# Red tides & harmful algal blooms



**Red tides are natural and seasonal phenomena but some cause damage and are referred to as Harmful Algal Blooms (HABs). An MPA may never be directly affected by a red tide or HAB, but MPA personnel should be aware of this phenomenon, as they may be called upon to provide expertise in the case of a HAB elsewhere in the country.**

Red tides or algal blooms are mass occurrences of a plankton species resulting from nutrient enrichment from intense upwellings, land runoff or other sources. About 300 species of algae are known to cause blooms, including dinoflagellates, diatoms, haptophytes and cyanobacteria, and some silicoflagellates. Algal blooms often occur in or adjacent to areas of upwelling when prevailing winds blow surface water offshore, causing cold, deep, nutrient-rich waters to rise up, bringing large quantities of phytoplankton with them that rapidly multiply due to favourable light and nutrient conditions. Algal blooms are most common in Eastern Africa around November and at the beginning of the north-east monsoon. For example, red tides were reported in Kenya (see case study), Zanzibar, Yemen, Oman and Mauritius in early 2002.

Blooms tend to look like streaks of reddish-brown to greenish-yellow floating debris, depending on the species involved, and may extend for several miles. The term 'Red Tide' is often used, because of dinoflagellate blooms, which can colour the water reddish-brown due to the carotenoid pigment in their cells.

## IMPACT OF HABs

Many red tides are harmless but about one quarter of the known species that cause blooms produce toxins. HAB or 'harmful algal bloom' is a generic term for events that result in poisonings, although not all of these occur as 'blooms'. HABs can be divided into those that cause human poisoning and those that cause fish and other animal deaths. The toxins tend to accumulate up the food chain when the plankton are eaten, becoming more concentrated at higher taxonomic levels. In this way, toxicity can cause severe health hazards even at a low abundance of toxin producers (this is particularly the case with ciguatera), and even result in the meat of sharks and turtles becoming toxic.

The toxins are generally classified according to the symptoms they give rise to, some of which are among the strongest known. There are indications that the frequency and intensity of HABs are increasing, perhaps due to increased nutrient run-off from agriculture and sewage effluent, or even to climate change, although this apparent increase may be due to better documentation.

The primary vector for human poisoning is shellfish, particularly bivalves, which can accumulate toxins quickly as they are filter feeders. Human poisoning is caused by dinoflagellates (may cause Paralytic Shellfish Poisoning (PSP), Diarrhetic Shellfish Poisoning (DSP) and Neurotoxic Shellfish Poisoning (NSP)), diatoms (may cause Amnesic Shellfish Poisoning (ASP), and cyanobacteria (*Trichodesmium thiebautii* blooms have been associated with breathing problems; *Lyngbya majuscula*, a primarily benthic species can cause 'swimmers itch'). Ciguatera poisoning can occur without a red tide, because ciguatoxins are produced by dinoflagellates (such as *Gambierdiscus, Ostreopsis* and *Prorocentrum*) that are invariably present in the benthic substrate.

J. Church

Unicorn and porcupine fish washed up dead in January 2002 after a red tide in Kiunga Marine National Reserve, Kenya (see case study).

HABs frequently result in large scale fish mortalities or shell fish poisoning which can adversely affect aquaculture, coastal tourism and fisheries. These can be caused by dinoflagellates (such as *Gymnodinium breve* and *G. mikimotoi*, which also cause NSP), cyanobacteria (such as *T. thiebautii*) and haptophytes (such as *Prymnesium parvum, Chrysochromulina polylepis* – producing a toxin that increases the permeability of fish gills, resulting in osmoregulatory stress and death). High density blooms of some diatoms, haptophytes and silicoflagellates (e.g. *Dictyocha speculum*), can clog fish gills causing suffocation.

Note that some marine organism mortalities and human poisonings have other causes. For example, humans can be poisoned by the bacterium *Vibrio* in oysters, and fish and crustacean kills in the WIO have often been associated with high dissolved oxygen concentrations in the water rather than red tides. If calm weather follows a bloom in a closed or semi-enclosed bay, the plankton may use up all the nutrients and 'die out', leaving behind a large decaying biomass. This can cause a 'black' tide due to production of toxic hydrogen sulphide by anaerobic bacteria, with associated mortalities of marine animals from oxygen depletion and because their gills become clogged with plankton; strandings of crustaceans may also occur.

## RESPONDING TO A HAB

The local Fisheries Department is usually responsible for dealing with a HAB. Fishers may be told that they can no longer catch or sell certain species and the general public and visitors may want to know if it is safe to eat marine products.

