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Research Article

**THE OCCURRENCE OF DINOFLAGELLATES IN THE
PHYTOPLANKTON OF THE GULF OF GDAŃSK COASTAL ZONE IN
1994-1997**

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Abstract

Observations of the development of Dinoflagellatae in the 1994-1997 period indicate that three species dominated in the coastal zone of the gulf of Gdańsk - *Peridiniella catenata*, *Heterocapsa triquetra*, and *Prorocentrum minimum*. The last two species are new elements in the phytoplankton structure, and their mass development is evidence that this group of phytoplankton is changing.

INTRODUCTION

Dinoflagellates play an important role in the phytoplankton of marine ecosystems. This group of algae has been present in Gulf of Gdańsk waters as a stable component of the plankton. All authors who describe the phytoplankton

of the Gulf of Gdańsk mention dinoflagellates. Thirty-eight dinoflagellates species were identified in 1927 and 1928, but only six of them were noted as frequent (Wołoszyńska 1929). Twenty years later, the number of species was nearly the same, but fewer species occurred frequently. Of 36 species, only one was described as dominant (Rumek 1948). A new phenomenon was observed in the Baltic Sea beginning in the mid 1970s, particularly in the region of the Gulf of Gdańsk; changes began to occur in the structure of the biocoenosis as a result of increased concentrations of nitrogen and phosphorus. New dominants appeared, and blooms of *Heterocapsa triquetra* (Ehrenberg) Stein 1883 have been noted for several years in June (Pliński 1990).

Prorocentrum minimum (Pavillard) Schiller 1933 has occurred in the Gulf of Gdańsk at low abundance levels for several years. However, in the summer of 1997 a significant increase in the numbers of cells was noted. In the same year, this species bloomed for the first time in one of the harbors in Gdynia, causing the water to turn a red-brown color (Witek and Pliński 2000). Changes in the composition and structure of flagellates indicate their role in processes which are responsible for the functioning of the Gulf of Gdańsk ecosystem. Therefore, knowledge of this phytoplankton group is very important.

The aim of this paper is to assess the frequency and abundance of Dinoflagellates in the coastal zone in the Gulf of Gdańsk in the 1994–1997 period and to study changes in the abundance and domination of this species during the investigated period.

MATERIALS AND METHODS

The material was collected in 1994, 1996 and 1997 from two sampling stations. One was located at the end of the pedestrian pier in Sopot and the other was at the sea promenade in Gdynia. Phytoplankton samples were usually collected at weekly intervals. They were collected only in Sopot in 1994, only in Gdynia in 1996, and from both locations in 1997.

Water samples were collected at each station from the surface layer and immediately preserved in Lugol's solution. Microscopic analyses were performed using an inverted microscope according to the methods recommended by the Baltic Marine Biologists (BMB) (Edler 1979) and those of the HELCOM Monitoring Program (1997).

The temperature of the surface water layer was recorded when the phytoplankton samples were collected.

