Wetlands more vulnerable to invasives as climate changes

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In the battle between native and invasive wetland plants, a new Duke University study finds climate change may tip the scales in favor of the invaders—but it's going to be more a war of attrition than a frontal assault.

"Changing surface-water temperatures, rainfall patterns and river flows will likely give Japanese knotweed, hydrilla, honeysuckle, privet and other noxious invasive species an edge over less adaptable native species," said Neal E. Flanagan, visiting assistant professor at the Duke Wetland Center, who led the research.

Increased human disturbances to watersheds and nutrient and sediment runoff into riparian wetlands over the coming century will further boost the invasive species' advantage, the study found.

"It's death by a thousand small cuts. Each change, on its own, may yield only a slight advantage for invasive species, but cumulatively they add up," said co-author Curtis J. Richardson, director of the Duke Wetland Center and professor of resource ecology at Duke's Nicholas School of the Environment.

If left unchecked, over time these change will reduce the diversity of plants found in many wetlands and could affect the wetlands' ability to mitigate flooding, store carbon, filter out water pollution and provide habitat for native wildlife, the authors said.

The scientists published their peer-reviewed findings this week in the journal *Ecological Applications*.

The study, funded by the U.S. Environmental Protection Agency (EPA), is the first large-scale field experiment to simulate how future environmental changes linked to global warming and land-use change will affect plant communities in major river systems in the U.S. Southeast.

It was conducted using plant species and biomass surveys, continuous real-time measurements of water levels and water temperatures, and statistical modeling of long-term plant abundance and growing conditions at 24 riparian floodplain sites in North Carolina and Virginia over a three-year period.

The Intergovernmental Panel on Climate Change (IPCC) projects that surface-water temperatures in the Southeast will increase by 1 to 5 degrees Celsius by the year 2100. Increased evaporation will reduce surface water base flows, while a 5 percent to 30 percent increase in precipitation, mostly in the form of intense storms, will cause pulsed hydrology—sudden, short-term rises—in water levels.

As these changes occur, the annual timing of when wetland soils warm up in spring will fluctuate and may no longer be synchronized with when river levels drop, Flanagan said.

This de-synchronization will affect all floodplain plants, but the natural phenotypic plasticity of invasive species allows them to adapt to it better than native species, which need both exposed soil and warmer temperatures to germinate.

As native species' germination rates decline, invasives will move in and fill the void, their increased abundance fueled by high levels of nutrients flowing into the wetlands in runoff from upstream agriculture and other disturbances.

"These findings underscore the need for us to better understand the interaction between climate, land use and nutrient management in maintaining the viability of native riparian plant communities," Richardson said.

"What makes this study so novel is that we used a network of natural, existing riparian wetlands to simulate the long-term impacts of IPCC-projected changes to water temperature and flow over the coming century," Richardson added.

Eighteen of the 24 wetlands used in the study were located downriver from dams or power plants built at least 50 years ago, he said. Ten of these wetlands were classified as warm sites, because water discharged back into the river by the upstream dam or power plant was heated by steam turbines or pulled from higher in a reservoir, where water temperatures were warmer.

Eight wetlands were classified as cold sites because the upstream dams pulled their outflow water from deeper in reservoirs, where temperatures were more than 5 degrees Celsius cooler than at warm sites.

"This allowed us to simulate the effect of long-term changes in water temperatures on native and invasive species abundance," Richardson said. All 18 dams regulated their outflow of water, allowing the team to simulate the effects of projected lower base flow and increased storm flows. Six wetlands in the study were located on undammed rivers and served as control sites.

More information: "Connecting Differential Responses of Native and Invasive Riperian Plants to Climate Change and Environmental

Alteration," Neal E. Flanagan, Curtis J. Richardson and Mengchi Ho, Duke University. *Ecological Applications*, Dec. 8, 2014. . dx.doi.org/10.1890/14-0767.1

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