The Salmon Connection

Farmers and fishermen have joined forces to help OSU researchers track the legendary journey of wild salmon.

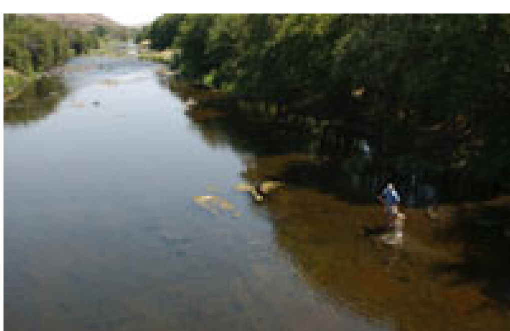
by Peg Herring

Farmers along the Columbia plateau and fishermen along the coast didn't think they had much in common. The water that flowed from the river to the sea sustained them in different ways. But when the wild salmon that had navigated those waters for eons grew scarce, farmers and fishermen found they shared a common concern.

Today, two of Oregon State University's branch agricultural experiment stations on opposite sides of the state have joined forces to sustain wild salmon. Thanks to the collaboration of farmers and fishermen, four new OSU faculty 400 miles apart are connecting the pieces in a puzzle that reaches all along the salmon's journey.

"Salmon research has a long, highly regarded history at Oregon State University," said Thayne Dutson, dean of OSU's College of Agricultural Science. But during the mid-1990s, salmon issues had become highly political. During a series of meetings he held at that time at several branch stations, Dutson heard the emotionally charged concerns from people across the state.

"Our meetings coincided with new stream quality listings by the state and threatened and endangered listings of some Columbia River salmon stocks," said Dutson. "People were feeling the effects of new restrictions and they were afraid for their livelihoods."



OSU ecologist David Wooster evaluates salmon habitat in the Umatilla River, which marks the beginning and end point of the journey of some of Oregon's wild salmon. Photo: Lynn Ketchum

In Newport, at OSU's Coastal Oregon Marine Experiment Station, Dutson heard from commercial fishermen and fish processing industries worried about staying in business without enough salmon to harvest. Across the state in Hermiston at OSU's Hermiston Agricultural Research and Extension Center, he heard from potato and wheat growers worried about staying in business with so many regulations in place to protect salmon.

Each community was frustrated. Each saw that for all the effort and sacrifice they had already endured to protect salmon and salmon habitat, the problem just seemed to get worse. Each focused on problems in other places. The coastal fishermen pointed to degraded streambanks and poor water quality far upriver, while Columbia Basin farmers questioned degraded estuaries and overfishing in the ocean. The stage was set for a crippling conflict.

Instead of a battleground, the two communities would find a common connection.

"It was clear that these two very different groups shared the same concern from two very different points of view," remembered Gary Reed, superintendent of the Hermiston station. "They wanted the same thing: a healthy environment where they could farm and fish and raise their families. So we decided to bring the two communities together to find a solution together."

Photo: Tom and Pat Leeson

At Dutson's suggestion, Reed and Lavern Weber, then superintendent of the Newport station, convened a joint meeting of the advisory boards of their two branch experiment stations. Fishermen and growers from communities almost a state apart agreed that what they both needed was more light and less heat on the issue of sustaining wild salmon. They called for a joint research program based at both branch stations in Newport and Hermiston to learn more about the life of salmon in fresh water, estuaries and the ocean.

The Salmon Ecology Research Program that resulted from this collaboration brought together scientists from different places and disciplines. Geneticist Michael Banks, originally from South Africa, and evolutionary ecologist Ian Fleming, originally from Canada, have their laboratories in Newport. Their collaborators, ecologists Sandy DeBano and David Wooster, work hundreds of miles inland in Hermiston at a branch station better known for its work on potatoes than on salmon.

The partnership of DeBano and Wooster extends beyond the workplace. The two are married and juggle parenthood with a rigorous research schedule studying the food of young salmon in the Umatilla River. Along the river, DeBano sweeps the streamside vegetation with a wide net, as Wooster wades into the stream to collect aquatic insects from the current and stream bottom. They sample lush woodlands and clear streams as well as bare, trampled banks to nab what might fall or fly or blow into the water's edge.

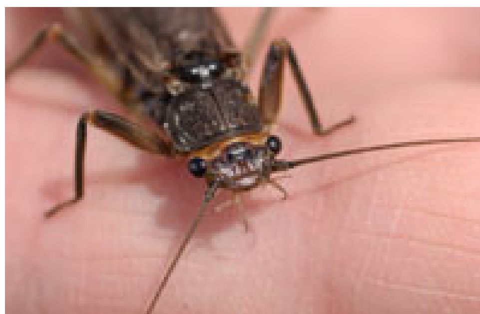
"The Umatilla River is typical of Columbia River tributaries east of the Cascade Mountains," explained DeBano. "It's felt the impacts of agriculture, grazing, gravel mining, deforestation, dams, roads and urban development. With about 70 percent of the streamside vegetation decimated, and lethally high water temperatures in places, salmon habitat has been greatly reduced. Native coho salmon and both fall and spring chinook salmon are now extinct from the river, and steelhead and bull trout are threatened with extinction."

In the 1980s, the Confederated Tribes of the Umatilla worked with natural resource agencies to create a tribal hatchery, reintroduce salmon and trout, and restore habitats on the Umatilla River. Wooster and DeBano work closely with tribal biologists as they track the success of reintroduced salmon.

"Habitat restoration costs money," explained Wooster. "If tribes and landowners are going to spend money and effort restoring salmon habitat, we've got to make sure that investment offers the best possible return. We need to identify the elements that create the highest quality salmon habitat."

