

Altered energy flow in the food web of an experimentally darkened lake

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Abstract. Theory suggests that alternative resources may begin to support a food web when highly used resources become less available relative to alternatives. To test the potential for alternative resources to support consumers, we experimentally darkened a lake whose consumers had relied heavily on algal resources (phytoplankton and benthic algae). We estimated the support consumers received from resources before and after darkening using a Bayesian mixing model and stable isotopes of carbon, nitrogen, and hydrogen. Between a prior year and the darkened year, phytoplankton biomass diminished by 60%, and surface dissolved oxygen saturation, $p\text{CO}_2$, and net ecosystem production indicated a shift from autotrophy to heterotrophy. Although a specialist copepod maintained a high reliance on phytoplankton after darkening, a generalist zooplankton predator (*Chaoborus* spp.) derived more support from terrestrial sources. Fishes received less support from benthic algae after darkening, and received greater support from floating-leafed macrophytes or terrestrial resources. Phytoplankton support of fishes increased or was similar between years, resulting in a convergence of the proportion of support that fishes and zooplankton received from phytoplankton. The changes in algal support of fishes suggest that fishes had an increased connection to the pelagic habitat and decreased connection to the benthic habitat after darkening. After darkening, most consumers received more support from resource alternatives like terrestrial material (snail, *Chaoborus* spp., some fishes) or from floating-leafed macrophytes (some fishes). These shifts indicate that resource support of consumers is dynamic, and highlight the potential for increased support of consumer biomass by alternative resources.

Key words: allochthony; Aquashade; automated sensor; dissolved organic carbon; fish; metabolism; snail; stable isotope; whole-ecosystem experiment; zooplankton.

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