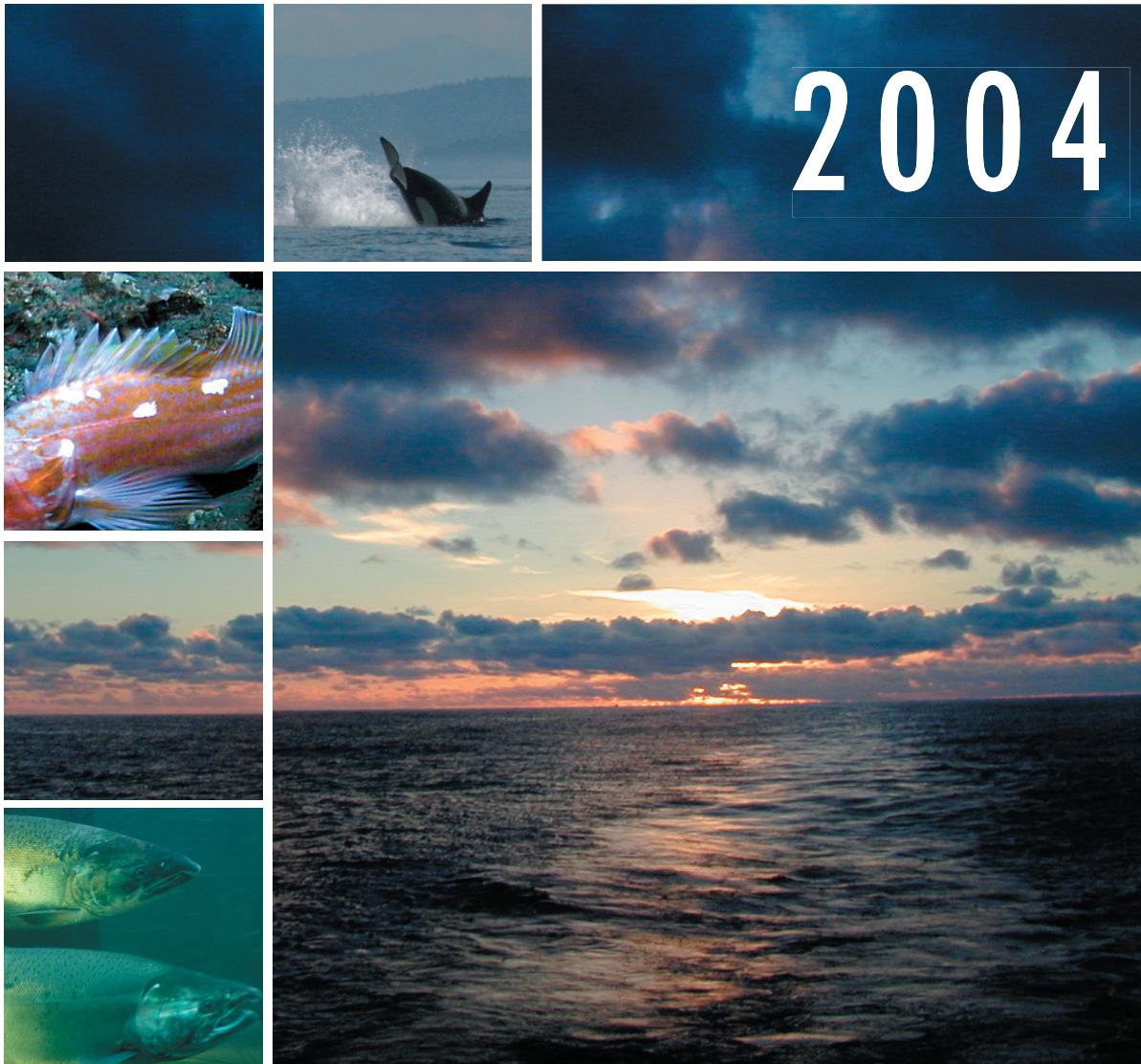


Northwest Fisheries Science Center

NOAA Fisheries • National Oceanic and Atmospheric Administration
U.S. Department of Commerce

