phytoplankton in the lake, water becomes clearer. Scientists measure water clarity using a secchi disk, a black and white disk that is lowered into the water. The farther down scientists can see the disk, the clearer the water, and the fewer phytoplankton there are. This is exactly what has happened in Lake Ontario since 1970.





Images credit Michigan Sea Grant

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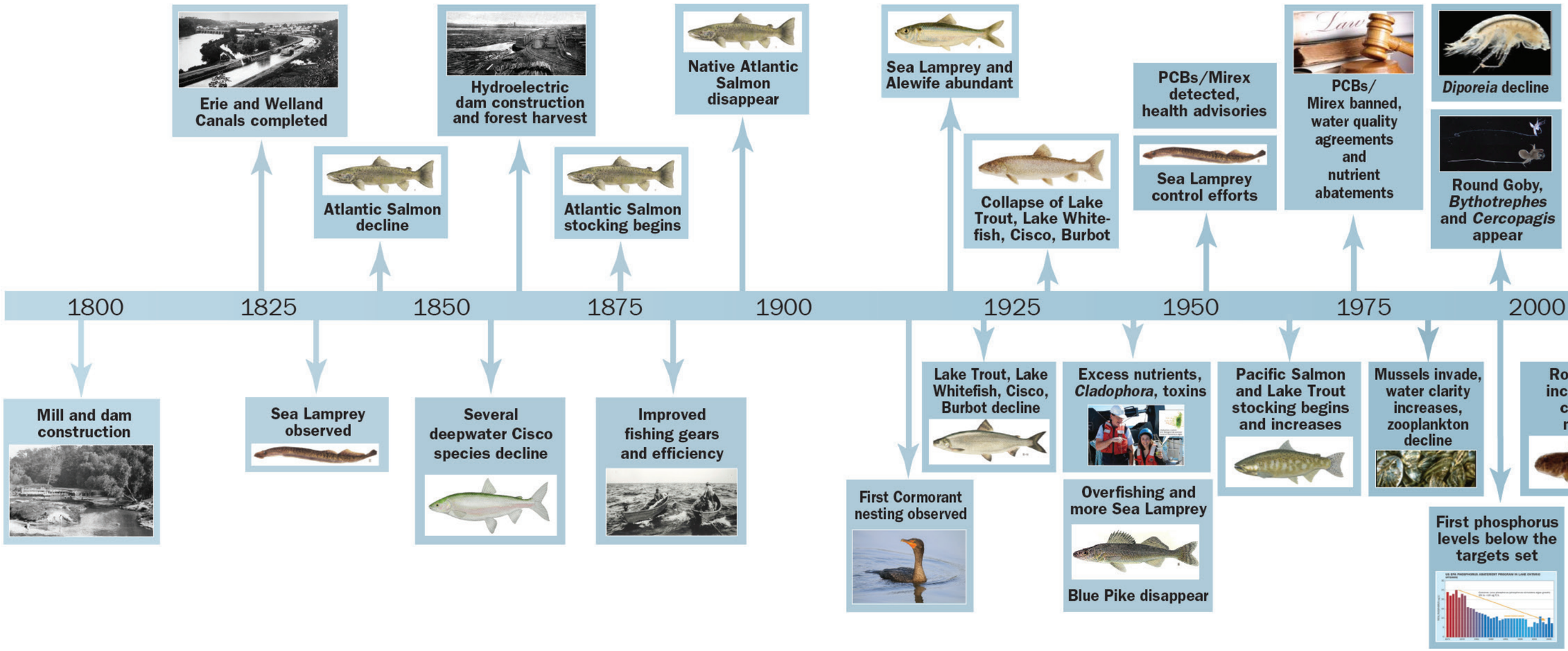
Changes Through Time

Studying and understanding previous events can tell us a great deal about how the Lake Ontario system might respond to events in the future like changing environmental conditions or new invasive species. So, sometimes to look forward, we need to look into the past…



