

## Diatoms (Bacillariophyceae) from Orissa State and Neighbouring Regions, India

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Seventy eight taxa of Bacillariophyceae belonging to 1 species of *Aulacoseira*, 1 species of *Cyclotella*, 1 species of *Tabellaria*, 1 species of *Diatoma*, 1 species of *Thalassionema*, 1 species of *Grammatophora*, 1 species of *Fragilaria*, 8 species of *Synedra*, 2 species of *Achnanthes*, 1 species of *Cocconeis*, 1 species of *Diadesmis*, 1 species of *Diplonies*, 2 species of *Gyrosigma*, 3 species of *Pleurosigma*, 15 species of *Navicula*, 4 species of *Pinnularia*, 3 species of *Stauroneis*, 1 species of *Eumotia*, 2 species of *Himantidium*, 11 species *Gomphonema*, 5 species of *Cymbella*, 1 species of *Cocconeis*, 4 species of *Amphora*, 1 species of *Rhopalodia*, 5 species of *Nitzschia* and 1 species of *Surirella* were reported from different fresh water habitats of Orissa state and its neighbouring regions of India. All the taxa were recorded for the first time from this region.

**Key Words:** Bacillariophyceae, fresh water habitats, India, Orissa state

### INTRODUCTION

The Bacillariophyceae are unicellular algae characterized by having a cell wall of silica. The wall consists of two valves that have more or less flat surfaces, held together by a band or girdle. They are found in freshwater and marine habitats, and also on moist soil surfaces. There are only few published records on the systematic account of freshwater diatom flora of the Indian sub-continent. Till date a total number of 173 species of diatoms belonging to 24 genera have been reported from various regions of India (Gonzalves and Gandhi 1953; Gandhi 1956, 1959, 1967; Sarode and Kamat 1979, 1983; Barhate and Tarar 1983, 1985; Somashekar 1983, 1984; Bongale 1985; Prasad and Jaitly 1985; Pal and Santra 1990; Sinha 1997; Kant and Gupta 1998), however, all these work have been confined to certain specific localities of Western and Southern India, e.g. Maharashtra, Gujrat and Karnataka states. Orissa state located in the east cost of India (Lat. 17° 48'-23° 34' N and Long. 81° 24'-87° 29' E) has an area of 1,55,842 km<sup>2</sup> and is rich in water bodies due to its several rivers, reservoirs, lakes, ponds and ditches, streams in the hilly terrain and waterlogged rice fields. Hence it was expected that many diatoms might be occurring in this part of India. So far there has been no

record of the fresh water diatoms of Orissa state, in the east coast of India. Through our survey for over a period of three years we for the first time reported 78 taxa of diatoms from Orissa state and its neighbouring regions of which 22 are new to India.

### MATERIALS AND METHODS

A total of 80 samples were collected from 69 sites (Table 1) comprising of various habitats, e.g. sewage, road side stagnant water, ponds, ditches, lakes, reservoirs, rivers, streams, canals, waterlogged rice fields and moist soil surfaces from Orissa and its nearby regions including Santiniketan, Kolkata (West Bengal) and Shillong (Meghalaya) during October 2003 to March 2006. The location of each site was determined with a Garmin 12 GPS receiver (Table 1). Samples were collected in sterilized Tarson specimen tubes using plankton net (45 µm pore size) and kept cool in ice chest while being transported to the laboratory. After initial observation, materials were fixed in Lugol's iodine solution (0.5%) to immobilize the cells. Each sample was assigned with a voucher number along with the date of collection, preserved in (4% v/v) formaldehyde and deposited at the department of Botany Utkal University, Bhubaneswar, Orissa. Temperature, pH and conductivity of the collection sites was measured on the spot using portable thermometer, pH meter (131E, Electronics

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**Table 1.** List of the sites of collection showing latitude, longitude, voucher number and the habitat.

Station no. (S)	Place of collection	Latitude	Longitude	Voucher no.	Habitat
1	Tankapani road, Bhubaneswar, Orissa	20° 14' 15.6" N	85° 52' 11.9" E	B9	Sewage
2	Kedargouri, Old town, Bhubaneswar, Orissa	20° 15' 51.4" N	85° 51' 2.6" E	B18, B21	Well
3	Satsanga vihar, Bhubaneswar, Orissa	20° 20' 4.4" N	85° 44' 88" E	B-33	Pond
4	Jharpada, Bhubaneswar, Orissa	20° 20' 40.3" N	85° 48' 61.1" E	B57	Canal
5	Sandikhuti, Daspur, Bhubaneswar, Orissa	20° 25' 18.5" N	85° 47' 37.0" E	B76	Pond
6	Daspur, Bhubaneswar, Orissa	20° 25' 18.5" N	85° 47' 37.0" E	B-80	Rice field
7	Utkal University, Bhubaneswar, Orissa	20° 18' 6.1" N	85° 50' 30.3" E	600	Ditch
8	Rameswar temple tank, Khurda, Orissa	20° 19' 54.6" N	85° 59' 83.1" E	143B	Pond
9	River Mahanadi, Cuttack, Orissa	20° 29' 10.3" N	85° 52' 58.3" E	131	River
10	Kathajodi, Cuttack, Orissa	20° 27' 28" N	85° 52' 46.6" E	247,250	River
11	Taladanda canal, Cuttack, Orissa	20° 27' 28.4" N	85° 52' 41.6" E	256	Canal
12	Manguli dam, Cuttack, Orissa	20° 27' 27" N	85° 52' 41.6" E	547	Puddle
13	Athagarh, Cuttack, Orissa	20° 28' 29" N	85° 54' 46.8" E	548	Lake
14	Halদিagarh, Kendrapada, Orissa	20° 23' 25.3" N	86° 28' 99.5" E	368	Canal
15	Madhyakhanda, Nayagarh, Orissa	20° 20' 56.8" N	84° 55' 76.2" E	725	Drain
16	Daspala, Nayagarh, Orissa	20° 20' 56.8" N	84° 55' 76.2" E	726	Pond
17	Kuturi, Nayagarh, Orissa	20° 33' 168" N	84° 49' 34.2" E	728	River
18	Deulajhari, Athamalik, Orissa	20° 50' 05.3" N	85° 05' 53.5" E	588	Hot spring
19	Angul, Orissa	20° 50' 15.3" N	85° 05' 49.5" E	599	Rice field
20	Padpadar, Baragarh, Orissa	21° 19' 58.4" N	83° 37' 10.6" E	443	Puddle
21	Baragarh, Orissa	21° 19' 58.4" N	83° 37' 10.6" E	445	Pond
22	Ang river, Baragarh, Orissa	21° 19' 58.3" N	83° 37' 11.6" E	447	River
23	Mandipali, Ganjam, Orissa	19° 18' 52.6" N	84° 47' 56.5" E	39	Pond
24	Bijipur, Berhampur, Ganjam, Orissa	19° 18' 52.4" N	84° 47' 03.8" E	79B	Pond
25	Maniakati, Ganjam, Orissa	19° 48' 78.8" N	84° 22' 46.3" E	95	Rice field
26	Rusikulya river, Ganjam, Orissa	19° 50' 39.9" N	84° 32' 17.3" E	148,149	River
27	Rusikulya river estuary, Ganjam, Orissa	19° 30' 01.1" N	84° 58' 01.07" E	272, 274, 284	River
28	Khadasing, Ganjam, Orissa	19° 8' 53.1" N	84° 47' 56.1" E	277	Canal
29	Aska, Ganjam, Orissa	19° 8' 51.1" N	84° 41' 36.5" E	290	Ditch
30	Berhampur, Ganjam, Orissa	19° 19' 5.5" N	84° 40' 11.4" E	160	Pond
31	Huma, Ganjam, Orissa	21° 54' 36.4" N	85° 01' 42.2" E	218	Saltpan drain
32	Rusikulya, Dhaugan, Ganjam, Orissa	19° 51' 53.6" N	84° 17' 38.6" E	229	River
33	Nirmalajhara, Ganjam, Orissa	19° 36' 7.1" N	84° 04' 00" E	125, 460, 484	Stream
34	Sonpur, Ganjam, Orissa	20° 50' 15.7" N	83° 54' 42.2" E	475	Puddle
35	Kalinga ghati, Ganjam, Orissa	20° 07' 82.7" N	84° 26' 22.0" E	716	Stream
36	Chikiti, Ganjam, Orissa	20° 32' 23.2" N	83° 24' 42.0" E	751	Pond
37	Asurabandha, Ganjam, Orissa	19° 48' 78.8" N	84° 22' 46.3" E	586	Rice field
38	Madhumara, Gajapati, Orissa	18° 46' 39.7" N	84° 06' 12.5" E	552	Ditch
39	Ramsagar lake Paralakhemundi, Gajapati, Orissa	18° 46' 52.7" N	84° 8' 19.5" E	554	Lake
40	R. Udayagiri, Gajapati, Orissa	19° 09' 23.4" N	84° 09' 02.5" E	562	Rice field
41	Kainpur, Gajapati, Orissa	19° 25' 59.6" N	84° 21' 39.4" E	608	Stream
42	Gandahati waterfall, Gajapati, Orissa	19° 25' 28.3" N	84° 21' 11.1" E	621	Stream
43	Khichilingi hill, Gajapati, Orissa	19° 26' 08.1" N	84° 37' 52.0" E	623	Stream
44	Narayanapur, Gajapati, Orissa	19° 25' 56.3" N	84° 30' 9.9" E	624	Stream
45	Rayagada, Orissa	19° 38' 17.2" N	83° 26' 47.1" E	632	Stream
46	Nagavali river, Rayagada, Orissa	19° 38' 18.1" N	83° 26' 58" E	636	River
47	Muniguda, Rayagada, Orissa	19° 38' 16" N	83° 26' 41.6" E	647, 648	Stream
48	Niyamagiri hill, Rayagada, Orissa	19° 38' 15" N	83° 26' 17.7" E	650	Stream
49	Rayagada, Orissa	19° 38' 27" N	83° 27' 43" E	653	Stream
50	Panimunda, Rayagada, Orissa	19° 38' 09" N	83° 27' 32" E	658, 660	Stream
51	Vansadhara river, Rayagada, Orissa	19° 38' 17.1" N	83° 27' 45.3" E	662	River
52	Ranipida, Rayagada, Orissa	19° 38' 45" N	83° 27' 20" E	663	Stream
53	Jhagadi, Rayagada, Orissa	19° 38' 17.4" N	83° 17' 44.2" E	665	Pond

**Table 1.** (continued)

Station no. (S)	Place of collection	Latitude	Longitude	Voucher no.	Habitat
54	Vansadhara river; Rayagada, Orissa	19° 38' 17.7" N	83° 17' 37.7" E	670	River
55	Vansadhara river, Rayagada, Orissa	19° 38' 17.5" N	83° 17' 39." E	671	River
56	Kalinga, Ganjam, Orissa	20° 07' 82.7" N	84° 26' 22.0" E	716	Stream
57	Sundurukumpa, Kandhamala, Orissa	20° 30' 86.9" N	84° 18' 34.1" E	719	Canal
58	Gadiapada, Kandhamala, Orissa	20° 30' 40.2" N	84° 26' 58.6" E	722	Stream
59	Daringbadi, Kandhamala, Orissa	19°47' 49.3" N	84° 22' 54.3" E	230, 232, 234	Stream
60	Salandi river, Bhadrak, Orissa	20° 58' 27.5" N	86° 39' 11.1" E	165	River
61	Chandipur, Balasore, Orissa	21° 26' 92.7" N	87° 00' 43.5" E	398	Wet soil
62	Chandipur, Balasore, Orissa	21° 26' 92.7" N	87° 00' 43.5" E	399	Canal
63	Baliapal, Balasore, Orissa	21° 40' 93.0" N	87° 04' 75.0" E	404	Ditch
64	Kaptipada, Mayurbhanj, Orissa	21° 33' 25.9" N	86° 26' 40.8" E	604	Rice field
65	Kolkata, West Bengal	22° 36' 45.1" N	88° 13' 10" E	297, 360	Wet soil
66	Botanical Survey of India, Kolkata, West Bengal	22° 36' 45.1" N	88° 13' 10" E	757	Pond
67	Galapbag Burdwan, West Bengal	23° 14' 86.3" N	87° 50' 89.1" E	700, 702	Pond
68	Santiniketan, Bolpur, Birbhun, West Bengal	23° 39' 39.6" N	87° 42' 20.8" E	711	Pond
69	Laitkar peak, Shillong, Meghalaya	25° 34' 20.3" N	91° 52' 33.5" E	341,342, 344	Stream

India) and conductivity meter (621E, Electronics India) respectively. The samples are cleaned with dilute sulphuric acid (0.1-1.0 N) and examined microscopically. Microphotograph of each specimen was taken using Meiji Trinocular research microscope fitted with Nikon Fx-801 camera. The organisms were identified following monographs of Kützing (1865); Venkataraman (1939), Huber-Pestalozii (1942); Desikachary (1987a, 1987b, 1988, 1989); Kant and Gupta (1998), Hauk (2003) and Rath and Adhikary (2005).

