

Diatom Flora from Different Aquatic Habitats in the Greater Cairo (Egypt)

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ABSTRACT

The present work has been undertaken to study the diatom flora of different localities in The Greater Cairo. These localities were selected to cover different aquatic habitats such as River Nile, irrigation canals, drains, springs, pools, ditches and fountains. Physico-chemical analysis of water samples collected from the different localities was carried out, as much as possible. *Nitzschia palea* and *Navicula cryptocephala* var. *veneta* were the most predominant and widespread taxa in these localities. The distribution pattern of the identified taxa varied significantly both qualitatively and quantitatively between the studied localities and indicated changes in floristic composition. These localities could be divided into 5 assemblages according to water resource and the dominant taxa at each assemblage. A total of 140 taxa related to 33 genera were identified in this study. Of these, 11 taxa have been considered as new records to Egypt. In addition, 3 of the recorded taxa in the present study have been considered as new records to the diatom flora of The Greater Cairo.

Key Words: Diatoms; Cairo; Egypt

INTRODUCTION

Many studies have been carried out in the vicinity of The Greater Cairo (Three governorates: Cairo, Giza & El-Qaleobiyah) concerned with the phytoplankton of the River Nile and its tributaries (Nosseir & Abu El-Kheir, 1970, 1972; El-Shimi, 1975, 1984; El-Ayouty & Ibrahim, 1980; Nassar, 1980; Shehata & Badr, 1985; Kobbia *et al.*, 1990; 1993, 1995; Shehab, 1995; Dowidar *et al.*, 2002; El-Awamri *et al.*, 2005).

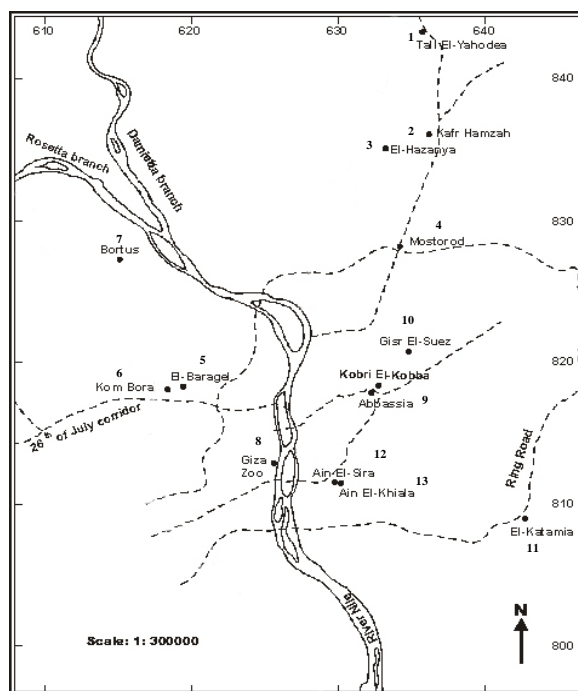
However, little of studies dealt with the diatom composition of different aquatic habitats in The Greater Cairo. Among of these studies El-Nayal (1935) identified 11 taxa collected from Abbassia, El-Nakhl, El-Birka and from the filter beds of Giza water works. Foged (1980) identified 57 diatom taxa from the fountain basin with *lotus* and *papyrus* plants in Cairo and 100 diatom taxa from Orman Giza. Abou-El-Kheir and Mekky (1986) identified 20 diatom taxa from Ain Helwan and 6 taxa from Ain El-Sira. Hamed (1995) identified 32 diatom taxa from Ain Helwan.

Therefore, the present work has been undertaken to study the diatom flora of different localities in The Greater Cairo. These localities were selected in order to cover as far as possible examples of the different aquatic habitats such as irrigation canals, drains, springs, pools, ditches and fountains. Physico-chemical analysis of water samples collected from three chosen localities was carried out.

MATERIALS AND METHODS

A total of 46 samples were collected from 13 different localities in The Greater Cairo (Fig. 1). Relative abundance

Fig. 1. Map of the greater Cairo including the different studied localities



values for all the collected samples at each locality were averaged. These sampling localities were:

1- Tall El-Yahodea "El-Qaleobiyah": A shallow stagnant water pool was observed at this historical place, from which greenish brown scum, epilithic growths and scrapings from

the different parts of *Phragmites* sp. were collected in winter 2000.

2- Kafr Hamzah "El-Qaleobiyah": A water sample and brown epilithic masses were collected in summer 2000 from a small irrigation canal found at this locality.

3- El-Hazanya Village "El-Qaleobiyah": Greenish-brown scum was collected in spring 2000 from the surface of a small irrigation canal at this locality.

4- Mostorod Drain "El-Qaleobiyah": It is a mixed drain of agricultural and industrial wastes, located in the way between Mostorod and Belbes. Greenish brown scum samples were collected from the water surface of this drain in winter 2001.

5- El-Baragel Village "Giza": Samples were collected in spring 2000 from a small irrigation canal surrounded by wide areas of cultivated lands. The collected samples included greenish-brown scum and green filaments floating on the water surface, thin green coatings on the submerged stones and brown growths on the different parts of *Ceratophyllum* sp.

6- Kom Bora Village "Giza": Samples were collected in spring 2000. The selected sampling point was a small agricultural drain in front of Ezbet Mohamed Salama. The water of this drain is nearly covered by *Lemna gibba*, while its side banks are characterized by dense growth of *Eichhornia crassipes*, *Ceratophyllum* sp. and *Phragmites* sp. plants. Algal films growing on the surface of the different parts of these plants were scraped. Green and greenish-brown scum floating over the water surface as well as green epipellic growths that form thin layers on the mud at the side banks of this drain were also collected.

7- Bartus Village "Giza": A water sample and green scum over the water surface of a small agricultural drain were collected from this locality in spring 2000.

8- Giza Zoo: The following three sites, which all receive water directly from River Nile without purification, were chosen to be investigated: (a) El- Gabalaya El-Malakya: The water stream inside this park flows through small waterfalls that lead to many large water basins. Samples were found as thin layers of brown scum floated over the water surface of these basins. In addition, a water sample was collected from shallow artificial lake of ducks and geese that also located inside this park, (b) Hippopotamus (river horse) pond: Green and brown scrapings were collected from the cemented side walls of the pond and from the outer surface of the pipe which supplies the pond with water, (c) A small waterfall in front of elephant house: The water stream flows through a rocky spiral path. Greenish brown scrapings were collected from the side walls of this path. Samples were collected from April 2000 up to February 2001.

9- Abbassia Square "Cairo": Green scrapings from the ceramic side walls of a large fountain basin in Abbassia Square were collected in Autumn 2002.

