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Effect of some Environmental Factors on the Distributions and Chlorophyll Contents of Fresh Water Phytoplankton of the River Nile before El-Qanater El-Khairia Barrage, Egypt.

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INVESTIGATIONS were carried out on the seasonal variations, biodiversity and chlorophyll contents of phytoplankton in relation to physico-chemical parameters of the River Nile water before El-Qanater El-Khairia barrage during two successive years (from summer 2006 to spring 2008). The detected phytoplankton community consisted of 176 species in 62 genera of six systematic algal divisions. Chlorophyta (42.05%) recorded the highest population followed by Bacillariophyta (40.91%), Cyanophyta (9.65%) and Euglenophyta (5.11%). Pyrrophyta and Xanthophyta were less dominant. Chlorophyta, Bacillariophyta and Cyanophyta were responsible for the remarkable fluctuations in the phytoplanktonic picture of the investigated water. The highest number of taxa of all divisions was recorded in summer 2006. These may due to the highest recorded values in K^+, Cl^-, NO_3^-, and PO_4^{-3} with lowest values in the electrical conductivity (E.C), total dissolved salts (TDS), HCO_3^- and CO_3^{2-} during this season. Algal productivity (as number of individuals L^{-1}) attained its highest value during summer 2007, while its lowest value was recorded in winter 2008. These may correlated to the highest recorded values of temperature, silicate and bicarbonate in association with complete depletion in Phosphorus and Carbonate values in the same season. The lowest number of taxa and the total algal productivity (as number of individuals L^{-1}) of all divisions were recorded during winter 2008. This was positively correlated with the relative increased in Sulphate, Carbonate, Magnesium and Phosphate concentrations during winter 2008.This may attribute to death and decomposition of aquatic microorganisms in this season. Summer 2006 showed maximum values in both Shannon-Weaver diversity (H) and species richness (D). There more or less positive correlations between the fluctuations of total chlorophyll contents (ug L^{-1}) and those of total number of individuals (L^{-1}) of the studied phytoplankton.

Keywords: Fresh water phytoplankton, Physico-chemical parameters, Algal chlorophyll contents, Diversity, Shannon's index.

Inland water bodies attracted the attention of various workers to study water quality and distribution of phytoplankton from time to time, (Ratha *et al.,* 2003). Aquatic algae (particularly phytoplankton) are the major primary producers, the most diverse and ubiquitous organisms in many aquatic systems. They plays an

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important role in maintaining the biological balance and quality of water due to their rapidly responds to changes in the aquatic environment (Shehata *et al*., 1997; Pandey *et al*., 1998 and Wolfram *et al*., 2007). Phytoplankton biomass constitutes a bio-monitoring index; however the productivity of an aquatic environment is directly corrected with the density of phytoplankton (Sobhy, 2008; Elewa *et al.*, 2009; Benarjee and Narasimha, 2013). Shannon-Weaver index values are biotic indices which reflect the characteristics of a phytoplankton community; however studies using number of species alone cannot describe community properties adequately (Mulder *et al*., 2001 and Weis *et al*., 2007). Chlorophyll in algae is vital to photosynthesis and for the survival of them in planet. Conventionally biologists and ecologists consider chlorophyll as a reliable and world-wide standard algal biomass index (Knefelkamp *et al.,* 2007; Shehata *et al*., 2008 and Boyce *et al*., 2010). Counting and volume assessment of cells and measurement of pigment concentration are widely used to estimate algal biomass (Smayda, 1978 and Jeffrey *et al*., 1997). The relationship between chlorophyll a and phytoplankton biomass has been widely studied (Tolstoy, 1979; Vörös and Padisák, 1991; Jones *et al*., 1996 and Rolland *et al*., 2010).

However Chlorophyll a is common to all photosynthetic organisms and it is relatively easy and rapid to quantify (Wetzel and Likens, 2000). The objective of this study was to investigate the diversity, species composition, seasonal succession and total chlorophyll contents of phytoplankton in relation to physicochemical parameters in the main branch of the River Nile water before El-Qanater El-Khairia barrage during two successive years (from summer 2006 to spring 2008), to establish basic knowledge that can be used for the aquatic management.

Material and Methods

Study area

Fresh water study region was located before El-Qanater El-Khairia barrage at 30° 11` 38`` N and 31° 07` 54`` E. However El Kanater El Khairia is one of the major cities El Qalyubiya Governorate in the north of Cairo (Egypt). The barrages are 16 km north of Cairo and are located on the Nile just before it splits to form the Damietta and Rosetta (or Rashid) branches.

