TAXONOMIC STUDY OF SOME EPIPHYTIC DIATOMS ON AQUATIC PLANTS FROM AL-HAWIZAH MARSHES, SOUTHERN OF IRAQ

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ABSTRACT

Sampling of epiphytic diatoms was collected from four species of host aquatic plants(Phragmites australis Trin ex., Typha domengensis Pers., Ceratophyllum demersum L. and Potamogeton pectinatus L.), from restored marshes in Al- Hawizah, southern Iraq. Total number of (29) epiphytic diatoms of seventeen genera, twenty-nine species and, eight varieties belonging to eight families of classBacillariophyceae were recorded. The present study recorded Synedra ulna var. oxyrhynchus f. contracta as new record to Iraq algal flora.

Keywords: Systematic study, Epiphytic diatoms, Wetlands, Al- Hawizah marshes, Iraq

INTRODUCTION

The Tigris and Euphrates have created about 15.000 Km^2 of wetlands known as Mesopotamian marshes in Iraq; these wetlands comprise a complex of interconnected shallow freshwater lakes and marshlands, which are considered the most extensive wetland ecosystem in the Middle East (Brasington, 2002). Most of these marshes were exposed to drying completely or partially during 1990s due to the ex government's policy. Various projects had been carried out on these marshes after the rehabilitation (Hamdan*et al*., 2010; Al-Haidarey *et al*., 2010).Previous studies did not focus on the Al-Hawizah marshes in contrast with other Mesopotamian marshes (Maulood *et al*., 1979; Al-Mousawi *et al*., 1994). Al-Hawizah marshes situated to the east of the river Tigris, a portion of these marshes (21%) extendsover the border into Iranian territory and from these sites marshes are fed by the Karkheh River (Iran) while the other portions are fed by the river Tigris (Scott, 1995). Recently few works on phytoplankton and primary production were published on these marshes (Al-Handal and Abdulla, 2010; Hassan *et al*., 2011; Hassan *et al*., 2012a). Kasim and Mukai (2006) mentioned the importance of the contributions of benthic diatom in food webs in waters. Other authors explained the ecological importance of all types of benthic diatoms in aquatic systems (Potopova et al., 2004; Bellinger, 2006; Lane and Brown, 2007).Benthic diatoms are unicellular or colonial, free living or attaching to the substratum by gelatinous extrusion and they are mostly associated with substrata throughout their life cycles (Kasim and Mukai 2006; Werner, 1977) categorized benthic diatoms into epiphytic (attached to other plants), epipsammic (on sand), epiplic (on sediment), and epilithic (attached to rock surfaces). Diatoms are sensitive to a wide range of environmental variables, and the community structure to changing physical factors such as sediment character, light, temperature, salinity and depth (Nozaki *et al*., 2003; Zalat, 1995; Jonsson, 1987). Chemical factors such as nutrients (Kormas *et al*., 2006) and biological factors such as grazing pressure by suspension feeders conditions in the environment can affect the community structure of diatoms (Yusoff et al., 2002; Mukai, 1996; Sawai, 2001). Sawai (2001) reported that the distribution of epiphytic diatoms of the Kanedasaki (salt marsh) is correlated to the nature of

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the vegetation and substratum). In Iraq few studies dealt with morphology and taxonomy of diatoms (Hadi et al., 1984; Al-Zubaidi, 1985; Kassim, and Al-Saadi, 1995; Al-Hassany, 2010; Hassan et al., 2012a, b). Present work aimed to study the systematic account for epiphytic diatoms on four species of host aquatic plants in Al-Hawizah marshes and to fill the knowledge gap in epiphytic algae in marshes for the first time.

