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Algal Diversity of Ansupa lake, Odisha, India

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भारत के ओडिशा राज्य की अंसुपा झील की शैवाल विविधता

चंदनाश्री बेहेरा, सौम्यरंजन दाश, विश्वजीत प्रधान, मृत्युंजय जेना एवं शिब प्रसाद अधिकारी

सारांश

प्रस्तुत शोध पत्र में अंसुपा झील की छः चयनित स्थलों से संग्रहित किये गये 72 शैवाल जातियों जिनमें सायनोबैक्टेरिया (11 जातियां), यूग्लिनोफायसी (4 जातियां), बैसिलेरियोफायसी (7 जातियां), क्लोरोफायसी की (17 जातियां), उल्वोफायसी (1 जाति) ट्रबोक्सीयोफायसी (2 जातियां), जिग्नेमैटोफायसी (29 जातियां) एवं कैरोफायसी (1 जाति) सम्मिलित हैं। हमारे द्वारा किये गये शोध से पता चला है कि झील में डेसमीड विविधता हरित शैवालों से प्रभावी रूप से अधिक है, जो झील के आलिगोट्राफिक स्थिति का द्योतक है।

ABSTRACT

In the present investigation, algal samples were collected from six selected sites of Ansupa lake and altogether 72 algal species belonging to Cyanobacteria (11 species), Euglenophyceae (4 species), Bacillariophyceae (07 species), Chlorophyceae (17 species), Ulvophyceae (1 Species), Trebouxiophyceae (2 species), Zygnematophyceae (29 species) and Charophyceae (1 species) were recorded. Furthermore, our study was revealed that desmid diversity was dominant followed by green algae in the lake, which was indicating the oligotrophic condition of water in the lake.

Keywords: Lake, desmid, diatom, green algae, planktonic

INTRODUCTION

Anuspa lake (20˚ 26′ 28.43” to 28˚ 28′ 34.44” N latitude and 85˚ 35′ 56.74” to 85˚36′ 30.01” E longitude; at al elevation of 57.8 m) is situated at Banki Block of Cuttack district under Athagada forest dission of Odisha state (Fig. 1). This lake is located on the left bank of the Mahanidi river and surrounded by two hills such as Saranda and Bishunupur hill. The length of the lake runs is approximately three kilometres and breadth varies from with maximum breadth 250 of 250-500 m. The total water spread area of this lake is 152.00 ha and catchment area 5231.00 ha. This pictorial lake has an international importance, for home to several migratory as well as domiciled birds. Shrinkage of the lake mouth due to siltation through flood water of river Mahanadi is one of the major problems for its existence. The lake was declared as a community reserve in 2003 having all the privileges of wildlife sanctuary or a National Park as per amendment made in the wildlife protection Act (1972). Although substantial works have been carried out on freshwater algal diversity in Odisha (Jena & al. 2005; Jena & al. 2006 a, b, c; Ratha & al. 2006, 2007; Jena & al. 2008; Jena & Adhikary 2007; Adhikary & al. 2009; Jena & Adhikary 2011; Adhikary & Jena 2012; Dash & al. 2020), no published record is available on the study of algal flora of Ansupa lake till date. Hence, the present endeavour was made to enumerate the algal diversity in the lake based on the work intiated during 2008 and subsequently recollected of samples during 2018 - 2019.

MATERIALS AND METHODS

Algal sampale were colleted from six selected (Fig. 1) viz., near Saranda hill (S1), near Malabiharpur village (S2), near Kadalibadi village (S3), middle of the lake (S4), middle of the lake towards Bishnupur hill (S5) and

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near Bishnupur village (S6) in 2018 and 2019 during summer and late monsoon seasons during the month of April and August respectively. All forms of sampes such as Epilithic, epiphytic, free floating and planktonic were collected in Tarson make sterilized specimen tubes. Planktonic algae were collected by using plankton net of 25µm pore size. Collected samples were preserved in 4% (v/v) formaldehyde and Lugol'slodine (0.5%) on the spot. Sample were assigned with a voucher number and deposited at Department of Botany, Berhampur University. Microphotograph of the algal species was taken by digital camera (Nikan-coolpix) fixed on Meiji trinocular phase contrast microscope (ML-TH-05). Each algal species was described and identified with the help of standard literature (Deshikachary, 1959; Scott & Prescott, 1961; Philipose, 1967; Gonzalves, 1981; Komárek & Fott, 1983; Deshikachary, 1987; Hindak, 1988; Hegewald & al., 1990; Cox 1996; Krishnamurthy, 1999; Komárek & Anagnostidis, 1999, 2005; Wotowski & Hindak, 2005; Adhikary & al., 2009; Das & Adhikary, 2014; Jena & al. 2014. Das & Keshri, 2016). Additionally, to avoid the confusion of classification of green algae and diatoms, the recent and update clssaifications were followed for Chlorophyceae and Bacillariophyceae (Krienitz & Bock, 2012; Kociolek & al., 2018). The author citation and protolog of given by following algae database https://www.algaebase.org (Guiry & Guiry 2020).

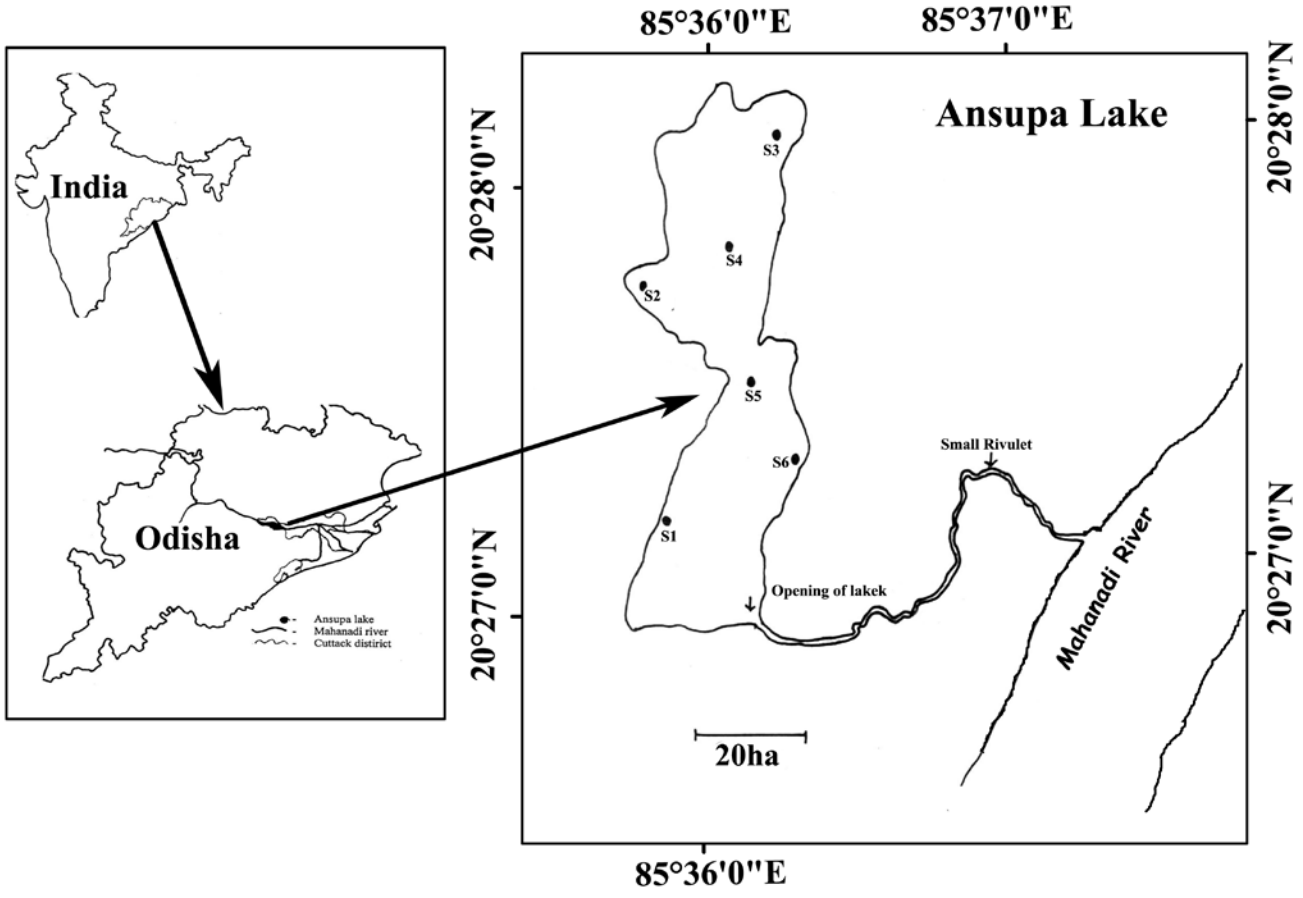

Fig. 1 Map showing the different collection site in Ansupa lake. S1. Near Saranda hill, S2. Near Malabiharpur village, S3. Near Kadalibadi village, S4. Middle of the lake, S5. Middle of the lake and S6. Near Bishnupur village.

