

DISTRIBUTION OF CHLOROPHYCEAE IN LAKE BUROLLUS, EGYPT.

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ABSTRACT

The standing crop of phytoplankton in Lake Burollus was estimated monthly during the years 1978 and 1979. The community was rich both in density and number of species and it consisted mainly of Chlorophyceae and Bacillariophyceae was less frequent.

The chlorophytes constituted about 53 % of the total phytoplankton counts. They were represented by 36 species included in 6 orders. The order Chlorococcales contributed about 96 % of the total chlorophytes, being dominated by *Scenedesmus* and *Dictyosphaerium* and to a less extent by *Pediastrum*, *Ankistrodesmus* and *Crucigenia*. Members of the orders Tetrasporales, Volvocales, Ulotrichales, Zygnematales and Oedogoniales were infrequently or rarely recorded.

The highest density of chlorophytes appeared about the middle of the Lake. Their numbers were subjected to seasonal as well as annual variations. Their maximum persistence was in general during the winter and spring beside a small increase in autumn. The average annual standing crop of chlorophytes in Lake Burollus amounted to 1,321,600 u/l in 1978, increased to 2,019,700 u/l during 1979. Most of the species recorded are Oligohalobous halophilous forms.

INTRODUCTION

Lake Burollus is a shallow brackish water lake lying at the north of the Nile Delta along the Mediterranean Coast of Egypt between longitudes $30^{\circ} 30'$ and $31^{\circ} 10'$ E and latitude $31^{\circ} 35'$ N. It covers an area of about 48,000 hectares and has an average depth of 115 cm. The Lake receives most of its water at its southern margins through five main drains (Fig. 1). Besides, Brimbil Canal opens at the western extremity of the Lake and Burollus drain at its north eastern side. The surplus drain water discharged into the Lake flows into the sea through a small opening called Boughaz El-Boung. Sea water may on rare occasions invade the eastern sector of the Lake particularly during winter.

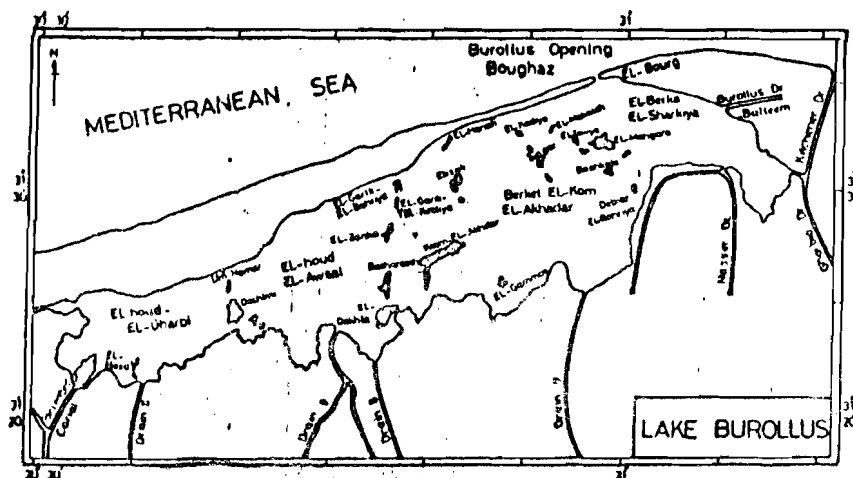


FIG. 1
Morphometry of Lake Burollus

According to the shallowness of Lake Burollus, its total area is related to the littoral zone where phanerogamic flora is widely distributed in the eastern Lake as well as in Lake margins (Samaan et al., 1988). The phytoplankton community in the Lake is rich both in density and number of species. Chlorophyceae contributed about 53.0 % of the total phytoplankton counts while Bacillariophyceae amounted to 26.8 %. Members of Cyanophyceae were less frequent and they averaged collectively 18.7 % of the total phytoplankton.

The present study deals with the distribution and seasonal variations of Chlorophyceae in the Lake during the years 1978 and 1979.

MATERIAL AND METHODS

Estimation of the standing crop of phytoplankton was performed according to the sedimentation technique. One liter of water sample was collected from the different stations with a Ruttner water sampler. The water was then discharged into a polyethylene bottle and fixed with 40 % neutral formaline solution. In the laboratory the samples were transferred into graduated cylinders of one liter capacity. Few drops of Ligol's solution were added and the samples were left to sediment for 48 hours. The supernatant clear water was then siphoned slowly until the sample was concentrated to exactly 100 ccs. Subsamples of 1 cc were transferred into a counting cell and each plankter was counted separately under a research microscope.

Eighteen stations were selected as representing the different parts of the Lake as shown in Fig. 2. These stations were further grouped into three sectors, namely; eastern Lake (stations 1-6), middle Lake (stations 7-12) and western Lake (stations 13-18).

