

RELATIONSHIP BETWEEN TOTAL CHLOROPHYLL AND PHYTOPLANKTON INDIVIDUALS OF ROSETTA BRANCH OF RIVER NILE, EGYPT

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ABSTRACT

Total chlorophyll concentrations of the phytoplanktonic samples of Rosetta branch of the River Nile at the stations before Edfina barrage (from station I to V) and after Edfina barrage (stations VI and VII) were studied during two successive years from August 2006 to April 2008. At all stations, the total chlorophyll contents of the identified algae and the maximum quantitative algal individuals were found maximum during summer 2007. Peak periods of total chlorophyll coincided with peak periods of the stations that recorded high algal biomass. Phytoplankton in Rosetta branch of the river Nile at the most studied stations (I, II, IV, V and VI) had chloro-character particularly in summer 2007. A positive correlation was observed between the fluctuations of total chlorophyll contents of the phytoplankton and those of total number of individuals at all investigated stations of Rosetta branch.

Key words: Microalgae biomass, algal chlorophylls, phytoplankton, Rosetta branch of river Nile.

INTRODUCTION

Biomass of micro-algae is a good source of nutrients and biologically active ingredients. Accordingly, estimation of algal biomass is very crucial. Chlorophyll concentration was widely used as a common predictor's technique for monitoring the reliability picture of dissolved nutrients and algal biomass in aquatic habitats (Fogg 1975, Tolstoy 1979, Desortová 1981, Vörös and Padisák 1991 and Kalchev *et al.* 1996 and Halil *et al.* 2008). Chlorophyll *a* is the main photosynthetic pigment in all oxygen-evolving photosynthetic algae while other algal pigments have limited

distribution and considered as accessory or secondary pigments (Akpan 1994). It constitutes approximately 1-2% of the dry weight of phytoplanktonic algae, its assessment is relatively easy, cheap and rapid to quantify in comparison to the analysis of a full suite of dissolved nutrients (Hakanson 1994, Passavante and Feitosa 2004, Brando *et al.* 2006, Shehata *et al.* 2008, Sobhy 2008, Todd *et al.* 2008 and Santos *et al.* 2010). In this paper, we analyze the relationship between total chlorophyll contents of the phytoplankton and their total number of individuals in Rosetta branch of river Nile.

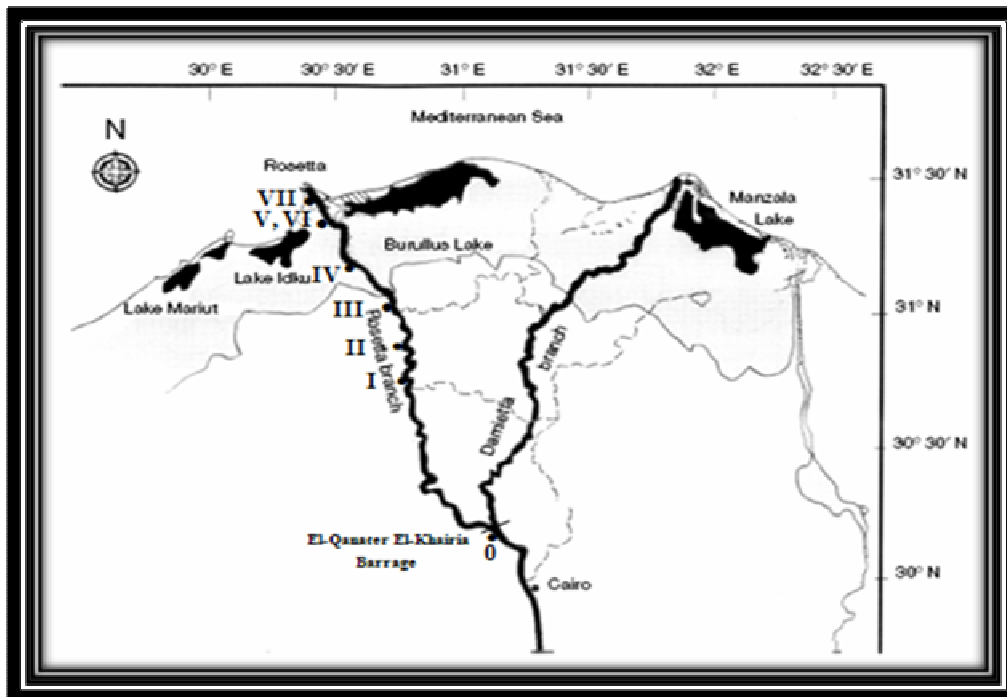


Fig. 1. Study Stations on Rosetta branch of the River Nile (Scale 1:40,00,000).

