DISTRIBUTION OF PLANKTONIC PROTOZOA IN SUEZ BAY (EGYPT)

By

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ABSTRACT

Zooplankton samples were collected monthly using a standard plankton net of 55 μm mesh size, from 8 stations in the Suez Bay (Egypt) throughout the period from October, 1990 & September 1991.

Planktonic Protozoa represented the second important component of zooplankton in Suez Bay after Copepoda and it numerically formed 31.4 % of the total population with average of 12,890 org/m^3. It comprised 13 species belonging to 10 genera within the phyla Ciliophora and Sarcomastigophora. Members of tintinnids (10 species) formed the main bulk of Protozoa (99.85% of their total numbers) and were dominated by ***Helicostomella subulata***, ***Tintinnopsis tubulosa*** *and* ***Tintinnopsis cylindrica***. *On the other hand, foraminiferans (2 species) and acanthareans (*one species*) remained rare.*

The horizontal distribution of the total protozoa showed its highest monthly averages at the littoral stations particularly at stations I & II (averages 23,560 and 21,890 org/m^3 respectively). The outer stations sustained lower densities with monthly averages fluctuating between 3,390 org/m3 at station VI and 12,120 org/m^3 at station VII. Seasonally, their main peaks of abundance occurred in November, 1990, April and September, 1991 at water temperature ranging from 21.7°C to 26.5°C and salinity from 41.37 to 42.40. An inverse relation was observed between the spatial and seasonal distribution of tintinnid *protozoa and that of Copepoda and Tunicata and this may be attributed to the grazing effect of the latter on the former.*

INTRODUCTION

Suez Bay represents a semi isolated shallow estuary lying at the northern extremity of the Gulf of Suez (Egypt) at latitude of 29° 55' N and longitude of 32° 31' E. The bay is opened to the gulf through most of its southern side and it is connected to the Suez Canal by a dredged channel of 24m deep (Fig. 1). The Suez City and its major industries occupy the north-western coastal line of the bay.

The water of the bay comes mainly from the Red Sea all the year round. It may also receive small amounts of Mediterranean water mixed with the more saline water of the Bitter Lakes through the Suez Canal during August and September when the level of the Mediterranean Sea stands few centimeters higher than the Red Sea (Morcos, 1970). Besides a constant supply of inland discharge is discarded into the Bay and it is usually contaminated by different kinds of pollutants, namely; the domestic effluents of the main sewer of Suez City, the influx of Suez fertilizer factory which contains inorganic nitrogen compounds and the waste water of the petroleum refineries.

Few studies concerning the distribution of Protozoa in Suez Bay and the neighbouring Suez Canal and Lake Timsah were previously carried out in the last few years (Dowidar, 1974 & El- Serehy, 1989 & 1992). The present study deals with the community composition of Protozoa in Suez Bay and their frequency percentage in relation to the other zooplankton components. The effect of the prevailing physico-chemical condition on their spatial and seasonal distribution is also considered.

MATERIAL AND METHODS

Monthly collections of zooplankton were conducted in Suez Bay during the period October, 1990-September, 1991, using a standard plankton net of 55μm mesh size and with a mouth diameter of 29 cm. The net was held vertically at the different stations from 5 and 10 m deep to the surface. The collected samples were preserved in 5 % formalin solution and their volumes were adjusted to 100 ml. Three separate subsamples of 2 ml each were examined under an inverted microscope (40X magnification) and the different protozoan species were counted. The standing crop was calculated as the total numbers of Protozoa per cubic meter recorded at both the surface water (0-5 m deep) and near the bottom layer (5-10 m deep).

For identification of protozoa the following texts were referred to: Brandt, 1906; Kofoid and Campbell, 1929, & 1939; Cushmann, 1948; Loeblich and Tappan, 1968; Marshall, 1969; Corliss, 1979; Lee *et al* 1985 and Sleigh, 1989. Protozoan species collected during this study were classified according to Lee *et al* (1985).

Eight stations were selected to represent the different habitats in the Bay (Fig. 1).

