



Research article

Diatoms diversity of Mahanandi, Kurnool district, Andhra Pradesh, India

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Abstract: The present study was undertaken to explore the diatom wealth of water bodies from the holy shrine Mahanandi and a water tank nearby Nandyal adjacent to Mahanandi, Kurnool district of Andhra Pradesh, India located between 15.4709° N, 78.6255° E. The algal samples were collected in different seasons. The preliminary taxonomic evaluation yielded 35 diatom taxa belonging to 17 genera viz. *Bacillaria* (1), *Cocconeis* (1), *Craticula* (2), *Cymbella* (5), *Diploneis* (1), *Epithmia* (1), *Eunotia* (1), *Fragilaria* (2), *Gomphonema* (6), *Gyrosigma* (2), *Mastogloia* (1), *Nitzschia* (1), *Pinnularia* (1), *Rhopalodia* (1), *Surirella* (2), *Tryblionella* (2) and *Ulnaria* (2).

Keywords: Diatoms - Mahanandi and Nandyal - Kurnool District.

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INTRODUCTION

Diatoms are commonly observed in microscopic phytoplankton in the aquatic ecosystem. Diatoms are comfortably distinguished from other groups of algae, they secrete a silica exoskeleton called frustule. The frustule comprises of two overlapping halves called thecae (valves). The identification and classification of the diatoms is generally based on the morphology of valves. Venkataraman (1939), Krishnamurthy (1954), Gandhi (1952, 1955, 1956, 1957a,b,c), Desikachari *et al.* (1986-1989) are worth mentioning in the field of diatom taxonomy. Zafar (1967), Venkateswarulu (1969) Seenayya (1972), Reddy & Venkateswarulu (1986) reported diatoms from Hyderabad erstwhile Andhra Pradesh. It is evident from the literature that studies on diatom studies from Andhra Pradesh are very few. Madhav & Kondalarao (2004), Jyothi & NarasimhaRao *et al.* (2013), MadhavaRao *et al.* (2015) described occurrence of diatoms as part of their studies. From Rayalaseema region of Andhra Pradesh the studies of Meeravali *et al.* (2015–2017) exclusively dealt with the taxonomic studies and distribution of diatom flora from Ananthapuramu district.

Algae are less studied from Kurnool region. Reddy & Venkateswarulu (1985) and Sudhakar & Venkateswarulu (1994) reported few diatoms as a part of their work in their ecological and limnological studies. Thus, it is clear that the diatom flora of Kurnool district has been poorly studied, this partly reflects a dearth of taxonomic knowledge and least focused research on diatoms. The study area, Mahanandi is a village situated east of the Nallamala Hills near Nandyal, Kurnool District, Andhra Pradesh. The Mahanandiswara Swamy Temple, a salient Lord Shiva shrine, is located here. This ancient temple dates back over 1,500 years. There is a Pushkarini (Temple tank) in front of the temple within the compound and this is called Rudra Gundam, the water is always crystal clear. There is an outlet from the Pushkarini at 405 feet height so that the depth is always maintained at a constant level. The water which comes out from the outlet is perennially utilized for irrigating the lands in and around the village. Geographically the study area is stretched between 15.4712° N, 78.6276° E. The present study deals with the taxonomic evaluation of diatom flora.

MATERIALS AND METHODS

30 diatom samples were collected during July to December 2019. The water samples were collected from

ponds and puddles in the vicinity of shrine and a tank nearby Nandyal. Free floating forms were collected with the help of planktonic mesh and benthic with pipette, fixed in 4% formalin at the site. Samples were treated with 30% hot H₂O₂ method. Detailed studies were conducted by observing specimens using Olympus CH20i Biological microscope and Olympus E-420 digital camera. Round *et al.* (1990) classification was opted for taxonomic analysis

RESULTS AND DISCUSSION

The exploration of water bodies yielded, a total of 35 diatom taxa belongs to 17 genera. Taxonomic validation is done with the help of Gandhi (1955, 1956, 1957a,b,c, 1958, 1967) and Prasad & Srivastava (1992), along with the additional help of other international publications (Hustedt 1930, Cleve-Euler 1951–1955).

