Monitoring the Lower Trophic Level of Lake Erie

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Abstract

Since 2008, the Great Lakes Center has monitored two sites in eastern Lake Erie for the Lower Trophic Level Assessment, a multiagency effort begun in 1999 by the Forage Task Group of the Great Lakes Fisheries Commission. This long-term project is aimed at building a database of biotic and abiotic information from sampling stations throughout Lake Erie to describe annual trophic conditions. From May through October, we collect physical limnology data, water samples, and plankton samples biweekly, and benthos at least twice a year.

Background

In 1999, the Forage Task Group of the Great Lakes Fisheries Commission designed and implemented the Lake Erie Lower Trophic Level Assessment (LTLA). This project involves at least seven agencies from the United States and Canada that were already invested in sampling on the lake, and serves to coordinate and standardize their methods for long term monitoring. As part of this initiative, a database was established to manage the data collected for the LTLA, to allow data sharing between agencies, and to generate reports on the status of the lake. The major goals of this project are to monitor specific parameters to encompass ecosystem change, build a database with years of data, and apply the information gleaned about Lake Erie to assess the environmental effects on fisheries production.

At least twenty sites, arranged in pairs, were established throughout Lake Erie. There are now over twelve years of data accumulated in the LTLA database. The Great Lakes Center has been actively involved in the LTLA since 2008, when we took over Stations 19 and 20 from the US Fish & Wildlife Service. Our goals in joining this sampling effort are to collaborate with other agencies in the region, receive access to the group database, and monitor for climate change and invasive benthic species. In 2010, Dr. Alicia Pérez-Fuentetaja (Biology/GLC) joined the Forage Task Group as a representative for Buffalo State.

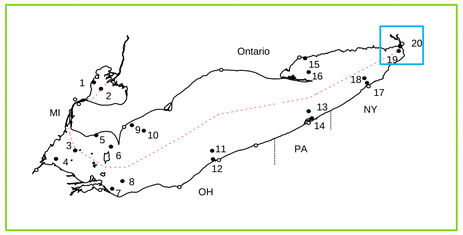


Figure 1. A map of Lake Erie, showing the 20 sampling sites of the Lower Trophic Level Assessment. The two sites in the blue box are maintained by Great Lakes Center staff. (Forage Task Group, 2009)

Sample Collection

To accurately capture ecosystem change, nine limnological parameters were identified by a panel of experts: temperature, oxygen, secchi depth, light, total phosphorous, chlorophyll *a*, phytoplankton, zooplankton, and benthos. The Great Lakes Center is capable of monitoring all of the parameters except light. In addition, we also measure pH, conductivity, and turbidity.

Figure 2. Typical field sampling procedures. (clockwise, from top left) Katie reads a vertical profile, which includes temperature, dissolved oxygen, pH, conductivity, and turbidity data; Mark fills sample bottles with composite water for phytoplankton, chlorophyll *a* and total phosphorus analysis; Mark collects benthic samples using a grab sampler; Katie collects composite water samples with a tube; Mark uses a zooplankton net to collect a zooplankton sample.

Sample Processing

This project also requires a fair amount of lab time. Chlorophyll *a* samples are filtered the day they are collected and the filters are frozen. Later, they are ground up to extract the chlorophyll into an aqueous acetone solution, and analyzed in our lab with a spectrophotometer using the Trichromatic Method (Standard Methods 10200H2c).

Benthos samples are sorted to isolate macroinvertebrates from the sediment and debris. The organisms are preserved so they can then be identified and counted when time permits. Plankton and total phosphorus samples are archived or sent to other facilities for analysis.

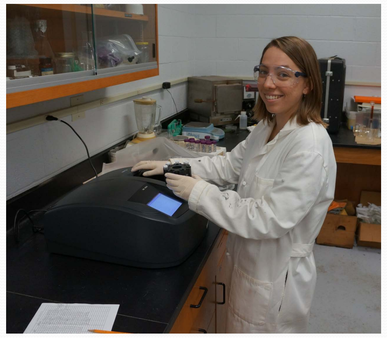


Figure 3. Katie processes chlorophyll samples in the lab using a spectrophotometer.

