Microbiology

DYNAMICS OF PHYTOPLANKTON SUCCESSION IN THE RIVER NILE AT MINIA (UPPER EGYPT); AS INFLUENCED BY AGRICULTURAL RUNOFF

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SUMMARY: The influence of agricultural wastewater effluents dumped to the Nile water at Minia (Upper Egypt) on phytoplankton distribution, diversity, succession, and standing crop was monthly evaluated in a comprehensive study for one year. Autumn harbored the highest standing crop at all sites. Bacillariophyta contributed the highest percentage composition. Chlorophyta and Cyanophyta rated second and third in the order of dominance, Euglenophyta was poorly represented. However, some members of the three groups tended to form blooms at certain times. The agricultural runoff induced gross changes in physicochemical characteristics of the Nile water and community structure of phytoplankton populations. Species of high occurrence being densly encountered at all sites were excelled by: Tabellaria fenestrata, Cyclotella bandanica, Cocconeis caespidata and Microcystic aeruginosa.

Key word: Phytoplankton.

INTRODUCTION

Aquatic ecosystems are dynamic systems, in which several biotic and abiotic variables change in space and time due to different processes. The realization of the causal changes in time of these complex systems are very restricted.

During the past few decades, particularly after the construction of High Dam at Asswan, increased research activities have been directed towards an understanding of the changes took place in the physicochemical characteristics of Nile water and consequently in phytoplankton composition. Much of these works were carried out on the Nile part extending from Assuit southward to Asswan (1,2,6,8,24). However, the algal flora of the River Nile located in the northern region of Upper Egypt was not yet been explored. Therefore, the present work has been achieved in an attempt to contribute studying the phytoplankton populations of the main stream of Nile at Minia district in relation to physicochemical characteristics of water.

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MATERIALS AND METHODS

The study area

Two ecologically different habitats were chosen for this study (Figure 1).

Station I: The sites of this habitat are located on the main stream of River Nile in a place before its connection with El-Mohit drain. It is situated about 16 Km northward Minia city.

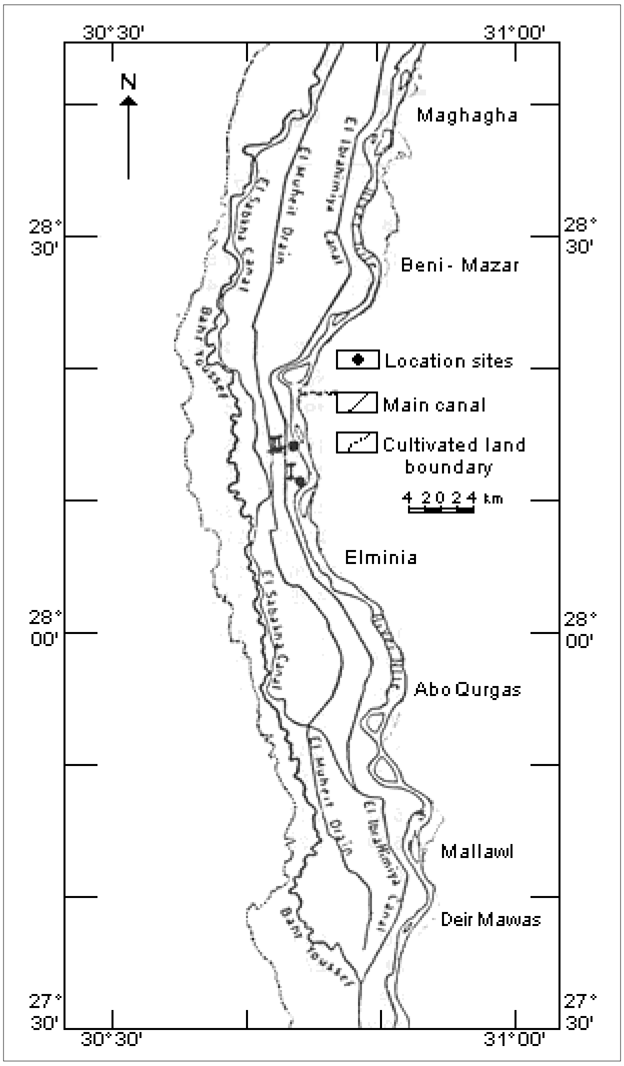
Station II: The sites of this station are located on the main stream of Nile River, just in the place of its connection with El-Mohit drain. It is situated at 22 Km north to Minia city.

