Olympic Region Harmful Algal Blooms

ORHAB PARTNERSHIP

ORHAB aims to build local self-sufficiency in mitigating impacts of harmful algal blooms (HABs), by providing improved tools for protecting public health, building consumer confidence in fishery products, and enhancing revenues for coastal communities in the Olympic region.

What is ORHAB?

The Olympic Region Harmful Algal Bloom (ORHAB) group was organized to develop collaboration and cooperation among federal, state and local management agencies, coastal Indian tribes, marine resource-based businesses, public interest groups, and academic institutions. The ORHAB partnership investigates the origins of blooms of toxic algae, monitors where and when the blooms occur, assesses the environmental conditions conducive to blooms and toxification of intertidal shellfish populations, and explores methods that can be used to reduce HAB impacts on humans and the environment. The ORHAB project is funded by the National Center for Coastal Ocean Science (NCCOS) under the Monitoring and Event Response to Harmful Algal Booms (MERHAB) program. ORHAB serves as the model that will assist NOAA in initiating similar projects in other U.S. coastal regions.

Strategy

By bringing together teams of experts from federal, state, tribes, and academic institutions, ORHAB seeks to develop tools needed to manage risks associated with HABs. This partnering will establish close working relationships between these groups and insure confidence in the resulting monitoring program.

The Washington Coast is home to one of the most productive recreational clam fisheries.

ORHAB Goal

Develop a cost-effective monitoring program for HABs that will be taken over by state managers and tribes in five years (2000-2005). At the present time ORHAB is focused on monitoring the toxic organism *Pseudo-nitzschia* and the toxin, domoic acid, produced by some *Pseudo-nitzschia* species. Domoic acid causes neurological damage and fatalities in humans, marine mammals and seabirds.

Objectives

The ORHAB partnership has established a set of objectives. They are:

- **To understand the environmental conditions that initiate and maintain blooms of harmful species**
- **To develop a sampling program and models for the prediction and mitigation of HABs**
- **To develop, test, and implement new technologies**

ORHAB Partnership

Battelle Marine Sciences Laboratory

National Centers for Coastal Ocean Science (NCCOS)

Northwest Fisheries Science Center (NWFSC)

Olympic Coast National Marine Sanctuary (OCNMS)

Pacific Shellfish Institute (PSI)

Makah Tribe

Quinault Indian Nation

Saigene Corporation

University of Washington (UW)

Washington Department of Fish and Wildlife (WDFW)

Washington Department of Health (WDOH)

Washington Department of Ecology (WDOE)

HAB IMPACTS ON THE WASHINGTON COAST

Economic Impacts

Washington's Olympic coast is isolated and rural. Most residents, especially tribes, depend on natural resources for income and subsistence. HABs are a consistent threat to the commercial, recreational, and subsistence fisheries of Washington state. The Pacific razor clam and Dungeness crab fisheries are adversely affected by sudden increases of domoic acid, a naturally occurring marine toxin. Washington State is one of the most important regions for shellfish aquaculture and beach harvest in the U.S. with an approximate annual commercial value near $100 million. Fisheries are the largest employer in WA coastal communities.

Razor clams are a delicacy on the Washington State coast.

The razor clam fishery is largely a recreational fishery in Washington State. The fishery generates on average about 250,000 digger trips to the southwest Washington counties which represents about a $12 million influx of tourist/fisher spending (e.g., motels, food, gasoline, souvenirs, etc). The small commercial razor clam fishery can represent about $1 million in revenue for the tribes in a year with abundant clams. The non-tribal commercial operation in Willapa Bay produces razor clams for crab bait.

Health Effects

The human illness known as amnesic shellfish poisoning (ASP) is caused when people eat fish, shellfish, or crab containing the toxin. Symptoms include vomiting, nausea, diarrhea, and abdominal cramps within 24 hours of ingestion. In more severe cases, neurological symptoms develop within 48 hours and include headache, dizziness, confusion, disorientation, loss of short-term memory, motor weakness, seizures, profuse respiratory secretions, cardiac arrhythmia, coma, and possibly death. There is no antidote for domoic acid.

The recreational razor clam fishery is valued at about $12 million annually.

Tribal Concerns

Shellfish, fish and crabs are important to the livelihood and culture of Native Americans living on the Olympic Peninsula of Washington. Two federally-recognized Indian tribes, the Makah and the Quinault, are participants in ORHAB. Maintaining fishing activities (including shellfishing and crabbing) that sustained their ancestors for centuries helps them preserve their self-sufficiency and cultural autonomy.

Shellfish and crabs are important commercial, recreational, and cultural assets for the Quinault Tribe.

The Quinault reservation is a large wedge of the Pacific coast west of Lake Quinault. In the Quinault language, the words *ta'aWshi xa'iits'os* mean "clam hungry", indicating the traditional dependence of the tribe on razor clams as a subsistence food. In addition to subsistence gathering, the Quinault tribe has a seafood processing plant where razor clams are canned. The tribe is allotted 50% of the razor clam harvest on their Usual and Accustomed (U&A) land. Therefore, commercially harvested clams supplement the income of tribal members.