MATERIALS AND METHODS

Samples of four species of host aquatic plants (*Phragmites australis* Trin. ex., *Typha domengensis* Pers., *Ceratophyllum demersum* L. and *Potamogeton pectinatus* L.), were collected from under water surface due to seasonal abundance and uneven local distribution from the study marshes (Al-Hawizah). The plant parts were placed in polyethylene bags and kept wet for laboratory examination. Separation of epiphytic diatom population from their host was carried out by scraping and manual shaking for 30 minutes (Zimba and Hopson, 1997). Bacillariophyceae taxa were studied after clearing the frustules by concentrated sulfuric acid and potassium dichromate method (Patrick and Reimer, 1966). Detailed studies were made under a compound microscope with camera and microns (µm) are used to describe the diameter (L: length and W: width) of each examined taxon and photographs were taken also. Several references were used for identification of epiphytic diatoms (Hadi *et al*., 1984; Al-Zubaidi, 1985; Patrick and Reimer, 1966; Hustedt, 1930; Patrick and Reimer, 1975; Pankow, 1976; Foged, 1978; Czarnecki and Blinn, 1978; Germain, H. 1981; Snoijs, 1993; Snoijs and Balashova, 1998). The identification references were listed beside each taxon.

RESULTS AND DISCUSSION

A total of 29 epiphytic diatoms (26 species belonging to order Pennales, and 3 species belonging to order Centrales) were identified. A total of 17 genera, 29 species and 8 varieties belonging to 14 families of class Bacillariophyceae, were described and photographed for the first time in the studied area in order to fill the gap of information of epiphytic algae in Mesopotamian marshes. One epiphytic diatom in this study was added to the flora of algae in Iraq as a new record according to Maulood and Toma (2004).

The following is a description of identified diatoms in this study:

Division: Bascilariophyceae

Order: Pennales

Family: Epithemiaceae

Genus: *Rhopalodia*

Species: *Rhopalodia gibba* var. *ventricosa* (Ehr.) Grunow (pl. 1, fig. 1)

[(Patrick and Reimer, 1975), 190, pl . 28 , figs . 3- 4 ; (Foged, 1977) ,106 , pl. 43, fig. 7 ; (Czarnecki, and Blinn, 1978),102 , pl.22 , fig .12; (Germain, 1981), 320, pl.119 , figs.1- 5 ; (Hadi *et al*., 1984), 534, pl.12 , fig.217 pl.37, figs. 3)

L.42.64 - 65.5 µm .W.9.3 µm; costae 7- 8 in 10 µm.

Genus: *Epithemia*

Species: *Epithemia zebra* (Ehr). Kützing (pl. 1, fig. 2)

[(Hustedt, 1930).729; 384, fig 29), 179 -180, pl . 24, figs . 3- 4; (Hadi *et al*., 1984), 536, pl.12 , fig.211; (38), 45, fig.132].

L .44.7- 50 9 µm.W.9.36- 10 µm; costae 3- 4 in 10 µm; 2-4 rows of areoloe between2 costae.

Species:*Epithemia zebra* var. ***procellus*** (Ehr.) Kützing (pl. 1, fig. 3)

[(Hustedt, 1930), 385, fig.731; (Pankow, 1976), 2 84, , fig . 601; (Foged, 1977) ,52 , pl. 37, fig. 4; (Germain, 1981), 316 , pl.116 , figs.1-11; (Hadi *et al*., 1984) , 536, pl.5 , fig.84; pl.12 , figs. 210,215 ; (Al-Zubaidi, 1985),119 , pl.6 ,figs . 11-14].

L.50 .96 -75.92 µm.W. 9.36 µm; costae 2- 4 in 10 µm; 4-5 rows of areoloe between 2 costae .

Species: *Epithemia sorex* Kützing (pl. 1, fig. 4)

[(Hustedt, 1930), 388, fig.736; (Patrick and Reimer, 1975), 188 , pl . 27 , fig . 4 ;(Lawson and Rushforh, 1975), 51, pl. 367, figs. 5; (Czarnecki. and Blinn, 1977), 29 , pl.19, fig.3 ; (Czarnecki and Blinn, 1978) , 100 , pl. 22 , fig. 10; (Hadi *et al*., 1984), 536, pl.5 , fig.83 ; pl.12 , figs. 213-214 ; (Snoijs, 1993), 49, fig.44].

L.22.8 µm.W.8.3 µm; costae 2 in 10 µm; 15 rows of areoloe between 2 costae.

