J. Mountain Res. P-ISSN: 0974-3030, E-ISSN: 2582-5011 DOI: https://doi.org/10.51220/jmr.v16i3.32
Vol. 16(3), (2021), 341-348

On Some Freshwater Soft Algae from Bhulla Taal Lake Lansdowne, District Pauri Garhwal, Uttarakhand

Rakesh Kumar Dwivedi[1*]
[1]*Department of Botany, B.D. Govt. P.G. College, Jaiharikhal*

Corresponding author Email id: dwivedirakeshji@gmail.com

Received: 4.10.2021; Revised: 12.12.2021; Accepted: 20.12.2021

Abstract: Bhulla taal is a freshwater artificial lake, famous for tourist attraction in Lansdowne city of Pauri Garhwal district of Uttarakhand state, India. The lake is situated on Shivalik range of the Garhwal Himalaya. Morpho-taxonomic identification reveals total 26 freshwater soft algal taxa from the lake belonging to class Cyanophyceae and Chlorophyceae. Taxon *Coenocystis subcylindrica* Korshikov has been reported for the first time from the western Himalayan range.

Keywords: Freshwater algae, Pauri Garhwal, Uttarakhand

Introduction

Mapping of algal diversity in Himalayan region is a mammoth task. Morpho-taxonomic identification of freshwater soft algae is the part of biodiversity inventories. Sporadic reports have been made so far especially regarding freshwater soft algal taxa of Himalayan region. The Lansdowne city is situated at 1780 meter above msl, in Garhwal Himalaya; a part of Shivalik range of Western Himalaya. Bhulla taal, a famous tourist destination of the area, is an artificial small lake maintained by the army cantonment board of the Garhwal Rifles Regiment Centre. The lake has length 140.75 meter, width 62.81 meter and the area ca. 4004.98 m^2. The lake is surrounded by the oak trees. It has inlet of water from northern end and the water goes out of the lake from its southern end and maintains the flow of water though out the year.

Sporadic reports on freshwater soft algae have been done form the Western Himalayan range. From Shivalik range of the Western Himalaya, fresh water soft algae have been reported by Dwivedi et al. (2006, 2008, 2008, 2009, 2014) mainly desmids, chlorococcalean and cyanophycean flora from Himachal Pradesh, from Kumaon region of the Uttarakhand, freshwater soft algae have been reported by Misra et al (2007, 2007) while that of from Garhwal Himalaya has been carried out by Habib (1998, 2001), Shukla et al. (2007, 2008), Misra et al. (2008) and Shukla et al. (2010).

Material and method

Freshwater algal samples were collected by random sampling method during summer seasons in May 2015 from the four different margins of the lake and in the middle of the lake through the boat. Epiphytic forms were collected by careful observations on the submerged plants. The samples were preserved with 4% formalin. Photomicrographs of the studied taxa were clicked by Nikon Labophot- II microscope in Phycology Laboratory of Lucknow University.

Taxonomic enumeration, and dentification of the taxa have been done according to standard monographs of Smith (1933), Tiffany and Britton (1952), Desikachary (1959), Philipose (1967), Gonzalves (1981), Komarek & Fott (1983), Prasad and Misra (1992) and authentic publications on freshwater algae of Prescott, G. W. (1961), da Silva and Felisberto, (2015) and Stastny (2010).

Results and discussion

1. *M. flos-aquae* (Wittr.) Kirchner

(Pl. 1, fig. 3)

Desikachary, T.V. (1959) (Pl. 17, fig. 11, pg. 94)

Cells 3-4 µm in diameter. Colonies roughly spherical, ellipsoidal, or somewhat elongate or often squarish in optical section, not clathrate, with indistinct colonial mucilage; cells spherical, with gas-vacuoles.

Collection no. & date Lans/BT/01, 10/05/2015

2. *Choococcus limneticus* Lemmermann

(Pl. 1, fig. 1)

Desikachary, T.V. (1959) (Pl. 26, fig. 4-5, pg. 107)

Cells without sheath 10 µm in dia., with sheath 14 µm in dia, cells sub-spherical, sheath distinct, unlamellated, colourless, cell contents olive-green.

