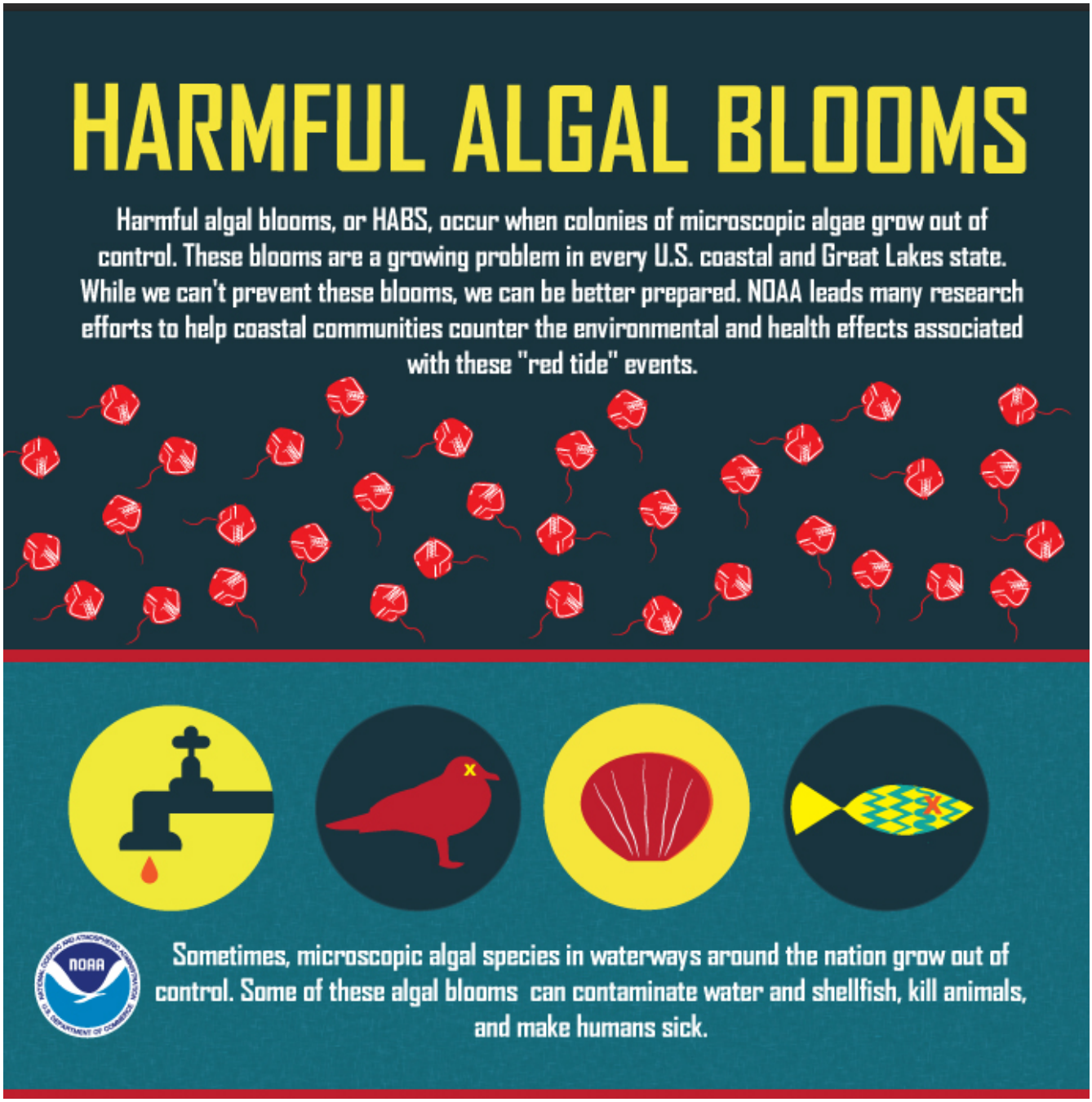
National Oceanic and
Atmospheric Administration
U.S. Department of Commerce

What is a harmful algal bloom?

Image credit: NASA

Harmful algal blooms, or HABs, occur when colonies of algae — simple plants that live in the sea and freshwater — grow out of control and produce toxic or harmful effects on people, fish, shellfish, marine mammals and birds. The human illnesses caused by HABs, though rare, can be debilitating or even fatal.

Ranging from microscopic, single-celled organisms to large seaweeds, algae are simple plants that form the base of food webs. Sometimes, however, their roles are more sinister. Under the right conditions, algae may grow out of control — and a few of these “blooms” produce toxins that can kill fish, mammals and birds, and may cause human illness or even death in extreme cases. Other algae are nontoxic, but eat up all of the oxygen in the water as they decay, clog the gills of fish and invertebrates, or smother corals and submerged aquatic vegetation. Still others discolor water, form huge, smelly piles on beaches or contaminate drinking water. Collectively, these events are called harmful algal blooms, or HABs.