## RESULTS AND DISCUSSION

A total of 78 diatom taxa belonging to 26 genera were recorded from several fresh water bodies of Orissa state and its neighbouring regions in the eastern part of India (Table 2). Out of these 22 taxa of diatoms, e.g. *Tabellaria fenestrata* (Lyngbye) Kützing, *Diatoma anceps* (Ehrenberg) Kirchner, *Fragilaria virescens* Ralfs, *Synedra crystallina* Kützing, *Synedra tergestina* Kützing, *Synedra ulna* (Nitzsch) Ehrenberg var. *amphirhynchus* (Ehrenberg) Grunow, *Synedra ulna* (Nitzsch) Ehrenberg var. *oxyrhynchus* (Kützing) Van Heurck, *Achnanthes subsessilis* Kützing, *Cocconeis pediculus* Ehrenberg, *Diademesmis confervacea* Kützing, *Navicula amphirhynchus* Ehrenberg, *Navicula major* Kützing, *Navicula sphaerophora* Kützing, *Navicula viridis* Kützing, *Navicula viridula* Kützing, *Eunotia amphioxys* Ehrenberg, *Himantidium arcus* Ehrenberg, *Himantidium minus* Kützing *Gomphonema parvulum* (Kützing) Grunow var. *micropus* (Kützing) Cleve, *Gomphonema telographicum* Kützing, *Cocconeis cistula*

Ehrenberg, *Amphora elliptica* Kützing, are reported first time from India. Description of each of these organisms is presented. The classification of the taxa was according to Round *et al.* (1990). Voucher number, date of collection, sites of collection, nature of the habitat along with the temperature (temp.), pH, conductivity (con.) of the sites at the time of collection of sample is also given.

Class: Coscinodiscophyceae

Order: Aulacseriales

Family: Aulacosiraceae

**Genus: *Aulacoseira* Thwaites**

1. *Aulacoseira granulata* (Ehrenberg) Simonsen (Pl. 1, Fig. 1)

(Synonym: *Melosira lineota* Grunow in Van Heurck)

Houk 2003, p.20, pl. XXV, figs. 1-10; pl. XXVI, figs. 1-4.

Planktic in pond and in river; Vouchers numbers, dates and sites: 160; 5<sup>th</sup> Feb 2004; Berhampur (S-30; Temp. 26°C; pH 7.2; Cond. 300  $\mu$ s); 284; 2<sup>nd</sup> June 2004; Rusikulya river estuary (S-27; Temp. 29°C; pH 8.4; Cond. 1200  $\mu$ s); 700; 28<sup>th</sup> Nov. 2005; Krishna Sayar park, (S-67; Temp. 25°C; pH 8.6; Cond. 379  $\mu$ s).

Class: Coscinodiscophyceae

Order: Thalassiosirales

Family: Stephanodiscaceae

**Genus: *Cyclotella* Kützing**

2. *Cyclotella meneghiniana* Kützing (Pl. 1, Figs. 2-3)

Kützing 1865, p.50, pl. 30, fig. 68.

Planktic in pond, epilithic in lake and in pond; Voucher numbers, dates and sites: 554; 6<sup>th</sup> Oct. 2005;

**Table 2.** List of diatoms recorded from Orissa state and its neighbouring regions, India

Sl. no	Taxa
1	<i>Aulacoseira granulata</i> (Ehrenberg) Simonsen (Pl. 1 Fig. 1)
2	<i>Cyclotella meneghiniana</i> Kützing (Pl. 1, Figs. 2-3)
3	<i>Tabellaria fenestrata</i> (Lyngbye) Kützing * (Pl. 1, Fig. 4)
4	<i>Diatoma anceps</i> (Ehrenberg) Kirchner * (Pl. 1, Fig. 5)
5	<i>Thalassionema nitschoides</i> Grunow (Pl. 1, Fig. 6)
6	<i>Grammatophora undulata</i> Ehrenberg (Pl. 1, Fig. 7)
7	<i>Fragilaria virescens</i> Ralfs * (Pl. 1, Fig. 8)
8	<i>Synedra crystallina</i> Kützing * (Pl. 1, Fig. 9)
9	<i>Synedra gracilis</i> Kützing (Pl. 1, Fig. 10)
10	<i>Synedra tabulata</i> Kützing (Pl. 1, Fig. 11)
11	<i>Synedra tergestina</i> Kützing * (Pl. 1, Fig. 13)
12	<i>Synedra ulna</i> (Nitzsch) Ehrenberg (Pl. 1, Fig. 12)
13	<i>Synedra ulna</i> (Nitzsch) Ehrenberg var. <i>aequalis</i> (Kützing) Hustedt (Pl. 1, Fig. 14)
14	<i>Synedra ulna</i> (Nitzsch) Ehrenberg var. <i>amphirhynchus</i> (Ehrenberg) Grunow * (Pl. 1, Figs. 15-16)
15	<i>Synedra ulna</i> (Nitzsch) Ehrenberg var. <i>oxyrhynchus</i> (Kützing) V.H. * (Pl. 1, Figs. 17-18)
16	<i>Achnanthes inflata</i> Kützing (Pl. 1, Fig. 22)
17	<i>Achnanthes subsessilis</i> Kützing * (Pl. 1, Fig. 23)
18	<i>Cocconeis pediculus</i> Ehrenberg * (Pl. 2, Fig. 1)
19	<i>Diademsis confervacea</i> Kützing * (Pl. 2, Fig. 2)
20	<i>Diplonies interrupta</i> (Kützing) Cleve (Pl. 2, Fig. 3)
21	<i>Gyrosigma acuminatum</i> (Kützing) Rabenhorst (Pl. 2, Fig. 5)
22	<i>Gyrosigma scalproides</i> (Rabenhorst) Cleve var. <i>eximia</i> (Thwaites) Cleve (Pl. 2, Fig. 4)
23	<i>Pleurosigma aestuarii</i> Brébison. ex. Kützing W. Son. (Pl. 2, Fig. 6)
24	<i>Pleurosigma javanicum</i> Grunow (Pl. 2, Fig. 7)
25	<i>Pleurosigma normanni</i> Ralfs (Pl. 2, Fig. 8)
26	<i>Navicula amphirhynchus</i> Ehrenberg * (Pl. 2, Fig. 9)
27	<i>Navicula cuspidata</i> Kützing (Pl. 2, Fig. 10)
28	<i>Navicula cuspidata</i> Kützing var. <i>ambigua</i> Ehrenberg (Pl. 2, Fig. 11)
29	<i>Navicula gracilis</i> Ehrenberg (Pl. 2, Fig. 12)
30	<i>Navicula kariana</i> Grunow var. <i>curta</i> (Cleve) Ross. (Pl. 2, Fig. 13)
31	<i>Navicula lamii</i> Manguin (Pl. 2, Fig. 14)
32	<i>Navicula major</i> Kützing * (Pl. 2, Fig. 15)
33	<i>Navicula microspora</i> Kant and Gupta (Pl. 2, Fig. 16)
34	<i>Navicula pupula</i> Kützing (Pl. 2, Fig. 17)
35	<i>Navicula protracta</i> (Grunow) Cleve (Pl. 2, Fig. 18)
36	<i>Navicula radiosa</i> Kützing (Pl. 2, Fig. 19)
37	<i>Navicula reinhardtii</i> Grunow f. <i>gracilior</i> Grunow (Pl. 2, Fig. 20)
38	<i>Navicula sphaerophora</i> Kützing * (Pl. 2, Figs. 21-22)
39	<i>Navicula viridis</i> Kützing * (Pl. 2, Fig. 23)
40	<i>Navicula viridula</i> Kützing * (Pl. 2, Figs. 24-25)
41	<i>Pinnularia biceps</i> Gregory (Pl. 2, Fig. 26)
42	<i>Pinnularia braunii</i> (Grunow) Cleve var. <i>amphicephala</i> (Mayer) Hustedt (Pl. 2, Fig. 27)
43	<i>Pinnularia gibba</i> Ehrenberg (Pl. 2, Fig. 28)
44	<i>Pinnularia viridis</i> (Nitzsch) Ehrenberg (Pl. 2, Fig. 29)
45	<i>Stauroneis anceps</i> Ehrenberg (Pl. 2, Fig. 30)
46	<i>Stauroneis phoenicentron</i> (Nitzsch) Ehrenberg (Pl. 2, Fig. 31)
47	<i>Stauroneis pusilla</i> Cleve (Pl. 2, Fig. 32)
48	<i>Gomphonema abbreviatum</i> Agardh (Pl. 2, Fig. 33)
49	<i>Gomphonema dichotomum</i> Kützing (Pl. 2, Figs. 34-35)
50	<i>Eunotia amphioxys</i> Ehrenberg * (Pl. 1, Fig. 19)
51	<i>Himantidium arcus</i> Ehrenberg * (Pl. 1, Fig. 20)
52	<i>Himantidium minus</i> Kützing * (Pl. 1, Fig. 21)
53	<i>Gomphonema hebridense</i> Gregory (Pl. 2, Fig. 36)

Table 2. (continued)

