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COMPARATIVE STUDY ON THE PHYTOPLANKTON STANDING CROP IN THE DIFFERENT SECTORS OF BURULLUS LAKE DURING 1997- 1998

BY

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Key words : phytoplankton, Lake Burullus.

ABSTRACT

Spatial and seasonal distribution of phytoplankton standing crop in lake Burullus were studied in the period from March ,1997 to February , 1998 which was indicated a pronounced dereased influx of fresh and saline water in the lake .

The phytoplankton standing crop showed a pronounced decline as compared with the previous studies .The phytoplankton was represented mainly by Bacillariophyceae (59.5 % of the total standing crop) and Chlorophyceae (21.2 %) , Cyanophyceae (11.9 %) while Euglenophyceae (5.4%) and Dinophyceae (2.0%) were infrequently observed . The highest counts of phytoplankton . were recorded in winter and were dominated by the diatoms , Cyclotella meneghiniana and Nitzschia spp ., which represent the main bulk of phytoplankton beside the green algae, Scenedesmus quadricauda ,Sc . acuminatus , pediastrum simplex , P.boryanum P.duplex in addition to the blue green algae Microcystis spp., Gloeocapsa rupestris , Anabaenopsis criculars and Merismopedia tenuissima. The highest counts of euglenoides were restricted in front of the drains specially at the southern margins of the lake .

Generally , the lake is regarded as polluted habitate specially in the eastern sector and tends to eutrophy as regards to the restriction of few species which represent the main bulk in each class. This is attributed to the decreased ammount of Nile fresh water and sea water flowing into the lake with the invesion of submerged hydrophytes.

INTRODUCTION

Lake Burullus represent one of the most important northern lakes in Egypt , it is a shallow brackish water habitate , lying at the north of the Nile Delta, along the Mediterranean Sea between longitudes 30 ^{0} 30` and 31$^0$ 10` E and at latitude 31^0 30` N. It covers an area of about 105.000 feddans and has an average depth of 103cm (personal communication). The lake recieves most of its water from five main drain on the southern margin .Besides, Brimbal canal at the western side and Burullus drain at the north eastern side (Fig. 1) The lake is affected by different kinds of pollutants from several sources ; agricultural drainage water , industrial effluents and sewage discharged from several pipes.

The present paper deals with comparison study between the distribution of phytoplankton standing crop in the different sector of lake Burullus and the pollutional status of the lake.

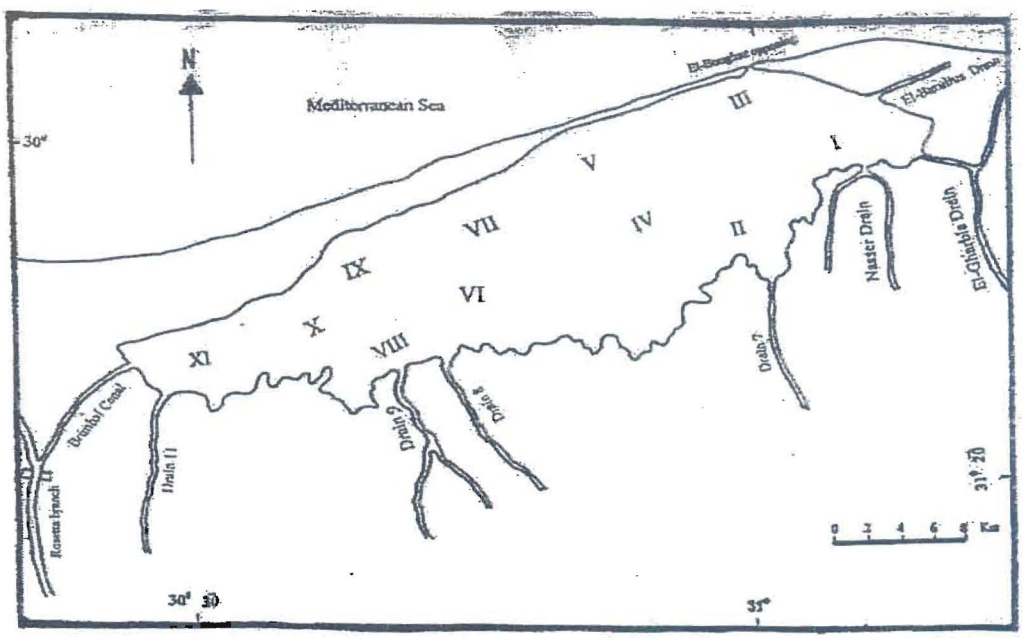

Fig. 1 : Stations chosen (11) on Burollos Lake (3 sectors) during 1997 - 1998

MATERIAL AND METHODS

1- Sampling period and choice of locations :-

Phytoplankton standing crop sampling was cauried out monthly during the period from March ,1997 to February , 1998 at 11 stations covered three sectors of lake Burullus mameley ;the eastern sector(sts .1-4) ,middle sector (sts .5 –8) and the western sector (sts. 9-11) .

