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Algal Vegetation of Reservoirs of Ganjam, Odisha, India

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ABSTRACT

The current study focuses on the diversity of algae in the six reservoirs of Ganjam District, Odisha. This investigation was conducted in January 2020-December 2021. In total, 31 algal species have been identified, including 4 species of Cyanobacteria, 3 species of Euglenophyta, 14 species of Bacillariophyta, 4 species of Chlorophyta, 5 species of Charophyta, and 1 species of Ochrophyta. On the other hand, 19 species are for the first time recorded from Ganjam, while 8 species are recorded for the first time from Odisha i.e. namely *Komvophoron constrictum* (Szafer) Anagnostidis and Komárek, *Cymbella lanceolata C. Agardh, Encyonopsisc zarneckii* Bahls, *Nitzschia reversa* W.Smith, *Desmodesmus brasiliensis* (Bohlin) E. Hegewald, *Cosmarium formosulum* Hoff, *Euastrum spinulosum* var. *burmense* (West and G.S.West) Willi Krieger, and *Centritractus belenophorus* var. *skujae* Kiriakov

Key words*: Algae, Ganjam, Planktonic, Reservoir*

Introduction

In terms of supporting life and keeping natural equilibrium, freshwater has historically been of minor value to people and other species in the environment; consequently, "water is the lifeblood of the planet"(Ghadar, 2006). Reservoirs and lakes are becoming increasingly important resources around the world, as man's primary concern was thought to be meeting his basic needs. The importance of water to human survival cannot be overstated (Imberger and Hamblin, 1982). Only 3% of the 71 % covering the Earth's surface is freshwater, whereas 97 percent is seawater. Available water supplies are diminishing all across the world as a result of climate change and the overuse of water sources (Sophocleous, 2004). For lakes that can be utilized for drinking water, certain criteria are critical. It also plays a crucial role in the hydrological cycle (Tranvik *et al.,* 2009). The importance of freshwater reservoirs as an environmental resource that may be utilized to benefit humanity cannot be overstated.Reservoirs are enormous man-made inland water basins built on rivers, mostly for irrigation purposes (Rakhmatullaev *et al.,* 2013). The vegetation in these water bodies does not change for prolonged periods unless there is a significant environmental shift in these habitats. A reservoir sustains biodiversity in the surrounding environment by providing a home for various aquatic bacteria, animals, and plants. It also serves as a source of fisheries output and a vital part of the local economy. The presence of algae also indicates the reservoirs' biological nature and present state (Matsumura-Tundisi and Tundisi, 2005).

Algae is crucial for practically all freshwater environments because they play a significant part in the food chain through primary production. They are also a helpful tool for assessing water quality (Dash *et al.*, 2020; Dash *et al.*, 2021; Pradhan *et al.*, 2022). Furthermore, algae that thrive in water bodies contaminated with organic wastes play a critical role in "Self-purification of Water Bodies," as they may absorb nutrients, heavy metals, pesticides, and organic and inorganic harmful compounds in their cells. Algae, especially phytoplankton, are the primary producers in the aquatic food chain and play an important role in the bio-monitoring of trophic status in water bodies (Behera *et al.,* 2021). The ecosystem is influenced by algae development in a habitat, and it responds quickly to changes in aquatic ecology, particularly in connection to nutrients (Behera *et al.,* 2020). Although there are over 15,000 species of algae, only a handful of them is practically relevant in pond waste stabilization. According to Goswami *et al.,* the initial step toward aquatic system conservation should be the identification and assessment of the aquatic body's algal variety composition (Goswami *et al*., 2021).

The coastal plains area in the east hill and tablelands in the west are the two main divisions of the Ganjam district. The district's western half is bordered by the eastern ghats. Between the eastern ghats and the Bay of Bengal lies the lowlands. Because the hills are so near to the sea, the rivers that run from them are short and prone to flooding. Because there are no large rivers, the plains are thin. The eastern coastal lowlands have more fertile and irrigated land. It is steep in the center and south, with magnificent well-watered valleys. Ghodahada Dam, Ramaguda Dam, Samarajhola, Surada Dam, Bhanjanagara Ghai, and Daha Dam were among the reservoirs that irrigated and nourished the valleys. Through community engagement, the initiative also aimed to employ local youngsters in different ecotourism activities. The surrounding region also offers a pristine beach and lovely green forest, in addition to the enormous water body reservoirs. Although there is a plethora of research on Odisha's freshwater algal diversity (Jena *et al.,* 2005; Jena *et al.,* 2006a; Jena *et al.*, 2006b; Jena *et al.*, 2006c; Ratha *et al.,* 2006; Jena and Adhikary, 2007; Ratha *et al.*, 2007; Jena *et al*., 2008; Adhikary *et al.*, 2009; Behera *et al*., 2020; Dash *et al.*, 2020; Behera *et al*., 2021; Dash *et al.,* 2021), there is no published data on the algal diversity of the reservoirs of Ganjam district. Therefore, the present investigation has been done for the first time to understand the algal diversity patterns of these exquisite reservoirs for conservation of biodiversity and pollution management.

Materials and Methods

The study site and sample collection : The location (longitude and latitude) of collection sites of various reservoirs of the Ganjam district were displayed in Figure 1. A total of 110 algal samples were collected from 6 reservoirs in the Ganjam district between January 2020, and December 2021. Planktonic samples were collected using a plankton net of 25 µm mesh size (Hydro-bios Kiel, Cat. No. 438001) Forceps, needles, and brushes were used to gather algae in different forms, such as epilithic biofilms, benthic, and epizoic algae. All algal samples were kept in a sterilized Tarson tube.

