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PRELIMINARY STUDY ON THE DIATOM FLORA OF COASTAL PERIPHITIC ASSEMBLAGES OF THE RED SEA AND SUEZ GULF, EGYPT.

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Abstract

Diatom flora of the coastal assemblages of the red Sea and Suez gulf in Egypt was investigated. 191 diatom taxa of diatoms were identified; 58 genera and 10 families. Naviculaceae (101 taxa), fragilariaceae (35 taxa), bacillariaceae (20 taxa and achnanthaceae (12 taxa) were the most common families. The data indicate that diatom populations of the study area appeared to be mainly dependent on the growth of certain genera viz; *Mastogloia*, *Nitzschia*, *Amphora* and *Diploneis*. Diatom assemblages were characteristic of tropical/ subtropical marine waters, however, a number of alloctonous diatom species were also recorded.

Key words: Marine diatoms, Periphyton, Coastal waters, Red Sea, Egypt

Introduction

The Red Sea is an intercontinental rift enclosed between Asia and Africa which is 1932 km long and 280 km wide. It is a unique environment since there are no permanent river inflows, rainfall is sparse, evaporation largely exceeds precipitation and seawater exchange with the Arabian Sea in the south is limited due to the very shallow sill of the Strait of Bab el Mandab (Seeberg-Elverfeldt, 2004). Due to high evaporation, values of sea surface salinity are high and increase from south to north up to 40 % (Edwards, 1987).

Little is known about the algal flora of the coastal water of the Red Sea in Egypt. References dealing with this subject are restricted to the phytoplankton (Halim, 1969; Ibrahim, 1988; Zalat, 1997; El-Naggar *et. al.*, 2002). Shaikh *et al*. (1986) and El-Naggar *et al.* (2002) found that diatoms were the most elaborated group forming phytoplankton communities of the Red Sea. Diatoms were also the main contributors of all marine sediments of the northern Red Sea (Seeberg-Elverfeldt, 2004).

In Saudi Arabia, the coastal water of the Red Sea was also scarcely investigated for algal flora. Dowidar (1983) and Shaikh *et al.* (1986) dealt with the primary productivity of phytoplankton in relation to a number of ecological variables. Khalil and Ibrahim (1987) conduced a study on seasonal fluctuation of phytoplankton productivity.

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The present work deals with the diatom flora of the coastal periphytic assemblages of the Red Sea and Suez gulf in Egypt in an attempt towards the completion of knowledge on the Egyptian algal flora.

Materials and Methods

Sampling sites were located along the west coasts of Red Sea and Suez Gulf as well as the east coast of Suez Gulf. The area of study is almost limited by the latitudes 26°35'-29°40'N and the longitudes 32°25'-34°20' E Ten sampling sites were chosen (Figure 1). Sampling sites were visited once during July and August 2005.

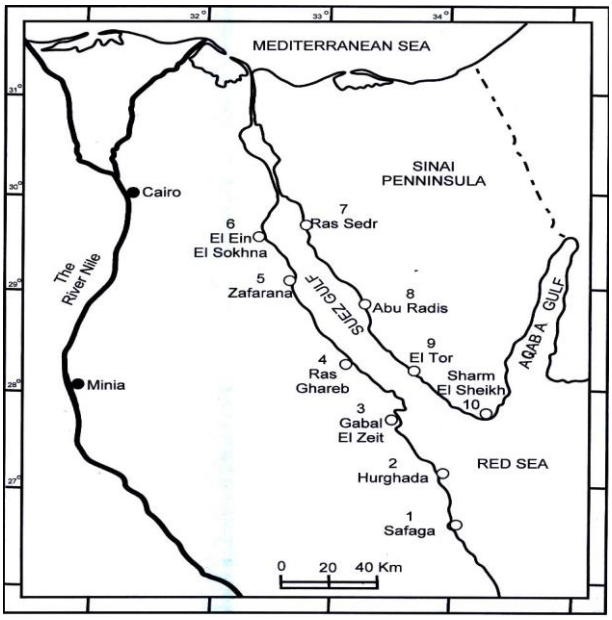

Figure (1): Map of the study area indicating sampling sites

Diatom samples were collected according to the standard methods reported by Prescott (1982), from solid objects found in water such as stones, mollusk shells, coral fragments, filamentous algae, seaweeds and aquatic plants. Samples were collected at well-illuminated areas at a depth up to 50 cm. Each site was represented by three sampling places and samples were mixed together and treated as a single sample. Samples were preserved by 2% formaldehyde solution after collecting and were transported later to the laboratory.

Samples were treated in the laboratory for the removal of organic debris in water and the protoplast of diatom cells so as to keep clear the diatom valves (Wojtal and Sobczyk, 2006). Samples were kept in conc. HCl overnight, boiled

for 10 min., rinsed several times with dist. water and then boiled in 33% H_2O_2 with trace amounts of $KClO_3$. After rinsing several times with dist. water, the clean diatom material was collected by decantation and suspended in 50% ethanol. Examination with light microscopy was performed using a phase contrast microscope. Diatom specimens were photographed at 1000 X magnification using an oil immersion lens.

For Scanning electron microscopy, aliquots of the digested samples were gently spread on cover slips, allowed to air-dry and were thereafter carbon-coated. Examination was performed using a Philips XL 30 ESEM scanning electron microscope.

Identification of diatoms was performed according to; Cleve-Euler (1951-1955), Krammer and Lange-Bertalot (1986, 1988, 1991a, b), Krammer (1992), Lange-Bertalot (1993), Metzeltin and Witkowski (1996), Witkowski *et al*., (2000). Relative abundance was based on counts of a given taxon in relation to the 500 total diatom valves that were counted for each sample. Taxa that attained 5% of the total counted valves were considered abundant; those with 2-5% were considered moderately abundant while taxa with less than 2% were considered rare (Wojtal and Sobczyk, 2006). Presence of taxa was calculated as percent of the number of sites in which a given taxon was recorded in relation to the total number of study sites.

Results and Discussion

The present results (Table 1) represent the diatom flora in the investigated area over a period from May to August 2005. The total number of diatom taxa (192) was composed of 58 genera and 10 families.

The data indicate that the reported diatom taxa can be considered characteristic for tropical/subtropical marine waters according to Seeberg-Elverfeldt, (2004). Number of taxa recorded for individual sampling sites was not consistent. The largest number of taxa was observed at sites 9 and 10. These sites are more likely to be the least subjected to oil pollution and it seems that tourism in Sharm El-Sheikh (site 10) does not produce about drastic changes to the environment. On the other hand, the least number of species was recorded at site 8 near the town Abu Rdis which is a big center of oil industry that may have adverse effects on aquatic life.

The data indicate that populations of most of the constituent species were small where ca 62% of the taxa was considered rare according to the used scale of abundance. Moderately abundant and abundant populations were recorded for about 30% and 7% of the constituent taxa, respectively. The Red Sea, especially in its northern part, has been frequently reported as an oligotrophic environment that was found to be stratified for most of the year. The depth of thermocline varies seasonally where it exceeds 200 m in winter and becomes shallow (30-60m) during spring and summer (Seeberg-Elverfeldt, 2004).

Table (1):Distribution and relative abundance of the recorded diatom taxa in the studied sites. Abundance of populations is denoted by +, ++ and +++ as rare, moderately abundant and abundant, respectively.

Sites	1	2	3	4	5	6	7	8	9	10	%presence	Locality of occurrence	Plate no.
Taxa	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++			
Family: Thalassiosiraceae Lebour 1930													
Genus: ***Cyclotella*** (Kützing) Brebisson1838													
C. ocellata Pantocsek			+			+			+		30	3, 6, 9	VII I
Genus: ***Stephanodiscus*** Ehrenberg 1845													
S. tephanodiscus hantzschii Grun.						+				+	20	6, 10	
Family: Coscinodiscaceae Kützing 1844													
Genus: ***Coscinodiscus*** Ehrenberg 1838													
C. nitidus Greg.									++		10	9	I
C. subvelatus Kütz.									++		10	9	I
Genus: Endictya Ehrenberg 1845													
Endictya oceanica Ehr.				+							10	4	
Family: Hemidiscaceae Henedy 1964													
Genus: ***Actinocyclus*** Ehrenberg 1837													
A. ochotensis Jouse									+++		10	9	I
A.subtilis(Greg.)Ralfs	+					++			+		30	1, 6, 9	I
Genus: ***Bacteriastrum*** Shadbolt 1845													
B. delicatulum Cl.										+	10	10	
Genus: ***Stictodiscus*** Greville 1861													
S. parallelus v. *balnearis* (Grun.) Peragallo								+			10	8	
Family: Biddulphiaceae Henedy 1931													
Genus: ***Biddulphia*** Gray 1821													
B. pulchella Gray		+							+++		20	2, 9	I, II
Genus: ***Odontella*** Kützing 1844													
O.aurita (Lyngb.) Ag.		++				++	++				30	2, 6, 7	VII I
Genus: ***Terpsinoë*** Ehrenberg 1843													
T. americana (Bailey) Ralfs									+		10	9	
Genus: ***Triceratium*** Ehrenberg 1841													
T. paralellum Greville							+			+	20	7, 10	
T. reticulatum Ehr.				+							10	4	I
Family: Fragilariaceae Hustedt 1930													
Genus: ***Ardissonia*** De Notaris 1870													
A. cristallina (Ag.) Grun.					++			++			20	5, 8	
A. formosa (Hantzsch) Grun.				++					+		20	4, 9	III, IX
A. fulgens (Greville) Grun.				+							10	4	
A. robusta (Ralfs) De Notaris									+		10	9	
Genus: ***Climacosphenia*** Ehrenberg 1843													
C. moniligera Ehr.	+		+		+++					+	40	1, 3, 5, 10	IV
Genus: ***Fragilaria*** Lyngbye 1819													
F.beroliensis(Lemm.) Lange-Bertalot								++			10	8	IX
F. construens f. *subsalina* (Hust.) Hust.		++									10	2	IX
F. fasciculata (Ag.) Lange Bertalot				+++							10	4	