HIGHLIGHTS



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MESSAGE FROM THE SCIENCE DIRECTOR



It is hard to believe that another year has come and gone. This past year has been very productive and I am excited to share with you some of the activities and accomplishments of NOAA Fisheries' Northwest Fisheries Science Center. I am proud of what Center scientists have achieved and appreciate the hard work and dedication of our many collaborators. In 2004, the Center continued to make significant advancements in ecosystem science by better understanding the many factors that affect oceans and living marine resources. To further bolster the Center's ecosystem efforts, the Center was selected as one of three NOAA Centers of Excellence to investigate linkages between oceans and human health. Although we have made many advancements, the West Coast continues to face a number of critical challenges, including recovering endangered and threatened salmon and steelhead populations, building sustainable groundfish fisheries, and conserving the Southern Resident killer whale population. Sound, innovative research is critical to addressing these challenges and I look forward to continuing our efforts in 2005.

Sincerely,

A handwritten signature in black ink that reads "Usha Varanasi". The signature is written in a cursive, flowing style.

Usha Varanasi

WHO WE ARE & WHAT WE DO

The Northwest Fisheries Science Center (NWFSC or Center) conducts research to help conserve and manage living marine resources (e.g., salmon, marine fish, and killer whales) and their habitats in the Northeast Pacific Ocean—primarily off the coasts of Washington and Oregon and in freshwater 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 that incorporates study of the organisms, their habitats, and controlling processes, such as environmental variability. In support of ecosystem science, Center scientists and staff conduct field and laboratory research in 5 primary areas:

- Status of Stocks
- Human-caused Stress/Risks
- Ocean and Climate Impacts
- Recovery and Rebuilding
- Innovation and Technology

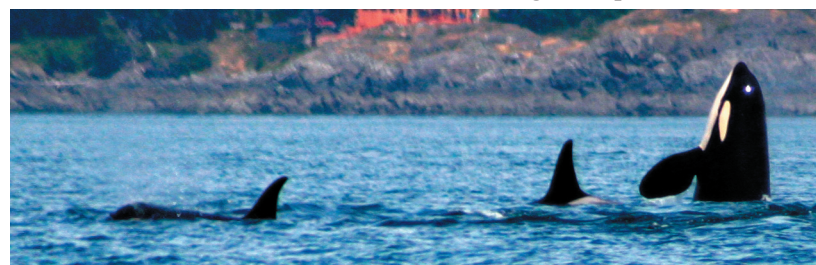
STATUS OF STOCKS

Stock assessments 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 identify and guide the monitoring and rebuilding of overfished or threatened fish stocks and depleted marine mammal populations.

In 2004 we:

Conducted an Updated Status Review of Southern Resident Killer Whales

There has been growing concern in the region about the declining number of Southern Resident killer whales (SRKW). NOAA reconvened a team of scientists from its three West Coast science centers to review and evaluate the most recent scientific and commercial information available on the whales. This scientific team, led by the NWFSC, considered critical questions like whether killer whales comprise a single species with several subspecies and whether factors that currently pose a risk for SRKWs might continue into the future. In their final report, the team determined that SRKWs appear to be a subspecies of killer whales. The team also identified concerns about the viability of SRKWs due to small-scale impacts over time, a major catastrophe, or small population size. This report has informed critical management actions: based on this updated status review, NOAA proposed to list SRKWs as threatened under the Endangered Species Act.



Southern Resident killer whales

Collected Critical Data on West Coast Groundfish

The West Coast groundfish fishery includes some 80 commercially fished stocks off Washington, Oregon, and California. Center scientists conducted two intensive coast-wide groundfish surveys: a Triennial Survey from Point Conception, CA to the Canadian border at 30-250 fathoms and a Bottom Trawl Survey from Cape Flattery, WA to the Mexican border at 30-700 fathoms. The Center chartered six commercial fishing vessels to assist with these surveys. During the surveys, scientists collected information about distribution, abundance, and age structure of groundfish populations, which provides the basis for stock assessments. In addition, the Center began to prepare for a very busy stock assessment season by holding two workshops in collaboration with the Pacific Fishery Management Council. In 2005, a record number of West Coast groundfish species (over 20) will be assessed in cooperation with the Southwest Fisheries Science Center and others. The Center's surveys and workshops will ensure that next year's demanding schedule is met and that the best possible scientific information is used in each assessment.

