

DISTRIBUTION OF ZOOPLANKTON COMMUNITIES IN THE SWASH ZONE ALONG THE MEDITERRANEAN COAST OF PORT-SAID (EGYPT).

BY

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ABSTRACT

Quantitative and qualitative estimations of zooplankton along the Swash zone of the Mediterranean Coast of Port-Said were carried out monthly during the period from July, 1992 to June, 1993 with the exception of November. The investigated area receives brackish water from Lake Manzalah.

Results prove that protozoans contributed the highest percentage (36.5 % of the total zooplankton counts) followed by crustaceans of both marine and brackish water forms (32.0%). Rotifers and coelenterate larvae appeared frequent. Coelenterates were dominant during summer while, rotifers prevailed in winter. Insects, polychaets, echinoderm larvae, mollusc veligers, nematods, Chaetognaths, and pelagic tunicates were rarely recorded. The annual average of the total zooplankton community reached 443,000 organisms/m³. Results revealed that the studied region is eutrophic as by sewage discharged from the neighbouring Port-Said City as well as the brackish water discharged from Lake Manzalah.

INTRODUCTION

The investigated area lies along the Mediterranean Coast of Port Said (Egypt) between El-Deeba in the West and the Suez Canal and Port Fouad in the East between longitudes 32° 6' and 32° 20' E and at latitude 31° 21' N. It has a shore line of about 28.5 Km at the Swash zone with average depth of 100 cm (Fig.1).

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The area is characterized by smooth bottom sediments of fine black silty sand. Few recent studies had been carried out at the offshore of this area, dealing with the different zooplankton components namely; Coelenterates

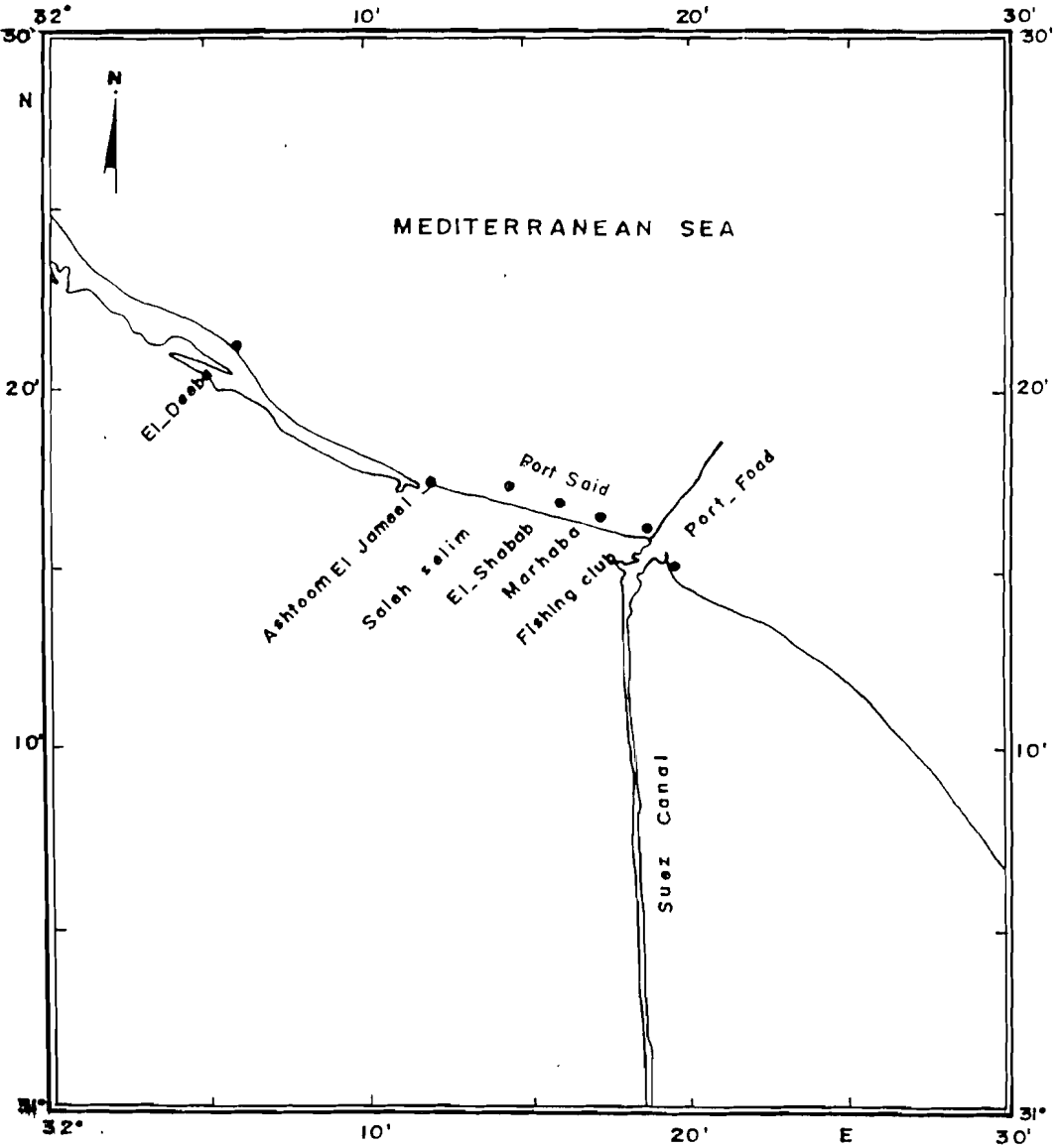


Figure 1: Location Map.

(Dowidar, 1981), copepods (Nour El-Din, 1987), and zooplankton groups other than copepods (Zakaria, 1992). However, no plankton estimations were performed in the very near shallow coastal water.

The investigated area receives a constant discharge of brackish water from Lake Manzalah through El-Gamil outlet which is contaminated by domestic sewage effluents of the neighbouring Port Said City.

The aim of the present study is to estimate the community composition and distribution of the different zooplankton groups in such shallow coastal area.

MATERIAL AND METHODS

Quantitative and qualitative estimations of zooplankton organisms were performed monthly along the shore line of Port Said (Egypt) from July, 1992 to June, 1993 with the exception of November.

Seven stations were selected as representing the different localities in the region, namely; El-Deeba (St I), El-Gamil (St II), Saleh Selim (St III), El-Shabab (St IV), Marhaba (St V), Fishing Club (St VI) and Port Fouad (St VII) as shown in figure (1).

