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PRELIMINARY STUDY ON PHYTOPLANKTON - ZOOPLANKTON RELATIONSHIP IN LAKE BUROLLUS, EGYPT

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ABSTRACT

The phytoplankton and zooplankton communities in Lake Burollus are considered as rich both in their total numbers and species composition. Their average annual values reached respectively 1,039,641 U/L and 100,972 organisms/m^3 during 1987. The phytoplankton was mainly represented by members of Bacillariophyceae (49.1 % by numbers of the total community) and Chlorophyceae (31.6 %) while, Cyanophyceae, Euglenophyceae and Dinophyceae were infrequently observed.

The zooplankton population was dominated by Cladocera (33.8 % by number of the total zooplankton), Rotifera (26.5 %) and Copepoda (25.8 %). Other groups of less frequency comprised Protozoa, Ostracoda, Malacostraca, free living nematodes and insect larvae. The highest standing crop of both phytoplankton and zooplankton appeared in the western sector of the lake.

The monthly variations of the total phytoplankton and zooplankton standing crops in the lake showed in general a reverse relation. Thus, the highest numbers of phytoplankton recorded in May (2,332,154 U/L) was accompanied with lowest density of zooplankton (18,855 organisms/m^3). Also the high counts of zooplankton observed in July (225,037 organisms/m^3) coincided with low density of phytoplankton (790,942 U/L). This was attributed to the grazing effect of zooplankton on phytoplankton.

INTRODUCTION

Lake Burollus is a shallow brackish water lagoon, with an area of about 50,000 hectar, lying at the north of the Nile Delta along the Mediterranean Coast of Egypt between longitudes 30° 30 and 31° 10 E and at latitude 31° 30 N.

The lake is connected with the Mediterranean Sea at its northern side through Boughaz El-Bourg and it receives most of its water at the southern margins from 5 drains, namely; Nasser Drain, Drains 7,8,9 and 11. Besides, Brimbal Canal opens into the western extremity of the Lake and Burollus Drain at the north eastern side (Figure 1). The water depth in the lake ranges between 50 and 160 cm. The deepest part lies about the middle of the lake and the depth of water decreases gradually towards the margins. According to the shallowness of the lake, the whole area is related to the littoral zone where the phanerogames are widely distributed and cover most of the eastern sector as well as the lake margins.

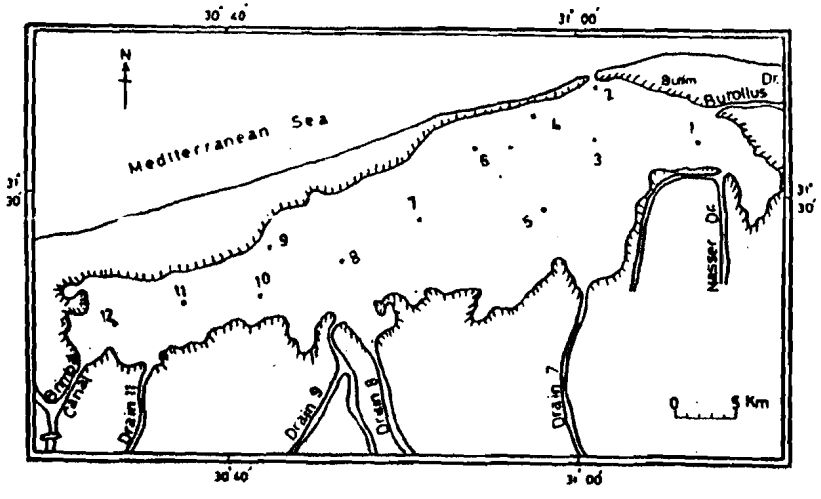

Fig. (1)
Lake Burollus and position of stations.

