

Western Ecological Research Center

Publication Brief for Resource Managers

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Fish Invasions Alter Lake Food Web Structure and Mercury Bioaccumulation

Two major threats to freshwater ecosystems worldwide are invasions of non-native species and pollution with contaminants. These two threats are particularly severe in California, where freshwater systems are both heavily invaded by non-native fish and heavily contaminated, especially with mercury. USGS scientists Collin Eagles-Smith and Tom Suchanek, with scientists from the University of California, Davis, and the Lake County Vector Control District evaluated how food web structure and mercury bioaccumulation changed with a series of invasions and extirpations of a non-native, plankton-feeding fish to Clear Lake, California. In a companion study the researchers identified changes in fish foraging habitat as the mechanism altering food web mercury levels. They reported their results in a recent special issue of *Ecological Applications*.

The authors analyzed a 20-year dataset of fish and invertebrate abundances, fish diets, and mercury concentrations from Clear Lake, and quantified trophic linkages in the lake's food web during that time period using carbon and nitrogen stable isotopes. They found that fish mercury concentrations increased with greater reliance on benthic (bottom-dwelling) prey such as midge larvae associated with lake sediments, as opposed to pelagic (open-water) prey such as zooplankton. Importantly, they also found that the invasion of the plankton-feeding, non-native threadfin shad depleted zooplankton densities and altered species distributions in the lake. As a result, the other fish species in the lake became more dependent upon benthic prey resources during times of high shad abundance, and their mercury concentrations increased by approximately 50% relative to when shad were not present in the lake. Interestingly, when shad populations crashed,

Management Implications:

- These results highlight the importance that food web structure can have on mercury bioaccumulation.
- Non-native species invasions can not only alter ecosystem structure, but also can change contaminant pathways within ecosystems.
- These results provide a powerful example of the value of long-term monitoring in detecting ecological change.

other fish species returned to more pelagic feeding habits and their mercury concentrations returned to pre-shad levels.

These studies highlight the importance of understanding the role of foraging habitat when evaluating fish mercury levels. They also provide a novel example of unintended consequences (changes in contaminant exposure) associated with non-native species invasions. Finally this work highlights the fact that mercury bioaccumulation in aquatic ecosystems can respond rapidly to changes in food web structure and trophic linkages.

Eagles-Smith, C. A., T. H. Suchanek, A. E. Colwell, N. L. Anderson. 2008. Mercury trophic transfer in a eutrophic lake: the importance of habitat-specific foraging. *Ecological Applications* 18:A196–A212.

Eagles-Smith, C. A., T. H. Suchanek, A. E. Colwell, N. L. Anderson, P. B. Moyle. 2008. Changes in fish diets and food web mercury bioaccumulation induced by an invasive planktivorous fish. *Ecological Applications* 18:A213–A226.