Bull. Nat. Inst Oceanogr. & Fish., ARE, 16 (1) 1990: 19 - 26.

PHYTOPLANKTON-ZOOPLANKTON RELATIONSHIP IN THE SURFACE WATER OF THE EASTERN HARBOUR (ALEXANDRIA).

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ABSTRACT

The phytoplankton standing crop and zooplankton population in the upper water layer of the Eastern Harbour were estimated monthly from August, 1986 to July, 1987. The effect of domestic sewage effluents discarded into the Harbour on the quantitative and qualitative distribution of the two communities was also investigated. Results illustrate maximum distribution of phytoplankton at the southern margin of the Harbour which is subjected to the direct influx of sewage decreasing gradually to the north towards the open-sea. The zooplankton population showed its maximum persistence about the middle of the Harbour and less so at the southern margins while its lowest density appeared nearby the open-sea. The peaks of phytoplankton were recorded in October, 1986 due to the increased numbers of **Cyclotella meneghiniana** and in May produced by the blooming of **Alexandrium minutum.** Other small increase appeared in March and was dominanted by **Amphicrysis compressa** and **Chaetoceros affinis.** These peaks were met with lower zooplankton counts. The Zooplankton population attained also three peaks of abundance; an outstanding peak in August and was dominated by the rotifers **Brachionus plicatilis** and **B. Calyciflorus** and two smaller ones in February and April, produced respectively by **Pedalia sp.** and **Tintinnopsis companula.** These three peaks coincided also with low phytoplankton community.

The phytoplankton-zooplankton standing crops showed in general, a reverse relationship during the vertically stratified period (May-October) due to the grazing effect of zooplankton on phytoplankton, while in the water mixed period (November-February) the two communities showed lower counts resulting from the invasion of the Harbour by offshore sea water, poor in both phytoplankton and zooplankton.

INTRODUCTION

The Eastern Harbour is a relatively shallow semiclosed basin sheltered from the sea by a break-water, leaving two openings named El-Boughaz and El-Silsila through which the exchange of water between the Harbour and the neritic Mediterranean water takes place (Fig. 1). Its total area is about 2.53 Km^2 with an average depth of 6 meters.

The Harbour receives a constant discharge of sewage waste water from eleven small outfalls opening at its southern margin and these amount annually about 35.2 x $10^6 m^3$.

Sea water may occasionally invade the Harbour particularly during the winter gales occurring between November and February (Zaghloul, 1989).

Parallel studies had been carried out in the Harbour during the same period of investigation concerning the physicochemical conditions (Zaghloul, 1989) and distribution of the total zooplankton (Aboul Ezz, et al, 1990).

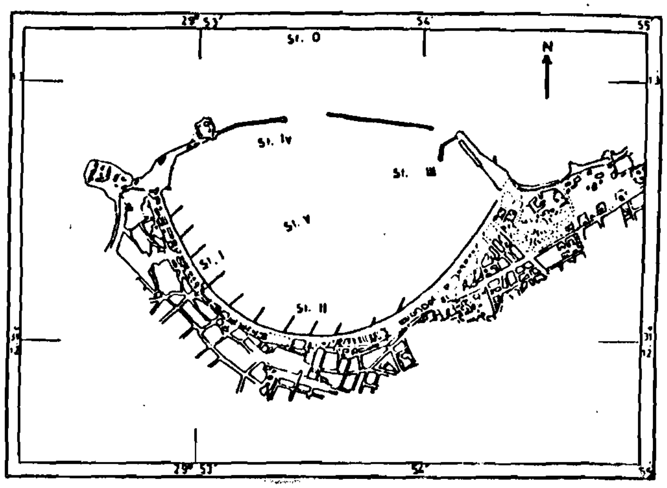

FIG. 1

Position of stations and outfalls.

MATERIAL AND METHODS

Quantitative samples of phytoplankton and zooplankton were collected monthly from August, 1986 to July, 1987 at five selected stations (Fig. 1).