Samples collection

Water samples were collected periodically (by filtering water in 15µm mesh plankton net.) from the studied barrage every season during two successive years (from summer 2006 to spring 2008). Water samples from the candidate region were held in ice boxes in form of three parts (part for physicochemical analysis, second water part was preserved with 5% formalin and used for the biological and counting of phytoplankton and the last water part for the analysis of total chlorophyll contents). All water samples were immediately transported to the laboratory for the physicochemical, biological and total chlorophyll analysis as well as for the counting of phytoplankton.

Physicochemical analysis

Temperature (air and surface water) was recorded on the spot using centigrade thermometer. pH of the water sample was measured by using the gun pH meter on the spot. Physicochemical analysis of the electrical conductivity (EC), the total dissolved salts (T.D.S.) and the major equivalent percentages (e %) of cations, anions, phosphate, nitrate, nitrite and silicate of the candidate water sample (300 mL) were done according to standard methods (APHA, 1998). Moreover the results of cations and anions were represented graphically by bar diagrams according to Klimentov, (1983).

Biological analysis and Counting of phytoplankton

Some of the preserved water sample was used to investigate the phytoplankton taxa under microscope (MICRO Star® AO Scientific Instruments) which were identified with the help of standard references of Zabelina *et al*. (1951); Gollerbach *et al*. (1953); Hendey (1964); Patrick and Reimer (1966 and 1975); Philipose (1967); Jensen (1985) and Faust and Gulledge (2002). In the another preserved water sample (about 50 liters of surface water), algal organisms were allowed to settle out in the measuring cylinders for 5 days. The supernatant liquid was then carefully withdrawn. The settled organisms were tipped into 250 ml beakers and again allowed to sink for 2 days. By so doing, it is possible to reduce the algal residue to 10 ml. According to Sourina (1981), after shaking from 10 ml concentrated material, an aliquot was withdrawn by a pipette and loaded into a Max Levy counting chamber haemocytometer. The results of algal count were expressed as number of individuals per liter.

Shannon–Weaver biodiversity index and Species richness

Shannon-Weaver diversity of phytoplankton was carried out using the method of Shannon and Weaver (1949). The mathematical equation for Shannon-Weaver index (H) is: $= -\Sigma$ (ni /N) ln (ni /N). Where, (ni) is the abundance of species i, and (N) is the total number of individuals in the community. The Species richness (D) has also been used according to Margalef (1968).

The mathematical equation for species richness is: $D = \dfrac{s-1}{\text{in}N}$

Where, (D) = species richens, (S) = the number of species in the population and N = total number of individuals in the population.

Total chlorophyll (ug L^{-1}) analysis

Total chlorophyll was extracted by dimethyl sulfoxide (DMSO) according to Burnison (1980). The extracted solution was measured by reading the absorbance (A) of the pigment extract spectrophotometrically (PERKIN-ELMER LAMBDA 2 UV/VIS) at 666 nm and calculated (ug L^{-1}) according to Seely *et al.* (1972). Total chlorophyll (ug L^{-1}) = A x C x F

A= reading at 666 nm. , (F) = 11.3 (factor). (C) = volume of extract / sample volume.

Results

Physicochemical Analysis

The physical characteristics of the studied water present in Table 1 and Fig. 1 revealed that, water temperature ranged between 16°C - 30°C in summer 2007 and winter 2008 respectively. pH values of water were fluctuated from around neutral (pH= 7.10) in spring 2008 to relatively high alkaline value (pH= 9.45) in autumn 2006. TDS were found in the same trend of the EC.However the higher values of EC and TDS were recorded during spring 2008 (0.56 mmhos/cm and 358.4 ppm respectively). Whereas the lower values were showed during summer 2006 (0. 30 mmhos/cm and 192.0 ppm respectively).Chemically, Na^{+} cation was the highest in the composition of equivalent percents (e %) during the all studied seasons, except in autumn 2007 when Ca^{++} was the most dominant one (its concentration was 51.70%). K^{+} was the minor cation, except in summer 2006 (9.16 %). However, Mg^{++} was varied from (16.57 % to 42.63 %) in spring 2008 and in winter 2007 respectively. With the reference to concentrations of major anions, the variability in their concentrations was also irregular with disappearance of carbonate during the all periods of study, except throughout spring 2007 and winter 2008 (11.28 % and 4.95 %, respectively). Bicarbonate attained the 1*st* rank of the anionic composition of water throughout all seasons (its concentrations varied from 4.46 % in summer 2006 to 78.93 % in summer 2007). During summer 2006, chloride occupied the dominant one (55.67 %). Additionally, nitrite concentrations were relatively low and completely disappeared in spring 2008. Also, phosphate was not recorded in summer 2007.Whereas nitrate showed highest value (0.74%) in summer 2006 and lowest value (0.19%) in spring 2008. Data dealing with silicate concentrations showed that the highest and lowest values (1.70 % and 0.10 %) were detected during summer and winter 2007, respectively.