Monthly trips were carried out during the period from March , 1997 till February , 1998 representing four seasons .

Qualitative and quantitative sampling of phytoplankton after preservation by 4% formaline was carried out by using sedimentation technique (uter mohe , 1936) and from the concentrated samples after siphonation , subsamples were transferred for qualitative and quantitative determinations by using binocular research microscop . the phytoplankton standing crop was calculated as their total numbers (units. e^{-1}) .

2- Species diversity :-

Diversity index of the phytoplankton community was estimated on calculator , according to the equation of Shanon &weaver (1963) as follows .

$H = - \Sigma^{n}_{i=1} P_i \text{ In } p_i$

Where Pi = importance of probability for each species (n/ N is the proportion of i, the ni species) to the total number of phytoplankton calls (N) .

RESULTS

Composition and distribution of the total phytoplankton :-

The phytoplankton community in lake Burullus represent a low diversified flora which included both fresh and brackish water species as well as little marine forms , few of them formed the main bulk of the community at the three sectors of the lake .

The phytoplankton community in the eastern sector of the lake (Sts. 1-4) comprised 52 species included in the classes Bacillariophyceae (29 spp) , Chlorophyceae (9 spp) , Cyanophyceae (7 spp) , in addition to other forms of Euglenophyceae (5 spp.) and Dinophyceae (2 spp.) .

The phytoplankton community in the middle sector (Sts . 5- 8) comprised 51 species included in the classes Bacillariophyceae (20 spp) , Chlorophyceae (15 spp) Cyanophyceae (11 spp) , beside other forms of Euglenophyceae (5 spp) and Dinophyceae not detected .

The phytoplankton in the western sector showed a low numbers of species as compared with the other two sectors since ,8 spp .belonging to class Bacillariophyceae; were recorded , Chlorophyceae (11 spp) , Cyanophyceae (9 spp) , Euglenophyceae (6 spp) and Dinophyceae (1 sp.) Appendix 1.

Bacillariophyceae , as a whole contributed about 59.5 % of the total phytoplankton in the lake with an annual average of 424 x 10^3 cell . l^{-1} . the diatoms appeared more dense in the middle sector representing about 67.1 % of the total phytoplankton in this sector with an average 557. 5 x 10^3 cell . l^{-1} , while the lower dense of diatoms were observed in the western sector contributing about 46.5 % of the total phytoplankton in this sector with an average of 248 x 10^3 cell .l^{-1}. On the other hand , the diatoms in the eastern sector contributing about 57.8 % of the total phytoplankton with average (421 x 10^3 cell . l^{-1}).

The genera *Nitzschia* , *Cyclotella* and *Navicula* were dominant in the eastern sector of the (averages 150 x 10^3 , 120 x 10^3 and 85 x 10^3 cell . l^{-1}. respectively , while *Melosira* , *Synedra* , *Cymbella* , *Amphora* and *Rhoicosphenia* were ferquent (averages 18 x 10^3 , 15 x 10^3 , 12 x 10^3 , 10^3 x 10 and 7 x 10^3 cell . l^{-1} . respectively . These genera represented collectively 99.0 % of the diatom standing crop in this sector The other diatoms were rare .

In the middle sector , the genera *Cyclotella* and *Nitzschia* were the most dominant (averages 250 x 10^3 and 180 x 10^3 cell . l^{-1} . respectively) , while the genera of *Navicula* , *Stauroneis* , *Cocconeis* and *Synedra* were frequent (averages 43 x 10^3 , 25 x 10^3 and 12 x 10^3 cell . l^{-1} . respectively) . These genera represented collectively 91.5 % of diatoms standing crop in this sector and the other diatoms were rare..

The genus *cyclotella* was dominant in the western sector (average 190 x 10^3 cell .l^{-1}) , while the genus *Nitzschia* was frequent (average 30 x 10^3 cell . l^{-1}) , the other diatoms remained rare .These two genera represented collectively 88.7 % of the diatoms standing crop in this sector .

