SHORE STEWARDS NEWS

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Harmful Algal Blooms (HAB)

From time to time, usually in late summer, great masses of microscopic algae can accumulate in dense visible patches along our coastal regions. These tiny plants, called phytoplankton, can turn our local waters to the color of tomato soup. Such blooms are all called "Red Tide", though only a few of the many species of plankton that produce "Red Tides" are toxic to humans. They are not the only ones that can cause problems. Plankton blooms are capable of causing toxic results even when the water appears clean and clear. In the Pacific Northwest there are three kinds of plankton that have caused harmful blooms: dinoflagellates, diatoms belonging to the *Bacillariophyta*, and blue - green algae known as *Cyanobacteria*. Blooms of blue-green algae and large macroalgae or seaweed have caused "Green Tides" that can alter water flow and decrease nutrients, light, and oxygen needed by plankton, other macroalgae, seagrasses and bottom dwelling vertebrates and invertebrates. These "Green Tides" have occurred throughout Puget Sound, the San Juan Islands, and along the Straight of Georgia

What Causes a Bloom?

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Algae, like all plants, have certain requirements in order for them to grow. Warm temperatures are needed. They use carbon from CO^2 dissolved in the water to build their cells. Nitrogen is taken directly from the atmosphere and is one of the 17 chemical elements required for plant growth and reproduction. This essential nutrient is found in the green chemical, chlorophyll, which allows plants to capture energy from the sun and make their own food. It is also used in the genetic material DNA and RNA that is so important during periods of rapid plant growth. Nitrogen is the nutrient that limits marine algal growth during the summer months. Trace amounts of phosphorus is also required and is usually the essential component that runs out first in fresh water habitats during the summer months. As summer wanes and fall begins the decrease in the energy from the sun is the major cause for the decline of algal blooms.

Humans have been changing the amount of phosphorus and nitrogen that is entering our waters. By adding fertilizer to your garden, some may run off during storm events into our streams, rivers and marine waters. Farming activities also add these nutrients to stormwater runoff. Failing septic systems are another Sourc,e and the burning of fossil fuels is a major contributor.

At right: NASA satellite photo of algal blooms off the coast of China in 2008, just prior to the start of the 2008 summer Olympic Games sailboat races.

Which Algae are Responsible?

Paralytic Shellfish Poisoning (PSP) is caused by various diatom species *Alexandrium, Gymnodinium catenatum,* and *Pyrodinium bahamense,* which produce saxitoxin. It causes health problems along the US West Coast from Alaska to California, Hawai'i, and in New England. This life-threatening toxin is purely neurological and symptoms appear rapidly. The most severe cases result in respiratory arrest within 24 hours of consumption of the toxic shellfish.

Diatoms from the *Pseudo-nitzchia* species have caused Amnesic Shellfish Poisoning (ASP) all along the US West Coast and New England. They produce a chemical biotoxin called domoic acid. Mussels, scallops, clams, and crabs concentrate this toxin. When consumed in high enough concentrations, the toxin can cause gastrointestinal disorders within 24 hours. In severe cases, neurological symptoms also appear, usually within 48 hours of toxic shellfish consumption and have been responsible for the dizziness, headache, seizures, disorientation, permanent short-term memory loss, respiratory difficulty, and coma. In 1987, four victims died after consuming toxic mussels from Prince Edward Island, Canada.

Dinoflagellates *Akashiwo sanguinea* was the culpret for last year's bird die off on the Washington Coast. This plankton produces surfactant, a soap-like substance. When marine birds are coated, they lose their ability to repel water and rapidly succumb to our cold waters. Some human caregivers have reported respiratory problems while rehabilitating the exposed birds.

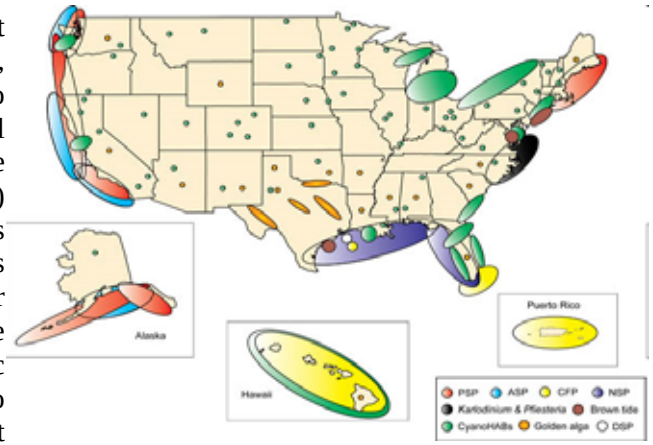
Blue-green algae *Anabaena , Mycrocystis and Aphanizomenon* species are the major ones that produce harmful algal blooms. The toxic effects are mostly seen in animals where animal illness or death occurs near a body of water. No humans have died, but exposure has been linked to outbreaks of "swimmers itch" and attacks of gastroenteritis.

