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STUDIES ON PHYTOPLANKTON IN SOME POLLUTED AREAS OF LAKE MANZALAH

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ABSTRACT

Standing crop and species composition of the phytoplankton were investigated in some polluted and non-polluted areas of Lake Manzalah. The samples were collected from eight stations for a period of one year (Summer, 1986-Spring, 1987). About 170 taxa were recorded and distributed in the following taxonomic groups: Bacillariophyceae, 83; Chlorophyceae, 28; Euglenophyceae, 10; Dinophyceae, 8; Crytophyceae, 1.

Two distinct peaks were noted, the major one in winter and the second minor in spring. The species composition during the annual peaks changed from site to site and from season to season. The most important species responsible for the annual peaks were: Cyclotella meneghiniana, Nitzchia closterium, Skeletonema costatum, Ankistrodesmus falcatus, Spirulina platensis, Anabena variabilis, Oscillatoria limnetica and Merismopedia punctata.

INTRODUCTION

The present study is a part of Wastewater Reuse Project, Co-operative Marine Technology Program for the Middle East. The first stage of this project commenced in autumn, 1986 with the object of investigating the impact of wastewater especially sewage on water quality and biological characters of the Lake Manzalah.

Lake Manzalah is the largest and most economically important of Egypt's coastal lakes. Its area is about 904,785 Km2 as measured by landsat imagery in 1981. The lake is very shallow, brackish and highly productive.

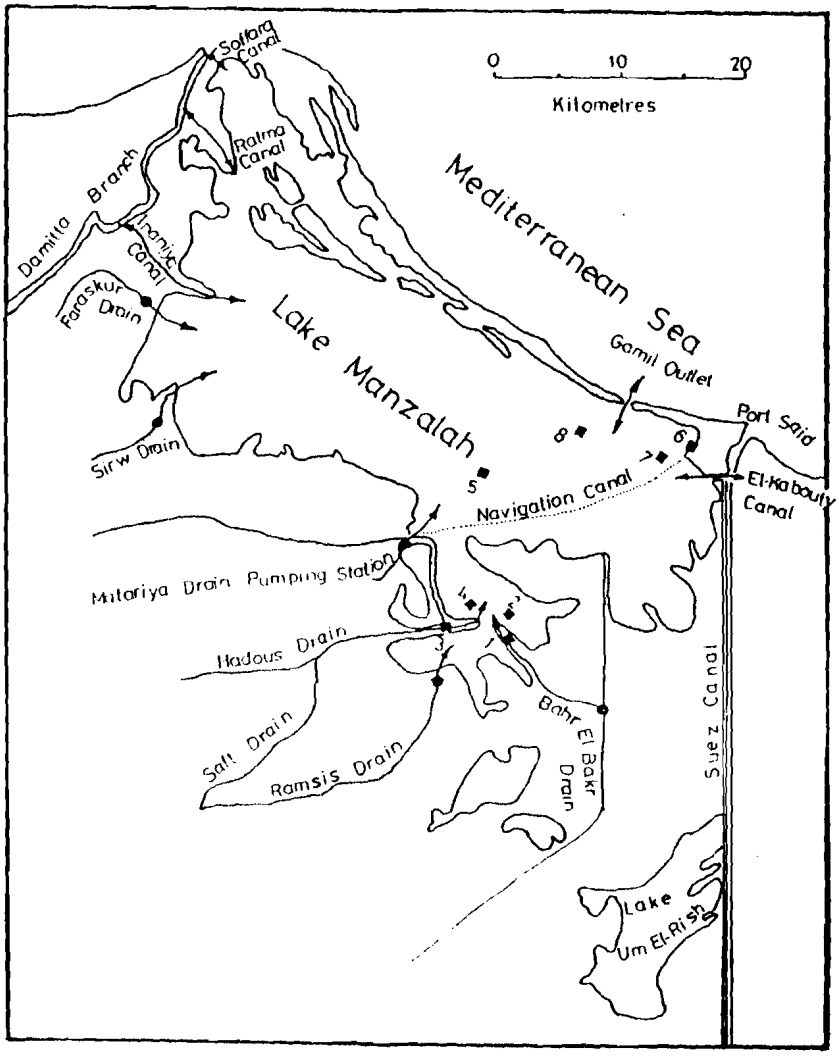

Fig. (1)
Map of Lake Manzalah,
(each number indicates a sample station).

RESULTS

Since there are ecological differences between the sampling stations, chiefly with regard to salinity, amount of nutrients and quality of waters, the phytoplankton communities showed marked variation and hence are discussed separately.