Chlorophyceae contributed about 21 .2 % of the total phytoplankton counts during the period of investigation (average 151 x 10 unit . l^{-1}) The genus *Scenedesmus* was the most productive one at all sectors. In the eastern sector , the chlorophytes contributed about 15% of the total phytoplankton in this sector (average 109 x 10 unit . l^{-1}) , while it represented about 21.1 % and 33.2 % of the total phytoplankton in the middle and western sector (averages 175 x 10^3 and 177 x 10^3 unit . l^{-1} respectively) .

microcephala , Navicula gracilis , N. humerosa , N. schizonemoids and less extent N. crypocephala , N. cuspidata , stauroneis anceps , synedra ulna , cocconeis placentula , Amphora ovalis Gyrosigma kutzingii , pleurosigma delicatulum . Scenedesmus quadricauda , Sc . acuminatus , Sc . bijugatus . and Actinastrum hantzschii were the dominant species of chlorophytes in this sector .

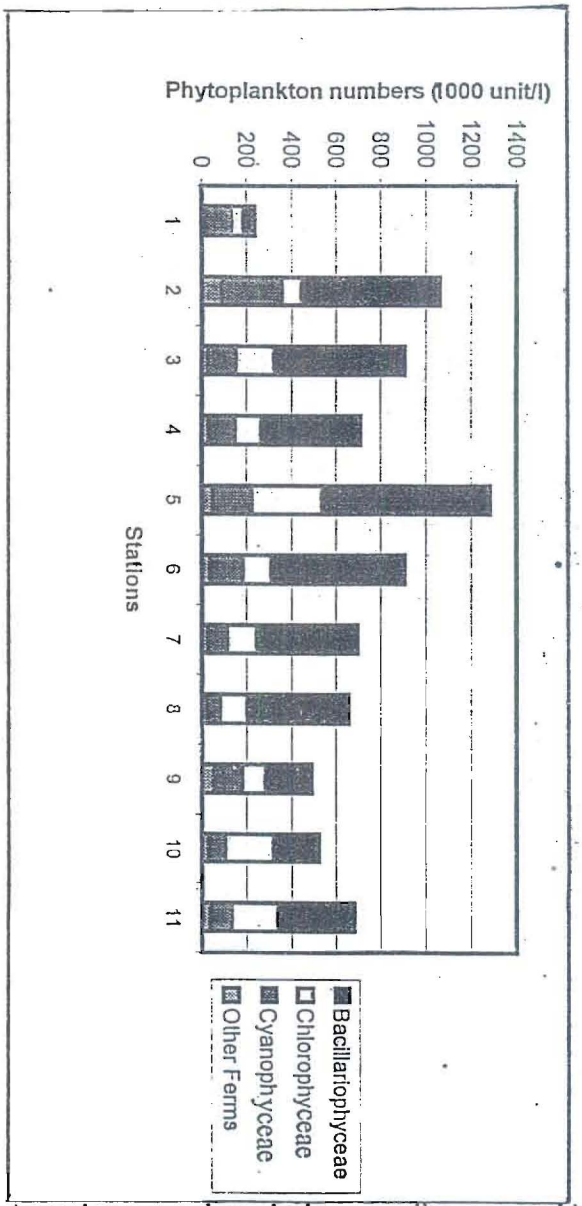

Fig.2: Annual average phytoplankton standing crop and its components (unit / l) recorded in the different stations of Lake Burullos