Sl. no	Taxa
54	<i>Gomphonema lanceolatum</i> Ehrenberg (Pl. 3, Figs. 1-2)
55	<i>Gomphonema parvulum</i> (Kützing) Grunow var. <i>micropus</i> (Kützing) Cleve * (Pl. 3 Fig. 3)
56	<i>Gomphonema montanum</i> Schumann var. <i>genuinum</i> Mayer (Pl. 3, Fig. 4)
57	<i>Gomphonema olivaceum</i> (Lyngbye) Kützing (Pl. 3, Fig. 5)
58	<i>Gomphonema parvulum</i> (Kützing) Grunow var. <i>micropus</i> (Kützing) Grunow (Pl. 3, Fig. 6)
59	<i>Gomphonema sphaerophorum</i> Ehrenberg (Pl. 3, Figs. 7-8)
60	<i>Gomphonema telographicum</i> Kützing * (Pl. 3, Fig. 9)
61	<i>Gomphonema vibrio</i> Ehrenberg (Pl. 3, Fig. 11)
62	<i>Cymbella affinis</i> Kützing (Pl. 3, Fig. 10)
63	<i>Cymbella cistula</i> (Hempr.) Grunow (Pl. 3, Fig. 12)
64	<i>Cymbella ehrenbergii</i> Kützing (Pl. 3, Fig. 13)
65	<i>Cymbella tumida</i> (Brébison) Van Heurck (Pl. 3, Fig. 14)
66	<i>Cymbella turgidula</i> Grunow (Pl. 3, Fig. 15)
67	<i>Cocconema cistula</i> Ehrenberg * (Pl. 3, Fig. 20)
68	<i>Amphora elliptica</i> Kützing * (Pl. 3, Fig. 16)
69	<i>Amphora coffeaeformis</i> Kützing (Pl. 3, Fig. 17)
70	<i>Amphora ovalis</i> Kützing (Pl. 3, Fig. 18)
71	<i>Amphora ovum</i> Cleve (Pl. 3, Fig. 19)
72	<i>Rhopalodia gibba</i> (Ehrenberg) O. Müller (Pl. 3, Figs. 21-22)
73	<i>Nitzschia amphibia</i> Grunow (Pl. 3, Fig. 23)
74	<i>Nitzschia obtusa</i> Wm. Smith (Pl. 3, Fig. 24)
75	<i>Nitzschia palea</i> (Kützing) Wm. Smith. (Pl. 3, Fig. 25)
76	<i>Nitzschia sigmoidea</i> (Nitzsch) Wm. Smith. (Pl. 3, Fig. 26)
77	<i>Nitzschia stagnorum</i> (Rabenhorst) Grunow (Pl. 3, Fig. 27)
78	<i>Surirella nervosa</i> (A.S.) Mayer (Pl. 3, Fig. 28)

\* Diatom taxa first reported from India

Paralakhemundi (S-38; Temp. 29°C; pH. 8.9; Cond. 786  $\mu$ s); Krishna Sayar park (S-67; Temp. 25°C; pH 8.6; Cond. 379  $\mu$ s).

Class: Fragilariophyceae

Order: Tabellariales

Family: Tabellariaceae

**Genus: *Tabellaria* Ehrenberg**

3. *Tabellaria fenestrata* (Lyngbye) Kützing \* (Pl. 1, Fig. 4)  
(Synonym: *Tabellaria fenestratum* Lyngbye; *T. fenestrata* var. *intermedia* Grunow)

Huber-Pestalozii 1942, p. 429, pl. CXXVII, fig. 519.

Frustules united to form colonies in zigzag chains; valves elongate, inflated laterally in the middle and at the poles; septa more than two, longitudinal, straight, perforate, present between girdle, intercalary, 33-116  $\mu$ m long and 4-15  $\mu$ m broad; pseudorapheae lateral to median; striae transverse and finely punctate.

Epiphytic in stream; Voucher number, date and site: 341; 6<sup>th</sup> Dec. 2004; Shillong (S-69, Temp. 19°C, pH 6.8; Cond. 150  $\mu$ s).

Class: Fragilariophyceae

Order: Fragilariales

Family: Fragilariaceae

**Genus: *Diatoma* Bory**

4. *Diatoma anceps* (Ehrenberg) Kirchner\* (Pl. 1, Fig. 5)

(Synonym: *Diatoma hyalinum* Kützing)

Kützing 1865, p. 47, pl. 17, figs. XX (1-4).

Frustules jointed to form zig-zag colonies; valves slightly lanceolate to linear, with obtuse end, 30-60  $\mu$ m long and 8-12  $\mu$ m broad; striation not distinct in fresh material. Epilithic in stream; Voucher number, date and site: 125; 4<sup>th</sup> Nov. 2003; Nimalajhara (S-33; Temp. 25°C; pH 6.8; Cond. 124  $\mu$ s).

**Genus: *Thalassionema* Grunow ex. Mereschkowsky**

5. *Thalassionema nitschoides* Grunow (Pl. 1, Fig. 6)

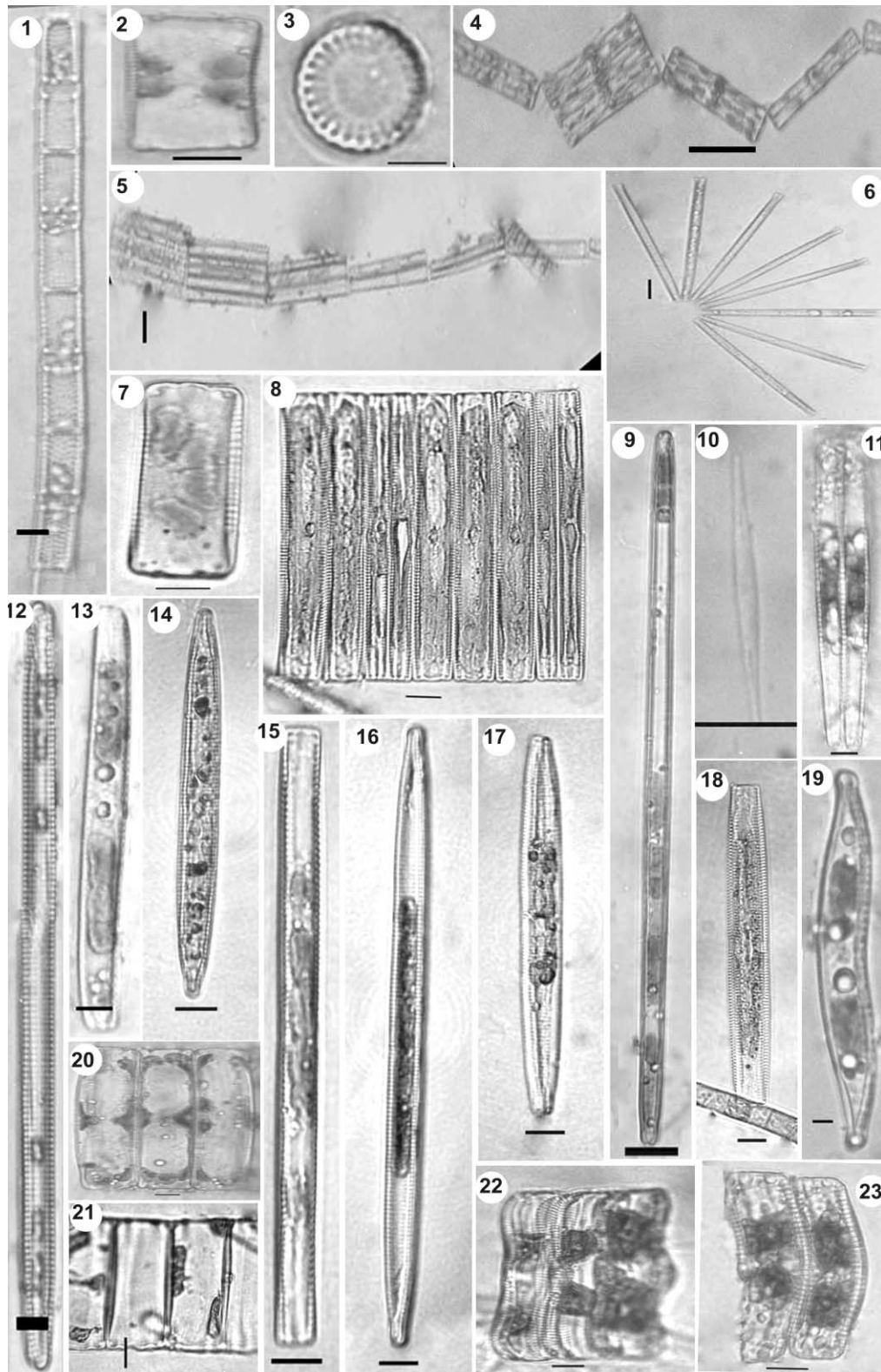
Rath and Adhikary 2005, p. 82, pl. 12, fig. 72.

Planktic in estuarine water; Voucher number, date and site: 140; 8<sup>th</sup> Jan. 2004; Budhabalanga river estuary (S-62; Temp. 25°C; pH 8.4; Cond. 900  $\mu$ s).

**Genus: *Grammatophora* Ehrenberg**

6. *Grammatophora undulata* Ehrenberg (Pl. 1, Fig. 7)

Rath and Adhikary 2005, p. 80, pl. 11, fig. 68.



**Plate 1. (Figs 1-23)** 1. *Aulacoseira granulata* (Ehrenb.) Simon., 2-3. *Cyclotella meneghiniana* Kütz., 4. *Tabellaria fenestrata* (Lyngb.) Kütz.\*, 5. *Diatoma anceps* (Ehrenb.) Kirch.\*, 6. *Thallasionema nitschoides* Grun., 7. *Grammatophora undulata* Ehrenb., 8. *Fragilaria virescens* Ralfs\*, 9. *Synedra crystallina* Kütz.\*, 10. *Synedra gracilis* Kütz., 11. *Synedra tabulata* Kütz., 12. *Synedra ulna* (Nitz.) Ehrenb., 13. *Synedra tergestina* Kütz.\*, 14. *Synedra ulna* (Nitz.) Ehrenb. var. *aequalis* (Kütz.) Hust., 15-16 *Synedra ulna* (Nitz.) Ehrenb. var. *amphirhynchus* (Ehrenb.) Grun.\*, 17-18. *Synedra ulna* (Nitz.) Ehrenb. var. *oxyrhynchus* (Kütz.) V. H\*, 19. *Eunotia amphioxys* Ehrenb.\*, 20. *Himantidium arcus* Ehrenb.\*, 21. *Himantidium minus* Kütz.\*; 22. *Achnanthes inflata* Kütz., 23. *Achnanthes subsessilis* Kütz.\* Scale bar: Figs 1-8, 11-23 = 10  $\mu$ m; 9-10 = 20  $\mu$ m.

Epizoic (attached to Pilla shell) in lake and planktic in pond; Voucher numbers, dates and sites: 548; 6<sup>th</sup> Oct. 2005; Ansupa lake (S-13; Temp. 28°C; pH 8.3; Cond. 121  $\mu$ s); 745; 14<sup>th</sup> Jan. 2006; Chikiti (S-36; Temp. 27°C; pH 7.9; Cond. 225  $\mu$ s).

**Genus: *Fragilaria* Lyngye**

7. *Fragilaria virescens* Ralfs\* (Pl. 1, Fig. 8)

(Syn. *Diatoma virescens* Hassall; *Fragilaria virescens* var. *diatomacea* Grunow)

Huber-Pestalozii 1942, p. 442, pl. CXXXI, fig. 528. a.; Kützing 1865, p. 46, pl. 16, fig. IV.

Frustules in girdle view linear rectangular, united together to form long bands, ribbon shaped colonies; valves linear with parallel sides, unilateral central area, 70-120  $\mu$ m long and 5-15  $\mu$ m bond; pseudoraphed; striation distinct but absent in the middle region, striae 5-10 in 10  $\mu$ m.

Epilithic in waterfall; Voucher number, date and site: 621; 26<sup>th</sup> Oct. 2005; Gandahati waterfall (S-42; Temp. 25°C; pH 7.2; Cond. 200  $\mu$ s).

**Genus: *Synedra* Ehrenberg**

8. *Synedra crystallina* Kützing\* (Pl. 1, Fig. 9)

(Synonym: *Diatoma crystallinum* Agardh)

Kützing 1865, p. 69, pl. 16, fig. (I) 2.

Frustules slender, long, linear, straight, end rounded-obtuse, apices truncate, longer than broad, 150-400  $\mu$ m long and 9-13  $\mu$ m broad; striation thin and not clearly visible.

Epilithic in stream and planktic in pond; Voucher number, date and sites: 658; 7<sup>th</sup> Nov. 2005; Panimunda (S-50; Temp. 23°C; pH 7.7; Cond. 137  $\mu$ s); 734; 14<sup>th</sup> Jan. 2006; pond, Chikiti (S-36; Temp. 26°C; pH 7.7; Cond. 201  $\mu$ s).