Systematic enumeration

Phylum: Bacillariophyta

Class: Bacillariophyceae

Order: Fragilariales

Family: Fragilariaceae

Genus: *Fragilaria* Lyngbye 1819

Fragilaria cpucina* var. *capucina Desmazieres 1830. Hustedt, F, A. Pascher's Die Susswasser 1930, p.138, F-126. Gupta. R.K, Botanical Survey of India, 2005, p.166, pl.52 F-1. [Fig. 1A]

Synedra capitellata Grunow

Colonial and simple. Frustules linear, long, symmetry bilateral, distal ends capitate. Araphid, central area smooth reaches margins. Length 40–80 µm, breadth 3–5 µm. Striae 20–25 in 10 µm.

Fragilaria capucina* sub sp. *rumpens (Kutzing) Lange-Bertlot 1993. Lange-Bertlot 85 Neue Taxa und uber 100 weitere neu 1993, pp.16-21, F-108, S.N. Meeravali et. al. Diatom flora of Ananthapuramu 2017, pl.3F.8. [Fig. 1B]

Synedra rumpens Kutzing.

Valves linear-lanceolate, symmetry bilateral, distal ends rostrate. Araphid, central area rectangular. Length 35–55 µm, breadth 2–3 µm. Striae 20–28 in 10 µm.

Fragilaria tenera (WM Smith) Lange-Bertlot. Krammer K and Lange-Bertlot 1986 (F-), Kumar & Singh 2017 Fresh water diaatoms Hanumangarh, Pl-1, F-9. [Fig. 1C]

Synedra tenera W. Smith

Colonial and simple. Frustules linear elongate symmetry bilateral, distal ends rostrate. Araphid, central area hyaline. Length 40–65 µm, breadth 2–3 µm. Striae 20–25 in 10 µm.

Order: Licmophorales

Family: Ulnariaceae

Genus: *Ulnaria* (Kutzing) Compere 2001

Ulnaria oxyrhynchus (Kutzing) Abol 2006. Hustedt, F., A. Pascher's Die Susswasser 1930, p. 152, F.160, Venkataraman, G. 1939, A Systematic account of S. Indian Diatoms. 307, F. 38. [Fig. 1D]

Synedra oxyrhynchus Kutzing

Valves linear, poles rostrate, pseudo raphe narrow. Central area distinct rectangular. Length 45–95 µm, breadth 2–4 µm. Striae 15–25 in 10 µm.

Ulnaria ulna* var. *danica (Kutzing) Compere & Bukhtiyarova 2006. Hustedt, F., A. Pascher's Die Susswasser 1930, p.154, Fig. 167, Bukhtiyarova, L.N. & Compère, P. (2006). New taxonomical combinations in some genera. [Fig. 1E]

Synedra danica Kützing

Valves narrow, linear, elongate, poles capitate, pseudo raphe not narrow. Central area reaches walls. Length 200–300 µm, breadth 2–3 µm. Striae 10–15 in 10 µm.

Ulnaria ulna* var. *subaequalis (Grunow) Abol 2003. Cleve-Euler, Dial, Schwed Fin, II, 1953, F.f-i, Gandhi H.P. Diatoms from Kolhapur, 1958, p.494, pl.2, F-17. [Fig. 1F]

Synedra subaequalis Grunow

Valves linear, distal ends sub-capitate, pseudo raphe narrow. Central area insignificant. Length 120–225 µm, breadth 3–5 µm. Striae 15–20 in 10 µm.

Order: Eunotiales

Family: Eunotiaceae

Genus: *Eunotia* Ehrenberg 1837

Eunotia lunaris (Ehr.) Schaarschmid 1881. Hustedt, Fr., Rabenhorst's Kryptogamenflora, Bd. VII, Teil 2, life 1-4, 1931-32, p. 302, fig. 769 a, b., Krishnamurthy V. 1954, Contribution to the diatom south., p.358, fig.12.

[Fig. 1G]

Synedra lunaris Ehrenberg

Valves dorsiventral, symmetrical to the transapical axis. Margin dorsal convex, ventral concave. Distal ends capitate. Raphe small terminal nodule distinct. Length 20–35 µm, breadth 4–6 µm, striae fine 20–30 in 10 µm.

