NCCOS
Center for Sponsored Coastal Ocean Research

Harmful Algal Blooms Overview

Issue

Harmful algal blooms (HABs) are blooms of species of algae that have negative impacts on humans, marine environments, and/or coastal economies. HABs include blooms of both microalgae (microscopic, single celled) and macroalgae (seaweeds). HABs are a natural feature in coastal ecosystems, but human activities are thought to contribute to their increasing frequency. Virtually every coastal state has now reported recurring blooms (For a map of HAB-related events in the US, visit: http://www.whoi.edu/redtide/HABdistribution/HABmap.html).

Some harmful microscopic algae produce potent toxins which cause illness or death in humans and marine organisms. Other types of harmful algae are non-toxic to humans but cause harm to fish and invertebrates by damaging or clogging their gills or by forming such large blooms that the death and subsequent decay of the algae lead to hypoxia (oxygen depletion) in the bottom waters of lakes, estuaries, and coastal environments. Macroalgal blooms can block sunlight to seagrasses and also cause hypoxia. Impacts of HABs include the devastation of critical coastal habitats, loss of economically and culturally vital shellfish resources, illness and death in populations of protected marine species, and serious threats to human health posed by algal toxins.

HABs have decimated the scallop fishery in Long Island's estuaries and have led to seasonal closures of various shellfisheries along the Atlantic, Gulf of Mexico, and Pacific Coasts. HABs have caused significant respiratory and other illnesses in coastal residents and vacationers. They may also have contributed to deaths of hundreds of manatees in Florida, sea lions in California, and other marine mammals, including dolphins in the Northern Gulf of Mexico. The average economic impact from HABs in the U.S. has been conservatively estimated at $82 million/year, and just one harmful algal bloom event can cost local coastal economies tens of millions of dollars (see Economic Impacts of HABs at: http://www.cop.noaa.gov/stressors/extremeevents/hab/current/HAB_Econ.html).

Approach

The 1998 Harmful Algal Bloom and Hypoxia Research and Control Act (HABHRCA) established an Interagency Task Force to develop a national HAB assessment and authorized funding for existing and new research programs on HABs, including the interagency (NOAA, EPA, NSF, NASA, ONR) Ecology and Oceanography of Harmful Algal Blooms (ECOHAB) program and the NOAA CSCOR MERHAB program. These programs involve federal, state, and academic partners and support interdisciplinary extramural research studies to address the issues of HABs in an ecosystem context. HABHRCA was reauthorized in 2004, requiring additional assessments and plans (that will include freshwater HABs) and authorizing continuation of existing or establishment of additional research programs on HABs.

Ecological Forecasting

One goal of CSCOR HAB programs is to develop predictive tools that can help managers mitigate bloom events and reduce bloom impacts. HAB forecasts can include predictions of HAB occurrence (long and short term), toxicity and dynamics. HAB forecasting models can also offer clues to causative factors in bloom initiation, toxicity, and decline. For more information, visit: http://www.cop.noaa.gov/stressors/extremeevents/hab/ecoforecasting.html

Research to Applications

CSCOR HAB programs sponsor research that contributes to or results in practical application products for management. These products include predictions of bloom initiation and transport, methods of detecting toxic cells and toxins, event response programs, bloom impact analysis, and methods of control, mitigation, and prevention. An ideal HAB management system would integrate the suite of products and services within a regional context, enabling more effective prevention, response and mitigation by managers.

Accomplishments

Accomplishments include not only product development but also advancements in scientific understanding, contributions to infrastructure support, and dissemination of knowledge (e.g. through workshops, public outreach). Below are a few examples of HAB research accomplishments supported by CSCOR HAB research programs.

Monitoring Partnership in the Pacific Northwest

Along the coast of the Washington Olympic Peninsula, razor clam and Dungeness crab harvesting have been closed for long periods of time due to blooms of two neurotoxin producing HABs, *Pseudo-nitzschia* and *Alexandrium*.

The Olympic Region Harmful Algal Bloom (ORHAB) partnership, initially funded by NOAA in 2000 continues its ongoing partnership comprised of federal, state and local management agencies, coastal Indian tribes, marine resource-based businesses, public interest groups, and academic institutions that developed a state of the art shellfish monitoring program along the Washington coast. ORHAB provides managers up to a week's early warning, allowing for timely and selective closures.

In water HAB sensor for *Karenia brevis*

NOAA (ECOHAB, MERHAB), EPA, NSF, ONR, and NASA have supported research on the optical characteristics of the Florida HAB, *Karenia brevis*, which has led to an in-water optical sensor that detects blooms in situ in real time. NOAA is supporting research to demonstrate the operational capabilities of the sensor on ship board for mapping, on moorings to provide early warning and on Autonomous Underwater Vehicles (AUVs) to confirm blooms that have been detected by satellite remote sensing (for more about remote sensing of HABs in the Gulf of Mexico, visit CCMA's website at: http://ccma.nos.noaa.gov/stressors/extremeevents/hab/welcome.html). For an extensive list of NOAA- and other agency-funded projects related to *Karenia brevis*, visit: http://www.cop.noaa.gov/stressors/extremeevents/hab/features/hab-projects.html

Models of HABs (*Alexandrium*) in the Gulf of Maine

Alexandrium forms blooms periodically in the Gulf of Maine and produces potent neurotoxins that can accumulate in filter-feeding shellfish. States in the region have extensive monitoring programs to protect human health. A decade of ECOHAB funded research on *Alexandrium* in the Gulf of Maine has developed coupled biological/physical models that show promise for forecasting where and when a toxic bloom will spread, giving state officials early warning of an approaching bloom so they can mitigate impacts on the public and the economy. For an extensive list of NOAA- and other agency-funded projects related to Alexandrium, visit: http://oceanservice.noaa.gov/redtide/pdfs/alexandrium_projects_ne.pdf

Additional CSCOR accomplishments can be found at: http://www.cop.noaa.gov/aboutus/accomplishments.html

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