According to bar diagrams (Fig. 1), summer 2006 (I) showed sodium chloride and magnesium sulphate character; autumn 2006 (II) showed magnesium bicarbonate, sodium sulphate character; winter 2007 (III) had magnesium bicarbonate, sodium sulphate and calcium bicarbonate salts character. Sodium-magnesium bicarbonate and sodium sulphate constituted the third water type during spring 2007 (IV). In summer 2007 (V) water had magnesium-calcium-sodium bicarbonate salty character. Autumn 2007 (VI) characterized by magnesium-calcium bicarbonate salts. Moreover, winter 2008 (VII) showed magnesium bicarbonate, sodium sulphate and calcium bicarbonate salts characters. Lastly, spring 2008 (VIII) showed calcium-sodium-magnesium bicarbonate and sodium sulphate salty properties.

B- Biological Analysis

The detected phytoplankton community (Table 2, Fig. 2) composed 176 algal taxa which related to 62 genera and belonging to six systematic algal divisions. Chlorophyta was the dominant division accounted for (42.05%) of total algal taxa, followed by Bacillariophyta (40.91%), Cyanophyta (9.65%) and Euglenophyta (5.11%). Pyrrophyta and Xanthophyta were less dominant.

TABLE 1. Seasonal variations in the physicochemical parameters of water during two successive years (from summer 2006 to spring 2008). T.D.S. = Total Dissolved Salts and E. C= Electrical conductivity.

Seasons	Temp (°C)	pH	EC (mmhos /cm)	T.D.S (ppm)	e% = equivalent percentage											
					Na^+	K^+	Ca^{2+}	Mg^{2+}	Cl^-	SO_4^{2-}	HCO_3^-	CO_3^{2-}	NO_3^-	NO_2^-	PO_4^{3-}	SiO_2
Summer 2006	24	8.33	0.30	192.0	47.99	9.16	17.95	24.91	55.76	22.30	4.46	0.00	0.74	0.01	16.73	1.21
Autumn 2006	21	9.45	0.48	307.2	47.92	3.18	13.45	35.45	18.80	17.04	59.40	0.00	0.25	0.01	4.51	0.57
Winter 2007	16	8.70	0.36	230.4	30.30	3.90	28.57	37.23	12.28	23.10	57.60	0.00	0.29	0.01	1.04	0.10
Spring 2007	23	9.15	0.33	211.2	55.79	3.86	8.61	31.75	8.95	21.79	56.03	11.28	0.39	0.04	1.56	0.90
Summer 2007	30	8.55	0.34	217.6	36.60	2.13	26.38	34.89	9.70	11.04	78.93	0.00	0.33	0.007	0.00	1.70
Autumn 2007	18	7.45	0.33	211.2	9.06	1.13	51.70	38.11	2.77	6.23	76.12	0.00	0.69	0.003	14.19	1.12
Winter 2008	17	8.81	0.44	281.6	40.48	4.02	12.87	42.63	17.71	26.04	50.0	4.95	0.26	0.01	6.73	0.43
Spring 2008	22	7.10	0.56	358.4	43.43	4.29	35.71	16.57	15.36	14.40	63.72	0.00	0.19	0.00	6.33	0.45

TABLE 2. Total algal distribution and seasonal variations in the number of taxa of different algal divisions.

Seasons	1st studied year								2nd studied year								Total algal distribution		
	Summer 2006		Autumn 2006		Winter 2007		Spring 2007		Summer 2007		Autumn 2007		Winter 2008		Spring 2008				
Algal divisions	Algal taxa	%	Algal taxa	%	Algal taxa	%	Algal taxa	%	Algall taxa	%	Algal taxa	%	Algal taxa	%	Algal taxa	%	Algal taxa	Algal genera	%
Cyanophyta	10	9.71	10	15.38	13	20.63	10	10.53	10	10.53	9	13.04	9	16.07	9	12.16	17	10	9.65
Bacillariophyta	43	41.75	23	35.38	23	36.51	33	34.74	44	46.32	29	42.03	18	32.14	32	43.24	72	22	40.91
Xanthophyta							1	1.05							1	1.35	1	1	0.57
Pyrrophyta	2	1.94	3	4.62	2	3.17	3	3.16	2	2.11	1	1.45	2	3.57	3	4.05	3	3	1.70
Euglenophyta	6	5.83	2	3.08	1	1.59	4	4.21	4	4.21	1	1.45			4	5.41	9	2	5.11
Chlorophyta	42	40.78	27	41.54	24	38.10	44	46.32	35	36.84	29	42.03	27	48.21	25	33.78	74	24	42.05
Total	103	100.00	65	100.00	63	100.00	95	100.00	95	100.00	69	100.000	56	100.00	74	100.00	176	62	100.00

