

# Phytoplankton of the Gulf of Gdańsk in 1992 and 1993

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Phytoplankton  
Seasonal changes  
Distribution  
Gulf of Gdańsk

MARCIN PLIŃSKI  
Institute of Oceanography,  
Gdańsk University,  
Gdynia

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## Abstract

The article presents the results of a quantitative analysis of phytoplankton in the Gulf of Gdańsk from samples taken in 1992 and 1993. The quantity of phytoplankton was higher in 1993 than in 1992. The greatest difference in cell numbers between the two years was found among the diatoms. A high number of dinoflagellates was observed during spring in both years.

## 1. Introduction

The phytoplankton of the Gulf of Gdańsk has been studied for several decades (Rumek, 1948, 1950; Pliński, 1975; Ringer, 1973; Pliński *et al.*, 1982; Pliński, 1985; Pliński and Picińska, 1986). The unstable ecological situation in the Baltic Sea, including the Gulf of Gdańsk, resulting from increasing eutrophication, requires this biocenosis to be monitored. A programme for monitoring the coastal ecosystem of the Gulf of Gdańsk was therefore established more than 20 years ago by the Department of Biological Oceanography, University of Gdańsk. As part of this programme, biological data were collected in 1992 and 1993. This paper presents the results of the quantitative phytoplankton analysis.

## 2. Material and methods

The material was collected from 23 stations distributed throughout the coastal zone of the Gulf of Gdańsk. The phytoplankton samples were usually

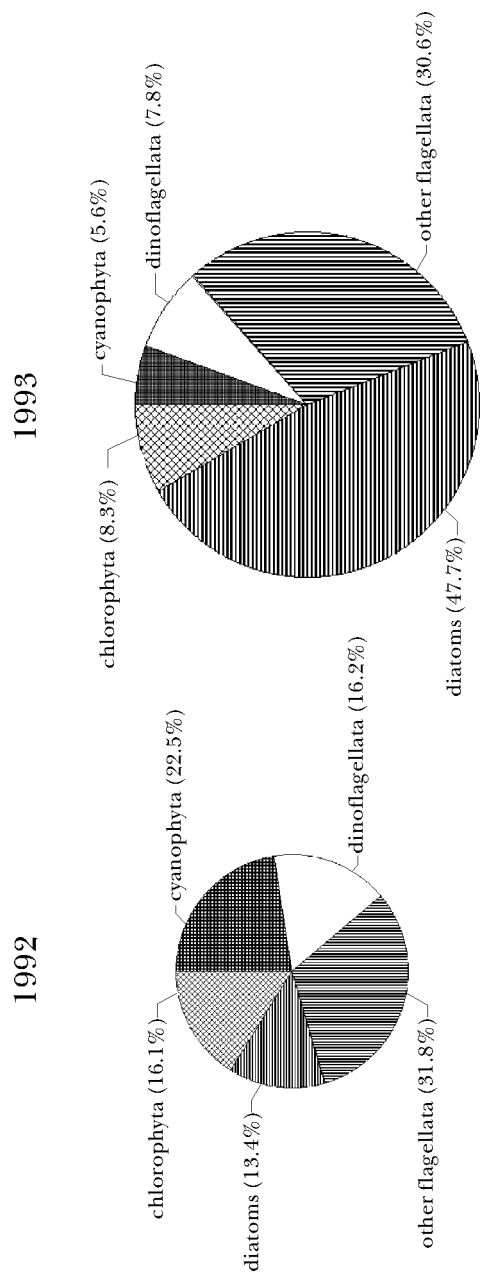


Fig. 1. Percentage of principal algal groups in the phytoplankton of the Gulf of Gdańsk in 1992 and 1993

taken once a month as follows: in 1992 between March and December (excluding April), and in 1993, also between March and December. Occasionally, there was a shortage of samples from certain stations owing to the unsuitable meteorological conditions.

By means of a 5-liter Patalas sampler, water samples were collected at each station from depths of 0, 10, 20 and 30 m depending on the bottom depths, and immediately preserved in Lugol solution on board ship. The microscopic analyses were performed in accordance with the methods recommended by BMB (Baltic Marine Biologists Organization) using an inverted microscope (Edler, 1979). The subsamples were sedimented for 24 hours in a 50 ml chamber.

The quantitative analysis results for each sample are presented on the figures as the average number of individuals per  $\text{dm}^3$  for selected combinations. Because of the lack of data from April 1992 (Fig. 1), the comparisons between the two years do not include the data for April 1993. The data for average monthly water temperature in coastal zone of the Gulf of Gdańsk was obtained from the Institute of Meteorology and Water Management in Gdynia (Fig. 2). The average numbers of the main algal groups were obtained from their numbers in each sample for a given month (Fig. 3) and area (Fig. 4). The occurrence of the main groups of algae in a given area is presented in the same way for a particular sampling date (Fig. 5).