RESULTS AND DISCUSSION

During the study, a comaprision of the samples collected during 2008 and subsequently investigation carried out during 2018- 2019 after 10 years were made. The status of algal diversity is given in table 1. Altogether 72 algal species belonging to 36 genera, 22 families, 19 orders 8 classes *viz.* Cyanobacteria, Euglenophyceae, Bacillariophyceae, Chlorophyceae, Ulvophyceae, Trebouxiophyceae, Zygnematophyceae and Charophyceae were recorded from Ansupa Lake. The members of Zygnematophyceae particularly the desmids (29 species) were the most dominant group in the lake followed by Chlorophyceae (17 species), Cyanobacteria (11 species) and Bacillariophyceae (07 species). Of these, 54 algal species (about 45 %) were recorded in

both 2008 and 2018-2019. Altgough the algal diversity of Ansupa lake has not changed singficantly during last 10 years but we found that the diversity of diatoms and desmids reduced significantly. The microphotographs of each species were given (Figs. 2 a-v, 3 a-x, 4 a-z). The systematic postion of algal species are arranged as per evolutionary trend and in alphabetical order.

Table 1: **List of algal species recorded during 2018-2019 and compassion with 2008.**

Algal species	Recorded in 2018/ 2019	Recorded in 2008
Class**: Cyanobacteria**		
Merismopedia punctata Mayen	+	+
Chroococcus tenax (Kirchner) Hieronymus	+	+
Chroococcus turgidus (Kützing) Nägeli	+	+
Spirulina nordstedtii Gomont	-	+
Phormidium corium Gomont ex Gomont	+	+
Lyngbya aestuarii Liebman ex Gomont	+	-
Lyngbya magnifica Gardner	+	-
Lyngbya majuscula Harvey ex Gomont	+	-
Lyngbya sordida Gomont	-	+
Anabaena orientalis S.C. Dixit	+	+
Scytonema hofmanni C. Agardh ex Bornet	+	+
Scytonema stuposum Bornet ex Bornet & Flahault	+	+
Scytonema tolypothrichoides Kützing ex Bornet & Flahault	+	+
Tolypothrix robusta N.L. Gardner	-	+
Class**: Euglenophyceae**		
Euglena spathirbyncha Skuja	+	+
Euglena sociabilis Dangeard	+	+
Trachelomonas armata (Ehrenberg) F. Stein	+	+
Phacus longicauda (Ehrenberg) Dujardin	+	+
Class**: Bacillariophyceae**		
Grammatophora undulata Ehrenberg	-	+
Synedra tubulata Kützing	-	+
Synedra ulna var. *amphirhynchus* (Ehrenberg) Grunow	+	+
Diadesmis confervacea Kützing	+	+
Gyrosigma sp.	-	+
Navicula gracilis Ehrenberg	+	+
Navicula papula Kützing	-	+
Navicula viridis (Nitzsch) Ehrenberg	-	+
Navicula viridula (Kützing) Ehrenberg	-	+
Pinnularia biceps W. Gregory	-	+
Pinnularia gibba (Ehrenberg) Ehrenberg	-	+
Himantidium sp.	-	+
Gomphonema olivaceam (Lynghye) Desmazières	-	+
Gomphonema vibrio Ehrenberg	+	-
Cymbella tumida (Brébisson) Van Heurck	-	+
Amphora elliptica (Agardh) Kützing	-	+
Amphora ovum Cleve	-	+
Rhopalodia gibba (Ehrenberg) O. Müller	-	+
Nitzschia obtusa W. Smith	+	+
Nitzschia palea (Kützing) W. Smith	+	+
Nitzschia sigmoidea (Nitzsch) W. Smith	+	+
Class**: Chlorophyceae**		
Akistrodesmus densus Korshikov	+	+
Ankistrodesmus stipitatus Komárková-Legnerová	-	+
Ankistrodesmus tortus Komárek & Comas González	-	+
Kirchneria irregularis (G.M. Smith) Hindák	+	+
Monoraphidium contontum (Thuret) Komarkova-Legnereva	-	+
Coelastrum cambricum var. *intermedium* (Bohlin) G.S. West	+	+
Coelastrum proboscideum Bohlin	+	-
Coelastrum reticulatum (Dangeard) Senn.	+	+
Dimorphococcus lunatus A. Braun	+	+
Desmodesmus brasilliensis (Bohlin) E. Hegewald	+	-
Scenedesmus columnatus Hortobagyi	-	+
Scenedesmus denticulatus var. *australis* Playfair	-	+
Scenedesmus obliquus (Turpin) Kützing	+	+
Scenedesmus obtusus Meyen	-	+
Microspora sp.	-	+
Pediastrum duplex var. *duplex* Sulek	+	+
Pediastrum duplex var. *asperum* (A. Braun) Hansgirg	+	+
Stauridium tetras (Ehrenberg) Ralfs	+	-
Tetraédron bifidum (W.B.Turner) Wille	-	+
Tetraédron regulare var. *longispinum* De Toni	-	+
Tetraédron triangulare Korshikov	-	+
Oedogonium auchitanum Cooke	+	+
Oedogonium brevicingulatum Jao	+	+
Oedogonium intermedium Wittrock ex Hirn	+	+

Oedogonium globosum Nordstedt ex Hirn	+	+
Oedogonium hirnii Gutwinski ex Hirn	+	+
Bulbochaete sp.	-	+
Chaetophoropsis pisiformis (Roth) B.Wen Liu, Qian Xiong, X.Dong Liu, Z.Yu Hu & G..Xiang Liu	+	+
Class: **Ulvophyceae**		
Cladophora glomerata (Linnaeus) Kützing	+	+
Pithophora mooreana Collins	-	+
Class: **Trebouxiophyceae**		
Botryococcus braunii Kützing	+	+
Oocystis kumaoensis K.P. Sigh	+	+
Class: **Zygnematophyceae**		
Closterium dianae var. *pseudodianae* (J. Roy) Willi Krieger	+	+
Closterium ehrenbergii var. *podolicum* Gutwinski Wittrock	+	-
Cosmarium angulatum f. *majus* (Grunow) Turner	+	+
Cosmarium arnellii Boldt	+	+
Cosmariuma wadhense Prasad & Mehrotra	-	+
Cosmarium circulare Reinsch	+	+
Cosmarium contractum O. Kirchner	-	+
Cosmarium divergens Krieger	+	+
Cosmarium forceps Brühl & Biswas	+	+
Cosmarium formosulum Hoff	+	+
Cosmarium lagerheimianum (Turner) Scott & Prescott	+	-
Cosmarium laeve Rabenhorst	-	+
Cosmarium lundellii var. *ellipticum* West & G.S. West	+	+
Cosmarium norimbergense var. *depressum* (W. & G.S. West) Willi Krieger & Gerloff	-	+
Cosmarium nudum (W.B.Turner) Gutwinski	+	-
Cosmarium obsoletum (Hantzsch) Reinsch	-	+
Cosmarium porteanum Archer	+	+
Cosmarium pseudopyramidatum P. Lundell	+	-
Cosmarium pseudogranatum var. *rotundatum* (Krieger) Meisik	-	+
Cosmarium pseudophoseolus Brühl& Biswas	-	+
Cosmarium pyramidatum Brébission ex Ralfs	+	+
Cosmarium quadrum var. sublatum (Nordstedt) West & G.S. West	+	-
Cosmarium tumidum Lundell	+	-
Euastrum ceylanicum (W. & G.S. West) Krieger	+	+
Euastrum denticulatum F. Gay	+	+
Euastrum spinulosum Delponte	+	+
Euastrum stigmosum W.B.Turner	+	+
Staurastrum arctiscon (Ehrenberg and Ralfs) P. Lundell	+	-
Staurastrum bicorne Hauptfleisch	-	+
Staurastrum bifidum Brébisson ex Ralfs	-	+
Staurastrum contectum W.B.Turner	+	+
Staurastrum gemmulatum W.B. Turner	-	+
Staurastrum leptocladum Norsdst.	+	-
Staurastrum pseudosebaldi Wille	-	+
Staurastrum sebaldi Reinsch var. *ornatum* Nordst.	+	-
Xanthidium perissacanthum Scott and Prescott	+	-
Pleurotaenium rectum Delponte	-	+
Sphaerozosma manipurense Brühl& Biswas	-	+
Arthrodesmus curvatus var. *americanus* Scott & Grönblad	+	+
Micrasterias foliacea Bailey ex Ralfs	+	+
Micrasterias pinnatifida (Kützing) Ralfs	-	+
Micrasterias radians W.B. Turner	+	+
Micrasterias tropica Nordstedt	+	+
Zygnema czurdae Randhawa	-	+
Zygnema gangeticum Rao	-	+
Spirogyra condensate Kützing	-	+
Spirogyra fluviatilis Hilse	-	+
Spirogyra weberi Kützing	-	+
Class**: Charophyceae**		
*Chara globulais*Thuiller	+	+
	72	103

