Intense algal blooms are not necessarily just the work of mankind

The Blame for Blooms

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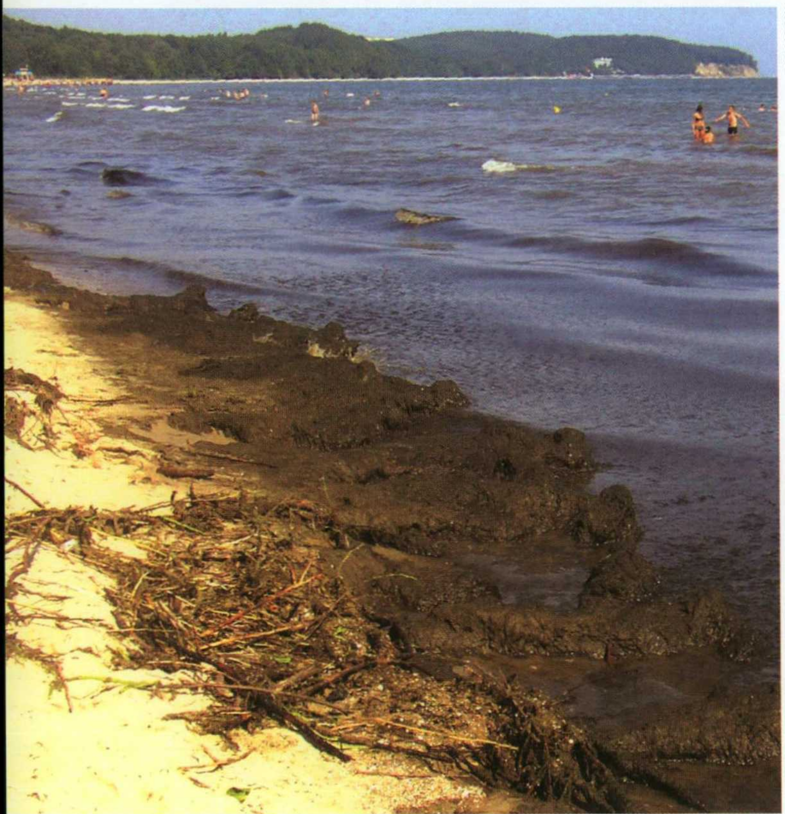
While the word “bloom” obviously has many positive connotations, the effects of the algal bloom phenomenon - now increasingly common in the Baltic Sea - are certainly nothing pleasant. Although the prevailing view is that mankind is to blame, that is probably not the whole story

To swim or not to swim? That is a question faced by scores of tourists who visit the Gulf of Gdańsk in the summertime, upon seeing an ugly green scum along the waterfront even though the water remains clear some distance from the shoreline. What causes the seawater to become colored and cloudy, and a slew of decomposing algae to accumulate near the shoreline? Nowadays more and more people are aware that this is due to a process called *eutrophication* - one of the most important problems faced not only by the Baltic Sea, but also by other maritime regions in the world.

Eutrophication gained intensity in certain regions of the Baltic back in the 1950s, and in others in the 1970s, especially along the western, southern, and eastern coasts. Nowadays the problem already affects the entire sea. The greatest eutrophication within the Polish economic zone is observed in the Gulf of Gdańsk and the Szczecin Lagoon, i.e. at the mouth of the two largest rivers emptying into the southern Baltic - the Vistula and Oder.

Baltic gone green

The term eutrophication denotes a process whereby the concentration of nutritive substances in a water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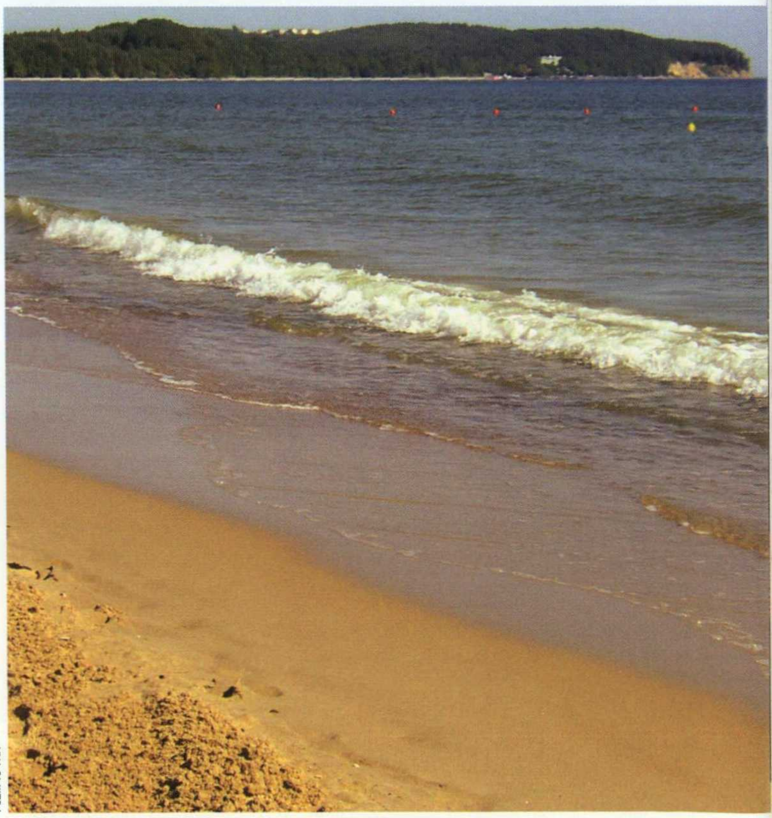
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The effects of algal blooms are of a local nature - even along the same beach there may be spots free of algae body increases - whether carried by a river, from strong precipitation and flooding on land, or from the decomposition of organic matter in bottom sediments. Influxes of various substances are thought to be able to trigger eutrophication, especially biogenic substances - i.e. inorganic compounds of nitrogen, phosphorus, and silicon - or organic matter.