10- Gizr El-Suez Drain "Cairo": It is a temporary drain for domestic wastewater from residential areas such El-

Matariah, Ain Shams and Gizr El-Suez. Brown scum samples were collected in winter 2000 from this locality.

11- El-Katamia "Cairo": Two epilithic samples were collected in winter 2000 from small water ditches that have been temporarily formed as a result of sanitary drainage at this locality.

12- Ain El-Sira "Cairo": Ain El-Sira is one of the most common springs in Cairo. Ain El-Sira region is subjected to continuous increase in the ground water level. The source of this water is the deep meteoric water (Data supplied by Research Institute of Ground Water "RIGW"). Samples collected from this locality included planktonic sample, epiphytes on *Phragmites* rhizomes and roots, brown scum on the water surface and epilithic brown growths on the surface of some rocks at this area. In addition, brown growth with bubbly appearance was scraped from a small ditches formed on the platform in front of this spring. Samples were collected in winter 2001.

13- Ain El-Khiala "Cairo": Ain El-Khiala is a spring located to the south of Ain El-Sira. The source of water at this spring is the shallow marine water (supplied by RIGW). A water sample, greenish brown scum and some brown filaments were collected in winter 2001 from this site.

Epilithic and scum samples were scraped using a sharp blade shovel, while attached algal filaments were collected by hand. Epiphytic samples were scraped from mosses and roots of higher plants and immersed in some water, shaken vigorously and rubbed gently to remove the attached algal film. After a rapid examination when fresh, all samples were fixed in 4% formalin solution.

The collected samples were prepared for investigation by cleaning frustules using the method described by Jouse *et al.* (1949). The material was mounted according to the method described by Proschkina-Laverenko *et al.* (1974).

The diatom taxa were identified according to Zabelina *et al.* (1951), Patrick and Reimer (1966, 1975), Schoeman and Archibald (1977), Jensen (1985), Gasse (1986), Krammer and Lang-Bertalot (1986, 1988) and Round *et al.* (1990).

The counting method described by Vilbaste (1994) was applied that 500 valves were counted per sample while the other valves were also identified and recorded. The relative abundance of each taxon was then indicated with: P = Predominant (50–20%), f = frequent (20–5%), c = common (5–1%), r = rare (1– 0.2%), + = noted and – = not noted. In cases where the diatom abundance was low, only 200 valves were counted. Individuals lying on girdle side were also counted.

Water samples were taken to analyze and determine the concentrations of some chemical parameters. These parameters include field measurements of water temperature, pH, dissolved oxygen (DO) and some chemical parameters. Laboratory chemical analysis of major cations and anions was carried out according to Jackson (1958).

RESULTS

A total of 140 taxa related to 33 genera, 8 families and 4 orders were identified from the 46 samples collected from the 13 different sampling localities which were chosen in The Greater Cairo. The diatom communities at the different sampling localities varied in their species composition, number of genera, number of taxa and the dominant species. A list of the recorded diatom taxa, their mean frequencies and the number of both genera and taxa at the different sampling localities were given in (Table I; Fig. 2). Although the qualitative dominance of Pennatae taxa in all the examined samples, some members of class Centricae such as *Cyclotella ocellata*, *C. meneghiniana* and *Melosira granulata* were of quantitative importance at some localities. Family Naviculaceae followed by family Nitzschiaceae were the most species-rich families at all sampling localities. In terms of species number, *Nitzschia* and *Navicula* were the most represented genera at these localities.

From a stagnant water pool in the 1st investigated locality a total of 41 taxa related to 16 genera were identified. These diatoms were mainly found as scum, epilithic as well as epiphytic growths on *Phragmites* sp. At this locality, *Nitzschia amphibia*, *N. fonticola* and *N. thermalis* were the predominant taxa. *Nitzschia palea* and *Navicula halophila* were of frequent occurrence.

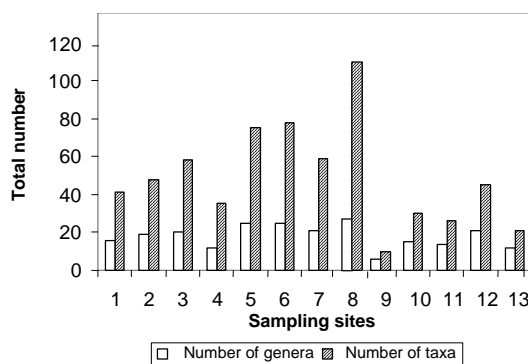
The diatom flora of the 2nd locality consisted of 48 taxa related to 19 genera. These diatoms grown as phytoplanktonic and epilithic masses in a small irrigation canal found at this locality. In contrast to the quality, most of the quantitatively important taxa (*Cyclotella meneghiniana*, *Melosira granulata* and *M. granulata* var. *angustissima*) belonged to class Centricae. On the other hand, *Synedra ulna* var. *danica*, as a member of class Pennatae, was also frequent at this site.

Fifty eight taxa related to 20 genera were encountered in the scum samples grown on the surface of a small irrigation canal situated at the 3rd studied locality. *Cyclotella meneghiniana* was the predominant taxa, while *Cyclotella ocellata*, *Melosira granulata* and *M. granulata* var. *angustissima* were the most frequent encountered taxa. Among the taxa related to class Pennatae, *Nitzschia palea* was the most frequent one.

From the scum samples which grown on the surface of Mostorod Drain water (the 4th locality), a total of 35 taxa related to 12 genera, 5 families and 3 orders were recorded. *Nitzschia palea* and *Navicula cuspidata* were the predominant taxa. *Cyclotella meneghiniana*, *C. ocellata*, *Melosira granulata* and *Navicula cryptocephala* were also recorded in high frequencies.

A total of 75 taxa related to 25 genera, 8 families and 4 orders were identified from scum, filamentous and epiphytic growths collected from a small irrigation canal situated in the 5th locality. *Nitzschia palea* and *Cyclotella meneghiniana* were the predominant taxa at this locality,

Fig. 2. Total number of genera and taxa recorded at the 13 sampling localities in the vicinity of the Greater Cairo (For localities see Table I)



whereas *Navicula cryptocephala* var. *veneta* and *Nitzschia fonticola* were the frequent taxa.

The 6th studied locality (A small agricultural drain) was characterized by a high number of taxa (78 taxa related to 25 genera). Samples collected from this drain were mainly epiphytic in addition to epipellic and scum samples. The identified diatom taxa at this site were dominated by *Nitzschia palea*, whereas *Navicula cuspidata*, *N. cryptocephala* var. *veneta*, *Achnanthes exigua*, *A. hungarica* and *Gomphonema parvulum* var. *lagenulum* were frequent.

