

## Algal flora of the river Bhadra at the outlet of Bhadra Dam, Shivamogga.

Rajeshwari M. S. and Krishnamurthy S. R.\*

Department of Applied Botany, Kuvempu University, Karnataka, India 577451.

\*Author for correspondence – email: srk\_sampa2005@rediffmail.com

### Abstract

Taxonomic survey of fresh water algae on lotic system of river Bhadra in and around Bhadra Dam site were carried out between 2012 and 2013. The qualitative analysis of algae have revealed the presence of 44 taxa belong to 26 genera respectively. The members of Bacillariophyceae are the dominating group which is followed by Chlorophyceae and Cynophyceae. The systematic and the morphological features are appended.

**Key word:** Bacillariophyceae, Bhadra river, Chlorophyceae, Cynophyceae, Lotic system, Benthic, Reservoir

### Introduction

The river Bhadra is one of the important tributary of Tunga-Bhadra which is also an important tributary of river Krishna, the river Bhadra is a perennial south west flowing river of south India about 2/3 portion of the river flow in the mountain region of the Western Ghats and remaining 1/3 portion flows in the plain region. The phycological studies of river Bhadra is very limited (David 1957 and Krishnaswamy 2006). However David (1957) studied and emphasized the Importance of algae in general and diatom in particular to assess the pollution load of river Bhadra at Bhadravathi, David (1957) used phycological character as one of the tool to assess the water quality of lotic ecosystem, in addition Krishnaswamy (2006) reported the filamentous algae in initial reaches of river. The other investigators (Shekhar 2008, Suresh 2011) were also studied algal of river Bhadra and attempted to correlate algal periodicity with various physical and chemical factor

### Materials and Methods

The River Bhadra originates in the Gangamoola of the Western Ghats and flows towards eastern side of peninsular India. Having joined river Tunga at Koodli flows in the name of Tungabhadra and finally joins the river Krishna, which flows into Bay of Bengal. The Bhadra river catchment area is 147 km sq and located between 13°25' to 13°50' latitude and 75°15' to 75°50' longitude the entire catchment area is located in the central part of the Western Ghats except a few kilometer which flows in the semi-dry lands of eastern part of Karnataka. The algal samples were collected at B.R. Project of Bhadra river outlet. The river bed is rocky with sparsely distributed aquatic vegetation. The pools of the river bed facilitate the growth of algae.

The algal samples were collected by modified methods of Blum (1957) and Venkateswarlu (1986). The cleaning of fresh water diatom is done by Brun's method of Sorade & Kamath 1984. The cleaned and preserved material was used for frequency measurements and species identification. Collected sample were observed using a microscope and taxonomic identification done systematically (Adoni 1985, Sorade & Kamath 1984, Desikachary.T.V.1957, Prasad and Misra 1992, S.G.Barthi and G.R.Hegde 1982).

### Results

The algal samples collected and identified are given in Table 1. A total of 44 taxa which belong to 26 genera are described.

### Description of the taxa:

**1. *Merismopedia punctata* Meyen.** (Plate 1, fig. 1)  
Desikachary, T.V. (1959) (Pg. 155)

Colonies small, 4-64 cells, about 60 µ broad; cells not closely packed, spherical 2.5 -3.5 µ broad, pale green.

Collection site: Freshwater near dam site of Bhadra, lakavalli, Karnataka, Date: 27-9-2012