MATERIALS AND METHODS

Study area

The study area extended through El-Gharbia and El-Beheira governorates, from which seven stations were selected to represent Rosetta branch of the river Nile (Map: 1); five stations before Edfina barrage (stations I, II, III, IV and V) and two stations after Edfina barrage (stations VI and VII). The stations were determined by using GPS (model: 315 MAGELLAN). Station (I) was represented in Kafr El-Zayat city (30°48'55" N and 30°48'23" E), (II) Shabrakhit city (31°01'53" N and 30°43'13" E), (III) El-Rahmania city (31°06'34" N and 30°38'59" E), (IV) El-Mahmoudia city (31°11'10" N, 30°31'58" E), (V) before Edfina barrage at Edfina city (31°18'20" N and 30°31'00" E), (VI) after Edfina barrage at Edfina city (31°18'23" N and 30°31'01" E), and station (VII) Rashid city (31°24'21" N and 30°25'36" E). All area of Rosetta branch after Edfina barrage receives the fresh Nile water through Edfina

barrage as well as drainage water flowing from Lake Burollus through Brimbal Canal. Also, The Mediterranean Sea water invaded Rosetta branch after the construction of Edfina barrage.

SAMPLE COLLECTION

Sampling of algae

Algal samples were collected from the previous five stations according to Sourina (1981). Collection of samples was performed seasonally for two successive years from August 2006 to April 2008.

Counting of phytoplankton

Counting of phytoplankton was done following Sourina (1981). After shaking 10 ml concentrated material, an aliquot was withdrawn by a pipette and placed into a Max Levy Counting Chamber Haemocytometer. All the areas were counted and results were expressed as number of individuals of phytoplankton per liter.

Table 1. Seasonal variations in the highest and lowest total number of individuals of phytoplankton taxa of different algal divisions ($\times 10^6 \text{ L}^{-1}$) of Rosetta branch of the river Nile. (Cyano.=Cyanophycophyta; Bacill.= Bacillariophycophyta; Xanth.= Xanthophycophyta; Pyrro.= Pyrrophyphyta; Euglen.= Euglenophycophyta and Chloro.= Chlorophycophyta and Su = summer; Wn = winter; Sp = spring; At = autumn; 2006 = / 06; 2007 = 0 / 7 and 2008 = / 08).

