FAQ: Harmful algal blooms that cause red tide

BACKGROUND INFORMATION

Algae are plant-like organisms that mostly live in water. They are found in both fresh and marine waters and range in size from microscopic to macroscopic (e.g., giant kelp). Essential to life on the planet, they provide much of the world’s oxygen and are major contributors to coastal food webs. A small subset of algae can harm humans and wildlife in fresh or coastal waters under certain conditions. When algae are present in large numbers it is called a “bloom.” A harmful algal bloom (HAB) can cause beach fouling, oxygen depletion, fish kills and foodborne illnesses. In the Gulf of Mexico, *Karenia brevis* (Figure 1) is one of the most common HAB organisms. *K. brevis* blooms are commonly known as “red tides” because of the color of the water during a bloom. This organism can produce a group of toxins called brevetoxins. These toxins are harmful to animals and humans. Table 1 highlights the species that cause red tide and other species in the Gulf of Mexico that are most likely to cause HABs in coastal waters. However, not all blooms from these algae will release toxins.

**Table 1.** Species that are most likely to cause HABs in coastal waters of the Gulf of Mexico and their potential impacts. Full descriptions can be found on the Center for Disease Control’s HAB webpage available here: [https://www.cdc.gov/habs/illness-symptoms-marine.html](https://www.cdc.gov/habs/illness-symptoms-marine.html).

<table>
<thead>
<tr>
<th>Harmful Algae Species</th>
<th>Type of Poisoning</th>
<th>Poisoning Causes and Symptoms</th>
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<tbody>
<tr>
<td><em>Karenia brevis</em></td>
<td>Neurotoxic shellfish poisoning</td>
<td>Caused by eating contaminated shellfish. Symptoms can include impacts to the nervous and digestive systems and usually are over within two to three days.</td>
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<td></td>
<td>Inhalation of brevetoxin</td>
<td>Caused by breathing in toxin while on land or in water. Symptoms include respiratory irritation, especially in people with underlying respiratory concerns (e.g., asthma).</td>
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<tr>
<td><em>Pseudo-nitzschia</em></td>
<td>Amnesic shellfish poisoning</td>
<td>Caused by eating contaminated shellfish. Symptoms can include nervous system impacts, such as memory loss, and can cause death.</td>
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<tr>
<td>species</td>
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<tr>
<td><em>Dinophysis</em></td>
<td>Diarrhetic shellfish poisoning</td>
<td>Caused by eating contaminated shellfish. Symptoms can include digestive system impacts and chills and usually are over within three days.</td>
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<td><em>species and Prorocentrum species</em></td>
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<tr>
<td><em>Gambierdiscus</em></td>
<td>Ciguatera poisoning</td>
<td>Caused by eating contaminated fish. Symptoms can include impacts to nervous, circulatory and digestive systems and can last from four days to years.</td>
</tr>
</tbody>
</table>

**What nutrients and conditions influence red tide?**

Algae, like other plants, require nutrients, such as nitrogen and phosphorus, to grow. Excess nutrients may contribute to red tides. While the causes of individual HAB events have been shown to vary across years and locations, nutrient input may help sustain an event once a red tide reaches the shoreline.

Sea surface temperature and upwelling events (mixing of nutrient-rich offshore waters with coastal waters) also contribute to HAB events. Studies have found that the position of the Loop Current within the Gulf of Mexico plays a significant role in maintaining a red tide event along Florida’s west coast. More events take place when the Loop Current is centered farther north, near the middle of the Gulf, though the explanations for this association differ.

**What conditions move red tide?**

Red tides are made up of microscopic algae (Figure 2) that are readily transported by winds, currents, tides and storms.
For example, one Florida red tide event in 2005 was carried from the southwest coast of Florida to the Panhandle during Hurricane Katrina and another may have spread in a similar way due to Tropical Storm Gordon in 2018. However, even though wind and currents are capable of transporting algae that cause red tide to the Alabama and Mississippi coasts, it does not mean that a bloom will form here. A recent study of two historical events in the Mississippi Sound found that the bloom was only able to intensify during one of them, when water conditions were favorable (e.g., optimal nutrient input levels, relatively warmer winter months, currents that support HABs). Mobile Bay's normally low-salinity waters are not favorable to support a red tide event.

