The first recorded bloom of *Prorocentrum minimum* (Pavillard) Schiller in the coastal zone of the Gulf of Gdańsk

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Abstract

Prorocentrum minimum (Pavillard) Schiller has occurred in the Gulf of Gdańsk in low abundance for several years. However, in summer 1997 a significant increase in the numbers of cells was noted. In the same year a *P. minimum* bloom was recorded for the first time in one of the harbour basins in Gdynia, giving rise to a brown-red coloration of the water.

1. Introduction

The genus *Prorocentrum* belongs to the Dinoflagellatae and includes 31 marine species with a very similar cell structure. They can occur in very high concentrations in coastal waters, which change colour as a result (Fott 1971). *Prorocentrum minimum* (Pavillard) Schiller varies considerably in shape, and several morphological forms have previously been assigned to different species. This is why *P. minimum* may sometimes be confused with *Prorocentrum balticum* (Lohmann) Loeblich (Larsen & Moestrup 1989).

This species is widespread in many marine areas such as Chesapeake Bay, the Sea of Japan and the North Sea (Tyler & Seliger 1978, 1981, Tangen 1979, Shimizu 1987, Marshall 1997). Moreover, *P. minimum* is very common in the Baltic Sea (Edler *et al.* 1996).

P. minimum has been found growing in vast numbers in coastal waters, and especially in estuarine areas, causing the water there to turn a brown colour. For example, a red tide with 1777 million cells per litre was recorded in Oslofjord (Tangen 1979). A red tide depends on numerous physical and

chemical environmental factors characteristic of coastal waters (Seliger *et al.* 1979). Water movements, such as frontal circulation patterns, upwelling and subsurface transport, are of great consequence for the formation of a red tide (Tyler & Seliger 1978, 1981). However, the influence of other organisms is also important. Luxuriant growths of *Skeletonema costatum* (Greville) P.T. Cleve stimulate the growth of most red-tide flagellates, especially of *P. minimum. S. costatum* probably produces some stimulants, which may help to explain the occurrence of dinoflagellates following the decline of diatom pulses (Iwasaki 1979).

Widely distributed and seasonally abundant especially in summer, *P. minimum* occurs in the form of several different strains, some of which produce toxins (Marshall 1997). These substances, secondary metabolites including the antibiotic β-diketone, are harmful to marine bacteria and other organisms. The mechanism of toxin production depends in a complex manner on a large number of environmental factors, and resembles the model according to which many antibacterial toxins are produced (Trick *et al.* 1981, 1984). *P. minimum* can produce two kind of toxins: hepatotoxic and diarrhetic shellfish toxin (Shimizu 1987). It is responsible for the death of fish and shellfish (Steidinger 1993) and is also dangerous to human consumers of mussels, especially during intensive *P. minimum* growth (Kat 1979). Poisonings have been accompanied by gastrointestinal complaints: vomiting, abdominal pain and diarrhoea (Shimizu 1987). However, whether *P. minimum* produces toxins causing neural paralysis has not been established (Okaichi & Imatomi 1979).

P. minimum has occurred in the Gulf of Gdańsk for several years now, usually in very low concentrations.

The aim of this paper is to discuss the bloom of *P. minimum* against the background of the occurrence of this species in the last few years.

2. Material and methods

The material was collected at two stations, one of which was located at the end of the pier in Sopot, the other at the end of the promenade in Gdynia. The phytoplankton samples were usually taken once a week, only in Sopot in 1994, only in Gdynia in 1996, and at both stations in 1997. Material was also taken from one of the Gdynia harbour basins during the *P. minimum* bloom in 1997 (Fig. 1).

Water samples were collected at each station from the surface layer and immediately preserved in Lugol solution. The analysis under an inverted microscope was performed in accordance with BMP guidelines (Edler 1979, HELCOM 1997).

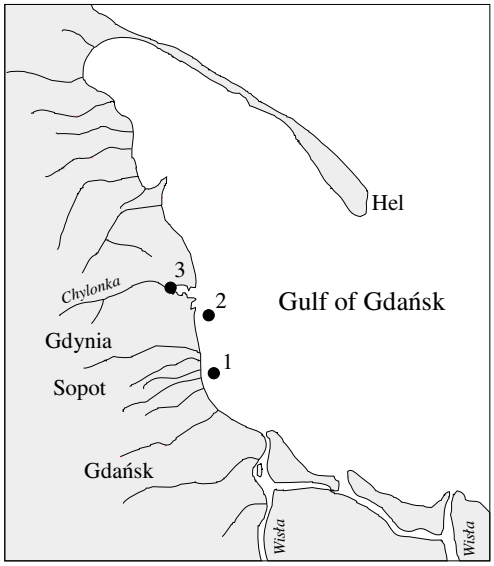


Fig. 1. Phytoplankton observation stations (1, 2, 3) in the coastal zone of the Gulf of Gdańsk

