

Morphotaxonomy of Chlorophyceae algae in the fresh waters of Kota barrage, Rajasthan

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ABSTRACT: There is negligible work published that records the abundance and morphotaxonomic features of Chlorophyceae algae of the Chambal River. In this paper we report the morphotaxonomic evaluation of algal flora identified in the fresh Chambal waters of Kota barrage, Rajasthan. Study of algal flora along the upstream and downstream of Kota barrage was carried out during between 2011 and 2013. A detailed morphotaxonomic description of 8 algal genera and 28 species across orders Chlorococcales, Desmidiaceae and Zygnematales that were identified is reported.

KEYWORDS: Morphotaxonomy, Chlorophyceae, Kota barrage, Chambal River

I. INTRODUCTION

Water forms an important constituent of living matter and is one of the most important and precious natural resources. Reservoirs, made by constructing dams across the rivers serve a variety of purposes like drinking, irrigation, industrial processes, fish and waterfowl, flood protection, recreation and generation of hydroelectricity.

In aquatic systems, algae constitute a vital link in the food chain. An understanding of their composition, distribution and correlation analysis of physical and chemical factors with biological factors (phytoplankton density) is of utmost importance to establish relationship for the management of aquatic ecosystems. Algae play an important role in purifying the water through photosynthesis and help in the rejuvenation of rivers while the health of lakes and their biological diversity is related to health of almost every component of the ecosystem (Sharma 2005 and Ramesh et al. 2007). Chlorophyceae are one of the classes of green algae. They are usually green due to the dominance of pigments chlorophyll a and chlorophyll b can be easily identified from their morphological characters.

Morpho-taxonomy involves identification of different species of a genus based on morphological characters. This communication deals with the taxonomic descriptions of the freshwater algae from river Chambal near Kota barrage, Rajasthan. During the study period eight genera— *Pediastrum*, *Scenedesmus*, *Coelastrum*, *Coelastrum*, *Cosmarium*, *Staurastrum*, *Closterium*, *Sigeoclonium* and *Spirogyra* of class Chlorophyceae were identified with more than one species.

II. MATERIALS AND METHODS

Sampling area

Kota Barrage is the fourth in the series of Chambal valley projects located about 0.8 km upstream of Kota city in Rajasthan. Sampling stations were identified both at the upstream and downstream flow of the Chambal River. Six sampling stations, spanning a stretch of 15 km were selected. Kota Barrage was taken as a reference point and three study stations were marked on either side of the Barrage and categorized as Upstream and Downstream stations.

Collection and Preservation

Samples of subsurface water were collected from the selected upstream and downstream sampling stations every month between 7.00 to 9.00 AM. The samples were concentrated using Henson's standard plankton net (pore size = 25 µm) in airtight bottles and polythene bags. Filamentous algae were collected from mass growth by hand. The collected samples

were observed fresh by preparing wet mounts within 48 h. For further preservation, samples were stored in Lugol's solution and 4% formaldehyde solution separately.

Morphotaxonomic observation

All samples collected were observed under a light microscope Olympus after wet mounting or fixed sample preparation. Microphotographs were taken at 40× magnification with Sony 8 MP camera. Additionally, camera lucida drawings for morphometric study were also done. Identification of algal forms was performed with the help of standard keys using monograph and relevant available literature namely Prescott (1951), Desikachary (1959), Randhawa (1959), Edmondson (1959), Palmer (1980) Anand (1998) and Perumal and Anand (2008).

Results and discussion

During the study period 8 Chlorophycean genera were identified with more than one species. Morphotaxonomy of selected genera are presented in Figure 1 and 2.

Taxonomic description of the genera recorded is detailed below:

Order -Chlorococcales

Genus – *Pediastrum* (Figure 1 a-g)

1. *Pediastrum duplex* Meyen

Prescott Pl. 48 fig 4 pg 223

Cells form 8-128 celled colonies, walls smooth, with lens shaped spaces between the inner cells, which are quadrate, the outer margin concave, peripheral cells quadrate, the outer margin extended into two tapering processes, cells 15.6 µm in diameter.

2. *Pediastrum duplex* Meyen var. *duplex* Sulek

Das, Bhakta and Adhikary Pl. 2 fig 34 pg 342

Coenobia 16 celled, 37.3 µm in diameter, intercellular spaces large and oval in between the inner cells, cells more or less H shaped with marginal sides, cells nearly parallel, cells 9 µm in diameter.

3. *Pediastrum duplex* var. *asperum* (A. Braun) Hansgirg

Das, Bhakta and Adhikary Pl 1 fig 33 pg 342

Coenobia 16 celled, 78.6µm in diameter, small lens shaped perforations between cells, inner cells quadrate to angular and in contact at the central portion of the side wall, inner side of marginal cells concave, outer sides produced into 2 spines like processes, cells 14.3 µm in diameter.