Harmful algal blooms, or HABs, are a growing problem in every U.S. coastal and Great Lakes state. While we can't prevent these blooms, we can be better prepared. NOAA leads many research efforts to help coastal communities counter the environmental and health effects associated with these events. (NOAA)
Download Image

Every U.S. coastal and Great Lakes state experiences HABs. These blooms are a national concern because they affect not only the health of people and marine ecosystems, but also the “health” of our economy — especially coastal communities dependent on the income of jobs generated through fishing and

tourism. With climate change and increasing nutrient pollution potentially causing HABs to occur more often and in locations not previously affected, it's important for us to learn as much as we can about how and why they form and where they are, so that we can reduce their harmful effects.

NOAA is on the forefront of HAB research to better understand how and why these blooms form, and to improve detection and forecasting of these seasonal events. One of our top goals is to provide communities with advance warning so they can adequately plan for and deal with the adverse environmental, economic and health effects associated with HABs.

To bloom or not to bloom

Research continues on the causes of harmful algal blooms

While we know of many factors that contribute to HABs, how these factors come together to create a "bloom" of algae is not well understood. HABs occur naturally, but human activities that disturb ecosystems seem to play a role in their more frequent occurrence and intensity. Increased nutrient loadings and pollution, food web alterations, introduced species, water flow modifications and climate change all play a role.

Studies show that many algal species flourish when wind and water currents are favorable. In other cases, HABs may be linked to "overfeeding." This occurs when nutrients (mainly phosphorus and nitrogen) from sources such as lawns and agriculture flow into bays, rivers, and the sea, and build up at a rate that "overfeeds" the algae that exist normally in the environment. Some HABs appear

in the aftermath of natural phenomena like sluggish water circulation, unusually high water temperatures, and extreme weather events like hurricanes, floods, and drought.

FACT

$10.3 M

—Estimated decrease in 2011 Texas oyster landings due to red tide

A harmful algal bloom offshore of San Diego County, California. Many people use the term “red tide” to refer to harmful algal blooms, but not all HABs turn the water red. Blooms may appear in a variety of colors depending on the species of algae involved – and some HABs have no color at all. (With permisson from Kai Schumann)
Download Image

Although all coastal states experience HABs, different organisms live in different places and cause different problems. Other factors, such as the structure of the coast, runoff, oceanography, and other organisms in the water, can also change the scope and severity of HAB impacts.

To address these differences, NOAA takes a regional approach in developing strategies for HAB management. By developing specific tools and information for specific areas — the Gulf of Mexico, Great Lakes, Northeast, Pacific Coast, Mid-Atlantic/Southeast, and Caribbean/Pacific Islands — NOAA is able to advance regional and local management capabilities to deal with major HAB threats

Partly cloudy and a chance of HABs

Forecasting HABs for coastal communities

Scientists forecast a harmful algal bloom just as they forecast a hurricane. Like a weather forecast, a HAB forecast provides local and state officials with advance warning that allows them to test potentially affected shellfish beds more precisely and for shorter periods of time and, if necessary, post advisories in coastal areas where there is a direct health risk.

Today, NOAA's HAB Operational Forecast System encompasses Florida and Texas — a region that routinely experiences HAB outbreaks. This forecast system identifies whether or not a bloom of algae is likely to contain a toxic species, where it is, how big it is, where it's headed, and if it could become more severe in the near future.

FACT

500,000

—Ohioans without clean drinking water in 2014 after HABs were found in Lake Erie near a water treatment plant

NOAA currently uses a combination of satellite imagery and water samples of the algae species Karenia brevis collected from the field by local partners, to forecast the location and intensity of red tide events. The conditions report for red tide in Florida and Texas are available to the public and gives respiratory irritation forecasts by coastal region. (Chase Fountain, Texas Parks & Wildlife) Download Image

In the Gulf of Mexico, especially the west coast of Florida and the Texas coast, the most frequent cause of HABs is *Karenia brevis*. The toxin from this HAB becomes airborne when waves break on the beach, which causes severe respiratory irritation. HAB forecasts in this region rely on satellite imagery, field observations, models, public health reports and buoy data. Using all this information, forecasters can create a public HAB Bulletin that predicts the likelihood of respiratory irritation to people in the area in the coming days. HAB Bulletins are posted twice a week during the bloom season.

Similar forecasts are now being tried out in Lake Erie, Puget Sound, Chesapeake Bay, the Gulf of Maine and other HAB hotspots.

