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THE STRUCTURE OF ZOOPLANKTON COMMUNITY IN LAKE MARYOUT, ALEXANDRIA, EGYPT

ABDEL AZIZ, N.E. AND ABOUL EZZ, S.M.
National Institute of Oceanography and Fisheries, Alexandria, Egypt

Key words: *Lake Maryout, Freshwater Zooplankton, Rotifers, Freshwater copepods*

ABSRACT

The goal of this study is to determine the temporal and spatial changes of zooplankton structure relative to the ecological characteristics of Lake Maryout which lies under stress of different types of discharged waste waters. The study was conducted bimonthly from November 1995 to September 1996. A total of 112 species were identified, including 13 marine forms. In terms of population density, rotifers ranked the main zooplankton component (68.9%), followed by Cladocera (5.8%) and Copepoda (3.1%).By number of species, rotifers (32 spp.), protozoans (31spp.) and copepods (18 spp.) were respectively the most diversified groups. The Main Basin which was characterized by low salinity, low oxygen content (annual averages: 2.6 ppt. and 3.9 mlO_2/L) harboured the highest number of species (88 spp.) and the densest population (average: 359500 org./m^3). The other three basins with higher salinity (5.9-7.8 ppt.), higher dissolved oxygen (4.9-6.2 ml O_2/L) were inhabited by lower number of species (53 -66 spp.) and poorer standing stock varying from 3400 org./m^3 in the Fishery Basin to 99430 org./m^3 in the Southwestern Basin. Insect larvae were dominant in the Southwestern Basin, forming 91. 6% of the standing stock, while rotifers and copepods dominated in the Northwest Basins (36.5% and 17.4% respectively) against copepods (54%) and rotifers (31%) in the Fishery Basin.

Except the low values in November and January zooplankton crop was generally high all the year round. The diversity index of the Fishery Basin recorded highest values (2.02-4.49) as compared with the other basins (0.01 and 2.81). The stepwise multiple regression analysis indicated the importance of all ecological parameters for the population density of zooplankton in the main basin of Lake Maryout, as the most reproductive one. The cluster analysis demonstrated the independence of each of the four basins by its own characteristic zooplankton community.

INTRODUCTION

Lake Maryout is the smallest of the four coastal lakes of the Nile Delta. It is actually isolated from the open sea and hasn't a natural connection to the Mediterranean Sea. During the last four decades its area decreased from 66000 acres to 17000 acres due to the reclamation projects to agriculture land. The lake is practically divided into four basins, the Main Basin (MB), occupying 6000 acres, Fishery Basin (FB) with an area of 1000 acres, Northwestern Basin (NB) of 3000 acres, and Southwestern Basin (SB) of 7000 acres. In fact, it serves as a drainage basin for the adjacent cultivated land, industrial and municipal wastes of Alexandria City through several drains (Fig. 1). The depth of the lake ranges from 0.6 to 2.7 m in the different basins.

Although several previous studies on lake zooplankton were conducted (Faouzi,1937; Steuer,1935&1942; El Hawary,1960; Elster and Vollenwieder,1961; Salah and Tamas,1970; Samaan and Aleem,1972; Abdel Aziz,1987 and Guerguess,1988), variations in the water quality of the lake (El-

* Corresponding author

Safty, 1995, El-Rayis *et al*., 1994; 1998) necessitate further studies of zooplankton community in order to follow its analogous variations.

The present paper aims at studying the structure and abundance of zooplankton during a year cycle, through bimonthly samples in the four basins of the lake, in order to follow up the long–term variations in this community, accompanied the modification of the ecological conditions through the past period. This study was carried out within a multi-disciplinary USAID Project (Contract No. 263-0100-C-00-5117-00) under the supervision of Metcalf & Eddy Int., and EA-Engineering, Science & Tech. Inc., to study the ecosystem of Lake Maryout and the coastal water of Alexandria City to find out the best alternative for the sewage disposal of Alexandria City.

MATERIALS AND METHODS

Samples collection was carried out bimonthly from November 1995 to September 1996. Twenty one stations were selected to represent the different ecological conditions of the four basins in the lake, comprising 12 stations in the Main Basin, and three stations in each of the other basins (Fig. 1). Zooplankton samples were collected by filtering 50 liters of the lake water at each station through standard plankton net with mesh size 80µm, the concentrated samples were preserved in 4%neutralized formalin. The recorded species were identified following Edmondson, 1959; Berzins, 1960; Harding and Smith, 1960; Hutchinson, 1967; Dussart, 1969; Bick, 1972 and Al-Hussaini & Demain, 1982. The standing stock was estimated as organisms/m^3 from the average of three counts of 5ml concentrated samples. The ecological conditions of the different basins were studied concurrently with zooplankton sampling by the chemical group working in the project mentioned above. Diversity index of zooplankton community was calculated according to Shannon and Weaver (1963). The stepwise multiple regression analysis was applied to determine the main ecological parameters controlling zooplankton production in the lake. The Similarity between the communities of zooplankton in the four basins of the lake was determined using Bray-Curtiz similarity index (Bray and Curtiz, 1957).

RESULTS

Zooplankton community in Lake Maryout was represented by a total of 112 species (Table1), varying in the four basins between a minimum of 5 species during November and a maximum of 59 species during September (Fig. 2). The marine forms had a limited role in the community structure, as they were represented by 13 species in the whole area and mainly restricted to the Fishery Basin (FB). Zooplankton community comprised 2 main components, the major one consisted of the important groups (Rotifera, Copepoda, Cladocera and Protozoa) which had the highest species richness (35, 18, 6, and 31 species) and formed together 78.2% of total zooplankton. The minor component contributed 21.8% to the total zooplankton including Nematoda, Coelenterata, Annelida, Ostracoda and Amphipoda. Besides, meroplanktonic larvae of polychaetes, cirripedes, decapods, molluscs and insects were also recorded; the latter having an effective role in the Southwestern Basin (SB) (Table 1 & Fig. 3).