Standardized Genetic Methods to Support Chinook Salmon Management Efforts

Center scientists led an ambitious multi-agency collaboration to standardize the collection of genetic data for Chinook salmon from southern California to northwest Alaska. Ten West Coast salmon genetic laboratories agreed on a standard set of genetic markers and standardized genotyping conventions that will allow data sharing and exchange. The team of state, federal, tribal and academic scientists is now developing a shared genetic database for use in a wide range of conservation and restoration applications. This collaborative project will advance our efforts to determine which stock individual Chinook salmon come from, support allocation of catch decisions, and implement new technologies.



Two commercial fishing vessels that participated in groundfish surveys

HUMAN-CAUSED STRESS/RISK

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 to hydropower systems.

In 2004 we:

Developed Techniques to Minimize Differences Between Hatchery and Wild Fish

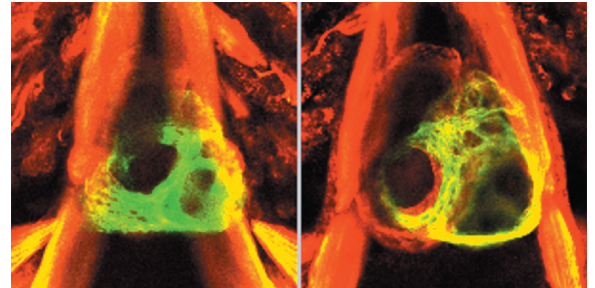
Hatcheries have the potential to assist in the conservation of wild stocks, but they also pose some risks. Maturation of males at a small size and early age is a natural life-history strategy for many salmon species including spring Chinook salmon; however, rates of early male maturation in hatchery fish can be 2-10 times higher than that of wild fish. High rates of early maturation have a number of adverse effects and reduce the number of returning adults for harvest or restoration efforts. Center scientists found that reducing spring Chinook growth in hatcheries during the summer and fall of the first year cuts early maturation rates in half. Results of this Center study are helping to improve hatchery practices, ensuring that hatchery fish can best contribute to salmon recovery.



Center scientists sampling wild spring Chinook salmon in the Yakima River to measure rates of early male maturation

Gleaned New Insights Into the Effects of Oil on the Early Life Stages of Fish

Polycyclic aromatic hydrocarbons (PAHs) are toxic compounds that are predominately derived from fossil fuels. The early life history stages of fish (embryos and larvae) can be especially sensitive to environmental contaminants like PAHs. Research has shown that PAHs cause developmental deformities, but the mechanism(s) by which PAHs act on embryos has been elusive for decades. To analyze the effects of PAHs on fish development, Center scientists, in collaboration with scientists from NOAA's Alaska Fisheries Science Center, Rakuno Gakuen University in Japan, and the University of Washington, used zebrafish (a small freshwater tropical fish) as a model. Using genetic techniques, scientists found that the developing heart is the most likely target of PAH toxicity, and that deformities in PAH-exposed embryos can be attributed to cardiac dysfunction. This research represents a significant scientific advancement: as a result of these studies, scientists may be able to develop new cardiovascular biomarkers that can help us better understand the effects of PAHs on fish populations.



Normal zebrafish heart (left) and abnormal heart (right)

Developed Seminal Scientific Reports to Support the Federal Columbia River Power System Biological Opinion

Over the last several decades, wild salmon populations have dramatically declined in the Columbia River Basin. The NWFSC has investigated salmon migration and survival for over 50 years and has a unique scientific program that studies the whole system in which dams occur. Center scientists completed three seminal reports that provide the scientific foundation for management actions regarding the Federal Columbia River Power System. These reports on salmon passage, survival, and viability have enabled NOAA to address highly contentious and critical conservation and management issues.



