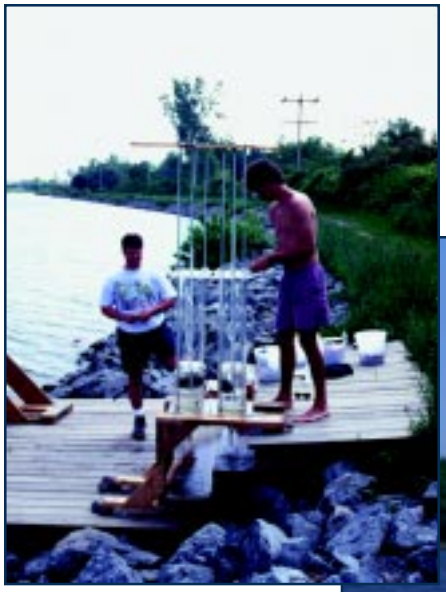
The Shell Game:
Where's the Phosphorus?

The Great Lakes basin is historically a hub of international economic activity. Ever since the first native peoples settled the region, the Great Lakes have been used for fishing, recreation, trade, and transportation. In modern times, these activities have created ecological problems for the Great Lakes, often threatening the continuation of those very activities. Two major problems are water pollution and the invasion of exotic species.

An important water pollutant for several decades has been phosphorus, once used in detergents but now common in fertilizer. Phosphorus is limited in freshwater lakes and its addition acts like fertilizer, causing unsightly algae blooms and explosive plant growth. When the algae and plants die, their decomposition can consume the lake's dissolved oxygen and result in fish kills. The expanded plant beds can choke formerly open water, interfering with swimming and boating. Officials and managers have sought to reduce phosphorus in surface waters in order to maintain water quality suitable for both wildlife and humans.

The invasion of exotic species has been another major ecological problem for the Great Lakes. Non-native species, often introduced by commercial shipping, may push out native species through competition and/or predation. They can also alter the functioning of the ecosystem through their presence, as does the zebra mussel (*Dreissena polymorpha*). Zebra mussels have much higher filter feeding capacity than native mussels do.

Combined with the high population densities that they can achieve, these molluscs have a big impact on the water column. The filtering activities of zebra mussels impact phosphorus cycling, making the jobs of water quality officials and managers even more complicated than they already are. The question is, do zebra mussels and zooplankton secrete the phosphorus contained in phytoplankton back into the water column or do zebra mussels sequester the phosphorus into their body tissues and shells? The answer to that question may impact management plans designed to reduce phosphorus pollution. Enter New York Sea Grant research.



Top: Greg Crego (left) and Greg Lampman (right), set the experimental chambers containing rocks covered with zebra mussels.

Bottom: Lampman checks the experimental chambers in the Erie Canal that allow him to measure filtering rates of the isolated mussels.

Photos courtesy of Joseph Makarewicz, SUNY College at Brockport

Top: Crego samples for veliger larvae of zebra mussels in the Erie Canal.

Bottom: Lampman checks zebra mussel cages where the molluscs are acclimated before use in an experiment.

New York Sea Grant researcher **Joseph Makarewicz** of the State University of New York College at Brockport and his team of graduate students conducted a project from 1992 to 1995 to examine the dynamics between zebra mussels and phosphorus. The research measured the inputs and outputs of phosphorus in a zebra mussel population in the Erie Canal. The team also conducted laboratory experiments that compared the rates at which populations of zebra mussels and zooplankton (such as *Daphnia*) graze on phyto- plankton and secrete phosphorus back into the water column. The major finding of the project was that zebra mussels divert phosphorus out of the water column and sequester it in their body tissue and shells.

This research was valuable in expanding knowledge about zebra mussel impacts, since at the time there was little known about the interaction between zebra mussels and phosphorus cycling. With research results showing that live zebra mussels take phosphorus out of the water column, management agencies trying to mitigate nutrient enrichment of their local surface waters can develop more effective abatement plans. Examples of local agencies that have benefited from this and related research by Makarewicz include the Livingston County Planning Department, the Monroe County Planning Department, and the Wayne County Soil and Water Conservation District. Each of these agencies is working on management plans to improve their local water quality that include components for phosphorus abatement. New York Sea Grant research such as this provides the knowledge to better inform local agencies so they can develop more effective management plans.

– Lane Smith

Emerging Scientists

This project also helped launch the science careers of four graduate students at SUNY Brockport who were part of the Makarewicz research team. Eileen Desormeaux received her MS degree and is currently a high school biology teacher in Chili, New York. Greg Crego earned his MS degree and is currently in the Ph.D. program at Mississippi State University fisheries department. Phil Tangorra received his MS degree and is now working for an environmental consulting firm in Utica, New York. Greg Lampman received his MS degree and worked as a research assistant at the Institute of Ecosystem Studies in Millbrook, New York. He currently works for the New York State Energy Research and Development Authority.

Photo by Diane Kuehn

Results of Sea Grant research are being used in the phosphorus abatement program for Sodus Bay in Wayne County.