

ALGAL DIVERSITY OF KANJIAHATA LAKE, NANDANKANAN, ODISHA, INDIA

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Kanjiahata Lake popularly known as Nandankanan Lake is situated between 85° 48' to 85° 50' E longitudes and between 20° 23' to 20° 25' N latitudes. The water spreads area of this lake is 105 ha. It is an important wetland lying to the south of Mahanadi delta head, within the boundary of Zoological Park, Nandankanan, Bhubaneswar. This lake has been declared as a "Wetland of National Importance" by MoEF & CC, Govt. of India since 2006. There is no published record available on algal diversity of this lake. The algal diversity of this lake has shown 32 genera, 16 families and 10 orders of 3 divisions such as Cyanophyta, Chlorophyta and Bacillariophyta. Altogether 50 algal species were recorded in this study. Chlorophyta is dominantly occurring in the lake. In this study a total of 17 algal species i.e. *Sorastrum spinulosum*, *Coenochlorosis pyrenoidosa*, *Nephrocystium lanutum*, *Cosmarium circulare*, *Cosmarium forceps*, *Cosmarium maculatum*, *Cosmarium pardalis*, *Cosmarium pseudopyramidatum* var. *oculatum*, *Cosmarium tumidum*, *Staudesmus unguiferus*, *Xanthidium perissacanthum*, *Staurastrum arcticonl*, *Staurastrum sebaldi* var. *ornatum*, *Staurastrum senarium*, *Staurstrum tripyrenoideum* were first time recorded from this lake.

Key words: Algae, diversity, Kanjiahata Lake, planktonic, free floating

Lakes are the primary resource and storehouse of freshwaters, valuable water system and intensively used for fisheries and recreation. However, the ecological natures of many Lakes have degenerated mainly as consequence of eutrophication. There are many Lakes in Odisha and extensive research has been carried out in Chilika Lake. However, there are no published records existing on algal flora of Kanjiahata Lake at Nandankanan, Bhubaneswar, Odisha. The lake is spread in 75 ha area, whereas about 30 ha is now separated by a road, which gets connected during monsoon. It is an important wetland lying to the south of Mahanadi delta head, within the boundary of Nandankanan Zoological Park. The lake has got immense socioeconomic value as the fishermen from the local village derive their livelihood. It is also a home for many local migratory birds of Odisha. In freshwater environment supporting hydrophytes vegetation is endowed with luxuriant growth of algae which are very sensitive to many of the land derived substances, both organic and inorganic. Algal diversity in Lake plays an important role in

determining tropic status and developing strategies for their conservation. Periphytic algae are an important ecological component of aquatic ecosystem and have been reported to be good indicators of water quality. The ecological disturbances of the lake caused by a number of physico-chemical factors have led to the loss of algal diversity of Lake. In the present study the algal diversity of Kanjiahata Lake carried out in the year 2014.

MATERIAL AND METHODS

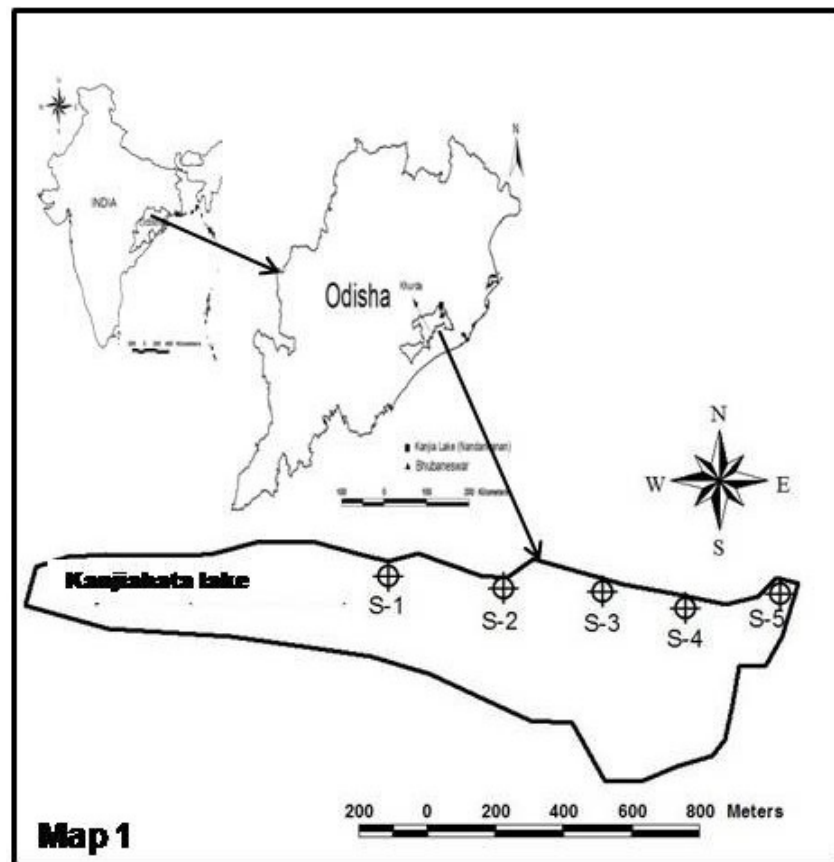
Five collection sites were selected for sampling of Kanjiahata Lake (Map 1). The collected sites were such as S1 (Near orchid house, botanical garden), S2 (Near evolution garden, botanical garden), S3 (Near Picnic spot, botanical garden), S4 (Lovers point, botanical garden) and S5 (Near boat ghat, Zoological park). Algal samples were collected thrice during July, September and October 2014. Planktonic samples were collected by plankton net (Brand: Hydrobios, Cat no. 438001, Mesh size: 25 µm). Samples were collected in sterile Tarson specimen jar. All the samples were preserved in 4% (V/V)

formaldehyde on the spot. Voucher number was given to each sample and deposited at department of Botany, Berhampur University. Microphotographs of each specimen was taken by phase contrast trinocular microscope (Olympous, BX 53) fitted with Olympous CCD colour camera (Olympous, SC-180). The algal species were identified based on important morphological characteristics enumerated by following published monographs (Das and Adhikary 2014, Perumal and Anand 2009, Komárek and Fott 1983, Brühl and Biswas 1926, Cox 1996, Scott and Prescott 1961).