F. leptostauron v. *dubia* (Grun.) Hust.						++		+	+		**30**	**6, 8, 9**	**IX**
F. leptostauron v. martyii (Herib.) Lange Bertalot	++	+	++	++			+		+	+	**70**	**1-4, 7, 9, 10**	
F. pinnata v. *pinnata* Ehr.			++		++						**20**	**3, 5**	**IX**
F. sopotensis Witkowski & Lange Bertalot										++	**10**	**10**	**IX**
F. ulna (Nitzsch) Lange Bertalot		+	+	+	+			+	+	+	**70**	**2-5, 8-10**	
F. ulna v. *acus* (Kütz.) Lange Bertalot				+							**10**	**4**	
Genus: ***Fragilariopsis*** Hustedt 1913													
Fragilariopsis sp. 1										+	**10**	**10**	**VII**
F. sp. 2										+	**10**	**10**	**VII**
Genus: ***Grammatophora*** Ehrenberg 1840													
G. angulosa v. *islandica* (Ehr.) Grun.										+	**10**		
G. maxima Grun.										+	**10**		
G. undulata Ehr.										+	**10**		
Genus: ***Hyalosynedra*** Williams & Round 1986													
H. laevigata (Grun.) Williams & Round	+	+++		+			+		+++	+++	**60**	**1,2,4,7, 9, 10**	**IX**
Genus: ***Licmophora*** Agardh 1827													
L. gracilis(Ehr.)Grun.		+++				+	+				**30**	**2, 6, 7**	
L. g. v. *anglica* (Kütz.) Peragallo				+							**10**	**4**	**VI, IX**
L. paradoxa (Lyngb.) Ag.									+++	+	**20**	**9, 10**	
L. remulus Grun.		+			++				+++	+++	**40**	**2, 5, 9, 10**	**IV**
Genus: ***Opephora*** Petit 1883													
O. mutabilis (Grun.) Sabbe& Vyverman									+		**10**	**9**	
Genus: ***Plagiogramma*** Greville 1859													
P. rhombicum Hust.		+				++	++				**30**	**2, 6, 7**	
P. pulchellum v. pygmaeum (Greville) Peragallo		++							++		**20**	**2, 9**	**VII**
Genus: Protoraphis Simonsen 1970													
Protoraphis atlantica Gibson										+++	**10**	**10**	
Genus: ***Rhabdonema*** Kützing 1844													
R. minutum Kütz.										+	**10**	**10**	
R. adriaticum Kütz.				+							**10**	**4**	
Genus: ***Rhaphoneis*** Ehrenberg 1844													
R. amphicerus (Ehr.) Ehr.									+		**10**	**9**	
Genus: ***Striatella*** Agardh 1832													
S. unipunctata (Lyngb.) Ag.							+				**10**	**7**	
Genus: ***Tabellaria*** Ehrenberg 1844													
T. flocculosa (Roth) Kütz.		+									**10**	**2**	
Genus: ***Trachysphenia*** Petit 1877													
T. australis Petit										++	**10**	**10**	
T. australis v. *rostellata* Hust.					+	++		+	+		**40**	**5, 6, 8, 9**	
Family: Achnanthaceae Henedy 1964													
Genus: ***Achnanthes*** Bory 1822													
A. amoena Hust.		++									**10**	**2**	**X**
A. brevipes				+	+		+			+	**40**	**4, 5, 7, 10**	
A. cuneata (Grun.) Grun.										+	**10**	**10**	
A. exciliata Giffen								++			**10**	**8**	
A. pseudogroenlandica Hendey							+			+	**20**	**7, 10**	
Genus: ***Cocconeis*** Ehrenberg 1837													

C. hauniensis Witkowki					++						**10**	**5**	**X**
C. hoffmannii Simonsen					+						**10**	**5**	
C. krammerii Lange-Bertalot & Metzeltin									++	+	**20**	**9, 10**	**X**
C. pellucida Grun.										++	**10**	**10**	
C. scutellum v. *scutellum* Ehr.	+									+	**20**	**1, 10**	
C. s. v. *speciosa* (Greg.) Cl.		++									**10**	**2**	**X**
C. stauroneiformis (W. Smith) Okuno										+	**10**	**10**	
Family: Naviculaceae Bessey 1907													
Genus: ***Amphora*** Ehreberg 1840													
A. bigibba v. interrupta (Grun.) Grun.				+							**10**	**4**	
A. cymatophora *Cholnoky*	+										10	1	II
A. delicatissima Krasske					++	++		++			**30**	**5, 6, 8**	**XI**
A. egregia Ehr.							+				**10**	**7**	**II**
A. exciliata Giffen			++			++					**20**	**3, 6**	**XI**
A. gracilis W. Smith				+							**10**	**4**	**II**
A. holsatica Hust.	++			+					+++		**30**	**1, 4, 9**	**II**
A. holsaticoides Nagumo& Kobayasi	++						+			+	**30**	**1, 7, 10**	**II**
A. laevissima Greg.	+	+									**20**	**1, 2**	
A. obtusa Greg.	++										**10**	**1**	
A. ostrearia Breb.									++		**10**	**9**	
A. ovalis (Kütz.) Kütz.									+		**10**	**9**	
A. proteus Greg.	++				++						**20**	**1, 5**	**II**
A. rhombica Kitton									++		**10**	**9**	
A. securicula Peragallo							++				**10**	**7**	
A. spectabilis Greg.								++	++		**20**	**8, 9**	**II**
Genus ***Anomoeoneis*** Pfitzer 1871													
A. sphaerophora (Kütz.) Pfitzer							+				**10**	**7**	**V**
Genus: ***Berkeleya*** Greville 1827													
B. scopulorum (Breb.) Cox			+++		++						**20**	**3, 5**	
Genus: ***Caloneis*** Cleve 1894													
C. alpestris (Grun.) Cl.									+		**10**	**9**	
C. amphisbaena (Bory) Cl.				+							**10**	**4**	**III**
C. elongata (Grun.) Cl.									+		**10**	**9**	
C. excentrica (Grun.) Cl.									++		**10**	**9**	**V**
C. liber (W. Smith) Cl.	++				+		+		++		**40**	**1, 5, 7, 9**	
C. linearis (Grun.) Boyer	++	+				++					**30**	**1, 2, 6**	
Genus: ***Craticula*** Grunow 1868													
C. cuspidata (Kütz.) D.G. Mann										++	**10**	**10**	**X**
Genus: ***Diploneis*** Ehrenberg 1844													
D. aestiva (Donk.) Cl.					++						**10**	**5**	**III**
D. bomboides (Schmidt) Cl.									+		**10**	**9**	**III**
D. bombus Ehr.							+			+	**20**	**7, 10**	**III**
D. crabro Ehr.	+			+	+		+				**40**	**1, 4, 5, 7**	
D. incurvata (Greg.) Cl.						++			++	+	**30**	**6, 9, 10**	
D. littoralis v. littoralis (Donkin) Cl.										+	**10**	**10**	**III**
D. notabilis (Greville) Cl.					++						**10**	**5**	
D. rex Droop									+		**10**	**9**	
D. smithii v. smithii (Breb.) Cl.	++	+							+		**30**	**1, 2, 9**	**III**
D. suborbicularis v.					+						**10**	**5**	

constricata Hust.													
Genus: ***Fallacia*** Stickle& D.G. Mann 1990													
F. balnearis Grun.					++						**10**	**5**	
F. florianae (Moeller) Witkowski				++							**10**	**4**	
F. forcipata (Greville) Stickle & D. G. Mann					+++						**10**	**5**	**IV, XI**
F. litoricola (Hust.) D. G.Mann		+	+		+						**30**	**2, 3, 5**	**XI**
F. oculiformis (Hust.) D.G. Mann									+++		**10**	**9**	
F. tenera (Hust.) D.G. Mann		++									**10**	**2**	**XI**
Genus: ***Fogedia*** Witkowski, Lange-Bertalot & Metzeltin													
F. geisslerae *witkowski, Metzeltin & Lange-Bertalot*					++						**10**		**X**
Genus: ***Frustulia*** Rabehorst 1853													
F. weinholdi Hust.					+						**10**	**5**	
Genus: ***Gomphonema*** Ehrenberg 1832													
G. olivaceum (Hornemann) Breb.				+							**10**	**4**	
Genus: ***Gyrosigma*** Hassal 1843													
G. scalproides (Thw.) Cl.			+								**10**	**3**	
G. spencerii W. Smith							+				**10**	**7**	
Genus: ***Haslea*** Simonsen 1974													
H. nautica (Cholnoky) Giffen				+			+		++	+	**40**	**4, 7, 9, 10**	
Genus: ***Lyrella*** Karayeva in Round 1990													
L. amphoroides D. Mann	+										**10**	**1**	**IV**
L. clavata (Greg.) D. Mann	+					++				+	**30**	**1, 6, 10**	
L. hennedyi (W. Smith) Stickle & D. Mann	+	+									**20**	**1, 2**	
L. lyra (Ehr.) Karayeva							+			+	**20**	**7, 10**	
L. majuscula (Hust.) Witkowski										+	**10**	**10**	
L. spectabilis (Greg.) D. Mann	+										**10**	**1**	
Genus: ***Mastogloia*** Thwaites 1856													
M. affirmata (Leudiger-Fortmorel) Cl.	++	++	+				++	+		+	**60**	**1-3, 7, 8, 10**	**V**
M. baldjikiana Grun.					+						**10**	**5**	
M. beaufortiana Hust.	+++		+								**20**	**1, 3**	
M. binotata (Grun.) Cl.	+++	+			+	+	++		+	+	**70**	**1,2, 5-7,9, 10**	**V, X**
M. brauniii Grun.					+		+				**20**	**5, 7**	**IV**
M. citrus Cl.	++	+	+		+						**40**	**1- 3, 5**	
M. crucicola v. crucicola (Grun.) Cl.	++	++			++				+		**40**	**1, 2, 5, 9**	**V**
M. erythrea v. erythrea Grun.		+					+		++	+	**40**	**2, 7, 9, 10**	**IV, X**
Mastogloia exigua Lewis							+++				**10**	**7**	
M. fimbriata (Brightwell) Cl.	++	+		+				+	+	+	**60**	**1, 2, 4, 8-10**	**V**
M. horvathiana Grun.				+						++	**20**	**4, 10**	
M. lanceolata Thwaites						++			++	++	**30**	**6, 9, 10**	
M. levis Voigt			+								**10**	**3**	
M. macdonaldii Greville	++	++									**20**	**1, 2**	
M. ovata Grun.										+	**10**	**10**	
M. peragalli Cl.	++										**10**	**1**	
M. similis Hust.	++		++			+				+	**40**	**1,3, 6, 10**	**IV**
Genus: Mastoneis Cleve 1894													

