CYANOPHYCEAEN AND CHLOROPHYCEAEN FLORA OF SIKKIM HIMALAYAS, INDIA

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ABSTRACT

The present paper enumerates 30 taxa of fresh water algae, in which 18 belong to the class Cyanophyceae, order Chroococcales and 12 Chlorophyceae taxa, orders Cladophorales, Oedogoniales, Chlorellales, Zygnematales and Udostichales. Species were identified from collected samples of high altitudinal zones of Sikkim Himalayas. All taxa have been reported for the first time from the study area.

Key words: Cyanophyceae, Chlorophyceae, Sikkim Himalayas

INTRODUCTION

The study of fresh water algal flora of high altitudinal zones of India has not been given due attention. A few records of Alfred (1973) from eastern Himalaya, Singh and Gupta (2000) from Arunachal Pradesh, Gupta (2000) from Meghalaya, Khare and Suseela (2004) from Uttarakhand gave some accounts of fresh water algae. Algal flora of Sikkim state has not been well studied, except some cursory reports of Sarita (1984), Prasad and Misra (1987) from Gangtok and its surrounding areas. This suggests that no serious effort has been made to explore the algal flora of Sikkim Himalayas.

Sikkim state due to its proximity to Himalayas faces extreme climatic conditions. On an average the maximum temperature records 20°C and minimum 12°C. Rainfall occurs throughout the year and state as a whole gets 80-90% of the annual rainfall during monsoon. The main source of water in small water bodies like pools, ditches, streams are from water falls and glaciers. Fresh water algal flora of different altitudinal ranges (1300-1700 m) of Sikkim has been surveyed.

MATERIALS AND METHODS

Samples were collected from pools, ditches, splashed rocks, slow-running streams, water falls and moist soils of three distinct places with different altitudinal ranges: Namchi, 1525 m; Gangtok, 1700 m and Rumtek Monastery, 1700 m during the year 2000 and 2001. These samples were preserved in 10% formalin and deposited at Phycology laboratory of National Botanical Research Institute, Lucknow. During microscopic observations, micro photographs were taken in Leica AYC 2000 research microscope.


SPECIES ENUMERATION

Class: Cyanophyceae
Order: Chroococcales
Family: Chroococceae
Anacystis rapestris (Lyng.) Drouet and Daily Pl. 1, Fig. 10
(Tiffany and Britton 1952, p. 331, Pl. 89, Fig. 1039)
Cells cylindrical, free floating, 6-2 μm in diameter, cell content blue green, homogeneous.
Locality: Small water stream at Namchi towards Namthang and Siliguri.
Sample No.: NBRI, ALSH-0188.

Aphanotoche castigata (Kutz.) Rabenh. Pl. 1, Figs. 14 and 20
(Desikachary 1959, p. 106, Pl. 26, Fig. 13)
The cells are oval to cylindrical, 3.6-4 μm in diameter and 6-8 μm long surrounded by thick mucilaginous sheath, the cell content blue green and homogeneous.
Locality: Small water stream at Namchi towards Namthang and Siliguri.
Sample No.: NBRI, ALSH-0188.

Aphanotoche stagnina (Kutz.) Nog Pl. 1, Fig. 18
(Desikachary 1959, p. 142, Pl. 22, Figs. 4, 5 and 9)
Thallus small, gelatinous, cells longer than broad, oblong cylindrical, 4.5 μm in long, 2.3 μm broad, cell content blue green, homogeneous.
Locality: A small water tank at Gandhi market in Gangtok.
Sample No.: NBRI, ALSH-023.

Chroococcus minimus (Kess.) Lemm Pl. 1, Figs. 12 and 19
(Desikachary 1959, p. 106, Pl. 26, Fig. 13)
Colonies 2-8 cells, enclosed by thin mucilaginous sheath, each cell spherical to ellipsoidal with 4.5 μm in diameter.
Locality: From stagnant water at the road side, Gangtok.
Sample No.: NBRI, ALSH-08.