Surface samples were collected from the Swash zone of the area which attained an average depth of about one meter. 100 liters of sea water were filtered at each station through a small standard phytoplankton net No. 25 (mesh size 55 micron). The collected samples were preserved directly in 4 % formalin solution. The volume of each sample was concentrated to 100 ml and subsamples of 2 ml or 1 ml (according to the concentration of zooplankton) were transferred into a counting cell and the different species were identified and counted using a binocular research microscope.

The standing stock of the zooplankton population was calculated as their total numbers per cubic meter.

For identification of the different zooplankton groups the following references were consulted; Gurney (1932, 1933), Rose (1933), Thompson (1948), Tregouboff and Rose (1957), Edmondson (1959), Newell and Newell (1963, 1979), Gonzalez and Bowman (1965), Williamson (1967), Marshall (1969), Riedl (1970), Hickman (1973), Smith (1977) and Laverack and Dando (1987). Protozoans were classified according to the new system of Lee, Hutner and Bovee (1985), while the other phyla were classified according to Yamazi (1971) and Omori & Ikeda (1984). The water salinity and temperature were measured directly in the field and given by (El-Deek *et al.*, 1994).

RESULTS

1. The hydrographic conditions:

The water salinity and temperature are considered among the most important factors that control the distribution and abundance of the different zooplankton components.

The monthly water salinity fluctuated mostly between 27.8‰ and 37.3‰. Exceptional lower salinity values which ranged from 12.5‰ to 16.5‰ were recorded at El-Gamil station during the period March to May as a result of the dilution effect of the brackish water flowing from Lake Manzalah into the sea through El-Boughaz opening. On the other hand, El-Deeba and Port-Fouad stations, being away from the inland discharge, sustained the highest salinity values (Table 1 & Figure 2).

The annual amplitude of temperature ranged from 12.5 °C in February to 28.5°C during August with annual average of 20.2 °C (Table 2). Low salinity values coincided with highest temperature in July, while both the minimum temperature and minimum salinity were recorded in January as shown from the Salinity-Temperature diagram (T-S) illustrated in figure (3).

Community composition and distribution of zooplankton :

The zooplankton population recorded during the present investigation comprised 95 taxons. The annual average of the total zooplankton amounted to 443,000 organisms/m³ (Tables 3 & 4). They were mostly confined to four main groups, namely; Protozoa, Coelenterata, Rotifera and Crustacea. Other planktonic organisms including Appendicularia and Chaetognatha, meroplanktonic larvae of molluscs, polychaetes, echinoderms, insects, ascidians and free living nematods were rarely recorded.

The monthly variations of the zooplankton population along the investigated area are given in Table (5) and figure (5). An outstanding peak was recorded in April (average 1,575,000 organisms/m³). This peak was dominated by protozoans especially tintinnids which contributed more than 92 % of the total population. Other increases were also observed during the period July-September, 1992 and in June, 1993. The July increase consisted mostly of different developmental stages of coelenterates, forming about 80 % of the total zooplankton community. On the other hand, the August, September and June peaks were dominated by crustaceans which contributed about 66%, 58 % and 60 % of the total zooplankton counts respectively.

Table (1): monthly distribution of salinity recorded at the different stations.

Months Stations	June 1993	July 1992	Aug.	Sept.	Oct.	Dec.	Jan. 1993	Feb.	March	April	May	Average
I. El-Deeba	36.5	30.61	38.03	39.11	39.0	33.5	36.5	36.5	32.5	39.5	38.8	36.41
II. El-Gamil	38.5	26.5	38.95	36.0	37.5	32.5	25.2	26.0	12.2	16.1	16.5	27.8
III. Saleh Selim	39.0	25.68	38.51	32.31	35.6	35.0	25.5	36.5	32.5	38.1	39.0	34.33
IV. El-Shabab	38.6	27.43	35.49	29.41	35.5	36.5	20.0	36.5	32.5	39.1	39.6	33.70
V. Marhaba	39.0	26.3	37.71	29.68	36.5	38.5	26.5	37.0	32.5	38.5	39.5	34.70
VI. Fishing Club	38.5	27.79	35.71	32.89	36.5	38.5	21.0	37.5	32.5	32.8	39.4	33.90
VII. Port-Pouad	38.5	28.5	38.7	39.5	39.0	39.2	33.0	37.5	38.5	39.8	38.5	37.33
T.av.	38.37	27.54	37.58	34.13	37.08	36.24	26.8	35.36	30.46	34.84	35.9	34.02
Seasonal average	34.5 ‰		35.6 ‰		32.8 ‰			33.7 ‰				

Table (2): Average monthly water temperature (oC).

Months	June 1993	July 1992	Aug.	Sept.	Oct.	Dec.	Jan.	Feb.	March	April	May	Average
Average Water Temperature	23.5	27.5	28.5	22.0	21.5	14.0	13.0	12.5	18.5	20.5	21.0	20.22
Seasonal average	26.5 oC		21.8 oC		13.2 oC			20.0 oC				

