PHYTOPLANKTON DIVERSITY AS A RESPONSE OF WATER QUALITY IN RIVER NILE QENA, EGYPT

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Abstract

Changes in phytoplankton density and its relation to physico-chemical nature of the River Nile water were monitored from March 2010 to February 2011 from six sampling sites along the River Nile at Qena, Governorate, Egypt. Physico-chemical parameters: temperature, pH, DO, COD, turbidity and nutrients were measured. Eighty three species have identified during the study belong to five divisions of phytoplankton. Chlorophyta was the predominant group by 36 species followed by Bacillariophyta (diatoms) (33sp.), Cyanophyta (11sp.), Dinophyta (2sp.) and Euglenophyta (1sp.). Phytoplankton density ranged from 2597 to 5227 org. ml^{-1} along the study period. Also, chlorophyll a content as indicator of algal growth and trophic state are ranged between 2.31 and 26.05 µg L^{-1} along the study period. Statistical analysis showed that positive correlation of total algal counts with pH, turbidity, DO and Chl.a. Furthermore, a pronounced correlation was detected between silica concentration and diatoms count.

Keywords: Algal count, Chlorophyll"a", Phytoplankton, River Nile, Water quality.

Introduction

The River Nile is the life artery of Egypt. Throughout the known Egyptian history, the Nile had dominating influences on the economy, culture, public health, social life and political aspects (**Abdel-Hamid *et al*., 1992**).

River Nile is the main source of potable water for Egypt. After High Dam construction generally is held long enough to permit significant changes in physical, chemicals and biological characteristics of water (**Fishar and Khalifa, 2003**).

According to the National Water Research Center (**NWRC, 2000**), the River Nile from Aswan to El-Kanater Barrage receives wastewater discharge from 124 point sources, of which 67 are agricultural drains and the remainders are industrial sources.

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Physical factors that influence the type and numbers of phytoplankton in the river are flow rate, light, water level, temperature and turbidity. Biologically, temperature and solar radiation occupy an important role in the control of planktonic life. Temperature changes not only affect physiological processes of cells, but also influence the kind of life that present in water (**Abo El-lil, 2003**). **Garret *et al*. (1970)** found that temperature was the major factor influencing both algal growth and phosphorus removal .The pH of a water body is very important in determination of water quality since it affects other chemical reactions such as solubility and metal toxicity (**Amer and Abd El-Gawad, 2012**). Dissolved Oxygen (DO) content, plays a vital role in supporting aquatic life and is susceptible to slight environment changes. Oxygen depletion often occurs during times of high community respiration. Hence, DO have been extensively used as a parameter delineating water quality and to evaluate the degree of freshness of a river (**Hassan *et al*., 2010**).

The main objectives of this research are studying the changes in phytoplankton distribution pattern and relation to physico-chemical properties of the River Nile water at Qena district.

Materials and Methods

Study area: Subsurface water samples were collected from the main sources of drinking water in River Nile, Egypt. Study area of the Nile is located at Qena district along a 60 Km. Six sampling sites were chosen (Fig.1) as follows:

$Site_{I}$ (**S_{I}**) = intake of Al-Hemadat water works

$Site_{II}$ (**S_{II}**) = intake of Al-Waqf water works

$Site_{III}$ (**S_{III}**) = intake of Al-ALumium water works

$Site_{IV}$ (**S_{IV}**) = intake of Naga - Hammady water works (Befor Naga-Hammady sugar company)

$Site_{V}$ (**S_{V}**) = in front of Naga-Hammady sugar company

$Site_{VI}$ (**S_{VI}**) = Al-derb (After Naga-Hammady sugar company)

Water Analysis: Water samples were collected monthly (from March 2010 to February 2011). Temperature and the pH values of water were determined in the field by thermometer and the electric pH meter (Handylab pH11/set, SCHOTT instruments, Germany), respectively. Other physico-chemical parameters of water (Turbidity, dissolved oxygen, chemical oxygen demand, ammonia, nitrite, silica, iron and manganese were determined according to the standard methods, recommended by the **APHA, 2005**. In addition, nitrate and phosphate were determined using the methods of **Gales *et al*. (1966)**.

Phytoplankton analysis: Nile water algae were identified according to **Hindak *et al*., (1975)** and counted using compound microscope (Leica DM500). Chlorophyll a values were measured according to standard method (**APHA, 1992**). Diversity index was performed according to **Shannon and Weaver (1963)**.