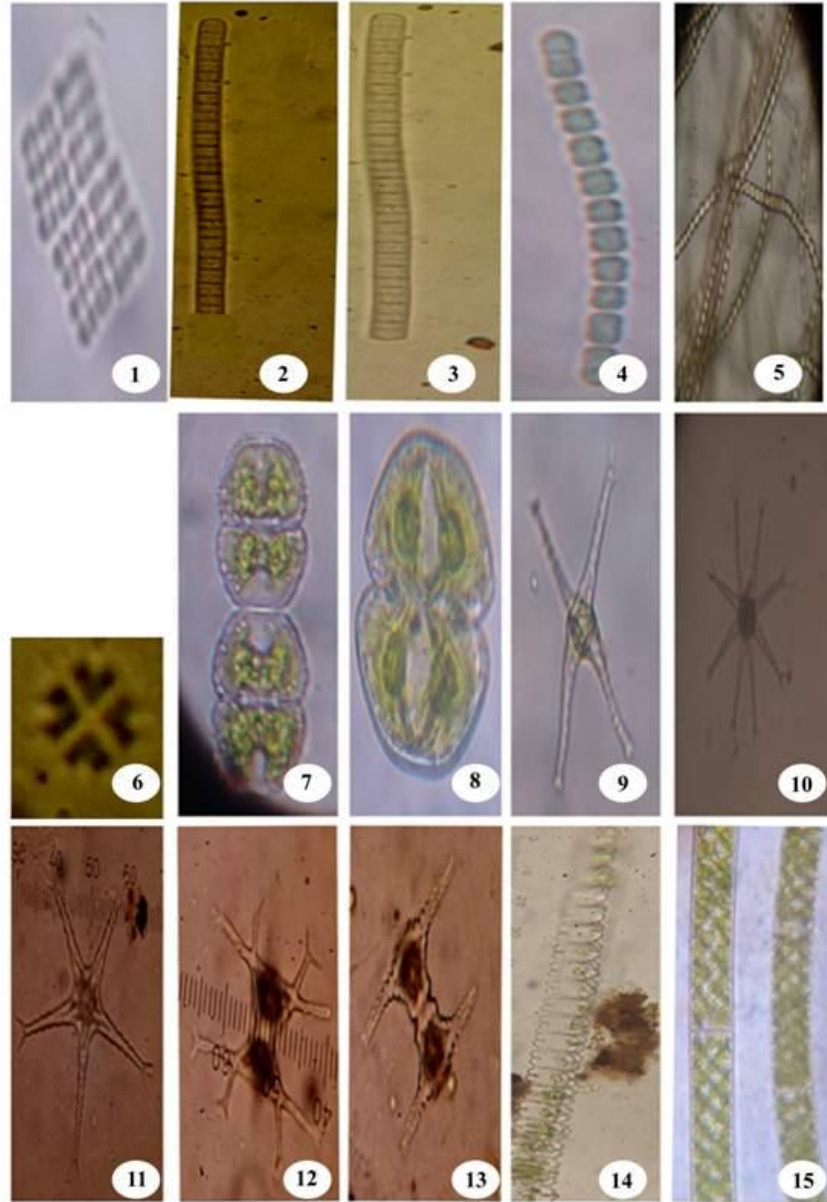


Figure 2, 3, 5, 6, 14, 15 = 10 X and Figure 1, 4, 7, 8, 9, 10, 11, 12, 13 = 40X .

**PLATE 1.**

1. *Merismopedia punctata* Meyen., 2. *Oscillatoria subbrevis* Schmide., 3. *Oscillatoria ornate* Var. *crassa* Rao, C.B. 4. *Nostoc muscorum* Ag. ex Born. et. Flah., 5. *Anabaena circinalis* Var. *crassa* Ghose., 6. *Pediastrum tetras* (Ehrenberg) Ralfs 1844, 7. *Cosmarium subalatum* West & West., 8. *Cosmarium nitidulum* De Not., 9. *Staurastrum smithii* (G.M. Smith) Teli., 10. *Staurastrum ophiura* LUNDSELL., 11. *Staurastrum pinnatum* Turn. var. *reductum* krieg., 12. *Staurastrum rosei* playf., 13. *Staurastrum subsaltans* W. & G.S. West var. *indonesianum* Scott & Prescott., 14. *Desmidiium* sp. 15. *Spirogyra notabilis* Taft

Figure 2, 3, 5, 6, 14, 15 = 10 X and Figure 1, 4, 7, 8, 9, 10, 11, 12, 13 = 40X .

**2. *Oscillatoria subbrevis* Schmide** (Plate 1, fig. 2)

Desikachary, T.V. (1959) (Pg. 207)

Trichome single, 5-6  $\mu$  Broad, nearly straight, not attenuated at the apices; cells 1-2  $\mu$  Long, not granulated at the cross-walls; end-cell rounded, calyptras absent.

Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 27-9-2012

**3. *Oscillatoria ornate* Var. *crassa* Rao, C.B.** (Plate 1, fig. 3)

Desikachary, T.V. (1959) (Pg.206)

Thallus dark blue-green; trichome straight, of uniform thickness 11-15  $\mu$  broad, constricted at the cross walls, cross-walls granulated; cells shorter than broad, 2-5.5  $\mu$ ; end cell convex without calyptras, not capitates.

Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 27-9-2012

**4. *Nostoc muscorum* Ag. ex Born. et Flah.** (Plate 1, fig 4)

Desikachary, T.V. (1959) (Pg. 385)

Thallus gelatinous-membranous, irregularly expanded, attached by the lower surface, tuberculate, 2-5cm diam.; filaments densely entangled; sheath distinct only at the periphery of the thallus, trichome 3-4  $\mu$  broad; cells short barrel shaped to cylindrical.

Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 27-9-2012

**5. *Anabaena circinalis* var. *crassa* Ghose.** (Plate I, fig. 5)

Desikachary, T.V. (1959) (Pg. 414)

Trichomes free-swimming, single, semi-circular, loosely coiled up to 4 times; cells nearly spherical, but generally shorter than broad, 5-7  $\mu$  in diameter, with pseudovacuoles; heterocyst globose, up to 8  $\mu$  broad; spores not seen.

Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 27-9-2012

**6. *Pediastrum tetras* (Ehrenberg) Ralfs** (Plate 1, fig. 6)

Rai, S.K and P.K. Misra .2012. fig 2 (Pg. 172)

Colonies rectangular, oval or circular, of 4- 8-16 celled, without intercellular spaces; marginal cells divided into two lobes by a deep linear to cuneate incision on the outer side reaching to the middle of the cell; each lobe truncate, slightly emarginated or further divided into two lobes; inner cells 4-6 sided with a single linear incision; colonies 12-16  $\mu$ m in diameter; cells 5-15  $\mu$ m in diameter.

Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 27-9-2012

**7. *Cosmarium subalatum* West & West** ( Plate 1, fig 7)

Prasad and Misra 1992, p. 85, pl. 24, fig. 22.

Cell 34.0  $\mu$ m long, 28.0  $\mu$ m broad and isthmus 8.0  $\mu$ m. Cells small, slightly longer than broad, deeply constricted, sinus narrowly linear; semicells widely truncate to pyramidal, sides tricinate, angles rounded, apex with two small crenations (excluding apical angles), crenations

bigranulate, central tumour rounded with 7 granules arranged in circular fashion; top-view elliptic; chloroplast axile with one pyrenoid in each semicell.

Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 27-9-2012

**8. *Cosmarium nitidulum* De Not.** ( Plate 1, fig 8 )

Prasad and Misra 1992, p. 168, pl. 22, fig. 21.

Cell 37.0 µm long, 27.0 µm broad and isthmus 10.0 µm. Cell small, slightly longer than broad, deeply constricted, sinus narrowly linear with slightly dilated apex, semi cells truncate-sub semicircular, tapering evenly from rounded basal angles to flattened apex with straight margin;

cell wall minutely punctuate, top-view elliptic; chloroplast monocentric with one pyrenoid.

Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 27-9-2012

**9. *Staurastrum smithii* (G.M.smith)Teli.**(Plate I, fig 9 )

S.G.Barthi and G.R.Hegde 1982:pl.1,figs.5,p.45

Differs from the type by narrower isthmus and shorter length. 4 divergent arms;chloroplast axial;pyrenoids one to many.

Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 27-9-2012

**10.*Staurastrum ophiura* LUNDELL** (Plate I, fig.11)

Peter F. M. Coesel and Lothar Krienitz 2008: fig.26 (Pg.386)

Cell strongly compressed, bilaterally or radially symmetrical; deeply constricted with acute-angled sinus;cell wall smooth or ornamented; apex of semicells extended into 8 divergent arms; chloroplast axial;pyrenoids one to many

Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 28-10-2012

**11. *Staurastrum pinnatum* Turn.var.*reductum krieg*** (Plate I, fig.11)

S.G.Barthi and G.R.Hegde 1982:pl.3,figs.1,p.35

Cell strongly compressed, bilaterally or radially symmetrical; deeply constricted with acute-angled sinus;cell wall smooth or ornamented; apex of semicells extended into 5 divergent arms;chloroplast axial;pyrenoids one to many.

Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 28-10-2012

**12.*Staurastrum rosei* playf.** (Plate I, fig.12)

S.G.Barthi and G.R.Hegde 1982:pl.8,figs.4,p.40

Cell strongly compressed, bilaterally or radially symmetrical; deeply constricted with acute-angled sinus;cell wall smooth or ornamented; apex of semicells extended into 8 divergent arms;chloroplast axial;pyrenoids one to many.

Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 28-10-2012

**13.*Staurastrum subsaltans* W & G.S. West var.*indonesianum* Scott & Prescott.**(Plate I, fig.13)

S.G.Barthi and G.R.Hegde 1982:pl.13,figs.5,p.46

Cell strongly compressed, bilaterally or radially symmetrical; deeply constricted with acute-angled sinus;cell wall smooth or ornamented; apex of semicells extended into 4 divergent arms;chloroplast axial;pyrenoids one to many.

Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 28-10-2012

**14. *Desmidium* sp.** (Plate I, fig no: 14 )

Adoni.A.D.(1985) (Pg.103)

Filaments unbranched, spirally twisted in gelatinous envelopes; cells broader than long, triangular or quadrangular in vertical view, without deep median constriction; cell wall smooth; chloroplast axial, with a lobe (deeply incised) and pyrenoid in each angle of a semicell.

Collection site: Freshwater near dam site of Bhadra, lakavalli, Karnataka, Date: 28-10-2012

**15. *Spirogyra notabilis* Taft** (Plate 1, fig.15)

Rosalina Stancheva *et.al* (2013) pl.6, fig.f (Pg.599)

Vegetative cells 33–35  $\mu\text{m}$  wide, 100–309  $\mu\text{m}$  long, transverse walls plane; chloroplasts 2–4 per cell; multicellular branched rhizoidal outgrowths present. Conjugation scalariform, tubes formed by both gametangia; cell wall thickened at conjugation. Fertile receptive gametangia enlarged near the zygospore, nearly cylindrical and slightly bent on the outer side

Collection site: Freshwater near dam site of Bhadra, lakavalli, Karnataka, Date: 28-10-2012

**16. *Spirogyra borgeana* Transeau** (Plate 2, fig 1)

Rosalina Stancheva *et.al* (2013) pl-3, fig.A (Pg.594)

Vegetative cells 26–33  $\mu\text{m}$  wide, 58–331  $\mu\text{m}$  long; transverse walls plane; chloroplast one or two per cell. Conjugation scalariform, tubes formed by both gametangia; fertile gametangia inflated on the outer side. Zygospores ellipsoid, 29–369 39–64  $\mu\text{m}$  or sometimes spherical with diameter 33–40  $\mu\text{m}$ , mesospore yellow-brown, smooth.

Collection site: Freshwater near dam site of Bhadra, lakavalli, Karnataka, Date: 28-10-2012

**17. *Zygnema fanicum*** (Plate 2, fig 2)

Zarina.A and Mustafa Shameel 2006, fig.3. (pg.427)

Unbranched filaments of short or long cylindrical cells; chloroplast two, stellate, each with a central pyrenoid; gametangia not filled with gelatinous material after zygote formation; zygospore either in the conjugation tube or in one of the gametangium. Cytological features: Vegetative cells 30–34  $\mu\text{m}$  broad and 51–69  $\mu\text{m}$  long; cells contain stellate chloroplasts with several long lobes

Collection site: Freshwater near dam site of Bhadra, lakavalli, Karnataka, Date: 28-10-2012

**18. *Melosia islandica* O.Muell** (Plate 2, fig 3)

Sarode.P.T.(1984) (Pg.19)

Cell cylindrical, united into long filaments; valves circular without marginal teeth, flat and frustules 6.7–7.3  $\mu\text{m}$  in diameter, rows of areoles straight 10–11 in 10  $\mu\text{m}$ .

Collection site: Freshwater near dam site of Bhadra, lakavalli, Karnataka, Date: 28-10-2012

**19. *Fragilaria construens* (Ehr.) Grun. var. *venter.f pusilla*** (Plate 2, Fig.4)

Sarode.P.T. & Kamat.N.D (1984) (Pg.26)

Cell rectangular in girdle view and usually united in free floating, frustules linear, attached together to form chain valves 12–14.5  $\mu\text{m}$  long, 2.9–3  $\mu\text{m}$  broad, linear lanceolate, pseudorape narrow, striae 14–16 in 10  $\mu\text{m}$ , strong.

Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 29-11-2012

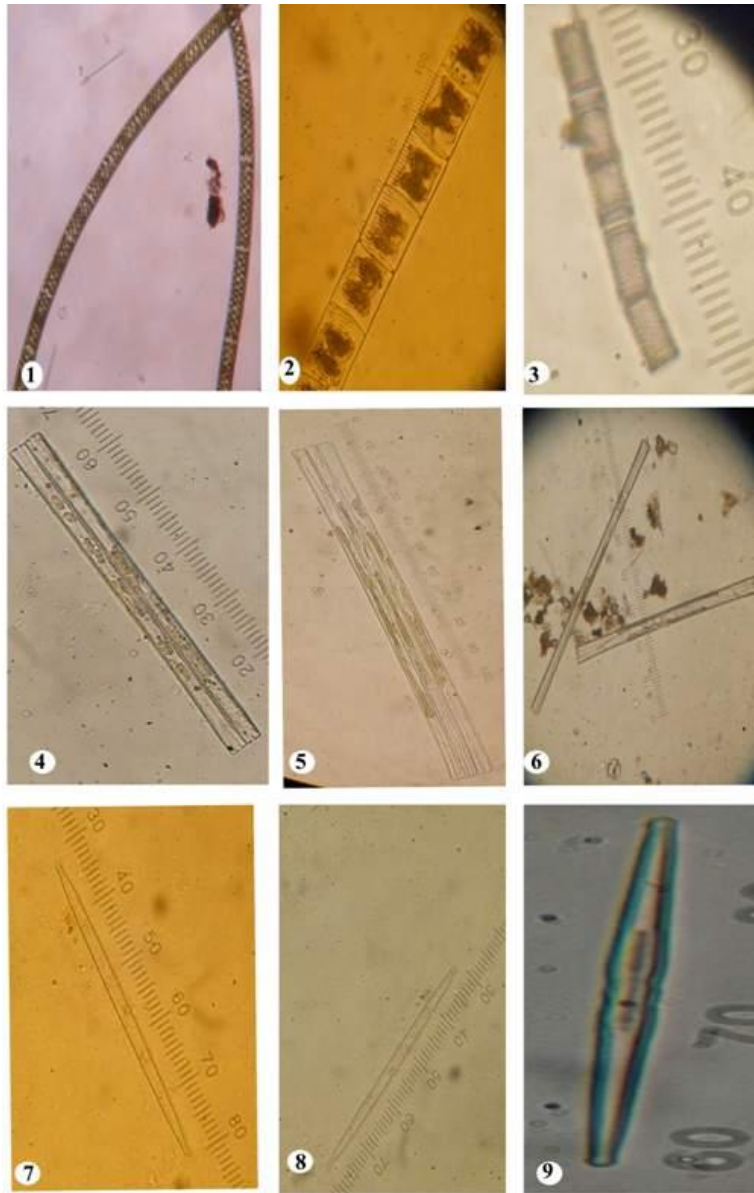


Figure 1 , 2 , 5 , 7 , 8 = 10 X and Figure 3 , 4 , 6 , 9 = 40X .

**PLATE 2**

1. *Spirogyra borgeana* Transeau., 2. *Zygnema. Fanicum.*, 3. *Melosia islandica* O.Muell., 4. *Fragilaria construens* (Ehr.) Grun. var. *venter.f pusilla.*, 5. *Fragilaria rumpens* (Kuetz) Carl .V. *fragilarioides* (Grun.) A.Cl., 6. *Fragilaria intermedia* Grun., 7. *Synedra acus* Kuetz.var.*radians* (Kuetz.).Hustedt. , 8. *Synedra ulna* (Nitz.) Her.var.*notata* Kuetz., 9. *Synedra tabulate* (Ag.) Kuetz.  
Figure 1 , 2 , 5 , 7 , 8 = 10 X and Figure 3 , 4 , 6 , 9 = 40X .

**20. *Fragilaria rumpens* (Kuetz) Carl .var. *fragilarioides* (Grun.) A.Cl. (Plate 2, Fig.5)**  
Sarode.P.T. & Kamat.N.D (1984) (Pg.28)

Cell rectangular in girdle view and usually with one or more intercalary bands between the girdles, united in free floating frustules in continuous chains; valves 32.3-42  $\mu$  broad, linear and striae 12-14 in 10  $\mu$ , coarse and distinct.

Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 18-12-2012

**21. *Fragilaria intermedia* Grun.** (Plate 2, Fig.6 )

Sarode.P.T. & Kamat.N.D (1984) (Pg.27)

Cell rectangular in girdle view; valves 74.8-89.6  $\mu$  long, 6-7.1  $\mu$  broad, linear with parallel margins, striae 10.12 in 10  $\mu$ , coarse and distinct.

Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 12-1-2013

**22. *Synedra acus* Kuetz.var.*radians* (Kuetz.).Hustedt.** ( Plate 2 , Fig.7)

Sarode.P.T. & Kamat.N.D (1984) (Pg.31)

Cell solitary and free floating ,valves 51 – 60  $\mu$  long, 2-2.5  $\mu$  broad,narrow,linear,needle like with slightly capitates ends; pseudoraphe narrow;central area round; striae 16.5-18 in 10  $\mu$ .

Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 11-2-2013

**23. *Synedra ulna* (Nitz.) Her.var.*notata* Kuetz** ( Plate 2 , Fig.8)

Sarode.P.T. & Kamat.N.D (1984) (Pg.33)

Cell solitary and free floating valves 55-64  $\mu$  long, 8-9.9  $\mu$  broad,linear with slightly marrowed and obtuse or strongly narrowed and acutely rounded ends; pseudoraphe narrow; central area absent or sometimes unilaterally widened; striae 10-11 in 10  $\mu$ , coarse.