Sampling

Subsurface water samples were collected at regular monthly intervals for a period of one year extending from December 1987 up to November 1988. Water temperature, visibility, pH value and fixation of O_2 for subsequent analysis were recorded in the filed at the sites of collection. Water samples for chemical investigation were collected in polyethylene bottles of one liter capacity, and laboratory analysis started within few hours from the time of collection. Chemical analysis of water was carried out following the methods adopted (12,18).

Aliquots of water samples were preserved for subsequent counting and identification. Lugl's solution (30) was the best useful preservative. Each net sample was divided into two por-

Figure 1: Location map of samples collected from different water areas in Minia governorate.



tions. The first was examined while fresh to identify the planktonic algae other than diatoms. The second was cleared for diatom identification. Identification was performed according to (4,22). All forms of phytoplanktonic organisms were counted using Sedgewick-Rafter cell. The results were, then expressed as counts per liter.

The data generated in this study were suitable for a quantitative analysis of the species diversity of phytoplankton communities. The appropriate statistics in Brillouins index (23) was used.

RESULTS

Some water quality data were collected to evaluate the possible effects of these aquatic environmental parameters on the phytoplankton distribution and productivity (Table 1).

Visibility measurements gave generally highest values during summer and lowest readings during spring. Apparently, the water temperature showed conspicuous rise during summer (28ºC), gradually declined on passing from summer to reach minimum (18ºC) in winter. pH value of water lies in the neutral and slightly alkaline side being ranged between 7.8 to 8.5.

The monthly mean values of dissolved O_2 ranged between minimum (8.6 mg 1^{-1}) recorded in June 1988 at station II and maximum (19.8 mg 1^{-1}) reached in November 1988 at Station I Generally, sites of Station I showed always higher concentrations of dissolved O_2 than that of station II. However, all sites represented highest concentrations during autumn and lowest ones during summer.

The total alkalinity which was estimated as bicarbonate ranged between 90 mg 1^{-1}, recorded in January 1988 at Station I and 195 mg 1^{-1} attained in December at Station II. Generally, it was slightly higher at station I as compared with that of Station II.

Table 1: Average monthly values of some physico-chemical characteristics of River Nile water in different stations at Minia governorate during the period December 1987-November 1988.

Months Stations		Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.
Transparency (cm)	I II	63 53	80 73	63 60	60 55	48 45	57 47	65 62	75 63	78 75	76 65	75 70	57 55
Temperature (ºC)	I II	16 16.5	18 19	19 19.5	21 21.5	21.5 22	27 28	26.5 27.5	27 27	29 30	27.5 28.5	25 25.5	19.5 19.5
pH value	I II	8.6 8.5	8.7 8.6	7.9 7.8	8 7.9	7.9 7.9	8.1 8	7.9 7.7	7.6 7.4	8.4 8.2	8.8 8.6	8.4 8.3	8.3 8.2
Dissolved O_2 (mg 1^{-1})	I II	14.2 13.4	13.8 13.8	14.8 12.2	12 11.6	14.4 13.8	15 14.6	10 8.6	11.1 8.8	15.1 12.4	14.6 13.8	16.6 15.7	19.8 18.8
Total alkalinity (mg 1^{-1})	I II	140 195	140 145	145 140	125 130	135 130	195 100	90 95	120 135	120 125	135 137.5	130 135	130 145

Table 1: Average monthly values of some physico-chemical characteristics of River Nile water in different stations at Minia governorate during the period December 1987-November 1988.

