



Research Article

Check list of diatom taxa from Vindhyan rivers in Central Highland region

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Abstract: Investigations were undertaken for the first time from the freshwater epilithic diatoms of the Vindhyan Rivers (Ken, Tons, Paisuni), Central Highland, India. Epilithic samples (33 nos) were obtained by scraping an area of 3x3 cm from cobbles at the 11 sampling stations (Ken, Tons, Paisuni) situated between latitude 23°30' to 26° N and longitude 78°30' to 82°30' E. In all 293 diatom taxa (species, varieties and forms) belonging 49 genera were identified, along with some unidentified forms.

Keywords: Ken, Tons, Paisuni, *Navicula*, *Nitzschia*

Introduction

No investigations exist on the diatom flora of Vindhya region in Central Highlands. There have been few studies in the Indo-Gangetic Plains from Varanasi and Allahabad (Singh 1961, 1962, 1963; Chadha 1979; Pandey & Pandey 1980 a, b, c, 1983; Pandey *et al.*, 1983; Gupta & Agrawal 2007; Nautiyal *et al.*, 2010). Hence, studies were made to generate information on the diatom flora of the Vindhya region. The present contribution provides a check list of diatom taxa from the Central highland region, Vindhya in particular, which has not been explored earlier.

Study-area

The rivers selected in Vindhya were located between 23°30' to 26°N, 78°30' to 82°30'E. The Vindhya rivers Ken, Paisuni and Tons flow north from low (north of Narmada, around Tropic of Cancer) to high latitude along southern fringe of the Indo-Gangetic Plains. The Ken and Paisuni are right-bank tributaries of the Yamuna River, while Tons that of the Ganga. Ken (340 km) and Tons (305 km) were relatively larger drainage compared to the Paisuni (100 km) having an average gradient of 0.91 m km⁻¹, 2.0 m km⁻¹ and 1.02 m km⁻¹, respectively. Except for the mouth zone these rivers vary topographically.

Materials and Methods

Sampling: Collections were made from 20 stations; 11 stations on 3 rivers in the Vindhya region. Sampling was performed across the width of the stream at the depth of 15-30 cm along the accessible banks. Diatoms were collected by scraping surface of stony substrate and preserved in formalin. These samples were first cleaned with double distilled water to remove traces of formaldehyde. Samples were given Hydrochloric acid-peroxide treatment, washed repeatedly and mounted in Naphrax. Each slide was examined by UPLANAPO x100 oil immersion objective under bright field to identify the species. Images of each taxon were obtained by NIKON Digital Imaging System and processed with Adobe Photoshop to prepare the photographic plates. Identifications were made according to standard literature (Verma 2001). The permanent mounts have been adequately stored at the Aquatic Biodiversity Unit,

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Check list

The Suborder **Coscinodiscineae** is represented by Family **Thalassiosiraceae** occurred as *Aulacoseira* (1 species) and *Cyclotella* (2 species).

Aulacoseira

1. *Aulacoseira granulata* (Ehrenb.) Simonsen. Metzeltin *et al.*, 2005, Iconographia Diatomologica, p. 1, figs. 1-4.

Cyclotella

2. *Cyclotella meneghiniana* Kütz., Hustedt 1930, p. 100, fig. 67a.
3. *C. pseudostelligera* Hustedt 1939, p. 581, figs 1, 2.

The Suborder Araphidineae is represented by Fragilariaceae. This family is represented by genera *Diatoma* (4 species), *Fragilaria* (2 species), *Staurosira* (2 species), *Synedra* (19 species) and *Tabellaria* (1 species).

Diatoma

4. *Diatoma mesodon* (Ehrenb.) Kütz. 1844, p. 47, pl. 17: fig. XIII.
5. *D. minus* Grun., Schmidt 1902, p. 268, figs. 60-61.
6. *D. tenuis* (Agardh) Van Heurck Synopsis 1885, p. 160.
7. *D. vulgare* var. *productum* (producta) Grun. 1862, p. 49 fig. 363.

Fragilaria

8. *Fragilaria* cf. *capucina* Desmaziers, Metzeltin *et al.*, 2005, p. 14, figs. 26-27.
9. *F. capucina* var. *vaucheria* (Kütz.) Lange-Bert., 1980, p. fig.747.

Staurosira

10. *Staurosira longirostris* (Frenguelli) Metzeltin *et al.*, 2005, p. 13, figs. 4-13.
11. *S. pinnata* Ehrenb. 1843, l. 3, figs 6, 8

Synedra

12. *Synedra acus* Kütz., 1844, p. 68, pl. 15: fig. 7.
13. *S. acus* var. *angustissima* (Grun.) van Heurck 1885, p. 151.
14. *S. acus* var. *radians* (Kütz.) Hustedt 1930, p. 155
15. *S. acus* var. 1 Kütz., 1844, p. 68, pl. 15: fig. 7.
16. *S. amphicephala* Kütz., 1844, p. 64, pl. 3: fig. 12.



17. *S. capitata* Ehrenb. 1836, p. 53.
18. *S. dorsiventralis* O.Müll., 1910, p. 45, pl. 114, fig. 3.
19. *S. rumpens* Kütz. 1844, p. 69, pl. 16/6, figs. 4-5.
20. *S. rumpens* var. *familiaris* (Kütz.) Hustedt 1930, p. 40, figs. 15, 16.
21. *S. rumpens* var. *fragilaroides* Grun., Hustedt 1930, fig. 12.
22. *S. tabulata* (C. Agardh) Kütz. 1844, p. 68, pl. 15, fig. 10.
23. *S. tabulata* var. *fasciculata* (Kütz.) Grun., Hustedt 1985, fig. 15.
24. *S. ulna* (Nitzsch) Ehrenb. 1832, p. 87.
25. *S. ulna* var. *aequalis* (Kütz.) Hustedt, 1914, p. 45.
26. *S. ulna* var. *amphirhynchus* (Ehrenb.) Grun. 1862, p. 83, fig. 397.
27. *S. ulna* var. *biceps* (Kütz.) Schönfeldt 1913, fig. 39.
28. *S. ulna* var. *danica* (Kütz.) Grun., p. 151; pl. 38, fig. 14A.
29. *S. ulna* var. *spatulifera* Grun., pl. 38, fig. 4.
30. *Synedra* sp. 1. Ehren., 1830.