Mastoneis biformis (Grun.) Cl.	++		+				+				**30**	**1, 3, 7**	**VI**
Genus: ***Navicula*** Bory 1822													
N. borneoensis Hust.										+	**10**	**10**	
N. cryptocephala Kütz.								+			**10**	**8**	
N. digitatoradiata (Greg.) Ralfs	+++		+		+						**30**	**1, 3, 5**	**III**
N. flagellifera (Hust.)								+			**10**	**8**	
N. pagophila Grun.			+								**10**	**3**	
N. palpebrialis Breb.							+				**10**	**7**	
N. pavillardii Hust.							+				**10**	**7**	
N. tripunctata (O. Müller) Bory			++			+		+			**30**	**3, 6, 8**	
Genus: ***Parlibellus*** Cox 1988													
P. delognei (Van Heurck) Cox				+							**10**	**4**	
Genus: Petroneis Stickle & D.G. Mann 1990													
Petroneis glaciales v. hudsonii Cl.	+										**10**	**1**	**VI**
P. humerosa (Breb.) Stickle & D. Mann	+										**10**	**1**	**VI**
Genus: ***Pinnularia*** Ehrenberg 1843													
P. stauroptera (Grun.) Cl.								++			**10**	**8**	**VII**
Genus: ***Plagiotropis*** Pfitzer 1871													
P. neovitrea Paddock	++			+			+			+	**40**	**1, 4, 7, 10**	
P. pusilla (Greg.) Kuntze					+						**10**	**5**	
Genus: ***Pleurosigma*** W. Smith 1852													
P. angualtum (Quek.) Cl.										++	**10**	**10**	
P. elongatum W. Smith									+		**10**	**9**	
P. naviculaceum Breb.					+						**10**	**5**	
P. normanii Ralfs										++	**10**	**10**	
P. praelongum Cl.	+										**10**	**1**	**VI**
P. salinarum Grun.	+		+			++					**30**	**1, 3, 6**	
P. strigosum W. Smith	+					++			+		**30**	**1, 6, 9**	
P. s. v. latum Cl.							+				**10**	**7**	**VI**
Genus: ***Seminavis*** D. G. Mann 1990													
Seminavis sp. 1	+		++	+	+		+			+	**60**	**1, 3-5, 10**	**II**
Semnavis sp. 2		++	+		+		+++		+++		**50**	**2, 3, 5, 7, 9**	**II**
Genus: ***Stauroneis*** Ehrenberg 1843													
S. anceps Ehr.										+	**10**	**10**	
S. groenlandica Östr.		++									**10**	**2**	
S. plicata Brockmann							+				**10**	**7**	
Genus: ***Trachyneis*** Petit in Folin & Pierre 1877													
T. aspera (Ehr.) Cl.		+	+	+	+	++	+++			+	**70**	**2- 7, 10**	**VI**
T. clepsydra Donkin					+						**10**	**5**	
T. velata A. Schmidt									+		**10**	**9**	
Family: Bacillariaceae Ehrenberg 1840													
Genus: ***Bacillaria*** Gmelin 1791													
B. socialis (Greg.) Ralfs				+							**10**	**4**	
B. paradoxa Gmelin								++			**10**	**8**	
B. paxillifer (O Müller) Hendey										+	**10**	**10**	
Genus: ***Nitzschia*** Hassal 1845													
N. acicularis (Kütz.) W. Smith									+		**10**	**9**	
N. angularis W. Smith									+++		**10**	**9**	
N. constricta (Kütz.) Ralfs				+							**10**	**4**	
N. dealpina Lange Bertalot & Hofmann						++					**10**	**6**	**XII**

N. dissipata (Kütz.) Ralfs							++				**10**	**7**	
N. distans Grun.									+		**10**	**9**	
N. lanceolata W. Smith										+	**10**	**10**	
N. lorenziana Grun.			+								**10**	**3**	
N. marginulata v. *marginulata* Grun	++			+++	+		+	+	+	+++	**70**	**1, 4, 5, 7-10**	**VII**
N. panduriformis v. *continua* Grun.							+				**10**	**7**	**XII**
N. panduriformis v. *panduriformis* De Toni					+	++			+		**30**	**5, 6, 9**	**VII**
N. panduriformis v. *lata* (Witt) Grun.							++				**10**	**7**	
N. pellucida Cl.			+								**10**	**3**	
N. reversa *W. Smith*									+		**10**	**9**	
N. scalpelliformis (Grun.) Grun.										++	**10**	**10**	**VII**
N. ventricosa Kitton										+	**10**	**10**	**VII**
N. vermicularis (Kütz.) Hantzsch			+								**10**	**3**	**VII**
Family: Epithemiaceae Grunow 1860													
Genus: ***Rhopalodia*** O. Müller 1895													
R. musculus (Kütz.) O. Müller			++		+	++				+	**40**	**3,5, 6, 10**	**V**
R. pacifica Krammer								++			**10**	**8**	**XI**
Family: Surirellaceae Henedy 1937													
Genus: ***Campylodiscus*** Ehrenberg 1840													
C. decorus Breb.	++		+			+					**30**	**1, 3, 6**	
Genus: ***Stenopterobia*** Brebisson 1875													
S. curvula (W. Smith) Krammer			+								**10**	**3**	
Genus: ***Surirella*** Turpin 1828													
S. ceylanensis v. *oblongestriata* Hust.									++		**10**	**9**	
S. fastosa (Ehr.) Kütz.	+					+			+	+	**40**	**1, 6, 9, 10**	**V**
S. lata W. Smith							+				**10**	**7**	
Surirella sp1	+										**10**	**1**	**V**
Surirella sp.2					+	+			+		**30**	**5, 6, 9**	**V**
Unknown diatom no.1					+				+++		**20**	**5, 9**	**XII**
Unknown diatom no.2	++				++					+	**30**	**1, 6, 10**	**XII**
Number of taxa/ site	**42**	**29**	**28**	**29**	**39**	**27**	**38**	**18**	**54**	**58**			

This may explain the scarcity of populations in the herein samples that could be attributed to the scarcity of nutrients. Consumption of dissolved nutrients especially nitrates and phosphates by aquatic plants including algae, and the difficulty to compensate their concentrations in water by replenishment from bottom sediments, that is dictated by thermal stratification, lead to depletion of these important nutrients from water (Boney, 1989). Some authors reported increase in population size at certain localities as a consequence of contamination with domestic pollutants. El-Naggar *et al*., (2002) attributed increase in population size to enrichment of water with N and P, the elements frequently reported as limiting nutrients (Boney, 1989). In the present investigation, it was taken in consideration to choose sampling sites far away as much as possible from pollution sources so as to report almost natural diatom assemblages.

Relatively a few number of taxa attained high presence values (50% or more) whereas the majority of taxa (123 taxa) showed lower values of presence referring to low frequency of the constituent taxa. The present communities were

characterized by a number of differential species that showed high fidelity to the communities of the investigated area viz; *Fragilaria leptostauron* v. *matyii*, *F. ulna*, *Hyalosynedra laevigata*, *Achnanthes brevipes*, *Diploneis crabro*, *Mastogloia affirmata*, *M. binotata*, *M. fimbriata*, Seminavis spp., *Trachyneis aspera* and *Nitzschia marginulata* v. *marginulata* (Plates II, V, VI, VII, IX and X). None of these taxa were reported in the literature cited because most of the research was concerned with phytoplankton, however, most of them were included in the species lists for sediments of the Red Sea in its northern part (Seeberg-Elverfeldt, 2004) and in Lake Timsah (Zalat 1997).

Some taxa which are not typical marine residents and are rather characteristic of brackish water were recorded such as *Cyclotella ocellata*, *Stephanodiscus hantzschii*, *Amphora ovalis*, *Anomoeoneis sphaerophora*, *Caloneis amphisbaena*, *Gomphonema olivaceum*, *Gyrosigma scalproides*, *G. spencerii*, *Navicula cryptocephala*, *N. tripunctata*, *Stauroneis anceps*, and *Nitzschia dissipata* (Plates III and VIII). These taxa sporadically occurred and had small population size. They seem to be alloctonous species that were introduced to the environment through discharge through different anthropogenic activities (Zalat 1997).

In conclusion, diatom assemblages recorded to the studied area were characteristic of tropical/ subtropical marine waters that mostly appeared in small populations. These assemblages comprised a number of alloctonous diatom species that are not true marine forms.

Acknowledgements

I'm greatly indebted to Dr Jolanta Piatek, Szafer Institute of Botany, Polish Academy of Science, for her unfailing help concerning Scanning Electron Microscopy. I'm also grateful to Mr Yasser Hefaina, Travel Ways Egypt Co., for financial support of the journey for collecting samples.

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Krammer, K. and Lange-Bertalot, H. (1988). Bacillariophyceae. 2. Teil: Bacillariaceae, Epithemiaceae, Surirellaceae. *In*: Ettl, H., Gerloff, J., Heying, H. and Mollenhauer, D. (eds): Süβwasserflora Mitteleuropa 2/2, Pub. G. Fischer Verlag, Stuttgart- New York, **596 pp**.

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دراسة أولية على فلورا الدياتومات فى المناطق الساحلية للبحر الأحمر وخليج السويس بمصر.

