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Stable Isotopes Disentangle Organic Matter Sources and Dynamics in Riverine Habitats

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Suspended particulate organic matter (POM) sampled in California's Sacramento-San Joaquin Delta was highly variable in its carbon and nitrogen isotopic composition over shorter spatiotemporal scales than have been previously considered. We developed statistical models to understand these variations over space and time. Principal component analysis of POM data revealed systematic patterns of correlation amongst variables which corresponded to potential POM sources, along with spatiotemporal differentiation of POM. Regression modelling and partial Mantel comparisons confirmed that water temperature and hydrological conditions were the primary measured variables driving POM compositional variability. We expanded this work by measuring compound specific isotope compositions of amino acids (AA) in various organic matter sources including higher plants, POM, zooplankton, and fishes to further elucidate the contribution of allochthonous and autochthonous materials to POM and secondary production. Comparison of the δ^{13}C of amino acids in POM and higher plants confirms that POM in our riverine ecosystem does not resemble that of unaltered higher plants. The absolute range of δ^{13}C in higher plant amino acids (mean range in values= 34‰) was significantly greater than that measured in POM (mean range=23‰). Despite being offset by up to 10‰ AA-δ^{13}C in POM, zooplankton, fish, and higher plants tended to be positively correlated, presumably owing to similarities in biochemical pathways in each. One exception was a sample collected on an active floodplain, which had a AA-δ^{13}C range indiscernible from terrestrial plants, potentially indicative of significant terrestrial/allochthonous organic matter input to floodwaters.

Among native and non-native fishes, nitrogen isotopic values had a high degree of similarity, and were more similar to zooplankton than higher plants. The $\Delta^{15}\mathrm{N}_{(Glu-Phe)}$ values that are indicative of trophic level within fishes and zooplankton do not support prevalence of an allochthonous source of nitrogen to those consumers. High similarity of AA-δ^{15}N in consumers demonstrates their reliance on a distinct subset of overlapping resources, which suggests that both the native and non-native fishes are competing for similar high quality food items.