Months Stations		Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.
Total suspanded matter (mg 1^{-1})	I	13	3	3	43	11	14	49	11	29	7	15	137
	II	38	3	3	57	11	27	51	18	41	14	28	12
Total hadness (mg 1^{-1})	I	38	37.4	37	36.8	42	36.8	33	27.6	35	37.8	36.4	36.8
	II	41.4	40.6	37.4	38	43	37.8	26.6	31.2	38.4	39.4	37.8	41.6
Chlondes (mg 1^{-1})	I	106.5	106.5	106.5	213	284	177.5	177.5	106.5	106.5	106.5	106.5	106.5
	II	142	142	177.5	106.5	213	284	177.5	248.5	142	142.5	142	159.75
Sulphate (mg 1^{-1})	I	26.5	30	26.5	26.5	20	25.5	16.5	13	16	12.5	12.5	16
	II	32	33.5	26.5	28.5	28	32	16.5	19	19	14	15.5	17
Carbonate (mg 1^{-1})	I	7.5	7.5	7.5	15	15	7.5	7.5	7.5	15	15	15	7.5
	II	7.5	7.5	7.5	15	15	7.5	7.5	7.5	15	15	7.5	7.5
Bicarbonate (mg 1^{-1})	I	213.5	213.5	213.5	213.5	183	152.5	183	187	183	183	213.5	183
	II	213.5	213.5	213.5	213.5	183	183	198.3	213.5	213.5	213.5	183	213.5
Nitrate (mg 1^{-1})	I	50	75	35	24	40	5	5	4.3	3.76	1.25	4.75	7.5
	II	75	75	38	25	50	5	5	7.5	4.25	1.25	5.25	10
Phosphate (μg 1^{-1})	I	100	50	100	85	50	10	10	13	7.5	4.5	20.5	10
	II	100	150	150	100	100	10	10	16.5	11	5	15	5
Silicate (mg 1^{-1})	I	265	360	205	315	160	250	305	350	155	115	35	25
	II	270	465	260	385	240	370	410	365	205	195	45	50
COD (mg 1^{-1})	I	2.5	2.3	2.1	2.5	2	1.8	1.7	1.6	0.4	0.3	2..8	3.7
	II	3	2.3	2.2	2.4	1.3	2	2	1.7	0.5	0.3	3.1	3.9
Total Chloraphyl (μg 1^{-1})	I	8.84	11.60	8.38	5.93	4.86	5.35	7.78	6.41	3.17	5.95	5.77	9.66
	II	9.51	7.17	6.47	8.70	4.29	6.47	6.34	6.39	1.97	5.27	8.48	8.09
Total carbohyclrate (μg 1^{-1})	I	0	0	0	0	0	0	0	0	3	0	2.5	0.2
	II	20	15	25	40	14	3.5	0	2	5	0.9	3	0.5
Ca^{+2} (mg 1^{-1})	I	26	23	25	20	27	26	14	18	26	27	25	26
	II	27	25	26	26	28	27	17	21	27	28	27	29
Mg^{+2} (mg 1^{-1})	I	12	14.4	12	10.8	15	10.8	9	9.6	9	10.8	11.4	10.8
	II	14.4	15.6	11.4	12	15	10.8	9.6	10.2	11.4	11.4	10.8	12.6
Na^{+} (mg 1^{-1})	I	39	38.5	38.5	23	29.5	27.5	25	25	27.5	32	29.5	20.5
	II	39	46.5	38.5	23	29.5	28	25.5	27.5	29.5	32	30	22
K^{+} (mg 1^{-1})	I	3.9	3.1	3.9	2.35	6.5	8	5	5	6	6	6	4.5
	II	3.9	3.85	3.9	3.1	6.5	6.5	6	6	6.5	6.5	6.1	5
Total soluble salts (mgl^{-1})	I	2.8	3.2	2.3	2.8	2.4	2.6	2.4	2.4	2.4	2.6	2.4	2.6
	II	2.4	3.3	2.3	2.8	3.4	2.6	2.4	4	2.6	2.7	2.7	2.4

Monthly mean values of total suspended matter showed always higher values at Station II with comparison to Station I, except in November, where it reached in the latter about 11 folds of the value recorded at Station II. This was mainly attributed to the relatively high photosynthetic activity noticed during autumn at Station I.

The total soluble salts of water at all studied sites fluctuated within very narrow limits. Monthly determination showed that it ranged between 2.28x10^{-4} ohms 1^{-1} recorded in February 1988 and 4x10^{-4} ohms 1^{-1} maintained in July 1988. No striking seasonal variations could be detected, furthermore no wide difference was exhibited in either monthly or seasonal values between sites of both stations.

Nitrate nitrogen was determined monthly, (Table 1) the data presented revealed that the nitrate content of Nile water may be regarded as being low throughout the period of investigation. It ranged from (1.25 mg 1^{-1}) and 75 mg 1^{-1}. Maximum nitrate content of water was recorded during winter, while the minimum was reached during summer and autumn seasons. Sites of Station II recorded always relatively higher nitrate levels than that of Station I.

The soluble phosphorus generally reached higher values during winter and spring and lower ones during summer and autumn. Monthly mean values fluctuated between (4.5 to 100 mg 1^{-1}) and (5 to 150 mg 1^{-1}) for sites of Stations I and II, respectively.