Stations	Total number of algal taxa	Seasonal variations in the highest and lowest total number of individuals of identified taxa of different algal divisions ($\times 10^6 \text{ L}^{-1}$)								
		Values	Algal divisions							Total
			Cyano.	Bacill.	Xanth.	Pyrro.	Euglen.	Chloro.		
I	192	Highest	0.9492 (Sp/ 08)	3.9087 (At/ 07)	0.0599 (Su/ 07)	0.1998 (Su/06)	0.4996 (Sp/07)	12.532 (Su/07)	14.8887 (Su/ 07)	
		Lowest	0.369 (At/ 07)	0.2149 (At/06)	- ve (At/ 06 and 07 +Wn/ 06 and 07 + Sp/ 08)	- ve (Wn and Sp/07)	0.0099 (Wn/08)	0.4877 (Wn/08)	1.2532 (Wn/ 08)	
II	172	Highest	0.5876 (Su/ 07)	1.1937 (At/ 07)		0.0748 (At/ 06)	0.1635 (Su/ 07)	9.8098 (Su/ 07)	11.2464 (Su/ 07)	
		Lowest	0.0496 (Wn/ 8)	0.0226 (At/ 06)		- ve (Wn/ 07)	0.0099 (Wn/08)	0.2479 (Wn/ 08)	0.8353 (Wn/ 08)	
III	155	Highest	0.6539 (Su/ 07)	1.4529 (At/ 07)		0.3298 (At/ 06)	0.2494 (Wn/07)	4.8312 (Sp/ 07)	5.9709 (Sp/ 07)	
		Lowest	0.2333 (Wn/08)	0.0022 (At/ 06)		- ve (Wn and Sp/07)	0.0198 (Wn/08)	0.288 (Wn/ 08)	0.7838 (Wn/ 08)	
IV	155	Highest	0.4618 (Su/06)	0.6069 (At/07)		0.075 (Su/ 06)	0.1499 (Su/ 06)	6.6842 (Su/ 07)	7.5011 (Su/ 07)	
		Lowest	0.0496 (At/ 06)	0.0009 (At/ 06)		0.0083 (Wn/ 07)	- ve (Wn/ 08)	0.2882 (Wn/ 08)	0.4274 (At/ 06)	
V	122	Highest	0.3097 (Su/07)	1.4189 (sp/ 07)		0.0899 (Sp/ 08)	0.0875 (Su/ 07)	6.5425 (Su/ 07)	7.4864 (Su/ 07)	
		Lowest	0.0297 (Wn/08)	0.0023 (At/06)		- ve (Wn/07)	- ve (Wn and Sp/ 08)	0.1787 (Wn/ 08)	0.403 (Su/ 06)	
VI	116	Highest	0.2399 (At/ 07)	1.5975 (At/07)		1.6217 (Sp/ 07)	0.0265 (At/ 07)	2.974 (Su/ 07)	4.2092 (Su/ 07)	
		Lowest	0.0198 (At/ 06)	0.0122 (Sp/08)		- ve (Wn /07)	- ve (Su/ 06 + Wn and Sp/ 08)	0.0843 (Su/ 06)	0.2508 (Sp/ 08)	
VII	108	Highest	0.1397 (At/ 07)	0.6456 (At/07)		0.211 (Sp/ 07)		1.2079 (Wn/ 07)	1.4575 (At/ 07)	
		Lowest	- ve (At/ 06)	0.0003 (At/06)		- ve (At/ 06)	- ve (Su/ 06 and 7 + At/ 06 + Wn/ 08 + Sp/ 06 and 8)	0.0099 (At/ 06)	0.0102 (At/ 06)	

Extraction of total chlorophyll of phytoplanktonic samples

Total chlorophyll was extracted by dimethyl sulfoxide (DMSO) according to Burnison (1980) as follows:

Five ml of the algal suspension was centrifuged at 3500 rpm for 5 min. The supernatant

was discarded and the residual pellet was resuspended in 5 ml of 95% DMSO, homogenized and kept for 5 min at 70°C in water bath. Such extract contains total chlorophyll and cell carotenoids. The extracted cells were recentrifuged again at 3500 rpm for 5 minutes. The extracted solution was measured by reading the absorbance

(A) of the pigment extract spectrophotometrically (PERKIN-ELMER LAMBDA 2 UV/VIS) at 666 nm. The chlorophyll concentration in the extract was calculated according to Seely *et al.* (1972).

Total chlorophyll (mg L^{-1}) = A x D x F; where
 A = absorbance at 666 nm, F = 11.3 (factor),
 D = volume of extract/sample volume

RESULTS AND DISCUSSION

The maximum qualitative algal taxa of the seven stations was represented by 192, 172, 155, 155, 122, 116 and 108 taxa respectively (Table 1). The maximum total quantitative algal taxa were recorded in summer 2007 (14,888,700, 11,2464, 7,5011, 7,4864 and 4,2092 individuals L^{-1} at stations I, II, IV, V and VI respectively); during spring 2007 at station (III: 5,9709) and during autumn 2007 at station (VII: 1,4575).

