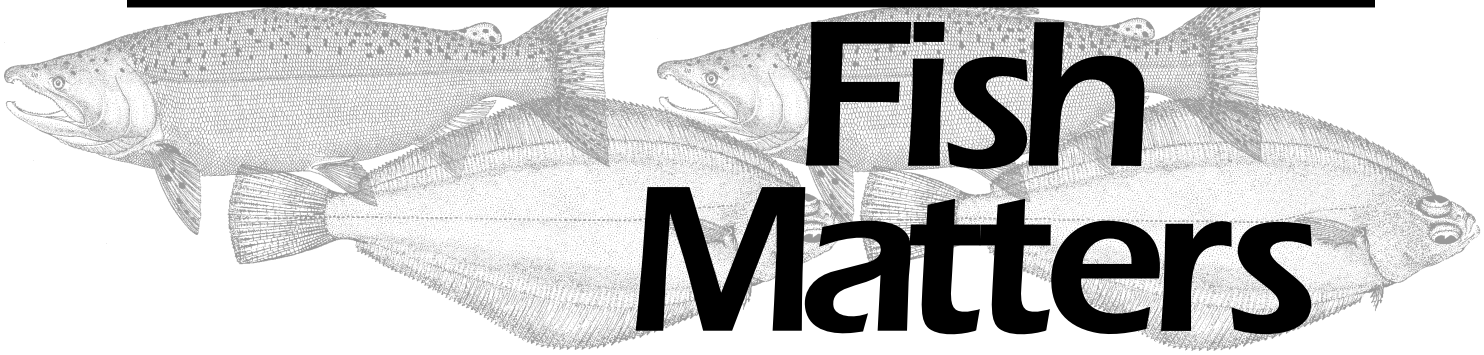
Northwest Fisheries Science Center



Fish Matters

Tribal Collaborations

the search for common ground

"The Creator made the Salmon. He planted the Salmon in the Rivers for the People. He taught them how to care for the Salmon which was created for them. 'Do not neglect this important food,' he said. 'Always remember the Sacred Rules when you take care of Salmon. Never take more than you need, never lay a Salmon on the ground with his head toward the River. Place Salmon with his head facing away from the water.' Thus the Creator gave the People these Sacred Laws."

From a traditional Yakama story,
compiled by Glenn Welker,
August 24, 1999

In late July 1999, Dr. Usha Varanasi, Science Director at the Northwest Fisheries Science Center, met with fisheries resource managers and scientists from the Confederated Tribes and Bands of the Yakama Indian Nation, the Confederated Tribes of the Warm Springs of Oregon, and the Confederated Tribes of the Umatilla Indian Reservation. She toured many of their fisheries-related facilities and research projects.

"I came looking for common ground," says Dr. Varanasi, "and a way for Center scientists to come together with Pacific Northwest Tribes to share our mutual commitment to preserving the legacy of salmon." But the challenge of looking for points of compatibility between Center scientists and tribal scientists was easily met. "Of our many constituents," says Dr. Varanasi, "the tribes have a similar view of natural resources and the science needed to make informed decisions about long-term management."

To get down to the Yakima River, she and her Yakama Nation tour guides slid down a steep, dusty bank on a 100-degree day. Dr. Varanasi then had to climb between the side of the 22-foot flat-bottomed aluminum boat and surrounding rail in order to get onboard, where she discovered there were no seats.

"They couldn't get our boat off the beach because the Yakima River was so low. While they tried to push the boat into the river current, they left me waiting in the boat. I remember thinking, 'If this boat takes off with just me in it, I'm in trouble!' "

A nearby picnicking family quickly joined in the growing

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National Marine Fisheries Service

National Oceanic and Atmospheric Administration

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Cooperative Research

between tribes and Northwest Fisheries Science Center

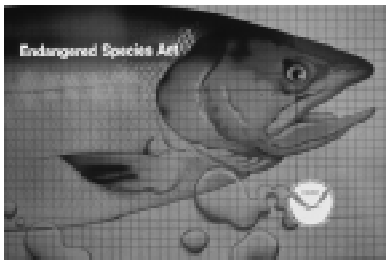
Tribes and tribal organizations with cooperative research projects with the Northwest Fisheries Science Center.

