Abstract

Littoral and pelagic habitats have been viewed independently in most studies of lakes. Mobile fishes that participate in both littoral and pelagic food webs can represent an important link between these habitats. Effects of fish predation on pelagic food webs are well described. However, the effects of littoral foraging by fishes on pelagic food web responses to fish predation are not well understood at the ecosystem scale. Littoral foraging by fishes has the potential to both increase internal nitrogen (N) and phosphorus (P) loading, and maintain high levels of predation on pelagic communities. The objectives of this research were to evaluate: (1) the effect of littoral foraging on nutrient cycling and phytoplankton responses to food web manipulation; (2) the effects of diel littoral:pelagic fish migrations on the spatial and temporal distribution of recycled N and P in lakes; (3) the supply ratio of N:P in fish excretion, and the effects of growth rates on supply ratios from fish populations in a diversity of aquatic ecosystems; (4) the effects of overwinter mortality on development of ontogenetic niche shifts in juvenile fishes; and (5) whether individual foraging specializations change in a density-dependent manner that sustains littoral-pelagic coupling.

My analyses demonstrated that littoral foraging by fishes has large impacts on nutrient cycles and enhances the responses of pelagic phytoplankton to food web manipulation. Diel migrations establish considerable nutrient heterogeneity in lakes that would not be present in the absence of fishes. Fish excretion regenerates nutrients at low N:P ratios which should contribute to development of bluegreen algae blooms. Severe overwinter mortality should cause juvenile fishes to develop risk-prone littoral:pelagic migrations. Individual foraging flexibility enables largemouth bass to persist on benthic prey but exert strong predation effects on pelagic communities in lakes. In general, littoral foraging by fishes alters the rates and ratios of nutrient supply to pelagic phytoplankton, while strong selection pressures amplify the role of predator-prey interactions in littoral:pelagic coupling.