9. *Synedra gracilis* Kützing (Pl. 1, Fig. 10)

Kützing 1865, p. 64, pl. 3, figs. XIV.

Epiphytic in saltpan and in ditch; Voucher numbers, dates and sites: 218; 1<sup>st</sup> April 2004; Saltpan (S-31; Temp. 30°C; pH 8.8; Cond. 2000  $\mu$ s); 444; 28<sup>th</sup> March 2005; Padpadar (S-20; Temp. 27°C; pH 7.4; Cond. 198  $\mu$ s).

10. *Synedra tabulata* Kützing (Pl. 1, Fig. 11)

(Synonym: *Diatoma tabulatum* Kützing)

Kützing 1865, p.68, pl. 15, fig. X (1-3).

Epiphytic in water logged rice field and epilithic in stream; Voucher numbers, dates and sites: 586; 10<sup>th</sup> Oct. 2005; Asurabandha (S-37; Temp. 30°C; pH 7.5; Cond. 300  $\mu$ s); 658; 7<sup>th</sup> Nov. 2005; Panimunda (S-50; Temp. 23°C; pH 7.7; Cond. 137  $\mu$ s).

11. *Synedra tergestina* Kützing\* (Pl. 1, Fig. 13)

Kützing 1865, p. 66, pl. 4, fig. XXXIII.

Frustules linear, slightly sigmoid with obtuse end, 40-75  $\mu$ m long and 7-10  $\mu$ m broad; striation distinct, transverse, thin, marginal, striae 10-12 in 10  $\mu$ m.

Epilithic in river; Voucher number, date and site: 284; 2nd June 2004; Rushikulya river estuary (S-27; Temp. 29; pH. 8.4; Cond. 1200  $\mu$ s).

12. *Synedra ulna* (Nitzsch) Ehrenberg (Pl. 1, Fig. 12)

(Synonym: *Synedra lanceolata* Kützing)

Huber-Pestalozii 1942, p. 459, pl. CXXXV, fig. 537 A

Epiphytic in river; Voucher number, date and site: 671; 7<sup>th</sup> Nov. 2005; Vansadhara river, (S-55; Temp. 23°C; pH 6.8; Cond. 30  $\mu$ s).

13. *Synedra ulna* (Nitzsch) Ehrenberg var. *aequalis* (Kützing) Hustedt (Pl. 1, Fig. 14)

(Synonym: *Synedra aequalis* Kützing; *Synedra obtusa* Wm. Smith)

Huber-Pestalozii 1942, p. 461, pl. CXXXV, fig. 542.

Epiphytic in water logged rice field and in stream; Voucher numbers, dates and sites: 599; 19<sup>th</sup> Oct. 2005; Angul (S-19; Temp. 27°C; pH 7.7; Cond. 325  $\mu$ s); 658; 7<sup>th</sup> Nov. 2005; Panimunda (S-50; Temp. 23°C; pH 7.7; Cond. 137  $\mu$ s); 663; 7<sup>th</sup> Nov. 2005; Ranipida, Rayagada (S-52; Temp. 27°C; pH. 7.9; Cond. 176  $\mu$ s).

14. *Synedra ulna* (Nitzsch) Ehrenberg var. *amphirhynchus* (Ehrenberg) Grunow\* (Pl. 1, Figs. 15-16)

(Synonym: *Synedra amphirhynchus* Ehrenberg)

Huber-Pestalozii 1942, p. 462, pl. CXXXVI, fig. 545.

Frustules slender, linear, straight, at the end narrow and slightly constricted to form a rounded end, many times longer than broad, 100-250  $\mu$ m in long and 10-12  $\mu$ m broad; striation distinct, parallel, absent at the middle, striae 9-12 in 10  $\mu$ m.

Epilithic in waterfall and in stream; Voucher numbers, dates and sites: 621; 26<sup>th</sup> Oct. 2005; Gandahati waterfall (S-42; Temp. 25; pH. 7.2; Cond. 200  $\mu$ s); 662; 7<sup>th</sup> Nov. 2005; Vansadhara river, (S-51; Temp. 26°C; pH 7.4; Cond. 260  $\mu$ s); 663, 7<sup>th</sup> Nov. 2005; Ranipida (S-52; Temp. 27°C; pH 7.9; Cond. 276  $\mu$ s).

15. *Synedra ulna* (Nitzsch) Ehrenberg var. *oxyrhynchus* (Kützing) Van Heurck\* (Pl. 1, Figs. 17-18)

(Synonym: *Synedra oxyrhynchus* (Kützing) Van Heurck; *Synedra oxyrhynchus* var. *genuina* Grunow; *Synedra oxyrhynchus* var. *undulata* Grunow)

Huber-Pestalozii 1942, p. 461, pl. CXXXV, fig. 538.

Frustules linear to slightly lanceolate, long, straight; end narrow roundly capitate, 100-200  $\mu$ m long and 10-15  $\mu$ m broad; striation parallel, throughout the valve, slightly radiate at the apices, striae 10-14 in 10  $\mu$ m.

Epilithic and epiphytic in waterfall, stream, river and

planktic in pond; Voucher numbers, dates and sites: 620; 26<sup>th</sup> Oct. 2005; Gandahati waterfall (S-42; Temp. 25°C; pH 7.2; Conductivity 200); 653; 7<sup>th</sup> Nov. 2005; Golagola, (S-51; Temp. 21°C; pH. 7.3; Cond. 67  $\mu$ s); 658; 7<sup>th</sup> Nov. 2005; Panimunda, Niyamagiri (S-50; Temp. 23°C; pH. 7.7; Cond. 137  $\mu$ s); 662; 7<sup>th</sup> Nov. 2005; Vansadhara river (S-51; Temp. 26°C; pH 7.4; Cond. 260  $\mu$ s); 663; 7<sup>th</sup> Nov. 2005; Ranipida (S-52; Temp. 27°C; pH 7.9; Cond. 276  $\mu$ s); 665; 7<sup>th</sup> Nov. 2005; Jhagadi (S-53; Temp. 27°C; pH 7.8; Cond. 325  $\mu$ s); 716; 22<sup>nd</sup> Dec. 2005; Kalinga ghati, (S-56; Temp. 24°C; pH. 7.2; Cond. 225  $\mu$ s).

Class: Fragilariophyceae

Order: Achnanthes

Family: Achnanthesaceae

**Genus: Achnanthes Bory**

16. *Achnanthes inflata* Kützing (Pl. 1, Fig. 22)

Sarode and Kamat 1979, p. 27, fig. 23

Epilithic in stream; Voucher number, date and site: 728; 19<sup>th</sup> Dec. 2005; Kuturi tiger sanctuary (S-17; Temp. 25°C; pH. 7.2; Cond. 280  $\mu$ s).

17. *Achnanthes subsessilis* Kützing\* (Pl. 1, Fig. 23)

(Synonym: *Achnanthes turgens* Ehrenberg)

Kützing 1865, p.76, pl. 20, fig. IV.

Frustules rectangular, slightly bent at the middle, 1-2 valves articulate, turgid form, laterally oblong, 30-50  $\mu$ m long and 5-14  $\mu$ m broad; striation intermediate or distinct, striae 6-9 in 10  $\mu$ m

Epilithic in stream; Voucher number, date and site: 647; 7<sup>th</sup> Nov. 2005; Muniguda (S-47; Temp. 24°C; pH. 7.9; Cond. 47  $\mu$ s).

Class: Fragilariophyceae

Order: Achnanthes

Family: Cocconeidaceae

**Genus: Cocconeis Ehrenberg**

18. *Cocconeis pediculus* Ehrenberg (Pl. 2, Fig. 1)

Kützing 1865, p. 71, pl. 5, fig. IX (1).

Frustules ovoid to elliptical, with marginal bend, lanceolate outline, rounded end, 20-25  $\mu$ m long and 10-17  $\mu$ m broad; striation not visible in fresh material.

Epiphytic in river; Voucher number, date and site: 670; 7<sup>th</sup> Nov 2005; Vansadhara river (S-54; Temp. 26°C; pH 7.4; Cond.138  $\mu$ s).

Class: Bacillariophyceae

Order: Naviculales

Family: Naviculaceae

**Genus: Diadesmis Kützing**

19. *Diadesmis confervacea* Kützing\* (Pl. 2, Fig. 2)

Kützing 1865, p. 109, pl. 30, figs. 8 a. b.

Frustules attached side by side to form ribbon shaped colony; filamentous, gelatinous, rectangular in girdle view, truncate flat, slightly gap between the valve at the middle, 10-30  $\mu$ m long and 5-12  $\mu$ m broad; striation not distinct.

Epilithic in well (attached to cemented wall), pond, epiphytic in stream (attached to *Spirogyra* sp.) in river, rice field, drain and canal; Voucher numbers, dates and sites: B18; 20<sup>th</sup> Nov. 2003; Kedargouri (S-1; Temp. 25°C; pH 6.9; Cond. 188  $\mu$ s); 143B; 5<sup>th</sup> Feb. 2004; Khurda (S-8; Temp. 27°C; pH 7.2; Cond. 275  $\mu$ s); 165; 14<sup>th</sup> Feb. 2004; Salandi river (S-60; Temp. 28°C; pH 6.9; Cond. 250  $\mu$ s); 197, 2<sup>nd</sup> March 2004; 256; 18<sup>th</sup> April 2004; Taladanda canal (S-11; Temp. 27°C; pH 8.2; Cond. 282  $\mu$ s); 229; 11<sup>th</sup> April 2004; Ruslikulya river (S-32; Temp. 27°C; pH 7.2; Cond. 300  $\mu$ s); 230; 11<sup>th</sup> April 2004; Daringibadi (S-59; Temp. 25°C; pH. 7.0; Cond. 180  $\mu$ s); 585; 10<sup>th</sup> Oct. 2005; Asurabandha (S-37; Temp. 30°C; pH 7.5; Cond. 300  $\mu$ s); 650; 7<sup>th</sup> Nov. 2005; Niyamagiri hill (S-48; Temp. 25°C; pH 7.0; Cond. 181  $\mu$ s); 653; 7<sup>th</sup> Nov. 2005; Gologala (S-49; Temp. 21°C; pH 7.3; Cond. 67  $\mu$ s).

**Genus: Diplonies Ehrenberg ex. Cleve**

20. *Diplonies interrupta* (Kützing) Cleve (Pl. 2, Fig. 3)

Desikachary 1988, p.10, pl. 571 figs. 1-3, 6.

Planktic in river; Voucher number, date and site: 274; 8<sup>th</sup> May 2004; Rushikulya river estuary (S-27; Temp. 29°C; pH. 8.4; Cond.1200  $\mu$ s).

**Genus: Gyrosigma Hassall**

21. *Gyrosigma acuminatum* (Kützing) Rabenhorst (Pl. 2, Fig. 5)

Desikachary 1988, p. 10, pl. 592, figs. 14-16; Rath and Adhikary 2005, p. 89, pl. 13, fig. 87.

Epiphytic in saltpan; Voucher numbers, date and site: 128; 1<sup>st</sup> April 2004; Huma (S-31; Temp. 30°C; pH 8.8; Cond. 2000  $\mu$ s).

22. *Gyrosigma scalproides* (Rabenhorst) Cleve var. *eximia* (Thwaites) Cleve (Pl. 2, Fig. 4); Venkataraman 1939, p. 319, fig.76.

Epilithic in stream; Voucher number, date and site: 653; 7<sup>th</sup> Nov. 2005; Golagola (S-49; Temp. 21°C; pH 7.3; Cond. 67  $\mu$ s).

