



Desmids from the ponds of historical fort Kavaledurga, central western ghats, Shivamogga- India

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Abstract

Fresh water green algae (Class – *Zygnematophyceae*) called desmids occur in different habitats of fresh water and also indicator of oligotrophic conditions for aquatic environment. Most studied algal taxa by various phycologist throughout the world. In India, many works reported on desmids flora, Central Western Ghats located in southern state of India. The historical ponds of this region have rich biodiversity and also scanty knowledge about their ecology. Samples are collected from August 2020 to February 2021 with the help of plankton net and wide mouth bottles and fixed with 4% formaldehyde. Present work revealed total of 27 taxa belonging to genera of Desmidiales, in that 10 belonging to *Cosmarium*, 7 to *Euastrum*, 5 to *Micrasterias*, 3 to *Pleurotaenium*, 1 each to *Gonatozygon* and *Triploceras*, all species identified with the help of standard literature.

Keywords: aquatic biodiversity, desmids, historical ponds, taxonomy, western ghats

Introduction

Desmids are fresh water green algae belongs to the class *Zygnematophyceae* are placed in the division *charophyta* (Yasmin *et al.*, 2011) [46]. They occur in diverse fresh water habitats with low salinity and low specific conductivity. Desmids are particularly have prominent beauty and variety of their forms with distinctive characters such as two valves or segments, either unicellular or pseudo filamentous (Ralfs, 1848). Among freshwater algae desmids have high number of taxa and also considered the geographically most studied algal group (Coesel, 1996) [11]. These groups loosely attached to the substrate because of absence of particular structures to be fixed, but they are part of periphytic habitats (Felisberto *et al.*, 2014) [16]. Ecologically desmids are more sensitive to environmental fluctuation thus they tools as bioindicators of aquatic environment (Aquino *et al.*, 2018) [5].

Western Ghats is in the world heritage site and one of the important biodiversity hotspots, that recognised by UNESCO. The state of Karnataka has Central Western Ghat regions including areas of five districts. In the rich ecosystem of Western Ghats there is a scanty knowledge regarding desmids diversity and distribution.

Materials and Methods

Study area

The historical fort kavaledurga is located in Shivamogga district, Central Western Ghats region of Karnataka. This place also called Bhuvanagiri was built in the 9th century, and it was renovated in the 14th century by Nayakas of Keladi. The fort situated on the hill top at latitude 13.71879°N longitude 75.12198°E and 5056ft above the sea level. The entire fort is around 8km in circumference with complex defenses and mainly arranged for rain water harvesting. This region has a humid tropical climate, the average annual rainfall is 3870mm and annual temperature is 23.3° C with 1541m altitude.

This fort has seven ponds they are interconnected through the water channels and is always full with water till the summer. Even today the water flows from top of the hills to bottom through the underground channel and gets accumulated into the big lake below the fort hill. But now a day's only six ponds stores the water.

Collection of Algal Samples

Algal samples were collected in all six ponds at monthly intervals for a period of seven months from August 2020 to February 2021. Plankton net (55mm) mesh size is used for sample collection, just below the surface water. All materials were immediately fixed with 4% formalin solution for permanent preservation and further taxonomic investigations. The preserved samples were observed under microscope and identification of taxa was done following standard literature Prescott (1942) [32]; Smith (1950) [41]; West & west (1895) [44]; Ducellier (1917) [15]; Lundell (1870) [25]; Ralfs (1848); Brebisson (1856) [8].

Result and Discussion

Cosmarium auriculatum Reinsch

Reinsch 1875; 83 – pl.XIV [14]; fig.5

Cell small. Semi elliptic margine; terminal pole truncate, auriculate with 3-4 tiny spines; slightly median constriction, open sinus, cell wall punctuate. Length = 63µm, width = 63µm, isthmus = 31.5µm.