OSU aquatic ecologist David Wooster examines a sample of river life he scooped from the Umatilla River as terrestrial ecologist Sandy DeBano sweeps the banks for riverside insects that would make a meal for young salmon in the Umatilla River near Hermiston. Photo: Lynn Ketchum

One way to measure the quality of salmon habitat is to assess the insects that live there. Some bugs are very picky about where they live. They require precise characteristics of water quality. If you measured water quality directly, you'd find that your measurements would vary widely, even within the course of a day. But locating particular insects in a section of stream can suggest the average quality of the stream throughout the bug's life.



Stoneflies in their larval stages are a feast for juvenile salmon. Photo: Lynn Ketchum

In pockets throughout the Umatilla watershed, mayfly nymphs scuttle through streambed gravel and caddisflies encase themselves in bits of river sand. By determining which bugs are important food for young salmon, and which plants are associated with those bugs, DeBano and Wooster's work can suggest where to invest restoration dollars to provide the best habitat for salmon.

DeBano and Wooster study one of the earliest elements of the sprawling life history of Pacific salmon. But, as every parent understands, early life often determines later success. Here, OSU salmon ecologist Ian

OSU's researchers capture fish in a seine net to study the growth rate and behavior of juvenile salmon in the estuary. Photo: Lynn Ketchum

Fleming takes up the investigation. Fleming explores the behavioral ecology and life history of fishes. He identifies how the characteristics of salmon parents affect the success of their offspring, and therefore the success of the population.

"By her choice of spawning area, the mother salmon determines where her young will spend those first critical weeks or months," said Fleming.

Despite the common perception of salmon as precisely programmed automatons, there's a great deal of variability among populations and individuals. Some juveniles linger in fresh water while others zoom downstream to the estuary. Some enter the ocean within months of emerging, others hold up in the river for a year. Such variation keeps a population safe from catastrophe.

Whatever their freshwater pattern, young salmon eventually head downstream toward the ocean. It is in the estuary where they transform themselves from freshwater to saltwater creatures. Here, where river meets ocean, is a Grand Central Station of all kinds of salmon coming and going, and a good place to examine the connections between upstream and ocean life.

"It is important to remember that these are not isolated environments, although they are distant," Fleming said. "When you make improvements in one place, the benefit can affect the population in another place."

But alternate survival strategies are possible only if the salmon have access to alternate choices of habitat. Hatchery management cannot duplicate the environmental diversity that shapes a successful, self-sustaining salmon population, according to Fleming.

There is strong interest in continuing to produce and catch hatchery-raised salmon and steelhead, according to Fleming. Yet there is concern that by raising fish in hatcheries, the salmon population gradually loses the diversity developed over generations that is necessary to adapt to particular environments. Fewer behavioral and life history options threaten their long-term survival.

In the long journey to the ocean and back again, salmon stocks get mixed up. Distinguishing particular runs and populations within this mix is necessary in order to protect endangered populations and allow fishermen to target abundant populations. For years, hatcheries have tagged some of the young salmon they produce in order to track their return. Newer methods use preprogrammed microchips capable of receiving and transmitting specific radio signals. While physical tagging can provide a way to track hatchery stocks, it is less useful for wild fish.

However, all fish carry natural genetic tags. Recent advances in molecular genetics have made it possible to use DNA from a pinhead-sized fin-clip to identify a fish's origin. This could help pinpoint fishable salmon stocks and steer fishing pressure away from threatened stocks. It also could help identify the wide range of survival options encoded in a wild population to avert disaster.

Understanding the genetic coding that distinguish fish stocks is the specialty of Michael Banks, a fisheries geneticist at the Newport branch station.

"Over the years, we have learned what is the norm for salmon behavior, but we still don't know how widely they vary in their behavior," said Banks. "It may be their variability that sustains them.

"We know that the ocean is not a consistent environment. There are oscillations that take place in cycles from seasons to decades that affect salmon survival. We need to know how salmon populations cope with environmental variability and what role genetics plays," said Banks.

Geneticist Michael Banks loads salmon DNA in his laboratory at the Hatfield Marine Science Center in Newport. From the DNA samples, Banks will generate a billion copies of targeted genetic markers that allow scientists to pinpoint genetic differences among salmon populations. Photo: Lynn Ketchum

To learn this, Banks searches for genetic signatures in salmon that can identify particular populations.

Every species on Earth has a particular order to its genes. If you could compare the order of genetic material of two individuals of the same species, most of it would be identical. However, only identical twins have the same exact sequence. At certain sites along the chromosome, the sequence of DNA varies slightly between individuals, expressing particular individual traits. At some sites, these sequences repeat many times, like a record skipping on a phonograph. These repeats are places where mutations are common, and inherited traits can be traced within family groups. Banks and his research team study these hiccups of repeated genetic information as windows into evolutionary change.

"We are learning that population differences go far beyond the concept of species," said Banks "We see micro-evolution, as genes are exchanged among different populations, particularly among populations with different life histories."

So, it's not just that life history reflects both nature and nurture. Banks wants to know to what extent the variety of both genetics and environment allow greater resilience in salmon populations.

The recent strong runs of salmon in the Columbia River and along the coast demonstrate that fluctuations are possible in a very dynamic system. When ocean conditions provide plenty of food and disperse predators, young salmon may have a better chance of survival when they first enter the sea. But even in years when ocean conditions are abysmal, some salmon survive.

In a way, salmon are like the communities they connect. They survive because of their differences. Fishermen in Newport and farmers in Hermiston have found something in common despite their differences. It's the salmon connection.

Captain Barry Fisher of Newport worked tirelessly before his death to help create the Salmon Ecology Research Program. Photo: Carol Fisher

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