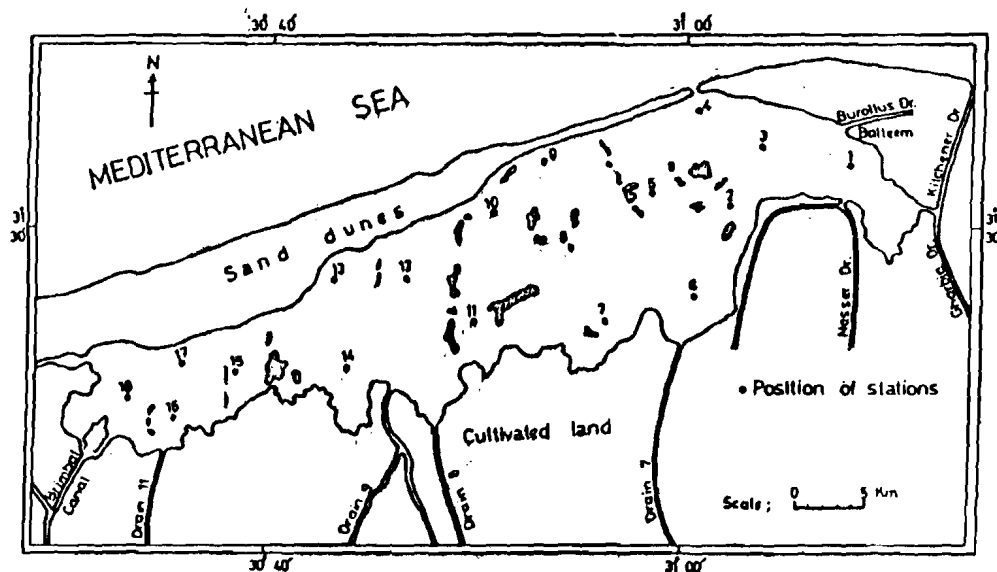


FIG. 2
POSITION OF STATIONS

RESULTS

Community Composition of Chlorophyceae:

Chlorophytes contributed respectively about 48.7 % and 58.9 % of the total phytoplankton counts in Lake Burullus during 1978 and 1979 (annual averages 1,321,600 & 2,019,700 u/l). They were represented by 36 species included in 6 orders. The order Chlorococcales formed the main constituent of green algae, comprising about 96 % of the total numbers. It was represented by 15 genera of which *Scenedesmus* Meyen and *Dictyosphaerium* Naegeli appeared as the most dominant plankters, while *Pediastrum* Meyen, *Ankistrodesmus* Corda and *Crucigenia* Morren were more or less frequent. The orders Tetrasporales, Volvocales, Ulotrichales, Oedogoniales and Zygnematales included collectively 10 genera which remained infrequent or rare throughout the whole investigation period.

The following is a list of the green algae recorded in the Lake :

- Division : Chlorophyta
Class : Chlorophyceae
- Order : Volvocales
Family : Chlamydomonadaceae
Chlamydomonas reinhardi Dang.
Carteria cordiformis (Carter) Dill.
- Family : Volvocaceae
Gonium pectorale Mull.
Pandorina morum (Mull.) Bory.
- Order : Tetrasporales
Family : Palmellaceae
Sphaerocystis schroeteri Chod.
- Order : Ulotrichales
Family : Ulotrichaceae
Geminella minor (Nag.) Hansg.
- Order : Oedogoniales
Family : Oedogoniaceae
Oedogonium sp.
- Order : Chlorococcales.
Family : Micractiniaceae
Golenkinia radiata Chod.
Micractinium pusillum Fresen.
- Family : Dictyosphaeriaceae
Dictyosphaerium pulchellum Wood.
- Family : Hydrodictyaceae
Pediastrum duplex Meyen.
Pediastrum boryanum (Turp.) Menegh.
Pediastrum tetras (Ehr.) Ralfs.
Pediastrum simplex Meyen.
Pediastrum sturmii Reinsch.
- Family : Oocystaceae
Tetraedron minimum (A. Braun) Hang.
Oocystis borgel Snow.
Chodatella subsala Lemm.
Franceia droescheri (Lemm.) G.M. Smith
Kirchneriella obesa Var. aperta (Teil.) Brun.
Ankistrodesmus falcatus (Corda) Ralfs
Ankistrodesmus setigerus (Schrod) G.S. West.
Ankistrodesmus longissimus (Lemm.) Wille.
Nephrocytium limneticum G.M. Smith.
Selenastrum gracile Reinsch.
- Family : Scenedesmaceae
Crucigenia quadrata Morren
Scenedesmus quadricauda (Turp.) Breb

Scenedesmus diagonalis S. Fang.
Scenedesmus bijugatus (Turp.) Kutz.
Scenedesmus bijugatus var. *alternans* Hansg.
Scenedesmus opaliensis Rich.
Actinastrum hantzschii Lagerh.

Order : Zygnematales
Family : Zygnemataceae
Spirogyra hassalii (Jenner) Petit.

Family : Desmidiaceae
Closterium parvulum Naeg. Var. *angustum* W.
& G. West.
Cosmarium elfvingii Racib.
Cosmarium subpachydermum Schmidle

Distribution and Seasonal Variations:

The distribution of the total chlorophytes in the Lake during two successive years is shown in Fig. 3. Their highest densities appeared in the middle sector which is more affected by the influx of the drain water. The increased numbers of the total chlorophytes during 1979 was mainly due to *Dictyosphaerium pulchellum*.

The seasonal variations of the total chlorophytes in the eastern Lake showed a pronounced increase in early winter, particularly in January, 1979 and less so in the spring (Fig. 4). The middle Lake sustained also a high peak in winter of 1979 and was dominated by *Dictyosphaerium*. The maximum persistence of green algae in the western sector appeared during the spring of 1978 (April-May) and in February and October, 1979. These peaks were attributed to *Scenedesmus* and *Pediastrum* spp.

The distribution of the different genera of green algae in the Lake as well as their seasonal variations are treated in the following pages according to their frequencies.

1. *Scenedesmus* Meyen.

The genus *Scenedesmus* was the most dominant green alga in Lake Burollus during 1978 but ranked the second in 1979. It formed numerically about 44.2 % (584,400 cells/l) and 30.6 % (618,800 cells/l) of the total chlorophytes during the two successive years. The genus was represented by 5 species. *Scenedesmus quadricauda*, *Sc. diagonalis* and *Sc. bijugatus* appeared more dominant. It showed highest counts in the western sector, decreasing gradually eastwards (Fig. 5).

