Health Facts

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The dark mass of a Harmful Algal Bloom below the surface of the water, which can produce serious health impacts.

Tides of Trouble:
Increased Threats to Human Health and Ecosystems from Harmful Algal Blooms

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The proliferation of Harmful Algal Blooms (HABs) is a matter of growing global environmental health concern. These dangerous blooms of tiny microalgae can produce potent toxins that can harm people, pets, and marine life, and contaminate aquatic food chains. Eating toxin-contaminated fish or shellfish, swimming in or drinking contaminated waters, or breathing the air on beaches affected by these toxins can cause acute and long-term illness, and even death. Symptoms can be particularly severe in the elderly or those with pre-existing respiratory conditions. For example, for people with asthma, spending even one hour at a beach affected by "red tide," where toxins can become airborne, can hamper breathing days later—and these aerosolized toxins can travel up to a mile inland. Coastal communities in the United States are affected every year by HABs, with individual events costing local economies tens of millions of dollars. Climate change may be contributing to the conditions that allow these blooms to flourish, with waters becoming warmer and more frequent heavy rains washing nutrient-rich runoff into waterways.

To address this rising tide of trouble, NRDC recommends increased support for research, adoption of improved policies and regulations related to monitoring for and responding to HABs, and several easy steps for protecting personal health and safety while at the beach.

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Harmful Algal Blooms Can Cause Human Illnesses and Economic Impacts

Some 76 million cases of foodborne illness are reported annually in the United States.[1] It has been estimated that nearly 20 percent of foodborne disease outbreaks in the United States may result from seafood consumption, with as many as half of those the result of naturally occurring algal toxins (in particular, Ciguatera Fish Poisoning; see map and table).[2] Unfortunately, algal toxins are not destroyed by cooking.[3] From 1993 to 2002, more than 550 cases of HAB-related illnesses were reported by the Centers for Disease Control and Prevention (CDC), although this is considered a low estimate since it is believed that seafood-related illnesses are under-reported, misdiagnosed, and possibly increasing.[4]

The risk of human illness from algal toxin exposure can be greatly reduced or prevented through harvesting closures and beach warnings, which are issued based on data provided through rigorous state monitoring programs. The economic costs of just one type of widespread HAB in the United States, the blue-green algae *Microcystis*, has been estimated in excess of $82 million annually, including public health, fisheries, and tourism losses.[5] In addition to human illness, there were 14 confirmed canine pet deaths in the United States from HAB exposures as of 2009.[6]

How to Protect Yourself and Your Family from HABs:[7]

The CDC recommends taking the following steps to protect your health when you suspect that waters are affected by HABs:

- Pay attention to postings: don't enter waters closed by local public health authorities, and heed shellfish and fishing advisories posted in sport-fishing areas.
- If you are in contact with algae-contaminated water, rinse off your skin with fresh water as soon as possible.
- Report musty-smelling or -tasting drinking water to your local water provider.
- Report any HAB-related illness to your physician and make sure they submit the information into available HAB-health reporting systems, since under-reporting is an issue.

TABLE: HAB-Related Illnesses, Toxins, Sources, and Adverse Health Effects[8]