Table 1

List of identified taxa of dinoflagellates

| | TAXA | 1994 | 1996 | 1997 |
|----|---|-------------|-------------|-------------|
| 1 | <i>Alexandrium oestensei</i> (Paulsen) Balech & Tangen 1985 | + | + | + |
| 2 | <i>Amphidinium</i> spp. | | | |
| 3 | <i>Dinophysis acuminata</i> Claparède & Lachmann 1859 | + | + | + |
| 4 | <i>Dinophysis acuta</i> Ehrenberg 1839 | | + | |
| 5 | <i>Dinophysis norvegica</i> Claparède & Lachmann 1859 | + | + | + |
| 6 | <i>Dinophysis rotundata</i> Claparède & Lachmann 1859 | | + | |
| 7 | <i>Diplopsalis</i> sp. | | + | |
| 8 | <i>Gonyaulax triacantha</i> E. Jørgensen 1900 | + | + | + |
| 9 | <i>Gymnodinium simplex</i> (Lohmann) Kofoid & Swezy 1921 | | | |
| 10 | <i>Gymnodinium</i> sp. 1 | + | | + |
| 11 | <i>Gymnodinium</i> sp. 2 | | | |
| 12 | <i>Gymnodinium splendens</i> Lebour 1925 | + | + | + |
| 13 | <i>Gyrodinium</i> sp. | | | |
| 14 | <i>Heterocapsa cf minima</i> Pomroy 1989 | + | + | + |
| 15 | <i>Heterocapsa rotundata</i> (Lohmann) Hansen 1995 | + | + | + |
| 16 | <i>Heterocapsa triquetra</i> (Ehrenberg) Stein 1883 | + | + | + |
| 17 | <i>Katodinium glaucum</i> (Lebour) Loeblich III 1965 | | + | + |
| 18 | <i>Peridiniella catenata</i> (Levander) Balech 1977 | + | + | + |
| 19 | <i>Prorocentrum balticum</i> (Lohmann) Loeblich III 1970 | + | + | + |
| 20 | <i>Prorocentrum minimum</i> (Pavillard) Schiller 1933 | + | + | + |
| 21 | <i>Protoberidinium bipes</i> (Paulsen) Balech 1974 | + | + | + |
| 22 | <i>Protoberidinium brevipes</i> (Paulsen) Balech 1974 | + | + | + |
| 23 | <i>Protoberidinium granii</i> (Ostenfeld) Balech 1974 | | | + |
| 24 | <i>Protoberidinium pellucidum</i> Bergh 1881 | + | + | + |
| 25 | <i>Protoberidinium</i> sp. 25-50µm | + | + | + |
| 26 | <i>Protoberidinium steinii</i> (E. Jørgensen) Balech 1974 | | | |
| 27 | <i>Scropsiella</i> sp. | + | | + |

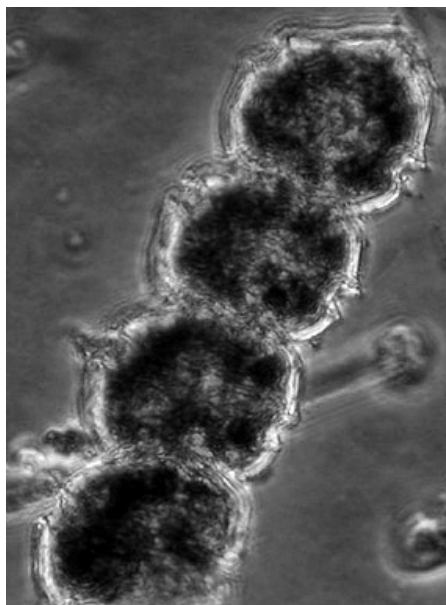


Fig. 1. *Peridiniella catenata* (fot. B. Witek)

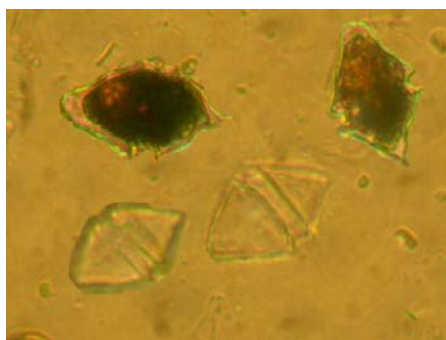


Fig. 2. *Heterocapsa triquetra* (fot. B. Witek)

RESULTS

Dinoflagellates were present from spring to fall. Twenty-seven taxa of dinoflagellates were identified, but only three - *Peridiniella catenata* (Fig. 1), *Heterocapsa triquetra* (Fig. 2), and *Prorocentrum minimum* (Fig. 3) dominated. There were also four forms of naked or armored dinoflagellates that were impossible to identify.

Two species dominated in 1994 in Sopot - *Peridiniella catenata* and *Heterocapsa triquetra*. *Peridiniella catenata* grew intensively in the middle of April with 1.6 million cells per liter of water. Immediately following the peak of *P. catenata*, a bloom of *Heterocapsa triquetra* appeared that lasted until August. The maximum

number of cells (6 million per liter) occurred in the middle of June. These two species were characteristic of spring phytoplankton during the period when light intensity is high but temperature is relatively low. Other species occurred in very small numbers (Fig. 4).

The quantity of dinoflagellates in 1996 was relatively low in comparison with that observed in 1994. A brief peak of *Peridiniella catenata* was noted in mid April at 3.5 million cells per dcm^3 of water. The *Heterocapsa triquetra* peak in this year was insignificant and occurred in July (Fig. 5).

