

Biological invasions increasing due to freshwater impoundments

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Parker Dam above Lake Havasu in Arizona is a good example of dams encroaching on waterways and enhancing the spread of invasive species, according to a new study led by the University of Colorado at Boulder. Credit: Pieter Johnson, University of Colorado

The growing number of dams and other impoundments is increasing the number of invasive species and the speed at which they spread, putting natural lakes at risk, says a study led by the University of Colorado at Boulder.

The research team combined data on water chemistry, the distribution of five "nuisance invaders" and boating activity from the Great Lakes region. The results showed the increasing occurrence of such species in impoundments creates "stepping-stone habitats" for them into natural

lakes, ponds and waterways in the region, said CU-Boulder Assistant Professor Pieter Johnson, co-lead author of the study.

The researchers looked at invaders like the Eurasian zebra mussel, the Eurasian water plant known as watermilfoil, the Eurasian spiny water flea, the rusty crayfish and the rainbow smelt. Such freshwater invaders often have direct negative effects on lake ecosystems, including reduced fishing success, changes in water clarity and fouling of fishing gear and water-pumping equipment, Johnson said.

The study appears as the cover story in the September issue of *Frontiers in Ecology and the Environment*, a publication of the Ecological Society of America. Co-authors on the study include Julian Olden of the University of Washington in Seattle and Jake Vander Zanden of the University of Wisconsin-Madison.

Zebra mussels recently jumped to reservoirs in the West, including Colorado, said Johnson, leading to mandatory boat inspections at some landings. The other invaders are either already in Colorado - the rainbow smelt and water milfoil - or have a high probability of being introduced, like the spiny water flea and rusty crayfish, he said.

"We believe impoundments may be functioning as 'hubs' for freshwater invaders, aiding their spread and establishment into natural water bodies," said Johnson of CU-Boulder's ecology and evolutionary biology department. The researchers wrote in the study that "reservoir construction and the conversion of free-flowing rivers to standing waters may ultimately facilitate the spread of invasive species across the landscape."

The team looked at data from 4,200 lakes and more than 1,000 impoundments across Wisconsin and the Upper Peninsula of Michigan. The study showed non-indigenous species are up to 300 times more

likely to occur in impoundments than in natural lakes, increasing the invasion risks for natural lakes.

"Collectively, these results suggest the benefits of building more reservoirs should be carefully balanced against the potential negative consequences, including increased biological invasions," Johnson said.

The study was funded in part by the National Science Foundation.

The study showed impoundments significantly reduced the average distance between "uninvaded" lakes and lakes inhabited by zebra mussels, increasing the number of natural lakes considered vulnerable to zebra mussel invasion by 50 percent.

The zebra mussel, first introduced into the Great Lakes in 1987 and which affects plankton abundance, nutrients and water clarity, also has caused declines in native mollusks and fouled industrial pipes. Another invader, the Eurasian watermilfoil, was introduced in the United States in 1944 through the aquarium plant trade and is now in 44 of the 48 contiguous states, causing changes in both vertebrate and invertebrate communities, said the team.

Other invaders posing threats include the Eurasian spiny water flea -- which colonized the Great Lakes region in the 1980s and which affects lake diversity and fouls commercial equipment -- and rusty crayfish, native to the Ohio river drainage and which has been shown to upset the balance of natural ecosystems, Johnson said.

A fifth, the rainbow smelt -- indigenous to marine environments -- has spread through the Great Lakes region and into the Mississippi and Hudson Bay watersheds, impacting local fish populations through predation and competition. Johnson said.

Climate-induced changes to water availability and increasing demand for water and flood control are expected to drive the construction of new reservoirs to increase water supplies in many regions of the United States, including the Midwest, said the authors.

Dam construction and biological invasions are major contributors to the biodiversity crisis in freshwater ecosystems, which exhibit higher rates of extinction and a greater proportion of threatened and endangered species than in terrestrial or marine environments, said Johnson.

There are more than 80,000 large dams and an additional 2.5 million smaller impoundments across the United States, said Johnson.

Source: University of Colorado at Boulder

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