HAB-Related Illness	Toxin	Route of Exposure	Symptoms of HAB-Related Illness
Amnesiac Shellfish Poisoning (ASP)	Domoic acid from diatoms	Consumption of contaminated shellfish and possibly fish.	Vomiting, diarrhea, abdominal pain, and neurologic effects (confusion, loss of memory, disorientation, seizure, and coma).
Diarrheic Shellfish Poisoning (DSP)	Okadaic acid from dinoflagellates	Consumption of contaminated shellfish.	Abdominal pain, diarrhea, chills, headache, fever, nausea, vomiting. Could be a tumor promoter.
Neurotoxic Shellfish Poisoning (NSP)	Brevetoxins from dinoflagellate *Karenia brevis*	Eating contaminated shellfish and possibly fish; called "Red Tides" because of reddish haze produced on ocean surface.	Dizziness, muscle aches, reversal of sensations of hot and cold, diarrhea, vomiting, seizures, paralysis, and tingling/numbness of lips, tongue and throat.
"Red Tide" Respiratory Irritation	Brevetoxins	Inhalation of airborne toxin in aerosolized seawater.	Acute eye irritation, respiratory distress, cough, and nasal irritation. Can complicate respiratory problems like asthma.
Paralytic Shellfish Poisoning (PSP)	Saxitoxins from dinoflagellates or pufferfish	Eating contaminated shellfish and fish.	Tingling, numbness, diarrhea, nausea, vomiting, loss of motor control, drowsiness, incoherence. Can be fatal.
Ciguatera Fish Poisoning (CFP)	Toxins from dinoflagellates	Consuming contaminated large reef fish, especially barracuda; has become one of the most common fish-related illnesses in U.S.[9]	Abdominal pain, nausea, vomiting, diarrhea, dizziness, numbness, tingling, reversal of hot/cold sensation, pain, weakness. Neurological symptoms can last months.
Estuary-Associated Syndrome	Pfiesteria toxins from dinoflagellates	Exposure to air or water contaminated by toxins from a fish-killing dinoflagellate that occurs in brackish waters.	Skin and eye irritation, fatigue, headache, short-term memory loss, and confusion.
Blue Green Algae (Cyanobacteria)	Anatoxins, microcystins, lyngbyatoxins, BMAA (toxic amino acid), etc.	Skin contact with, or inhalation or ingestion of contaminated water.	Skin and eye irritation, digestive, respiratory, neurological symptoms. Linked to ALS, Alzheimer's, and Parkinson's disease.

Table adapted from: Sandifer P, Sotka C, Garrison D, Fay V. (2007); and Van Dolah (2000)

The Connection Between Climate Change and Harmful Algal Blooms

Although bloom frequencies and distributions are variable, in the last 30 years HAB events have been increasing in their reported frequency and distribution. The extent of their impacts on human health, natural resources, and local economies throughout the world has also increased.[10] While shorter-term weather events and human activities play key roles in the actual location, magnitude, and timing of blooms, climate change can affect the risks of HABs occurring in many marine and freshwater bodies. Several studies suggest that this rise is likely to continue, and that several aspects of climate change may create conditions favorable for their growth.[11]

