Changes in carbon stable isotope ratios during periphyton development

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ABSTRACT: Stable isotopes are widely used to infer trophic relationships with little attention paid to temporal variability at the base of the food web. We examined changes in the carbon-stable isotope composition during periphyton development, sampling periphyton that accumulated on ceramic tiles at four stream sites over a 2-month period. Periphyton ^{13}C rose and fell in general concordance with rising and falling biomass at all four sites, resulting in significant correlations between periphyton $\delta^{13}C$ and chlorophyll *a* (Chl *a*). Mean $\delta^{13}C$ values at one site rose from -26‰ to -20‰ in 2 weeks, falling back to -24‰ the next week after a large scouring spate. Periphyton ^{13}C also underwent a smaller, longer-term increase that correlated with a gradual rise in stream temperature. Multiple regression analysis with both Chl a and temperature as independent variables accounted for up to 88% of the temporal variability in $\delta^{13}C$, with Chl *a* the largest source of variability. Water velocity, measured on each sampling occasion, was unrelated to temporal changes in ^{13}C. Depletion of inorganic carbon within the periphyton matrix is the probable cause of increasing ^{13}C in periphyton as biomass develops. Rising $\delta^{13}C$ values during periphyton biomass development suggest the possibility of carbon-limited periphyton growth, even in alkaline waters. The strong link between biomass and periphyton ^{13}C helps explain the large range of $\delta^{13}C$ reported for periphyton in streams, where temporal and spatial variability in periphyton biomass are notorious.

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