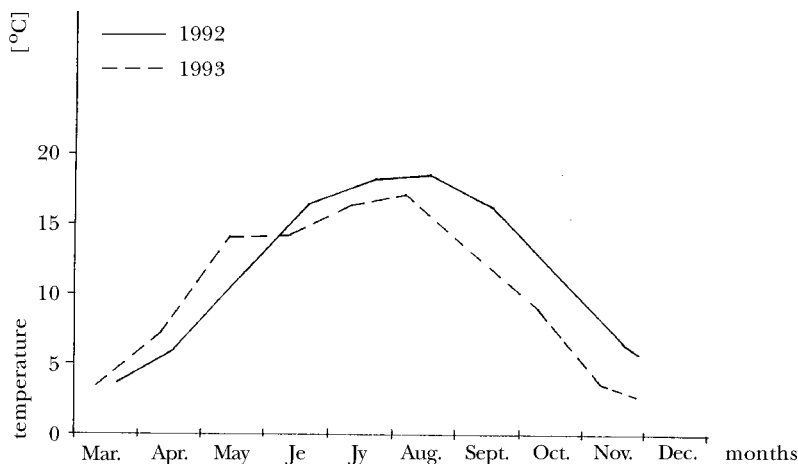


Fig. 2. Monthly average water temperature of coastal waters in the Gulf of Gdańsk in 1992 and 1993 (mean data for Gdynia and Hel meteorological stations – IMGW materials)

### 3. Results

#### 3.1. Seasonal changes

Comparison of the average annual numbers of phytoplankton shows that the phytoplankton was more numerous in 1993 than in 1992 (Fig. 1). The main differences were found in the diatoms. A significant increase in small *Cyclotella* species and the spring diatom bloom was recorded in 1993. Also among the flagellates, the summer bloom of Crytophyceae was more intensive in 1993 than in 1992.

During spring in both years (Fig. 3) it was observed that dinoflagellates occurred in large numbers, with *Peridiniella catenata* (Levander) Balech being dominant. In 1993 diatoms were very frequent during the dinoflagellate bloom, especially such species as *Skeletonema costatum* (Grev.) Cleve, *Melosira arctica* (Ehrenberg) Dickie in Pritchard, *Synedra tabulata* (C.A.Ag.) Kützing, *Diatoma elongatum* (Lyng.) C.A.Ag.; small *Cyclotella* spp. were present in very large numbers. Summer was the season when the blue-green algae were present, in 1992 in especially high numbers. During this period these algae were accompanied by large numbers of small cryptomonads. The autumnal phytoplankton was dominated by the same small cryptomonads. The larger numbers of blue-green algae recorded in 1992 could have been due to the fact that the temperature in summer 1992 was higher than during the same season the following year (Fig. 2).

#### 3.2. Distribution

The annual occurrence of the dominant groups of algae and their distribution is shown in Fig. 4, and their occurrence in a selected area on a given sampling date is presented in Fig. 5.

The largest quantity of phytoplankton was recorded in the vicinity of Świbno, especially during spring (May), when diatoms and green algae dominated. They were also dominant to the east of this area, *e.g.* near Stegna.

The lowest numbers of phytoplankton were recorded in the Bay of Puck (stations P1 and P2); only the rapid growth of small Cryptophyceae was recorded in August 1993, and this fell slowly until December. The area of Mechelinki (M1 and M2) was characterized by a rather higher number of phytoplankton than the Puck Bay area, and the species composition was more variable during the whole growing season. Significant quantitative differences were found in June and July between 1992 and 1993. Crytophyceae were very numerous in 1992, whereas an increase in dinoflagellates with dominant *Peridiniella catenata* was recorded in spring (April) 1993.

The open-water area of the Gulf of Gdańsk (J23 and So4) is characterized by a typical phytoplankton development cycle with the spring and

