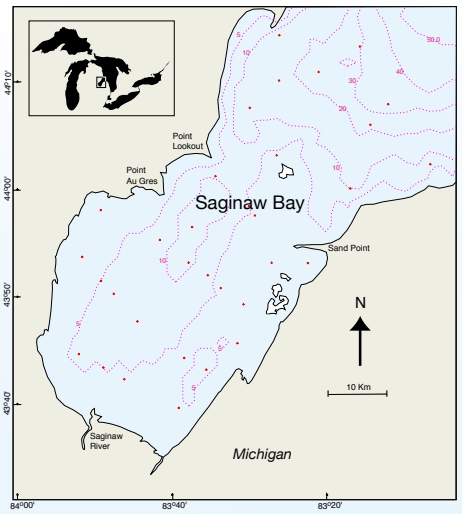
Managing the Impact of Multiple Stressors in Saginaw Bay

In 2007, the NOAA Great Lakes Environmental Research Laboratory, CILER, and several other partners began a 5-year project studying the effects of multiple stressors on Saginaw Bay in Lake Huron. Like many coastal areas around the world, Saginaw Bay has been subjected to numerous stressors originating from human activities. These stressors have included toxic contaminants, nutrients, sediments, overfishing, exotic species, and more recently, declining water levels. The combined effect of these stressors has compromised the health of Saginaw Bay and resulted in the loss of many ecosystem features and services that people value. The project is now in the synthesis stage; we are currently analyzing data and compiling reports of our main findings.

For the past several years, we have been conducting research in the field and the laboratory to study how these stressors interact to influence Saginaw Bay's fisheries and water quality. The information from these studies will be used to guide the development of several mathematical models that will help identify useful management options. Mathematical models will help researchers to organize what is known about the effects of stressors in Saginaw Bay and to identify the important processes about which very little is known. Additionally, the models will allow scientists to conduct simulated experiments, such as reducing phosphorus input to the Bay, to evaluate the logical outcome of alternative management actions.

Another objective is the development of an "Adaptive Integrative Framework" so that our models and field studies will be used interactively to inform one another. As an important component of this Adaptive Integrative Framework, our research will be conducted in coordination with local stakeholder groups under the guidance of representatives from the Michigan Departments of Natural Resources (DNR) and Environmental Quality (DEQ). This interactive environment will help the public understand the goals and difficulties involved in effectively studying and managing Saginaw Bay. In turn, our research will be informed and guided by local knowledge and an enhanced appreciation of the ecosystem services that the public considers most important.

Muck accumulation along the Bay City, MI shoreline.



TOP OBJECTIVES

Fisheries

- Management of dominant percid (walleye and yellow perch) populations and their associated fisheries.
- Manage for a diverse ecosystem, fish communities, and fisheries.
- Restoration of native species and control of non-natives.
- Manage for long-term sustainability.

Water Quality

- Predicting and managing muck deposition on beaches.
- Prediction and managing *E. coli*/ pathogens outbreaks.
- Determine what type of management efforts or policy changes would be effective in reducing the impacts of contaminants in Saginaw Bay (i.e. dredging of hot spots).
- Managing sediment loading.
- Managing and understanding the impacts of agriculture in Saginaw Bay (i.e. nutrient loads, sedimentation, *E. coli*).

Important Stressors & Their Effects

Phosphorus

Phosphorus is a nutrient that causes algae to grow. While it is essential to have some phosphorus in the water, too much can stimulate the growth of nuisance and toxic algae. Even though the Great Lakes Water Quality Agreement established a target phosphorus load for Saginaw Bay in 1978, inputs of this important nutrient continue to cause problems. Our results indicate that the target load (440 tonnes/year) is not being met, nor is the target concentration (15 ug/L) being met in the inner Bay (see Figures 1 and 2).

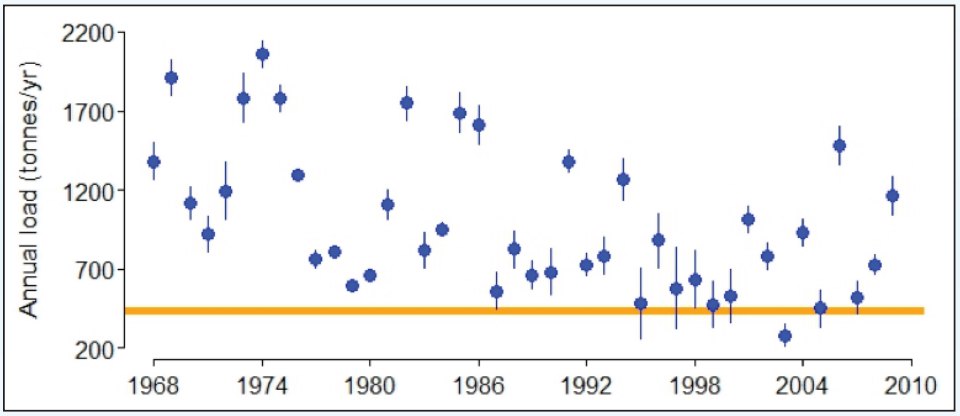


Figure 1. Estimated annual phosphorus load from 1968 to 2010.