RESULTS

Altogether 50 algal species recorded in this study from Kanjiahata Lake. All belonging to 32 genera: *Oscillatitia*, *Lyngbya*, *Stauridium*, *Sorastrum*, *Botryococcus*, *Coenochloris*, *Nephrocytium*, *Dimorphococcus*,

Ankistrodesmus, *Chlorella*, *Closterium*, *Netrium*, *Euastrum*, *Micrasterias*, *Cosmarium*, *Staurodesmus*, *Xanthidium*, *Staurastrum*, *Desmidium*, *Hyalotheca*, *Spondylosium*, *Spirogyra*, *Zygnema*, *ragillaria*, *Synedra*, *Achanthes*, *Navicula*, *Pinnularia*, *Himantidium*, *Gomphonema*, *Amphora* and *Nitzschia*, of 16 family: Oscillatoriaceae, Hydrodictyaceae, Botryococcaceae, Oocystaceae, Chlorellaceae, Mesotaeniaceae, Closteriaceae, Desmidiaceae, Zygnemataceae, Fragillariaceae, Acanthaceae, Naviculaceae, Pinnulariaceae, Gomphoneceae, Catenulaceae and Bacillariaceae, of 10 Orders: Oscillatoirales, Spaheropleales, Chlorellaes, Zygnematale, Desmidiiales, Fralariales, Achanthales, Naviculales, Cymbellales and Bacillariales of 3 divisions Cyanophyta, Chlorophyta and Bacillariophyta. Among three divisions the green algae (Chlorophyta) were the dominant in the Kanjiahatahata Lake. List



Map 1: The map showing the location of Kanjiahata Lake, Nandankanan, Odisha, India

of all algal species are given in Table 3 and photographs given in Plate 1 (Fig.1-29) and Plate 2 (Fig.30-50). The details of systematic accounts and description of all the algal species given below:

Systematic account of algal species

Cyanophyta

Order: Oscillatoriales

Family: Oscillatoriaceae

Genus: *Oscillatoria* Vaucher ex Gomont

1. *Oscillatoria leonardii* Compere (Fig. 1)

Das and Adhikary 2014, p. 67, Pl. 3, Fig. 12

Trichome solitary, crosswall unconstructed, cells are pale bluish green and round apices. Cells are 4-9 μm broad and 6.4-7 μm long.

Habitat: Epiphytic, Evolution garden side; Voucher No. K4; Date: 22nd July 2014.

Genus: *Lyngbya* C. Agardh ex Gomont

2. *Lyngbya arboricola* Brühl and Biswas (Fig. 2)

Adhikary *et al.* 2009, p. 24, Pl.15, Fig. 6

Trichome single, greenish, thin sheath, cells are rectangular and hormogones distinct with 2-20 cells. Cells are broader than longer, 18-26 μm broad and 5-6 μm long.

Habitat: Planktonic, Evolution garden side; Voucher No. K4; Date: 22nd July 2014.

Chlorophyta

Order: Sphaeropleales

Family: Hydrotycaceae

Genus: *Stauridium* Meyen

3. *Stauridium tetras* (Ehrenberg) Ralfs (Fig. 3)

Synonym: *Pediastrum tetras* (Ehrenberg) Ralfs 1845

Komárek and Jankovška 2001, Pl. 20, Fig. 43; Perumal and Anand 2009, p. 44, Pl. 11, Fig. 27

Cells are in colony, floating, disc shaped, generally cells 4-8-16-32-64 or more, polygonal, arranged in a single layer, one to two or four marginal processes are present, Cells cells 9-10 μm broad and 6-8 μm long.

Habitat: Epiphytic, Evolution garden side; Voucher No. K50; Date: 22nd July 2014.

Genus: *Sorastrum* Kützing

4. *Sorastrum spinulosum* Nägeli (Fig. 4)

Synonym: *Sorastrum crassispinosum* (Hansgirg) Bohlin

Komárek and Fott 1983, p. 310, Pl. 93, Fig. 5

Cells reniform to cuneate, three angled and with a short stock from the basal angle, two short pointed spines from each of outer angle, chloroplast parietal with single pyrenoid. Colonies of 4-8-16-32 cells, cells are 8-20 μm broad and 6-18 μm long.

Habitat: Planktonic, Lovers point side; Voucher No. K42; Date: 26th October 2014.

Order: Chlorellales

Family: Botryococcaceae

Genus: *Botryococcus* Kützing

5. *Botryococcus braunii* Kützing (Fig. 5)

Synonym: *Botryococcus giganteus* Reinsch

Perumal and Anand 2009, p. 71, Pl. 11, Fig. 29

Colonies free floating, cell shape spherical or irregular, green, without a conspicuous gelatinous envelope, enclosed tough hyaline membrane. Cells are 3-6 μm broad and 6-12 μm long.

Habitat: Planktonic, Evolution garden park side; Voucher No. K49; Date: 22nd July 2014.

Genus: *Coenochloris* Koršikov

6. *Coenochloris pyrenoidosa* Koršinkov (Fig. 6)

Synonym: *Coenochloris hindakii* Komárek

Komárek and Fott 1983, p. 390, Pl. 116, Fig. 2

Cells oval, chloroplast long as broad, pyrenoid may be present or sometimes absent. Cells are 20-25 μm diameter and colonies 50-100 μm diameter.

Habitat: Planktonic, Botanical garden side; Voucher No. K1; Date: 22th July 2014.

Family: Oocystaceae

Genus: *Nephocytiun* Nägeli

7. *Nephocytiun lanutum* West and West

(Fig. 7)

Krienitz 1990, p. 181, Pl. 9, Fig. c

Cells are oval, longer than broad, always colonial, tetrahedral, chloroplast with pyrenoid, cell wall not distinct. Cells are 12-17 µm long and 8-13 µm broad.

Habitat: Epiphytic attached to aquatic weeds, Zoological park side; Voucher No. K25; Date: 26th October 2014.

Genus: *Dimorphococcus* A. Braun

8. *Dimorphococcus lunatus* A. Brown (Fig. 8)

Das and Adhikary 2014, p. 167, Pl. 13, Fig. 3

Cells in groups of four on the ends of fine branched threads, inner cells sub cylindrical and the outer cells cordate. Cells are 12-17.5 µm long and 5.5 µm broad.

Habitat: Planktonic, Zoological park side; Voucher No. K26; Date: 26th October 2014.

Family: Ankistrodesmaceae

Genus: *Ankistrodesmus* Komárek et Comas

9. *Ankistrodesmus tortus* Komárek et Comas (Fig. 9)

Jena and Adhikary, 2011, p. 26, Pl. 2, Fig. 17

Coenobia 2-4-8 celled, cells fasciculate bundles, cells acicular to narrowly fusiform, end tapering to acute apices, single chloroplast, parietal, without pyrenoid. Cells are 2-3 µm broad and 20-30 µm long.

Habitat: Planktonic, Picnic spot side; Voucher No. K5; Date: 26th October 2014.

