

Stable Isotopes Reveal Diet Overlap between Invasive Asian Carps and Native Filter-Feeding Fishes in the Lower Missouri River, USA

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Introduction

The recent invasion and extremely rapid population growth of silver carp (*Hypophthalmichthys molitrix*) and bighead carp (*H. nobilis*) in the Mississippi River basin has caused concern that increased competition for plankton might be detrimental to native planktivores. Bigmouth buffalo (*Ictiobus cyprinellus*), gizzard shad (*Dorosoma cepedianum*) and paddlefish (*Polyodon spathula*) are filter-feeding fishes native to the basin that might be negatively affected by the Asian carps. If diet overlaps, and a limited food resource exists, then competition is likely. In this study, we used stable carbon and nitrogen isotopes ($\delta^{13}\text{C}$ and $\delta^{15}\text{N}$) to trace energy flow pathway, trophic positions and dietary overlaps.

Results

Our isotope data indicate that the food base of the filter-feeding fishes was particulate organic matter (POM) in the water column. This is evidenced by the similarity of $\delta^{13}\text{C}$ values of POM and the fish muscle tissue. Although $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ of POM varied greatly among stations, the isotopic compositions of silver carp and gizzard shad sampled from several stations did not differ significantly, suggesting that these fishes integrated the organic matter throughout the river regions. Several fishes had a positive relationship between total length and muscle $\delta^{15}\text{N}$. This can be explained by increases in trophic position as fish grew. A dual isotope plot revealed stepwise $\delta^{15}\text{N}$ increases from POM to zooplankton and fishes. The $\delta^{15}\text{N}$ values of bighead carp, hybrids, bigmouth buffalo and paddlefish varied within 1‰, indicating that they shared similar trophic position and had high degrees of trophic overlap. The $\delta^{15}\text{N}$ values of silver carp and gizzard shad differed by less than 1‰ and are 2‰ lower than those of other species, suggesting that they relied on similar diets at the lower trophic positions.

Conclusions

This study demonstrates dietary overlap between the invasive Asian carps and the native filter-feeding fishes and the usefulness of stable isotopes as natural tracers for carbon flow and trophic position in the aquatic ecosystem.