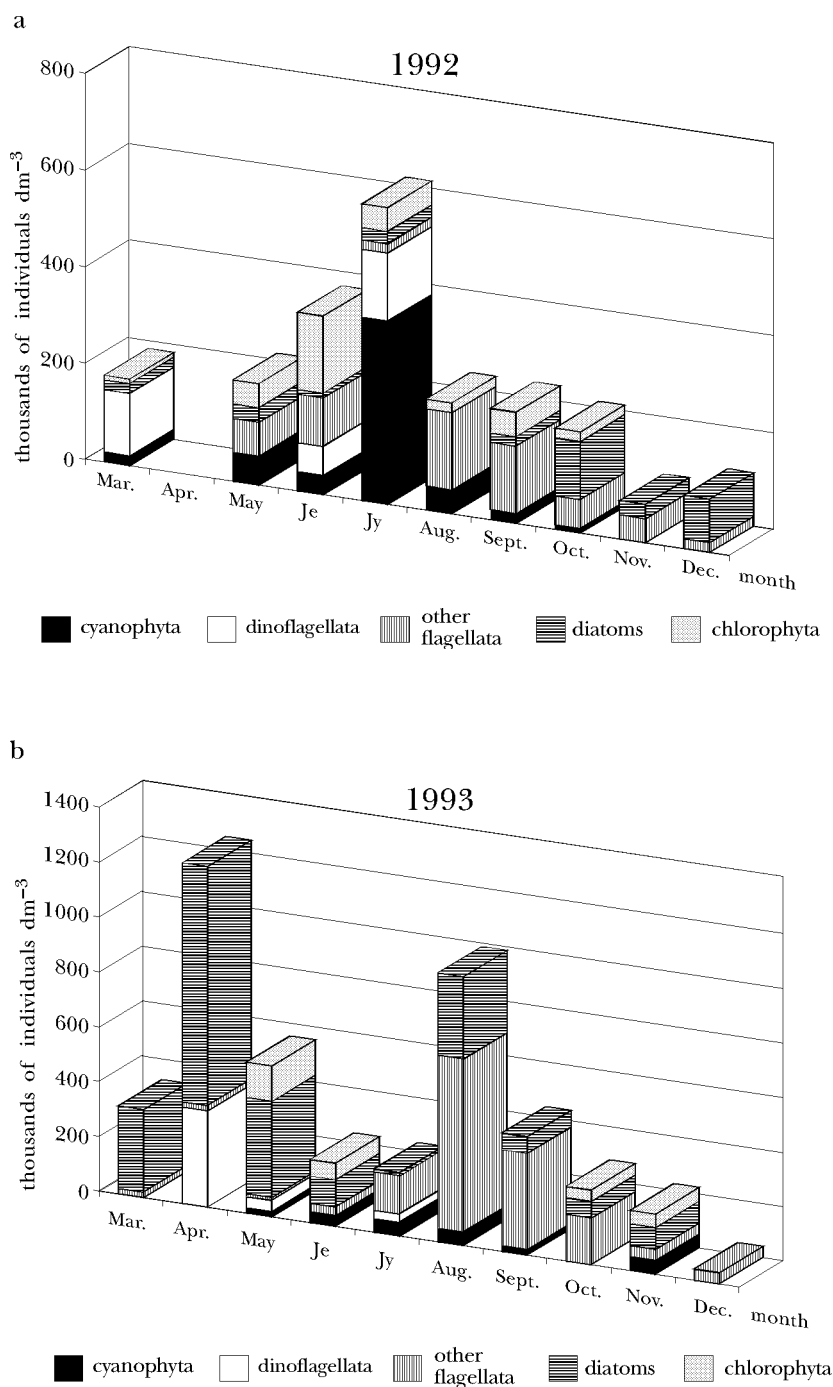


Fig. 3. Monthly average number of main algal groups in the phytoplankton of the Gulf of Gdańsk in 1992 (a), and 1993 (b)

