

Effects of Eutrophication on Food Chain Length in Rivers and Riparian Zones

(河川および河畔における食物連鎖長に富栄養化が及ぼす影響).

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Food Chain Length (FCL) is an important ecosystem attribute that reflects food-web composition and could affect its persistence to disturbance. Theoretically, resource availability is one of the determinants that can regulate FCL even in a river ecosystem but few research has been conducted till today. Eutrophication (nutrient enrichment) caused by anthropogenic activities could change FCL through the addition or removal of intermediate trophic levels in a river. More studies have examined the effects of anthropogenic activities on FCL of lentic systems compared to lotic ones. Also, river ecosystem is strongly linked to its adjacent riparian zone by reciprocal flows of matters and organisms, but few study examined the responses of FCL in linked river-riparian ecosystems to anthropogenic activities. We examined the effects of eutrophication on FCL in rivers and their adjacent riparian zones using stable isotopes of carbon ($\delta^{13}\text{C}$) and nitrogen ($\delta^{15}\text{N}$).

The study was conducted in three rivers i.e. Satsunai, Otofuke and Bisei (4 sites in each river) along Tokachi river basin, Hokkaido, Japan. All the samples of aquatic and riparian consumers were collected in July, 2015. Electric conductivity (EC), pH, Temperature, ammonium (NH_4^+), nitrite (NO_2^-), nitrate (NO_3^-) concentration of river water were measured to identify the level of eutrophication and ash-free dry mass of algae (AFDM, mg/cm^2) was quantified to estimate the primary productivity. FCL was defined as the differences in $\delta^{15}\text{N}$ between top predators and their basal resources. We determined the relative contribution of different food items in consumers with IsoSource mixing model. Statistical analyses were done by using GLM and GLMMs.

Nitrate was significantly correlated with both of primary productivity and $\delta^{15}\text{N}$ of algae. FCL of river ecosystems were negatively correlated with primary productivity. Rainbow trout (*Oncorhynchus mykiss*) was taken as a top predator and FCL ranged from 3.0–4.6‰ across rivers which perhaps caused because of an increase in omnivores, herbivores and other low trophic position species in rivers. FCL of riparian zone with frog (*Rana pirica*) and ground beetle (Family-Carabidae) being as top predator was not affected by eutrophication in our study. Our results suggested that eutrophication could shorten FCL in rivers without changing substantially the FCL of their adjacent riparian zone.