In 1997, dinoflagellates occurred at significantly fluctuating frequencies throughout the vegetative period. The highest quantity of them was noted in late July and early August when the dominating species was *Heterocapsa triquetra*, which produced a long-standing, intensive bloom that was comparable with its

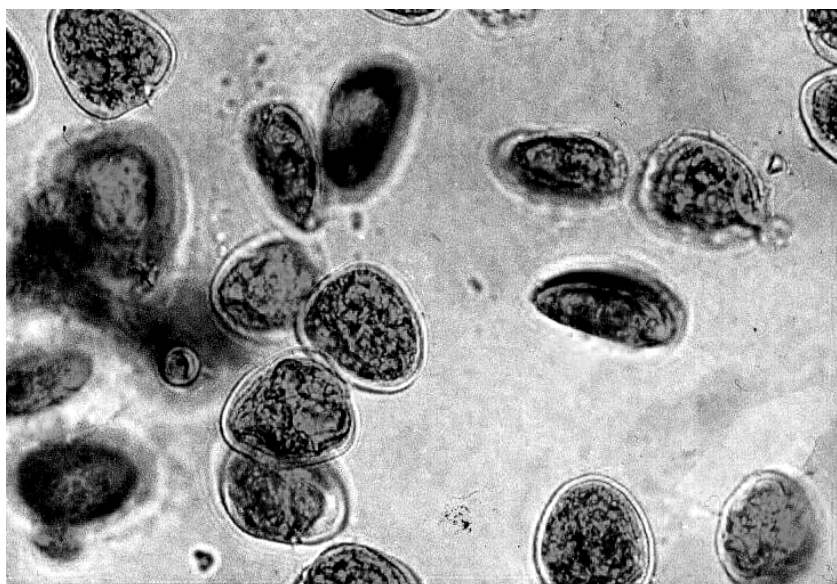


Fig. 3. *Prorocentrum minimum* (fot. B. Witek)

occurrence in previous years. In late August and early September intensive growth was noted in *Prorocentrum minimum*, which had not previously occurred in such numbers (Fig.4). The occurrence of dinoflagellates in Sopot was very similar to that observed in Gdynia. The composition of dominants was similar but they did not attain the same quantities; not one exceeded a million cells per liter (Fig. 6,7).