During this study, phytoplankton communities are represented by six algal classes, namely: Bacillariphyceae, Cyanophyceae, Chlorophyceae, Euglenophyceae, Dinophyceae and Cryptophyceae. The seasonal fluctuation of these classes and their constituent species at the selected stations are represented as follows:

Bahr El-Bakar Drain (Station 1)

This drain represents the major source of wastewater into the lake (sewage, industrial and agricultural wastes). Its salinity ranged from 0.709%o in autumn to 1.55%o in spring.

The results presented in Table 1 and Fig. 2 show that four algal groups were recorded in this drain, namely Bacillariophyceae, Chlorophyceae, Cyanophyceae and Euglenophyceae. The phytoplankton showed two peaks in spring and autumn with 419 and 415.7 x 106 units/m3.

Bacillariphyceae were always found to be the dominant group constituting from 38.3 to 85.4% of the total phytoplankton crop. Their maximum production (358 x 106 units/m3) was found in spring and the minimum (116.4 x 106 units/m3). The leading species of Bacillariales were Cyclotella meneghiniana and Nitzschia closterium.

Chlorophyceae constituted from 9.9 to 39.5% of the total phytoplankton. They reached to the maximum (average 133.2 x 106 cells/ m3) in summer while their minimum (41.2 x 106 units/m3) occurred in autumn. The green algae were represented mainly by Actinastrum hantzschii, Pandorina morum, Ankistrodesmus falcatus and Ceolatrum microporum.

Cyanophyceae showed a very irregular production and constituting from 2.2 to 41% of the total alga; cells. Their maximum stock (average 170.5 x 106 units/m3) occurred in autumn while the minimum (average 6.48 x 106 cells/m3) was recorded in winter. They were dominated by Spirulina platensis, Merismopedia punctata and Oscillatoria limnitica.

Euglenophyceae never exceeded 3.7% of the total algal cells and represented by two genera, namely: Phacus and Euglena.Their maximum (average 15 x 106 units/m3) was observed in summer and the minimum (0.6 x 106 units/m3) occurred in autumn. The leading species among Euglenophyceae were Phacus caudata, Phacus triqueter and Euglina viridis.

Table 1. Seasonal fluctuation of phytoplankton crop at the selected sampling stations.

(No. of Units X $10^6/m^3$)

	Algal Classes	1	2	3	4	5	6	7	8
summer	Bacillariophyceae	156	601.2	257.4	76.3	86.2	34.8	21.6	9.4
	Chlorophyceae	133.2	322.6	13.4	19.5	14	---	---	---
	Cyanophyceae	102.8	525.8	4.2	19.3	51.7	178	12.8	---
	Euglenophyceae	15	13.8	1.6	7.1	---	---	---	---
	Dinophyceae	---	---	---	---	---	3	33.2	21.6
	Total	407	1463.4	276.5	122.5	151.9	215.8	67.6	31
autumn	Bacillariophyceae	203.4	86.2	34	52.4	166.2	93.4	220.2	92.8
	Chlorophyceae	41.2	28.4	12	18.8	124.4	327.2	10.2	27.4
	Cyanophyceae	170.5	64.9	13.6	22.8	11	63.3	617	120
	Euglenophyceae	0.6	2.4	0.2	0.6	4.2	1.6	---	---
	Dinophyceae	---	---	---	---	---	---	0.9	6
	Total	415.7	181.9	59.8	94.6	1801.6	485.5	848.3	246.2
winter	Bacillariophyceae	30	148	66.8	432	6170	4683	12680	8190
	Chlorophyceae	6	1764	12.6	360	1730	4066	2760	3100
	Cyanophyceae	5	97.3	20.6	22	301	2344	918	188
	Euglenophyceae	2	---	1.2	---	30	20	50	---
	Dinophyceae	---	---	---	---	---	---	50	---
	Cryptophyceae	---	---	---	---	50			
	Total	43	2009.3	101.2	814	8281	9003.4	16938	11478
spring	Bacillariophyceae	358	704	822	172	4428	1884	642	280
	Chlorophyceae	50	96	260	172	1024	2960	1412	1416
	Cyanophyceae	9	4	5	---	12	9	30	144
	Euglenophyceae	2	4	12	6	4	1064	8	12
	Dinophyceae	---	---	---	---	8	---	---	---
	Total	419	808	1099	350	5476	5917	2092	1840

