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Use of deep autochthonous resources by zooplankton: Results of a metalimnetic addition of ^{13}C to a small lake

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Abstract

Resources in lakes are vertically partitioned due to stratification and trophic interactions. Metalimnetic phytoplankton could be an important resource for zooplankton that either reside in the metalimnion or migrate through this layer. However, it is difficult to estimate metalimnetic resource use, especially using isotope approaches, because surface and deep phytoplankton often have similar isotopic compositions. To overcome this limitation, we experimentally enriched the metalimnetic dissolved inorganic carbon (DIC) ^{13}C pool in Peter Lake to enhance the isotopic separation between metalimnetic phytoplankton and other resources. Metalimnetic $\delta^{13}C$-DIC peaked at 73.2‰ after the isotope addition and maintained an average enrichment of 34.5‰ above epilimnetic $\delta^{13}C$-DIC for 62 d. Combining hydrogen and carbon stable isotope values, we estimated the epilimnetic, metalimnetic, and terrestrial resource use by zooplankton, using a Bayesian mixing model that accounted for uncertainties in both consumers and sources. We also measured diel vertical migration and net ecosystem production with in situ bottle incubations over the course of the experiment. Metalimnetic resource use was minor (0–8%) for zooplankton that either resided in the epilimnion of the lake during the day or migrated there at night. For consumers that resided in the metalimnion, metalimnetic phytoplankton accounted for 18–21% of zooplankton isotope composition. The most important resource for all zooplankton was terrestrial organic matter (56–73% of consumer mass), regardless of habitat. This experiment indicates that, in lakes like Peter Lake, metalimnetic autochthonous resources are of minor importance to zooplankton relative to epilimnetic autochthonous and allochthonous resources.