Harmful Algal Blooms and Hypoxia Research in Washington State

The Problem

Harmful algal blooms (HABs) are a threat to human and ecosystem health and coastal economies in Washington. Incidents of shellfish toxicity are increasing in Washington coastal waters, where two HAB genera (*Alexandrium* and *Pseudo-nitzschia*) produce potent neurotoxins that accumulate in shellfish. To protect human health, the State of Washington conducts intensive monitoring and frequently closes recreational and commercial harvesting. Even so, in 2000, nine people became seriously ill and three were hospitalized from consuming neurotoxin-contaminated shellfish from Carr Inlet. Algal blooms also contribute to hypoxia (low oxygen condition that harms or kills animals) in marine and freshwater ecosystems, such as the hypoxia that has become a problem in Hood Canal. Economic losses associated with HABs are conservatively estimated to exceed $1 billion nationally over the next several decades.

Sign on Washington beach indicating shellfish closure.

Program Description

The National Centers for Coastal Ocean Science (NCCOS) of the National Ocean Service/National Oceanic and Atmospheric Administration (NOAA) has a major research investment in the State of Washington (about $9M to NOAA facilities, $12.7M to partners from 2000-2007) focused on understanding the causes of HABs and using this information to help state agencies develop more effective methods of monitoring and prediction. The short term goal is to prevent (or minimize) the impacts of HABs. The long term goal is to develop an understanding of the causes of blooms that will lead to forecasting capabilities and possible prevention strategies. This research is conducted through three major competitive, extramural NCCOS programs established in response to the Harmful Algal Bloom and Hypoxia Research and Control Act: the multi-agency Ecology and Oceanography of Harmful Algal Blooms Program (ECOHAB) focuses on understanding the causes of HABs; the Monitoring and Event Response to Harmful Algal Blooms Program (MERHAB) focuses on improving the abilities of coastal managers to protect human health and minimize impacts of HABs on coastal economies; and the Coastal Hypoxia Research Program (CHRP) focuses on developing modeling tools and information for managers to assess hypoxia management strategies. In addition, NCCOS maintains internal capabilities for responding to HAB events and conducting biotoxins research to complement these extramural competitive research programs.

NOAA HAB and Hypoxia Programs in the Pacific Coast Region

- ECOHAB
- MERHAB
- CHRP
- Event Response

ECOHAB Projects

ECOHAB Pacific Northwest: Ecology and Oceanography of Toxic *Pseudo-nitzschia* in the Pacific Northwest Coastal Ocean. A 5-year study of the physiology, toxicology, ecology and oceanography of toxic *Pseudo-nitzschia* species off the Pacific Northwest coast. Toxins produced by *Pseudo-nitzschia* cause closures of razor clam and Dungeness crab fisheries. This research will lead to improved capabilities to predict the onset and path of these toxic bloom events. Funded 2002-07 by NOAA ($5.28M), NSF ($3.42M) and NASA ($278K), led by the University of Washington.

Effects of Algal Toxin Exposure in Early Life History Stages of Fish. Results of this research have defined the specific sub-lethal effects of algal toxins on early life stages of the economically and

ecologically important forage fish, the Pacific herring. Funded 2002-05 by NOAA ($346K), led by NOAA Northwest Fisheries Science Center.
The Relationship Between Paralytic Shellfish Toxins and *Alexandrium* Cysts in Puget Sound, WA. Determining the source of cysts to help focus State and local monitoring efforts and may lead to prediction of bloom events. Funded 2004-2007 by NOAA ($444K), led by Univ. of Washington.
Harmful Ulvoid Macroalgal Blooms in Washington State: Distribution, Environmental Effects, and Toxin Production. Understanding causes, controls, and impacts of green algal blooms in Puget Sound. Recent studies have isolated green algal toxins found to be detrimental to seagrasses, fish, and invertebrates. Funded FY 2005-07 by NOAA ($455K), led by Western Washington University.

MERHAB Projects

Olympic Region Harmful Algal Bloom (ORHAB). Regional partnership formed to address concern over seemingly random closures of razor clam fisheries due to outbreaks of marine toxins caused by HABs. Research has described underlying dynamics of HABs, designed simple testing methods, and provided advance warning of toxic events to razor clam fishery managers. Partnership includes Washington Departments of Fish and Wildlife/Ecology/Health Food Safety and Shellfish, Quinault Indian Nation, The Makah Tribe, Pacific Shellfish Institute, Battelle Marine Sciences Laboratory, Olympic National Marine Sanctuary, and Olympic Natural Resources Center. Funding helped 6th Congressional District partners identify long-term state support for monitoring HABs from shellfish license fees. NOAA funded 2000-2004 ($2.7 M).

Announcement of closure of razor clam recreational fisherv in 2003.

NOAA-Quileute HAB Monitoring. NOAA and the Quileute Tribe are developing and testing new methods of detecting toxic algal blooms for monitoring quality and safety of important shellfisheries. NOAA funded 2004-2007 ($285K).
Quinault Shellfish HAB Sampling and Monitoring. Supporting Quinault Indian Nation (QIN) efforts to expand shellfish sampling within the Washington State coastal area managed or co-managed by QIN and incorporate new HAB sampling technologies to build an independent testing ability. NOAA funded 2005-2007 ($221K).
Monitoring Toxic *Alexandrium* in Puget Sound Using qPCR. Examines the efficacy of developing a sensitive, real-time molecular method to assay the abundance of the HAB *A. catenella* for prediction or early warning of shellfish PSP toxicity. NOAA funded 2005-2007 ($304K), led by Woods Hole Oceanographic Institution.

CHRP Project

Historical Trends of Hypoxia in Two Basins of Puget Sound. Reconstructing history of hypoxia in two basins of Puget Sound by examining geochemical and biological records of past hypoxic events in age-dated sediment cores. Tools such as biomarkers or geochemical parameters may allow for predictions of hypoxia for given current conditions and potential scenarios, including management alternatives. NOAA funded 2005-2006 ($517K). Led by Battelle Memorial Inst., Bryn Athyn College, University of Washington, Texas A & M University, and U.S. Geological Survey.

Resources: Dr. Robert Magnien, Director, NOAA Center for Sponsored Coastal Ocean Research. 301-713-3338 x159; rob.magnien@noaa.gov, or contact NOAA at HABS@noaa.gov, website: http://www.cop.noaa.gov/