4. *Pediastrum duplex* Var. *clathratum* A.Braun Lager

Prescott Pl. 48 fig 6 pg 223

Colony with larger perforations than in the typical form, walls with deep emarginations, apices of lobes with peripheral cells truncate, cells 18 µm in diameter.

5. *Pediastrum simplex* var. *duodenarium* (Bailey) Rabenhorst

Prescott Pl. 50 fig 5 pg 227

Colony perforate, composed of 36-64 cells with their inner margins concave, the outer margins of inner cells forming a long process, peripheral cells forming a stout process, cells 11-15 μ m in diameter.

6. *Pediastrum Simplex* Meyen var. *Simplex* Komarek

Das, Bhakta and Adhikary Pl. 2 fig 37 pg342

Coenobia 16 celled, large intercellular spaces, outer surface tapered into a long process, internal cells similar to marginal cells with shorter processes, cells 35 μ m long and 16 μ m broad.

7. *Pediastrum tetras* (Ehrenberg) Ralfs

Prescott Pl. 40 fig. 6

Colony entire, without intercellular spaces, marginal cells divided into 2 lobes with a deep single incision in the outer free margin 6.3 μ m in diameter.

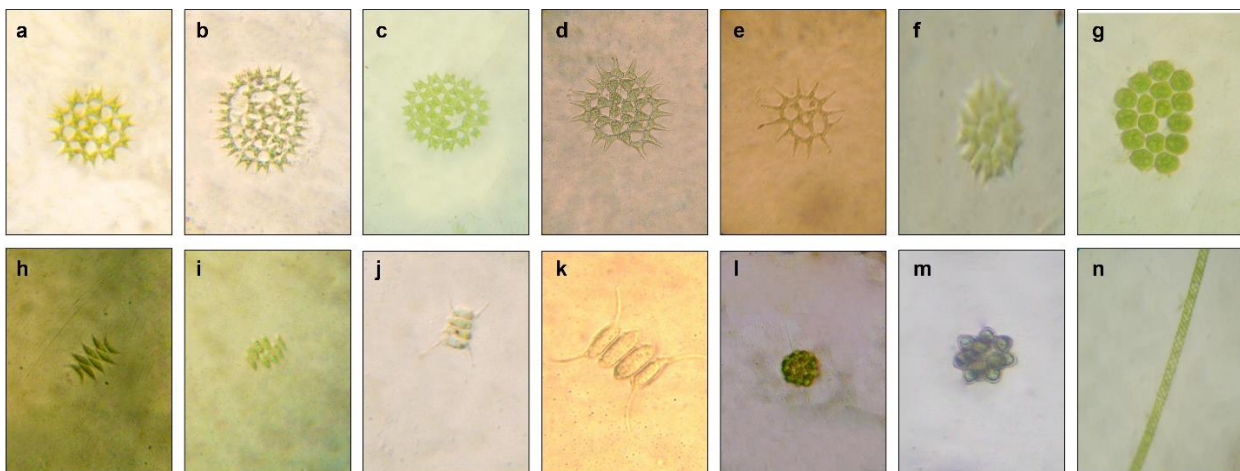


Figure 1. (a) *Pediastrum duplex* (b) *Pediastrum duplex* var. *duplex* showing H-shaped cells (c) *Pediastrum duplex* var. *asperum* (d) *Pediastrum simplex* var. *duodenarium* (e) *Pediastrum simplex* var. *simplex* (f) *Pediastrum tetras* showing no intercellular spaces (g) *Pediastrum duplex* var. *clathratum* (h) *Scenedesmus dimorphous* (i) *Scenedesmus obliquus* (j) *Scenedesmus opoliensis* (k) *Scenedesmus quadricauda* with long curved spines (l) *Coelastrum microporum* (m) *Coelastrum proboscideum* (pyramidal colony) (n) *Spirogyra hyalina* Cleve.

Genus- *Scenedesmus* Meyen (Figure 1 h-k)

1. *Scenedesmus dimorphous* (Turp.) Kütz

Prescott Pl. 63 fig 8, 9 pg 277

Colony composed of 4 or 8 fusiform cells arranged in a single or alternating series, the inner cells with straight sharp apices, the outer cells lunate, strongly curved, with acute apices, cells 3-6 μ m in diameter.

2. *Scenedesmus obliquus* (Turp.) Kütz [Synonym-*Scenedesmus bijugatus* Kütz]

Das and Adhikary Pl. 2 fig 12 pg 30

Coenobia 4 celled, arranged in a linear or sublinear series, fusiform with acute or slightly rounded ends, cells 25.5-29 µm long and 5.5-6.7 µm broad.