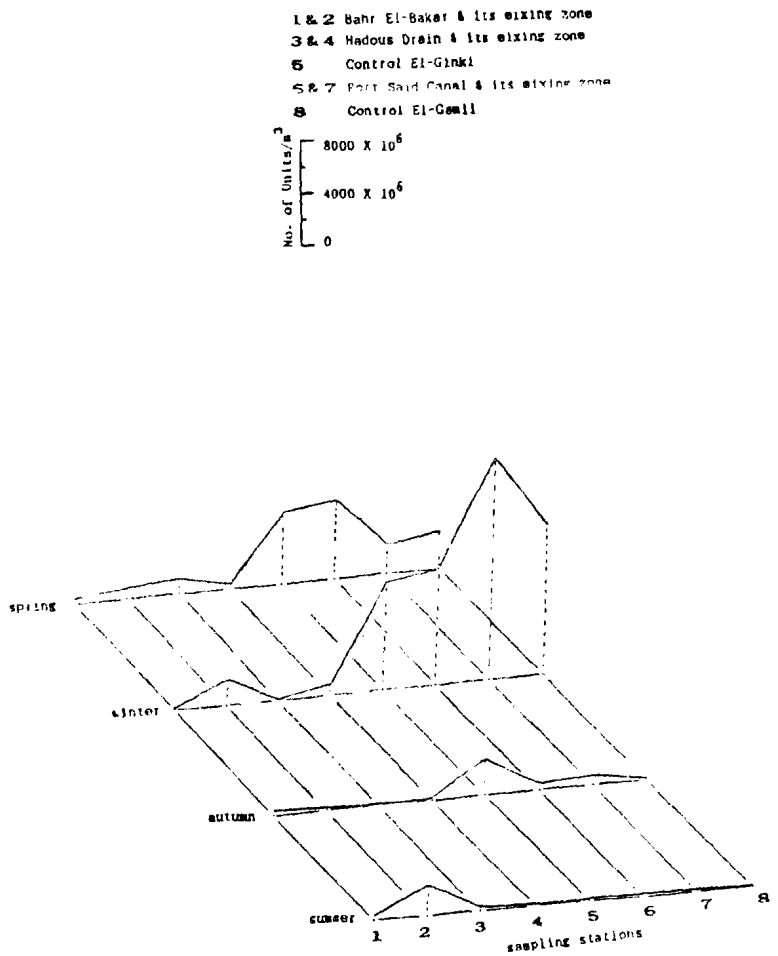

Fig. (2)
Seasonal variation of phytoplankton crop
at the selected sites of Lake Manzalah.

Mixing Zone of Bahr El-Bakar (Station 2)

This station lies directly under the influence of sewage, industrial and agricultural wastes discharge from Bahr El-Bakar Drain. Its salinity ranged from 1.2 in autumn to 1.5‰ in spring.

As the preceding station, the phytoplankton communities were represented by Bacillariophyceae, Chlorophyceae, Cyanophyceae and Euglenophyceae. Two peaks of phytoplankton were observed in winter and summer. The maximum phytoplankton crop (average 2009 x 10^ units/m3) was recorded in winter while the minimum (average 181 x 106 units/m3) occurred in autumn.

Members of Bacillariophyceae were always found to be the dominant group, except in winter when the green algae were dominant. Bacillariales were represented mainly be **Cyclotella meneghiniana, Nitzschia closterium and Melosira granulata.**

Chlorophyceae constituted from 11.9 to 87.8% of the total algal cells. Their maximum stock (average 1764 x 106 units/m3) was found in winter and the minimum (28 x 106 units/m3) was recorded in autumn. The leading species of green algae were: **Pandorina morum, Pediastrum clathratum and Ankistrodesmus falcatus.**

Cyanophyceae constituted from 0.5 to 35% of the total phytoplankton cells. Their maximum stock (average 525 x 106 units/m3) was observed in summer and the minimum (4 x 106 units/m3) occurred in spring. The blue green predominated by **Spirulina platensis, Merismopedia punctata, Chroococcus limneticus and Oscillatoria limnetica.**

Euglenophyceae were well represented in summer, autumn and spring, while they were completely absent in winter. Their maximum production (13.8 x 106 units/m3) was observed in summer. The leading species were **Phacus triqueter and Euglena viridis.**

Hadous Drain (Station 3)

This drain is the major source of agricultural wastes into the lake, constituting 49% of the total infollwing water. Its salinity ranged from 0.618 in autumn to 3.05‰ in winter. Two peaks of phytoplankton were observed in summer and in spring with 276.5 and 1099 x 106 units/m3.