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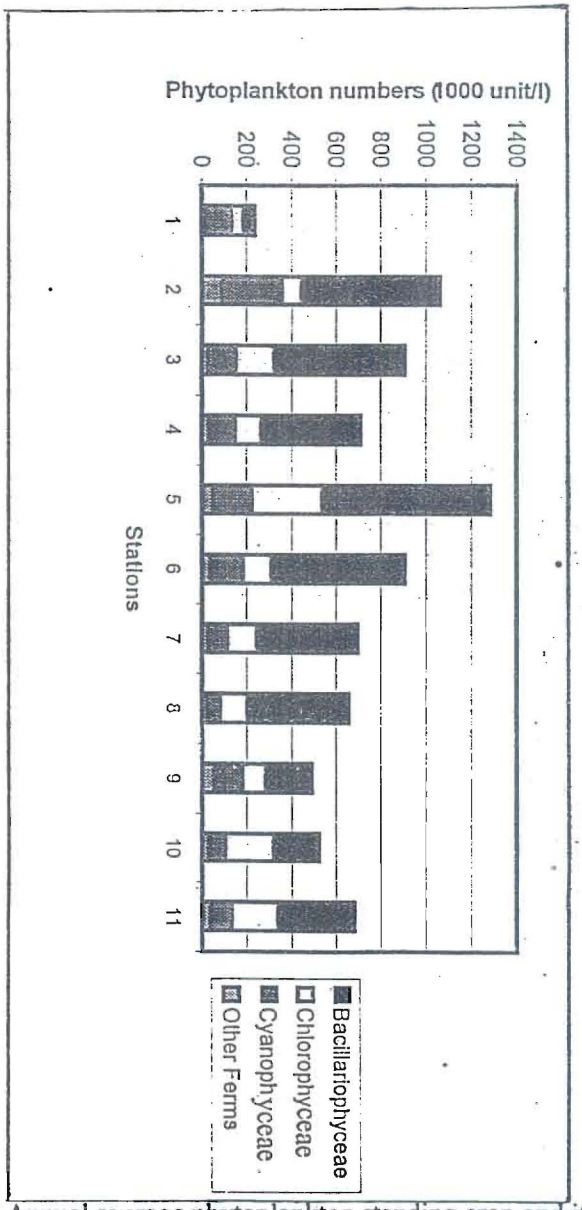

Fig.2: Annual average phytoplankton standing crop and its components (unit / l) recorded in the different stations of Lake Burullos

Table 1: Monthly variations of phytoplankton standing crop (1000 unit .l^{-1}) recorded in the different sectors and stations of lake Burullus during the period from March , 1997 till february , 1998 .

Sector	Easterm				Middle				Western			
St / Month	1	2	3	4	5	6	7	8	9	10	11	Average
March, 97	120	260	660	560	1960	650	360	330	360	1280	300	649
Apr.	200	700	800	490	1200	800	500	700	500	390	460	613
May.	315	860	700	500	900	560	390	480	620	600	160	553
Jun.	260	900	530	380	700	700	600	290	390	260	350	487
Jul..	340	690	640	290	1680	950	490	300	490	500	750	647
Aug.	190	880	490	1320	1520	1200	530	390	690	300	680	745
Sep.	420	980	700	1230	800	1700	700	500	360	580	800	797
Oct.	250	1760	800	1530	760	850	860	690	280	670	860	846
Nov.	300	1320	960	600	600	640	600	800	350	420	900	681
Dec.	210	900	1300	690	1600	560	680	690	80	590	1300	782
Jan , 98	150	1650	1750	450	890	830	890	900	500	380	680	825
Feb.	160	1800	1500	500	1800	950	900	1200	610	50	700	925
Averages	243	1058	500	712	1201	866	625	631	436	502	662	713
	729				831				533			

The lowest standing crop was recorded at station 1 in the eastern sector which lie nearby El- Hawiss drain , this may be attributed to the high polluted wastes discharged from kochiner drain (El – Gharbia) and the high density of submarged hydrophytes .

Seasonal variation

Generally , the highest phytoplankton counts were recorded in winter (average 844 x 10^3 unit . l^{-1}) . This was followed by a pronounced decrease during spring (605 x 10^3 unit . l^{-1}) , summer (626 x 10^3 unit . l^{-1}) , while a slightly decrease was recorded during autumn (775 x 10^3 unit . l^{-1}) . The seasonal variations of the different classes of phytoplankton in the lake are shown in fig . (3).

Bacillariophyceae was the most dominant during autumn and winter (average 440 & 500 x 10^3 cell . l^{-1}) . They showed a high peak in the later season at station 3 in the eastern sector (average 880 x 10^3 cell . l^{-1}) and was dominated by *Cyclotella meneghiniana* ,*Cyclotella kutzingiana* and to a less extent by *Nitzschia palea* , *Nitzschia longissima* , *Cocconeis placentula* and *Navicula gracilis* . Other smaller peaks were also obeserved at stations 2 & 5 (800 x 10^3 and 816 x 10^3 cell . l^{-1}) due to the increased numbers of *Cyclotella meneghiniana* , *C. kutzingiana* at station 5 and *Navicule* sp at station 2 . The autumn diatom peaks were recorded at station 2 , 4 and 6 (averages 690 , 720 & 620 x 10^3 cell . l^{-1} respectively) these peaks were attributed to the most productive diatoms , *Gyrosigma acuminatum* and *pleurosigma* dilicatulum at station 2 while , the peak at station 4 was due to the increased number of *Nitzschia palea* , *N.longissima* and *Navicula gracilis* . *Navicula* spp., *Cyclotella meneghiniana* , *Gyrosigma kutzingii* and *pleurosigma delicatulum* were caused the peak at station 6. *Diatoma hiemale* was recorded at station 6 with less extent . The lowest density of diatoms were recorded in summer (average 339 x10^3 cell . l^{-1}).

