

## FRESHWATER BENTIC DIATOMS IN NILE DELTA AND EL-FAYUM, EGYPT

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### Abstract

Freshwater Benthic algal samples were collected from seven governorates in the Nile Delta (1- El-Sharkia. 2- El-Gharbia. 3-El-Dakahlya. 4- Damietta. 5-El-Menofia. 6- El-Beheira. 7-Kafr El-Sheikh.) in addition to El-Fayum governorate during the period 2001-2004. The study was made for collecting and identifying as much as possible of the diatom species which occur in the different freshwater benthic habitats. A total of 220 taxa related to 38 genera were identified during this work, 199 taxa from the different localities in Nile Delta and 144 taxa from El-Fayum. The distribution and mean frequencies of diatoms in the sampling localities of the studied area were done. Most of species recorded in this investigation were oligohalobous cosmopolitan. This study showed also that *Cyclotella meneghiniana*, *C. ocellata*, *Cocconeis placentula*, *Melosira granulata*, *Nitzschia palea*, *N. obtusa* and *N. obtusa* var. *scalpelliformis* were the most prominent species in Nile Delta and El-Fayum. Ecological data as well as dimensions and photomicrographs of 29 taxa using LM and SEM were made.

**Keywords:** Diatoms, Egypt, Flora, Taxonomy

### Introduction

Diatoms are distributed in all waters except the hottest and most hypersaline. They are abundant in the phytoplankton and phytobenthos of marine and freshwater whatever the latitude. Hardly a sample can be taken from aquatic habitat that does not contain some cells of diatoms (Round *et al.*, 1990).

In spite of the extensive studies have been carried out in Nile Delta and El-Fayum province (El-Ayouty and Ibrahim, 1980, Kobbia *et al.*, 1990, Kobbia *et al.*, 1991, Kobbia *et al.*, 1995, Deyab *et al.*, 2000, Shaaban-Dessouki *et al.*, 2004, Abdel-Aziz, 2005 and Konsowa *et al.*, 2006). These studies dealt with the distribution and species composition of freshwater algal communities, in relation to the physicochemical characteristics of water as well as in response to some environmental stresses.

Few studies on the freshwater diatom flora in Egypt have been conducted (Muller 1899, Abdin 1949, Hustedt 1949, Aleem 1958, Faged 1980, El-Shimy 1984, Gab-Allah and Touliabah 2000 and El-Awamri *et al.*, 2005.) These studies were restricted in certain geographical regions (River Nile, Sinai, Wadi El-Natron, El-Fayum and the Greater Cairo). However it is not clear from the literature any taxonomic and floristic studies on freshwater benthic diatoms in Nile Delta.

Therefore, the study was made for collecting and identifying as much as possible of the diatom species which occur in the different freshwater benthic habitats in Nile Delta and El-Fayum, Egypt.

### ***Materials and Methods***

Benthic freshwater algal samples were collected from seven governorates in the Nile Delta in addition to El-Fayum governorate during the period 2001-2004.

A total of 61 samples from various forms of vegetations and localities were collected. The sample localities were: 1- El-Sharkia (10 samples from Zagazig, Bilbeis and Mania El-Kamh) 2- El-Gharbia (7 samples from Zifta, Kafr El-Ziyat and Tanta). 3- El-Dakahlya (8 samples from Mansoura, Mit Ghamr and Talkha). 4- Damietta (3 samples from Damietta and Kafr El-Batikh). 5-El-Menofia (6 samples from Shibin El-Kom, Quesina and El-Bagur). 6-El-Beheira (10 samples from Kafr El-Dawar, Abu Humus and Rosetta) 7-Kafr El-Sheikh (5 samples from Kafr El-Sheikh and Sakha). 8- El-Fayum (12 samples from El-Fayum city, Ain El-Celene, Abshway, Sannouris and Tamia). The different forms of algal vegetations include epiphytic diatoms on *Ceratophyllum* sp. , *Lemna gibba*, *Potamogeton* sp. , *Cladophora* sp., woody Persian wheels, aerophilous flora on mosses, attached diatoms on roots of *Phragmites* sp., marginal mud, rocks' scraping, small irrigation canals, epipsammic , epilithic and epipelic samples from branches and canals of River Nile and agricultural drains. Relative abundance values for all the collected samples at each governorate were averaged.

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

The diatom taxa were identified according to Zabelina *et al.* (1951), Patrick and Reimer (1966 and 1975), Gasse (1986), Krammer and Lang-Bertalot (1986 and 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. In cases where the diatom abundance was low, only 200 valves were counted. Individuals lying on girdle side were also counted.

The collected samples were prepared for LM and SEM investigation by cleaning frustules using the method described by Jouse *et al.*, (1949-b). For LM study, the material was mounted according to the method described by Proschkina-Lavernko

*et al.*, (1974). The technique used to prepare diatoms for SEM is that adopted by Hasle and Fryxell (1970).

The terminology of the ultrastructure of diatoms follows that suggested by Anonymous (1975), Ross *et al.*, (1979) and Round *et al.*, (1990).

## **Results and Discussion**

A total of 220 taxa related to 38 genera were identified during this work (from 2001-2004) from Nile Delta and El-Fayum. The distribution and mean frequencies of diatoms in the sampling localities of the studied area were represented in Table (1). Results of the present study revealed that *Cyclotella Kützingiana*, *C. meneghiniana*, *C. ocellata*, *Cocconeis placentula*, *C. placentula* var. *euglypta*, *Gomphonema parvulum*, *Melosira granulata*, *M. granulata* var. *angustissima*, *M. varians*, *Navicula cuspidata*, *N. mutica*, *Nitzschia amphibia*, *N. epiphytica*, *N. fonticola*, *N. obtusa*, *N. obtusa* var. *scalpelliformis*, *N. palea*, *Stephanodiscus hantzschii*, *Syndera ulna* var. *danica* were the most wide spread taxa in Nile Delta and El-Fayum.

Results also showed that 199 taxa were recorded from the different localities in Nile Delta and 144 taxa were recorded from El-Fayum. Some diatoms taxa were restricted to certain localities, these numbers of taxa ranged from 2-10 in the different localities of Nile Delta, while the exclusive taxa of El-Fayum reached to 29 taxa. This result denotes that the species composition in Nile Delta is similar, cosmopolitan species and varied slightly from the freshwater diatoms of El-Fayum.

By comparison with the diatom assemblages of the different governorates, it was found that the lower number of taxa (48) was recorded in Kafr El-Sheikh while the maximum number was recorded in El-Beheira, This fluctuation mainly due to the number of samples investigated and the nature of habitat of the collected sample (personal observation).

This study showed also that *Cyclotella meneghiniana*, *C. ocellata*, *Cocconeis placentula*, *Melosira granulata*, *Nitzschia palea*, *N. obtusa*, *N. obtusa* var. *scalpelliformis* were the most prominent species in Nile Delta and El-Fayum. These taxa were recorded in all sampling localities in relatively high frequencies as compared with the other taxa. The above mentioned species showed some similarities with the diatom flora of River Nile according to the works of (El-Shimy 1984, Gab-Allah & Touliabah 2000 and El-Awamri *et al.*, 2005.) These similarities qualitatively and some quantitatively especially in the dominance of *Cyclotella meneghiniana*, *C. ocellata* and *Melosira granulata*. Many of the species dominating in one locality may also occur at many or all other investigated localities (cosmopolitan). Thus, it could be concluded that the diatom flora in Nile Delta and El-Fayum differ according to the relative proportions of species than to their presence or absence. Similarly, there were no clear differences in specific diatom composition as function of substrate. For example few of

the dominant species *Cyclotella Kützingiana*, *C. ocellata*, *Melosira granulata* and *M. granulata* var. *angustissima* are typically phytoplankton diatoms (Van Heurck, 1899, Hustedt, 1927-1966, Patrick and Reimer, 1966 & 1975, Foged 1980, Palmer 1980 and Gasse 1986) and represented here as benthic diatoms.