Bacillariophyceae were always dominant, constituting from 56.9 to 93.1% of the total phytoplankton crop. Their maximum crop (822 x 106 units/m3) was found in spring, while their minimum (34 x 106 units/m3) occurred in autumn. Bacillariales predominated by **Nitzschia closterium, Cyclotella meneghiniana and Melosera granulata.**

Chlorophyceae constituted from 4.8 to 23.7% of the total algal cells. They reached to their maximum (260 x 106 units/m3) in spring and the minimum (12 x 106 units/m3) in autumn. The leading species of green algae were_Pediastrum calthratum and Ankistrodesmus falcatus.

Cyanophyceae formed from 0.5 to 22.7% of the total phytoplankton production. Their maximum crop (13.6 x 106 units/m3) was recorded in autumn and the minimum (2.06 x 106 units/m3) occurred in winter. The blue green predominated by Spirulina platensis, Merismopedia punctata, Oscillatoria limentica and Anabaenopsis circularis.

Euglenophyceae were represented only by Euglen acus and Euglena viridis.

Mixing Zone Of Hadous Drain (Station 4)

This station lies directly under the influence of agricultural wastes discharge from Hadous Drain. The salinity of this area ranged from 0.7 in autumn to 3.05%o in winter. Two peaks of phytoplankton were observed in winter (814 x 106 units/m3) and in spring (average 350 x 106 units/m3). Here again, the phytoplankton communities were represented by Bacillariophyceae, Chlorophyceae, Cyanophyceae and Euglenophyceae.

Bacillariales were always the dominant group, constituting from 49.1 to 62.2% of the total phytoplankton crop. Their maximum crop (average 432 x 106 units/m3) was

observed in winter and the minimum (52.4 x 106 units/m3) occurred in autumn. They dominated by Cyclotella meneghiniana and Melosira granulata.

Chlorophyceae formed from 15.9 to 49.1% of the total phytoplankton. Their maximum crop (360 x 106 units/m3) was found winter and the minimum (18.8 x 106 units/m3) occurred in autumn. The leading species of green algae were Ankistrodesmus falcatus and Pediastrum clathratum.

Cyanophyceae were absent in spring while their maximum crop (22.8 x 106 units/m3) was recorded in autumn. The dominant blue greens were Merismopedia punctata and Comphospharia aponiana.

Euglenophyceae were absent in winter and their maximum production (7.1 x 106 units/m3) occurred in summer. Euglena acus was always the leading species among this class.

Control El-Genki (station 5)

This site lies outside the polluted area. It is therefore, the least polluted or even clean as compared with the above mentioned sites. Its salinity ranged from 1.24%o in autumn to 7%o in summer.

Two peaks of phytoplankton were found in winter (average 8281 x 106 units/m3) and in spring (average 5476 x 106/m3). The phytoplankton communities were represented by six classes namely, Bacillariophyceae, Chlorophyceae, Cyanphyceae, Euglenophyceae, Dinophyceae and Crytophyceae.

Bacillariales were always well represented constituting from 56.8 to 92.3% of the total phytoplankton crop. Their maximum crop (6170 x 106 units/m3) was observed in winter and the minimum (86.2 x 106 units/m3) occurred in summer. Cyclotella meneghiniana and Nitzschia closterium were the dominant species among Bacillariales.

Chlorophyceae constituted from 6.9 to 20.9% of the total phytoplankton population. They reached to the maximum crop (1730 x 106 units/m3) in winter while the minimum (14 x 106 units/m3) occurred in summer. The leading species of green algae were Scenedesmus quadricauda and Ankistrodesmus falcatus.

Cyanophyceae were always present but often in a small number and constituted a small percentage of the total phytoplankton (0.2 to 33.6%). Their maximum crop (301 x 106 units/m3) was recorded in winter and the minimum (51.7 x 106 units/m3). The blue greens dominated by Oscillatoria limentica and Anabaena variabilis.

Euglenophyceae were absent in summer while their maximum crop (30 x 106 units/m3) was observed in winter. Euglena viridis and Phacus triqueter were the leading species.

Dinophycaea were only present in spring and represented by Goniaulax apiculata.

Cryptophyceae were only present in spring and represented by Goniaulax apiculata.

Cryptophyceae were observed in winter and represented by Cryptomonas erosa.

Port Said Canal (Station 6)

This canal represents the major source of sewage to the north eastern basin of the lake. Its salinity ranged from 6.34‰ in winter to 24‰ in summer. The phytoplankton classes recorded in this station were Bacilloriphyceae, Chlorophyceae, Cyanophyceae, Euglenophyceae and Dinophyceae.