Familly:Cymbellaceae

Genus: *Cymbella*

Species:*Cymbellacistula*(Hemprich) Cleve (pl. 1, fig. 5)

[(Hustedt, 1930), 363, fig.676 a; (Patrick and Reimer, 1975),29-30, pl . 4 , fig . 6; (Foged, 1977),40 , pl. 37, figs. 6 - 7; (Czarnecki and Blinn, 1977),34 , pl.8, fig. 5; (Czarnecki and Blinn, 1978),59 , pl.14 , fig. 8; (Germain, 1981), 282 , pl.103, figs.1-11; (Hadi *et al*., 1984), 534, pl.4 , figs.69-73; pl.11 , fig. 196; (Al-Zubaidi, 1985),116, pl.5,figs. 87-88; (Snoijs and Vilbaste, 1994), 35, fig.123].

L .42.64 - 97.76 µm .W.17.6 µm ; striae 9-10 ventrally in 10 µm and 8-9 dorsally in 10 µm.

Species: *Cymbella ventricosa* Kützing (pl. 1, fig. 6)

[(Hustedt, 1930) , 359, fig.661 ; (Lawson and Rushforh, 1975), 47, pl. 33, figs. 1- 3; (Hadi *et al*., 1984), 534, pl.11 , fig.199 ; pl.1 , fig.195; (Snoijs and Potapova, 1995), 46, fig. 234].

L .17.68 µm .W.7.2 µm ; striae 13 ventrally in 10 µm and 12 dorsally in 10 µm.

Species:*Cymbella tumida* (Bréb) V. Heurck (pl.1, fig. 7)

[(Hustedt, 1930), 366 , fig.677; (Patrick and Reimer, 1975),58 , pl . 10 , fig . 8; (Czarnecki and Blinn, 1978), 63 , pl.15 , fig. 8; (Foged, 1978),49 , pl. 37 , figs. 2-3; (Germain, 1981), 288 , pl.106 , figs.1-2; (Hadi *et al*., 1984), 534, pl.4 , fig. 70 ; pl.11 , fig.194; (Al-Zubaidi, 1985),117, pl.5, figs. 93-94].

L .49.92 - 97.76 µm .W.7.68 µm ; striae punctuate about 17- 20 punctae in 10 µm ; striae 9 ventrally and 10 dorsally in 10 µm.

Family: Epithemiaceae

Genus: *Denticula*

Species: *Denticula rainierensis* Sov. (pl. 1, fig. 8)

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[(Czarnecki and Blinn, 1977), 28 , pl.19, fig. 2; (Czarnecki and Blinn, 1978),98 , pl.22 , figs. 5a , 5b; (Hadi *et al*., 1984), 536, pl.6 , fig. 110; pl.10 , fig. 179; (Al-Zubaidi, 1985),119, pl.6 ,fig. 105].

L .17.68 –28.08 µm .W. 4.16 – 5.1 µm .; costae 7-8 in 10 µm.

Family: Achnanthaceae

Genus: *Achnanthes*

Species:*Achnanthes lanceolata* var. *dubia*Grunow(pl. 1, fig. 9)

[(Czarnecki and Blinn, 1977), 70, pl.7, fig. 6].

L .14.56 – 16.64 µm. W. 5.2 – 5.72 µm; striae 9-10 in 10 µm.

Family: Fragilariaceae

Genus: *Diatoma*

Species: *Diatoma vulgare* Bory (pl. 1, fig. 10)

[(Hustedt, 1930), 126 fig. 103; (Patrick and Reimer, 1966) ,109-110, pl . 2 , fig . 10; (Lawson and Rushforh, 1975), pl. 3 , fig. 8; (Foged, 1977),28 , pl. 5, fig. 8; (Czarnecki and Blinn, 1977), 70 , pl.7, fig. 6; (Czarnecki and Blinn, 1978),27 , pl.5 , fig. 3; (Germain, 1981), 282 , pl.103 , figs.1-11; (Hadi *et al*., 1984), 520, pl.1, fig. 17; pl.8 , fig. 137; (Al-Zubaidi, 1985),116, pl.5,figs . 87-88 ; (Snoijs, 1993), 52, fig.38].

L .28.08 µm .W. 13.5 µm; costae 8 -9 ventrally in 10 µm.