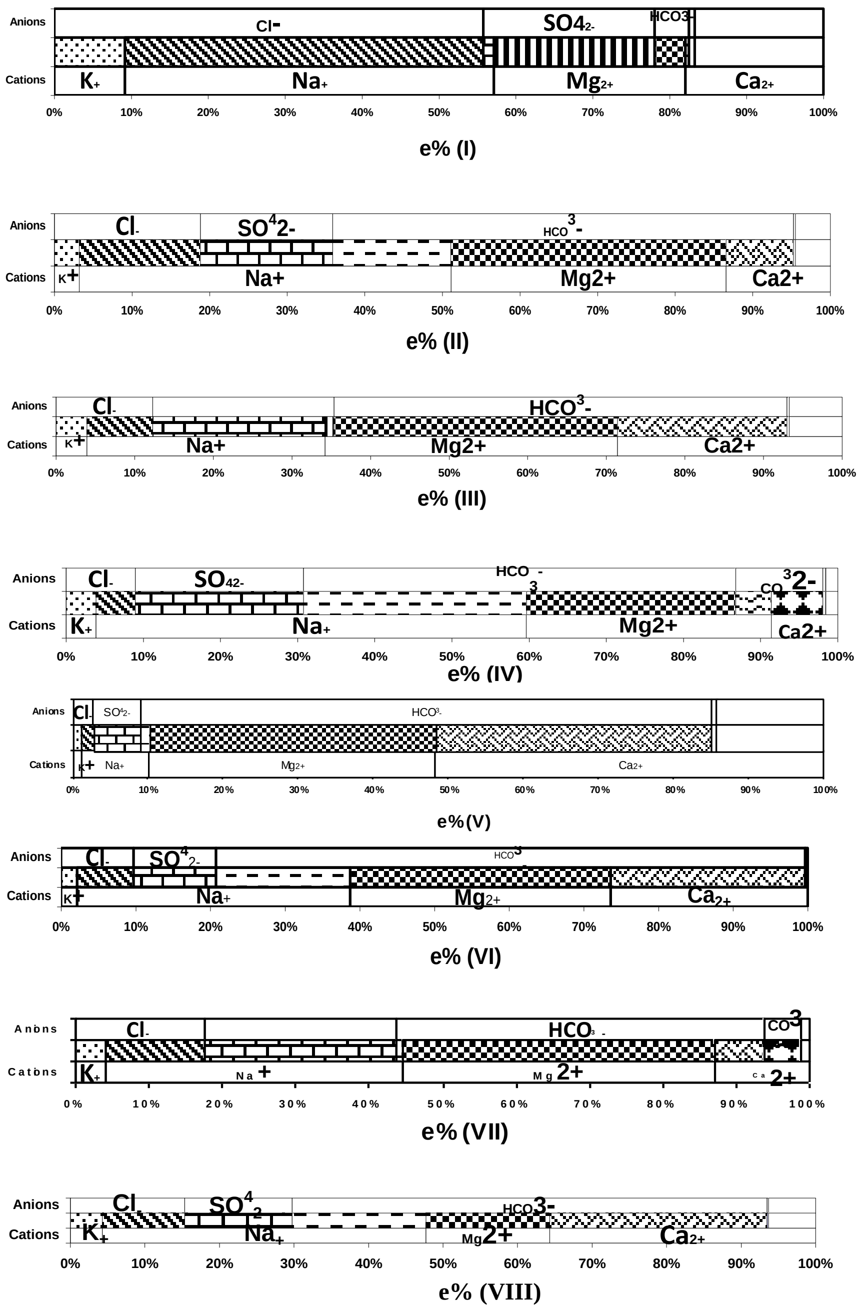

Fig. 1. Bar diagram for the analysis of water during Summer 2006 (I), Autumn 2006 (II),Winter 2007 (III), Spring 2007 (IV), Summer 2007 (V), Autumn 2007 (VI), Winter 2008 (VII) and Spring 2008 (VIII) seasons.