Order: Achnanthales

Family: Cocconeidaceae

Genus: *Cocconeis* Ehrenberg 1837.

Cocconeis placentula Ehr. 1838. Kuetzing, F.T. 1849. P. 52; Prasad, B. N. and Srivastava, M. N. (1992) Vol 1, p.198, pl.27, fig.6.

[Fig. 1H]

Cocconeis punctata Ehrenberg 1841

Frustules elliptic. Distal ends rostrate. Axial area wide, central area oval, margin distinct. Raphe single, pseudo raphe distinct, striations linear on one valve. Length 30–50 µm, breadth 14–22 µm, Striae 14–16 in 10 µm.

Order: Cymbellales

Family: Cymbellaceae

Genus: *Cymbella* Agardh 1830

Cymbella affinis Kutzing 1844. Kutzing 1844: p.,80, pl. 6: F-15, Prasad, B. N. and Srivastava, M. N. (1992) Vol 1, p. 266 pl. 34, F-5. Jiunn-Tzong Wu 2011, p. 306- 307, pl. 98, F-a-f.

[Fig. 1I]

Cymbella tumidula Grunow 1875

Valves asymmetric, margin dorsal convex, ventral straight, inflated centre. Apices broad, capitate. Raphe thick, eccentric, proximal deflected ventrally, distal dorsally. Axial area linear, gradually widening proximally. Central area ovoid. Length 20–30 µm, breadth 4–6 µm. Striae coarse, proximal 10–12, distal 8–10 in 10 µm.

Cymbella affiniformis Krammer. 2002. Krammer, K. (2002), *Cymbella*, In: *Diatoms of Europe*, Vol.3, 45,162;pl.25, F.1-8.

[Fig. 1J]

Valves asymmetric, margin dorsal convex, ventral ventral straight, inflated centre. Apices not rostrate. Raphe thick, eccentric, proximal drop like, distal dorsally bent. Axial area linear. Central area elliptic. Length 30–40 µm, breadth 5–8 µm. Striae coarse, proximal 10–18, distal 8–12 in 10 µm.

Cymbella aspera (Ehrenberg) Cleve 1894. Hustedt, F., A. Pascher's *Die Susswasser* 1930, p. 365, fig. 680, Gandhi H.P.1959 Fresh water diatoms. Sagar. Mysore. p. 323, F. 45.

[Fig. 1K]

Cocconema asperum Ehrenberg.

Valves asymmetric, margin dorsal convex, ventral central area expanded. Apices broadly rounded not rostrate. Raphe eccentric, proximal straight, distal deflected dorsally. Axial area broad, straight. Central area prominent, ventral straight, dorsal convex. Length 30–60 µm, breadth 10–15 µm. Striae, proximal 20–28, distal 15–22 µm.

Cymbella excisa var. *procera* Krammer 2002. Krammer *Cymbella* in H. Lange-Bertlot (ed.) *Diatoms of Europe* 2002: 28, 159; pl.9, F.1-7, pl.10, F.10-13;pl.12,F.7. S.N. Meeravali et. al, *Diatom flora of Ananthapuramu* 2017, pl.5F.4.

[Fig. 1L]

Valves dorsiventral. Margin dorsal convex, ventral central inflated. Apices broad, rostrate. Raphe eccentric. Axial area narrow. Central area indistinct, stigma present, 1–2. Length 20–35 µm, breadth 5–8 µm. striae proximal 10–15, distal 10–12 in 10 µm.

Cymbella tumida (Brebisson) Vasn Heurck 1880. Van Heurck 1880: 64; pl. 2,F-10, Gandhi H.P. 1960 *Diatom Flora of Bombay&Sal.* P. 104,F-65&66, Joimm-Tzong Wu et al, 2011, p. 321., pl. 105,F.b-f.

[Fig. 1M]

Cocconema tumidum Brebisson

Valves strongly dorsiventral. Margin dorsal strongly convex, ventral straight, Apices broadly rostrate. Raphe arcuate, central nodule distinct. Axial area narrow. Central area large, ovoid and circular. Length 30–50 µm, breadth 8–10 µm. striae coarse, radiate, proximal 20–28, distal 16–18 in 10 µm.

