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RESEARCH ARTICLE

Hydrogen isotope discrimination in aquatic primary producers: implications for aquatic food web studies

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Abstract Large differences in δ^2H of primary producers between aquatic and terrestrial ecosystems are used to identify subsidies, discriminate organic matter sources, and reduce uncertainty in food web studies. Previous investigations of hydrogen isotope ratios suggest there may be predictable differences between the δ^2H of water and organic matter for different types of primary producers. We define the difference in the net isotopic discrimination between water and bulk organic matter (om) as: $\Delta_H = (\delta^2H_{om} - \delta^2H_{water}) \div (1 + \delta^2H_{water} \div 1{,}000)$. We summarized Δ_H values from published literature and we measured the δ^2H of water and primary producers in order to compare Δ_H among aquatic and terrestrial primary producers. Measurements were made from three water body types (lake, river, coastal lagoon) and their associated watersheds. Although we predicted a large and equivalent net isotopic discrimination for aquatic primary producers, we found considerable variability among groups of aquatic producers. Macroalgae, benthic microalgae, and phytoplankton had more negative Δ_H values (i.e. greater isotopic discrimination) than both aquatic macrophytes and terrestrial vegetation. The more positive δ^2H_{om} and hence lower Δ_H of terrestrial vegetation was expected due to relative increases in the heavier isotope, deuterium, during transpiration. However, the more positive values of δ^2H_{om} and relatively low Δ_H in aquatic macrophytes, even submerged species, was unexpected. Marine macroalgae had high variability in δ^2H_{om} as a group, but low variability within distinct species. Variability among types of primary producers in δ^2H_{om} and in Δ_H should be assessed when hydrogen is used in isotopic studies of food webs.

Keywords Deuterium · Macrophytes · Macroalgae · Hydrogen isotopes · Food webs · Lakes · Rivers · Coastal zone

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