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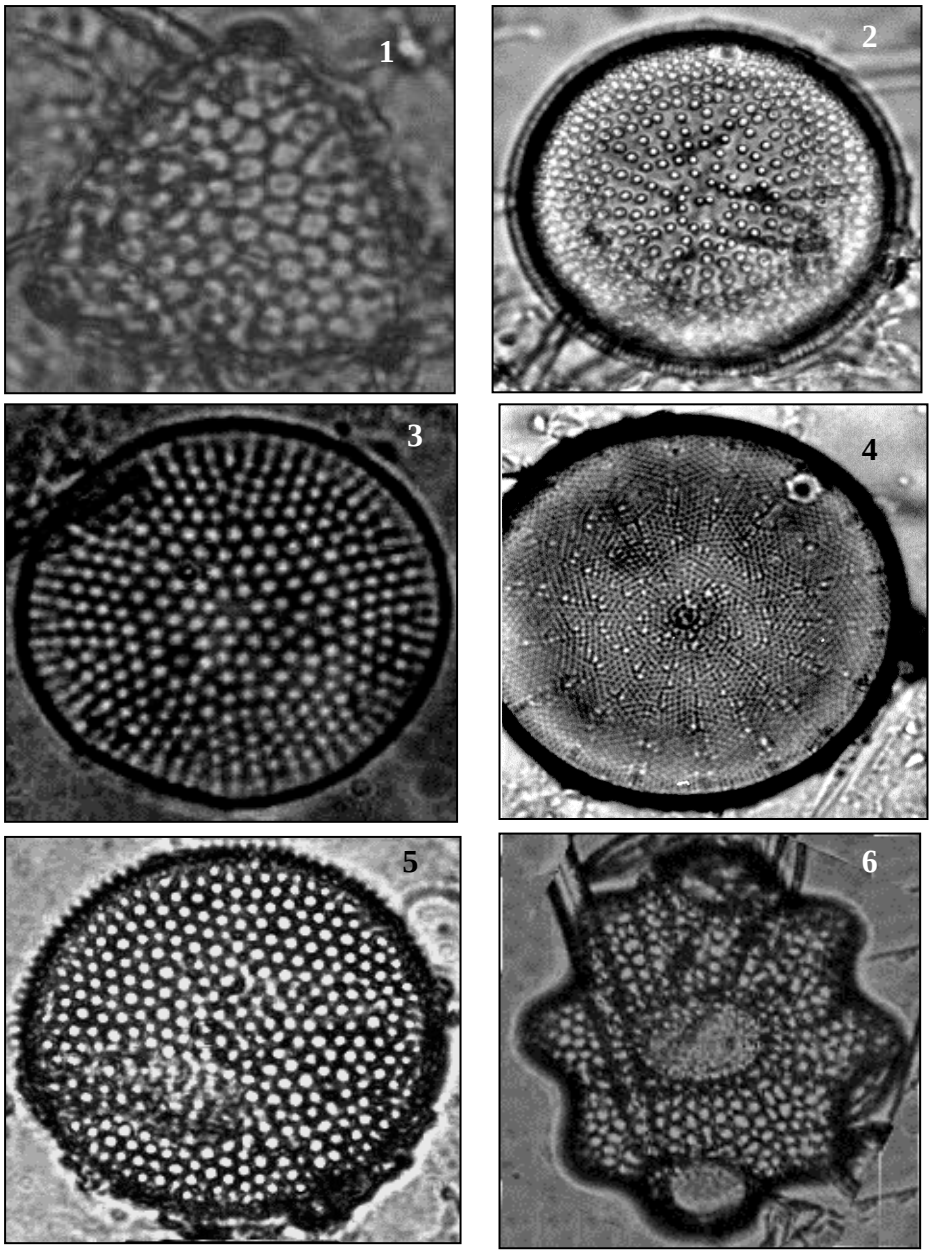
قسم النبات بكلية العلوم جامعة المنيا

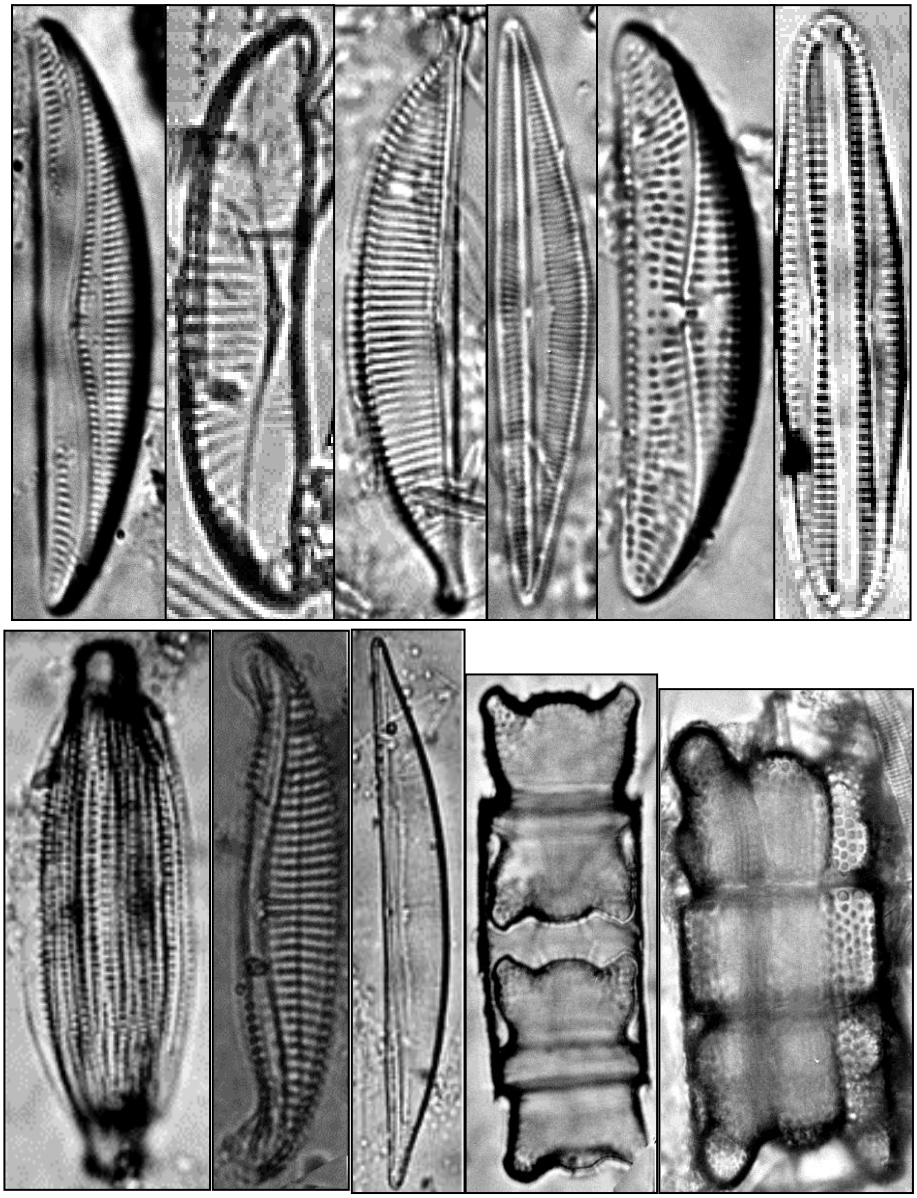
يتضمن البحث دراسة لفلورا الدياتومات على امتداد سواحل البحر الأحمر وخليج السويس بمصر وقد أمكن من خلال الدراسة تسجيل 191 نوعا من الدياتومات ممثلة لثمانى وخمسين جنسا تنتمى لعشر فصائل وتندرج تحت رتبتى المركزيات والريشيات من طائفة الطحالب العصوية. وقد كانت الفصائل؛ النافيكولاسية (101 نوعا) والفلاجيلارياسية (35 نوعا) والباسيلارياسية (20 نوعا) والأكنانتاسية (12نوعا) هى الأكثر شيوعا فى منطقة الدراسة فى حين اشتملت باقى الفصائل على عدد محدود من الأنواع. وقد أظهرت النتائج أن أجناس ماستوجلويا، نيتشيا، أمفورا وديبلونيس تميزت باحتوائها على أكبر عدد من الأنواع مقارنة بغيرها من الأجناس. وتتميز عشائر الدياتومات فى منطقة الدراسة بانتمائها لعشائر البيئات البحرية للمناطق الاستوائية والمدارية إلا أن بعض الأنواع غير البحرية الدخيلة والتى تتميز بقدرتها على تحمل الملوحة قد أقحمت فى البيئة البحرية من جراء النشاطات الإنسانية المختلفة.

Plate(I)



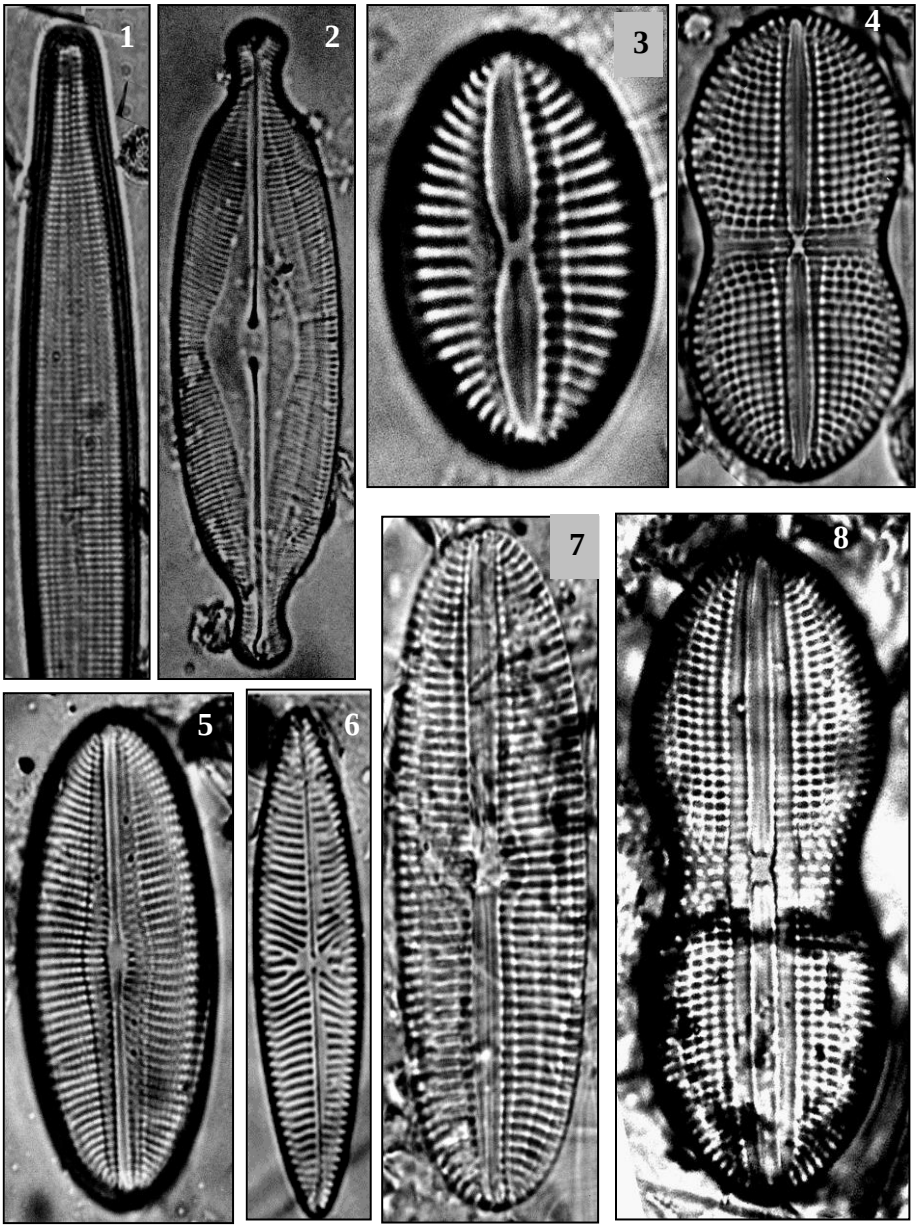
Figures 1-6; 1- *Triceratium reticulatum* Ehr. 2, *Actinocyclus ochotensis* Jouse, 3- *A. subtilis* (Greg.) Ralfs, 4- *Coscinodiscus nitidus* Greg., 5- *C. subvelatus* Greg., 6- *Biddulphia pulchella* Gray (middle part of valve face).