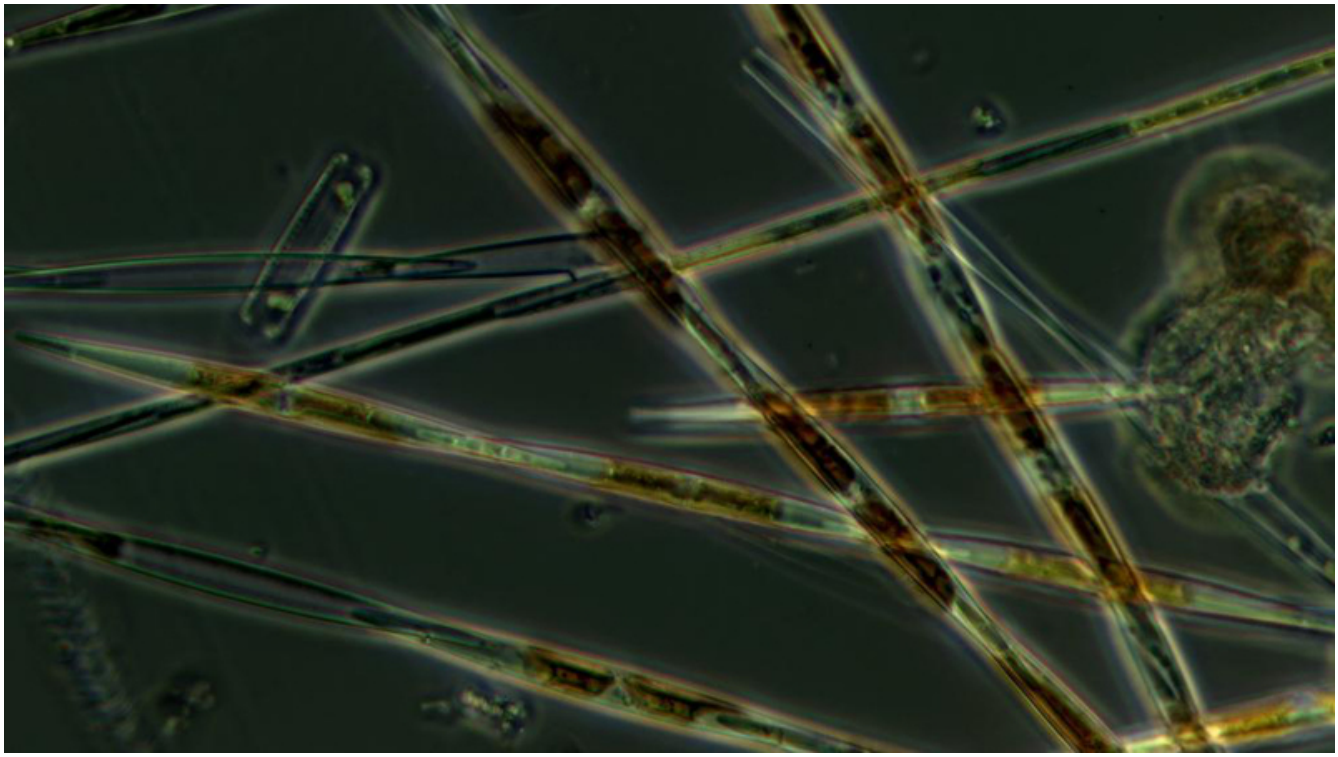
Hide and seek

Locating and monitoring HABs is a complex task

Finding HABs and measuring their toxins is a complex task. While traditional methods are time-consuming and require specialized labs, NOAA researchers are working on faster, cheaper and better ways to detect and monitor algal blooms and their toxins.

In 2015, NOAA joined forces with NASA, the U.S. Environmental Protection Agency and U.S. Geological Survey to transform satellite data designed to probe ocean biology into information that will help protect the American public from harmful freshwater algal blooms. The effort is designed to be an early warning system for toxic and nuisance algal blooms in freshwater systems by using satellites that can gather color data from freshwater bodies during scans of the Earth. Based off this information, state and local agencies can provide the public with public health advisories. In addition, the project will improve the understanding of the environmental causes and health effects of these cyanobacteria and phytoplankton blooms in the United States.

Another technique now in development involves the use of underwater sensors on buoys or attached to unmanned underwater vehicles. For example, NOAA is funding the development of a network of automated submersible microscopes called “Imaging Flow Cytobots” for monitoring and early warning of HABs. Every 20 minutes, this device sips the water. As the water stream passes a laser, a picture is taken of any cells that contain the algal pigment, chlorophyll. A computer analyzes the image to identify the algal cell, counts any HAB cells, and sends a message to a public health manager when the numbers of HAB cells exceed a threshold.