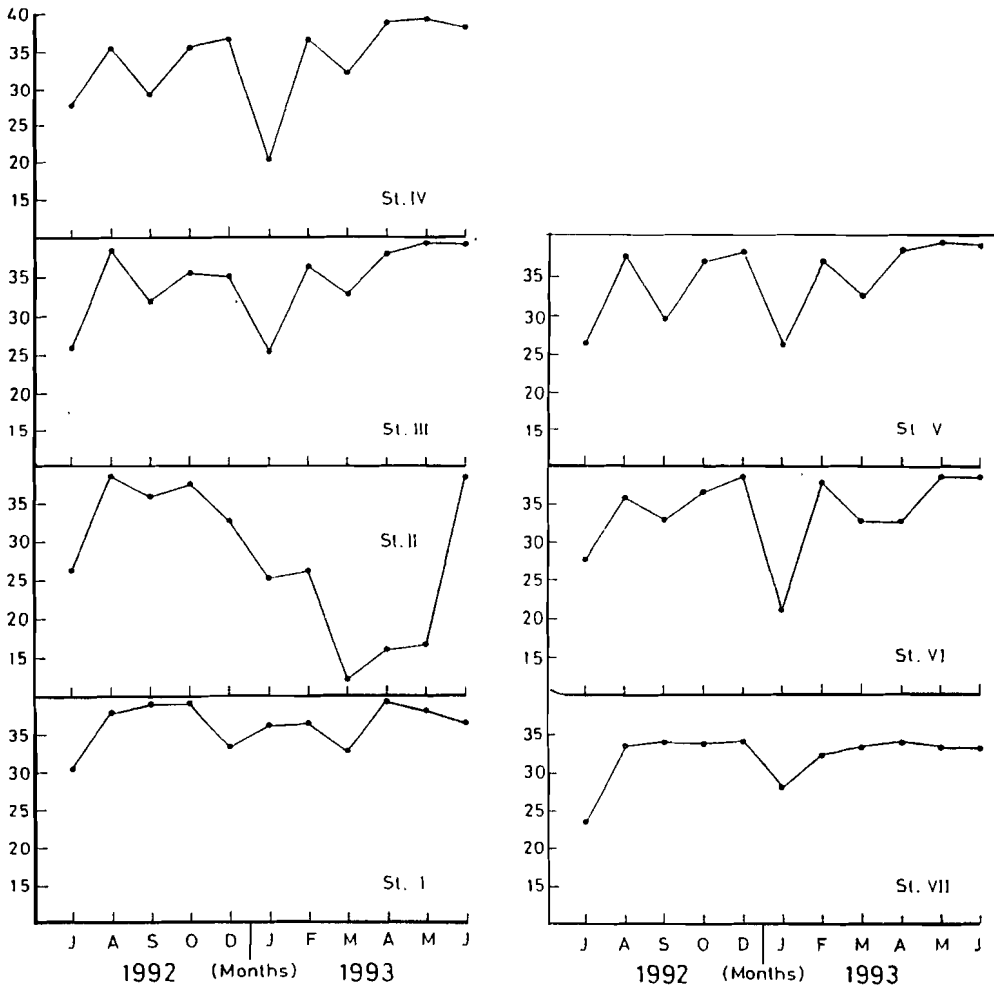


Figure (2): Distribution of Salinity at the different stations near Port Said from July 1992 to June 1993.

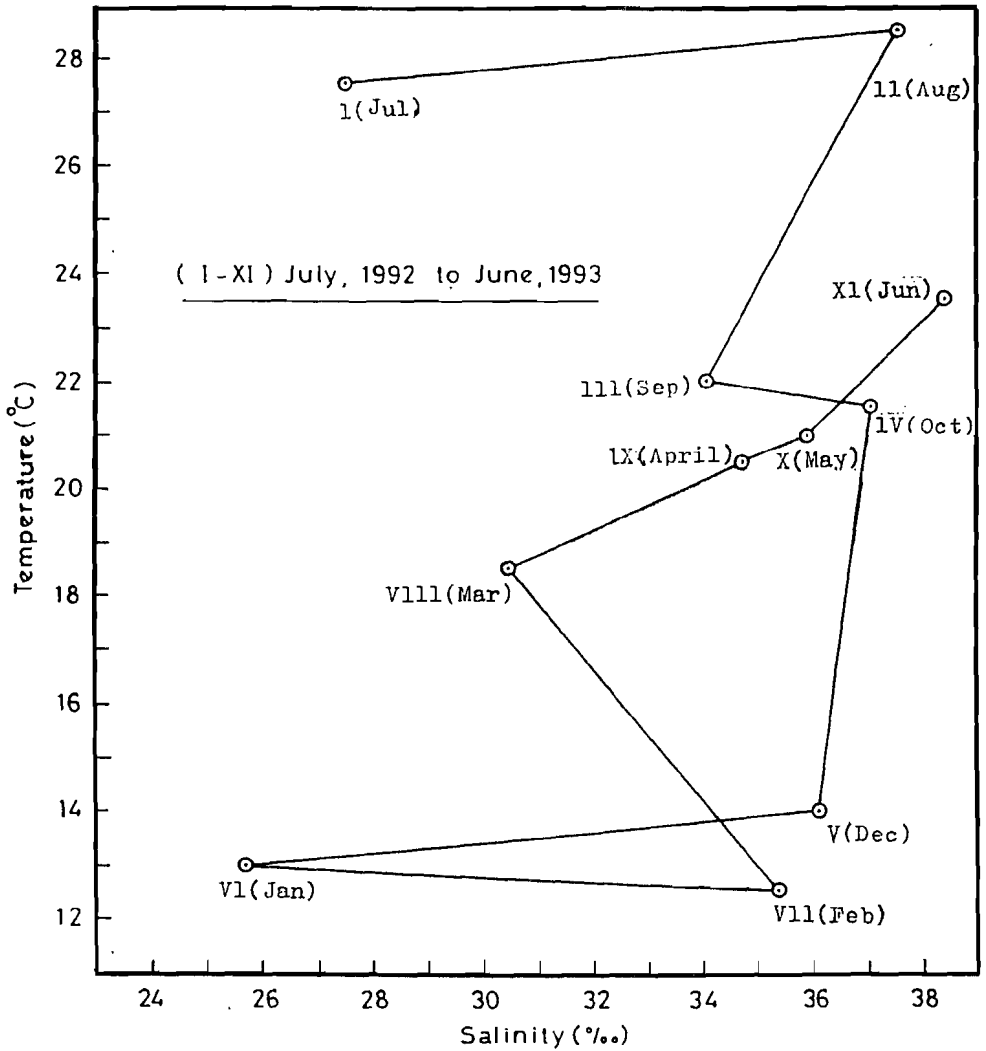


Figure (3): Salinity-Temperature diagram (T-S) for the surface water near Port Said from July 1992 to June 1993.

The distribution of the zooplankton population at the different stations during the four seasons is illustrated in figure 6 (a-d). The peak of abundance recorded in spring was confined to station IV (average 3,515,500 organisms/m³) and it consisted mostly of protozoans. The summer and autumn were dominated by crustaceans with 43.8 % and 62.7 % of the total population respectively. Other wise, rotifers contributed the main components in winter at station II.

Distribution of the different groups of zooplankton:

1. Protozoa

Protozoans contributed about 36.5% of the total zooplankton community (average 154,200 organisms/m³). They appeared more dominant in spring forming 66.3 % of the total population (Fig. 7). They were represented in the area by Ciliophora and Rhizopoda. Tintinnidea predominated the other protozoans.