Most of species recorded in this investigation are oligohalobous (freshwater) but there are a group of species such as *Achnanthes brevipes*, *A. brevipes* var. *intermedia*, *Amphora coffeaeformis*, *Bacillaria paradoxa*, *Biddulphia laevis*, *Nitzschia hungarica*, *N. obtusa*, *N. obtusa* var. *scalpelliformis* *N. punctata* and *Terpsinoe musica* which are considered mesohalobous or eurhalyine species (Hustedt, 1927-1966, Patrick and Reimer, 1966 & 1975, Foged 1980, and Gasse 1986) were recorded in Nile Delta and El-Fayum in the present investigation and in many Egyptian studies in freshwater habitats (Foged 1980, El-Shimy 1984, Gab-Allah and Touliabah 2000).

In fact and according to these observations, these species have a wide ecological spectrum and therefore they are capable to live in haline as well as freshwater habitats.

#### **Ecological data as well as dimensions and photomicrographs of 29 taxa using LM and SEM. are represented as follows**

***Achnanthes brevipes* Ag.** (Plate 1, figs. 1- a&b)

Dimensions: length 30-110µm, breadth 12-28µm, striae 7-8 in 10µm

Locality 1,3,4,6 and 8 (epiphytic and epilithic)

Ecology: mesohalobous, but common in Egypt in fresh water habitats.

***A. brevipes* var. *intermedia* (Kütz.) Cl.** (Plate 1, figs. 2- a&b).

Dimensions: length 30-110µm, breadth 12-28µm, striae 7-8 in 10µm

Locality 1,3,4,6 and 8

Ecology: mesohalobous, but common in Egypt in fresh water habitats.

***Anomoneis sphaerophora* (Kütz) Pfitzer.** (Plate 1, fig. 3).

Dimensions: length 55-65µm, breadth 17-20µm, striae 12-15 in 10µm

Locality 2,5 and 8

Ecology: halophilic, alkalibiontic, cosmopolitan.

***Amphora coffeaeformis* (Ag.) Kütz.** (Plate 1, fig.4).

Dimensions: length 26-40µm, breadth 10-13µm, transapical striae delicate 16-20 in 10µm

Locality: 1 to 8

Ecology: mesohalobous, alkalibiontic, cosmopolitan.

***A. ovalis* Kütz.** (Plate 1, fig. 5).

Dimensions: length 45µm, breadth 6µm, striae 12 in 10µm

Locality: 8

Ecology: oligohalobous (indifferent), alkaliphilic, cosmopolitan.

**Table 1:** Mean frequencies of diatoms recorded at the different sample localities 1- El-Sharkia. 2- El-Gharbia. 3-El-Dakahlya . 4- Damietta. 5-El-Menofia. 6- El-Beheira. 7- Kafr El-Sheikh. 8- El-Fayum during 2001-2004.

**P = Predominant (50–20 %), f = frequent (20–5 %), c = common (5–1 %), r = rare (1–0.2 %), + = noted and – = not noted**

Name of Diatom Taxa	1	2	3	4	5	6	7	8
<b>Genus: <i>Achnanthes</i> Bory 1832</b>								
<i>Achnanthes affinis</i> Grun.		+	+	+		+	+	
<i>A. brevipes</i> Ag.	+		+	r		c		f
<i>A. brevipes</i> var. <i>intermedia</i> (Kütz.) Cl.	+		+			+		+
<i>A. conspicua</i> A. Mayer					+		+	
<i>A. delicatula</i> (Kütz.) Grun		+		r			+	
<i>A. exigua</i> Grun.	r	+				r		r
<i>A. hauckiana</i> Grun.			+					+
<i>A. hungarica</i> Grun.		+		+		+		+
<i>A. inflata</i> (Kütz.) Grun.								+
<i>A. lanceolata</i> (Bréb.) Grun.	+							+
<i>A. marginulata</i> Grun.			+			+		
<i>A. minutissima</i> var. <i>cryptocephala</i> Grun.						+		+
<i>A. orientalis</i> Hust.					+		+	
<b>Genus: <i>Amphiprora</i> Ehr. 1841</b>								
<i>Amphiprora alata</i> Kütz.	+		+			+		+
<b>Genus: <i>Amphora</i> Ehr. 1840</b>								
<i>Amphora coffeaeformis</i> (Ag.) Kütz	+	+	+		+	r	+	+
<i>A. ovalis</i> kütz								+
<i>A. ovalis</i> var. <i>pediculus</i> (kütz) V.H.ex Det.		+			+			+
<i>A. perpusilla</i> Grun.								+
<i>A. turgida</i> Greg.								+
<i>A. veneta</i> kütz	+							+
<i>A. ventricosa</i> Greg.								+
<b>Genus: <i>Anomoneis</i> Pfitzer 1871</b>								
<i>Anomoneis sphaerophora</i> (kütz) Pfitzer.		+			+			+
<b>Genus: <i>Bacillaria</i> Gmelin 1788</b>								
<i>Bacillaria paradoxa</i> Gmelin.	+		+		+	+	+	+
<b>Genus: <i>Biddulphia</i> Gray 1821</b>								
<i>Biddulphia laevis</i> Ehr.	+	+		+		+		c
<b>Genus: <i>Caloneis</i> Cl. 1891</b>								
<i>Caloneis amphisbaena</i> (Bory.) Cl.	+	+		+				+
<i>C. bacillum</i> (Grun.) Cl.					+			+
<i>C. clevei</i> (Lagst.) Cl.		+	+				+	
<i>C. permagna</i> (J.W.Bail.) Cl.		+		+		+		+
<i>C. silicula</i> (Her.) Cl.	+				+			+
<i>C. silicula</i> var. <i>tumida</i> Hust.		+			+			

Cont. Table 1

Name of Diatom Taxa	1	2	3	4	5	6	7	8
Genus: <i>Campylodiscus</i> Ehr. 1840								
<i>Campylodiscus clypeus</i> Ehr.			+		+	+		+
<i>C. clypeus</i> var. <i>bicostata</i> (W.Sm.) Hüst								+
Genus: <i>Cocconeis</i> Ehr. 1834								
<i>Cocconeis pediculus</i> Ehr.						+		
<i>C. placentula</i> Ehr.	c	f	p	r	f	c	+	c
<i>C. placentula</i> var. <i>euglypta</i> (Ehr.) Cl.	f	r	r	r	f	f	r	f
<i>C. placentula</i> var. <i>intermedia</i> (Herib.) perag. Cl.	+	+		+				
<i>C. placentula</i> var. <i>roxii</i> (Brun.et perag.) Cl.								+
Genus: <i>Cyclostephanos</i> Round 1982								
<i>Cyclostephanos</i> sp.								+
Genus: <i>Cyclotella</i> Kütz 1833								
<i>Cyclotella comta</i> (Ehr.) Kütz	+			+	+			
<i>C. Kützingeriana</i> Thwaites.	r	f	r	r	+	+	+	+
<i>C. meneghiniana</i> Kütz.	c	p	f	c	+	p	p	c
<i>C. ocellata</i> Pant.	c	c	c	r	f	r	r	c
<i>C. operculata</i> (Ag.) Kütz.			+					+
Genus: <i>Cymatopleura</i> W.Sm. 1851								
<i>Cymatopleura elliptica</i> (Bréb.) W.Sm.				+		+		+
<i>C. solea</i> (Bréb.) W.Sm.	+	+						+
<i>C. solea</i> var. <i>regula</i> (Ehr.) Grun.				+		+		
Genus: <i>Cymbella</i> Ag. 1830								
<i>Cymbella affinis</i> Kütz.	+							+
<i>C. cistula</i> (Hemp.) Grun						+		
<i>C. cymbiformis</i> (Ag.? Kütz.) V.H.								+
<i>C. delicatula</i> Kütz.				+				
<i>C. prostrata</i> (Berk) Cl.								+
<i>C. pusilla</i> Grun.						+		
<i>C. tumida</i> (Bréb.ex Kütz.) V.H.	+	+			+		+	
<i>C. turgida</i> (Greg.) Cl.			+					
<i>C. ventricosa</i> Kütz.		+				+		+
Genus: <i>Diploneis</i> Ehr. 1840								
<i>Diploneis elliptica</i> (Kütz.) Cl.			+			+		
<i>D. ovalis</i> (Hilse) Cl.	+	+		+	+	+		+
<i>D. ovalis</i> var. <i>oblongella</i> (Nag.) Cl.			+					
Genus: <i>Epithemia</i> Bréb 1838								
<i>Epithemia sores</i> Kütz.	+		+	+				+
<i>E. turgida</i> (Ehr.) Kütz.	+				+	+	+	+
Genus: <i>Fragilaria</i> Lyngbye 1819								
<i>Fragilaria brevistriata</i> Grun.								+
<i>F. brevistriata</i> var. <i>inflata</i> (Pant.) Hüst			+					