Fifty nine taxa related to 21 genera were identified from the phytoplanktonic and scum samples which were collected from the 7th locality (A small agricultural drain). *Nitzschia palea* was the predominant species, while *Navicula cryptocephala*, *Navicula cryptocephala* var. *veneta* as well as *Cocconeis placentula* var. *euglypta* were frequent.

The 8th studied locality (Giza Zoo) was characterized by the highest number of taxa as compared with the other localities that were investigated (111 taxa belonging to 28 genera) were identified from all the samples which were collected from the different sampling sites of Giza Zoo (Table I). Some members of class Centricae such as *Cyclotella meneghiniana*, *C. ocellata*, *Melosira granulata* and *M. granulata* var. *angustissima* were recorded in high frequencies throughout the study period at most of the investigated sites. Family Naviculaceae and family Nitzschiaceae accounted for the highest number of species that include 42 and 29 taxa, respectively (represented 37.8% and 26.1% of the total identified taxa). *Nitzschia*, *Navicula* and *Gomphonema* included more species than any other genera that they represented by 26, 14 and 10 taxa, respectively.

The mean average the physico-chemical characteristics of Giza Zoo water (collected from lake of ducks and geese) are given in Table II. Minimum water temperature was recorded in winter (18.5°C), while the maximum was recorded in summer (28°C). The recorded pH values were in the slightly alkaline side that ranged between

Table I. Mean frequencies of diatoms recorded at the different sampling localities in The Greater Cairo (El-Qaleobiyah, Giza and Cairo)

P = predominant (50-20%), f = frequent (20-5%), c = common (5-1%), r = rare (1-0.2%), + = noted, - = not noted.

Sampling localities: 1- Tall El-Yahodea, 2- Kafr Hamzah, 3- E l-Hazanya Village, 4- Mostorod Drain, 5- El-Baragel Village, 6- Kom Bora Village, 7- Bartus Village, 8- Giza Zoo, 9- Abbassia Square, 10- Gisir El-Suez, 11- El-Katamia, 12- Ain El-Sira and 13- Ain El-Khiala.

Diatom taxa	Sampling localities												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Division: Bacillariophycophyta													
Class: Centricae													
Order: Disconales													
Family: Coscinodiscaceae													
Genus: <i>Cyclotella</i> Kütz.													
<i>Cyclotella Kuetzingiana</i> Thwaites.	r	r	r	r	+	+	-	r	-	-	-	c	-
<i>C. meneghiniana</i> Kütz.	r	c	p	f	p	c	c	f	+	-	r	r	+
<i>C. ocellata</i> Pant.	r	p	f	f	c	r	c	f	+	+	c	+	+
Genus: <i>Melosira</i> Agardh													
<i>Melosira granulata</i> (Ehr.) Ralfs.	+	p	f	f	r	r	c	f	-	-	r	+	+
<i>M. granulata</i> var. <i>angustissima</i> O.Müll.	+	f	f	c	r	+	r	f	-	+	r	+	-
<i>M. moniliformis</i> var. <i>subglobosa</i> Grun.	-	-	-	-	-	-	-	-	-	-	-	-	r
<i>M. varians</i> Ag.	-	-	+	-	-	-	-	+	-	-	-	-	-
Genus: <i>Stephanodiscus</i> Ehrenberg													
<i>Stephanodiscus hantzschii</i> Grun.	r	c	c	c	r	+	r	c	-	+	r	+	-
Genus: <i>Thalassiosira</i> Cleve													
<i>Thalassiosira fluviatilis</i> Hust.	-	+	c	-	c	+	r	+	-	-	-	+	-
Order: Biddulphiales													
Family: Biddulphiaceae													
Genus: <i>Biddulphia</i> Gray													
<i>Biddulphia laevis</i> Ehr.	+	+	-	-	+	+	+	+	-	-	-	-	-
Genus: <i>Terpsinoe</i> Ehrenberg													
<i>Terpsinoe musica</i> Ehr.	+	-	-	-	+	+	+	-	-	-	+	-	-
Class: Pennatae													
Order: Araphinales													
Family: Fragilariaceae													
Genus: <i>Fragilaria</i> Lyngbye													
<i>Fragilaria brevistriata</i> Grun.	-	-	r	+	-	+	-	r	-	+	-	-	-
<i>F. capucina</i> var. <i>mesolepta</i> Rabh.	-	-	-	-	-	-	-	+	-	-	-	-	-
<i>F. construens</i> (Ehr.) Grun.	-	+	+	-	-	+	-	c	-	-	-	+	-
<i>F. construens</i> var. <i>subsalina</i> Hust.	-	-	-	-	-	-	-	r	-	-	-	-	+
<i>F. construens</i> var. <i>venter</i> (Ehr.) Grun.	-	-	-	-	-	+	-	+	-	+	-	-	-
<i>F. pinnata</i> Ehr.	-	-	-	-	-	-	-	r	-	+	-	-	-
<i>F. pinnata</i> var. <i>lancettula</i> (Schumann) Hust.	-	-	-	-	+	+	-	+	-	-	-	-	-
Genus: <i>Synedra</i> Ehrenberg													
<i>Synedra acus</i> var. <i>radians</i> (Kütz.) Hust.	+	+	+	+	+	+	r	r	+	+	+	-	-
<i>S. rumpens</i> Kütz.	-	-	-	-	-	-	-	+	-	-	-	-	-
<i>S. tabulata</i> (Ag.) Kütz.	+	-	+	-	+	+	+	+	-	-	+	f	r
<i>S. ulna</i> (Nitzsch.) Ehr.	r	c	r	r	-	+	-	r	-	-	+	-	-
<i>S. ulna</i> var. <i>aequalis</i> (Kütz.) Hust.	r	r	r	r	r	+	r	r	-	-	-	-	-
<i>S. ulna</i> var. <i>danica</i> (Kütz.) Grun.	+	f	c	r	r	+	r	r	-	-	-	+	-
Order: Raphinales													
Suborder: Monoraphineae													
Family: Achnanthaceae													
Genus: <i>Achnanthes</i> Bory													
<i>Achnanthes brevipes</i> Ag.	-	-	-	-	+	-	-	-	-	-	+	-	-
<i>A. brevipes</i> var. <i>intermedia</i> (Kütz.) Cl.	-	-	-	-	r	+	+	+	-	-	-	+	f
<i>A. exigua</i> Grun.	r	-	c	r	r	f	r	r	-	+	-	-	-
<i>A. hauckiana</i> Grun.	-	-	-	-	-	-	-	+	-	-	-	-	-
<i>A. gibberula</i> Grun.	-	-	-	-	-	-	-	-	-	-	-	+	-
<i>A. hungarica</i> Grun.	+	-	-	-	+	f	+	+	-	+	-	-	-
<i>A. inflata</i> (Kütz.) Grun.	-	-	r	-	r	+	+	c	-	-	-	-	+
<i>A. lanceolata</i> (Bréb.) Grun.	+	-	r	-	r	+	+	c	-	-	-	-	-
<i>A. minutissima</i> var. <i>cryptocephala</i> Grun.	-	-	-	-	-	-	-	+	p	-	-	+	-
<i>A. orientalis</i> Hust.	-	-	-	-	-	-	-	-	-	-	-	r	-
Genus: <i>Cocconeis</i> Ehrenberg													
<i>Cocconeis pediculus</i> Ehr.	+	-	+	-	r	-	r	-	-	-	-	+	+
<i>C. placentula</i> Ehr.	+	-	+	-	r	+	+	+	-	-	-	-	-
<i>C. placentula</i> var. <i>euglypta</i> (Ehr.) Cl.	+	r	+	-	c	c	f	+	-	-	-	r	+
Genus: <i>Rhoicosphenia</i> Grunow													
<i>Rhoicosphenia curvata</i> (Kütz.) Grun. ex. Rabh.	r	-	-	-	-	-	-	+	-	-	-	-	-