If historical data are not available, and there is no long term sampling programme, it will not be possible to identify the cause of a bloom definitively. However, samples should be taken immediately if there are signs of human poisoning, mortality of marine animals or discoloration of the water. Samples should be kept cold and in the dark, and sent for analysis preferably within 24 hours. Freezing samples can destroy cells and make species identification more difficult, but may be necessary if the analysis cannot be done quickly. Samples should include:

- water – several samples of at least one litre, from different locations and depths;
- tissue from dead animals (as fresh as possible), e.g. gills and livers, and entire animals can be taken if not too large;
- algal mats and seagrass leaves (kept in water), in the case of suspected ciguatera (e.g. if there are human poisonings but no visible bloom).

### KEY POINTS FOR THE MPA

**If a red tide occurs in or near an MPA, the MPA personnel must be prepared to help the Fisheries Department and provide advice as needed. For example:**

- **Seek immediate technical advice from national, regional and international experts.**
- **Consult with relevant organisations in the area, and send samples off for analysis immediately.**
- **Alert visitors and local residents of the problem and request them to keep a watch for dead organisms on the beach and other signs.**
- **Recommend that marine products should not be harvested or consumed until samples have been analysed; where livelihoods of local communities are affected, consider ways in which the MPA might be able to help.**
- **Check NOAA satellite photos for increased level of chlorophyll.**
- **Designate one person the task of managing media, emails and any queries.**

## Sources of further information

UNESCO's Intergovernmental Oceanographic Commission HAB Programme is the main global initiative: **www.ioc.unesco.org/hab.** It gives information on training courses, a Taxonomic Reference List of Toxic Plankton Algae, a Bibliographic HAB database and shows how to obtain the email newsletter and the following publications:

Anderson, D.M. *et al.* (eds.) 2001. *Monitoring and Management Strategies for Harmful Algal Blooms in Coastal Waters*. APEC Report #201-MR-01.1, Asia-Pacific Programme and IOC Technical Series No.59.

Hallegraeff, G.M., Anderson, D.M. & Cembella, A.D. (eds.) 2003. *Manual on Harmful Marine Microalgae*. 2nd Ed. – primary reference on sampling, identification, monitoring and management of HABs.

Hansen, G. *et al*. (eds.) 2001. Potentially harmful microalgae of the Western Indian Ocean – a guide based on a preliminary survey. *IOC Technical Series No.* **41**. French and English.

Other sources of information:

Botes, L. 2003. Phytoplankton Identification Catalogue. Saldanha Bay, South Africa. *Globallast Mongraph Series,* No.**7**, IMO, London. **http://globallast.imo.org**

COI. 2000. Manuel Methodologique. *Suivi et prevention des Intoxications par Consommation d'Animaux Marins (ICAM) dans le Sud-Ouest de l'Ocean Indien*. Prog. Regional Environnement/ Commission de l'Ocean Indien. **www.coi-info.org**

For testing samples: Analabs Ltd, P.O.Box 24780, Nairobi, Kenya. **analabs@net2000ke.com**

### CASE STUDY

## Red tide at Kiunga Marine National Reserve, Kenya

In January 2002, a HAB occurred along the East African coast from Mogadishu in Somalia to Lamu in northern Kenya associated with the strong upwelling of the Somali current and an unusually strong NE wind (force 5-6) that may have blown it onshore. In the area of Kiunga National Marine Reserve, in northern Kenya, the bloom lasted for ten days, with extensive fish mortality during the first three days and numerous fish and other marine animals, such as turtles, being washed up on the beaches or found floating on the ocean surface. Consumption of and trade in fish from the area was banned for two weeks and trade in shellfish for four weeks. There were no human fatalities but some cases of eye irritations and headaches. The economy, however, was seriously affected as local communities are almost entirely dependent on fisheries. Furthermore, media interest deterred tourists from visiting.

Because of the impact of the red tide on biodiversity and local livelihoods, Kenya Wildlife Service, WWF (which supports the MPA) and the Fisheries Department contacted HAB specialists in Kenya and South Africa. On their advice, water and tissue samples were collected and sent on ice to Nairobi, where some were analysed and others sent on to South Africa. Both laboratories identified *Gymnodinium* as a major component of the bloom, and satellite imagery for the period confirmed an increased level of chlorophyll in the area. Nevertheless, the exact reasons for the bloom remain unclear. The MPA, with support from WWF, also helped with publicity and answering the numerous queries from the local and international media.