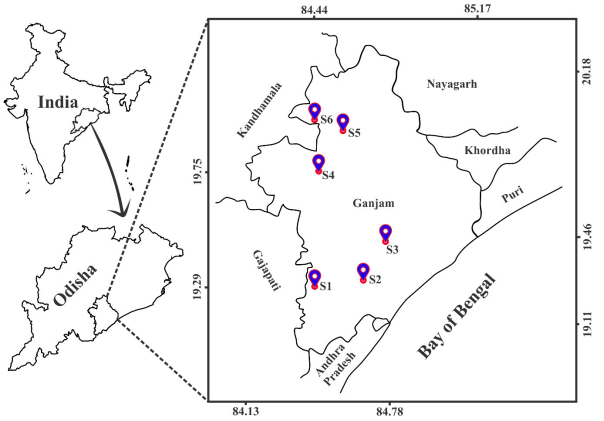

Fig. 1. Map showing different collection sites of Ganjam district, Odisha, India. **S1**: Ghodahada Dam (N"19º 17.718º, E"084º 26.872º), **S2**: Ramaguda Dam (N"19º 19.850º, E"084º 29.728'), **S3**: Samarajhola Dam (Nº19º 27.971', E"084º 44.829"), **S4**: Surada Dam (N"19º 45.224', E"084º 25.451"), **S5**: Bhanjanagara Ghai (N"19º 57.670', E"084º 34.308'), and **S6**: Daha Dam (N"19º 57.454", E"084º 27.801').

Sample preservation: Samples were preserved on the spot with 4 percent (v/v) formaldehyde, and a copy of each sample was retained without any preservative for microscopic examination. Each sample was provided a voucher number and stored at Department of Botany, Berhampur University.

Microscopy and microphotography: Under a phase-contrast light microscope, the collected

samples were examined and morphological traits of algal species were studied. Each species' microphotograph was shot with an Olympus CCD camera (Olympus, Model no: SC-180) mounted to the microscope (Olympus, Model: BX 53).

Morphological description: Important phenotypic features of algal species such as cell structure, cell/colony size, and color were described and compared to linediagrams and microphotographs of algal taxa published in the literature and identified(Kützing, 1865; Turner, 1892; Hustedt, 1930; Huber-Pestalozzi, 1955; Desikachary, 1959; Prescott, 1964; Wolowski and Hindák, 2005; Adhikary *et al*., 2009; Das *et al*., 2010; Jena and Adhikary, 2011; Adhikary and Jena, 2012; Karthick *et al*., 2013; Mohanty and Adhikary, 2013; Meeravali *et al*., 2015; Roy and Pal, 2015; Kumar and Singh, 2017; Bahls *et al*., 2018; Das Sarkar *et al*., 2019; Volkova *et al*., 2020).

Results and Discussion

A total of 31 algal species were recorded from the different reservoirs of Ganjam district, Odisha (Table 1, plate 1 Figure a-p, Plate 2 Figure a-o). These species are represented by 26 genera belonging to 21 families, 17 Orders, and 6 divisions algal such as Cyanobacteria, Bacillariophyta, Euglenophyta, Chlorophyta, Charophyta, and Ochrophyta. Among the 6 divisions, the Bacillariophyta were dominant, and Ochrophyta were found least occurring in the six reservoirs of the Ganjam district. Moreover, the pie chart showed the percentage of algal distribution such as Bacillariophyta (45%), Charophyta (16%), Cyanobacteria (13%), Chlorophyta (13%), Euglenophyta (10%) and Ochrophyta (03%) respectively (Figure 2).

Furthermore, a total of 19 species were reported for the first time from Gnajam district, i.e. namely *Anabaena iyengarii* var. *unispora* R.N. Singh, ***Komvophoron constrictum*** (Szafer) Anagnostidis & Komárek, *Euglena oxyuris* f. *charkoviensis (Svirenko) Bourrelly, Phacusp leuronectes (O.F. Müller) Nitzsch ex Dujardin,* ***Cymbella lanceolata*** C. Agardh, ***Encyonopsisc zarneckii*** Bahls, *Pinnularia amabilis* K. Krammer, *Pinnularia subsimilis* H.P. Gandhi, ***Synedra ulna* var. *oxyrhynchus*** (Kützing) O'Meara, *Synedra ulna* var. *amphirhynchus* (Ehrenberg) Grunow, *Nitzschia palea* (Kützing) W. Smith, ***Nitzschia reversa*** W. Smith, *Coscinodiscus centralis* Ehrenberg, ***Desmodesmus brasiliensis*** (Bohlin) E. Hegewald**,** *Pediastrum duplex* var. *coronatum* Raciborski, *Cosmarium maculatum* W.B. Türner, *Cosmarium formosulum Hoff, Euastrum spinulosum* var. *burmense* (West and G.S. West) Willi Krieger and *Centritractus belenophorus* var. *skujae* Kiriakov. Further, eight (08) algal species reported for the first time from the Odisha (mentioned above in bold letter). Further, the distribution of algal diversity in these six reservoirs was found approximately similar to each other. However, the most essential thing to mention is that 61 percent of the algal species are new to

