Researchers develop new model to assess fish passage

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Fishes, such as salmon, who must swim upstream to their birthplace to spawn are often impeded by obstacles like dams and roads that crisscross rivers and streams. A team of researchers from the University of Georgia and the U.S. Army Corps of Engineers Engineer Research and Development Center has developed a new model that could help environmental managers determine the most cost-effective way to improve the fishes' chances of reaching spawning grounds. Their work was recently published in the journal *Ecological Applications*.

Kyle McKay, lead author and a research civil engineer with the ERDC and doctoral student in the UGA Odum School of Ecology, said that many migratory fish species are in decline worldwide-with serious economic, cultural and environmental consequences.

"Shad populations on the East Coast, Alabama shad on the Gulf Coast, as well as some of the sturgeon, have all shown strong declines over time," McKay said. "Whether it's herring in the Northeast or salmon in the West or catfishes in the Mekong, there are lots of examples of fishes that use both the ocean and fresh waters."

Dams and road crossings can become obstacles to their migrations. "You can certainly imagine that a large dam is a significant barrier, but that doesn't mean that a road crossing is insignificant," McKay said. "If a culvert is perched 2 feet above a stream's surface and you're a 3-inch-long fish, you don't have much chance of getting beyond that point."

McKay and his colleagues-Jock Conyngham and Craig Fischenich of the USACE-were tasked with coming up with a plan to improve migratory fish habitat in the Truckee River in Nevada, where there are more than 30 potential barriers to upstream fish movement. And they had to stay within a limited budget while doing so.

"What we were trying to do was to create a logical framework to prioritize fish passage improvements," he said. "Can we get more bang for our buck in terms of what can be very expensive projects, like dam removal or installation of fish ladders and things like that? Are there ways to improve economic efficiencies?"

To tackle the problem, McKay and John Schramski of the UGA College of Engineering created a mathematical model based on network analysis. To determine the level of a watershed's connectivity-and therefore its suitability as migratory fish habitat-they had to take into account the physical characteristics of the watershed itself as well as those of its barriers.

Using their model, the researchers looked specifically at 11 dams in the Truckee River system.

"We looked at every combination of potential actions," McKay said. Potential actions included dam removal, but mostly consisted of alterations like the installation of fish ladders. In all, they tested more than 1,000 potential combinations, coming up with 20 cost-effective plans for improving upstream fish passage.

McKay is now working on turning the model into an online tool so that other environmental managers seeking to restore fish passage can use it too.

"I think that there's a really amazing nexus here in terms of aging infrastructure and ecosystem restoration," he said. "There's a lot of opportunity with old dams that are no longer used or are economically obsolete. And with the intersection of that set of needs and declining migratory fishes in a worldwide context, I think people realize there's an opportunity that could be seized."

Provided by University of Georgia