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Lake Erie 2004-2005: Climate change and phytoplankton community composition

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Ecological communities respond to global climate variability and local perturbations. Phytoplankton are responsible for about 25 percent of global photosynthesis, but are primarily important as the base of the food web in an aquatic ecosystem.

To gain insight into the importance of temperature, we compared data for the phytoplankton community composition on Lake Erie in 2004 and 2005. Algal pigments in extracts of filtered water samples are determined by high performance liquid chromatography with photodiode array and fluorescence detectors (HPLC-PDA/Fl). Within a set of 21 chlorophylls and carotenoids, certain pigments serve as biomarkers for the major classes of phytoplankton in Lake Erie (cryptophytes, chlorophytes, diatoms, cyanobacteria). Multiple linear regression analysis is used to calculate class abundances from biomarker concentrations.

In 2004, the seasonal change in temperature was not as pronounced as in 2005; overall, 2004 was significantly cooler than 2005. Total biomass was comparable for both years; the contribution of diatoms and cyanobacteria was also similar, 30 and 24 percent, respectively. Of the remaining 46 percent of phytoplankton, cryptophytes were three times more abundant in 2004 ($P\ 0.00026 < 0.05$ df 48). Conversely, chlorophytes were four times less abundant in 2004 ($P\ 0.000000004 < 0.05$ df 46).

In the foodweb, diatoms and cryptophytes are an important source of essential fatty acids to zooplankton. Cryptophytes are also small, soft, and easily digested. The experimental data suggest that cooler temperatures in Lake Erie result in food of higher quality to zooplankton, than periods of warm temperatures.