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The Secret Code of Salmon

Researchers are developing new genetic tools to sort out salmon in the ocean and help fishermen target healthy stocks and avoid endangered ones.

by Peg Herring

If you've ever been salmon fishing, chances are you've seen a salmon with a tag in its nose. It's not visible nor trendy like a diamond stud you might see on a human nose. It's a tiny fleck of thread-thin wire embedded deep in the cartilage and encoded with information about the fish's history.

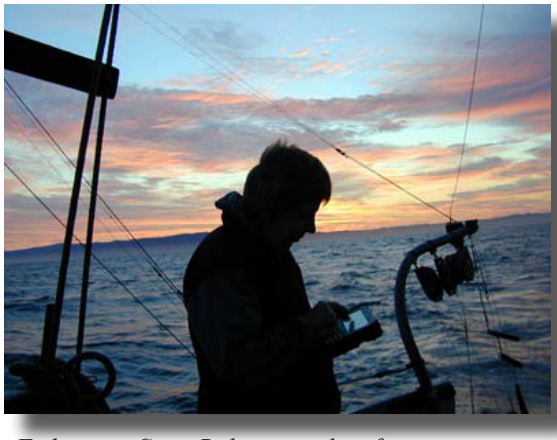
Recovery of coded wire tags has long provided fishery managers with a way to track where salmon originated and where they were landed. Hatchery salmon, that is, and usually months after they're caught. Up to now, ocean salmon management has depended on averaging these and other data across a sea of mixed stocks of salmon. New technology promises to help sort out this big kettle of fish in the ocean so that local fisheries can target abundant stocks of salmon and avoid endangered populations.

The new technology uses a much more complete code of population history: genes.

A group of geneticists from California through Alaska, including Michael Banks and colleagues at OSU's Coastal Oregon Marine Experiment Station, are developing methods to examine the genetic relationship among Chinook in the northeast Pacific, to determine the most likely origin of both wild and hatchery fish caught in the ocean.

Their analysis focuses on microsatellites, a stretch of repeated genetic material that shows up like the skipping repetition on a scratched record album. Geneticists examine these hiccups of repeated genetic information to discriminate different life histories among populations within a species. By examining 13 microsatellites on the salmon genome, for example, researchers can pinpoint with at least 90 percent accuracy the river basin where the salmon originated.

Banks was a key player in research in California where the first microsatellites were isolated from Chinook salmon and used to distinguish the particular timing of winter, spring, and fall salmon runs from the Sacramento River. As a result of earlier research, the technology was in place in 2006 when 700 miles of Oregon and California coastline faced severe restrictions to salmon fishing to protect scarce runs of Klamath River salmon.



Fisherman Scott Boley records information on a data logger, part of a new study to determine the river of origin of ocean-caught salmon. Photo courtesy of Scott Boley.

"Although Klamath stocks were weak, other salmon stocks in the ocean were healthy," said Banks, who heads OSU's Marine Fisheries Genetics Lab at the Hatfield Marine Science Center in Newport. "The fundamental question was, can Oregon fishers gain access to healthy stocks without impacting Klamath stocks?"

To help answer that question, the Oregon Legislature Emergency Board approved the Cooperative Research on Oregon Ocean Salmon project (ProjectCROOS), a pilot project that brought scientists and salmon fishermen together to collect clues to where Chinook salmon travel in the ocean.

"We got legislative approval for the project on June 17, 2006, and we had boats in the water the next day," said Jeff Feldner, a commercial salmon fisherman in Newport who was hired to manage the project's data collection from more than 80 boats fishing off the Oregon coast. The project combined at-sea and laboratory research to help determine the genetic fingerprints of each salmon caught off the Oregon coast. Funds for the project came from the Oregon Watershed Enhancement Program through the Oregon Salmon Commission.

A tiny snip of fin is all the geneticists need to decipher the genetic signature of salmon. Photo: Scott Boley

The project outfitted each fisherman with a toolbox to collect the necessary samples for genetic testing. On each salmon they caught, fishermen attached a barcode tag and scanned the identifying number into a data logger, along with where and when the fish was caught, its size, and other information. They took a snippet of pectoral fin to determine the fish's genetic profile and a couple of scales to determine the fish's age, then delivered the samples to Banks' lab in Newport.

"I'd pick up samples in the dropbox each morning and we'd run them that day," Banks said. "We were shooting for a 24-hour turnaround of information to get up-to-the-day information on the movement and origin of the catch."

During the research, the OSU scientists tested more than 1,500 salmon and compared their genetic sequencing with a database of genetic signatures of fish from 200 river basins from California to Alaska, a database developed by the Chinook Technical Committee of the Pacific Salmon Commission. They found that about five percent of the fish caught off the Oregon coast originated from the Klamath Basin; about two-thirds came from California. Most of the others were from Oregon's rivers, primarily the Columbia and its tributaries, and a small percentage from British Columbia and Alaska. These preliminary research findings underscored the importance of broadening the study to include Washington and California, and the National Marine Fisheries Service labs in both those states are now working with Oregon researchers to expand the scope of the research.

According to Scott Boley, a Gold Beach fisherman who helped on the project, this new tool promises to change salmon management because for the first time managers can answer questions about both hatchery and wild fish in the ocean.

"Up to now we've managed fish based on averages rather than in real time," said Boley. "We've restricted 700 miles of coastline because we know what has happened in the past. This new tool allows us to track what is happening now, to track when and where specific stocks are in the ocean.

"Because salmon mix up in the ocean, we've managed fisheries around the most vulnerable stocks," Boley continued. "But that's deprived small coastal communities of having local fisheries targeting specific runs. By having real-time monitoring of local fishing grounds it is possible to spread out the fishery, instead of putting lots of pressure on a few stocks. Genetic testing of fish in the ocean has the potential to protect the fish and the fishery both."

Genetic information alone won't revolutionize salmon management next year, according to Peter Lawson, a fisheries biologist with the National Oceanic and Atmospheric Administration. The new technology offers a much clearer picture of salmon in the ocean, but to make management decisions about where and when to fish, more information is needed on how fish congregate and travel. "We hope to be able to identify the distribution of stocks of concern and allow fishing outside that range, even as the fish move," Lawson said.

"We're interested to know how the distribution of fish is related to oceanographic data," said Banks. To that end, the ProjectCROOS team joined forces with colleagues at OSU's College of Oceanic and Atmospheric Sciences to test an ocean-going remote-controlled glider that cruised through the salmon fishing grounds and recorded oceanographic data.

"We've worked closely with the industry and agencies to apply our developing science to an immediate management problem and to communicate ecosystem science data to a community of users in 'real time' via the web," said Gil Sylvia, the superintendent of OSU's Coastal Oregon Marine Experiment Station. Eventually, these tools could play a role in marketing, too. The barcodes that fishermen attach to each fish stay with the fish from boat to market. "Labeling river of origin could become a marketing strategy, like the Copper River salmon of Alaska," he said.

More than 80 boats fishing off the Oregon Coast contributed data to help identify different stocks of salmon in the ocean during the summer of 2006. Photo: Lynn Ketchum

It is not just luck that makes research available when problems arise. "We have an advisory board at COMES that helps us anticipate future problems," Sylvia said. "Most research takes at least five years to develop from basic research to practical application, so we need to anticipate the needs of the coastal community at least five years out to be able to provide practical solutions to evolving problems."
