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REGULATION OF LAKE PRIMARY PRODUCTIVITY BY FOOD WEB STRUCTURE[1]

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Abstract. We performed whole-lake manipulations of fish populations to test the hypothesis that higher trophic levels regulate zooplankton and phytoplankton community structure, biomass, and primary productivity. The study involved three lakes and spanned 2 yr. Results demonstrated hierarchical control of primary production by abiotic factors and a trophic cascade involving fish predation.

In Paul Lake, the reference lake, productivity varied from year to year, illustrating the effects of climatic factors and the natural dynamics of unmanipulated food web interactions. In Tuesday Lake, piscivore addition and planktivore reduction caused an increase in zooplankton biomass, a compositional shift from a copepod/rotifer assemblage to a cladoceran assemblage, a reduction in algal biomass, and a continuous reduction in primary productivity. In Peter Lake, piscivore reduction and planktivore addition decreased zooplanktivory, because potential planktivores remained in littoral refugia to escape from remaining piscivores. Both zooplankton biomass and the dominance of large cladocerans increased. Algal biomass and primary production increased because of increased concentrations of gelatinous colonial green algae.

Food web effects and abiotic factors were equally potent regulators of primary production in these experiments. Some of the unexplained variance in primary productivity of the world's lakes may be attributed to variability in fish populations and its effects on lower trophic levels.

Key words: fish; food web; herbivory; lakes; largemouth bass; piscivory; planktivory; primary production; zooplankton.