Elevated Temperature and Land Use Flood Frequency Alteration Effects on Rates of Invasive and Native Species Interaction in Freshwater Floodplain Wetlands

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The primary objective of this research project is to assess how predicted climate and land use driven changes in hydrologic flux and temperature regimes of floodplain ecosystems affect plant communities in terms of their vulnerability to the establishment and spread of invasive species and, in turn, ecosystem functions and services. Future climate scenarios for the southeastern United States predict that surface water temperatures will increase (in concert with air temperature) and that stream flows will likely decrease, with a greater proportion of annual watershed hydrologic yield occurring during major storm events. Land use changes (urban vs. forested, etc.) have been shown to raise water temperature and increase pulsed water releases during storms. This research project focuses on the relationships between native species composition, diversity, productivity, and invasibility of floodplain ecosystems affected by alterations of water temperature and annual hydrographs driven by climate and land use changes. The investigators will use a combination of varying scale experimental studies and one novel large-scale regional study to verify the experimental and threshold modeling results.

There are four study levels: (1) A field-based warming experiment will allow the investigators to directly evaluate and model treatment effects of temperature and hydrology on species invasions, community composition, and ecosystem services of an experimental (restored) floodplain ecosystem. (2) There are 99 diversity plots on a floodplain that will be used to test how species richness affects species invasions. (3) There are 102 permanent vegetation plots that will be distributed over three hydrogeomorphic zones in the floodplain (stream bank, low terrace, and high terrace) to assess species invasions affected by pulsed waters. (4) Regional studies on wetlands downstream of surface and bottom-releasing dams will be used to assess pulsed water and temperature effects on invasive species as compared to control rivers. At each experimental level the investigators will assess how feedbacks from invasive species alter ecosystems services such as flood control, sediment retention, and maintenance of water quality. A unified Bayesian hierarchical model will be developed as a decision support tool to predict temperature and hydrology thresholds for invasive species response to alterations in floodplain ecosystems.

Experimental results will be used to estimate the effects of predicted temperature increases and increased storm flow events on the ability of existing floodplain communities to resist invasive species. Proposed Bayesian modeling methods can address nonlinear responses and provide a risk assessment probability analysis to predict ecosystem threshold shifts.

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