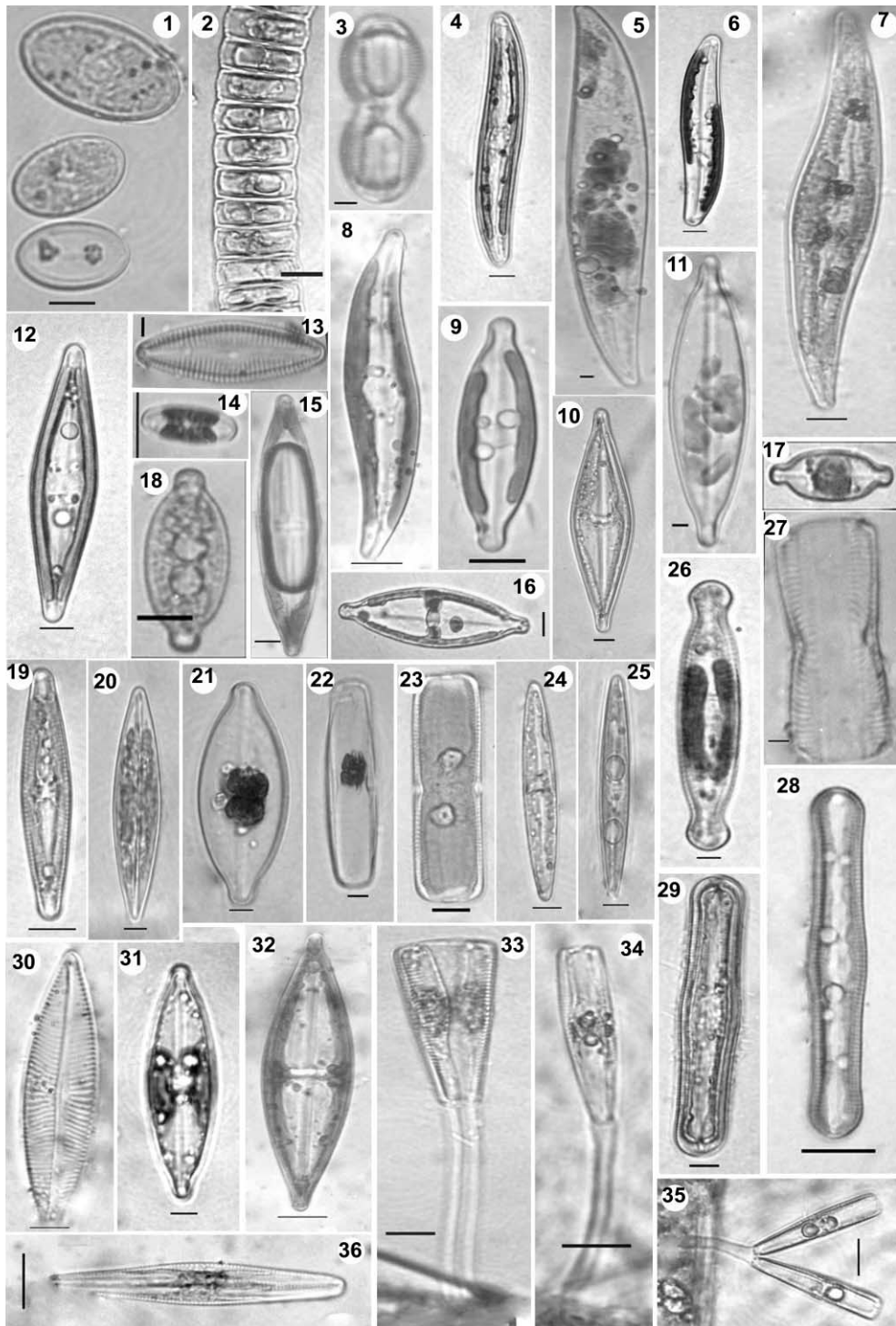
**Genus: Pleurosigma Wm. Smith**

23. *Pleurosigma aestuarii* Brébison. ex. Kützing W. Son. (Pl. 2, Fig. 6)

Desikachary 1989, p. 5, pl. 680, fig. 8 & 9.

Epiphytic in river; Voucher numbers, dates and sites: 165; 14<sup>th</sup> Feb. 2004; Salandi river (S-60; Temp. 27°C; pH





**Plate 2. (Figs 1-36)** 1. *Cocconeis pediculus* Ehrenb.\*, 2. *Diademsis confervacea* Kütz.\*, 3. *Diplonies interrupta* (Kütz.) Cl., 4. *Gyrosigma scalproides* (Rabenh.) Cl. var. *eximia* (Thwait.) Cl., 5. *Gyrosigma acuminatum* (Kütz.) Rabenh., 6. *Pleurosigma aestuarii* Bréb. ex. Kütz. W. Son. 7. *Pleurosigma javanicum* Grun., 8. *Pleurosigma normanni* Ralfs 9. *Navicula amphirhynchus* Ehrenb.\*, 10. *Navicula cuspidata* Kütz., 11. *Navicula cuspidata* Kütz. var. *ambigua* Ehrenb., 12. *Navicula gracilis* Ehrenb., 13. *Navicula kariana* Grun. var. *curta* (Cl.) Ross, 14. *Navicula lamii* Manguin, 15. *Navicula major* Kütz.\*, 16. *Navicula microspora* Kant et Gupta, 17. *Navicula pupula* Kütz., 18. *Navicula protracta* (Grun.) Cl., 19. *Navicula radiosa* Kütz., *Navicula reinhardtii* Grun. f. *gracilior* Grun., 20. *Navicula reinhardtii* Grun. f. *gracilior* Grun., 21-22. *Navicula sphaerophora* Kütz.\*, 23. *Navicula viridis* Kütz.\*, 24-25. *Navicula viridula* Kütz.\*, 26. *Pinnularia biceps* Greg., 27. *Pinnularia braunii* (Grun.) Cl. var. *amphicephala* (May.) Hust., 28. *Pinnularia gibba* Ehrenb., 29. *Pinnularia viridis* (Nitz.) Ehrenb., 30. *Stauroneis anceps* Ehrenb., 31. *Stauroneis phoenicentron* (Nitz.) Ehrenb., 32. *Stauroneis pusilla* Cl., 33. *Gomphonema abbreviatum* Ag., 34-35. *Gomphonema dichotomum* Kütz., 36. *Gomphonema hebridense* Greg. Scale bar: Figs 1-7, 10-13, 15-35 = 10  $\mu$ m; 8, 36 = 20  $\mu$ m; 14 = 30  $\mu$ m.

6.9; Cond. 250  $\mu$ s).

24. *Pleurosigma javanicum* Grunow (Pl. 2, Fig. 7)

Desikachary 1989, p. 5, pl. 677, fig. 2.

Epilithic in stream; Voucher number, date and site collection site: 658; 7<sup>th</sup> Nov. 2005; Panimunda (S-50; Temp. 23°C; pH 7.7; Cond. 137  $\mu$ s).

25. *Pleurosigma normanni* Ralfs (Pl. 2, Fig. 8)

Desikachary 1987, p. 8, pl. 310, fig. 7.

Epilithic in lake; Voucher number, date and site: 554; 6<sup>th</sup> Oct. 2005; Ramsagar lake (S-39; Temp. 29°C; pH. 8.9; Cond. 786  $\mu$ s).

**Genus: Navicula Bory**

26. *Navicula amphirhynchus* Ehrenberg\* (Pl. 2, Fig. 9)

Kützing 1865, p. 95, pl. 4, fig.-XIII; pl. 28, fig. 47.

Frustules broadly elliptic-lanceolate with quite narrowly rostrate apices, apices constructed to form truncate, longer than broad, 50-100  $\mu$ m long, 10-20  $\mu$ m broad; raphae thin and central area slightly widened; striation barely visible in fresh material.

Epilithic in pond, river, stream and epiphytic in puddle; Voucher numbers, dates and sites: 143B; 5<sup>th</sup> Feb. 2004; Khurda (S-8; Temp. 27°C; pH 7.2; Cond. 275  $\mu$ s); 475; 4<sup>th</sup> June 2005; Sonpur (S-34; Temp. 28°C; pH 7.8; Cond. 484  $\mu$ s); 636; 26<sup>th</sup> Oct. 2005; Nagavali river (S-46; Temp. 28°C; pH 7.8; Cond. 400  $\mu$ s); 653; 7<sup>th</sup> Nov. 2005; Golagola (S-49; Temp. 21°C; pH. 7.3; Cond. 67  $\mu$ s).

27. *Navicula cuspidata* Kützing (Pl. 2, Fig. 10)

(Synonym: *Navicula fulva* Ehrenberg; *Frustulia cuspidata* Kützing.)

Kützing 1865, p. 94, pl. 3, figs. XXIV.

Epiphytic in water logged rice field and epilithic in stream; Voucher number, date and site: 647, 648; 7<sup>th</sup> Nov. 2005; Muniguda (S-47; Temp. 24°C; Ph. 7.9; Cond. 47  $\mu$ s).

28. *Navicula cuspidata* Kützing var. *ambigua* Ehrenberg (Pl. 2, Fig. 11)

Kant and Gupta 1998, p. 158, pl. 122, fig. 7.

Epiphytic in rice field; Voucher number, date and site: 583; 10<sup>th</sup> Oct. 2005; Asurabandha (S-37; Temp. 30°C; pH 7.5; Cond. 300  $\mu$ s).

29. *Navicula gracilis* Ehrenberg (Pl. 2, Fig. 12)

(Synonym: *Cymbella hyalina* Agardh; *Frustulia avenacea* De Brébison)

Kützing 1865, p. 91, pl. 3, figs. XLVIII & pl. 30, fig. 57.

Slimy, epiphytic in rice field Voucher number, date and site: 562; 6<sup>th</sup> Oct. 2004; Saradapadar, (S-40; Temp. 28°C; pH. 7.8; Cond. 350  $\mu$ s).

30. *Navicula kariana* Grunow var. *curta* (Cleve) Ross. (Pl. 2, Fig. 13)

Desikachary 1989, p. 2, pl. 640, fig. 19.

Epilithic in stream and epiphytic (attached to *Spirogyra* sp.) in river; Voucher numbers, dates and sites: 232; 11<sup>th</sup> April 20045; Daringibadi (S-59; Temp. 25°C; pH 7.0; Cond. 180  $\mu$ s); 247; 18<sup>th</sup> April 2004; Kathajodi river (S-10; Temp. 30°C; pH 7.2; Cond. 221  $\mu$ s).

31. *Navicula lamii* Manguin (Pl. 2, Fig. 14)

Kant and Gupta 1998, p. 158, pl. 127, fig. 11.

Epilithic in lake; Voucher number, date and site: 554; 6<sup>th</sup> Oct. 2005; Ramsagar lake, (S-39; Temp. 29°C, pH 8.9; Cond. 786  $\mu$ s).

32. *Navicula major* Kützing\* (Pl. 2, Fig. 15)

(Synonym: *Bacillaria fulva* Nitzsch; *Frustulia major* Kützing)

Kützing 1865, P. 97, pl. 4, fig. XIX.

Frustules elongate-elliptic; towards apices rotundas, in valve view rectangular, middle or axial portion granular, 50-75  $\mu$ m long and 10-15  $\mu$ m broad; striation transverse, less visible, striae 10-12 in 10  $\mu$ m.

Epilithic in stream; Voucher number, date and site: 663; 7<sup>th</sup> Nov. 2005; Ranipida (S-52; Temp. 27°C; pH 7.9; Cond. 276  $\mu$ s).

33. *Navicula microspora* Kant et Gupta (Pl. 2, Fig. 16)

Kant and Gupta 1998, p. 27, pl. 127, fig. 12.