Scenedesmus spp. were recorded all the year-round. Their maximum persistence was in general during the spring of 1978 and in winter and autumn of 1979. Other increase was also observed in the eastern Lake during January, 1978 (Fig. 6).

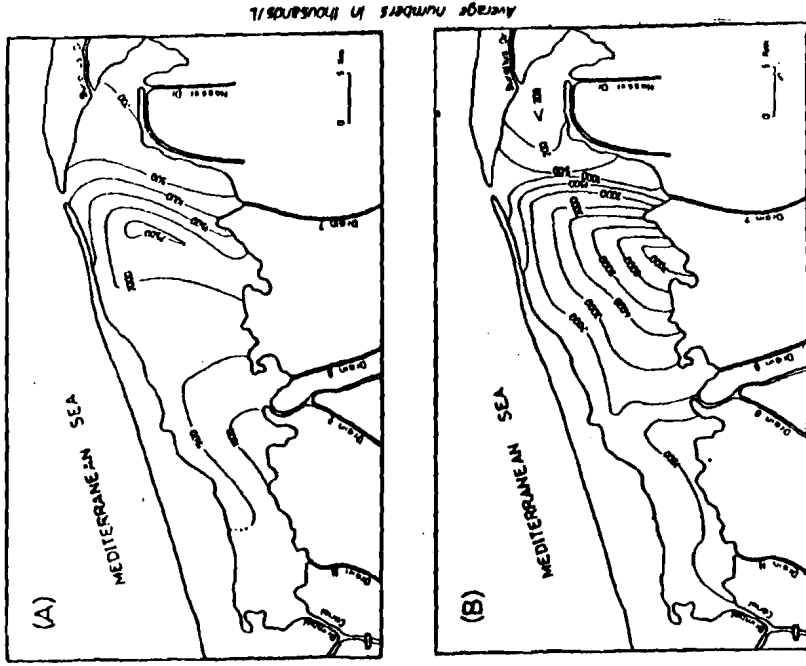


FIG. 3
Horizontal distribution of Chlorophyceae
in thousands/1 in Lake Burollus.
(A) Average of 1978 (B) Average of 1979

