Predicting Relative Risk of Invasion by the Eurasian Saltcedar and New Zealand Mud Snail in River Networks Under Different Scenarios of Climate Change and Dam Operations in the Western United States

N. LeRoy Poff[1], Gregor T. Auble[2], Brian P. Bledsoe[1], Denis Dean[1], Jonathan Friedman[2], David Lytle[3], David M. Merritt[4], David Purkey[5], David A. Raff[6], and Patrick B. Shafroth[2]
[1]Colorado State University, Fort Collins, CO; [2]U.S. Geological Survey, Fort Collins, CO; [3]Oregon State University, Corvallis, OR; [4]U.S. Forest Service, Washington, DC; [5]Stockholm Environmental Institute, Davis, CA; [6]U.S. Bureau of Reclamation, Denver, CO

Predicting the spread and establishment of invasive species in river ecosystems under climate change requires developing models that mechanistically link species population success to climate-sensitive environmental drivers. The goal of this research project is to build a general and mechanistic framework with which to predict the future potential distribution of two invasive species expected to expand their ranges under a warming climate in streams and rivers of the western United States. The investigators hypothesize that local site invasibility will be regulated by climate-sensitive thresholds of hydrogeomorphic disturbance, which will vary throughout river networks in response to reach-scale channel geomorphology, future precipitation regimes, and operation of dams, which modify natural flow regimes.

In a geographic region predicted to support saltcedar snails in the near future, the investigators will downscale projected scenarios of temperature and precipitation as inputs to the Water Evaluation and Planning (WEAP) model framework, allowing generation of streamflow regimes at ca. 50 km^2 sub-basins based on precipitation and water management operations (including dams). An artificial neural network (ANN) model will be used to spatially distribute the WEAP hydrologic predictions throughout river networks at the reach scale (100s of meters). These reach-scale flow regime predictions, in conjunction with GIS-derived measures of channel and valley bottom geomorphology, will allow application of the biological model to assess the most likely locations in river networks for successful saltcedar and mud snail invasion given the flow-mediated disturbance regimes of any of several future climate scenarios. Further, using the coupled WEAP-ANN model, the investigators will explore how a range of water management operations might influence the likelihood of invasive establishment in these climate contexts. Finally, innovative stochastic population models will be used to evaluate the probability of long-term success of the invasive species across a range of habitat vulnerability.

This synthetic, multi-scale approach will generate a sequence of spatially explicit maps that will provide science guidance to support strategic decision-making regarding the spatially distributed risk of, and possible adaptation to, the spread of invasive species at local to regional scales in the western United States. The model will be general enough that it can be applied to other riverine species and resources, including non-invasive species.

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