- Confederated Tribes of Umatilla Indian Reservation
- Makah Nation
- Nez Perce Tribe
- Quileute Tribe
- Quinault Nation
- Shoshone-Bannock Tribes
- Suquamish Tribe
- Tulalip Tribes

- Columbia River Inter-Tribal Fish Commission
- Northwest Indian Fisheries Commission
- Point-No-Point Treaty Council
- Skagit Cooperative

The Northwest Fisheries Science Center has a long history of cooperative research with tribes, state and federal agencies, private organizations, and universities. The following summarizes current cooperative research with Pacific Northwest tribes that focus on some of the key issue in fisheries research and management today.

Saving listed salmon species from extinction



In 1991, the National Marine Fisheries Service (NMFS) listed Snake River sockeye salmon as endangered and spring/summer chinook salmon as threatened under the Endangered Species Act. Because scientists agreed that these fish would become extinct before recovery plans could improve their habitats, they decided that captive broodstock rearing would be necessary to maintain these gene pools and preserve the fish's adaptability until their native habitat and dam-passage are improved.

Captive broodstock programs are a form of artificial propagation where fish are cultured in captivity for most or all of their life cycle. The Center maintains captive broodstocks of Redfish Lake sockeye salmon and six stocks of Snake River spring/chinook salmon. The first fish from these programs have now been released. These captive broodstocks have proven to be an important lifeline in the recovery process.

Among other collaborators, three tribes are involved: namely, the Shoshone-Bannock Tribes; Confederated Tribes of the Umatilla Indian Reservation; and the Nez Perce Tribe.

Research to help recover threatened chinook salmon in Puget Sound

In March 1999, the National Marine Fisheries Service listed chinook salmon in the Puget Sound Evolutionarily Significant Unit (ESU) as a threatened species under the Endangered Species Act. This ESU includes all naturally spawned populations of chinook from the rivers and streams flowing into Puget Sound,

Unfortunately the team has trouble collecting "real-time" field data on the Washington coast because the areas are too remote to access on a routine basis, and funding and staff are limited.

In June 1998 the Marine Biotoxin Team developed a partnership with the Quileute Tribe to use their seawater samples to identify the species producing domoic acid. In September, the team identified high numbers of the diatom *Pseudo-nitzschia pseudodelicatissima*, which produces toxic domoic acid, just a few days before record levels of domoic acid were found in razor clams.

Sampling beaches for the presence of razor clams which might be contaminated with domoic acid

As a part of their management duties and responsibilities, the Olympic National Park, Washington State Department of Fish and Wildlife (WDFW), the Quinault Nation, the Quileute Tribe, and the Hoh Tribe estimate the abundance and size frequency of razor clam

Cooperative razor clam population assessment on Kalaloch Beach

populations within the Kalaloch District of the Olympic National Park. This data would then be used to make decisions about the harvest of razor clam populations while providing sustainability of the population as a part of the Kalaloch Razor Clam Management Plan.

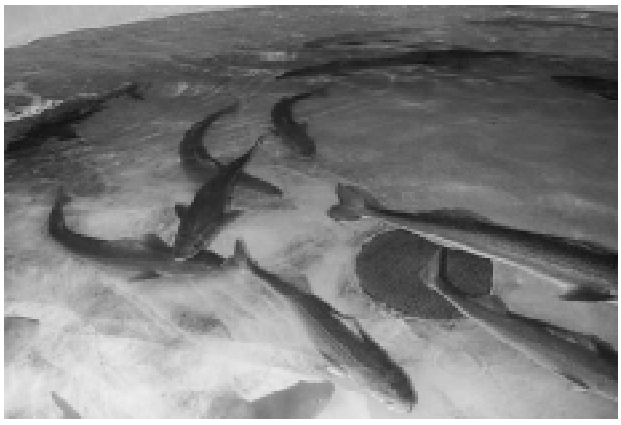
This year, the Center's Marine Biotoxin Team became involved in this project to determine the distribution of domoic acid in razor clams on Kalaloch Beach. Both the WDFW and Quinault tribe were partners in the annual survey and agreed to provide the Center with razor clam samples. The Team is now analyzing the samples to see if there are patterns of domoic acid distribution among razor clams depending upon their location between high and low tide. The data collected from this study will aid in the development of improved statistical sampling protocols.

"There is real value in a partnership with coastal communities who are collecting field data in areas too remote for us to routinely access," said Dr. Jack Wekell of the Center team. "With continued collaboration, we will develop the capability to predict, or at least mitigate, some of the impacts of harmful algal bloom events on the Washington coast."