Regardless of their high species richness, the standing crop of rotifers was mostly composed of *Brachionus angularis*, *B. calyciflorus*, *B. urceolaris*, *Filinia longiseta* and metamorphoses stages, which collectively formed 97.4% of the total rotifers in the lake, while *Moina micrura* was the most dominant cladoceran, constituting about 98.6% of this group, The copepods were dominated by *Acanthocyclops americanus*

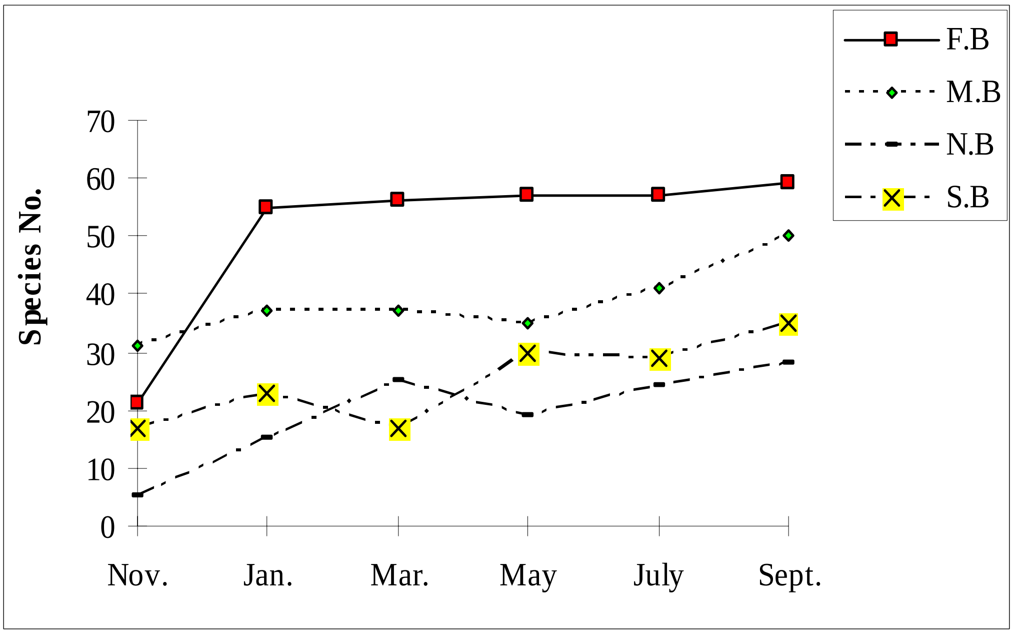

Fig. 2: Bimonthly variations of species richness in the four basins.

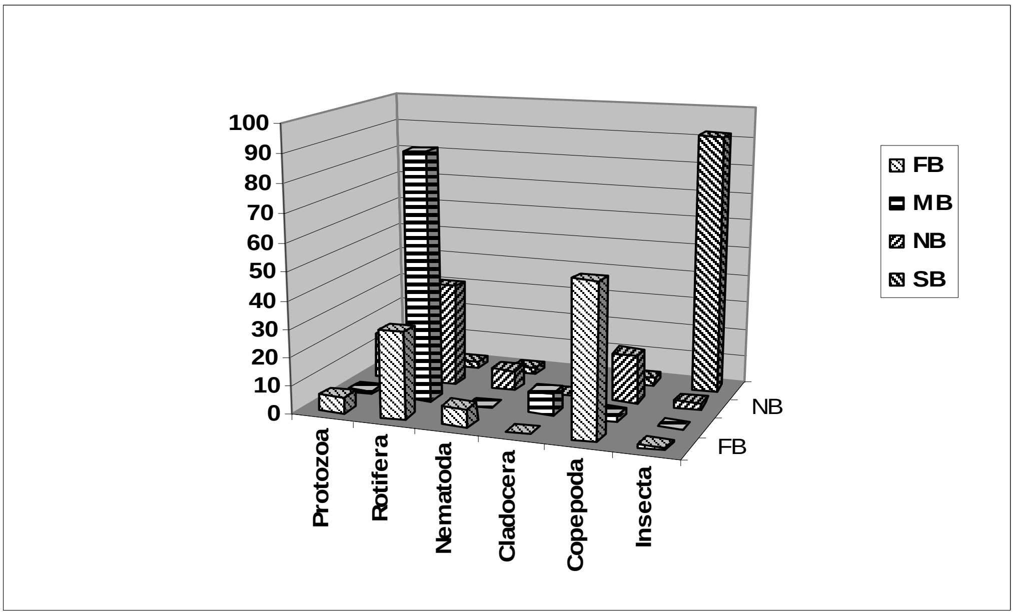

Fig. 3: Contribution (%) of different groups to total zooplankton in the four basins.

and *A. vernalis*, both represented 30.7% of the total copepods, but the bulk of this group was found as nauplii larvae (60%). In the mean time, the protozoans comprised mainly *Paramecium* spp., *Centropyxis* spp. and *Difflugia* sp., which together formed 63.5% of the total protozoans.

The standing stock of the total zooplankton as well as the population density of the different groups experienced wide variations among the different basins of the lake. The poorest population appeared in the FB and NB (annual averages: 3404 &6218 org./ m^3 respectively), while the greatest count was reported in the MB (359514 org./m^3). However, the SB harboured comparatively high population density (99400 org./m^3). The temporal variations indicated the warm period (March-September) as the more productive with the highest peak in September (Fig.4), mainly due to outstanding growth of *B. angularis*, *B. calyciflorus*, *Filinia* spp. and insect larvae.

To understand the real dynamics of zooplankton community in Lake Maryout it is better to concern the quantitative and qualitative structure of community in each of the four basins independently.