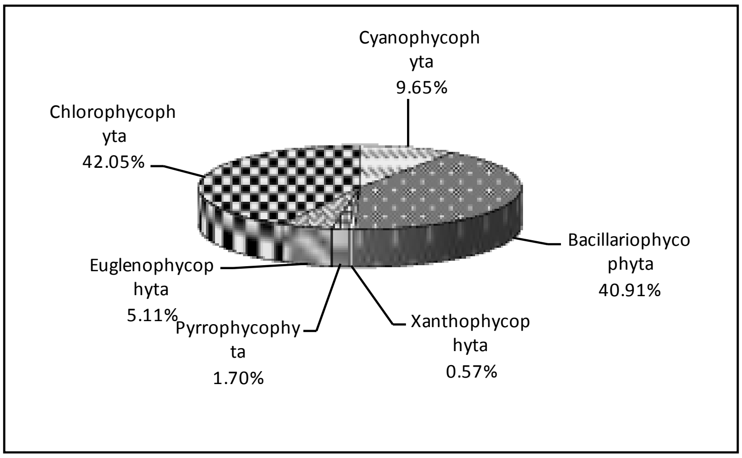

Fig. 2. Qualitative percentages of the different algal divisions

The highest number of taxa of all divisions was recorded in summer 2006 (103 algal taxa) and the lowest one was showed during winter 2008 (56 algal taxa). Cyanophyta (Table 2) was present in high numbers of taxa during winter 2007 (13 algal taxa) while the minimum recorded taxa were observed in autumn 2007, winter and spring 2008. With respect to diatoms, they reached their highest species diversity in both summer seasons 2006 and 2007 (43 and 44 algal taxa, respectively). Xanthophyta represented by *Heterothrix quadrata* that appeared only in spring seasons. *Peridinium cinctum* was recorded in all investigated seasons, followed by *Ceratium hirrundinella.* Concerning euglenoids, *Euglena gracilis* was observed in most studied seasons. However, there were no members related to this division in winter 2008. The maximum number of Chlorophyta was recorded in spring 2007 (44 taxa, Table 2) while the minimum ones were detected in winter 2007 (24 taxa).

Quantitatively, the algal productivity (as number of individuals L^{-1}) present in Table 3, attained its highest value during summer 2007 (11774.300 individuals L^{-1}), while the lowest value was recorded in winter 2008 (590.800 individuals L^{-1}). Summer 2007 showed Chloro-Bacillario-Cyano-character. This was chiefly due to the overgrowth of *Pediastrum simplex* var. *doudenarium, Dictyosphaerium pulchellum, Coelastrum scabrum* and *Staurastrum paradoxum* (from green algae); *Synedra ulna* var. *danica*, *Melosira granulata*, *Melosira granulata* var. *angustissima* and *Cyclotella ocellata* (from diatoms) and *Microcystis aeruginosa, Merismopedia punctata* and *Microcystis aeruginosa* f. *flos aquae* (from blue green algae). The 2nd type of quantitatively phytoplanktonic character was green algae-diatoms-character which recorded during summer 2006, autumn 2007 and winter 2008.The organisms responsible for this appearance were *Dictyosphaerium pulchellum, Scenedesmus quadricauda, Staurastrum paradoxum, Coelastrum scabrum, Pediastrum simplex* var. *doudenarium,* *Errerella bornhemiensis*, *Actinastrum hantzschii*, *Selenastrum minutum* and *Sphaerocystis schroeteri* (from green algae) and *Cyclotella ocellata*, *Synedra ulna* var. *danica*, *Melosira granulata* and *Fragilaria construens* (from diatoms).

In autumn 2006 and in spring seasons 2007 and 2008, Chloro-Cyano-character was detected, due to the contribution of some members of blue green algae in the main bulk of productivity, besides the green algal taxa, such as *Pseudoholopedia convoluta*, *Merismopedia punctata*, *Microcystis firma*, *M. aeruginosa*, *Gomphosphaeria aponina* and *Microcystis aeruginosa* f. *flos aquae*. Winter 2007 characterized by blue green-green algae-character. This could be attributed to the higher growth of blue green algae, especially *Synechocystis pevalekii* and the quantitative decrease in individuals or complete disappearance of some green algal taxa.

TABLE 3. Seasonal variations in total number of individuals (x 10^6 L^{-1}) of taxa of different algal divisions, the total chlorophyll contents, Shannon-Wiener diversity indices (H), and species richness (D) of the phytoplankton.