Plate (II)



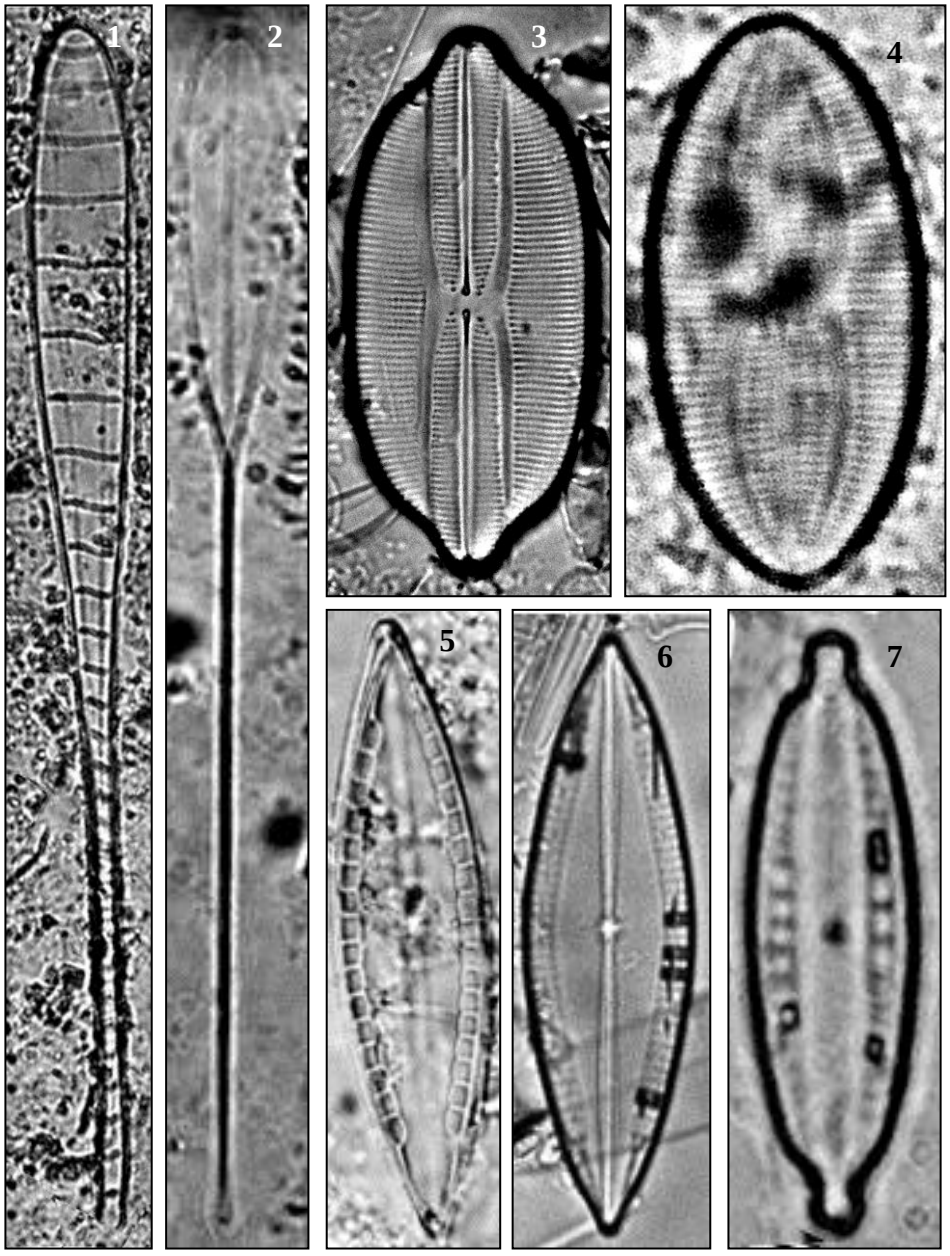
Figures 1-11; 1- *Amphora gracilis* W. Smith, 2- *A. spectabilis* Greg., 3- *Amphora holsaticoides* Nagumo & Kobayasi, 4-, Seminavis sp., 5- *Amphora proteus* Greg., 6- *A. cymatophora* Cholnoky, 7- *Amphora holsatica* Hust., 8- *A. egregia* Ehr., 9- Seminavis sp.2, 10- *Odontella aurita* (Lyngb.) Ag., 11- *Biddulphia pulchella* Gray.

Plate (III)



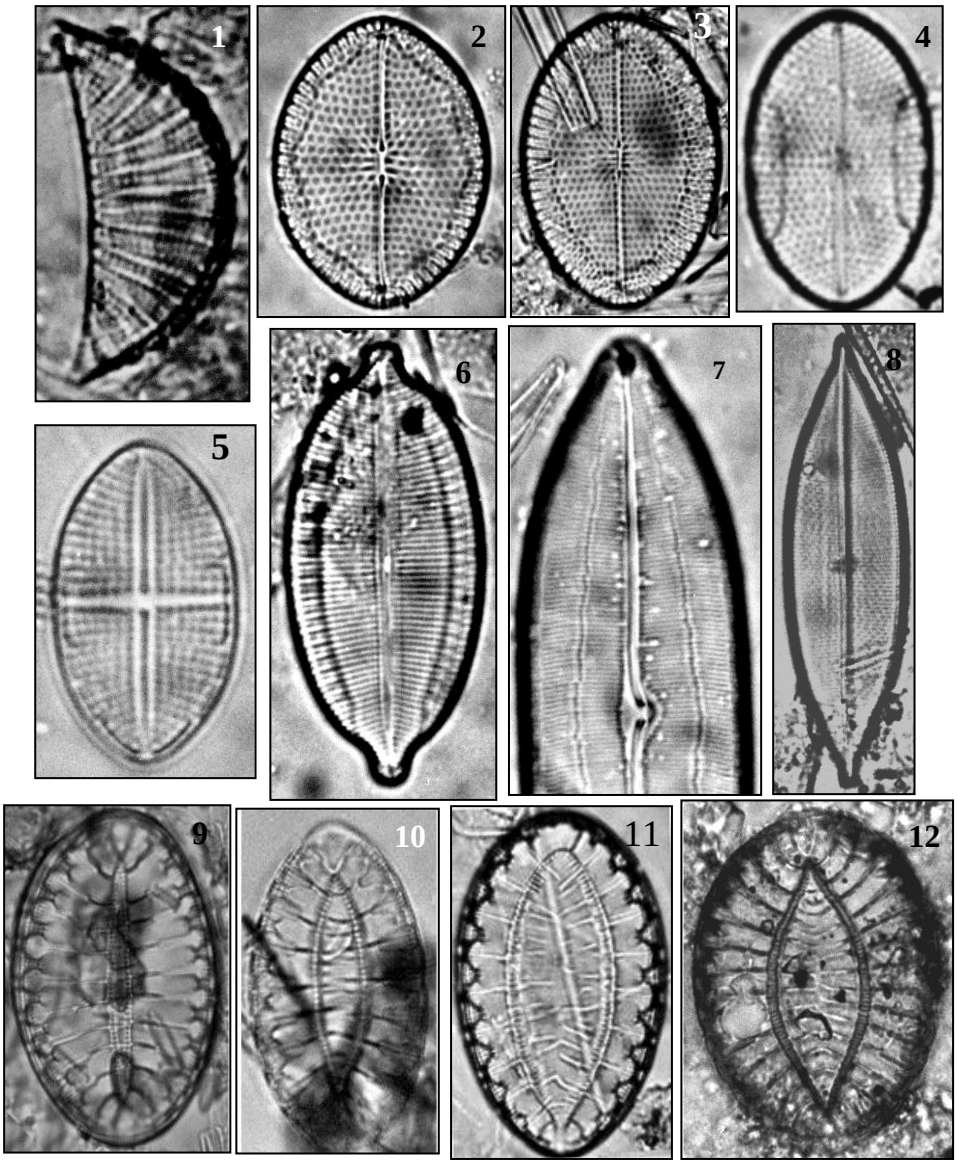
Figures 1-8; 1- *Ardissonia formosa* (Hantzsch) Grun, 2- *Caloneis amphisbaena* (Bory) Cl. 3- *Diploneis smithii* v. *smithii* (Breb.) Cl., 4- *D. bombus* Ehr., 5- *D. litoralis* v. *litoralis* (Donk.) Cl., 6- *Navicula digitatoradiata* (Greg.) Ralfs, *7- D. aestiva* (Donk.) Cl., 8- *D. bomboides* (Schmidt) Cl.