Family: Chlorellaceae

Genus: *Chlorella* Beijerinck

10. *Chlorella vulgaris* Beijerinck (Fig. 10)

Synonym: *Chlorella candida* Shihira and R.W. Krauss

Das and Adhikary 2014, p. 149, Pl. 12, Fig. 2

Unicellular, green, spherical, cell solitary and chloroplast cup shaped with distinct pyrenoid at the centre. Cell diameter is 5-6 µm.

Habitat: Planktonic, Orchid house side; Voucher No. K31; Date: 22nd July 2014.

Order: Zygnematales

Family: Mesotaeniaceae

Genus: *Netrium* Itzigsh and Rothe

11. *Netrium digitus* Itzigsh and Rothe (Fig. 11)

Synonym: *Closterium digitus* Ehrenberg

Jena and Adhikary 2011, p. 35, Pl. 5, Fig. 16

Cells solitary, stout, elliptical; poles rounded; cell wall un-segmented, un-constricted, smooth, 30-35 µm broad and 174-182 µm long, large chloroplast, axial one each half of the cell with radiating longitudinal spherical ridges.

Habitat: Planktonic, Zoological park side; Voucher No. K25; Date: 26th October 2014.

Order: Desmidiaceae

Family: Closteriaceae

Genus: *Closterium* Wittrock

12. *Closterium calosporum* Wittrock (Fig. 12)

Jena *et al.* 2006, p. 20, Pl. 1, Fig. 2

Cells are solitary, green, sickle shaped, attenuated, chloroplast two, pyrenoid not arranged in row. Cells are 119-138 µm long and 13-17 µm broad.

Habitat: Planktonic, Evolution garden side; Voucher No. K50; Date: 22th July 2014.

Family: Desmidiaceae

Genus: *Euastrum* Ehrenberg ex Ralfs

13. *Euastrum ansatum* Ralfs var. *pyxedatum* Delponte ex Delponte (Fig. 13)

Synonym: *Euastrum rotundum* Playfair

Adhikary and Jena 2012, p. 228, Pl. 2, Fig. 18

Cell solitary, longer than broad, deeply constricted at the middle, sinus narrowly linear, apical margin of semi-cells elevated, polar lobe elevated with angled deep incision. Cells are 60-90 µm long, 30-40 µm broad at base, apex 15 µm broad and isthmus 10-15 µm broad.

Habitat: Planktonic, Evolution Garden side; Voucher No. K50; Date: 22nd July 2014.

Genus: *Micrasterias* Arardh ex Ralfs

14. *Micrasterias foliacea* Bailey and Ralfs (Fig. 14)

Das and Adhikary 2014, p. 126, Pl. 10, Fig. 1
Cell solitary, sometimes inter-linked to form filamentous or long chain, rectangular in outline, deeply constricted, sinus narrow linear, semi-cells 5 lobed, basal part of the polar lobes with sub parallel sides,

Habitat: Planktonic, boat ghat side; Voucher No. K20; Date: 26th October 2014.

15. *Micrasterias pinnatifida* Ralfs (Fig. 15)
Synonym: *Micrasterias oscitans* var. *pinnatifida* Kützing ex Ralfs Rabenhorst

Adhikary and Jena 2012, p. 229, Pl. 03, Fig. 4
Cells are small, deeply constricted, linear sinus, slightly open outward, semi cells, three lobes, interlobular, incisions, deep and broadly constricted, lateral lobes horizontal, cell wall minutely punctuate, cells slightly longer than broad, 40-60 µm long and 40-50 µm broad, isthmus 10-15 µm broad.

Habitat: Epilithic or planktonic, Lovers point side; Voucher No. K38; Date: 26th October 2014.

Genus: *Cosmarium* Ralfs

16. *Cosmarium bitrapezoideum* Brühl and Biswas (Fig. 16)

Das and Adhikary, 2014, p. 108, Pl. 8, Fig. 5
Cells are solitary, length is almost equal to breadth, semi-cells trapezoid form, flat apices, deeply constricted, cell wall smooth, semi cells 44-48µm long, 42-43.5µm broad.

Habitat: Planktonic, Picnic spot side, Kanjia Lake; Voucher No. K5; Date: 26th October 2014.

17. *Cosmarium circulare* Reinsch (Fig. 17)
Synonym: *Cosmarium lundellii* var. *circulare* (Reinsch) Willi Krieger

Brühl and Biswas 1926, p. 286, Pl. 09, Fig. 87
Cells solitary, green, longer than broad, cell wall smooth and circular deeply constricted, semicells ovate, unequal cells, 46-53 µm broad and 53µm long, isthmus 13 µm broad.

Habitat: Planktonic, Lovers point side; Voucher No. K45; Date: 26th October 2014.

18. *Cosmarium forceps* Brühl and Biswas (Fig. 18)

Brühl and Biswas 1926, p. 286, Pl. IX, Fig. 86
Cells are looks like solitary; cells are broader than longer, sinus deeply constricted, narrower, acute angles, cell wall punctuate. Cells are 60-80 µm long and 70-80 µm broad, isthmus 40-50 µm broad.

Habitat: Planktonic, Botanical garden side; Voucher No. K2; Date: 22nd July 2014.

19. *Cosmarium javanicum* Nordst. (Fig. 19)
Synonym: *Cosmarium maculatum* W.B. Turner
Jena *et al.*, 2006, p. 25, Pl. 2, Fig. 10

Cells solitary, longer than broad, sinus deeply constricted, narrow, linear, closed, semi-cells ellipsoid, cell wall smooth punctuate. Cells are 108 µm long and 82 µm broad, isthmus 35 µm broad.

Habitat: Planktonic Orchid house side; Voucher No. K17; Date: 20th September 2014.

20. *Cosmarium lundelli* Turner (Fig. 20)

Das and Adhikary, 2014, p. 61, Pl. 8, Fig. 19
Cells smaller, sinus open outwards, semi-cells sub circular, rounded basal angles, truncate apices, chloroplast parietal with 2 paranoids. Cells are 48-5 m long and 44-45 m broad.

Habitat: Planktonic, Evolution garden Side; Voucher No. K49; Date: 22nd July 2014

21. *Cosmarium maculatum* Turner (Fig. 21)
Turner 1992, p. 49, Pl. 8, Fig. 68

Cells solitary, deep green, longer than broad, constricted sinus, wide, broad based, semi-cells, slightly narrow apex, cell wall with fine granulation. Cells are 102-107 µm long and 40-48 µm.

Habitat: Planktonic, Evolution garden Side; Voucher No. K49; Date: 22nd July 2014.

22. *Cosmarium moniliforme* Ralfs (Fig. 22)
Brühl and Biswas 1926, p. 291, Pl. 8, Fig. 62 a

& b

Cell faces semicircular, semi-cells slightly elliptical, cells are longer than broad. Cells are 17.5-52 μm long and 10-27 μm broad.