Does the species that produces red tide create spores? (If so, do the spores persist on land?)
The species that produces red tide does not produce spores and cannot persist on land. Some HAB species produce cysts, which are dormant “seeds” created during a bloom and are capable of living through harsh conditions. Studies have identified temporary cysts of the genus *Karenia* (one of the red tide producers) that can form under experimental and field conditions, but it is not clear under which conditions these cysts can reinitiate blooms.

How long does red tide toxin last?
Brevetoxin, the toxin associated with red tide events that causes human illness and fish kills, may persist for a long time in sand, mud and submerged aquatic vegetation. Absorbed by aquatic species, it also can linger in the food chain for weeks or months after the end of a bloom. Few studies have been conducted to determine the rate of breakdown of brevetoxins in fish carcasses. However, one study found a 90% decrease in the concentration of brevetoxin in tissue from dead fish after 2-3 weeks. Toxins were still detectable in fish tissue up to 77 days after death, and breakdown was faster when fish were exposed to the elements than when they were buried. There are no data to indicate whether toxins in fish carcasses pose any human health risk.

Do closure levels for harvesting shellfish vary by HABs species?
Yes, the type of HAB will determine closure levels for shellfish harvesting as directed by the Interstate Shellfish Sanitation Commission (ISSC). *K. brevis* cells produce brevetoxins. *Pseudo-nitzschia* may produce domoic acid, another type of natural toxin. This toxin has led to shellfish closures in the Pacific and Atlantic. Both algae types are monitored by public health officials in Mississippi and Alabama. Certain concentrations of these species can lead to closures of shellfish beds and/or additional health impacts (Table 2). The National Oceanic and Atmospheric Administration’s Harmful Algal Blooms Observing System (HABSOS) website ([habsos.noaa.gov](http://habsos.noaa.gov)) is one source that reports recent and historical *K. brevis* bloom events (Figure 3).

**TABLE 2. Shellfish closure levels and respiratory impacts from two HAB species found in the Gulf of Mexico based on the number of cells per liter of water.**

<table>
<thead>
<tr>
<th>Species</th>
<th>Shellfish closure level (cells/L)</th>
<th>Respiratory impacts (cells/L)</th>
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<tbody>
<tr>
<td><em>Karenia brevis</em></td>
<td>5,000 or above</td>
<td>50,000 or above</td>
</tr>
<tr>
<td><em>Pseudo-nitzschia</em></td>
<td>1,000,000 or above</td>
<td>N/A</td>
</tr>
</tbody>
</table>

How do waters reopen to shellfish harvests?
To reopen, first the cell counts of the algae must drop below the level that triggered the closure (e.g., 5,000 cells/L for *K. brevis*) to indicate the bloom has passed. Second, public health officials must determine the shellfish are safe for human consumption. Shellfish break down the toxins over time depending on water temperature and species. State public health agencies will collect shellfish tissues and analyze them to determine that the shellfish are safe for human consumption. Once the agencies determine the shellfish are safe to eat, the waters can reopen.
How often are waters tested for red tide in Florida compared to Alabama and Mississippi?
Volunteers and county agencies sample in the Florida Panhandle. They send samples to the Florida Fish and Wildlife Conservation Commission once or twice per week when HAB events are identified. The Florida Division of Aquaculture and Consumer Services also collects its own samples. Sampling frequency in Florida increases if it is in a shellfish harvesting area. The Alabama Department of Public Health conducts sampling for HABs on a weekly basis during the warm weather months at established sites. The Mississippi Department of Marine Resources samples coastal waters bimonthly and more frequently if a HAB is discovered.

Do states communicate about risks of a bloom moving along the coast?
Yes, there is communication among state agencies in Florida, Alabama and Mississippi regarding HABs.

HUMAN SAFETY

How do agencies determine if it is safe to swim?
The Beaches Environmental Assessment and Coastal Health Act (BEACH Act) is a federal law that directs monitoring of marine waters for different types of pollution. Beaches that post data from BEACH Act monitoring will have signs posted to notify the public if K. brevis counts are from 5,000 to 50,000 cells/L (approximately a 1 in 5 chance a person would experience eye and respiratory irritation at that range). It is up to the local government to make the decision to close public beaches. K. brevis cell counts that exceed 50,000 cells/L are not considered safe to swim in. The Alabama Department of Public Health issues advisories, not beach closures. Local governments can post double red flags to take the final action to close the waters, just like with the rip currents system of flying double flags. Mississippi closes the waters when there is a human health hazard but allows beach access. In Sarasota County, Florida, officials have taken lifeguards off the beach during severe HAB events, which unofficially closed the beach.