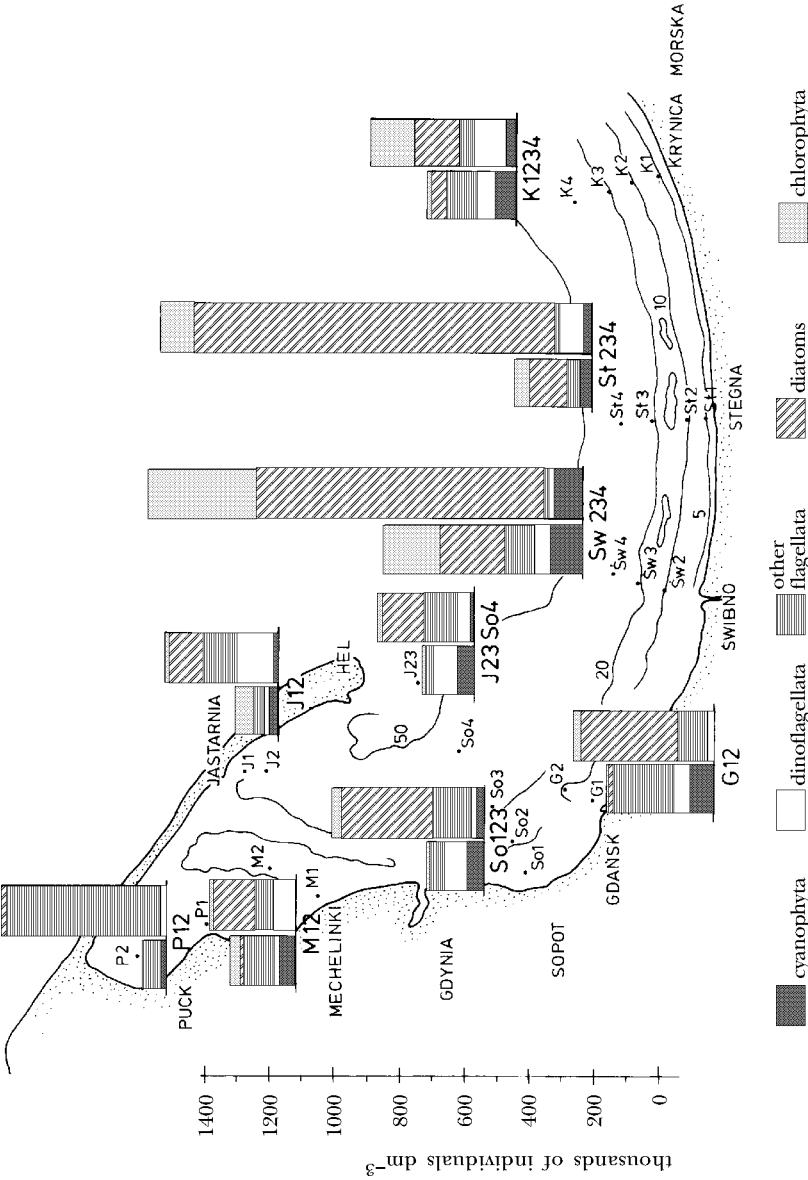
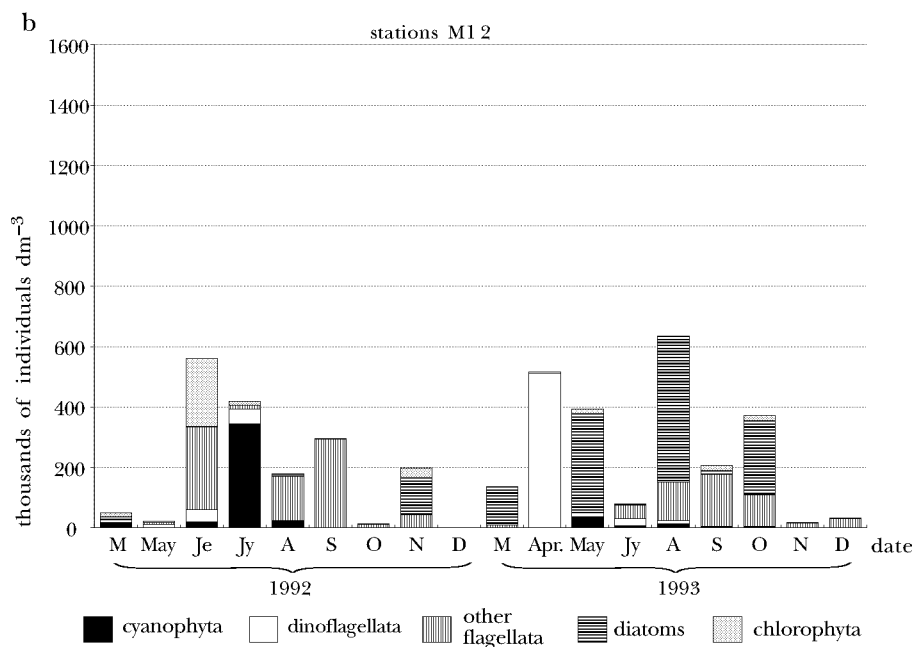