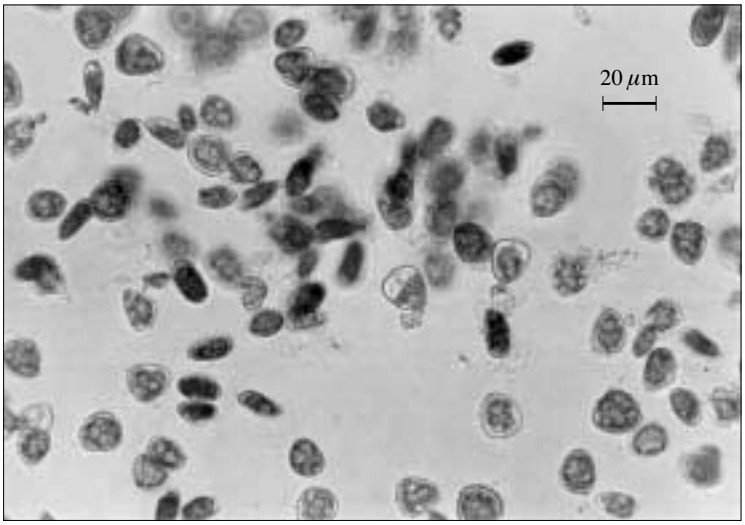
The temperature of the surface water was measured at the same time as the phytoplankton samples were taken.

3. Results

In the Gulf of Gdańsk in 1997 higher numbers of *P. minimum* cells per litre were recorded in comparison with previous years in these coastal waters (Fig. 2).

An extraordinary bloom of *P. minimum* (Fig. 2) was observed in one of the Gdynia harbour basins, located at the mouth of the Chylonka stream (Fig. 1). On 22 August a 400 m^2 area of the water in the basin suddenly turned brown-red and remained that colour until 9 September. The authors were able to measure the number of cells from 28 August onwards. The highest number recorded was 350 million cells per litre (Fig. 3). During this time the water temperature was 17–22°C. This bloom of *P. minimum* did not extend beyond this basin. On 9 September the coloration of the water disappeared as suddenly as it had appeared. In any case larger-than-usual numbers of this species were recorded in the coastal zone until the end of October and well into November as well (Fig. 4). The numbers of cells were the same at the Gdynia promenade station and off the end of the Sopot pier, even though the latter is much farther distant from the port in Gdynia.

a



b

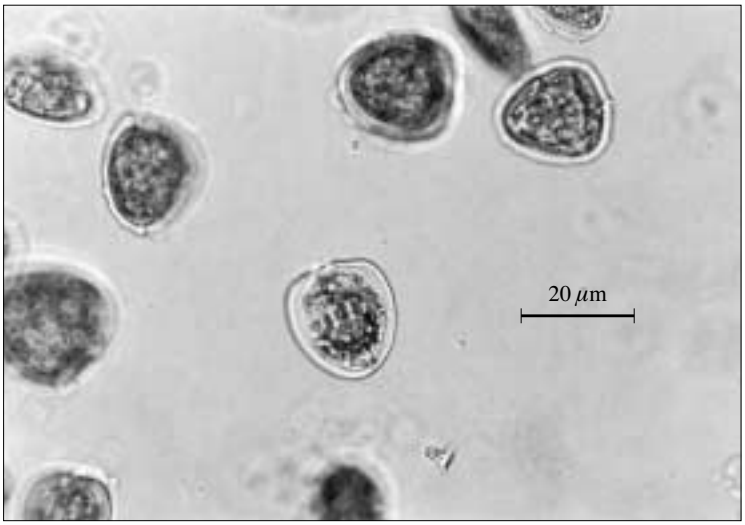


Fig. 2. *Prorocentrum minimum* (photo: Witek B.); bloom in Gdynia harbour in 1997 (a), single cells under high magnification (b)