Cont. Table 1

Name of Diatom Taxa	1	2	3	4	5	6	7	8
<i>F. capucina</i> var. <i>mesolepta</i> Rabb.	+							
<i>F. construens</i> (Ehr.) Grun.				+				
<i>F. construens</i> var. <i>subsalina</i> Hüst.		+				+		
<i>F. construens</i> var. <i>venter</i> (Ehr.) Grun.							+	
<i>F. crotonensis</i> kitt		+						+
<i>F. intermedia</i> Grun.								+
<i>F. lapponica</i> Grun.		+						
<i>F. pinnata</i> Ehr.	+		+				+	
Genus: <i>Frustulia</i> Rabb. 1853								
<i>Frustulia</i> , <i>rhomboids</i> (Thwait.) Detoni					+			+
<i>F. vulgaris</i> (Thwait.) Detoni			+					+
Genus: <i>Gomphonema</i> Ag. 1824								
<i>Gomphonema acuminatum</i> var. <i>coronatum</i> (Ehr.) W.Sm.				+		+		+
<i>G. angustatum</i> (Kütz.) Rabb.						+		+
<i>G. angustatum</i> var. <i>productum</i> Grun.	+							
<i>G. augur</i> Her.			+					
<i>G. clevei</i> Fricke.		+				+		
<i>G. constrictum</i> var. <i>capitatum</i> (Ehr.) Cl.		+		+				+
<i>G. gracile</i> Ehr.	+							
<i>G. gracile</i> var. <i>lanceolatum</i> Kütz.			+			+		
<i>G. intricatum</i> Kütz.	+							+
<i>G. intricatum</i> var. <i>pumilum</i> Grun.			+			+		
<i>G. lanceolatum</i> Ehr.	+							
<i>G. lanceolatum</i> var. <i>insignis</i> (Greg.) Cl.	+			+		+		
<i>G. longiceps</i> Ehr.			+				+	
<i>G. longiceps</i> var. <i>subclavata</i> Grun.								+
<i>G. olivaceum</i> (Lyngb.) Kütz.	+	+		+				+
<i>G. parvulum</i> (Kütz.) Grun.	+	+	+	+	+	+	+	+
<i>G. parvulum</i> var. <i>lagenulum</i> (Kütz. Grun.) Hust.			+					
<i>G. sphaerophorum</i> Ehr.				+				
<i>G. truncatum</i> Ehr.						+		
<i>G. sp1</i>								+
<i>G. sp2</i>								+
Genus: <i>Gomphonitzschia</i> Grun. 1868								
<i>Gomphonitzschia ungeri</i> Grun.		+		+				+
Genus: <i>Gyrosigma</i> Hassall 1845								
<i>Gyrosigma acuminatum</i> (Kütz.) Rabb.								+
<i>G. distortum</i> var. <i>parkeri</i> Harr.								+
<i>G. macrum</i> (W.Sm.) Griff & Henfr.	+							
<i>G. spencerii</i> Grun					+			
Genus: <i>Hantzschia</i> Grun. 1877								

Cont. Table 1

Name of Diatom Taxa	1	2	3	4	5	6	7	8
<i>Hantzschia amphioxys</i> (Ehr.) Grun.	+		+		+		+	+
<i>H. amphioxys</i> f. <i>capitata</i> O.Müller.	+	+		+	+		+	+
Genus: <i>Mastogloia</i> Thw. 1856								
<i>Mastogloia braunii</i> Grun						+		+
<i>M. elliptica</i> (Ag.) Cl.								+
<i>M. smithi</i> Thw.								+
Genus: <i>Melosira</i> Ag. 1824								
<i>Melosira granulata</i> (Ehr.) Ralfs.	c	f	c	c	f	c	p	f
<i>M. granulata</i> var. <i>angustissima</i> O.Müll.	f	f	r	+	r	r	c	c
<i>M. islandica</i> O. Müll.						+		
<i>M. italica</i> (Ehr.) Kütz.				+				+
<i>M. varians</i> Ag.	+	r	r	+	f	+	+	c
Genus: <i>Meridion</i> Ag. 1824								
<i>Meridion circulare</i> Ag.								+
Genus: <i>Navicula</i> Bory 1824								
<i>Navicula bacillum</i> Ehr.						+		
<i>N. cincta</i> (Ehr.) Kütz.						+		
<i>N. confervacea</i> (Kütz.) Grun.		+				+	+	
<i>N. cryptocephala</i> Kütz.								+
<i>N. cryptocephala</i> var. <i>veneta</i> (Kütz.) Grun.								+
<i>N. cuspidata</i> (Kütz.) Cl.	r	r	r	f	f	+	+	f
<i>N. cuspidata</i> var. <i>ambigua</i> (Ehr.) Grun.								+
<i>N. dicephala</i> (Ehr.) W.Sm.								+
<i>N. exigua</i> var. <i>capitata</i> Patr.								+
<i>N. gastrum</i> (Ehr.) Kütz.	+				+			
<i>N. gregaria</i> Donk.		+	+		+	+		+
<i>N. halophila</i> (Grun.) Cl.	+			+		+		+
<i>N. menisculus</i> Schum.	+		+		+		+	+
<i>N. mutica</i> Kütz.	+	+	+	+	+	+	+	+
<i>N. pupula</i> Kütz.						+		
<i>N. pygmaea</i> Kütz.	+	+	+	+	+	+		+
<i>N. radiosa</i> Kütz.	+		+		+			+
<i>N. rhynchocephala</i> Kütz.	+	+		+				+
<i>N. salinarum</i> Grun.			+			+		
<i>N. symmetrica</i> Patr.	+				+			
<i>N. tuscula</i> Her.						+		+
<i>N. viridula</i> var. <i>rostellata</i> (Kütz.) Cl.		+	+	+				+
Genus: <i>Neidium</i> Pfitzer 1871								
<i>Neidium affine</i> (Ehr.) Cl.								+
<i>N. dubium</i> (Ehr.) Cl.								+
<i>N. iridis</i> (Ehr.) Cl.						+		