Epilithic in stream, planktic in pond and scum on stagnant water surface of ditch; Voucher numbers, dates and sites: 297; 9<sup>th</sup> Aug. 2004; Botanical Survey of India, Kolkata, (S-66); 600; 20<sup>th</sup> Oct 2005; Utkal University campus (S-7; Temp. 28°C; pH. 8.2; Cond 400  $\mu$ s); 660; 7<sup>th</sup> Nov. 2005; Panimunda (S-50; Temp. 23°C; pH 7.7; Cond. 137  $\mu$ s); 702; 28<sup>th</sup> Nov. 2005; Krishna sayar park (S-67; Temp. 25°C; pH. 8.6; Cond. 379  $\mu$ s); 751; 14<sup>th</sup> Jan. 2006; Chikiti (S-36; Temp. 27°C; pH 7.9; Cond. 445  $\mu$ s).

34. *Navicula pupula* Kützing (Pl. 2, Fig. 17)

Kützing 1865, p. 93, pl. 30, figs. 40.

Scum on stagnant water in ditch, epiphytic (attached to *Phormidium* sp.) side tube well; Voucher numbers, dates and sites: 552; 6<sup>th</sup> Oct. 2005; Madhumara (S-38; Temp. 30°C; pH 7.7; Cond. 300  $\mu$ s); 588; 18<sup>th</sup> Oct. 2005; Deulajhari, Athamalik (S-18; Temp. 41°C; pH 7.01; Cond. 60  $\mu$ s).

35. *Navicula protracta* (Grunow) Cleve (Pl. 2, Fig. 18)

Rath and Adhikary 2005, p. 87, pl. 12, fig. 83

Epiphytic in saltpan and epiphytic (attached to *Phormidium* sp.); Voucher numbers, dates and sites: 218; 1<sup>st</sup> April 2004; Huma (S-31; Temp. 30°C; pH 8.8; Cond. 2000  $\mu$ s); 588; 18<sup>th</sup> Oct. 2005; Deulajhari, Athamalik (S-18; Temp. 41°C; pH 7.01; Cond. 60  $\mu$ s).

36. *Navicula radiosa* Kützing (Pl. 2, Fig. 19)

Kützing 1865, p. 91, pl. 4, fig. XXIII.

Epilithic in stream associated with *Spirogyra* sp.; Voucher number, date and site: 650; 7<sup>th</sup> Nov. 2005; Muniguda (S-48; Temp. 25°C; pH 7.0; Cond. 181  $\mu$ s).

37. *Navicula reinhardtii* Grunow f. *gracilior* Grunow (Pl. 2, Fig. 20)

Pal and Santra 1990, p. 78, pl. 1, fig. 24.

Epilithic in stream; Voucher number, date and site: 460; 4<sup>th</sup> June 2005; Nirmalajhara (S-33; Temp. 25°C; pH 6.8; Cond. 124  $\mu$ s).

38. *Navicula sphaerophora* Kützing\* (Pl. 2, Figs. 21-22)

Kützing 1865, p. 95, pl. 4, figs. XVII.

Frustules elliptic-lanceolate; at the middle area dorsal side strongly convex, central area broad, constricted apices, obtuse, raphae median wide; striation thin, not visible in fresh material; 20-40  $\mu$ m long and 10-30  $\mu$ m broad.

Epiphytic in puddle; Voucher number, date and site: 475; 4<sup>th</sup> June 2005; puddle, Sonpur (S-8; Temp. 28°C; pH 8.4; Cond. 484  $\mu$ s).

39. *Navicula viridis* Kützing\* (Pl. 2, Fig. 23)

(Synonym: *Bacillaria viridis* Nitzsch; *Frustulia viridis* Kützing)

Kützing 1865, P. 97, pl. 4, fig. XVIII.

Frustules linear oblong, rectangular in valve view, lanceolate in girdle view, slightly rotundatum towards apices, 50-80  $\mu$ m long and 10-20  $\mu$ m broad; striation transverse, striae 8-12 in 10  $\mu$ m.

Epilithic in stream; Voucher number, date and site: 660; 7<sup>th</sup> Nov. 2005; Panimunda (S-50; Temp. 23°C; pH 7.7; Cond. 137  $\mu$ s).

40. *Navicula viridula* Kützing\* (Pl. 2, Figs. 24-25)

(Synonym: *Frustulia viridula* Kützing)

Kützing 1865, p. 91, pl. 3, fig. XLIV.

Frustules linear lanceolate, elongated, attenuated towards apices to obtuse end, 25-75  $\mu$ m long and 5-12  $\mu$ m broad; raphae not clear; striation clearly visible in fresh material.

Epilithic in waterfall, stream and epiphytic in river: Voucher numbers, dates and sites: 618, 621; 26<sup>th</sup> Oct. 2005; Gandahati waterfall (S-42; Temp. 25°C; pH 7.2; Cond. 200  $\mu$ s); 658; 7<sup>th</sup> Nov. 2005; Panimunda (S-50; Temp. 23°C; pH 7.7; Cond. 137  $\mu$ s); 670; 7<sup>th</sup> Nov. 2005; Vansadhara river (S-54; Temp. 26°C; pH 7.4; Cond. 138  $\mu$ s); 719; 19<sup>th</sup> Dec. 2005; Sundurukumpa (S-57; Temp. 27°C; pH 7.8; Cond. 325  $\mu$ s).

**Genus: *Pinnularia* Ehrenberg**

41. *Pinnularia biceps* Gregory (Pl. 2, Fig. 26)

Desikachary 1989, p. 4, pl. 669, fig. 7-10.

Epilithic in stream; Voucher number, date and site.:

460; 4<sup>th</sup> June 2005; Nirmalajhara (S-33; Temp. 25°C; pH 6.8; Cond. 124  $\mu$ s).

42. *Pinnularia braunii* (Grunow) Cleve var. *amphicephala* (Mayer) Hustedt (Pl. 2, Fig. 27)

Desikachary 1989, p. 8, pl. 307, fig. 6.

Epiphytic in river Voucher number, date and site: 272; 8<sup>th</sup> May 2004; Rushikulya river estuary (S-27; Temp. 29°C; pH 8.4; Cond. 1200  $\mu$ s).

43. *Pinnularia gibba* Ehrenberg (Pl. 2, Fig. 28)

Desikachary 1989, p. 4, pl. 669, fig. 21.

Epiphytic water lake; Voucher number, date and site: 548; 6<sup>th</sup> Oct. 2005; Ansupa lake (S-13; Temp. 28°C; pH 8.3; Cond. 121  $\mu$ s).

44. *Pinnularia viridis* (Nitzsch) Ehrenberg (Pl. 2, Fig. 29)

Desikachary 1989, p. 4, pl. 668, fig. 18-22.

Epilithic in pond, scum on stagnant water surface of ditch; Voucher numbers, dates and sites: 39; 27<sup>th</sup> Oct 2003; Mandiapali (S-23; Temp. 29°C; pH. 7.5; Cond. 195  $\mu$ s); 600; 20<sup>th</sup> Oct. 2005; Utkal University campus (S-7; Temp. 28°C; pH. 8.2; Cond. 400  $\mu$ s).

**Genus: *Stauroneis* Ehrenberg**

45. *Stauroneis anceps* Ehrenberg (Pl. 2, Fig. 30)

Bongale 1985, p. 24, pl. 1, fig. 14.

Planktic in pond; Voucher number date and site: 399; 14<sup>th</sup> Jan. 2005; Chandipur (S-62; Temp. 29°C; pH. 7.9; Cond. 420  $\mu$ s).

46. *Stauroneis phoenicentron* (Nitzsch) Ehrenberg (Pl. 2, Fig. 31)

Desikachary 1989, p. 7, pl. 701, figs. 4-5.

Epilithic in waterfall; Voucher number date and site: 633; 26<sup>th</sup> Oct. 2005; Hatipathar waterfall (S-43; Temp. 25°C; pH 7.3; Cond. 410  $\mu$ s).

47. *Stauroneis pusilla* Cleve (Pl. 2, Fig. 32)

Rath and Adhikary 2005, p. 82, pl. 12, fig. 217 & 173.

Planktic in canal; Voucher numbers dates and sites: 277; 8<sup>th</sup> May 2004; Khadasing (S-28; Temp. 28°C; pH. 8.4; Cond. 487  $\mu$ s); 360; 6<sup>th</sup> Dec. 2004; Botanical Survey of India (S-66).

Class: Bacillariophyceae

Order: Naviculales

Family: Eunotiaceae

**Genus: *Eunotia* Ehrenberg**

48. *Eunotia amphioxys* Ehrenberg\* (Pl. 1, Fig. 19)

Kützing 1865, p.36, pl. 29, fig. 44 and pl. 30, fig. 1.

Frustules boat shaped, at the middle lower valve depressed with punctate keel; upper valve slightly convex; pectulated at the ends; 50-90  $\mu$ m long and 5-12  $\mu$ m broad.

Epiphytic in river; Voucher number, date and site: 274; 8<sup>th</sup> May 2004; Rushikulya river estuary (S-27; Temp. 29°C; pH 8.4; Cond. 1200  $\mu$ s).

**Genus: *Himantidium* Kützing**

49. *Himantidium arcus* Ehrenberg\* (Pl. 1, Fig. 20)

(Synonym: *Eunotia arcus* Ehrenberg)

Kützing 1865, p. 39, pl. 29, fig. 43 c.

Frustules laterally rectangular or linear arcuate, 2-4 valves; conjugated to form complex, apices rotundas, sub-curve, 50-10  $\mu$ m long and 10-22  $\mu$ m broad; striation thin, marginal, seen at the middle.

Epilithic in stream; Voucher number, date and site: 728; 19<sup>th</sup> Dec. 2005; Kuturi tiger sanctuary (S-17; Temp. 25°C; pH 7.2; Cond. 280  $\mu$ s).

50. *Himantidium minus* Kützing\* (Pl. 1, Fig. 21)

Kützing 1865, p. 39, pl. 16, fig. X (1-4).

Frustules attached side by side to form ribbon shaped colony, unilateral, rectangular and linear in girdle view, longer than broad; 30-50  $\mu$ m long and 15-25  $\mu$ m broad; striations not clear.

Epilithic in pond and in stream; Voucher numbers, dates and sites: 727; 728; 19<sup>th</sup> Dec. 2005; Kuturi tiger sanctuary (S-17; Temp. 25°C; pH 7.2; Cond. 280  $\mu$ s).

Class: Bacillariophyceae

Order: Naviculales

Family: Gomphonemaceae

**Genus: *Gomphonema* Ehrenberg**

51. *Gomphonema abbreviatum* Agardh (Pl. 2, Fig. 33)

(Synonym: *Licmophora minuta* Kützing; *Gomphonema brevipes* Kützing)

Kützing 1865, p. 84, pl. 8, fig. VIII.

Epilithic in stream; Voucher number date and site: 721; 19<sup>th</sup> Dec. 2005; Gadiapada (S-57; Temp. 23°C; pH 7.3; Cond. 205  $\mu$ s).

52. *Gomphonema dichotomum* Kützing (Pl. 2, Figs. 34-35)

(Synonym: *Gomphonema gracile* Ehrenberg)

Kützing 1865, p. 85, pl. 8, fig. XIV.

Epilithic in stream and planktic in pond; Voucher numbers dates and sites: 722; 19<sup>th</sup> Dec. 2005; Gadiapada, (S-57; Temp. 23°C; pH 7.3; Cond. 205  $\mu$ s); 757; 8th March 2006; pond, Botanical Survey of India gardens, Kolkata (S-66; Temp. 25°C; pH 8.6; Cond. 379  $\mu$ s).