Habitat: Planktonic, Picnic spot side; Voucher No. K14; Date: 26th October 2014.

23. *Cosmarium pardalis* Cohn (Fig. 23)

Scott and Prescott 1961, p. 64, Pl. 29, Fig. 1, 2.

Cells of medium size, semi-cells rounded with angles, convex sides, cell wall scrobiculated in periphery and in the semi-cells wall, cells are longer than broad, isthmus is present. Cells are 62 μm long and 56 μm broad.

Habitat: Planktonic, Boat ghat side; Voucher No. K59; Date: 26th October 2014.

24. *Cosmarium pseudoconnatum* Nordst. (Fig. 24)

Scott and Prescott 1961, p. 66, Pl. 25, Fig. 4

Cells solitary, cells are longer than broad, no sinus, semi-cells rounded, cell wall granulated, Isthmus is present. Cells are 65-66 μm long and 49-54 μm broad.

Habitat: Planktonic, Boat ghat side; Voucher No. K21; Date: 26th October 2014.

25. *Cosmarium pseudopyramidatum* Lundell var. *oculatum* Krieger (Fig. 25)

Synonym: *Cosmarium pseudopyramidatum* f. *minus* Raciborski

Scott and Prescott, 1961, p. 67, Pl. 27, Fig. 2

Cells are longer than broad, isthmus is present. Cells are 60 μm long and 36 μm broad.

Habitat: Planktonic, Boat ghat side; Voucher No. K49; Date: 26th October 2014.

26. *Cosmarium quadrum* Lundell (Fig. 26)

Jena *et al.* 2006, p. 27, Pl. 2, Fig. 19

Cells solitary, yellowish green to deep green, as long as broad, sinus constricted, narrow and linear, semi-cells quadrate, flatted, slightly depressed at the middle. Cells 29-45 μm long and 29-45 μm broad, isthmus is 10-13 μm broad.

Habitat: Planktonic, Boat ghat side; Voucher No. K21; Date: 26th October 2014.

27. *Cosmarium tumidum* Lundell (Fig. 27)

Scott and Prescott 1961, p. 72, Pl. 27, Fig. 16

Cells are longer than broad, isthmus is present. Cells are 32 μm long and 26 μm broad and isthmus is 7 μm long.

Habitat: Planktonic, Zoological park side; Voucher No. K25; Date: 26th October 2014.

Genus: *Staurodesmus* Teiling

28. *Staurodesmus unguiferus* Turner (Fig. 28)

Synonym: *Staurastrum unguiferum* Turner

Turner 1892, p. 130, Pl. 15, Fig. 8

Cells longer than broad, H shaped semi-cells, concave circular semi-cells apex, wider isthmus, sinus open and clearly constricted, semi-cells having small pines of each lateral sides. Cells are 20-30 μm long and 13-20 μm broad.

Habitat: Planktonic, Boat ghat side; Voucher No. K28; Date: 22nd July 2014.

Genus: *Xanthidium* Ehrenberg ex Ralfs

29. *Xanthidium perissacanthum* Scott and Prescott (Fig. 29)

Scott and Prescott 1961, p. 83, Pl. 41, Fig. 1-2

Cell large, spine are present around the cells, spine number varies from cell to cell, semi-cells oblong, deeply constricted, sinus closed, linear within, widely open to the exterior, chloroplast present and axial; cells are longer than broad. Cells are 66-70 μm long and 56-60 μm broad.

Habitat: Free floating, Botanical garden side; Voucher No. K6; Date: 22nd July 2014.

Genus: *Staurastrum* (Meyen) Ralfs

30. *Staurastrum arctiscon* (Ehrenberg and Ralfs) P. Lundell (Fig. 30)

Synonym: *Xanthidium arctiscon* Ehrenberg ex Ralfs

Thomasson 1962, p. 296, Fig. 47

Cells are variable in size, longer than broad, bilaterally symmetrical, narrow isthmus, semi-cells triangular in top view, chloroplast with pyrenoids. Cells are 20 μm long and 27 μm broad.

Habitat: Planktonic, Boat ghat side; Voucher No. K21; Date: 26th October 2014.

31. *Staurastrum leptocladum* Norsdst. (Fig. 31)

Adhikary and Jena 2012, p. 230, Pl. 3, Fig. 8
Cells are solitary, broader than long, middle constricted, acute incised sinus, isthmus long, semi-cells having elongated base, extended in to prolong horns at both side, Cells are 35- 45 μm long and 80-100 μm broad with horns, isthmus 8-10 μm .

Habitat: Planktonic Picnic spot side; Voucher No. K15; Date: 20th September 2014.

32. *Staurastrum sebaldi* Reinsch var. *ornatum* Nordst. (Fig. 32)

Thomasson 1967, p. 295, Fig. 2 (4-5)
Cells are solitary, symmetrical, form a scarcely deserves distinction and can better be included with in the range of variability. Cells are broader than long, 8-94 μm long and 81-90 μm broad

Habitat: Planktonic, Zoological park side; Voucher No. K22; Date: 26th October 2014.

33. *Staurastrum senarium* (Ehrenberg) Ralfs (Fig. 33)

Synonym: *Desmidium senarium* Ehrenberg 1843

Scott and Prescott 1961, p.107, Pl. 67, Fig.7-9
Cells are variable, narrow isthmus, acute sinus, broader than long, cells 25-27 μm long, 33-37 μm broad, isthmus 9-10 μm .

Habitat: Free floating, Botanical garden side; Voucher No. K1; Date: 22nd July 2014.

34. *Staurastrum sexangulare* (Bulnheim) Rabenhost var. *crassum* Turner (Fig. 34)

Basionym: *Didymocladon sexangularis* Bulnheim

Turner 1892, p. 117, Pl. 15, Fig. 1

Cells solitary, deep median constriction in to top view, cells with five radiate process, denticulate, glabrous, serrate, apex with tri-fid, small smooth teeth. Cells are 40-52 μm long

and 32 μm broad, isthmus 12-17 μm broad.

Habitat: Planktic, Botanical garden side; Voucher No. K1; Date: 22nd July 2014.

35. *Staurastrum tripyrenoideum* Scott and Prescott (Fig. 35)

Scott and Prescott 1961, p. 114, Pl. 49, Fig. 6
Cells are large, isthmus narrow, sinus widely open, semi-cells sub-triangular, spine present ventral and dorsal surface, pyrenoids present, equally convex, cells little broader than long. Cells are 30 μm long and 35 μm broad, isthmus 12 μm broad.

Habitat: Free floating, Botanical garden side, Voucher No. K3; Date: 22nd July 2014.