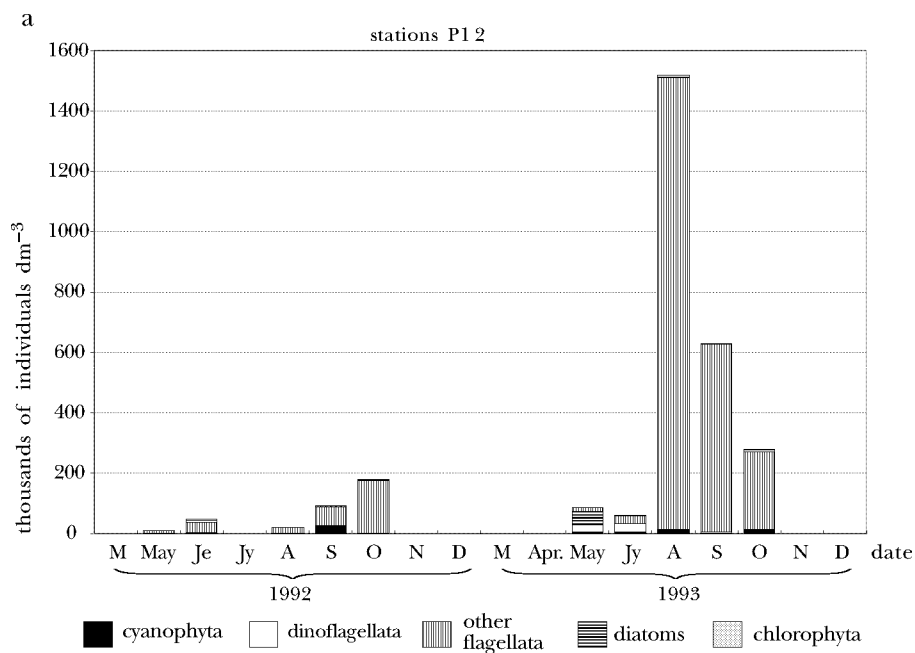
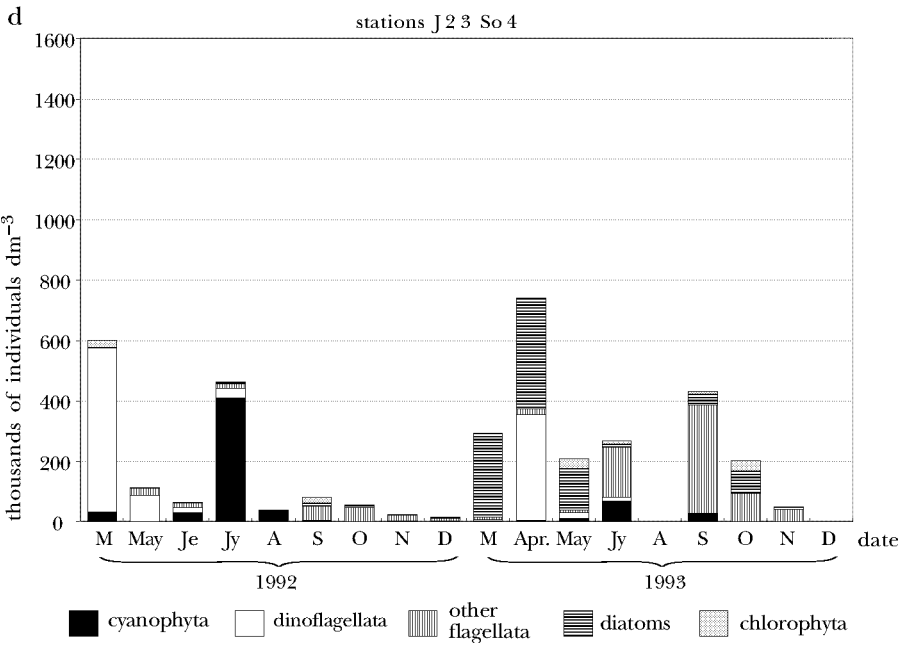
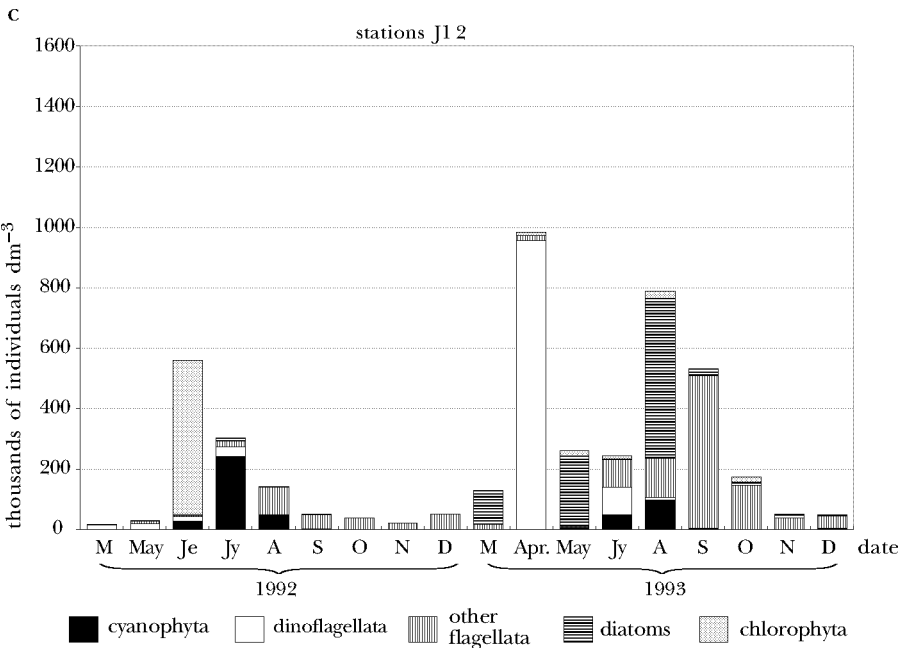