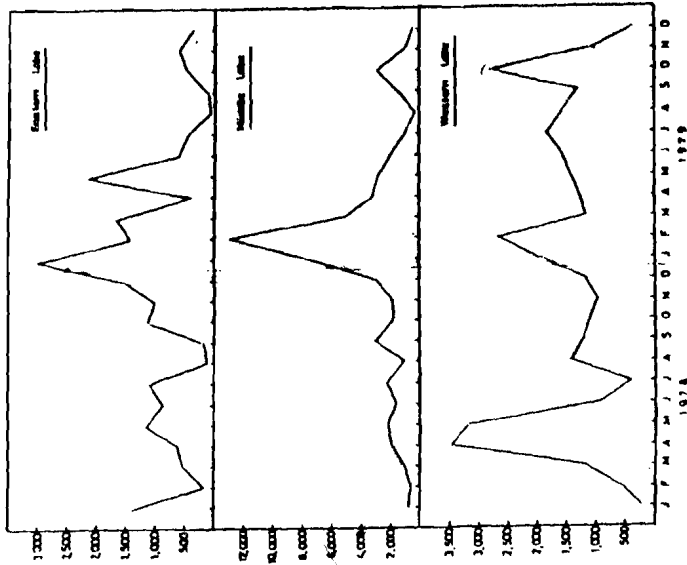


FIG. 4
Seasonal variations of green algae
in Lake Burollus

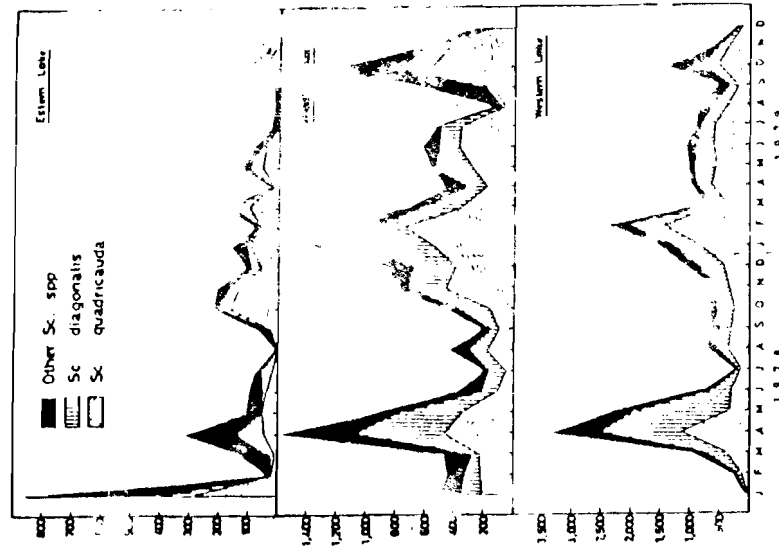


FIG. 6
Seasonal variations of *Scenedesmus* spp.
in Lake Burullus

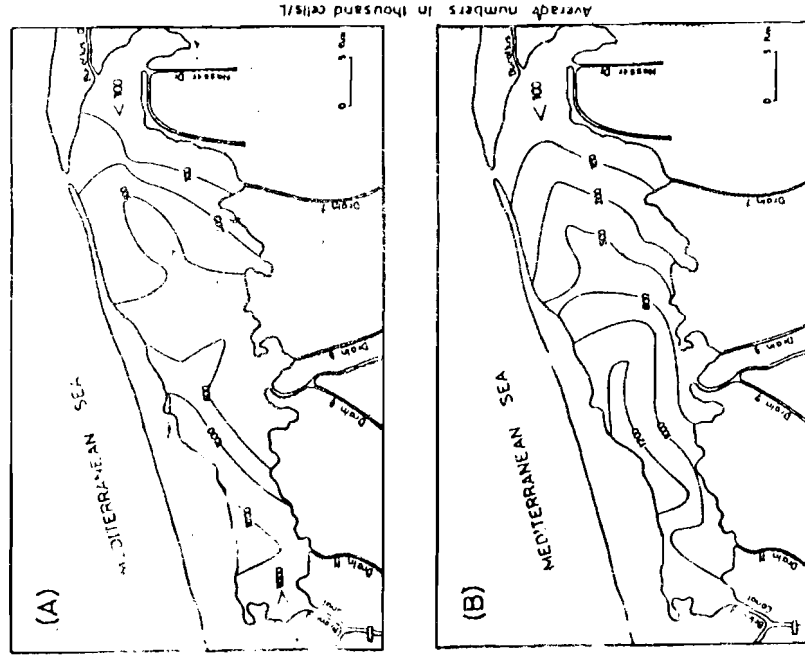


FIG. 5
Horizontal distribution of *Scenedesmus* spp.
(thousand cells/l) in Lake Burullus.
(A.) Average of 1978 (B) Average of 1979

2. *Dictyosphaerium Naegeli.*

The species *Dictyosphaerium pulchellum* appeared as the most dominant green alga in Lake Burollus during 1979 where it flourished in the middle Lake, particularly at the southern margins between Drains 7 and 8 (Fig. 7). Its percentage frequency to the total chlorophytes amounted respectively 29.1 % (384,200 cells/l) and 48.2 % (973,600 cells/l) during 1978 and 1979.

The highest density of *D. pulchellum* was recorded in January and February, 1979 at the eastern and middle Lake respectively, while it was missed there during the winter of 1978 (Fig. 8). The species appeared in the western sector in low counts during scattered months.

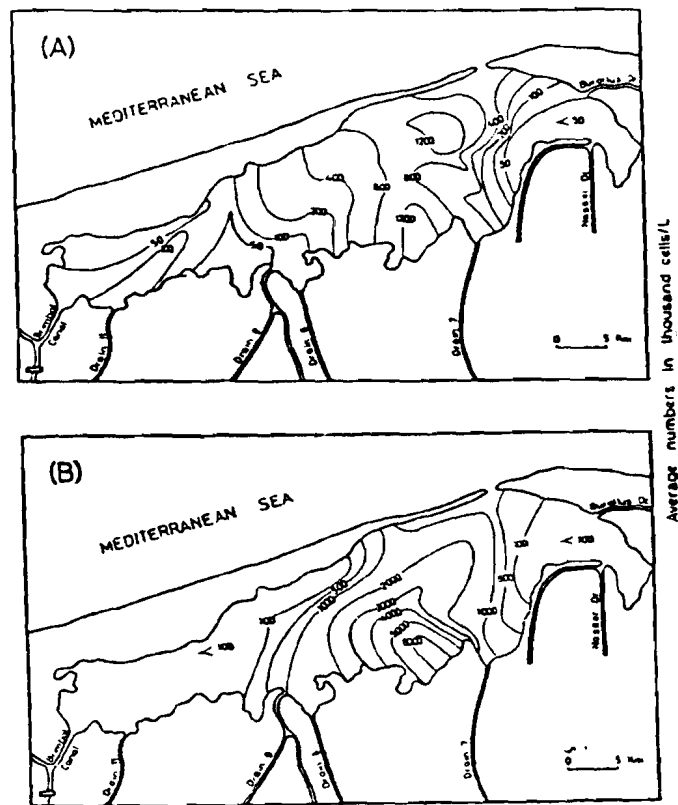


FIG. 7
Horizontal distribution of *Dictyosphaerium* sp.
(thousand cells/l) in Lake Burollus.
(A) Average of 1978 (B) Average of 1979

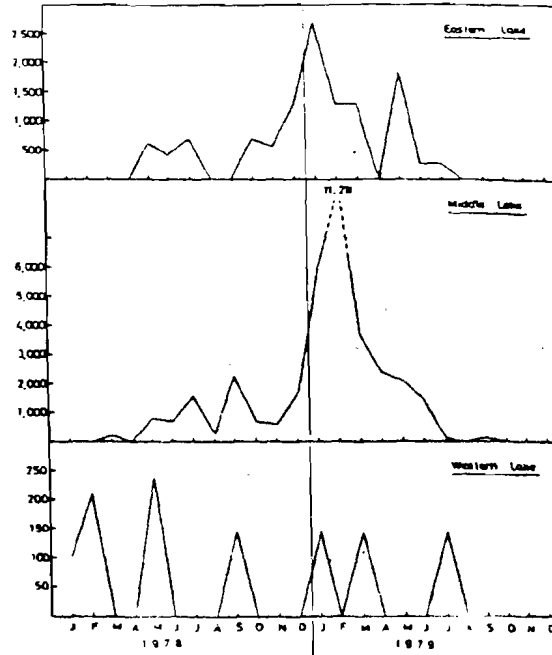


FIG. 8
Seasonal variations of *Dictyosphaerium* sp.
in Lake Burollus

3. *Pediastrum* Meyen.

The genus *Pediastrum* constituted numerically about 5.3 % of the total chlorophytes during the two successive years. However, its average annual values for the whole Lake increased from 69,700 cells/l in 1978 to 107,500 cells/l during 1979. As shown in Figure 9 the highest standing crop of *Pediastrum* spp. was recorded in the middle and western sectors particularly along the northern margins. The genus was represented by 5 species, being dominated by *P. duplex* and *P. boryanum*.