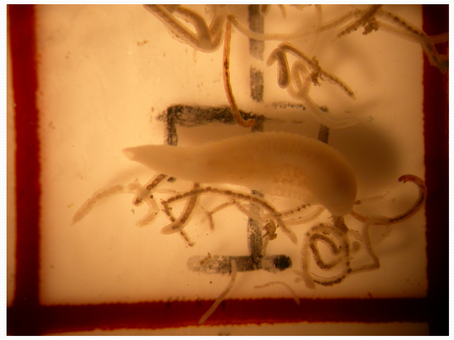


Figure 4. A benthic sample under a stereomicroscope for counting and identification. There are oligochaete worms, chironomid larvae, and a leech (*Hirudinea*).

Temperature Profiles

There are a number of ways to interpret the data collected in the LTLA database, depending on one's focus. Although it makes the most sense to incorporate data from the entire lake, one way to visualize the temperature data collected at one location is to make an isopleth plot. This kind of graph puts temperature profiles from multiple dates on one graph, with lines connecting equal temperatures. It's useful for seeing how temperature changes throughout the water column over time and whether the water becomes stratified. Isopleths can be compared between different locations in the same year, or at a single location between years for a sense of the seasonal variability.

For instance, 2009 had a much colder spring than 2012, but both years had milder summers. By contrast, 2011 swung between 4°C in May and 24°C in August. The spring temperatures may be influenced by ice cover such that years with earlier ice-out warm faster than years with later ice-out.

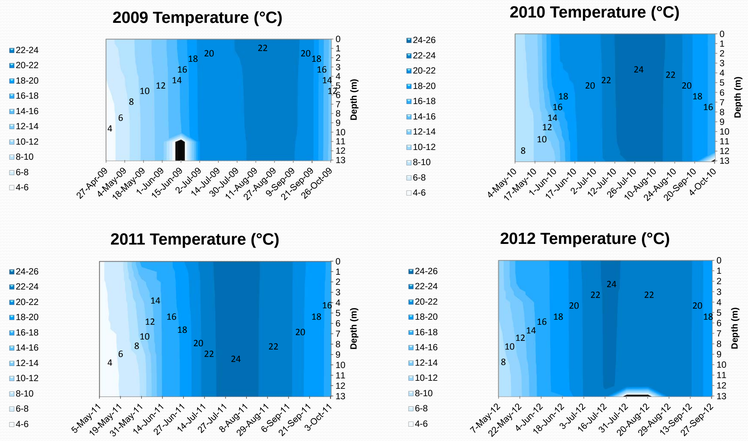


Figure 5. Temperature isolpleth plots for one of our sites (Station 19) over four different years, 2009-2012. The black areas just represent a shallower profile due to variability in the bottom of the lake. This sample site it is fairly shallow, so it is able to mix readily and does not typically stratify.

Conclusion

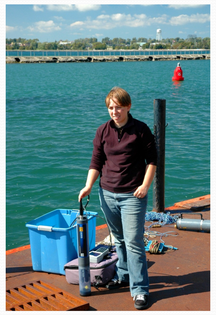
Long-term monitoring projects aren't quite like other studies in that there often isn't a hypothesis. The main goal is to describe the changes occurring in Lake Erie over a long period of time by collecting decades of data. The database can also be used by fisheries managers to help make decisions based on trophic indices.

We will continue to monitor our two sites and contribute to the Lake Erie LTLA. In the future, we may also gain access to the complete database.

References

American Public Health Association (APHA). 2005. *Standard Methods of Water and Wastewater*. 21st ed. American Public Health Association, American Water Works Association, Water Environment Federation publication. APHA, Washington D.C.

Great Lakes Fishery Commission Lake Erie Forage Task Group, http://www.glfc.org/lakecom/lec/FTG.htm



Acknowledgements

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