Genus: *Desmidium* Agardh ex Ralfs

36. *Desmidium bengalicum* Turner (Fig. 36)

Das and Adhikary 2014, p. 125, Pl. 9, Fig. 20
Cells are filamentous un-branched broad than long, quadrangular; median constriction shallow, sinus diverse shaped, not angular, cells apex having U-shaped shallow depression. Cells are 15-20 μm long and 20-30 μm broad.

Habitat: Planktonic, Lovers point side; Voucher No. K44; Date: 26th October 2014.

Genus: *Hyalotheca* Ehrenberg ex Ralfs

37. *Hyalotheca dissiliens* Brebisson var. *hians* Wolle (Fig. 37)

Synonym: *Desmidium mucosum* Dillwyn Brébisson

Jena *et al.* 2006, p. 30, Pl. 3, Fig. 9

Cells cylindrical to discoidal, surrounded by a mucilaginous envelope, poles flattened without incision, middle slightly constricted, chloroplast axial without pyrenoid. Cells are 12-15 μm long and 14-27 μm broad.

Habitat: Free floating, Evolution garden side; Voucher No. K64; Date: 22nd July 2014.

Genus: *Spondylosium* Brébisson ex Kützing

38. *Spondylosium incurvatum* Turner (Fig. 38)

Jena and Adhikary 2011, p. 45, Pl. 6, Fig. 11, Cells united, filamentous joined together by mucilaginous pads, semi-cells spinous, deeply constricted, sinus widely open and linear, semi cells broader than long, slightly curved, apex inward, chloroplast single, axial, with a pyrenoid in each semi-cells. Cells are 24-26 μm long and 25-30 μm broad, isthmus 7-8 μm broad.

Habitat: Free floating, Orchid house side; Voucher No. K67; Date: 22nd July 2014.

39. *Spondylosium planum* (Wolle) W. West and G.S. West (Fig. 39)

Synonym: *Sphaerosma pulchrum* var. *planum* Wolle

Das and Adhikary 2014, p. 130, Pl. 10, Fig. 6; West et al. 1923, p. 222, Pl. 160, Fig. 23

Cells are rectangular, slightly broader than long, elliptical semi-cells, connected in a series to form a chain, constriction shallow open, apex rounded. Cells are 6-9 μm long and 7-10 μm broad.

Habitat: Planktonic, Orchid house side; Voucher No. K31; Date: 22nd July 2014.

Order: Zygnematales

Family: Zygnemataceae

Genus: *Spirogyra* Link

40. *Spirogyra maravillosa* Transeau (Fig. 40)

Das and Adhikary 2014, P. 84, Pl. 5, Fig. 13

Cylindrical cells, cross walls, not constricted, apical cells are round, 2-3 spiral chloroplasts, cells 2-4 times longer than broad. Cells are 28.5 μm broad and 63-114 μm in long.

Habitat: Free-floating, Lovers point side; Voucher No. K39; Date: 26th October 2014.

Genus: *Zygnema* Agardh

41. *Zygnema gangeticum* Bhashyakarla Rao (Fig. 41)

Adhikary et al. 2009, p. 77, Pl. 34, Fig. 5

Thallus filamentous, un-branched, greenish, cells rectangular to square, not constricted, chloroplast -2, star shaped, apical

cells broadly rounded. Cells are 12 μm broad and 55 μm in long.

Habitat: Free floating, Boat Ghat side; Voucher No. K39; Date: 26th October 2014.

BACILLARIOPHYTA

Order: Fragilariales

Family: Fragilariaceae

Genus: *Fragilaria* Lyngbye

42. *Fragilaria virescens* Ralfs (Fig. 42)

Jena et al., 2006, p. 383, Pl. 1, Fig-8

Cells rectangular in girdle view, united together to form long bands, ribbon shaped colonies, intercalary bond, stellate colonies, bilaterally symmetric, numerous chromatophores, small discoid bodies or one to four laminate plate with pyrenoids. Cells are 70-115 μm long and 5-15 μm broad.

Habitat: Free floating, Boat Ghat side; Voucher No. K29; Date: 22nd July 2014.

Genus: *Synedra* Ehrenberg

43. *Synedra ulna* (Nitzsch) Ehrenberg (Fig. 43)

Basionym: *Bacillaria ulna* Nitzsch

Cox 1996, p. 45 and 119, Fig. 15. b

Frustules rectangular in girdle view, longer than broad, valves linear at the centre, narrowing to blunt sub-rostrate or rostrate apices. Cells are 60-580 μm long and 5-9 μm broad.

Habitat: Planktonic, Boat ghat side; Voucher No. K29; Date: 22nd July 2014.

Order: Achnanthales

Family: Achnanthaceae

Genus: *Achnanthes* Bory de Saint-Vincent

44. *Achnanthes subsessilis* Kützing (Fig. 44)

Jena et al. 2006, p. 383, Pl. 1, Fig. 23

Frustules rectangular, slightly band at middle, 1 to 2 valves articulate, turgid forms laterally oblong, bilaterally symmetric. Cells are 30-50 μm long and 5-15 μm broad.

Habitat: Planktonic, Boat ghat side; Voucher

Table 1: List of algal species recorded from different locality of Kanjiahata Lake, Nandankanan, Odisha