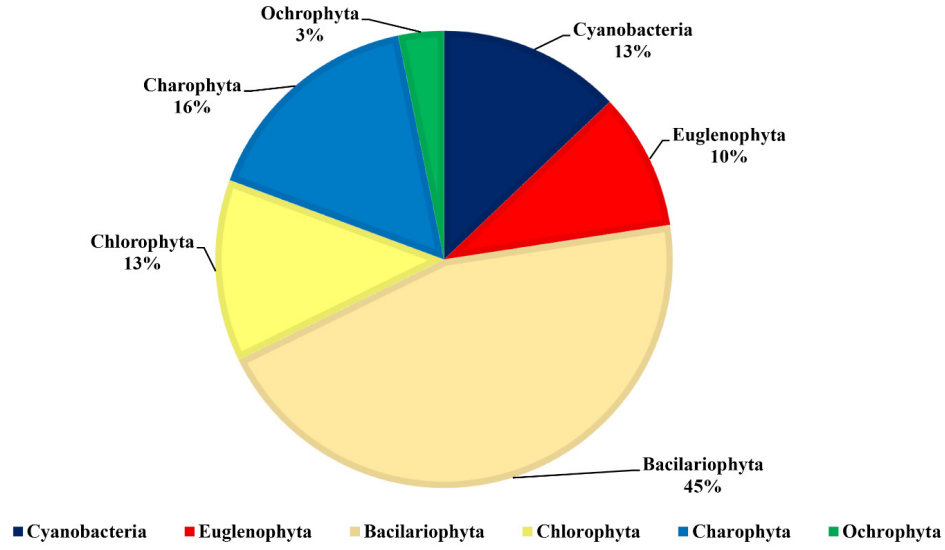

Fig. 2. Percentage of algal distribution of Ganjam, Odisha, India

Table 1. Showing the algal distribution of some water-reservoir of Ganjam, Odisha, India.

	Name of the organisms	Different reservoir of Ganjam District					
		S1	S2	S3	S4	S5	S6
	CYANOBACTERIA						
1.	*Synechococcusa eruginosus* Nägeli, 1849	+	+	-	+	+	+
2.	*Komvophoron constrictum* (Szafer) Anagnostidis & Komárek	-	-	+	+	-	+
3.	*Anabaena iyengarii* var. *unispora* R.N. Singh	+	+	-	+	-	+
4.	*Anabaena circinalis* Rabenhorst ex Bornet & Flahault	+	+	+	-	-	+
	EUGLENOPHYTA						
5.	*Euglena oxyuris* f. *charkoviensis* (Svirenko) Bourrelly	+	+	+	-	-	+
6.	*Phacus pleuronectes* (O.F. Müller) Nitzsch ex Dujardin	-	-	+	+	+	-
7.	*Trachelomonas hispida* (Perty) F.Stein	-	-	+	+	-	+
	BACILLARIOPHYTA						
8.	*Coscinodiscus centralis* Ehrenberg	-	+	-	-	-	+
9.	*Aulacoseira granulata* (Ehrenberg) Simonsen	-	-	+	+	+	-
10.	*Amphora elliptica* (C. Agardh) Kützing	-	+	-	+	+	-
11.	*Cymbella lanceolata* C. Agardh	+	+	+	-	-	+
12.	*Encyonopsisc zarneckii* Bahls	-	-	+	-	+	-
13.	*Gomphonema lanceolatum* Ehrenberg	+	+	-	+	-	-
14.	*Diadesmis confervacea* Kützing	-	+	-	-	+	-
15.	*Gyrosigmaa cuminatum* (Kützing) Rabenhorst	+	-	-	-	-	+
16.	*Pinnularia amabilis* K.Krammer	+	-	+	+	-	+
17.	*Pinnularia subsimilis* H.P.Gandhi	-	+	-	+	-	+
18.	*Synedra ulna* var. *oxyrhynchus* (Kützing) O'Meara	+	+	-	-	+	+
19.	*Synedra ulna* var. *amphirhynchus* (Ehren b.) Grunow	-	-	+	+	-	+
20.	*Nitzschia palea* (Kützing) W.Smith	+	-	+	-	+	+
21.	*Nitzschia reversa* W.S mith	+	-	-	+	+	+
	CHLOROPHYTA						
22.	*Chlorella vulgaris* Beijermick	+	-	+	-	+	+
23.	*Desmodesmu sbrasiliensis* (Bohlin) E.Hegewald	+	+	-	+	-	-
24.	*Pediastrum duplex* var. *coronatum* Raciborski	+	+	-	-	-	+
25.	*Pandorina morum* (O.F.Müller) Bory	-	+	-	-	+	-
	CHAROPHYTA						
26.	*Cosmarium maculatum* W.B. Turner	-	-	+	+	-	+
27.	*Cosmarium formosulum* Hoff	-	+	+	-	+	-
28.	*Euastrums pinulosum* var. *burmense* (West & G.S. West) Willi Krieger	-	+	+	-	-	+
29.	*Staurastrum bicorne* Hauptfleisch	-	-	-	+	+	-
30.	*Spirogyra sp.*	-	+	+	-	+	-
	OCHROPHYTA						
31.	*Centritractu sbelenophorus* var. *skujae* Kiriakov	-	-	+	-	-	+

Ganjam. The details of the systematic account and description of all the algal species are described below in taxonomical order with complexity wise.

Systematic account of algal species

Division Cyanobacteria

Class Cyanophyceae

Order Synechococcales

Family Synechococcaceae

Genus *Synechococcus* C. Nägeli, 1849

1. *Synechococcus aeruginosus* Nägeli 1849 (pl. 1 fig. d)

Desikachary, 1959, p. 126, pl. 25, Fig. 12

Cells 9.81 µm long and 5.73 µm broad, bluish-green, solitary, finely granulated cell content with rounded apices. Planktonic, Ramaguda Dam; Voucher No. RMD06; Date: 29th July 2020.

Family Gomontiellaceae

Genus *Komvophoron* K. Anagnostidis and J. Komárek 1988

2. *Komvophoron constrictum* (Szafer) Anagnostidis and Komárek 1988 (pl. 1 Fig. c)

Komárek and Anagnostidis, 2005, p. 333, Fig. 462

Cells 4.29 µm long and 5.7µm broad, barrel shaped with rounded ends, cell content with few small black granules, apical cell rounded; trichome

slightly bent, deeply constricted at the cross walls. Planktonic, Samarajhola Dam; Voucher No. SJD03; Date: 22nd Sept. 2020.