Table I continued.....

Diatom taxa	Sampling localities												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Suborder: Diraphineae													
Family: Naviculaceae													
Genus: <i>Amphiprora</i> Ehrenberg													
<i>Amphiprora alata</i> (Ehr.) Kütz.	-	-	-	-	+	-	-	-	-	-	-	+	+
Genus: <i>Amphora</i> Ehrenberg													
<i>Amphora coffeaeformis</i> (Ag.) Kütz.	c	r	r	-	r	+	+	r	-	+	p	p	p
<i>A. ovalis</i> var. <i>pediculus</i> (Kütz.) V.H.ex Det.	+	-	+	-	r	+	r	+	-	-	-	-	-
<i>A. perpusilla</i> Grun.	-	-	-	-	+	+	-	+	-	-	-	-	-
Genus: <i>Anomoneis</i> Pfitzer													
<i>Anomoneis sphaerophora</i> (Kütz.) Pfitzer.	+	+	r	-	r	+	-	+	-	-	+	+	-
Genus: <i>Caloneis</i> Cleve													
<i>Caloneis amphisbaena</i> (Bory.) Cl..	-	-	+	-	-	-	-	+	-	-	-	-	-
<i>C. bacillum</i> (Grun.) Cl.	-	-	-	-	-	-	-	+	-	-	-	-	-
<i>C. budensis</i> (Grun.) Krammer.	-	-	-	-	-	-	+	-	-	+	-	+	-
<i>C. clevei</i> (Lager.) Cl.	+	-	-	-	+	+	-	r	p	+	-	-	-
<i>C. permagna</i> (J.W.Bail.) Cl..	-	+	+	-	-	-	-	+	-	-	-	-	-
<i>C. silicula</i> (Ehr.) Cl.	-	-	-	-	+	+	+	-	-	-	-	-	-
<i>C. silicula</i> var. <i>tumida</i> Hust.	-	-	-	-	-	-	+	-	-	-	-	-	-
Genus: <i>Cymbella</i> Agardh													
<i>Cymbella affinis</i> Kütz.	-	-	-	-	-	+	-	+	-	-	-	-	-
<i>C. pusilla</i> Grun.	-	r	-	-	-	-	-	+	-	-	r	r	-
<i>C. tumida</i> (Bréb.ex Kütz.) V.H..	-	+	-	-	-	+	-	+	-	-	-	-	-
<i>C. ventricosa</i> Ag.	-	-	-	-	-	-	-	+	-	-	-	-	-
Genus: <i>Diploneis</i> Ehrenberg													
<i>Diploneis ovalis</i> (Hilse) Cl.	-	-	r	-	r	+	r	r	-	+	+	r	-
<i>D. ovalis</i> var. <i>oblongella</i> (Naeg.) Cl.	-	-	-	r	-	-	-	-	-	-	-	+	-
Genus: <i>Gomphonema</i> Hustedt													
<i>Gomphonema angustatum</i> var. <i>producta</i> Grun.	-	-	-	-	+	c	-	-	-	-	-	-	-
<i>G. clevei</i> Fricke.	-	-	-	-	-	-	-	+	-	-	-	-	-
<i>G. augur</i> Ehr.	-	-	-	+	+	-	-	-	-	-	-	-	-
<i>G. constrictum</i> var. <i>capitatum</i> (Ehr.) Cl.	-	-	-	-	+	-	+	+	-	-	-	-	-
<i>G. gracile</i> Ehr.	-	-	-	-	-	-	-	+	-	-	-	-	-
<i>G. gracile</i> var. <i>lanceolata</i> Kütz.	+	-	-	-	r	r	-	+	-	-	-	-	-
<i>G. intricatum</i> Kütz.	-	-	-	-	-	-	-	+	-	-	-	-	-
<i>G. intricatum</i> var. <i>pumila</i> Grun.	-	-	-	-	-	-	-	+	-	-	-	-	-
<i>G. lanceolatum</i> Ehr.	-	-	-	-	-	-	-	+	-	-	-	-	-
<i>G. lanceolatum</i> var. <i>insignis</i> (Greg.) Cl.	-	+	-	+	r	+	+	-	-	-	-	-	-
<i>G. longiceps</i> var. <i>subclavata</i> Grun.	r	-	-	+	r	+	r	+	-	-	-	-	-
<i>G. parvulum</i> (Kütz.) Grun.	r	+	r	+	r	c	c	r	-	+	-	+	-
<i>G. parvulum</i> var. <i>lagenulum</i> (Grun.) Hust.	r	+	r	-	c	f	r	r	-	-	-	-	-
Genus: <i>Gyrosigma</i> Hassall													
<i>Gyrosigma acuminatum</i> (Kütz.) Rabh .	-	-	+	+	+	+	-	+	-	-	-	-	-
Genus: <i>Mastogloia</i> Thwaites ex Wm. Smith													
<i>Mastogloia smithi</i> Thw.	-	-	-	-	-	-	-	-	-	-	-	+	-
Genus: <i>Navicula</i> Bory													
<i>Navicula confervacea</i> (Kütz.) Grun.	-	+	-	-	+	+	-	+	-	-	-	+	-
<i>N. cryptocephala</i> Kütz.	r	r	r	f	c	c	f	f	-	-	-	c	r
<i>N. cryptocephala</i> var. <i>veneta</i> (Kütz.) Grun.	r	c	c	c	f	f	f	f	f	c	f	f	c
<i>N. cuspidata</i> (Kütz.) Kütz.	+	+	c	p	+	f	-	+	+	-	-	-	-
<i>N. cuspidata</i> var. <i>ambigua</i> (Ehr.) Cl.	+	-	+	c	-	r	-	+	-	-	-	-	-
<i>N. exigua</i> var. <i>capitata</i> Patr.	-	-	-	-	r	+	+	+	-	-	-	-	-
<i>N. gastrum</i> (Ehr.) Kütz.	-	+	+	-	-	+	+	+	-	-	-	+	-
<i>N. halophila</i> (Grun.) Cl.	f	-	-	-	r	+	-	-	-	-	-	c	-
<i>N. mutica</i> Kütz.	-	-	r	-	r	+	+	c	-	-	-	+	-
<i>N. mutica</i> var. <i>cohnii</i> (Hilse) Grun.	-	-	-	-	-	-	-	+	-	-	-	-	-
<i>N. pupula</i> Kütz.	-	+	+	-	r	+	+	+	-	-	-	-	-
<i>N. pygmaea</i> Kütz.	-	+	c	c	r	r	+	+	-	+	-	+	-
<i>N. rhynchocephala</i> Kütz.	-	c	c	r	+	r	r	r	-	+	-	-	-
<i>N. symmetrica</i> Patr.	-	+	-	+	r	+	+	r	-	-	-	+	-
<i>N. tuscula</i> Ehr.	-	-	-	-	-	-	-	+	-	-	-	-	-
Genus: <i>Neidium</i> Pfitzer													
<i>Neidium dubium</i> (Ehr.) Cl.	-	-	-	-	-	-	-	+	-	-	-	-	-
Genus: <i>Pinnularia</i> Ehrenberg													
<i>Pinnularia acrosphaeria</i> W.Sm.	-	-	-	+	-	+	-	+	-	-	-	-	-
<i>P. borealis</i> Ehr.	-	-	-	-	-	+	-	-	-	-	-	-	-
<i>P. braunii</i> var. <i>amphicephala</i> (A.Mayer) Hust.	-	+	-	-	+	+	-	-	-	+	-	-	-
<i>P. viridis</i> (Nitzsch.) Ehr.	-	+	-	-	+	-	+	+	-	-	-	-	-