Sablefish aquaculture

Several marine fish species have been identified as priority for commercial market-oriented aquaculture development in the Pacific Northwest. However, before rearing of juvenile marine fishes can be undertaken for aquaculture purposes, an environmentally sound, cost-effective culture system needs to be developed. These systems requires coordinated research on reproduction, early life history, nutrition, pathology, physiology, engineering, genetics, and fish culture. Joint studies by Center staff, tribal fishery biologists, and the fishing industry are targeting key life-history stages of the most important fish species to develop systems for spawning and mass-rearing juveniles to market size.

Initial efforts to develop breeding and rearing technologies for sablefish has resulted in the establishment of a broodstock. Spawning experiments will proceed when chillers are put online next year.



Sablefish broodstock held in culture for 18 months at the Center's Manchester Research Station

conducted by the Yakama Nation Fisheries Department, the tribe invited Center scientists and technicians to lend their expertise in gear installation, operation, and troubleshooting in the fall of 1999. As described in a memo from the tribe expressing their thanks for the Center's participation, "This research would be difficult without the use of radiotelemetry gear and the technical assistance we received from NMFS."

Information gathered from the 1999 coho radiotelemetry project will provide a solid foundation for the remainder of the project in 2000 and 2001. "All Yakama Nation fisheries personnel involved in the coho radiotelemetry project look forward to continuing to work with NMFS during the final two years of this project," said the complimentary memo.

Predation on the Columbia River

Caspian tern colony

The Columbia River Inter-Tribal Fish Commission has been studying Caspian tern bird colonies located on islands in the estuary and elsewhere in the Columbia River. During the study, they manually collected PIT tags from the bird colonies, which are used to mark smolts during a variety of research projects conducted by the Center. To supplement the manual method of PIT-tag retrieval, researchers at the Center received a grant to modify an automated PIT-tag detection and reading system for use on the bird colonies. After the birds have left the colonies for the season, the automated system was used to collect data from the PIT tags on the relative vulnerabilities to avian predation of hatchery versus wild fish, as well as barged versus inriver migrating fish, and to make comparisons among different hatchery release groups. Through informal cooperation, between 50,000 and 60,000 PIT tags have been located and decoded.

Harmful algal blooms

Identifying and predicting harmful algal blooms on the Washington coast

The highest levels of toxic domoic acid in razor clams are found in the heart of the traditional subsistence shellfish grounds of the Quileute Tribe, Quinault Nation, and Hoh Tribe living along the Washington coast. Domoic acid is produced by diatoms which bloom in coastal waters and are consumed by razor clams, Dungeness crab, mussels, and anchovies. Although the accumulation of domoic acid does not appear to harm fish or shellfish, humans who consume them can be poisoned. Domoic acid poisoning in humans, which can be fatal in some cases, results in a short-term memory loss that can be permanent.

Washington coast at LaPush

To insure the safety of recreational and tribal subsistence fishers eating local shellfish, samples of shellfish are sent to the Washington State Department of Health for analysis of domoic acid levels. The Center Marine Biotoxin Team has partnered with the Quileute Tribe Natural Resources Department to collect weekly seawater samples at La Push and Kalaloch, Washington for analysis of toxic cells, toxin levels, nutrients, salinity, and temperature. These data will then be used to develop a risk model for sampling the beaches.

Kalaloch has been a "hot area" for domoic acid contamination of razor clams since it was first observed on the Washington state coast in 1991. The Marine Biotoxin Team of the Northwest Fisheries Science Center is trying to determine why some of the highest levels of domoic acid recorded are found in razor clams at this location. Once the species producing the domoic acid has been identified, team members hope to develop genetic probes for quick and accurate detection which could provide an early warning system to subsistence and recreational shellfishers.

including the Strait of Juan De Fuca, from the Elwha River eastward, and the rivers and streams flowing into Hood Canal, South Sound, North Sound, and the Strait of Georgia in Washington.

Freshwater habitat: sediment and scour

In cooperation with the Tulalip Tribes and the Skagit System Cooperative scientists, Center scientists are examining the effects of fine sediment intrusion and scour on salmonid "survival to emergence" in the Skagit and Stillaguamish River Basins. Low egg-to-fry survival rates are a limiting factor in the production of fry populations needed to recover chinook salmon. It is estimated that nearly 70 percent of fry fail to emerge (that is, nearly 70 percent of the time, fry emerge at levels where they cannot replace themselves on spawning beds) on the Stillaguamish River, and 30 percent fail to emerge on the Skagit River.

