Status of Macroinvertebrates in Lake Ontario

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Overview

Historically, the benthic community of Lake Ontario was dominated by an amphipod (*Diporeia* spp.), which together with fingernail clams (Sphaeriidae), oligochaetes, and chironomids, were the main components of the cold-stenotherm macrobenthic community occupying most of the deeper waters of all the Great Lakes (Cook and Johnson, 1974). These organisms are primarily detritivorous, dependant on surface production (particularly diatom blooms) sinking to the profundal areas.

The 1990's were a decade of rapid transformation for the Lake Ontario benthic community. Two dreissenid mussel species *D. polymorpha* (Zebra) and *D. bugensis* (Quagga) were introduced in 1989 and 1991 via ballast water exchange by commercial shipping. These non-native mussels are very efficient grazers of phytoplankton and may completely cover the bottom substrate. Both US and Canadian lake-wide studies documented the rapid spread of *D. polymorpha* and *D. bugensis* in shallow (0-30 m) habitats along the entire southern coast by 1995. Between 1992 and 1995, an increase in the biomass of both species was observed, but the increase of *D. bugensis* was much greater and *D. bugensis* appeared to replace D. polymorpha. *D. bugensis* was also observed as deep as 85 m in 1995, indicating the species ability to spread to deep, soft substrate habitats. By 2003, *D. polymorpha* were observed to depths of 220m.

As dreissenids became firmly established, the amphipod *Diporeia* dramatically decreased in abundance. We observed a decline from 3011 to 145 individuals per m^2 in the shallowest zone (12-88 m) between 1994 and 1997. Other researchers observed a similar decline from 5420 to 1937 individuals per m^2 between 1990 and 1995. In 2003, the average densities had declined to 5 individuals per m^2. Low nearshore Lake Ontario abundances of *Diporeia* observed in the 1980's had been attributed to contaminants rather than trends in water column productivity or fish predation. Large annual fluctuations of amphipod populations have been commonly observed in Lake Ontario. These population fluctuations have been hypothesized to be due to food variability or the intraspecific competition for food within or between year classes, but rarely reach the point of population collapse. During the 1990's, the timing of dreissenid expansion and *Diporeia* decline has suggested possible competition between the two organisms for sinking detrital food. Similar coupling between *Diporeia* declines and increases in dreissenid mussels has been observed in Lake Michigan and Lake Erie. There is a particular concern for the potential of *D. bugensis* to expand its range to deep offshore habitats where *Diporeia* still has healthy populations.

The objective of this study is to examine the status of the Lake Ontario benthic community in 2008 and document if the changes observed through the 1990 and 2003 are continuing. Our approach was to conduct a lake-wide spatial assessment of the benthic community along five transects in Lake Ontario during fall of 2008. The results of the 2008 survey will be compared with similar collections made in 1990, 1994, 1995, 1997, and 2003 as well as some historical collections from the 1960s and 1970s. The roles of lake oligotrophication and *D. bugensis*

competition on the decline of *Diporeia* populations will be evaluated evaluated with this time series.

Objective

Increase number of regional coastal and Great Lakes ecosystems delineated with approved indicators of ecological health and socioeconomic benefits that are monitored and understood.

Proposed Work

Lake wide monitoring of benthic macroinvertebrates have been done in Lake Ontario since 1994. Changes in population and community structure reflect the impacts of nutrient enrichment and invasive species. In cooperation with the US EPA and EC, lake wide estimates have been conducted since 1994, 1997, 1999, 2002, and 2008. The benthic survey in 2008 is critical to assessing the impacts of dreissenids on Lake Ontario open water ecosystem.

The sampling design for 2008 includes 59 sites where triplicate Ponar samples will be collected. Additional sediment samples will be collected and analyzed for TOC and grain size. All benthic organisms will be counted at each site. Lengths of *Diporeia* will also be measured for estimating total weight.

Governmental/Societal Relevance

The population increase and spread of dreissenids in Lake Ontario has led to changes in the food web including large impacts on important commercial and recreational fisheries. This project will provide information on changes in the temporal and spatial populations of important benthic species including *Diporeia*, *Dreissena polymorpha* and *D. bugensis*. There is a diverse community of potential users of the modeling forecasts we are developing. Environmental management within the Great Lakes is a partnership among federal, state, and local authorities. In addition, the Great Lakes region is rich in environmental advocacy groups.