A. Ciliophora

1. Tintinnidea (Chonotrichida)

Tintinnids appeared all the year round with an annual average of 143,000 organisms/m³ and contributed about 32.3 % of the total zooplankton community. The order was represented by 19 species namely; Tintinnopsis cylindrica (Dod), T. campanula (Ehr.), T. beroidea (St.), T. minuta (Wailes), T. nordiguisti (Nordovist), Favella ehrenbergi (Claperede & Lachmann) , F. serrata (Mob.), Cymatocylis mediterranea (Kofoid & Campbell), Parafavella subdentata (Jorgensen), P. denticulata (Ehr.), P. cylindrica (Jorgensen), P. digitalis (Kofoid & Campbell), Stenosemella ventricosa (Claperede), Codonellopsis lusitanica (Jorgensen), C. ecaudata (Brandt), Tintinnus virteus (Brandt), T. latus (Jorgensen), Helicostomella subulata (Ehr.) and Metacylis vitreoides (Kofoid & Campbell).

Their highest counts appeared at El-Shabab station particularly in spring. On the other hand, Port Fouad station harboured the least density of tintinnids (average 3950 organisms/m³) and they were restricted to the months September, March and April. Seasonally, the highest density of tintinnids was observed in April (average 1,471,286 organisms/m³) mainly due to the increased numbers of Stenosemella ventricosa at most stations with its predominance at El-Shabab station and less so at Marhaba and Saleh Selim stations. The species appeared also at El-Deeba in May. In general, the species was the dominant tintinnid forming 79 % of their total counts, although, it was recorded only in April and May parallel to the increased concentration of phosphate produced by sewage discharge (El-Deek *et al.*, 1994).

Table (3): Monthly distribution of the total Zooplankton recorded at the different stations (organisms/m³) from July, 1992 to June, 1993.

Months stations	El-Deeba	El-Gamil	Saleh Selim	EL-Shabab	Marhaba	Fishing Club	Port Fouad	T. av.
July 1992	7040	9750	1021500	736000	1560000	568500	14000	559540
August	---	472500	734000	869000	718000	451000	326000	595080
September	256000	680000	708000	1052000	291000	499500	379500	552290
October	392000	202020	136000	130000	80110	724000	166000	263170
November	---	---	---	---	---	---	---	---
December	1500	10500	34500	3000	12000	0	345000	13710
Jan 1993	1500	258000	1500	1500	1500	10500	4500	39860
February	0	192000	---	---	---	43500	1500	59260
March	157500	466500	249000	703500	111000	361500	390000	348870
April	70500	127540	597000	9670500	427500	85500	45000	1574780
May	220500	649500	660000	172500	87040	370500	298500	351220
June	156000	484500	351750	503250	356250	689250	306730	406810
Total	126260	322980	449330	1384120	364440	345790	178750	443000

--- not collected

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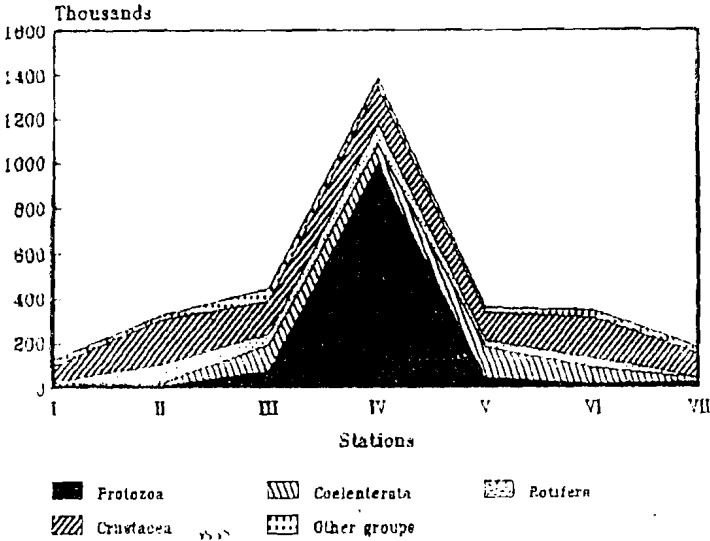


Figure (4): Average annual values of the Zooplankton groups/in thousands org./m³ recorded at the different Station.

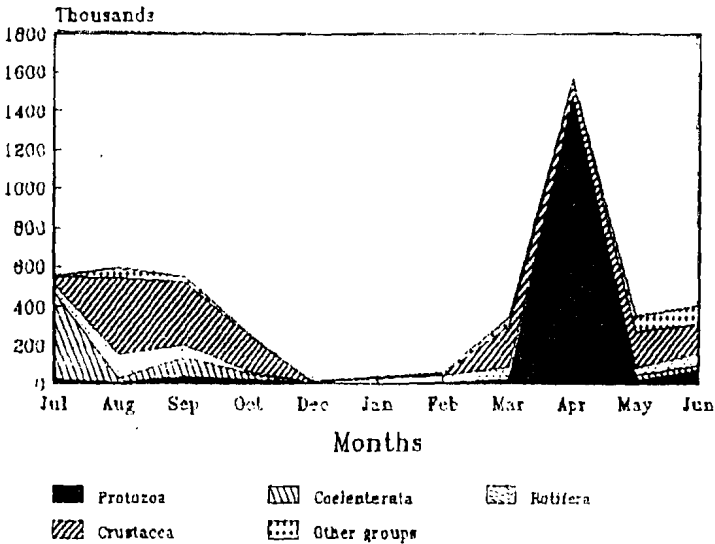


Figure (5): Monthly variations of the Zooplankton groups org./m³ recorded during the period July 1992-June 1993.

Table (4): Average annual values of the different groups of zooplankton (organisms/m³) recorded at the different stations during the period July, 1992 - June 1993.

Stations Groups	El-Deeba	El-Gamil	Saleh Selim	El-Shabab	Marhaba	Fishing Club	Port Fouad	T. av.	%
Protozoa	11280	8250	75550	993970	46320	18790	26430	168650	37
Coelenterata	11850	7700	118380	91850	138550	69320	14590	64600	14
Rotifera	1850	87070	46000	84380	28030	45090	4090	42360	9.4
Crustacea	75130	201500	152170	176550	124690	179860	106640	145220	32
Insecta	0	2180	520	100	80	0	0	410	0.1
Polychaeta	10250	7090	29480	21420	5820	15680	1730	13070	2.9
Nematoda	230	480	700	950	300	820	290	540	0.1
Mollusca	15220	5590	24080	9280	13970	12820	23040	14860	3.3
Tunicata	300	2800	2450	5620	6680	2320	1800	3138	0.7
Other groups	150	320	0	0	0	1090	140	243	0.05
Total	126260	322980	449330	1384120	364440	345790	178750	453000	

Table (5): Monthly variations of the different groups of Zooplankton (organisms/m³) recorded from July, 1992 to June, 1993. (Data represent average values of stations I-VII).

