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Upstream Battle: Fishes Shun Modern Dam Passages, Contributing to Population Declines

A river study in the U.S. Northeast has found that many fish species are unable to use standard passageways to swim past dams on their spawning runs

By Amy Kraft | Wednesday, February 20, 2013 | 2 comments

Fishes may not need bicycles, as Gloria Steinem once suggested, but elevators and ladders can come in handy. Since the 1960s the Federal Energy Regulatory Commission has required dam builders to install state-of-the-art fish passages on public waterways to help shad, salmon and other species make their annual spring journeys upriver to spawn. Hydropower dams have built inclined water channels called ladders that fishes could swim through or elevators that use caged buckets to lift fish up and over the dam. Although these passages are monitored to ensure that fishes use them, a new study by ecologists and economists shows that very few fishes actually pass through to reach their spawning grounds, which exacerbates the decline in fish populations.

A crew from NOAA installs a ladder on a dam in Massachusetts.
Image: Flickr/NOAA

Jed Brown of the Masdar Institute of Science and Technology in Abu Dhabi and colleagues analyzed decades-worth of data on fish passages in the Merrimack, Connecticut and Susquehanna rivers in the U.S. Northeast. Roughly 2 percent of the targeted number of American shad made it through Essex Dam on the Merrimack River in 2011 and close to 0 percent passed through dams on the Connecticut and Susquehanna. Restoration targets for river herring, two species of silver-colored fishes, are in the hundreds of thousands to millions of fish but in recent years, less than 1,000 herring on average have returned to these rivers from the ocean. Atlantic salmon numbers in the Connecticut River have been similarly low despite decades of restoration efforts.

One problem is that some fish passages are maladapted to the fishes they were built to help. A 2001 report by the United States Geological Survey showed that some fishes require specialized fishways because they cannot maneuver on ladders, which are meant to simulate natural rapids. For example, Atlantic salmon and river herring can easily navigate fish ladders because they naturally plunge through headwaters. Sturgeon and striped bass, on the other hand, do not possess the same swimming ability. “If you have one bad dam or one bad fishway, then the fish really aren’t moving up the river,” says Theodore Castro-Santos, a research ecologist at USGS’s Conte Anadromous Fish Research Center in Massachusetts. Castro-Santos said that modern fishways are modeled after those installed on the Bonneville Dam in the 1950s and have never been properly studied to prove their effectiveness.

Even if fish do make it upstream to spawn, many have a hard time getting back downstream. A 1994 study in *Transactions of the American Fisheries Society* found that some fish species get killed attempting to pass through turbines. “We’ve taken species that

spawn more than once in their lives and turned them into one-time spawners," says John Waldman, a professor of biology at Queens College, The City University of New York, one of the authors of the new study.

The best solution to restoring fish populations, Waldman argues, is dam removal. Past research on dam removal showed that it is effective at restoring fish stocks and improving water quality. Studies on the removal of Edwards Dam, a 280-meter-long hydroelectric dam on the Kennebec River in Maine, found that fisheries have improved since its take-down in 1999 and insect counts have increased, a good indicator of improved water quality.

But dams are an important source of renewable energy, and removing them is costly and can have sudden, dramatic impacts on ecosystems, as this 2001 study in *Hydrological Processes* noted. Castro-Santos believes that instead of removing dams, more robust research should be conducted on fishways and the various fish species that move through them. A 2012 study in *River Research and Applications* looked at how the biological characteristics of different fish species determined their propensity to use certain types of fishways. "In order to evaluate the effectiveness of fishways, you need to know the behavior of fish," Castro-Santos says.

Waldman agrees that improved fishway technology could be the answer. "If a dam can't be taken down the best fishway possible is better than any alternative," he says.

For now the researchers hope that the study will help guide authorities as they consider dam renewal licenses and as construction begins on dam projects in the Amazon and Mekong rivers. "This is a warning to the rest of the world where big dam projects are starting," Waldman says. "If it's not working in the northeast U.S., it's not likely to work elsewhere."