Cosmarium blyttii Wille

Wille 1880; 25 – pl.1; fig.7

Small cells, deeply constricted, trapiziform semicircular semi-cell with rectangular base; truncate apex, 4 crenates; granular cell wall. Length = 28µm, width = 21µm, isthmus = 17.5µm.

Cosmarium connatum Brebisson ex Ralfs.

Brebisson ex Ralfs 1848; 108 – pl.XVII [17]; fig.10

Cells two times as long as broad and slightly constricted at middle; circular frond appears striated with distinct border and compressed; punctate cell wall. Length = 91µm, width = 59.5µm, isthmus = 52.5µm.

Cosmarium decoratum West & G.S.West

West & G.S.West 1895; 61- pl.VII [7]; fig.21

Cell with deep median constriction slightly open sinus, tapering toward the apex; semi-cell pyramidal, semicircular to truncate, rounded basal apical margin, series of dense granular cell wall hexagonally arranged. Length = 119µm, width = 87.5µm, isthmus = 35µm.

Cosmarium depressum (Nageli) P.Lundell, nom.illeg

Lundell 1871; ser.3, 8(2); 1-100, 8 pls

Cells small and broader than long with deep constriction, linear, narrow; segments elliptic with depressed apex; smooth cell walls rarely punctate. Length = 35µm, width = 52.5µm, isthmus = 10.5µm.

Cosmarium granatum Brebisson ex Ralfs

Ralfs 1848; 96 – pl. XXXII [32]; fig.6

Cell slightly larger with deeply constricted at middle, linear notch on each side; segments smooth, entire and slope rapidly at base, triangular and truncate. Length = 38.5µm, width = 24.5µm, isthmus = 14µm.

Cosmarium obsoletum f. dentatum (Hantzsch) Reinsch

Reinsch 1867; 142 – pl.22:D:1; figs. 1-4

Medium sized cell, broad elliptical and wider than length, semi-cells are semi-circular or semi-elliptical; thickened cell wall at basal corner like a papillae and dotted. Length = 87.5µm, width = 101.5µm, isthmus = 56µm.

Cosmarium pseudoretusum F. Ducellier

Ducellier 1918; 99 – ser.II 10; 85-154, fig.134

Deep median constriction with closed sinus, semi-cells slightly diverging and retuse at sinus, both apical and lateral angles rounded; laterally elliptic and vertically elliptic with slight swelling; irregularly punctate cell wall. Length = 31.5µm, width = 21µm, isthmus = 7µm.

Cosmarium quadratum (F.Gay) De Toni

De Toni 1889; 934 – vol.I. pp. [3]-12[i] – cxxxix, 1-1315

Cells slightly longer than wide with deep sinus, linear; segments sub-rectangular and apex dilated; smooth cell wall. Length = 24.5µm, width = 17.5µm, isthmus = 7µm.

Cosmarium quadrum P.Lundell

Lundell 1871; 25 – pl.II [2]; fig.4

Large cells as long as broad, deep constriction sinus closed with dilated ends; rectangular segments, rounded edges; cell wall with dense granules. Length = 63µm, width = 63µm, isthmus = 28µm.

Euastrum ansatum Ehrenberg ex Ralfs

Ralfs 1848; 85 – pl.XIV [14]; fig.2 a-f

Cell longer than broad, flattened segments at the base and tapering into a neck, linear terminal notch; circular end with entire lobes; single inflation on each side with punctuated Fond. Length = 105µm, width = 52.5µm, isthmus = 17.5µm.

Euastrum ceylanicum f.majus T.Hinode

Hinode 1960; 114, fig.3:19, 20(as major)

Cells vary from medium to large, deeply constricted, 3 lobed, sinus linear, subcuneate apical lobe with central shallow notch; horizontal lateral lobes, ornamented cell wall, dentate towards distal regions. Length = 70µm, width = 66.5µm, isthmus = 14µm.