Chlorophyceae reached its maximum value in the lake during winter at station 5 (390 x 10^3 unit . l^{-1}) mainly due to *Scenedesmus quadricauda* and to its lowest values at stations 1 and 2 (41 and 62 x 10^3 unit . l^{-1} respectively) which were domintated by *Sc . accuminatus* , *Sc. Bijugatus* beside *Sc. quadricauda* in addition to *Pediastrum simplex* , *P. simplex* var , *P. duplex* , *P. duplex* var ., *Actinastrum* gracilimum and *Staurastrum paradoxum* which were dominated at station 2 .

The green algae *Sc quadricauda* , *Sc. Accuminatus* , *Sc . bijugatus* and *Ankistrodesmus falcatus* were frequently recorded at the different stations during spring and summer. In autumn, the chlorophytes were dominant in the western sector (St. 10 &11) , while they were infrequent at the other two sectors.

The blue green algae appeared as frequent forms all the year round , being more abundant at the eastern sector specially at station 2 in autumn and winter (446 and 430 x 10^3 unit . l^{-1} respectively) and was dominated by *Oscillatoria limnetica* , *Microcystis incerta* and *Gloeocapsa rupestris* at the former season and dominated by *Anabaenopsis circularis* , *Oscillatoria limnetica* and *Merismopedia punctata* at the later , while the

other two seasons sustained more or less low counts, but showing small increase in spring at station 5 in the middle sector (fig .3).

The other forms namely ; *Euglena* spp and *Gymnodinium* sp . showed their maximum persistence in autumn at station 2 (165 x 10^3 cell . l^{-1}) , and their minimum in summer at station 1 (9 x 10^3 cell . l^{-1}) , Other increase was recorded in winter at station 2 (154 x 10^3 cell . l^{-1}) due to the increased numbers of *Euglena granulata*.