Mean monthly concentrations of soluble silicon did not exceed 465 mg 1^{-1}, which was recorded in January 1988 at Station II. On the other hand, the lowest contents of silicate was displayed in November at both stations. Generally, silicate content of water was high during winter and low during autumn at all sites. Nevertheless it exhibited always higher levels at Station II.

Determination of seasonal values of COD revealed the absence of constant regular trend. However, it ranged between 1.2 mg 1^{-1} during summer to 2.8 mg 1^{-1} during spring at Station I and from 1.4 mg 1^{-1} during summer to 2.5 mg 1^{-1} during winter. No wide differences were noticed between either monthly or seasonal levels of COD at both stations.

Monthly concentrations of chlorides generally exhibited relatively higher values in the water of Station II as compared to that of Station I. It ranged between 106 mg 1^{-1} and 284.5 mg 1^{-1}.

No striking seasonal or even monthly variations were observed in sulphate, carbonate and bicarbonate contents of water either at Station I or II. Moreover, no wide differences were exhibited between monthly averages of such parameters at both stations. However, seasonal values showed always higher levels at Station II. Monthly variations of divalent cations of Ca^{2+} and Mg^{2+} are given in (Table 1). Calcium, concentrations tended to be higher during spring and autumn and lower during summer. Maximum concentrations of Mg^{2+} was reached during winter and the lowest ones exhibited during summer. Similarly, sodium content of water attained maximum levels during winter and dropped to minimum during summer. On the other hand, potassium ions recorded maximum levels during summer which followed by sharp decline to reach minimum during winter.

Total chlorophyll

From the data presented in (Table 1) it can be seen that total chlorophyll concentrations ranged from 3.17 mg 1^{-1} in August 1988 to 11.66 mg 1^{-1} in January 1988 at station I and from 1.97 mg 1^{-1} in August 1988 to 9.5 mg 1^{-1} in December 1987 at Station II, a phenomenon which did not coincided with phytoplankton density throughout the period of investigation.

Floristic study of phytoplankton

Standing Crop: The average monthly total number of phytoplankton (unicellular, colonial, filamentous), all counted as single cells/liter at all sites of both stations are demonstrated in (Figure 2). It is evident that the total cell count at Station I ranged between minimum ($4.9x10^6$ 1^{-1}) recorded in July and maximum ($50.550x10^6$ 1^{-1}) attained in September 1988. At Station II; however, it was fluctuated from $5.9x10^6$ cells/1^{-1} exhibited in July 1988 to $45.200x10^6$ cells/1^{-1} reached in February 1988.

Concerning to seasonal variations, it was obvious that autumn represented the richest season, since it harbored the maximum yield at both stations, being amounted to $41.0x10^6$ cells/1^{-1} and $33.15x10^6$ cells/1^{-1}, whereas summer could be considered the poorest season, since the total counts did not exceed $12.6x10^6$ cells/1^{-1} and $10.2x10^6$ cells/1^{-1} for Stations I and II, respectively. However, the annual standing crop recorded higher yield at station II in comparison to Station I, being amounted to $22.398x10^6$ cells/1^{-1}.

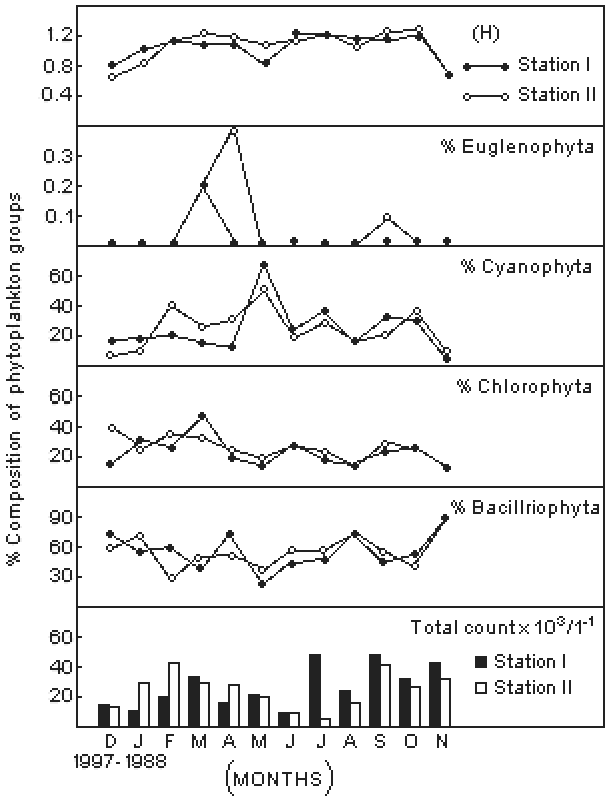


Figure 2: Monthly variations in the average total cout (standing crop) of all phytoplankton populations, the percentage distribution of the main phytoplanktonic groups and species diversity index (H) in different sites of the River Nile waters at Minia (Upper Egypt) during the period December 1987-November 1988.