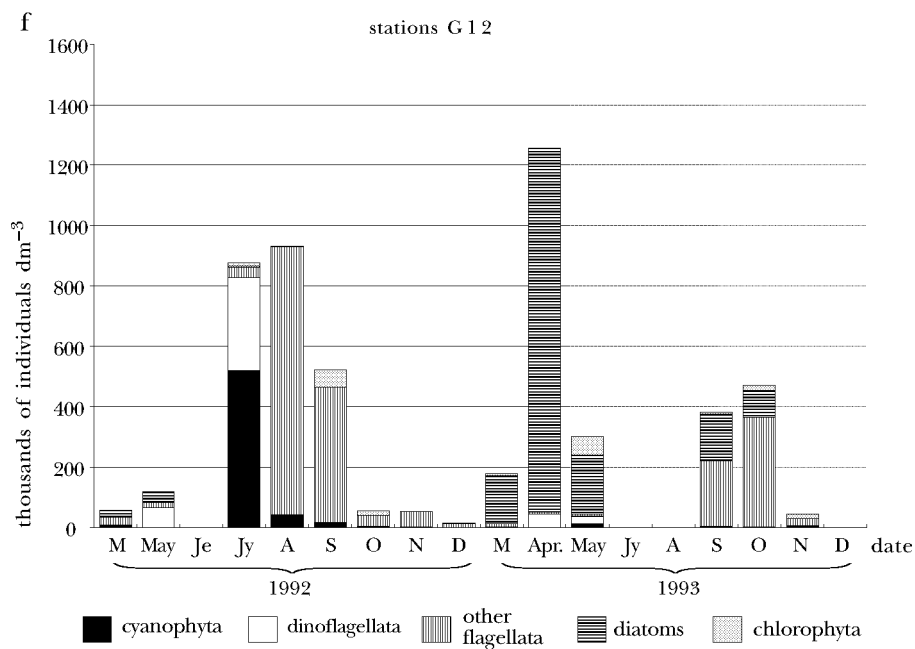
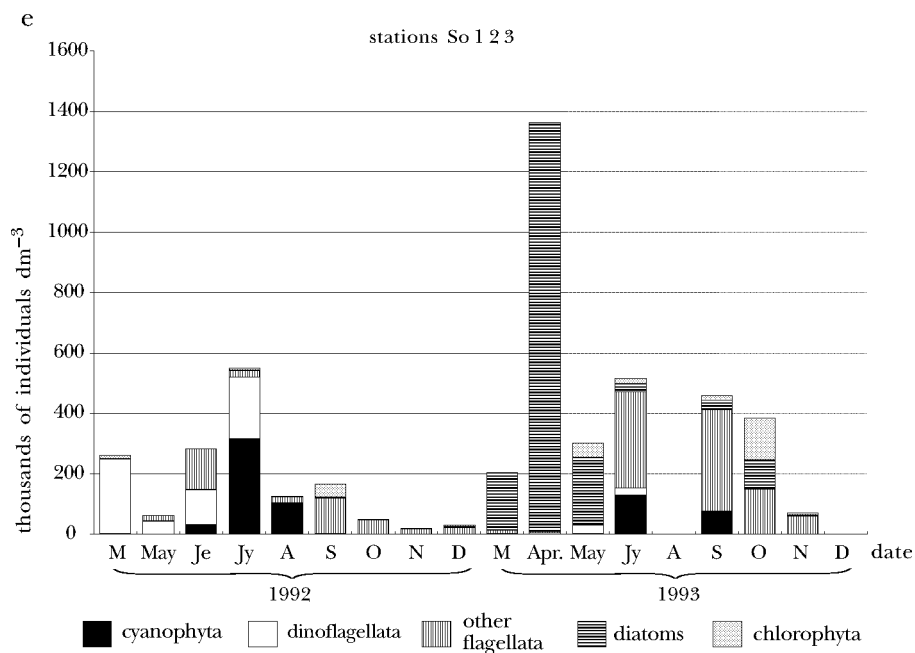