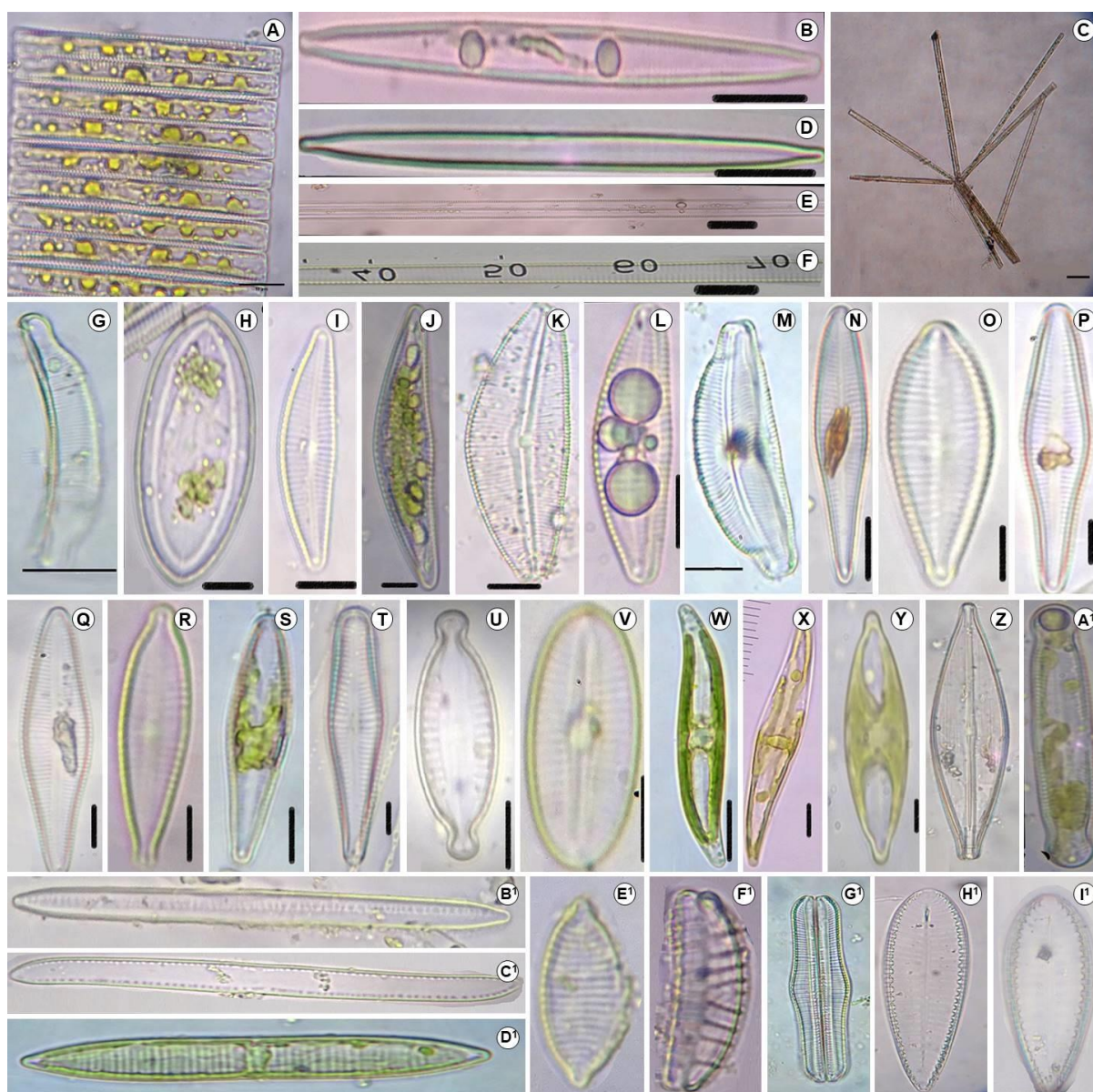


Figure 1. A, *Fragilaria capucina* var. *capucina* Desmazieres; B, *F. capucina* sub sp. *rumpens* (Kutz.) Lange-Bertlot; C, *F. tenera* (WM Smith) Lange-Bertlot; D, *Ulanaria oxyrhynchus* (Kutz.) Abol; E, *U. ulna* var. *danica* (Kutz.) Compere & Bukhtiyarova; F, *U. ulna* var. *subaequalis* (Grunow) Abol; G, *Eunotia lunaris* (Ehr.) Schaarschmid; H, *Cocconeis placentula* Ehr.; I, *Cymbella affinis* Kutz.; J, *C. affinis* Krammer; K, *C. aspera* (Ehr.) Cleve; L, *C. excisa* var. *procera* Krammer; M, *C. tumida* (Brebisson) Vass Heurck; N, *Gomphonema affine* Kutz.; O, *G. augur* var. *augur* Ehr.; P, *G. augur* var. *turris* (Ehr.) Lange-Bertlot; Q, *G. lanceolatum* Ehr.; R, *G. parvulum* (Kutz.) Kutzing; S, *G. subclavatum* (Grunow) Grunow; T, *G. truncatum* Ehrenberg; U, *Mastogloia baltica* Grunow in Van Heurck V. *Diploneis ovalis* (Brebisson) Cleve; W, *Gyrosigma acuminatum* (Kutzing) Rabenhorst; X, *G. attenuatum* (Kutz.) Rabenhorst; Y, *Craticula accomodiformis* Lange-Bertlot.; Z, *Craticula cuspidata* (Kutzing) D.G. Mann; A¹, *Pinnularia nodosa* Smith; B¹, *Bacillaria paxillifera* (O.F. Muller) T. Marsson; C¹, *Nitzschia obtusa* Smith; D¹, *Tryblionella apiculata* Gregory; E¹, *Tryblionella compressa* (Bailey) Poulin; F¹, *Epithemia sores* Kutzing; G¹, *Rhopalodia gibba* (Ehrenberg) Muller; H¹, *Surirella tenera* Gregory; I¹, *Surirella tenera* var. *splendidula* Schmidt