Pediastrum spp. appeared in the eastern Lake during scattered months of 1978 and in the spring and autumn of 1979. They persisted in the middle and western sectors all the year-round, showing highest counts in late summer and early autumn as well as during the winter of 1979 (Fig. 10).

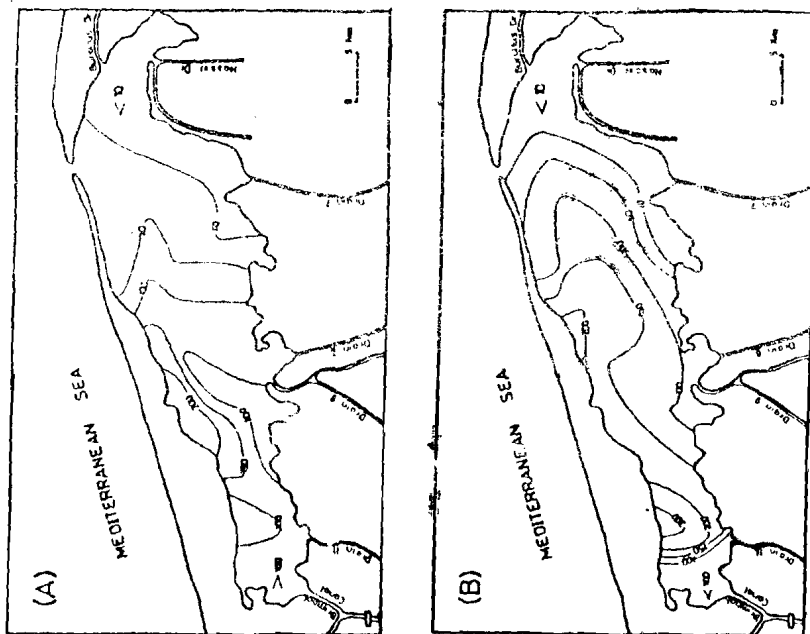


FIG. 9
Horizontal distribution of *Pediastrium* spp.
(thousand cells/l) in Lake Burullus.
(A) Average of 1978 (B) Average of 1979

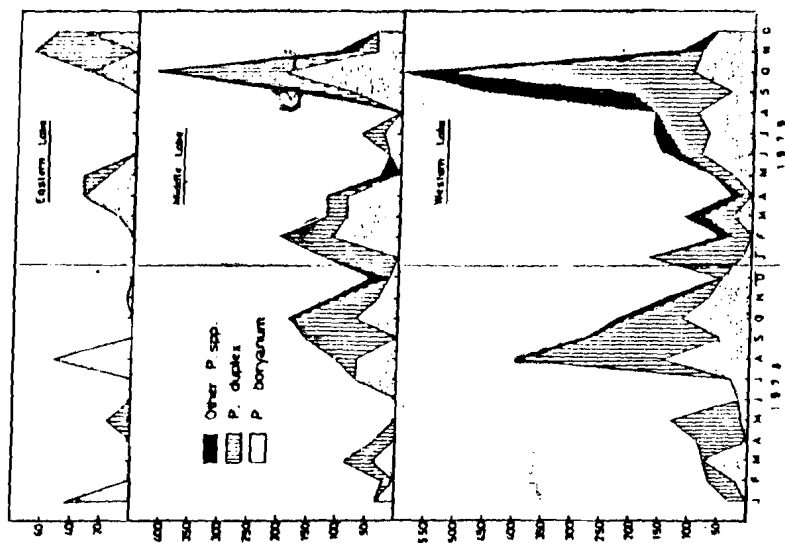


FIG. 10
Seasonal variations of *Pediastrium* spp.
in Lake Burullus

4. *Ankistrodesmus* Corda.

The genus *Ankistrodesmus* formed about 5.7 % (74,600 cells/l) and 2.5 % (50,400 cells/l) of the chlorophytes during 1978 and 1979 respectively, being more frequent in the eastern Lake (Fig. 11). *Ankistrodesmus* included 3 species and was dominated by *A. falcatus*.

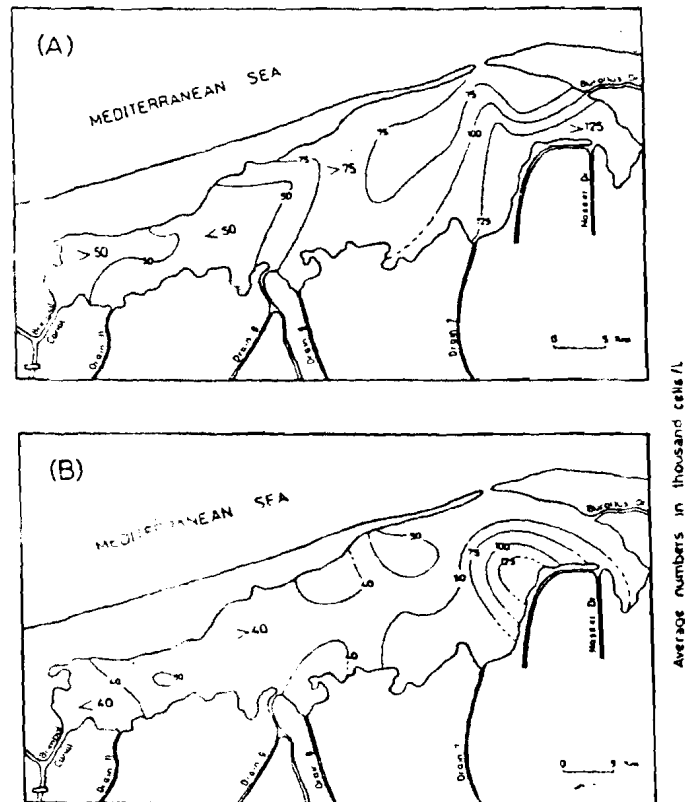


FIG. 11
Horizontal distribution of *Ankistrodesmus* spp.
(thousand cells/l) in Lake Burullus.
(A) Average of 1978 (B) Average of 1979

As shown in Figure 12 *Ankistrodesmus* spp. were generally more dense in the three sectors in late winter and during the spring. The peaks were mainly represented by *A. falcatus*, except that recorded in the western Lake during May, 1978 which comprised both *A. falcatus* and *A. longissima*.