Quantitative algal taxa reached its lowest number in winter 2008 (1,253,200 - 835,300 and 783,800 individuals L^{-1} at stations I, II and III respectively); in autumn 2006 at station IV (427,400 individuals L^{-1}) and VII (010,200 individuals L^{-1}); in summer 2006 at station V (403,000 individuals L^{-1}) and during spring 2008 at station VI (250,800 individuals L^{-1}): Quantitatively, at station (I), Xanthophycophyta, Pyrrophyphyta and Euglenophycophyta, had no

role in the algal biomass, while Pyrrophyphyta and Euglenophycophyta had generally low quantitative values in the algal standing crop of stations (II, III, IV, V, VI). Regarding Cyanophycophyta, Pyrrophyphyta and Euglenophycophyta, they had no role in the algal biomass at station VII. According to the total number of individuals, the phytoplankton in Rosetta branch of the River Nile at the most studied stations (I, II, IV, V and VI) had Chloro-character in summer 2007.

The results of total chlorophyll contents of the recorded algae of Rosetta branch before and after Edfina barrage during the whole period of study are represented in Table 2, Figs. 2 to 8. At all stations, the total chlorophyll contents of the identified algae reached their maximum peaks during summer 2007 (23 - 15.63 - 18.33 - 9.66 - 20.98 - 13.34 and 12.15 mg L^{-1} , respectively) comparing with the total chlorophyll contents in other seasons. The lowest values of total chlorophyll contents of the phytoplankton were detected in autumn 2007 (0.47 - 0.68 and 0.47 mg L^{-1} at stations I, III and V respectively); in winter 2007 (0.47 and 0.67 mg L^{-1} at stations II and IV respectively); during spring 2008 (0.21 mg L^{-1}) at station VI and during autumn 2006 (0.60 mg L^{-1}) at station VII.

Table 2. Total chlorophyll contents (mg L^{-1}) of phytoplankton of Rosetta branch of the river Nile.

Stations	Total chlorophyll contents (mg L^{-1})							
	1 st studied year (summer 2006 to spring 2007)				2 nd studied year (summer 2007 to spring 2008)			
	Su/06	At/06	Wn/07	Sp/07	Su/07	At/07	Wn/08	Sp/08
I	21.40	9.96	0.70	16.20	23.0	0.47	1.56	4.98
II	9.34	9.65	0.47	3.69	15.63	1.61	1.19	3.17
III	5.76	1.40	.09	5.40	18.33	0.68	1.19	2.18
IV	0.83	1.09	0.67	4.31	9.66	0.73	1.19	2.75
V	0.93	1.40	5.56	1.40	20.98	0.47	0.93	2.49
VI	5.05	0.72	1.81	0.67	13.34	1.87	1.71	0.21
VII	2.02	0.60	5.56	0.62	12.15	1.14	1.11	1.40

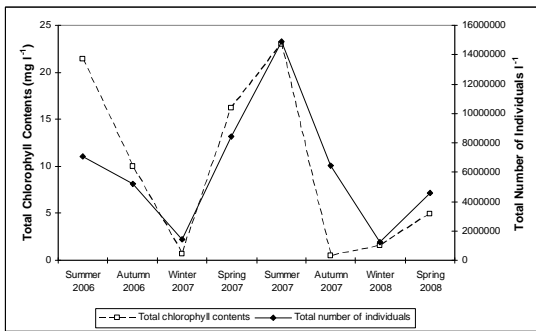


Fig. 2. Relationship between total chlorophyll contents and total number of individuals of Rosetta branch at Kafr El-Zayat city (station I).

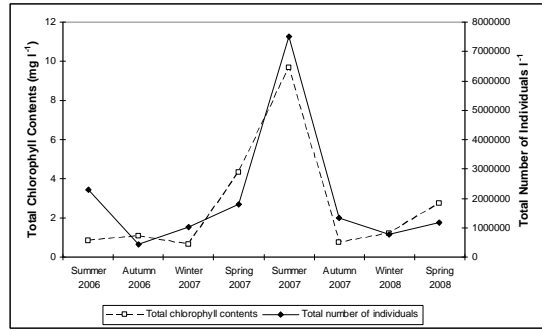


Fig. 5. Relationship between total chlorophyll contents and total number of individuals of Rosetta branch at El-Mahmoudia city (station IV).