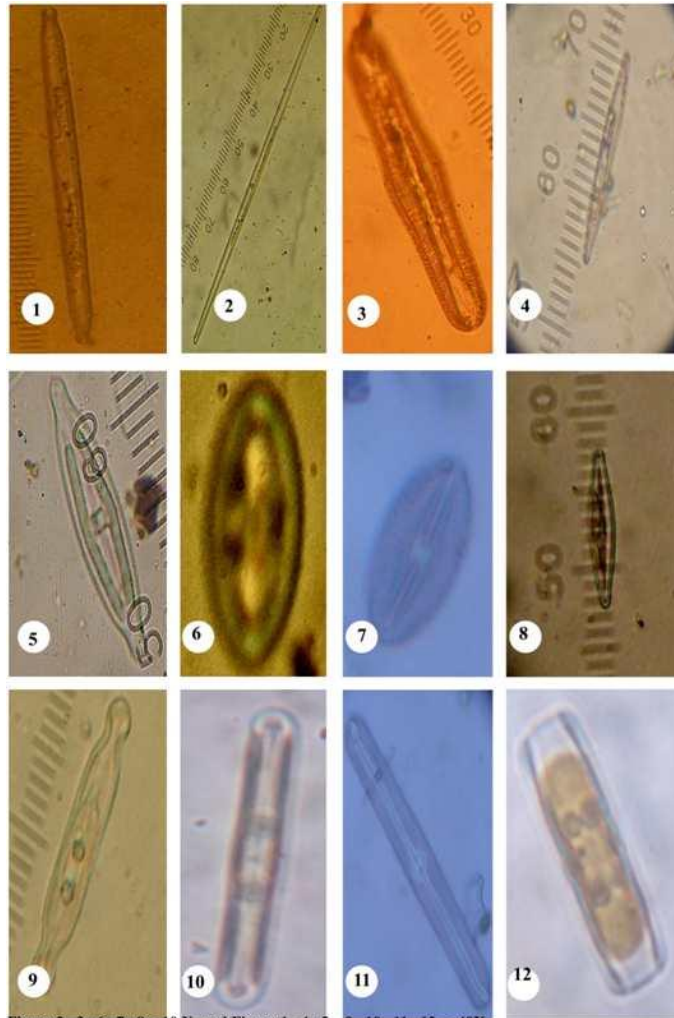
Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 17-3-2013

**24. *Synedra tabulate* (Ag.) Kuetz** ( Plate 2 , Fig.9 )

Sarode.P.T. & Kamat.N.D (1984) (Pg.31)

Cell solitary and free floating in radiate free floating colonies,valves 46.3-54.2  $\mu$  long,3-2.9  $\mu$  broad,central area absent; striae 12-13.6 in 10  $\mu$ .

Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 1-4-2013



**PLATE 3**

1. *Synedra minuscula* Grun., 2. *Synedra acus* Kuetz., 3. *Achanthes andicola* (Cleve) Hustedt 4. *Mastogloia amoyensis* Voigt v. *robusta* Gonzalves et Gandhi., 5. *Frustulia jogensis* Gandhi., 6. *Diplonies puella* (Schum.?) Cleve., 7. *Diplonies subovalis* Cleve., 8. *Anomoeoneis styriaca* (Grun.) Hustedt., 9. *Navicula hustedtii* Krasske., 10. *Pinnularia acrosphaeria* (Breb.) W. Smith f. *undulata* Cleve., 11. *Pinnularia amanuensis* Hustedt f. *indica* 12. *Amphora ovalis* Kuetz. v. *gracilis* (Ehr.) Cleve., Figure 2, 3, 6, 7, 8 = 10 X and Figure 1, 4, 5, 9, 10, 11, 12 = 40X.

25. *Synedra minuscula* Grun., (Plate 3, fig 1)  
Sarode.P.T. & Kamat.N.D (1984) (Pg.31)

Valves 17.2-22.5  $\mu$  long, 3-4  $\mu$  broad, linear lanceolate with narrowed, rounded ends; axial area narrow, linear lanceolate; central area slightly widened; striae 14-15 in 10

Collection site: Freshwater near dam site of Bhadra, lakavalli, Karnataka, Date: 12-5-2013

26. *Synedra acus* Kuetz. (Plate 3, fig.2)  
Sarode.P.T. & Kamat.N.D (1984) (Pg.30)

Frustules linear in girdle view, dilated at the ends; valves 75-90  $\mu$  long, 3-4.5  $\mu$  broad, narrow, linear to lanceolate, somewhat broad in the middle, gradually tapering towards the ends; ends obtuse; pseudoraphe narrow, linear; central area without striae; striae 14-15 in 10  $\mu$ , fine.



Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 12-5-2013

**27. *Achanthes andicola* (Cleve) Hustedt.** (Plate 3, fig 3)

Sarode.P.T. & Kamat.N.D (1984) (Pg.51-52)

Valves 41-47  $\mu$  long, 9.5-10.5  $\mu$  broad, linear, lanceolate, gibbous in the middle; ends obtusely rounded; raphe valve with straight raphe, terminal fissure not reaching the poles; axial area narrow, linear; central area broad, reaching the margins; rapheless valve with narrow pseudoraphe; central area linear, reaching the margins; striae 14-15 in 10  $\mu$  strong, slightly radial or perpendicular to the middle line..

Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 12-5-2013

**28. *Mastogloia amoyensis* Voigt v. *robusta* Gonzalves et Gandhi.** ( Plate 3, fig 4 )

Sarode.P.T. & Kamat.N.D (1984) (Pg.60)

Valves 55-61  $\mu$  long, 12.5 -16 broad, lanceolate with slightly constricted and acutely rounded ends; axil area narrow; central area small; raphe thin and straight; loculi lateral in the middle and smaller at the ends, five in number larger loculi 3.5-5  $\mu$  long and smaller loculi 2.5  $\mu$  long; striae 16-20 in 10  $\mu$ , parallel, punctae.

Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 12-5-2013

**29. *Frustulia jogensis* Gandhi.** ( Plate 3, fig 5 )

Sarode.P.T. & Kamat.N.D (1984) (Pg.63)

Valves 57.2-59  $\mu$  long, 13-13.2  $\mu$  broad, linear lanceolate with constricted, produced beak like rounded ends; raphe thin, delicate and straight, enclosed between the siliceous ribs; axial area very narrow , striae about 32 in 10  $\mu$ .

Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 12-5-2013

**30. *Diplonies puella* (Schum.?) Cleve** ( Plate 3, fig.6 )

Sarode.P.T. & Kamat.N.D (1984) (Pg.87)

Valves 12-18.2  $\mu$  long, 6.5-7.8  $\mu$  broad, elliptic with rounded ends, valve surface costate; costae 13-14 in 10 in  $\mu$ , thick and distinct, confined in the furrows as large alveoli; central nodules large, dilated.

Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 22-6-2013

**31. *Diplonies subovalis* Cleve** ( Plate 3, fig.7)

Sarode.P.T. & Kamat.N.D (1984) ( Pg.87)

Valves 25.2-34.9  $\mu$  long, 14-15.2 broad, broadly elliptical with rounded ends; central nodule large and rounded; furrows narrow and closely following the central nodule and its horns; costae 8-10 in 10  $\mu$ , strong, alternating with double row of alveoli; alveoli 16-18 in 10  $\mu$ .

Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 22-6-2013

**32. *Anomooneis styriaca* (Grun.) Hustedt.** ( Plate 3, fig 8 )

Sarode.P.T. & Kamat.N.D (1984) (Pg.99)

Valves 18-24  $\mu$  long, 5-5.8  $\mu$  broad, rhombic lanceolate with broadly rounded ends; raphe thin and straight with central pores wide apart; striae 26-28.2 in 10  $\mu$ , punctate, radial and crossed by many longitudinal wavy hyaline bands.

Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 26-7-2013

**33. *Navicula hustedtii* Krasske.** (Plate 3, fig 9)

Sarode.P.T. & Kamat.N.D (1984) (Pg.113)

Valves 21.5-24  $\mu$  long, 5.5-6  $\mu$  broad, elliptic lanceolate with produced, capitate and rounded ends; raphe thin and straight; axial area narrow; central area slightly widened; striae 16-17 in 10  $\mu$  radial throughout.

Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 27-8-2013

**34. *Pinnularia acrosphaeria* (Breb.) W.Smith f.undulata Cleve** ( Plate 3, fig.10)

Sarode.P.T. & Kamat.N.D (1984) ( Pg.129)

Valves 58-72  $\mu$  long, 10.5-11.5  $\mu$  broad, linear, in flated in the middle with broadly rounded ends; raphe thin and straight axial area very wide with irregularly disposed punctae; central area not prominent; striae 12-14 in 10  $\mu$  radial in the middle and scarsely convergent at the ends.

Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 27-8-2013

**35. *Pinnularia amanuensis* Hustedt f.indica** (Plate 3 , fig .135)

Sarode.P.T. & Kamat.N.D (1984) (Pg.129)

Valves 77-116  $\mu$  long, 21-24.8  $\mu$  broad, linear with parallel margins and cuneately rounded ends; raphe thick, complex, with thick unilaterally bent central pores and bayonet shaped slightly curved terminal fissures; axial area wide, linear; central area large, reaching the margins with a row of punctae on either side of the central pores; striae 7-9 in 10  $\mu$ , strongly radial in the middle and convergent at the ends.

Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 27-8-2013

**36. *Amphora ovalis* Kuetz. var. *gracilis* (Ehr. ) Cleve.** ( Plate 3 , fig no: 12 )

Sarode.P.T. & Kamat.N.D (1984) (Pg.162)

Frustules 61-64  $\mu$  long, 25.6-28  $\mu$  broad, elliptic with truncate ends in girdle view; valves lunate with convex dorsal side and concave ventral side with rounded ends; raphe arcuate with dorsally bent central pores; axial area very narrow; central area large, reaching the ventral side; striae 12-13 in 10  $\mu$ , coarsely punctate, radial on the dorsal side and radial in the middle and convergent at the ends on ventral side..

Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 27-8-2013

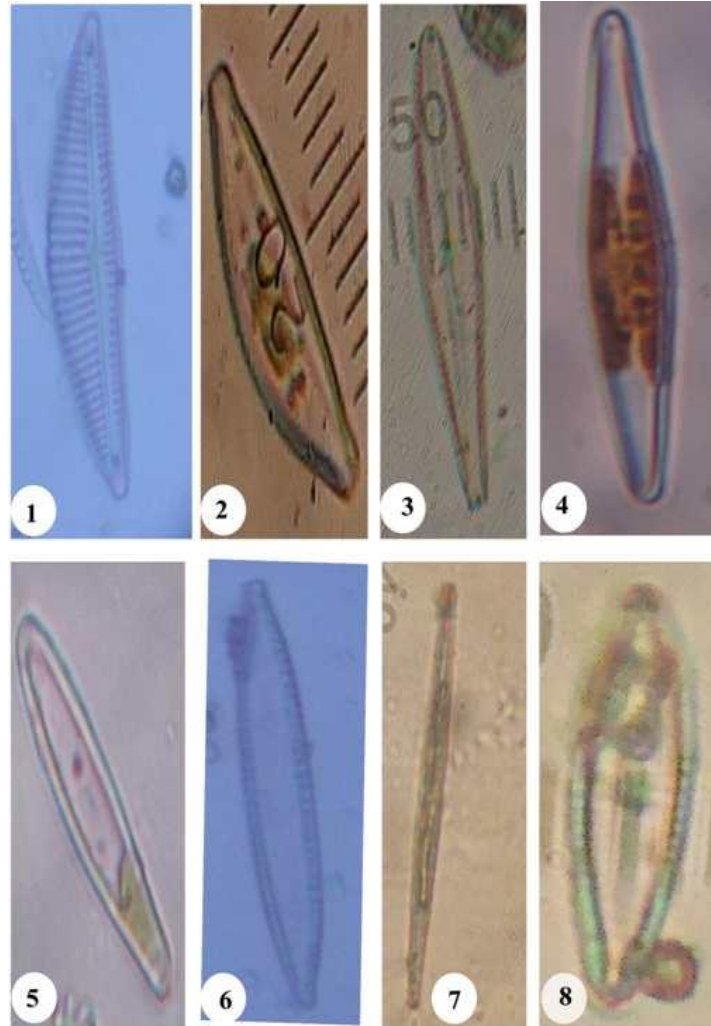


Figure 3, 4, 5 = 40 X and Figure 1, 2, 6, 7, 8 = 100X .