Under favorable conditions, such an increased concentration of nutrients in water prompts the intense reproduction of single-cell algae (phytoplankton). The water then changes color, becomes cloudy, and foams up or has green flocs floating in it, and it is then said to be in bloom. Blooming is a natural phenomenon that occurs at certain times in all water bodies. In the Baltic, however, intense blooms of phytoplankton are being observed through the entire vegetative cycle. Blooms of blue-green algae occur in the summer. Some species of these microorganisms are, under certain conditions, able to produce strong toxic compounds harmful to the health and life of other marine species, as well as to humans (chiefly while swimming). Moreover, blooms of other potentially toxic species of phytoplankton, including the diatoms and dinoflagellates which flow in here from the North Sea, are now occurring with increasing frequency.

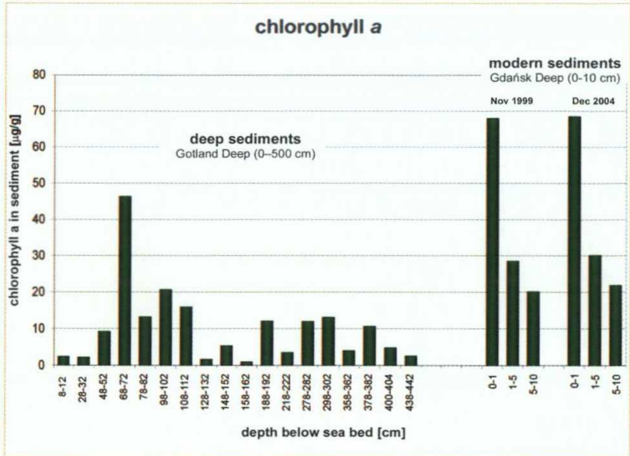
Aside from phytoplankton, filamentous macroalgae also grow rapidly when there is an increased influx of nutrients. Scarcity of light and sinking organic matter reaching other macroalgae growing at greater depths - brown algae of the genus *Fucus* and red algae - cause the latter to die. In shallower waters, in turn, expansive species grow intensely on the soft sea floor. Severed macroalgae and dead phytoplankton then sink into the depths, and can be carried by sea currents and waves across very long distances before they settle on the sea floor. They may also drift and accumulate along the coastline, the decaying algae then rendering swimming impossible.

Such intense sedimentation of organic material is initially beneficial to organisms living within the benthic sediments or on the water/sediment border. Yet the decay of such material consumes much oxygen, potentially leading to an oxygen shortage or a complete anoxia, thus killing many of the species living on the sea floor. In water bodies with weak water circulation, such species might even die out altogether, triggering further changes throughout the food chain.

The climatic aspect

Quite a range of methods can be used to measure a given water body's degree of eutrophication. A method developed by the Marine Pollution Laboratory of the PAN Institute of Oceanology uses high performance liquid chromatography (HPLC) to measure chloropigments, especially chlorophyll and similar compounds, in benthic sediments. This is cheaper and less labor-intensive than other standard methods. Molecules of chlorophyll *a*, the most commonly occurring green pigment in plant organisms, contain a porphyrin ring which is quite resistant to decay, and so measurements provide a time-averaged picture.

Research carried out by the Marine Pollution Laboratory under the international EU BASYS program detected large quantities of un-decomposed chlorophyll in deep sediments (6 m beneath the sea floor) from the Gotland Deep, the deepest part of the Baltic. The sediments formed 8,000 years ago contained quantities of the pigment which were similar to those now found in surface sediments from the most eutrophic part of the Polish Baltic - the Gdańsk Deep. This finding indicates that the eutrophication of this area centuries ago could have been comparable to that seen today - or even greater, given the compound's instability. The conclusion is that climatic changes (warming) might also, alongside mankind, be responsible for the currently observed eutrophication of the Baltic Sea and other marine bodies. ■



A high concentration of chlorophyll *a* in Baltic seafloor sediments formed many centuries ago indicates that modern-day eutrophication may not be purely attributable to mankind

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Further reading:

Kowalewska G. (2005). Algal pigments in sediments as a measure of eutrophication in the Baltic Sea Environment. *Quaternary International, 130*, 141-151.

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