The dynamics of seasonal change of the phytoplankton biomass in the Gulf of Gdańsk

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Phytoplankton biomass
Blue-green algae
Diatoms
Dinoflagellates
Green algae
Gulf of Gdańsk

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Abstract

The results of the phytoplankton biomass measurements as mean values from depths of 0 and 5 m are described and established on the basis of samples collected in the western part of the Gulf of Gdańsk between May and November 1977 and between March and December 1978. The obtained results of biomass ranged from 0.03 to more than 2.00 $mg \cdot dm^{-3}$. The values of biomass in spring and autumn were found to be higher than in summer, and this was caused by an intensive development of diatoms.

1. Introduction

The aim of this paper was to obtain the data about the dynamics of seasonal changes of the phytoplankton biomass in the Gulf of Gdańsk. The knowledge of this problem is very important for ecological characteristics of the marine ecosystem, especially in the Gulf of Gdańsk, because of the increasing pollution, which has been very intensive for the several last years. During this period the changes in composition and quantity of phytoplankton have been observed (Pliński *et al.*, 1982). Till now is impossible to establish such relations in biomass of phytoplankton because the problems concerned and presented in former papers (on phytoplankton in the Gulf of Gdańsk) were limited to the composition and occurrence of this ecological fraction only (Rumek, 1948, 1950; Pliński, 1975). The present paper may serve in the future as a source of comparison of the phytoplankton biomass changes.

2. Material and methods

The material has been collected from 6 stations, distributed in the western part of the Gulf of Gdańsk (Fig. 1). The samples of phytoplankton were usually taken once a month as follows: in 1977 during the period between May and November, in 1978 –

between March and December. Occasionally, there was a shortage of samples, because the meteorological conditions were unsuitable.

Water samples were collected from the depths of 0 and 5 m by means of a 5 liter Patalas' sampler and preserved with Lugol's solution. The analyses were performed by the Utermöhl's method, using an inverted microscope (Utermöhl, 1958). The samples in chambers of 50 ml volume were sedimented for 24 hours.