Percentage composition

The data illustrated (Figure 2) clearly establish as well that the percentage distribution of the four main phytoplanktonic groups recorded in The Nile water at both stations showed significant monthly and seasonal differences. However, at all sites Bacillariophyta represented the highest percentage distribution. This group dominated the others namely; *Chlorophyta*, *Cyanophyta*, *Euglenophyta* during 10 months out of 12. The average seasonal percentage composition of Bacillariophyta ranged from 43.56% to 59.36% at Station I; and from 42.86% to 58.6% at Station II. *Chlorophyta* ranked second in the order of dominance at Station I. The propagules of this phylum sustained maximum seasonal average (24.86%) during spring and minimum one (18.4%) during autumn. Such group tended to occupy second rank in the order of dominance allover 7 months out of 12 at the sites of Station II, contributing to monthly percentage fluctuated from 10.8 to 37%.

Cyanophyta dominated the other groups at both stations in May 1988, exhibiting percentage composition which constituted for 66.4 and 51.6% of total count for Stations I and II, respectively. The total count of *Cyanophyta* showed remarkable increases in the sites of Station II, an observation which subsequently lead to put *Cyanophyta* in the 2nd order of dominance during the months April, July, September and October.

Euglenophyta at both stations was rarely and randomly recovered, being isolated once and 3 times at Stations I and II, respectively. The propagules of such group were so low to contribute any influential role in standing crop allover the period of study.

Species composition

The generalized picture emerging from the data presented in (Table 2) is that a total of 76 species were sampled although the investigation period at Station I. Out

Table 2: A list of recorded phytoplankton, their seasonal counts (Countx10/1^{-1}), their relative density and annual standing crops Stations I, II or River Nile at Minia govemorate during the period December 1987-November 1988 (4 replicate each sample).