ECOSYSTEM & CLIMATE

Living marine resources in the Pacific Northwest use and depend on a variety of environments from freshwater streams and rivers to estuaries and the oceans. Center scientists conduct research to better understand how natural environmental fluctuations impact living marine resources, how humans affect these resources, and how the oceans, through living marine resources, affect human health.

In 2004 we:

Became a NOAA Center of Excellence to Investigate Linkages Between Oceans and Human Health

Oceans and humans are inextricably linked: our activities on land, sea, and air impact the health of the oceans and the health of the oceans impacts us. NOAA created an oceans and human health initiative to better understand and predict ocean-related impacts to human health. This initiative consists of a suite of programs and includes the designation of three research centers in Seattle, WA; Ann Arbor, MI; and Charleston, SC. The West Coast Center for Oceans and Human Health is based at the NWFSC and builds off of our current expertise and studies along the West Coast to fill critical information needs. West Coast Center scientists are investigating the impacts of pathogens, marine biotoxins, and toxic chemicals on both seafood and sentinel species. This research will help us better understand and predict human health impacts from the oceans and assist resource and human health managers in making sound decisions. Our key research partners include the University of Washington, the University of California at Davis, The Marine Mammal Center, Oregon State University, the Institute for Systems Biology, and NOAA's Alaska Fisheries Science Center.

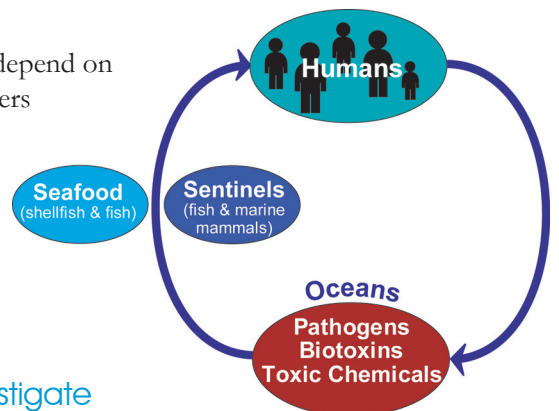


Diagram illustrating the linkages between oceans & human health

Determined Why Clams are Resistant to Paralytic Shellfish Toxins

Saxitoxins are produced by algae of a specific genus and accumulate in clams when they filter feed. People who ingest tainted shellfish can get Paralytic Shellfish Poisoning (PSP), a potentially lethal event. It has long been puzzling why some clams are not affected by saxitoxins, but humans are. Center scientists, in collaboration with Canada's National Research Council, the University of Washington, and the University of Maine found a mutation in the nerve signaling pathway of clams from areas that have recorded PSP incidents. This very small mutation results in incredible resistance (over 1,000 times) of clams to saxitoxins. Because exposed clams are resistant to saxitoxins, accumulation is greater and humans are at higher risk of PSP. This research will provide important insight into the impacts of saxitoxins on humans and advance our ability to prevent PSP incidences.

Advanced Understanding of a Lethal Bacterial Pathogen

Vibrio vulnificus is the leading cause of seafood-related mortality in the United States and is contracted through the ingestion of raw shellfish, like oysters. Center scientists have isolated and characterized a key surface protein that contributes to the pathogen's ability to attach to and colonize surfaces. With this information and continued research, we hope to eventually develop methods to depurate or remove *Vibrio vulnificus* from shellfish before they are eaten, eliminating this serious cause of seafood-related mortality.



Vibrio vulnificus

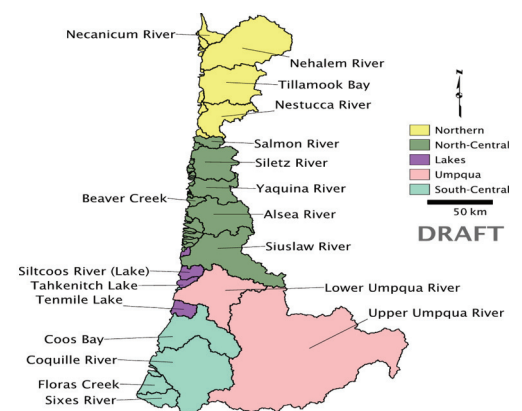
RECOVERY & REBUILDING

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 2004 we:

Improved the Scientific Underpinning for Salmon Recovery Plans

Center scientists are directly involved in salmon recovery planning efforts on the West Coast. Recovery plans are being developed for 17 listed salmon and steelhead populations in 4 geographic domains under the NWFSC's jurisdiction. Center scientists chair the Technical Recovery Teams (TRTs) in each of these domains and Center staff conduct many of the technical analyses that support recovery planning. The Oregon/Northern California Coast TRT identified historically independent populations of coho salmon for use in recovery planning; Center staff, with assistance from the Interior Columbia TRT, determined the intrinsic potential of freshwater tributary habitats in the Columbia River Basin to support salmon under current and historic conditions; and the Willamette-Lower Columbia and Puget Sound TRTs conducted technical reviews of 17 draft watershed and sub-basin recovery plans and assisted policy groups in their evaluation of recovery scenarios. The Center's efforts are critical to completion of effective recovery plans for endangered and threatened salmon populations.



Historically independent populations of Oregon coho salmon grouped into five geographical strata or areas

Tagged and Released Lingcod in South Puget Sound

Lingcod populations in South Puget Sound are at historically low levels. One management option is to supplement the wild population with fish raised in captivity. Key questions with this strategy, however, include: will fish produced in captivity survive? will they take up residence in appropriate habitat? will they displace wild populations? and will they reproduce in the wild? To begin addressing these questions, Center scientists, in cooperation with the Northwest Indian Fisheries Commission and the Washington Department of Fish and Wildlife, tagged 14 lingcod, raised at the Center's facility, with acoustic tags. They then released these lingcod into South Puget Sound. With the help of both stationary and mobile hydrophones, as well as a remotely operated vehicle, scientists will track the lingcod to determine where the fish are, what habitats they are using, and whether male fish are displaying normal reproductive behavior. This type of research is critical to developing sound management options for recovery of marine fish populations.



Scientists releasing tagged lingcod

Developed a Draft Research Plan & Continued Key Southern Resident Killer Whale Research

The Center is developing a comprehensive 3-5 year research plan to focus all Southern Resident killer whale (SRKW) research efforts. To form the basis for this plan, the Center, in partnership with the Washington Department of Fish and Wildlife and the Canadian Department of Fisheries and Oceans, held a workshop to identify key scientific questions and methods for SRKW recovery and conservation. The Center, in collaboration with local, national, and international scientists, also continued key SRKW research on evolutionary relationships, noise/vessel interactions, prey/health assessment, and winter distribution. This research yielded invaluable information and will support recovery efforts for SRKWs. For example, the Center conducted the first research cruise to survey for SRKWs in the winter months and during this cruise successfully located several groups of killer whales, including two SRKW pods—a critical accomplishment given how little we know about SRKWs when they leave Puget Sound.

INNOVATION & TECHNOLOGY

Center scientists develop and apply new technologies, techniques, and tools to support management, conservation, and recovery of the Pacific Northwest's living marine resources.

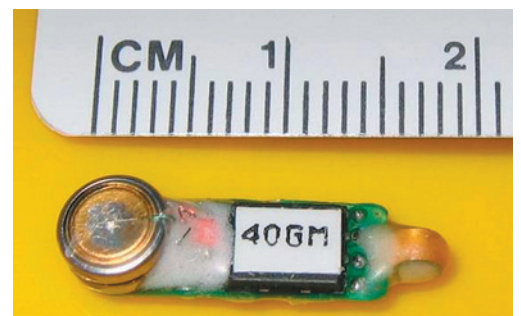
In 2004 we:

Tested Advanced Technologies Critical to Ecosystem Science

Center scientists led an interdisciplinary scientific team from Washington, Oregon, and California on a two-week advanced technologies research cruise to explore a deepwater ecosystem, Cherry Bank, off the coast of Southern California. During this cruise, scientists used acoustic and optical instruments to sample an entire cross section of the ocean, from seafloor to surface, including fish, plankton, benthic organisms, rock and sediment, and the water column. With information collected from this cruise, scientists created an integrated map of Cherry Bank. This type of multi-disciplinary project will help improve assessments of fish and their ecosystems.