For phytoplankton, one liter of surface water was taken at each station with a plastic Ruttner sampler. Estimation of the standing crop was carried out by using the sedimentation method. The different species were identified and counted. The magnitude of the standing crop of phytoplankton was expressed in cells/L.

Zooplankton samples were collected by filteration of 100 liters from surface water at each station through a standard plankton net No. 25 (mesh size 55 micron). The collected samples were preserved directly with 4% formalin solution. The volume of each sample was concentrated to 100 ml and sub-samples of 5 ml were counted and each plankter was identified. The distribution of the total zooplankton organisms was calculated as their numbers per cubic meter.

RESULTS

A. Composition and Distribution of Phytoplankton:

The phytoplankton community was mainly represented by Bacillariophyceae which constituted numerically about 66.4 % of the total phytoplankton, Dinoflagellates (21.9 %) and Chrysophyceae (9.2 %). Other groups were rarely recorded and contributed collectively about 2.5 % of the total phytoplankton counts. About 77 species were recorded during the period of investigation; diatoms were represented by 48 species, blue green algae included 6 species, chlorophytes comprised 7 species and Dinophyceae 13 species, two species of Euglenophyceae and one species of Chrysophyceae were also estimated.

The maximum distribution of the total phytoplankton was recorded at stations I and II which harboured respectively average annuals of 5,287 x 10^3 and 5,466 x 10^3 cells/L. These values decreased gradually northwards to 4,979 x 10^3 cells/L about the middle of the Harbour (St. V) and 3,684 x 10^3 and 3,325 x 10^3 cells/L respectively at stations III and IV which are situated nearby the open-sea (Fig. 2a). The annual standing crop of phytoplankton for the whole Harbour averaged 4,349 x 10^3 cells/L.

As regards the seasonal variations, the magnitude of standing crop of phytoplankton in the Harbour during the stratified period ranged between 2 x 10^6 and 15 x 10^6 cells/L (Fig. 3). The community composition differed from one month to the other. **Chaetoceros affinis** reached its highest persistence in October. The peaks of **Cyclotella meneghiniana** were in October and June, **Amphichrysis** compressa showed its maximum persistence in March, while a blooming of Alexandrium minutum was recorded in May. In general, the community composition of the phytoplankton peaks was dominated by few species.

During the mixed period (November-February), the water in the Harbour was vertically homohaline as a result of its invasion by the open sea water. Such water is usually poor in phytoplankton and consequently, the Harbour sustained lower standing crops fluctuating between 272 x 10^3 and 427 x 10^3 cells/L but the community composition comprised several species.

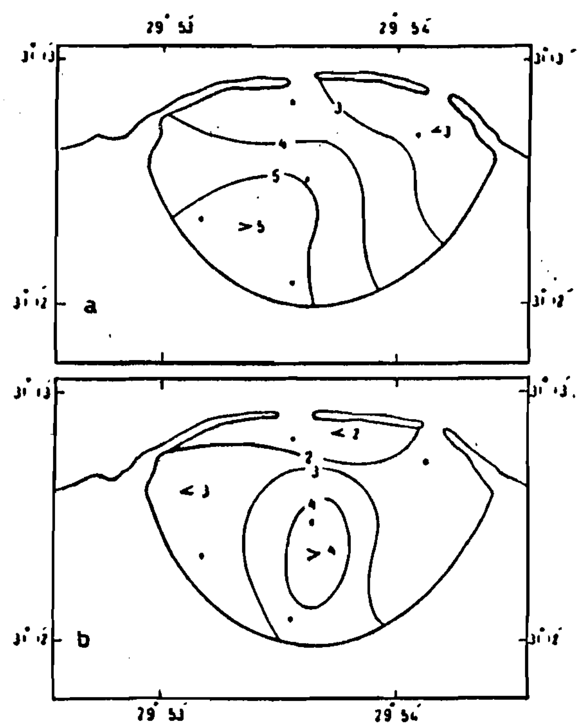

FIG. 2

Horizontal distribution of the phytoplankton (x 10^6 cells/L) and zooplankton communities (x 10^6 organisms/m^3)
a- Phytyplankton b- Zooplankton