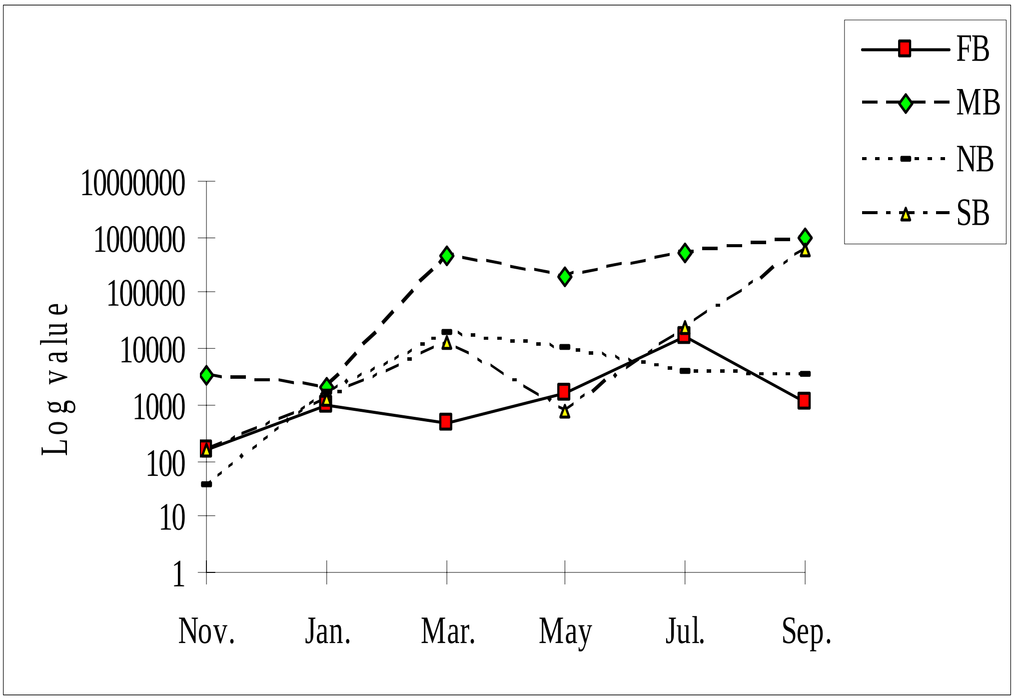

Fig. 4: Temporal variations of zooplankton deensity (Organisms/m^3) in the four basins.

Fishery Basin Community (FB):

In this basin, the species richness was relatively low (57 spp.) but the monthly variations of diversity index was the highest (Fig. 5), with an annual average of 3.3. All the marine species recorded in the lake were represented in this basin. The community structure was nearly stable most of the year, whereas the monthly number of species varied between 55 and 57, except in November which sustained markedly lower number of species (Fig.2). copepods, rotifers and protozoans were the most diversified groups (Table 1).

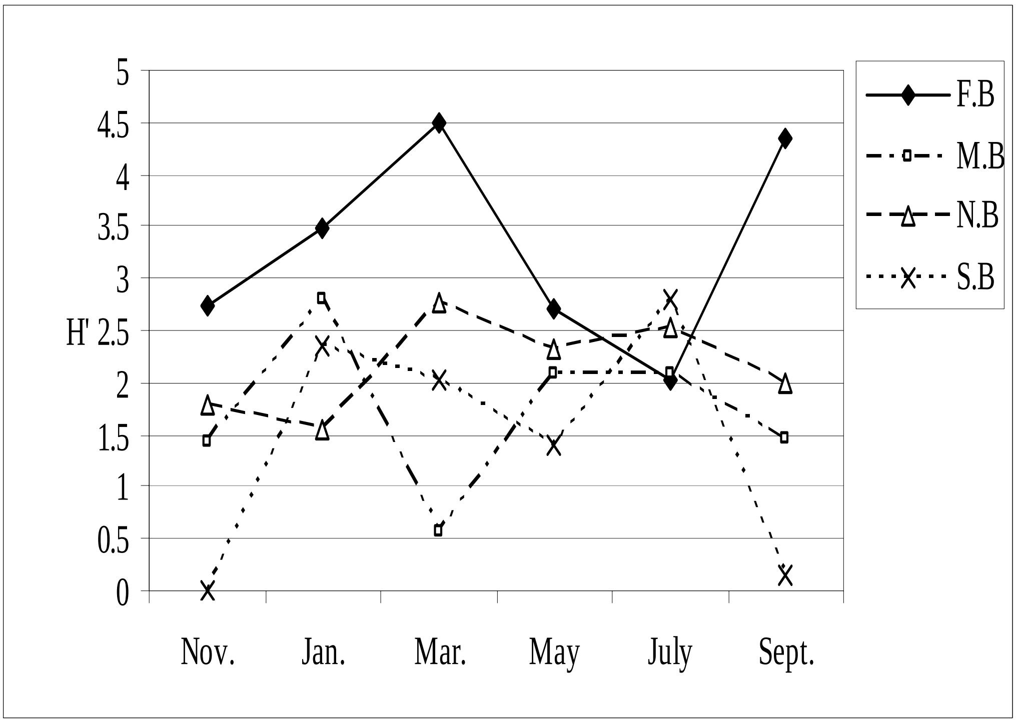

Fig. 5: Temporal variations of diversity index (H') in the four basins.

The standing stock of this basin was the lowest of all basins of the lake, having an annual average of 3400 org./m^3 with the dominance of copepods and rotifers (54% &31%) (Fig.3). The relative abundance of both groups showed monthly alternations, being sometime higher for one group and vise versa for the other in other times. In addition to the dominance of copepod nauplii (48.2%), few species of other groups showed also active contribution to zooplankton abundance, like the rotifers *Monostyla closterocerca* (6.6%) and *Lecane luna* (5%), the protozoan *Difflugia* spp. (4.7%) and the nematod *Dorylaimus stagnalis* (4.5%) (Table 1). Seasonally, zooplankton appeared to be low all the year round, except a peak in July (16044org./m^3) (Fig.4), which was caused mainly by copepod nauplii, in addition to the rotifers *Monostyla closterocerca*, *L. luna*, *Proales daphnicola*, *B. urceolaris* and the Protozoan *Difflugia* sp.