Family: Suirellaceae

Genus: *Surirella*

Species: *Surirella ovata* Kützing (pl. 1, fig. 11)

[(Hustedt, 1930), 442, fig. 863,864; (Lawson and Rushforh, 1975), 56, pl. 40, fig. 9; (Czarnecki and Blinn, 1978),120, pl.27 , fig. 1; (42),663 , pl. 15, fig. 9; (Germain, 1981), 326, pl.149 , fig.3; (21), 541, pl.7, fig. 122; pl.14 , fig. 240].

L .26 - 33. 28 µm. W. 17.68 µm ; costae 4-5 in 10 µm ; striae 15-17 in 10 µm.

Family: Naviculaceae

Genus: *Diploneis*

Species: *Diploneis ovalis* var. *oblongella*(Näg.) Cleve (pl. 1, fig. 12)

[(Hustedt, 1930), 449, fig. 391; (Germain, 1981), 144, pl.55, figs.9-11; (Al-Zubaidi, 1985), 109, pl.3, fig.57].

L. 28.12 µm; W. 11.44 µm; striae 15 in 10 µm.

Family: Nitzschiaceae

Genus: *Hantzschia*

Species: *Hantzschia amphioxys* (Ehr.) Grunow (pl. 1, fig. 13)

[(Hustedt, 1930), 394, fig. 747; (Foged, 1971), 294, pl. 18, fig.3; (Lawson and Rushforh, 1975), 52, pl. 38, fig. 1; (Foged, 1977), 71, pl. 43, fig.9; (Czarnecki and Blinn, 1977), 61, pl.16, fig. 1; (Czarnecki and Blinn, 1978), 104 , pl.23 , fig. 4; (Germain, 1981), 326, pl.123 , figs.1, 2].

L .28.08 µm .W.5.2 µm ; keel punctae 8 in 10 µm; striae 15 in 10 µm.

Family:Naviculaceae

Genus: *Mastogloia*

Species: *Mastogloia smithii* var. *amphcephala* Grunow (pl. 1, fig. 14)

[(Hustedt, 1930), 216, fig.315; (Patrick and Reimer, 1966),299, pl . 72 , figs . 14-15; (Foged, 1977), 72 , pl. 16 , figs. 2a, b -3a,b; (Hadi *et al*., 1984), 530, pl.3 , figs.49-50; pl.10 , figs.175 -176; (Czarnecki and Blinn, 1977): (Snoijs and Potapova, 1995), 62, fig.250].

L .34.32 µm. W.10.4 µm; striae 18 in 10; loculi 7 in 10 µm.

Species: *Mastogloia* braunii Grunow (pl. 1, fig.15a,b)

[(Hustedt, 1930), 218, fig.320; (Patrick and Reimer, 1966), 302, pl. 20, figs. 18-19; (Hadi *et al*., 1984), 530, pl.3, figs.51- 52; pl.10, figs.170- 171; (Al-Zubaidi, 1985),106, pl.2,fig.37; (Snoijs, 1993),70 , fig.56].

L. 41.6-46.8 µm; W. 14.56-15.6 µm; striae 20 in 10 µm; loculi 5 – 8 in 10 µm.

Family: Naviculaceae

Genus: *Navicula*

Species: *Navicula lanceolata* (Ag.) Kützing (pl. 1, fig. 16)

[(Hustedt, 1930), 305, fig. 540;(Patrick and Reimer, 1966), 511-512 ,496, pl. 48, figs.19-20; (Lawson and Rushforh, 1975), . 36, pl. 24 , fig. 6; (Czarnecki and Blinn, 1977), 50 , pl.2, fig. 8; (Foged, 1971) , 302, pl. 2, fig. 2; (Czarnecki and Blinn, 1978), 84 , pl.19, fig.8; (Germain, 1981), 180, pl.68, figs.1-3: (Snoijs, 1993), 81, fig.66].

L. 31.2 µm; W. 6.24 µm; striae 15 in 10µm.

Genus: *Navicula*

Species: *Navicula mutica* var. *nivalis* (Ehr.) Hustedt (pl. 1, fig. 17)

[(Hustedt, 1930), 275, fig. 453c; (Germain, 1981), 212, pl.80, figs7,8].