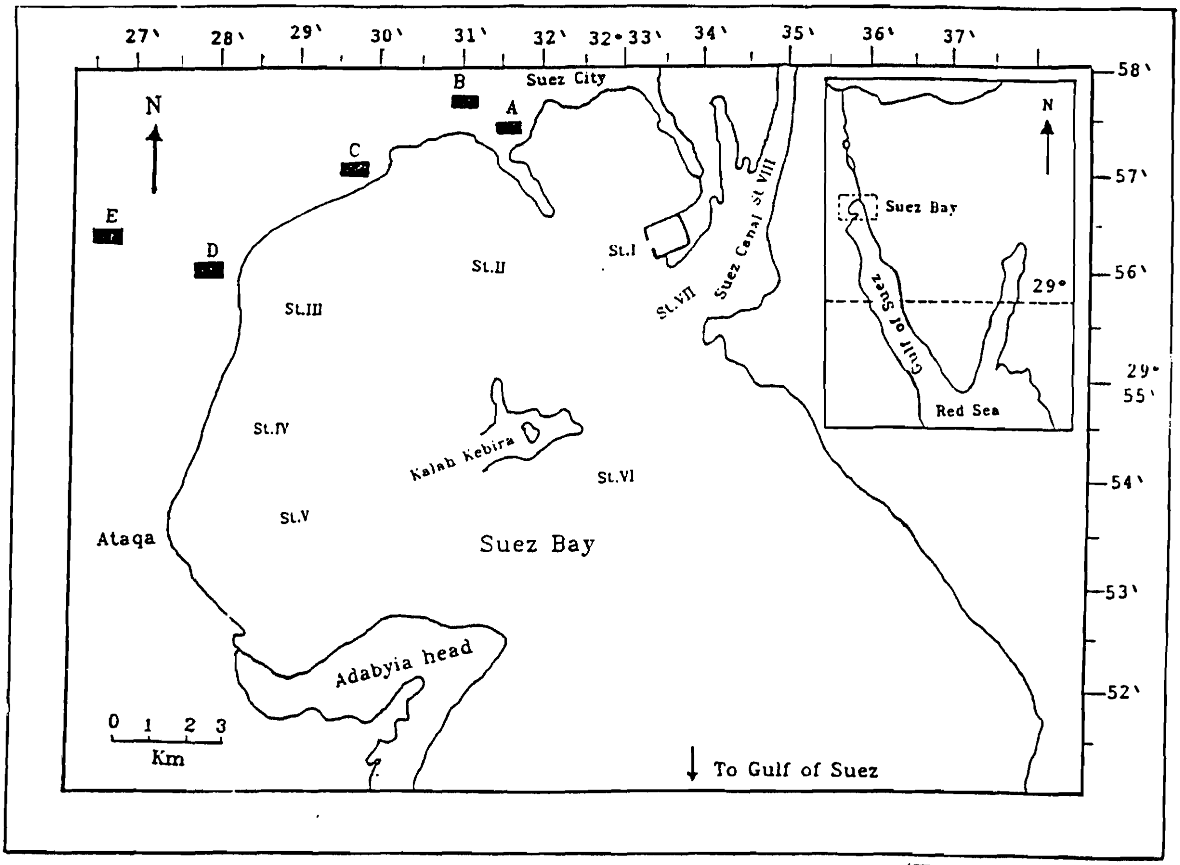

Figure 1: A map of Suez Bay showing the position of sampling stations and sources of pollution (A: Al-Naser Petroleum Company, B: Masr Pet. Co., C: Suez Pet. Co., D: Electricity Station, E: Fertilizer Factory).

Station I lies infront of Suez Port and it is affected by the navigation activities of ships which create water turbulence.

Station II is located near to El-Zeitia Port which serves for charging and discharging of oil vessels and its water is partially contaminated with oil.

Station III is situated on the western side of the bay and it receives the polluted water of Suez City.

Station IV lies infront of the National Institute of Oceanography and Fisheries and it is affected by the polluted water flowing southward from station III.

Station V is located opposite to Ataqa Port which serves as a harbour for the fishing boats.

Station VI is situated about the middle of the eastern side of the bay near to Kala Kebira Islet.

Station VII and VIII lie on the southern extremity of Suez Canal. The average water depth of the bay ranges between 10 and 14 m except at stations VII and VIII where it reaches about 27 m.

The monthly averages of water temperature ranged between 23.4°C for surface layer and 22.9°C for the near bottom layer. The salinity values averaged to 41.86.

RESULTS

Planktonic Protozoa ranked as the second important component of zooplankton in Suez Bay after Copeopoda. It numerically constituted about 31.4% of the total standing stock of zooplankton with an average of 12,890 org/m^3. Protozoa were represented by 13 species belonging to 10 genera within the orders Choreotrichida, Foraminiferida and Holacanthida. The former formed the main bulk of Protozoa while the other ones appeared very rare. The classification of the recorded species is shown in the following list.

Subkingdom: Protozoa
Phylum: Ciliophora
Subphylum: Postciliodesmatophora
Class: Spirotrichea
Subclass: Choreotrichea
Order: Choreotrichida
Suborder: Tintinnina
Family: Codonellidae
Tintinnopsis cylindrica Daday
T. tocatinesis kofoid & campbell
T. tubulosa Levender
Family: Ptychochlididae
Favella ehrenbergii Claperede & Lachmann
F. Panamensis Kofoid & Campbell
Family: Metacylididae
Helicostomella subulata Ehrenberg
Metacylis vitreoides Kofoid & Campbell
Family: Codonellopsidae
Codonellopsis lusitanica Jorgensen
Stenosemella sp.
Family: Tintinnidae
Tintinnus sp.
Phylum: Sarcomastigophora
Subphylum: Sarcodina
Superclass: Rhizopoda
Class: Granuloreticulosea
Order: Foraminiferida
Family: Textularidae
Textularia sp.
Family: Globorotalidae
Globigerina sp.
Superclass: Actinopodea
Class: Acantharea
Order: Holacanthida
Family: Acanthochiasmatidae
Acanthochiasma krohnii D' Orbigny

1 - Tintinnid Protozoa

The loricate ciliates (tintinnids) dominated the protozoan community in terms of both numerical abundance and number of species. They included 10 species within 5 famelies and 7 genera numerically contributed 99.85% to the total Protozoa and 31.37% to the zooplankton population (average 12,870 org/m^3).

As shown in figure (2) tintinnids appeared more dense in the surface water (0-5 m deep) than the near bottom layer (5-10 m deep) except in Station IV. Their averages during the whole period of investigation amounted to 15,920 and 9,830 org/m^3 for the two layers respectively. Their highest counts were recorded at the littoral stations particularly at stations I and II and they tended to decrease gradually southward. In addition to the littoral station V, the outer station VI-VIII sustained low counts particularly station VI. The monthly variations of tintinnids showed three peaks of abundance at most stations, mainly, in November, 1990; April and September, 1991. On the other hand, the winter (January & February) harboured the lowest counts (Fig. 3).