Months Groups	July 1992	August	Spet	Oct.	Dec.	Jan 1993	Feb	March	April	May	June	T. av.	%
Protozoa	24640	8830	36790	27710	9640	860	1500	16290	1474070	16500	79290	154190	36
Coelenterata	451410	18940	100860	27140	210	0	3750	4930	4070	34500	19390	60470	14
Rotifera	38540	126830	66070	10290	0	34070	38630	66860	210	37500	59140	43470	10
Crustacea	36000	390420	319860	190020	640	3860	4500	216640	76280	186430	154810	143600	33
Insecta	0	170	0	0	0	0	6000	0	10	0	860	640	0.1
Polychaeta	1360	18420	3640	4000	0	0	0	2360	8570	68570	29890	12440	2.9
Nematoda	700	1300	210	860	430	860	1130	0	0	210	540	570	0.1
Mollusca	6640	29920	23500	2860	2790	210	3750	41790	11360	7290	30430	14590	3.3
Tunicata	250	0	1360	0	0	0	0	0	210	220	30320	2940	0.7
Other groups	0	250	0	290	0	0	0	0	0	0	2140	240	0.05
Total	559540	595080	552290	263170	13710	39860	59260	348870	1574780	351220	406810	433000	

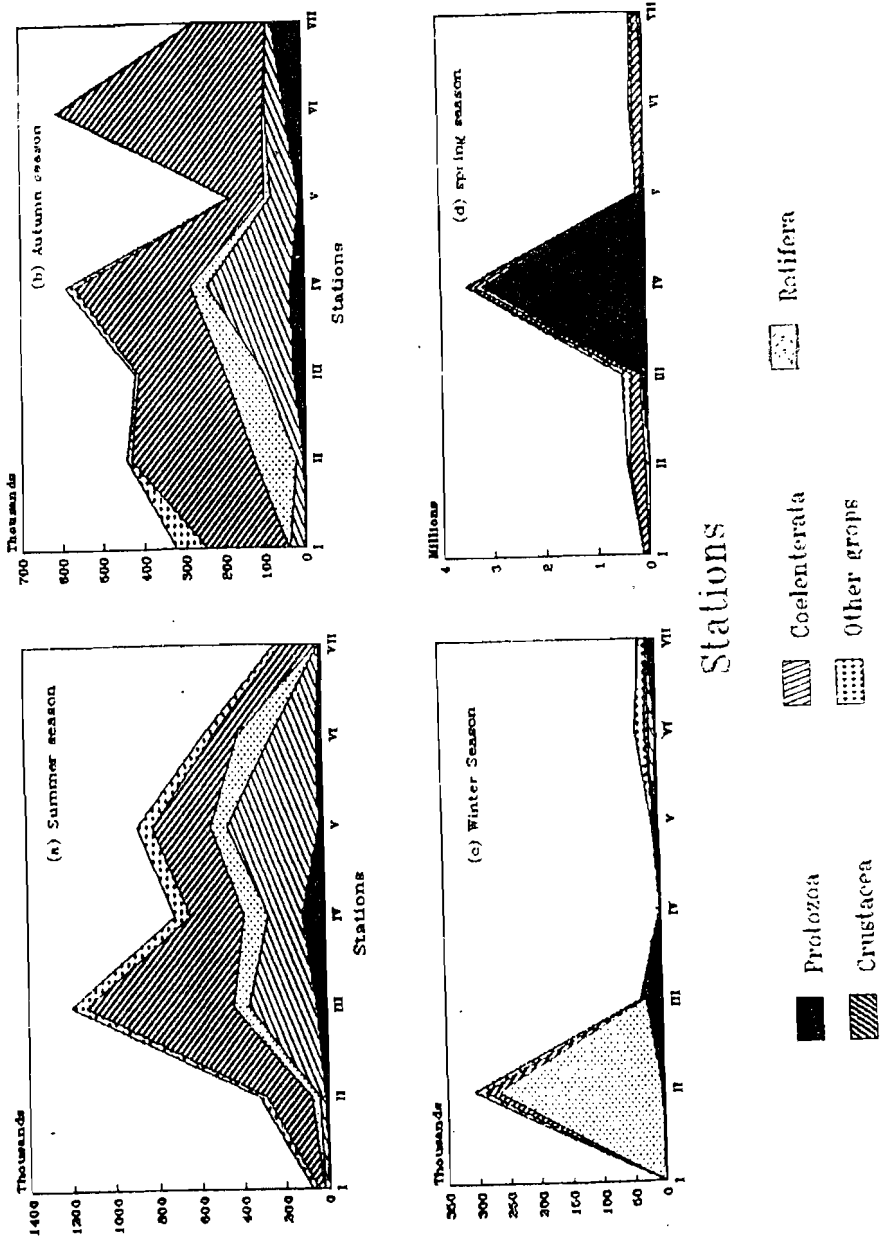


Figure (6): Distribution of the total zooplankton groups (org./m³) recorded at the different stations in four seasons.

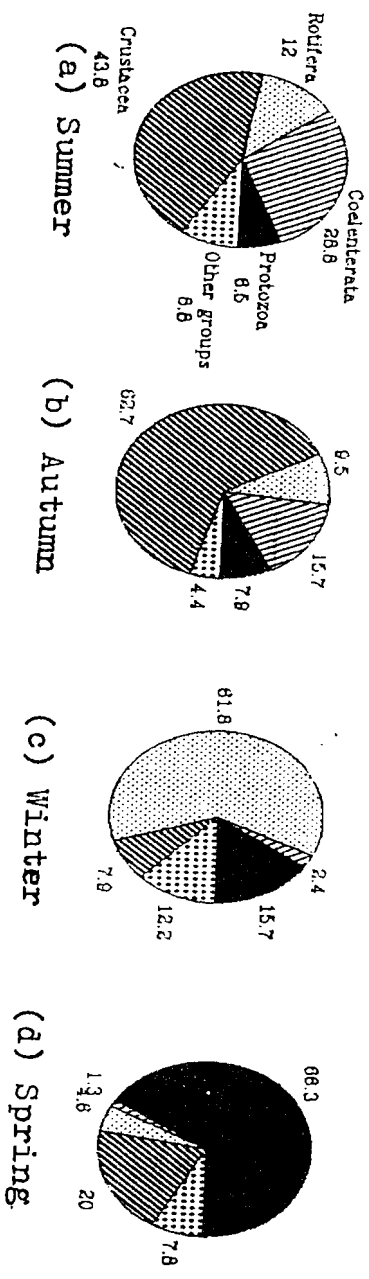


Figure (7): Percentage frequency of the dominant groups of zooplankton during different seasons.