Collection no. & date Lans/BT/03, 10/05/2015

3. *Merismopedia glauca* (Ehr.) Naegeli

(Pl. 1, fig. 2)

Desikachary, T.V. (1959) (Pl. 29, fig. 5, pg, 155)

Diameter of Cell, 3-4 µm, dia. of colony 10 µm, colony light blue green, almost rectangular with slightly sinuate-crenate margins cells; ovate or hemispherical, present in multiples of four, regularly arranged to form quadrangular colonies. Cell contents blue green homogenous, without granules but each cell have distinct centrally situated gas vacuole, cell wall smooth thick.

Collection no. & date Lans/BT/01, 10/05/2015

4. *O. princeps* Vaucher ex Gomont var. *crassa* Rao

(Pl. 1, fig. 4)

Desikachary, T.V. (1959) (Pl. 39, fig. 11, pg. 206)

Trichome 45 µm broad, 5µ m long, blue-green, more or less brownish, violet or reddish, mostly forming a thallus, mostly straight, not constricted at the cross-walls, blue-green to dirty green, slightly or briefly attenuated at the apices and bent, end cells flatly rounded, slightly capitate without or with slightly thickened membrane.

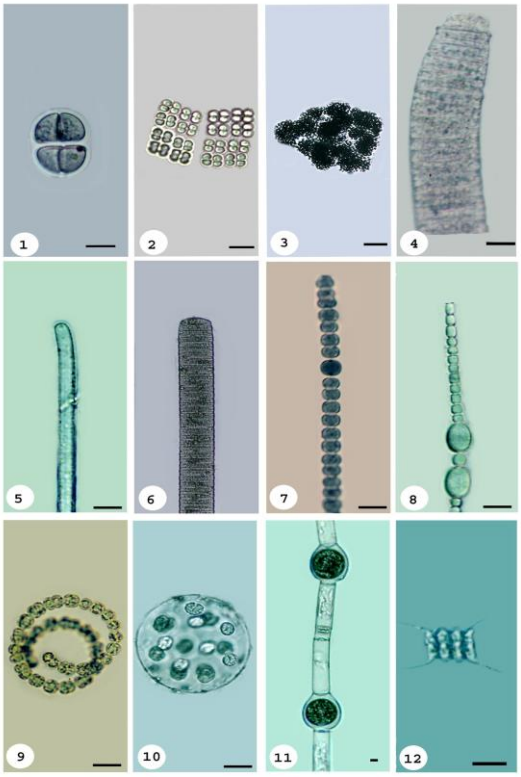
Collection no. & date Lans/BT/01, 10/05/2015

5. *Oscillatoria peronata* f. *attenuata* Skuja

(Pl. 1, fig. 5)

Desikachary, T.V. (1959) (Pl. 41, fig. 14, pg. 205) Trichome 10 µm broad, 3-4 um long.
Trichomes erect and flexuous, apices briefly attenuated and bent or curved, well constricted at the cross walls, 13-15 µm broad, single or aggregated in floccose masses; cells finely granular, septa more or less granulated, end cell humilis depressed hemispherical, calyptra absent.