Table I continued.....

Diatom taxa	Sampling localities												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Genus: <i>Pleurosigma</i> W. Sm.													
<i>Pleurosigma elongatum</i> W.Sm.	-	-	+	-	+	-	+	+	-	-	-	+	C
Genus: <i>Stauroneis</i> Ehrenberg													
<i>Stauroneis</i> sp.	-	-	-	-	-	-	-	-	-	-	-	+	+
Suborder: Aulonorphineae													
Family: Epithemiaceae													
Genus: <i>Epithemia</i> de Brébisson													
<i>Epithemia sorex</i> Kütz.	-	-	-	-	+	+	r	r	-	-	-	-	-
<i>E.turgida</i> (Ehr.) Kütz.	-	-	-	-	-	-	+	r	-	-	-	-	-
Genus: <i>Rhopalodia</i> O.Müll.													
<i>Rhopalodia gibba</i> (Ehr.) O.Müll.	-	-	-	-	+	+	-	c	-	-	+	-	-
<i>R.gibba</i> var. <i>ventricosa</i> (Kütz.) H. & M. Perag.	-	-	r	-	+	+	+	r	-	-	-	-	-
<i>R.musculus</i> (Kütz.) O.Müll.	-	-	-	-	+	-	-	+	-	-	-	-	-
<i>R. vermicularis</i> O.Müll.	-	-	-	-	-	-	-	r	-	-	-	-	-
Family: Nitzschiaceae													
Genus: <i>Bacillaria</i> Gmelin													
<i>Bacillaria paradoxa</i> Gmelin.	+	-	c	-	+	+	-	r	-	-	-	-	-
Genus: <i>Hantzschia</i> Grunow													
<i>Hantzschia amphioxys</i> (Ehr.) Grun.	-	+	r	-	-	+	r	+	-	+	+	-	-
<i>H. amphioxys</i> f. <i>capitata</i> O.Müller.	-	-	-	-	-	-	-	+	-	-	-	-	-
Genus: <i>Nitzschia</i> Hassal													
<i>Nitzschia acicularis</i> W.Sm.	-	+	r	+	-	+	-	+	-	-	-	-	f
<i>N. acuta</i> Hantzsch.	-	-	-	-	-	-	-	+	-	-	-	-	-
<i>N. amphibia</i> Grun.	p	r	c	r	r	r	+	r	+	-	+	+	-
<i>N. angustata</i> var. <i>acuta</i> Grun.	-	-	-	-	-	-	-	-	-	-	-	c	-
<i>N. clausii</i> Hantzsch.	-	+	r	-	+	+	-	r	-	+	-	-	-
<i>N. communis</i> Rabh.	-	-	-	-	+	+	-	+	-	p	r	-	-
<i>N. dissipata</i> (Kütz.) Grun.	+	-	-	-	+	r	c	-	-	+	+	-	-
<i>N. filiformis</i> (W.Sm.) Hust.	-	-	+	-	-	-	-	+	-	+	-	-	-
<i>N. fonticola</i> Grun.	p	-	r	-	f	c	c	+	-	-	-	r	f
<i>N. frustulum</i> (Kütz.) Grun.	-	-	+	-	-	+	-	+	-	p	-	-	c
<i>N. gracilis</i> Hantzsch.	-	-	+	+	-	-	-	+	-	-	-	-	-
<i>N. hungarica</i> Grun.	+	+	-	-	c	+	c	+	-	-	-	r	-
<i>N. intermedia</i> Hantzsch.	-	-	-	-	-	-	-	+	-	-	-	-	-
<i>N. interrupta</i> (Reichelt) Hust.	-	-	+	-	-	-	-	+	-	-	-	-	-
<i>N. linearis</i> W.Sm.	-	+	+	r	-	+	+	+	-	-	-	-	-
<i>N. lorenziana</i> Grun.	-	-	-	-	-	-	-	+	-	-	-	-	-
<i>N. microcephala</i> Grun.	r	+	+	-	-	-	-	r	-	r	r	+	-
<i>N. obtusa</i> W.Sm.	-	-	-	r	-	-	-	r	-	-	-	+	-
<i>N. obtusa</i> var. <i>scalpelliformis</i> Grun.	-	r	c	r	+	r	+	c	+	+	-	c	-
<i>N. palea</i> (Kütz.) W.Sm.	f	c	f	p	p	p	p	f	c	c	f	c	r
<i>N. pellucida</i> Grun.	-	-	-	-	-	-	-	-	-	-	f	c	f
<i>N. sigma</i> (Kütz.) W.Sm.	-	+	+	-	-	-	-	+	-	-	-	-	-
<i>N. sigmoidea</i> (Ehr.) W.Sm.	-	-	-	-	-	-	-	+	-	-	-	-	-
<i>N. siliqua</i> Archibald	-	-	-	-	+	-	-	-	-	-	-	-	-
<i>N. subtilis</i> (Kütz.) Grun.	-	-	-	-	-	-	-	+	-	-	-	-	-
<i>N. thermalis</i> Kütz.	p	+	r	c	r	c	+	+	-	c	c	-	-
<i>N. thermalis</i> var. <i>minor</i> Hilse.	-	-	-	-	-	-	-	+	-	-	c	-	-
<i>N. tryblionella</i> Hantzsch.	-	-	-	-	-	+	+	+	-	-	-	-	-
<i>N. tryblionella</i> var. <i>debilis</i> (Arnott) A.Mayer.	-	-	-	-	-	-	-	+	-	-	+	-	-
<i>N. tryblionella</i> var. <i>levidensis</i> (W.Sm.) Grun.	-	+	-	-	+	-	+	-	-	-	-	-	-
<i>N. vitrea</i> Norman.	-	+	r	r	+	+	+	+	-	+	-	-	-
Family: Surirellaceae													
Genus: <i>Campylodiscus</i> Ehrenberg													
<i>Campylodiscus clypeus</i> Ehr.	-	-	-	-	-	-	-	-	-	-	-	r	-
Genus: <i>Cymatopleura</i> W.Smith													
<i>Cymatopleura solea</i> (Bréb.) W.Sm.	-	+	-	-	-	-	-	+	-	-	-	-	-
Genus: <i>Surirella</i> Turpin													
<i>Surirella angustata</i> Kütz.	-	-	-	-	+	-	+	-	-	-	-	-	-
<i>S. capronii</i> Bréb.	-	-	-	-	+	-	-	-	-	-	-	-	-
<i>S. ovalis</i> Bréb.	-	-	-	-	-	+	+	+	-	+	-	-	-
<i>S. ovata</i> Kütz.	-	-	-	-	r	+	-	-	-	-	-	-	-
<i>S. robusta</i> var. <i>splendida</i> Ehr.	-	+	-	-	+	-	-	-	-	-	-	-	-
Total number of genera	16	19	20	12	25	25	21	28	6	15	14	21	12
Total number of taxa	41	48	58	35	75	78	59	111	10	30	26	45	21
Number of Centricae genera	5	5	4	3	6	6	6	4	1	3	4	4	2
Number of Centricae taxa	8	8	8	6	9	9	8	6	2	3	6	7	4
Number of Pennatae genera	11	14	16	9	19	19	15	24	5	12	10	16	10
Number of Pennatae taxa	33	40	50	29	66	69	51	105	8	27	20	38	17

