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Research Article

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New Additions to the Freshwater Algae I - Chlorophyceae

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ABSTRACT

The algal biodiversity of Western Ghats (Idukki District, Kerala) is an unexplored area to a great extent. This is the first systematic study conducted on the 'Algal Flora of Western Ghats', and other parts of Idukki. Through extensive field visit during various seasons, algal specimens are collected, preserved and identified. The specimens are located with the help of a GPS and digital images are produced through advanced digital photomicrography. 19 new taxa belonging to the class Chlorophyceae are collected, identified as new to science and new reports from Indian subcontinent and Kerala state. The collections are preserved at the Algal Research Division of the Research Centre at Sacred Heart College, Thevara, Cochin, Kerala.

Keywords*: Algal biodiversity, GPS, digital photomicrography, Western Ghats, endemic.*

INTRODUCTION

Biodiversity provides the basis of life on earth. With the explosive growth of human population, the life supporting system of earth is becoming increasingly threatened as the rate of global change accelerates. India is not an exception to such an extent of biodiversity depletion mainly due to man-made endeavors.

Monographing the algal flora of India was started as early as 1959. However, so far no systematic study has been conducted on the algal flora of fresh waters of Kerala[1]. The present investigation is an attempt to systematically study the freshwater algal flora of Western Ghats (Idukki District, Kerala, India), one of the biodiversity hotspots in the world which is an unexplored virgin land enriched with great many a species of algae. It shows tremendous diversity and uniqueness with respect to geographical, topographical and climatic conditions. The highlands slope down from Western Ghats, which rise to an average height of 900 meters, with a number of peaks well over 1900 m in height, where the temperature is very low especially during winter; temperature varying between -1ºC - 15ºC in November/January and 5ºC to 15ºC during March/April. This area receives plenty of rains from both the South-West monsoon during June-August and the North-East monsoon during October-November.

MATERIALS AND METHODS

This study comprised of extensive field visit to different parts of the Western Ghats region of Idukki district during various seasons. Algal samples were collected with the help of plankton net, in the case of smaller forms and direct mass collection for larger ones. Collections were made from the surface level, shallow bed, underside of rocks, mucilage masses attached to dripping rocks, tree trunks, streams, pools, rocky water bodies, ditches, canals, etc. Algal specimens are collected, preserved and identified. The specimens are located with the help of a GPS. The temperature and pH were noted. Digital images of various taxa are taken with the help of a digital camera attached to the microscope and are transferred to the computer for further analysis.

RESULTS AND DISCUSSION

1. *Monoraphidium elongatum* sp. nov. (Plate 1, Figs. 1-4)

Sub-Family : Ankistrodesmoideae
Family : Chlorellaceae
Order : Chlorococcales

The cells are fusiform, mostly straight or curved with pointed ends[2]. Cells joined together to give rise to threads of considerable length. 5-6.5µm wide filaments. Chloroplast one, parietal and trough-shaped; pyrenoids many, distinct.

Habitat: Village pond

Collection No. **243** [N 09 50' 46.32"; E 77 01' 07.72"; pH 8.1; Temp 22^0C]

2. *Chaetonema bulbosa sp. nov.* (Plate 1, Figs. 5-6)

Family : Chaetophoraceae
Order : Chaetophorales

Thallus epiphytic on spirogyra filaments; cylindrical, branched, filamentous, olive green colour; cells 2-2.5µm in diamenter, 15-25µm in length; chloroplastparietal, several pyrenoids scattered in the cytoplasm. Balloon like structures are seen at the tip of some of the branches which in turn give rise to two or many branches. These structures are 7-9µm x 9-11µm in size.

Habitat: Paddy field converted to tapioca cultivation

Collection No. **214(2)** [N 09 56' 10.22"; E 76 46' 43.18"; pH 7.9; Temp 26^0C]

3. *Onychonema laeve* Nordst var. *ovatum* var. nov. (Plate 1, Fig.7)

Family : Desmidiaceae
Order : Zygnematales

Cell body 10-12µm long, 15-18µm wide, constriction 4-5.5µm wide; semicells oavate ellipsoidal or reniform[3], from each side single short spines directing inward; apex flat with two long projections to connect with adjoining cell.