MATERIAL AND METHODS

Estimation of the standing crops of both phytoplankton and zooplankton was performed monthly in the lake from January to December, 1987. Quantitative estimation of phytoplankton was carried-out by using the sedimentation technique. One litre of water sample was collected from each station with a Ruttner water sampler and fixed with 4 % neutral formaline solution. The water samples were transferred to graduated cylinders of one litre capacity, and the samples were left for 48 hours to sediment after adding few drops of ligol's solution. The supernatant water was then siphoned until the sample was concentrated to 100 ml. Sub-samples of 1 ml were transfeered into a counting cell, and each plankter was counted saparately under a binocular research microscope. The phytoplankton was then calculated as their total numbers per litre.

The zooplankton samples were collected by filtering 250 litres of the lake water at each station through a small standard plankton net No. 25 (mesh size 55 micron), using a plastic container of ten liters capacity. The colleoted samples were preserved directly with 4 % formaline solution. The volume of each sample was concentrated to 100 ml. and subsamples of 5 ml were transferred into a counting cell and each planker was counted separately, using a research binocular microscope. The distribution of the zooplankton organisms was calculated as their total numbers per cubic mater.

Twelve stations were selected as representing the different habitats in the lake, their locations are shown in figure (1). The stations were further grouped into three main sectors, namely; eastern lake (Stations 1-4), middle lake (Stations 5-8) and western lake (Stations 9-12).

RESULTS

Composition and Distribution of Phytoplankton :

The phytoplankton community of Lake Burollus is considered as rich both in density and number of species. Most of them are fresh or brackish water forms. The diatoms were represented by 49 species. They consitituted numerically about 49.1 % of the total phytoplankton (average 511 x 10^3 cell/L), and were dominated by **Nitzschia microcephala** Grun., **N. palea** (Kutz.) W. Sm. **N. closterium** Sm. and **Cyclotella meneghiniana** Kutz.. Other frequent diatoms comprised **Melosira granulata** (Ehr.) Ralfs., **Mastogloia elliptica** (Ag.) Cleve., **M. smithii** Thw., **Synedra ulna** Ehr. and Cocconeis placentula Ehr..

The chlorophytes included 37 species. They formed about 31.6 % of the total phytoplankton (average 329 x 10^3 u/L) and were mostly represented by **Scenedesmus quadricauda** (Turp.) Breb and less so by **Geminella minor** (Nag.) Hansg., **Teraedron minimum** (A. Braun) Hansg. and **Ankistrodesmus**

falcatus (Corda) Ralfs. Other frequent green algae included **Crucigenia quadrata** Morren., **Sphaerocystis schoeteria** Chod., **Pediastrum duplex** Meyen and **P. boryanum** (Turp.) Menegh..

The blue green algae were infrequently encountered in the plankton and represented collectively about 1.7 % of the total population (18 x 10^3 u/L). However, **Merismopedia punctata** Meyen, **M. minima** Beck. and **Oscillatoria limentica** Lemm. appeared in considerable numbers during certain months. Members of Euglenophyceae (**Euglena** and **phacus**) and Dinophyceae (**Gymnodinium**) persisted also as inferquent forms. A bloom of a cryptomonad sp. was recorded in May infront of Baltim City (Station 1) as a result of organic pollution, reaching about 19 million cells/L.

As shown in table (1) the highest standing crop of phytoplankton was recorded in the western lake, and it decreased in the middle and eastern lake, except at station (1) which harboured a bloom of cryptomonad sp. as mentioned previously.

TABLE 1
Average annual numbers in thousands per liter of the total phytoplankton recorded in the different sectors of the lake during 1987.

Sector / Phytoplankton	Average No. in thousands / L			
	Eastern Lake	Middle Lake	Western Lake	Average
Bacillariophyceae	529	310	702	511
Chlorophyceae	189	320	478	329
Cyanophyceae	12	24	18	181
Other forms	507	20	19	182
Total No. in thousands/L	1,237	665	1,217	1,040

The monthly of the total phytoplankton showed lowest densities in March, October and November with average numbers of 571,950 u/L 496,430 u/L and 495,970 u/L respectively. On the other hand, the peaks were recorded in January (average 1,474,070 u/L), May (average 2,332,250 u/L) and in September (average 1,352, 100 u/l) as illustrated in figure (2). The winter peak (January) consisted mainly of Cyclotella and Geminella and to a less extent of Nitzschia, Synedra, Scenedesmus and Tetraedron, while the peak of May was produced by the bloom of cryptomonad sp. at station 1 and by Scenedesmus, Ankistrodesmus, Tetraedron, Cyclotella, Nitzschia, Mastogloia and Synedra in the other stations. The autumn peak (Sebtemper) was dominated by Nitzschia followed by Melosira, Cyclotella, Synedra, Scenedesmus, tetraedron and Sphaerocytis.