+ = present, - = absent

SYSTEMATIC ENUMERATION

Class: **Cyanobacteria,** Order: **Synechococcales,** Family: **Merismopediaceae**

1. **Merismopedia punctata** Meyen, Neu. Sys. Pfla.-Physio., 440, 1839. **(Fig. 2 a)**

Colonies small, 4-64 cells, pale blue green, 60 µm broad, cells not closely packed, cell spherical or ovoid 2.5-3.5 µm broad.

Planktic; site (S1); voucher no. ASL02, date: 05.06.2018.

Order: **Chroococales**, Family: **Chroococcaceae**

2. Chroococcus tenax (Kirchner) Hieronymus, Beit. Biol. Pfla., 5: 483, 1892. **(Fig. 2 b)**

Mostly in colony, colony 2-4 cells, pale blue green,

without sheath 16-21 µm diameter and with sheath 20-26 µm in diameter, sheath yellow to brown, lamellate and very thick.

Planktic; site (S1); voucher no. ASL02, date: 05.06.2018; Site (S6); ASL50, date: 10.05.2019.

3**. Chroococcus turgidus** (Kützing) Nägeli, N. Denks. Allg., 10 (7): 46, 1849. **(Fig. 2 c)**

Cells spherical or ellipsoidal, single or in groups, mostly 2-4 cells, seldom many, colour blue green to olive green, cells without sheath 8-32 µm, with sheath 13-25 µm diameter, sheath colorless and not distinctly lamellate.

Planktic; site (S2); voucher no. ASL06, date: 05.06.2018; site (S3); voucher no. ASL40, date: 10.05.2019.

Order: **Oscillatoriales**, Family: **Oscillatoriaceae**

4. **Phormidium corium** Gomont ex Gomont, Ann. Sc. Nat. Bot., ser. 7, 16: 172, 1892. **(Fig. 2 d)**

Filament straight, net like, thin sheath, bright, blue green, 8-10 µm wide slightly constricted at the cross walls, cells isodiametric 3.4-6.6 µm long, apical cell rounded to conical 10 µm long.

Epilithic; site (S2), voucher no. ASL04, date: 05.06.2018; site (S6); voucher no. ASL20, date: 05.06.2018.

5. **Lyngbya aestuarii** Liebman ex Gomont, Ann. Sc. Nat. Bot., ser. 7, 16: 172, 1892 **(Fig. 2e)**

Filament bluish green, sheath thick, yellowish brown, 24 µm broad, cells granulated, 3.3-5.6 µm long and 13.3 µm broad and cells not constricted at cross wall.

Free floating; site (S1), voucher no. ASL01, date: 05.06.2018.

6. **Lyngbya magnifica** N.L. Gardner, Mem. N. Y. Bot. Gard., 7: 40, 1927. **(Fig. 2 f)**

Trichome rigid, long, blackish green, sheath present, smooth, 2.5 µm thick, cell 34 µm broad and 3.8-5 µm long, apical cell rounded and cells not constricted at the cross walls.

Epilithic; site (S2), voucher no. ASL05, date: 05.06.2018.

7. **Lyngbya majuscula** Harvey ex Gomont, Ann. Sci. Nat. Bot., ser. 7, 16: 131, 1892. **(Fig. 2 g)**

Filament long, trichome rigid, brownish green, sheath thick, yellowish brown, 5 µm thick, cell 30 µm broad and 5 µm long.

Free floating; site (S2); voucher no. ASL07, date: 05.06.2018; site (S6), voucher no. ASL50; date: 10.05.2019.

Order: **Nostocales**, Family: **Nostocaceae**

8. **Anabaena orientalis** S.C. Dixit, Proc. Ind. Acad. Sci., Sec. B,3: 101, 1936**. (Fig. 2 h)**

Thallus mucilaginous, thin-blue-green, trichome 4.2-5 µm broad, apical cell acutely conical; cells barrel shaped as long as shorter than broad: heterocyst sub spherical or oval 6 µm broad and 6-10 µm long spores on both side of the heterocyst.

Epipelic; site (S1); voucher no. ASL03, date: 05.06.2018

Family: **Scytonemataceae**

9. **Scytonema hofmanni** C. Agardh ex Bornet & Flahault, Ann. Sci. Nat. Bot., ser. 5: 97, 1886. **(Fig. 2 i)**

Thallus thick, brownish green, filament false branched, sheath thin, hyaline, 2.5 µm broad, cell sub-quadrate or slightly longer than broad, densely granulated cell 10 µm long and 7 µm broad, heterocyst oblong, 6-12 µm long and 5-9 µm broad.

Epipelic; site (S6): ASL16, date: 05.06.2018.

10**. Scytonema stuposum** Bornet ex Bornet & Flahault, Ann. Sci. Nat. Bot., ser. 5: 92, 1886. **(Fig. 2 j)**

Thallus blackish violet to reddish, false branched, thick sheath, gelatinous, 3.33µm broad, cell 12-15µm broad and 3-5 µm long, cell sub quadrate, heterocyst 14-16 µm broad and 6-6.6 µm long, filament 18-21 µm broad.

Epipelic; site (S6), voucher no. ASL17, date. 05.06.2018

11. **Scytonema tolypothrichoides** Kützing ex Bornet & Flahault, Ann. Sci. Nat. Bot., ser. 5: 100, 1886. **(Fig. 2 k)**

Thallus blue green, filament thick, 15 µm broad, cell broader than long, heterocytous, cell 12- 14 µm broad and 13 -15 µm long.

Epipelic; site (S3), voucher no. ASL08, date: 05.06.2018

Class**: Euglenophyceae,** Order**: Euglenida,** Family**: Euglenaceae**

12. **Euglena spathirbyncha** Skuja, Sym. Bot. Upsa., 9(3): 196, 1948. **(Fig. 2 l)**

Cell spindle shaped, cell terminating by an acute hyaline, tail piece is with tendency to the widening of cells in their middle part, chloroplast numerous, disc shaped, cell 66-85 µm long and 12-20 µm broad

Thin bloom, planktic; site (S2), voucher no. ASL34, date: 10.05.2019

13**. Euglena sociabilis** P.A. Dangeard, Le Bota., 8: 182, 1902. **(Fig. 2 m)**

Cell spindle shaped, rounded at the anterior, gradually tapering to the posterior and passing into short tailpiece, chloroplast about 10 per cell, lobed up to the centre of cell, double-sheathed pyrenoids, 62-87 µm long and 15-27 µm broad.

Thin bloom, planktic; site (S3), voucher no. ASL39, date: 01.05.2019.

14. **Trachelomonas armata** (Ehrenberg) F. Stein, expl. pl. XXIII: figs 37, 38. 1878. **(Fig. 2 n)**

Cell broadly ellipsoidal to oval, thickened around apical pore (6-8 µm in diameter) with toothed, spiny collar; posterior end broadly rounded, wall punctuate long spines 3-10 µm long at posterior end, 30-45 µm long and 29-32 µm broad.

