Contributions of Lower Trophic Level Dynamics, Dreissenid Mussels, and Physical Processes to Lake Erie Changes

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Over the last 30 years, Lake Erie has been the focus of a program to reduce cultural eutrophication through nutrient regulation. Consequently, phosphorus loading has undergone dramatic decreases, generally reaching target-loading levels (11,000 tonnes). This reduction led to a marked decrease in both phytoplankton (from 5.3 to 0.63 mg/L) and crustacean zooplankton (from 0.30 to 0.14 mg/L) seasonal average biomasses from 1970 to 1995. Since 1995, there has been an increase in seasonal average phytoplankton biomass (up to 3.44 mg/L in 2002), whereas crustacean zooplankton biomass has leveled off (average 0.11 mg/L 1996-2001). We hypothesize that these changes are due to internal loading from dreissenid mussels. These invaders have reached and maintained high densities in the Western Basin where their abilities to filter particulate nutrients while excreting soluble forms in combination with turbulent mixing regimes can represent a significant increase in phosphorus fertilization. In turn, more algae can grow and along with the general west-east flow in Lake Erie, as the phytoplankton sink and are decomposed, oxygen is used up, which leads to hypoxic zone formation. Physical forces, including storm frequency, wind speed and direction, precipitation, and other mixing phenomena combined with the above biological processes control the extent and duration of hypoxic or anoxic zones in the Central Basin. These data provide an example of the high degree of complexity inherent in a large lake ecosystem, along with the need for explicit hypotheses while investigating these ecosystems.