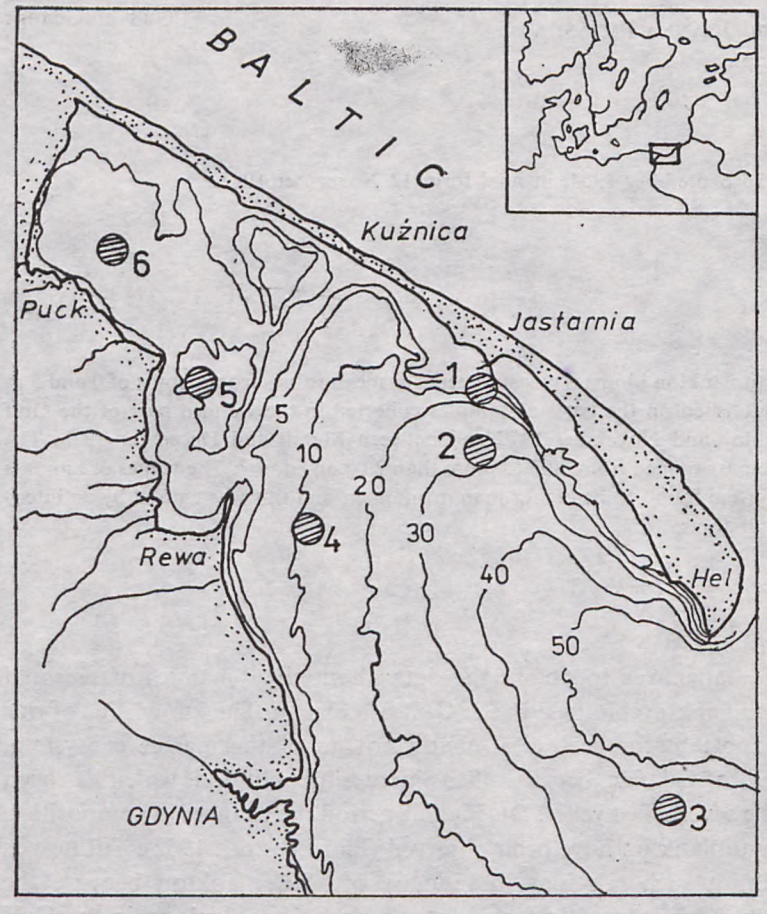

Fig. 1. Distribution of stations in the investigated area

The phytoplankton biomass was determined by calculating the cell volume of each species using the geometrical figures to simplify the cell shape (Edler, 1979). Only one value as a mean amount of thirty measurements was used for each species. The biomass of phytoplankton is given in $mg \cdot dm^{-3}$ as a mean value of measurements for samples from depths of 0 and 5 m, and it was calculated from a cell weight using the formula of specific gravity of algae – generally accepted as $1.00\ g \cdot cm^{-3}$ (Kiselev, 1956 after Gollerbach and Ština, 1969).

3. Results

The values of phytoplankton biomass ranged from 0.03 to over 2.00 mg·dm^{-3} (Table 1). For the whole investigated area for both years of observations, higher values of biomass were noted in spring and autumn than in summer. That phenomenon was caused by an increase of number of diatoms in those seasons.

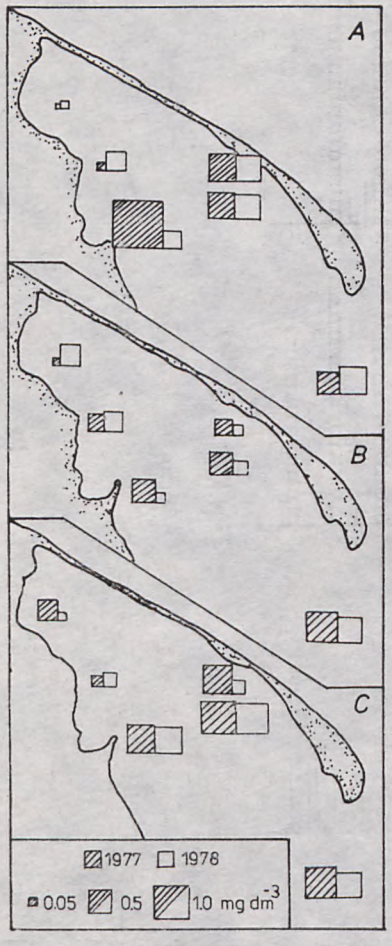

Fig. 2. Mean seasonal values of the phytoplankton biomass at each station
A – spring, *B* – summer, *C* – autumn

Table 1. Mean seasonal values of the phytoplankton biomass (in mg·dm^{-3}) at each station

Year	Season	Number of station					
		1	2	3	4	5	6
1977	spring	0.64	0.62	0.40	2.01	0.06	0.03
	summer	0.33	0.50	0.81	0.45	0.28	0.04
	autumn	0.71	1.04	0.82	0.76	0.13	0.39
1978	spring	0.56	0.53	0.63	0.33	0.38	0.07
	summer	0.09	0.22	0.53	0.10	0.30	0.38
	autumn	0.16	0.92	0.60	0.65	0.18	0.05

The smallest values of biomass were observed in the inner part of the Bay of Puck – the isolated part of the Gulf of Gdańsk (stations 5 and 6). This area has specific hydrological conditions. It was indicated in other publications that the

