

Northwest Fisheries Science Center

Highlights 2007



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Message from the Science Director

I would like to share with you some of the notable activities and accomplishments of NOAA's Northwest Fisheries Science Center in 2007. I am proud of what Center scientists achieved during this challenging and productive year, and appreciate the hard work and dedication of our many collaborators. As one of the three NOAA Centers of Excellence investigating the critical connections between oceans and human health, staff received national media attention and recognition for their efforts in addressing seafood safety concerns and transferring technologies to seafood consumers. We also celebrated 60 years of fishery genetics that began at the Montlake Laboratory, strengthened NOAA's role in regional ocean governance initiatives, and continued to make advances in the science to support an ecosystem approach to managing our living marine resources. The West Coast, whose ecosystem is strongly tied to state of the California Current, continues to face critical challenges, including building sustainable groundfish fisheries, recovering endangered and threatened salmon and steelhead populations and conserving the endangered Southern Resident killer whale population. I am committed to supporting sound, innovative research and improved observations to better understand and improve the condition of living marine resources and their ecosystems, and I look forward to continuing our efforts in 2008.



Sincerely,

A handwritten signature in black ink that reads "Usha Varanasi".

Usha Varanasi

Who We Are and What We Do

The Northwest Fisheries Science Center (NWFSC or Center) conducts research to help conserve and manage living marine resources (e.g., marine fish, salmon, and killer whales) and their habitats in the Northeast Pacific Ocean—primarily off the coasts of Washington and Oregon and in rivers and streams in Washington, Oregon, and Idaho where anadromous fish, like salmon, go. The Center's research assists resource managers in making sound decisions that build sustainable fisheries, recover endangered and threatened species, sustain healthy ecosystems, and reduce human health risks.

Conserving and managing living marine resources requires an ecosystem approach. This approach is specific to individual ecosystems, changes according to different conditions, and considers multiple social and environmental factors that exist both inside and outside the specific ecosystem of study. To improve knowledge of ecosystems in the Pacific Northwest, we study organisms, their environments, and processes, such as environmental variability. In support of ecosystem science, Center scientists and staff conduct field and laboratory research and develop tools and models in five primary areas:

- Status of Stocks
- Human-caused Stress/Risks
- Ecosystem Observations and Climate Variability
- Recovery and Rebuilding, and
- Innovation and Technology

What follows are some of the Center's 2007 accomplishments in each of these areas.

Status of Stocks

Stock assessments and status reviews determine the status of fish and marine mammal populations by integrating a broad array of information, including biology, population dynamics, environmental conditions, and risk factors. These assessments are a critical tool used by managers to set biologically sustainable harvest levels for healthy fish stocks and to guide the monitoring and rebuilding of overfished or threatened fish stocks and depleted marine mammal populations.

In 2007 we:

Collected Critical Data on West Coast Groundfish

The West Coast groundfish fishery includes some 80 commercially fished stocks off Washington, Oregon and California and supports millions of dollars in economic activity. Center scientists conducted two intensive coast-wide groundfish surveys: a bottom trawl survey from Cape Flattery, WA to the Mexican border and a Pacific hake acoustic survey conducted jointly with Canada from south of Monterey, CA to the Alaska-Canada boundary. These surveys provide critical fishery-independent information about the distribution, abundance and age structure of groundfish and other populations, and serve as the basis for stock assessments of commercially important species. In 2007 the Center also conducted nine stock assessments of groundfish species, including sablefish and hake, the two most valuable West Coast commercial species, and the longnose skate, the first skate assessment on the West Coast. These assessments provide critical scientific guidance for the Pacific Fishery Management Council's management actions in 2009-2010.



Improved Observer Program using Advanced Technology

The Center leads the West Coast Groundfish Observer Program. As part of this program, observers are placed on commercial fishing vessels to monitor and record total groundfish catch, bycatch, and discards associated with different fisheries. In addition to observing fleets targeting groundfish species, in 2007 observers also worked closely with the pink shrimp industry to increase the information collected on groundfish bycatch. Observers also continued testing an innovative electronic monitoring system on shore-based hake vessels. The electronic monitoring system, which integrates video, GPS, and winch and hydraulic sensors, helps improve documentation of fishing practices and holds promise for wider applications in monitoring fishing activities.