53. *Gomphonema hebridense* Gregory. (Pl. 2, Fig. 36)

Pal and Santra 1990, p. 74, pl. 1, fig. 7.

Epiphytic in puddle; Voucher number, date and site: 443; 28<sup>th</sup> March 2005; Padpadar, (S-20; Temp. 27°C; pH 7.4; Cond. 379  $\mu$ s).

54. *Gomphonema lanceolatum* Ehrenberg (Pl. 3, Figs. 1-2)

Kützing 1865, p. 87, pl. 29, fig.73.

Epiphytic in rice field; Voucher number, date and site: 586; 10<sup>th</sup> Oct 2005; Asurabandha (S-37; Temp. 30°C; pH. 7.5; Cond. 198  $\mu$ s).

55. *Gomphonema parvulum* (Kützing) Grunow var. *micropus* (Kützing) Cleve\* (Pl. 3 Fig. 3); Kützing 1865, p. 84, pl. 8, fig. XII.

Frustules small linear-cuneate, asymmetrical, end truncate, both base obtuse, 10-30  $\mu$ m long and 5-10  $\mu$ m broad; striation distinct, marginal, parallel, striae 8-10 in 10  $\mu$ m.

Epizoic in canal and epiphytic in puddle; Voucher numbers, dates and sites: 305; 9<sup>th</sup> Aug. 2004; Santiniketan (S-67; Temp. 26°C; pH. 7.7; Cond. 210  $\mu$ s); 443; 28<sup>th</sup> March 2005; Padpadar (S-20; Temp. 27°C; pH 7.4; Cond. 198  $\mu$ s).

56. *Gomphonema montanum* Schumann var. *genuinum* Mayer (Pl. 3, Fig. 4)

Pal and Santra 1990, p. 75, pl. 1, fig.15.

Epiphytic (attached to *Spirogyra* sp.) in pond; Voucher number, date and site: 692; 28<sup>th</sup> Nov. 2005; Burdwan University campus (S-67; Temp. 25°C; pH. 8.6; Cond. 309  $\mu$ s).

57. *Gomphonema olivaceum* (Lyngbye) Kützing (Pl. 3, Fig. 5)

Kützing 1865, p.85, pl. 7, figs. XIII & XV; Pal and Santra 1990, p. 75, pl. 1, fig. 27.

Epiphytic in puddle in fresh water lake and planktic in pond; Voucher numbers; dates and sites: 443; 28<sup>th</sup> March 2005; Padpadar (S-20; Temp. 27°C; pH 7.4; Cond. 198  $\mu$ s); 548; 6<sup>th</sup> Oct. 2005; Ansupa lake (S-13; Temp. 28°C; pH 8.3; Cond. 121  $\mu$ s); 757; 8<sup>th</sup> March 2006; pond, Botanical Survey of India gardens, Kolkata (S-66; Temp. 25°C; pH 8.6; Cond. 379  $\mu$ s).

58. *Gomphonema parvulum* (Kützing) Grunow var. *micropus* (Kützing) Grunow (Pl. 3, Fig. 6)

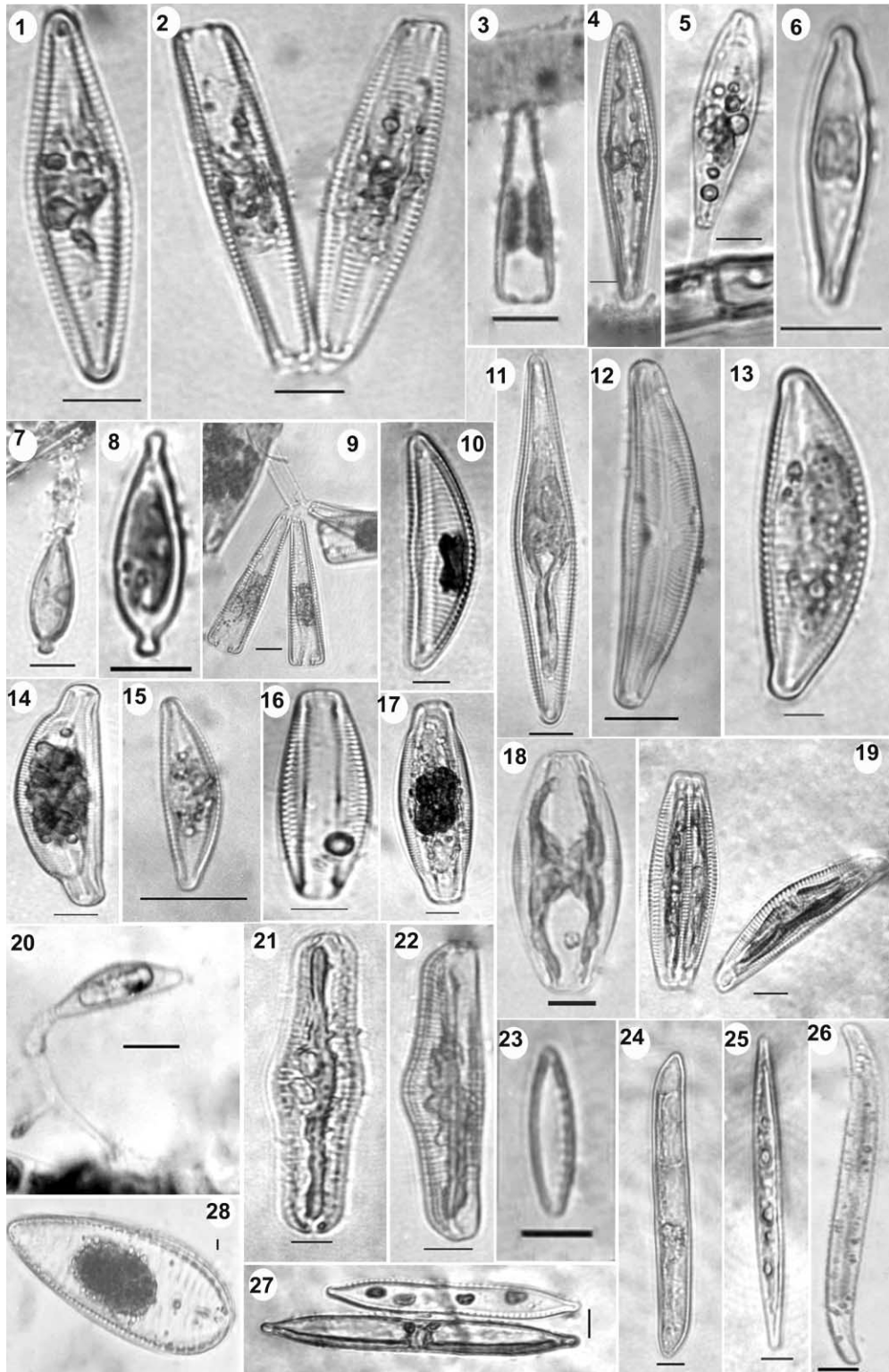
Pal and Santra 1990, p. 75, pl. 1, fig. 16; Sinha and Naik 1997, p. 50, pl. 19, fig. 8 a-k.

Planktic in pond; Voucher number, date and site: 751; 14<sup>th</sup> Jan. 2006; Chikiti (S-36; Temp. 27°C; pH 7.9; Cond. 445  $\mu$ s).

59. *Gomphonema sphaerophorum* Ehrenberg (Pl. 3, Figs. 7-8)

Pal and Santra 1990, p. 75, pl. 1, fig. 25; Sinha and Naik 1997, p. 50, pl. 19, fig. 9 a-f.

Epiphytic in river, epilithic in stream and planktic in pond; Voucher numbers, dates and sites: 165; 14<sup>th</sup> Feb. 2004; Salandi river (S-60; Temp. 27°C; pH 6.9; Cond. 250  $\mu$ s); 658; 7<sup>th</sup> Nov. 2005; Panimunda (S-50; Temp. 23°C;



**Plate 3. (Figs 1-28)** 1-2. *Gomphonema lanceolatum* Ehrenb., 3. *Gomphonema parvulum* (Kütz.) Grun. var. *micropus* (Kütz.) Cl.\*, 4. *Gomphonema montanum* Schum. var. *genuinum* May., 5. *Gomphonema olivaceum* (Lyng.) Kütz., 6. *Gomphonema parvulum* (Kütz.) Grun., 7-8. *Gomphonema sphaerophorum* Ehrenb., 9. *Gomphonema telographicum* Kütz.\*, 10. *Gomphonema vibrio* Ehrenb., 11. *Cymbella affinis* Kütz., 12. *Cymbella cystula* (Hempr.) Grun., 13. *Cymbella ehrenbergii* Kütz., 14. *Cymbella tumida* (Bréb.) V.H., 15. *Cymbella turgidula* Grun., 16. *Amphora elliptica* Kütz.\*, 17. *Amphora coffeaeformis* Kütz., 18. *Amphora ovalis* Kütz., 19. *Amphora ovum* Cl. 20. *Cocconema cystula* Ehrenb.\*, 21-22. *Rhopalodia gibba* (Ehrenb.) O. Müll., 23. *Nitzschia amphibia* Grun., 24. *Nitzschia obtusa* Wm. Smith, 25. *Nitzschia palea* (Kütz.) Wm. Smith, 26. *Nitzschia sigmoidea* (Nitz.) Wm. Smith, 27. *Nitzschia stagnorum* (Rabenh.) Grun., 28. *Surirella nervosa* (A.S.) May. Scale bar: Figs 1-6, 8-11, 13-14, 16-22, 24-28 = 10  $\mu\text{m}$ ; 3, 7, 12, 15, 23 = 20  $\mu\text{m}$ .

pH 7.7; Cond. 137  $\mu\text{s}$ ); 751; 14<sup>th</sup> Jan. 2006; Chikiti (S-36; Temp. 27°C; pH 7.9; Cond. 445  $\mu\text{s}$ ).

60. *Gomphonema telographicum* Kützing\* (Pl. 3, Fig. 9)  
Kützing 1865, p. 84, pl. 8, fig. IX.

Frustules cuneate, apices slightly wide, truncate, base acute, 30-60  $\mu\text{m}$  long and 7-14  $\mu\text{m}$  broad, stipe long with 2-3 valves at the end, stipe 20-32  $\mu\text{m}$  long and 6-8  $\mu\text{m}$  broad, striation clearly distinct, marginal; striae 8-10 in 10  $\mu\text{m}$ .

Epilithic in stream; Voucher number, date and site: 721; 19<sup>th</sup> Dec. 2005; Gadiapada (S-58; Temp. 23°C; pH. 7.3; Cond. 205  $\mu\text{s}$ ).

61. *Gomphonema vibrio* Ehrenberg (Pl. 3, Fig. 11)  
Kützing 1865, p.87, pl. 29, figs.75.

Epiphytic in pond, puddle, rice field, river; Voucher numbers, dates and sites: B76; 29<sup>th</sup> Jan. 2004; Daspur (S-5; Temp. 28°C; pH 8.0; Cond. 205  $\mu\text{s}$ ); 443; 28th March 2005; Padpadar, (S-20; Temp. 27°C; pH 7.4; Cond. 379  $\mu\text{s}$ ); 582; 10<sup>th</sup> Oct. 2005; Asurabandha (S-37; Temp. 30°C; pH 7.5; Cond. 300  $\mu\text{s}$ ).

Class: Bacillariophyceae

Order: Naviculales

Family: Cymbellaceae

**Genus: *Cymbella* Agardh**

62. *Cymbella affinis* Kützing (Pl. 3, Fig. 10)

Kützing 1865, P. 80, pl. 6, fig. XV; Pal and Santra 1990, p. 73, pl. 1, fig. 3.