1 - Genus *Helicostomella* Jorgensen

***Helicostomella subulata* Ehr.** was the only representative of the genus in Suez Bay and it contributed numerically 52.75 % of the total tintinnids (average 6,790 org/m^3). The species showed its highest density in the surface water of stations I & II (averages 16,465 and 15,996 org/m^3 respectively), while station VI sustained the lowest counts at both layers (Fig. 4).

Seasonally, ***H. subulata*** showed a major peak of abundance in April, 1991 (averages 56,380 and 39,450 org/m^3 for the surface and near bottom layer respectively) and a lower one in November, 1990 (averages 32,780 and 24,520 org/m^3 for the two layers respectively). Moreover, it remained rare in the other months and was completely missing during February and May (Fig. 5).

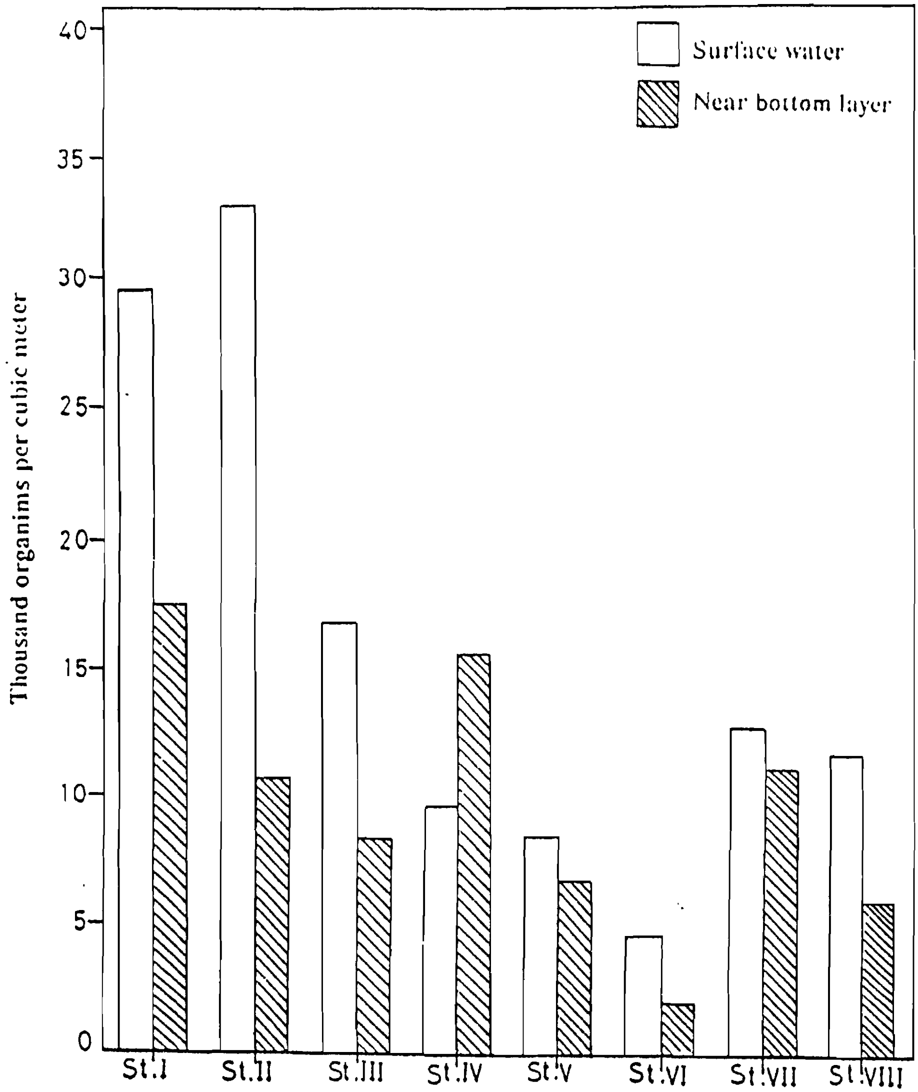

Figure 2: Average values of total tintinnids (organisms/m^3) recorded at the different stations in Suez Bay during the period October, 1990 - September, 1991.

The species is widely distributed along the coasts of south and north Europe and N.W. Africa (Marshall, 1969), Mediterranean (Jorgensen, 1924; Dowidar 1965) Gulf of Suez (Dowidar, 1974), South Red Sea near Massaua (Komarowasky, 1962) and along Dejeddah Coast (Jorgensen, 1924).