Tabellaria

31. *Tabellaria flocculosa* (Roth) Kütz. 1844, p. 17, fig. 21.

The Suborder Raphidineae is represented by family Eunotiaceae, Achnanthaceae, Naviculaceae, Epithemiaceae, Bacillariaceae and Surirellaceae. Eunotiaceae Kütz. 1844 is represented by genus *Eunotia* (6 species) only.

Eunotia

32. *Eunotia* sp. 1. Ehren., 1837.
33. *Eunotia* sp. 2. Ehren., 1837.
34. *Eunotia lunaris* (Ehrenb.) Grun. pl. 35, figs. 3, 4, 6.
35. *E. pseudopectinalis* Metzeltin et al., 2005, p. 24, figs. 15-18.
36. *E. pseudofaba* Metzeltin et al., 2005, p. 18, figs. 9-12.
37. *E. sudetica* O. Muller, Hustedt 1914, p. 55.

Family Achnanthaceae Kütz. 1844 is represented by genera *Achnanthes* (1 species), *Achnanthidium* (14 species), *Planothidium* (5 species) and *Cocconeis* (6 species).

Achnanthes

38. *Achnanthes coarctata* (Brébisson) Grun. Cleve & Grun. 1880, p. 20.

Achnanthidium

39. *Achnanthidium biolettiana* Grun. var. *subatomus* Lange-Bertalot 1989, p. 28, pl. 57: fig. 8, pl. 59: figs. 1-11.
40. *A. biolettiana* Grun. var. *subatomus* Lange-Bertalot 1989, p. 28, pl. 57: fig. 8, pl. 59: figs. 1-11.
41. *A. cf. exilis* Kütz. 1833, p. 577; pl. 16, fig. 53.
42. *A. exigua* Grun. var. *exigua*, K. Sv. Vet. Akad. Handl. 1880, vol. 17, 2, p. 21.
43. *A. exigua* var. *constricta* Torka Hustedt 1921, p. 145, figs. 7, 8.
44. *A. linearis* (W. Smith) Grun., Round & Bukhtiyarova 1996, figs. 37: 19-23 or *Achnanthes petersenii* Hustedt, 1936, p. 179, figs. 10-14.
45. *A. minutissima* var. *gracillima* (Meister) Lange-Bertalot, Round & Bukhtiyarova 1996, figs. 54: 21-32, 55: 1-3.
46. *A. minutissima* var. *minutissima* Kütz. 1833, p. 578, fig. 54.
47. *A. minutissima* var. *minutissima* Kütz. 1833, p. 578, figs. 54 (figs. 51: 1-20 u.a., vgl. REM-Figs. auf Tafel 52 u. 56) or var.?
48. *A. minutissima* var. *jackii* (Rabenhorst) Lange-Bertalot et Ruppel 1980, p. 18.
49. *A. minutissima* var. *scotica* (Carter) Lange-Bertalot in Lange-Bertalot & Krammer 1989, Bibliothica Diatomologica, figs. 34: 1-6.
50. *A. modestiformis* Lange-Bertalot in Lange-Bertalot & Krammer 1989, Bibliothica Diatomologica, figs. 55: 33-42.
51. *A. petersenii* Hustedt 1936, Bot. Arch. p. 38, pl. 179, figs. 10-14.
52. *A. taeniata* Grun. 1880, p. 22, pl. 1, fig. 5.

Planothidium

53. *Planothidium lanceolata* var. *elliptica* Cleve 1891, figs. 86: 33-34.
54. *P. lanceolata* (Brébisson) Grun. var. *lanceolata*, Lange-Bertalot 1999, p. 281.
55. *P. lanceolata* fo. *rostrata* (Óstrup) Lange-Bertalot 1999, p. 6, pl. 279.
56. *P. lanceolata* ssp. *frequentissima* Lange-Bertalot 1993, p. 27, pl. 4.

57. *P. lanceolata* ssp. *dubia* (Grun.) Lange-Bertalot 1997, p. 148, pl. 206.

Cocconeis

58. *Cocconeis pediculus* Ehrenb. 1838, p. 194, pl. 21: fig. 11.
59. *C. placentula* Ehrenb. 1838, p. 194.
60. *C. placentula* var. *egyptia* (Ehrenb.) Cleve 1895, p. 170.
61. *C. placentula* var. *lineata* (Ehrenb.) Van Heurck 1885, p. 133, pl. 30, figs. 31-32.
62. *C. cf. scutellum* Ehren. 1838, p. 194, pl. 14: fig. 18.
63. *Cocconeis* sp. Ehren., 1837, p. 173.

Family Naviculaceae Kütz. 1844 is represented by genera *Amphipleura* (1 species), *Amphora* (12 species), *Anomooneis* (1 species), *Brachysira* (2 species), *Caloneis* (6 species), *Cymbella* (31 species), *Cymbopleura* (14 species), *Encyonema* (5 species), *Diploneis* (6 species), *Frustulia* (1 species), *Gomphocymbelopsis* (1 species), *Gomphonema* (15 species), *Gyrosigma* (3 species), *Mastogloia* (1 species), *Navicula* (32 species), *Navicula* sensu lato (5 species), *Adlafia* (2 species), *Aneumastus* (2 species), *Craticula* (5 species), *Diademesis* (2 species), *Fallacia* (2 species), *Geissleria* (1 species), *Hippodonta* (2 species), *Luticola* (8 species), *Placoneis* (2 species), *Sellaphora* (7 species), *Neidium* (4 species), *Pinnularia* (7 species), *Rhoicosphenia* (1 species), *Scoliopleura* (1 species) and *Stauroneis* (2 species).