Chroococcus minor (Kutz.) Nog Pl. 1, Fig. 1
(Desikachary 1959, p. 105, Pl. 24, Fig. 1)
Cells spherical in pairs, 4 μm in diameter, enclosed by thin mucilaginous sheath, cell content blue green, homogeneous.
Locality: On stagnant water at the road side, Gangtok.
Sample No.: NBRI, ALSH-08.

Chroococcus montanus (Hance Pl. 1, Fig. 2
(Desikachary 1959, p. 106, Pl. 26, Fig. 12)
Thallus mucilaginous, cells hemi-spherical in shape, 5.2 μm in diameter, enclosed by thin mucilaginous sheath, the cell wall thin and smooth.
Locality: Squeezed from submerged plants below the water fall towards Hanumanthak.
Sample No.: NBRI, ALSH-027.

Chroococcus schizodermatius West Pl. 1, Fig. 23
(Desikachary 1959, p. 103, Pl. 26, Fig. 17)
Cells in groups of 2-4, oval in shape, 7.2 μm in diameter, enclosed by thick mucilaginous sheath, lamellated, cell content blue green with smooth cell wall.
Locality: A pool below the water fall in front of Rumtek Monastery.
Sample No.: NBRI, ALSH-049.

Chroococcus varius Braun Pl. 1, Figs. 16 and 24
(Prescott 1951, p. 451, Pl. 100, Fig. 15)
An irregular shaped colony of 2-8 spherical cells enclosed by thick hyaline mucilaginous sheath, cell content blue green, homogeneous, cells 2.8 μm in diameter.
Locality: From stagnant water at the road side, Gangtok.
Sample No.: NBRI, ALSH-08.
Gloeocapsa atrata (Turp.) Kutz Pl. 1, Fig. 5
(Desikachary 1959, p. 139, Pl. 27, Fig. 6)
Thallus mucilaginous with 2-4 cells, spherical, surrounded by thin mucilaginous sheath, 4.5 μm in diameter, cell content blue green, homogeneous.
Locality: Small water stream at Namthang and Siliguri.
Sample No.: NBRI. ALSH 188.

Gloeocapsa coriacea Kutz Pl. 1, Fig. 8 and 13
(Desikachary 1959, p. 121, Pl. 34, Fig. 11)
Cells spherical, 3 μm in diameter, surrounded by thin mucilaginous sheath, cell wall thick and smooth.
Locality: Squeezed from submerged plants below the water fall towards Hamman tok and on surface moist soil at the forest department of Gangtok.
Sample No.: NBRI. ALSH-013, 027.

Gloeocapsa decorata (Abr.) Richter Pl. 1, Fig. 4
(Desikachary 1959, p. 114, Pl. 24, Fig. 9)
Cells spherical, single or up to 2-4 together, 6.2 μm in diameter, enclosed by thick gelationous sheath, lamellated, cell content blue green, homogeneous.
Locality: A road side water tank at Gangtok and small water stream at Namchi towards Namthang and Siliguri.
Sample No.: NBRI. ALSH-03, 0188.

Gloeocapsa gelatinosa Kutz Pl. 1, Figs. 17 and 19
(Desikachary 1959, p. 139, Pl. 27, Fig. 6)
Cells spherical, 3.8 μm in diameter, enclosed by thick hyaline mucilaginous sheath, lamellated, cell content blue green, homogeneous.
Locality: Small water stream at Namchi towards Namthang and Siliguri.
Sample No.: NBRI. ALSH-0188.

Gloeocapsa montana Kutz Pl. 1, Figs. 2, 3, 15 and 21.
(Desikachary 1959, p. 123, Pl. 24, Fig. 14)
Cells spherical, 5.2 μm in diameter, single or two together in a colony, enclosed by thick hyaline mucilaginous sheath, lamellated, cell content blue green, homogeneous.
Locality: Small water stream at Namchi towards Namthang and Siliguri and in stagnant water of roadside pool in Gangtok.
Sample No.: NBRI. ALSH-08, 0188.