Cont. Table 1

Name of Diatom Taxa	1	2	3	4	5	6	7	8
Genus: <i>Nitzschia</i> Hassall 1845								
<i>Nitzschia acicularis</i> W.Sm.								+
<i>N. acuta</i> Hantzsch.								+
<i>N. amphibia</i> Grun.	+	+	+	+	+	+	+	+
<i>N. angustata</i> var. <i>acuta</i> Grun.			+					+
<i>N. apiculata</i> (Greg.) Grun.	+					+		
<i>N. bilobata</i> W.Sm.	+			+				+
<i>N. clausii</i> Hantzsch.							+	
<i>N. communis</i> Rabh.				+				
<i>N. dissipata</i> (Kütz.) Grun.		+				+		+
<i>N. epiphytica</i> O. Müll.	+	+	+	+	+	+	+	+
<i>N. filiformis</i> (W.Sm.) Hust.						+		+
<i>N. fonticola</i> Grun.	+	+	+	+	+	+	+	+
<i>N. frustulum</i> (Kütz.) Grun.	+			+	+	+		+
<i>N. gracilis</i> Hantzsch.			+					
<i>N. granulata</i> Grun.						+		+
<i>N. holsatica</i> Hüst.					+			
<i>N. hungarica</i> Grun.	+	+		+		+	+	+
<i>N. intermedia</i> Hantzsch.								+
<i>N. interrupta</i> (Reichelt) Hust.		+			+	+		+
<i>N. kützingiana</i> Hilse.	+				+			+
<i>N. linearis</i> W.Sm.	+					+		
<i>N. longissima</i> var. <i>reversa</i> W.Sm.			+	+	+	+		+
<i>N. lorenziana</i> Grun.					+			
<i>N. microcephala</i> Grun.			+					+
<i>N. obtusa</i> W.Sm.	+	+	+	+	+	+	+	+
<i>N. obtusa</i> var. <i>scalpelliformis</i> Grun.	f	r	r	r	+	+	c	c
<i>N. palea</i> (Kütz.) W.Sm.	f	r	r	r	f	f	f	r
<i>N. paleacea</i> Grun.					+			
<i>N. punctata</i> (W. Sm.) Grun.	+			+				+
<i>N. recta</i> Hantzsch.	+	+	+		+			
<i>N. sigma</i> (Kütz.) W.Sm.			+					
<i>N. sigmoidea</i> (Ehr.) W.Sm.	+		+		+	+	+	
<i>N. spetabliis</i> (Ehr.) Ralfs		+		+				
<i>N. sublineris</i> Hüst	+				+			+
<i>N. subtilis</i> (Kütz.) Grun.		+	+					+
<i>N. thermalis</i> Kütz.	+				+			
<i>N. thermalis</i> var. <i>minor</i> Hilse.	+							
<i>N. trybionella</i> Hantzsch.						+		+
<i>N. trybionella</i> var. <i>debilis</i> (Arnott) A.Mayer.						+		+
<i>N. trybionella</i> var. <i>levidensis</i> (W.Sm.) Grun.	+		+			+		+

Cont. Table 1

Name of Diatom Taxa	1	2	3	4	5	6	7	8
<i>N. trybionella</i> var. <i>victoriae</i> Grun.		+	+			+	+	+
<i>N. vitrea</i> Norman.					+			+
Genus: <i>Opephora</i> P. Petit 1888								
<i>Opephora martyi</i> Herib.			+					+
Genus: <i>Pinnularia</i> Ehr. 1840								
<i>Pinnularia acrosphaeria</i> W.Sm.	+		+	+				+
<i>P. alpina</i> W.Sm.						+		+
<i>P. borealis</i> Ehr.							+	+
<i>P. braunii</i> (Grun.) Cl.					+			+
<i>P. braunii</i> var. <i>amphicephala</i> (A.Mayer) Hust.							+	+
<i>P. gibba</i> Ehr.		+						+
<i>P. majar</i> (Kütz.) Cl.		+					+	+
<i>P. microstauron</i> (Ehr.) Cl.	+	+	+			+		+
<i>P. microstauron</i> var. <i>brebissonii</i> (Kütz.) Hust.				+		+		
<i>P. viridis</i> (Nitzsch.) Ehr.			+		+			
<i>P. viridis</i> var. <i>intermedia</i> Cl.	+							
Genus: <i>Pleurosigma</i> W. Sm. 1852								
<i>Pleurosigma angulatum</i> (Quack.) W.Sm.	+	+						+
<i>P. elongatum</i> W.Sm.	+				+		+	
Genus: <i>Rhoicosphenia</i> Grun. 1860								
<i>Rhoicosphenia curvata</i> (Kütz.) Grun. ex. Rabh.		+	+		+	+		+
Genus: <i>Rhopalodia</i> O. Müller 1897								
<i>Rhopalodia gibba</i> (Ehr.) O.Müller.	+		+	+	+	+		+
<i>R. gibba</i> var. <i>ventricosa</i> (Kütz.) H. & M. Perag.								+
<i>R. gibberula</i> (Ehr.) O.Müller.			+				+	+
<i>R. musculus</i> (Kütz.) O.Müller.			+		+	+		+
<i>R. vermicularis</i> O.Müller.								+
Genus: <i>Stauroneis</i> Ehr. 1843								
<i>Stauroneis acuta</i> W.Sm.								+
<i>S. phoenicneteron</i> Ehr.	+			+		+		
Genus: <i>Stephanodiscus</i> Ehr. 1845								
<i>Stephanodiscus astrea</i> (Ehr.) Grun.								+
<i>S. astrea</i> var. <i>minutulus</i> (Kütz.) Cl. et Müll.	+		+					+
<i>S. hantzschii</i> Grun.	+	+	+	+	+	+	+	+
Genus: <i>Surirella</i> Turpin 1828								
<i>Surirella angustata</i> Kütz.								+
<i>S. capronii</i> Bréb.		+	+	+		+	+	+
<i>S. lapponica</i> A. Cl	+				+			
<i>S. ovalis</i> Bréb.	+			+			+	+
<i>S. ovata</i> Kütz.		+		+				+
<i>S. robusta</i> var. <i>splendida</i> Ehr.		+				+		

Cont. Table 1

Name of Diatom Taxa	1	2	3	4	5	6	7	8
Genus: <i>Synedra</i> Ehr.1830								
<i>Synedra acus</i> var. <i>radians</i> (Kütz.) Hust.			+					
<i>S. capitata</i> Ehr.				+				
<i>S. pulchella</i> (Ralfs) Kütz.							+	
<i>S. rumpens</i> Kütz.	+		+					
<i>S. tabulata</i> (Ag.) Kütz.								+
<i>S. ulna</i> (Nitzsch.) Ehr.	+		+					f
<i>S. ulna</i> var. <i>aequalis</i> (Kütz.) Hust.	+	+						+
<i>S. ulna</i> var. <i>danica</i> (Kütz.) Grun.	r	+	+	+	+	+	+	f
<i>S. ulna</i> var. <i>impressa</i> Hust.	+							
<i>S. ulna</i> var. <i>spathulifera</i> Grun.			+					
<i>S. vaucheriae</i> Kütz.							+	+
Genus: <i>Terpsinoe</i> Ehr. 1843								
<i>Terpsinoe musica</i> Ehr.						+		
Genus: <i>Thalassiosira</i> Cl. 1873								
<i>Thalassiosira fluviatilis</i> Hust.	+		+					+
Number of genera	27	24	26	22	25	28	19	37
Number of taxa	84	65	74	61	62	85	48	144

***Bacillaria paradoxa* Gmelin.**

(Plate 2, fig. 6).

Dimensions: length 70-80µm, breadth 6-8µm, transverse striae 20-25 in 10µm

Keel puncta (fibulae 6-8 in 10µm)

Locality: 1, 3, 5, 6, 7 and 8

Ecology: mesohalobous, pH, indifferent, cosmopolitan, found also in freshwater.

***Caloneis silicula* (Ehr.) Cl.**

(Plate 2, fig.7).

Dimensions: length 55-62µm, breadth 12-15µm, striae 15-16 in 10µm

Locality: 1, 5 and 8

Ecology: oligohalobous (indifferent), alkaliphilic, cosmopolitan.

***Cocconeis pediculus* Ehr.**

(Plate 2, figs. 8-a&amp;b).