Habitat: Canal made in a paddy field converted to rubber cultivation

Collection No. **229(1)** [N 09 57' 17.04"; E 76 47' 03.21"; pH 7.6; Temp 26^0C]

4. *Cosmarium spinulosa* sp. nov. (Plate 1, Figs. 8-9)

Family : Desmidiaceae
Order : Zygnematales

Cells solitary or in short chains of (2-4 cells) with deep median constriction (isthmus). Semicells reniform, with a single large pyrenoid (10µm in diameter). Chloroplast notched at the poles and concave at the isthmus region. Cell wall smooth when young and with short spinules on maturity. Nucleus in isthmus. Asexual reproduction by cell division. Mitosis followed by cytokinesis at isthmus. Cells 32-45µm long, 22-30µm wide, isthmus 5-7µm.

Habitat: Canal made in a paddy field converted to rubber cultivation

Collection No. **229(1)** [N 09 57' 17.04"; E 76 47' 03.21"; pH 7.6; Temp 26^0C]

5. *Cosmarium spinoreniformis* sp. nov. (Plate 1, Fig. 10)

Family : Desmidiaceae
Order : Zygnematales

Cells solitary with deep median constriction (isthmus)[4]. Semicells reniform. Cell wall smooth with a single spine on opposite side of the semi cells. Nucleus in isthmus. Asexual reproduction by cell division. Mitosis followed by cytokinesis at isthmus. Cells 30-45µm long, 32-38µm wide, Isthmus 10-12µm.

Habitat: Hill stream

Collection No. **57** [N 9 49' 15.94"; E 76 50' 35.10"; pH 8.7; Temp 22^0C]

6. *Cosmarium bikopa* sp. nov. (Plate 1, Fig. 11)

Family : Desmidiaceae

Order : Zygnematales

Cells solitary with deep closed median constriction (isthmus). Semicells *kopa* (tea cup) shaped. Cell wall smooth and notched at the poles. Chloroplast filling the entire cell with a single prominent pyrenoid in each semi cell. Cells 22-30µm long, 12-17µm wide, Isthmus 5-7µm.

Habitat: Roadside ditch

Collection No. **90** [N 10 03' 52.39"; E 77 04' 00.64"; pH 10.3; Temp 19^0C]

7. *Closterium francia* sp. nov. (Plate 1, Fig. 12)

Family : Desmidiaceae

Order : Zygnematales

Cell solitary, (120-170µm long), usually elongate-cylindric to elongate-fusiform, curved. Cells usually tapering toward both ends; ends rounded. Cell wall smooth, wall colorless; in median region, slightly elevated on the concave side. Chloroplasts two per cell, axial, elongate, with fimbricate margins. Pyrenoids many, larger in the central region and smaller in the sub-polar region, usually clumped.

Habit: River Periyar

Collection No. **188** [N 09 57' 02.11"; E 76 59' 01.05"; pH 7.6; Temp 21^0C]

8. *Closterium granulopolaris* sp. nov. (Plate 1, Fig. 13)

Family : Desmidiaceae

Order : Zygnematales

Cell solitary, (240-280µm long), usually elongate-fusiform. Cells usually tapering toward both ends; ends pointed. Cell wall smooth, wall colorless; in median region, slightly elevated on the concave side. Chloroplasts two per cell, axial, elongate, with undulate margins. Pyrenoids many, in a single row, of uniform size; each end of cell with vacuole containing a bunch of granules.

Habitat: Paddy field

Collection No. **213(2)** [N 09 56' 02.20"; E 76 47' 01.34"; pH 8.2; Temp 26^0C]

9. *Closterium granulopolaris* sp. nov. var. *lunaris* var. nov. (Plate 1, Fig. 14)

Family :Desmidiaceae

Order : Zygnematales

Cell solitary, (270-320µm long), usually elongate-fusiform and lunar shaped. Cells usually tapering toward both ends; ends pointed. Cell wall smooth, colourless; in median region, slightly elevated on the concave side. Chloroplasts two per cell, axial, elongate, with undulate margins. Pyrenoids not well distinct; each end of cell with vacuole containing a bunch of granules.

Habitat: Paddy field

Collection No. **247** [N 09 54' 49.92"; E 76 49' 00.67"; pH 9.1; Temp 20^0C]

10. *Closterium bumeranga* sp. nov. (Plate 1, Fig. 15)

Family : Desmidiaceae

Order : Zygnematales

Cell solitary, (60-80µm long), usually elongate-bumerang shaped. Cells usually tapering toward both ends; ends blund. Cell wall smooth, wall colorless and slight thick. Chloroplasts two per cell, axial, elongate. Pyrenoids distinct, two in each semi cell.

