Red-tide phenomenon

Red tide is a phenomenon caused by microscopic algae blooms, during which algae become so numerous that they discolor coastal waters (hence the name "red tide"). The algal bloom may also deplete oxygen in the waters and/or release toxins that may cause illness in humans and other animals. Scientists actually prefer the term "Harmful Algal Blooms" (HAB) as the term "red tide" erroneously includes many blooms that discolor the water but cause no harm, and also excludes blooms of highly toxic cells that cause problems at low (and essentially invisible) cell concentrations. Therefore, harmful algal bloom is a more appropriate term.Red tides are not necessarily red and many have no discolouration at all. They are unrelated to movements of the tides.

Red tide is a common name for a phenomenon more correctly known as an algal bloom (large concentrations of microorganisms), an event in which estuarine, marine, or fresh water algae accumulate rapidly in the water column and results in discoloration of the surface water. It is usually found in coastal areas.

Not all redtides produce toxins. Some do. Even though they do not produce any toxin,their sheer mass could clog the gills or may utilize dissolved oxygen in the sea leading to anoxic conditions. In either case, they could be detrimental to the shellfish, crustaceans and fishes. When contaminated or toxin laden fish are consumed by humans it causes serious health problems such as paralysis, diarrhea, amnesia etc. after which the toxic episodes are known. In recent decades there has been a steady increase in the occurrence of red tides globally and is attributed to pollution.

There are approximately 4,000 species of microscopic algae in the oceans with about 300 of these being identified with periodic explosions of growth or blooms. These single species blooms are what discolor the water surface changing it to colors of red, brown, yellow, purple, green or white depending on the species of algae. When these have properties that are considered harmful to humans and other life, they called "Harmful Algal Blooms".

Since the 1980s, there has been a significant increase in the incidence of HABs worldwide. In many areas, the HABs are occurring more frequently, over larger areas and lasting longer. Countries affected by these algal bloom events include: Argentina, Australia, Brazil, Canada, Chile, Denmark, England, France, Guatemala, Hong Kong, India, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, New Guinea, Peru, the Philippines, Romania, Russia, Scotland, Spain, Sweden, Thailand, the United States, and Venezuela.

Red tides and toxins

Red tides are very much in the news these days. Dinoflagellates are usually regarded as the causative organisms, but not all red tides are caused by dinoflagellates and not all dinoflagellates cause red tides. Furthermore, not all red-tide forming algae are toxic. Even the colour factor is

variable: so-called 'red tides' may be brown, yellow, green, etc. Some red tides may be very extensive and several square kilometers of ocean may be affected, even to the extent that satellites have been used to track blooms.

Surface waters of these blooms usually have 1-20 million cells per litre and some are associated with the production of toxins, resulting in fish kills and mortality of other marine organisms.

Toxic blooms of dinoflagellates fall into three categories: (1) blooms that kill fish but few invertebrates; (2) blooms that kill primarily invertebrates; (3) blooms that kill few marine organisms, but the toxins are concentrated within the siphons, digestive glands, or mantle cavities of filter-feeding bivalve mollusc such as clams, oysters, and escallops, causing paralytic shellfish poisoning (known as PSP). The most notorious PSP-causing dinoflagellate on the Pacific coast of north America is Gonyaulax catenella, which produces a neurotoxin called saxitoxin that is 100,000 times more potent than cocaine.

Sax toxin acts to prevent normal transmission across neuromuscular synapses by interfering with the movement of sodium ions through excitable membranes. Mussels may become too toxic for human consumption when concentrations of Gonyaulax catenella reach only 100-200 cells per millilitre, but concentrations of 23-30,000 cells per litre will be necessary before a bloom is apparent to the unaided eye. Normally, the toxicity in the mussels disappears within 2-3 weeks after a bloom, but much longer retention times have been found.

Causes of algal blooms

A range of factors seems to be involved, but very little definite information is available. In some places there appears to be a strong correlation between the occurrence of upwelling (nutrient-rich waters that comes from deep water) and such blooms. But, in other areas, the blooms have been found to be associated with tidal turbulence. Blooms in other areas seem to be set off by heavy rainfall on the land, the runoff washing phosphates into the sea and also lowering the salinity, which factors seem to favour dinoflagellate growth. It is also thought that Vitamin B12, which is required by most dinoflagellates, may also be washed into the sea from the soil and salt-marsh areas, where it is produced by bacteria and blue-green algae. Humic substances have also been suggested as possible causative agents.

Toxic dinoflagellate blooms are recognized to be initiated from benthic resting stages, the cysts occurring in sediments and serving as 'seed populations' when environmental factors cause their resuspension. Such a cycle of encystment is a regular occurrence for many estuarine and neritic species that cause blooms.

Red tides are caused by increase in nutrients that algae need, usually due to farm runoff, causing an overpopulation. Their occurrence in some locations appear to be entirely natural while in others they appear to be a result of human activities. The frequency and severity of algal blooms in some parts of the world have been linked to increased nutrient loading from human activities.

In other areas, algal blooms are a seasonal occurrence resulting from coastal upwelling, a natural result of the movement of certain ocean currents. The growth of marine phytoplankton is generally limited by the availability of nitrates and phosphates, which can be abundant in agricultural run-off as well as coastal upwelling zones. Coastal water pollution produced by humans and systematic increase in sea water temperature have also been implicated as contributing factors in red tides[citation needed]. Other factors such as iron-rich dust influx from large desert areas such as the Saharan desert are thought to play a major role in causing red tides. Some algal blooms on the Pacific coast have also been linked to occurrences of large-scale climatic oscillations such as El Niño events. While red tides in the Gulf of Mexico have been occurring since the time of early explorers such as Cabeza de Vaca, it is unclear what initiates these blooms and how large a role anthropogenic and natural factors play in their development. It is also debated whether the apparent increase in frequency and severity of algal blooms in various parts of the world is in fact a real increase or is due to increased observation effort and advances in species identification methods.

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Harmful Agal Blooms can create potent toxins given the right conditions and may cause harm through the production of toxins or by their accumulated biomass, which can affect co-occurring organisms and alter food-web dynamics, The potential impacts are many including:

Some toxic species can cause a variety of human ailments, contracted either through inhaling airborne toxins, skin contact or, more commonly, eating contaminated shellfish. These toxins may cause amnesia, stomach cramps, nausea, memory loss, paralysis and even death.

Some species are merely unpalatable to other marine life because of gelatinous envelopes or other characteristics and they exact their harmful effects by essentially “starving” the food chain. Other species can cause physical damage, as the blooms of species which contain barbs that lodge among gill tissues of fish, causing death. Such blooms can cause a great deal of financial damage by killing farmed fish, which are grown in crowded aquaculture pens. HABs can cause

substantial economic losses to coastal communities through loss of tourism and impact on commercial fishing.

The causes of the HAB “epidemic” is somewhat disputed as some scientists belive it is the result of increased monitoring, but most agree with the following:

The primary human contribution to HABs is thought to be nutrient pollution — from, amongst other things, agriculture, sewage outfalls and mining — creating a more favorable, nutrient-rich environment in coastal waters in which certain groups of algae can thrive. Climate change may also be making some coastal environments more hospitable to harmful algae species.

Many species of algae are also transported around the world in ships’ ballast water and discharged in areas where they did not previously occur. Others are distributed accidentally through the transfer of shellfish for aquaculture.