Family: Gomphonemataceae

Genus: *Gomphonema* Ehrenberg 1832.

Gomphonema affine Kutzing 1844. Kutzing, Die Kieselschaligen Bacillarien oder Diatomeen F.T. 1844. P. 86, pl. 30; F.54. Balasubramanian karthik et al, 2011, p.231. S.N. Meeravali et al, Diatom flora Kanekal reservoir, p.34, pl. 1, F. 11. [Fig. 1N]

Gomphonema dichotomum* var. *affine (Kutzing) G. Rabenhorst 1864.

Frustules club shaped. Apex rostrate. Raphe centre, straight. Axial area linear, narrow to poles. Central area distinct. Length 30–50 μm , breadth 8–10 μm . Striae radial, coarse 15–20 in 10 μm .

Gomphonema augur* var. *augur Ehrenberg. Ehrenberg C.G. Bericht über die zur Bekanntmachung geeigneten Verhandlungen der Königlich-Preussischen Akademie der 1841, pp. 197-219, Jeelani M, Lake ecology Kashmir, 2016, pp. 103, table.25. [Fig. 1O]

Gomphonema apiculatum Ehrenberg 1843

Frustules wedge shaped. Apex head pole apiculate, foot pole round, apices capitate. Raphe straight, simple. Axial area straight. Central area indistinct on one side. Length 30–50 µm, breadth 6–10 µm. Striae coarse, 8–12 in 10 µm.

Gomphonema augur* var. *turris (Ehrenberg) Lange-Bertlot. 1985. Krammer, K. And Lange-Bertlot, H. Naviculaceae Neu un wenig bekannte Taxa, 1985, P. 44; pl. 37, F, 1-7, Gandhi H.P. Diatom flora of Bombay, 1960, p. 108, F. 72&73. **[Fig. 1P]**

Gomphonema turris Ehrenberg.