Dimensions: length 27-40µm, breadth 10-20µm, striae 16-18 in 10µm

Locality: 6

Ecology: A frequent epiphyte on aquatic macrophytes. Oligohalobous (in different), alkaliphilic, cosmopolitan.

***Cymatopleura elliptica* (Bréb.) W.Sm.**

(Plate 2, fig. 9).

Dimensions: length 60-68µm, breadth 40-45µm, marginal costae 4 in 10µm

Locality: 4, 6, and 8.

Ecology: oligohalobous (indifferent), alkaliphilic, cosmopolitan.

***C. solea* (Bréb.) W.Sm.**

(Plate 2, fig. 10).

Dimensions: length 70-95µm, breadth 22-25µm, marginal costae 8-9 in 10µm

Locality: 1, 2 and 8

Ecology: oligohalobous (indifferent), alkaliphilic, cosmopolitan.

- Diploneis ovalis* (Hilse) Cl.** (Plate 2, figs. 11- a&b).  
 Dimensions: length 30-32µm, breadth 12-13µm, striae 9-10 in 10µm  
 Locality: 1, 2, 4, 5, 6 and 8.  
 Ecology: oligohalobous (indifferent), alkaliphilic, cosmopolitan.
- Gomphonema acuminatum* var. *coronatum* (Ehr.) W.Sm.** (Plate 3, fig. 12).  
 Dimensions: length 30-85µm, breadth 7-11µm, striae 8-11 in 10µm  
 Locality: 4, 6 and 8  
 Ecology: oligotrophic to slightly mesotrophic, cosmopolitan.
- G. constrictum* var. *capitatum* (Ehr.) Cl.** (Plate 3, fig. 13- a, b and c).  
 Dimensions: length 30µm, breadth 12µm, striae 10-11 in 10µm  
 Locality: 2, 4 and 8.  
 Ecology: oligohalobous (indifferent), alkaliphilic, cosmopolitan.
- G. gracile* Ehr.** (Plate 3, fig. 14).  
 Dimensions: length 45-50µm, breadth 9µm, striae 12 in 10µm  
 Locality: 1  
 Ecology: oligohalobous (indifferent), alkaliphilic, cosmopolitan.
- G. olivaceum* (Lyngb.) Kütz.** (Plate 3, fig. 15).  
 Dimensions: length 20-35µm, breadth 6-8µm, striae 12 in 10µm  
 Locality: 1, 2, 4 and 8.  
 Ecology: oligohalobous (indifferent), alkaliphilic, cosmopolitan.
- G. parvulum* (Kütz.) Grun.** (Plate 3, fig. 16).  
 Dimensions: length 16-25µm, breadth 5-7µm, striae 12-14 in 10µm  
 Locality: 1 to 8  
 Ecology: oligohalobous (indifferent), pH-circuneutral, cosmopolitan, a wide ecological spectrum.
- G. truncatum* Ehr.** (Plate 3, fig. 17).  
 Dimensions: length 40-70µm, breadth 8-15µm, striae 9-11 in 10µm  
 Locality: 6  
 Ecology: oligohalobous (indifferent), alkaliphilic, cosmopolitan, common in shallow freshwater habitats.
- Navicula viridula* var. *rostellata* (Kütz.) Cl.** (Plate 4, fig. 18).  
 Dimensions: length 30-35µm, breadth 9-11µm, striae 9-10 in 10µm  
 Locality: 2, 3, 4 and 8.  
 Ecology: oligohalobous (indifferent), alkaliphilic, cosmopolitan.
- N. amphibia* Grun.** (Plate 4, fig. 19).  
 Dimensions: length 12-16µm, breadth 3-4µm, fibulae 7-9 in 10µm  
 Locality: 1 to 8.  
 Ecology: oligohalobous (indifferent), alkaliphilic, cosmopolitan.
- Nitzschia angustata* var. *acuta* Grun.** (Plate 4, fig. 20).  
 Dimensions: length 31-40µm, breadth 5-7µm, transapical striae 18-20 in 10µm  
 Locality: 3 and 8.  
 Ecology: oligohalobous (indifferent), alkaliphilic, cosmopolitan.

- N. hungarica* Grun.** (Plate 4, fig. 21).  
 Dimensions: length 70-75µm, breadth 6-9µm, keel puncta fibulae 7-9 in 10µm, transapical striae 16-20 in 10µm  
 Locality: 1, 2, 4, 6, 7 and 8.  
 Ecology: mesohalobous, alkaliphilic, cosmopolitan, found in freshwater.
- N. microcephala* Grun.** (Plate 4, fig. 22).  
 Dimensions: length 8-15µm, breadth 3-4µm, fibulae 12-13 in 10µm, transapical striae 33-35 in 10µm  
 Locality: 3 and 8.  
 Ecology: oligohalobous (indifferent), alkaliphilic, cosmopolitan.
- N. obtusa* W.Sm.** (Plate 4, figs. 23- a&b).  
 Dimensions: length 50-75µm, breadth 4-7µm, fibulae 9-10 in 10µm, transapical striae 30-32 in 10µm  
 Locality: 1 to 8.  
 Ecology: oligohalobous (indifferent), alkaliphilic, cosmopolitan.
- N. punctata* (W. Sm.) Grun.** (Plate 5, figs. 24).  
 Dimensions: length 9-12µm, breadth 5µm, transapical striae 10-20 in 10µm  
 Locality: 1, 4 and 8.  
 Ecology: euryhaline and mesohalobous, rarely freshwater.
- Opephora martyi* Herib.** (Plate 5, fig. 25).  
 Dimensions: length 8-11µm, breadth 3-4µm, striae 8-9 in 10µm  
 Locality: 3 and 8  
 Ecology: oligohalobous (indifferent), alkaliphilic, cosmopolitan.
- Surirella ovalis* Bréb.** (Plate 5, fig. 26).  
 Dimensions: length 31µm, breadth 20µm.  
 Locality: 1, 4, 7 and 8  
 Ecology: mesohalobous, cosmopolitan.
- S. ovata* Kütz.** (Plate 5, fig. 27).  
 Dimensions: length 30µm, breadth 24µm.  
 Locality: 2, 4 and 8  
 Ecology: oligohalobous (indifferent), alkaliphilic, cosmopolitan.
- Synedra tabulata* (Ag.) Kütz.** (Plate 5, fig. 28).  
 Dimensions: length 45µm, breadth 2-7µm, striae 9-14 in 10µm  
 Locality: 8  
 Ecology: slightly brackish, cosmopolitan.
- S. ulna* var. *danica* (Kütz.) Grun.** (Plate 5, fig. 29).  
 Dimensions: length 110-170µm, breadth 5-8µm, striae 8-10 in 10µm  
 Locality: 1 to 8  
 Ecology: oligohalobous (indifferent), alkaliphilic, cosmopolitan.

