Natural isotope tracers for studying stream ecology

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Freshwater ecosystem is one of the threatened systems, on which human activity has affected by nutrient loading, artificial modification and introduction of exotic species. Decline of biodiversity in freshwater ecosystem is a matter of concern, however, it is often difficult to compare with ecosystem level property, i.e. ecosystem function. Isotope ratios of living organisms and nutrients are one of the useful indicators to bridge the two parameters. Current development of isotope technique, especially, nitrogen isotope ratios of individual amino acids and natural abundance of carbon-14 (Δ^{14} C), has potential advantage to evaluate interactions between species. We used these techniques in the following three ecosystems.

We first developed a methodology to describe food web structure using nitrogen isotope ratios of individual amino acids in riverine ecosystem, where aquatic and terrestrial resources are mixed. We applied this approach to food webs in Yasu and Ado streams, which are tributaries in the Lake Biwa watershed. Then, we compared $\Delta^{14}\!C$ values of aquatic organisms, and confirmed a utility to quantify the reliance between aquatic or terrestrial productions. In Gomadan-area, we studied trophic structures of headwater streams, using a chronosequence after a clear-cut. The ecological response in the studied streams to clear-cutting and re-planting of Japanese cedar is much slower (~20 years) than the chemical response (<5 years). More than 50 years is required for the food web structure to completely recover from clear-cutting. In Arida-river, nitrogen isotope ratios of living organisms were higher downstream, indicating the effect of nutrient loading from orchard (especially tangerine), however, food-web structure didn't change as a result of moderate eutrophication.