Seasons Algal Divisions	Summer 2006	Autumn 2006	Winter 2007	Spring 2007	Summer 2007	Autumn 2007	Winter 2008	Spring 2008
Cyanophyta	1.199	1.0739	1.7736	1.5627	1.9988	0.5591	0.1391	1.5041
Bacillariophyta	3.0283	0.3587	0.7019	0.7665	2.3308	1.0144	0.2086	0.7823
Xanthophyta				0.0233				0.0349
Pyrrophyta	0.2998	0.1497	0.0498	0.0699	0.3998	0.0199	0.0098	0.1047
Euglenophyta	0.3494	0.0498	0.0249	0.0932	0.1996	0.0099		0.1396
Chlorophyta	4.5457	1.8973	1.3726	4.2446	6.8453	1.777	0.2333	2.9373
Total number of individuals (N) L^{-1}	9.4222	3.5294	3.9228	6.7602	11.7743	3.3803	0.5908	5.5029
Total chlorophyll contents (ug L^{-1})	35.75	2.02	0.83	6.96	21.19	0.68	0.52	3.95
(H)	5.63	4.71	4.72	5.05	4.69	4.04	4.91	4.77
(D)	6.35	4.24	4.08	5.98	5.77	4.52	4.14	4.70

C- Shannon–Weaver Biodiversity Index and Species Richness

Data related to Shannon-weaver diversity index (Table 3) showed that the main branch of the River Nile before El-Qanater El-Khairia barrage reached its highest phytoplanktonic species diversity in summer season 2006 (H= 5.63), whereas the lowest value (H= 4.04) was detected in autumn 2007. The best species richness of the main branch of the River Nile before El-Qanater El-Khairia barrage was recorded in summer 2006 (D= 6.35), whereas the lowest one was in winter 2007 (D= 4.08).

D- Total Chlorophyll Contents of Phytoplankton

Total chlorophyll contents of phytoplankton during all periods of study (Fig 3) showed that, the highest total chlorophyll amount (35.75 ug L^{-1}) was recorded in summer 2006, while the lowest one (0.52 ug L^{-1}) was detected in the algal collection of winter 2008. In general, total chlorophyll of the phytoplankton of the studied fresh water region were reached their highest amounts during two summer seasons 2006 and 2007 (35.75 and 21.19 ug L^{-1} respectively).This was in the same trend of the detected total number of individuals L^{-1}. On the other hand, autumn and winter seasons characterized by low amounts of total chlorophyll.

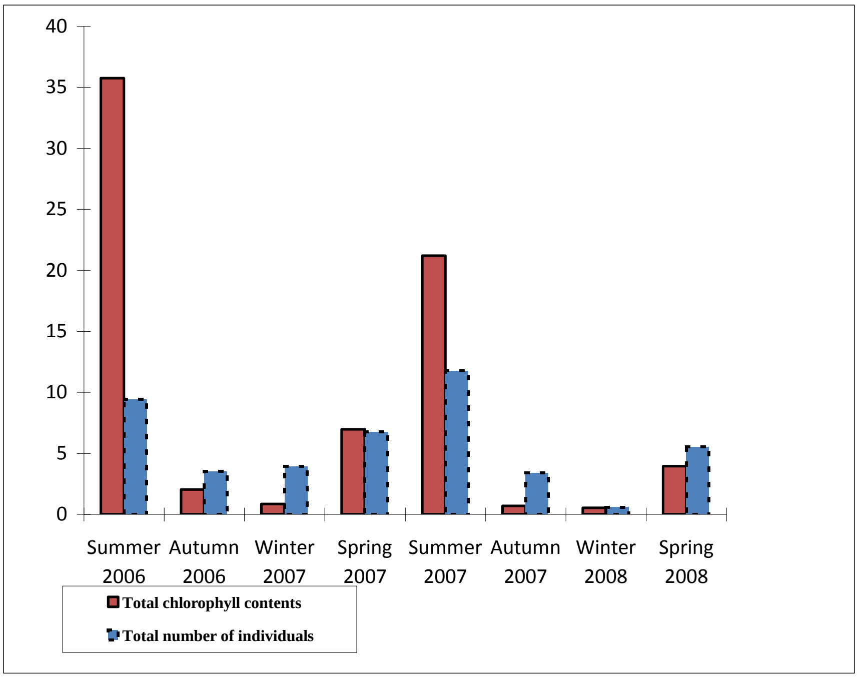

Fig. 3. Correlation between total chlorophyll contents (ug L^{-1}) and total number of individuals (L^{-1}).

