

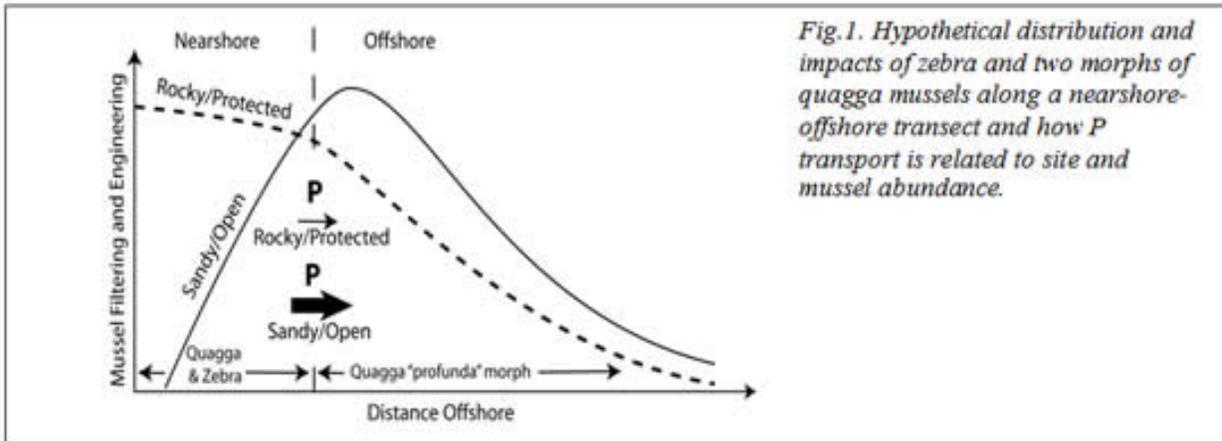
Spatial Structure and Biophysical Coupling in Pelagic Food Webs—connecting the Nearshore Shunt and Offshore Desert with the Laser Plankton Survey System (LPSS)

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Overview

It is increasingly obvious from our projects in Lake Michigan and Erie that spatial coupling in pelagic food webs horizontally and vertically on a diel basis is critical to understand ecosystem structure and function. This is especially important now in a dreissenid dominated world in which dreissenid engineering activities have created a nearshore P shunt and an offshore desert driven not only by P retention inshore but also massive impacts of the mussel themselves offshore (Figure 1). This in turn affects the pelagic food web by removal of phytoplankton and by alteration of light climate that potentially affects horizontal distribution of fishes and diel vertical migration (DVM) distribution of zooplankton and fishes. Saginaw Bay may be considered a nearshore shunt and open Lake Huron may be thought of as the offshore sink. In addition, although there are studies of acoustic abundance in the open lake there has never been an acoustic survey in this very large bay (80 km long). We propose to examine horizontal and vertical distribution of important variables along the axis of the bay to the open lake using an LPSS that we will repair and upgrade: temperature structure, phytoplankton fluorescence (phytoplankton), phycocyanin fluorescence (blue-green algae), colored dissolved organic matter (CDOM) fluorescence, light climate (PAR), suspended solids (scatter meter), zooplankton-sized particles (size and identify some taxa by shape factor), and oxygen. Fishery acoustics towed simultaneously with our new PSS will give spatial distribution of major food web components. Due to the desertification of the offshore region the bay may be an important place for forage fishes. The study of the changes in spatial structure along the axis will also give insight into the retention potential of the bay. Nutrients and microzooplankton will be examined at selected sites to fill in the picture. This exploratory study in conjunction with ongoing changes observed the open lake and those proposed for CSCOR'08 will give insight into the connections between these two systems. This exploration will be important for designing a transect sampling program of Lake Huron for CSCOR'08. This is an important adjunct to MultiStress, which does not consider forage fishes (a critical part in the food web) or linkages between bay and open lake. The proposed work will provide valuable information needed for models of food web response to invasive species in a number of projects. There is urgency to make sure the LPSS is ready and have details of deployment from GLERL research vessels are worked out before CSCOR and the Lake Michigan Food Web Study ramp up in 2010 with studies in 3 lakes simultaneously.



Proposed Work

- Repair and make software changes to correct problems of data overload experienced in using Laser Optical Plankton Counter (LOPC) in Lake Erie in 2007
- Replace troublesome CTD and fluorometer on Laser Plankton Survey System (LPSS).
- Add the following sensors: PAR (to replace one borrowed from us), CDOM (important for mapping out colored organic matter that can help correct problems with correlation of lake color and satellite images), phycocyanin sensor (for mapping out *Microcystis* and other blue-greens), scatter meter (built in with new fluorometer to measure suspended solids).
- Write software to analyze LOPC data and other sensor data stream.
- Run day/night transects to map out variables in bay—must run over same ground during day and night to get a complete picture of spatial structure of physical and biotic variables.
- Use and test software to analyze data with particular emphasis on statistical analyses.
- Explore possibility of using shape factors as an aid to identification of large particles (e.g., *Microcystis* colonies, *Bythotrephes*).
- Make sure LPSS can be used on vessels that will be deployed in Lake Huron, Michigan, and Erie in 2010.

Scientific Rationale

It is increasingly obvious from our projects in Lake Michigan and Erie that spatial coupling in pelagic food webs horizontally and vertically on a diel basis is critical to understand ecosystem structure and function. This is especially important now in a dreissenid dominated world in which dreissenid engineering activities have created a nearshore P shunt and an offshore desert driven not only by P retention inshore but also massive impacts of the mussel themselves offshore (Figure 1). This in turn affects the pelagic food web by removal of phytoplankton and by alteration of light climate that potentially affects horizontal distribution of fishes and diel vertical migration (DVM) distribution of zooplankton and fishes. Saginaw Bay may be considered a nearshore shunt and open Lake Huron may be thought of as the offshore sink. Using the LPSS and fisheries acoustics will allow us to better define these connections and explore spatial

distribution and abundance of forage fishes which are unknown and important for the ecology and fisheries of the bay.

In order to remain on the cutting edge of research and to maximize GLERL investments that have been made in previously acquired instrumentation, we would like to not only repair problems with the LPSS but invest in the integration of new sensors that will allow us to expand the scope of our spatial observations. In particular, we propose adding a CDOM sensor and phycocyanin sensor along with turbidity meter to map out suspended solids. The phycocyanin sensor will be particularly useful for mapping out HAB distribution in the bay and the CDOM sensor in conjunction with the turbidity meter will help in developing better correlations between satellite imagery and phytoplankton abundance.

Governmental/Societal Relevance

The profound ecosystem changes in Saginaw Bay are of great interest to the public, to state DNRs, and to Congress. The development of tools to map out plankton and fish distribution is of the utmost importance for understanding fisheries recruitment and HABs.

Relevance to Ecosystem Forecasting

The data collected in this project will be important for developing a big-picture view of the Saginaw Bay and Lake Huron linkage and forage fish abundance so that the importance of the bay can be defined at a larger scale than ever before examined.