Planktic; site (S1), voucher no. ASL32, date: 10.05.2019.

15. **Phacus longicauda** (Ehrenberg) Dujardin, Hist. Nat. Zooph, 337, 1841. (Family: Phacaceae) **Fig. 2 o)**

Cell broadly oval, pear shaped in outline; anterior end rounded, posterior end straight, gradually tapering to from sharply pointed end, 120-25 µm long and 55-60 µm broad.

Planktic; site (S2), voucher no. ASL38, date: 10.05.2019.

Class: **Bacillariophyceae**

16. **Synedra ulna** var. **amphirhynchus** (Ehrenberg) Grunow, Verh. K. Zool.-Bot. Ges. Wien 12: 397. 1862. (Order: Fragillariales, Family: Fragilariaceace) **(Fig. 2 p)**

Frustules slender, linear, many times longer than broad, 100-250 µm long and 10-12 µm broad, striation distinct, absent at the middle, striae 9-12 in 10 µm.

Planktic; site (S3); voucher no. ASL12, date: 05.06.2018; voucher no. ASL38, date: 10.05.2019.

17. **Diadesmis confervacea** F.T. Kützing, Bacillarien, 152, 1844. (Order: Naviculales; Family: Diadesmidaceae**) (Fig. 2 q)**

Frustules attached end to end to form ribbon shaped structure, cell rectangular, frustules 10-30 µm long and 5-12 µm broad.

Epipelic; site (S1), voucher no. ASL03; date: 05.06.2018.

18. **Navicula gracilis** Ehrenberg, Abh. K. Akad. Wiss. Berlin, 64, 69., 1832. (Order: Naviculaes, Family: Naviculaceae) **(Fig. 2 r)**

Frustules linear, lanceolate, elongate, axial area narrow, central wide, 84-90 µm long and 17- 20 µm broad.

Planktic; site (S6); voucher no. ASl51, date: 10.05.2019

19. **Gomphonema vibrio** Ehrenberg, Abh. K. Akad. Wiss. Berlin, 416, 1843. Order: Cymbellaes, Family: Gomphonemataceae**) (Fig. 2 s)**

Frustules linear, lanceolate, elongated, attenuated to long and sub acute rostrate end, raphae thin, medium striation transverse, parallel, 5-100 µm long and 10-15 µm broad, striae 10-12 in 10 µm.

Planktic; site (S6); voucher no. ASL18, date: 05.06.2018; site (S2); voucher no. ASL34, date: 10.05.2019.

Order: **Bacillariales**, Family: **Bacillariaceae**

20. **Nitzschia obtusa** W. Smith, A Syn. Br. Diat., 1: 39, 1853. **(Fig. 2 t)**

Frustules linear end obliquely truncate, 84-90 µm long and 7-10 µm broad, striation thin, striae 7-15 in 10 µm.

Planktic; site (S5); voucher no. ASL13, date: 05.06.2018.

21. **Nitzschia palea** (Kützing) W. Smith, A Syn. Br. Diat., 2: 89. 1856. **(Fig. 2 u)**

Frustule linear, sub lanceolate, attenuated to subacute apices, 25-70 µm long and 3-8 µm broad, striae 10-12 in 10 µm.

Planktic; site (S6); voucher no. ASL18, date: 05.06.2018.

22. **Nitzschia sigmoidea** (Nitzsch) W. Smith, A Syn. Br. Diat., 1: 38, 1853. **(Fig. 2 v)**

Frustrules linear, sigmoid with rounded end, raphae thin, striae not distinct; 123-130 µm long and 10-14 µm broad.

Planktic; site (S6); voucher no. ASL51, date: 10.05.2019.

Class: **Chlorophyceae**, Order: **Sphaeropleales,** Family: **Selenastraceae**

23. **Akistrodesmus densus** Korshikov, The Fr.-water Alg. Ukr. SSR. V, 300, 1953**. (Fig. 3 a)**

Coenobia multi-celled, cells dense, relatively free, slightly detached from each other, colonies spherical, cells equal in long and broad, cells 50-80 µm long and 25-4 µm broad; coenobia 70-80 µm diameter.

Planktic; site (S2); voucher no. ASL38, date: 10.05.2019.

24. **Kirchneria irregularis** (G.M. Smith) Korshikov, The Fr.-water Alg. Ukr. SSR.V, 319, 1953. **(Fig. 3 b)**

Coenobia 8-16-32 celled, spherical, markedly sigmoid with overlapping ends, chloroplast parietal, cell 20-28 µm long and 3-5 µm broad.

Planktic; site (S4); voucher no. ASL42; date: 10.05.2019.

25. **Coelastrum cambricum** var. **intermedium** (Bohlin) G.S. West, J Linn. Soc. London, Bot. 38:136, 1907 **(Fig. 3 c)**

Colonies spherical and usually 32 cells, green, cell rounded, connected to each other by short gelatinous outstanding projections, cells 13- 21 µm in diameter, colonies 8-108 µm diameter.

Planktic; site (S2); voucher no. ASL38, date: 10.05.2019.

26. **Coelastrum proboscideum** Bohlin in Wittrock, Nordstedt & Lagerheim, no. 1240, 1896. **(Fig. 3d)**

Coenobia more or less pyramidal, 8-16 celled. 40-110µm in diameter, intercellular spaces usually large and polygonal cells truncated and six sided with the lateral sides slightly concaved, cells 6-12 µm diameter.

Planktic; site (S5); voucher no. ASL13, date: 05.06.2018.

27. **Coelastrum reticulatum** (P.A. Dangeard) Senn, Bot. Zeit., Leipzig, 57:66, 1899. **(Fig. 3 e)**

Coenobia spherical, 8-16-32 celled, 30-70 µm diameter cells spherical, enclosed by a gelatinous sheath, cells inter connected by 6-9 long gelatinous processes; chloroplast single, parietal, without pyrenoid; cells 7-15 µm diameter.

Planktic; site (S4); voucher no. ASL42, date: 10.05.2019.

28. **Dimorphococcus lunatus** A. Braun, Alg. Unicell. 44, 1855. **(Fig. 3 f)**

Coenobia 4 celled, arranged alternately in a zigzag fashion, cells are reni-formed and end rounded, cells 9-25 µm long and 4-15 µm broad, colonies up to 50-100 µm diameter.

Planktic; site (S2); voucher no. ASL03, date: 05.06.2018.

29. **Desmodesmus brasilliensis** (Bohlin) E. Hegewald, Algol. Stud. 96:7, 2000. **(Fig. 3 g)**

Coenobia 4 celled, cell cylindrical attenuated apices, longitudinal ridge from pole to pole of the cell, small teeth at the end of each cell, cells 13-15 µm long and 4-6 µm broad.

Planktic; site (S4), voucher no. ASL45, date: 10.05.2019.

30. **Scenedesmus obliquus** (Turpin) Kützing, Linn. 8: 609, 1833. (Family: Selenastraceae) **(Fig. 3 h)**

Coenobia 4 celled, cell arranged in a linear or sub linear series, fusiform with acute or slightly rounded ends, cells10-20 µm long and 2-8 µm broad.

Plankic; site (S3); voucher no. ASL09, date: 05.06.2018.

Family: **Hydrodictyaceae**

31. **Pediastrum duplex** Meyen, Nova. Acta. Phys.-Medi. Acad. Caes. Leop.-Caro. Nat. 14: 772, 1829. **(Fig. 3 i)**

Plant body is a coenobium, having large intercellular spaces, cell are H shaped of the margin, single chloroplast with pyrenoid, green, cells 12-15 µm in diameter.

Planktic; site (S6); voucher no. ASL51, date: 10.05.2019.

32. **Pediastrum duplex** var. **asperum** (A. Braun) Hansgirg, Prod. Alg. Böh. 6 (5): 112. 1855. **(Fig. 3 j)**

Coenobia 16 celled, small lens shaped perforation between cells, inner cells quadrate to angular contract at the central portion of the side wall, outer sides produced into two short truncate processes, 90 µm in diameter, chloroplast single with pyrenoid; cells 8-18 µm in diameter.

Planktic; site (S2); voucher no. ASL06, date: 05.06.2018.

33. **Stauridium tetras** (Ehrenberg) E. Hegewald in Buchheim & al. 2005, J Phycol. 41:1051, 2005. **(Fig. 3 k)**

Coenobia 4 celled, cells deeply lobed, green, outer sides produced into two short truncate processes; chloroplast single with pyrenoid, 8 µm in diameter.