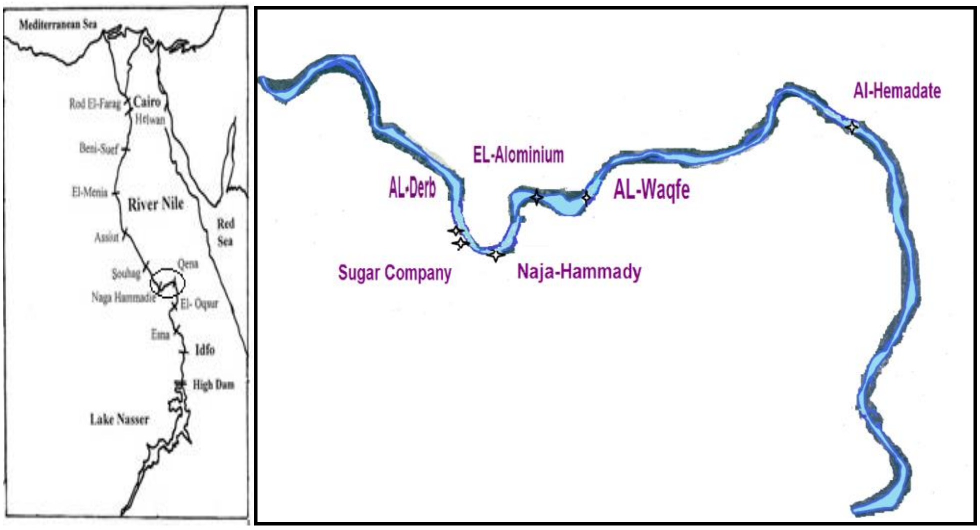

Fig. 1: Location map of the River Nile showing sampling sites.

Statistical Analysis: Statistical analysis was established applying regression coefficient according to **Challerjee and Machler, 1995**.

Results and Discussion

Physico-chemical analysis of Nile water:

Temperature: The temperature values ranged between 17.8 and 30.6 °C along the study period (Table1). Water temperature of River Nile plays an important role for the heat budget of the Nile water (**Abdel-Satar, 2005**). Temperature is a key factor which regulates River Nile phytoplankton population (**Mohammed, *et al*. 1986; Abd El-Hady, 2014**). Temperature showed negative correlation with pH value, dissolved oxygen and phytoplankton counts (Table 2). Similar results were obtained by **Sharma *et al*. (2008)** who found that, temperature showed negative correlation with DO (= -0.9) in Narmada River, India.

Table 1: Annual range of River Nile water characters during March 2010-February 2011.

Parameters	Site I	Site II	Site III	Site IV	Site V	Site VI
Temperature ºC	19.60-30.10	17.80-30.60	18.30-29.00	18.80-28.60	18.80-28.20	18.80-28.10
PH	8.00-8.57	7.80-8.39	8.00-8.59	8.00-8.69	8.00-8.85	8.00-8.53
Turbidity NTU	1.00-4.00	0.62-3.77	1.40-5.34	1.00-5.75	0.93-3.95	1.00-4.66
DO #	5.00-7.50	4.80-7.40	5.30-8.30	5.50-8.70	5.20-8.80	5.20-8.00
COD #	7.20-13.70	3.90-13.70	5.50-23.39	5.00-19.50	3.30-17.80	4.00-15.30
Ammonia #	Nil-0.27	Nil -0.03	Nil-0.40	Nil-0.17	Nil-0.13	Nil-0.32
Nitrate #	0.13-1.00	0.11-0.83	0.15-1.61	0.16-1.24	0.18-1.18	0.16-1.26
Nitrite #	Nil-0.09	Nil-.01	Nil-0.16	Nil-0.08	Nil-0.07	Nil-0.15
Phosphate	Nil-0.01	Nil-0.01	Nil-0.05	Nil-0.07	Nil-0.04	Nil-0.12
Dissolved Silica #	2.60-14.26	1.66-12.00	1.82-9.50	1.46-10.40	1.36-8.42	1.38-12.40
Iron #	0.05-0.33	0.06-0.32	0.09-0.39	0.07-0.53	0.04-0.25	0.06-0.25
Manganese #	Nil-0.09	Ni-0.06	Nil-0.06	Nil-0.08	Nil-0.07	Nil-0.08

* **Nil**=0 **DO** = Dissolved Oxygen **COD** = Chemical Oxygen demand **#** = mg L^{-1}

The pH: The pH of the water of River Nile was alkaline (7.80-8.85). The highest value was associated with prevailing algae (Fig.2). Correlation analysis (Table 2) showed that positive correlation of pH with total algal counts (r =+ 0.938), DO (r = +0.754) and also Chl.a (r =+ 0.883). Similar observation recorded by **Shehata and Badr (2010)** revealed that, pH showed positive correlation with DO (r =+ 0.59) and total algal counts (r =+ 0.65) in River Nile Cairo, Egypt. The increase in total phytoplankton counts was accompanied by an increase in pH values (**Hammad and Ibrahim, 2012**), this could be explained by **Lai and Lam (1997)** who mentioned that phytoplankton photosynthetic activity at surface water consumes carbon dioxide from the water, resulting in increasing pH values.