Conducted Updated Status Review of Puget Sound Steelhead

There has been growing concern in the region about the continued widespread decline of Puget Sound steelhead, despite substantially reduced harvest levels. In response to a public petition, NOAA reconvened a team of scientists to review and evaluate the most recent scientific and commercial information available on this distinct population segment. This scientific team, led by the NWFSC, determined that the factors that likely pose a risk for Puget Sound steelhead include degraded habitat, blockages by dams and other man-made barriers, unfavorable ocean conditions, and harmful hatchery practices. In their final report, the team also concluded that the current protective measures in Puget Sound did not substantially mitigate the factors threatening the future viability of steelhead. This report has informed critical management actions: based on this status review, NOAA proposed to list the Puget Sound steelhead as threatened under the Endangered Species Act.

Human-caused Stress/Risks

Humans are an integral part of ecosystems. Humans affect their surrounding environment and as a result living marine resources face a number of risks from toxic chemicals in sediments and waters, interaction of stormwater and impervious surfaces, habitat loss or alteration by human activities and climate change. Each life stage and species can be affected differently.

In 2007 we:

Led Outreach Efforts to Advance Ecosystem Approaches for Puget Sound

Earlier this year, Center scientists coordinated and led a collaborative effort involving multiple agencies and many scientists to produce the report, *Sound Science*, about the Puget Sound ecosystem and ways that science can inform recovery decisions. *Sound Science* highlights likely key threats facing the Sound in the future, identifies gaps in scientific knowledge, and advances an ecosystem approach to managing the Sound's resources. Also, because of the broad-based approach used in developing *Sound Science*, a description of the process was published as an essay in *Fisheries*, making it a nationally recognized concept. The Center also spearheaded an outreach strategy involving presentations to the Washington State legislature and local planning groups and dissemination of the *Sound Science* report to almost 1,000 constituents. Ongoing efforts involve sharing this common-vision statement of the Puget Sound ecosystem with hundreds of public libraries, high schools and universities, where it is currently used as a primary text in at least one conservation biology graduate course. As the first collaborative report to take an ecosystem view of the Puget Sound, the Center's leadership in this effort will also help support several ongoing regional initiatives, including Governor Christine Gregoire's initiative to restore Puget Sound by the year 2020 and the development of a comprehensive ecosystem plan to be developed by the Puget Sound Partnership.

Improved Juvenile Salmon Passage Model for Columbia River and Estuary

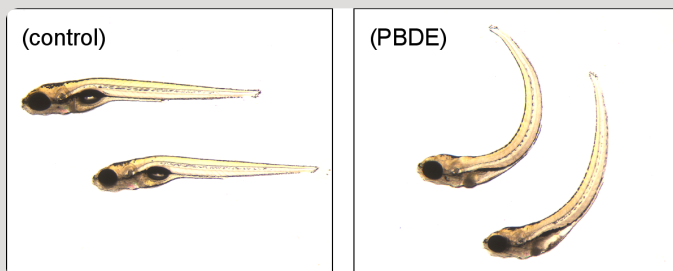
Salmon migrating through the Columbia River hydropower system encounter a number of dams during their upstream and downstream migrations. In 2007, the Center, regional fishery managers, and the University of Washington completed a two-year effort to develop a juvenile salmon passage model (COMPASS) that helps better assess future effects of the hydropower system on the survival of migrating smolts. Major improvements from the previous model include simulation of fish survival and travel time through the reservoirs, in addition to a user interface that allows managers to design river operation scenarios and quickly assess the impact on salmon populations. The COMPASS model played a pivotal role in helping NOAA Fisheries evaluate alternative proposed actions for operation of the Federal



Columbia River Power System and will be a cornerstone for water and salmon management in the Pacific Northwest. Also in 2007, the Center, together with Pacific Northwest National Laboratories, surgically-implanted over 80,000 new miniature acoustic tags to successfully generate survival estimates and assessed the effects of bacterial kidney disease in juvenile Chinook as they migrate from Lower Granite Dam to the mouth of the Columbia River. This new generation tag addressed a critical data need for salmon survival information during passage through the lower Snake and Columbia Rivers, and the estuary downstream from the hydropower system.