A close-up of Pseudo-nitzchia, a common a common type of phytoplankton. Sometimes, Pseudo-nitzchia blooms may produce domoic acid, a neurotoxin that can cause amnesiac shellfish poisoning. (NOAA)
Download Image

FACT

$2.4 million

—Estimated lost income of tribal commercial harvesters from the 2015 closure of Pacific Northwest Quinault tribal fisheries due to HABs

The Phytoplankton Monitoring Network is another initiative that is making a difference. This program trains volunteers around the nation to gather water samples and identify potentially harmful types of phytoplankton (one-celled organisms) in coastal waters.

Supporting coastal communities

NOAA provides ongoing support to coastal states during HAB events

When HABs occur, NOAA is there to help. NOAA maintains rapid response capabilities that help coastal managers get critical data on the types of species and toxins during a HAB event.

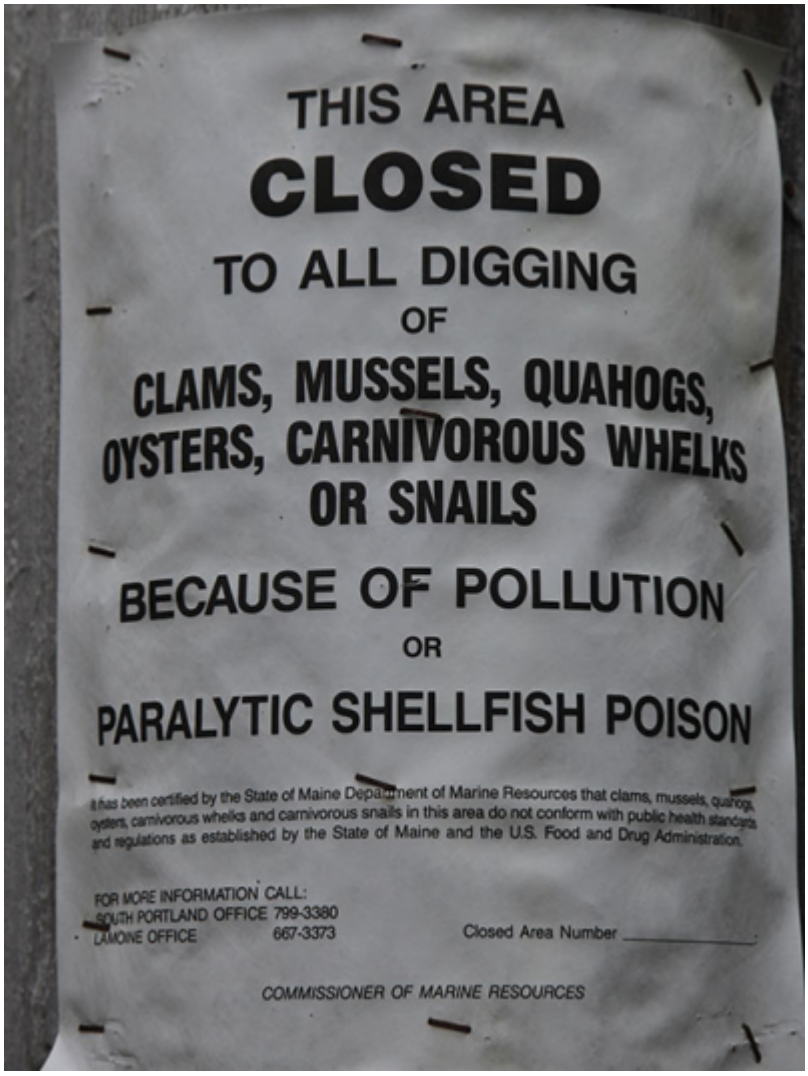
The HAB Event Response Program provides immediate assistance for managing events by offering technology and expertise, providing supplemental financial support for investigating events, and ensuring events are properly documented. Through this program, NOAA helps to minimize human health risks, assists in identifying the causes of marine animal mortalities, offers training opportunities for managers, and sets baseline conditions for new or reemerging harmful blooms.

NOAA's HAB Analytical Response Team delivers scientific guidance and identification of harmful algae and their toxins during suspected HABs, during related marine animal mortality events, and during potential for toxin-related human illness.

NOAA's Prevention, Control, and Mitigation of Harmful Algal Blooms Research program focuses on transitioning promising technologies and strategies to coastal managers to help develop cost-effective HAB management strategies.

These are just some of the NOAA tools and services aimed at promoting healthier fisheries and ecosystems by reducing the impacts of harmful algal blooms on people, the economy, and the environment. While we can't prevent HABs from happening, we can work together to promote awareness to the dangers they pose and reduce their impacts.

Additional HAB Resources and Links



Public warning signs appear in areas that have been closed due to high levels of toxin in shellfish. (NOAA)
Download Image

FACT

$40 million

—Estimated loss in tourism spending from the 2015 closure of Washington's recreational razor clam harvest due to HABs