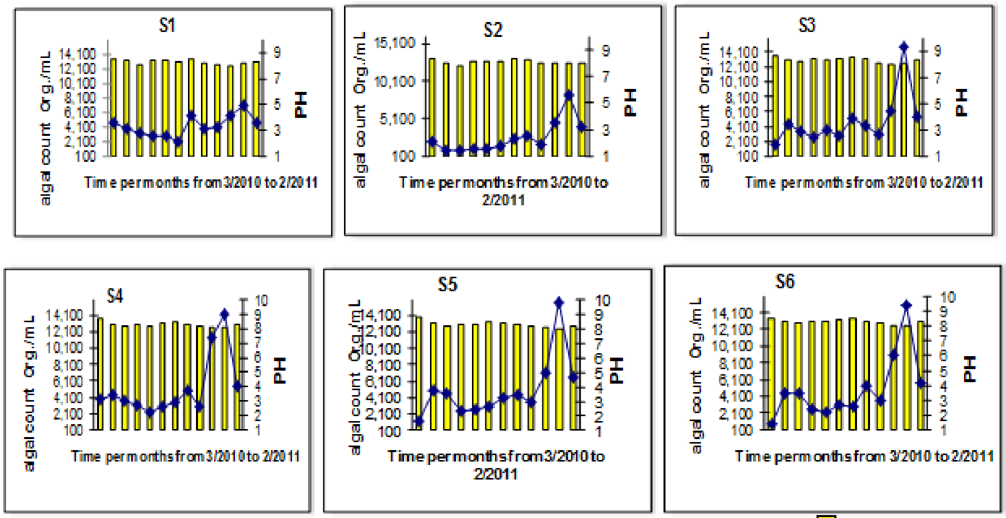

Fig. 2: Relationship between ◆ total algal count (Org/ml) and PH Along River Nile

Turbidity: During the study there was an increase in turbidity values during autumn and winter months this may be due to flood and winter plug. Lowest turbidity value of 0.62 NTU was recorded at S_{II} and the highest value of 5.75 NTU at S_{IV}. Positive correlation was found between turbidity values and total algal counts (Fig.3). This confirmed by statistical analysis which (r = + 0.618) between turbidity and total algal counts (Table 2) this is in agreement with **Shehata and Badr (2010)** observed that, turbidity showed positive correlation with total algal counts (r =+0.94) in River Nile Cairo, Egypt.

Table 2: Correlation coefficient values (r) among the physico-chemical parameters of River Nile water samples in Qena.

Parameters	PH	Tur.	Temp.	DO	COD	PO_4^{3-}	NH_3	NO_2^-	NO_3^-	SIO_2	Fe^{2+}	Mn^{2+}	Total	Chl.a
PH	1													
Tur.	0.590	1												
Temp.	-0.301	-0.259	1											
DO	0.754	0.403	-0.686	1										
COD	0.629	0.875*	-0.316	0.277	1									
PO_4^{3-}	-0.656	-0.732	0.007	-0.206	-0.798	1								
NH_3	-0.204	-0.077	-0.052	-0.503	0.346	-0.034	1							
NO_2^-	0.410	-0.299	-0.413	0.741	-0.357	0.296	-0.516	1						
NO_3^-	-0.256	-0.204	0.278	-0.242	-0.301	-0.251	-0.354	-0.129	1					
SIO_2^-	-0.502	-0.333	0.872*	-0.685	-0.444	0.392	0.003	-0.371	-0.069	1				
Fe^{2+}	0.392	0.960**	-0.134	0.264	0.752	-0.571	-0.123	-0.407	-0.230	-0.120	1			
Mn^{2+}	-0.256	0.225	-0.047	0.187	-0.251	0.232	-0.713	0.020	0.188	0.129	0.408	1		
Total	0.938**	0.618	-0.592	0.905*	0.615	-0.519	-0.239	0.504	-0.333	-0.685	0.432	-0.091	1	
Chl.a	0.883*	0.612	-0.492	0.940**	0.467	-0.407	-0.485	0.565	-0.308	-0.536	0.486	0.164	0.953**	1

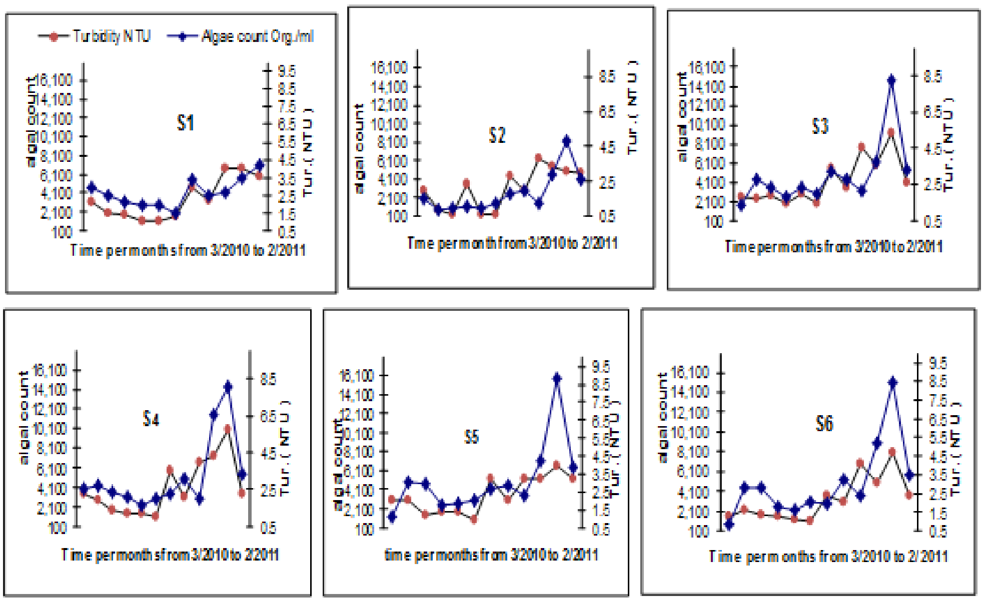

Fig. 3: Relationship between total algal count (Org/ml) and turbdity along River Nile