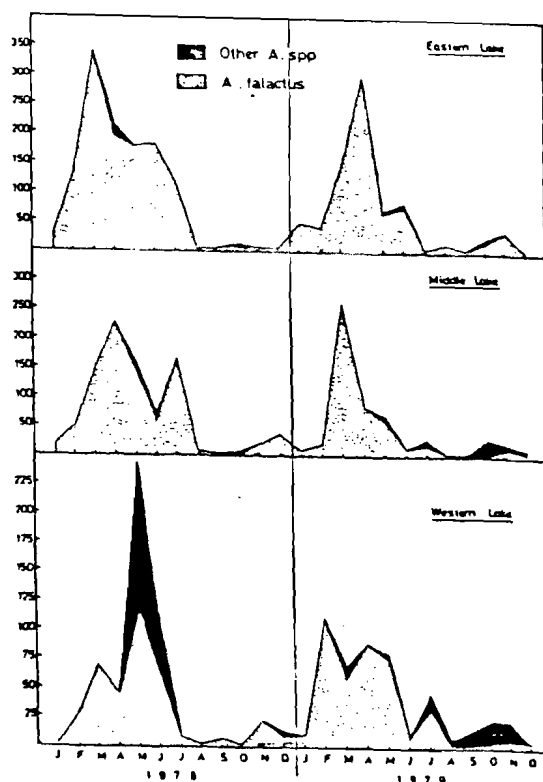


FIG. 12
Seasonal variations of *Ankistrodesmus* spp.
in Lake Burollus

5. *Crucigenia* Morren.

The average annual counts of *Crucigenia quadrata* reached 60,000 and 91,000 cells/l during 1978 and 1979 respectively, comprising about 4.5 % of the total chlorophytes in the Lake. The species showed its maximum persistence in the middle Lake (Fig. 13).

Crucigenia quadrata appeared all the year-round in the three sectors, showing scattered peaks which were mostly confined to the summer and autumn (Fig. 14).

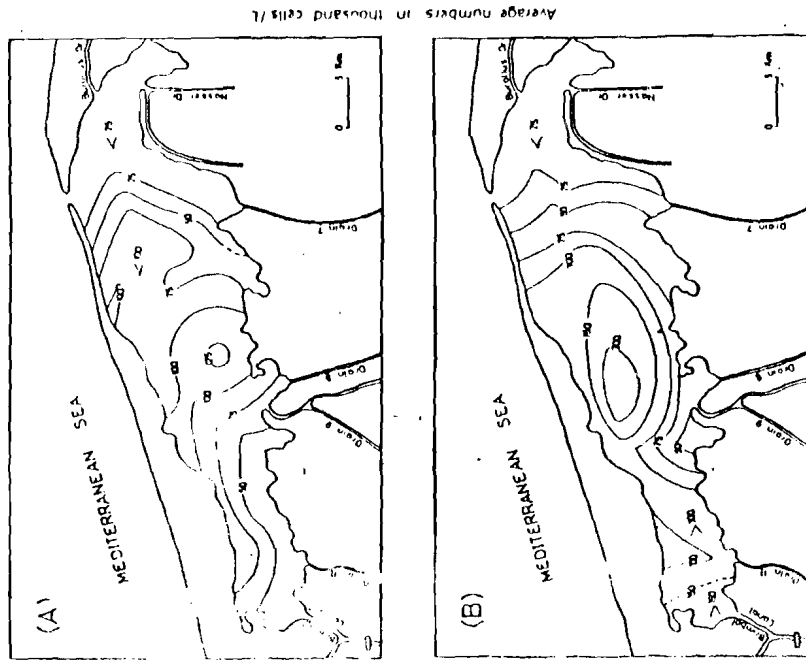


FIG. 13
 Horizontal distribution of *Crucigenis* sp.
 (thousand cells/l) in Lake Burullus.
 (A) Average of 1978 (B) Average of 1979

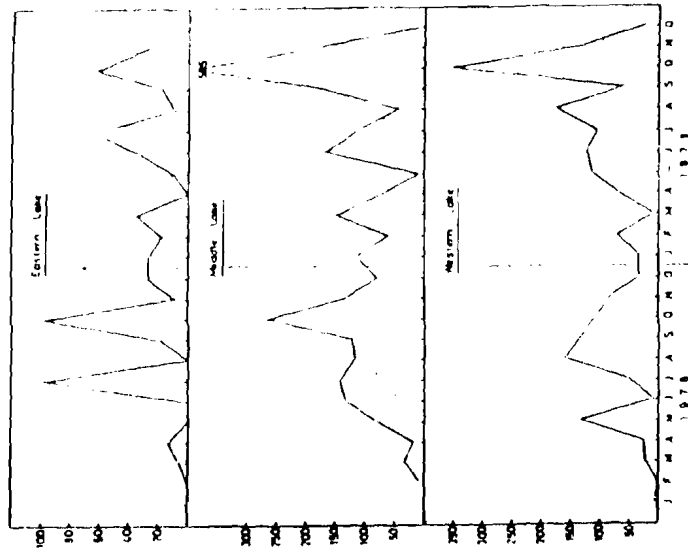


FIG. 14
 Seasonal variations of *Crucigenis* sp.
 in Lake Burullus

6. *Oocystis Naegeli*.

