Patterns and controls of lotic algal stable carbon isotope ratios

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ABSTRACT: Spatial and temporal variations in stable carbon isotope ratios (i.e., $\delta^{13}C$) of primary producers are common but poorly understood features of isotopic characterizations of aquatic food webs. I investigated factors that control $\delta^{13}C$ of algae (concentration and $\delta^{13}C$ of inorganic carbon, algal fractionation, and growth rates) in riffle habitats across a gradient in stream size and productivity in northern California. There was considerable seasonal and spatial variation in $\delta^{13}C$ of the green alga *Cladophora glomerata*, microalgal-influenced epilithic biofilms, and their herbivores. Algal and herbivore $\delta^{13}C$ were depleted in ^{13}C in small, unproductive tributary streams (-44‰ to -30‰) compared with more productive sites downstream (-31‰ to -23‰). The majority of variation in algal d13C of *Cladophora* and epilithic biofilms was determined by dissolved CO_2 (CO_{2aq}) via effects on $\delta^{13}C$ of CO_{2aq} and photosynthetic fractionation. In contrast, two other taxa (the cyanobacterium *Nostoc pruniforme* and the red alga *Lemanea* sp.) showed little variation in $\delta^{13}C$ or fractionation in response to varied inorganic carbon availability because of their distinct modes of inorganic carbon acquisition. Although variation in algal $\delta^{13}C$ might complicate use of $\delta^{13}C$ to resolve consumer diet sources under some circumstances, better understanding of such variation should improve the use of $\delta^{13}C$ techniques in aquatic food web studies.