US EPA Mid-Continent Ecology Division

Research Project Summary

Evaluation of Optically Acquired Zooplankton Size-Spectrum Data as a Potential Biological Metric of Condition in the Great Lakes

Overview

Changes in the Great Lakes take a long time to produce notable significant degradation, because of large water volume and long flushing times of the Great Lakes. Early detection of change is therefore important. Biotic indicators low on the food web are often the first trophic levels to be affected, followed by change at regional scales that may be indicative of impending change at even larger scales. A comprehensive index of ecosystem or biotic integrity for the Great Lakes should include zooplankton which contribute to the health of expected uses (e.g. fisheries).

An Optical Plankton Counter (OPC) towed behind a ship has potential for developing a biological measure for monitoring and assessment at the zooplankton trophic position in a food web. An OPC can acquire the raw data for determining mean size, abundance, and biomass, and additionally provide "spectral" information on the zooplankton community size structure. Also, the statistical and logistical problems posed by the expanse of the Great Lakes even on a regional basis can be reduced. This project is investigating the feasibility and the economics of using an OPC to provide a measure of size-structure and biomass of zooplankton communities as parameters to be developed as an indicator metric for zooplankton. Specifically, our goal is to determine if an OPC can be used to characterize and differentiate zooplankton communities in the Great Lakes. This project will also help in defining the spatial variability in pelagic community structure for improving assessment and monitoring design strategies, because of the spatial mapping capabilities of OPC in situ measurements.

A Focal Point mini-OPC (Model 2D), fluorometer, transmissometer, and a CTD is towed behind a research vessel to gather zooplankton size-spectrum and abundance data, fluorescence levels, light transmittance, conductivity, temperature, and depth. GPS data is included in the data structure. The surveys began summer 2002 in the western arm of Lake Superior at a reference site, and at sites in all of the Great Lakes in conjunction with a STAR grant project (GLEI; Niemi et al. 2001*). Sample sites in all of the Great Lakes were determined by a GLEI identified process to select near shore areas across a gradient of anthropogenic stress. At each site a paired set of transects are conducted.

Future directions will use the towing of electronic instrumentation packages to explore effects determined by the size of tributary inputs or embayment areas as potential areas in which to change and improve sampling strategies for greater efficiency, economics, and reliability of assessment monitoring.

*Niemi G, and others. 2001. Development of Environmental Indicators of Condition, Integrity, and Sustainability in the Great Lakes Basin. US EPA STAR Grant.

Key Products

Yurista PM, Kelly JR, and Miller SJ. 2005. Evaluation of optically acquired zooplankton size-spectrum data as a potential tool for assessment of condition in the Great Lakes. Environmental Management 35(1):34-44.

Yurista PM, Kelly JR, and Miller SJ. Comparisons of zooplankton community size structure in the Great Lakes. Journal of Geophysical Research -- Oceans: in press.

Yurista PM and JR Kelly. Spatial patterns of water quality and plankton from high-resolution continuous in situ sensing along a 537-km nearshore transect of western Lake Superior, 2004. Aquatic Ecosystems Health and Management, Book Chapter Ecovision Series. (In review)

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