Taxa	Winter		Spring		Summer		Autumn		Total annual count		Relative density	
	I	II	I	II	I	II	I	II	I	II	I	II
Chlorophyta												
Actinastrum hantzschii	100	-	400	350	150	-	-	50	650	400	0.2%	0.1%
Ankistrodesmus falcatus	400	600	1900	3750	1300	2200	1250	1750	4850	8300	1.8	3.0
Botryosphaeria sudotica	150	450	500	550	200	200	600	550	1450	1750	0.5	0.7
Codatella citiata	200	100	200	150	100	-	100	100	600	350	0.3	0.1
Closterium acutwn	350	450	250	250	50	-	600	500	1250	1200	0.5	0.4
Closterium moniliferm	50	-	-	50	50	50	-	-	100	100	0.03	0.03
Chlamydomonas rendri	250	300	150	150	50	50	100	-	550	500	0.2	0.1
Coelastrum microsporum	200	200	50	100	200	300	800	350	1250	950	0.5	0.3
Closteriopsis longissima	50	-	50	50	-	-	-	-	100	50	0.04	0.01
Cosmarium botrytis	-	-	-	50	50	50	100	150	150	250	0.05	0.08
Dictyospharium pulchellum	2100	10400	10750	550	550	250	3700	3900	18800	20050	6.9	5.8
Elkatothrix virids	150	300	250	50	50	50	700	250	1150	650	0.4	0.2
Golenkinia radiata	50	100	100	100	-	100	150	50	350	350	0.1	0.1
Golenkiniopsis solitaria	100	100	100	50	-	50	150	250	350	450	0.1	0.2
Gonium formosum	-	-	50	50	-	-	-	-	50	50	0.02	0.01
Kirchnerlella lunaris	-	150	150	250	100	50	300	-	550	450	0.2	0.2
Micractinum pusillum	100	300	100	150	150	350	200	250	550	1050	0.2	0.4
Cocystis borgeisnow	450	1100	600	700	400	250	1000	1000	2450	3050	0.9	1.0
Oedogonium crispum	-	-	150	50	-	100	-	-	150	150	0.05	0.05
Pediastrum simplex	150	250	300	350	1500	850	7450	5700	9400	7150	3.4	2.8
Scenedesmus quadricaud	200	500	300	200	150	100	300	750	950	1550	0.4	0.61
Scenedesmus flexuosus	2800	6500	3500	3300	450	650	2200	1100	8950	11550	3.2	4.0
Scenedesmus aquminatus	-	-	-	-	150	-	600	950	750	950	0.3	0.3
Scenedesmus opoliensis	-	-	50	50	-	-	-	-	50	50	0.01	0.01
Staurastrum rotula	200	550	300	300	650	250	1950	1250	3100	2350	1.2	0.8
Spirogyra aequinoctiallis	-	50	-	-	-	-	-	-	-	50	-	0.01
Selenastrum gracile	-	-	-	50	-	-	-	-	-	50	-	0.01
Bacillariophyta												
Bacillaria paradoxa	100	-	100	50	-	-	-	-	200	50	0.07%	0.01%
Cymbella caespitosa	50	-	100	50	50	50	200	150	400	250	0.1	0.08
Caloneis lepidula	-	-	-	50	-	-	-	50	-	100	-	0.03
Diploneis oculata	-	50	-	-	-	-	-	-	-	50	-	0.01
Diatomella balfouriona	50	50	-	-	-	-	50	-	100	50	0.03	0.01
Fragilana capitata	550	1800	900	1200	800	900	6500	3650	10150	3.27	3.58	
Fragilaria constrensis	1400	200	300	450	500	300	200	250	1200	0.9	0.4	
Gyrosigma lucianum	-	-	-	-	-	250	50	50	50	300	0.01	0.01
Gyrosigma distortum	-	50	50	-	-	-	150	-	200	50	0.07	0.01
Comphonema lanceolatum	50	50	-	-	50	-	-	-	100	50	0.03	0.01
Nitzschia paleacea	-	-	750	1050	1850	1200	1100	550	3700	2800	1.4	0.6
Nitzschia acicularis	-	50	-	-	-	-	-	-	-	50	-	0.01
Nitzschia balfouriona	650	1350	400	1250	1300	600	550	800	2900	4000	1.05	1.4
Nitzschia subtilissma	50	50	-	-	-	-	250	150	300	200	0.1	0.07
Nitzschia closterium	-	-	-	-	-	100	-	50	-	150	-	0.05
Navicula cuspidata	300	350	550	500	500	600	600	650	1950	2100	0.71	0.67
Navicula longirostris	100	150	400	350	300	300	600	550	1400	1350	0.5	0.4
Navicula anglica	50	-	-	-	-	-	-	200	50	200	0.01	0.07
Navicula placentula	-	-	-	50	-	-	-	-	-	50	-	0.01
Navicula papula	-	-	-	50	-	-	-	-	-	50	-	0.01
Rhabdomina adriaticum	100	50	150	100	50	100	50	50	350	300	0.1	0.1

Table 2: A list of recorded phytoplankton, their seasonal counts (Countx10/1^{-1}), their relative density and annual standing crops Stations I, II or River Nile at Minia govemorate during the period December 1987-November 1988 (4 replicate each sample).