Frustules wedge shaped. Apex head pole apiculate, foot pole rounded. Raphe straight, simple. Axial area straight. Central area distinct. Length 25–50 µm, breadth 8–12 µm. Striae coarse, central 1–2 short one side, puncta isolated opposite side, 8–12 in 10 µm.

Gomphonema lanceolatum Ehrenberg. Ehrenberg, C.G. Verbreitung und einfluss des mikroskopischen (1843), p. 306, pl. II [2] (1): F. 37. Dwivedi & Misra, 2015, pp. 31, pl. 2, F. 2. **[Fig. 1Q]**

Valves lanceolate-clavate, broadly wedge-shaped apex and attenuated base. Raphe straight. Axial area straight; Central area unilateral, prominent, stigma isolated, opposite. Striae clearly punctuate. Length 35–55 µm, breadth 8–12 µm broad. Striae 10–12 in 10 µm.

Gomphonema parvulum (Kutzing) Kutzing 1849. Kutzing, F.T. Species Algarum, 1849. P. 65, txt. 14, Prasad B.N. and Srivatsava M.N 1992. Vol. I, mp. 255, pl. 33, F. 19. **[Fig. 1R]**

Sphenella parvula Kutzing

Frustule club shaped. Apices rostrate, capitates, base capitate. Raphe central, straight. Axial area straight. Central area small. Length 20–30 µm, breadth 8–10 µm. Striae fine, 12–18 in 10 µm.

Gomphonema subclavatum (Grunow) Grunow 1884. Grunow, A. Die diatomeen von franz josefs-land 1884, p. 98, pl. 1(A): F. 13, Narayan & Barupal, 2015, p. 3437, pl. 1(10), F. 1E. **[Fig. 1S]**

Gomphonema montanum var. *subclavatum* Grunow

Valve clavate. Apices round. Axial area narrow. Central area clear, linear, striae radiate. Length 30–45 µm, breadth 8–10 µm. Striae 8–12 in 10 µm.

Gomphonema truncatum Ehrenberg 1832. Ehrenberg, C.G. Über die entwicklung. Abhandlungen der Koniglichen Akademie Wissenschaften zu berlin 1832, P. 88, txt. 1, Sangita P, 2012, Preliminary report of diatoms from Assam, p. 57, F. 6. **[Fig. 1T]**

Gomphonema constrictum var. *truncatum* (Ehrenberg) Gutwinski 1887

Frustule wedge shaped. Apices, head pole broadly rounded, foot pole narrowly rounded. Raphe straight. Axial area broad. Central area distinct, stigma present. Length 40–50 µm, breadth 10–15 µm. Striae coarse, 10–16 in 10 µm.

Order: Mastogloiales

Family: Mastogloiaceae

Genus: *Mastogloia* Thwaites 1856.

Mastogloia baltica Grunow in Van Heurck 1880. Van Heurck, Synopsis des Diatomees de Belgique Atlas, 1880, pl. IV, F. 24, Sarode and Kamat, 1984, p. 60, pl. 6, F. 128. **[Fig. 1U]**

Frustules elliptic. Margin protracted. Both apices capitate. Raphe straight. Axial area narrow, centre not broad. Length 15–30 µm, breadth 5–8 µm. Striae unresolvable.

Order: Naviculales

Family: Diploneidaceae

Genus: *Diploneis* Ehrenberg in Cleve 1894

Diploneis ovalis (Brebisson) Cleve 1894. Cleve, P.T.. Synopsis of the naviculoid diatoms. Part I, 1894, p. 96, txt. 64, Mangrove Ecosystem manual, ICAR, p. 29, F. 29. **[Fig. 1V]**

Navicula smithii Brebisson

Valves oval-elliptical. Apices round. Raphe filiform, proximal pointed, central nodule prominent, horns prominent. Axial area broad. Central area distinct, oval. Length 25–40 µm, breadth 10–18 µm. Striae 8–12 in 10 µm.

