Signals from the Atlantic salmon highway

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For years scientists have struggled to understand the decline and slow recovery of Atlantic salmon, a once abundant and highly prized game and food fish native to New England rivers. Biologists agree that poor marine survival is affecting salmon in the U.S. and Canada, but specific causes are difficult to determine in the ocean. Small acoustic tags and associated technology may provide some answers.

Thirty of 150 Atlantic salmon smolts tagged by NOAA's Northeast Fisheries Science Center (NEFSC) in Maine's Penobscot River and released in Brewer, Maine in mid-May have crossed a line of underwater receivers off Halifax, Nova Scotia, the first fish to be tracked using the new global Ocean Tracking Network. The concept is similar to an EZ pass for highway toll booths, but for fish.

"The tracking system is deployed and working, which is great news," said John Kocik, who is leading the tagging project with colleague James Hawkes at the NEFSC's Maine Field Station in Orono, Maine. "We started ultrasonic tagging programs in Maine in 1997 and have learned much about salmon ecology in the estuaries and bays of the Gulf of Maine," Kocik said. "Our team is really excited that fish from our most recent work in the Penobscot River have been detected so far along on their migration northward. The first data provided valuable information about how long it took Atlantic salmon from the Penobscot River to reach Halifax."

The acoustic transmitters or tags, which are about the size of the silver eraser holder on a pencil, were surgically implanted in May in salmon

smolts that were each six to seven inches in length. The surgeries, done at the Eddington Salmon Club, take less than seven minutes. After a brief recovery, the smolts were released at the nearby Brewer Boat Ramp.

Each tag has a unique identification code that transmits an ultrasonic signal every few seconds. To detect these tags locally, NEFSC maintains a network of more than 80 acoustic receivers that extend from Brewer, on the Penobscot River near Bangor, into the Gulf of Maine. The local receivers, about the size of a standard flashlight and spaced about a half mile apart, act much like the EZ pass system at highway toll booths - when a fish swims near the receiver, its identity and the time of detection is recorded by the receiver.

The Penobscot receiver network is a collaborative effort between NEFSC, the University of Maine, and the U.S. Geological Survey (USGS). The University of Maine and USGS maintain freshwater and some estuarine receivers, while NEFSC maintains the majority of the estuarine receivers and all those in marine areas. Biologists download data monthly by tending the receivers by boat.

Once data is downloaded for the season, biologists can learn which route each fish took, how long it took to get to the Gulf of Maine, and most importantly, which fish survived and where fish that did not exit the Penobscot River may have died. This information can help uncover the causes of mortality.

Kocik says the establishment of the Halifax array by the Ocean Tracking Network as a distant receiver line on the Atlantic shelf affords a new opportunity to detect U.S. salmon on their migration to the Labrador Sea. Other NEFSC biologists have been tagging about 250,000 salmon annually since the 1980s using traditional external tagging methods, which help determine survival but don't provide the level of detail about

fish movements that the acoustic tags do.

The Ocean Tracking Network array works like the coastal network in Penobscot Bay. Once the tagged fish swim near passive acoustic receivers on the ocean floor, which are about 800 meters (2,500 feet) apart in a line 22 kilometers (about 14 miles) long, information is transmitted to the receivers and then downloaded via modem to computers on nearby research vessels tending the array. The first tagged salmon crossed the Halifax line in early June.

While only 30 of 150 ultrasonically tagged fish have been detected to date, these early data suggest that many young salmon are surviving their migration north to feed and grow in waters of the Labrador Sea, coastal West Greenland and northern Canada.

"Given the fact that we are looking for a fish that is still less than a foot long that could be anywhere in the Northwest Atlantic Ocean, finding them in such apparent concentrations hundreds of miles from Brewer, Maine is remarkable and very encouraging," Kocik said. "Broad-scale ocean arrays such as the Halifax Array are a great tool to examine the marine ecology of such an uncommon fish in a large marine environment."

NEFSC biologists used ultrasonic tags to track wild-origin Atlantic salmon in Maine's Narraguagus River system and estuary from 1997 to 1999 and again from 2002 to 2004. More recently, telemetry operations moved to the Penobscot River to look at a larger marine system and to study the largest Atlantic salmon population in the U.S.

The current project, scheduled to run through 2010, is designed to look at the emigration survival and ecology of smolts of different hatchery origins, such as those fish that are naturally reared spending two years in a river or those stocked from a hatchery just weeks before migrating to

the ocean.

Kocik and his colleagues in the NEFSC Atlantic Salmon Task are looking primarily at marine losses of Atlantic salmon to try to determine what is causing so many salmon to die at sea. "Telemetry is only one tool we use," Kocik said of the current ultrasonic tagging efforts. "We have three scientists in the Labrador Sea right now working with Canadian colleagues as part of the international Salmon at Sea (SALSEA) project to determine where Atlantic salmon are and are not, and to try to get detailed genetic and dietary information about the various North Atlantic salmon stocks. "

Global monitoring efforts like the Ocean Tracking Network are another tool. The network was established in 2007 with support from the Canadian government and is headquartered at Dalhousie University in Halifax, Nova Scotia. Once fully operational, it will enable marine scientists around the world to track the movements and behavior of marine life as well as to monitor ocean conditions such as temperature, salinity, and currents.

"Atlantic salmon are an iconic fish, but they're endangered and people want to know what's happening to the population," said Mike Stokesbury, director of research for the Ocean Tracking Network. "This is the first step to finding out where the salmon are dying and what's causing the decline."

Kocik says marine arrays like the Ocean Tracking Network will add significantly to the data available from existing receivers in the Penobscot and other rivers in Maine and in the Gulf of Maine. New regional observing systems like the Gulf of Maine Ocean Observing System will add even more data about environmental and climate conditions.

"We know specifically where a tagged salmon has been and when, and that helps us fill in a big gap," Kocik said. "The news is encouraging. In 2008 more than 2,000 adult salmon returned to the Penobscot River to spawn, the highest annual total in more than 20 years. Research like this ultrasonic tagging project will help us understand why, and perhaps then managers can work to actively improve Atlantic salmon marine survival."

Source: NOAA National Marine Fisheries Service