The Makah tribe (*Kwi-dai-da'ch* or "the people who live near the Rocks and the Seagulls") live on the northwestern tip of the continental U.S., on Cape Flattery at the entrance to the Strait of Juan de Fuca. The Makah have relied on the sea for centuries. To this day, this tribe is dependent on shellfish (mussels, clams, scallops) for subsistence and is exploring shellfish aquaculture (mussels and scallops) as a source of income.

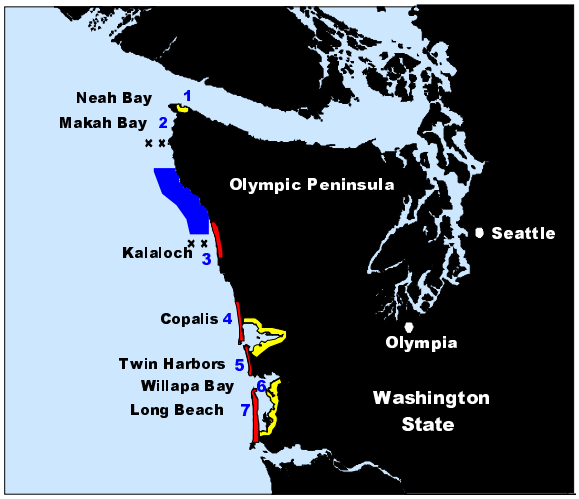
Other coastal tribes, including the Quileute, Hoh, and Shoalwater, will benefit from ORHAB, resulting in greater self-sufficiency and reliance on natural resources.

> "Tribal education is a key factor. ORHAB is educating coastal tribes about the science of HABs by teaching phytoplankton identification and enabling the collaboration between tribes, co-managers, and scientists"
>
> ***Vince Cook, Makah Tribe***

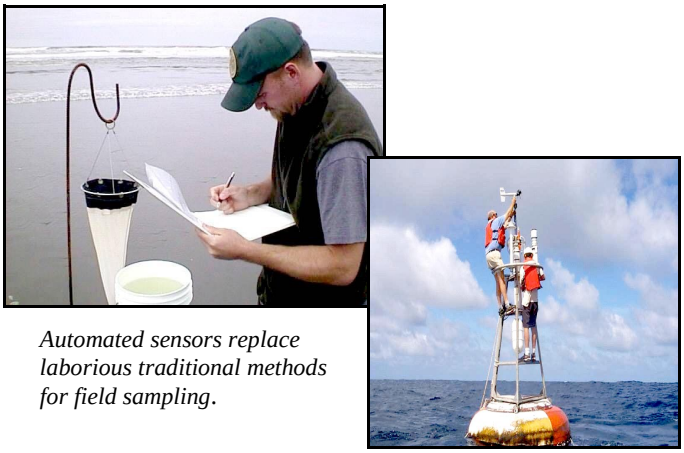
BETTER MONITORING THROUGH ORHAB PARTNERSHIP

Sampling

ORHAB technicians sample at 7 locations (*right*) on the Washington coast that have major razor clam beds, oyster, and mussel aquaculture operations. Sea water from nearshore (dark blue) and beach sites (numbered) is collected and tested for toxin, chlorophyll, and nutrients as well as salinity and temperature. Each week, technicians identify phytoplankton to give information about numbers and species of toxic *Pseudo-nitzschia* present. ORHAB technicians are an essential link to effective communication on the 300 miles of remote coastline. They share all information collected with other ORHAB partners to assist managers in making decisions about coastal shellfish closures. In addition, razor clams are sampled and tested for domoic acid about twice a month. The ORHAB beach sites are sampled by the Makah Tribe (1, 2), Quinault Tribe (3, 4), WDOE and PSI (6), and WDFW (5, 7). The area outlined in red denotes major razor clamming beaches; sites outlined in yellow are areas of oyster and mussel harvest. The moorings are maintained by OCNMS (X). The nearshore area (dark blue) is the location of NWFSC sampling, at several depths, in summer months.



ORHAB sampling sites



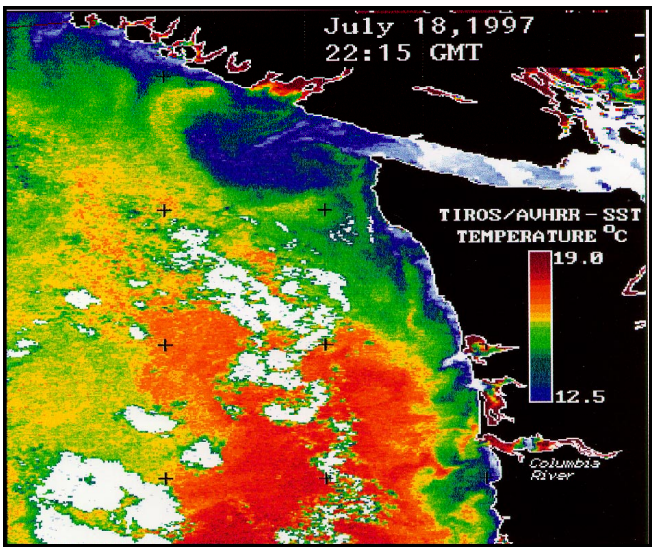
Automated sensors replace laborious traditional methods for field sampling.

