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# Trophic niche divergence between native amphibians and an invasive crayfish promotes their coexistence in pond ecosystems

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## Abstract

Invasion theory suggests that biological invasions are responsible for large changes in species interactions in natural communities, because invasive species have large trophic niches and alter the diet of native communities, notably due to their competitive superiority. The non-native red swamp crayfish, *Procambarus clarkii*, is considered to dramatically alter aquatic food webs and especially to prey upon larval amphibians and outcompete adults. However, to date, this issue has been poorly studied using biomarkers such as stable isotopes, especially because sampling muscle (the reference tissue) is lethal and inappropriate for the vulnerable amphibian species.

This work aimed at (1) testing the relevance of sampling the fin of amphibians as a surrogate to the muscle to estimate isotopic ratios of carbon and nitrogen, and (2) exploring the type and extent of trophic interactions between the red swamp crayfish and four species of the amphibian community in natural ponds. We predicted that the sympatry with the invader would change the niche width of amphibian populations and result in substantial niche partitioning. Food webs were studied in 20 ponds selected over a gradient of crayfish densities and habitat features (1810 samples including 1230 amphibians and crayfish), in western France. Fin and muscle isotopic ratios were strongly related for the four amphibian species, validating the use of non-lethal fin punches for stable isotope analyses given specific correction factors. Large variations in amphibian niche width were recorded, especially for anuran tadpoles when compared to urodele adults. Niche overlaps of amphibians and crayfish were very limited and shifts in the trophic niches of amphibians were mainly contingent upon environmental pond conditions. Our results highlighted that the high flexibility in trophic niche of amphibians would facilitate their co-existence with the invasive crayfish in pond ecosystems.

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