Collection no. & date Lans/BT/02, 10/05/2015



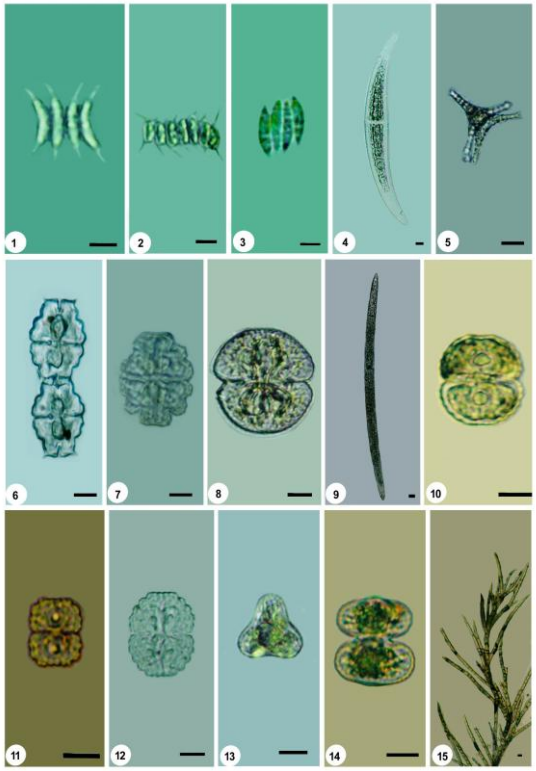


Fig Plate 1 **Fig Plate 2**

Explanation of Plate -1 : 1. *Choococcuslimneticus*Lemmermann, 2. *Merismopedia glauca* (Ehr.) Naegeli, 3. *Microcystis. flos-aquae* (Wittr.) Kirchner, 4. *Oscillatoria princeps*Vaucher ex Gomont var. *crassa* Rao, 5. *O.peronata* f. *attenuata*Skuja, 6. *O. sancta* (Kuetz.) Gomont, 7. *Anabaena macrospora*Klebahm, 8. *A. iyengarii*Bharadwaja, 9. *A. spiroides*Klebahn,10. *Coenocystissubcylindrica*Korshikov, 11. *Oedogonium brevicingulatum* var. *brevicingulatum*Jao, 12. *Scenedesmus tropicus* Crow, All scales are equal to 10 µm

Explanation of Plate -2: 1. *Scenedesmusacuminatus* (Lagerheim) Chodat, 2. *S. longus*Meyen 3. *S. arcuatus* var. *capitatus* G.M. Smith, 4. *Closterium moniliferum* (Bory) Ehrenberg, 5. *Staurastrumneglectum* G.S. West, 6. *Euastrumsinuosum* var. *reductum* West & West 7. *E subornatum* West & West var. *brazilienseBorge*, 8. *Cosmariumobsoletum* (Hantzsch) Reinsch, 9. *Closterium braunii*Reinsch, 10. *Cosmariumawadhense* Prasad & Mehrotra, 11. *C. medioretusum*Coesel, 12. *C. ornatum* Eichler &Gutwinski, 13&14. *Staurastrumlunatum* Ralf, 15. *Stigeoclonium tenue* (Agardh) Kuetzing, All scales are equal to 10 µm except fig. 4, 9 & 15 which are equal to 50µm

6. *O. sancta* (Kuetz.) Gomont

(Pl. 1, fig. 6)

Desikachary, T.V. (1959) (Pl. 42, fig. 10, Pg. 203)

Trichome 2.5 µm long, 11 µm broad, thallus dark green, trichome slightly bent, distinctly

Collection no. & date Lans/BT/02, 10/05/2015

7. *Anabaena macrospora* Klebahm

(Pl. 1, fig. 7)

Prescott, G. W. (1961) (Fig. 4-6, pl. 117, pg. 517)

Cells 7 µm in width, heterocyst 7 µm in width. Trichomes planktonic, straight or flexuous, solitary; cells globose or somewhat ellipsoid, 5-6.5 µm in dia., with abundant pseudo-vacuoles; heterocyst spherical about 6 µm in diameter, spores not adjoining the heterocyst.

Collection no. & date Lans/BT/01, 10/05/2015

8. *A. iyengarii* Bharadwaja

(Pl. 1, fig. 8)

Desikachary, T.V. (1959) (Pl. 76, fig. 1, pg. 406)

Cells 5-6 µm in width, heterocyst 7 µm in width, spores 8 µm in width and 10-11 µm in length, trichome single, cell barrel shaped, slightly longer than the broad, end cells with rounded apex, heterocyst spherical, spores ellipsoidal on either side of the heterocyst. Epispore thick and smooth.

Collection no. & date Lans/BT/04, 10/05/2015

9. *A. spiroides* Klebahn

(Pl. 1, fig. 9)

Desikachary, T.V. (1959) (Pl. 71, fig. 9, pg. 395)

Cells 7-8 µm broad

Trichome free floating, single, regularly spirally coiled, spirals 45-55 µm broad, cells spherical with distinct gas vacuoles.