Genus: *Gyrosigma* Hassal 1845

Gyrosigma acuminatum (Kutzing) Rabenhorst 1853. Rabenhorst *Die Süßwasser-Diatomaceen (Bacillarien.)*, 1853: 47, pl. 5: fig. 5a., S.N. Meeravali et. Al Diatom flora of Ananthapuramu 2017, pl. 7F. 4. **[Fig. 1W]**

Frustulia acuminata Kutzing

Valves sigmoid. Apices broad, rounded. Raphe sigmoid, proximal pointed, distal deflected opposite directions. Axial area narrow. Central area elliptical. Length 30–60 µm, breadth 6–10 µm. Striae 15–20. in 10 µm.

Gyrosigma attenuatum (Kutzing) Rabenhorst 1853. Rabenhorst, Die süßwasser-diatomeen (Bacillarien) 1853. P.47, Halder & Sinha, 2015, New report of four Bacillariohycean, p. 30, pl. 1 and 2, F.3. [Fig. 1X]

Frustulia attenuate Kutzing.

Valves sigmoid. Apices acute. Raphe sigmoid. Axial area narrow and slender. Central area small, round. Length 50–75 µm, breadth 6–10 µm. Striae fine 10–20 in 10 µm.

Family: Stauroneidaceae

Genus: *Craticula* Grunow 1867

Craticula accomodiformis Lange-Bertlot 1993. Lange-Bertlot H. Neue taxa und uber (1993), p.13, pl. 69, F.6-8, Alkananda B, 2011 Monitoring tropical urban wetlands p.105, code. CRAC. [Fig. 1Y]

Valves oval-elliptical. Poles capitate. Axial area straight. Raphe straight. Central area broad. Length 55–75 µm, breadth 10–15 µm. Striae unresolvable.

Craticula cuspidata (Kutzing) D.G. Mann 1990. Round, F.E, Crawford, R.M. & Mann, D.G. (1990), The diatom biology, pp. [i-ix], 1-747, Ecology, conservation and restoration of Chilika lagoon, India, p.259, table. 11.1. [Fig. 1Z]

Frustulia cuspidata Kutzing

Valves elliptical. Poles capitate. Axial area straight. Raphe straight. Central area narrow. Length 40–90 µm, breadth 15–20 µm. Striae linear and transverse, 20–25 in 10 µm.

Family: Pinnulariaceae

Genus: *Pinnularia* Ehrenberg 1843.

Pinnularia nodosa Smith. 1856. Smith, W. 1856. A synopsis of the British Diatomaceae, Das. S.K., 2012, Fresh water Algae. Nagaland, p.118, pl. 3, F.75. [Fig. 1A¹]

Navicula nodosa Ehrenberg 1843

Valve linear. Margin undulate. Apices sub-capitate. Raphe eccentric, proximal pointed, distal hooked. Axial area broad. Central area large. Length 30–5 µm, breadth 4–6 µm. Striae radiate, 20–22 in 10 µm.

Order: Bacillariales

Family: bacillariaceae

Genus: *Bacillaria* Gmelin 1791

Bacillaria paxillifera (O.F. Muller) T. Marsson 1880. Cleve Euler, A, plat. Schwed. Finn, V: 1952, F. 1457 (*N paradoxa* v. *genuine* Nach Grunow), Gopinath C.P. 1984, Littoral diatoms of southwest coast Ind, p. 26, F. 3(s-u). [Fig. 1B¹]

Vibrio paxillifer O.F. Muller

Valves linear-lanceolate. Apices rostrate-cuneate. Raphe system fibulate, sub-central. Length 50–80 µm, breadth 3–4 µm. Striae 20–30 in 10 µm. Fibulae, linked, valve resembling ladder.

Genus: *Nitzschia* Hassall 1845.

Nitzschia obtusa W. Smith 1853. W. Smith, A synopsis of the British Diatomaceae 1853, p.39, pl.13, F.109, Prasad B. N. And Srivastava, M.N, 1992, Vol I, p.299, pl.37, F.7. [Fig. 1C¹]

Bacillaria obtusa (W smith) Elmore 1895.

Valves broad, slightly sigmoid. Apices wedge shaped. Raphe, fibulate eccentric. Length 50–100 µm, breadth 4–6 µm. Fibulae 12–8 in 10 µm. Striae very fine, 20–25 in 10 µm.