Macroalgae blooms are a common phenomenon world-wide. The *ulvoid* species or sea lettuce blooms occur regularly in Western Washington but the abundance and places vary from year to year. Currently these blooms are under study to determine the extent nutrient inputs and climate are affecting their occurrences.

How are they Harmful?

Most of the algal blooms are non-toxic. Unfortunately, a small number of them can produce potent neurotoxins that are able to move through the food web and accumulate to levels where they affect and even kill the higher forms of life such as zooplankton, shellfish, fish, birds, marine mammals, and even humans that feed either directly or indirectly on them.

Marine biotoxins produced by phytoplankton are some of the most potent toxins in the world, and extremely dangerous. For some toxins, doses at the microgram per kilogram level are more than sufficient to kill. When enough toxin is accumulated in fish or shellfish, even small amounts of cooked or raw tissue can kill a human. HAB events have been recorded that produced enough paralytic shellfish poison (PSP) toxin in mussels that the consumption of one or two small mussels could have killed a normal, healthy adult human. While some toxins are very potent, requiring only small amounts to produce illness or death, other less potent toxins may accumulate enough to still cause harm. The total dose of domoic acid needed to produce a minimal toxic effect is fairly high (tens of milligrams) but it can be concentrated to high levels in shellfish resulting in mild stomach distress to permanent brain damage and even death.



Distribution of HABs in the U.S.
From Woods Hole Oceanographic Institute

Large algal blooms have also been responsible for the creation of over 400 dead zones around the world affecting over 95,000 square miles. When one of the limiting growth requirements is depleted, the algae will die and fall to the bottom of the sea, where it decays. This process uses the available oxygen from the surrounding water until levels drop to a point where fish and crab suffocate. Divers discovered Hood Canal's dead zone in May of 2006. A new dead zone has appeared off the coast of Oregon for the last 5 years and is getting larger. For the first time this past year, Washington's coast had reports of dead fish and invertebrates as far north as Kalaloch. Low –oxygen areas have been reported in Samish Bay.

Areas of Concern

Continuous increases of algal blooms have been seen during the last 50 years. Human contributions to this phenomenon include increased nitrogen and phosphates from fertilizer and animal wastes, pollution, climate shifts and transport in ship ballast water. Some reasons for these increases may be due to increased number of observers, increased scientific awareness, and increased detection capabilities.

What is Being Done?

Tracking and monitoring provides warnings against eating and swimming in affected areas. Equipment is being developed to test water directly for the toxins rather than being sent to a lab for analysis. Antidotes are in development for the biotoxins. This research has led to a possible treatment for cystic fibrosis. A potential new research tool to control "Red Tide" is being tried in Florida's Sarasota Bay. Natural clays are sprayed over the harmful algal blooms to reduce the amount of algae in the water and limit oxygen reduction from the decay process.

The best way to prevent shellfish poisoning is to avoid collecting shellfish during extended warm and sunny periods. The PNW usually experiences such times during late spring, summer and early fall. If you collect shellfish from a beach previously closed due to marine biotoxins, one still needs to be cautious. Little neck clams can hold the toxins for up to 9 months. Butter clams can hold the toxin up to 18 months. Always check the **Red Tide Marine Biotoxin Hotline** at **1-800-562-5632** before collecting and consuming shellfish. Remember, the toxic levels in shellfish are only tested every week or 2 and not every beach is tested. Also remember the toxin may be high enough to be hazardous even when the water appears clear and clean!

Resources

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Harmful Algal Blooms Marine Biotoxins, NOAA Northwest Fisheries Science Center, http://www.nwfsc.noaa.gov/hab/habs_toxins/marine_biotoxins/index.html

Harmful Algae, U.S. National Office for Harmful Algal Blooms at Woods Hole Oceanographic Institution, http://www.whoi.edu/redtide/page.do?pid=9257

Harmful Algal Bloom Research, Smithsonian Environment Research Center (SERC), http://www.serc.si.edu/labs/protistan_ecology/flocculation.aspx

This product is funded by the Island County Marine Resources Committee and the Northwest Straits Commission. You can view the Marine Resources Committee website at www.islandcountymrc.org
The website for the Northwest Straits Commission can be seen at http://www.nwstraits.org/

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