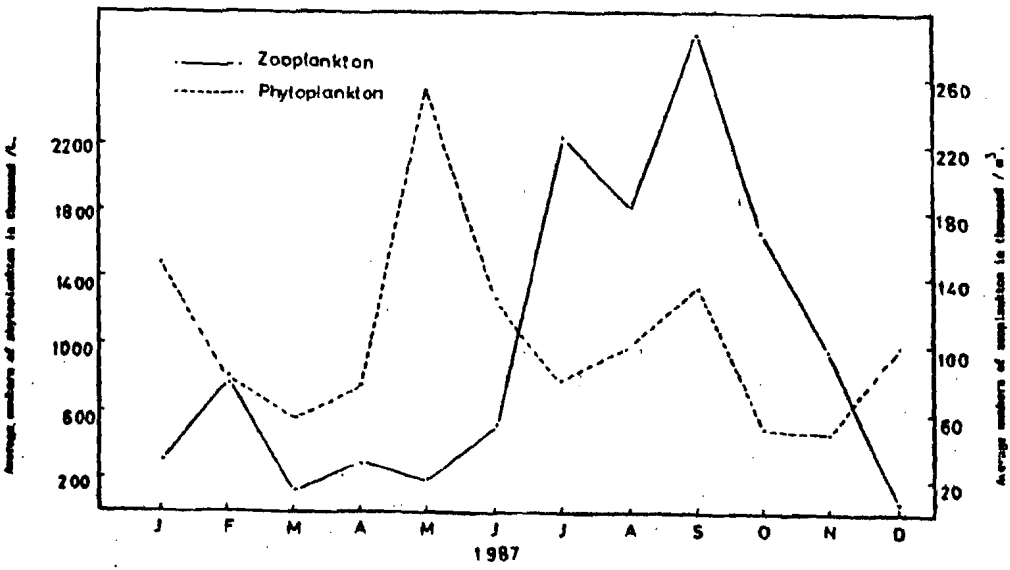

Fig. (2)
Monthly variations of the standing crop of phytoplankton (thousand u/l) and zooplankton population (thousand organisms /m^3) recorded in Lake Burollus during 1987.

Composition and Distribution of Zooplankton :

The zooplankton population in Lake Burollus was dominated by three main groups, namely; Cladocera, Rotifera and Copepoda which consituted respectively 33.8 %, 26.5 % and 25.8 % by number of the total zooplankton. Other plankters such as Protozoa (Foraminifera, Rhizopoda and Tintinnids), free living nematodes, Ostracoda, Malacostraca, insect larvae and cirriped larvae were infrequently observed and they formed collectively 13.9 % of the total population.

The average annual counts of Cladocera reached 34,177 organisms/m^3. They included eight species within four families. **Moina micrura** Kurz. and **Diaphanosoma excisum** Sars appeared as dominant plankters, while **Alona, Ceriodaphnia, Chydorus** and **Oxyurella** spp. were less frequent. The average annual standing stock of amounted 26,716 organisms/m^3. It was represented by 23 species within six families. The more dominant species were **Brachionus calyciflorus,** Pallas **Keratella quadrata** Mull, and **Monostyla bula** Gosse, while **Filinia, Polyarthra, Synchaeta** spp. appeared less frequent. Copepoda ranked the third position among zooplankton with an average annual of 26,068 organisms/m^3. It was represented by 18 species and was dominated by members of Cyclopoidae particularly **Acanthocyclops americanus** March, **Cyclops vernalis,** Fisher and **Mesocyclops leuckarti** Claus.