Bacillariales show a very irregular production and constituted from 16.1 to 52.0% of the total phytoplankton crop. Their maximum crop (4683 x 106 units/m3) was observed in winter and the minimum (34.8 x 106 units /m3) occurred in summer. The dominant species of diatoms were Nitzschia closterium, Cyclotella meneghiniana and Skeletonema costatum.

Members of Chlorophyceae were absent in summer while they occupied the first predominance place in autumn and spring. The maximum crop of green algae was observed in winter (3066 x 106 units/m3). Their dominant species were Curteria klebsii and Ankistrodesmus falcatus.

Cyanophyceae showed a great irregularity, constituting from 0.15 to 82.50% of the total phytoplankton crop. Their maximum production (234.4 x 106 units/m3) was found in winter and the minimum (9 x 106 units/m3) in spring. The leading species among the blue green were Merismopedia punctata, Spirulina platensis, Chroococcus limniticus and Anabaenopsis circularis.

Euglenophyceae were absent in summer and their maximum crop (1064 x 106 units/m3) was found in spring. They dominated by Phacus morii and Euglena viridis.

Dinophyceae were only recorded in summer and represented by Exuviella apora (3 x 106 cells/m3).

Mixing Zone Of Port Said Canal (Station 7)

This lies under the influence of sewage and wastewater of Port Said Canal. Its salinity varies from 5%o in winter to 22%o in summer. Two peaks of phytoplankton were recorded in winter and spring with 16938 and 2092 x106 units/m3.

The phytoplankton communities were represented by five classes, namely Bacillariophyceae, Chlorophyceae, Cyanophyceae, Euglenophyceae and Dinophyceae.

Bacillariales occupied the first predominance place in winter, constituting 74.9% of the total phytoplankotn crop. Their maximum crop (12680 x 106 units/m3) was recorded in winter and the minimum (21.6 x 106 units/m3) occurred in summer. Nitzschia closterium and Skeletonema costatum were the leading species among the group.

Chorophyceae were absent in summer, while they were dominant in spring. forming 67.5% of the total phytoplankton population: The leading species of green algae were Ankistrodesmus falcatus and Crucigenia spp.

Cyanophyceae were always present and predominated in autumn, constituting 72.7% of the total phytoplankton. Their maximum crop (918 x 106 units/m3) was found in winter and the minimum (12.8 x 106 units/m3) in summer . The dominant species of this group were Merismopedia punctata, Spirulina platensis and Oscillatoria limnetica.

Euglenophyceae were observed in winter and spring. They were represented by Euglena viridis and Phacus triqueter.

Dinophyceae were absent in spring while in summer they reached to maximum crop (33.2 x 106 units/m3). Exuviella apora and Goniaulax apiculata were the leading species among this group.

Control of Gamil (Station 8)

This site lies far from the end point of discharge of Port Said Canal. Its salinity ranged from 4.3 in winter and 29.0‰ in summer. Two peaks of phytoplankton were recorded in winter and in spring with average 11478 and 1840 x 106 units/m3. Here again, the phytoplankton communities were represented by Bacillariophyceae, Chlorophyceae, Cyanophyceae, Euglenophyceae and Dinophyceae.

Bacillariales constituted from 15.2 to 71.4% of the total phytoplankton. Their maximum crop (8180 x 106 units/m3) was recorded in winter and the minimum of 9.4 x 106 units/m3 occurred in summer. The leading species among this group were Cyclotella meneghiniana and Skleletonema costatum.

Chlorophyceae were absent in summer while they reached the maximum (3100 x 106 units/m3) in winter. The green algae dominated by Ankistrodesmus falcatus.

Cyanophyceae were absent in summer while their maximum crop (188 x 106 units/m3) occurrent in winter. Spirulina platensis, Chroococcum limneticus and Merismopedia punctata were the dominant blue greens.

Euglenophyceae were only recorded in spring and represented by Euglena spp., especially E. acus.

Dinophyceae were observed in summer and autumn. In summer, they predominated over the other algal groups, constituting 69.7 % of total phytoplankton crop. leading species of this group was Exuviella apora.

DISCUSSION

During this investigation , a total of 170 species of phytoplankton have been recorded. These phytoplanktons were distributed in the following taxonomic groups: Bacillarriophceae,83; Chlorophyceae, 40; Cyanophceae, 29; Euglenophyceae,10; Dinophyceae, 7 and Cryptophceae, 1.

