平成２9年度　環境科学院　修士論文内容の要旨

Aquatic food-web structure in floodplain waterbodies in relation to nutrient pollution, ecosystem size, and invasive species

（氾濫原水域における食物網構造と栄養塩負荷、 生態系サイズ、および外来種との関係）

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Food-web helps to understand the dynamics of energy transfer in an ecosystem, and is an important conceptual tool for illustrating the feeding relationships among species which provides critical information in understanding ecosystem structure. Food chain length (FCL) is one way to quantify and characterize food-web, and used to represent the trophic structure and exerts strong influences on community composition, species diversity and ecosystem function. In lentic systems, unionid mussels (Order: Unionoida, Family: Unionidae) used frequently to represent food-web base since they have low mobility and filter-feed largely on suspended fine particulate organic matter. Productivity and ecosystem size are among the strong determinants of FCL. Most previous studies focused largely on larger and deeper systems, but less on smaller and shallower systems. Also, there is limited understanding of how human activities such as increase in nutrient inputs can affect FCL and how such an interaction can be indirectly affected by the presence and distribution of invasive aquatic species. The floodplain waterbodies are habitat for unique wildlife species and important for nutrient processing, but now critically endangered globally. This study aimed to provide FCL and food-web information for Ishikari floodplain waterbodies, which are threatened with habitat degradation, fragmentation and proliferation of invasive species, for the future sound restoration and management.

The study was conducted in 42 waterbodies in Ishikari floodplain, Hokkaido, Japan. All the samples of aquatic consumers were collected in December, 2015, May, July, August, October, November, 2016. Electrical conductivity (EC), pH, temperature, dissolved oxygen (DO), nitrite (NO_2^-), nitrate (NO_3^-), total nitrogen (TN), total phosphorus (TP), chlorophyll a (chl.a) concentration of water were measured to identify water quality. Carbon and nitrogen isotope ratios of consumers, seston, aquatic plants and detritus were measured. FCL was defined as the differences in nitrogen isotope ratio ($\delta^{15}N$) between top predators and baseline (unionid mussels). Major food resources of consumers were also estimated by the use of carbon isotope ratios ($\delta^{13}C$). Statistical analyses were done by using GLM and GLMM.

TN and $\delta^{15}N$ were both high and thus the effects of human activities were inferred. Mussel $\delta^{15}N$ and $\delta^{13}C$ significantly varied with seasons with the median change <1‰, which was much less than the ranges of FCL estimates among sites. There was no significant correlation between mussel $\delta^{15}N$ and any of water pollution measures (e.g., TN). Invasive species were commonly at the top and mussels were at the bottom of webs with 2-3 tropic steps below, forming a relatively simple food-web in Ishikari floodplain waterbodies. There was a significant difference between the corrected $\delta^{13}C$ value of mussel and phytoplankton but not with detritus, suggesting mussels' feedings on detritus rather than seston. Higher-level fish consumers generally depended on the same carbon sources as mussels. There was no significant relationship between FCL and other factors considered (i.e., waterbody size, productivity, TN level), suggesting that nutrient pollution and habitat degradation are not the determinant of food-web structure. Our results also demonstrated that carbon sources of food webs were slightly different among waterbody types related to historical formation processes and a productivity gradient. Future management at least should take into the account this diversity although the contemporary food-web is dominated by invasive species.