7.2 in spring and 7.7 in autumn. Electrical conductivity values ranged between 0.76 ds/m in autumn and 2.88 ds/m in winter. As calculating the total dissolved salts (T.D.S.), it was found that the water at this locality is generally freshwater (average value of T.D.S. equals 865.6 ppm). Dissolved oxygen concentrations ranged between 0.7 ppm in winter and 10.8 ppm in spring. Minimum concentrations of both calcium and magnesium (30.06 & 36.5 ppm, respectively) were recorded in summer, while maximum concentrations of these elements (150.3 & 60.83 ppm, respectively) were recorded in winter. Minimum concentrations of both sodium and potassium (38.39 & 2.73 ppm, respectively) were recorded in autumn, while maximum concentrations of these elements (394.25 & 32.42 ppm, respectively) were recorded in winter. Bicarbonate concentrations fluctuated between 109.8 ppm in winter and 256.1 ppm in summer. Carbonate concentration was under the detected level in all seasons. Minimum concentrations of both chloride and sulphate (47.16 & 84.62 ppm, respectively) were recorded in summer, while maximum concentrations of these elements (700.35 & 429.3 ppm, respectively) were recorded in winter. Nitrate concentrations ranged between 0.02 ppm in both summer and autumn and 0.05 ppm in both spring and winter. Maximum nitrite concentration was recorded in autumn (0.5 ppm), while minimum value was recorded during the other seasons (0.1 at each). Phosphate concentrations ranged between 2 ppm in summer and 3 ppm in winter. Silicate concentrations fluctuated between 7 ppm in summer and 9 ppm in both spring and autumn. As calculating the water hardness, it was found that the water of this site is very hard and hardness values ranged between 225.3 ppm in summer and 625.7 ppm in winter.

The 9th sampling locality was characterized by poor diatom flora that only 10 taxa related to 6 genera were identified from the green epilithic scrapings which were collected from the fountain basin in Abbassia. *Achnanthes*

minutissima var. *cryptocephala* and *Caloneis clevei* were the predominant species. *Navicula cryptocephala* var. *veneta* was frequent, while *Nitzschia palea* was of common occurrence (Table I).

Thirty taxa related to 15 genera were distinguished in the scum samples which were collected from the 10th locality. This sampling locality was characterized by the dominance of *Nitzschia communis* and *N. frustulum*. *N. palea*, *N. thermalis* and *Navicula cryptocephala* var. *veneta* were of common occurrence at this locality.

From the epilithic samples which were collected from the small water ditches the 11th locality, a total of 26 taxa related to 14 genera, 7 families and 4 orders were identified. *Amphora coffeaeformis* was the predominant species. However, *Navicula cryptocephala* var. *veneta*, *Nitzschia palea* and *N. pellucida* were of frequent occurrence at this site.