Throughout stations, the standing crop was relatively higher at F03 and F01 (5375&

3438 org./ m^3) than that at station FO2 (1936 org/ m^3). The species distribution among the sampled stations revealed a pronounced difference in the dominance pattern. The major inhabitants of station FO3 were the copepod nauplii (64.7%), the rotifers *B. calyciflorus* (3.6%), *B. urceolaris* (5.6%), *M. closterocerca* (5.3%) and the copepods *A. vernalis* (3.2%) and *Canthocamptus gracilis* (2.5%), while those at station F01 were the rotifers *L. luna* (17.4%), *M. closterocerca* (13.6%), *Chromogaster* sp.(12.7%), the nematod *D. stagnalis* (13.2%) and protozoan *Difflugia* sp.(6.3%). At station FO2 copepod nauplii had the absolute dominance (70%) of the standing stock. It seems that the ecological conditions (Table 2) had a great effect on the species distribution and population density in the FB.

Main Basin Community (MB):

Zooplankton had the highest species richness (88 spp.) throughout the lake, but the diversity index attained low values (Fig. 5), with annual average of 1.7. The community structure was the most diversified in July and September (41& 50 species respectively), while during the other months the number of species was approximately closed, varying between 31 and 37 species (Fig.2). Rotifera, Protozoa and Nematoda were the richest groups by the species number (Table 1).

As compared to other basins, the MB was inhabited by the greatest population density (Annual average: 359500 org./m^3), demonstrating abnormally wide monthly variations (Fig.4). High standing crop (186700 - 498200 org./m^3) was observed during the period March-July, and attributed to the rotifers (Fig.3), which were dominated by *B. angularis* (May-September), *B. calyciflorus* (March-September), *B. urceolaris* (March-July), *F. longiseta* (May-September). Species of other groups were also found as co-dominant, like the cladoceran *M. micrura* (May- September) (7.6%) and the copepod *A. americanus* (May-September) (2.5%). In addition to the above mentioned species, relatively high counts were temporarily reported for the protozoans *Paramecium caudatum* (November-September), *Difflugia* spp.(March-July) and *Centropyxis aculeata* (March- September). On the spatial scale, species dominance in the MB demonstrated pronounced difference between stations (Fig. 6).

Concerning the spatial distribution of the standing crop the MB was divided into two parts, the highly productive one, which comprised stations M01- M06, M09 & M13 and harboured from 349550 org./m^3 to 1031170 org./ m^3. This part was characterized by the highest PH (7.9-8.1), low salinity (1.8-2.3 ppt), higher water temperature and phytoplankton standing crop. The second remarkably lower productive part, represented by the other remaining stations, was inhabited by poor standing crop (720 org./ m^3 -147380 org./m^3). The stations of this part were affected directly by Omoum and Kalaa flowing drains as M11& MO8 where a very strong current of Omoum drain through the channel could account for the low zooplankton abundance in these stations and M10 is located just outside the Western Treatment Plant discharge. The basin had relatively low oxygen content, lowest salinity and PH range of 7.3-8 (Table 2).

Northwest Basin Community (NB):

In this basin, zooplankton community was composed totally of 49 species and characterized as the lowest diversified one in the whole lake. It was dominated by rotifers (17spp.), protozoans (14spp.) and copepods (8spp.). March, July and September sustained the highest species richness, while November showed the lowest number of species (Fig.2). The diversity index fluctuated between 1.55 in January to 2.76 in March (Fig.5), with an annual average of 2.2.

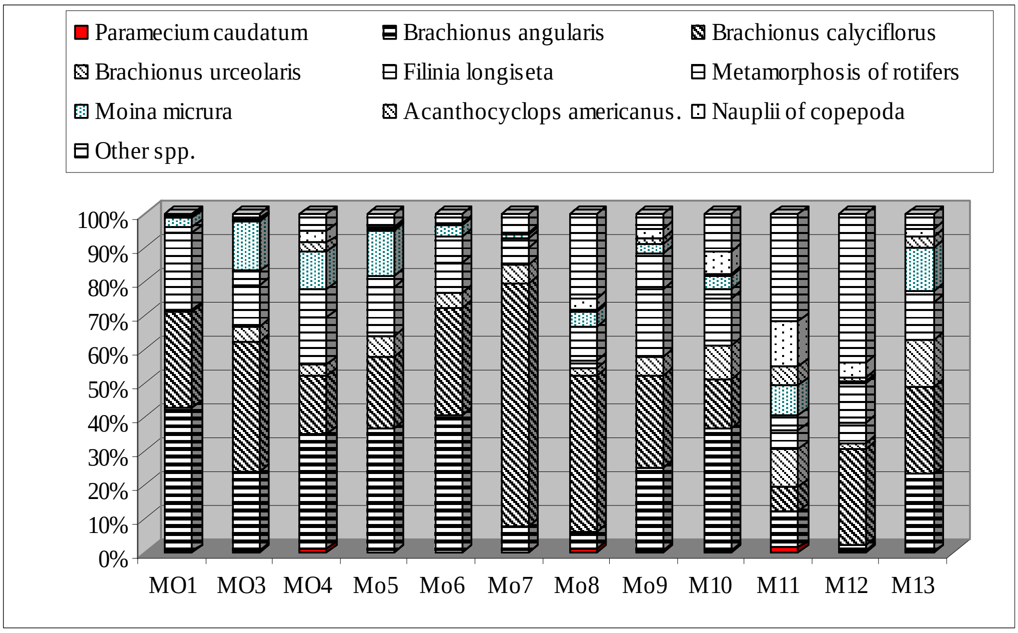

Fig. 6: Relative abundance (%) of dominant species to total zooplankton in the Main Basin.

The zooplankton density was also low in northern basin (annual average 6213 org./ m^3), showing a wide range of monthly variation and two peaks in March and May (Fig.4). The March peak was dominated by the rotifers *B. calyciflorus*, *B. urceolaris*, *Anuraeopsis fissa*, the ostracod *Cypridina* sp., and the protozoans *Difflugia* sp. and *Askenasia* sp. In May the dominant species were mostly different, including the ostracod *Cypridina* sp, the foraminiferan *Ammonia beccarii*, the copepod *A. americanus*, the protozoans *Askenasia* sp. and *Difflugia* sp., the rotifer *Proales daphnicola*, the nematod *Dorylaimus* sp..

