Harmful Algal Blooms and Hypoxia in the Pacific Coast Region

Introduction

Harmful algal blooms (HABs) and hypoxia (severe oxygen depletion) are often interrelated issues affecting an increasing number of Great Lakes and coastal ecosystems. Virtually every coastal state has reported recurring blooms, and a recent national assessment revealed that over half of our Nation's estuaries experience hypoxic conditions. Impacts have included the devastation of critical coastal habitats, loss of economically and culturally important shellfish resources, illness and death in populations of protected marine species, and serious threats to human health posed by algal toxins. Just one HAB event can cost tens of millions of dollars to local coastal economies and the total costs associated with HABs over past decades have been conservatively estimated at over $1 billion.

Sign posted on Washington beach indicating shellfish closure.

The Problem

There are several causes of HABs and hypoxia. Some are natural, but others are human-induced, and on-going National Oceanic and Atmospheric Administration (NOAA) sponsored research continues to identify and distinguish these causes. Some of these blooms produce toxins which cause illness in humans and marine organisms, like blooms of two Pacific coast HAB genera (*Alexandrium* and *Pseudo-nitzschia)*, that produce potent toxins that accumulate in shellfish and can cause paralytic shellfish poisoning (PSP) and amnesic shellfish poisoning (ASP) in humans. Other types of HABs, while non-toxic, reach such large size that the death and subsequent decay of the algae lead to hypoxia in estuarine and coastal bottom waters.

Program Description

In the Pacific Coast Region, NOAA has supported multi-year, interdisciplinary research studies to address the issues of HABs and hypoxia in an ecosystem context. Working closely with Federal, State, and academic partners, NOAA has investigated the factors that regulate the dynamics of HABs and how they cause harm, applied remote sensing (satellites and ocean observing systems), and developed linked bio-physical models that form a critical base for building ecological forecasts, molecular methods from medical science, and bio-chemical analyses for the detection and tracking of algal species and their toxins. Through these efforts NOAA has made considerable progress in the ability to detect, monitor, assess, and in some cases, predict HAB and hypoxia events.

NOAA HAB and Hypoxia Programs in the Pacific Coast Region

- ECOHAB
- MERHAB
- CHRP
- Event Response
- Marine Biotoxins
- CoastWatch

Accomplishments

NOAA studies are helping to advance the state of the science and also lead to results with direct application to needs of state coastal resource and public health managers. Recent successes in detecting HABs and hypoxia events demonstrate the value of these research investments in helping coastal managers undertake short- and long-term efforts to reduce, and ultimately, prevent the detrimental effects caused by these phenomena.

HAB Detection: In 2004, *Pseudo-nitzschia* cells and toxins were measured along four Olympic Coast beaches in Washington as part of a Monitoring and Event Response for Harmful Algal Blooms (MERHAB) supported study, allowing State and Tribal officials to determine the safety of razor clams. This allowed for the selective opening of three beaches and the decision to keep a fourth highly popular beach closed due to high levels of toxin. In the past all of the beaches might have been closed. By having the scientific data needed to selectively open and close the beaches, Washington State officials were able to ensure the safety of this highly popular recreational dig which generated nearly one million dollars in three days for Olympic coastal communities.

More than 30,000 clam diggers may descend on the Washington coast in a single weekend, filling beaches, restaurants, and motels.

Ecological Forecasts: A long-term Ecology and Oceanography of Harmful Algal Blooms (ECOHAB) project goal in the Pacific Northwest is to develop bloom forecasts of the toxic diatom, *Pseudo-nitzschia*. Researchers in Olympic coastal region are testing the hypothesis that these bloom events affecting coastal communities are largely caused by toxic algal species growing in the vicinity of the Juan de Fuca eddy which are subsequently transported to nearshore waters by storms. Investigators are looking at the variability of this eddy (size, location, intensity) and at the timing and frequency of storms with respect to presence of the HAB species. Results will benefit coastal managers by providing insights into possible predictors of toxic blooms and by helping identify oceanic/atmospheric conditions favorable for transport of toxic *Pseudo-nitzschia* onshore, where it is frequently transferred up the food chain affecting marine mammals and humans.

Event Response: Based partially on the dramatic mass mortality events of marine mammals that took place on the California coast during 2000, NOAA has established a suite of programs which provide immediate assistance to state and federal coastal managers and public health officials to reduce the impact of HAB events through rapid, coordinated assistance during toxic algal blooms, related health incidents, and marine animal mortality events. Event Response supported an assessment of toxicity related to a bloom of the cyanobacteria *Microcystis aeruginosa* in upper San Francisco Bay in 2003. The results were used to inform the public, stakeholders, and government resource managers and to guide future management action. In 2005, Event Response funding sponsored a workshop in which 12 environmental and human-health officials from Oregon learned new techniques, such as phytoplankton cell counts and rapid toxin tests, which can provide early warnings for potential toxin-related shellfish bed and beach closures.

Looking to the Future

NOAA is making advances in the capacity for resource managers to anticipate and respond to HAB and hypoxic events along the Pacific Coast. Regional efforts, such as ECOHAB-Pacific Northwest and the MERHAB Olympic Region Harmful Algal Bloom project, continue to fund research on HAB events in the Pacific Coast Region. Efforts are underway to implement HAB monitoring and toxin detection programs that incorporate innovative technologies to increase the precision and lead time of warnings for local communities.

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