Gloeocapsa polydermatica Kutz Pl. 1, Fig. 22
(Desikachary 1959, p. 115, Pl. 25, Fig. 6)
Thallus mucilaginous, compact, cells spherical, 4.5 μm broad, cell content blue green, homogeneous.
Locality: Small water stream at Namchi towards Namthang and Siliguri.
Sample No.: NBRI. ALSH-0188.

Gloeocapsa kuetzingiana Nag Pl. 1, Fig. 11
(Desikachary 1959, p. 119, Pl. 23, Fig. 4)
Thallus mucilaginous, consists 4 small cells, spherical, 3.2 μm broad, enclosed by thin mucilaginous sheath, cell content blue green, homogeneous.
Locality: Small water stream at Namchi towards Namthang and Siliguri.
Sample No.: NBRI. ALSH-0188.

Merismopedia glauca (Bhr) Nag Pl. 1, Fig. 6
(Desikachary 1959, p. 155, Pl. 29, Fig. 8)
Cells regularly arranged in rectangular structure with crenate margin, cells ovate, hemispherical, 2-2.3 μm in diameter, cell content blue green, homogeneous.
Locality: On rocks with splashed water near water fall in front of Rumtek Monastery.
Sample No.: NBRI. ALSH-049.

**Merismopedia elegans** A. Br. Pl. 1, Fig. 25
(Desikachary 1959, p. 150, Pl. 29, Fig. 9)
Colonies small with 16 celled, cells oblong, closely arranged having 5.5-6.0 μm in diameter, free floating.

**Locality:** On rocks splashed by water at Rumtek Monastery.

Sample No.: NBRI. ALSH-0131.

**Microcystis bengalesis** Benerji Pl. 1, Fig. 26
(Desikachary 1959, p. 89, Pl. 19, Fig. 56)
Colonies irregularly branched, cells cylindrical, 3.5 μm in diameter, sheath distinct, surrounds the number of daughter colonies.

**Locality:** A small tank on the roadside at Gangtok view point.

Sample No.: NBRI. ALSH-0133

Class: Chlorophyceae

Order: Cladophorales

Family: Cladophoraceae

**Cladophora glomerata** (Linna.) Kuetz. Pl. 2, Fig. 13
(Tiffany and Britton, 1952, p. 45, Pl. 13, Fig. 93)
Cells of main axis 20.2 μm long, 15.8 μm broad and branching in Y shaped structure, 11.5 μm long, 12.2 μm broad often a glomerate clusters with reticulate chloroplast.

**Locality:** A small pool at the Gangtok view point.

Sample No.: NBRI. ALSH-0106

**Cladophora lactevirens** (Dillw.) Kuetz Pl. 2, Fig. 6
(Prasad and Misra 1992, p. 54, Pl. 7, Fig. 6)
Epithel, branching of the filament pseudo-dichotomous, cells of main axis 31.5 μm long, 60 μm in diameter, cells of branchlets 50.6 μm long, 25.2 μm in diameter.

**Locality:** On rocks splashed by water at Namchi.

Sample No.: NBRI. ALSH-092

Order: Oedogoniales

Family: Oedogoniaceae

**Oedogonium gracilis** (Tiffany) Wittrock Pl. 2, Fig. 10
(Prescott 1951, p. 170, Pl. 29, Fig. 2)
Vegetative cells cylindrical, 18.5 μm in diameter, 12.8 μm long, oogonium solitary ovoid, globose, 38.5 μm in diameter, 35 μm long with a superior opening pore, oospore globose, 40 μm in diameter, filling the oogonium.

**Locality:** On rocks splashed by water at Namchi.

Sample No.: NBRI. ALSH-0102

This species is narrower than those reported by Prescott (1951), in which the vegetative cell 20.75 μm and oogonium 44.46 μm in diameter.

