



Stable Isotopic Perspective on Opportunistic Dietary Shifts of Bighead and Silver Carps Co-occurring in Native Habitats, China

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Abstract

Filter-feeding bighead carp (*Hypophthalmichthys nobilis*) and silver carp (*Hypophthalmichthys molitrix*) are globally important species in terms of higher fish production and suitability in biological control of eutrophication. Previous studies on feeding ecology of these two species were mainly based on gut content analyses of fish in confined and controlled environments. By using $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ stable isotope ratios and Bayesian mixing models an attempt was made to analyze the trophic relationships among freely foraging bighead and silver carps, and their potential food items in four trophically different lakes in China. In each lake, three study sites were selected. At each study site, trophic condition was assessed using habitat characteristics. Fish were collected from gill nets and fke nets, to retrieve dorsal, white muscle tissue for stable isotope analysis. Zooplankton, phytoplankton, fine particulate organic matter and detrital plant particles within the sediment were collected as potential food types to analyze $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values. Stable isotopic values of food sources were significantly different among four lakes (Kruskal-Wallis; $P < 0.005$). Habitat characteristics were significantly different among four lakes and hot (summer) and cold (winter) sampling periods (2-way ANOVA; $P < 0.05$). Bayesian mixing models revealed that both fish species had similar diets within lakes, and where dietary shifts occurred, both species displayed dietary shifts simultaneously. Diet was generally based on plankton, however, detritus was the main food in the lake subjected to urban pollution. Diet of both species shift towards phytoplankton when algal biomass was high in the lake with artificial fertilization. Niche breadth was variable but in general clear size-based resource partitioning was observed, with bighead carp preying more on zooplankton and occupying a higher trophic position, and silver carp feeding more on phytoplankton. Isotopic niche tend to overlap in the habitats with high non-algal turbidity, and marked with lower conductivity and pH values.

Keywords: $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$, Bayesian mixing, filter-feeding fish, Layman metrics, sub-tropical lakes