Collection no. & date Lans/BT/01, 10/05/2015

10. *Coenocystis subcylindrica* Korshikov

(Pl. 1. Fig. 10)

Komárek and Fott (1983) (Tafel 124, fig 1, pg. 411)

Colonies are spherical, oval, slightly irregular or several sub-colonies, arranged parallel in 1 or 2 planes, slightly irregularly, with a distance from each other. Cells are widely ovoid or sometimes slightly asymmetrical shape. Chloroplast is parietal, massive, without pyrenoid. Cells are 5−7 µm in length and 3-5 µm in width.

Collection no. & date Lans/BT/01, 10/05/2015

11. *Oedogonium brevicingulatum* var. *brevicingulatum* Jao

(Pl. 1 fig. 11)

Gonzolves (1982) (Fig. 9.22A, pg.159)

Macrandrous, homothallic, vegetative cells cylindric 32 µm broad, basal cell short, oogonium single, obovoid, 51 µm in diameter, poriferous, pore superior, oospore globose not filling the oogonium, spore wall smooth

Collection no. & date Lans/BT/02, 10/05/2015

12. *Scenedesmus tropicus* Crow

(Pl. 1 fig. 12)

Philipose (1967) (Fig. 185, pg. 279)

Colony 4-celled, subquadrate, cells more or less biconvex in middle attenuated towards apex with inflated poles. Poles of terminal cells provided with long recurved spine. Chloroplast parietal with a large single pyrenoid. Cells 15 µm long, 4-6 µm broad, spines 12 µm long.

Collection no. & date Lans/BT/03, 10/05/2015

13. *S. acuminatus* (Lagerheim) Chodat

(Pl. 2 fig. 1)

Philipose, M.T. (1967) (Fig 161a, pg. 251)

Cell 20 µm long, 4 µm broad. Colonies curved and of 4-8 fusiform cells with sharp pointed ends. All the cells in a colony lunate or the interior cells forming a flat plate.

Collection no. & date Lans/BT/04, 10/05/2015

14. *S. longus* Meyen

(Pl. 2 fig. 2)

Philipose, M.T. (1967) (Fig 180a, pg. 273)

Colony flat, eight cells arranged in a single linear siries, cells oblong cylindrical with rounded poles. Poles with 2 spines at each end. Cell 8-10 µm long, 4-5 µm broad, spines 8-12 µm long.

Collection no. & date Lans/BT/04, 10/05/2015

15. *S. arcuatus* var. *capitatus* G.M. Smith

(Pl. 2. Fig. 3)

Philipose, M.T. (1967) (Fig 166k, pg. 257)

Colony curved, 4 celled, in sublinear series. Cells slightly curved with one side convex and other slightly concave. End of cells stumpy with nodular thickenings. Cells 5 µm broad, 12-15 µm long.

Collection no. & date Lans/BT/01, 10/05/2015

16. *Closterium moniliferum* (Bory) Ehrenberg

(Pl. 2. Fig. 4)

Tiffany L.H. & Britton, M.E. (1992) (Pl. 52, fig. 549, pg. 172)

Cell 305 µm long, 46 µm broad, and apex 6 µm. Cell stout, moderately curved, inner margin inflated in the middle, cell uniformly narrowed with rounded apex. Cell wall smooth, chloroplast with 6 ridges with pyrenoids and vacuoles.

Collection no. & date Lans/BT/03, 10/05/2015

17. *Staurastrum neglectum* G.S. West

(Pl. 2. Fig. 5)

Coesel, P.F.M. & Meesters, K.J. 2013. (Pl. 95: 1-3, pg. 124)

Body of semi-cell in apical view is triradiate, cell 20 µm in length twisted at isthmus, processes ornamented, end of the processes tipped with minute spines.