Amphipleura

64. *Amphipleura pellucida* (Kütz.) Kütz. 1844, p. 103, pl. 3, fig. 52, pl. 30, fig. 8.

Amphora

65. *Amphora aequalis* Krammer 1980, p. 212-213, figs. 25-35.
66. *A. calumetica* (Thomas) Peragallo 1897, figs. 153: 8, 9.
67. *A. chaurra* Metzeltin et al., 2005, p. 131 figs. 1-7.
68. *A. copulata* (Kütz.) Schoeman & R.E.M. Archibald 1986, p. 429.
69. *A. inariensis* Krammer 1980, p. 211, figs. 21-24, 36-37, 43-45.
70. *A. libyca* Ehrenb. 1841, p. 205.
71. *A. montana* Krasske 1932, p. 119 pl. 2, fig. 27.
72. *A. normanii* Rabenhorst 1864, p. 88.
73. *A. ovalis* (Kütz.) Kütz. 1844, p. 107.
74. *A. pediculus* (Kütz.) Grun. ex A. Schmidt 1875, pl. 26: fig. 99.
75. *A. twentiana* Krammer 2003, figs. 138: 25-29.
76. *A. veneta* Kütz. 1844, p. 108, pl. 3, fig. 25.

Anomooneis

77. *Anomooneis sphaerophora* E. Pützer 1871, p. 77, pl. 3, fig. 10

Brachysira

78. *Brachysira vitrea* (Grun.) R. Ross in Hartley 1986, Journal of the Marine Biological Association of the United Kingdom, p. 607.
79. *Brachysira* sp. Kütz., 1836.

Caloneis

80. *Caloneis bacillum* (Grun.) Cleve 1894, Le Diatomiste, p. 99.
81. *C. cf. bacillum* (Grun.) Cleve 1894, Le Diatomiste, p. 99.
82. *C. beccariana* (Grun.) Cleve 1984, Synopsis of the naviculoid diatoms, p. 283, fig. 50.
83. *C. silicula* (Ehren.) Cleve 1894, Synopsis of the naviculoid diatoms, p. 51.
84. *C. silicula* var. *elliptica* Frengulli, Metzeltin et al., 2005, Iconographia Diatomologica, p. 155, figs. 17-22.
85. *Caloneis* sp. P. Cleve, 1894, p. 46.

Cymbella

86. *Cymbella aspera* (Ehren.) Cleve 1894, Synopsis of the naviculoid diatoms, p. 175.
87. *C. australica* (A. Schmidt) Cleve 1894, Synopsis of the naviculoid diatoms, p. 176.
88. *C. bengalensis* Grun. in A. Schmidt et al., 1875, Atlas der Diatomaceen-kunde pl. 9, fig. 12, 13