PLATE 4

1. *Cymbella turgid* (Greg.) Cleve., 2. *Cymbella amphicephala* Naeg., 3. *Gomphonema lanceolantum* Her., 4. *Gomphonema subtile* Ehr. V. *malayensis* Hustedt., 5. *Gomphonema intricatum* Kuetz., 6. *Hantzschia linearis* ( O.Muell. ) A . Cl ., 7. *Nitzschia intermedia* Hantzsch., 8. *Surirella linearis* W. Smith f. *kolhapurensis* .

Figure 3, 4, 5 = 40 X and Figure 1, 2, 6, 7, 8 = 100X

37. *Cymbella turgid* (Greg.) Cleve ( Plate 4 , fig.1)

Sarode.P.T. & Kamat.N.D (1984) (Pg.177)

Valves 22-69.5  $\mu$  long 7-16  $\mu$  broad, lunate with strongly convex dorsal and almost straight or often ventrally gibbous ventral margin; ends more or less acute, rounded; raphe strongly excentric, straight with central pores dorsally bent and terminal fissures ventrally directed; axial area moderate, linear; central area small, elliptical; striae 8-9 in 10  $\mu$  in the middle and 12-13 in 10  $\mu$  at the ends, strong, lineate and radial, convergent at the ends on the ventral side.

Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 25-9-2013

38. *Cymbella amphicephala* Naeg.( Plate 4 , fig.2 )

Sarode.P.T. & Kamat.N.D (1984) (Pg.166)

Valves 27-32.5  $\mu$  long, 7-8-8-5  $\mu$  broad, asymmetrical, semilanceolate; dorsal side strongly convex; ventral side slightly convex in middle; ends constricted, produced and capitate; raphe thin and straight with terminal fissures dorsally bent; axial area very narrow; central area small; striae 12-14 in 10  $\mu$  on the dorsal side and 14-16 in 10  $\mu$  on the ventral side, very slightly radial.

Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 25-9-2013

**39. *Gomphonema lanceolantum* Ehr.** ( Plate 4, fig.3 )

Sarode.P.T. & Kamat.N.D (1984) (Pg.190)

Valves 40-110  $\mu$  long, 8-16  $\mu$  broad, lanceolate clavate with distinctly rounded apex and base; base somewhat narrower, raphe slightly thick and straight; axial area narrow, linear central area slightly unilateral with an isolated stigma on the opposite side; striae 11-12 in 10  $\mu$ , radial and lineate.

Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 25-9-2013

**40. *Gomphonema subtile* Ehr. var. *malayensis* Hustedt.** ( Plate 4, fig.4)

Sarode.P.T. & Kamat.N.D (1984) (Pg.198)

Valves 35-44  $\mu$  long, 6.2-7.5  $\mu$  broad, lanceolate clavate with slightly produced, narrowly capitate rounded apex and gradually attenuated base; raphe thin and straight; axial area narrow, linear; central area small , slightly unilateral with an isolated stigma on the opposite side; striae 9-10 in 10  $\mu$ , radial and punctate.

Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 25-9-2013

**41. *Gomphonema intricatum* Kuetz.** ( Plate 4, fig 5 )

Sarode.P.T. & Kamat.N.D (1984) (Pg.188)

Valves 33-45  $\mu$  long, 7-7.8  $\mu$  broad, subclavate with constricted slightly swollen broadly rounded apex and attenuated rounded base; raphe slightly thick ; axial area narrow , linear; central area unilateral with an isolated stigma on the opposite side ; striae 18 in 10  $\mu$  in the middle and 10 in 10  $\mu$  towards the end, radial and coarse.

Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 25-9-2013

**42. *Hantzschia linearis* ( O.Muell. ) A . Cl .** ( Plate 4, fig 6 )

Sarode.P.T. & Kamat.N.D (1984) (Pg.209-210)

Valves 120.5- 162.5  $\mu$  long , 10.2-12.5  $\mu$  broad, arcuate, linear, dorsal margin uniformly convex, ventral margin concave but more so in the middle, ends long, narrowed, constricted. Produced and subcapitate; keel excentric, keel punctae 7-8 in 10  $\mu$ , large , middle to widely set; striae 14-16 in 10  $\mu$  coarse.

Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 26-10-2013

**43. *Nitzschia intermedia* Hantzsch** ( Plate 4, fig 7 )

Sarode.P.T. & Kamat.N.D (1984) (Pg.218-219)

Valves 87-145  $\mu$  long, 6-7  $\mu$  broad, linear lanceolate elongated with cuneate, constricted, produced subcapitate ends; keel excentric, keel punctae 8-10 in 10  $\mu$  , small ; striae about 25 in 10  $\mu$  , fine.

Collection site: Freshwater near dam site of Bhadra , lakavalli , Karnataka , Date: 28-11-201

**44. *Surirella linearis* W. Smith f. *kolhapurensis*.** (Plate 4, fig 8)

Sarode.P.T. & Kamat.N.D (1984) (Pg.231-232)

Valves 23-26  $\mu$  long, 7-8  $\mu$  broad, isopolar, linear lanceolate with wedge shaped, rounded ends ; middle line not visible; axial field linear lanceolate; flap margin very narrow; costae about 8 in 10  $\mu$  , radial and rib like.

