Invited Abstract

LAKE ERIE PLANKTON AT THE MILLENNIUM PLUS ONE: PROCESSES AND PROBLEMS

DAVID A. CULVER[1], Erin Haas[1], and Murray Charlton[2]

[1]Department of Evolution, Ecology, and Organismal Biology, The Ohio State University, Columbus, OH 43210, USA

[2]National Water Research Institute, Environment Canada, Burlington, Ontario, L7R 4A6

Since 1970, decreased phosphorus and increased nitrogen input have affected the functioning of the Lake Erie pelagic ecosystem (including algal, zooplankton, and fish abundances), even before the introduction of dreissenids further altered biological balances in the lake. Previously, we reported May-August mean algal biomass (mg wet weight/l) in the western basin declined from 5.3 (1970) to 2.0 (1985) to 0.9 (1995-97). Algal biomass data for the central and eastern basins for these years were (3.1, 1.0, 0.7) and (2.3, 0.4, 0.4), respectively. While we do not yet have algal counts from 1998-2000, chlorophyll measurements from all three basins suggest that algal abundances have increased recently.

The cyanophyte blooms dominated by Aphanizomenon and Anabaena that were so common in the 1970s have abated, with Chrysophyta and Cryptophyta dominating in 1996-97 in the western basin (67% and 21%, respectively). Central basin algae were dominated by Chrysophyta (55%), Cryptophyta (24%), and Pyrrhophyta (10%). Nevertheless, major blooms of toxic strains of Microcystis occurred in the western basin in 1995, 1998, and 2000, suggesting that phosphorus and ammonia availability may be increasing. Various lines of evidence suggest that zebra mussel excretion of phosphorus and nitrogen has increased nutrient content of the lake, at least in the western and west central basins. The highest algal concentrations occur in areas of agricultural runoff (e.g.. at the mouths of the Maumee and Sandusky Rivers), municipal discharge (e.g., around the Bass Islands and near Cleveland), and in areas where frequent upwellings bring nutrient-rich water to the surface (e.g., east of Long Point).

If zebra mussels are responsible for the recent cyanophyte blooms, their expansion over soft sediments suggests that Lake Erie algal blooms may continue to increase. In effect, increased internal loading of nutrients will counteract progress made in limiting external loading.

Zooplankton biomass has changed as well. While crustacean abundance was fairly constant from 1996 through 1999 in all three basins, samples collected in 2000 showed a 40% increase in the western basin relative to 1999, a 100% increase in the central and eastern basins. The increased contribution of rotifers, and especially dreissenid veligers, to the total zooplankton community has been particularly noticeable in samples from 2000. Biomass does not tell the whole story, of course, and we are anxious to make

calculations of secondary productivity for these samples, and estimate changes in grazing rates and nutrient excretion rates by the different components of the zooplankton.

Better understanding of the role of turbulent mixing on the impact benthic zebra mussels on pelagic algae is required. We also need much more information on spatial distribution and size distribution of zebra and quagga mussels, particularly as they expand to low turbulent energy, soft substrates. Most of our data on phytoplankton distribution are from surface samples, whereas it is clear that highest concentrations may be far below the surface. At the same time, distribution of plankton and nutrients from the inlets from the major western basin inlets (Detroit, Maumee, and Sandusky Rivers) profoundly affects the patchiness of the plankton, which we blithely sample based on fixed sites. Remote sensing of chlorophyll distribution will enable us to better model variation in surface algal abundance under the influences of rivers, cities, and upwelling events. Seasonal variation in phosphorus, nitrogen, and silica loadings are needed desperately for the modeling efforts, at a time when information is becoming increasingly scarce, particularly for the Detroit River.