Habitat: Uncultivated paddy field

Collection No. **267** [N 09 57' 56.80"; E 76 44' 35.51"; pH 6.9; Temp 26^0C]

11. *Micrasterias mahabuleshwarensis* Hobs. var. *quadrifida* var. nov. (Plate 1, Fig. 16)

Family : Desmidiaceae

Order : Zygnematales

Cells large (400µm long), solitary with very deep median constriction (isthmus). Other shallow or deep incisions divide each semicell into apical lobe and two lateral lobes, each further subdivided to form four lobes. Several species with small or large protuberances or hollow processes, either near base or middle of each semicell, or on one or more of peripheral lobes. Cell wall smooth with numerous granules or spinules, either covering most of cell. Chloroplast one per semicell, with numerous scattered pyrenoids.

Habitat: River side stream

Collection No. **308** [N 09 56' 21.57"; E 76 48' 07.56"; pH 6.3; Temp 31^0C]

12. *Spirogyra violacea* sp. nov. (Plate 1, Figs. 17-19)

Family : Desmidiaceae

Order : Zygnematales

Vegetative cells 64-72µm x 145-190µm; septa plane; chloroplasts 2, making 2-3 turns. Conjugation scalariform; tubes formed by both gametangia; female gametangia cylindric, inflated up to 55µm in diameter, zygospore ellipsoid, 32-56µm x 70-82µm, mesospore slightly brownish and smooth.

The present taxon differs from *S. microspora* where conjugation is lateral and mesopore is yellow. Also it is having a characteristic blue-violet colour in the cell.

Habitat: Rocky forest stream

Collection No. **245** [N 09 49' 18.91"; E 76 54' 39.45"; pH 8.4; Temp 20^0C]

13. *Spirogyra chelachuvedensis* sp. nov. (Plate 1, Figs. 20-22)

Family : Desmidiaceae

Order : Zygnematales

Vegetative cells 26-30µm x 130-170µm; septa plane; chloroplasts 3, making 3-4 turns. Conjugation scalariform; tubes formed by both gametangia; female gametangia cylindric, inflated up to 48 mm in diameter, zygospore compressed ellipsoid, 32-35µm x 65-75µm, mesospore thick, golden brown and smooth.

Habitat: Village stream

Collection No. **94** [N 09 55' 09.17"; E 76 57' 51.72"; pH 8.9; Temp 23^0C]

14. *Spirogyra karimannurensis* sp. nov. (Plate 1, Figs. 23-24)

Family : Desmidiaceae

Order : Zygnematales

Vegetative cells 26-30µm x 170-220µm; septa plane; chloroplasts 3, making 2-3 turns. Conjugation scalariform; tubes formed by both gametangia; female gametangia cylindric, inflated up to 60µm in diameter, zygospore ovoid-ellipsoid, 40-44µm x 65-70µm, mesospore thin walled without any colour and smooth.

Habitat: Paddy field

Collection No. **250** [N 09 54' 59.21"; E 76 46' 31.94"; pH 7.6; Temp 24^0C]