3. *Scenedesmus quadricauda* (Turp.) Breb

Prescott Pl. 64 fig 2 pg 280

Colony consisting of 2-4-8 oblong-cylindrical cells usually in one series, outer cells with a long curved spine at each pole, inner cell without spines or with mere papillate at the apices, cells variable in size, 3-18 µm in diameter, 9-35 µm long.

4. *Scenedesmus opoliensis* P. Richter

Prescott Pl. 63 fig 18 pg 279

Colony composed of 2-4-8 naviculoid cells arranged in a single series, with free walls of outer cells convex, apices of cells with long spines but inner cells with a spine at one pole only or sometimes without spines only, cells 6-8 µm in diameter, 14-26 µm long.

Genus *Coelastrum* (Figure 1 l-m)

1. *Coelastrum microporum* Nageli

Prescott Pl. 53 fig. 3 pg 230

Coenobium spherical, composed of 8-64 sheathed globose cells, cells inter connected by very short gelatinous processes leaving small intercellular spaces. Cells 8-20µm in diameter including the sheath.

2. *Coelastrum proboscideum* Bohlin

Prescott Pl 53 fig. 5 pg 230

Colonies spherical of 8-32 cells, cells pyramidal composed of 8 cone shaped cells with the apex of the cone directed outward, cells 8-15µm in diameter, cells adjoined a large space in center.

Order-Desmidiaceae

Genus- *Cosmarium* (Figure 2 e-h)

1. *Cosmarium depressum* (Nag.) Lund

Suseela and Topo 2007 Pl. II fig 6 pg 107

Cells broadly rounded oval to semicircular in shape, sinus linear, chloroplast axile, two pyrenoids in each semi cell. Cell wall thin and smooth. Length 38.5 µm, 34.5 µm broad and isthmus 11.8 µm.

2. *Cosmarium impressulum* Elfr. *F. suborthogonum* (Racib) West and West

Tripathi et al., 2012 Pl 1 fig 13 pg 6.

Cells 19 µm long, 14 µm broad and isthmus 10 µm in diameter

3. *Cosmarium pseudopyramidatum* Lund var. *occulatum* Krieger

Misra et al., 2008 Pl. fig 19 pg 181

Cells of medium size 1.8-1.9 times longer than broad, deeply constricted, sinus narrowly linear, semicell oblong hexagonal, basal and apical angles sharp, apex widely truncate with straight margin, centre of each semicell with a faint protuberance, cell wall smooth. Long cell 15µm long isthmus 3.5µm.

4. *Cosmarium laeve* Rab.

Suseela and Topo 2007 Pl. I fig 18 pg 107

Cells spherical with rounded apices, number of pyrenoids scattered in each cell. Length 21.24 µm, width 13.82 µm and isthmus 4.2 µm.

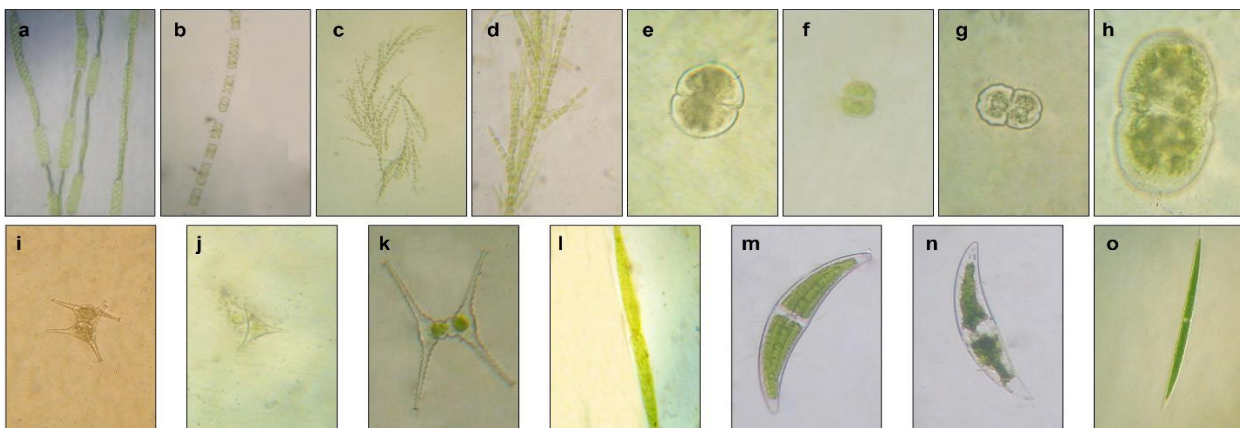


Figure 2. (a) *Spirogyra hyaline* Cleve with reproductive bodies (b) *Spirogyra gratiana* (c) *Stigeoclonium lubricum* (d) *Stigeoclonium tenue* (tuft of filaments) (e) *Cosmarium depressum* with axile chloroplast (f) *Cosmarium impressulum* (g) *Cosmarium pseudopyramidatum* var. *occulatum* (h) *Cosmarium laeve* (i) *Staurastrum unicorne* var. *gracile* showing forked processes (j) *Staurastrum gracile* var. *coronulatum* showing dentations in top view (k) *Staurastrum longibrachiatum* showing hollow slender processes (l) *Closterium acerosum* var. *elongatum* (m) *Closterium turgidum* showing chloroplast with many pyrenoids (n) *Closterium ehrenbergii* (o) *Closterium acerosum*.