Dissolved Oxygen (DO): Dissolved oxygen in natural water depends on the physical, chemical and biological activities in the water body. DO reach a maximum value of 8.80 mg O_2 L^{-1} in December at S_V and reached a minimum value of 4.80 mgO_2L^{-1} in September at S_{II} (Fig.4). The WHO (**world health organization 2004**) suggested the standard of DO is > 5 mg O_2L^{-1}. From a biological standpoint, the phytoplankton density in Nile water strongly influences the concentration of dissolved oxygen. High levels of dissolved oxygen were observed during winter months when phytoplankton especially those belonging to diatoms group were abundant (Figs.3&6). DO showed positive correlation with total algal counts (r = + 0.905), pH (r = + 0.754) and nitrite (r =+0.741). **Gharib and Abdel-Halim (2006)** showed that, oxygen in Lake Nasser exhibits a positive correlation with phytoplankton abundance and phytoplankton biomass.

Chemical Oxygen Demand (COD): COD provides a measure of the oxygen equivalent to that portion of the organic matter in a sample that is susceptible to oxidation by a strong chemical oxidant. The maximum value of COD (23.39 mg L^{-}

[1]) was recorded at S_{III} and minimum value of 3.30 mg L^{-1} at S_V as show in (Table1). Most of recorded COD values exceeded the limit stated of Egyptian guide (Not exceed 10 mg L-1) indicates presence of pollution at all investigated sites. The results are generally in agreement with these obtained by **Abdel-Satar (2005)** showed a pronounced increase in COD (3.2-50.09 mg L^{-1}) in the riverbank water than the Midstream sites exceeding the Egyptian standard values for COD (10 mg L^{-1}).

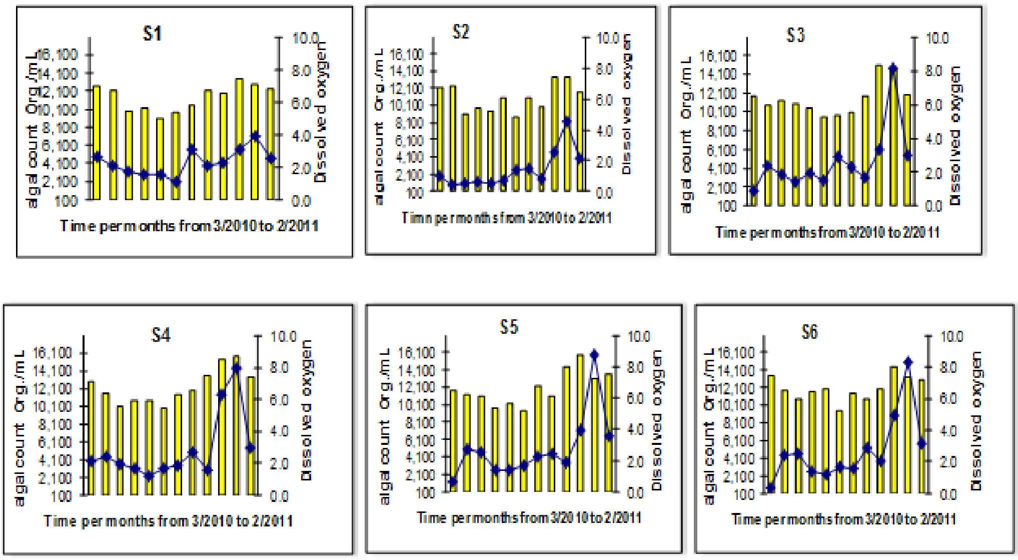

Fig. 4: Relationship between ◆ total algal count (Org/ml) and dissolved Oxygen along River Nile

Nitrogen content: Nitrates, nitrites, ammonia, and organic nitrogen are nitrogen forms that occur in water. The results of nitrite showed low levels during the whole period of investigation. This might be attributed to the fast conversion of NO_2^- to NO_3^- ions by nitrifying bacteria (**Abdo, 2004**). Nitrate values ranged between 0.11 and 1.26 mg L^{-1} during the study period (Table1). The relation between nitrate and total algal counts was very clear where the minimum level of nitrate corresponded by maximum values of algal counts (Fig.5). The decrease in nitrate concentrations in spring and summer months at studded sites might be attributed to the uptake of nitrate by natural phytoplankton and its reduction by denitrifying bacteria (**Sabae and Abdel-Satar, 2001**). The increase in nitrate during cold months might be attributed to low consumption by phytoplankton as well as the oxidation of ammonia by nitrifying bacteria and biological nitrification (**Abdo, 2013**). Nitrates showed negative correlation with phytoplankton counts (r= -0.333).