Collection no. & date Lans/BT/03, 10/05/2015

18. *Euastrum sinuosum* var. *reductum* West & West

(Pl. 2, fig. 6)

Prasad & Misra 1992. (Pl 19, fig. 2, pg. 135)

Cells small, 1.7 times longer than broad, deeply constricted, sinus narrowly linear with dilated extremity, lateral lobes bilobulate and less prominent, polar lobe quadrate oblong with deep median incision, punctation on cell wall not seen. Cell 40 µm, in length, width 21 µm, isthmus 5 µm.

Collection no. & date Lans/BT/03, 10/05/2015

19. *E subornatum* West & West var. *braziliense* Borge

(Pl.2 fig 7)

da Silva F.K.L. & Felisberto, S.A. (2015) (fig. 2j)

Cell slightly longer than wide, 40 x 30 µm isthmus 8 µm with median constriction, central linear sine, fully open, opening to the isthmus; trapezoidal semicell, lateral lobes rounded; slightly truncated polar lobe; semicell with tumescence in the midline of the lateral lobes formed by a single ring of granules; cell wall ornate with granules.

Collection no. & date Lans/BT/04, 10/05/2015

20. *Cosmarium obsoletum* (Hantzsch) Reinsch

(Pl. 2. Fig 8)

Prasad & Misra 1992. (Pl. 22. Fig. 16 pg. 170)

Cell 58 µm long, 65 µm broad, and isthmus 20 µm, transversely elliptic, slightly broader than the long, deeply constricted, sinus narrow with dilated apex and slightly open outwards, cell wall punctate, chloroplast axile with two pyrenoids in each semicells.

Collection no. & date Lans/BT/04, 10/05/2015

21. *Closterium braunii* Reinsch

(Pl. 2 fig. 9)

Tiffany & Britton (1952) (Pl. 51, fig. 541, pg. 176)

Cell 720 µm long, 40 µm broad, apex 8 µm. wall yellowish and very finely striate, becoming brown at poles which are punctate.

Collection no. & date Lans/BT/03, 10/05/2015

22. *Cosmarium awadhense* Prasad & Mehrotra

(Pl. 2, fig. 10)

Prasad & Misra (1992) (Pl. 21, fig. 27, pg. 153)

Cell 26 µm long, 18 µm broad, isthmus 14 µm. cell small, slightly longer than broad, sinus narrowly linear toward apex and slightly open, semicells sub-semicircular, apex truncate with more or less straight margin, each semicell with one large chloroplast and one pyrenoid.

Collection no. & date Lans/BT/04, 10/05/2015

23. *C. medioretusum* Coesel

(Pl. 2. Fig. 11)

Stastny (2010) (fig. 166)

Cell small, 18 µm long, 12 µm broad, isthmus 6 µm, apex of semicells flattened, margin crenated, chloroplast with one pyrenoid.

Collection no. & date Lans/BT/04, 10/05/2015

24. *C. ornatum* Eichler & Gutwinski

(Pl. 2. Fig. 12)

Prescott et.al. (1981) (Pl. 256, Fig. 6, pg. 239)

Cell medium sized, slightly longer than the borad, length 34 µm, width 28 µm, isthmus 15 µm, semicell with narrow sinus opening, chloroplast with two pyrenoids in each semicell.

Collection no. & date Lans/BT/02, 10/05/2015

25 & 26. *Staurastrum lunatum* Ralf

(Pl. 2 fig. 13, 14)

Prescott (1940) (Pl II, Fig. 20-21, pg. 9)

Length 26 µm, width with processes 29 µm, isthmus 10 µm

Collection no. & date Lans/BT/02, 10/05/2015

27. *Stigeoclonium tenue* (Agardh) Kuetzing

(Pl. 2 fig. 15)

Tiffany & Britton (1952) (Pl 10, fig. 70, pg. 34)

Cell 7-10 µm long, and 5-8 µm broad, branches more often opposite, some always solitary, tuft bright green.

Collection no. & date Lans/BT/02, 10/05/2015

Out of total 26 taxa reported from the Bhulla lake, the taxon *Coenocystis subcylindrica* Korshikov has been reported for the first time from the western Himalayan range.

Acknowledgement

Author is thankful to the Head, Department of Botany, University of Lucknow for providing the facilities of microphotography and literature.