Taxa	Winter		Spring		Summer		Autumn		Total annual count		Relative density	
	I	II	I	II	I	II	I	II	I	II	I	II
Synedra acus	-	200	450	550	50	250	100	-	600	1000	0.2	1.0
Synedra amphicephola	-	100	100	-	-	-	400	300	500	400	0.21	0.1
Synedra Lenera	-	150	150	100	100	-	1000	900	1250	1150	0.5	0.4
Tabellaria fenestrata	1300	2050	1750	2600	1200	1150	9450	9650	13700	15450	5	5.0
Thalassosira gravida	150	200	450	500	-	-	50	50	650	750	0.25	0.28
Cyclotella bandanica	15750	27400	9550	13800	4150	2300	10300	7400	39750	50900	14.4	17.7
Cocconeis caespitosa	1750	3450	850	1300	750	500	950	700	4300	5950	1.5	2.1
Melosira granulata	4900	6000	10250	8900	10550	9750	37750	24650	63450	49300	22.5	17.2
Cyanophyta												
Anabeana aequalis	100	350	150	100	150	100	3300	3200	3700	3700	1.3%	1.3%
Aphanocapsa rivularis	540	2300	8800	8650	900	950	1550	1550	11900	13450	4.33	4.6
Aphancthece muralis	-	50	-	-	-	-	-	-	-	50	-	0.01
Anabaenopsis tananyikae	-	-	-	-	-	-		100	-	100	-	0.03
Chrooccoccus turgidas	600	1300	950	1050	500	300	400	600	2450	3250	1.0	0.5
Coelosphaerium stagnale	3100	11650	1200	1400	750	750	18250	13900	23300	27700	8.5	9.7
Dactylococcopsis fascicularis	-	50	150	50	150	50	50	50	350	200	0.1	0.07
Goleocapsa puncitata	300	300	250	450	200	150	150	300	900	1200	0.3	0.4
Lyngbya aerugineocaerulae	-	-	-	-	-	-	-	50	-	50	-	0.01
Microcystis aeruginosa	1400	1350	7850	7400	750	600	2600	3100	12600	12450	4.5	4.3
Microcystis wesenbergil	150	2400	150	1550	150	100	150	50	60	4100	0.2	0.1
Merismopedia elegans	400	1450	600	1700	3800	2100	600	600	5400	5850	2.0	2.0
Merismopedia gluca	-	50	-	-	-	-	-	-	-	50	-	0.01
Oscillatoria chalybea	550	250	-	50	100	200	300	200	950	700	0.3	0.2
Spirulina major	1050	200	-	50	-	-	-	-	1050	250	0.07	0.08
Synechocystis aquatitis	300	500	500	500	150	250	300	200	1250	1450	0.06	0.5
Synechococcua aeruginosus	150	100	-	-	-	-	50	150	200	250	0.07	0.08
Treubaria triappendiculata	-	-	-	-	-	-	-	50	-	50	-	0.01
Euglenophyta												
Euglena pisciformis	-	-	-	150	-	-	-	50	-	200	-	0.08
Total no of species	48	54	51	58	47	46	53	56				
									272450	292750		
Total no of individuals	46200	88750	68500	55800	37800	30600	123000	99450				
(H)	3.02	2.71	3.08	3.51	3.62	3.53	3.06	3.18				

N.B. Filamentous and colonial organisms were counted as one organism.

of these, 31 species belong to each of *Chlorophyta* and *Bacillariophyta*, 14 to *Cyanophyta*. At Station II; however, the number of recovered species increased to reach 80 ones. Out of these, 28 belong to *Chlorophyta*, 32 to *Bacillariophyta*, 19 to *Cyanophyta* and only one to *Euglenophyta*.

The number of recovered species at both stations fluctuated during all months of investigation period, a phenomenon that led subsequently to gross changes in community structure. At Station I, the highest number of species was reached in March 1988 (52) and the lowest one (29) was attained in December 1987. Similarly, a peak of species number (49) was noticed at Station II in March 1988 while the least number (26) was recorded in August.

Relative density and frequency of occurrence

The data presented in (Table 2) reveal also that a total of 25 species rated high occurrence at Station I. Out of these, 10 belong to *Chlorophyta*, 7 to *Bacillariophyta* and 8 to *Cyanophyta*. The most highly abundant of these species were represented by: *Melosira granulata, Cyclotella bandanica, Dictyosphaerium pulchellum, Tabellaria fenestrata, Microcystis aeruginosa, Scenedesmus flexuosus, Merismopedia elegans, Ankistrodesmus falcatus, Coconeis caespitosa, Staurastrum rotula* and *Chroococcus turgidus*. On the other hand, a total of 26 species which rate high occurrence were sampled at Station II. Of these 11 belong to *Chlorophyta* 8 to *Bacillariophyta* and 7 to *Cyanophyta*. The most highly abundant species, contributing to high relative densities were excelled by: *Cyclotella bandanica, Melosira granulata, Dictyosphaerium pulchellum, Microcystis aeruginosa, Fragilaria capitata, Ankistrodesmus falcatus, Pediastrum simplex, Merismopedia elegans, Nitzschia balfouriona* and *Oocystis borgeisnow*.

Species diversity index

Apart of some minor fluctuations, the species diversity index registered monthly for phytoplankton populations at both stations (Figure 2) tended to be slightly higher at Station I during the months December, 1987, January, February, June, July and November 1988. On the other hand, it shoued higher indices at Station II during October, September, July, May, April and March 1988. This indicates the existence of favorable environment of phytoplankton at Station I during winter and summer. The high numerical indices of species diversity during autumn and spring, at Station II reveals a rich water quality.