Throughout stations, zooplankton described clearly different densities, whereas the highest standing crop (8381org./ m^3) appeared at station N01 and the lowest (3753org./ m^3) at station N02. This basin seems to be homogeneous in the term of species dominance, since most of them were found at the three stations, but with different relative abundance. These species were the protozoans *Askenasia* sp. and *Difflugia* sp., the foraminiferan *A. beccarii*, the nematodes *D. stagnalis* and *Anaplectus* sp., the rotifers *B. calyciflorus*, *B. urceolaris*, *Proales daphnicola* , *A. fissa* and *L. luna*, the ostracod *Cypridina* sp. and the copepod *A. americanus*. The NB was characterized by a narrower range of variations in the ecological conditions (Table 2).

Southwest Basin Community(SB):

Zooplankton in this basin was represented by 60 species, with a ranking of dominant groups similar to that in the NB, as follows: rotifers (15 spp.), protozoans (19 spp.), and copepods (10 spp.) (Table1). The monthly species richness indicated the highest diversified communities in May, July and September, and the lowest diversified ones in other months (Fig. 2). The diversity index attained the minimum value in November and the maximum one in July (Fig.5), with the lowest annual average of 1.5 in the whole lake.

High standing crop (annual average 99420 org./m^3) was estimated in the SB, but with wide monthly variations (Fig.4). The Insect larvae appeared as the absolute dominant component, forming 91.6% of the total count (Fig.3), mainly due to extremely abnormal growth (1,582,900 org./m^3) of Coarctate pupae of insects at station S03 in September. These larvae are of typically benthic fauna growing well with the submerged vegetation at SO3 and entered zooplankton samples with the water agitation. Of other groups, rotifers were encountered with suitable density (2.2%) in July (9523 org./m^3). Except the September peak at station S03, zooplankton crop was generally low over the year (Fig 4) at all stations, amounting at both stations S01 and S02 to 6800org./m^3). However, the dominance of species demonstrated clear spatial variations, whereas at station S02, the insect larvae represented 50% of the total count, copepods (23%) and dominated by copepodides, *A. americanus* , *C. gracilis* and *Onychocamptus mohamed*, and the ostracode *Cypricercus* sp. (17.8%), but station S01 was dominated by copepod nauplii (24%), insect larvae (21%) and several rotifer species, which represented collectively 20.8%. The salinity in this basin fluctuated between 5.8 and 6.1 ppt., dissolved oxygen (4.1-5.5 ml/l), and pH (7.5-8.8).

The Comparison of the relative abundance of different groups and species richness between the four basins revealed that the relative abundance of the three main groups (rotifers, copepods and potozoans) ranked in descending order in the four basins as follows: MB>NB>SB>FB for rotifers, FB>NB>MB>SB for copepods, and NB>FB>MB>SB for protozoans. On the other hand, the species richness of the three groups ranked as follows: MB> SB>NB>FB for rotifers, FB>SB>NB>MB for copepods, and MB>SB>NB>FB for protozoans.

The man–made division of the lake contributes to pronounced differences in community structure in the four basins, whereas the similarity dendrogram (Fig. 7) indicates two main groups. The first group includes the most productive stations in the MB with similarity of about 79%, while the second group is subdivided into four subgroups representing the similarity between stations in each of the three other basins, but with markedly lower similarity (38.2% - 59.4%).

DISCUSSION

The shallowness of Lake Maryout and the continuous discharge of different types and quantity of waste waters affected the water quality of the lake. The hydraulic regime controlling the water level and the division of the lake into four unequal basins have also contributed to the variation of physico-chemical as well as biological characteristics of each basin. However, the different areas, water circulation and flushing time for each basin may play a role in the structure and density of zooplankton community.

There is no doubt that, the narrow changes of the ecological conditions usually cause the stability of the ecosystem. In the MB, limited variations of salinity lead to high diversified zooplankton community, as compared to the other basins, which experienced comparatively wide salinity changes. The relative stability of salinity in the MB was preferable for many species (26 spp.), that restricted their existence to this basin, while marine forms were found mainly in the FB which showed the highest salinity. However, the rapid renewal of the lake water may increase the similarity of species composition between the basins, whereas 42% of the recorded species appeared at least in three basins. But the variable water quality was responsible for the marked differences in the key species in each basin, since *M. closterocerca* , *L. luna*, *D. lebes*, *D. stagnalis* were the key species in the FB, *B. angularis*, *B. calyciflorus*, *B. urceolaris*, *F. longiseta* and *M. micrura* in the MB, *B. calyciflorus*, *B. urceolaris*, *Difflugia* sp., and *Cypridina* sp. in the NB, and insect larvae in the SB.

Regarding the species richness and relative abundance of the main zooplankton groups in the different basins, rotifers attained the highest values in the MB, in association with the lowest average values of salinity and dissolved oxygen, while copepods demonstrated the highest relative abundance and species richness in the FB at the highest salinity average and high oxygen contents. This means that rotifers are more tolerant to the polluted conditions in the MB and could build healthy populations, but copepods could not withstand these conditions as they showed the lowest species richness and relative abundance in the MB. El-Rayis *et al* (1994) recorded that the Main Basin was heavily contaminated with pollutants such as anthropogenic organic matter, nutrients and (H_2S), resulting from untreated domestic sewage and industrial effluents of the eastern coasts of Alexandria City before 1993. After the primary treatment of these wastes in the eastern and western treatment plants the concentration of these pollutants showed but slightly decrease (El-Rayis *et al* ,1998). The other basins lie under the effect of two sources of these discharged waste waters. Such gradient was clearly noticed when comparing the abundance and species richness in the four basins of the copepods and rotifers. The first group is sensitive to the ecological and environmental conditions (Abdel Aziz and Dorgham, 2002) and the other as indicator of polluted conditions (Winner, 1975).