References

Brook A.J (1992). Desmids of the *Staurastrum tetracerum*-group from a eutrophic lake in mid-wales. *Brit. Phycol. J.*17. 259-274

da Silva F.K.L. & Felisberto, S.A. (2015) Euastrum and Micrasterias (family Desmidiaceae) in lentic tropical ecosystem, Brazil. *Biota Neotropica*. 15(1): 1-12.

Desikachary TV (1959). Cyanophyta. I.C.A.R. Monograph on algae, New Delhi. 686p.

Dwivedi RK, Misra PK, Shukla CP, Tripathi SK (2008). On some Desmids from

Southern Himachal Pradesh of Western Himalaya and its foothills. *Phytotaxonomy*. 8: pg 83-86.

Dwivedi RK, Shukla SK. Shukla CP, Misra PK, Seth MK (2008). Cyanophycean algal flora of Southern Himachal Pradesh, India. *Ecoprint*. 15: 29-36 pp.

Dwivedi RK, Shukla CP, Misra P.K., Shukla SK., Seth M.K. (2009) On some freshwater desmids from Southern Himachal Pradesh of Indo-Western Himalaya. *Feddes Repertorium*. 123: 3-4, pp. 236-249.

Dwivedi R.K. & Misra P.K. (2013). On the occurrence of three new taxa of freshwater algae *Lagerheimia* Chodat from Indo-western Himalaya. *Phykos*. 43(1). 46-50.

Dwivedi R.K. & Misra P.K. (2014). On some freshwater algae of district Una, Himachal Pradesh, India. *Phytotaxonomy*. 14. 103-106.

Gonzalves, E.A. (1982) Oedogoniales, I.C.A.R. monograph on algae. New Delhi. 757p.

Habib, I. Ghildiyal, J.C., Negi, C. and Chaturvedi, U.K. (1998). A systematic account of Chlorococcales from Kotdwar, Garhwal. *Phykos* 31 (1-2): 125-129.

Habib I (2001). A preliminary study on certain algal flora from the foothills zone of Garhwal Himalaya. *J. of Econ. and Taxon. Bot.* 25(2): 317-322.

Komárek J, Fott B (1983) Das Phytoplankton des Süsswasers. Stuttgart. Germany. 1-1044.Misra, P.K., Rai, A.K., Chauhan, R.S. and Shukla, S.K. (2007a). Algal flora of Naukuchia Tal, Nainital district, Uttaranchal state. *J. of Ind. Bot. Soc.* 86(1&2): 71-77.

Misra PK, Rai AK, Shukla SK (2007). Some fresh water desmids from Kumaon Himalaya. *J. of App. Biosciences*, 33(1): 53-58.

Misra PK, Misra ., Shukla, M., and Prakash, J. (2008) Some desmids from Garhwal region of Uttarakhand, India. *Algae*. 23(3): 177-186.

Shukla SK, Shukla CP, Misra PK (2008). Desmids (Chlorophyceae, Conjugales, Desmidiaceae) from foothills of Western Himalaya, India. *Algae*, 23(1): 1-14.

Shukla Chandra Prakash, Singh DB, Shukla SK, Misra PK (2010). Studies on Cyanophycean Algae of Garhwal Region of Uttarakhand State. *Res. Dimension*. 1; 12-17.

Philipose, M.T. (1967). Chlorococcales, I.C.A.R. Monograph on algae. New Delhi. 365p.

Tiffany LH, Britton ME (1952). The algae of Illinois. Hafner publishing Co., New York. 407p.

Prasad B.N. and Mishra P.K. (1992) Monograph on fresh water algal flora of Andman and Nicobar islands. Vol.2. Bisen Singh, Mahendra Pal Singh, Dehradun, 284pp.

Smith GM (1933). The fresh water algae of the United States, McGraw-Hill Book Company Inc., New York, 716p.

Statsny J (2010). Desmids (Conjugatophyceae, Viridiplantae) from the Czech Republic; new and rare taxa, distribution, ecology. *Fottea*. 10(1), 1-74.