Genus: *Tryblionella* W. Smith 1853.

Tryblionella apiculata Gregory 1857. Gregory. W. On the post-Tertiary diatomaceous sand. 1857. P.79, pl. 1, F. 43, Alakananda B., 2011, Bio monitoring to assess the efficacy of reclamation urban water bodies wetlands of Bangalore. [Fig. 1D¹]

Nitzschia apiculata (W. Gregory) Grunow 1878

Valves panduriform. Margin contracted at centre on both the sides. Apices rostrate. Raphe eccentric. Length 40–60 µm, breadth 4–6 µm. Striae prominent, 18–18 in 10 µm.

Tryblionella compressa (Bailey) Poulin 1990. Poulin et al. Les Diatomees (Bacillariophyta) benthiques 1990. p.96, F. 98. Krishnamurthy V. 1954. Contribution to the diatoms South. Ind, p.379, F.73. [Fig. 1E¹]

Pyxidicula compressa J.W. Bailey

Valves ovate-broad elliptic. Apices rostrate. Raphe eccentric. Length 20–35 µm, breadth 4–8 µm. Striae coarse, punctate, 8–12 in 10 µm.

Order: Rhopalodiales

Family: Rhopalodiaceae

Genus: *Epithemia* Kutzing 1844

Epithemia sorex Kutzing 1844. Hustedt, F., A. Pascher's *Die Susswasser*, 1930, p. 388, F. 736, Gandhi, H.P., Mohan D.J & Vora A.B. preliminary diatomological investigation of Nadial bog. Kashmir. 1982, p. 492, pl. 1, F. 12. [Fig. 1F¹]

Eunotia westermanni var. *sorex* (Kutzing) G. Rabenhorst 1847.

Valves dorsiventral. Margin ventral concave, dorsal highly arched. Apices sub-capitate. Raphe bi-arcuate, canal arched almost to the dorsal margin. Length 20–60 µm, breadth 6–12 µm. Coastae prominent, striae 8–12 in 10 µm.

Genus: *Rhopalodia* O. Muller 1895

Rhopalodia gibba (Ehrenberg) O. Muller 1895. Otto Muller *Rhopalodia ein neues Genus der Bacillariaceen* 1895, p. 65, pl.1, F.15-17, P.K. Misra et al 2012 *Phykos* 42 (2): 14-34 ,p.32,pl.4.F.1 [Fig. 1G¹]

Navicula gibba Ehrenberg

Frustule linear. Apices broad. Raphe fibulate, along dorsal margin. Centre inflated. Length 30–150µm, breadth 10–15 µm. Striae coarse, 12–18 in 10 µm. Coastae, prominent 8–10 in 10 µm, fibulae 6–8 in 10 µm.

Order Surirellales

Family Surirellaceae

Genus *Surirella* Turpin 1828

Surirella tenera W. Gregory 1856. Hustedt, F. 1930, *Bacillariophyta (Diatomeae) Zweite Auflage*. In: *Die susswasser flora Mitteleuropas*. Heft 10 (pascher, A.Eds) pp. [i]-vii, [1]-446,. Rana D & Bhandari D 2016, Isolation and characterisation of diatoms, pp. 18, pl.2, f.a. [Fig. 1H¹]

Frustules elliptic, large. Hetero polar, truncate-rounded apices. Raphe marginal, enclosed in canal. Axial area hyaline and narrow. Marginal undulations regular, thick. Length 70–110 µm, breadth 15–30 µm. Costae thick, central transverse, distal radial, 4–6 µm. Striae fine unresolvable.

Surirella tenera* var. *splendidula Schmidt 1875. Schmidt. A et al *Atlas der Diatomaceen-kunde*. Series I. 1875, pl.23, F.6, Gandhi H.P. *Diatoms from partabgarh*, 1955, p.335, F.53. [Fig. 1I¹]

Frustules ovate-elliptic. Apices truncate-rounded. Raphe marginal, enclosed in canal. Axial area narrow. Marginal folding thick, projections distinct. Length 60–120 µm, breadth 20–30 µm. Coastae thick, central transverse, distal radial, 4–6 µm. Striae fine unresolvable.

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