Sl. no.	Name of the organisms	Different locality of Kanjiahata lake				
		S1	S2	S3	S4	S5
	CYANOPHYTA					
1	<i>Oscillatoria leonardii</i> Compere	+	+	-	-	-
2	<i>Lyngbya arboricola</i> Brühl and Biswas	+	+	-	-	-
	CHLOROPHYTA					
3	<i>Stauridium tetras</i> (Ehrenberg) Ralfs	+	+	-	-	-
4	<i>Sorastrum spinulosum</i> Nägeli	+	+	-	+	-
5	<i>Botryococcus braunii</i> Kützing	+	-	-	-	-
6	<i>Coenochloris pyrenoidosa</i> Koršinkov	+	+	-	-	-
7	<i>Nephrocystium lanutum</i> West and West	-	+	-	+	-
8	<i>Dimorphococcus lunatus</i> A.Brown	-	-	+	-	+
9	<i>Ankistrodesmus tortus</i> Komárek et Comas	-	-	-	+	+
10	<i>Chlorella vulgaris</i> Beijerinck	+	-	-	-	+
11	<i>Netrium digitus</i> Itzigsh and Rothe	-	-	-	+	+
12	<i>Closterium calosporum</i> Wittrock	-	-	-	+	+
13	<i>Euastrum ansatum</i> Ralfs var. <i>pyxedatum</i> Delponte ex Delponte	-	+	-	+	-
14	<i>Micrasterias foliacea</i> Bailey and Ralfs	-	-	+	-	+
15	<i>Micrasterias pinnatifida</i> Ralfs	+	-	+	-	-
16	<i>Cosmarium bitrapezoideum</i> Brühl and Biswas	+	+	-	-	-
17	<i>Cosmarium circulare</i> Reinsch	+	-	-	-	+
18	<i>Cosmarium forceps</i> Brühl and Biswas	-	-	-	+	-
19	<i>Cosmarium javanicum</i> Nordst.	-	-	-	+	-
20	<i>Cosmarium lundelli</i> Türner	+	+	-	-	-
21	<i>Cosmarium maculatum</i> Türner	-	-	+	-	+
22	<i>Cosmarium moniliforme</i> Ralfs	+	+	+	-	-
23	<i>Cosmarium pardalis</i> Cohn	+	+	+	+	-
24	<i>Cosmarium pseudocannatum</i> Nordst.	+	-	+	-	-
25	<i>Cosmarium pseudopyramidatum</i> Lundell var. <i>oculatum</i> Kriegel	+	+	+	-	-
26	<i>Cosmarium quadrum</i> Lundell					
27	<i>Cosmarium tumidum</i> Lundell	-	-	-	+	+
28	<i>Staurodesmus unguiferus</i> Türner	+	-	-	-	-
29	<i>Xanthidium perissacanthum</i> Scott and Prescott	-	-	-	+	+
30	<i>Staurastrum arcticon</i> (Ehrenberg and Ralfs) P. Lundell	-	-	-	+	+
31	<i>Staurastrum leptocladum</i> Nordst.	-	-	+	-	-
32	<i>Staurastrum sebaldi</i> Reinsch var. <i>ornatum</i> Nordst.	+	+	-	+	-
33	<i>Staurastrum senarium</i> (Ehrenberg) Ralfs	-	+	+	-	-
34	<i>Staurastrum sexangulare</i> (Bulnheim) Rabenhost var. <i>crassum</i> Türner	-	-	+	-	+
35	<i>Staurastrum tripyrenoideum</i> Scott and Prescott	-	+	-	-	+
36	<i>Desmidium bengalicum</i> Türner	-	+	+	-	-
37	<i>Hyalotheca dissiliens</i> Brebisson var. <i>hians</i> Wolle					
38	<i>Spondylosium incurvatum</i> (Türner)	-	-	+	-	+
39	<i>Spondylosium planum</i> (Wolle) W. West and G.S. West	-	+	-	+	-
40	<i>Spirogyra maravillosa</i> Transeau	-	+	+	-	-
41	<i>Zygnema gangeticum</i> Bhashyakarla Rao	-	+	-	+	+
	BACILLARIOPHYTA					
42	<i>Fragilaria virescens</i> Ralfs	+	-	-	-	-
43	<i>Synedra ulna</i> (Nitzsch) Ehrenberg	-	+	-	+	-
44	<i>Achnanthes subsessilis</i> Kützing	+	-	+	++	-
45	<i>Navicula rhomboides</i> (Ehrenberg) De Toni	-	+	-	-	+
46	<i>Pinnularia sudetica</i> Hilse	+	+	-	-	+
47	<i>Himantidium minus</i> Kützing	-	-	+	-	-
48	<i>Gomphonema intricatum</i> var. <i>vibrio</i> (Ehrenberg) Cleve	-	-	-	+	+
49	<i>Amphora ovalis</i> Kützing	+	-	+	-	++
50	<i>Nitzschia sigma</i> (Kützing) W. Smith	-	-	-	+	+

+ = Present; ++ = abundantly present; - = absent, S1= Near orchid house, botanical garden, S2 = Near evolution garden, botanical garden, S3 Near Picnic spot, botanical garden, S4 = Lovers point, botanical garden and S5 = Near boat ghat, Zoological park