Other tintinnid species such as Tintinnopsis beroides, T. campanula, Tintinnus virteus and Favella spp. appeared frequently at most stations in the different seasons. The rest of the tintinnid spp were persisted in low counts particularly during winter. Several environmental conditions appear to control the regional and seasonal variations of tintinnids and these include biological factors such as food supply and predation as well as the prevailing physico-chemical conditions like temperature, salinity and dissolved oxygen (Smetacek, 1981; Robertson, 1983; Sanders, 1987 and Verity, 1987). Generally, temperature is the main factor determining the distribution of tintinnids. Many authors observed that the maximum tintinnid abundance is associated with high temperature (Capriulo and Carpenter, 1983 and Verity, 1987). In the investigated area, the optimum temperature for flourishing of tintinnids ranged between 20.5 °C and 21.0 °C and the optimum salinity range was between 32.8 ‰ and 39.4 ‰. On the other hand, low temperature and salinity were unfavorable for the development protozoan groups particularly tintinnids. The amount of dissolved oxygen appears also to have a pronounced influence on the distribution of tintinnids. Thus, the highest values were recorded in spring parallel to the increased density of tintinnids (El-Deek et al., 1994).

2. Ciliata (Holotrichida):

Members of the order Ciliata contributed numerically 1.1 % of the total protozoa with annual average of 1699 organisms/m³. They appeared more frequent during May and June at an average water temperature of 22 °C and Salinity of 38.9 ‰, and in December at 14 °C and 38.5 ‰. They were recorded in considerable numbers at Port-Fouad, El-Shabab and Fishing Club stations and were represented by nine species namely; Platyophrya sp, Plagiopyla sp, Spirozoona sp, Cohnilembus, Paruroleptus, Oxytricha fallax (Stein), Vorticella companula (Ehr.), Endosphaera sp and Disematostoma.

Seasonally, their maximum persistence was recorded at Saleh-Selim and Port-Fouad stations in December, mainly due to Cohnilembus sp. Two other increases appeared in May at Port-Fouad as produced by Endosphaera and Spirozoona, and during June at El-Shabab and Fishing Club stations due to Oxytricha fallax and Endosphaera sp. Otherwise, Vorticella and zooflagellates appeared very rare during scattered months.

B. Rhizopoda

Rhizopoda was represented in this study by the orders Foraminiferida and Amoebaea.

1. Foraminiferida.

Members of Foraminifera appeared all the year round at all stations and contributed 1.3% of the total zooplankton population with annual average of 5911 organisms/m³. They appeared more dominant during September, October and June. They were missed in July but contributed low counts throughout the rest of the year. El-Shabab and Port-Fouad stations harboured their high counts, where the surface sediments at these stations have high content of fine black sand. The order comprised Ammonia beccarii (Linnaeus), Eliphidium sp. and Globigerina sp.

2. Amoebaea

These rhizopods constituted collectively 0.4 % of the total zooplankton population (average 1,711 organisms/m³). They comprised Centropyxis aculeata (Ehr.), C. constricta (Ehr.), C. ecornis (Ehr.), C. aerophila (Deflandre), Diffflugia oblonga (Ehr.) and D. lebes (Penard). They appeared more frequent during autumn (average 3,285 organisms/m³) and spring (average 1786 organisms/m³) at an average water temperature of about 20.8 °C and salinity 34.8 %. On the other hand, they were rarely observed in summer and winter. Centropyxis ecornis and Diffflugia oblonga were the most common species especially at Port-Fouad, Saleh Selim and EL-Shabab stations.

II. Coelenterata (Cnidaria)

Coelenterates comprised the classes Hydrozoa and Scyphozoa. They appeared in considerable numbers during summer (28.8 % of the total zooplankton) and less so in autumn (Fig. 7).

A. Hydrozoa:

Hydroida was mainly represented in the area by the hydroid polyps of Obelia spp. and Aglaephenia elongata, medusae of Obelia spp., Gymnoblasic hydroid of Bougainvillia and, Gymnoblaster of Penneria. Planktonic stages of these Coelenterates, such as Blastula and planula larvae were frequently observed. These hydrozoans contributed about 13.9 % of the total zooplankton (average 62,750 organisms/m³). Parts of Obelia colonies appeared as the most dominant group in July forming 82.3 % of the total zooplankton population especially at El-Shabab station.

Their numbers decreased sharply during August then showed light increase in September. Generally, these hydroids with different stages attained their maximum abundance with rising temperature during summer.

Siphonophores appeared scarcely in the collected samples with annual average of 312 organisms/m³. They were recorded during August-October and were represented by three species, namely; Eudoxaides spiralis (Bigelow), Lensia conoidea (Sars) and Apylopsis tetragona (Otta).

B. Scyphozoa:

Floating Scyphozoa were represented in the area of investigation by two adult species of Aurelia aurita (Lam.) with average diameter of 45 cm and Rhizostoma pulmo (Agassiz) having 92 cm diameter in average.

Small sized Scyphistoma and Scyphistoma hydrotube stages were recorded in the plankton collections beside planula larvae of Aurelia in August at Saleh Selim and Marhaba stations and in September at Marhaba station. They contributed collectively 10,405 organisms/m³ in average. Planula larvae of Aurelia were rarely estimated during May and June (average 535 organisms/m³). The annual average of their occurrence in the plankton samples did not exceed 0.4 % of the total population (average 1,898 organisms/m³).