Planktic; site (S4); voucher no. ASL10, date: 05.06.2018.

Order: **Oedogoniales**; Order: **Oedogoniales,** Family: **Oedogoniaceae**

34. **Oedogonium auchitanum** Cooke, Br. Fr.-water Algae 157, 1884. **(Fig. 3 *l*)**

Macrandrous, heterothallic, vegetative cells cylindrical 85-133 µm long and 20-25 µm broad, oogonium single, 40-55 µm long and 40-50 µm broad; oospore globose 30-45 µm long.

Epiphytic; site (S2); voucher no. ASL05, date: 05.06.2018.

35. **Oedogonium brevicingulatum** Jao, Pap. Mich. Acad. Sci. 20: 57, 1935. **(Fig. 3 m)**

Macrandrous, homothallic, vegetative cells cylindrical, 83-133 µm long and 20-25 µm broad, oogonium single 40-55 µm long and 40-50 µm broad; oospore globose, 30-45 µm long.

Epiphytic; site (S6); voucher no. ASL20, date: 05.06.2018.

36. **Oedogonium intermedium** Wittrock ex Hirn, Wittr. & Nordst., Hirn, Acta. Soc. Sci. fenn. 27: 94, 1900. **(Fig. 3 n)**

Macrandrous, homothallic, vegetative cell cylindrical, 35-50 µm long and 15-18 µm broad, oogonium 34-36.6 µm long and 30-33.3 µm broad, antheridial cell 4 µm long and 14 -16 µm broad.

Epiphytic; site (S6); voucher no. ASL20, date: 05.06.2018; site (S3); voucher no. ASL41, date: 10.05.2019.

37. **Oedogonium globosum** Nordstedt ex Hirn, Acta. Soc. Sci. Fen., 27: 94, 1900. **(Fig. 3 o)**

Macrandrous, homothallic, vegetative cells cylindrical, 10-18 µm in diameter 40-75 µm long, oogonia solitary, globose, 35 µm long and 32 µm broad, oospore globose, antheridia10-12 4-6 µm long and µm broad.

Epiphytic; site (S3); voucher no. ASL08, date: 05.06.2018.

38. **Oedogonium hirnii** Gutwinski ex Hirn, Acta. Soc. Sci. Fen., 27: 93, 1900. **(Fig. 3 p)**

Macrandrous, homothallic, vegetative cell 28-60-80 µm long and 7-17 µm broad, oogonia 45-50 µm long and 30-35 µm broad, antheridia 8-11 µm broad and 4-7 µm long in 4 seriate.

Epiphytic or free floating; site (S6); ASL50, date: 10.05.2019.

Order: **Chaetophorales**, Family: **Chaetophoraceae**

39. **Chaetophoropsis pisiformis** (Roth) B. Wen Liu, Qian Xiong, X. Dong Liu, Z. Yu Hu & G. Xiang Liu , J Phycol. 55 (1): 77, 2019 (Published in 2018) **(Fig. 3 q)**

Thallus gelatinous, profusely brunched, both erect and

prostrate system, rhizoids present, chloroplast single, erect system dichotomously branched, cell 15-65 µm long and 4-8 µm broad.

Free floating; site (S2); voucher no. ASL07, date: 05.06.2018.

Class: **Ulvophyceae;** Order: **Cladophorales;** Family: **Cladophoraceae**

40. **Cladophora glomerata** (Linnaeus) Kützing, Phyco. Gena., 1: 266, 1843. **(Fig. 3 r)**

Filament branched, branches making acute angle with the axis, rhizoids present, aseptate, developed from the base of the axis, cell of the main axis 400 -550 µm long and 34 µm broad; cell of the branches 140-175 µm and long 45 µm broad.

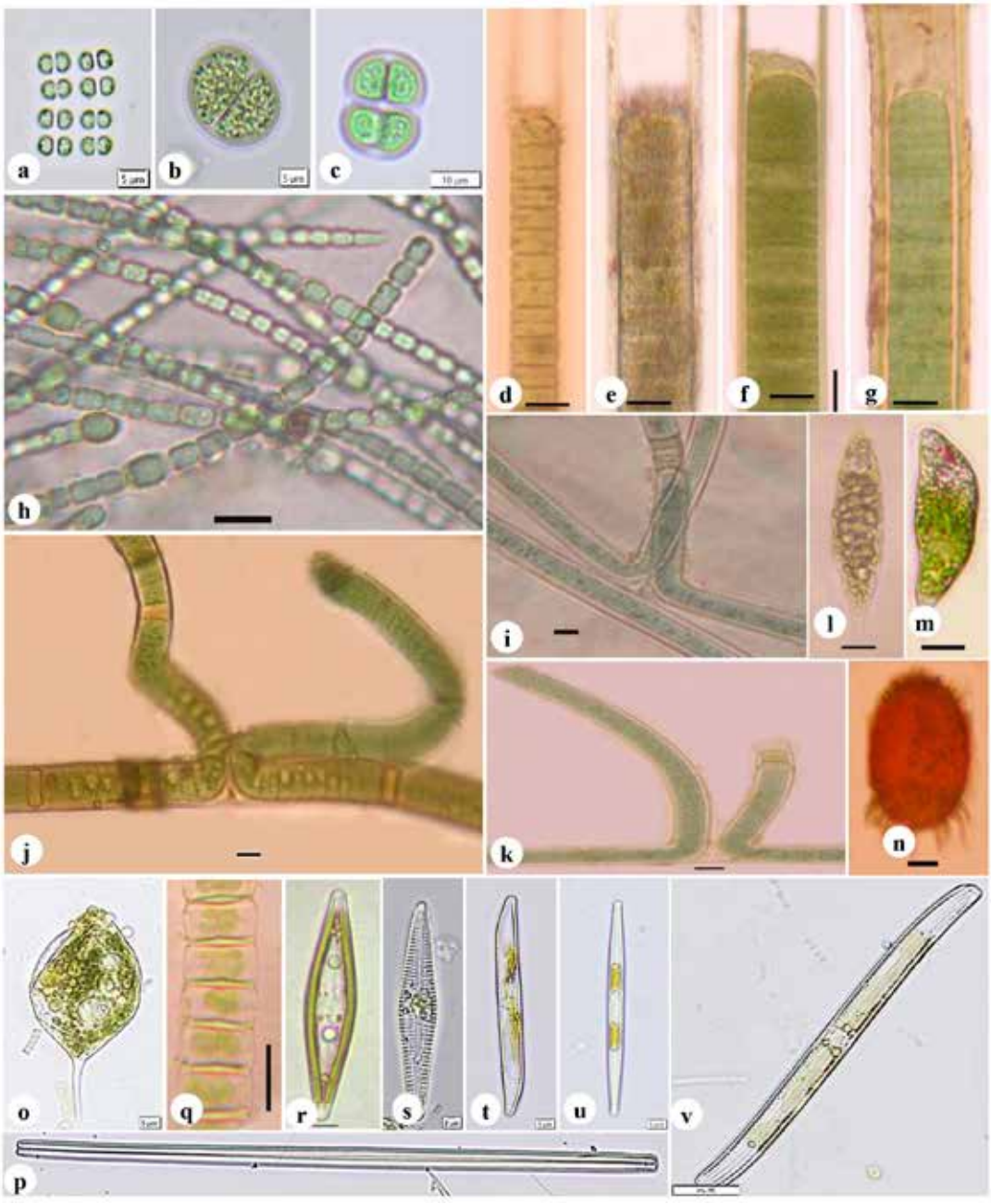

Fig. 2 (a-v): a. *Merismopedia punctata*, **b.** *Chroococcus tenax*, **c.** *Chroococcus turgidus*, **d.** *Phormidium corium*, **e.** *Lyngbya aestuarii*, **f.** *Lyngbya magnifica*, **g**. *Lyngbya majuscula,* **h**. *Anabaena orientalis*, **i**. *Scytonema hofmanni*, **j.** *Scytonema stuposum*, **k.** *Scytonema tolypothrichoides*, **l.** *Euglena spathirbyncha*, **m.** *Euglena sociabilis*, **n.** *Trachelomonas armata*, **o.** *Phacus longicauda*, **p**. *Synedra ulna* var. *amphirhynchus*, **q.** *Diadesmis confervacea*, **r**. *Navicula gracilis*, **s.** *Gomphonema vibrio*, **t.** *Nitzschia obtusa*, **u.** *Nitzschia palea*, **v.** *Nitzschia sigmoidea* (Scale bar: a, b, o, p, s-v =5 µm; c-n, q, r = 10 µm).