Many rotifers are included among polysaprobic organisms that inhabit highly polluted environments (Liebman, 1962), whereas *B. angularis* ,*B. calyciflorus*, *F. longiseta* and *Lecane* spp. indicate semi-polluted waters (Patrick, 1950), the dominance of *B. angularis*, *Brachionus* spp., *F. longiseta* and *A. fissa* in the lake designate eutrophy and are usually recorded in mixotrophic waters (Pejler,1957; Berzins, 1949). Thus the quantitative and qualitative distribution and species composition of rotifers in the Main Basin indicated its highly eutrophic and polluted conditions. Michael (1964) claimed that rotifers prefer more alkaline waters. This agrees with the present data where the alkalinity of the lake water ranged from 108-412 mg Ca CO_3/l with an average of 227 mg Ca CO $_3$/l , the highest value was recorded in the Main Basin (158-412 mg Ca CO /l) which harboured the most abundant rotifers. *B. calyciflorus* prefers mixotrophic environments rich in nutrients. The cladoceran *Daphnia* sp. represented in the lake by ephippia with resting eggs illustrated that the ecological conditions were unfavourable for hatching and releasing their young forms. The present data demonstrated that *M. micrura* was the main dominant cladoceran in Lake Maryout, while other species remain rare. Such observations are in agreement with Edmondson (1959) who stated that in limnetic regions, the cladoceran populations are rich in density, poor in species diversity.

Protozoa is regarded by many authors as being a good indicator of organic pollution (Odum, 1971; Curols, 1982; Hull, 1984; Sladecek and Sladecek, 1988), the case which occurred in the present study, whereas relatively high numbers of freshwater species (24 spp.) and total density (annual average 1634 org./ m^3) were recorded in the lake.

Generally, the rapid changes of the water content as well as the discharged wastes appeared to be the main responsible factor for all the variations occurred in the water quality as well as the zooplankton community in Lake Maryout. The interaction between all the ecological parameters has an effect on the zooplankton abundance as was deduced from the stepwise regression analysis which produced the following equation for calculation the zooplankton abundance:

Zooplankton abundance = -21000000 + 628124 x Temp. + 875471.47 x pH+ 609732.51 x Sal.- 128768.4 x DO + 1712697.8 x NO_2 + 106812.94 x NH_3 – 7461.85 x BOD + 737121.31 x NO_3 – 993837.2 x PO_4 + 323.54 x Chlorophyll *a* + 1452.29 x Total alkalinity – 1110.13 x Chloride – 694.14 x Hardness + 581930.65 x H_2S

The successive intermittent studies (El-Hawary, 1960; Samaan and Aleem, 1972; Abdel Aziz, 1987; Guerguess, 1988) on zooplankton of Lake Maryout were concentrated on the Main Basin. From those studies and the present one it is noted that the number of zooplankton species in this basin increased from 10 species in 1958 to 86 in 1996. Also, the standing crop dropped from about one million org./m^3 in 1982-1983 to $360x10^3$ org./m^3 in 1996, this decrease was accompanied by serious changes in the community structure, from 13 rotifer species, 10 copepods, and one cladoceran in 1982-83 to 28 rotifer species,7 copepods, and 6 cladocerans. All these changes are supposed to be a consequence of the concurrent and frequent changes of different ecological conditions of the lake, resulting from variable types of human activities. Furthermore, the increase of the species richness and standing crop of rotifers in the MB could be explained also by the extremely high phytoplankton biomass as compared to other basins (Table 2), which is usually the preferable food for many rotifers.

Anyway, the cluster analysis provides that variations of the ecological conditions caused significant changes in the community structure in the four basins, whereas each of which has its own characteristic community, while in the MB two communities were identified corresponding to two different water masses occurred in this basin.

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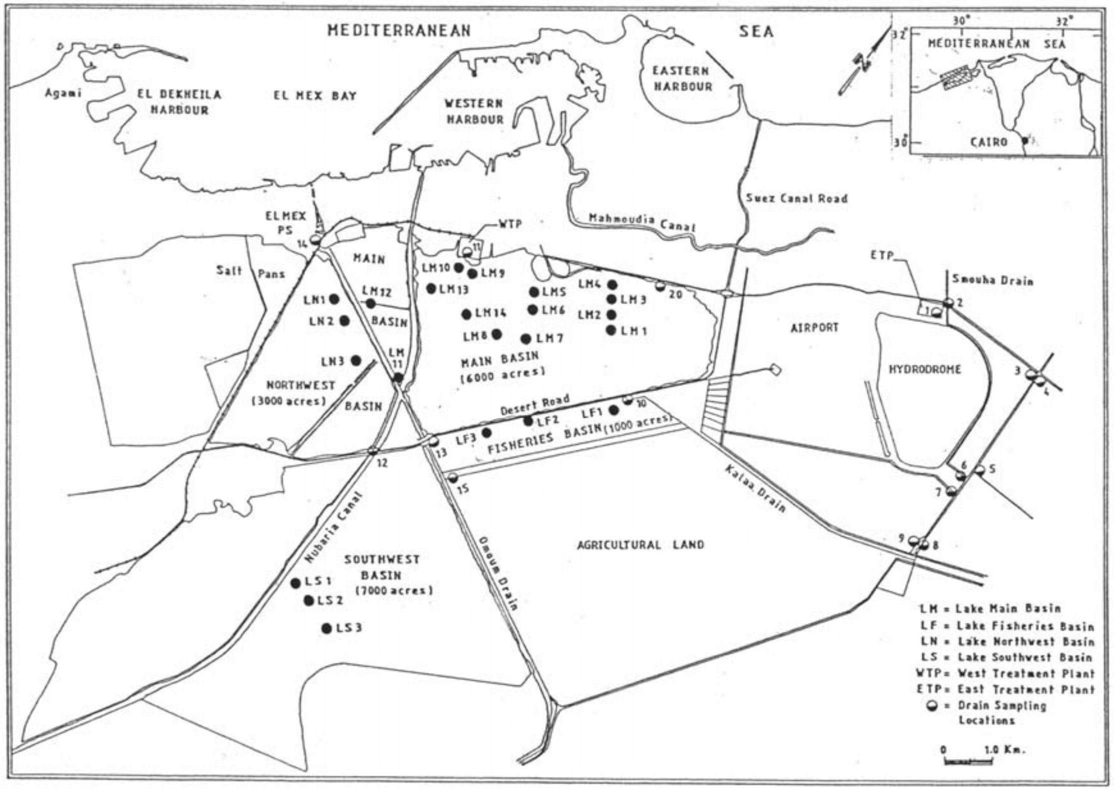

Fig (1): Positions of sampling stations in Lake Maryout

.