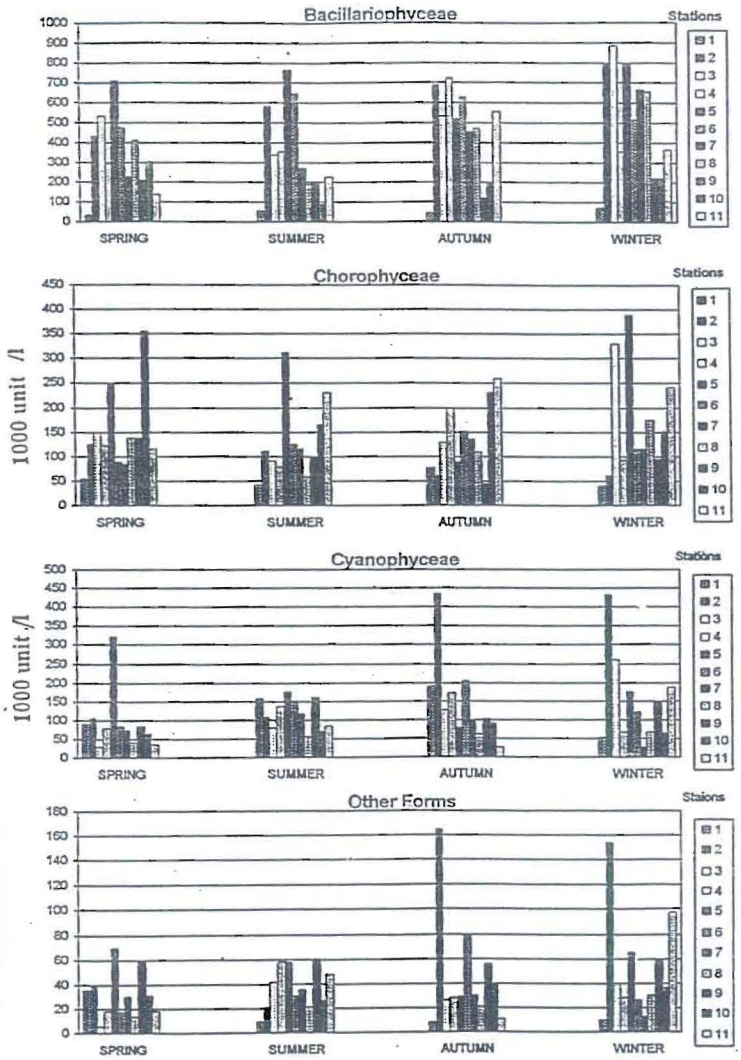

Fig 3: Sensonal variations of the standing crop of various phytoptankton clsses (1000 unit/l) at different stations in Lake Burullos.

From the data obtained its obvious that , the community composition reduced to 83 species recorded in lake Burullus during the period of investigation , in cluding 37 diatoms , 23 green algae , 14 blue . green algae and 9 species of other forms , while the previous data recorded 124 species (El – Sherif, 1983), 98 species (El-Sherif,1988) .The former class (Bacillariophyceae) formed the main bulk of the population in the three sectors of the lake during the study period , but the percentage frequency of the other groups differed from one sector to the other .

Concerning the diversity index , higher values of 0.85 to 1.06 were observed in the middle sector during February , 1998 and September at stations 5 and 6 respectively , while the low diversity were calculated in the eastern sector in winter (March , 1997) at station 1 attaining 0.21 and 0.32 respectively , while in the western sector during March and December at stations 10 and 11 its recorded with values 0.51 and 0.58 respectively .

Generally, a pronounced decrease in the diversity and standing crop of phytoplankton in lake Burullus as compared with the previous data. El- Sherif,1983 recorded 2,745,364 unit . l^{-1} during 1978 , 3,429,582 unit . l^{-1} during 1979 , while E-Sherif, 1988 recorded 1,039,641 unit . l^{-1} during 1987. recorded by El- Sherif , 1983 and El- Sherif , 1993 who recorded 3,429, 583 units . l^{-1} during 1979 (El – Sherif , 1983) .

The increased numbers of diatoms may be attributed to the increased concentration of silicon with the effect of fresh water discharged from the drains which consider the main component of diatoms frustules (Donoso & phinney , 1988 ; Gouni & Tsekos , 1989). The pronounced decrease of Chlorophyceae in the easterm sector was mainly due to the high density of *Potamogeton pectinatus* which reduce the nutrient salts at this sector inhibiting the growth of green algae specially at station 1 (Tilman *et al*, 1986) .

DISCUSSION

The results obtained from the present investigation indicate that, Lake Burullus harboured lower phytoplankton standing crop and low diversified during 1997 when compared with that previously recorded during 1987 – 1988 (El – Sherif , 1993) . This is attributed to the continental drainage water discharged into the lake with high load of agricultural and industrial wastes in addition to the sewage effluents. Further more ,the invasion of submerged hydrophytes which covered a wide area from the lake specially in the eastern sector , as well as the decrease of annual fresh water Nile flood and sea water entering the lake through the narrow Boughaz openning .

Concerning the phytoplankton community in the lake consists mostly of fresh water as well as brackish and few saline forms .

In the middle sector , its obvious that the total count of phytoplankton were higher than that in the other two sectors , this may be attributed to the lower density of submerged hydrophytes which created an open area. This observation is coincided with Shwatz and Grunedling , 1985 .

Bacillariophyceae . was the most productive one , constituting about 59.5 % of the total phytoplankton standing crop in the lake . The genus *Cyclotella* was the most dominant among the other genera of diatoms in the lake , constituting about 43.9 of the total diatoms , it was represented mainly by *C. meneghiniana* and *C. kutzingiana* . The development of such two species may by attributed to the high load of organic matters discharged with the drainage water . This observation was agreement with Abdalla *et al* (1991) , also Radwan , 1994 found that the flourishment of this genus in Damietta estuary which subjected to the same conditions of organic pollution .