Attached to lower surface of boat in water; site (S6); voucher no. ASL17, date: 05.06.2018.

Class: **Trebouxiophyceae,** Order: **Trebouxiales**, Family: **Botryococcaceae**

41. **Botryococcus braunii** Kützing, Sp. Alg., Leipzig, 892, 1849. **(Fig. 3 s)**

Colony free floating, irregular shape, green, without a conspicuous gelatinous envelope, but completely enclosed by a tough, hyaline membrane, cells 6-12 µm long and 3-6 µm broad.

Planktic; site (S2); voucher no. ASL35, date: 10.05.2019.

Order: **Chlorellales**, Family: **Oocystaceae**

42. **Oocystis kumaoensis** K.P. Singh, Curr. Sci. 29 (1): 30.1960. **(Fig. 3 t)**

Cells solitary, broadly ellipsoidal, rounded poles, cell wall thick, chloroplasts about 15, parietal, discoidal with pyrenoid, cell 31.2-35.1 µm long and 19.5-23.4 µm broad.

Planktic; site (S4); voucher no. ASL42, date: 10.05.2019.

Class: **Zygnematophyceae**, Order: **Desmidiales**, Family: **Closteriaceae**

43. **Closterium dianae** var. **pseudodianae** (J. Roy) Willi Krieger, Krypt. -Flora von Deuts., Leipzig, 13(1): 297. 1935. **(Fig. 3 u)**

Cell solitary, curved, central part obtuse, gradually broader, slightly swollen at the middle, cell wall brown, chloroplast single, axial, cell 200-300 µm long,10-15 µm broad at the middle, 5-7 µm broad at the apex.

Planktic; site (S2); ASl38; date: 10.05.2019.

44. **Closterium ehrenbergii** var. **podolicum** Gutwinski, Spra. w. Kom. Fizjo. Akad. Umie. w Krak. 30:81, 1895. **(Fig. 3 v)**.

Cell solitary, moderately curved, gradually attenuated, ventral margin straight at the midregion, the dorsal margin strongly curved; wider at the central part, apex obtuse, 4-5 times longer than broad, cell wall smooth, 450-580 µm long and 90-100-40 µm broad.

Planktic; site (S2); voucher no. ASL06, date: 05.06.2018.

Family: **Desmidiaceae**

45. **Cosmarium angulatum** f. **majus** (Grunow) W.B. Turner, Kungl. Sven. Veten.-Akad. Handl. 25(5): 56, 1893. **(Fig. 3 w)**

Cell solitary, longer than broad, sinus narrow, margin smooth, chloroplast, axial, two pyrenoidsin each semicell, semicell somewhat rounded, 80 µm long and 40 µm broad, isthmus 18 µm.

Planktic; site (S3); voucher no. ASL39, date: 10.05.2019.

46. **Cosmarium arnellii** Boldt, K. Sevenska Vet.-Akad. Förh. 42(2): 107, 1885. **(Fig. 3 x)**

Das & Adhikary, 2014, p. 105, pl. 7, fig. 25.

Cell solitary, green, chloroplast axial, semicell semicircular, sinus deeply constricted, cell 60 65 µm long and 47-50 µm broad, isthmus 20- 25 µm broad.

Planktic; (S5); voucher no. ASL48, date: 10.05.2019.

47. **Cosmarium circulare** Reinsch, Abh. Sen. Nat. Ges. 6(2): 113, 1867. **(Fig. 4 a)**

Cell solitary, green, longer than broad, wall smooth deeply constrictedsemicellsovate, unequal cells 46-53 µm broad and 53- 58 µm long, isthmus 13 µm broad.

Planktic; site (S5); voucher no. ASL14, date: 05.06.2018.

48. **Cosmarium divergens** Krieger, Arch. Hydrobiol., Suppl. 11: 175, 1932. **(Fig. 4 b)**

Cell solitary, green, semicell slightly rectangular, pyrenoid present in each semicell, cell 22-26 µm long and 20-22 µm broad, isthmus 6µm.

Planktic; site (S4); voucher no. ASL43, date: 10.05.2019.

49. **Cosmarium forceps** Brühl & Biswas, Mem. Asia. Soc. Bengal 8(5): 286, 1926. **(Fig. 4 c)**

Cell solitary, front view distinctly broader than long; oblong elliptic to circular in shape; outer margin uniformly curved, deeply constricted sinus much narrower, open outwards with forceps shaped angle, semicell's angles acute, small denticulate, cell wall punctuate, chloroplasts axial, cells 60-80 µm long, 70-85 µm broad, isthmas 40-50 µm broad.

Planktic; site (S6); voucher no. ASL18, date: 05.06.2018.

50. **Cosmarium formosulum** Hoff, Vid. Med. Dan. Nat. Fore. 194, 1888. **(Fig. 4 d)**

Cell slightly longer than broad, deeply constricted, sinus linear, semicells broadly ovate, margin crenate, chloroplast axial, 40-42 µm long and 38-40 µm broad, isthmus 10 µm broad.

Planktic; site (S4); voucher no. ASL11, date: 05.06.2018.

50. **Cosmarium formosulum** Hoff, Vid. Med. Dan. Nat. Fore. 194, 1888. **(Fig. 4 d)**

Cell slightly longer than broad, deeply constricted, sinus linear, semicells broadly ovate, margin crenate, chloroplast axial, 40-42 µm long and 38-40 µm broad, isthmus 10 µm broad.

Planktic; site (S4); voucher no. ASL11, date: 05.06.2018.

51. **Cosmarium lagerheimianum** (W.B. Turner) Biswas, Rec. Bot. Surv. India 15 :65, 1949. **(Fig. 4 e)**

Cell Solitary, green, semicell semicirular, depressed, rotundatus, suface with nymerous ppapillae and papillae are longer than usual and arise from an inflated basemargin toothed, longer then broad, cell 96-120 µm long and 67-70 µm broad, isthmus 35 µm.

Planktic; site (S3); voucher no. ASL39, date: 10.05.2019.

52. **Cosmarium lundellii** var. **ellipticum** West & G.S. West, J Roy. Micr. Soc. 5, 1894. **(Fig. 4 f)**

Cell solitary, green, transversely elliptic, slightly longer than board or almost as long as board; sinus deeply constricted, narrow with dilated apex and slightly open outwards; semicells depressed circular; chloroplast axial; cell wall smooth, cell 45-48 µm long and 40- 45 µm broad, isthmus 20 µm.

Planktic; site (S4); voucher no. ASL45, date: 10.05.2019.

53. **Cosmarium nudum** (W.B.Turner) Gutwinski, Bull. Int. Acad. Sci. Cracovie 39: 594, 1902. **(Fig. 4 g)**

Cell solitary, ovate, wall smooth sinus deep, semicell dolabriform, cell broader than long margin convex to rounded, cell 30 -35 µm long and 33-38 µm broad, isthmus 9 µm broad.

Planktic; voucher no. ASL06, date: 05.06.2018.

54. **Cosmarium porteanum** Archer, Pro. Nat. Hist. Soc. Dublin 3: 49, 1860. **(Fig. 4 h)**

Cell solitary, green, chloroplast axial, semicell semicircular, sinus deeply constricted; cell 60 -65 µm long and 47- 50 µm broad, isthmus 20 µm.

Planktic; site (S5); voucher no. ASL14, date: 05.06.2020.

55. **Cosmarium pseudopyramidatum** P. Lundell, Nova Acta R. Soc. Sc. Upsal. ser. 3, 8(2): 41**,** 1841. **(Fig. 4 i)**

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

Planktic; site (S4); voucher no. ASL12, date: 05.06.2018; site (S2); voucher no. ASL34, date: 10.05.2019.

56. **Cosmarium pyramidatum** Brébission ex Ralfs, Br. Desm. London, 94, 1848. **(Fig. 4 j)**

Cell solitary, longer than broad, truncate, elliptic in out line, deeply constricted, sinus narrow; semicells truncate, pyramidate, basal angles rounded, chloroplast axile and dicentric with 2 pyrenoids in each semicell, 65-70 µm long and 40-45 µm broad, isthmus 16 µm.