Assessed Exposure and Impacts of Toxic Compounds on Fish Health

In 2007, Center scientists helped complete the first comprehensive study of contaminants in the Lower Columbia River and estuary and their effects on the productivity of endangered and threatened salmon populations. In collaboration with the Bonneville Power Administration, the Lower Columbia Estuary Partnership, and the US Geological Survey, scientists found that the levels of several persistent pollutants, including DDT and other pesticides, were present in juvenile Chinook populations from several ESA-listed stocks that could adversely affect their health and survival. In another study, scientists determined that exposure to polybrominated diphenyl ether (PBDE) flame retardants, an emerging pollutant of concern, can disrupt the thyroid hormone system and impair development of fish larvae at high levels. This research helps advance our understanding of the biological impacts and health risks resulting from the exposure to legacy pollutants as well as rising levels of emerging pollutants of concern.



Developed Socioeconomic Tools to Analyze Impacts to Fishing Industry

Social scientists study the human dimension of ecosystems to better understand people and their association with and potential impact on marine resources. In 2007, Center scientists completed a cost-earnings survey of the limited groundfish entry fleet, a regional economic impact model for fishing-dependent communities on the West Coast, and a large-scale survey of the whale-watching industry to help generate a socio-cultural description of the unique relationship between whale-watching vessels and the endangered Southern Resident killer whales in the Puget Sound. Working jointly with the Alaska Fisheries Science Center as part of a national effort, Center scientists also completed a community profiling project of 125 communities engaged in fishing activities along the West Coast and North Pacific. The Center's efforts will help decision makers consider socioeconomic impacts to human communities while setting sustainable harvest levels for overfished stocks and minimizing the effects on fishing communities.

Ecosystem Observations & Climate Variability

Living marine resources in the Pacific Northwest use and depend on a variety of environments from freshwater streams and rivers to estuaries and the ocean. Center scientists conduct research to better understand how natural environmental fluctuations impact species, how they respond to natural disasters, and how changes in the oceans can lead to effects on human health.

In 2007 we:

Developed an Online Ocean Index for the Northern California Current Large Marine Ecosystem

We know that the state of the ocean when salmon first enter it is critical to their survival, but we had few tools to predict ocean survival, until now. Over the past decade, the Center has been monitoring the coastal ocean environment off the Washington and Oregon coasts, its interaction with the California Current, and how it affects the abundance, growth, distribution and survival of salmon. As a result, scientists have discovered many critical links between the physical conditions in the ocean (i.e., sea-surface temperature, salinity, and upwelling strength) and how biological communities respond to those conditions (i.e., changes in predator and prey abundance and diversity). In 2007 the Center completed an online database of its ocean index tool, which combines oceanographic data with biological indicators to predict changes in adult salmon populations from the Columbia River basin and coho salmon from the Oregon coast. This database will provide easily-accessible and up-to-date information to inform regional managers and fishers of salmon recruitment one year in advance for coho and up to two years in advance for Chinook.

Investigated the Effects of Climate Change on Salmon Survival

The ability of juvenile salmon to survive to adulthood is directly linked to the habitat available for them to use. However, changing ocean conditions due to climate change is thought to vary the amount and availability of this habitat. Using electronic tagging data from 15 populations in the Salmon River, Idaho, Center scientists and their collaborators at the University of Washington showed that salmon populations responded differently to climate conditions and that habitat conditions determined the type of response. Scientists also used models to predict how these populations will respond to climate change under a variety of stream flow and temperature scenarios, based on data provided by the Intergovernmental Panel on Climate Change. The models suggested that salmon populations will significantly decrease in abundance and exhibit a marked increase in probability of extinction if temperatures rise to levels estimated by the 'worst-case' scenarios. Such information will be critical to resource managers in their recovery efforts for ESA-listed species.

Developed and Commercialized Rapid Detection Tool for Harmful Algal Blooms in Shellfish

Harmful algal blooms can seriously affect human health and coastal community economies, yet the timing, occurrence and toxicity of these events are only beginning to be understood. In 2007 Center scientists received a prestigious NOAA Technology Transfer Award for their collaborative work with the Quileute and Quinault tribes, NOAA Ocean Service, and the National Center for Coastal Ocean Science towards the development and commercialization of rapid, cost-effective kits to detect the harmful algal toxin domoic acid in seawater and shellfish. This rapid detection method provides much improved sensitivity to measure domoic acid at levels far below those currently used to close shellfish beds or suspend crab harvesting. As a result, resource managers will have the ability to issue early public health warnings to human populations at the greatest risk of exposure. Such early warnings will allow for selected beach closures or targeted shellfish harvest, estimated to save tribes, recreational and commercial fishers up to \$20 million annually and help increase public confidence in seafood safety.