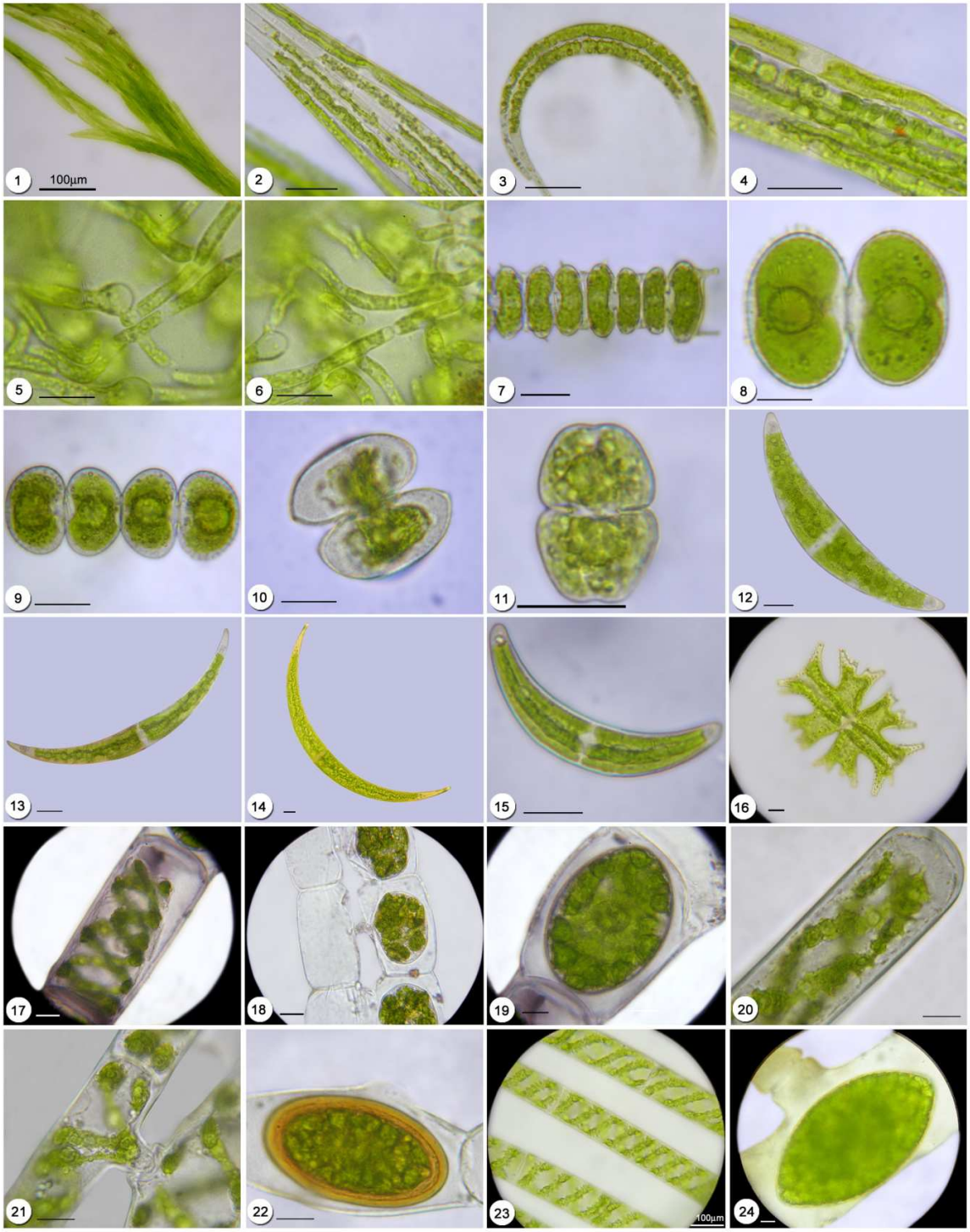

PLATE 1
Figures 1 - 24 Scale Bar = 10µm

15. *Spirogyra thankamaniensis* sp. nov. (Plate 2, Figs. 25-28)

Family : Desmidiaceae

Order : Zygnematales

Vegetative cells 40-45µm x 330-390µm; septa plane; chloroplasts 3, making 1-1.5 turns. Conjugation scalariform; tubes formed by both gametangia; there are two types of zygospores, one elongated and compressed and the other ellipsoid; the elongated spore producing gametangium is not inflatted while the latter producing gametangia is inflated up to 35µm in diameter, and the spore is 25-30µm x 40-42µm, elongated zygospore is 20-22µm x 50-55µm; mesospore thick, yellowish brown and smooth. Both types of zygospores are produced in a double scalariform conjugation.

Habitat: Slow running stream

Collection No. **242** [N 09 51' 10.11"; E 77 00' 38.79"; pH 8.7; Temp 23^0C]

16. *Hyalotheca dissiliens* (Smith) Brebisson var. *elongata* var. nov. (Plate 2, Fig. 29)

Family : Desmidiaceae

Order : Zygnematales

Cell body 22-25µm long, 12.5-13.5µm wide; dumb-bell shaped cells.

Habitat: River

Collection No. **179** [N 10 00' 57.29"; E 76 47' 32.51"; pH 5.6; Temp 21^0C]

17. *Pleurotaenium simplicissimum* Gronbl. var. *longum* var. nov. (Plate 2, Figs. 30-33)

Family : Desmidiaceae

Order : Zygnematales

Cells very long and slender, about 25 times as long as wide; margins undulate at the centre, and not extending to the entire length; poles slightly dilated, truncate; 870-930 µm long, 25-35µm wide; isthmus 30-32µm.

Habitat: Village pond

Collection No. **243** [N 09 50' 46.32"; E 77 01' 07.72"; pH 8.1; Temp 22^0C]

18. *Staurastrum tohopekaligense* Wolle var. *trifurcatum* West fa. *bulbobizonata* fa. nov. (Plate 2, Figs. 34-36)

Family : Desmidiaceae

Order : Zygnematales

Cell body 32-47µm long, 30-65µm wide, isthmus 16µm. There are two layers of bulbous projections on either side of the isthumus.