89. *C. bengaliformis* Krammer 2002, Diatoms of Europe 3, p. 172, pl. 142: figs 8-9.
90. *C. cymbiformis* C.Agardh 1830, Conspectus Criticus Diatomacearum, p. 10.
91. *C. diversa* Krammer 2002, Diatoms of Europe 3, p. 168, pl. 68: figs 1-9.
92. *C. excisa* Kütz. 1844, Die kieselschaligen Bacillarien oder Diatomeen, p. 80, pl.6, fig.17.
93. *C. excisa* var. *angusta* Krammer 2002, Diatoms of Europe 3, p. 159, pl. 9: figs 8-13.
94. *C. excisa* var. *excisa* Krammer 2002, figs. 5: 1, 8: 1-26, 9: 19-25, 12: 6.
95. *C. excisa* var. *procera* Krammer 2002, p. 159, pl. 9: figs 1-7.
96. *C. gracilliformis* Krammer 2002, p. 167, pl. 54: figs 12-15.
97. *C. hantzschiana* Krammer 2002, figs. 27: 8-14; 28: 1-19; 29: 1-12; 30: 9-14.
98. *C. helvetica* Kütz. 1844, p. 79, pl. 6: fig. 13.
99. *C. kappii* (Cholnoky) Cholnoky 1956, p.61, fig.17-20.
100. *C. kolbei* Hustedt 1949, p. 46; pl.1, fig.20-26.
101. *C. kolbei* var. *kolbei* Krammer 2002, figs. 14: 8-23; 31: 8, 9.
102. *C. lancetiformis* Krammer 2002, p. 167, pl. 54: figs 7-11.
103. *C. metzeltinii* Krammer 2002, p. 166, pl. 49: figs 6-11.
104. *C. neoleptoceros* Krammer 2002, p. 134,173; pl.156, fig.1-8; pl.157, fig.1-19.
105. *C. novaezeelandiana* Krammer 2002, p. 166, pl. 47: figs 6-9.
106. *C. omaniana* Krammer 2002, figs. 55: 1-6.
107. *C. parva* (W.Smith) Wolle 1890, pl. 7, fig. 19.
108. *C. parviformis* Krammer 2002, figs. 15: 8-12 (2002).
109. *C. pervarians* Krammer 2002, p. 164, pl. 41: figs 7-12 (2002).
110. *C. simonsenii* Krammer in Krammer & Lange-Bertalot 1985, pl.7, fig.1-9.
111. *C. sumatrensis* Hustedt 1937, p. 429, pl. 25: figs 17-19
112. *C. tropica* Krammer 2002, p. 164, pl. 44: figs 7-10.
113. *C. tumida* (Brébisson in Kütz.) van Heurck 1880, p. 64, pl.2, fig.10.
114. *C. turgidula* Grun. in A. Schmidt *et al.*, 1875, pl.9, figs. 23-26.
115. *C. turgidula* var. *venezoleiana* Krammer 2002, p. 166, pl. 48: figs 12-17.
116. *C. vulgata* Krammer 2002, figs. 32: 7-13; 36: 1-14; 37: 16-21; 38: 1-18; 39: 1-7.
117. *Cymbella* sp. *C.Agardh*, 1830.
- Cymbopleura**
118. *Cymbopleura angustata* Krammer 2003, figs. 102: 1-7; 105: 9-17b; 109: 12-16.
119. *C. angustata* var. *tenuis* Krammer 2003, figs. 102: 8-10; 103: 1-6.
120. *C. citrus* (Cattrer and Bailey-Watts) Krammer 2003, figs. 97: 5-12.
121. *C. jalaisensis* Grun., Krammer & Lange-Bertalot 1985, p. 2 (1), figs.134: 14-22.
122. *C. kuelsii* Krammer 2003, figs. 113: 1-7b; 127: 11, 12, 19, 20-27.
123. *C. kuelsii* var. *nonfasciata* Krammer 2003, figs. 127: 20-27.
124. *C. lapponica* Grun. ex Cleve 1894, p. 165, pl.4, fig.28.
125. *C. naviculiformis* (Auerswald) Krammer 2003, figs. 76 1-13; 771-13; 781-8;79;1-14; 8012; 821-12; 839-11.
126. *C. rupicola* (Grun.) Krammer 2003, figs. 66: 1-17; 67: 1-18.
127. *C. rupicola* sp.1 (Grun.) Krammer 2003, figs. 66: 1-17; 67: 1-18.
128. *C. microcephala* Grun. in van Heurck 1885, p. 63; pl.8, fig.36-39.
129. *C. sparsistriata* var. *parva* Krammer 2003, figs. 132: 21-33.
130. *C. vana* Lange-Bertalot & Krammer 2003, figs. 93: 9-18.
131. *Cymbopleura* sp. Krammer, 1999.
- Encyonema**
132. *Encyonema jemtlandicum* var. *venezolanum* Krammer 1997, p. 166, pl. 14: figs 1-5, pl. 50: fig. 8.
133. *E. minutum* (Hilse) D.G.Mann in Round, Crawford & Mann 1990, p. 667.
134. *E. perminutum* Krammer Metzeltin *et al.*, 2005, p. 130, figs. 6-15.
