SOUTH CENTRAL
CLIMATE ADAPTATION SCIENCE CENTER
FRESHWATER HARMFUL ALGAL BLOOMS IN A CHANGING CLIMATE

A harmful algal bloom (HAB) is a broad term used to describe any toxic algal bloom in freshwater systems. Toxins in HABs can cause illness in humans, livestock, pets, and other animals. HABs occur when the physical and chemical conditions are ideal for the growth of cyanobacteria – a type of phytoplankton which are sometimes called "blue-green algae" due to their color because they photosynthesize similar to algae and other plants. Favorable conditions for HAB formation include nutrient-rich inland water bodies, warm temperatures, prolonged hot days, and low wind speeds. The frequency, duration, and intensity of freshwater HABs are on the rise worldwide, partly due to the impact of climate change on conditions conducive to HAB development.

Human activities play a part in exacerbating HAB growth. For example, waste from concentrated animal feeding operations and fertilizer from agricultural fields contain minerals that feed cyanobacteria. These chemicals flow into streams and lakes after heavy rainfall. Other contributors include the loss of riparian areas (the vegetated banks of a river or steam) and increased impervious (watertight) surfaces in landscapes which allow excess nutrients to flow more readily.

Not all algal blooms are a threat to humans, livestock, pets, and other animals. However, cyanobacteria species, under the right conditions, can be toxic and require caution. Toxicity can not be determined by looking at a body of water but must be confirmed through laboratory analysis. If you are uncertain, it is best to avoid contact with the water to stay safe.

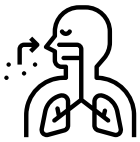
Factors that Contribute to Freshwater Harmful Algal Blooms

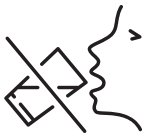
- *Nutrients and Precipitation Extremes:* Nitrogen and phosphorus are essential mineral elements for plant growth and are key components of fertilizers. Fertilizers are added to some landscapes to promote plant growth, including on agricultural fields, golf courses, and urban lawns. However, when it rains, fertilizer tends to wash into streams, lakes, and other bodies of water. A surplus of nutrients can lead to eutrophication, a process where water bodies become overly enriched with nutrients, which can cause changes in the phytoplankton community, often leading to the dominance of cyanobacteria and the loss of oxygen in the ecosystem. Climate change impacts precipitation patterns, causing increased rainfall intensity in certain areas. This intense rainfall can result in flash floods. In intense rainfall or flooding, rain washes nutrients and other substances from the land into bodies of water, providing sustenance for algae and cyanobacteria.
- *Temperature and Stratification:* Algae and cyanobacteria thrive in warm and hot conditions. Warmer temperatures intensify the temperature differences at various levels of lakes and ponds, causing colder water to sink towards the bottom of bodies of water while warmer water remains on the surface. The warmer surface layer leads algae and cyanobacteria to photosynthesize and bloom. Some toxic species prefer the hotter conditions with optimal water temperatures above 77°F [25° C] that are projected to occur more often with climate changes.
- *Extended Warm Seasons:* The changing climate is leading to longer warm seasons and altering seasonal temperature patterns. These impacts can include high air temperatures, high evaporation rates, and low wind speed. In many regions, snow melt occurs earlier in the spring and the first snowfall occurs later in the fall. The longer warm season impacts the timing and conditions of lake turnover in both the spring and the fall. This extended season provides a longer period for algae and cyanobacteria to thrive.

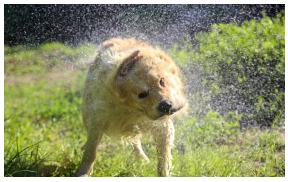
Harmful Algal Blooms in a Changing Climate

Health Hazards for Humans and Animals

Toxins in harmful algal blooms (HABs) are a cause for concern as they can cause illness in humans, livestock, pets, and other animals. Ingesting contaminated water has led to animal fatalities. The three main toxins produced are categorized by which body region is affected. Those that affect the liver are called hepatotoxins; those that affect the skin are dermatoxins; and those that affect the nervous system are neurotoxins.







Human Exposure: Exposure to these toxins can occur in several ways, including direct contact with HABs during recreational activities, consuming contaminated drinking water, eating fish or shellfish that contain a toxin, or breathing toxin-containing droplets from the air. Symptoms include rash, abdominal pain, nausea, vomiting, bloody diarrhea, fever, gastrointestinal symptoms, drowsiness, or headache. However, symptoms may vary depending on the toxin(s) causing the illness.

Animal Exposure: Pets, livestock, and wildlife face a greater risk of illness or death than humans due to their behavior and exposure to toxins. Animals are at risk as they may seek relief from heat by entering a pond during hot weather conditions, exposing themselves to a toxic bloom. Livestock and wildlife may experience mass mortality incidents when exposed to these toxins. Dogs are particularly vulnerable to mortality after exposure because they can ingest a significant amount of toxin from licking their fur following contact with water containing HABs. Signs of exposure in dogs are typically gastrointestinal, such as vomiting and foaming at the mouth, usually more severe than in humans. Signs in all animals include lethargy, stumbling, twitching, or violent tremors.

Recommended Actions

For a State, Tribal, or local agency, it is important to have protocols in place to swiftly and appropriately monitor and respond to HABs. Regular monitoring of waters can be costly, so many jurisdictions offer educational resources on HABs. Outreach materials, like the slogan "When in doubt, stay out," can discourage people from entering affected water bodies. Remember, you cannot tell if a HAB is occurring just by looking at the water. While humans can be educated to make safe decisions, animals cannot. Agricultural producers and resource managers should protect animals, like preventing cattle from accessing ponds with toxic blooms. Wildlife is harder to shield.

Detecting HAB-related illnesses is challenging due to the lack of specific diagnostic tools. The One Health for Harmful Algal Blooms System (OHHABS), a voluntary program overseen by the Centers for Disease Control (CDC), focuses on communication and reporting among the public, local health departments, veterinarians, and physicians. Effective communication among agencies and professionals is vital for diagnosing and treating illnesses caused by algae or cyanobacteria exposure.

With climate change acting as an exacerbating factor to an increase in the frequency and intensity of HABs, each State or local agency or Tribal Nation should consider developing its own guidelines or procedures to detect and address HABs based on their specific needs. States and Tribes can formulate policies prioritizing the safety, health, and welfare of the public.

OHHABS
ONE HEALTH Harmful Algal Bloom System

Yvette Wiley prepared the literature review and text for this fact sheet. Version 1