DISCUSSION

Due to the short life cycles of phytoplankton, the algal species composition and diversity is known to change seasonally in response to changes in physical, chemical and biological conditions of the water (Reynolds, 1984; Solanki, 2013). Hence their standing crop and species composition indicate the quality of the water mass in which they are found (Ishaq and Khan, 2013). The current qualitative results showed that, the detected phytoplankton community composed 176 algal taxa which related to 62 genera and belonging to six systematic algal divisions. Chlorophyta was the dominant algal group, followed by Bacillariophyta, Cyanophyta and Euglenophyta. Pyrrophyta and Xanthophyta were less dominant. These were positively correlated to the neutral to alkaline nature of the studied water .By referring to this observation, a similar picture has been reported by Gharib (2006), Mishra *et al.* (2009) and Ishaq and Khan (2013) who pointed out that the members of Chlorophyta and Bacillariophyta are more characteristic of the neutral to alkaline conditions.

The greatest number of taxa of all divisions was recorded in summer 2006 (103 algal taxa). These were positively correlated to the highest recorded values in K^+, Cl^-, NO_3^-, and PO_4^{-3} with lowest values in E.C, TDS, HCO_3^- and CO_3^{2-} during summer 2006 (Table 1). Since, under the highest level of potassium, the growth and photosynthesis of algae usually become rich (Cole, 1983). In addition, Phosphate, nitrate and chloride contents play a vital role in algal distributional pattern (Ishaq and Khan, 2013).

Current study also showed positive correlation between the dominance of euglenoides (number of individuals L^{-1}) and with the highest contents of NO_3^- and PO_4^{-3} in association with the lowest content of HCO_3^- during summer 2006 (Salman *et al*, 2013). The highest extensive growth of total individuals of all algal divisions was recorded in summer 2007 (11774.300 individuals L^{-1}).This season had Chloro-Bacillario-Cyano-character with magnesium-calcium-sodium bicarbonate salty feature. These may correlated to the highest recorded values of temperature, silicate and bicarbonate with complete depletion in phosphorus and carbonate in the same season.

In accordance with this result, Rajagopal *et al*, (2010) and Schabhuttl *et al*, (2013) who pointed out that higher water temperature is considered to be one of the most important factors in the productivity and periodicity of the phytoplankton standing crop, the distribution and seasonal variations of floating algae as well as the chemical and physical characteristics of water. El-Hadad, 2005 and Abdo *et al*., 2010 who also stated that, the complete depletion in phosphorus and carbonate contents during summer season may be attributed to the flourishing of phytoplankton and the increase in the photosynthetic process. Moreover, blue green algae assimilate phosphate at a faster rate and accumulate large amount of reserve phosphate for extended growth periods at low phosphate concentration. Meanwhile, Okbah and El- Gohary (2002) stated that, the decomposition and death of diatom, in addition to the increase of generation rate from underlying sediments are the factors influencing silicate concentration.

The seasonal variations in numbers of individuals (L^{-1}) of three quantitatively major divisions (Chlorophyta, Bacillariophyta and Cyanophyta) were responsible for the remarkable fluctuations in the phytoplanktonic picture of the investigated water (Abdel-Satar, 2005 and Ishaq and Khan, 2013). Quantitatively, Chlorophyta dominated over other recorded divisions, where the highest productivity (number of individuals L^{-1}) of them was showed during summer 2007 and 2006 respectively. These were positively correlated with EC and T.D.S values those classified the studied water under the fresh water category (Freeze and Cherry 1979 and Jakhar, 2013).

In accordance with these results, Rajagopal *et al*., (2010) who reported that, Chlorophyta are a large and important group of freshwater algae. Moreover the current results revealed that, the lowest number of taxa and the total algal productivity (as number of individuals L^{-1}) of all divisions were recorded during winter 2008 (56 algal taxa and 590.800 individuals L^{-1} respectively). This was positively correlated with the relative increased in sulphate, carbonate, magnesium and phosphate concentrations during winter 2008 which may attribute to death and decomposition of aquatic microorganisms (El-Hadad, 2006 and Abdo *et al*., 2010).

Shannon-Weave biodiversity index has been used to estimate community biodiversity broadly (Guo *et al.*, 2010). The Shannon-Weaver index values of phytoplankton in the studied region showed little variation among seasons. This suggesting that, overall of phytoplankton species richness and diversity were quite stable all year round (Khuantrairong and Traichaiyaporn, 2008). The maximum values of both Shannon-Weaver diversity (H) and species richness (D) were recorded in summer 2006. These suggesting the strongest ecological health status of the main branch of the River Nile before El-Qanater El-Khairia barrage during this season. Shannon-Weaver index values (varied from 4.04 to 5.63) of phytoplankton communities during all the studied seasons were more than 3.