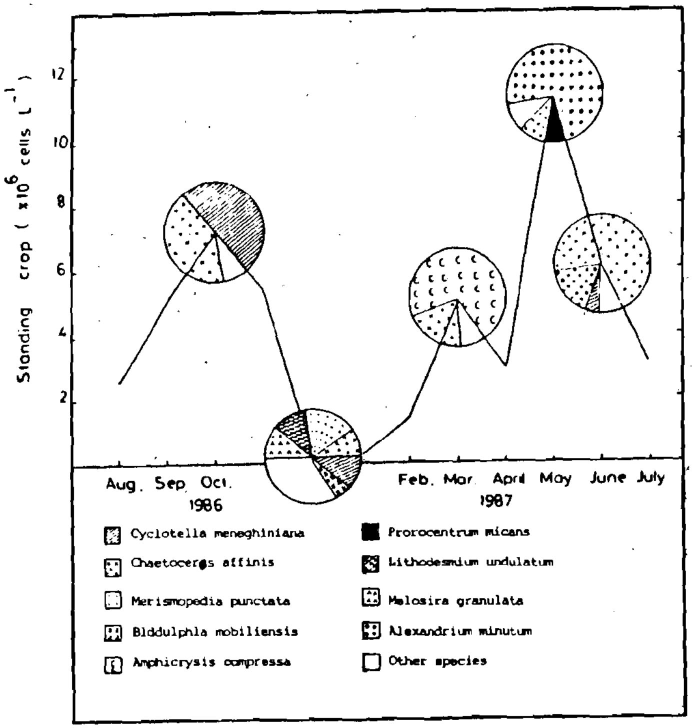

FIG. 3

Integrated surface standing crop and compositions of the bloom peaks and of the December minimum.

B- Composition and distribution of Zooplankton:

The zooplankton population in the Harbour was dominated by three main groups namely; Protozoa (Tintinnidea, Ciliata, Rhizopoda and Foraminifera) which consituted numerically about 43 % of the total zooplankton, Rotifera (37.6 %) and Crustacea (Cirriped larvae, crustacean eggs, cladocera and Ostracoda) forming 14.5 %. Other plankters were rarely recorded (4.9 %). The highest density of zooplankton was recorded at stations V (middle of the Harbour) and II (southern margins). These two stations harboured respectively average annuals of 447 x 10^3 and 313 x 10^3 organisms/m^3. The lowest population density appeared at stations III and IV which lie at the northern side, nearby the open sea. They averaged respectively 202 x 10^3, 192 x 10^3 organisms/m^3. Station I sustained a comparable moderate value of 224 x 10^3 organisms/m^3 (Fig. 2 b).

The average annual counts of Protozoa reached 124,424 organisms/m^3 and was dominated by the tintinnids Tintinnopsis beroidea and T. campanula. Rotifera averaged 109,060 organisms/m^3. It was represented by six species, being dominated by Brachionus colyciflorus and B. plicatilis.

The average annual standing stock of crustacea amounted 46,295 organisms/m^3. Copepoda was the most dominant order of crustacea with 42,198 organisms/m^3. It was represented by 15 species and was dominated by Euterpina acutifrons, Oithona nana, Paracalanus parvus and Acartia latistosa.

The seasonal variations of the total zooplankton population showed an outstanding peak in August which consisted mainly of the rotifers Brachionus plicatilis, B. calyciflorus and protozoans Tintinnopsis beroidea, Oxytricha fallax. Two other smaller peakes were also recorded in February and April which were respectively dominated by Pedalia sp. of rotifers and Tintinnopsis campanula of tintinnids (Fig. 4).