Order Nostocales

Family Nostocaceae

Genus *Anabaena* Bory ex Bornet & Flahault, 1886

3. *Anabaena iyengarii* var. *unispora* R.N. Singh, 1939 (pl. 1 Fig. a)

Desikachary, 1959,p.416,pl. 78, Fig.5

Cells 4.2 µm long and 6.3 µm broad, barrel-shaped; thallus bluish-green; trichome straight; heterocyst intercalary, spherical or oval, 8.3 µm broad, 8.01 µm long, spores single or at both the sides of heterocyst. Planktonic, Ghodahada Dam; Voucher No. GHD05; Date: 23rd Aug 2020.

4. *Anabaena circinalis* Rabenhorst ex Bornet and Flahault, 1886 (pl. 1 Fig. b)

Desikachary, 1959,p. 412, pl.77, Fig. 2

Cells 4.29 µm long and 5.7 µm broad, barrel-shaped or spherical, sometimes shorter than broad, apical cells colonial; thallus bluish-green, mucilaginous; trichome elongated, straight or slightly bent, mostly without sheath, gas vacuolated, heterocyst sub-spherical, 7.8 µm long, 6.2 µm broad. Planktonic, Ghodahada Dam; Voucher No. GHD01; Date: 23rd Aug 2020.

Division Euglenophyta

Class Euglenophyceae

Order Euglenales

Family Euglenaceae

Genus *Euglena* Ehrenberg 1830

5. *Euglena oxyuris f. charkowiensis* (Svirenko) Bourrelly1950(pl. 1 Fig. e)

Huber-Pestalozzi, 1955, pl. Vii, Fig.42

Cell 77.59 µm long and 14.46 µm broad, green, elongated, cylindrical, bent but twisted, anterior end curved, posterior endblunts with appointed tail; pellicle yellowish-green with spiral rows; chloroplasts numerous small ovoids, two large paramylon bodies numerous, tail long. Planktonic, Ramaguda Dam; Voucher No. RMD01; Date: 29th July 2020.

Genus *Phacus* Dujardin, 1841

6. *Phacus pleuronectes* (O.F.Müller) Nitzsch ex Dujardin, 1841 (pl. 1 Fig. f)

Wolowski and Hindák, 2005, p.36, Fig. 204

Cell 50.03 µm long and 29.6 µm broad, broadly ovoid to sub-orbicular in outline, slightly asymmetrical anterior end narrowly rounded and shallow bilobed, apical furrow up tohalf of the cell length, slightly twisted, posterior end with slender cauda, turning oblique to one side, dorsal keel frolf anterior end, pellicle longitudinally striated; chloroplast parietal, numerous discs shaped, usually one large or two ring or disc-shaped paramylon bodies. Planktonic, Samarajhola Dam; Voucher No. SJD07; Date: 22nd Sept. 2020.

Genus *Trachelomonas* Ehrenberg 1834

7. *Phacus pleuronectes* (Perty) F.Stein 1878 (pl. 1 fig. g)

Huber-Pestalozzi, 1955, pl. LXIII, Fig. 520

Cell 36.4 µm long and 31.5µm broad, brown, ovoid, anterior end inwards, lorica thick; chloroplast numerous with two pyrenoids. Planktonic, Samarajhola Dam; Voucher No. SJD01; Date: 22nd Sept. 2020.

Division Bacillariophyta

Class Coscinodiscophyceae

Order Coscinodiscales

Family Coscinodiscaceae

Genus Coscinodiscus Ehrenberg 1839

8. *Coscinodiscus centralis* Ehrenberg 1839 (pl. 1 fig. h)

Kumar and Singh, 2017, p. 229, Fig. 4

Valves 49.17 µm diameter, saucer-to Petridis shaped, cells discoid, presence of several small plate-like chloroplasts; areolae radiating from central annulus with a central space; striae are very fine. Planktonic, Ramaguda Dam; Voucher No. RMD09; Date: 29nd July 2020.

Order Aulacoseirales

Family Aulacoseiraceae

Genus *Aulacoseira* Thwaites 1848

9. *Aulacoseira granulata* (Ehrenberg) Simonsen 1979 (pl. 1 Fig. j)

Roy and Pal, 2015, p. 52, Fig. 2k

Frustule 8.3 µm in diameter, with a mantle height of 12.48 µm; frustules are cylindrical, join face-to-face and form filamentous colonies; The mantle has straight sides and the valve face is flat. The mantle areolae are square. Linking spines are located at the end of each per valvar costa. Linking triangular or bifurcated, spines are short. Planktonic, Surada Dam; Voucher No. SRD02; Date: 25th Jun 2021.

Class Bacillariophyceae

Order Thalassiophysales

Family Catenulaceae

Genus *Amphora* Ehrenberg ex Kützing 1844

10. *Amphora elliptica* (C.Agardh) Kützing 1844 (pl. 1 Fig. i)

Jena *et al.,* 2006c, p. 390, pl. 3, Fig. 16

Frustule 83.2 µm long and 28.03 µm broad; Frustules in girdle view elliptic-lanceolate or slightly attenuated, obtuse truncate; central area-wide, longer than broad, striation distinct transverse at both the