The peaks of phytoplankton varied greatly from site to other with reference to time , magnitude and the leading species. In Bahr El-Bakar Drain, two peaks of phytoplankton occurred in spring and autumn with 419 and 415.7 x 10 units /m3 , the leading species were Nitzschia closterium and Cyclotella meneghiniana respectively. While in its mixing zone (Station 2) the two peaks were observed in winter and summer with 2009.3 and 1463.4 x 106 units /m3, the dominant species were Ankistrodesmus falcatus and Cyclotella meneghiniana, respectively.

In Hadous drain , the two peaks were found in spring summer with 1099 and 276.5 x 106 unites \m3 , the leading species were Cyclotella meneghiniana and Nitzschia closterium, respectively.

On the other hand, the two peaks in each of the other sampling sites were recorded in winter and spring.

The present results indicate that the phytoplankton was represented by typically eutrophic species. The most dominant phytoplanktons were Cyclotella meneghiniana, Melosira granulata, Nitzschia closterium, Anabaena spp.Microcystis aeruginosa and Ankistrodesmus falcatus. These species are mentioned as eutrophic nature (Swayer, 1966). Desmids are very rare and represented only by Closterium idiosporium .Panneles of Bacilliariophyceae were less in quantity compared to centrals. In this connection, Rawsan (1956) and Kutkuhn (1958) stated that Desmidaceae and

Pennales generally exhibit strong oligtrophic tendency. based on these, the study sites can be caregorized as eutrophic.

According to the present results, a distinct eutrophication was observed in the central and northern sites (Stations 5,6,7, & 8). A similar eutrophication by much less in quantity occurred in the mixing zones of Bahr El-Bakar and Hadous Drain (Station 2&4 respectively).

The eutrophication was indicated by a phtoplankton community containing several blue green algae as Oscillatoria limnetica, Merismopedia punctata, Chroococcus limneticus; the green algae Ankistrodesmus falcatus, Dictyosphaaerium pnlchellum and the diatoms Cyclotella meneghiniana, Skeletonema costatum and Nitzschia closterium.

As has emerged from these results, in spite of the considerable amounts of wastes discharged into Lake Manzalah via Bahr El-Bakar and Hadous Drains, the eutrophication has remained local and occurred in the central and northern stations. The dense and luxuriant phytoplankton during eutrophication are effective for natural purification of wastewater. Also, the brackish waters, with high electrolyte content, and the basic nature of these stations, thus resembling these sites with high metabolism and a good capacity for self-purification.

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The phytoplankton organisms recorded during this investigation are given in the following list. As to the position of the stations, see Fig. 1.

	1	2	3	4	5	6	7	8
I.BACILLARIOPHYCEAE								
Nitzschia closterium(Ehr.)W.Sm.	*	*	*	*	*	*	*	*
N.palea(Kütz.)W.Sm.	*	*	*	*	*	*	*	*
N.commutata Grun.	*	*						
N.thermalis(Kütz.) Grun.	*	*	*				*	
N.apiculata(Greg.) Grun.	*	*	*	*	*	*		
N.hungarica Grun.	*	*	*	*		*		
N.filiformis W.Sm.	*	*	*	*		*	*	*
N.acicularis W.Sm.	*	*			*	*	*	
N.microcephala (Arnott.)A.Mayer	*	*			*			
N.tryblionella (Arnott.)A.Mayer	*				*	*		
N.vitrea var. recta Norman	*							
N.fasciculata Grun.	*	*	*	*				
N.gracilis Hantzsch				*	*			
N.ignorata Krasske	*	*						
N.sigmoidea (Ehr.) W.Sm.	*	*						
N.angustata (W.Sm.) Grun.		*				*	*	
N.sigma W.Sm.						*	*	*
N.angularis W.Sm.	*	*						
N.Kutzingiana Hilse							*	*
N.parvula Lewis	*	*		*				
N.conticola Grun.	*	*		*				
N.obtusa W.Sm.		*		*				
Melosira granulata Ag.	*	*	*	*	*	*	*	*
M.granulata var.angustissima O.Mu.	*	*	*	*	*			
M.varians Ag.	*	*	*	*	*			
Navicula cryptocephala Kütz.	*	*	*	*	*	*	*	*
N.populo var.capitata W.Sm.	*	*		*	*	*		
N.viridula Kütz.	*	*	*	*	*	*	*	*
N.radiosa Kütz.	*	*		*	*	*	*	
N.pygmaea Kütz.	*	*	*	*	*	*	*	*
N.eleptica Kütz.		*				*	*	*
N.gracilloides A.Mayer					*			
N.plicata Donk.					*			
N.mutica Kütz.					*			
N.cuspidata var.ambigua Grun					*			
N.cancellata Donk.							*	*
Bacillaria paradoxa Gmel	*	*	*	*	*	*	*	*
Cyclotella meneghiniana Kütz.	*	*	*	*	*	*		*
C.comta (Ehr.)Kütz.	*	*	*	*				
C.kutzingiana Thwaites	*	*	*	*	*	*		
C.striata (Kütz.)Grun						*	*	*
Tropidoneis lepidoptera Greg.					*	*	*	*
Campylodiscus bicostatus W.M.Smith				*	*			
Coccaneis placentula Ehr.	*	*	*	*	*	*	*	*

