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Updated September 5, 2019

Freshwater Harmful Algal Blooms: An Overview

Scientific research indicates that in recent years, the frequency and geographic distribution of harmful algal blooms (HABs) have been increasing nationally and globally. They have been recorded in all 50 states. HABs can be detrimental to human health, pets, livestock, aquatic ecosystems, and the economy.

What Are Harmful Algal Blooms?

Algal communities are naturally occurring components of healthy aquatic ecosystems, such as lakes, rivers, and estuaries. However, under certain environmental conditions—such as increased temperatures and nutrient concentrations (e.g., nitrogen and phosphorus)—colonies of algae can grow excessively (or "bloom") and produce toxins. These HABs sometimes produce discolorations in the water that can appear as scums, paint-like slicks, clotted mats, or foam. Even when visible signs of a bloom are absent, however, algal toxins may still be harmful.

While many types of algae can cause HABs in bodies of freshwater, cyanobacteria typically cause the most frequent and severe blooms. Some species of cyanobacteria produce toxins, called cyanotoxins, which can cause hepatic (liver-related), neurologic, respiratory, dermatologic, and other symptoms. These may be acute or chronic, mild or severe, and may be fatal in some cases. Humans may be exposed to cyanotoxins by consuming tainted drinking water, fish, or shellfish; swimming or recreating in waters with certain concentrations of cyanotoxins present; or inhaling aerosolized toxins. The cyanotoxins associated with these HABs can also kill pets, farm animals, and wildlife, and contaminate or kill fish, leading to recreational, economic, and environmental losses.

HABs can also contribute to deteriorating water quality and ecosystem health. An over-abundance of cyanobacteria or other algae can block out sunlight and clog fish gills. In addition, as the algae die and decompose, they consume oxygen, leaving waterways in a hypoxic (low oxygen) state, sometimes forming dead zones—areas with little or no oxygen where life cannot survive. Such areas can suffocate and kill fish and other aquatic life.

What Causes Harmful Algal Blooms?

Many factors may influence the occurrence and prevalence of HABs in freshwater, including nutrient concentrations, water temperature, availability of light, pH, and water circulation. Nutrient enrichment is widely recognized as one of the key causes of HAB formation.

While some sources of nutrients in waterbodies are natural, many anthropogenic (i.e., human) activities contribute nutrients from both point (direct) and nonpoint (diffuse) sources. Point sources include municipal and industrial wastewater discharges and concentrated animal feeding operations (from manure discharge). Nonpoint sources include other animal feeding operations, agricultural runoff (fertilizers and manure), urban stormwater runoff (fertilizers, pet waste, phosphate-containing soaps), failing septic systems, and atmospheric deposition of nitrogen oxides generated by fossil fuel combustion.

Efforts to Address Harmful Algal Blooms

Congress has recognized the increasing frequency of HABs and has passed legislation in an effort to address their public health, economic, and environmental consequences. The Harmful Algal Bloom and Hypoxia Research and Control Act of 1998 (HABHRCA) as amended, established an interagency task force, required the task force to prepare reports and plans addressing marine and freshwater HABs, and authorized funding for research, education, monitoring activities, etc. Congress most recently reauthorized HABHRCA in January 2019 (P.L. 115-423), requiring the task force to submit a scientific assessment of HABs once every five years, requiring the National Oceanic and Atmospheric Administration (NOAA) to develop and maintain a public website on HAB and Hypoxia Program activities, and authorizing NOAA or the Environmental Protection Agency (EPA) to determine that a hypoxia or HAB event is an event of national significance.

In 2015, in response to public safety concerns arising from a major HAB event in Toledo, Ohio, Congress passed legislation addressing algal toxins in drinking water (P.L. 114-45; for more information, see CRS In Focus IF10269, *Algal Toxins in Drinking Water: EPA Health Advisories*). In the Water Infrastructure Improvements for the Nation Act, Congress directed EPA to designate a Harmful Algal Bloom Coordinator to coordinate projects and activities involving HABs in the Great Lakes. In addition to HAB-specific legislation, the Clean Water Act (CWA) authorizes EPA to address water quality concerns associated with HABs.

Many federal agencies are involved in carrying out various HAB-related activities, including conducting research, monitoring algal toxins and water quality, forecasting HABs, supporting projects to improve water quality, and facilitating community outreach efforts. The federal agencies and organizations HABHRCA specifically requires to participate on the task force include the Department of Commerce, NOAA, EPA, Department of Agriculture, Department of Interior, Department of the Navy, Department of Health and Human Services, National Science Foundation, National Aeronautics and Space Administration, Food and Drug Administration, Office of Science and Technology Policy, Council on Environmental Quality, Centers for Disease Control and Prevention, and Army Corps of Engineers.