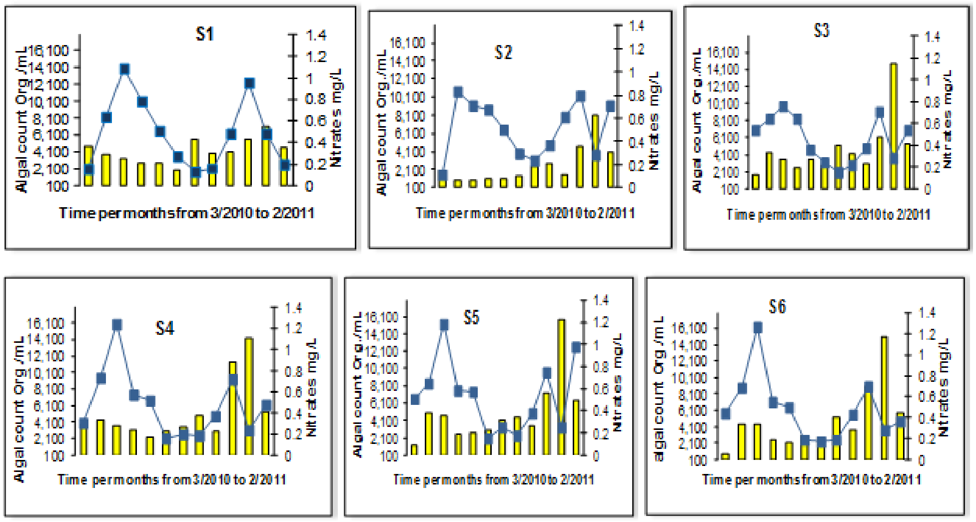

Fig. 5: Relationship between ◆ total algal count (Org/ml) and ▯ nitrate conc. along River Nile

Phosphate: Phosphorus is available in the form of phosphate (PO_4-P) in natural waters and generally occurs in low to moderate concentration (**Stickney, 2005**). The maximum phosphate concentration of 0.12 mg L^{-1} was recorded at S_{VI} and minimum value of 0.01 mg L^{-1} at S_I and S_{II} (Table1). Statistical analysis in Table 2 showed negative correlation between phosphate and pH (r= -0.656). The same results recorded by **Abdel-Satar (2005)** showed negative correlation between pH and ortho-P as well as total-P, suggesting that the solubility of phosphorus is dependent on pH.

Silica: Dissolved silica is an important nutrient for formation the silica wall of diatoms (dominate phytoplankton assemblages). During the study period silica values ranged from 1.36 to 14.26 mg L^{-1}. The lowest values were associated with maximal growth of phytoplanktonic diatoms at all sites in summer months. The dissolved silica in Nile water showed negative correlation with algal counts (r = -0.685), pH (r = -0.502) and nitrate (r = - 0.069) and positive correlation with temperature (r =+0.872) (Table 2) which agreed with (**Shehata and Badr, 2010**).

Microelements: Fe and Mn were investigated duri/ng the study and generally showed little amounts; also the results obtained reflect a positive correlation between Fe and Mn during most months indicated that the association of two elements originates from a common source during transportation and/or depositional reactions. These results agree with that reported by **Abdel-Satar (2008)** revealing that the concentrations of these elements are dependent on each other.

Biological analysis

A total of 83 algal species belonging to the five main algal groups, of which 1 species belonging to Eugleophyta, 2 species to Dinophyta , 11 species to Cyanophyta, 33 species to Bacillariophyta and 36 species to Chlorophyta. A maximum numbers of 69 and 67 species of phytoplankton were recorded at S_{III} and S_{VI} respectively, which obtained the highest value of the nutrients content. However S_V showed the least number of species (61). Although S_{IV} had the maximum individual number of phytoplankton (5227 Org.ml^{-1}) it attained a relatively low number of species (64 species, Table 3). The total algae number ranged from 2597 to 5227 Org. ml^{-1} with a maximum attained during winter months where diatom was the dominant group. Cyanophyta ranged between 456 and 1184 Org. ml^{-1}, for Chlorophyta ranged between 734 and 1484, Euglenophyta ranged from 1 to 4, Dinophyta ranged between 10 and 24 while Bacillariophyta ranged between 1382 and 2878 Org.ml^{-1}. Cyanophyta highest content was recorded at S_I and S_V may be due to the high temperature values and also nutrient content, while the highest count of Chlorophyta was recorded at S_{III}. The highest diatom count was recorded at S_{IV} where the lowest silica content (Fig.6).

Table3. Annual variations in cell number of total phytoplankton at six sites.