	1	2	3	4	5	6	7	8
Cymatopleura solea (Breb.)W.Sm.	*	*	*	*	*	*	*	*
C.elliptica Breb.					*	*		
Amphiprora paludosa W.Sm.					*	*	*	*
A.alata Kutz.					*	*	*	*
Fragillaria crotensis Kitton	*	*	*	*	*			
F.intermedia grun.	*	*						
Gyrosigma macrum W.Sm.	*	*	*	*	*	*	*	*
G.kutizingiana (grun.)Cleve	*	*						
G.spenceril (W.Sm.)Cleve				*		*		
Neidlum affine (Ehr.)Cleve	*	*		*				
N.iridis (Ehr.)Cleve						*	*	*
N.capitillata Ehr.	*	*						
Gomphonema angustata (Kütz.)Rabh.	*	*		*				
G.olivaceum Kütz.	*	*	*	*				
G.parvulum Kütz.	*	*	*	*				
Caloneis amphisbaena (Bory.)Cleve	*	*						
Pleurosigma elongatum W.Sm.	*	*	*	*	*	*	*	*
Amphora ovalis Kütz.	*	*		*	*			
A.veneta Kütz.		*		*	*			
A.coffeaeformis Kütz.						*	*	*
Synedra ulna (Nitzsch)Ehr.	*	*	*	*	*	*	*	*
S.tabulata (Ag.)Kütz.						*	*	*
Achnanthes brevipes Ag.		*		*	*			
A.lancéolata Breb.					*			
Pinnularia gibba Ehr.		*		*	*			
P.alpina W.Sm.					*			
Thalassiosira decipiens Grun.		*		*	*	*	*	*
Skeletonema costatum (Grev.)Cl.					*	*	*	*
Lithodesmus undulatum Ehr.						*	*	*
Chaetoceros affinis Lauder						*	*	*
C.pendulus Karsten							*	*
Diplonois interrupta (Kütz.)Cleve						*	*	*
Stauroneis anceps Ehr.	*	*	*	*				
Surirella elegans Ehr.	*			*	*			
Epithemia zebra (Ehr.)Kütz.		*			*			
E.argus Kutz.					*			
Asterionella japonica Cleve							*	*
Opephora martyi Heribaud					*			
Mastogila dansei Thwaites					*			
II.CHLOROPHYCEAE								
Actinastrum hantzschii Lagerh	*	*	*	*	*			

	1	2	3	4	5	6	7	8
Kirchneriella obesa(W.West)Sch.	*	*	*	*	*			
K.lunaris (Kirch.)Moebius	*	*	*	*	*	*	*	
Scenedesmus bijugatus(Trup.)Lag.	*	*	*	*	*	*		
S.quadricauda (Trup.)de Brébisson	*	*	*	*	*	*	*	*
S.quadricauda var.alternans G.M.S	*	*		*	*			
S.opoliensis P.Richter	*	*		*	*	*	*	
S.acuminatus (Lagerh)Chodat	*	*		*	*	*		
S.dimorphus (Trup.)Kütz.	*	*			*			
S.arcuatus Lemmermann	*	*			*			
S.acutiformis Schroder		*			*			
Carteria klebsii (Dang.)Dill	*	*		*	*			
C.cordiformis (Carter)Dill.		*		*	*			
Ankistrodesmus falcatus(Corda)Ral	*	*	*	*	*	*	*	*
A.falcatus var.spirilliformisWest	*	*	*	*	*	*	*	*
Tetraedron minimum (A.Br.)Hansg.	*	*	*	*	*	*	*	*
T.trigonum (Naeg.)Hansg.	*	*	*	*	*	*	*	*
Pandorina morum (Muell.)Bory	*	*	*	*	*	*		
Micractinium pusillum Fresenius	*	*	*	*	*			
Coelastrum microporum Naegeli	*	*			*	*		
Chlorella vulgaris Beyerinch	*	*	*	*	*			
Selenestrum gracile Reinsch		*		*	*	*		
S.minutum (Naeg.)Collins	*	*	*	*	*	*		
Oocystis borgei Snow	*	*	*	*	*	*	*	
Dictyosphaerium pulchellum Wood	*	*	*	*	*	*	*	*
Crucigenia tetrapedia (kirch)West	*	*			*	*	*	*
Chlamydomonas Ehrinbergii Gorosch.					*	*		
Pediastrum boryanum (Trup.)Menegh	*	*	*	*	*			
P.tetras (Ehr.)Ralfs					*	*		
P.biradiatum Meyen					*			
P.longicone Ehr.				*	*	*		
P.duplex Meyen				*	*	*		
Tetrastrum heteracanthum(Nord)Ch.					*	*		
T.gaibatum (Roll)Ahlstrome				*	*			
Gleocystis gigas (Kütz.)Lagerh.				*	*			
Sphaerocystis shroeteri Chodat					*			
Spirogyra decimina (Mull.)Kütz.	*	*	*	*	*			
Closterium idiosporium W.&G.S.West		*			*			
Chlorogonium elongatum Dang.		*		*	*			
Chodatella subsala Lemm.		*		*	*			