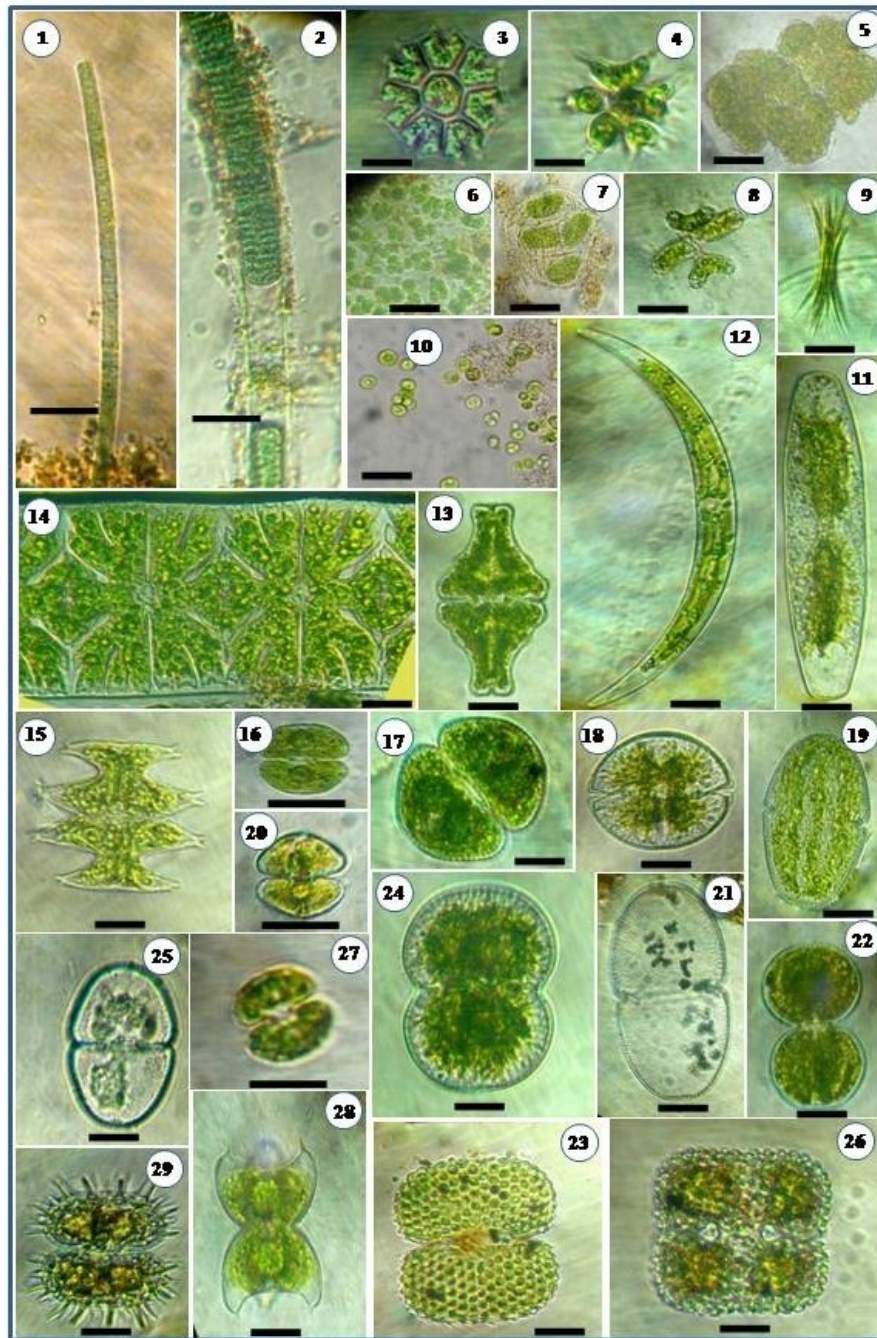


Figure.1-29: 1. *Oscillatoria leonardii* Compere, 2. *Lyngbya arboricola* Brühl and Biswas, 3. *Stauridium tetras* (Ehrenberg) Ralfs, 4. *Sorastrum spinulosum* Nägeli, 5. *Botryococcus braunii* Kützing, 6. *Coenochloris pyrenoidosa* Koršinkov, 7. *Nephroclytium lanutum* West and West, 8. *Dimorphococcus lunatus* A.Brown, 9. *Ankistrodesmus tortus* Komárček et Comas, 10. *Chlorella vulgaris* Beijerinck, 11. *Natrium digitus* Itzigsh and Rothe, 12. *Closterium calosporum* Wittrock, 13. *Euastrum ansatum* Ralfs var. *pyxedatum* Delponte ex Delponte, 14. *Micrasterias foliacea* Bailey & Ralfs, 15. *Micrasterias pinnatifida* Ralfs, 16. *Cosmarium bitrapezoideum* Brühl and Biswas, 17. *Cosmarium circulare* Reinsch, 18. *Cosmarium forceps* Brühl & Biswas, 19. *Cosmarium javanicum* Nordst, 20. *Cosmarium lundelli* Turner, 21. *Cosmarium maculatum* Turner, 22. *Cosmarium moniliforme* Ralfs, 23. *Cosmarium pardalis* Cohn, 24. *Cosmarium pseudoconnatum* Nordst, 25. *Cosmarium pseudopyramidatum* Lundell var. *oculatum* Kriegel, 26. *Cosmarium quadrum* Lundell, 27. *Cosmarium tumidum* Lundell, 28. *Staurodesmus unguiferus* Turner, 29. *Xanthidium perissacanthum* Scott and Prescott. Scale bar = 10 µm