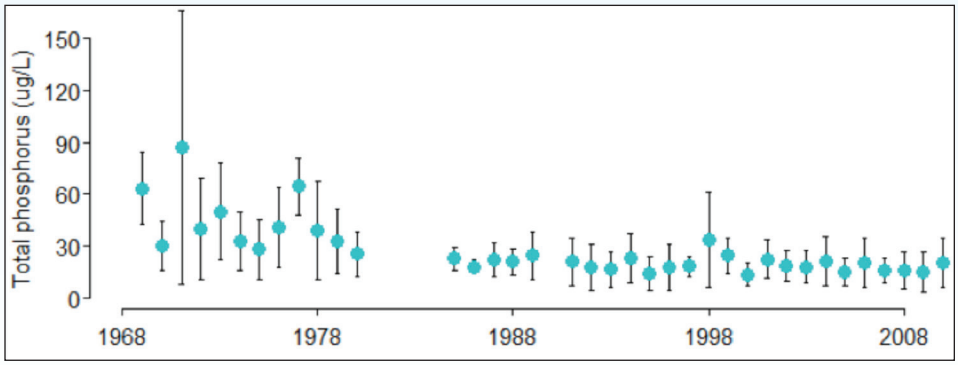


Figure 2. Annual phosphorus load (inner bay) from 1968 to 2010.

Invasive Species

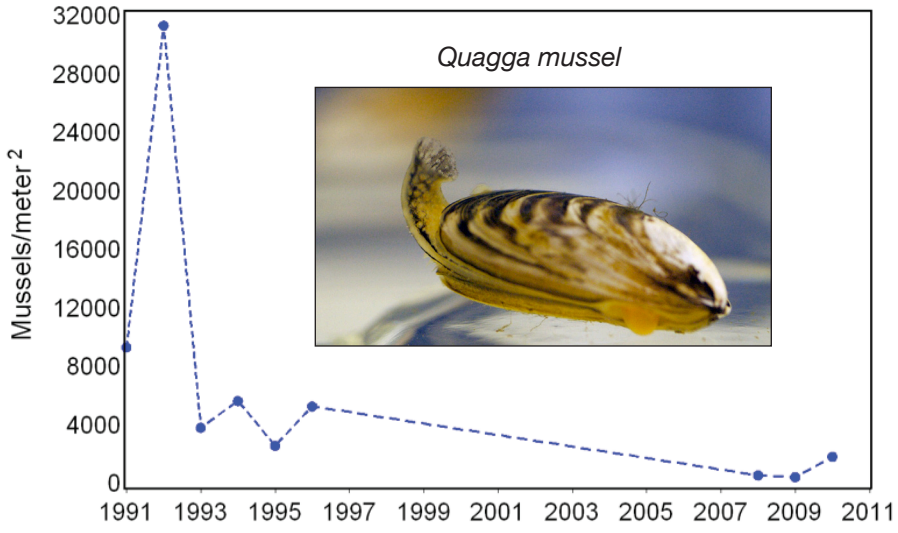


Figure 3. Annual mussel density in Saginaw Bay from 1991 to 2010.

Invasive Species

Many invasive species have entered the Great Lakes in recent years. Zebra and quagga mussels have been especially important because they filter large quantities of water, removing some algae and sediments from the water column. As a result the water has generally become clearer since these mussels invaded. However, because the water is clearer, more sunlight reaches the bottom of the shallow Bay causing nuisance algae to grow. These algae accumulate in the shallow areas along the shoreline and decay, resulting in a very unpleasant "muck". In addition, zebra and quagga mussels refuse to filter some of the toxic or harmful species of algae (some cyanobacteria, aka blue-green algae) – returning them to the water where they continue to grow. Our results indicate that mussel densities are lower than they were in the 1990s (Figure 3), and the population is now mostly quagga instead of zebra mussels. Our results also indicate that another recent invader, the round goby, serves as an important prey item for Saginaw Bay walleye.

For additional info contact:
Craig Stow (craig.stow@noaa.gov),
Scott Peacor (peacor@msu.edu)

www.glerl.noaa.gov

PARTNERS

NOAA
CILER Cooperative Institute for Limnology and Ecosystems Research
Michigan State University
DEQ
LTI
DNR Department of Natural Resources Michigan
WMU Western Michigan University 1903
Purdue University
The University of Akron
Case Western Reserve University Est. 1826
Wayne State University