Like phytoplankton, the highest standing stock of zooplankton appeared in the western sector with about 200,860 organisms/m^3 and it decreased gradually eastwards (table 2). The more dominant species in the eastern sector were, **Cyclops vernalis, Moina micrura** and **Diaphanosoms excisum.** In the middle lake, a slight increase of zooplankton counts, compared with the eastern lake, has been observed as the result of the increased numbers of cladocerans (24,636 organisms/m^3) and copepods (19,422 organisms/m^3). The dominant species there were **Moina micrura, Diaphanosoma excisum** and **Cyclops** spp. An outstanding peak of abundance was recorded in the western sector due to the increased numbers of cladocerans and rotifers (average 69,283 and 68,290 organisms/m^3 respectively).

As shown in figure (2) the monthly variations of the total zooplankton in Lake Burollus showed two peaks of abundance. The first small one appeared in February and was dominated by **Acanthocylops americanus, Cyclops vernalis; Mesccyclops leuckarti** as well as copepod larvae. The second high peak was observed during the period July-September. The July community consisted mainly of rotifers, particularly **Brachionus calyciflorus** and the cladocerans **Moina micrura** and **Diaphanosoma excisum.** In August, the population comprised Copepoda, Cladocera and Protozoa **(Poraminifera)** with nearly the same frequency. The dominant species in September were **Diaphanosoma, Moina** and to less extent **Cyclops vernalis, Acanthocylops americanus** and copepod larvae.

Table 2
Average annual in thousand per cubic meter of the total zooplankton recorded in the different sectors of the lake during 1987

Groups of zooplankton / Sector	Eastern Lake	Middle Lake	Western Lake	Average annual
Cladocera	8,613	24,636	69,283	34,177
Rotifera	1,615	10,241	68,290	26,716
Copepoda	22,970	19,422	35,754	26,048
Other forms	5,629	8,932	27,531	14,031
Total	38,827	63,231	200,858	100,972

DISCUSSION

The phytoplankton community in Lake Burollus was generally dominated by the diatom **Nitzschia, Cyclotella, Melosira, Mastogloia** and **Synedra** as well as chlorophytes **Scenedesmus Ankistrodesmus** and less so by **Crucigenia, Pediastrum** and **Dictyosphaerium.** These forms are characteristic members of eutrophic lakes (Jarnefelt, 1956). Sparling and Nalewajko (1970) mentioned that, **Cyclotella sp., Melosira granulata, Synedra ulna; Merismopedia punctata** and **Chroococcus turgidus** are significantly associated with base rich lakes in southern Ontario which is similar to the community composition in Lake Burollus. Accordingly, Lake Burollus is related to eutrophic base rich lakes.

In general, the highest annual standing crop of both phytoplankton and zooplankton appeared in the western lake and they decreased gradually eastwards. Similarly, Makarewicz and Likens (1979) found a linear relation between the total numbers of both phytoplankton and zooplankton in various lakes in New-Hampshire. On the other hand, the monthly variations of the two components showed inverse relation resulting from the grazing effect of zooplankton on phytoplankton. Thus, the highest numbers of phytoplankton were always accompanied with low counts of zooplankton except in September (Fig. 2).

The species composition of the zooplankton community plays also an important role in determining this relation. Thus, the high counts of herbivorous rotifers and cladocerans are usually responsible for the reduction of phytoplankton density (Pourriot, 1957; Champ and Pourriot, 1977). This inverse relation between the two communities was more pronounced in Lake Burollus during July and August where the zooplankton population consisted mostly of herbivorous forms. On the contrary, the simultaneous increase of both phytoplankton and zooplankton in September was attributed to the increased numbers of cyclops which are mostly carnivorous (Hartig et al, 1982).

Results of the present investigation indicate that Lake Burollus is an eutrophic lake which serves as an excellent breeding ground for fish due to its richness in both phytoplankton and zooplankton.

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