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ARTICLE

Fathoming: Ancient Fish, Modern Methods

by Dr. Heather Deese and Catherine Schmitt

NOAA Fisheries staff collecting receiver data from Penobscot Bay

Through the static comes a faint, metallic *ping!* Getting louder now, *ping...ping...ping*. It is the sound of a shortnose sturgeon, a dinosaur of a fish that is roaming the murky bottom of the Penobscot River Estuary, a species all but forgotten by most people in the area until documentation a few years ago by University of Maine fisheries biologists.

Like warblers and monarch butterflies, sea-run fish undertake fantastic migrations, traveling through the open ocean, up the crowded Atlantic Coast, eventually returning to the freshwater rivers and streams in which they were born. However little is known about where and how these fish travel.

But in the last five years, new technology and regional collaborations are providing fisheries scientists with a glimpse into the "black box" that is the saltwater migration of sea-run, or anadromous, fish. An expanding network of moored acoustic receivers in the water "listen" for individualized, low-frequency codes-*ping!*-emitted by tags implanted or attached to fish.

"It's like an EZ-pass system for fish," said John Kocik of the National Oceanic and Atmospheric Administration's (NOAA) Northeast Fisheries Science Center, referring to the electronic highway toll collection system. Kocik began acoustic tracking of Atlantic salmon in 1996 in the Narraguagus River in Downeast Maine, partnered with Joseph Zydlewski of the U.S. Geological Survey's (USGS) Cooperative Fish and Wildlife Research Unit and Michael Kinnison from the University of Maine to establish a receiver network in the Penobscot River in 2005. At the prompting of graduate student Chris Holbrook, the team began using acoustic telemetry to study young salmon-called smolts-that were being stocked by state and federal agencies in the river to supplement wild fish.

By tagging hatchery-reared and wild Atlantic salmon juveniles and releasing them below the last dam on the Penobscot River, NOAA scientists follow migrating fish, comparing survival rates, migration speed and pathways. "Our work in the Narraguagus showed that 35 to 50 percent of fish made it out to the Gulf of Maine," said NOAA's Kocik, "and preliminary data from the Penobscot indicate slightly better survival rates."

Zydlewski and Kinnison looked at upstream releases, how dams were affecting mortality and survival, and which pathways smolts were using.

"In the past, studies with small numbers of fish focused around dams were too limited to show the big picture from headwaters to the sea," said Kinnison. "With our expanded network [of acoustic receivers] we were able to identify which sections of the river had the greatest influence on fish passage success, and where bottlenecks existed for migrating adults. We saw that fish didn't travel in a straight line up or down river, but moved repeatedly upstream and downstream. The same individual adult might pass a dam three or four times."

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The Penobscot network has grown to include more than 100 receivers, from above West Enfield to Penobscot Bay, where there is an array of receivers off Vinalhaven, and offshore in the Gulf of Maine where receivers are mounted on Northeastern Regional Association of Coastal Ocean Observing Systems or NERACOOS (formerly called GoMOOS) buoys.

Once a receiver is in the water, it will pick up signals from any tagged fish that travels within about a half mile. As research in other states parallels what is happening in Maine, fish are turning up in surprising places. The NERACOOS buoys off the coast of Maine picked up striped bass from the Chesapeake Bay and Connecticut River. Penobscot stripers have been detected as far south as Delaware. Receivers in the Kennebec River, installed by the Maine Department of Marine Resources for striped bass monitoring in 2007, picked up Atlantic and shortnose sturgeon that Kinnison and Gayle Zydlewski had tagged in the Penobscot River.

"We knew that Atlantic sturgeon had huge ranges, so these data confirm that," said Gayle Zydlewski of the University of Maine. "But we didn't know about shortnose sturgeon moving between rivers." Zydlewski and her graduate students (co-advised with Kinnison) have followed shortnose sturgeon as they leave the Penobscot River and cruise the Maine coast, here and there dipping into a coastal river for a tidal cycle or two.

"Before," said Kinnison, "folks might not have been looking for their fish beyond the river where they were tagged. Finding this connection between the Kennebec and the Penobscot has motivated researchers to look beyond individual river systems." The Maine telemetry network is now expanding west to rivers as far south as the Saco.

The findings are causing federal agencies to reconsider how some species are managed, said Kinnison. "Should species like shortnose sturgeon be evaluated on a Gulf of Maine scale, instead of as separate river-based units like distinct population segments? Has this ability to interchange been important to the species in the past? It's not just semantic, because managing populations that normally interact as isolated units could have inadvertent negative consequences. This is an important change in how we view the species, and it's trickling down the coast."

"More telemetry and more people putting out receivers is showing us a whole new world," said Gayle Zydlewski. When researchers pick up signals from fish they don't know, they usually identify it by contacting the manufacturer, Vemco, to find out who bought the tags. Now, the Atlantic Coast Telemetry Network, coordinated by Dwayne Fox at Delaware State University, is helping to manage different telemetry data exchange. "What started with word-of-mouth and email exchanges is now a more formalized network of research groups from Maine to Florida with telemetry arrays ranging in size from small river drainages to coastal systems," said Fox,

Gulf of Maine researchers are also connected with Canadian counterparts through the Dalhousie University-based Ocean Tracking Network.

The value in all this networking and shared data is that biologists are now learning when fish leave and where they go; and when they come back and how often. All of it shining a little bit more light into the black box of ocean migration.

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