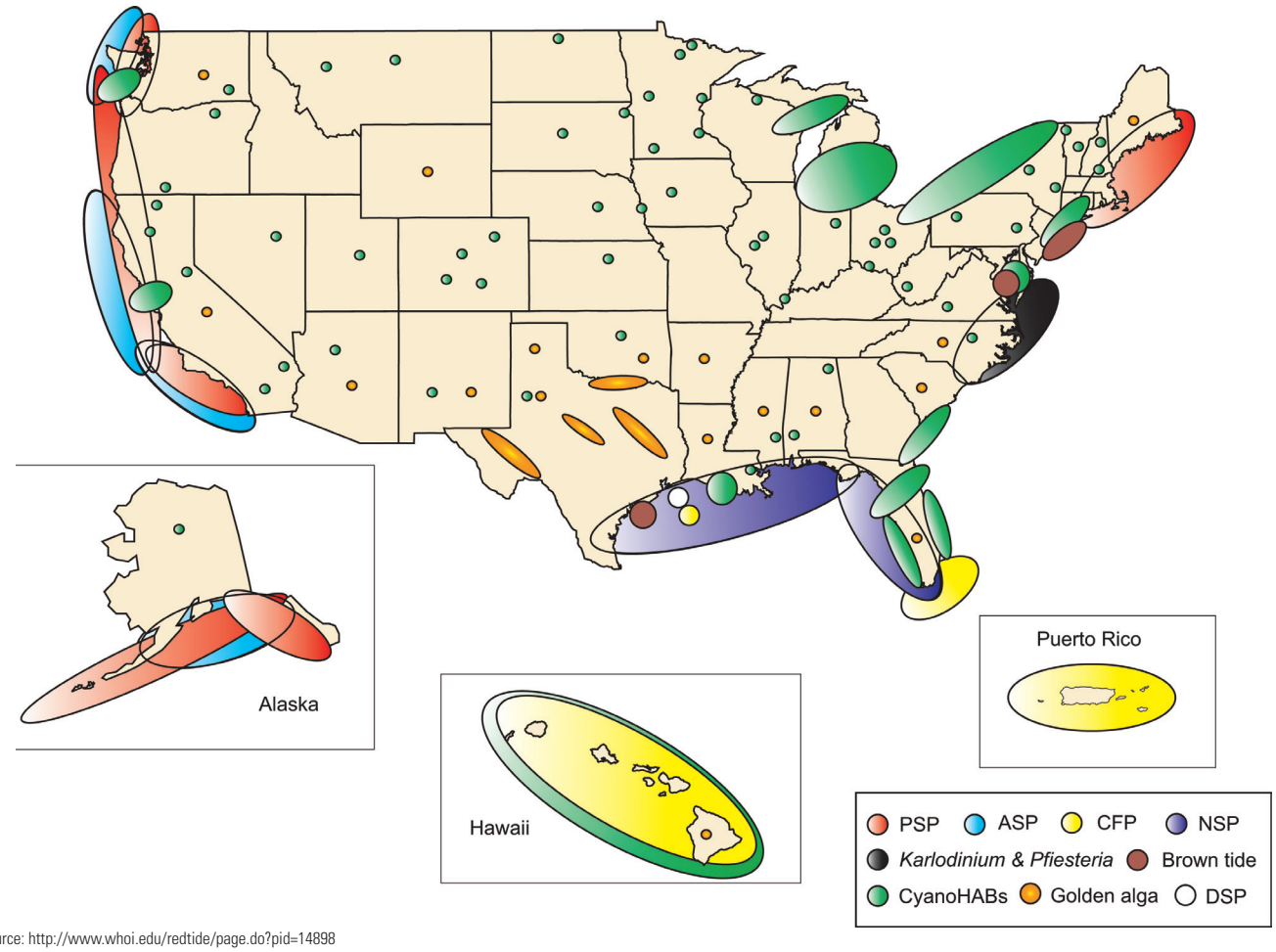
According to the Intergovernmental Panel on Climate Change (IPCC), a worldwide increase in algal blooms is among the "very likely" impacts to stem from climate change as it influences environmental conditions that can have impacts on the growth toxicity and geographic distribution of species associated with HABs.[12] Some ways climate change can influence HABs include:

- warming temperatures and changing sunlight conditions that can alter species interaction and ecological processes;
- changing rainfall that washes nutrients, sediments, and contaminants into waterways; and
- alterations in wind and current patterns that can affect species distribution, nutrient upwelling, and vertical stratification, and movement.[13]

As noted above, one potential influence of climate change on HABs is more frequent heavy rainfall events, which can wash nitrogen-rich fertilizer, sewage, or sediment off the land and into water, and increase nutrient loading into waterways. The amount of rain falling in the heaviest 1 percent of downpours has increased 20 percent in the past century in the United States, a trend very likely to continue with climate change.[14]

Distribution of Harmful Algal Blooms in the United States

PSP: Paralytic Shellfish Poisoning; ASP: Amnesiac Shellfish Poisoning; CFP: Ciguatera Fish Poisoning; NSP: Neurotoxic Shellfish Poisoning; DSP: Diarrheic Shellfish Poisoning.
Note that dots represent the occurrences of the organisms and toxins that cause these syndromes, not the human health effects.



