



Seasonal changes in the importance of the source of organic matter to the diet of zooplankton in Loch Ness, as indicated by stable isotope analysis

Grey, Jonathan, Roger I. Jones, Darren Sleep

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ABSTRACT: Seasonal variations in the stable isotope composition ($d^{13}C$ and $d^{15}C$) of crustacean zooplankton and their putative food sources in oligotrophic Loch Ness were recorded during 1998. Bulk particulate organic matter (POM) showed $d^{13}C$ values consistent with a terrestrial plant origin from the catchment and exhibited little seasonal variation, whereas POM $d^{15}C$ was more variable, probably due to associated microbial action. In contrast, phytoplankton $d^{13}C$ was relatively light and showed some seasonal variation, but $d^{15}C$ values were more constant. The isotopic signatures of both POM and phytoplankton remained sufficiently distinct from each other throughout the period of study to allow their relative contributions to zooplankton diet to be assessed. Zooplankton isotopic signatures shifted seasonally, reflecting a dietary switch from a reliance on allochthonous carbon derived from POM during winter and early spring to heavy dependence on algal production during summer. Annually, crustacean zooplankton in Loch Ness derive approximately 40% of their body carbon from allochthonous sources, likely mediated via microbial links. Separate determination of isotope ratios for the main zooplankton species allowed a more detailed trophic investigation. The most abundant zooplankton species in the loch, *Eudiaptomus gracilis*, incorporated appreciable allochthonous carbon even during the peak of phytoplankton productivity. By contrast, *Daphnia hyalina* grew mainly in late summer and autumn and derived almost 100% body carbon from algal sources. This study is the first to quantify such a seasonal switch in zooplankton dependence between allochthonous and autochthonous sources of organic matter in a large lake.

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