**Oedogonium subanulatum** Tiffany and Button Pl. 2, Figs. 5 and 12
(Prasad and Misra 1992, p. 233, Pl. 11, Fig. 10)
Macrothecae, monoeocious, vegetative cells cylindrical, 13 μm diameter, 40 μm long, oogonium solitary, ellipsoidal, 36.2 μm long, 33 μm broad, oospore broadly ellipsoidal, fill the oogonium.

**Locality:** On rocks splashed by water at Namchi.

Sample No.: NBRI. ALSH-0192.

**Oedogonium varians** Witt et Lund Pl. 2, Fig. 3
(Prasad and Misra 1992, p. 73, Pl. 11, Fig. 6)
Macrothecae, monoeocious, vegetative cells cylindrical, 13.5 μm in diameter, 50-55 μm long, oogonium solitary, depressed, globose, 38.5 μm broad, 32.8 μm long, oospore globose and 29.5 μm in diameter, fill the oogonium.

**Locality:** A small pool at the Gangtok view point.

Sample No.: NBRI. ALSH-0106.
Order: Chaetophorales
Family: Chaetophoraceae

*Stigeoclonium tenue* (Agar.) Kuetz Pl. 2, Fig. 1
(Kant and Gupta 1998, p. 109, Pl. 108, Fig. 3)
Filament dichotomously branched, branches always solitary, opposite, cells 5-6.8 μm long and 7.2 μm in diameter.
**Locality:** Small stream on the way of Gangtok viewpoint.
**Sample No.:** NBRI. Al SH-0148.
**Order:** Zygnematales
**Family:** Zygnemataceae

*Spirogyra exilis* W. et. W.S. West Pl. 2, Fig. 1
(Ramlahawa 1959, p. 323, Fig. 305)
Vegetative cells long, cylindrical, 70 μm long and 20.8 μm in diameter with plane end wall, the chloroplast 3-5 turns, conjugation scalariform, sterile cell cylindrical, zygospore ovoid with rounded ends having 40 μm length and 21.2 μm width.
**Locality:** A small ditch on road side at Gangtok taxi stand.
**Sample No.:** NBRI. Al SH-0129.

The diameter of vegetative cell and zygospore are smaller than those reported by Prasad and Misra (1992) from Andaman Nicobar having 24.5-37 μm in diameter and 29-32 μm broad.

*Spirogyra indica* Rao. Pl. 2, Fig. 2
(Araud 1998, p. S4, Fig. 167)
Filaments long, cylindrical, cells 73-8 μm long, 22.5 μm in diameter with plane end wall chloroplast single, solitary, spirally arranged in ribbon like structure with 2-3 turns, conjugation by tubes from both gametangia, fertile cell cylindrical (some times slightly swollen), zygospores spherical, laterally compressed with 32.5 μm in diameter.
**Locality:** A small ditch on road side at Gangtok taxi stand.
**Sample No.:** NBRI. Al SH-0129.

*Spirogyra pratensis* Trancou Pl. 2, Fig. 9
(Prasad and Misra 1992, p.87, Pl. 14, Figs. 5, 7)
Vegetative cells 18.2 μm in diameter, 60 μm long with plane end walls having single spiral chloroplast making 2-3 turns, conjugation scalariform, tubes formed by both gametangia, fertile cell fusiform inflated upto 34.5 μm in diameter, zygospores ellipsoid 21 μm broad, 40 μm long.
**Locality:** In the water stream near water fall towards Haanuman tok.
**Sample No.:** NBRI. Al SH-0129.

*Zygema unneigenum* Ramlahawa. Pl. 2, Fig. 7
(Kant and Gupta 1998, p. 122, Pl. 56, Fig. 6)
The vegetative cells elongated, cylindrical, 18 μm in diameter, 100 μm long, each cell having two star shaped chloroplasts with single pyrenoid.
**Locality:** A small pool at Gangtok viewpoint.
**Sample No.:** NBRI. Al SH-0106.