Euastrum denticulatum F.Gay

West 1905; vol.II, p.56, pl.XXXIX [39]; fig.4

Cells longer than wide, semi quadrangular and deep median constriction, slightly open at ends; shallow incisions is at inter lobe, lateral lobes with convex apex; polar lobe with semi-oval deep sinus and straight apical margin. Length = 38.5µm, width = 24.5µm, isthmus = 17.5µm.

Euastrum didelta Ralfs

Ralfs 1848; 84 – pl.XIV [14]; fig.1

Fronde longer than wide with inflated base, median constriction almost enclosed and slightly open at end; pyramidal segments, tapering upwards into intermediate tubercles; end bilobed, forming a lip; cell wall thick with punctate. Length = 70µm, width = 52.5µm, isthmus = 17.5µm.

Euastrum elegans Ralfs

Ralfs 1848; 89 – pl.XIV [14]; figs 7 b-d

Oblong cell twice as long as broad, end emerginate and round; median constriction slightly open at end, lobe with horizontal spine on each side, polar lobes divided into narrow processes. Length = 45.5µm, width = 24.5µm, isthmus = 10.5µm.

Euastrum moebii (Borge) Scott & Presc. Var. *tetrachastriforme* West & west

Scott & Presc. 1960; 329 - pl.1; fig.2

Cell length and width considerably same, margins divided into two truncate parts; polar lobe with 4 lobules bearing 2 or 3 blunt teeth, trapezoidal semi-cells; rectangular in front view; cell wall scrobiculate with irregularly arranged pits. Length = 157.5µm, width = 157.5µm, isthmus = 14µm.

Euastrum oblongum Ralfs

Ralfs 1848; 80 – pl.XII [12]

Cell 2 or 3 times longer than broad, 5 lobed; lateral lobes broad with shallow notch, terminal lobe with linear notch and all ends rounded, polar lobe with median incision; cell wall smooth. Length = 105µm, width = 52.5µm, isthmus = 24.5µm.

Micrasterias foliacea Bailey ex Ralfs

Ralfs 1848; 210 – pl.XXXV [35]; fig.3

3 lobed cells wider than long, cells forming pseudofilamentous at poles; lateral lobes deeply bifurcate, polar lobe an integrate apex, dentate, concave margins; semi-cell semi-rectangular lateral lobe slightly smaller than the polar lobe; end concave and easily distinguishable taxa. Length = 84µm, width = 94.5µm, isthmus = 17.5µm, apex = 49µm.

Micrasterias furcata C.Agardh ex Ralfs

Ralfs 1848; 73 – pl.IX [9]; fig.2

5 lobed cells longer than wide, linear divisions forked at apex, central sine widely open; lateral lobes deep and U or V shaped, polar lobe little more than half of its length with semi-circular sinus, bigger and more robust than lateral lobes. Length = 164.5µm, width = 157.5µm, isthmus = 21µm.

Micrasterias mahabuleshwariensis J.Hobson var. *mahabuleshwariensis*

Hobson 1863; 169, fig.1

Cells slightly longer than wide, deep median constriction, median incision triangular, widely open; semi-rectangular incision at polar lobe, lateral lobes divided into narrow

processes with serrate margins; straight apical margin at polar lobes and sharply projected and cell with intramarginal spines. Length = 147µm, wide = 143.5µm, isthmus = 35µm, arm length = 73.5µm.

Micrasterias pinnatifida Ralfs

Ralfs 1848; 77 – pl.X [10]; fig.3

Cell wider than long, plane frond and deeply constricted; 3 lobed, horizontal, triangular and bidentate at apex; lateral lobes larger than polar lobes. Length = 80.5µm, width = 87.5µm, isthmus = 45.5µm.

Micrasterias thomasiana W.Archer

Archer 1862; 239 – pl.XII [12]; figs 1-10 (as *Thomasiana*) Orbicular, smooth frond; segments 5 lobed three stout at base, conspicuous, prominent, hollow projections; lateral lobes dichotomously branched, sub-divisions bi or tridentate, not tapering, acute angles, acutely emarginate end lobe. Length = 227.5µm, width = 182µm, isthmus = 31.5µm.