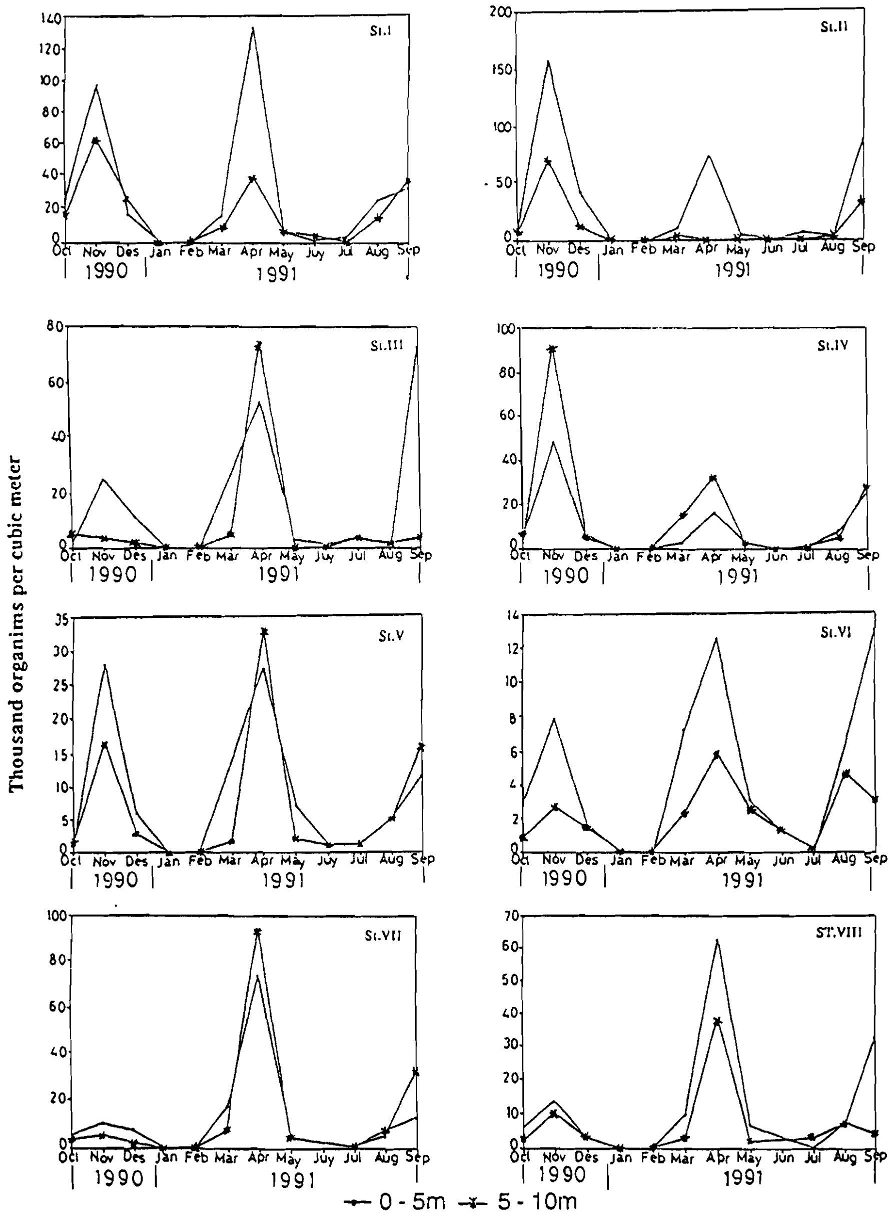

Figure 3: Monthly variations of total tintinnids (organisms/m^3) recorded at the different stations in Suez Bay during the period October, 1990 - September, 1991.

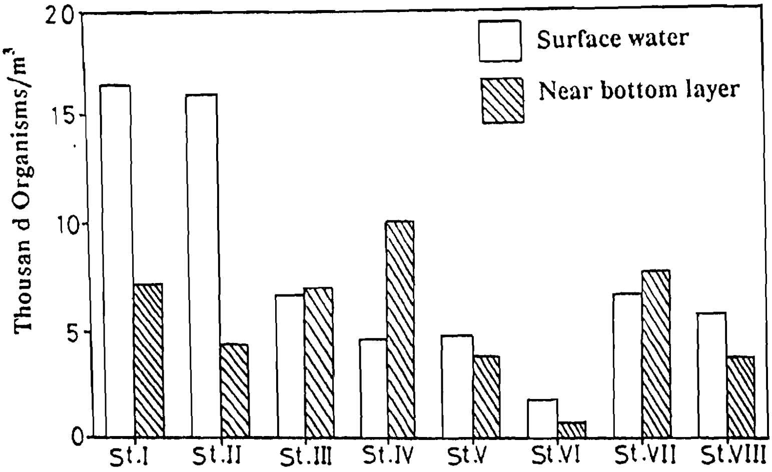

Figure 4: Average values of *Helicostomella subulata* (organisms/m^3) recorded at the different stations in Suez Bay during the period October, 1990 - September, 1991.

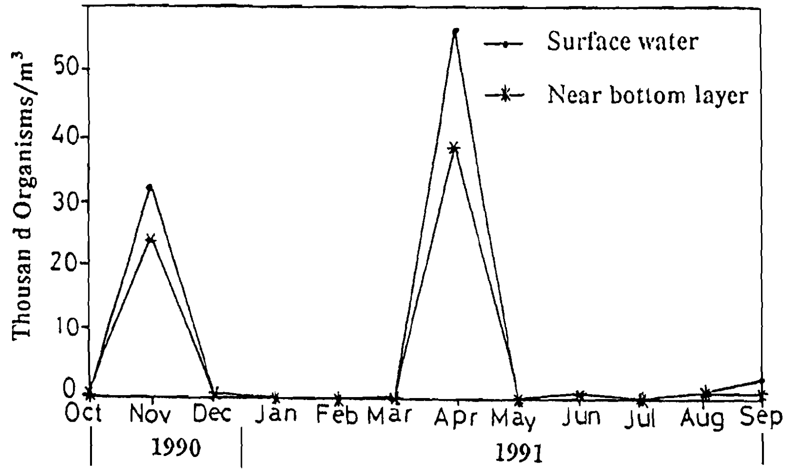

Figure 5: Monthly variations of *Helicostomella subulata* (organisms/m^3) recorded in Suez Bay during the period October, 1990 - September, 1991 (data represent average values of stations I - VIII).