L. 14.56 - 20.8 µm; W. 6.2 - 7.28 µm.

Species: *Navicula rhynchocephala* Kützing (pl. 1, fig. 18)

[(Hustedt, 1930), 296, fig. 501; (Patrick and Reimer, 1966), 505, pl . 48, fig. 6; (Lawson and Rushforh, 1975), 36, pl. 24, fig. 6; (Czarnecki and Blinn, 1977), 52, pl.13, fig. 3; (Carter and Bailey-Watts, 1970), 586, pl.13, figs.10-11; (Germain, 1981), 180, pl.69, figs.1; (Hadi *et al*., 1984), 533, pl.4, fig. 60; (Al-Zubaidi, 1985), 113, pl.4, fig. 74].

L .49.9 -50.9 µm .W. 10.4 µm; striae 11 - 13 in 10µm.

Family: Nitzschiaceae

Genus: *Nitzschia*

Species: *Nitzschia scalaris* (Ehr.) W.Smith (pl. 2, fig. 19 a,b)

[(Hustedt, 1930), 409, fig.783; (Germain, 1981), 330, pl.123, fig.3; (Al-Zubaidi, 1985), 124, pl. 7, figs. 135- 137; (41), 82, fig. 270].

L .520 - 613.6 µm; W. 20.8 - 21.84 µm; 3-4 keel punctae in 10µm; striae 10 in 10µm.

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Species: ***Nitzschia filiformis*** (W. S.) Hustedt (pl. 2, fig. 20)

[(Hustedt, 1930), 422, fig. 818 a-c; (Lawson and Rushforh, 1975), 53, pl. 38, fig. 6; (Czarnecki and Blinn, 1977), 68, pl.17, fig 7; (Czarnecki and Blinn, 1978), 114, pl. 25, fig. 3; (Germain, 1981), 372 , pl.140, figs.6-8; (Hadi *et al*., 1984), 538, pl.6, fig. 112; pl.14, fig. 238; (Al-Zubaidi, 1985),121, pl.6, figs. 119 - 120; (Snoijs, 1993) , 88, fig. 74].

L. 40.56 – 61.3µm; W. 4.16 – 5.2 µm; 8-9 keel punctae in 10 µm.

Species: ***Nitzschia obtusa*** W.Smith (pl. 2, fig. 21)

[(Hustedt, 1930), 422, fig. 817 a-c; (Pankow, 1976), 298, fig. 625; (Hadi *et al*., 1984), 539, pl.6, fig. 113-114 ; pl.15, figs. 32-35; (Al-Zubaidi, 1985),123, pl.7, fig. 132].

L .156.8 – 173.68 µm; W. 9.36 – 10.4 µm; 5 - 6 keel punctae in 10 µm.

Family: Fragilariaceae

Genus: ***Synedra***

Species: ***Synedra ulna*** **var.** ***oxyrhynchus*** **form.** ***contracta*** Hustedt (new record in form) (pl. 2, fig22) .

[(Hustedt, 1930), 152, fig. 161].

L. 87.36 µm; W. 6.24 µm; 9-12 striae in 10 µm.

Species: ***Synedra ulna var. danica*** (Kütz.) Grunow (pl. 2, fig. 23)

[(Hustedt, 1930), 154, fig. 168; (Patrick and Reimer, 1966), 151, pl. 7, fig. 4; (Germain, 1981), 78, pl.25, figs. 7-8].

L. 161.2 µm; W. 5.2 µm; 9-10 striae in 10 µm.

Species: ***Synedra vaucheriae*** Kützing (pl. 2, fig. 24)

[(Hustedt, 1930), 161, fig. 192-194; (Germain, 1981), 80, pl.28, figs. 1-21; (Hadi *et al*., 1984), 324, pl. 1, figs.13; pl. 8; figs.138-139: (Foged, 1977), 63 , pl. 6 , figs. 8-9: (Snoijs and Potapova, 1995),56 , fig.244].