Pleurotaenium ovatum (Nordstedt)

Scott & Presc. 1961; 17 - pl.6; figs. 1,2

Cells more longer than wide, lateral margins strongly concave, median constriction shallow, single set of granules composed of 5-6 granules at apex that can be seen in frontal view; cell wall punctuated and hyaline apical view; circular, ribbon like chloroplast and multiple. Length = 343µm, width = 111.6µm, isthmus = 70µm.

Pleurotaenium trabecula* var. *rectum (Delponte) West & west

West & west 1904; 212 – pl, 13; figs. 4,5

Cells long, bilaterally symmetrical with blunt ends; two semi-cells join in the central area, almost cylindrical, apices gradually attenuated; cell wall punctuated. Length = 591.48µm, width = 33.48µm, isthmus = 22.32µm.

Pleurotaenium verrucosum (Ralfs) H.C.Wood

Bailey 1846; vol.I, p.127; fig.4

Cells much longer with numerous whorls of small prominences; undulated margins, equal waved outline with slight projections, arranged like numerous transverse rings. Length = 318.5µm, width = 52.5µm, isthmus = 35µm.

Gonatozygon aculeatum W.N.Hasting

Hasting 1892; 29; fig.1

Cells long, cylindrical more longer than wide; apex of cells slightly dilated and truncate; cell wall with aculeate spines. Length = 301µm, width = 14µm, spines = 10.5µm.

Triploceras gracile Bailey

Bailey 1851; 38 – pl.1; fig.10

Cells very longer than wide, slight median constriction, conspicuous; semi-cells gradually narrow at apex, 8-10 spines; upper portion large, curved upwards apex divided into two short processes with 1-2 simple spines; cell wall smooth. Length = 457.56µm, width include spines = 44.64µm, isthmus = 22.32µm.

Totally 27 species were reported in this investigation belonging to 6 genera. Among 6 genera *Cosmarium* (10 taxa) and *Euastrum* (7 taxa) were most abundant in this ponds. *Micrasterias* (5 taxa) and *Pleurotaenium* (3 taxa) were the next abundant genera. *Gonatozygon* (1 taxa) and *Triploceras* (1 taxa) were least abundant genera. Members of *Cosmarium* and *Euastrum* are cosmopolitan, ubiquitous and exhibit high diversity in oligotrophic and mesotrophic aquatic forms (Aquino *et al.*,2018) [5]. The present study provide baseline data on diversity and distribution of taxa *Zygnematophyceae* members, also excellent tool for assessing water quality and they are very sensitive to environmental fluctuations. Therefore, this study gives importance for the track of aquatic ecosystems and provide knowledge about preservation and conservation of the biodiversity.

