Integrating Future Climate Change and Riparian Land Use To Forecast the Effects of Stream Warming on Species Invasions and Their Impacts on Native Salmonids

Julian D. Olden[1], Timothy Beechie[2], Joshua J. Lawler[1], and Christian E. Torgersen[1],
[1]University of Washington, Seattle, WA; [2]National Oceanic and Atmospheric Administration (NOAA), Seattle, WA

This project develops and applies an analytical framework that quantifies how future climate change and riparian land use influences the direct and indirect effects of invasive species on the survival of Pacific salmon in the John Day River in Oregon. Climate change, increasing agricultural land use, and invasive species threaten the functioning of freshwater ecosystems in the Pacific Northwest. Elevated stream temperature is one of the most pervasive water quality issues in this region, and projected climate change and riparian vegetation loss are predicted to exacerbate this problem. Rising temperatures have direct implications for coldwater native salmon, but they also will alter the composition of aquatic biota by facilitating range expansion and altering the impacts of warmwater invasive species.

The investigators will integrate climate-change projections, geomorphic sensitivity, riparian land use, stream thermodynamics, and ecological niche modeling to quantify the potential range expansion and temperature-mediated impacts of invasive smallmouth bass (*Micropterus dolomieu*) and northern pikeminnow (*Ptychocheilus oregonensis*) in critical habitats that support endangered Chinook salmon (*Oncorhynchus tshawytscha*). The proposed work will: (1) predict spatiotemporal patterns of riverine thermal regimes in response to future climate change, geomorphic sensitivity, and riparian land-use; (2) forecast species-specific responses to projected future thermal regimes; and (3) evaluate alternative scenarios of climate change to identify critical opportunities for riparian habitat restoration and protection to mediate future climate-induced warming of streams and species invasions.

This project provides both the science and decision-support tools required to forecast with certainty how the interactive effects of climate change, land use change, and invasive species will affect native salmon in the future. Model results provide spatially explicit predictions of the vulnerability of adult and juvenile Chinook salmon to the direct effects of stream warming associated with climate and land use change, and the indirect, temperature-mediated effects of smallmouth bass and northern pikeminnow range expansion. Model outputs improve the scientific capabilities for guiding management strategies and policies aimed at minimizing the future range expansion of invasive species through protection and restoration of riparian vegetation that creates and maintains a coolwater habitat. More broadly, this project and the analytical framework it developed is readily applicable to other species of concern and relevant in other river systems of the Pacific Northwest, where the range expansion of warmwater fishes in response to climate change and riparian-habitat loss is ongoing and of imminent threat to native fishes.

EPA Grant Number: R833834