III. Rotifera

The rotifer population contributed about 14.3 % of the total zooplankton community with annual average of 60732 organisms/m³. They predominated the other zooplankton components during winter (Figure 7). They were represented by 12 species, namely; Keratella quadrata Muller (41.7 % of the total rotifers), K. hiemalis Apstein (3.3 %), K. tropica Apstein (0.4 %), Brachionus plicatilis Pallas (35.1 %), B. urceolaris Muller (5.2 %), B. calyciflorus Pallas (1.9 %), B. angularis Gosse (1.0 %), Synchaeta oblonga Ehr. (11.1 %), Trichocerca cylindrica Imof (0.1 %), Asplanchna priodontata Gosse, Colurella sp. and Rotifer sp.

The horizontal distribution of rotifers showed their maximum persistence at El-Gamil station which is affected by the influx of the brackish water flowing from Lake Manzalah particularly during winter and autumn. El-Shabab station harboured relatively high counts during summer and autumn while, the Fishing Club station contributed high numbers of rotifers in summer.

The monthly variations of the total rotifers showed a high peak in January (220,500 organisms/m³) and it was mainly dominated by Keratella quadrata which contributed more than 98 % of the total rotifers. Another increase was observed in August (131,500 organisms/m³) resulting from Brachionus plicatilis (91.8 %).

Keratella quadrata dominated the other rotifers in winter and early spring and this was associated with low temperature (17.8 °C) and high pH values which agree with the records of Guerguess (1979) in Lake Manzalah, Aboul Ezz (1984) in Lake Burollus, Zaghoul (1976) in Rosetta Estuary and Helal (1981) in Damietta Nile Branch. The species was only recorded at El-Gamil station in winter, while it was more frequently observed at El-Shabab station in spring.

Brachionus plicatilis ranked as the second dominant rotifer species. It is mainly a marine form with euryhaline affinities (Capuzzo, 1979). It was more abundant during summer with high frequency in August. These observations were previously emphasized by Hutchinson (1967), Epp & Winston (1977), Capuzzo (1979), Aboul Ezz (1984), Guerguess (1979), Samaan and Aleem (1972), Zaghoul (1976), Helal (1981) and Aboul Ezz *et al.*, (1990). The species appeared more dominant at El-Gamil, El-Shabab, Saleh Selim and Marhaba stations.

IV. Arthropoda

This phylum was mainly represented by members of the class Crustacea which appeared more dominant during autumn (62.7 % of the total population) and less so in summer (Fig. 7). On the other hand, Insecta appeared very rare.

Crustacea:

1. Copepoda.

Copepoda contributed about 29.2 % of the total zooplankton counts (average 127,748 organisms/m³). They were represented by the following 23 species which comprised both brackish and marine forms:

Acartia latisetosa Kriczaguin (0.47 % of the total copepods), A. Clausi Giesb., A. grani Sars, Centropages kroyeri Giesb, Paracalanus parvus Claus (1.6%), Calanus sp. (0.4 %), Clausocalanus Sp. Isias clavipes Boeck, Eucalanus sp. (0.2 %), Oithona nana Giesb. (11.3 %), O. plumifera Baird (0.6 %), Oncaea minuta Claus (0.1 %), Oncaea sp (0.1 %), Clytemnestra scutellata Dana, Acanthocyclops americanus Marsh (4.6 %), Cyclops vernalis Fisher (1.5 %), Diacyclops sp (1.1 %), Euterpina acutifrons Dana (8.3 %), Microsetella norvegica Boeck (1.4 %), Macrosetella gracilis Dana (0.4 %),

Oncychocamptus mohammed Blanchard (0.1 %), Canthocamptus gracilis Sars and Schizopera clanestine Klie (0.6%).

The adult copepods contributed collectively 33.1 % of the total copepod counts. The copepod nauplii and copepodite stages formed 66.9 %.

Oithona nana and Euterpina acutifrons appeared in considerable numbers at all stations during the different seasons except in winter when most marine species were displaced by the brackish Acanthocyclops americanus particularly at El-Gamil station. Euterpina acutifrons was more dominant at Saleh Selim, El-Shabab and Fishing Club stations in summer (August and June).

The other copepod species appeared with low counts at scattered stations during one month or the other. The highest population density of copepods were recorded in August (373,291 organisms/m³) and September (298,213 organisms/m³), while they attained low values in winter (January and February) with average of 1500 organisms/m³ and were completely missed in December.

2. Cladocera:

Cladocerans appeared very rare and were mostly represented by brackish water species such as Diaphanosoma excisum Sars which was restricted to Marhaba station in July (average 2,857 organisms/m³), Moina micrura Kurz at El-Shabab station in March (429 organisms/m³) and Daphina sp. at El-Gamil and El-Deeba stations in April and May (642 organisms/m³). Besides, the marine cladoceran Penilia sp. was encountered at El-Deeba station (286 organisms/m³) in September.

These results indicated that cladocerans were more common at temperature range between 20.0 and 28.5 °C while they completely disappeared at 12.5° C. Various investigators have also pointed out the controlling effect of temperature on the distribution of Cladocera. Similarly, Guerguess (1979) reported the peaks of Cladocera in Lake Manzalah during summer. Samaan and Aleem (1972) mentioned it in Lake Mariut in March and June. Aboul Ezz (1984) recorded the maximum density of Cladocera in Lake Burollus during summer and autumn at temperature 28 °C.

3. Ostracoda:

Ostracoda was recorded all the year round except in May with annual average of 1,633 organisms/m³ and forming 0.4 % of the total zooplankton. They were represented by Conchoecia obtusata Sars in July (average 2,786 organisms/m³) and Cypridina sp. which appeared during the rest of the year with highest values in September and March (averages 5,571 and 2,357 organisms/m³ respectively).

4. Amphipoda:

The amphipod Gammarus marinus Sars appeared during most of the year with annual average of 1,578 organisms/m³. The species was more frequent in July (average 13,857 organisms/m³) at most stations except El-Deeba and El-Gamil stations.

5. Mysidacea:

The species Mysis oculata Loven was rarely recorded at the different stations during October, August and July.

6. Cumacea:

Three species of Cumacea namely; Cumella sp, Diastylis sp. and Bodotria sp. were sparsely recorded. They appeared in considerable numbers in October at El-Shabab and Saleh Selim stations (average 1, 448 organisms/m³).