Addressed Health and Seafood Safety Concerns

The risk to human health through the consumption of contaminated seafood was a major concern following Hurricane Katrina. Scientists from the NWFSC's West Coast Center of Oceans and Human Health continued year-long surveys and co-authored a manuscript summarizing results of their analyses of water, sediments, and seafood for presence of pathogens, toxins, and contaminants in the Gulf of Mexico. The Center also had a key role for the agency on seafood science and safety issues and gained nationwide attention by publishing a timely perspective on the dilemma of seafood benefits and risks.

Recovery & Rebuilding

Over the last several decades certain living marine resources have become depleted and, in some cases, are in danger of extinction. Recovering and rebuilding these populations are important for ecological, economic and cultural reasons.

In 2007 we:

Continued our Scientific Leadership for Salmon Recovery

Center scientists are directly involved in salmon recovery efforts on the West Coast. Recovery plans are already completed or close to completion for 16 listed salmon and steelhead populations in three geographic domains under the Center's jurisdiction. Center scientists chaired the Technical Recovery Teams (TRTs) in each of these domains and conducted many of the technical analyses that supported recovery planning. With the imminent publication of recovery plans for most of the Pacific Northwest's domains, in 2007 the Center successfully transitioned from developing population viability goals to the role of science advisors in support of recovery plan implementation. For example, the Puget Sound and Interior Columbia TRTs applied innovative models to evaluate the threats caused by changes in habitat, harvest levels, climate impacts, hydrology, and fish population dynamics. Information from these user-friendly modeling efforts provides technical documentation of the impacts of recovery strategies on salmon and can help guide adaptive management strategies over time as new information becomes available.

Used Captive Broodstock Technology to Aid in Recovery of Listed Salmon

Many recovery efforts for ESA-listed stocks of Pacific salmon include the use of Center-developed captive broodstock technology, where fish are reared in specialized freshwater and marine systems to ensure high survival and production of eggs, smolts, and pre-spawning adults. This year, in collaboration with the US Fish and Wildlife Service, Bonneville Power Administration, state agencies and three tribes, the Center helped reduce the extreme risk of extinction for Redfish Lake sockeye salmon and rebuild core genetic populations of Snake River Chinook salmon. Approximately 1,400 adults and 200,000 progeny from Snake River sockeye and Chinook salmon were provided to Idaho and Oregon for use in recovery efforts.

Implemented Watershed Monitoring Program to Evaluate Restoration Efforts

Across the Pacific Northwest, public and private organizations are working to improve stream and riverine habitat conditions for threatened and endangered salmon. However, the types of data required to evaluate the success of freshwater restoration actions and resulting response in the targeted species are routinely collected, especially data on multiple recovery actions done at the watershed scale. In 2007, Center scientists successfully implemented a program of Intensively Monitored Watersheds (IMWs) in three watersheds in the Columbia River Basin. This model-based approach involves concentrating and integrating watershed-scale research and monitoring efforts on a few locations, which enables the collection of enough data on physical and biological attributes to develop a comprehensive understanding of how restoration actions affect salmon production, information that cannot be gained from monitoring at the reach scale of streams. The information from IMWs will help address the critical need for data for evaluating the response of salmon to different levels and suites of restoration actions.



Innovation & Technology

New technologies, techniques, and tools are essential to support and improve management, conservation, recovery, and rebuilding of the Pacific Northwest's living marine resources.

In 2007 we:

Refined the Atlantis Model to Support an Ecosystem Approach to Management in the California Current

An ecosystem approach to management will require new tools and observations, such as spatially-explicit ecosystem scale models. This year Center scientists continued work to develop and test a model (Atlantis) of the California Current marine ecosystem that integrates physical, chemical, ecological, and fisheries dynamics. The model's structure includes detailed biological information on predator-prey relationships among 54 groups of primary producers, consumers, and habitat-forming species (i.e., kelp, corals) in over 60 different spatial zones. The model's application will help scientists better understand the impacts of climate change and effects of fishing on the ecosystem, and will help decision-makers develop fisheries management alternatives that incorporate an ecosystem approach.