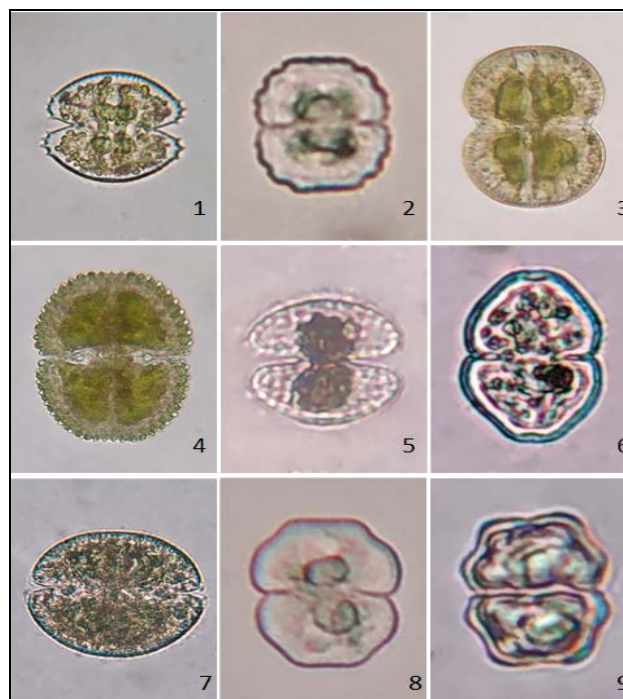


Plate 1: 1. *Cosmarium auriculatum* 2. *Cosmarium blyttii* 3. *Cosmarium connatum* 4. *Cosmarium decoratum* 5. *Cosmarium depressum* 6. *Cosmarium granatum* 7. *Cosmarium obsoletum* f. *dentatum* 8. *Cosmarium pseudoretusum* 9. *Cosmarium quadratum*.

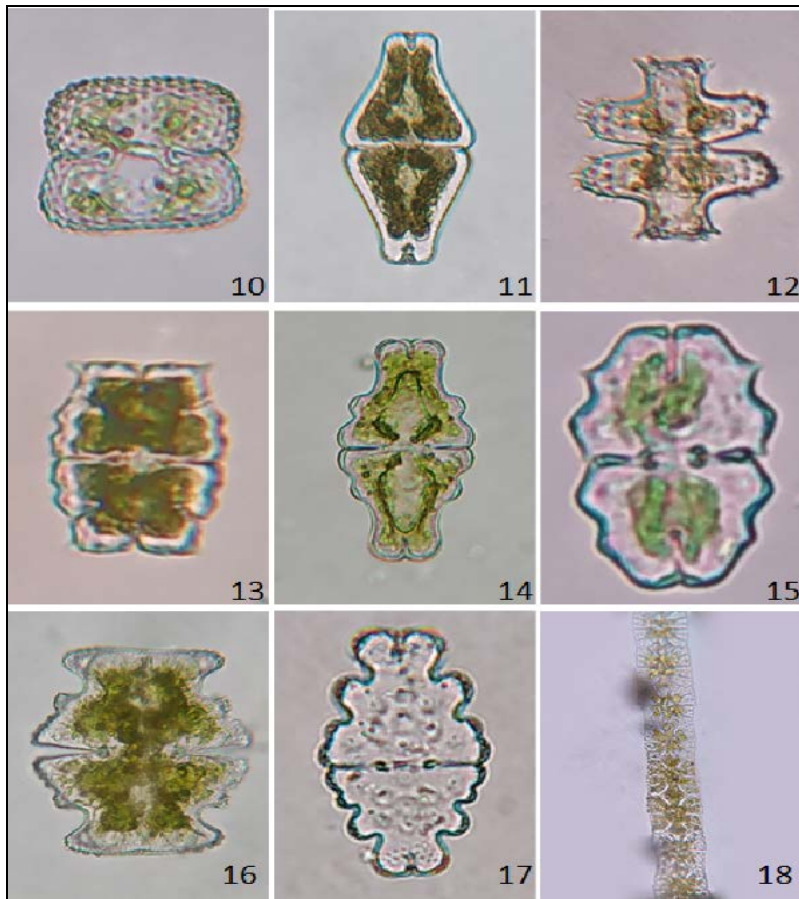


Plate 2: 10. *Cosmariu mquadrum* 11. *Euastrum ansatum* 12. *Euastrum ceylanicum* f. *majus* 13. *Euastrum denticulatum* 14. *Euastrum didelta* 15. *Euastrum elegans* 16. *Euastrum moebii* 17. *Euastrum oblongum* 18. *Micrasterias foliacea*.



Plate 3: 19. *Micrasteria sfurcata* 20. *Micrasterias mahabuleshwariensis* var. *mahabuleshwariensis* 21. *Micrasterias pinnatifida* 22. *Micrasterias thomasiana* 23. *Pleurotaenium ovatum* 24. *Pleurotaenium trabecula* var. *rectum* 25. *Pleurotaenium verrucosum* 26. *Gonatozygon aculeatum* 27. *Triploceras gracile*

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