2 - Genus *Tintinnopsis* Stein

The genus ***Tintinnopsis*** contributed 37.5 % of the total tintinnids (average 4,830 org/m^3) and it was represented by ***T. tubulosa***, ***T. cylindrica*** and ***T. tocatinensis.***

Tintinnopsis tubulosa **Lev.** formed 51.0 % of the genus counts (average 2,460 org/m^3). It appeared more dense at stations I and II while station VI sustained the lowest counts (Fig. 6). Its maximum persistence was recorded in autumn (September-November) as well as in March and May, 1991 (Fig. 7). The species is widely distributed along the coasts of Europe and N.W. Africa (Marshall, 1969), along the coasts of Florida (Cosper, 1972) and in the Red Sea (Halim, 1969), Suez Bay (Dowidar, 1974), Lake Timsah (El- Serehy, 1989), South Red Sea near Massaua (Komarowasky, 1962) and along Dejeddah Coast (Jorgensen, 1924).

Tintinnopsis clyindrica **Dad.** constituted 43.0 % of the genus counts (average 20,77 org/m^3). It appeared more frequent at the littoral stations I, II and III.

Seasonally, the species occurred abundantly during November and December, 1990 and it reached its maximum persistence in September, 1991 with 23,890 and 10,380 org/m3 in the surface water and near bottom layer respectively. Otherwise, it remained very rare between January and July (Fig. 7). ***T. cylindrica*** was previously recorded in the Mediterranean, Baltic and western Pacific (Cosper, 1972), Suez Bay (Dowidar, 1974) and in Lake Timsah on Suez Canal (El-Serehy, 1989).

Tintinnopsis tocatinensis **Kof. & Camp.** was less common and it constituted only 6.0 % of the genus counts (average 290 org/m^3). Its highest averages were recorded at station I (845 and 500 org/m^3 in the surface water and near bottom layer respectively). The species appeared mainly in autumn (October and November) and it attained a peak in March with averages of 2,210 and 1,260 org/m3 for the surface and near bottom layer respectively. It remained very scarce in the other months. ***Tintinnopsis tocatinensis*** was observed in south Atlantic (Balech, 1948), Suez Gulf (Dowidar, 1974), Lake Timsah (El-Serehy, 1989) south Red Sea near Massaua (Komorowasky, 1962) and along Dejeddah coast (Jorgensen, 1924).

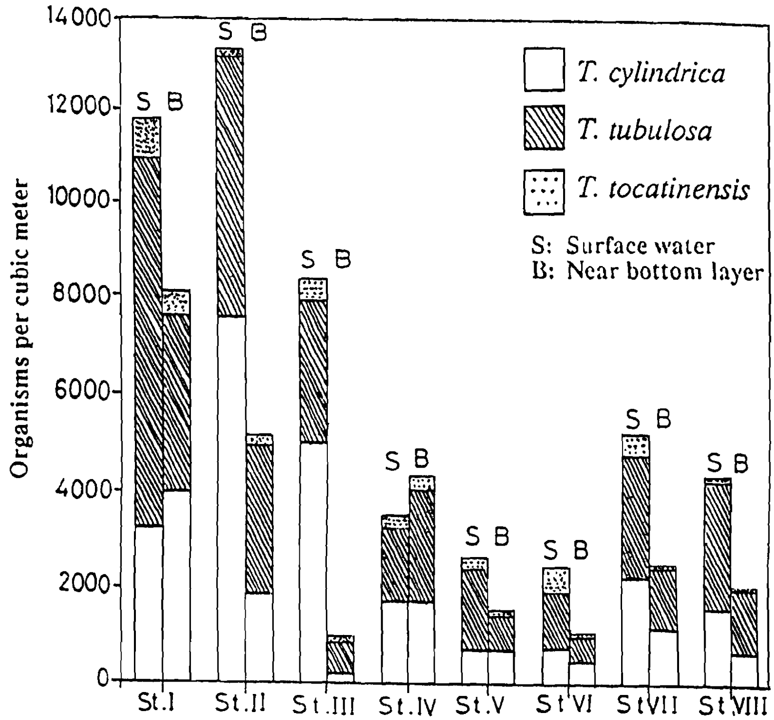

Figure 6: Average values of genus *Tintinnopsis* (organisms/m^3) recorded at the different stations in Suez Bay during the period October, 1990 - September, 1991.

3 - Genus *Favella* Jorgensen

The genus *Favella* formed 6.2 % of the total tintinnids in Suez Bay (average 800 org/m^3) and it comprised ***F. panamensis*** and ***F. ehrenbergii***. ***Favella panamensis*** constituted 60% of the genus counts (average 480 org/m^3). It appeared more frequent at the littoral stations I and II as well as at the outer station VII (Fig. 8). The species showed 2 peaks of abundance, namely; in December, 1990 andMarch, 1991 and it remained very rare during the rest of the investigation period (Fig. 9). ***Favella panamensis*** was previously recorded in the Pacific (Kofoid & Campbell, 1929), St. Andrew Bay (Hopkins, 1966), Red Sea (Halim, 1969), Lake Timsah (El- Serehy, 1989), South Red Sea near

Massaua (Komarowasky, 1962) and along Dejeddah Coast (Jorgensen, 1924). ***Favella ehrenbergii*** formed 40% of the genus counts (average 320 org/m^3). It appeared more frequent in the surface water of stations II, III, IV and VIII as well as in the near bottom layer of stations IV and V (Fig. 8). Seasonally, the species was frequently noticed during October and November (averages 550 and 400 org/m^3 respectively) and it reached a peak in September with 4,020 and 1,670 org/m^3 in the surface water and near bottom layer respectively (Fig. 9). It was missed in the other months. The species was recorded along the northern and southern coasts of Europe as well as N.W. Africa (Marshall, 1969) and in Lake Timsah (El- Serehy, 1989).