Oocystis borgei formed numerically about 3.0 % (40,000 cells/l) and 1.6 % (31,300 cells/l) of the total green algae during 1978 and 1979 respectively. It remained more frequent in the middle Lake. The species was recorded in the three sectors all the year-round, showing irregular monthly fluctuations (Fig. 15).

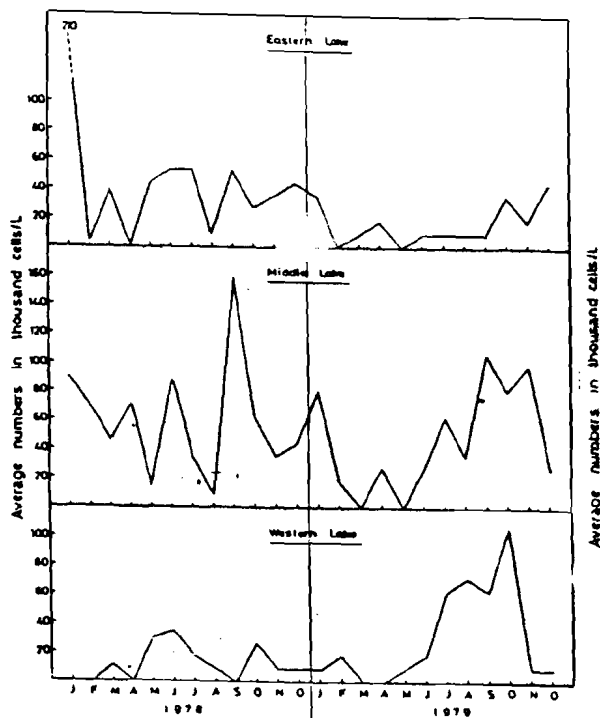


FIG. 15
Seasonal variations of *Oocystis* sp.
in Lake Burollus

7. *Tetraedron Kutz.*

Tetraedron minimum contributed about 3.0 % of the total green algae during 1978 (40,000 cells/l) but decreased to 1.2 % in 1979 (24,900 cells/l). As shown in Figure 16, the species was recorded throughout the whole investigation period, being more common in the spring and autumn.

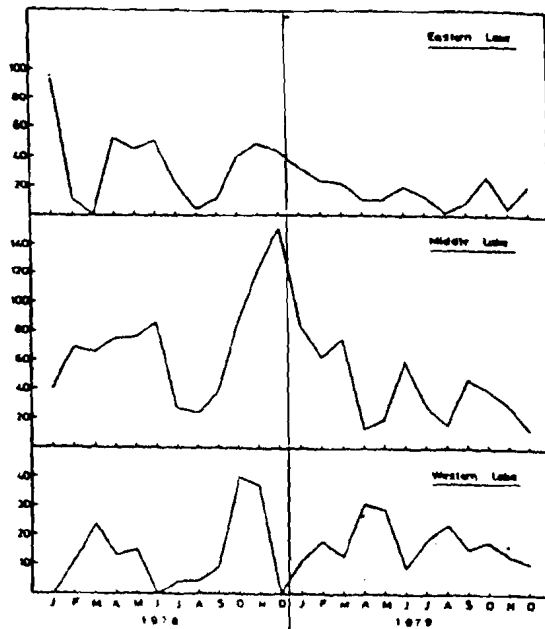


FIG. 16
Seasonal variations of *Tetraedron* sp.
in Lake Burollus

8. *Sphaerocystis* Chodat.

Sphaerocystis schroeteri was only encountered between May and December, 1979. The peaks were recorded in the summer and/or autumn (Fig. 17). Its annual average values for the whole Lake reached 34,700 cells/l during 1979, contributing about 1.7 % of the total chlorophytes.

9. *Geminella* (Turpin) Lagerheim

Geminella minor constituted respectively about 2.4 % (32,000 fil./l) and 1.5 % (29,600 fil./l) of the total green algae during 1978 and 1979. The species was recorded all the year-round, showing maximum distribution in May, 1978 in the eastern and middle sectors and in early autumn of 1979 in the middle Lake (Fig. 18).

10. *Nephrocytium* Naegeli

Nephrocytium limneticum was infrequently recorded in the Lake with annual averages of 4,900 and 13,300 cells/l during the two successive years. Its persistence in 1978 was confined to few stations but it showed wider distribution during 1979. The species appeared more frequent in the summer and autumn.

