In western floodplains, species adapt to bullfrog, sunfish invaders

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Non-native bullfrogs and sunfish species, introduced for consumer and

sport purposes, are known to alter ecosystems and hinder native amphibians and fish in the Pacific Northwest highlands. But scant research exists about how these introductions affect native species in lowland floodplains.

A new study of a southwestern Washington floodplain finds that most native species adapt well to the invaders by shifting their food sources and feeding strategies.

The results may hold true for other lowland waterbodies and other native species in response to bullfrogs and sunfish invaders. The findings could also help wildlife managers develop appropriate action plans where these non-natives are established.

"The study shows that native species, at least in this floodplain, can tolerate non-native bullfrogs and sunfish," said Meredith Holgerson, assistant professor of ecology and evolutionary biology in the College of Agriculture and Life Sciences, and first author of the study, "Freshwater Floodplain Habitats Buffer Native Food Webs from Negative Effects of Non-native Centrarchids and Bullfrogs," published online March 28 in the journal *Freshwater Science*.

Diverse habitats—which create places to hide—and plentiful alternate food sources are two main factors that allow native species to coexist with non-native invaders, Holgerson said.

"The good news is that we don't need to worry about removing these non-native species from floodplains like we do in high elevation systems where bullfrogs and sunfish have adverse effects," Holgerson said. "If we want to manage something, we should manage for the habitat."

This could include promoting available food resources and maintaining emergent vegetation along waterbody edges where fish or amphibian

larvae can hide, she said.

Both bullfrogs and sunfish have been introduced by people into fresh waterbodies globally. Bullfrogs, native to the northeastern U.S., were brought to the West Coast for farming for frog legs. Sunfish, also known as centrarchid fishes, including bass, crappie, bluegill and sunfish, were introduced in the West for recreational fishing.

In the study, the researchers investigated how native and non-native species coexist by analyzing what the different species ate and whether they competed for the same resources. Ideally, a perfect study design would have compared waterbodies that had only bullfrogs and natives; only sunfish and natives; both invaders together and natives; and water bodies without either invader.

"Unfortunately, in an invaded landscape, you often get both bullfrogs and sunfish together," Holgerson said.

In water bodies with and without non-natives, the scientists took tissue samples from a range of predators and prey, and measured their carbon and nitrogen stable isotopes, which occur naturally in the landscape. The isotopic signatures for carbon (ratios of carbon-12 and carbon-13) in a consumer's tissue can be traced to different food sources to understand what it is eating.

Similarly, isotopic signatures for nitrogen (ratios of nitrogen-14 and nitrogen-15) reveal an organism's place within the food chain. Organisms that are higher on the food chain retain more of the heavier nitrogen-15 than of nitrogen-14, Holgerson said.

Overall, the ecologists found that two species of native salamander larvae and native three-spine stickleback fish fed a little lower on the food web and shifted food resources in the presence of bullfrogs and

sunfish. The data suggest that stickleback—known to have flexible diets—ate more open-water zooplankton and less bottom-dwelling invertebrates (crustaceans, worms and aquatic insects) when competing with sunfish for food.

The isotopic data suggest that salamander larvae shifted from open water to hiding more at pond edges, where they ate more bottom-dwelling invertebrates.

Frogs were less affected by nonnative introductions. As frog larvae are herbivorous, the data suggest that the algae they ate was plentiful enough to limit competition between nonnative bullfrog and native frog larvae.

"By shifting their feeding strategies, native species may be able to coexist with these non-natives, as opposed to undergoing population declines," Holgerson said.

More information: Meredith Holgerson et al, Freshwater floodplain habitats buffer native food webs from negative effects of non-native centrarchids and bullfrogs, *Freshwater Science* (2022). DOI: 10.1086/720137

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