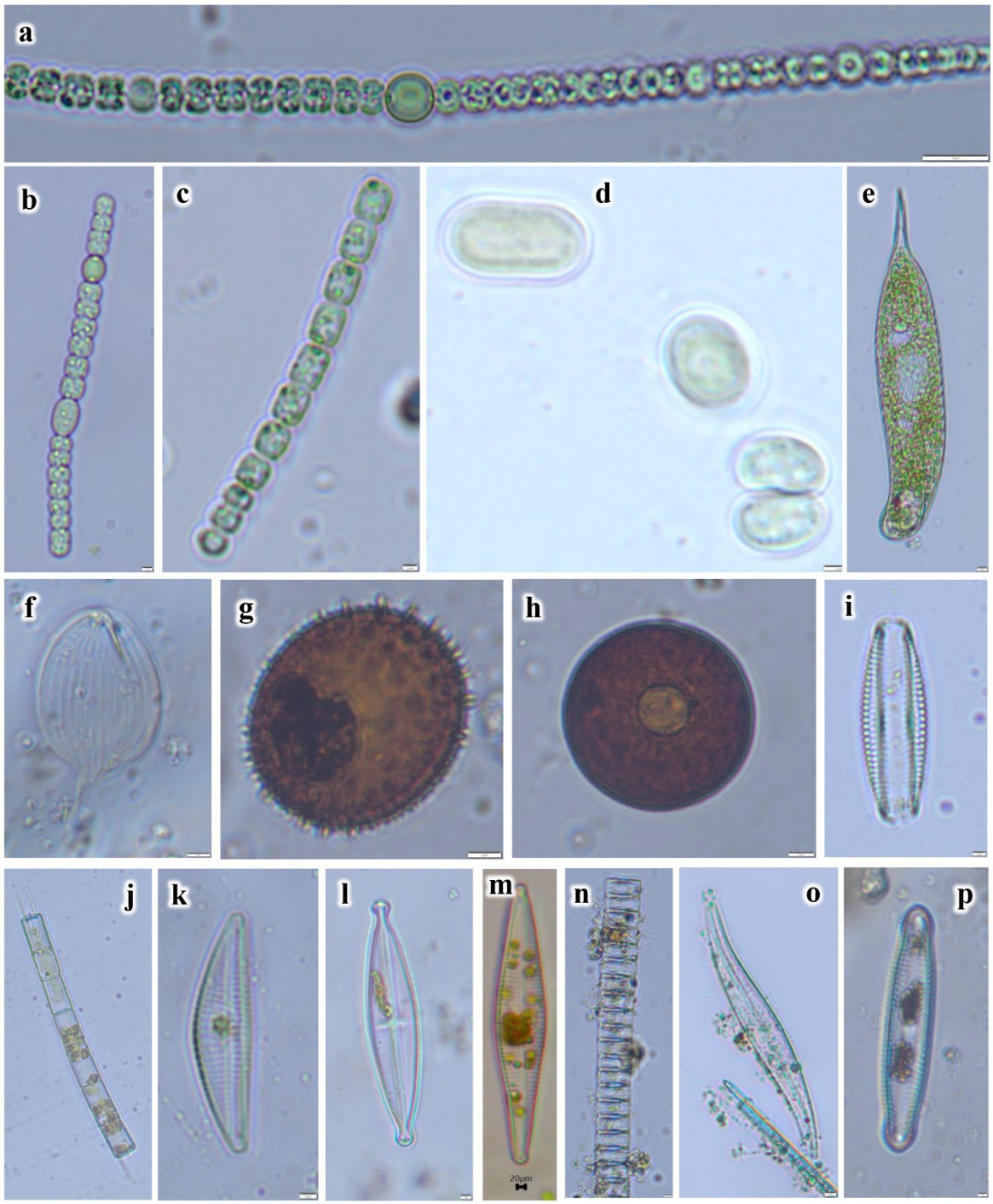

Plate 1. Fig. (a- p), a. *Anabaena iyengarii* var. *unispora* R.N. Singh; **b.** *Anabaena circinalis* Rabenhorst ex Bornet & Flahault; **c.** *Komvophoron constrictum* (Szafer) Anagnostidis & Komárek; **d.** *Synechococcus aeruginosus* Nägeli; **e.** *Euglena oxyuris* f. *charkoviensis* (Svirenko) Bourrelly**; f.** *Phacus pleuronectes* (O.F.Müller) Nitzsch ex Dujardin; **g.** *Trachelomonas hispida* (Perty) F. Stein; **h.** *Coscinodiscus centralis* Ehrenberg**i.** *Amphora elliptica* (C. Agardh) Kützing; **j.** *Aulacoseira granulata* (Ehrenberg) Simonsen; **k.** *Cymbella lanceolata* C. Agardh; **l.** *Encyonopsisc zarneckii* Bahls; **m.** *Gomphonema lanceolatum* Ehrenberg; **n.** *Diadesmis confervacea* Kützing; **o.** *Gyrosigmaa cuminatum* (Kützing) Rabenhorst; **p.** *Pinnularia amabilis* K. Krammer. **Figure Scale (2 µm: b, c, d, e, l, o, p; 5 µm: f, g, h, i, k, n; 10 µm: a, j; 20 µm:m).**

sides. Planktonic, Ramaguda Dam; Voucher No. RMD04; Date: 29th July 2020.

Order Cymbellales

Family Cymbellaceae

Genus *Cymbella* C. Agardh 1830

11. *Cymbella turgida* W.Gregory 1856 (pl. 1 fig. k)

Husted, 1930, p. 358, Fig. 660

Frustule 78 µm long and 21.25 µm broad; cells lunar-forming with strongly convex dorsal and almost straight, in the middle mostly slightly flared ventral margin, not protruding at the ends, more or less pointedly rounded, raphe strongly eccentric, erect, terminal nodes on the dorsal side distant from the ends, pole columns long, ventral directed. Planktonic, Ghodahada Dam; Voucher No. GHD08; Date: 23rd Aug 2020.

Genus *Encyonopsis* Krammer, 1997

12. *Encyonopsisc zarneckii* Bahls 2013 (pl. 1 Fig. l)

Bahls *et al.,* 2018, p. 49, pl. 12, Fig. 1-3

Frustule 47.94 µm long, 4.7 µm broad, axial area narrow, near valve midline; valves linear-lanceolate, slightly dorsiventral; apices capitate, central area small, asymmetric, rounded on the dorsal side, defined by two unevenly shortened striae on the ventral side;raphe weakly lateral, filiform near the proximal and distal ends. Proximal raphe ends weakly expanded, deflected dorsally; distal raphe fissures hooked toward the ventral side. Planktonic, Samarajhola; Voucher No. SMJ06; Date: 22nd July 2021.