7. Decapoda:

Larval stages of Penaeidae (Penaeus sp), and zoea of crab were frequently recorded at most stations in July (average 4,786 organisms/m³). Mysis stages of shrimp were rarely observed at Saleh-Selim and Marhaba stations in August and October respectively.

8. Isopoda:

Two isopod species of Flabellifera were rarely recorded at El-Gamil and Saleh Selim stations in October (average 857 organisms/m³).

9. Cirripede larvae:

The cirripede larvae appeared during summer, autumn and spring with annual average of 7,468 larvae/m³ (1.6 % of the total zooplankton). They showed their peaks of abundance in March (31,286 larvae/m³), May (25,928 larvae/m³) and August (18,583 larvae/m³).

10. Crustacean eggs:

Crustacean eggs were sampled during the whole investigation period except in winter with annual average of 4,371 eggs/m³ (1.0 % of the total zooplankton). They showed their highest counts in autumn (average 17,750 eggs/m³).

Insecta :

Insect larvae were rarely represented by pupae of aquatic insects at El-Gamil station during February (average 6,000 pupae/m³).

V. Annelida

Various larval stages of polychaets were recorded in the investigated area and they constituted about 3 % of the total zooplankton population (average 13,744 larvae/m³). They appeared all the year round, showing three peaks of abundance, namely; in August (34,167 larvae/m³), May (68,143 larvae/m³) and June (29,803 larvae/m³). They were more frequent at Saleh Selim station.

VI. Nematoda

Free living nematods contributed 0.1 % of the total zooplankton (average 571 worms/m³). They were estimated all the year round except in March and April with high counts in August (average 1,333 worms/m³) and February (1,125 worms/m³). The Fishing Club and El-Shabab stations harboured more nematods than the others as they are more affected by domestic sewage discharged from the vicinity of these stations.

VII. Mollusca

Because the shallowness of the area of investigation, the meroplanktonic larvae of molluscs such as veligers of lamellibranchs and gastropods beside the pteropod shells Limacina inflata were rarely recorded all the year round with an average annual value of 14,155 organisms/m³ (3.1 % of the total zooplankton community). Their maximum persistence was in summer, autumn and spring forming respectively 4.8 %, 12.0 % and 6.4 % of the total zooplankton counts. They appeared more abundant at El-Deeba, Saleh Selim and Port-Fouad stations which lie far away from the discharge of brackish water.

VIII. Echinodermata

Scattered specimens of Echinoderm larvae were rarely recorded at El-Deeba and Port-Fouad stations in June with annual average 19 larvae/m³.

IX. Chaetognatha

Sagitta sp. appeared once in June (average 10 organisms/m³) at Port-Fouad station.

X. Chordata (Protochordata)

Appendicularia were rarely observed in the investigated area and forming 0.6% of the total community (average 2,919 organisms/m³). They were represented by Oikopleura dioica Fol., O. parva Lohmann and O. longicauda Vogt. O. dioica appeared in considerable numbers in June at all stations (average 29,892 organisms/m³) forming 7.4 % of the total zooplankton. Besides, the three species were recorded in small counts in September (1,357 organisms/m³) at El-Shabab, Saleh Selim and Marhaba stations when the salinity ranged between 29.41 % and 32.31 %.

Ascidian tadpoles were scarcely observed in June and July with annual average 62 larvae/m³).

DISCUSSION

Due to the shallowness, of the investigated area which did not exceed one meter, the community composition of zooplankton comprised both holoplanktonic and mesoplanktonic organisms as well as meroplanktonic larvae of sessile bottom dwellers which usually appear more dominant in the coastal water system.

Estimation of the zooplankton population in the Swash zone of Port-Said area revealed that it is highly affected by the brackish drain water of Lake Manzalah, beside the domestic sewage discarded from Port Said City. The community was dominated by brackish organisms during certain times of the year provided by excess amounts of drain water flowing into the sea and decreased water salinity. This was more pronounced in July, January and March at an average low salinity of 28.25 ‰ (Fig.3). On the other hand, the month of June which sustained high salinity of 38.37 ‰, was dominated by marine forms such as, tunicate species particularly Oikopleura dioica which appeared more dominant at relatively high temperature of 23.5 °C. These

observations agree with the findings of Bernard (1958), El-Maghraby & Halim (1965), and Aboul Ezz (1975). Brachionus plicatilis was also more dominant during the warm seasons with its peak in August. Hutchison (1967) mentioned B. plicatilis as a common species in saline water. Capuzzo (1979) regarded it as a marine species. Zaghoul (1979) and Helal (1981) showed its maximum occurrence along the Rosetta and Damietta Estuaries in June and August. On the other hand, Keratella quadrata reached its maximum persistence in January similar to the results of Zaghoul (1976), Guerguess (1979), Helal (1981) and Aboul Ezz (1984). The percentage frequency of rotifers showed maximum abundance during winter (61.8 % of the total zooplankton) when the water salinity appeared low. The minimum (1.3 %) was recorded in spring (Fig. 7).

Coelenterates consisted mostly of the larval stages of hydromedusae and less so of Scyphomedusae. Their occurrence was related to the warm seasons where high temperature (26.5 °C) and high salinity (37 ‰) prevailed the area. Dowidar (1981), showed that the hydromedusae were numerous at the inshores and decreasing towards the oceanic waters. Their distribution is also affected by other factors such as the abundance of suitable food received from the highly eutrophic water of Lake Manzalah and degree of pollution. The lowest concentration of hydromedusae was found in winter at low temperature (13 °C) and low salinity (32 ‰).

The present study revealed that the standing stock of hydromedusae showed their peaks in summer and autumn forming 28.8 % and 15.7 % of the total zooplankton population which agree with the observations of Dowidar (1981) and Zakaria (1992). Most of the recorded hydromedusae were restricted to Leptomedusae particularly Obelia colonies, parts of Obelia polyps and Planula larvae. Anthomedusae were rarely recorded as larval stages of Pennaria and Bougainvillia (Gymnoblasic hydroid).

Scyphomedusae were represented in the investigated area by Rhizostoma pulmo and Aurelia aurita which attained different sizes and caused annoyance problems along the coast in the last few years. They appeared also in summer along the Mediterranean coasts of Egypt. The maximum abundance of these Coelenterates were at El-Arish region (Zakaria, 1992). Atta (1991) recorded five species of scyphomedusae along the coast of El-Arish, from which Aurelia aurita and Rhizostoma pulmo were the only records in the present investigation.

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