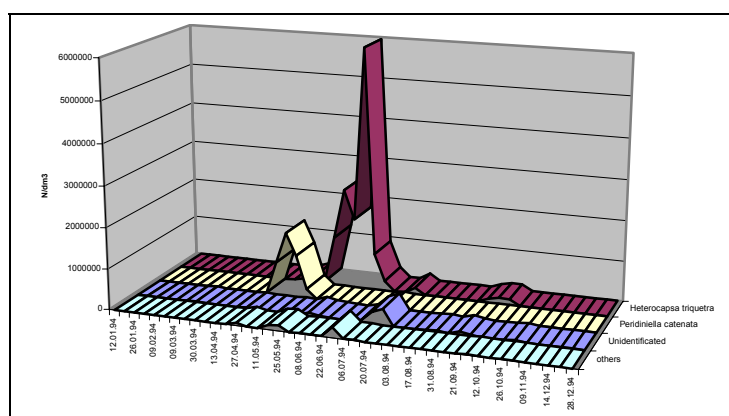


Fig. 4. Dominated Dinoflagellatae in the year 1994 in Sopot

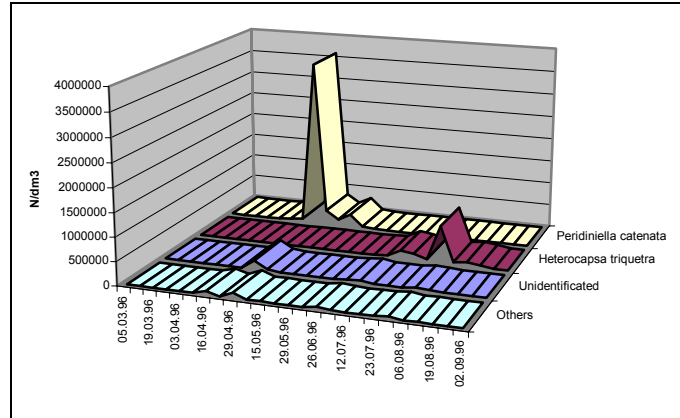


Fig. 5. Dominated Dinoflagellatae in the year 1996 in Gdynia

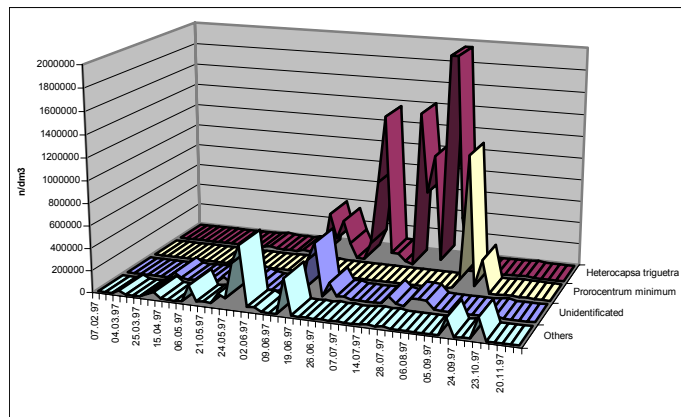


Fig. 6. Dominated Dinoflagellatae in the year 1997 in Sopot

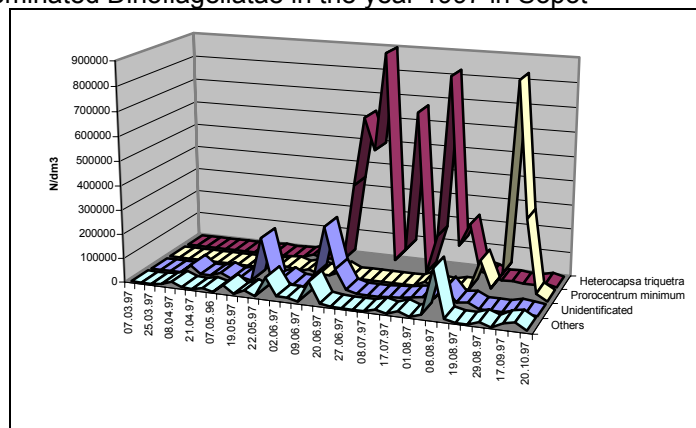


Fig. 7. Dominated Dinoflagellatae in the year 1997 in Gdynia

DISCUSSION

No significant differences in the occurrence of dinoflagellates during the investigation period were noted. They dominated in the late spring for several years (Pliński 1995). Dinoflagellates play an important role among other flagellates with regard to the number of species and quantity. In recent years, two species of dinoflagellates were very common: *Heterocapsa triquetra* and *Peridiniella catenata*. Blooms of *H. triquetra* have been observed since 1977 in the Gulf of Gdańsk, and this species has now become a constant element in the seasonal succession of dominants. It had significant peaks in late June and early July in the 1980s (Pliński and Picińska 1986). In the 1990s, the maximum abundance was observed in July and August (Pliński 1995, Pliński and Dobroń 1999). Until the 1990s, *P. catenata* had been a rare component of the phytoplankton, but later this species caused large red blooms (Witek *et al.* 1993, Pliński and Józwiak 1994). This species occurs in high numbers in April, and its abundance is increasing yearly. A surprising situation occurred in 1997 when the abundance of *P. catenata* was very low.

Some new phenomena in dinoflagellate occurrence were noted in 1997. *Prorocentrum minimum* produced a significant bloom in the second half of the summer. This species was recorded in the Gulf of Gdańsk at low abundance levels for several years. The presence of extraordinary blooms of *P. minimum* in the Gulf of Gdańsk had never been noted before. The mass growth of this species, which causes the water to turn red-brown, was recorded for the first time in 1997 in the littoral of the Gulf of Gdańsk. This species was one of the dominant elements of the phytoplankton in late August and early September in 1997 throughout the Baltic Sea. The observed increase in the occurrence of *P. minimum* in the Gulf of Gdańsk in 1997 reflected the general situation governing the Baltic phytoplankton at that time (Witek and Pliński 2000).

The authors contend that a new ecological structure in the dinoflagellate community has been established in the Gulf of Gdańsk.

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