IV

	1	2	3	4	5	6	7	8
III.CYANOPHYCEAE								
Spirulina platensis (Nord.)Geitler	*	*	*	*	*	*	*	*
S.laxissima G.S.West	*	*	*	*	*			
Oscillatoria chalybaea Mertens	*	*		*	*			
O.tenuis C.A.Agardh	*	*	*	*	*			
O.laetevirens Grouan	*	*						
O.limnetica Lemmermann	*	*	*	*	*	*	*	*
O.brevis Kütz.	*	*						
O.formosa Bory.	*	*						
O.amphibia Agardh	*	*						
Phormidium tenue Gomont	*	*						
P.molle (Kütz.)Gomont	*	*	*	*	*	*	*	
P.ambiguum Gomont	*	*			*			
Merismopedia tenuissima Lemmer.	*	*	*	*	*	*	*	
M.punctata Meyen	*	*	*	*	*	*	*	*
M.elegans A.Braub	*	*						
Raphidiopsis curvata Fritsch&Rich	*	*			*			
Chroococcus limneticus Lemmermann	*	*		*	*	*	*	*
C.turgidus (Kütz.)Naegeli.	*	*			*	*	*	
Anabaena variabilis Kütz.	*	*		*	*	*	*	
A.spiroides Klebahn	*	*			*			
A.flos-aquae (Lyng.) Brébisson	*	*			*			
Anabaenopsis circularis V.Miller	*	*	*	*	*	*	*	*
Microcystis auroginosa Kütz.	*	*			*	*	*	
M.flos-aquae (Wittr.)Kirchner	*	*			*			
Coelosphaerium naegelianum Unger		*		*	*			
Aphanozeamon flos aquae Unger	*	*			*			
Gomphosphaeria aponiana Kütz.					*	*	*	*
Lyngbya limnetica Lemm.	*	*		*	*			
L.major Meneg.	*	*		*	*			
IV.EUGLENOPHYCEAE								
Euglena viridis Ehrenberg	*	*	*	*	*	*	*	*
E.acus Ehrenberg	*	*	*	*	*	*	*	*
E.granulata (Klebs.)Lemm.	*	*	*	*	*	*	*	
E.oxyuris Schmardh	*	*	*	*	*	*	*	
Phacus triqueter (Ehr.)Dujardin	*	*	*	*	*			
P.morii (Koczwara)Skvortzow	*	*		*	*			
P.caudata Hubner	*	*	*	*	*	*	*	
P.longicauda (Ehr.)Dujardin	*	*	*	*	*			
P.tortus (Lemm.)Skvortzow	*	*		*	*	*	*	
P.pleuronectes (O.F.Muell)Dujard.	*	*	*	*	*			
V.CRYPTOPHYCEAE								
Cryptomonas erosa Ehr.					*	*	*	

	1	2	3	4	5	6	7	8
VI.DINOPHYCEAE								
Exuviella apora Schiller						*	*	*
Peridinium trochoidium Stein							*	*
P.cerasus Paulsen							*	*
P.diabolus Cleve							*	*
Oxytoxum sp.							*	*
Prorocentrum micans Ehr.							*	*
Goniaulax apiculata Penard							*	*

1&2 Bahr El-Bakar & its mixing zone

3&4 Hadous Drain & its mixing zone

5 Control El-Ginki

6&7 Port Said Canal & its mixing zone

8 Control El-Gamil