Nitzschia took up the second important position among the other genera of diatoms in Burullus lake , constituting about 30.2 % of the total diatoms . This genus was mainly represented by *N. palea* . The highest number of this species was recorded in the eastern sector at station 2 nearby drain 7 where the high load of organic matters and high values of chlorosity (2.3 – 8.7 g Cl. l^{-1}) previously recorded during the same period of investgation by Radwan 2000 . This observation is coincided with Abdel Hamid , 1986 who reported that *N. palea* is regarded as euryhaline diatom which can tolerate a wide range of chlorosity and different pollutants . Other species of *Nitzschia* were recorded with high counts in the eastern sector , namely ; *N. longissima, N. sigma* and *N. closterium.* This observation is coincided with El- Sherif *et al* , 1989 who reported that these species were dominant in the western sector of Burullus lake where a high levels of chlorosity . The other genera and species of Bacillariophyceae wmre ferquent and rare due to the pronounced decrease of sea water invasion . From the data obtained , its obvious that , Chlorophyceae was the second important position . The genus *Scenedesmus* was the first dominant among the other genera of chlorophytes in the lake , the species belonging to this genus were *Sc. quadricauda* , and *Sc. Acuminatus* which developed nearby the drains , where the high levels of organic matters and phosphate . This observation was coincided with Munawar (1970) who mentioned that the drainage water with high levels of phosphate and oxidizable organic matter develop the growth of *Scenedesmus* and *Euglena* .

The flourishment of *pediastrum* spp ., specially in the western sector were influenced mainly by the low levels of chlorosity which recorded (0.6-2.8 g $C1.1^{-1}$) , in addition to the high values of pH and dissolved oxygen. This observation was coincided with Zafar (1964) who mentioned that the growth of *pediasrum* and some other species of Chlorococcales was attributed to the fresh water habitate and high values of pH and dissolved oxygen . The same species of *Pediastrum* which recorded in our investigation previously identified in lake Burullus by Samman *et al* ., 1989 .

It is obvious that, cyanophytes were more abundant at station 2 in the eastern sector due to the flourish of *Oscillatoria* and *Gloeocapsa*. This may attributed to the high load of domestic sewage and nutrient salts discharged from kotchener drain nearby station 2. The same genera were dominant in the estuary of Damietta branch where the high load of organic pollution and high levels of nutrient salts (Radwan ,. 1994). This observation was agreement with Saad and Antoine , 1983 who reported that flourishment of *Oscillatoria, Gloeocapsa* and *Microcystis* was correlated with the domestic sewage effluents .

The euglenoides were more occurrence at the southern margins in front of drains 7,8 and 9 at stations 2,6 and 8 due to the continental discharges of organic matters from these drains . This observation was coincides with Radwan, 1994 who mentioned that *Phacus pleuronectes* and *ph., longicauda* as well as *Euglena* spp. were indicators to the high loads of organic pollution with domestic sewage in the estuary of Damietta branch

The dinoflagellates were rare and restricted only in the eastern sector near to the Boughaz region where the source of saline water from the sea , also scarce numbers were recorded in the western sector due to the same reason .

It can be concluded that the phytoplankton standing crop in the present investigation in Burullus lake were lower than that previously recorded during 1978 – 1979 (El-Sherif , 1983) and that recorded in the period from January , 1987 to March 1988 (El-Sherif , 1993) . This may be attributed to the decrease in the total area of the lake and the high density of submerged hydrophytes to covering extensive area from the lake specially in the eastern sector .

The restriction of phytoplankton species in all sectors , in spite of high production of certain dominant species may by due to the effect of organic loads and nutrient salts from the reclaimed lands in addition to the pronounced decrease of fresh water influx into the lake further more the construction of bridge at Boughaz El- Burullus effect the amount of sea water which entering the lake caused a pronounced decrease in fish diversity and restriction of species .

Concerning the phytoplankton community in lake Burullus , Bacillariophyceae was the most productive one in all sectors constituting about 59.5 % of the total phytoplankton of the lake , followed by Chlorophyceae (21.2 % , Cyanophyceae was less frequent (11.9 %) and other forms 7.4 % .The highest phytoplankton count and diversity was observed at stations in thé middle sector nearby drain (Besak region).

From the data obtained ,it is obvious that Lake Burullus is considered as an slightly eutrophic as a few species of phytoplankton are usually responsible for the increased numbers of the population with a mixed Chlorococcales – diatoms plankton type .