How can the red tide affect my pets?
Pet owners should monitor their pets for signs of respiratory irritation at that range). It is up to the local government to make the decision to close public beaches. K. brevis cell counts that exceed 50,000 cells/L are not considered safe to swim in. The Alabama Department of Public Health issues advisories, not beach closures. Local governments can post double red flags to take the final action to close the waters, just like with the rip currents system of flying double flags. Mississippi closes the waters when there is a human health hazard but allows beach access. In Sarasota County, Florida, officials have taken lifeguards off the beach during severe HAB events, which unofficially closed the beach.

How can the red tide affect my pets?
Pets, like people, can be affected by red tides. They can suffer respiratory irritation while on the beach or ingest the toxin when cleaning themselves after swimming or consuming dead fish or other sea life. Take steps to limit pet exposure to these risks.

When is it safe to clean up?
Cleanup procedures can be conducted as soon as the impacts are seen. However, if a red tide bloom is still active, personnel may experience throat and/or eye irritation while performing cleanup activities.

Is special equipment needed to protect workers?
It is recommended that people wear masks to help prevent respiratory symptoms, particularly those that exhibit signs of irritation in the presence of a red tide.

During severe events in Florida, officials hired shrimp trawlers to collect dead fish while they were still in the water so fewer dead fish reached the beaches.

What protection should people with respiratory issues (e.g., asthma) use?
Healthy individuals can use a dust mask to help prevent respiratory symptoms. However, it is recommended that people with asthma avoid exposure to airborne brevetoxins. Symptoms of aerosolized brevetoxins may be felt as far as 4 miles away from the coast. Although scientific studies have not been conducted, the Florida Department of Health suggests that properly fitted 95N masks be worn during cleanup and related activities.

How should we dispose of dead fish or sea life? According to the Alabama Department of Environmental Management and Alabama Department of Conservation and Natural Resources, fish and other wildlife should be collected and disposed of in double heavy-duty plastic bags in an approved landfill.

Do we need to decontaminate equipment?
Decontamination of cleanup equipment is not necessary.

LEGAL ASPECTS

Do local governments have to issue swimming advisories at certain red tide levels?
No. The State of Alabama has a HAB Response Plan, but it does not require action by local governments. The HAB Response Plan is based on the Alabama Department of Environmental Management conducting sampling, the Alabama Department of Public Health conducting testing and the State Public Health Officer issuing Public Health Advisories for swimming areas by email and fax. The State of Mississippi's HAB Response Plan similarly outlines actions regarding testing and isolation of contaminated areas, but it does not impose local actions.

The federal and state laws covering testing and notification for swimming safety are based on a specific bacteria (enterococci) and not based on the presence of HABs. There are requirements for closing oyster beds based on levels of harmful algae in the water, but the guidelines do not apply to swimming areas.

Which agency is responsible for directing actions and local governments during a HAB?
In Alabama, the Department of Public Health is the lead agency for advisories; the Alabama Department of Environmental Management gathers the information on cell counts of HAB species. In Mississippi, the responsibility for HAB responses is divided between the Mississippi Department of Marine Resources, which gathers the HAB cell count information and manages the fisheries, and the Mississippi Department of Environmental Quality, which focuses on public safety, posts beach monitoring data and reports coastal water quality.
SEAFOOD SAFETY

Is it OK to eat seafood at a restaurant or from a seafood market during a red tide?

Seafood purchased commercially is safe to eat because the monitoring system in place closes areas to harvest before there is a risk to consumers. Oysters, clams, mussels and most bivalve shellfish in the areas affected by a harmful algal bloom are not safe to eat during red tide; the animals accumulate toxins as they consume the algae. Shellfish growing waters will be closed to harvest by the appropriate state agencies as soon as a bloom begins. This is to prevent potentially exposed shellfish from going to market.

Cooking or freezing will not eliminate the toxins from a red tide. Does cooking or freezing destroy the toxins?

Cooking or freezing will not eliminate the toxins from a red tide. The toxins cannot be seen or tasted.

Recreational harvesting of shellfish during a red tide in affected areas is not safe.

The edible parts of other types of seafood (crabs, shrimp and fish) are safe and can be eaten during a red tide. Fish fillets are safe to eat since the red tide toxins may accumulate in the guts of fish, which are usually discarded. Typically, it is not recommended to eat washed up or distressed seafood, as the causes of the behavior (or death) cannot be known with certainty.

Does cooking or freezing destroy the toxins?

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REFERENCES