Sediment input into salmon habitat in western Washington is largely due to landslides. Landslide magnitude and frequency is related to natural geomorphic conditions, as well as land-use effects such as timber harvest and road construction. Quantitative sediment supply and transport data have already been developed for each of these watersheds. Studies have shown that egg-to-fry life stage survival is a function of scour depth (resulting from spring runoff, flooding, or high rainfall) and fine sediment concentration.

Tribal and Center scientists are currently monitoring the rate and grain-size characteristics of intruding sediments, and the depth and frequency of scour in chinook spawning gravels during embryo incubation-to-fry emergence on streams in these targeted river basins.

The goal of the research is to determine the relative importance of fine sediment intrusion and scour for egg-to-fry life-stage survival and the relative importance of sediment input processes to fine sediment intrusion rates and scour depth.

Freshwater habitat: log jams

Freshwater pool habitat for chinook salmon waiting to spawn has been identified as a critical factor in the recovery of threatened and endangered chinook salmon. Center scientists are monitoring the biological response of adult chinook salmon to the placement of engineered log jams in cooperation with the Tulalip Tribes, the Lummi Nation, and the Lower Elwha S'Klallam Tribe. Five log jams have been placed in the North Fork Stillaguamish River to create and enhance holding pool habitat for spawning chinook salmon. Scientists are conducting snorkel surveys to determine the relative use of holding pools created by the jams relative to other holding areas. Surveys will also be conducted on the Nooksack and Elwha Rivers after engineered jams are completed in 1999 and 2000.

Engineered log jams on the North Fork Stillaguamish River

Freshwater habitat: thermal refuges

Summer stream temperatures in the North Fork Stillaguamish River can exceed key thresholds for adult chinook salmon resulting in a decrease in egg survival and adult mortality. However, specific stream temperature data and effects of these temperatures have not been determined for the Stillaguamish.

Adult summer chinook holding in the North Fork Stillaguamish River

Center and Tulalip Tribes scientists are trying to fill this data gap to help recover chinook on the North Fork Stillaguamish River. Their research is attempting to answer the following questions: 1) How do summer low flows, in combination with high stream temperatures, affect the timing, location, and fecundity of spawning chinook? 2) Are there zones within the mainstem and North Fork that become "lethal" for holding adult chinook? 3) Are cold water sources associated with some of the areas utilized for holding, and how do they effect stream temperature?

Scientists hypothesize that a critical aspect of Stillaguamish summer/fall chinook recovery will be to locate, document, protect, and restore areas of thermal refuge for adult chinook salmon holding to spawn. Historic holding areas and potential areas will also be identified.

Straying of chinook hatchery fish

A critical measurement of the status of the summer/fall chinook salmon stocks on the Snohomish River is the annual estimate of spawning escapement which can produce an accurate assessment of the number of naturally spawning chinook salmon. Chinook salmon produced at the Tulalip and Skykomish Hatcheries may contribute to natural spawning escapement in the Snohomish Basin, but the extent of straying by hatchery fish is not well understood. The technique used to study straying in this project involves thermally marking otoliths of developing chinook embryos produced at the hatcheries so they can be distinguished from their wild counterparts. Over 4.3 million chinook fry were marked and yearly samples have been taken in this ongoing project.

Consequences of inbreeding in hatchery chinook salmon

This project is an ongoing collaboration (since 1994) with the Suquamish Tribal Fisheries Department and the University of Washington. The goal of the research is to determine the consequences of inbreeding in hatchery chinook salmon. Hatchery programs can pose several genetic risks to salmon populations resulting from loss of genetic variability. One such risk is a reduction in a population's mean fitness. Preliminary results for a Puget Sound population of fall chinook salmon indicate that after one generation of inbreeding, a reduction of 9-24 percent in survival to the eyeing, hatching, and alevin stages occurred in inbred relative to control progeny. These results indicate that populations of Pacific salmon may be sensitive to moderate inbreeding. Carefully designed breeding schemes should be used to maximize genetic variation in hatchery broodstocks, because the extent of inbreeding depression over the entire life cycle is not yet known.