DISCUSSION

Monthly measurements of hydrographical parameters of the Nile water in the catchment area at Minia reveal a complex relationship between hydrological conditions and phytoplankton dynamics of the river water. Since the annual phytoplankton cycle at Station II could be probably effected by the drain effluents. This could raise the concentration of nutrient status in the upper productive layer which intern would increase the standing crop. The annual total cell counts recorded at Station II amounted to $24.3 \times 10^6/1^{-1}$, relevant to $22.955 \times 10/1^{-1}$, registered for Station I. The increase in annual standing crop in the former could be mainly attributed to the rise in nitrates, phosphates, silicates and chlorides at such sites. These nutrients derived from the runoff of agricultural effluents into El-Mohit drain water, to be conveyed onto the Nile at Station II. The importance of these nutrients for phytoplankton production was repeatedly confirmed (10,15, 27, 29). Such results seemed to be in harmony with the findings obtained by (5,7).

The pH values of the Nile water at both investigated stations were generally in the neutral and slightly alkaline side; being ranged between 7.8-8.5. Although slight local variations in pH values at the different sites were displayed during most of the year, yet Station II sustained relatively higher values, particularly during the fall period, where a dense algal vegetation was prominent. The relatively high pH values of water habitats was attributed by Neos and Varma (21) to excessive growth of algae which could result in increased photosynthetic activity (7) of affect the number of phytoplankton species (14,16) and /or support the growth of certain algal groups (25, 26).

Local monthly and seasonal fluctuations of anions and cations in the Nile water noticed during this investigation could be related to the interference of interactive effect of one ion on the uptake of another, the relative efficiencies of absorption mechanisms of the various algal groups, the dynamics of phytoplankton decays (19), or to the leakage of ions by aquatic organisms, the agricultural runoff and the utilization of the absorbed ions by phytoplankton.

The results herein obtained showed evidently that autumn represented the richest season at both stations; being harbored the highest yield of standing crop, whereas Summer demonstrated the poorest one (least total cell counts). This was mainly correlated with optimization of most of the physicochemical characteristics of water mass during fall season. Such observations seemed to be consistent with those obtained (17,20).

The main phytoplanktonic groups; recorded in the Nile water during the present study; namely *Chlorophyta*, *Bacillariophyta*, *Cyanophyta* and *Euglenophyta* were subjected to conspicuous monthly and seasonal variations at all sites. However, under all conditions the percentage distribution of *Bacillariophyta* exceeded that of the other groups at both stations for approximately 10 months out of 12. *Chlorophyta* rated 2nd in the order of dominance at Station III. The percentage composition of *Cyanophyta* and *Euglenophyta* tended to be higher at Station II than that of Station I. These observations clearly indicate that the inhibition and/or stimulation of growth of different algal groups or species may be one aspect of the effect of nutrient status of habitat which modify the algal population and growth activities. According to Essa (9), who investigated the phytoplankton population in the River Nile at Assuit, the most striking communities at all sites investigated were those consisting largely of close associations between green algae, diatoms and blue greens. In accordance to this, Holmes and Whitton (13) speculated that the growth of many species of many species of blue green and green algae being presumably favored because they can grow at a wide range of chemical variables.

Blooming of certain species belong to any of the main phytoplanktonic groups was frequently occurred for some times at Station II. For instance, *Ankistrodesmus falcatus* tented to flourish vigorously during spring and early summer. Other species such as *Cylindrospermum stagnale, Navicula cuspidata, N. Longirostris, Melosira granulata* and *Fragilaria capitata* contributed to dense populations during spring. Whereas, *Dictyosphaerium pulchellum* and *Pediastrum simplex* were bloomed during autumn. Still remain, the propagules of *Tabellaria fenestrata, Cyclotella bandanica, Cocconeis caespidata* and *Microcystis aeruginosa* which were isolated with appreciable counts all the year round.

The dense flourishment of the above mentioned species, as a result of abnormal growth and enhancement cell activities, was mainly attributed to increased eutrophication caused by the excessive loads of runoff drainage water at such sites. This is in agreement with the results obtained (3,20,28).

In general, it could be concluded that the relation between the chemical composition of water and the growth of algae is affected by a multitude of environmental conditions and the physiological properties of the algal organisms.

The data obtained during this investigation lend a support to take into account that the catchment area of the River Nile at Minia district provide original relatively moderate fertile water, and algal growths seldom develop to such an extent that the human use of the water is affected diversely. Only at the sites of junction with El Mohit drain, the impoundment of agricultural runoff leads to an enrichment of Nile water, simulating algal growth of certain species from time to time.

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