Habitat: Paddy field converted to pineapple cultivation

Collection No. **229** [N 09 57' 17.04"; E 76 47' 03.21"; pH 7.6; Temp 26^0C]

19. *Staurastrum echinata* sp. nov. (Plate 2, Fig. 37)

Family : Desmidiaceae

Order : Zygnematales

Cell body 50-65µm long, 65-75µm wide, central region wide; isthmus 20µm. Each semi cell with two hollow processes arising from the corners of the radiations; each process with three spinules and two to many verrucae.

Habitat: Canal made between coconut palms

Collection No. **231** [N 09 56' 50.87"; E 76 47' 23.64"; pH 9.1; Temp 20^0C]

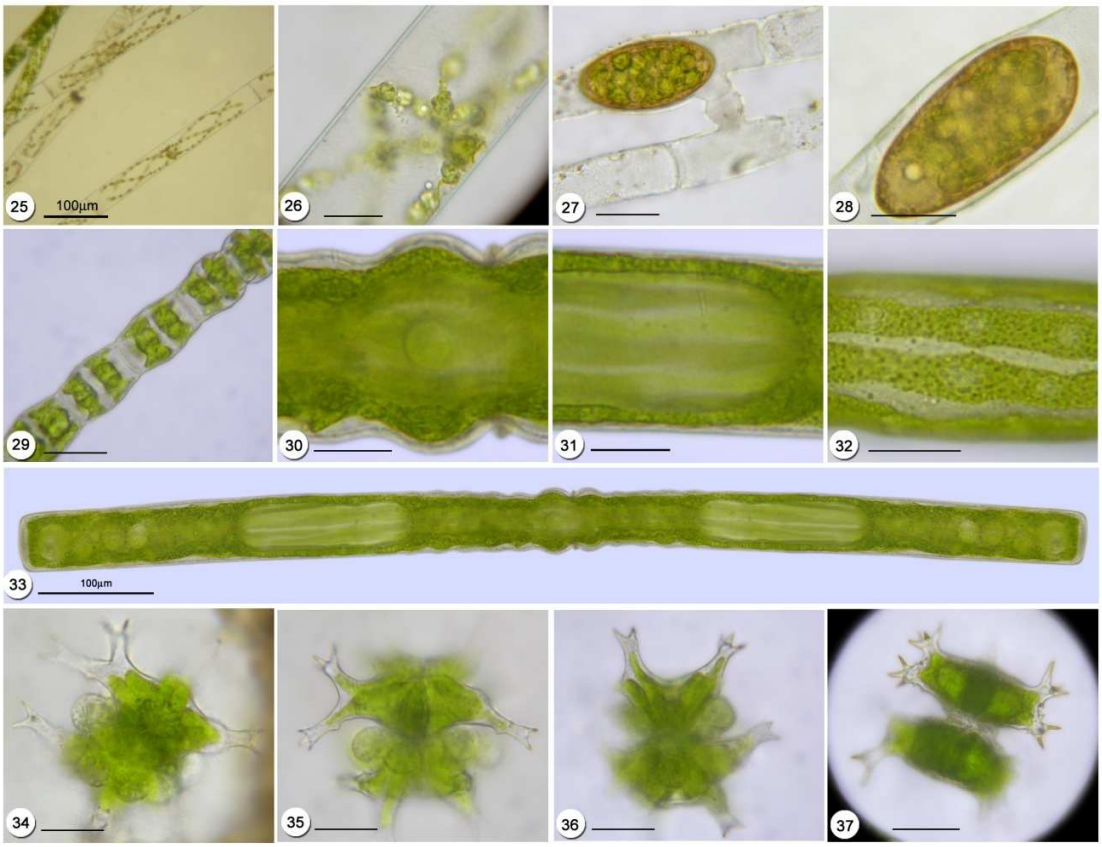

PLATE 2

Figures 25 - 37 Scale Bar = 10µm

CONCLUSION

The Western Ghats region of Idukki with tropical ever green forest and rich freshwater resources is rich in microalgal diversity. In the present study, out of the 19 new reports of the class Chlorophyceae, 13 are new species, 5 are new varieties and 1 is a new form. Being the primary producers in the grazing food chain, microalgae hold the key for the productivity of all water bodies. All animals living in water are directly or indirectly linked with microalgae in their life cycle. Mapping and enlisting all these taxa is the preliminary step to understand their links with other life forms.

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