135. *E. silesiacum* (Bleisch) D.G.Mann 1990, figs. 117: 1-24.
136. *E. vulgare* Krammer var. *vulgare* Krammer 1997, Bibliothica Diatomologica 36, p. 167, pl. 36: figs. 4-10.
- Diploneis**
137. *Diploneis minuta* Petersen 1928, The aerial algae of Iceland, p. 381, fig. 6.
138. *D. oblongella* (Nägeli) Cleve-Euler in Cleve-Euler & Osvald 1922, Beschreibung zur Kartenblätter Väse, p. 57.
139. *D. peterseii* Hustedt 1937, Archiv für Hydrobiologie, figs. 110: 16-17.
140. *D. pseudovalis* Hustedt 1930, Bacillariophyta, p. 253, fig.403.
141. *D. smithii* (Brébisson) Cleve 1894, synopsis of the naviculoid diatoms, p. 96.
142. *D. subovalis* Cleve 1894, Planktonundersökningar, Cilicoflagellater och Diatomacéer, figs. 109: 8-9.
- Frustulia**
143. *Frustulia weinholdii* Hustedt 1937, Kryptogamen-Flora von Deutschland, pl.406, figs.7-8.
- Gomphonema**
144. *Gomphonema angustum* C.Agardh 1831, Conspectus Criticus Diatomacearum, p. 33.
145. *G. angustatum* (Kütz.) Rabenhorst 1864, Flora europaea algarum aquae dulcis et submarinae, p. 283.
146. *G. augur* var. *spheriophorum* (Ehrenb.) Grun. 1878, Algen und Diatomaceen aus dem Kaspischen Meere, fig. 157: 9.
147. *G. clevei* Fricke in Schmidt *et al.*, 1902, Atlas der Diatomaceen-kunde, pl. 234: figs. 44-46.
148. *G. augur* var. *turris* (Ehrenb.) Lange- Bertalot, Hustedt 1937-1938, Schlu. Arch. Hydrobiol., Suppl. p. 439, pl. 28, figs. 14-16.
149. *G. gracile* Ehren. 1838, Infusionstierchen als vollkommene Organismen 217; pl.18, fig.3.
150. *G. gracile* var. *lancoelatum* (Kütz.) Cleve 1894, Synopsis of the naviculoid diatoms, p. 183.
151. *G. lagenula* Kütz. Metzeltin *et al.*, 2005, Iconographia Diatomologica, p. 145, figs. 12-18.
152. *G. lanceolatum* Ehren., Kütz. 1844, Kieslagen Bacillarien oder Diatomeen, 87, pl. 29: fig. 73.
153. *G. minutum* (C.Agardh) C.Agardh 1831, Conspectus Criticus Diatomacearum, p. 34.
154. *G. parvulum* (Kütz.) Kütz. 1849, Species algarum, p.65.
155. *G. parvulum* var. *micropus* (Kütz.) Cleve, Schmidt 1902, Rep. Norweg. Fish. Invest., pl. 234, Figs. 16-17.
156. *G. pumilum* var. *rigidum* Reichardt & Lange-Bertalot Metzeltin *et al.*, 2005, Iconographia Diatomologica, p. 145, figs. 37-44.
157. *G. sp. cf. apicatum* Ehrenb., Metzeltin *et al.*, 2005, Iconographia Diatomologica, p. 138, figs. 11-14.
158. *G. truncatum* Ehren. 1832, Abhandlungen der Königlichen Akademie Wissenschaften zu Berlin, p. 88.
159. *Gomphonema* sp. Ehren., 1832.
- Gomphocymbellopsis**
160. *Gomphocymbellopsis ancyli* (Cleve) Krammer 2003, Diatoms of Europe 4, 128; pl.143, fig.1-20; pl.144, fig.10-19; pl.145, fig.1-3.
- Gyrosigma**
161. *Gyrosigma acuminatum* (Kütz.) Rabenhorst 1853, Die Süsswasser-Diatomeen (Bacillarien), p. 47; pl.5, fig.5a.
162. *G. attenuatum* (Kütz.) Cleve 1894, Synopsis of the naviculoid diatoms, p. 115.
163. *G. scalpoides* (Rabenhorst) Cleve 1894: 118 118.
- Mastogloia**
164. *Mastogloia smithii* Thwaites in W. Smith (1856) Syn. Brit. Diat. p. 2, fig. 65.
- Navicula**
165. *Navicula amphiceropsis* Lange-Bertalot & Rumrich in Rumrich, Lange-Bertalot & Rumrich 2000, Diatoms of the Andes, p. 153; pl.42, figs.1-12.
166. *N. angusta* Grun. 1860, Über neue oder ungenügend gekannte Algen, p. 528; pl.3, fig.19.
167. *N. antonii* Lange-Bertalot in Rumrich *et al.*, 2000, Annotated Diatoms Micrographs, p. 155.