Fall chinook salmon survival studies

This cooperative research project with the Nez Perce Tribe and U.S. Fish and Wildlife Service is attempting to measure the survival of fish passing through the Snake River Dam system.

Subyearling migrants from the Lyons Ferry Hatchery are PIT-tagged and trucked upstream to Hells Canyon and the Clearwater River each week to determine the effects of water temperature, river flow, and dam bypass systems on survival rates. These hatchery fish are used as surrogates for wild fish, since there are so few wild fish in existence. The Nez Perce are helping with the tagging and release of fish on the Clearwater River. The Center is also assisting the tribe by PIT-tagging fish for a study they are conducting on supplementation.

Basic research on impact of hatchery fish on wild stocks

Straying by hatchery chum salmon in Puget Sound

Chum salmon populations in Puget Sound are considered healthy and are not listed under the Endangered Species Act. However, there are ongoing concerns about harvest rates of hatchery fish versus wild stocks in terminal fisheries like Tulalip Bay and straying of hatchery-origin fish into natural spawning areas of wild stocks.

Tulalip fisheries technician Robert Skoog removing a chinook salmon carcass from the Skykomish River, October 1998. The carcass is returned to the river after removal of the otoliths and a few scales.
(Photo courtesy the Tulalip Tribe)

Tulalip fisheries technician Richard Young removing otoliths from a chinook salmon.
(Photo courtesy the Tulalip Tribe)

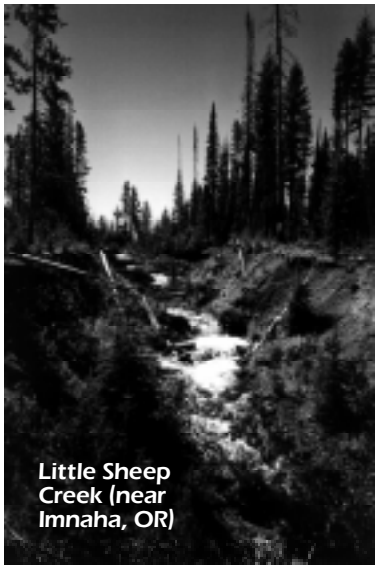
In the early 1990s, a genetic marking technique was used at the Tulalip Tribes Tulalip Hatchery to change allele frequencies at two loci in chum salmon so they are permanently different than wild chum stock. The presence of the mark was used to detect straying of hatchery-origin fish into natural spawning areas, estimate the stock composition of mixed-stock fisheries, and provide managers in the Stillaguamish-Snohomish terminal area with a tool that could be used to increase the harvest of hatchery fish and reduce the harvest of wild stocks.

Samples of adult chum salmon were taken from terminal area fisheries, hatchery return facilities, and natural spawning areas. The genetic analysis of the samples are analyzed by the Washington Department of Fish and Wildlife's Genetics Laboratory in Olympia.

Preliminary results indicate that the Tulalip Hatchery run may be underestimated by as much as 33 percent. In-river samples to date show that there is no evidence of straying from the Tulalip Hatchery of chum salmon into natural spawning areas in the Stillaguamish and Snohomish River systems. The exception to this is in an urbanized area where the channel of Quilceda Creek has been artificially altered and Tulalip Hatchery fish have been found spawning.

Relative reproductive success of naturally-spawning hatchery and wild steelhead

The success of hatchery fish spawning in nature has remained one of the most problematic issues in the conservation and recovery in Pacific salmon. The Center has recently initiated a cooperative study with research biologists from the Nez Perce Tribe and Oregon Department of Fish and Wildlife (ODFW) to quantify the reproductive success of naturally spawning hatchery steelhead. This study uses advanced genetic technologies to examine juvenile fish in rearing areas on Little Sheep Creek in northeast Oregon and identify their parents from the pool of hatchery and wild fish passed above the weir (a trap used by fishery managers to collect adults during their upstream migration). This work is an extension of ongoing studies in the Snake River Basin that seek to monitor the genetic effects of hatchery propagation on threatened and endangered salmon populations.