List of phytoplankton species recorded in lake Burullus (1997- 1998)

Phytoplankton spp.	E	M	W
1- Bacillariophyceae :			
- *Nitzschia palea* W.Sm.	+	+	-
- *N. longissima* (Breb) Ralf .	+	+	+
- *N. microcephala* Grun.	-	+	-
- *N closterium* Sm.	+	+	+
- *N. obtusa* W.Smith.	-	-	+
- *N. sigma* (kutz) W.Sm .	+	-	-
Cyclotella meneghiniana Kutz	+	+	+
C. Kutzingiana. Thwaites	-	+	+
C. kutzingii kutz	+	-	+
C. sp.	-	-	+
Navicula humerosa Breb	+	+	+
N. graclis (Ehr .)	-	+	+
N. cryptocephala Kutz	+	+	+
N. schizonemoids H. van Heurk	+	+	-
N. cuspidata Kutzing	-	+	-
N. yarrensis Grun	+	-	-
Rhoicosphenia curvata Grun	+	-	-
Cymbella cistula (Hempr) kirch	+	-	-
Amphora ovalis kutz	+	+	-
A. paludosa Sm.	-	+	-
A. coffeoformes Ag	+	-	-
Melosira granulata (Ehr.) Ralfs	+	-	-
M. varians Ag	+	-	-
Synedra ulna Ehr.	+	+	-
S. tabulata kutz	+	+	-
S. longissima W.Sm	+	-	-
Pleurosigma elongatum Sm .	+	-	-
P. delicatulum Sm.	-	+	-
Gyrosigma acuminatum Kutzing	+	-	-
G. kutzingii Kutzing	-	+	-
Bacillaria paradoxa Gmel	+	-	-
Surirella striatula turp.	+	-	-
Diploneis bombus A.S	+	-	-
Cocconeis placentula Ehr .	+	+	-
Pinnularia sp.	+	-	-
Diatoma vulgaris	+	+	-
Staueonris anceps (Ehrenberg)	-	+	-

Cont.

Phytoplankton spp.	E	M	W
11- Chlorophyceae			
Scenedesmus quadricauda (Turp) Breb	+	+	+
Sc. acuminatus (Lagerh) Chodat	+	+	+
Sc. bijugatus (Turp) Kutz	+	+	+
Sc. bijugatus var.alternans Hansg.	-	+	-
Sc. dimorphus (Turpin) Kutzing	-	-	+
Ankistrodesmus falcatus Var. *mirabile* W.& G. S. West .	-	+	-
Ankistrodesmus falcatus Var. *spiriliformis* G.S. West	+	-	-
Actinastrum hantzschii Lagerth	-	+	+
Chlorococcum humicula (Nag)	+	+	-
Closterium parvulum Var. *angustum* W.& G.S. West	-	+	-
Pediastrum duplex Meyen .	-	+	+
P. boryanum (Turp) Menegh	-	+	+
P. simplex Meyen	-	+	+
P. tetras (Ehr.) Rals	-	+	-
P. simplex Var. *duodenarium* (Bailey)	-	-	+
Cosmarium geleatum W.& G.S West	-	+	-
Staurastrum paradoxum Menegh	+	-	-
Staurastrum tetracerum Ralfs	-	+	+
Chlorella sp.	-	+	-
Cosmarium elfungii Racib	+	-	-
Cosmarium sublumidum Nordst	+	-	-
Chlorella vulgaris Beij	+	-	-
111- Cyanophyceae			
Anabaenopsis circularis (G. S. West) Wol . & Miller	-	+	+
Oscillatoria limnetica lemm .	+	+	+
O. princeps Vaucher	-	+	-
Merismopedia punctata Meyen .	-	+	+
M. tenuissima Lemm .	-	+	+
M. minima Beck	-	+	-
Microcystis incerta Lemmermann	-	+	+
M. aeruginosa kutz; emend . Elenkin .	+	-	+
Chroococcus turgidus Kutz	-	+	+
Ch. Limneticus Lemmermann	-	+	-
Ch. dispersus (Keissl) lemmer	+	+	+
Lyngbya limnetica Lemm .	+	+	-
Gloeocapsa rupestris kuetzing	+	-	+
Nostoc muscorum	+	-	+

Cont.

Phytoplankton spp.	E	M	W
IV – Euglenophyceae			
Euglena granulata (Kelbs) Lemm.	+	+	+
Euglena gracilis Kelbs	+	+	+
Euglena sp.	+	-	-
Euglena sp.	+	-	-
Euglena sp.	-	-	+
Euglena acus Ehrenberg	-	+	+
Phacus setosa France	+	+	+
Phacus pleuronectes (Muell) Dujardin	-	+	+
V- Peridinaceae			
Gymnodinium sp.	+	-	-
Peridinium sp .	+	-	+

E : Eastern sector
M : Middle sector
W : Western sector

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