New research shows fishways have not helped fish

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In spite of state-of-the-art fish passage facilities, actual numbers of fish passing through them at hydropower dams in the Northeast over several decades reached only a tiny fraction of targeted goals. Credit: UMass Amherst

Despite modern designs intended to allow migratory fish to pass, hydropower dams on major Northeast U.S. waterways, including the Merrimack and Connecticut rivers, have failed to let economically important species such as salmon, shad and river herring reach their spawning grounds, say a team of economists and fish ecologists including Adrian Jordaan of the University of Massachusetts Amherst.

This raises serious questions about the impact of new dams now being planned and constructed on major waterways worldwide, say the researchers in the current issue of *Conservation Letters*. The international team led by J. Jed Brown of the Masdar Institute of Science and Technology, United Arab Emirates, included investigators at SUNY College of Environmental Science and Forestry, Syracuse; Virginia Tech, the University of Arizona, City University of New York and the University of Victoria, British Columbia as well as UMass Amherst.

They found that in spite of state-of-the-art fish passage facilities, actual numbers of fish passing through them over several decades reached only a tiny fraction of targeted goals. "It may be time to admit failure of fish passage and hatchery-based restoration programs and acknowledge that ecologically and economically significant diadromous species restoration is not possible without dam removals," say Jordaan, Brown and colleagues.

The three river systems studied, the Merrimack, Connecticut and Susquehanna, are historically important for fish populations that migrate from the sea to spawn in rivers, known as diadromous species. They include sturgeon, salmon, shad, alewife, blueback herring and eel. Four of the nearly 20 dams studied are on the Susquehanna, with more than 10 on the Connecticut and five on the Merrimack. Jordaan points out that the Connecticut River watershed has more than 1,000 dams on tributaries, but those on the river's main stem have the most impact on all species.

Numbers of American shad, once one of America's premier food fish, that passed through these dams has hovered around 2 percent of the target in the Merrimack River and close to zero percent of target in the other two. "These dams are contributing to reduced resilience of not only shad, but all diadromous species," says UMass Amherst's Jordaan. "The result is that other factors including climate change will have a greater impact on these populations that are at fractions of their historical levels."

Restoration targets for river herring vary from several hundred thousand to millions of fish. However, in recent years, river herring returns on these rivers have averaged less than a thousand fish. Karin Limberg, a fisheries ecologist at SUNY Syracuse, says, "Once these rivers supported tens of millions of pounds of biomass of these species and provided valuable protein to a growing nation."

Using publically available data collected by various agencies since the 1960s, the research team shows that these state-of-the-art fish passage facilities have been unsuccessful. Some migratory species, such as sturgeons, do not pass through at all. But even the species that do make it through do so in numbers far less than stated targets.

System-wide passage efficiencies, defined as passage from the most downstream dam in a river up past the uppermost main stem dam with fish passage facilities, hover at less than 3 percent, the researchers report. Many of the species require habitat upstream of these dams, and without it diadromous fish populations are unlikely to recover, if past performance is an indication of future success.

The researchers note that at one fish passage facility with an educational center, no fish at all passed in a typical year. Strategies and techniques have not only failed to help fish cope with dams on these rivers, they add, but the losses of diadromous fish in the river systems has a major impact on food fisheries and biodiversity. Jordaan says they represent lost seafood production and greatly weakened marine food webs.

The authors support finding new approaches to the problem and call for ecologists and economists to propose alternatives to main stem dams. In Maine, they note, one creative solution developed by a broad coalition was to purchase two main stem dams on the state's largest river, the Penobscot. It offers an ideal situation because it splits into two rivers low in the watershed, allowing augmented hydropower capacity in one branch to compensate the electric utility with alternative power generation. But Jordaan says it remains to be seen whether the situation there can be improved for fish migrating upriver without more dam removals in the main stem and tributaries. And the challenge will be much greater in more typical rivers such as the Connecticut and other major east coast rivers that do not offer "two rivers in one."

He adds, "We feel these species represent a lost connection between marine and freshwater systems that is more important than the numbers." Their conclusions serve as a cautionary tale, he says, for planners in China, Laos and Cambodia, where engineers are on the verge of constructing hundreds of new main stem dams on major rivers such as the Mekong, the second most biodiverse freshwater system and host to the world's most productive inland fisheries in the world.

For the future, UMass Amherst's Jordaan recently received a grant from the Lenfest Ocean Program of Pew Charitable Trust to evaluate the historical role of forage fish in lost fisheries production and the implications for future sustainability.

Provided by University of Massachusetts Amherst