Table (1)- Check list and annual average count (organisms/m3)of zooplankton species recorded in different basins of Lake Maryout November 1995 September 1996)

Species	**F. B.**	**M. B.**	**N. B.**	**S. B.**	**Species**	**F. B.**	**M. B.**	**N. B.**	**S. B.**
Protozoa					**Ciliophora (continue)**				
Zooflagellata:					*Oxytricha fallax*(Stein)	0	4	1	65
Dendromonas spp.	1	225	36	211	*Paramecium caudatum*(Ehr.)	2	1312	68	29
Rhizopoda:					*Paramecium* spp.	1	46	0	21
Arcella arenata (Ehr.)	0	22	0	0	*Platycola* sp.	0	41	0	0
Arcella discoides(Ehr.)	1	172	18	0	*Strombidium* sp.	0	9	0	27
Arcella sp.	0	23	0	0	*Trachelophyllum* sp.	0	0	18	0
Centropyxis aculeata(Ehr.)	0	1203	0	2	*Vorticella* sp.	0	65	4	0
Centropyxis ecornis(Ehr.)	2	18	0	1	* *Eutintinnus* sp.	1	0	0	0
Difflugia spp.	161	748	395	123	*Tintinnopsis* sp.	5	9	30	1
Ammonia beccarii (Linn.)	3	65	227	42	**Porifera**	1	0	0	2
* *Elphidium* sp.	1	0	0	0	**Coelenterata**				
Cyloforina contorta Linn.)	1	0	0	1	* *Obelia* spp.	1	0	0	1
Ciliophora:					**Rotifera**				
Acropisthium mutabile(Perty)	0	10	0	0	*Anuraeopsis fissa*(Gosse)	8	40	297	172
Askenasia sp.	21	332	351	17	*Ascomorpha saltans*(Bartsch)	0	475	61	36
Balantidium spp.	0	150	1	10	*Brachionus angularis*(Gosse)	1	119491	4	79
Bursaria truncatella (O.F.Muller)	0	16	0	3	*Brachionus budapestiensis*(Dady)	0	1723	0	0
Colpidium sp.	0	37	0	0	*Brachionus calyciflorus*(Pallas)	69	100705	534	60
Cyclogramma sp .	0	11	0	0	*Brachionus plicatilis*(O.F.Muller)	5	182	35	0
Cyclotrichium sp .	4	34	35	2	*Brachionus quadridentata*(Hermann)	0	0	44	0
Didinium sp.	0	104	52	60	*Brachionus urceolaris*(O.F.Muller)	110	17648	495	131
Endosphaera spp.	5	95	17	0	*Cephalodella* sp.	0	115	2	0
Euplotes patella(O.F.Muller)	0	135	0	7	*Chromogaster* sp.	122	14	52	208
Lionotus fasciola(Ehr.)	1	57	0	14	*Colurella* sp.	20	29	1	0

Table(1)- continued

Species	F. B.	M. B.	N. B.	S. B.	Species	F. B.	M. B.	N. B.	S. B.
Dipleuchlanis sp.	0	13	0	0	**Trematoda**				
Eothinia sp.	0	0	0	0	Cercaria of *Fasciola*	0	0	1	0
Euchlanis sp.	0	13	0	0	*Schistosoma mansoni*	0	0	0	18
Filinia brachiata(Rousselet)	0	2027	0	0	**Nematoda**				
Filinia longiseta(Ehr.)	1	55106	69	40	*Acromadora* sp.	0	28	0	3
Hexarthra mira(Hudson)	0	326	0	0	*Anaplectus* sp.	19	38	132	66
Hexarthra sp.	0	449	2	0	Ascaris (eggs).	0	61	0	1
Keratella quadrata(O.F.Muller)	0	3	0	0	*Aphelenchoides* sp.	1	4	0	0
Lecane luna(O.F.Muller)	169	55	270	100	*Dorylaimus stagnalis*	154	246	253	1659
Lecane sp.	0	0	8	0	*Dorylaimus* sp.	0	46	0	0
Lepadella sp.	0	9	0	0	*Dolichodorus* sp.	0	9	0	5
Macrochaetus subquadratus(Perty)	0	0	0	1	*Ethmolaimus* sp.	0	11	0	0
Monostyla bulla(Gosse)	1	5	62	81	*Mesodorylaimus* sp.	0	0	0	0
Monostyla closterocerca(Schmanda)	226	46	0	53	*Microlaimus* sp.	0	10	12	0
Monostyla lunaris(Her.)	67	26	37	104	Nematoda sp.	0	21	0	1
Polyarthra sp.	0	523	0	0	*Rhabdolaimus* sp.	43	42	48	9
Proales daphnicola(Thompson)	115	740	130	516	**Annelida**				
Rotaria sp.	0	36	0	0	*Chaetogaster limnaei*(K.VonBear)	0	24	0	0
Scaridium sp.	0	31	0	0	* Spionid larvae of Polychaetes	5	0	0	17
Testudinella patina(Hermann)	0	0	0	0	**Cladocera**				
Trichocerca cylindrica(Imhof)	0	19	0	7	*Ceriodaphina cornuta*(Richard)	0	6	0	0
Trichocerca porcellus(Lennings)	0	0	0	7	*Daphnia* sp.	1	215	17	18
Trichocerca ratus(Muller)	0	2	0	0	* *Evadne spinifera*(P.E.Muller)	1	0	0	0
Trichocerca sp.	0	0	0	0	*Moina micrura*(Kruz)	1	26978	1	1
Metamorphosis of rotifers	146	17356	168	564	*Moinodaphnia macleayii*(King)	0	1	0	0

.