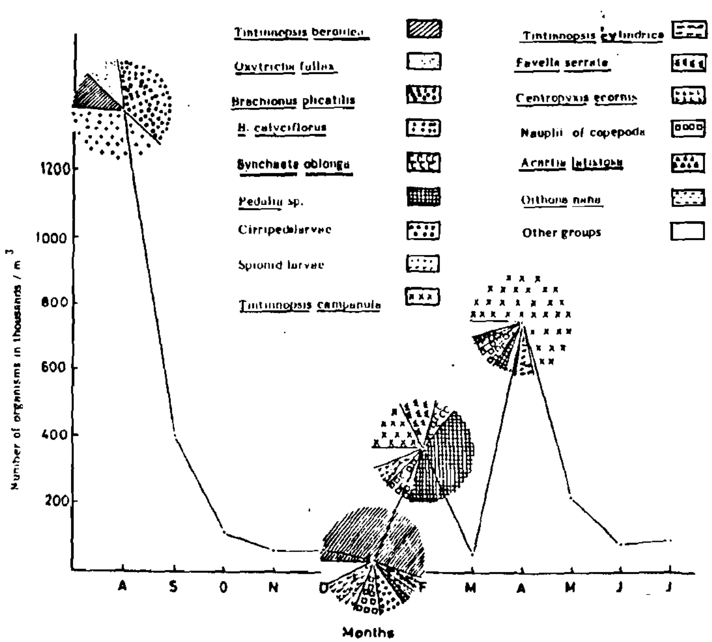

FIG. 4

Monthly variations of the total zooplankton in the Eastern Harbour during 1986-1987.

DISCUSSION

The phytoplankton community in the Eastern Harbour comprised 77 species which was dominated by **Cyclotella meneghinina, Chaetoceros affinis, Amphicrysis compressa, Alexandrium minutum** and less so by **Merismopedia punctata, Melosira granulata, Biddulphia mobiliensis, Prorocentrum micans** and **Lithodesmium undulatum**. These forms are characteristic members of eutrophic waters. Sparling and Nalewajko (1970) mentioned that Cyclotella sp., Melosira **granulata** and **Merismopedia punctata** are significantly associated with high eutrophication regions.

The zooplankton population in the Harbour was dominated by rotifers, in particular **Brachionus calyciflorus** and B. **plicatilis**. Such organisms are usually common in areas rich in organic matter and consequently many bacteria are usually present (Hutchinson, 1967).

The examination of the stomach content of **B. calyciflorus** by Guerguess (1979) in Lake Manzalah revealed the dominance of Cyclotella meneghiniana and Euglena sp. This is confirmed by the present investigation as the peaks of Brachionus **calyciflorus** and B. **plicatilis** were accompanied with lowest density of phytoplankton due to their grazing effect. Halbach and Gisela (1974) demonstrated two antagonistic influences of algae on rotifers; a positive influence as a food resource and a negative one at high densities caused by toxic algal substances released into the medium. The bloom of **Alexandrium minutum** recorded in May coincided with minimum standing stock of zooplankton and this may be attributed to its inhibiting effect on the growth of zooplankton. In general, the peaks of zooplankton was met with lowest density of phytoplankton and vice versa, indicating a reverse relationship between the communities. However, during the winter when the magnitudes of the standing crops of both phytoplankton and zooplankton were low, this inverse relation was not pronounced

The present results indicate that water pollution in the Eastern Harbour is high as a result of the large amounts of untreated sewage effluents discarded there. Although the dominant species of both phytoplankton and zooplankton surviving in the Harbour are considered to be tolerant to sewage pollution, yet, these effluents have a general bad effect on the environmental conditions there. Thus, it is recommended that sewage effluents should be treated before being discarded into the Harbour to improve its water quality or it is better to use land desposal scheme in order to obtain clean beaches.

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