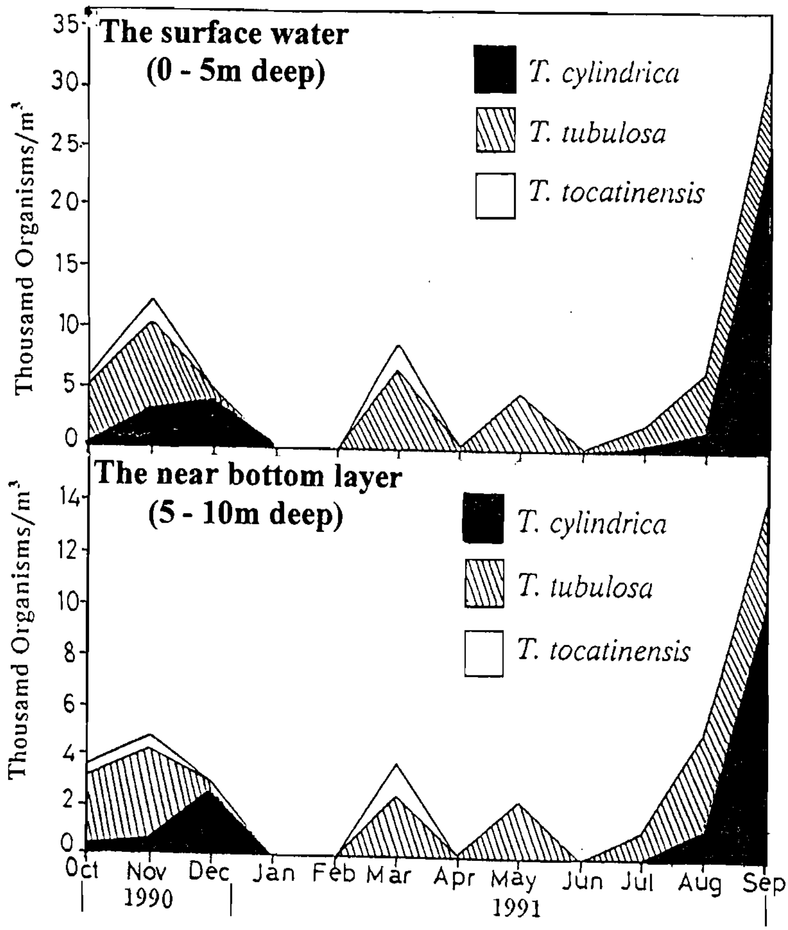

Figure 7: Monthly variations of *Tintinnopsis* (organisms/m^3) recorded in Suez Bay during the period October, 1990 - September, 1991 (data represent average values of stations I-VIII).

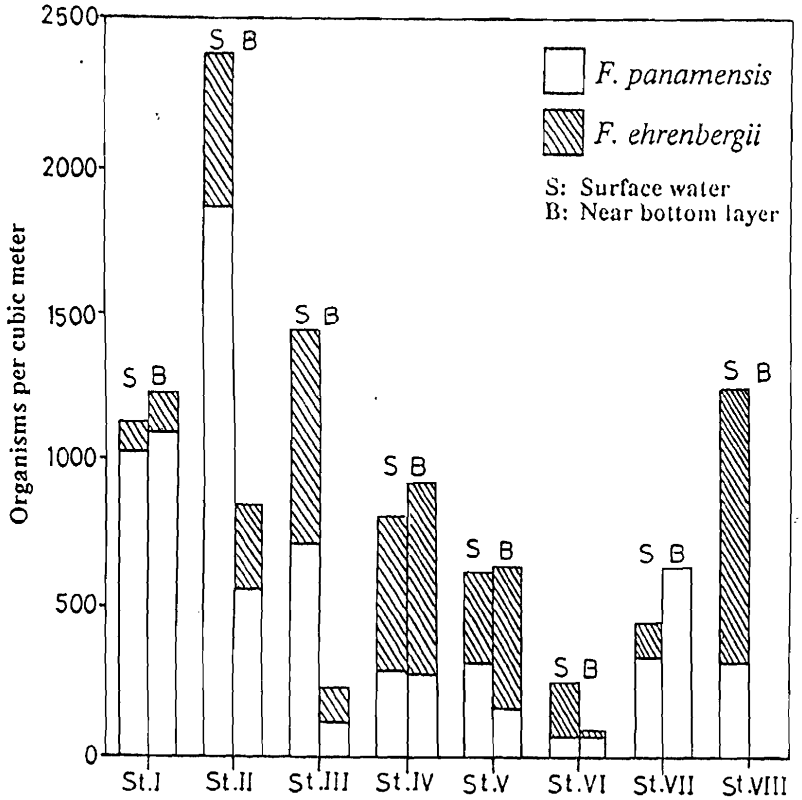

Figure 8: Average values of genus *Favella* (organisms/m^3) recorded at the different stations in Suez Bay during the period October, 1990 - September, 1991.

4 - Genus *Stenosemella* Jorgensen

Stenosemella sp contributed 3.2% to the total tintinnids (average 410 org/m^3). It appeared more frequent in the surface water of station II and near bottom layer of station I (Fig. 10). The species was mostly confined to the autumn and it attained its highest density of 3,210 and 3,280 org/m^3 in the surface water and near bottom layer respectively during November. It was missed in the other months except in March and April (Fig. 11).