After amendments to HABHRCA in 2014, the task force was reconstituted as the Interagency Working Group on the Harmful Algal Bloom and Hypoxia Research and Control Act, which is responsible for maintaining a national HAB/hypoxia program. NOAA and EPA share primary responsibility for administering the national HAB and hypoxia program, with NOAA leading marine aspects of the program and EPA in charge of freshwater aspects.

In its role under HABHRCA and the CWA, EPA's efforts to address HABs include coordinating efforts of multiple entities, developing regulations and guidelines to protect water quality, conducting research, providing financial assistance, and educating the public.

In June 2019, EPA used its authority under the CWA to publish final water quality criteria for two algal toxins in waters used for recreational purposes (84 *Federal* Register 26413). States may consider such criteria when developing water quality standards—measures that describe the desired condition or level of protection of a water body and what is needed for protection. Alternatively, they may use these values as the basis of swimming advisories for public notification purposes at recreational waters. EPA had proposed draft criteria in December 2016. Many entities—including states, representatives of publicly owned treatment works, agricultural organizations, and environmental groups—provided comments on the draft criteria. Some were supportive of the criteria for purposes of informing swimming advisory decisions but did not support the use of the criteria for developing water quality standards. They noted, among several implementation concerns, that cyanotoxins are not a pollutant discharged into waterways but rather result from other pollutants (nutrients) entering waterways, among other factors. Some commenters generally supported EPA's criteria for use in both swimming advisories and development of water quality standards but also discussed the importance of reducing nutrient inputs to address HABs. Regarding the proposed concentration levels, some commenters felt that they were overly protective, while others felt they should be more stringent. EPA's final recommended concentrations for the two algal toxins are 8 µg/L for microcystin and 15 µg/L for cylindrospermopsin (higher than the draft concentrations of 4 µg/L and 8 µg/L, respectively).

EPA has emphasized the need to reduce nutrient pollution from all sources to address public health and environmental impacts associated with HABs. However, the CWA does not authorize EPA to regulate all sources. It authorizes EPA to regulate point sources of nutrients but not nonpoint sources of nutrient pollution.

Some states have developed guidelines for algal toxins, primarily for use in guiding swimming advisories. Also, states have listed waters as impaired, or not meeting water quality standards, for algal blooms or algal toxins. Some of these states have begun to develop Total Maximum Daily Loads (TMDLs)—essentially pollution budgets—to address them. Most states have identified nutrient-related pollution as a priority to be addressed by their TMDLs and/or alternative restoration plans. States rely heavily on financial assistance from EPA in implementing these plans and, more broadly, in addressing nonpoint source pollution that leads to degraded water quality and HAB formation. Congress has long provided financial assistance through EPA for regional, state, and local programs through CWA section 106 and 319 planning grants, geographic programs (e.g., Chesapeake Bay and Great Lakes), and other sources. President Trump's FY2020 budget request proposes to significantly reduce or eliminate funding for most of these programs. (For information on financial assistance for agricultural nutrient management from the U.S. Department of Agriculture, see CRS Report R43919, *Nutrients in Agricultural Production: A Water Quality Overview*.)

Research Gaps

Scientists widely recognize research gaps that hinder the ability to prevent, predict, minimize, and suppress HABs. In reauthorizing HABHRCA in 2014, Congress directed NOAA—through the interagency working group—to prepare a comprehensive research plan and action strategy to address marine and freshwater HABs and hypoxia. A February 2016 task force report discusses the key challenges in HAB and hypoxia management and the gaps in the research and management communities' knowledge of HAB and hypoxia events. Examples of gaps include the limited ability to predict the timing, species composition, and toxicity of HABs and the need to strengthen and integrate new and existing monitoring programs.

Issues for Congress

While Congress, federal agencies, and states are taking steps to address HABs, many observers assert that further action is needed to make progress that outpaces the growing consequences of nutrient pollution.

Congress has passed legislation to help drive and fund research efforts and improve collaboration among the many federal agencies involved in HAB-related activities. Moving forward, Congress may be interested in oversight of the implementation of HABHRCA and related authorities.

Most observers agree that further research is needed to understand the most appropriate way to predict, minimize, and suppress HAB outbreaks, including whether and how to regulate algal toxins. These advocates assert that Congress should ensure that adequate funding is available for such research.

To control HABs, some advocate regulating nonpoint source pollution, arguing that point sources are disproportionately regulated while nonpoint sources are the larger contributors to nutrient pollution. Others argue that EPA and other federal agencies should continue to focus on collaborative, voluntary efforts to address nonpoint source pollution that contributes to HAB formation and that Congress should continue to fund these programs.

For a discussion of the HAB-related bills introduced to date in the 116th Congress, as well as further information about the issues discussed above, see CRS Report R44871, *Freshwater Harmful Algal Blooms: Causes, Challenges, and Policy Considerations*.

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