Planktic; site (S1); voucher no. ASL31, date: 10.05.2019.

57. **Cosmarium quadrum** var. **sublatum** (Nordstedt) West & G.S. West, Br. Desm. London., 21, 1912. **(Fig. 4 k)**

Cell solitary, green, sinus deeply constricted, semicell quadrate, flatted, cell 63-66 µm long and 50-55 µm broad, isthmus 15 µm.

Planktic; site (S3); voucher no. ASL09, date: 05.06.2018.

58. **Cosmarium tumidum** P. Lundell, Nova Acta R. Soc. Sc. Upsal. ser. 3, 8(2): 45, 1871. **(Fig. 4 l)**

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

Planktic; site (S3); voucher no. ASL09, date: 05.06.2020.

59. **Euastrum ceylanicum** (W. & G.S. West) Krieger, Die Desm., Akad. Verl. Ges, Leipzig, 13 (1): 588, 1937. **(Fig. 4 m)**

Cell solitary, green, slightly longer than broad, constricted sinus; open widely, linear, semicells three lobed, lateral wall with short spine, cells 40- 45 µm long and 35-40 µm broad, isthmus 8 µm.

Planktic; site (S4); voucher no. ASL45, date: 10.05.2019.

60. **Euastrum denticulatum** F**.** Gay, Bul. Soc. Bot. France 31: 335, 1884. **(Fig. 4 n)**

Cell solitary, deeply constricted isthmus, semicelltapoziform, apical margin of polar lobe with u shaped invagination in the middle: cell 25-33 µm long and 20-26 µm broad, isthmus 5-7 µm.

Planktic; site (S6); voucher no. ASL18, date: 05.06.2018.

61. **Euastrum spinulosum** Delponte, Mem. R Acad. Sc. Torino, ser. 2, 28: 97, 1876. **(Fig. 4 o)**

Cell solitary, yellowish green, longer than broad; constricted sinus, broadly rounded to flattened lateral lobes, trapezoid polar tube; cell wall with bigger granules arranged in more or less circular fission; cells 50-55 µm long, 45-50 µm broad, isthmus 9 µm.

Planktic; site (S5); voucher no. ASL48, date: 10.05.2019.

62. **Euastrum stigmosum** W.B. Turner, Kongl. Sv. Vet. Akad. Handlinger 25 (5): 85, 1892. **(Fig. 4 p)**

Cell solitary, green, longer than broad, deeply constricted, sinus narrow, apical angles with stout spine, margin lobed, cell 43-48 µm long, 25-30 µm broad; isthmus 6 µm.

Planktic; site (S3); voucher no. ASL09, date: 05.06.2018.

63. **Staurastrum arctiscon** (Ehrenberg ex Ralfs) P. Lundell, Nova Acta R. Soc. Sc. Upsal. ser. 3, 8(2): 70, 1871. (**Fig. 4 q)**

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.

Planktic; site (S4); voucher no. ASL12, date: 05.06.2018; site (S2); voucher no. ASL34, date: 10.05.2019.

64. **Staurastrum contectum** W.B. Turner, Kongl. Sv. Vet. Akad. Handlingar 25(5):111, 1893. **(Fig. 4 r)**

Cell solitary, green, semicellcuneatae, lateral processes bifid, cell 21-25 µm long and 18-22 µm broad; isthmus 8 µm and processes 3-4 µm long.

Planktic; site (S2); voucher no. ASL34, date: 10.05.2019.

65. **Staurastrum leptocladum** Norsdstedt, Vid. Med. fra Dansk Nat. For. København 21: 228, 1870. **(Fig. 4 s)**

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.

Planktic; site (S3); voucher no. ASL09, date: 05.06.2020.

66. **Staurastrum sebaldi** var. **ornatum** Nordstedt, Lunds Univ. Årsskr. 9 (Afh.II, 10): 34, 1873. **(Fig. 4 t)**

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

Planktic; site (S4); voucher no. ASL12, date: 05.06.2018

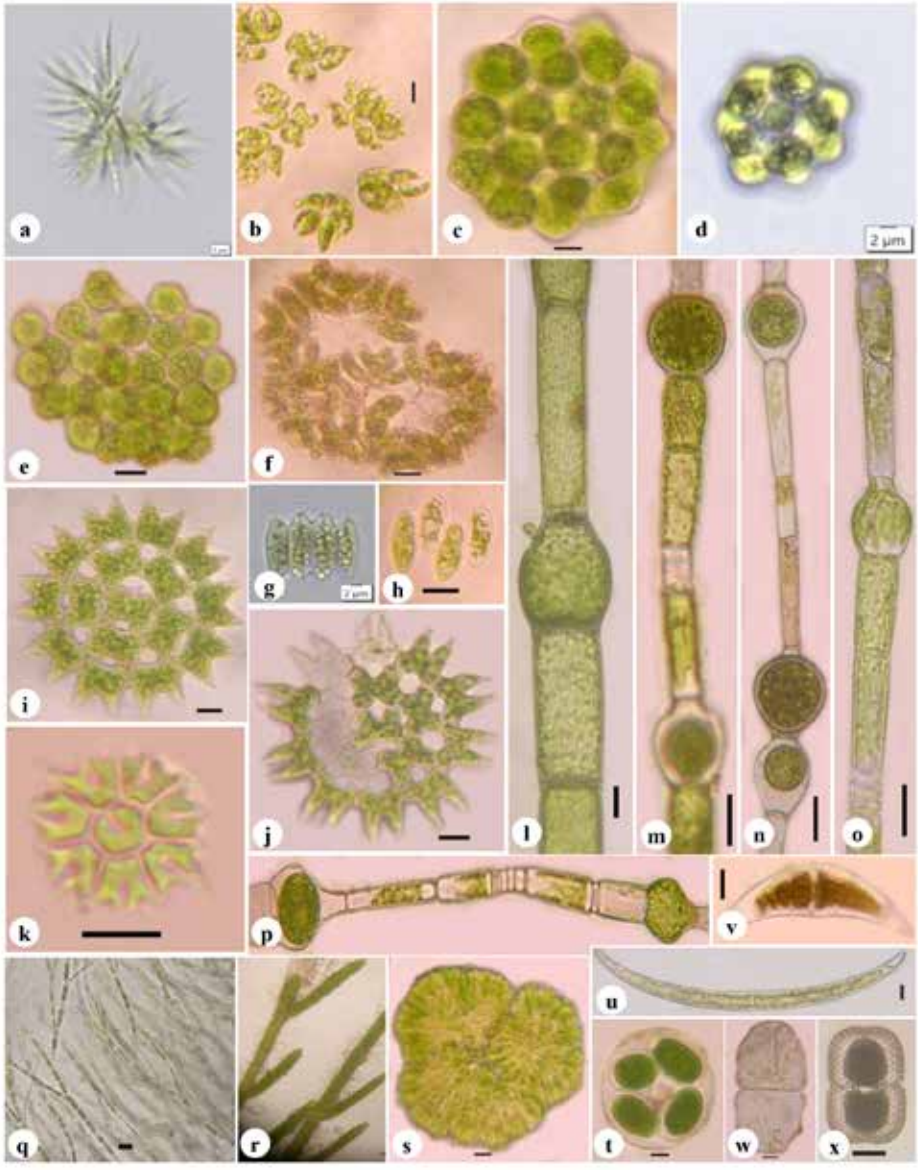

Fig. 3 (a-x): a. *Akistrodesmus densus*, **b.** *Kirchneria irregularis*, **c.** *Coelastrum cambricum* var. i*ntermedium*, **d.** *Coelastrum proboscideum*, **e.** *Coelastrum reticulatum*, **f.** *Dimorphococcus lunatus*, g. *Desmodesmus brasilliensis*, **h.** *Scenedesmus obliquus*, **i.** *Pediastrum duplex*, **j.** *Pediastrum duplex* var. *asperum*, **k.** *Stauridium tetras*, **l.** *Oedogonium auchitanum*, **m.** *Oedogonium brevicingulatum*, **n.** *Oedogonium intermedium*, **o.** *Oedogonium globosum*, **p.** *Oedogonium hirnii*, **q.** *Chaetophoropsis pisiformis* **, r.** *Cladophora glomerata*, **s.** *Botryococcus braunii*, **t.** *Oocystis kumaoensis*, **u.** *Closterium dianae* var. *pseudodianae,* **v**. *Closterium ehrenbergii* var. *podolicum,* **w.** *Cosmarium angulatum* f. *majus*, **x.** *Cosmarium arnellii* (Scale bar: a = 5 µm; d = 2 µm; b, c, e -k, s-x = 10 µm; l-r = 20 µm).

