



Red Tide in the Northeast

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P1099



New England
red tide
dinoflagellate,
*Alexandrium
tamarensis*. D.
Beatty, WHOI
Sea Grant

Many algal species form blooms, commonly referred to as "red tides," each with different impacts. Most of these blooms are harmless, but a few species of phytoplankton cause red tides that are poisonous to marine animals and to humans. Because of this, scientists prefer the term "harmful algal bloom" (or HAB). Of the more than 60 different species of phytoplankton that cause red tides, only four or five have been identified as toxic.

Red tides are not new. The first of the 10 plagues of Egypt, described in Exodus, may be one of the earliest recorded instances of a red tide ("... and all the waters that were in the river turned to blood. And the fish that were in the river died, and the water stank ..."). Red tides occur on both sides of the Atlantic, off

Florida, and along the Pacific coast into Alaska.

Red Tide in New England

There are millions of microscopic plants (phytoplankton) that exist in almost every drop of coastal seawater. With the right conditions, (sunlight and proper nutrients), these plants photosynthesize and multiply, creating a "bloom." The organism that causes toxic red tide, or HAB, in New England is a microscopic one-celled alga called *Alexandrium tamarensis*. *Alexandrium* propels itself through the water using two tiny whip-like extensions called flagella. Its life cycle includes a dormant cyst stage that can survive cold winters in bottom sediments. The cysts, which also contain toxin, are the seeds for future blooms. These cysts facilitate the spread of toxic red tides into new areas since they are easily transported by tidal currents, dredge material disposal, and transplanted shellfish.

Alexandrium toxin (saxitoxin) becomes concentrated in shellfish—clams, quahogs, mussels, scallops, oysters, and other bivalves. These shellfish are "filter feeders" that obtain nourishment by siphoning in water and filtering out the phytoplankton, which are their food. A large oyster can filter up to seven gallons of plankton-bearing water an hour; a clam, half that amount. This means that during a red tide bloom, a single shellfish could accumulate billions of *Alexandrium* organisms in just 24 hours. The shellfish themselves are not affected by the toxin.

Non-filter feeders such as finfish, lobsters, crabs, and shrimp are safe to eat even if caught in red tide waters. On the other hand, shellfish may not be safe even before or after a visible red tide occurs. It takes several weeks of flushing with clean water to purge the shellfish of red tide toxin and make them safe to eat.

People who eat shellfish containing *Alexandrium* toxin may be afflicted with paralytic shellfish poisoning (PSP). PSP can result from eating just a few clams. Saxitoxin attacks the human nervous system within 30 minutes with symptoms that may include numbness of the lips, tingling of the extremities, uncoordinated movements, incoherent speech, and nausea. PSP symptoms may be mistaken for drunkenness. In severe cases, paralysis of the breathing mechanism can cause death within a few hours. No cases of death attributed to PSP have been reported in New England, although this syndrome is associated with fatalities elsewhere in the U.S. and the world. Thus far there have been no human illnesses associated with the 2005 bloom.

No known antidote exists for saxitoxin. First aid should focus on getting medical attention and alleviating the symptoms of gastrointestinal and respiratory distress. Treatment may include pumping the stomach and inducing vomiting. PSP usually last 12 to 24 hours and leaves no apparent effects after the crisis is past. It is an unpleasant and potentially dangerous illness, though rarely fatal in the United States.

Scientists used to believe that humans and birds were the only animals affected by PSP, but they have learned that PSP toxins can cause massive fish kills and may affect marine mammals as well.

New England's first major experience with toxic red tide occurred in September 1972, when population blooms of toxic phytoplankton appeared from Maine to Cape Cod. Approximately 30 cases of PSP were reported, with no fatalities. An official ban on shellfish in those areas and the resulting publicity frightened the public, so they not only stopped eating all shellfish, but shunned perfectly safe seafoods as well.