Lake Ontario timeline *credit Loriann Cody*

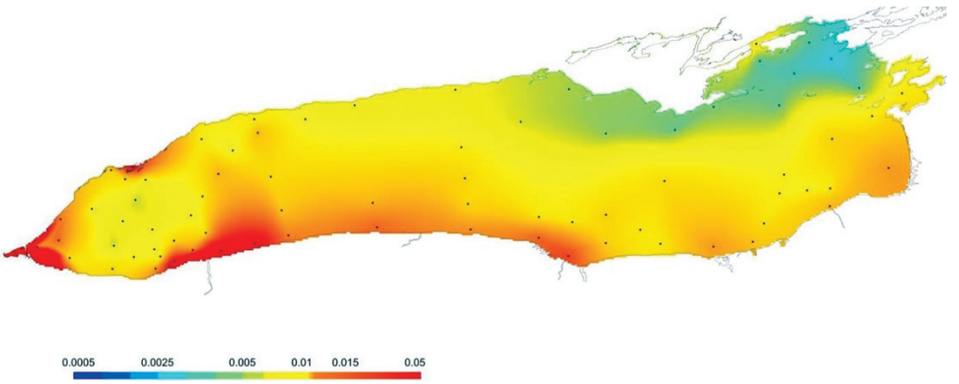
Image credits: Atlas of Inland Fishes of New York; New York State Department of Environmental Conservation Biological Survey Series; Inland Fishes of New York (Online); Matt Paufve; Loriann Cody; Maritime Museum of the Atlantic; Paul Focazio; Peter Thompson; The Lake Scientist; Utah Accident Attorney; Wikiwand

Learning from the Present

Lake Ontario is a complex system, and not only has it changed through time, there are differences within the lake itself. Certain areas have different chemical, physical, and biological characteristics compared to other areas. During CSMI 2013, scientists combined their efforts to better understand some of these differences and how they influence Lake Ontario and the organisms within it.

An Example: Nutrient Loading in Lake Ontario

Lakewide monitoring of water quality helps to show regional differences within the lake. Below is a representation of the surface concentrations of total phosphorus in the spring of 2013 in Lake Ontario. The southern and western regions of Lake Ontario have higher concentrations of phosphorus compared to the northern and eastern portions, where phosphorus is relatively low. These differences exist because of higher loadings from certain sources such as urban areas and intense agriculture, high inputs from Lake Erie via the Niagara River and the Welland Canal, and due to lakewide circulation patterns which mix the different water masses. Tracking the changes in the spatial distributions of water quality helps scientists to understand changes in Lake Ontario's nutrient dynamics over time.



Lake Ontario surface total phosphorus (mg/L) in the spring of 2013. Areas in red are areas where total P is relatively high, and areas in blue are those with relatively low total P.
Image credit Environment and Climate Change Canada's Great Lakes Surveillance Program

Looking to the Future

Many things have happened since CSMI 2013, and scientists will consider these changes when planning for CSMI 2018 and other future efforts. Some of the factors that scientists will be considering include:

- Declines in phosphorus continue while nitrogen is increasing in Lake Ontario;
- Round Goby play an important role as a species that moves from shallow to deeper waters each winter, moving energy from mussels to other parts of the food web;
- Arguably the most important prey fish population in Lake Ontario (Alewife), has changed dramatically in the past few years, and stocking practices have been altered in response;
- Drivers of cyanobacteria and ***Cladophora*** blooms occurring in some Lake Ontario embayments;
- The potential for application of new and advanced technologies to monitor Lake Ontario;
- The zooplankton community is experiencing change as well (declines in ***Bythotrephes*** for example), and this could directly influence prey fish and phytoplankton communities.

Scientists will continue to work together to better understand Lake Ontario. With unified efforts focused on evaluations through time and across space, they will be able to better forecast, manage, and prepare for the future in Lake Ontario.

References

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

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