Results of the physico-chemical analysis of Ain El-Sira and Ain El-Khiala water samples were represented in Table II. Water temperature readings at the time of collection were 18°C at Ain El-Sira and 16°C at Ain El-Khiala. The pH values at both springs were on the slightly alkaline side (7.4 & 7.6 at Ain El-Sira & Ain El-Khiala, respectively). Analyses also indicated that Ain El-Khiala characterized by higher electrical conductivity and higher ionic content than those recorded in Ain El-Sira. As calculated the total dissolved salts in both springs, it was found that Ain El-Sira water was brackish, while that of Ain El-Khiala was saline. Dissolved oxygen concentration at Ain El-Sira (28.8 ppm) was much higher than that recorded at Ain El-Khiala (10.4 ppm). Sodium was the most dominant cation at both springs (1287.36 & 9482.76 ppm at Ain El-Sira and Ain El-Khiala, respectively), while chloride was the most abundant anion (2109.93 & 23230.5 ppm at Ain El-Sira & Ain El-Khiala, respectively). Sulphate was the second important anion (742.79 & 2122.6 ppm at Ain El-Sira & Ain El-Khiala, respectively). Silicate

Table II. Physico-chemical characteristics of Giza Zoo, Ain El-Sira and Ain El-Khiala

Parameter	Spring Name		
	Giza Zoo (Locality no. 8)	Ain El-Sira (Locality no. 12)	Ain El-Khiala (Locality no. 13)
Temperature (°C)	22.9	18	16
pH	7.5	7.4	7.6
EC ds/m	1.4	8.07	66.7
DO (ppm)	7.6	28.8	10.4
Ca ⁺⁺ (ppm)	70.6	420.84	3807.62
Mg ⁺⁺ (ppm)	51.1	218.98	1216.55
Na ⁺ (ppm)	239.6	1287.36	9482.76
K ⁺ (ppm)	11.9	138.67	154.3
HCO ₃ ⁻ (ppm)	164.6	219.51	439.02
CO ₃ ²⁻ (ppm)	0.00	0.00	0.00
Cl ⁻ (ppm)	246.3	2109.93	23230.5
SO ₄ ²⁻ (ppm)	239.5	742.79	2122.6
NO ₃ ⁻ (ppm)	0.04	0.25	1
NO ₂ ⁻ (ppm)	0.04	0.1	1.3
PO ₄ ³⁻ (ppm)	2.5	1	1
SiO ₂ (ppm)	8.3	4	4.5
T.D.S. (ppm)	865.6	5164.8	42688
Hardness (ppm)	386.7	1952.2	14514.9

concentrations were more or less the same at both springs (4 ppm at Ain El-Sira & 4.5 ppm at Ain El-Khiala). Calculation of water hardness revealed that waters of both springs were very hard (1952.2 & 14514.9 ppm at Ain El-Sira & Ain El-Khiala, respectively).

From the 12th locality (Ain El-Sira), a total of 45 species related to 20 genera, were identified (Table I). These diatoms were found as epiphytic, planktonic, epilithic and scum growths in the water of this spring. *Amphora coffeaeformis* was the predominant species at this locality, whereas *Synedra tabulata* and *Navicula cryptocephala* var. *veneta* were frequent. In addition, one typically marine form (*Campylodiscus chypeus*) was recorded in this locality (rare form).

A total of 21 taxa related to 12 genera, were recognized from the scum, phytoplanktonic and epiphytic samples collected from Ain El-Khiala spring (the 13th locality). *Amphora coffeaeformis* was the most predominant species at this locality, while *Achnanthes brevipes* var. *intermedia*, *Nitzschia acicularis*, *N. fonticola* and *N. pellucida* were frequent. *Melosira moniliformis* var. *subglobosa*, a typically marine taxa, was rare at this locality.

From the data of the present study, it is apparent that the distribution pattern of the identified taxa varied significantly both qualitatively and quantitatively between the 13 studied localities and indicated changes in floristic composition. These localities could be divided into 5 assemblages:

Assemblage (1): localities from 2-7 (Table I). This assemblage represented the diatom flora of small irrigation canals as well as agricultural and industrial drains. The waters of these localities were shallow and characterized by the presence of many macrophytes, filamentous algae, epilithic and epipelagic diatoms. The most dominant and widespread taxa in this assemblage were mainly: *Nitzschia palea*, *Cyclotella meneghiniana*, *C. ocellata*, *Melosira granulata*, *Navicula cryptocephala*, *N. cryptocephala* var. *veneta* and *Melosira granulata* var. *angustissima*. In addition, the following taxa were also widespread but mostly present in low frequencies: *Synedra ulna* var. *danica*, *Stephanodiscus hantzschii*, *Navicula rhynchocephala*, *Gomphonema parvulum*, *Navicula pygmaea*, *Nitzschia amphibia*, *Synedra ulna* var. *aequalis* and *S. acus* var. *radians*.

Assemblage (2): localities 8 (Table I). This assemblage represented the phytoplanktonic diatom flora of the shallow artificial lake of ducks and geese, the water stream inside El-Gabalaya El-Malakya (aerial & sub-aerial epilithic), the Hippopotamamus pond (aerial & sub-aerial epilithic) and the waterfall of the elephant house (aerial & sub-aerial epilithic). The most dominant and wide spread taxa in this assemblage throughout the study period at most investigated sites were mainly, *Cyclotella meneghiniana*, *Cyclotella ocellata*, *Melosira granulata* var. *angustissima*, and some taxa were found to be common or frequent *Achnanthes inflata*, *A. lanceolata*, *Navicula mutica*, *Nitzschia obtusa*

var. *scalpelliformis*, *N. palea* and *Rhopalodia gibba* were the most prominent ones.

Assemblage (3): localities 1, 10 and 11 (Table I). This assemblage included stagnant and sewage drainage waters (very polluted). The diatom flora of these localities was mainly epilithic and epiphytic forms. The most common species were *Nitzschia thermalis*, *N. palea*, *Amphora coffeaeformis* and *Navicula cryptocephala* var. *veneta*. Some of the recorded taxa such as *Cyclotella ocellata*, *Melosira granulata* var. *angustissima*, *Stephanodiscus hantzschii*, *Synedra acus* var. *radians*, *Nitzschia microcephala* and *N. dissipata* were consistently recorded at these three localities but as rare or just noted taxa.

Assemblage (4): localities 12 and 13 (Table I). This assemblage composed of brackish and saline shallow water habitats (Ain El-Sira and Ain El-Khiala). The dominant taxa were: *Amphora coffeaeformis*, *Navicula cryptocephala* var. *veneta*, *Nitzschia pellucida*, *Synedra tabulata*, *Nitzschia fonticola* and *Achnanthes brevipes* var. *intermedia*.

Assemblage (5): locality no. 9 (Table I). This assemblage represented only the epilithic diatoms collected from a fountain basin in Abbassia Square. The predominant species were *Achnanthes minutissima* var. *cryptocephala* and *Caloneis clevei*. Although this division of the 13 different localities, some of the recorded taxa such as *Nitzschia palea*, *Cyclotella ocellata* and *Navicula cryptocephala* var. *veneta* were able to present in all these different habitats.

DISCUSSION

Among the identified taxa in the 13 different sampling localities which were chosen in The Greater Cairo to be investigated, *Nitzschia palea* was a prominent one. It was recorded at all sampling localities in relatively high frequencies as compared with other taxa. This taxon was described by many authors such as Venkateswarlu (1971), Nather Khan (1991), Jüttner *et al.* (1996), Silva-Benavides (1996) and Dere *et al.* (2002) as α -mesosaprobic species and as potent indicator of organic pollution. *Navicula cryptocephala* var. *veneta* was the second most important taxon that it was also recorded at all sampling sites with relatively high frequencies. This species was also considered to be tolerant to organic pollution (Nather Khan, 1991; Jüttner *et al.*, 1996; Silva-Benavides, 1996). The widespread occurrence of these two taxa may indicate the polluted character of these localities.