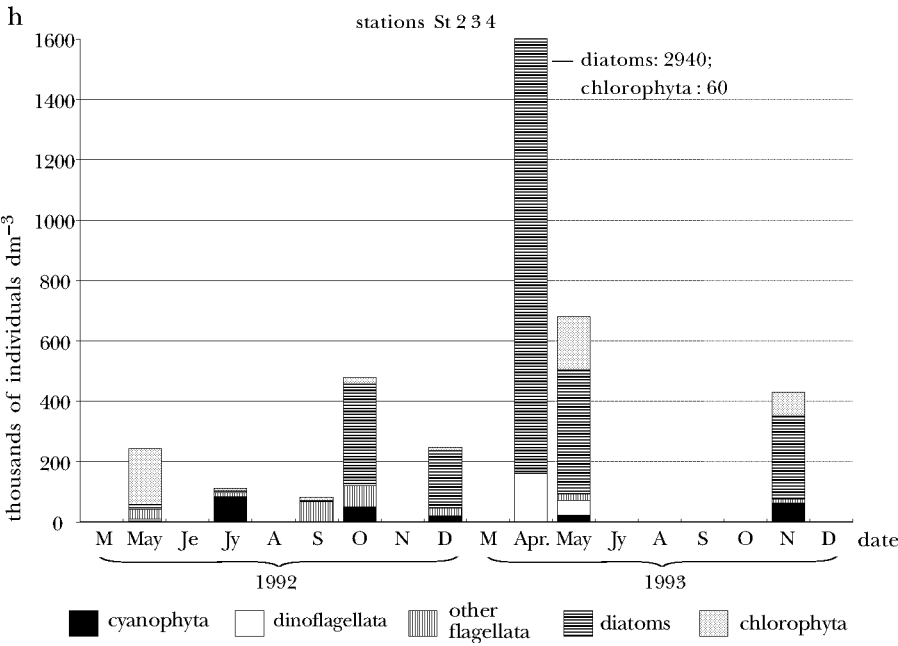
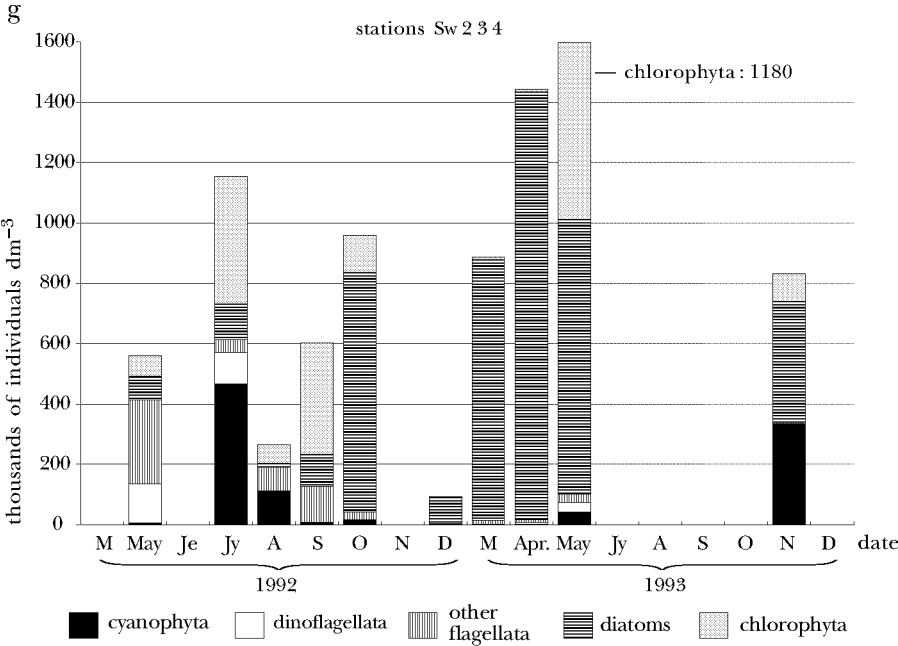
Fig. 4. Distribution of main algal groups in the Gulf of Gdańsk in 1992 (left-hand block) and 1993 (right-hand block)