Plate (IV)



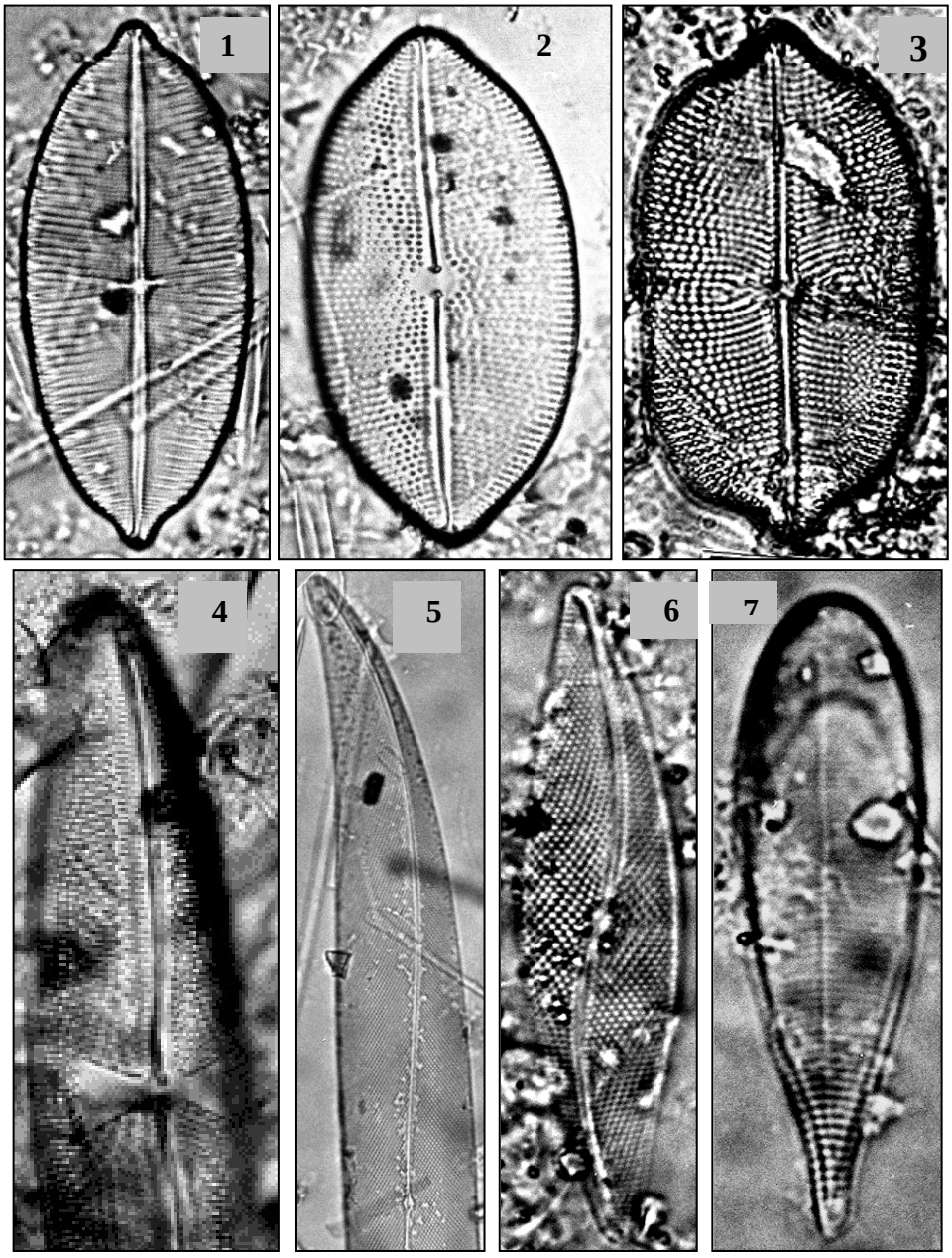
Figures 1-7; 1- *Climacosphenia moniligera* Ehr. 2, *Licmophora remulus* Grun., 3- *Lyrella amphoroides* D. Mann, 4- *Fallacia forcipata* (Grev.) Stickle & D. G. Mann, 5- *Mastogloia braunii* Grun., 6- *M. erythrea* v. *erythrea* Grun., 7- *M. similis* Hust.

Plate(V)



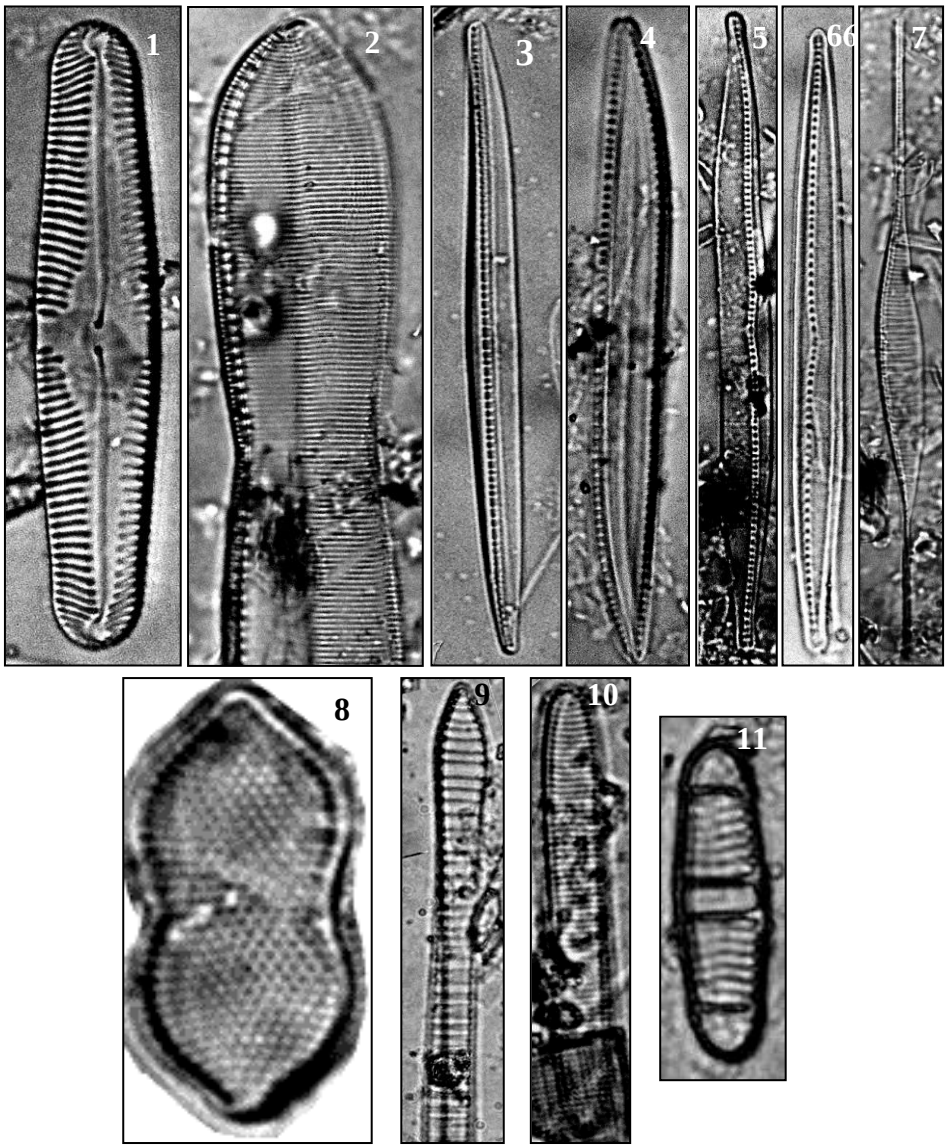
Figures1-12; 1- *Rhopalodia musculus* (Kütz.) O. Müller, 2, 3- *Mastogloia fimbriata* (Brightwell) Cl., 4- *M. binotata* (Grun.) Cl., 5- *M. crucicola* v. *crucicola* (Grun.) Cl., 6- *M. affirmata* (Leudiger-Fortmorel) Cl., 7- *Caloneis excentrica* (Grun.) Cl., 8- *Anomoeoneis sphaerophora* (Kütz.) Pfitzer, 9, 10- *Surirella fastusa* (Ehr.) Kütz. 11- S. sp 1, 12- S. sp.2.

Plate (VI)