Family Gomphonemataceae

Genus *Gomphonema* Ehrenberg 1832

13. *Gomphonema lanceolatum* Ehrenberg 1843 (pl. 1 fig. m)

Jena *et al.,* 2006c, p. 388, pl. 3, Fig. 1

Frustule 49.32 µm long and 9.72 µm broad,valves linear-lanceolate, center slightly inflated, apices rounded, base broadly rounded; raphe thick, median, terminal fissures curved forming hook-like structure. central area unilateral, puncta present. Planktonic, Surada Dam; Voucher No. SRD03; Date: 25th Jun 2021.

Order Naviculales

Family Diadesmidaceae

Genus *Diadesmis* Kützing 1844

4. *Diadesmis confervacea* Kützing 1844 (pl. 1 Fig. n)

Synonym: *Navicula confervacea* (Kützing) Grunow 1880

Kützing, 1865, p. 109, pl. 30, Fig. 8a

Frustule rectangular, 110.2 µm long and 13.36 µm broad, frustule isattached end to end to form ribbon-shaped structure. Planktonic, Ramaguda Dam; Voucher No. RMD03; Date: 29th Jul 2020.

Family Naviculaceae

Genus *Gyrosigma* Hassall 1845

15. *Gyrosigmaa cuminatum* (Kützing) Rabenhorst 1853 (pl. 1 Fig. o)

Hustedt, 1930, p.223, Fig. 329

Frustule 40.96 µm long and 6 µm broad at middle elongated, slightly sigmoid, usually broader at middle and gradually attenuated towards ends, lanceolate; raphe thin, sigmoid with the distinct central nodule. Planktonic, Daha Dam; Voucher No. DHD03; Date: 15th May 2021.

Family *Pinnulariaceae*

Genus *Pinnularia* Ehrenberg 1843

16. *Pinnularia amabilis* K. Krammer, 2000 (pl. 1 Fig. p)

Karthick *et al.,* 2013, pl. 73

Frustule 55.17 µm long and 9.37 µm broad; striae density 8-10 in 10 µm; valves linear, with slightly undulating valve outline, ends broadly capitate; raphe narrow and undulating; proximal raphe ends unilaterally bent, axial area linear; striae curves, and radiate. Planktonic, Daha Dam; Voucher No. DHD01; Date: 15th May 2021.

17. *Pinnularia subsimilis* H.P. Gandhi 1970 (pl. 2 Fg. a)

Mohanty and Adhikary, 2013, p.617, pl. 3, Fig.4

Frustule 34.50 µm long and 7.53 µm broad, linear, lanceolate, slightly attenuated towards the apices, roundedends; raphethin, median, axial area linear, narrow, gradually widening towards the center; striation not clearly visible. Planktonic, Surada Dam; Voucher No. SRD05; Date: 25th Jun 2021.

Order Fragilariales

Family Fragilariaceae

Genus *Synedra* Ehrenberg, 1830

18. *Synedra ulna* var. *oxyrhynchus* (Kützing) O'Meara 1875 (pl. 2 Fig. b)

Meeravali *et al.,* 2015, p. 6924. pl. 1, Fig. 16

Frustule 57.26 µm long and 5.03 µm broad, linear, narrowly lanceolate with rounded ends, pseudoraphe tin, narrow, formed by the union of axial and central area, central area absents, striation fine, lineate, transverse, parallel throughout the valve. Planktonic, Bhanjanagar Ghai; Voucher No. BNG01; Date: 21st Dec 2021.

19. *Synedra ulna* var. *amphirhynchus* (Ehrenb.) Grunow (pl. 2 Fig. c)

Synonym: *Synedra amphirhynchus* Ehrenberg

Das *et al.,* 2010, p. 353, pl. 4, Fig. 106

Frustule 261.7 µm long and 12 µm broad, slender,

linear, straight, at the end narrow and suddenly constricted to form capitateend; striation distinct, parallel, absent at the middle, many times longer thanbroad. Planktonic, Surada Dam; Voucher No. SRD01; Date: 25th Jun 2021.

Order Bacillariales

Family Bacillariaceae

Genus *Nitzschia* Hassall 1845

20. *Nitzschia palea* (Kützing) W. Smith 1856 (pl. 2 Fig. d)

Jena *et al.,* 2006b, p. 391, pl. 3, Fig. 25

Frustule 67.56 µm long and 7.31 µm broad, striae 10-12 in 10 µm, linear, sub-lanceolate, attenuated to subacute apices. Planktonic, Samarajhola; Voucher No. SJD02; Date: 22nd July 2020.

21. *Nitzschia reversa* W. Smith, 1853(pl. 2 Fig. e)

Sinonym: *Nitzschia closterium* Eulenstein

Das Sarkar *et al.,* 2019, p. 8, Fig. 4A

Frustule 30.8 µm long and 2.48 µm broad, lanceolate, ends long rostrate, twisted in opposite directions, giving the valve a general sigmoid appearance; Linear frustule in connective view; fibulae small, equidistant;very delicate striation. Planktonic, Ghodahada Dam; Voucher No. GHD05; Date: 23rd Aug 2020.

Phylum Chlorophyta

Class Trebouxiophyceae

Order Chlorellales

Family Chlorellaceae

Genus *Chlorella* Beyerinck [Beijerinck] 1890

22. *Chlorella vulgaris* Beijermick (pl. 2 Fig. f)

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

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

Cell diameter is 4 µm, unicellular, green, spherical, cell solitary, and chloroplast cup-shaped with distinct pyrenoid at the center. Planktonic, Daha Dam; Voucher No. DHD02; Date: 15th May 2021.