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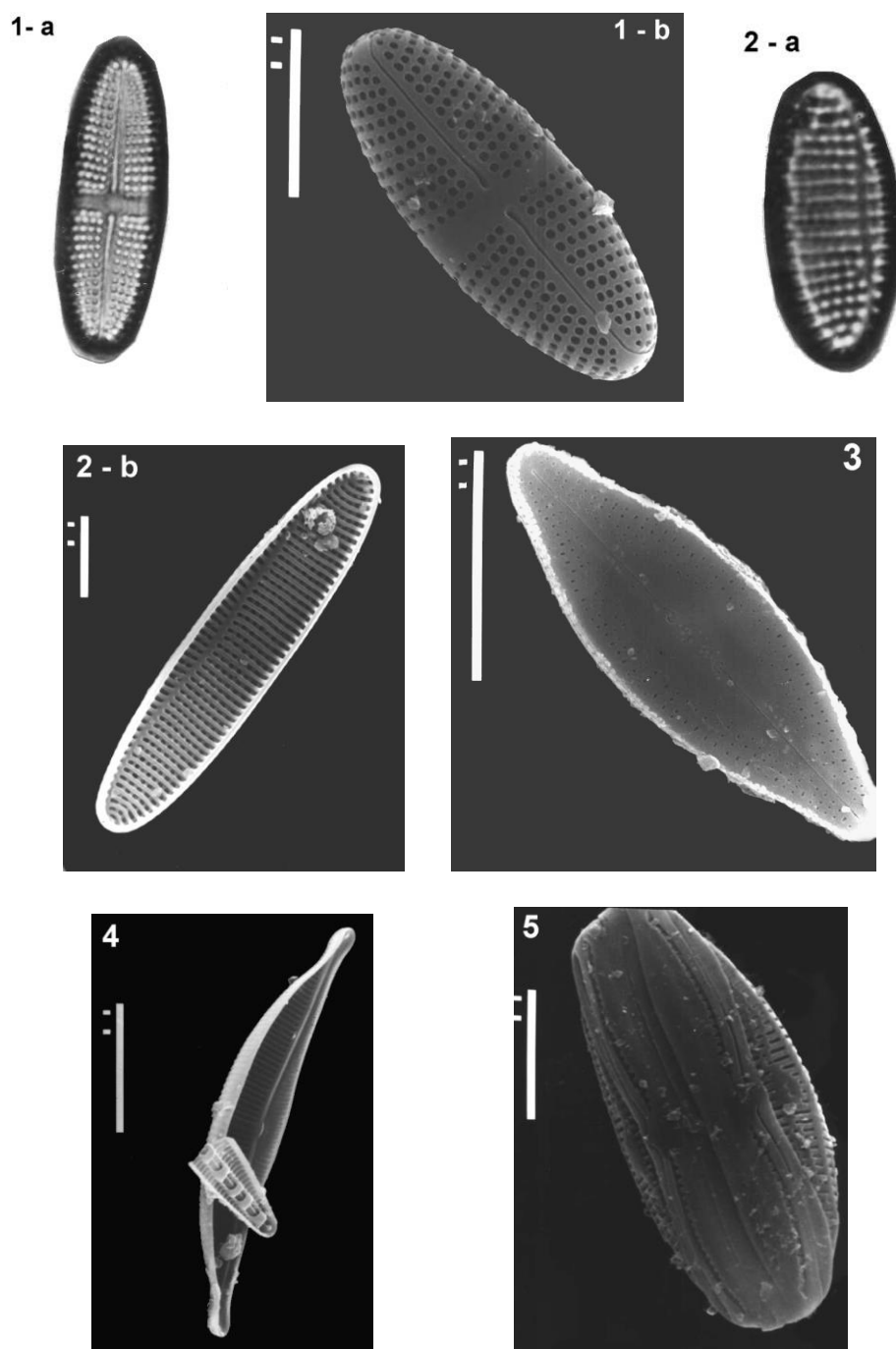
## دياتومات المياه العذبة اللاصقة في بعض مناطق دلتا النيل و الفيوم (مصر)

أحمد عبد الرحمن العوامري

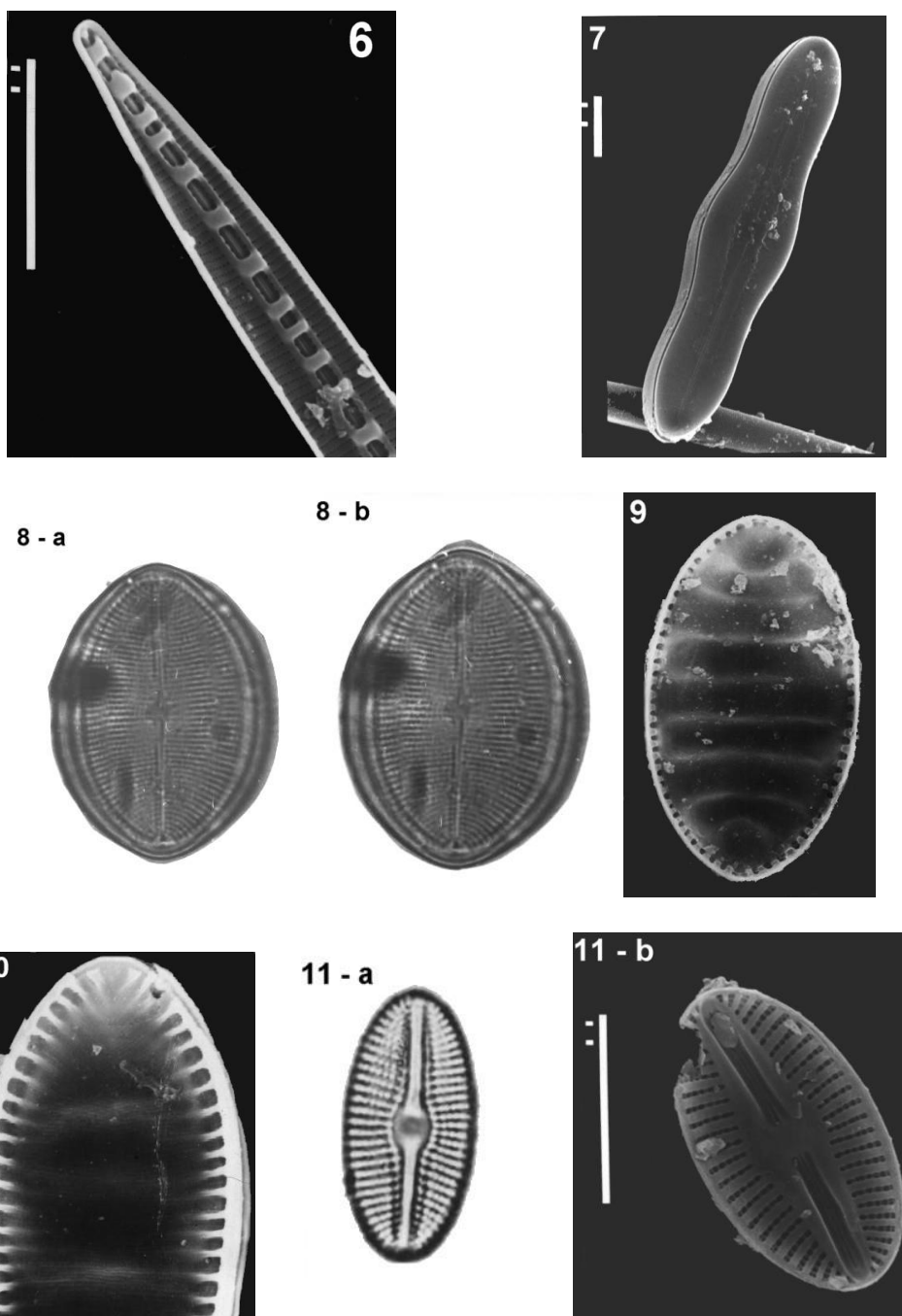
قسم النبات كلية العلوم جامعة عين شمس

يهدف هذا البحث إلى دراسة دياتومات المياه العذبة اللاصقة في مناطق الدراسة بدلتا النيل و الفيوم (مصر). و قد تم جمع عينات طحلبية ممثلة لمختلف بيئات المياه العذبة من سبع محافظات بدلتا النيل و هي الشرقية و الغربية و الدقهلية و دمياط و المنوفية و البحيرة إضافة إلى محافظة الفيوم. أسفرت الدراسة عن تسجيل 220 وحدة تصنيفية تنتمي إلى 38 جنسا، و لقد تم تسجيل 199 وحدة تصنيفية بدلتا النيل إضافة إلى 144 وحدة تصنيفية من البيئات العذبة بالفيوم و قد سجل انتشار و توزيع كل نوع منها . و أظهرت الدراسة أن البيئة الرئيسية لغالبية الأنواع المسجلة هي المياه العذبة إضافة لكونها شائعة الإنتشار عالميا و أظهرت الدراسة أن أكثر أنواعها انتشارا في دلتا النيل و الفيوم هي *Cyclotella meneghiniana*, *C. ocellata*, *Cocconeis placentula*, *Melosira granulata*, *Nitzschia palea*, *N. obtusa*, *N. obtusa* var. *scalpelliformis* و هذا العمل إشتمل أيضا على ذكر أهم الظروف البيئية و الظاهرية لعدد 29 وحدة تصنيفية مستعينا بذلك بالمجهر الضوئي و المجهر الإلكتروني الماسح.