5 - Genus *Tintinnus* Schkank

Tintinnus sp was rarely noticed at the different stations during September and October with averages of 91 and 511 org/m^3 for the surface water and 107 and 386 org/m^3 in the near bottom layer for these 2 months respectively.

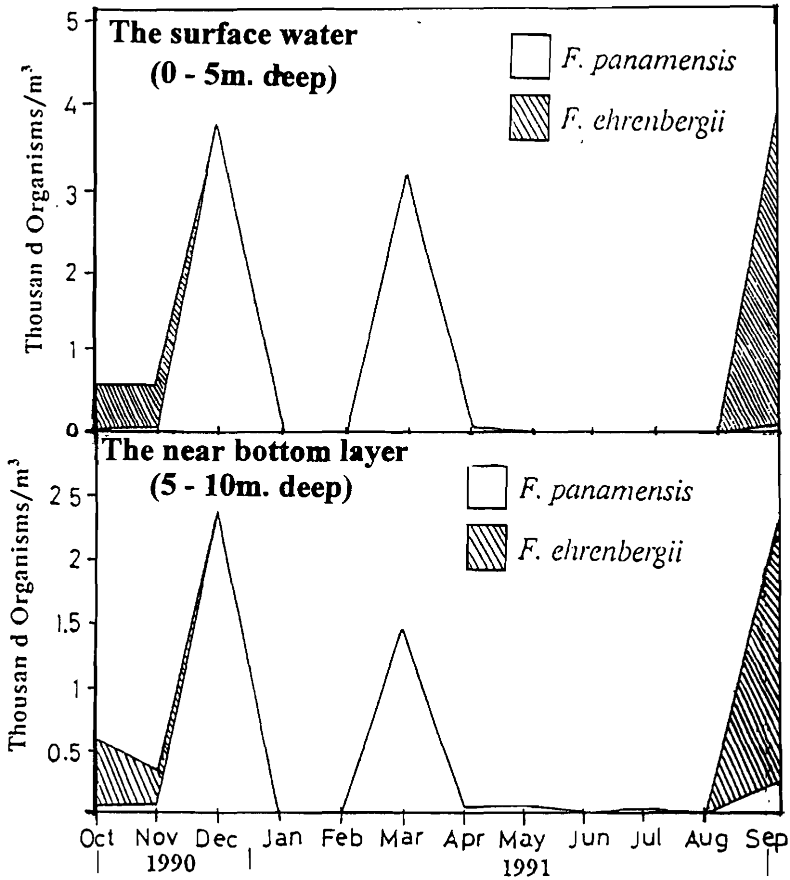

Figure 9: Monthly variations of Genus *Favella* (organisms/m3) recorded in Suez Bay during the period October, 1990 - September, 1991 (data represent average values of stations I-VIII).

6 - Genus *Metacylis* Jorgensen

Scattered specimens of ***Metacylis vitreoides* Kof. & Camp.** appeared at both layers of stations I, II and III during September and October. Its average during the period of investigation was only one org/m^3. The species was previously recorded in the Arctic Seas and Greenland Coasts (Marshall, 1969).

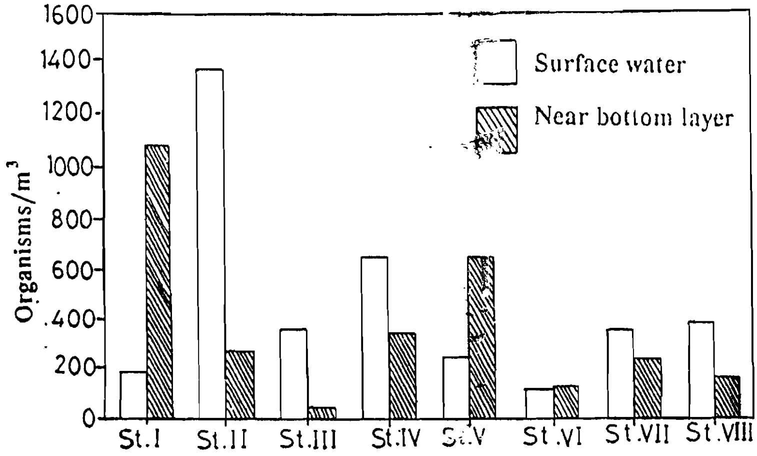

Figure 10: Average values of *Stenosemella* sp. (organisms/m3) recorded at the different stations in Suez Bay during the period October, 1990 - September, 1991.

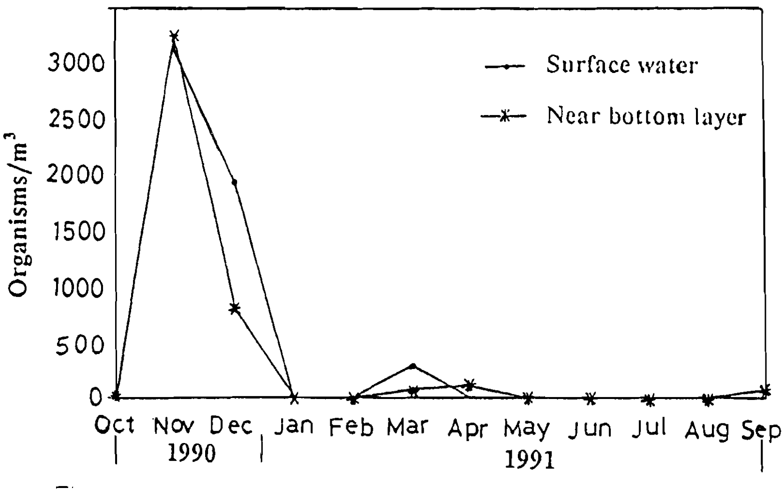

Figure 11: Monthly variations of *Stenosemella* sp. (organisms/m3) recorded in Suez Bay during the period October, 1990 - September, 1991 (data represent average values of stations I-VIII).