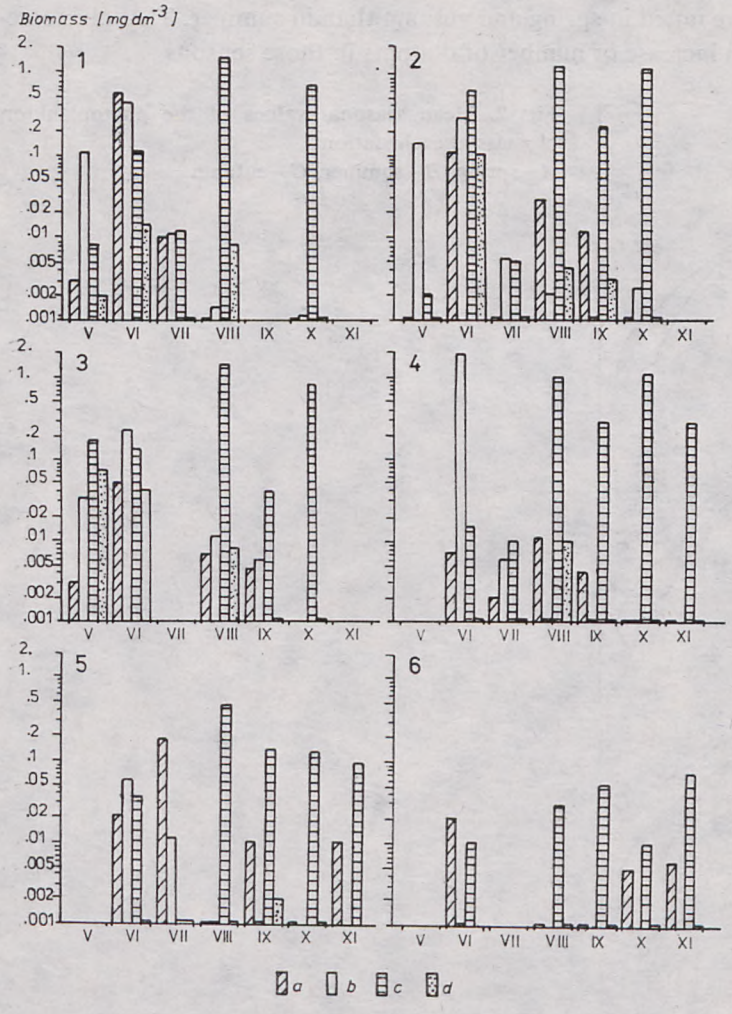

Fig. 3. Monthly changes of biomass of the main groups of algae at the stations 1–6 in 1977 *a* – blue-green algae, *b* – dinoflagellates, *c* – diatoms, *d* – green algae

amount of phytoplankton was lower in the Puck Bay-inner in comparison with the rest of the Gulf of Gdańsk (Pliński, 1979). The seasonal fluctuations of biomass values were also stronger in that part than in the rest of the investigated area, and the values were nearly of the same order. The biomass at the other four stations (1, 2, 3, 4) was higher in 1977 in comparison with 1978 (Fig. 2).

The dynamics of biomass changes were clearly connected with seasonal succession of phytoplankton composition. In the succession of the phytoplankton species and

groups in the investigated area, the following period could be distinguished: vernal maximum, summer minimum and autumnal domination of diatoms. In the early spring time, *eg* the end of March and the whole April, the diatoms dominated. That