Automated sensors

To reduce costs associated with human labor and expensive traditional methods of measurements, automated techniques are being phased into the project. During the summer months, a series of moorings with sensors for temperature, salinity, and fluorescence are deployed using OCNMS vessels at several sites along the Washington coast to provide a detailed record of environmental parameters. This information will assist ORHAB personnel in developing HAB models which will eventually allow coastal managers to forecast HAB events. In order to do this, we must develop technology on these moorings that will allow real-time automated sensing of cells and toxins.

Forecasting Tools

We now have theories about how these blooms of *Pseudo-nitzschia* start. The Juan de Fuca eddy region (cold water) is a site of persistent upwelling (nutrient enrichment) throughout the summer months. Blooms of *Pseudo-nitzschia* may initiate in this zone. The duration of upwelling and the timing of the first major fall storms are factors believed to influence the levels of toxin that reach coastal razor clam populations. The Battelle Marine Sciences Laboratory is using satellite images, such as the one shown here, to examine the extent and movement of the eddy. The University of Washington is developing a model to understand the physical conditions that transport *Pseudo-nitzschia* to the coast. Using these tools, we believe it may be possible to track and forecast the timing and movement of HABs as they come ashore.



Satellite image showing the Juan de Fuca eddy as a cold water mass

ORHAB ACCOMPLISHMENTS

Inspired from the bottom up by local community needs, ORHAB met for the first time in the summer of 1999. ORHAB's research efforts, made possible by federal funding, have been underway since the summer of 2000. Due to ORHAB, our understanding of the processes that govern the timing and spatial distributions of *Pseudo-nitzschia* cells and their transport to coastal shellfish has already been enhanced.

Dr. Rita Horner (far right in picture), UW, teaches phytoplankton sampling at a training class on the Washington coast.

Management Accomplishments

ORHAB has brought together research professionals from different agencies-tribal, state, federal, and private- into a cooperative, multi-disciplinary project. It has increased communication between resource managers and research scientists to create the most effective HAB monitoring program for the Washington coast. This has resulted in a greater number of beach openings for razor clam harvest. Finally, ORHAB has helped the WDOH to relax the regulatory threshold for closing the recreational razor clam harvest, bringing state standards into conformity with federal standards.

Previously, state standards had been more stringent, due to uncertainties about the timing and location of domoic acid outbreaks. To date, ORHAB has lessened the impact of short-notice recreational harvest closures. Routine phytoplankton monitoring by ORHAB technicians has resulted in the posting of "HAB Alerts" to inform managers of rising levels of *Pseudo-nitzschia* cells in Washington coastal waters. The formation of working relationships among the region's agencies plays a decisive role in achieving the project's ultimate goal: a commitment to carry on the monitoring effort into the future without reliance on federal support.

"ORHAB has helped managers in Washington State by enhancing communication between regulatory agencies, tribes, and HAB experts. This project has added confidence to the decisions made by coastal managers and has resulted in more beach openings for commercial, subsistence, and recreational harvests."

Frank Cox, Washington State Department of Health

Scientific Accomplishments

During the first 2 years of ORHAB, *Pseudo-nitzschia* blooms events were observed in both May and September along the coast, which has led to an understanding of the timing and species composition of blooms. Knowledge concerning the environmental conditions that influence the duration of *Pseudo-nitzschia* blooms has increased as well, helping to understand why razor clams become toxic in some years, but not in others. Other accomplishments include the development of a model that describes bloom transport from the Juan de Fuca eddy to the Washington coast. This model will assist in predicting future *Pseudo-nitzschia* blooms. Satellite imagery is also being used to "track" the movement of the Juan de Fuca eddy waters throughout the growth season.

"Because the ORHAB project provides us with weekly phytoplankton levels at several beach locations, the WA State Dept of Health has allowed the Dept of Fish and Wildlife to reduce the number of razor clam samples to be tested prior to beach opening for harvest. This results in reduced cost and faster analysis. Because of our strong collaboration with other partners, toxin testing of clams now takes only 2 days; before ORHAB we needed one week to post results."

Dan Ayres,
Washington State Department of Fish and Wildlife

Outreach

Regular meetings occur between ORHAB partners to review and modify the cooperative workplan to better serve the needs of managers. Research scientists have trained Olympic coast locals in all sampling protocols required for monitoring phytoplankton, domoic acid, and environmental parameters. The ORHAB partners also communicate with public interest groups, politicians, and the general public about the value of long-term HAB monitoring along the Washington coast. If you would like further information about ORHAB activities, please contact Dr. John C. Wekell at the ad-

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