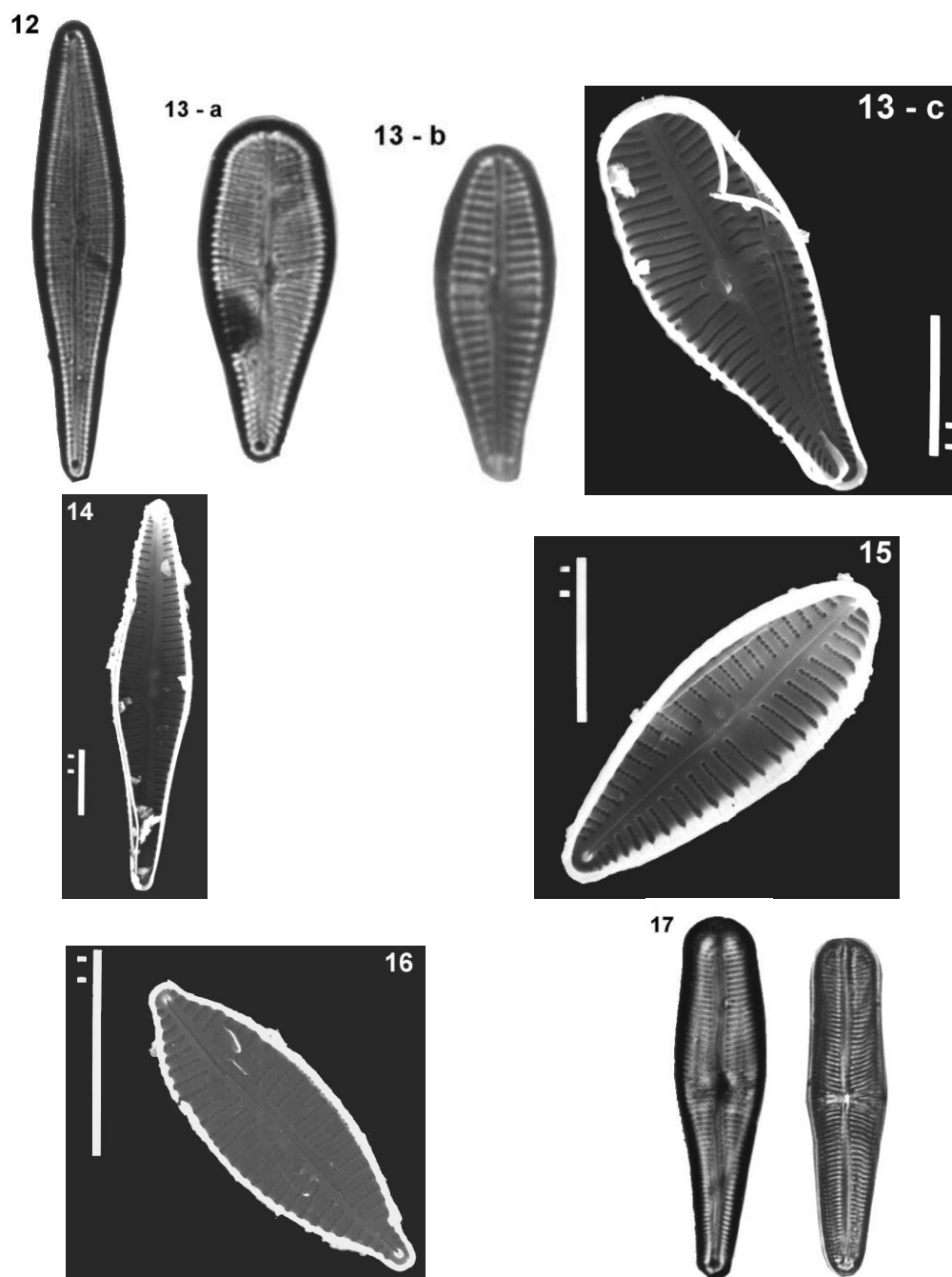




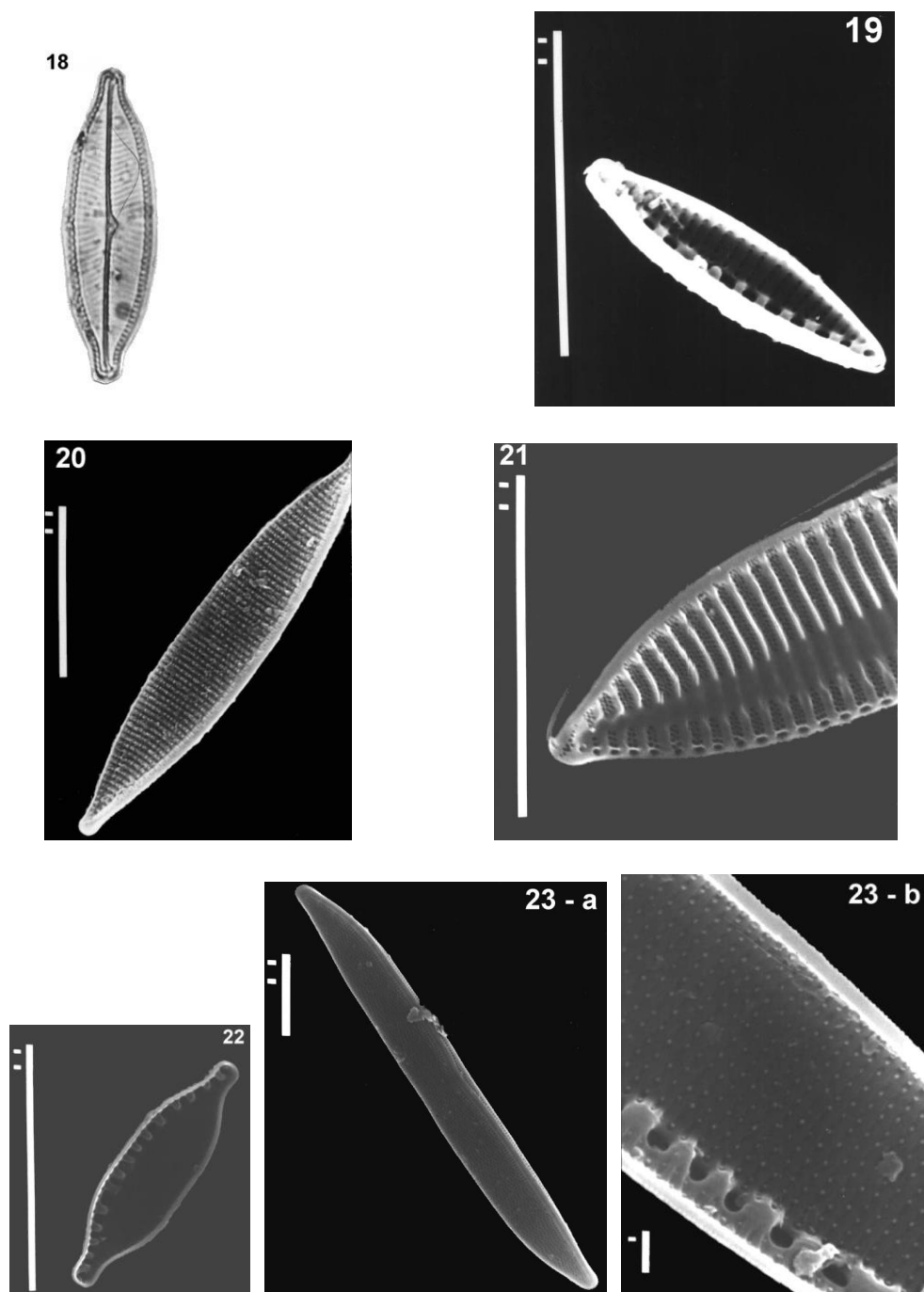
**Plate I:** Fig.1-a: *Achnanthes brevipes* Ag. LM(x1500), fig. 1-b: *A. brevipes* Ag. SEM, bar= 10µm , fig. 2-a: *A. brevipes* var. *intermedia* (Kütz.) Cl. LM(x1500), fig. 2-b: *A. brevipes* var. *intermedia* (Kütz.) Cl. SEM, bar= 10µm, fig. 3: *Anomoneis sphaerophora* (Kütz.) Pfitzer. SEM, bar= 10µm, fig. 4: *Amphora coffeaeformis* (Ag.) Kütz SEM, bar= 10µm, fig. 5: *A. ovalis* Kütz SEM, bar= 10µm.