L. 22.88 - 35.36 µm; W. 3.12 - 4.16 µm; 10-14 striae in 10 µm.

Family: Fragilariaceae

Genus: ***Fragilaria***

Species: ***Fragilaria brevistriata*** Grunow (pl. 2, fig. 25)

[(Hustedt, 1930), 145, fig. 151; (Patrick and Reimer, 1966), 128, pl. 4, fig. 14]

L. 16.4 -20.8 µm; W. 4.16 µm; striae 10-17 in 10 µm.

Family: Nitzschiaceae

Genus: ***Bacillaria***

Species: ***Bacillaria paxillifer*** (Müll.) Hendy (pl. 2, fig. 26)

((Hustedt, 1930), 396, fig.755 b; (Pankow, 1976), 290, pl . 19 , fig.1; (Czarnecki and Blinn, 1978), 103, pl.23, fig.220; (Germain, 1981), 326 , pl.123 , figs.1-2 ; (Hadi *et al*., 1984), 537, pl.6, fig 111; pl.13 , fig. 220; (Al-Zubaidi, 1985),120, pl.6, figs . 112,113 ; (Snoijs, 1993), 26, fig.12).

L. 72.8-100.88 µm; W. 5.16 µm; striae 20-25 in10 µm and 5-7 keel punctae in 10 µm.

Order: Centrales

Family: Coscinodiscaceae

Genus: *Cyclotella*

Species: *Cyclotella striata* (Kütz.) Grunow (pl. 2, fig. 27)

[(Hustedt, 1930), 101, fig. 71; (Hadi *et al*., 1984)., 518, pl.1, fig. 22; pl.8, fig. 135] .

Dia. 26-43.68 µm; Costae 8-10 in 10 µm.

Family: Coscinodiscaceae

Genus: *Melosira*

Species: *Melosira juergensi*Agardh (pl. 2, fig. 28)

[(Hustedt, 1930), 84 fig. 40 ;(Germain, 1981), 22, pl.1, figs.3-7; (Al-Zubaidi, 1985), 102, pl.1, figs. 2, 3; (Snoijs, 1993), 75, fig. 61].

L .27.04 µm; W. 13.52 µm.

Species: *Melosira dickiei* (Thwa.) Kützing (pl. 2, fig. 29)

[(Hustedt, 1930), 86 fig. 42; (Germain, 1981), 24, pl.2, figs.1-8; (Al-Zubaidi, 1985), 102, pl.1, figs. 2, 3].

L. 19.76 µm; W. 10.4 µm.

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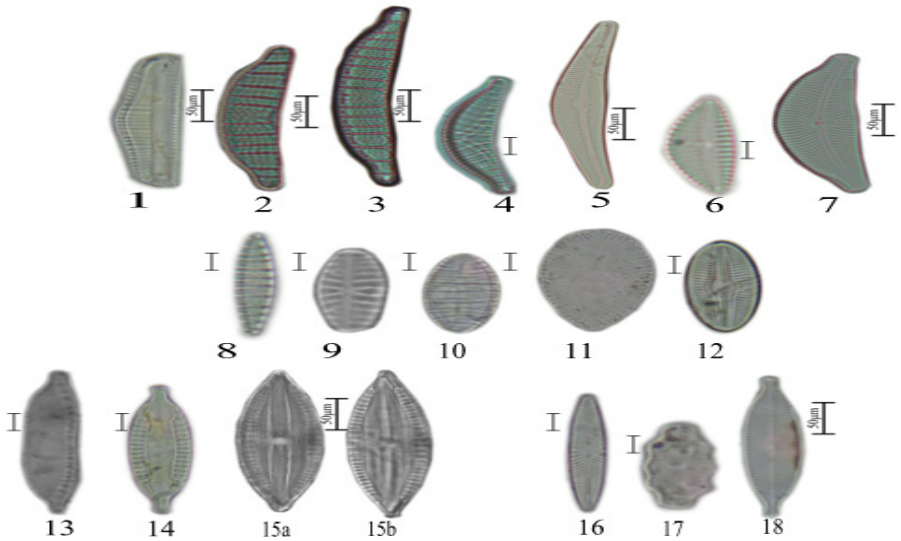