Referring to the results obtained in this study, it was found that the diatom flora of the 1st assemblage (mainly included small irrigation canals as well as agricultural and industrial drains) showed some similarity to the diatom flora of River Nile and its tributaries (El-Shimi, 1975, 1984, Nassar, 1980; El-Awamri *et al.*, 2005) qualitatively and sometimes quantitatively especially in the dominance of *Cyclotella ocellata*, *C. meneghiniana*, *Melosira granulata* and *M. granulata* var. *angustissima*

Although the algal flora of Giza Zoo did not attract the attention to be studied, it was found to be characterized by rich diatom flora. A total of 111 taxa belonging to 28 genera related to 8 families and 4 orders were identified from all the samples collected from the different sampling sites of Giza Zoo. Most of the identified taxa in Giza Zoo were freshwater forms, while some mesohalobien forms were also recorded but mostly in low frequencies except *Nitzschia obtusa* var. *scalpelliformis* which was recorded in relatively high frequencies in scum samples collected from El-Gabalaya El-Malakya. The presence of β -mesosaprobic species, *Cyclotella meneghiniana*, in high frequencies throughout the study period of Giza Zoo may indicate the polluted character of this study area.

Comparing the diatom flora of Giza Zoo with that of River Nile (El-Awamri *et al.*, 2005), it was noted that about 83% of the identified diatom taxa from Giza Zoo samples was also recorded in River Nile flora. Although this relatively great similarity in the species composition of these two entities, it was observed that some taxa which were recorded to be of rare occurrence in River Nile such as *Achnanthes inflata*, *A. lanceolata*, *Navicula mutica*, *Nitzschia obtusa* var. *scalpelliformis* and *Rhopalodia gibba* were found to be of common, frequent or predominant occurrence in some of the sampling sites of Giza Zoo. This may be due to the difference in habitats in which these diatoms grow that shallow aquatic, benthic and aerial habitats in Giza Zoo support the growth of many benthic and aerial forms. On the other hand, *Cyclotella ocellata*, *Melosira granulata*, *M. granulata* var. *angustissima*, and *Stephanodiscus hantzschii*, which were the most common taxa in River Nile, were also recorded in high frequencies in the diatom flora of Giza Zoo throughout the study period.

As comparing the average values of the different physico-chemical parameters recorded in Giza Zoo with those recorded in River Nile (El-Awamri *et al.*, 2005), which is the source of water in the different sampling sites of Giza Zoo, it was found that temperature and pH values were more or less the same. Average concentration of dissolved oxygen recorded at Giza Zoo was lower than that recorded in River Nile water. In contrast, average value of electrical conductivity recorded at Giza Zoo was higher than that recorded in River Nile water and this may be due to the general increase in most anions and cations concentrations at Giza Zoo as compared with those recorded in River Nile which may be partially attributed to animal activities in Giza Zoo water.

High salinity level of Ain El-Sira and Ain El-Khiala waters (3rd assemblage) reflected on the diatom flora of these localities. The brackish water form *Amphora coffeaeformis* was the predominant taxon at both localities. Some of the most frequent taxa at these localities (such as *Synedra tabulata* and *Achnanthes brevipes* var. *intermedia*) were also brackish water forms. In addition, two typically marine forms: *Campylodiscus clypeus* and *Melosira moniliformis* var. *subglobosa* were also recorded at Ain El-

Sira and Ain El-Khiala, respectively. The decrease in the number of taxa recorded at Ain El-Khiala (21 taxa related to 12 genera) as compared with those recorded at Ain El-Sira (45 taxa related to 20 genera) may be explained by the marked increase in the salinity level in the former locality (salty water). This assumption could be supported by the findings of Servant-Vidary and Roux (1990) and Clavero *et al.* (2000) who also observed a clear decrease in the number of diatom species and diversity along with increasing salinity.

The diatom flora of Ain El-Sira and Ain El-Khiala springs showed high levels of total dissolved salts. Mesohalobien species were found to dominate the diatom flora of these localities. Hamed (1995), in his study on the algal flora of the brackish water spring "Ain Helwan", reported that *Synedra tabulata*, *Achnanthes brevipes* var. *intermedia* and *Nitzschia obtusa* var. *scalpelliformis* were the most common mesohalobien taxa during the period of investigation of this spring. The diatom flora of Ain El-Sira was characterized by the dominance of *Amphora coffeaeformis*, while *Synedra tabulata* and *Navicula cryptocephala* var. *veneta* were frequent. Abou El-Kheir and Mekkey (1986) listed 6 diatom taxa related to 3 genera from Ain El-Sira and reported that this study area characterized by poor algal flora that Bacillariophyta was the only group found in it. They found that the freshwater form *Nitzschia palea* var. *genuina* f. *minor* was dominant whereas the brackish form *Amphora coffeaeformis* var. *boreales* was predominant.

The present results also indicated that many of the species dominating at any one of the investigated localities may also occurred at many or all other investigated localities (cosmopolitan). Thus, it could be concluded that the investigated localities differ more according to the relative proportions of species than to their presence or absence. Similarly, there were no clear differences in specific diatom compositions as a function of substrate. For example, typically phytoplanktonic diatom taxa may also present in all other growth forms (epilithic, epipelic, epiphytic, etc.) but the difference will be mainly in the quantity of these taxa at the different substrates.

In conclusion, the systematic study of the diatom flora of The Greater Cairo, a total of 140 taxa related to 33 genera were identified. According to the main available literature on the diatom flora of Egypt (Shaaban, 1994; Zalat, 1995 and 2002; Zalat and El-Sheekh, 1999; El-Awamri *et al.*, 2000; Gab Allah & Touliabah, 2000), the present investigation added 11 taxa to all previous records of the Egyptian diatom flora; these were *Achnanthes gibberula*, *A. orientalis*, *Caloneis budensis*, *C. clevei*, *Fragilaria construens* var. *subsalina*, *Navicula mutica* var. *cohnii*, *N. symmetrica*, *Nitzschia pellucida*, *N. siliqua*, *N. thermalis* var. *minor* and *Synedra rumpens*. In addition, 3 of the recorded taxa in the present study considered as new records to the diatom flora of The Greater Cairo; these were

Fragilaria pinnata var. *lancettula*, *N. communis* and *N. interrupta*.

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