Sites / Division	Site I		Site II		Site III		Site IV		Site V		Site VI	
	Cell number	Species number	Cell number	Species number	Cell number	Species number	Cell number	Species number	Cell number	Species number	Cell number	Species number
Cyanophyta	1184	9	456	8	874	8	910	7	865	9	781	8
Chlorophyta	1265	29	734	29	1360	32	1419	30	1484	29	1367	31
Euglenophyta	4	1	1	1	2	1	3	1	2	1	2	1
Dinophyta	12	2	24	2	20	2	17	2	17	2	10	2
Bacillariophyta	1651	25	138 2	26	2525	26	2878	24	2682	20	2804	25
Total	4116	66	259	65	4781	69	5227	64	5050	61	4964	67
Diversity	1.5		1.35		1.36		1.56		1.51		1.51	

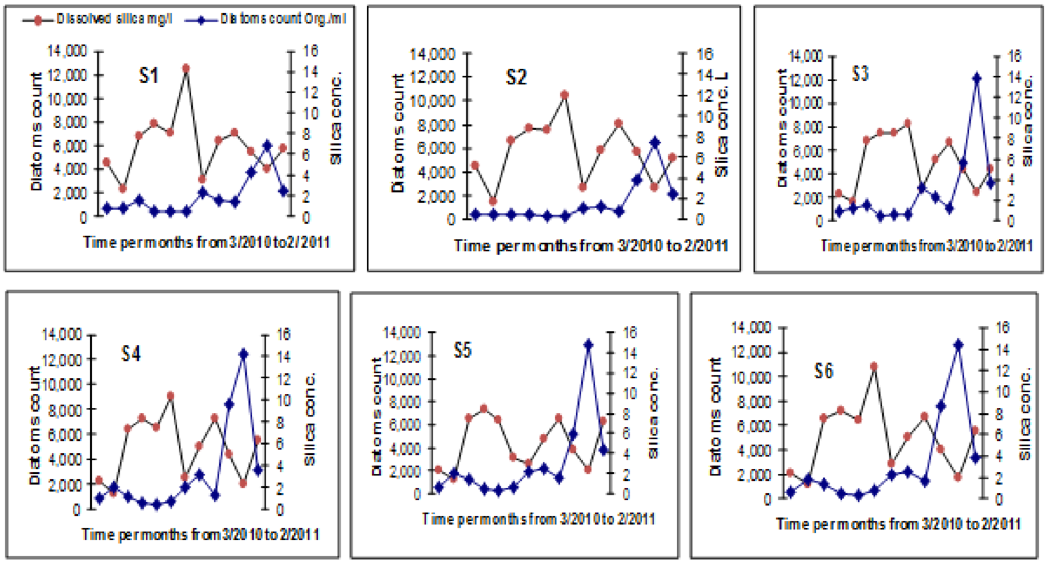

Fig.6: Relationship between Diatoms count (Org./ml) and dissolved silica along River Nile.

The variations of temperature are found to affect the periodicity diversity and succession of the phytoplankton group (**EL-sheekh *et al*., 2010**). The vigorous growth of Cyanophyta is correlated with the increase of phosphorus of surface water, whereas, silica depletion leads to a replacement of the large diatoms by large Cyanophyta **(Deyab *et al*., 2002**).

The main value of diversity index among the different sites ranged from 1.17 at S_I (because of the relatively high movement of water) to 1.36 at S_{II} (may be due to the presence of an island). This range indicates that, this area is moderately polluted.

According to the frequency of abundance (Table 4) of Cyanophyta, *Microcystis flos-aquae, Merismopedia elegans* and *Dactylocoleobsis-rhaphidioides* were the most dominant species within the different sites. Cyanophyta often dominate the fresh-water phytoplankton community in surface waters, particularly in eutrophic system and are major producers of toxins as well as taste and odor compounds (**Codd *et al*., 1989**). The abundance of *Microcystis* at the all studded sites during whole period of the study, it can be linked to the work of **Sa'ad and Antane (1978)** who showed that low value of N and P increases the growth of *Microcystis spp*.

The most frequent species of Chlorophyta which recorded within the different sites were *Chlamydomonas ehrenbergi, Botryococcus braunil, Dictyoshaerium puluchellum, Ankistrodesmus falcatus* and *Scenedesmus armatus.* Among the diatoms, *Stephanodiscus hantzschii, Cyclotella ocellata, Melosira granulate, Nitzschia holsatica, Diatoma elongatum* and *Syndra uln*a were the most dominant throughout the year at different sites (Table 4). In general terms, the diatoms found are characteristic of eutrophic water bodies and most are recorded as halophytic which preferring alkaline waters (**Wolf, 1982; Shehata *et al*., 2009**) which correspond to the conditions of relative high pH in the River Nile.

Table 4. Annual variations in frequency of different taxa at different sites at the studied area.

Species	Site I	Site II	Site III	Site IV	Site V	Site VI	T.F
Cyanophyta							
Anabaena constrica	1	1	2	2	1	1	8
Chrococcus turgidus	1	1	1	1	1	1	6
Coelosphaerium kuetzingellanum	1	--	---	--	--	----	1
Dactylocoleobsis-Irregularis	1	1	1	1	1	1	6
Dactylocoleobsis-rhaphidioides	5	5	3	6	6	8	33
Gomphosphaerium naegellana	2	1	1	3	2	1	10
Merismopedia elegans	3	3	3	4	4	3	20
Microcystis flos-aquae	362	135	270	273	254	277	1571
Nostoc linckia	------	6	--	---	---	--	6
Oscillatoria princeps	----	---	--	--	1	1	2
Spirulina abbreviate	1		1		1	--	3
Chlorophyta							
Ankistrodesmus falcatus	7	5	8	10	9	9	48
Actinastrum hantzschili	3	2	4	4	4	4	21
Botryococcus braunii	23	12	31	30	25	36	157
Chlamydomonas ehrenbergi	312	183	334	341	349	304	1823
Chlorella vulgaris	----	---	1	---	----	---	1
Chodatella cillate	1	1	1	2	1	2	8
Closterium pronum	3	1	2	3	3	5	17
Coelastrum microporum	2	1	2	2	2	2	11

Table 4. (Cont'd.).