168. *N. capitatoradiata* Germain 1981, Proc. 6th International Diatom Symposium Budapest, p. 188; pl.72, fig.7.
169. *N. cataracta-rheni* Lange-Bertalot 1993, Bibliotheca Diatomologica, p. 99; pl.59, fig.13-15.
170. *N. caterva* Hohn & Hellermann 1963, Transactions of the American Microscopical Society, p. 296; pl.3, fig.38.
171. *N. cincta* (Ehren.) Ralfs in Pritchard 1861, History of Infusoria, p. 901.
172. *N. cryptocephala* Kütz. 1844, Die kieselschaligen Bacillarien oder Diatomeen, p. 95, pl. 3: figs. 20, 26.
173. *N. cryptofallax* Lange-Bertalot & Hofmann in Lange-Bertalot 1993, Bibliotheca Diatomologica, p. 103; pl.47, fig.11; pl.48, figs.1-4.
174. *N. cryptotenella* Lange-Bertalot in Krammer & Lange-Bertalot 1985, Bibliotheca Diatomologica, p. 62; pl.18, figs.22-23; pl.19, fig.1-10, pl.27, figs.1,4.
175. *N. cryptotenelloides* Lange-Bertalot 1993, Bibliotheca Diatomologica, p. 105; pl.50, figs.9-12; pl.51, figs.1-2.
176. *N. erifuga* Lange-Bertalot in Krammer & Lange-Bertalot 1985, Bibliotheca Diatomologica, p. 69; pl.17, figs.10-12.
177. *N. exilis* Kütz. 1844, Die kieselschaligen Bacillarien oder Diatomeen p. 95; pl.4, fig.6.
178. *N. germainii* Wallace 1960, Notulae Naturae, pl.2, fig.1A-C.
179. *N. hofmanniae* Lange-Bertalot 1993, Bibliotheca Diatomologica, p. 116; pl.48, figs.12-18; pl.49, figs.1,2.
180. *N. irmengardis* Lange-Bertalot in Lange-Bertalot & Metzeltin 1996, Iconographia Diatomologica, p. 78; pl.80, figs.18-23.
181. *N. notha* Wallace 1960, Notulae Naturae, p.4; pl.1, figs.4A-D.
182. *N. phylleptosoma* Lange-Bertalot in Lange-Bertalot & Genkal 1999, Iconographia Diatomologica, p. 69; pl.13, figs.1-5.
183. *N. radiosa* Kütz. 1844, Die kieselschaligen Bacillarien oder Diatomeen, p. 91, fig. 4: 23.
184. *Navicula radiosafallax* Lange-Bertalot 1993, Bibliotheca Diatomologica, p. 131; pl.52, figs.1-3.
185. *N. radiosiola* Lange-Bertalot 1993, Bibliotheca Diatomologica, p. 132; pl.53, figs.4-8.
186. *N. reichardtiana* Lange-Bertalot in Lange-Bertalot & Krammer 1989, Bibliotheca Diatomologica, p. 163, figs.98:19-27.
187. *N. rustellata* Kütz. 1844, Die kieselschaligen Bacillarien oder Diatomeen, p. 95, pl. 3, fig. 65.
188. *N. schroeteri* Meister 1932, Kieselalgen aus Asien, p. 38, fig.100.
189. *N.* sp. 4 Lange-Bertalot 2001, Diatoms of Europe 2, figs. 52: 8-29.
190. *N. subrhynchocephala* Hustedt 1935, Archiv für Hydrobiologie Supplement, p. 156; pl.1, fig.11.
191. *N. symmetrica* Patrick 1944, Boletim do Museu Nacional, nova serie, botanica, p. 5, fig.6.
192. *N. trivialis* Lange-Bertalot 1980, Cryptogamie: Algologie, p. 31; pl.1, figs.5-9; pl.9, figs.1-2.
193. *N. veneta* Kütz. 1844, Die kieselschaligen Bacillarien oder Diatomeen, p. 95; pl. 30, fig. 76.
194. *N. viridula* (Kütz.) Ehren. 1838, Infusionsthierchen als vollkommene Organismen p. 183.
195. *N. viridulaealis* Lange-Bertalot in Rumrich et al., 2000, Iconographia Diatomologica, p. 174; pl.38, fig.5.
- Navicula sensu lato**
196. *Navicula* cf. *kotschyi*; cf. *grimmei* Metzeltin et al., 2005, Iconographia Diatomologica, p. 60, figs. 14-19.
197. *N. mitigata* Hustedt 1966, Die Kieselalgen Deutschlands, (Figs. 62: 12).
198. *N. seminulum* Grunow 1860, Über neue oder ungenügend gekannte Algen, figs. 76: 30-36.
199. *N. medioconvexa* Hustedt 1961, Die Kieselalgen Deutschlands, Österreichs und der Schweiz unter Berücksichtigung der übrigen Länder Europas sowie der angrenzenden Meeresgebiete, figs. 70: 1-7.
200. *N. stroemii* Hustedt 1931, Akademische Verlagsgesellschaft, figs. 69: 1-10; 83: 3.
- Adlafia**
201. *Adlafia miniscula* (Grun.) Lange-Bertalot 1999, Iconographia Diatomologica p. 6, pl. 32.
202. *A. parabryophila* (Lange-Bertalot) Lange-Bertalot 1999, Bibliotheca Diatomologica, p. 38, pl. 89.
- Ancumastus**
203. *Ancumastus stroesei* (Østrup) D.G.Mann in Round, Crawford & D.G. Mann 1990, The Diatoms: Biology and morphology of the genera, p. 663.
204. *A. tuscula* (Ehrenb.) Mann & Sticle in Round et al., 1990, The Diatoms: Biology and morphology of the genera p. 663.
- Craticula**
205. *Craticula ambigua* (Ehren.) D.G.Mann in Round, Crawford & Mann 1990, The Diatoms: Biology and morphology of the genera, p. 666.
206. *C. buderi* (Hustedt) Lange-Bert. 2000, Iconographia Diatomologica, p. 9, pl. 101.
207. *C. citrus* (Krasske) E.Reichardt 1997, Diatom Res., p. 12, pl. 305..
208. *C. halopannonica* Lange-Bertalot 2001, Diatoms of Europa 2, p. 113, 218; pl.85, figs.1-6.
- Fallacia**
209. *Fallacia meridionalis* Metzeltin et al., 2005, Iconographia Diatomologica, p. 61, figs. 30-37.
210. *Fallacia pygmaea* (Kütz.) A.J.Stickle & D.G.Mann in Round, Crawford & Mann 1990, The Diatoms: Biology and morphology of the genera, p. 668.
- Diadesmis**
211. *Diadesmis confervacea* (Kütz.) Grun. in Van Heurck 1880, Synopsis des Diatomees de Belgique, figs. 75: 29-31.
212. *D. platensis* Metzeltin et al., 2005, Iconographia Diatomologica, p. 56, figs. 1-10.
- Geissleria**
213. *Geissleria decussis* (Hustedt) Lange-Bert., 1996, Iconographia Diatomologica 2, p. 65.
- Hippodonta**
214. *Hippodonta subtilissima* Lange-Bertalot, Metzeltin & Witkowski 1996, Iconographia Diatomologica, p. 265; pl.3, fig.16-23.
215. *Hippodonta* sp. Lange-Bertalot, Witkowski & Metzeltin, 1996.
- Luticola**
216. *Luticola* aff. *goeppertiana* order aff. *obligata* (?) Krammer 1999, Iconographia Diatomologica, figs. 62: 1-18.
217. *L. mutica* var. *lanceolata* (Frenguelli) M.Aboal 2003, Diat. Monogr., p. 315.
218. *L. mutica* fo. *intermedia* Hustedt 1921, Hedwigia, figs. 63: 16.
219. *L. mutica* (Kütz.) D.G.Mann in Round et al., 1990, The Diatoms: Biology and morphology of the genera, p. 670.
220. *L. muticopsis* (Van Heurck) D.G.Mann 1990, The Diatoms: Biology and morphology of the genera, p. 671.
221. *L. peguana* (Grun.) D. G. Mann 1990, The Diatoms: Biology and morphology of the genera, p. 671.
222. *L. saxophila* (Bock) ex Hustedt 1966, D. G. Mann 1990, The Diatoms: Biology and morphology of the genera, p. 671.
223. *L.* cf. *uruguensis* Metzeltin et al., 2005, Iconographia Diatomologica, p. 83, figs. 1-4.
- Placoneis**
224. *Placoneis elegines* W. Smith, Metzeltin et al., 2005, Iconographia Diatomologica, figs 75, 1-9; SEM-Figs. 75, 10.
225. *P. witkovskii* Metzeltin et al., 2005, Iconographia Diatomologica, p. 71, figs. 8-15.
- Sellaphora**
226. *Sellaphora americana* (Ehrenb.) D. G. Mann var. *americana* Metzeltin et al., 2005, Iconographia Diatomologica, p. 63, figs. 1-2.