Class Chlorophyceae

Order Sphaeropleales

Family Scenedesmaceae

Genus *Desmodesmus* (R.Chodat) S.S.An, T.Friedl & E. Hegewald, 1999

23. *Desmodesmus brasiliensis* (Bohlin) Hegewald, 2000 (pl. 2 Fig. g)

Jena and Adhikary, 2007, p. 181, pl. 3, Fig. 22.

Cells 17.68 µm long and 5.05 µm broad; coenobia 4-celled, cells cylindrical or slightly ellipsoid with attenuated apices, the longitudinal ridge from pole to pole on each side of the cell, ends of each cell with 2.66 µm small teeth. Planktonic, Surada Dam; Voucher No. SRD07; Date: 25th Jun 2021.

Family Hydrodictyaceae

Genus *Pediastrum* Meyen 1829

24. *Pediastrum duplex* var**.** *coronatum* Raciborski, 1890 (pl. 2 Fig. h)

Adhikary *et al.,* 2009, p. 54, pl. 26, Fig. 3

Cells 8.14 µm broad and 7.61µm long; inner cells four-cornered with a small lens-shaped perforation in front and another at the back, marginal cells slightly longer than broad, lateral cells in contact along one third the length, processes of marginal cells ending in short spines; coenobia 16-32-64 celled and more, coenobium 85.12 µm in diameter; chloroplast single,parietal with a pyrenoids. Planktonic, Daha Dam; Voucher No. DHD02; Date: 15th May 2021.

Order Chlamydomonadales

Family Volvocaceae

Genus *Pandorina* Bory 1826

25. *Pandorina morum* (O.F. Müller) Bory1826 (pl. 2 Fig. i)

Synonym: *Volvox morum* O.F. Muller

Jena *et al.,* 2008, p. 14, pl. 1, Fig. 20

Cells 8-10 µm broad and as much longer; both the ends broadly rounded 8-16 celled, cell obovate, broadside, turns towards outside, narrower and rounded posterior towards inside angular by mutual compressed, closely packed; coenobium short ellipsoidal or nearly spherical, embedded in a common homogenous colonial envelope,35.88 µm in diameter; chloroplast massive cup-shaped covered most of the surface of the cell, with one basal pyrenoid; flagella not clearly seen, emerging from two funnels shaped opening in the outer colonial envelope.Planktonic, Ramaguda Dam; Voucher No. RMD02; Date: 29th July 2020.

Division Charophyta

Class Zygnematophyceae

Order Desmidiales

Family Desmidiaceae

Genus *Cosmarium* Corda ex Ralfs, 1848

26. *Cosmarium maculatum* W.B. Turner 1893(pl. 2 Fig. j)

Türner 1892, p. 49, pl. 8, Fig. 68

Cell are 147 µm long and 88.2 ìm broad; cells solitary, deep green, longer than broad, constricted sinus, wide, broad-based, semi cells, slightly narrow apex, cell wall with fine granulation. Planktonic, Daha Dam; Voucher No. DHD05; Date: 15th May 2021.

27. *Cosmarium formosulum* Hoff 1888 (pl. 2 Fig. k)