Species	Site I	Site II	Site III	Site IV	Site V	Site VI	T.F
Cosmarium granatum	----	---	---	1	1	1	3
Cosmerium praemorsum	---	---	1	---	---	---	5
Crucigenia apiculata	8	4	9	5	7	6	39
Dictyosphaerium puluchellum	5	4	13	13	13	13	61
Eudorina elegans	1	---	1	1	1	1	5
Golenkinia radiate	2	2	2	2	1	2	11
Haematococcus pluvialis	1	1	1	1	1	1	6
Kirchenriella obese	1	1	1	2	1	2	8
Micractinium pasillum	3	2	3	4	5	4	21
Mougeotia scalaris	---	---	---	---	---	1	1
Nephrocytium agardhlanum	1	1	2	2	2	2	10
Oocystis lactularis	1	1	1	--	----	---	3
Oocystis parva	3	3	5	4	6	5	26
Oocystis soltaria	1	1	2	2	1	2	9
Pandorina morum	---	----	----	1	----	---	1
Pediastrum angulosum	2	1	2	2	2	2	11
Pediastrum gracillimum	1	1	1	1	1	1	6
Pediastrum tetras	1	--	1	--	--	---	2
Scenedesmus acuminatus	2	1	1	2	2	1	9
Scenedesmus acutus	2	2	2	2	2	3	13
Scenedesmus armatus	5	7	8	8	7	8	43
Scenedesmus obllquus	--	1	1	1	1	1	5

Table 4. (Cont'd.).

Species	Site I	Site II	Site III	Site IV	Site V	Site VI	T.F
Scenedesmus patydiscus	1	1	--	--	--	1	3
Selenastrum gracile	1	2	1	2	1	1	8
Sphaerocystis schroeteri	---	1	1	1	1	1	5
Staurastrum paradoxum	2	1	2	3	3	2	12
Tetraedron minimum	2	3	2	1	3	2	13
Ulothrix subitllssima	2	1	2	4	2	3	14
Euglenophyta							
Trachelomonas armata	1	1	1	1	1	1	6
Dinophyta							
Ceratium hirundinella	1	1	1	2	2	1	8
Peridinium tabulatum	3	8	5	4	3	3	26
Bacillariophyta							
Amphipleura pellucida	---	1	1	---	---	---	2
Amphora Ovalis	1	1	1	1	1	1	6
Asterionella formosa	1	1	---	1	----	---	3
Caloneis amphisbaena	---	1	---	---	---	1	2
Cocconneis pediculus	8	5	6	8	7	8	42
Cocconneis scutellm	1	1	1				3
Cyclotella ocellata	68	87	94	110	98	101	558
Cymatopleura solea	1	---	1	---	----	1	3
Cymbella tumida	2	3	1	2	3	1	12
Diatoma elongate	13	14	20	24	22	21	114
Diatoma hiemale	1	2	1	2	1	1	8

Table 4. (Cont'd.).							
Species	Site I	Site II	Site III	Site IV	Site V	Site VI	T.F
Fragilaria capucina	1	1	1	1	1	1	6
Fragilaria crotonensis	1	1	1	1	1		5
Fragilaria leptostauron	1	1	1	1	1	1	6
Fragilaria pinnata	2	1	1	1	1	1	7
Gomphonema acuminatum	---	1	1	1	---	---	3
Gomphonema olivaceum	1	2	1	2	2	2	10
Gyrosigma kutzingii	---	1	---	---	--	1	2
Melosira granulate	59	53	100	82	81	78	453
Navicula cryptocephala	3	3	3	4	4	3	20
Navicula cuspidata	----	---	1	---	---	1	2
Navicula pygmaea	---	---	---	---	1	---	1
Nitzschia hiemalis	---	---	1	---	--	---	1
Nitzschia holsatica	14	10	21	32	24	26	127
Nitzschia linearis	11	9	14	20	16	15	85
Nitzschia paradoxa	1	--	---	---	---	--	1
Nitzschia sigmoedea	1	1	1	1	1	1	6
Pinnularia gibba	---	---	--	1	---	1	2
Stephanodiscus hantzschii	308	234	524	588	521	553	2728
Surirella robusta	1	1	1	1	--	1	5
Syndra acus	1	---	---	1	---	1	3
Syndra ulna	11	11	21	22	16	19	100
Syndra Vaucheriae	2	1	1	2	1	1	8

Chlorophyll "a" content:

The concentration of Chl.a ranged from 2.31 to 26.05 µg L^{-1} (Fig.7). The highest value of Chl.a was detected during winter months at all sites due to the most common filamentous forms with high Chl.a content especially those belonging to diatoms, namely, *Melosira granulate*, which contain high Chl.a content. However, good relationship between phytoplankton and Chl.a content were established indicating that physiological state of River Nile phytoplanktonic algae is in good condition. This agreement with the results obtained by **Shehata *et al*., 2009** found Chl.a content ranged from 11.7 to 52.7 µg L^{-1} for River Nile water. However the highest value of Chl.a was detected during winter season. **Havens (1994)** reported that, the maximum Chl.a concentration was more 40 mg L^{-1} at eutrophic Lake at Florida and he found a good relation between chlorophyll a concentration and algal bloom frequencies. Statistical analysis showed that positive correlation of Chl.a with total algal counts (r =+ 0.953), pH (r =+0.883) and turbidity (r= +0.612).

