

## Responses of nitrogen stable isotopes in fish to phosphorus limitation in freshwater wetlands



Human-induced eutrophication has altered ecological processes in aquatic ecosystems. Detection of ecological changes is a prerequisite for protecting ecosystems from degradation. In this study, nitrogen stable isotopes ( $\delta^{15}\text{N}$ ) in fish are evaluated as indicators of environmental changes in south Florida wetlands. Stable nitrogen isotope ( $\delta^{15}\text{N}$ ) data of select fish species and water quality collected from the Florida Everglades between the 1990s and 2000s were used to assess the relationship between total phosphorus concentrations and  $\delta^{15}\text{N}$  ratios. The  $\delta^{15}\text{N}$  ratios in nine of ten select fish species increase significantly as total phosphorus concentration in the surface water increases. There were significant relationships between total nitrogen concentration in the surface water and  $\delta^{15}\text{N}$  ratios in several fish species. The pattern of changes in  $\delta^{15}\text{N}$  ratios along nutrient gradients suggests that increased eutrophication is recorded as the  $\delta^{15}\text{N}$  ratios in fish. The lack of human wastewater loading, the dominance in agricultural runoff and the high TN:TP ratio suggest that phosphorus is the limiting factor driving ecosystem productivity and the changes of

$\delta^{15}\text{N}$  ratios in fish. Results from this analysis demonstrate that  $\delta^{15}\text{N}$  ratios in fish integrate biotic responses to eutrophic process over time and could be a robust indicator for early ecological changes.

**Auteurs du document :** Jianming Hong, Binhe Gu

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