

Impact of dissolved organic carbon, phosphorus, and grazing on phytoplankton biomass and production in experimental lakes

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Abstract

Phytoplankton biomass and production in lakes tend to be increased by phosphorus input and decreased by grazing or high levels of colored, dissolved organic carbon (DOC). We estimated and compared the effects of these three factors by using data from three lakes that were manipulated during 1991–1995, and data from a reference lake. Multivariate probability distributions of chlorophyll or primary production, as predicted by P input rate, DOC, and grazer length, were fit to the data. All three factors had substantial effects on chlorophyll, primary production, and their variability. Comparable reductions in the mean and variance of chlorophyll and primary production were achieved by reducing P input rate from 5 to 0.5 mg m⁻² d⁻¹, increasing DOC from 5 to 17 mg C liter⁻¹, or increasing mean crustacean length from 0.2 to 0.85 mm. The negative effect of mean crustacean length (an index of size-selective predation) results from grazing by herbivorous zooplankton. The negative effect of DOC on primary producers could be explained by shading. The results suggest that natural variation in colored DOC concentrations is a major cause of variation in primary production.