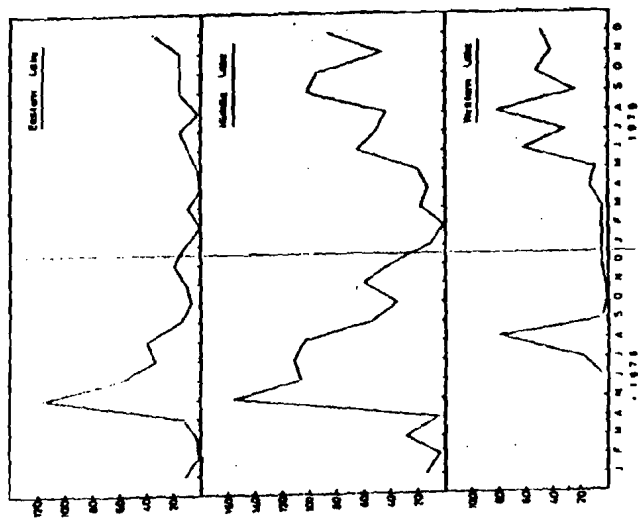


FIG. 18
Seasonal variations of *Geminella* sp.
in Lake Burollus

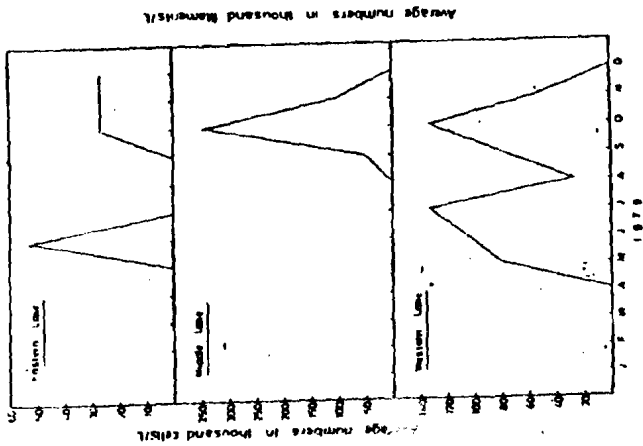


FIG. 17
Seasonal variations of *Sphaerocystis* sp.
in Lake Burollus

11. *Carteria* Diesing.

The annual average counts *Carteria cordiformis* amounted to 6,600 and 10,500 cells/l during 1978 and 1979 respectively. It appeared more common in the eastern Lake particularly during the autumn.

12. *Cosmarium* Breb.

The genus was represented in the Lake by *C. elfvingii* and *C. subpachydermum*. Its annual average standing crop reached 6,600 and 6,500 cells/l during 1978 and 1979 respectively. *Cosmarium* spp. appeared more common during the autumn and early winter.

13. *Franceia* Lemm.

Franceia droescheria was infrequently recorded in the collected samples during 1978, with an annual average of 11,100 cells/l. This value further decreased to 2,300 cells/l in 1979. The species was more common in autumn and early winter.

Other rare chlorophytes:

Other 12 species of green algae were scarcely observed at scattered stations during one month or the other and they contributed collectively about 0.9 % of the total chlorophytes. These comprised *Pandorina morum*, *Actinastrum hantzschii*, *Golenkinia radiata*, *Chlamydomonas reinhardi*, *Chodatella subsala*, *Gonium pectorale*, *Microactinium pusillum*, *Kirchneriella obesa*, *Closterium parvulum*, *Selenastrum gracile*, *Spirogyra hassallii* and *Oedogonium* sp.

DISCUSSION

The chlorophytes in Lake Burollus contributed numerically about 53 % of the total phytoplankton. They were dominated by members of Chlorococcales particularly *Scenedesmus* spp. and *Dictyosphaerium pulchellum*, while *Pediastrum* spp., *Ankistrodesmus* spp. and *Crucigenia quadrata* remained more or less frequent. All of them are considered among the eutrophic chlorococcal plankton (Hutchinson, 1967).

The predominance of Chlorococcales over the other chlorophytes were also recorded in most Egyptian lakes but with different dominant species. Thus, in the highly polluted Lake Mariut the green algae contributed about 70 % of the total phytoplankton (39,347 thousand u/l) and these consisted mainly of *Planktosphaeria gelatinosa* and *Crucigenia* spp. (Ghobrial, 1987). For the mesotrophic Lake Edku their percentage frequency dropped to 8.2 % of the total phytoplankton (1,274 u/l) where *Scenedesmus* spp. and *Pediastrum* spp. formed the major green algae (Soliman, 1983). In the fertile man-made Lake Nasser the percentage frequency of chlorophytes dropped to 0.4 % of the total phytoplankton (24,477 u/l) but still Chlorococcales, mostly *Pediastrum* spp. persisted as the main component (Zaghloul,

1985). Similarly the chlorophytes of the Nile water near Edfina contributed about 3.5 % of the total phytoplankton (29,136 u/l) and they were represented mostly by *Scenedesmus* spp., *Pediastrum* spp. and *Actinastrum hanzschi* (Zaghloul, 1976). Conzalves and Joshi, (1946) recorded high percentage of Chlorococcales in alkaline water which is similar to prevailing conditions in the Egyptian inland waters.

The general climate of Burollus region is that of the warm temperature zones. The average monthly water temperature fluctuates between 29°C during the summer (July-August) and 13°C in winter (January-February). Most of the green algae inhabiting the Lake are eurythermic forms which appeared all the year-round but showing optimum growth rate at temperature range between 14 and 24°C. Singh (1960) mentioned that Chlorococcales favour high temperature and usually predominate in tropical waters.

The Lake is considered among the slightly brackish water habitats, with average chlorosity values fluctuating between 0.7 and 4.2 gm Cl/l (El-Sherif, 1983). The southern margins lying nearby the land drains usually sustain low chlorosity values while the highest records appear around the Boughaz area (Lake-sea connection). Subsequently, the total chlorophytes were more dense in the middle Lake and around the southern margins, coinciding with the decreased chlorosity. Also most of the species recorded are oligohalobous, halophilous forms which can tolerate water salinity up to 5 ‰.

According to the shallowness of Lake Burollus most of the chlorophytes recorded there are littoral forms, characteristic pond flora as previously recorded by El-Nayal (1935 and 1936). Many species were also recorded in the Nile water (Elster and Vollenweider, 1961).

One of the characteristic features in Lake Burollus is the pronounced variations in the percentage composition of the different phytoplankton species from one year to the other as well as the magnitude of the annual standing crop during the two successive years.

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