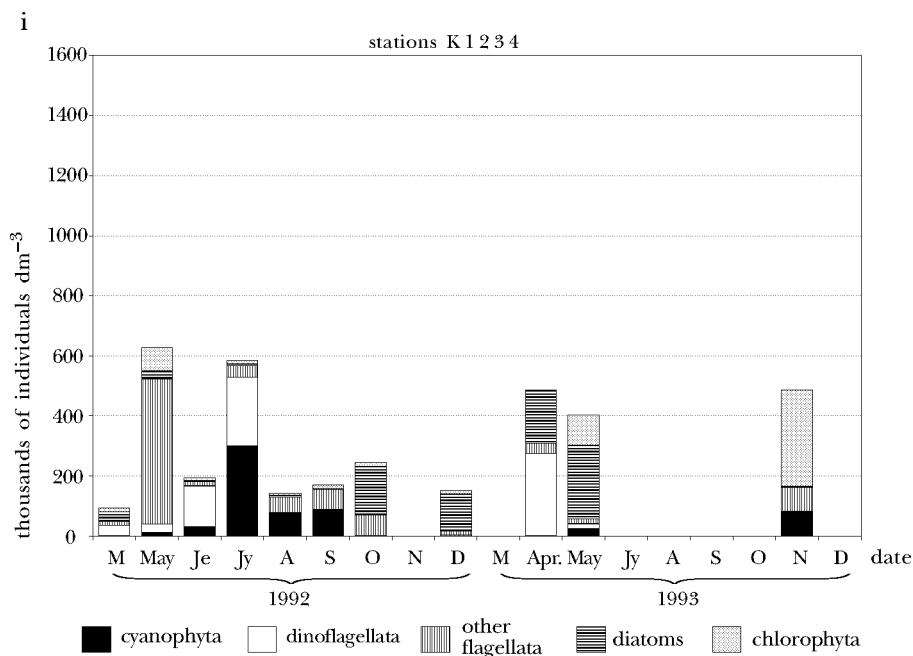


Fig. 5. Average number of phytoplankton of the Gulf of Gdańsk for a selected stations: P1,2 (a), M1,2 (b), J1,2 (c), J23 and So4 (d), So1,2,3 (e), G1,2 (f), Sw2,3,4 (g), St2,3,4 (h), K1,2,3,4 (i); (no bars means less than one thousand of individuals  $\text{dm}^{-3}$ )

autumn diatom peaks and the summer (July) domination of blue-green algae *Microcystis aeruginosa* Kützinger and *Aphanizomenon flos-aquae* (L.) Ralfs ex Bornet et Flah. In the coastal area around Sopot (So1,2,3) the numbers of phytoplankton were low; only in April 1993 was a slight increase in diatoms (small *Cyclotella* and *Skeletonema costatum*) reported.

In the area near Gdańsk (stations G1 and G2) two periods with increased phytoplankton numbers were recorded: April 1993, when diatoms were dominant (small *Cyclotella* and *Skeletonema costatum*), and in summer 1992 when blue-green algae and dinoflagellates (July) or other flagellates (August) were prevalent. To the east of the Vistula mouth, the clear predominance of unicellular green algae was characteristic; however, farther east, their density diminished. The main species there were *Scenedesmus acuminatus* (Lagerh.) Chodat, *S. quadricauda* (Turpin) Breb., *Ankistrodesmus falcatus* (Corda) Ralfs, *Chlorella* spp., *Oocystis submarina* Lagerh., *Monoraphidium* spp. *Coelastrum microporum* Naegeli, *Pediastrum duplex* Meyen, *P. boryanum* (Turpin) Menegh., *Crucigenia rectangularis* Naegeli.

## 4. Conclusion

The quantity of phytoplankton in the Gulf of Gdańsk differed during the investigation period, being considerably higher in 1993 than in 1992, owing to the intense blooms of diatoms in spring and of cryptomonads in summer. Moreover, in the springs of both years large numbers of dinoflagellates were reported. The highest numbers of phytoplankton were found in the area around Świbno and farther east, which is certainly an effect of advancing eutrophication, most evident near the Vistula mouth (Wiktor and Pliński, 1992).

The composition and quantity of phytoplankton during 1992 and 1993 differ in comparison with previous investigation periods. A diminution in the number of species has been observed in the phytoplankton community. In 1946–1947, Rumek (1948) reported about 260 taxa in this region, but by 1981 that number had fallen to about 200 (Pliński *et al.*, 1985). This reduction is clearly pronounced in the case of dinoflagellates: their number dropped from 36 taxa to around 10.

The decrease in the number of taxa has been accompanied by an increase in the abundance of other species, which has led to a change in the structure of the blooms. Particularly intense blooms of blue-green algae and dinoflagellates have been observed. Among the latter, *Heterocapsa tiquetra* (Ehrenberg) Stein has been very abundant since 1981 (Pliński and Picińska, 1986) and *Peridiniella catenata* (Levander) Balech since 1992 (Pliński and Józwiak, 1994). Comparing data from the whole coastal monitoring programme *i.e.* since the beginning of the 1970s, it can be stated that the proportion of the small-cell fraction in the phytoplankton has increased, which the 1992–1993 data very clearly demonstrate.

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