Planktic and epilithic in pond; Voucher numbers, dates and sites: 702; 28<sup>th</sup> Nov. 2005; Krishna sayar park (S-67; Temp. 25°C; pH. 8.6; Cond. 379  $\mu\text{s}$ ); 751; 14<sup>th</sup> Jan. 2006; Chikiti (S-36; Temp. 27°C; pH 7.9; Cond. 445  $\mu\text{s}$ ).

63. *Cymbella cistula* (Hempr.) Grunow (Pl. 3, Fig. 12)  
Prasad and Jatley 1985, p. 137, fig. 3.

Epiphytic in river, puddle and in canal; Voucher numbers; dates and sites: 165; 14<sup>th</sup> Feb. 2004; Salandi river (S-60; Temp. 27°C; pH 6.9; Cond. 250  $\mu\text{s}$ ); 253; 18<sup>th</sup> April 2004; Taladanda canal (S-11; Temp. 27°C; pH 8.2; Cond. 282  $\mu\text{s}$ ); 443; 28<sup>th</sup> March 2005; Padpadar (S-20; Temp. 27°C; pH 7.4; Cond. 379  $\mu\text{s}$ ).

64. *Cymbella ehrenbergii* Kützing (Pl. 3, Fig. 13)  
Kützing 1865, p. 79, pl. 6, fig. X1-2.

Epiphytic in river (attached to *Spirogyra* sp.) and epilithic in stream; Voucher numbers; date and sites: 149; 5<sup>th</sup> Feb. 2004; Rushikulya river (S-26; Temp. 28°C; Cond. 450  $\mu\text{s}$ ); 232; 11<sup>th</sup> April 2004; Daringibadi (S-59; Temp. 25°C; pH 7.0; Cond. 180  $\mu\text{s}$ ); 247; 18<sup>th</sup> April 2004; Kathajodi river (S-10; Temp. 30°C; pH. 7.2; Cond. 221  $\mu\text{s}$ ).

65. *Cymbella tumida* (Brébison) V.H. (Pl. 3, Fig. 14)

Pal and Santra 1990, p. 74, pl. 1, fig. 4; Sinha and Naik 1997, p. 47, pl. 17, fig. 4 a-c.

Epiphytic in river and epilithic in stream; Voucher numbers, dates and sites: 165; 14<sup>th</sup> Feb. 2004; Salandi river (S-60; Temp. 27°C; pH 6.9; Cond. 250  $\mu\text{s}$ ); 653; 7<sup>th</sup> Nov. 2005; Gologala (S-49; Temp. 21°C; pH. 7.3; Cond. 67  $\mu\text{s}$ ); 722; 19<sup>th</sup> Dec. 2005; Gadiapada (S-57; Temp. 23°C; pH 7.3; Cond. 205  $\mu\text{s}$ ).

66. *Cymbella turgidula* Grunow (Pl. 3, Fig. 15)

Pal and Santra 1990, p. 74, pl. 1, fig. 6.

Epiphytic in canal, puddle and epilithic in waterfall; Voucher numbers, dates and sites: 254; 18th April 2004; Taladanda canal (S-11; Temp. 27°C; pH 8.2; Cond. 282  $\mu\text{s}$ ); 443; 28<sup>th</sup> March 2005; Padpadar (S-20; Temp. 27; pH 7.4; Cond. 198  $\mu\text{s}$ ); 632; 26<sup>th</sup> Oct. 2005; Hatipathar waterfall (S-43; Temp. 25°C; pH 7.3; Cond. 410  $\mu\text{s}$ ).

**Genus: *Cocconema* Kützing**

67. *Cocconema cistula* Ehrenberg\* (Pl. 3, Fig. 20)

(Synonym: *Bacillaria cistula* Ehrenberg; *Gomphonema simplex* Kützing)

Kützing 1865, p. 80, pl. 6, fig. I.

Frustules small, linear-oblong, obtuse end, truncate, 10-30  $\mu\text{m}$  long and 5-9  $\mu\text{m}$  broad; striation transverse, 5-8 in  $\mu\text{m}$ ; stipe filiformis, obsoletum, gelatinous.

Epiphytic in river; Voucher number, date and site: 447; 28<sup>th</sup> March 2005; Ang river (S-22; Temp. 29°C; pH. 7.5; Cond. 350  $\mu\text{s}$ ).

Class: Bacillariophyceae

Order: Naviculales

Family: Catenulaceae

**Genus: *Amphora* Ehrenberg ex. Kützing**

68. *Amphora elliptica* Kützing\* (Pl. 3, Fig. 16)

Kützing 1865, p.108, pl-5, fig. XXX.

Frustules in girdle view elliptic lanceolate or slightly attenuated, obtuse truncate; central area wide, longer than broad, 50-60  $\mu\text{m}$  long and 10-16  $\mu\text{m}$  broad; striation distinct transverse at the both the sides, striae 8-9 in 10  $\mu\text{m}$ .

Epiphytic in canal, epipellic attached to surface of moist soil and planktic in pond; Voucher numbers, dates and sites: 253; 18<sup>th</sup> April 2004; Taladanda canal (S-11; Temp. 27°C; pH 8.2; Cond. 282  $\mu\text{s}$ ); 547; 5<sup>th</sup> Oct. 2005; Manguli dam (S-12; Temp. 26°C; pH 8.7; Cond. 121  $\mu\text{s}$ ); 700; 28<sup>th</sup> Nov. 2005; Krishna Sayar park (S-68; Temp. 25°C; pH 8.6; Cond. 379  $\mu\text{s}$ ); 745, 751; 14<sup>th</sup> Jan. 2006; Chikiti (S-36; Temp. 27°C; pH 7.3; Cond. 205  $\mu\text{s}$ ).

69. *Amphora coffeaeformis* Kützing (Pl. 3, Fig. 17)

Kützing 1865, p. 108, pl. 5, fig. XXXVII; Venkataraman

1939, p. 341, fig. 104.

Epilithic in stream; Voucher number, date and site: 721; 19<sup>th</sup> Dec. 2005; Gadiapada, (S-57; Temp. 23°C; pH 7.3; Cond. 205  $\mu$ s).

70. *Amphora ovalis* Kützing (Pl. 3, Fig. 18)

(Synonym: *Navicula amphora* Ehrenberg; *Frustulia ovalis* Kützing)

Kützing 1865, P.107, pl-5, fig-XXXV and XXXIX.

Slimy scum on water surface of rice field, planktic in canal and in pond; Voucher numbers, dates and sites: B76; 29<sup>th</sup> Jan. 2004; Daspur (S-5; Temp. 28°C; pH 8.0; Cond. 205  $\mu$ s); 253; 18<sup>th</sup> April 2004; Taladanda canal (S-11; Temp. 27°C; pH 8.2; Cond. 282  $\mu$ s); 751; 14<sup>th</sup> Jan. 2006; Chikiti (S-36; Temp. 27°C; pH 7.9; Cond. 225  $\mu$ s).

71. *Amphora ovum* Cleve (Pl. 3, Fig. 19)

Desikachary 1987, p. 3, pl. 231, fig. 10.

Epilithic in river and planktic in pond; Voucher numbers, dates and sites: 671; 7<sup>th</sup> Nov. 2005; Vansadhara river (S-55; Temp. 23°C; pH 6.8; Cond. 30  $\mu$ s); 700; 28<sup>th</sup> Nov. 2005; Krishna Sayar park (S-67; Temp. 25°C; pH 8.6; Cond. 379  $\mu$ s); 751; 14<sup>th</sup> Jan. 2006; Chikiti (S-36; Temp. 27°C; pH 7.9; Cond. 225  $\mu$ s).

Class: Bacillariophyceae

Order: Rhopalodiales

Family: Rhopalodiaceae

**Genus: *Rhopalodia* O. Müller**

72. *Rhopalodia gibba* (Ehrenberg) O. Müller (Pl. 3, Figs. 21-22)

Desikachary 1987, p. 3, pl. 231, fig. 10.

Planktic in river and epilithic in stream; Voucher numbers, dates and sites: 131; 28<sup>th</sup> Nov. 2003; Mahanadi river (S-9, Temp. 29°C; pH. 7.3; Cond. 318); 146; 6<sup>th</sup> Feb. 2004; Maniakati (S-25; Temp. 28°C; pH 7.3; Cond 205); 721; 19<sup>th</sup> Dec. 2005; Gadiapada (S-57; Temp. 23°C; pH 7.3; Cond. 205  $\mu$ s).

Class: Bacillariophyceae

Order: Bacillariales

Family: Bacillariaceae

**Genus: *Nitzschia* Hassall**

73. *Nitzschia amphibia* Grunow (Pl. 3, Fig. 23)

Huber-Pestalozii 1942, p. 474, pl. CXXXVIII, fig. 564.

Epiphytic (attached to *Zygnema* sp. and *Spirogyra* sp.) in canal; Voucher number, date and site: 368; 24<sup>th</sup> Dec. 2004; Haldiagarh (S-14; Temp. 27°C; pH 7.2; Cond. 270  $\mu$ s).

74. *Nitzschia obtusa* Wm. Smith (Pl. 3, Fig. 24)

Desikachary 1987, p. 6, pl. 379, fig. 11.

Epilithic in sewage and in canal, epiphytic in saltpan

(attached to aquatic weed) and planktic in pond; Voucher number, date and site: B9; 20<sup>th</sup> Nov. 2003; Tankapani road (S-1; Temp. 30°C; pH. 8.8; Cond. 349  $\mu$ s).

75. *Nitzschia palea* (Kützing) Wm. Smith. (Pl. 3, Fig. 25)

Desikachary 1987, p. 8, pl. 305, fig. 15.

Epiphytic in water logged rice field, puddle, surface of wet soil and scum on stagnant water surface in pond; Voucher numbers, dates and sites: 443; 28<sup>th</sup> March 2005; Padpadar (S-20; Temp. 27°C; pH 7.4; Cond. 198  $\mu$ s); 604; 18<sup>th</sup> Oct. 2005; Kaptipada (S-64; Temp. 27°C; pH 7.8; Cond. 379  $\mu$ s); 700; 28<sup>th</sup> Nov. 2005; Krishna Sayar park, (S-67; Temp. 25°C; pH 8.6; Cond. 379  $\mu$ s); 726; 19<sup>th</sup> Dec. 2005; Madhyakhanda, Dasapala (S-16; Temp. 27°C; pH 8.2; Cond. 367  $\mu$ s).

76. *Nitzschia sigmoidea* (Nitzsch) Wm. Smith. (Pl. 3, Fig. 26)

Desikachary 1989, p. 4, pl. 663, fig. 3.

Epiphytic in pond; collection site: Voucher number, date and site: B76; 29<sup>th</sup> Jan. 2004; Daspur (S-5; Temp. 28°C; pH 8.0; Cond. 205  $\mu$ s).

77. *Nitzschia stagnorum* (Rabenhorst) Grunow (Pl. 3, Fig. 27)

Desikachary 1987, p. 8, pl. 305, fig. 21.

Planktic in pond; Voucher number, date and site: 757; 8<sup>th</sup> March 2006; pond, Botanical Survey of India gardens, Kolkata (S-66; Temp. 25°C; pH 8.6; Cond. 379  $\mu$ s).

Class: Bacillariophyceae

Order: Bacillariales

Family: Surirellaceae

Genus: *Surirella* Turpin

78. *Surirella nervosa* (A.S.) Mayer (Pl. 3, Fig. 28)

Desikachary 1989, p. 8, pl. 726, figs. 6-8.

Planktic in pond; Voucher number, date and site: 165; 14<sup>th</sup> Feb. 2004; Salandi river (S-60; Temp. 27°C; pH 6.9; Cond. 250  $\mu$ s).

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