Developed an Acoustic Tagging and Detection System in the Columbia River Estuary

The Columbia River estuary is a vital link for salmon between freshwater and marine habitats, however, we know very little about juvenile salmon survival in this area. The Center developed an acoustic tagging and detection system to measure juvenile salmon survival from Bonneville Dam to the mouth of the estuary. Center scientists will use this system to make critical survival estimates, which will help inform hydropower management operations and salmon recovery actions.



Mini-acoustic tag used to measure salmon survival

Created Databases to Support New Assessments

Salmon recovery is unique because of the large number of organizations, groups, and individuals involved. Being able to access, synthesize, and query data collected by these entities is critical to advancing recovery efforts and ensuring efficiency. The Center created several key databases to assist with these efforts. Center staff developed the Pacific Coast Salmon Recovery Fund database, in close collaboration with the Northwest Regional Office, 4 states, and 10 tribal groups. Through this database, users can access various reports on projects and funding distribution; find graphs, charts, maps, and documents; and query various Fund components. Center staff also developed a hatchery operations database that contains all of the available hatchery information since 1990 for Washington, Oregon, and Idaho. This database has enabled scientists to better answer key questions related to hatchery and wild salmon interactions.



OUR FACILITIES, OPERATIONS, & STAFF

A strong infrastructure is critical to ensuring that the Center can provide the science needed to conserve and manage living marine resources and their ecosystems.

In 2004 we:

Strengthened Center Research Programs

The Center continued to implement recommendations of an ad-hoc internal evaluation committee to improve Center planning, programs, and operations. The Center created an innovative Research Planning Team that unites staff and management perspectives to ensure that research efforts are forward-thinking and well-integrated. The Center also continued its highly successful seminar series and internal grants program to provide training for Center scientists.

Strengthened Educational and Diversity Opportunities

Center staff participated in local outreach events and career fairs, including the annual NOAA Science Camp in Seattle, WA and SeaFest celebration in Newport, OR to promote environmental literacy. Center staff also provided over 40 students with educational and career opportunities to help increase interest in careers that support NOAA's mission. In addition to already established partnerships, this year the Center partnered with the American Association for the Advancement of Science ENTRY POINT! Program, which offers outstanding internship opportunities to students with disabilities.



Staff delivering an educational program

Improved Safety and Operations

The Center balanced air flow in one of its Montlake buildings and replaced 32 older chemical hoods with new low airflow models, improving safety and energy efficiency. The Center also improved the seawater treatment and discharge system that supports research activities in Newport, OR and developed a comprehensive small boat operator program. Ninety-four Center staff were trained in the safe operation of small research boats.

Provided Scientific Leadership to Support NOAA

Center staff continued to provide critical technical support to the Northwest Regional Office on many salmon, marine fish, and killer whale issues. Center staff also continued to serve as experts on national and international committees and teams, including the North Pacific Marine Science Organization (PICES), the International Council for the Exploration of the Sea (ICES), the Pacific Coast Ocean Observing System (PaCOOS), and NOAA's aquaculture, climate, and ecosystems initiatives.

Received Recognition for Achievements

Center staff received a number of awards this year in recognition of their hard work and accomplishments, including the Youth Employer of the Year Award by the Washington State Governor's Committee on Disability Issues and Employment; a Coastal America Partnership Award; the "Best of the Best" Employee Award by NOAA's Environmental Compliance and Safety Office; an Environmental Protection Agency Bronze Medal; a Department of Commerce (DOC) Gold Medal; two DOC Silver Medals; two NOAA Bronze Medals; a NOAA Administrator Award; a NOAA Distinguished Career Award; the Best Presentation Award at NOAA TECH 2004; the Grace Hopper Award for Outstanding Achievement by the Seattle Girls' School; and an Award of Excellence by the Aquaculture Engineering Society.



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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