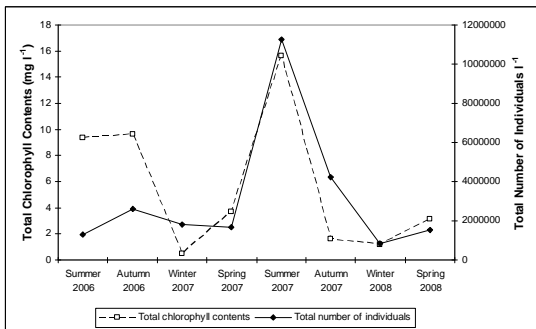


Fig. 3. Relationship between total chlorophyll contents and total number of individuals of Rosetta branch at Shabrakhit city (station II).

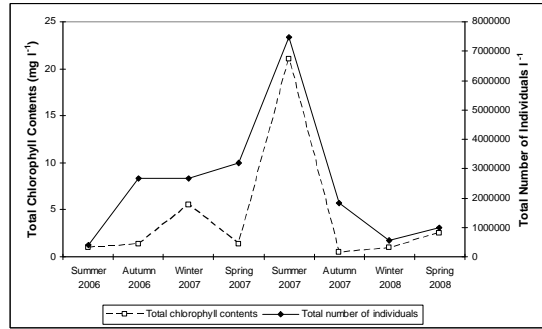


Fig. 6. Relationship between total chlorophyll contents and total number of individuals of Rosetta branch before Edfina barrage at Edfina city (station V).

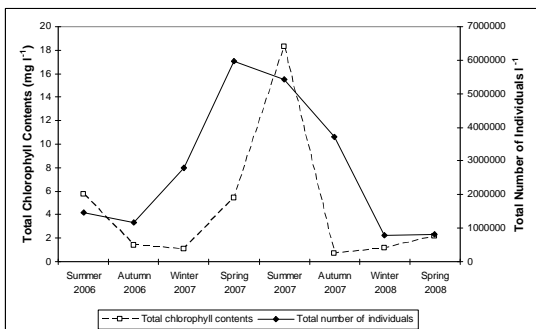


Fig. 4. Relationship between total chlorophyll contents and total number of individuals of Rosetta branch at EL-Rahmania city (station III).

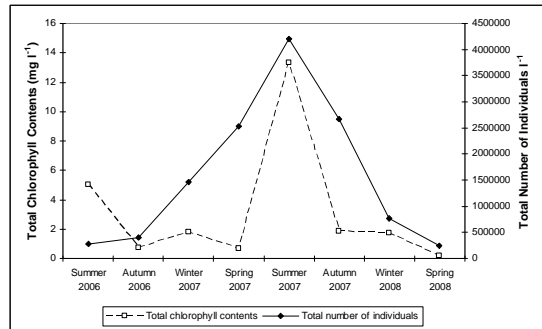


Fig. 7. Relationship between total chlorophyll contents and total number of individuals of Rosetta branch after Edfina barrage at Edfina city (station VI).

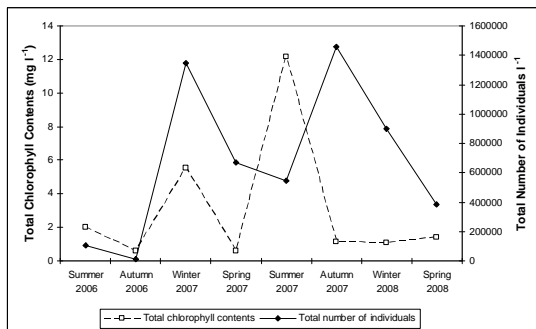


Fig. 8. Relationship between total chlorophyll contents and total number of individuals of Rosetta branch at Rashid city (station VII).

Station I showed the highest maximum peaks in total chlorophyll, maximum quantitative algal individuals and qualitative algal taxa. The present study showed that peak periods of chlorophyll coincided with peak periods of phytoplanktonic number. This is in agreement with the observations of Ekpenyong (2000), Marisol and Jordi (2000), Descy *et al.* (2005), Todd *et al.* (2008), Elewa *et al.* (2009) and Senthil *et al.* (2009). A similar variation was observed between the fluctuations of total chlorophyll contents of the phytoplankton and those of total number of individuals at all investigated stations of Rosetta branch.

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