Table(1)- continued

Species	F. B.	M. B.	N. B.	S. B.	Species	F. B.	M. B.	N. B.	S. B.
Simocephalus vetulus(Schodler)	0	78	1	0	**Copepoda (continue)**				
Ephippium of cladocera	0	5	0	0	*Cyclops* sp.	10	0	2	2
Ostracoda					* *Euterpina acutifrons* (Dana)	1	0	0	1
Cypricercus affinis(Fischer)	15	108	6	69	*Horsiella* sp.	18	0	17	0
Cyprideis sp.	1	16	0	0	*Nitocra lacustris*(Schman)	2	0	17	2
Cypridina sp.	17	349	993	1072	*Onychocamptus mohammed*(Kewitsch)	2	9	84	249
Potamocypris sp.	0	4	0	0	* *Oithona nana*(Giesb.)	3	0	0	0
Cirripedia					* *Oncaea minuta*(Giesb.)	1	0	0	0
* Cirripede larvae	3	66	0	2	* *Paracalanus* sp.	1	0	0	0
Amphipoda					*Schizopera clandestina*(Klie)	1	0	0	21
Gammarus spp.	1	1	0	0	*Thermocyclops* sp.	0	35	0	0
Copepoda					Nauplii of copepoda	1642	5054	560	1437
Acanthocyclops americanus(Marsh)	23	3005	232	306	Copepodite stages	4	13	64	253
Acanthocyclops vernalis(Fischer)	78	768	17	6	**Mollusca**				
* *Acartia latisetosa*(Kriczaguin)	2	0	0	0	* *Limacina inflata*(D`orbigny)	1	0	0	0
Canthocamptus gracilis(Sars)	47	2	80	285	Lamellibranch veliger	2	5	4	1
Canthocamptus sp.	3	0	8	18	**Insect larvae**	29	25	142	91101
* *Canuella perplexa*(Scott)	0	0	0	0	**Crustacean eggs**	1	5	0	0
* *Corycaeus* sp.	0	1	0	2	**Fish eggs**	0	44	0	1
Cyclops serrulatus(Lillijeborg)	0	43	0	0					
					Sum	**3405**	**359514**	**6213**	**99424**

* Marine forms

Table 2- The range and average values of different ecological characterstics of the Lake Maryout basins

Parameter	**MB Range**	**Average**	**FB Range**	**Average**	**NB Range**	**Average**	**SB Range**	**Average**
Depth (m)	0.4-3.0	1.15	0.8-1.5	1.14	0.45-1.15	0.73	0.5-1.0	0.74
Temperature (°C)	16.3-28.6	23.5	16.6-30	24	16.0-27.8	23	14.5-27.3	23
P H	7.3-8.0	7.67	7.6-9.66	8.17	7.0-8.9	8.31	7.5-8.8	8
S%	1.4-3.8	2.6	4.5-10	7.8	3.7-9.7	7	3.1-7.9	5.9
Dissolved Oxygen(ml O2/1)	0-11.3	3.9	1.1-15.5	6.2	3.2-9.5	6.3	0.3-9.8	5
H2S(mg/1)	0.01-12.0	1	0.1-1.1	0.3	0.01-1.2	0.43	0.1-1.2	0.3
Hardeness	400-2000	858.8	1460-3100	2354	1410-2850	1939	1420-2250	1799
Total Alkalinity (mg/l)	158-412	320	112-270	209	108-336	193.7	112-260	186.7
Chlorides	490-4260	1236	2750-7300	4288	2575-5200	3776	2600-5175	3369
Secchi depth	30-90	60	45-60	55	30-40	35	30-65	50
Chlorophylla (mg/m^3)	0.2-484	70.6	0.2-89.8	6.2	0.36-8.9	3.1	0.2-7.12	1.89
NO2-N(mg/1)	0.001-2.3	0.11	0.001-0.014	0.005	0.001-0.04	0.01	0.0003-0.01	0.003
NH3-N(mg/1)	0.03-33.1	8.11	0.03-0.48	0.09	0.03-1.4	0.24	0.03-0.92	0.21
BOD(mg/1)	1.2-420	38.7	0.3-89	19.94	1.1-23.4	6.75	0.8-81.6	6.77
NO3-N(mg/1)	0.01-3.3	0.35	0.01-0.45	0.08	0.003-0.32	0.07	0.01-0.1	0.035
PO4-P(mg/1)	0.01-6.78	2.23	0.01-0.45	0.07	0.01-0.04	0.02	0.01-0.14	0.041

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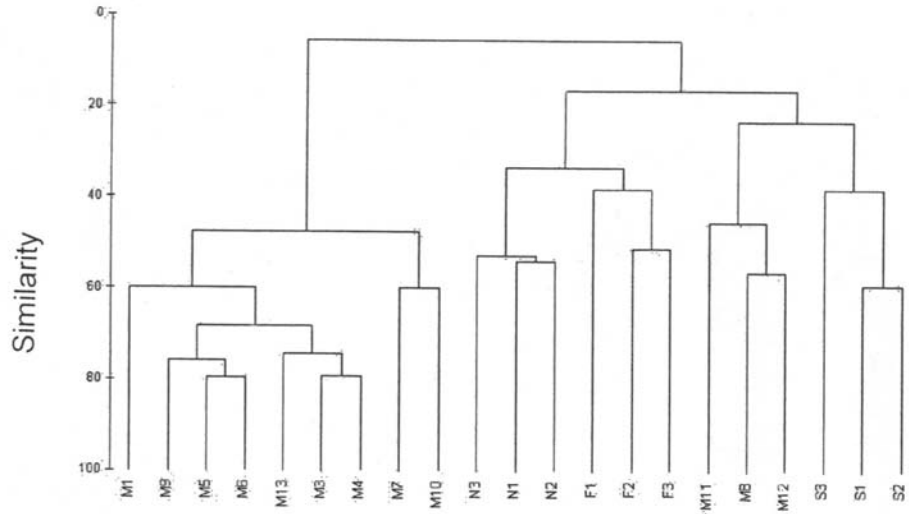

Fig. 7- Dendrogram of cluster analysis of zooplankton community in Lake Mayout.