Plate (1): Class I: Bacillariophyceae: Order: Pennales: figs. 1. *Rhopalodia ventricosa*, 2.*Epithemia zebra*, 3.*E.zebra var.procellus*, 4.*E.sorex*, 5.*Cymbella cistola*, 6. *C. ventricosa*, 7. *C. tumida*, 8. *Denticula rainierensis*, 9. *Achnanthes lanceolatum* var *dubi*, 10. *Diatoma vulgare*, 11. *Surirella ovata*, 12. *Diplonis ovalis* var. *oblenglla*, 13. *Hantzschia amphioxys*, 14. *Mastogloia smithii* var. *amphicephala*, 15. a, b. *M.braunii*, 16. *Navicul lanceolata*, 17.*N. mutica* var.*nivalis*, 18.*N. rhynchocephala* (each scale represents 10 µm unless otherwise mentioned).

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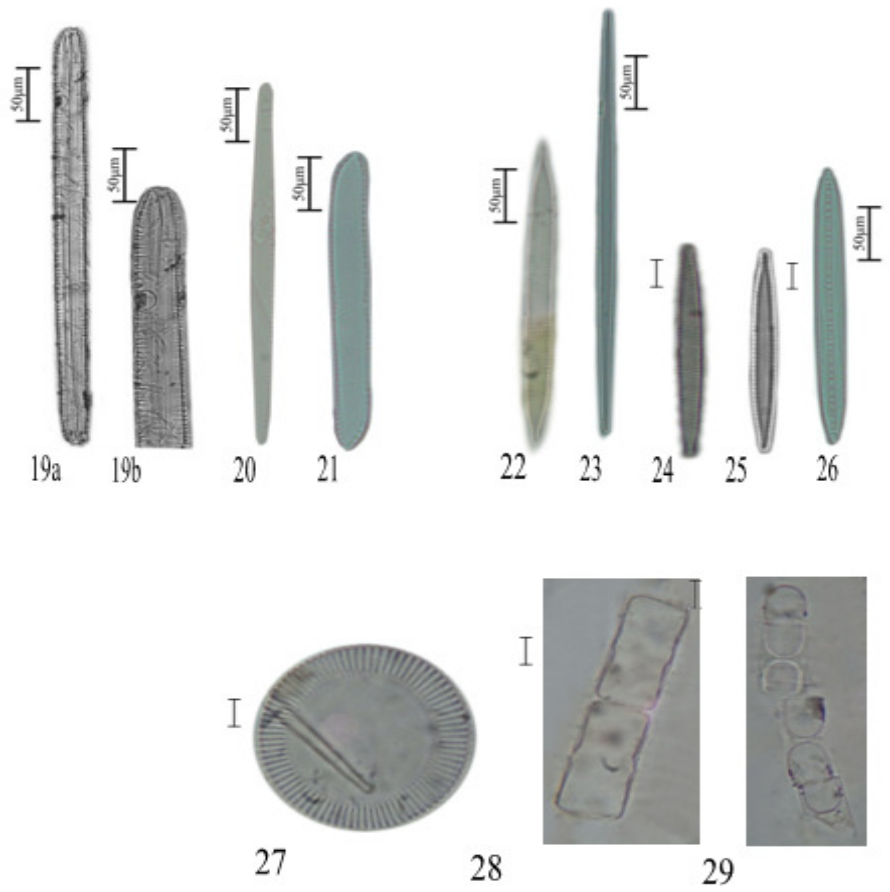

Plate (2): Class I: Bacillariophyceae: Order: Pennales: figs. 19a, b. *Nitzschia scalaris*, 20. *N.filiformis* 21.*N. obtusa*, 22.*Synedra ulna*.var.*oxyhynchus* fo.*contracta*, 23.*S. ulna* var. *danica*, 24.*S.vaucheria*, 25.*Fragilaria brevistriata*, 26.*Bacillaria paxillifer*, Order: Centrales: figs. 27. *Cyclotella striata*, 28.*Melosira juergensi*, 29.*Melosira dickiei* (each scale represents 10 µm unless otherwise mentioned).

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