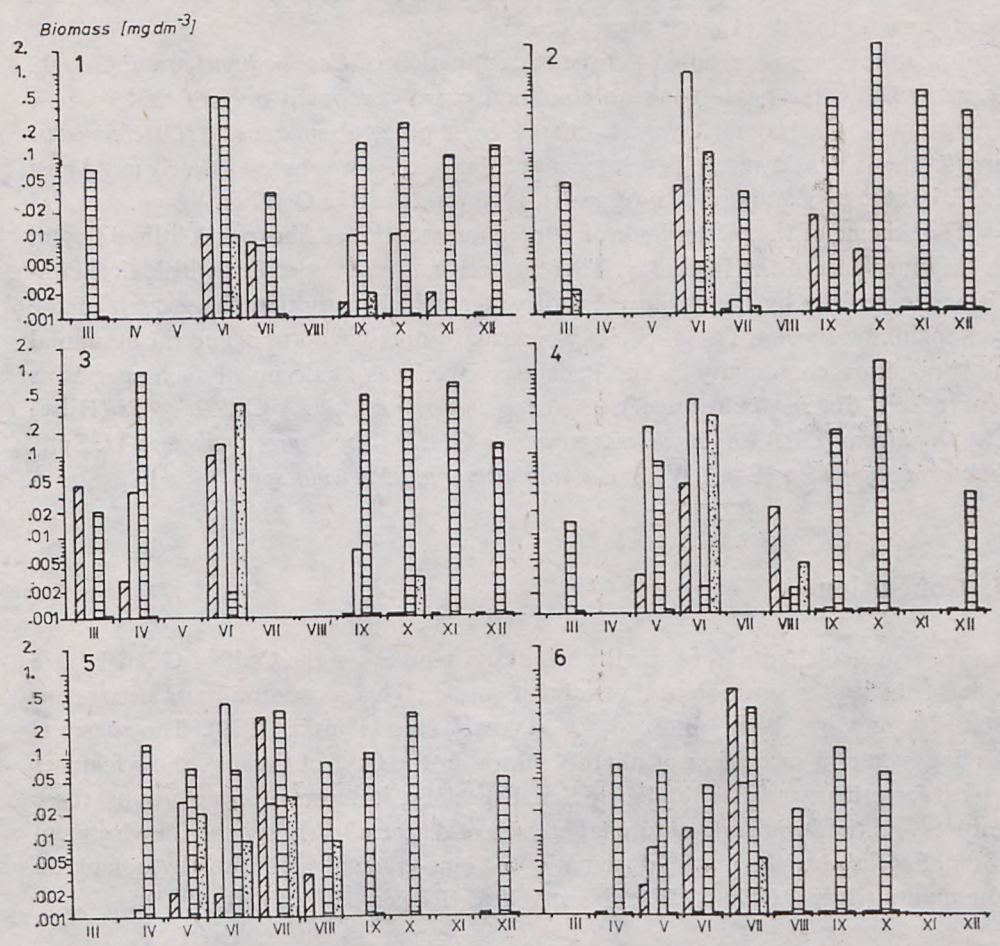

Fig. 4. Monthly changes of biomass of the main groups of algae at the stations 1–6 in 1978. For explanations see Fig. 3

phenomenon was clearly marked at the station 3 in 1978 (Fig. 3 and 4). The most abundant species in that period were *Achnanthes taeniata* Grun., *Melosira nummuloides* (Dillw.) Ag., *Chaetoceros* spp., *Sceletonema costatum* (Grev.) Cl., and *Thalassiosira baltica* (Grun.) Ostenfeld. In May a decrease of phytoplankton biomass was observed, but in June the biomass increased again. It was caused by a great development of dinoflagellates–community in which the most abundant species were *Peridinium triquetrum* (Ehr. ex Stein) Lebour, *Gonyaulax triacantha* Jörgensen, and *Dinophysis* spp.. The green algae also occurred during that period. This group formed an important part of phytoplankton, especially at stations 3 and 4. The most abundant genus were *Scenedesmus*, *Pediastrum*, *Ankistrodesmus* and *Oocystis*.

The blue-green algae: *Aphanizo menon flos-aquae* (L.) Ralfs ex Bornst, *Nodularia spumigena* Mertens, and *Anabaena spp.* dominated in the phytoplankton community in the summer season, particularly in July, when the biomass values were low. The biomass of blue-green algae was bigger in the Puck Bay-inner than in the other part, where also diatoms and green algae occurred.

In autumn there was noted a distinct domination of *Coscinodiscus granii* Gough. In many cases, the phytoplankton community was composed only of that species. The biomass reached high values, caused by a great abundance of *Coscinodiscus granii*. The evident dynamic development of that species was noted as early as August 1977, but the maximum of its biomass in 1978 was found in October.

The scheme of the phytoplankton succession mentioned above was little different in the inner part of the Puck Bay. There, it was caused by specific hydrological conditions, especially by the shallowness of water, which permitted the growth of the tychoplankton species. Those species were usually noted in autumn and the autumnal phytoplankton community in the Puck Bay-inner was made up of such species as (apart from *Coscinodiscus granii*): *Diploneis interrupta* (Kütz.) Cl., *D. ovalis* (Hilse) Cl., *D. didyma* (Ehr.) Cl., *Bacillaria paradoxa* Gmelin, *Amphiprora paludosa* W. Sm., *Nitzschia sigmoidea* (Ehr.) W. Sm., *Amphora spp.*, *Navicula spp.*

4. Conclusion

The seasonal changes of the phytoplankton biomass in the Gulf of Gdańsk were connected with the succession of dominant species. This succession has a permanent character and has been observed for several years (Pliński, 1979). The seasonal development and succession of phytoplankton in the Gulf of Gdańsk show features typical for other waters of the Baltic Sea. Especially, in terms of algae groups, these features are: the vernal and autumnal growth of diatoms, early summer development of dinoflagellates and summer domination of blue-green algae in the phytoplankton community (Bagge, Niemi, 1971; Niemi, 1973; Ringer, 1973; Edler, 1977).

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