Map source: http://www.whoi.edu/redtide/page.do?pid=14898

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It is projected that global warming will also cause water temperatures to continue to rise. Already, in marine and freshwater bodies, temperatures are rising during both winter and summer because of global warming.[15] With scientists now studying the complex factors that affect when and where toxic HABs occur, some studies suggest that HAB species will be able to invade new areas due to warming water temperatures. In some freshwater lakes, warmer temperatures allow HABs to exploit longer stratification periods and thrive, and droughts that increase lake salinities can also favor HABs.[16] Some harmful HAB species that were previously constrained by temperature have already expanded their ranges into more northern waters in areas of the North Sea and off the Atlantic and Pacific Coasts of Canada.[17,18] Others have been shown to have longer periods of bloom activity, such as in the Puget Sound and Seattle.[19] The map shows the tremendous variety of HABs (and their toxins) that have been reported to occur in U.S. waters.

Improved technology and information on HABs has increased the number of reports and ability to detect blooms in recent years. Forecasting systems are helping to project the upcoming seasonal severity of blooms in U.S. coastal waters.[20] Shorter-term forecasts can give early warning when a bloom is occurring, predict or track where it is going, and if it is getting bigger or smaller.[21]

Recommendations for Federal Action to Mitigate Danger of Harmful Algal Blooms

- **Adopt regulations to reduce pollution to minimize the toll of HABs on ecosystems, the economy, and human health.** Funding should strengthen enforcement of regulations that control nutrient pollution from point sources (like sewage treatment plants and aquaculture facilities) and non-point sources (e.g., agricultural and septic tank runoff).
- **Support the Oceans and Human Health Reauthorization Act of 2010 (S. 1252) that would revamp and extend funding for oceans-health research and outreach.** Since the passage of the Harmful Algal Bloom and Hypoxia Research and Control Act (HABHRCA) in 1998, and its amendment in 2004, numerous advancements in government and academic HAB research have led to useful tools to prevent, control, or mitigate the occurrence of HABs and their impacts. Now is the time to employ these developments to fight HABs.
- **Pursue increased research to help determine whether there exists a combination of nutrients, temperature, and other factors—a "perfect storm" of environmental conditions—that spark these blooms to occur, and how they terminate.** Continuous ongoing measurements of the multiple key variables in key locations would enable even more precise mapping of areas most vulnerable to different types of HABs, and could help improve community preparedness planning.
- **Expand funding so that current local and regional early warning systems can be supported on a daily basis and new systems can be developed, piloted, and evaluated.** These systems could integrate remote sensing data of HAB cells and their toxins, and current water condition reports to create local community alerts on days when HAB threats exist or are predicted.
- **Expand current health monitoring and clinician training programs to recognize HAB-related illnesses and implement new programs, especially in areas where the increase of HABs is likely.** One study has suggested that fatalities usually happen in areas where HABs haven't previously occurred, since monitoring programs are lacking and hospital facilities are not used to treating people affected by HABs.
- **Warning systems should target vulnerable groups**, such as the elderly, women of reproductive age, those with depressed immune function (e.g., people with HIV/AIDS and chemotherapy patients), children, people with chronic diseases, and those with respiratory disease.

More Information on HABs and Their Effects on Human Health

Woods Hole Oceanographic Institution. 2010. *Harmful Algae* website: http://www.whoi.edu/redtide/

Click the interactive link at http://www.whoi.edu/redtide/page.do?pid=14898 to generate maps that show the frequency of the different major HAB-related problems in U.S. coastal waters over the last ten years.

CDC's HAB website: http://www.cdc.gov/hab/default.htm and their **Harmful Algal Bloom-Related Surveillance Systems (HABISS) website:** http://www.cdc.gov/hab/surveillance.htm

Interagency Oceans and Human Health Research Implementation Plan: A Prescription for the Future: Chapter 3: HABs (pg. 39): Download from: http://www.eol.ucar.edu/projects/ohhi/

References