Applied a Chemical Ecology Approach to Reveal New Information on Killer Whale Contaminant Levels

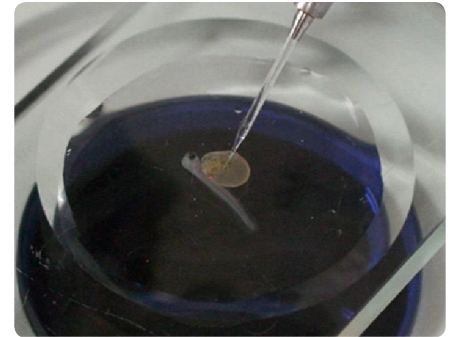
Top marine predators such as killer whales integrate chemical signals from the prey they consume, and these signals reveal information about pollution levels, their prey species, and regions from which prey were taken. With traditional approaches it would be very difficult to discern prey habitats and contaminant sources in killer whales. Through a unique collaboration with Canadian scientists and others and the use of state-of-the-art of analytical environmental chemistry, the Center analyzed recently collected biopsy samples from endangered Southern Resident killer whales (SRKW). This population of whales was recently listed under the U.S. ESA and Canadian Species at Risk Act. As a result, scientists contributed much-needed contemporary information on the levels and likely sources of legacy pollutants banned since the 1970s, persistent organic pollutants that are relatively new to the environment, and potential risks for adverse health impacts. The results of this international collaboration using a novel suite of analytical techniques were published in *Marine Pollution Bulletin*.



Testing New Surrogate Technology and Germ Cell Cryopreservation to Recover Endangered Salmon

Cryopreservation of egg and sperm cells has been used to preserve rare genetic lines or endangered species of many plants and animals. However, this technique had limited applications for fish because of the lack of a technology to cryopreserve fish eggs.

As the first trial of a new surrogate technology pioneered in Japan, Tokyo University, University of Idaho and Center scientists cryopreserved immature sperm cells from juvenile endangered Redfish Lake sockeye salmon and transplanted these immature cells into a female rainbow trout "surrogate". The surrogate trout are now developing ovaries with Redfish Lake sockeye salmon eggs. When the trout spawn two years from now, we will know if the eggs are fertile. The Center's collaborative efforts with Tokyo University, University of Idaho, and Idaho Department of Fish and Game show promise in helping reduce the extinction risk of the most highly endangered Pacific salmon population while habitat restorations efforts proceed.



Microinjection of immature male germ cells into surrogate trout

Expanded Genetic Databases and Species Identification Capabilities

In 2007 the Center collected genetic data from over 32,000 individuals from 200 different species, including Pacific salmon, killer whales, deep-water corals, rockfish, and abalone. Scientists also significantly increased our forensics activities to support the enforcement of salmon ESA violations, expanded our species identification expertise to include more species beyond salmon, upgraded DNA sequencing software at two research stations, and advanced our forensic species voucher collection in collaboration with the University of Washington. The capability to produce high-quality genetic data for salmon and other species has helped

the Center develop more collaborative projects with federal, state and tribal organizations and make valuable contributions toward ecosystem-level research.

Our Facilities, Operations, and Staff

Scientists and staff are the heart of the Center and are its most important asset. Adequate facilities and a strong infrastructure are critical to supporting the high-quality work of Center scientists and staff, ensuring that the Center provides the science needed to conserve and manage living marine resources and their ecosystems.

In 2007 we:

Led Regional Collaboration Efforts and Advanced NOAA's Participation in Ocean Initiatives

NOAA's expansion of regional coordination and communication efforts, with an emphasis on Regional Collaboration, allowed the NWFSC to address NOAA's priorities at both the national and regional scale while improving productivity and value to customers. As part of the NOAA West regional team, the Center strengthened NOAA's partnerships with scientists working on three national priorities: integrated ecosystem assessments, hazard resiliency in coastal communities and integrated water resource services. In addition, the NWFSC responded to new opportunities to engage NOAA in regional ocean governance initiatives, including the Puget Sound Partnership's (PSP) action agenda for the recovery of the Puget Sound and the West Coast Governors Agreement (WGCA) to improve ocean health. For example, the NWFSC provided leadership for NOAA West within the Pacific Northwest to outline the federal role in assisting the PSP.