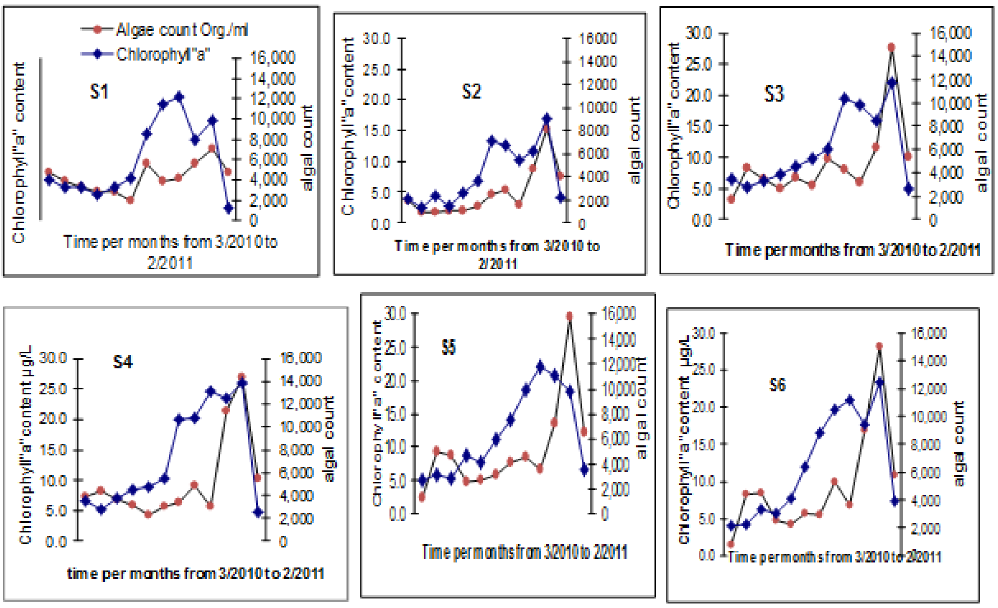

Fig.7: Relationship between Chlorophyll "a" content and total algal count along River Nile.

Conclusion

The most of the water samples were below or out of limited according to the WHO standards. In general the River Nile water quality was satisfactory and suitable for human consumption and other domestic uses. The total algal counts of the River Nile has significantly changed during different months and increased at winter months. Account of algae in surface water samples is a necessary part of water quality monitoring. Algal counts are more consistent to expect the type of drinking water treatment steps for overcoming the planktonic algae.

Recommendations

Regular monitoring of phytoplankton in drinking water sources is necessary to considerate the development of phytoplankton populations structure ,the status of River Nile water quality and selection of water treatment schemes for overcoming Nile water algae.

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تنوع الهائمات النباتية استجابة لنوعية المياة فى نهر النيل بمحافظة قنا ـ مصر

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يهدف البحث الى متابعة التغيرات في كثافة الفيتوبلانكتون (الهائمات النباتية) وعلاقتها بالخواص الفيزيائية والكيميائية لمياه نهر النيل في الفترة من مارس 2010الى فبراير 2011 في ست مواقع بطول نهر النيل بمحافظة قنا– مصر. حيث تم قياس درجة الحرارة والرقم الهيدروجيني و الأكسجين الذائب والأكسجين المستهلك كيميائيا والعكارة والمواد المغذية (المغذيات). فى هذه الدراسة تم تسجيل 83 نوعاً من الفيتوبلانكتون تنتمى الى خمسة اقسام من الطحالب منها 36 نوع تتبع مجموعة الطحالب الخضراء حيث كانت المجموعة السائدة خلال فترة الدراسة و 33 نوع تتبع مجموعة الدياتومات و 11 نوع تتبع مجموعة الطحالب الخضراء المزرقة و نوعين للدينوفيتا (الطحالب السوطيه الدواره) ونوعاً واحداً يتبع الطحالب اليوجلينية. تراوح العدد الكلى للطحالب ما بين 2597 الى 5227 طحلب / ميللى لتر. أما بالنسبة لتركيز

الكلوروفيل أ والذى يعتبر دليل على نمو الطحالب فقد تراوح ما بين 26.05 الى 2.31 ميكروجرام/ لتر.التحليل الاحصائى أظهر علاقة ايجابية بين العدد الكلى للطحالب وكلا من الرقم الهيدروجيني والعكارة و الأكسجين الذائب وكلوروفيل أ. إضافة الى ذلك فهناك علاقة واضحة بين تركيز السليكا والعدد الكلى للدياتومات.