Little Sheep Creek (near Imnaha, OR)

A major difference is that this new work will enable estimates of reproductive success in real time, rather than waiting for the genetic effects of successful spawning to accrue over multiple generations. Though not as broad in scope, this more intensive new study is likely to provide information that will help guide appropriate hatchery propagation policy. The Center is providing both the technological capability for the DNA-typing of highly variable microsatellite markers, as well as the analytical work in making parentage assignments. State and Tribal collaborators are contributing their biological expertise and familiarity with river access and sampling, including private property issues and geographic distribution of juvenile rearing areas. Both ODFW and the Nez Perce Tribe have been pivotal in collecting fin-clip tissue samples both from returning adults passed over the weir and from their juvenile progeny upstream.

Coho salmon reintroduction into Yakima Subbasin

A critical component of the coho salmon reintroduction program in the Yakima Subbasin is identification and delineation of the spawning distribution of returning adult coho salmon. Although this research is being

laughter as her guides tried to slide the boat across the gravel. They seemed curious about the exotically dressed Dr. Varanasi. "They wondered if I was a Native American. I am actually from India and was wearing a traditional punjabi dress," she said.

The boat, which was steered by Joe Jay Pinkham, a veteran Yakama river man and former Marine, took Dr. Varanasi and Dr. William Rodgers, the Center's new tribal liaison, on a tour of salmon habitat sites. Dr. Rodgers, a professor at the University of Washington law school, is well known for his involvement in the Boldt Two decision which made tribes key players in the management of fishery resources.

It isn't easy picturing Dr. Varanasi, speeding at 30 mph up the Yakima River. After all**,** most people are accustomed to seeing the Science Director presiding over Center affairs from her office in Seattle. But Dr. Varanasi has a passion for science. Good science. Science that withstands the scrutiny of colleagues and the changing tide of politics, politicians, and funding. Science that addresses long-term issues, not just the latest crisis.

Tribal scientists and managers briefed Dr. Varanasi on key issues facing each of the three tribes she visited. The first issue is how to rebuild harvestable stocks, using hatchery stocks to supplement populations. Although tribal scientists recognize NOAA Fisheries' concerns about the impacts of hatchery stocks on protected wild stocks, they want to see the scientific rationale supporting these concerns. The second issue, particularly for tribes that are upstream from dams, is whether they should build up runs of salmon when salmon are still subject to significant mortality caused by downstream dams. The third issue for tribes is how to bolster the science underlying tribal hatchery supplementation projects so that these projects can withstand the scrutiny of independent science reviews.

The number-one question asked of Dr. Varanasi was how the Center's science is integrated into the regulatory side of the National Marine Fisheries Service (NMFS). Her answer was, "this is defined almost daily."

The challenge of recovering salmon is considerable, not only because of their range—from the Pacific Ocean to the headwaters of the major western rivers—but also because of the number of risks salmon face. These risks include harvest, competing hatchery fish, habitat degradation, passage through the hydropower system, and changing ocean conditions. Solving the human-caused problems to insure recovery requires science that assesses cumulative change from an ecosystem perspective, rather than incremental change from a specific site. This kind of science is more difficult to design and see through to completion.

"Fisheries research and management is very controversial, and the stakes are high with the listing of so many species of salmon. Many individuals and organizations are suspicious of the federal government," said Dr. Varanasi, "but I am confident that our work will be accepted in time."

"We already conduct significant research in cooperation with at least eight tribes and four tribal organizations in the Pacific Northwest, and we are now exploring ways to improve the communication of science with our tribal constituents."

During her trip, Dr. Varanasi explored opportunities for the Center's scientists to provide educational resources for tribal scientists, managers, and students. She examined the possibility of providing student internships, lecture series, and distance learning programs through tribal colleges and schools. One of the major challenges she identified was the great geographic distances between the Center and many of the tribes in eastern Oregon and Washington.

"I am excited by the educational opportunities we can derive from joining ancient cultures and modern educational technology, all with the goal of benefitting the long-term health and sustainability of our fishery resources," said Dr. Varanasi. Although NMFS and the fisheries agencies that preceded it have existed for over 125 years, tribes have a cultural history with salmon and salmon management that goes back 8,000 years.

At the Roza Dam collection facility, Dr. Varanasi had a chance to talk to the tribal staff who were collecting salmon from the river in a small research shack. The staff were frantically sorting and inserting PIT-tags in salmon just lifted from the river for a broodstock research project. They were trying to minimize the stress to the salmon.

"When I complimented the staff on the good job they were doing," noted Dr. Varanasi, "they said it felt so good to have someone there to see how much they love salmon."