Relevance to Ecosystem Forecasting

The research from this project will be useful for predicting the ecological impact on competing benthic macroinvertebrates and the impact of invasive species on native benthic communities. Ecosystem forecasting the impacts of dreissenids, an exotic species, in the Great Lakes is critical to managing the fisheries in Lake Ontario. With the invasion of dreissenids into the Great Lakes, there has been a major disruption in the Great Lakes food web. Similar to work in Lake Michigan (see Nalepa), this research will provide valuable information for model validation on the changes in Lake Ontario food web and the shift in competition and predation among Great Lake benthic macroinvertebrates.

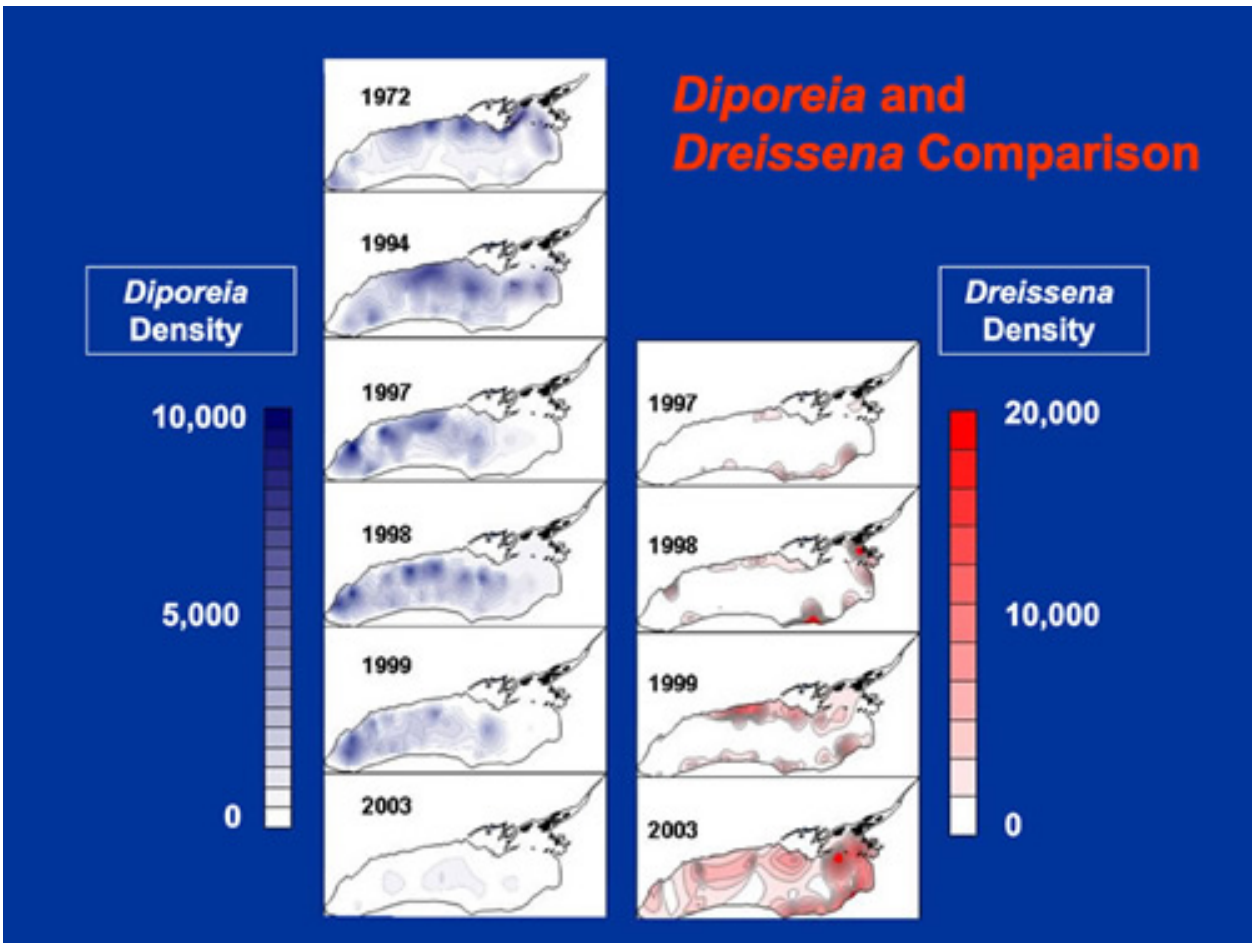

***Figure 1**: Diporeia and Dreissena comparison.*

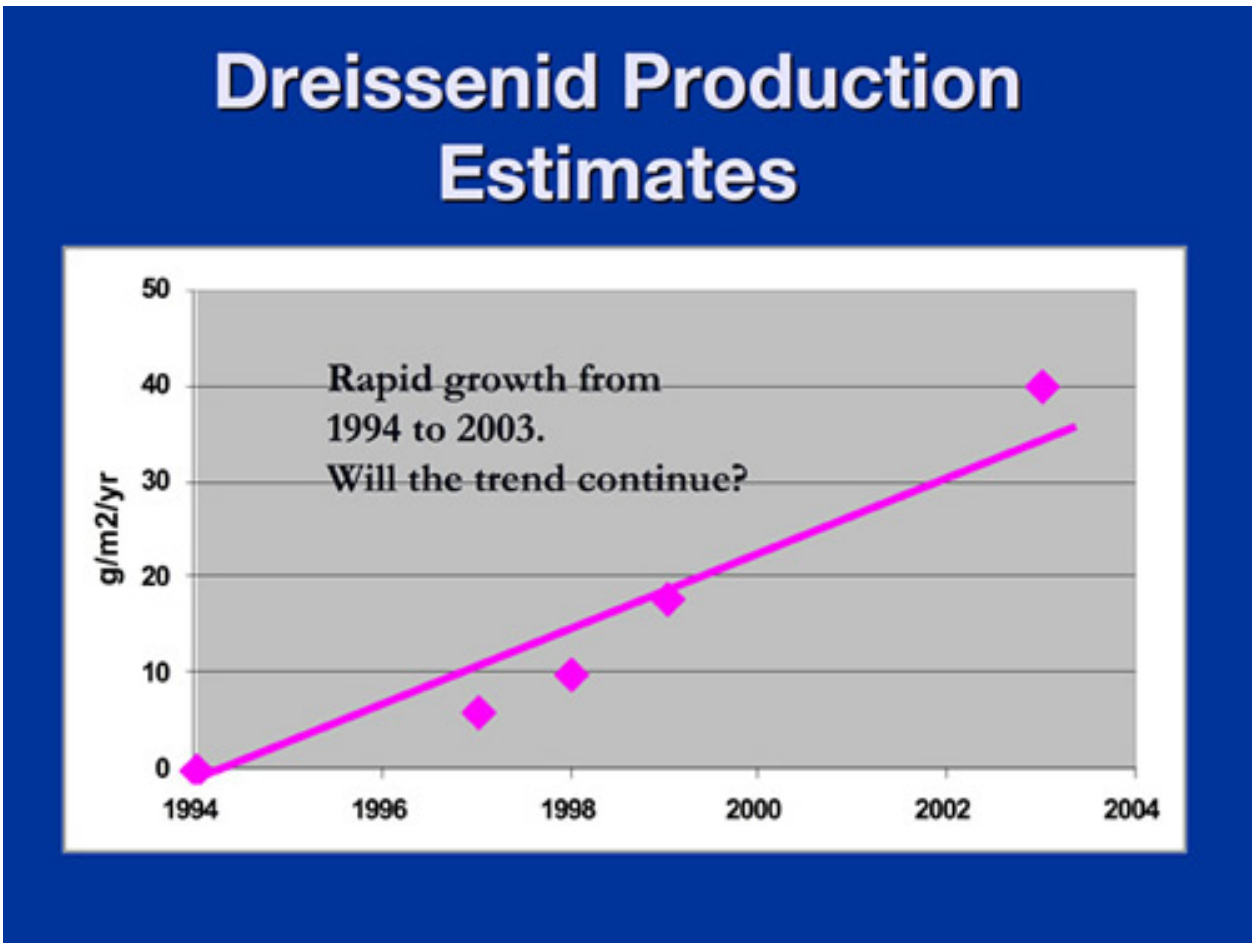

***Figure 2**: Dreissenid production estimates.*

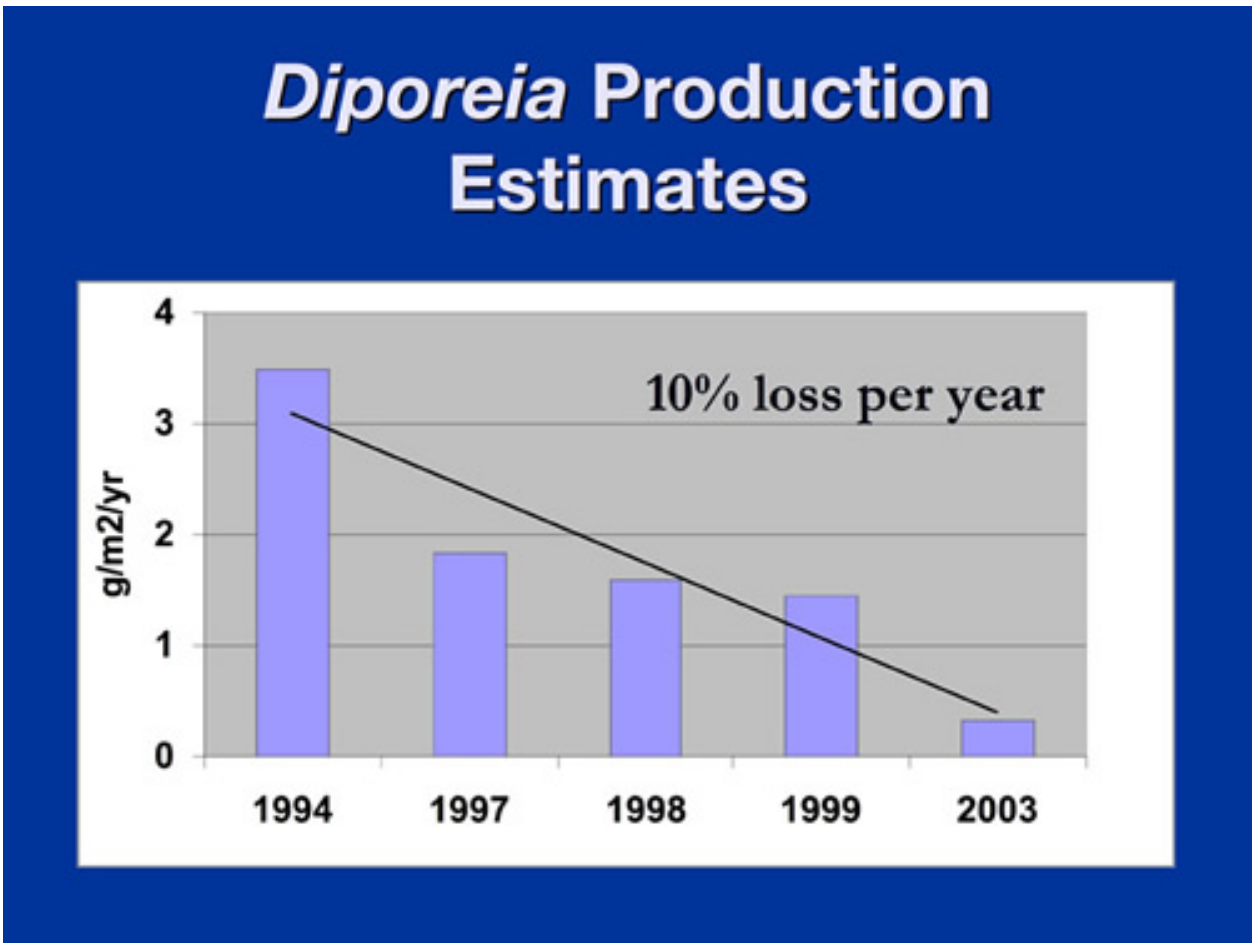

***Figure 3**: Diporeia production estimates.*