227. *S. bacilloides* Hustedt, Metzeltin *et al.*, 2005, Iconographia Diatomologica, p. 66, figs. 18-21.
 228. *S. densistriata* Lange-Bert. 1996, Iconogr. Diatomol. 2, p. 102, pl. 25; fig. 9.
 229. *S. hustedtii* Krasske 1923, Hedwigia, figs. 71: 22-24.
 230. *S. laevissima* (Kütz.) D.G.Mann 1989, British Phycological Journal, p. 2.
 231. *S. mutaloides* Lange-Bertalot & Metzeltin, Metzeltin *et al.*, 2005, Iconographia Diatomologica, p. 64, figs. 6-9
 232. *S. pupula* (Kütz.) Mereschkovsky 1902, Annals and Magazine of Natural History Ser., p. 187; pl.4, fig.1-5.

Neidium

233. *Neidium ampliatum* (Ehren.) Krammer 1985, Bibliotheca Diatomologica, p. 101.
 234. *N. binodiforme* Krammer 1985, Bibliotheca Diatomologia, figs. 100: 6-8.
 235. *N. berynicum* Mayer 1917, Bacillariales aus der Umgegend von Wurzburg, figs. 103: 11-16.
 236. *Neidium* sp. Pfitzer, 1871.

Pinnularia

237. *Pinnularia acrosphaeria* Rabenhorst 1853, Die Süßwasser-Diatomeaceen, p. 45; pl.6, fig.36.
 238. *P. borealis* Ehren. 1843, Verbreitung und Einfluss des mikroskopischen Lebens in Süd- und Nord-Amerika, 420 (132); pl.1/2, fig.6; pl.4/1, fig.5.
 239. *P. braunii* (Grun.) Cleve 1895, Synopsis of the naviculoid diatoms, p. 75.
 240. *P. subrostrata* (A.Cleve) Cleve-Euler 1955, Die Diatomeen von Schweden und Finnland, p. 58.
 241. *P. frauenbergiana* var. *caloneiopsis* Lange-Bertalot & Werum, 2004, Iconographia Diatomologica, p. 84 figs. 1-15.
 242. *P. stomatophora* (Grun.) Cleve 1895, Synopsis of the naviculoid diatoms, p. 83.

Scoliopleura

243. *Scoliopleura peisonis* Grun. 1860, Über neue oder ungenügend gekannte Algen, figs. 148: 21-24.

Stauroneis

244. *Stauroneis anceps* Ehren. 1843, Verbreitung und Einfluss des mikroskopischen Lebens in Süd- und Nord-Amerika, p. 306 [18 in reprint], 422; pl. 2/1: fig. 18.
 245. *S. nobilis* Schumann 1867, Synopsis of the British Diatomaceae, figs. 87: 1-2.

Family Epithemiaceae Grun. 1860 is represented by genera *Epithemia* (1 species) and *Rhopalodia* (2 species).

Epithemia

246. *Epithemia* sp. Brébisson, 1844: 33.

Rhopalodia

247. *Rhopalodia gibberula* (Ehren.) Otto Müller 1895, Rhopalodia ein neues Genus der Bacillariaceen, p.58.
 248. *R. parallela* (Grun.) O.Müller 1895, Rhopalodia ein neues Genus der Bacillariaceen, p. 64; pl.1, figs.13,14.

Family Bacillariaceae Ehrenb. 1840 is represented by genera *Bacillaria* (1 species), *Denticula* (1 species), *Hantzschia* (1 species) and *Nitzschia* (32 species).

Bacillaria

249. *Bacillaria pacillifer* (O.F.Müller) T.Marsson 1901, Diatomaceen von Neu-Vorpommern, p. 254.

Denticula

250. *Denticula kuetzingii* Grun. 1862, Verh. Kais.-Königl. Zoo.-Bot. Ges. Wien., p. 546, 548; pl.28/12, fig.27.

Hantzschia

251. *Hantzschia amphioxys* (Ehren.) Grun. in Cleve & Grun. 1880, Beiträge zur kenntniss der arctischen Diatomeen, p. 103.