Therefore the water quality of the studied region should be classified as clean water. This was in agreement with Whitton, (1975) and Hooper *et al*., (2005) who stated that, a high diversity value suggests a healthier ecosystem and a low diversity value a less healthy or degraded one. The reduction in numbers of species and the increase in number of individuals that characterize polluted areas results in significant decreases in values of diversity. The sharp decline in species richness (D) in winter 2007 is likely due to the highest numbers of cyanophytes taxa (13 taxa) and their slightly highest number of individuals (1773.6 individuals L^{-1}) during this season (Khuantrairong and Traichaiyaporn, 2008).

Data of total chlorophyll were reached their highest amounts during two summer seasons. This was in the same trend of the detected total number of individuals (11774.300 and 9.4222 individuals L^{-1} in summer 2007 and 2006 respectively). Autumn and winter seasons characterized by low amounts of total chlorophyll. These observed more or less positive correlations between the fluctuations of total chlorophyll contents (mg L^{-1}) and those of total number of individuals per liter (Wetzel and Likens, 2000 and Rolland *et al*., 2010).

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تأثير بعض العوامل البيئية على الإنتشار و محتوي الكلوروفيل لطحالب المياه العذبة لفرع للنيل قبل سد القناطر الخيرية, مصر.

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هذا البحث تم خلال عامين متتاليتين (من صيف عام ٢٠٠٦ حتى ربيع عام ٢٠٠٨) لدراسة تأثير بعض العوامل البيئية على التنوع الموسيمى و الكتلة الحيوية و محتوي الكلوروفيل للهائمات الطحلبية فى المياه العذبة للفرع مجال الدراسة. من خلال الدراسة تم تسجيل ١٧٦ نوع طحلبى ينتسب إلى ٦٢ جنس تابعين إلى ستة أقسام طحلبية. حيث سادت نوعيا الطحالب الخضراء (٤٢،٠٥ ٪) و وتلاها فى ذلك الطحالب العصوية (٤٠،٩١ ٪) و الطحالب الزرقاء المخضرة (٩،٦٥ ٪) ثم الطحالب اليوجلينية (٥،١١ ٪) فى عينات مياه الفرع. و قد أظهرت الدراسة أيضا أن كلا من الطحالب الصفراء و البيروفيتىة كانوا أقل تمثيلا على الإطلاق. كما لوحظ أن كلا من الطحالب الخضراء و الطحالب العصوية و الطحالب الزرقاء المخضرة قد كان لهم دورا ملحوظا و رئيسيا فى التنوع النوعى والعددى لفلورة الفرع.

و سجلت النتائج أعلى عدد للوحدات الطحلبية على صعيد كل الأقسام الطحلبية المسجلة خلال صيف ٢٠٠٦ و الذى تميز بإرتفاع فى قيم كلا من البوتاسيوم, الكلوريد, النيترات و الفوسفات مع إنخفاض فى قيم كلا من جهد التوصيل الكهربائى، كمية الأملاح الكلية الذائبة والكربونات البيوكربونات. بالإضافة إلى ذلك قد شاهد صيف ٢٠٠٦ أيضا على أعلى قيم فى كلا من تنوع شانون ويفر(H) و سيادة الأنواع الطحلبية (D).

أما أعلى تنوع عددى للكتلة الحيوية فقد تم تسجيله خلال صيف ٢٠٠٧ الذي تميز بإرتفاع فى قيم كلا من درجات احرارة و السليكات و البيوكربونات مع إنعدام ملحوظ فى قيم كلا من الفوسفات و الكربونات. و قد أثبتت الدراسة أن أقل عدد فى كلا من الوحدات الطحلبية و الكتلة الحيوية للطحالب المدروسة كان خلال شتاء ٢٠٠٨. وقد جاء هذا متفقا مع إرتفاع قيم كلا من الكبريتات و الكربونات و الماغنسيوم و الفوسفات الذى قد يؤدى لموت و تحلل الكائنات الحية الدقيقة لمياه الفرع خلال نفس الموسم سالف الذكر. كما أثبتت الدراسة أن هناك علاقة طردية إلى حد ما بين الكمية الكلية لصبغة الكلوروفيل و الأعداد الكلية للهائمات الطحلبية.