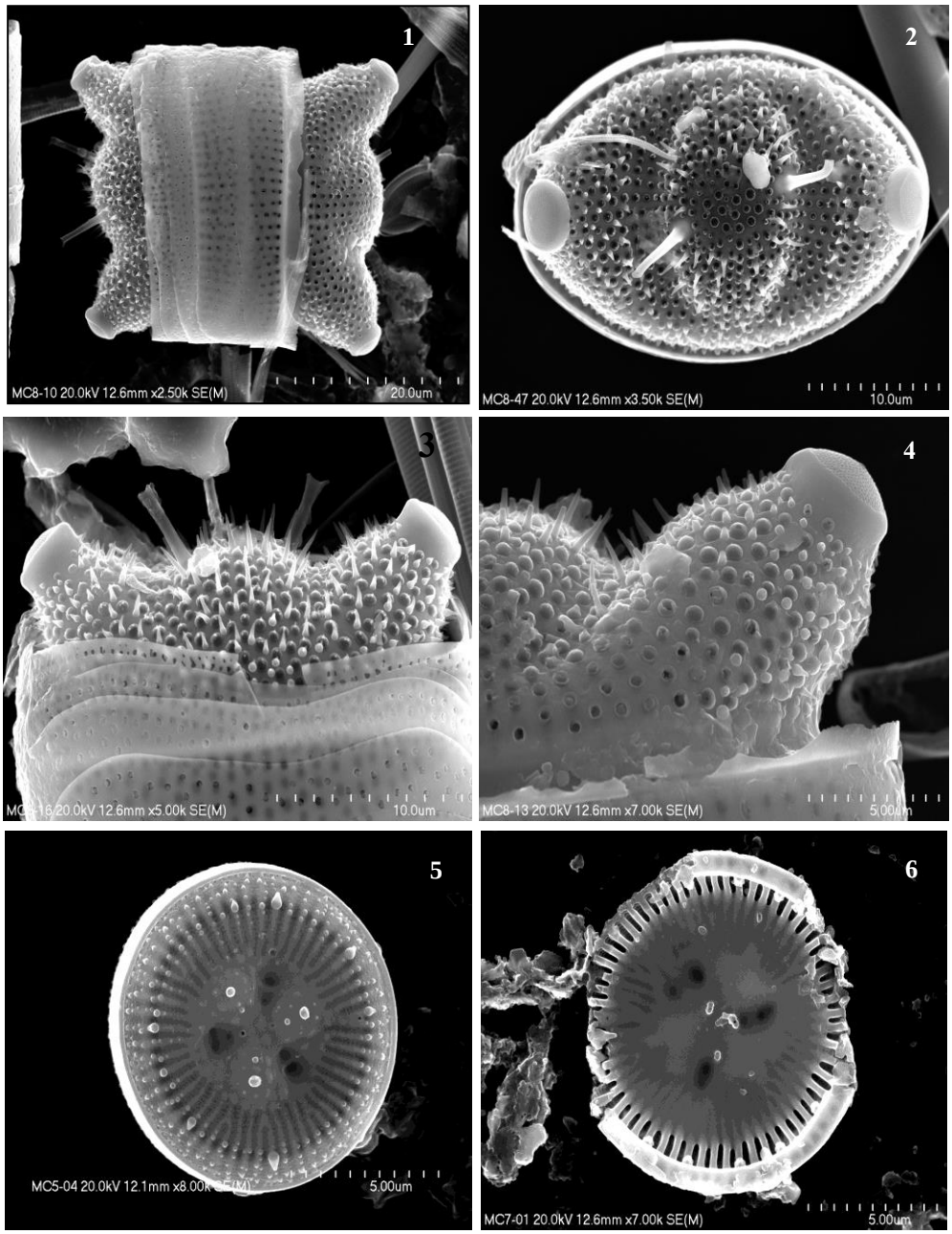
Figures 1-7; 1- *Mastoneis biformis* (Grun.) Cl., 2- *Petroneis glaciales* v. *hudsonii* Cl., 3- *P. humerosa* (Breb.) Stickle & D.G. Mann, 4- *Trachyneis aspera* (Ehr.) Cl. 5- *Pleurosigma praelongum* Cl., 6- *P. strigosum* v. *latum* Cl., 7- *Licmophora gracilis* v. *anglica* (Kütz.) Peragallo.

Plate (VII)



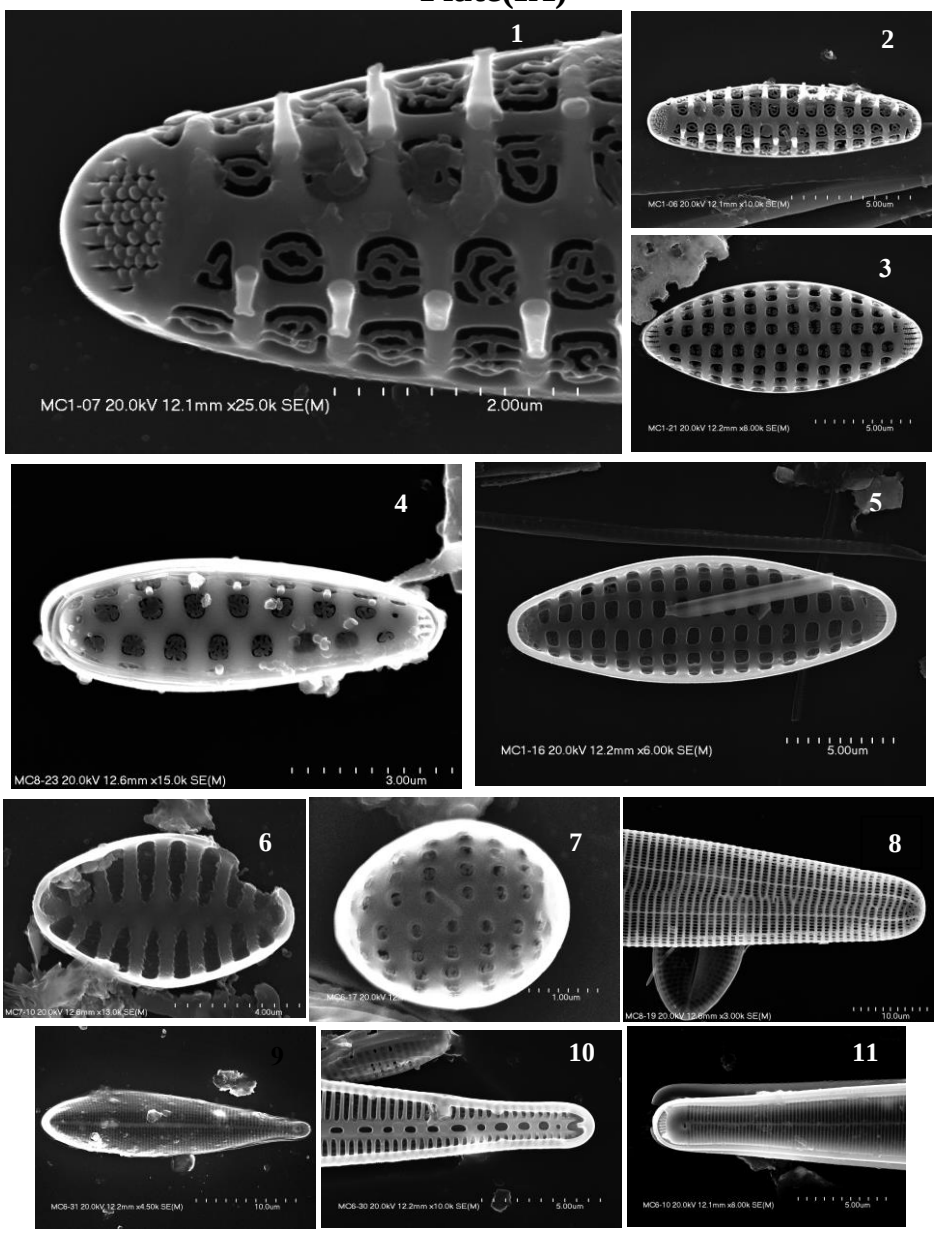
Figures 1-11; 1- *Pinnularia stauroptera* (Grun.) Cl., 2- *Nitzschia marginulata* v. *marginulata* Grun., 3, 4- *N. vermicularis* (Kütz.) Hantzsch, 5, 6- *N. scalpelliformis* Grun., 7- *N. ventricosa* Kitton, 8- *N. panduriformis* v. *panduriformis* De Toni, 9- Fragilariopsis sp.1, 10- F. sp.2, 11- *Plagiogramma pulchella* v. *pygmaeum* (Grev.) Peragallo.

Plate (VIII)



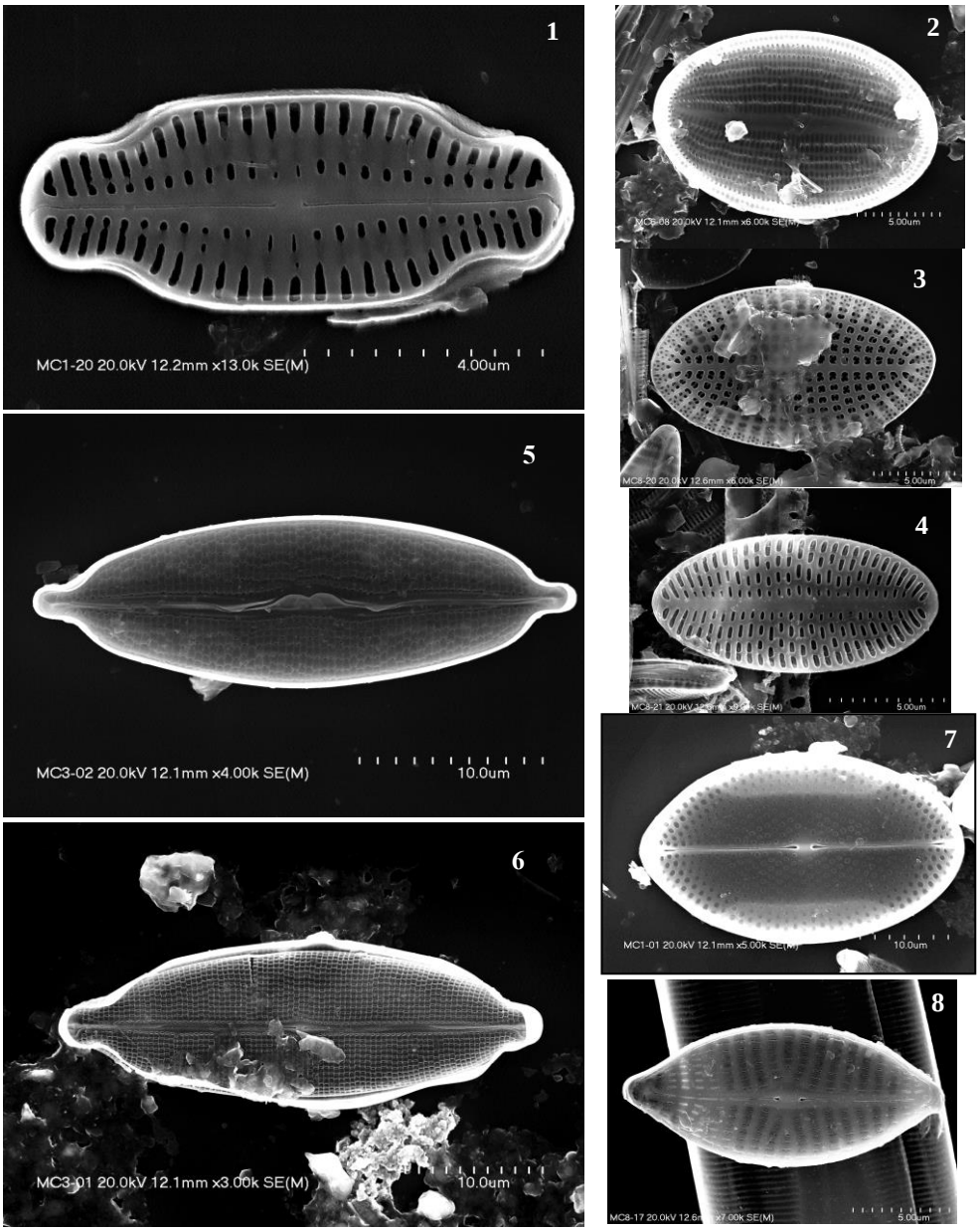
Figures 1-6; 1- 4 *Odontella aurita* (Lyngb.) Ag., 1, whole cell, 2- middle part of the valve face, 3, 4 spines and elevations on the valve face, 5, 6- *Cyclotella ocellata* Pantocsek.