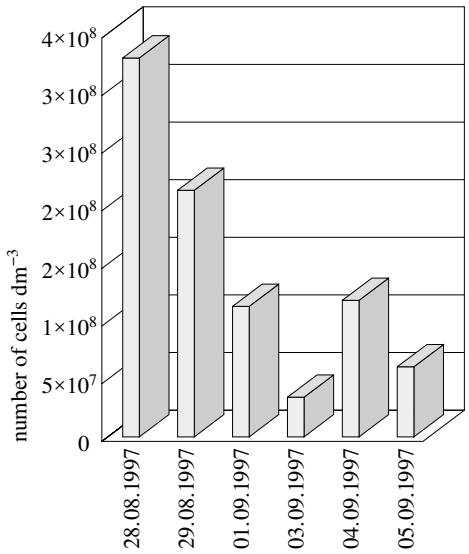


Fig. 3. Cell numbers in the *Prorocentrum minimum* bloom in Gdynia harbour in 1997

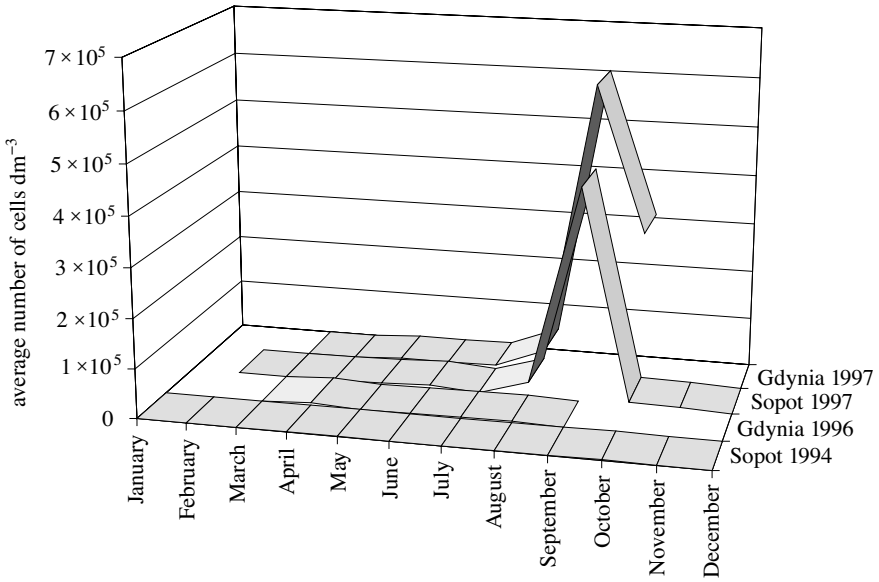


Fig. 4. Density of *Prorocentrum minimum* in the coastal waters of the Gulf of Gdańsk (1994–97)

4. Discussion

Prorocentrum species are widely distributed and can be found over most of the Baltic Sea. *P. minimum* was common in the Central Baltic Proper in the monitoring period of 1986–93 (Edler *et al.* 1996).

Marshall (1997) has reviewed records of dinoflagellate blooms, including the blossoming of *P. minimum* in Chesapeake Bay from 1963 to 1989. The majority (67%) of these blooms occurred near the mouths of rivers entering the Bay. These facts indicate that the bloom noted in one of the Gdynia port basins occurred under ecologically favourable estuarine conditions. The port basin in which the bloom occurred is situated at the mouth of the Chylonka stream, one of the worst polluted watercourses entering Gulf of Gdańsk (WIOŚ 1996).

P. minimum has been recorded in the Gulf of Gdańsk in low abundance for several years now. However, the presence of extraordinary blooms of *P. minimum* in the Gulf of Gdańsk has never been noticed before. The mass growth of this species, causing the water to turn red, was recorded for the first time in 1997 along the littoral of the Gulf of Gdańsk.

1997 was an exceptional year. In the whole Baltic this species was one of the dominant elements in the phytoplankton in late August and early September (Alga-Line 1977). The observed increase in the occurrence of *P. minimum* in the Gulf of Gdańsk in 1997 reflected the general situation governing the Baltic phytoplankton.

1997 was also exceptional because of the eutrophic flood waters carried into the Baltic by the rivers Wisła and Odra. This may have been one of the causes of the intensive growth of *P. minimum* in the Baltic (Alga-Line 1997). None the less, the cause of the brown-red bloom that occurred locally in a harbour basin in Gdynia, well away from direct contact with the waters of the Gulf of Gdańsk, should probably be sought at the mouth of the Chylonka stream. Presumably, then, the intensive growth of *P. minimum* in the Baltic Proper may have been due to the hydrological situation both in the entire Baltic catchment area and in the many estuaries, from which *P. minimum* could have been transported hundreds of kilometres from the littoral zone to the open sea (Tyler & Seliger 1978, 1981). Future research will no doubt show whether this bloom of *P. minimum* was just an isolated episode or a foretaste of its large-scale growth in the Gulf of Gdańsk.

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