Staff Training and Center Research Direction

The Center continued its highly successful internal grants program, which provides scientists with funding opportunities for cutting-edge research. In its seventh year, we offered a formal mentorship program to improve grant-writing skills and funded 9 awards totaling \$219K. In addition, the Center's Research Planning Team (RPT) continued its efforts to improve Center planning, programs and operations. The RPT completed a research plan identifying key research priorities in the near and long term, which will ultimately ensure coordination of Center research with agency goals and improve the Center's effectiveness in achieving its mission. The Center also continued its seminar series "Monster Seminar Jam" that invites well-recognized scientists to give seminars and interact with staff to provide continuing education to Center scientists and facilitate interactions with other scientists in the region, nationally, and internationally. The Center also completed the third year of its joint seminar series with the University of Washington to address topics related to oceans and human health. The Pacific Northwest is unique in having a NOAA-funded Oceans and Human Health Center located at the NWFSC and a NSF/NIEHS funded Center at the University of Washington, and we are taking advantage of this close proximity to build collaborations and to engage stakeholders in the region on key issues.



Celebrated 60 Years of Fisheries Genetics

Over 200 scientists and staff attended an international symposium hosted by the Center and University of Washington on the history of advances in the fields of genetics, biotechnology, and evolutionary biology as well as the application of new molecular approaches to future fisheries management. The symposium was dedicated to the Center's pioneering geneticist Fred Utter and his six decades of contributions to fishery genetics, which transformed the management and conservation of fishery resources. This groundbreaking research spawned new fields, such as genetic forensics, that are now well known to the public and greatly enhanced appreciation for NOAA's innovative products and services.



Hosted Watershed Restoration Workshops

The Center hosted a series of watershed restoration science workshops in 2007, including our 5th biennial Watershed Program Open House. Together with the Washington Department of Fish and Wildlife, we also organized and presented a series of workshops and open houses to train state and local restoration practitioners in the latest restoration science. Presentations and posters at these events showcased the innovative research being conducted by NOAA scientists, helped keep staff and stakeholders abreast of current restoration practices and technologies, and fostered valuable collaborative opportunities.

Strengthened Educational and Diversity Opportunities

Our staff participated in local outreach events and career fairs, including the annual NOAA Science Camp, Salmon Homecoming, Water for Life Festival, and NOAA Kids' Day in Seattle, WA to promote environmental literacy and stewardship. As one of the co-leads for the NOAA West regional collaboration team, the NWFSC worked with NOAA line offices to coordinate the first NOAA West Day in Long Beach, CA, an event that will serve as the template for enhancing ocean literacy and education via partnerships with other museums, aquaria and educational institutions along the West Coast. Center staff also provided over 45 students with educational and career opportunities to help increase interest in careers that support NOAA's mission. We also received recognition for serving as the NOAA coordinating office for the American Association for the Advancement of Science ENTRY POINT! Program, including a feature in the journal Science, and through this program provided 8 internship opportunities for students with disabilities.

Improved Safety and Operations


The Center implemented several improvements to safety, energy efficiency, and security facility-wide. The Center established a comprehensive field safety program with training for over 220 Center staff, updated the electrical system at the Montlake campus, participated in agency efforts to develop an avian influenza plan, established risk assessment safety plans for several scientific processes in the field and laboratory, and responded to a mold crisis with the completion of the new 11,400 square foot modular South Building to house over 95 scientists. The Center also successfully implemented the Oracle Collaboration Suite, an integrated "virtual office" system that enhanced online collaboration and document-sharing capabilities for over 250 employees and 225 external customers.

Received Recognition for Achievements

Many staff received awards this year in recognition of their hard work and accomplishments. The awards included one Department of Commerce Silver Medal, three NOAA Bronze Medals, one NOAA Distinguished Career Award, the NOAA Technology Transfer Award, the NOAA Fisheries/ American Fisheries Society's Dr. Nancy Foster Habitat Conservation Award, the Pan American Biotechnology Association's Marine Biotechnology Award, one Award for Publications Excellence, one Fulbright Scholar grant, and an Early Presidential Career Award for Scientists and Engineers.

Learn More & Come See us in Action

Sharing our work with other scientists, with policymakers, and with the public is important to us. To learn more about what we do, please visit our website at www.nwfsc.noaa.gov. To arrange a visit or obtain additional information, please call 206-860-3200.



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