*Zygema pectinatum* (Vatellini C.A. Agardh.) Pl. 2, Fig. 8
(Triffey and Britton 1952, p. 138, Pl. 42, Fig. 446)
Vegetative cells are cylindrical, 80 μm long, 25.8 μm in diameter, each cell having two star shaped chloroplast with single pyrenoid, the zygospore globose to ovoid 15.5 μm broad in the conjugation tube with medium spore wall which is thick and smooth.
**Locality:** On rocks splashed by water at Namchi.
**Sample No.:** NBRI. Al SH-0192.

**Order:** Ulvales
**Family:** Ulvaceae

*Ulothrix tenuissima* Kuetz Pl. 2, Fig. 11
(Kant and Gupta 1998, p. 102, Pl. 32, Fig. 5)
Vegetative cells much broader than length, quadrat, 20 μm in diameter, 12.8 μm long, chromatophore usually in a median band with 2-4 pyrenoids.
**Locality:** A small water spring at Namchi.
**Sample No.:** NBRI. Al SH-0186
Plate 1. Figs. 1. Cladonia cristatella (Kuntze) Nyl., Figs. 2, 3, 13 and 21. Gloeocapsa montana Kütz., Fig. 4. Gloeocapsa decorticata (A. Br.) Richter, Fig. 5. Gloeocapsa atrata (H. C. J.) Kütz., Fig. 6. Merismopedia glauca (Hunt) Nag. Fig. 7. Cladonia conspersa Hundsgr., Figs. 8 and 13. Gloeocapsa coronaria Kütz., Fig. 10. Alectoria nigrescens (Usnea) Drouet and Denny., Fig. 11. Gloeocapsa liensiana Nag., Figs. 12 and 19. Cladonia minimum (Keissl.) Lemm., Figs. 14 and 20. Aphanoplecta castanea (Kuntze) Rabenh., Figs. 16 and 24. Cladonia varia Braun., Figs. 17 and 20. Gloeocapsa gelatinosa Kütz., Fig. 18. Aphanoplecta uralensis Nag., Fig. 22. Gloeocapsa polycladonata Kütz., Fig. 23. Cladonia schradeniana West., Fig. 25. Merismopedia elegans A. Br., Fig. 26. Microcyclus hongkongensis B. Rejegi.
Plate 2. (Fig. 1. Stigmenia hamata (Agardh) Kuetz., Fig. 2. Sprirogyra lanceolata Rau., Fig. 3. Ostergonion varians Wüetrock et Lundell., Fig. 4. Sprirogyra exilis W. et. W. S. West., Figs. 5 and 12. Ostergonion subcarinatum Eichh. and Britton., Fig. 6. Cladophora haulovae (Dillw.) Kuetz., Fig. 7. Zygmenia microspora Randiwa., Fig. 8. Zygmenia pectinatum (Vinet-H.) Agardh., Fig. 9. Sprirogyra procerus Transfer., Fig. 10. Ostergonion gracilis (Eichh.) Wüetrock., Fig. 11. Ulbriix tenella (Kuetz., Fig. 13. Cladophora glomerata (Linn.) Kuetz.).
RESULTS AND DISCUSSION

During the course of the present investigation, a total of 30 taxa of two different classes Cyanophyceae and Chlorophyceae have been studied on the basis of morpho-taxonomic observations. Out of thirty taxa, the genus *Gloecapsa*, *Chroococcus*, *Oedogonium* and *Spirogyra* are common in occurrence. While, the genus *Merismopedia*, *Aphanothece*, *Cladophora*, *Zygmena*, *Aparatius*, *Microcyrtis*, *Stegonolenium* and *Hedwigia* occurred in dominant form. The morpho-taxonomic variations are also observed in some taxa with that of rest of Indian algal flora. This variation could be due to the high altitude, low temperature and other climatic and ecological conditions of the locality.

ACKNOWLEDGEMENT

The authors are thankful to the Director, National Botanical Research Institute, Lucknow for his constant encouragement and laboratory facilities.

REFERENCES