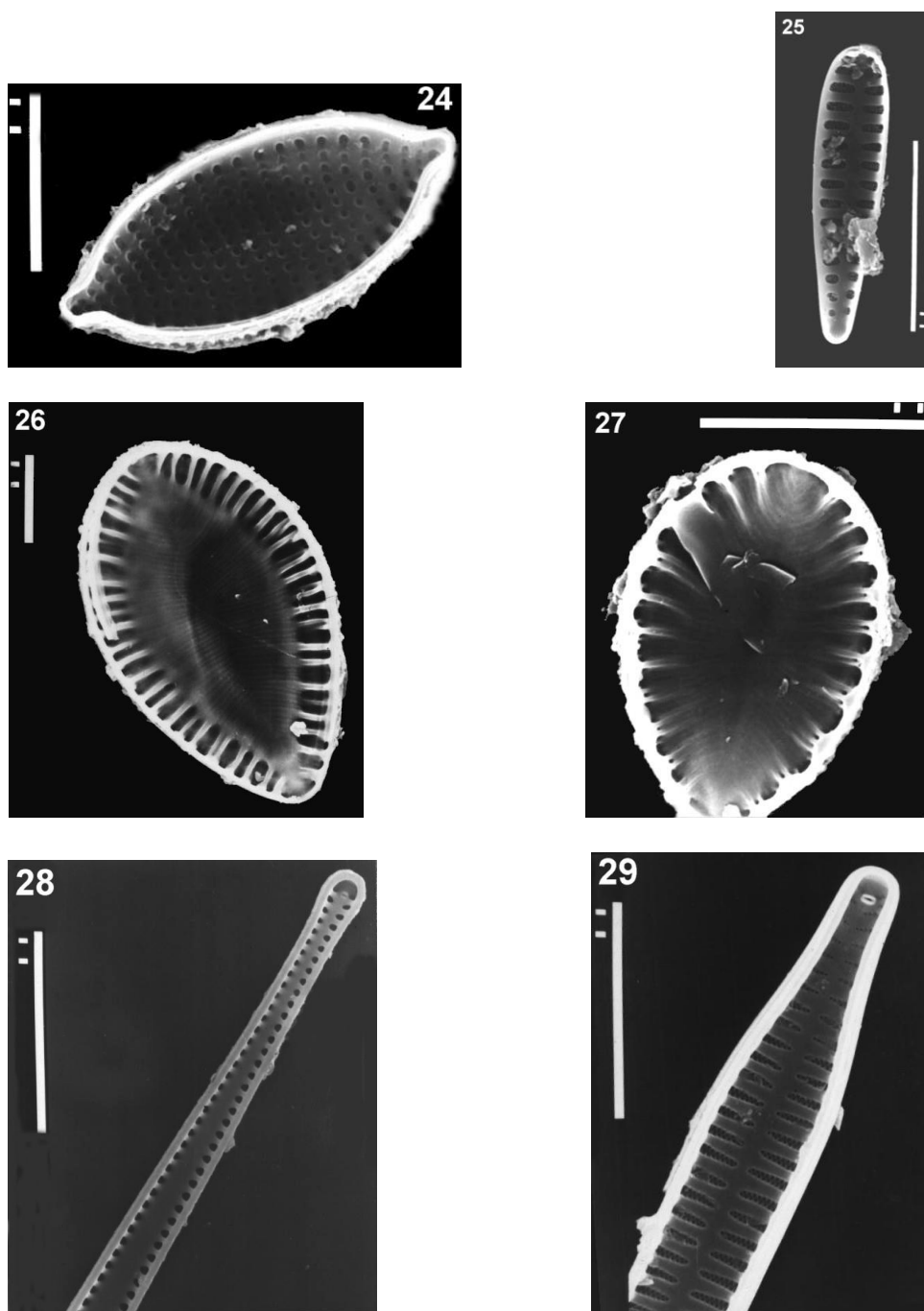
**Plate II:** Fig. 6: *Bacillaria paradoxa* Gmelin. SEM, bar= 10µm, fig. 7: *Caloneis silicula* (Ehr.) Cl. SEM, bar= 10µm, fig. 8-a: *Cocconeis pediculus* Ehr. LM(x1000), fig. 8-b: *C. pediculus* Ehr. LM(x1000), fig. 9: *Cymatopleura elliptica* (Bréb.) W.Sm. SEM, bar= 10µm, fig. 10: *C. solea* (Bréb.) W.Sm. SEM, bar= 10µm, fig. 11-a: *Diploneis ovalis* (Hilse) Cl. LM(x1500), fig. 11-b: *D. ovalis* (Hilse) Cl. SEM, bar= 10µm.



**Plate III:** Fig. 12: *Gomphonema acuminatum* var. *coronatum* (Ehr.) W.Sm. LM(x1500), fig. 13-a&b: *G. constrictum* var. *capitatum* (Ehr.) Cl. LM(x1500), fig. 13-c: *G. constrictum* var. *capitatum* (Ehr.) Cl. SEM, bar= 10µm, fig. 14: *G. gracile* Ehr. SEM, bar= 10µm, fig. 15: *G. olivaceum* (Lyngb.) Kütz. SEM, bar= 10µm, fig. 16: *G. parvulum* (Kütz.) Grun. SEM, bar= 10µm, fig. 17: *G. truncatum* Ehr. LM(x1000).



**Plate IV:** Fig. 18: *Navicula viridula* var. *rostellata* (Kütz.) Cl. LM (x1500), fig. 19: *N. amphibia* Grun. SEM, bar= 10µm, fig. 20: *Nitzschia angustata* var. *acuta* Grun. SEM, bar= 10µm, fig. 21: *N. hungarica* Grun. SEM, bar= 10µm, fig. 22: *N. microcephala* Grun. SEM, bar= 10µm, fig. 23-a: *N. obtusa* W.Sm. SEM, bar= 10µm, fig. 23-b: *N. obtusa* W.Sm. SEM, bar= 1µm.



**Plate V:** Fig. 24: *N. punctata* (W. Sm.) Grun. SEM, bar= 10µm, fig. 25: *Opephora martyi* Herib. SEM, bar= 10µm, fig. 26: *Surirella ovalis* Bréb. SEM, bar= 10µm, fig. 27: *S. ovata* Kütz. SEM, bar= 10µm, fig. 28: *Synedra S. tabulata* (Ag.) Kütz. SEM, bar= 10µm, fig. 29: *S. ulna* var. *danica* (Kütz.) Grun. SEM, bar= 10µm.