Nitzschia

252. *Nitzschia acicularis* (Kütz.) W.Smith 1853, A synopsis of the British Diatomaceae, p. 43, pl. 15: fig. 12.
 253. *N. acuminata* (W. Smith) Grun. Metzeltin *et al.*, 2005, Iconographia Diatomologica, p. 194, figs. 3-4.
 254. *N. acuta* Peragallo & Peragallo 1899, Diatomées marines de France et des districts maritimes voisins, p. 281; pl.72, fig.19.
 255. *N. amphibia* Grun. 1862, Verh. Kais.-Königl. Zoo.-Bot. Ges. Wien., p. 574; pl.28/12, fig.2.
 256. *N. calida* Grun. 1880, Beiträge zur Kenntniss der arktischen Diatomeen, p. 75.
 257. *N. capitellata* Hustedt, Hustedt 1985, The Pennate Diatoms, fig. 792.
 258. *N. clausii* Hantzsch 1860, Beiträge zur Kenntniss der arktischen Diatomeen, p. 40; pl.6, fig.7. Description in Grun. 1892, p.559, 573.
 259. *N. coarctata* Grun. 1880, Beiträge zur Kenntniss der arktischen Diatomeen, p. 68.
 260. *N. communis* Rabh. Hustedt 1930, Bacillariophyta, f. 798. A. S. Atl. T. 348, figs. 10-19.
 261. *N. compressa* (Bailey) C.S.Boyer 1916, The Diatomaceae of Philadelphia and vicinity, p. 116; pl.39, fig.7.
 262. *N. debilis* (Arnott) Grun. in Cleve & Grun. 1880, eiträge zur kenntniss der arctischen Diatomeen, p. 68.
 263. *N. dissipata* (Kütz.) Grun. 1862, Verh. Kais.-Königl. Zoo.-Bot. Ges. Wien., p. 561.
 264. *N. fonticola* (Grun.) Grun. in Van Heurck 1881, Synopsis des Diatomées de Belgique Atlas, pl. 69, figs.15-20.
 265. *N. frustulum* (Kütz.) Grun. in Cleve & Grun. 1880, eiträge zur kenntniss der arctischen Diatomeen, p. 98.
 266. *N. ganderheimensis* Krasske, Hustedt 1985, The Pennate Diatoms, fig. 804.
 267. *N. gracilis* Hantzsch 1860, Hedwigia, p. 40; pl.6, fig.8.
 268. *N. hantzschiana* Rabenhorst 1860, Hedwigia p. 40; pl.6, fig.6.
 269. *N. hungarica* Grun. 1862, Verh. Kais.-Königl. Zoo.-Bot. Ges. Wien., p. 568; pl.28/12, fig.31.
 270. *N. intermedia* Hantzsch ex Cleve & Grun. 1880, eiträge zur kenntniss der arctischen Diatomeen, p. 95.
 271. *N. levidensis* (W.Smith) Grun. in van Heurck 1881, Synopsis des Diatomées de Belgique Atlas, pl. 57, fig. 15.
 272. *N. levidensis* (W. Smith) Grun. var. *victoriae* Metzeltin *et al.*, 2005, Iconographia Diatomologica, p. 198, figs. 2-3.
 273. *N. linearis* (C.Agardh) W.Smith 1853, A synopsis of the British Diatomaceae, p. 39; pl. 13: fig. 110.
 274. *N. obtusa* var. *lata* Hagelstein Metzeltin *et al.*, 2005, Iconographia Diatomologica, p. 200, figs. 1-4.
 275. *N. palea* (Kütz.) W.Smith 1856, A synopsis of the British Diatomaceae, p. 89.
 276. *N. punctata* (W.Smith) Grun. 1878, Algen und Diatomaceen aus dem Kaspischen Meere, p. 117.
 277. *N. recta* Hantzsch ex Rabenhorst 1862, Die Algen Europa's, No.1283.
 278. *N. sinuata* var. *tabellaria* (Grun.) Grun. in van Heurck 1881, Synopsis des Diatomées de Belgique Atlas, p. 176; pl.60, fig.12-13.
 279. *N. spec. cf. rostellata* Hustedt, Metzeltin *et al.*, 2005, Iconographia Diatomologica, p. 204, fig. 14.
 280. *N. tennis* W.Smith 1853, A synopsis of the British Diatomaceae, p. 40; pl.13, fig.111.
 281. *N. umbonata* (Ehren.) Lange-Bertalot 1978, Nova Hedwigia, p. 648-650; pl.1,2,4.
 282. *N. woltereckoides* Gandhi, Gandhi 1998, Fresh water Diatoms of Central Gujarat, p. III, fig. 175.
 283. *Nitzschia* sp. Hassall, 1845: 435

Family Surirellaceae Kütz. 1844 is represented by one genus *Surirella* (9 species).

Surirella

284. *Surirella angusta* Kütz. 1844, Die Kieselschaligen Bacillarien oder Diatomeen, p. 61; pl.30, fig.52.
 285. *S. apiculata* var. *penduriformis* Frenguelli, Metzeltin *et al.*, 2005, Iconographia Diatomologica, p. 222, figs. 3-9.
 286. *S. striatula* Turpin 1828, Mémoires du Musée d'Histoire Naturelle; 363, pl. 15: figs. 2-10.

287. *S. linearis* W.Smith 1853, A synopsis of the British Diatomaceae, p. 31; pl.8, fig.58.
 288. *S. minuta* Brébisson in Kütz. 1849, Species algarum, p. 38.
 289. *S. ovalis* Brébisson, Hustedt 1930, Bacillariophyta, p. 441, f. 860.
 290. *S. splendida* (Ehrenb.) Kütz., Metzeltin *et al.*, 2005, Iconographia Diatomologica, p. 227, figs. 1-4.
 291. *S. splendida* (Ehrenb.) Kütz., Hustedt, 1930, Bacillariophyta, p. 437, fig. 851.
 292. *Surirella* sp. Turpin, 1828: 363.
5. Nautiyal P., Singh K.R. & Verma J. (2010). Diatom flora in the artificial habitat (Pond) of Allahabad. Proceedings of National Academy of Sciences, Section B, Vol., 80 Part III.
 6. Pandey UC & Pandey DC. Addition to the algal flora of Allahabad–IV–Diatoms. Phycos 1980a; 19(2): 153-160.
 7. Pandey UC & Pandey DC. Addition to the algal flora of Allahabad–IV–Diatoms. Phycos 1980b; 1(2): 153-159.
 8. Pandey UC & Pandey DC. Diatom flora of Allahabad–I Proceedings of Indian Academy of Sciences, 1980c; 46(2): 350-355.
 9. Pandey UC, Tiwari GL & Pandey DC. Diatom flora of Allahabad, India II. Bibliotheca Phycologica, 1983.
 10. Singh CS. A systematic account of the fresh water diatoms of Uttar Pradesh-II. In: Proceeding National Institute of Science, India 1961; 31(B): 203-223.
 11. Singh CS. A systematic account of the fresh water diatoms of Uttar Pradesh-I. In: Proceeding National Institute of Science, India 1962; 32(B): 233-241.
 12. Singh CS. A systematic account of the fresh water diatoms of Uttar Pradesh-I. In: Proceeding Nat. Institute of Science, India 1963; 29(B): 622-631.

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References

- Chadha A & Pandey DC. Algal flora of Allahabad. Part IV A general account. Biblio. Phycol.1983; 66: 141-178.
- Chadha A. Investigations on the Algal Flora of Allahabad. D. Phil. Thesis, University of Allahabad, Allahabad 1979.
- Gupta S & Agrawal SC. Survival and mortality of diatoms *Navicula grimmeri*, and *Nitzschia palea* affected by some physical and chemical factors. Folia Microbiol. 2007; 52 (2): 127-134.
- Jyoti Verma (2011). Lotic Diatom diversity patterns in mountain chains (North India). Lambert Academic Publishing, pp. 176. SBN-13: 978-3-8465-0822-0.

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