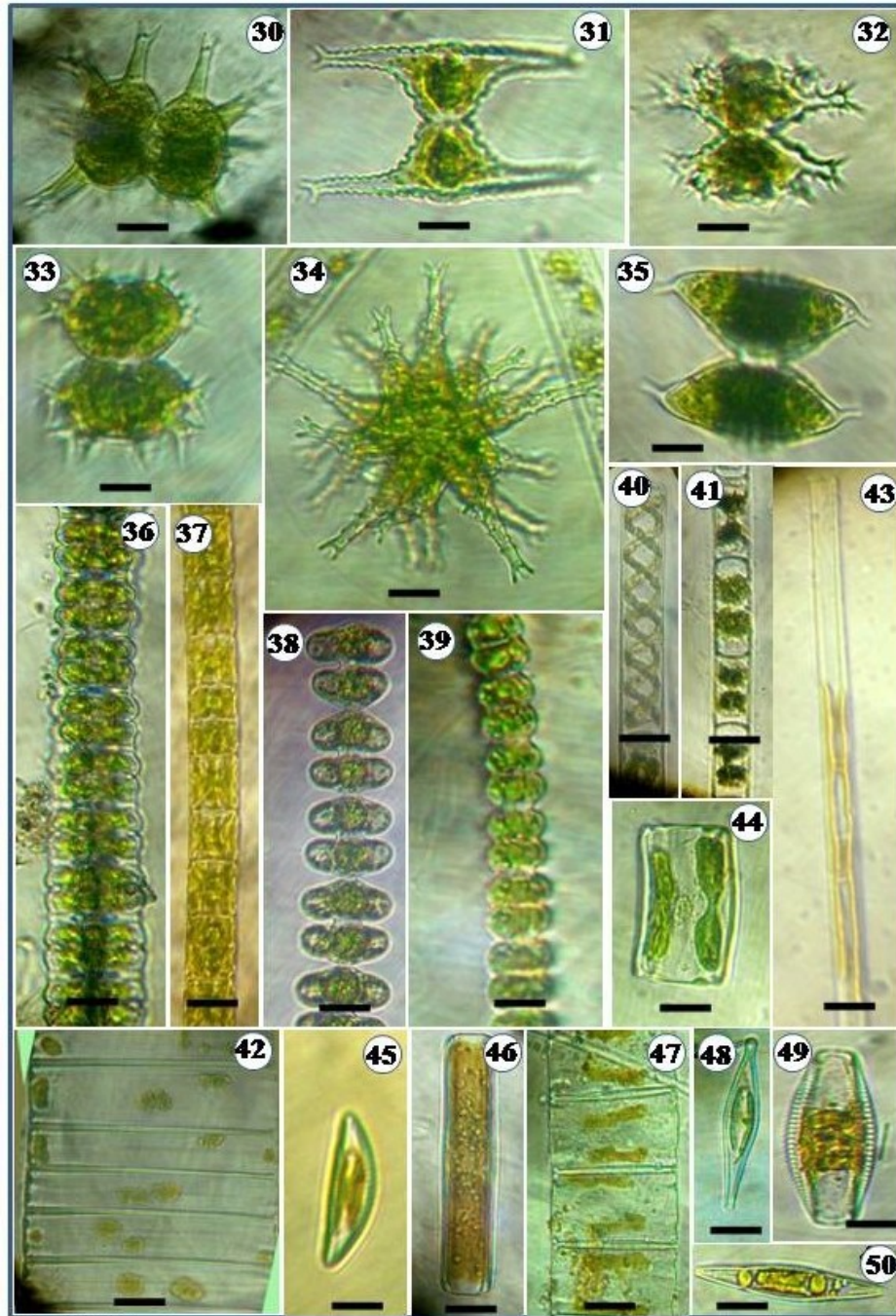


Figure. 30-50: 30. *Staurastrum arcticon* (Ehrenberg and Ralfs) P. Lundell, 31. *Staurastrum leptocladum* Nordst, 32. *Staurastrum sebaldi* Reinsch var. *ornatum* Nordst, 33. *Staurastrum senarium* (Ehrenberg) Ralfs, 34. *Staurastrum sexangulare* (Bulnheim) Rabenhosst var. *crassum* Türner, 35. *Staurastrum tripyrenoideum* Scott and Prescott, 36. *Desmidium bengalicum* Türner, 37. *Hyalotheca dissiliens* Brebisson var. *hians* Wolle, 38. *Spondylosium incurvatum* (Türner), 39. *Spondylosium planum* (Wolle) W. West and G.S. West, 40. *Spirogyra maravillosa* Transeau, 41. *Zygnema gangeticum* Bhashyakarla Rao, 42. *Fragilaria virescens* Ralfs, 43. *Synedra ulna* (Nitzsch) Ehrenberg, 44. *Achnanthes subsessilis* Kützing, 45. *Navicula rhomboids* (Ehrenberg) De Toni, 46. *Pinnularia sudetica* Hilse, 47. *Himantidium minus* Kützing, 48. *Gomphonema intricatum* (Ehrenberg) var. *vibrio* Cleve, 49. *Amphora ovalis* Kützing, 50. *Nitzschia sigma* (Kützing) W. Smith.

Scale bar =10 μ m

No. K29; Date: 22nd July 2014.

Order: Naviculales

Family: Naviculaceae

Genus: *Navicula* Bory de Saint-Vincent

45. *Navicula rhomboides* (Ehrenberg) De Toni (Fig. 45)

Das and Adhikary 2014, p. 242, Pl. 18, Fig. 38
Frustules solitary, linear, lanceolate, side middle area is gradually tapering, end wide rounded, striation transverse and parallel. Cells are 7.2 µm long and 2 µm in broad.

Habitat: Planktonic, Lovers point side; Voucher No. K37; Date: 22nd July 2014.

Family: Pinnulariaceae

Genus: *Pinnularia* Ehrenberg

46. *Pinnularia sudetica* Hilse (Fig. 46)

Synonym: *Pinnularia viridis* f. *sudetica* (Hilse) Mayer

Cox, 1996, p. 71, Pl.22, Fig. J

Valves smaller, linear, rounded apices, cells are longer than broad, rectangular like. Cells are 45-90 µm long and 9-12 µm broad.

Habitat: Planktonic, Orchid house side; Voucher No. K18; Date: 20th September 2014.

Genus: *Himantidium* Kützing

47. *Himantidium minus* Kützing (Fig. 47)

Synonym: *Eunotia pectinalis* f. *minor* Kützing Otto Müller

Jena *et al.* 2006, p. 383, Pl. 1, Fig. 21

Frustules attached side by side, cells rectangular in girdle view, united into form ribbon shaped colonies, bilaterally symmetric, chromatophores numerous, small discoid bodies. Cells are 30-50 µm long and 15-25 µm broad.

Habitat: Epiphytic (attached to aquatic weeds), Boat ghat side; Voucher No. K29; Date: 22nd July 2014.

Order: Cymbellales

Family: Gomphonemataceae

Genus: *Gomphonema* Ehrenberg

48. *Gomphonema intricatum* var. *vibrio* (Ehrenberg) Cleve (Fig. 48)

Basionym: *Gomphonema vibrio* Ehrenberg

Das and Adhikary 2014, p. 250, Pl. 19, Fig. 10

Frustules elongated, attenuated to long, sub acute linear, lanceolate, thin, median, striation transverse, parallel raphae; cells are longer than broad. Cells: 70-80 µm long and 13-15 µm broad.

Habitat: Epiphytic Orchid house side; Voucher No. K19; Date: 26th October 2014.

Order: Thalassiophysales

Family: Catenulaceae

Genus: *Amphora* Ehrenberg ex Kützing

49. *Amphora ovalis* Kützing (Fig. 49)

Synonym: *Clevamphora ovalis* (Kützing) Mereschkowsky

Jena *et al.* 2006, p. 391, Pl. 3, Fig. 18

Frustules in girdle view oval, strongly biconvex dorsal valves, ventral valve's margin weakly concave, cells are longer than broad. Cells are 50-100 µm long and 10-20 µm broad.

Habitat: Planktonic, Boat ghat side; Voucher No. K13; Date: 20th September 2014.

Order: Bacillariales

Family: Bacillariaceae

Genus: *Nitzschia* Hassal

50. *Nitzschia sigma* (Kützing) W. Smith (Fig. 50)

Synonym: *Sigmatella sigma* (Kützing) Frenguelli

Rath and Adhikary 2005, p. 91, Pl. 13, Fig. 92

Frustules, slightly sigmoid, linear valves view, cells are longer than broader. Cells are 280-312 µm long and 11 µm broad.

Habitat: Epilithic, Lovers point side; Voucher No. K53; Date: 22nd July 2014.

DISCUSSION

A total of 50 algal species belonging to Cyanophyta, Chlorophyta and Bacillariophyta were recorded from the Kanjiahata Lake. Among three divisions, algae belonging to Chlorophyta were dominant followed by Bacillariophyta and Cyanophyta. The distribution of algal species at five collection sites is presented in Table 1. The occurrences of algal species are recorded maximum in the water near Orchid house side (Site-1) and there very few species were recorded in the water near Boat ghat Side (Site-5). The algal diversity of different Lake of India are reviewed in this study (Ahmad 1972, Anand 1975, Das and Santra 1982, Girigakumari and Abraham 2007, Murugesan and Sivasubramanian 2005, Rath and Adhikary 2005, Pandey *et al.* 1998; Srivastava and Odhwani 1993). However, there were very least similarities of algal diversity of different Lakes of India with the present study. Moreover, this lake harbour 17 algal species first time recorded in Odisha state. These are *Sorastrum spinulosum*, *Coenochlorosis pyrenoidosa*, *Nephrocytiun lanutum*, *Cosmarium circulare*, *Cosmarium forceps*, *Cosmarium maculatum*, *Cosmarium pardalis*, *Cosmarium pseudopyramidatum* var. *oculatum*, *Cosmarium tumidum*, *Staudesmus unguiferus*, *Xanthidium perissacanthum*, *Staurastrum arctisconl*, *Staurastrum seabaldi* var. *ornatum*, *Staurastrum senarium* and *Staurstrum tripyrenoideum*. In this study the result of algal occurrence showed 78% Chlorophyta followed by 18% Bacillariophyta and 4% Cyanophyta. We have recorded one economic important green algal species i.e. *Botryococcus brauni* from this Lake. There were many desmids species abundantly occurred in different sites of this lake in the present study, which indicates the oligotrophic status of water of the Lake.

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