

Global food web alteration following goldfish introduction in palmate newt dominated pond ecosystem

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Introduction of invasive species is one of the main threat to amphibians worldwide. Beyond direct predation or competition effects with native species, omnivorous invasive species are of particular concern as they can have important and long-term impacts on native populations by affecting the entire communities. In Larzac (Southern France), declining trends in the pond-breeding palmate newt (*Lissotriton helveticus*) populations are correlated to goldfish (*Carassius auratus*) introductions. However, the processes leading to local extinction of newts as well as other native organisms from invaded ponds are not fully understood. In particular, by destroying the aquatic vegetation, goldfish may have a strong impact on the pond ecosystem, potentially making it an unsuitable habitat for newts. To assess the impact of goldfish leading to newt extinction, we compared community assemblages and isotopic community niches of consumers in ponds naturally dominated by palmate newts and in ponds where newts have been extirpated following goldfish introduction, using various techniques including carbon and nitrogen stable isotope analysis in a Bayesian framework. We used recent developments in standardization methods to account for variation in isotopic composition of basal resources when comparing consumer food webs across multiple sites. Our results show that beyond direct interactions with newts, goldfish have profound detrimental impacts on the ecological communities of ponds by operating a global alteration of the food web on multiple trophic levels. Changes were characterized by a trophic downgrading, reduction in diversity and trophic redundancy, and the extirpation of almost all exploitable resources available for newts. In the long-term, these changes likely explain newts exclusion from invaded ponds and illustrate the complex detrimental effects of omnivorous fish introductions for native ecosystems.

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