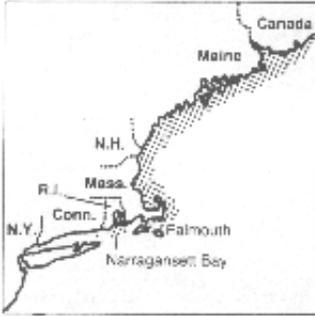
Spring 2005 brought the worst "bloom" of the toxic alga *Alexandrium fundyense* since the massive outbreak of 1972. The conditions needed for such a massive bloom to occur are quite rare. The New England spring weather of 2005 produced higher than usual amounts of rain and snowmelt in addition to two nor'easters in May. These conditions coupled with constant northerly and easterly wind patterns may have pushed the abundance of *Alexandrium* cells south into Massachusetts Bay and Cape Cod Bay. There was also an intense bloom off western Maine in autumn 2004 that may have provided a larger source of cells at the beginning of the season.

Where and when red tides occur

Red tide can occur any time during the boating season if weather conditions are right. Dry sunny spells followed by a sudden storm can encourage *Alexandrium* to multiply, and physical conditions such as winds, tides, and currents can act to contain and concentrate the organisms in one place.

When billions of organisms are present, they may tint the water. A red tide may suddenly appear in localized patches or longshore streamers. A few days or weeks later, the red color disappears. However, it should be noted that water discoloration does not necessarily accompany the presence of toxic phytoplankton blooms. This has been especially true in the Gulf of Maine and off Canada. Some red tide organisms emit a bluish green bioluminescent light that can make the waves glow at night.

The map below shows the areas of New England's coast where shellfish have been contaminated with PSP toxins. Be alert in those areas.



Know when shellfish are safe

Many monitoring stations along New England's coasts constantly test shellfish and water for the presence of red tide toxins. A strictly enforced public health mechanism prevents shellfish from reaching the market if any toxicity is discovered. When toxicity is found, affected areas are closed to shellfishing. Notices are posted near the infected beds and in the local press, and shellfish wardens patrol the closed areas.

In spite of these safeguards, recreational boaters risk exposure to PSP toxins if they collect shellfish in remote areas where there is no posting.

When cruising in unfamiliar waters, ask about red tide before gathering shellfish. Even if the water looks clear, shellfish may not be safe to eat. *Alexandrium* may be present in concentrations too low to turn the water red, yet still high enough to make shellfish toxic. In the Gulf of Maine and Canada, boaters should assume all mussels are contaminated and other shellfish suspect during June, July, and August. Toxic shellfish do not look or taste different from normal shellfish. Cooking will kill bacteria, but will not destroy the PSP toxin.

Boaters should also be warned that, east of Rhode Island, strictly enforced local shellfish ordinances governs who gets permits and where they may dig. Many cruising boaters digging a bucket of clams have been caught and fined by zealous shellfish wardens in the Northeast.

When in doubt, or when reliable red tide information is not available, don't dig. But your shellfish from retail markets, catch finfish, or have a shore dinner in a restaurant.

Important facts to remember about PSP

- Finfish, lobsters, shrimp, and crabs are safe to eat even when they are caught in red tide waters.
- Bivalves such as clams, scallops, mussels, and oysters from red tide waters are UNSAFE.
- Cooking does not destroy the red tide toxin.
- Water that looks clear can still contain enough Alexandrium organisms to make shellfish unsafe.

For further reading:

Coleman, Barbara A., Doetsch, R.N., and Sjoblad, R.D. "Red tide: A recurrent marine

phenomenon." *Sea Frontiers* 32(3):184-192, May-June 1986.

White, Alan W. "... And all the waters ... were turned to blood!": Red tide in the Northeast." *Nor'Easter* 1(1):26-31; 1989. Copies available from WHOI Sea Grant, Woods Hole, MA 02543.

Red Tides. Okaichi, Tomotoshi (Ed.) Vol. 4 Tokyo : Terra Scientific Pub. Co. ; Dordrecht : Kluwer, 2004. 432 p.,

Links:

<http://oceanservice.noaa.gov/redtide/>

<http://www.whoi.edu/sbl/liteSite.do?litesiteid=3230>

<http://www.whoi.edu/redtide/>

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