7 - Genus *Codonellopsis* Jorgensen

***Codonellopsis lusitanica* Jorg.** was also rarely noticed at stations I, II, III and VI during September with an average of 150 org/m^3. The species was previously recorded in Mediterranean (Jorgensen, 1924) and along the coasts of south Europe and N.W. Africa (Marshall, 1969). It is a new record in Suez Bay.

II - Foraminifera

Foraminifera formed only 0.15 % of the total protozoan counts (average 19 org/m^3) and it was represented by ***Globigerina*** sp. and ***Textularia*** sp. ***Globigerina*** sp. was infrequently recorded in the surface water of station I and VII which sustained annual averages of 61 and 32 org/m^3 respectively. Otherwise, it remained very scarce in the other stations. The species showed maximum persistence in September when it reached 144 org/m^3 in the surface water and 108 org/m^3 in the near bottom layer. Its average for the whole period of investigation amounted to 13 org/m^3. ***Textularia*** sp. occurred scarcely and was mostly confined to stations VII and VIII. It appeared mainly in September (average 61 org/m3) and it averaged 6 org/m^3 for the whole investigation period.

III - Acantharea

Acanthochiasma kroh. was the only acantharean Protozoa recorded in the bay. It appeared once in September at stations III and IV and was represented by 6 specimens/m^3. The pecies was previously recorded in the southern Red Sea (Cleve, 1900 and 1903).

DISCUSSION

The zooplankton population of Suez Bay was mainly represented by three major groups, namely; Copepoda which constituted numerically 60.8% of the total population, followed by Protozoa (31.4 %) and Tunicata (4.5%) while the other components remained infrequent or rare (Abd El-Rahman, 1993). This agrees with the observations of Blanco ***et al*** (1990) who recorded copepods and tintinnids as being the most abundant taxa in polluted waters.

Tintinnids are widespread ciliated protozoa, populating both the neritic and oceanic regions of most seas and feeding chiefly on phytoplankton (Beers & Stewart, 1967, 1969 & 1971; Zeitzschel, 1969; Johansen, 1977 and Kimor & Golandsky-Baras, 1977 & 1981). They constituted numerically 99.85 % of the total Protozoa in Suez Bay with an average of 12,870 org/m^3.

The most important environmental conditions controlling the spatial and seasonal distribution of tintinnids include temperature and salinity as well as other biological factors such as food supply and predation (Smetacek, 1981; Robertson, 1983; Sanders, 1987 and Verity, (1987). Several authors noticed that the maximum abundance of tintinnids occurs at relatively high temperature (Capriulo and Carpenter, 1983 and Verity, 1987). In Suez Bay the peaks of tintinnids were recorded in November, 1990, April and September, 1991 at temperature ranging between 21.7 and 26.5°C. Higher temperatures over 27.0°C and lower values below 19.0°C were found to be unfavourable for their flourishing.

The bay is regarded among the relatively high saline water habitats and its salinity ranged mostly between 41.10 and 42.80. The lower salinity values were observed at the littoral station III as a result of inland discharge into the area. The tintinnid peaks occurred at salinities ranging between 41.37 and 42.40. Higher salinities over 42.5 appear to reduce the growth of tintinnids. This is similar to the observations of Dowidar (1974) in the Bitter Lakes where their high salinity reduced tintinnid abundance.

Also, predation affects the abundance of tintininds as they constitute significant food source for fish larvae (Zeitzschel, 1969 and Damodara Naidu, 1983), euphasiids (Capriulo & Ninivagii, 1982), copepods (Turner and Anderson, 1983), cladocerans and mollusc larvae (Damodara Naidu, 1983) and ctenophores (Stocker ***et al.***, 1987). This may explain the reduced counts of tintinnids recorded at station V which was accompanied by high density of copepods, while the higher values of tintinnids observed at station I coincided with lower counts of the other Zooplankton components. The seasonal variations of the total zooplankton counts in the bay showed also maximum abundance of copepods and tunicates in summer which in turn reduced the density of tintinnids (Abd El-Rahman, 1993)..

The most dominant species ***Helicostomella subulata*** showed 2 peaks of abundance during April and November and these were accompanied by a general decrease in the number of the other zooplankton components particularly tunicates.

The taxonomic composition of the planktonic protozoa in Suez Bay was generally similar to that recorded in the other coastal areas with ***Helicostomella, Tintinnopsis*** and ***Favella*** being the dominant genera (Smetacek, 1981, Revelant & Gilmartin, 1983, 1987 and Verity, 1987).

Diversity has always been used as an index of ecosystem well beings with species rich communities being healthier than those poor in species numbers (Magurran, 1988). In Suez Bay, the zooplankton community comprised 63 species of which 13 protozoan species were enumerated. The diversity index of the population remained low and it fluctuated between 1.03 and 3.59 with annual average of 2.02 (Abd El- Rahman, 1993). This may be attributed to the relatively rapid environmental changes that may prevent the survival or reproduction of the non-tolerant species. Also, the different pollutants discarded into the bay (mineral oil, sewage and industrial wastes) may participate in the low species diversity. Seasonally, the diversity index appeared relatively low in November (average 2.08), April (1.72) and September (1.89) when the tintinnid population peaked as a result of the increased density of only one or few species.

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