Plate(IX)



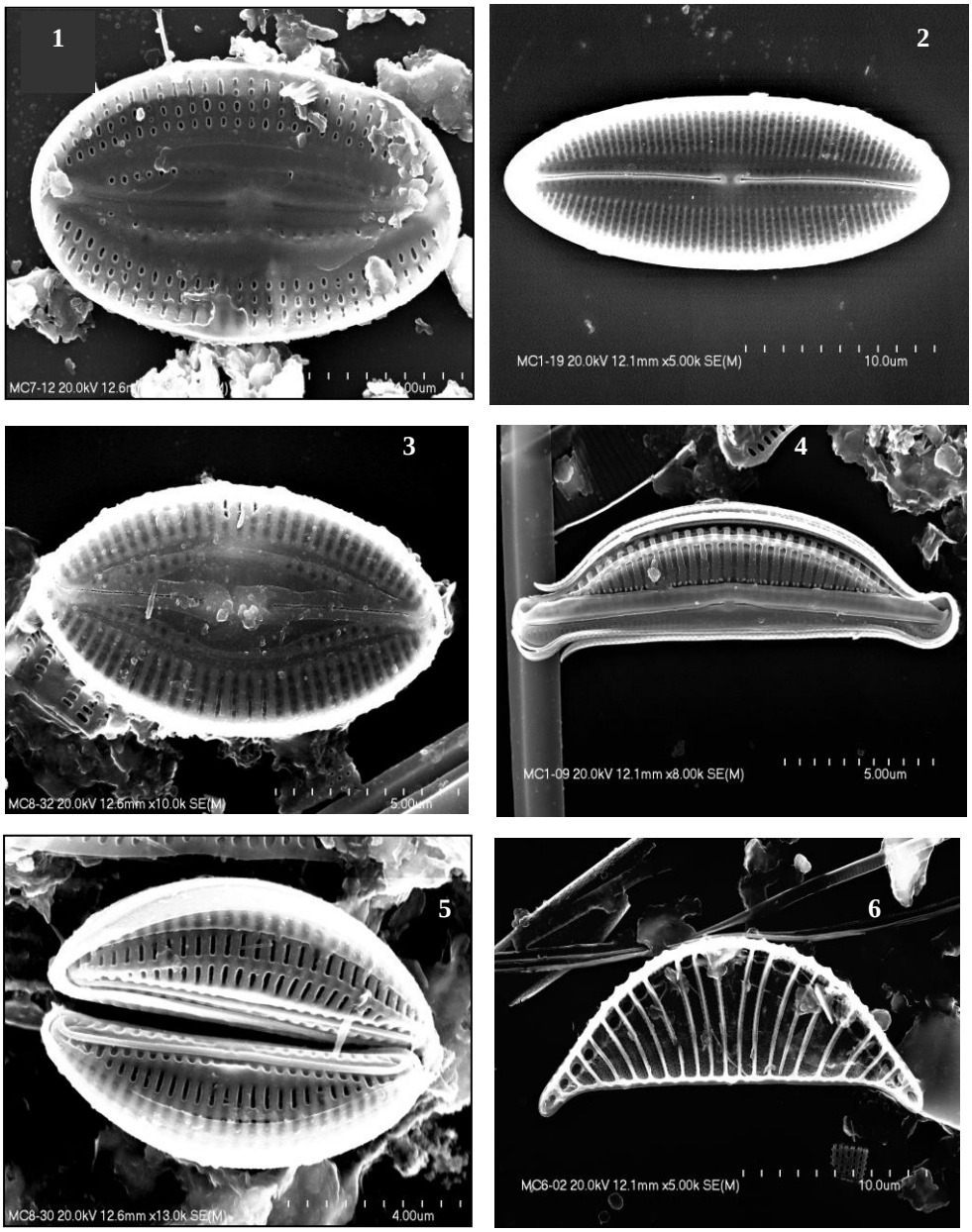
Figures 1-11; 1-3 *Fragilaria pinnata* v. *pinnata* Ehr., 4- *F. berolinensis* (Lemm.) Lange-Bertalot, 5- *F. leptostauron* v. *dubia* (Grun.) Hust., 6- *F. construens* f. *subsalina* (Hust.) Hust., 7- *F. sopotensis* Witkowski & Lange- Bertalot, 8- *Ardissonia formosa* (Hantzsch) Grun. 9, 10- *Licmophora gracilis* v. *anglica* (Kütz.) Peragallo, 11- *Hyalosynedra laevigata* (Grun.) Williams & Round.

Plate (X)



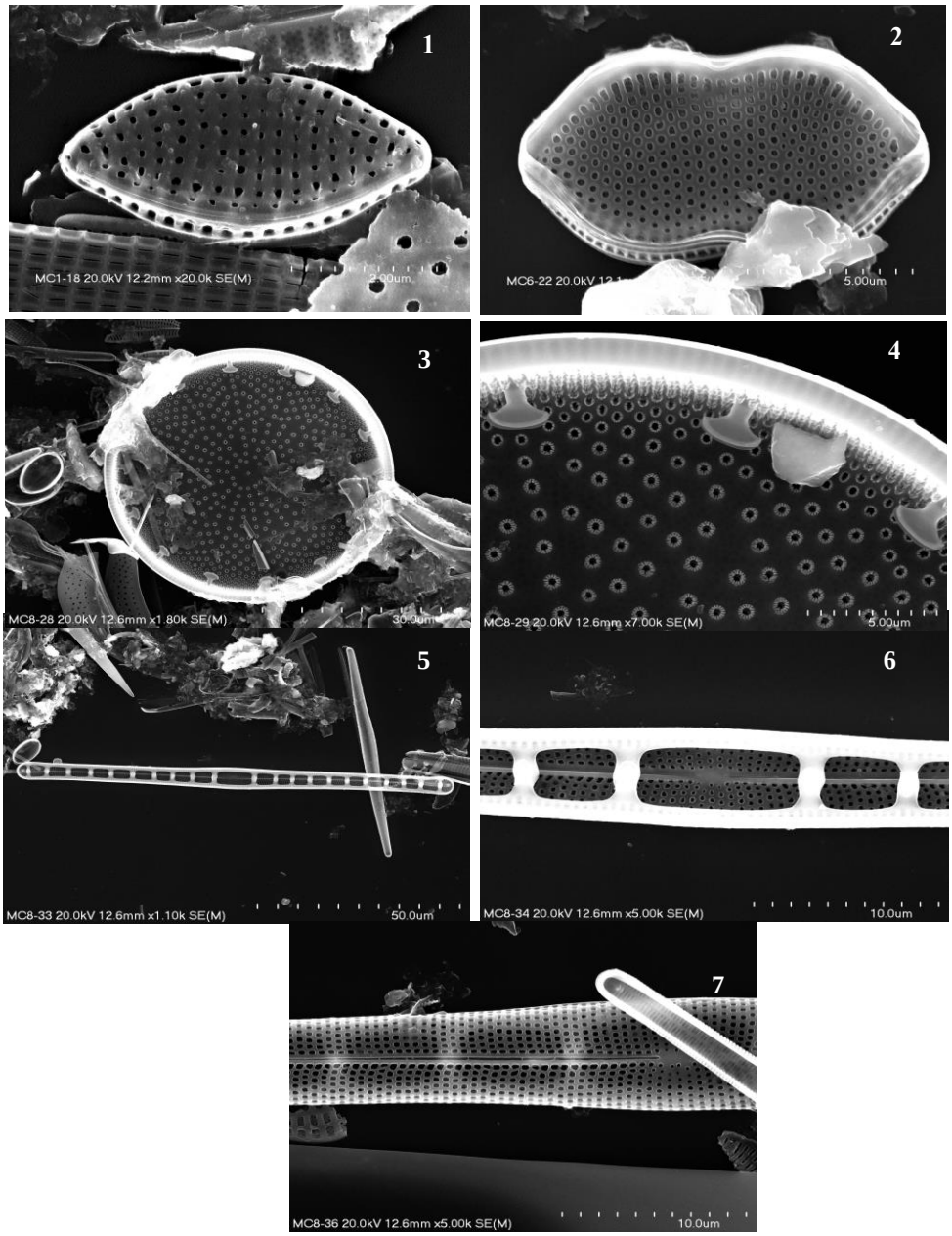
Figures 1-8; 1- *Achnanthes amoena* Hust., 2- *Cocconeis krammerii* Lange-Bertalot & Metzeltin, 3- *C. scutellum* v. *speciosa* (Greg.) Cl., 4- *C. hauniensis* Witkowski, 5- *Mastogloia erythrea* v. *erythrea* Grun., 6- *Craticula cuspidata* (Kütz.) D.G. Mann, 7- *Mastogloia binotata* (Grun.) Cl., 8- *Fogedia geisslerae* Witkowski, Metzeltin & Lange-Bertalot.

Plate (XI)



Figures 1-6; 1- *Fallcia tenera* (Hust.) D.G. Mann, 2- *F. litoricola* (Hust.) D.G. Mann, 3- *F. florianae* (Moeller) Witkowski, 4- *Amphora delicatissima* Krasske, 5- *A. exciliata* Giffen, 6- *Rhopalodia pacifica* Krammer.

Plate (XII)



Figures 1-7; 1- *Nitzschia dealpina* Lange Bertalot & Hof-mann, 2- *N. panduriformis* v. *continua* Grun., 3, 4- unknown diatom no. 1; 3- entire valve, 4- enlarged portion, 5-7, unknown diatom no.2 5, whole cell, 6, 7 frustule middle part from inferior and exterior, respectively.