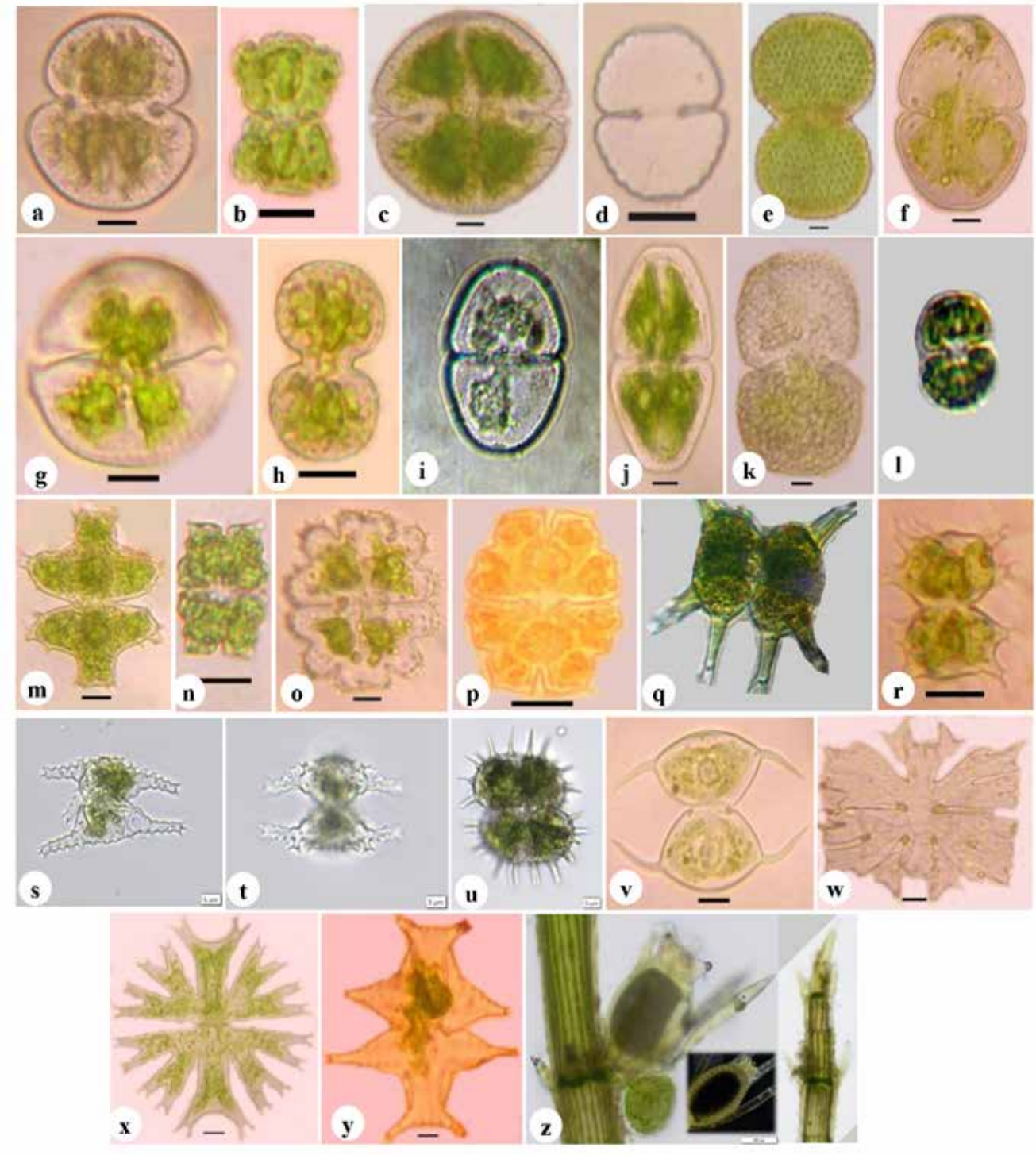

Fig. 4 (a-z): **a**. *Cosmarium circulare*, **b**. *Cosmarium divergens,* **c**. *Cosmarium forceps*, **d**. *Cosmarium formosulum*, **e.** *Cosmarium lagerheimianum*, **f.** *Cosmarium lundellii* var. *ellipticum*, **g**. *Cosmarium nudum*, **h**. *Cosmarium porteanum*, **i.** *Cosmarium pseudopyramidatum*, **j.** *Cosmarium pyramidatum*, **k.** *Cosmarium quadrum* var. *sublatum*, **l.** *Cosmarium tumidum*, **m.** *Euastrum ceylanicum*, **n.** *Euastrum denticulatum*, **o.** *Euastrum spinulosum*, **p.** *Euastrum stigmosum*, **q.** *Staurastrum arctiscon*, **r.** *Staurastrum contectum*, **s.** *Staurastrum leptocladum,* **t.** *Staurastrum sebaldi* var. *ornatum*, **u**. *Xanthidium perissacanthum*, **v**. *Arthrodesmus curvatus* var. *americanus*, **w**. *Micrasterias foliacea*, **x**. *Micrasterias radians*, **y**. *Micrasterias tropica*, **z**. *Chara globulais* (Scale bar: a-y =10 µm; z = 100 µm).

67. **Xanthidium perissacanthum** Scott & Prescott**,** Hydrobiol. 17(1/2): 83, 1961. **(Fig. 4 u)**

Cell large, spines 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.

Planktic; site (S2); voucher no. ASL34, date: 10.05.2019.

68. **Arthrodesmus curvatus** var. **americanus** Scott & Grönblad, Acta Soc. Sc. Fenn., Nova Ser. B 2(8): 25, 1957. **(Fig. 4 v)**

Cell solitary, green, chloroplast axial with pyrenoids, cell wall smooth, lateral processes present on both sides of semicell, 38 µm long and 64 µm broad, isthmus 13 µm.

Planktic; site (S1); voucher no. ASl32, date: 10.05.2019.

69. **Micrasterias foliacea** Bailey ex Ralfs, Br. Desm., 216, 1848. **(Fig. 4 w)**

Cell small, united in filaments by interlocking at polar lobes; outer line rectangular, deeply constricted, sinus narrow, semicells 5 lobed, polar and lateral angles uncinate, lateral lobes asymmetrical, superior lobes divergent, cell wall smooth, cell 60-70 µm long and 63-73 µm broad, isthmus 13-18 µm.

Planktic; site (S3); voucher no. ASL39, date: 10.05.2019.

70. **Micrasterias radians** W.B. Turner, Kongl. Sv. Vet. Akad. Handlingar 25(5): 91, 1893. **(Fig. 4 x)**

Cell sub circular, stelliform, semicells bifid, acuminate ends, cell slightly longer than broad, green, cell wall smooth, cell 100-110 µm long and 90-95 µm broad, isthmus 13.3 µm.

Planktic; site (S5); voucher no. ASL48, date: 10.05.2019; site (S4); voucher no. ASL45, date: 10.05.2019.

71**. Micrasterias tropica** Nordstedt, Desm. Bras. 219, 1870 **(Fig. y)**

Cell deeply constricted, sinus open, semicell 3-lobed, margin of the central portion of the polar lobe sometimes minutely dentate, teeth present, cell longer than board, 100-110 µm long and 90-97 µm broad, isthmus 20 µm.

Planktic; site (S4); voucher no. ASL12, Date: 05.06.2018.

Class: **Charophyceae,** Order: **Charales**; Family: **Characeae**

72. **Chara globulais** Thuiller, Fl. Env. Paris, 2: 472, 1799. **(Fig. 4 z)**

Plant monoecious, moderately stout, 2.5-7.5cm height, stem with long internodes and triplastichouscortication primary and secondary cortical cell equal in diameter, stem with 6-9 leaves, plant monoecious, antheridia and oogonia at the same node and subtended by 2 bracts, oogonia 0.8-0.95 mm long, artheridia 0.5-0.9 mm diameter.

Sub-merged; site (S6); ASL19, date: 05.06.2018, voucher no. ASL51, date: 10.05.2019.

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