Collection site: Freshwater , near dam site of Bhadra , lakavalli , Karnataka , Date: 19-12-2013

### Acknowledgements

Authors are thankful to the head of Department of P.G. Studies and Research in Applied Botany, Kuvempu University, Jannasahyadri, Shankaraghatta, Shivamogga, Karnataka for providing the facilities and also to the DST, New Delhi for the financial assistance for Rajeshwari M.S as inspire fellow and Inspire Reg.no: IF120328.

### References

- Adoni,A.D,Gunwant.,Joshi.,KartikGhosh.,Chourasia.S.,Vaishya.A.K.,ManojYadav.,Verma.H.G.,1985. *Work book on limnology*.Pratibha publishers,c-10.gour nagar,sagar-470 003,India.pp 216
- Bharati,S.G. and Krishnamuthy, S.R., 1990. Effect of industrial effluents on river Kali around Dandeli, Karnataka. Part-I. Physico-chemical complexes.*Indian J. Environ. Hlth.* 32(2) : 167-171.
- Blum,J.L.,1957. An ecological study of the algae of the Saline river.*Hydrobiol.* 9(4): 361-408
- Desikachary,T.V., Prasad, A.K.S.K., Hema, P., Sreelatha, M., Sridharan, V.T. & Subrahmanyam, R. (1987) Marine diatoms from the Arab Sea and Indian Ocean, in: Desikachary, T.V. (ed.), *Atlas of diatoms. Fasc. IV*. Madras Science Foundation, Madras, Pp. 1—7, pp 332–400A
- David A.,1957. Studies on the pollution of river Bhadra river fisheries at Bhadravathi( Mysore state) with Industrial Effluent .*Central inland fisheries research sub-station, Allahabad.* pp.133 -162
- Jagdish Krishnaswamy., Milind Bunyanb ., Vishal ., Mehtac., Niren Jain. K. ,Ullas Karanth.2006. Impact of iron ore mining on suspended sediment response in a tropical catchment in Kudremukh, Western Ghats, India . *Forest Ecology and Management* 224 (2006) 187–198.
- Joubert, G.1980. A bioassay application for quantitative toxicity management using the green algae, *Selenastrum Capricornutum*.*Water Res.* 14: 1759-1763.
- Mrutyunjay Jena & Siba Prasad Adhikary. 2007.Chlorococcales (Chlorophyceae) of Eastern and North-eastern States of India. *Algae Vol.* 22(3), 2007
- Ndiritu, G.G. Ndiritu. Nathan. N. Gichuki and Ludwig Triest.2006.Distribution of epilithic diatom in response to environmental condition in an urban tropical stream, Central Kenya.*Biodiversity and Conservation* 15:3267-3293.
- Peter F. M. Coesel · Lothar Krienitz.2008. Diversity and geographic distribution of desmids and other coccoid green algae.*Biodivers Conserv* (2008) 17:381–392.
- Prasad B.N. and Misra P.K. 1992. *Algal flora of Andaman and Nicobar island, Vol. II B*. Singh and M.P.Singh Publ.,Dehradun, 284 pp.
- Rai.S.K and P.K.Misra .2012. Taxonomy and Diversity of Genus *Pediastrum* Meyen (Chlorophyceae, Algae) in East Nepal.*Our Nature* (2012) 10: 167-175
- Randhawa, M.S. 1959. Zygnemaceae. ICAR, New Delhi, 478 pp.
- Rosalina stancheva *et.al* . 2013. Identity and Phylogenetic placement of Spirogyra species (zygnematophyceae, charophyta) from California streams and elsewhere. *J. Phycol.* 49, 588–607
- Sarode, P.T. & Kamat, N.D.1984. *Freshwater diatoms of Maharashtra*. Saikripa Prakashan, Aurangabad, India. 338 pp.
- Scott,A.M.&Prescott,G.w.,1961.Indonesian Desmids.*Hydrobiologia* 17:165-185.

Shekhar, S., Kiran, T.R., Puttaiah, E.T., Shivaraj, K.M., Mahadevan. 2008. Phytoplankton as index of water quality with reference to industrial pollution. *Journal of Environmental Biology*, 29(2) 233-236.

Sudhakar G, Jyothi, B. Venkateswarlu, V. 1991. Impact of paper mill effluents on the distribution of cyanobacteria in the river Godavari, India. *J. Waste management, Vol. II, pp. 263-269, 1991.*

Suresh, B., Manjappa, S., Puttaiah, E.T. 2011. Seasonal Variation of phytoplankton in Tungabhadra river near Harihar-Karnataka. *Research journal of biological sciences* 6(2):65-68

Sunil Kumar Shukla., Chandra Prakash Shukla., and Pradeep Kumar Misra. 2008. Desmids (Chlorophyceae, Conjugales, Desmidiaceae) from Foothills of Western Himalaya, India. *Algae Volume 23(1): 1-14, 2008*

Sabitri Shrestha, Shiva Kumar Rai and Min Raj Dhakal. 2013. Algae of Itahari Municipality and its adjoining Area, Eastern Nepal. *Shrestha S et al. (2013). Int J Appl Sci Biotechnol, Vol. 1(1): 5-10*

S.G. Bharthi and G.R. Hegde. 1982. The genera *Staurstrum* Meyen and *Stauroidesmus* Teli (Desmidiaceae) in Karnataka and Goa State (India). *Hydrobiologia* 96.31-51(1982).

Venkateswarlu, V. An ecological study of the algae of the River Moosi, Hyderabad (India) with special reference to water pollution. I. Physico-chemical complexes. *Hydrobiol.* 33(1): 117-143 (1969a).

Whitton, B. A., Rott, E., Eds. 1996. Use of algae for monitoring rivers II. Universität Innsbruck, Innsbruck, Austria, 196 pp.

Zarina, A., Masud-ul-hasan and Mustafa Shameel. 2006. Taxonomic studies of the Genus *Zygnema* from north-eastern areas of Pakistan. *pak. j. bot.*, 38(2): 425-433, 2006.