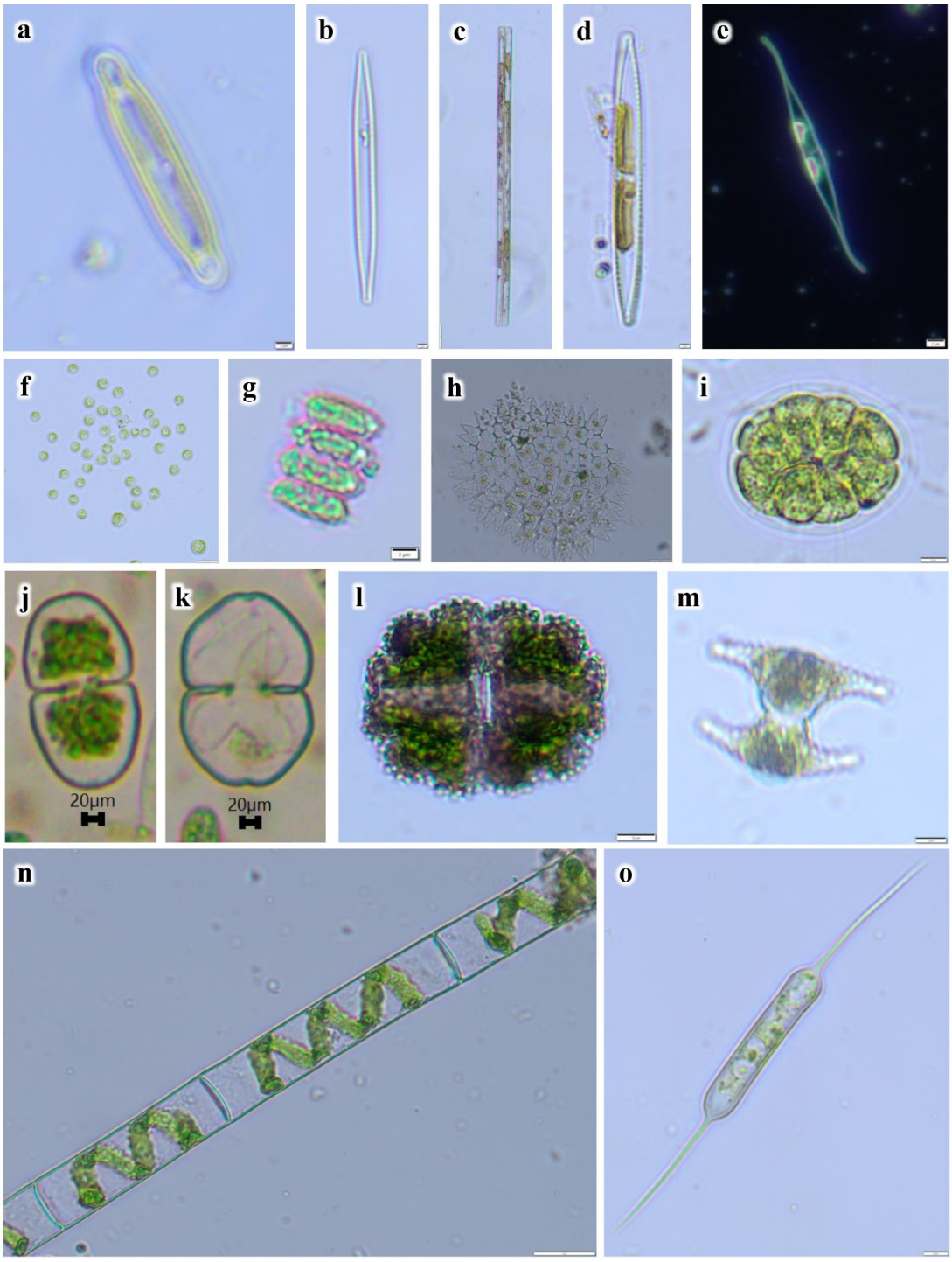

Plate 2. **Fig. (a-o), a.** *Pinnularia subsimilis* H.P. Gandhi; **b.** *Synedra ulna* var. *oxyrhynchus* (Kützing) O'Meara; **c.** *Synedra ulna* var. *amphirhynchus* (Ehrenb.) Grunow; **d.** *Nitzschia palea* (Kützing) W.Smith; **e.** *Nitzschia reversa* W. Smith; **f.** *Chlorella vulgaris* Beijermick; **g.** *Desmodesmus brasiliensis* (Bohlin) E. Hegewald; **h.** *Pediastrum duplex* var. *coronatum* Raciborski; **i.** *Pandorina morum* (O.F. Müller) Bory; **j.** *Cosmarium maculatum* W.B. Turner; **k.** *Cosmarium formosulum* Hoff; **l.** *Euastrum spinulosum* var. *burmense* (West & G.S. West) Willi Krieger; **m.** *Staurastrum bicorne* Hauptfleisch; **n.***Spirogyra* sp.; **o.** *Centritractus belenophorus* var. *skujae* Kiriakov. **Figure Scale** (**2 µm: a, b, d, e, g; 5 µm: i, m, n, o; 10 µm: f, h, l; 20 µm: c, j, k).**

Behera *et al.,* 2020, p. 218, fig. 4d

Cell 119.23 µm long and 89.23 µm broad, isthmus 10 ìm broad; slightly longer than broad, deeply constricted, sinus linear, semi cells broadly ovate, margin crenate, chloroplast axial. Planktonic, Bhanjanagar Ghai; Voucher No. BNG03; Date: 21stDec 2021.

Genus *Euastrum* Ehrenberg ex Ralfs1848

28.*Euastrum spinulosum* var**.** *burmense* (West and G.S.West) Willi Krieger 1937(pl. 2 Fig. l)

Das and Adhikary, 2014, p. 96, pl. 6, Fig. 20.

Cells 67.1 µm long and 55.4 µm broad, isthmus 38.94 µm broad; cells a littlelonger than broad, narrow and opensinus, polarlobes broadly truncate with the intermediate notch, Within the polar and lateral lobes, there are short spines, as well as one broad median and two tiny lateral protuberances above the isthmus. Planktonic, Samarajhola; Voucher No. SJD04; Date: 22nd July 2020.

Genus: *Staurastrum* Meyen ex Ralfs1848

29. *Staurastrum bicorne* Hauptfleisch 1888 (pl. 2 Fig. m)

Adhikary *et al.,* 2009, p.76, pl. 33, Fig. 13.

Cells 22.44µm long and 34.07µm broad; isthmus 7.48µm broad; apical margin of semi cell bent and having one lateral process on each side; lateral process tip bifurcated with two small teeth and margin with small spines; lateral process tip bifurcated with two small teeth and margin with short spines. Planktonic, Bhanjanagar Ghai; Voucher No. BNG05; Date: 21st Dec 2021.

Order Zygnematales

Family Zygnemataceae

Genus *Spirogyra* Link 1820

30. *Spirogyra* sp. (pl. 2 Fig. n)

Volkova *et al.,* 2020, p. 1096, Fig. 3D

Vegetative cells 190-199 µm long and 19-20 µm broad; transverse walls plane; 1 chloroplast with 3-3.5 turns per cell. Planktonic, Bhanjanagar Ghai; Voucher No. BNG02; Date: 21st Dec 2021.

Phylum Ochrophyta

Class Xanthophyceae

Order Mischococcales

Family Sciadiaceae

Genus *Centritractus* Lemmermann 1900

31. *Centritractus belenophorus* var**.** *skujae* Kiriakov (pl. 2 Fig. o)

Prescott, 1964, p. 139, Fig. 231

cells 40.27 µm long and 7.81 µm broad; cells elongate, cylindric with a spine at one or both the poles, cells long and broad. Planktonic, Samarajhola; Voucher No. SJD09; Date: 22nd July 2020.

Conclusion

In the present study it was found that six reservoirs of Ganjam district of Odisha are important habitat of algal bio-resources in terms of the presence of many microalgae including two important algal species such as *Chlorella vulgaris* and *Desmodesmus brasiliensis* which are having many uses biotechnological applications. Further, all the algal species reported in the present investigation indicate the oligotrophic status of the water. However, seasonal monitoring of algal flora occurrence and distribution is required to maintain the water quality and to conserve the biodiversity in these wetlands for the future.

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