Genus - *Staurastrum* Meyen (2 i-k)

1. *Staurastrum unicorne* Turner var. *gracile*

Suseela and Topo 2011 Pl. I fig 8 pg 89

Cells single, small deeply constricted, semicells cuneate or triangular the sides convex, angles of the semi cells produced into smooth processes with capitate ends and short fine spines, chloroplast two, axile, one in each semi cell with a central axis enclosing a big pyrenoid and three massive deeply forked processes radiating into each angle.

2. *Staurostrum gracile* Ralfs var *coronulatum* Boldt.

Prasad and Misra 1992 Pl 25 fig 7,11 pg 196

Misra et al., 2008 Pl. 2 fig 39 pg 183

Cells of medium size about 2-3 times longer than broad, depressed, constriction shallow with an acute notch, semi-cells somewhat broad towards the slightly convex apex, apices showing undulate margins and relatively shorter and emarginated processes tipped with 2-3 minute spines, top view triangular with dentation within the lateral margin.

3. *Staurostrum longibrachiatum* (Borge) Gutwin var *intermedium* Iyengar and Bai (1940)

Suseela and Topo 2011 Pl. II fig 25 pg 86

Cells single, medium size, fairly constricted, sinus widely open, semi-cells truncate gradually attenuated at the apex with four big verrucae at the apex, two big in the center and two small on either side of the semi-cells produced into long hollow slender processes with sharply dentate upper and lower margins, ends of the processes bifurcated, a short verrucae at the base of the process on each side of the semi-cells, poles continued into long processes with slightly undulate margins, and about four verrucae in the top view, cell wall punctate.

Genus – *Closterium* (Figure 2 I-o)

1. *Closterium acerosum* (Schr.) Eher. var *elongatum* (Breb.)

Misra et al., 2008 Pl.2 fig 31 pg 184

Cells narrowly fusiform, outer margin curved inner margin gradually tapering to the narrow and often slightly thickened, with rounded truncate apices, cell wall smooth colourless, with or without a median girdle. Chloroplast without ridges. Pyrenoids 3-4 in a medium series. Cells 200 µm long, 13 µm in diameter, apices 4 µm broad.

2. *Closterium ehrenbergii* Meneghini

Misra et al., 2008 Pl.2 fig 30 pg 182

Cells 35µm wide and 220µm long, moderately curved, cell wall smooth, colorless, pyrenoids numerous, scattered, terminal vacuoles containing a cluster of small granules.

3. *Closterium turgidum* Ehrenberg

Kant and Gupta Pl. 57 fig 1

Cells 750 µm long and 45 µm broad, cell curved, ends rounded, poles rounded, chloroplast with many pyrenoids.

4. *Closterium acerosum* (Schr.) Ehrenberg

Kant and Gupta Pl. 58 fig 10

Cells 500-600 µm long and 50-58 µm broad, at the apex 7-9 µm, ends rounded and slightly bent at the middle.

Order-Zygnematales

Genus –*Stigeoclonium* (Figure B:3-4)

1. *Stigeoclonium lubricum* (Dillw.) Kuetzing

Prescott Pl. 10, fig 1, 2 pg 115

Filaments elongate, branches opposite, branches ended in a blunt point, cells 18 µm long 10µm in diameter.

2. *Stigeoclonium tenue* (C.A.Ag.) Kuetzing

Prescott pg 117

Thallus an elongate tuft of very slender tapering filaments, the branches opposite or alternate, cells nearly quadrate , cells 7-10 in diameter µm.

Genus- *Spirogyra* (Figure 1 and Figure 2 a,b)

1. *Spirogyra hyalina* Cleve

Randhawa Pl. 318 fig 294 a-c

Cylindrical vegetative cells, 224 long, 39.2µm broad, plane end walls, chloroplast 3, makes 3 turns.

2. *Spirogyra gratiana* Transeau

Pres. Pl.74, fig 9 pg 315

Filaments composed of elongate cylindric cells, 28-33 µm in diameter, 144-240 µm long, chloroplast 2,3or 4.

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