# Diversity of corticolous algae from Similipal Biosphere reserve, Mayurbhanj, Odisha

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**Abstract**

Similipal Biosphere Reserve an untapped reservoir of diverse algal resources, is located in the central part of the Mayurbhanj district of Odisha lies between 21° 28" and 22° 08" North latitude and 86° 04" and 86° 37" East longitudes. The present investigation aims to document diverse algal forms collected from tree bark surfaces of different collection sites of the Similipal Biosphere Reserve. A total of 19 species were recorded from 10 sampling sites of Biosphere during the study. Out of these, 18 were cyanobacteria and only one belonging to green algae. The major dominant cyanobacterial taxa were *Nostoc* (4) followed by *Gloeocapsa* (2), *Chroococcidiopsis* (2), *Aphanocapsa* (2), *Phormidium* (2), *Scytonema* (2), *Myxosarcina* (1), *Stigonema* (1), *Tolypothrix* (1), *Fischerella* (1) and a single species of green algae named *Desmococcus olevaceoous* were recorded during the study.

**Key words**: Corticolous algae, Diversity, Enumeration, Similipal Biosphere Reserve.

## Introduction

Corticolous algae are inhabitants of the bark of trees from the areas of different altitudes. They occur as dark, gelatinous, red dark or brown patches, streaks or velvet masses. They are exposed to air and absorb water, minerals and other nutrients directly from the atmosphere. Most studies on taxonomy and ecology of aerophytic algae were conducted in temperate regions with great emphasis on those occurring on soil, buildings and monuments (Harload and Schlichting, 1975; Metting, 1981; Starks *et al.*, 1981; Ortega-Calvo *et al.*, 1991; Broady and Ingerfeld, 1993; Flechtner *et al.*, 1998; Salleh and Millow, 1999; Gaylarde and Gaylarde, 1999; Rindi and Guiry, 2003; Rindi *et al.*, 2005; López-Bautista *et al.*, 2006; Uher, 2007; Lemes *et al.*, 2010; Zammit *et al.*, 2011). However, studies on the taxonomy of corticolous sub aerial algae are incomplete and limited due to the lack of exploration and seasonal collection of samples. There are a few workers who have worked on these aspects from different regions of the globe. (Rindi *et al.*, 2006; Neustupa and Škaloud, 2008, 2010; Mikter *et al.*, 2006). There is a marked difference between the sub aerial algal assemblages found in temperate and tropical countries (Islam, 1960). Many aspects of corticolous algae such as habitats, ecology and taxonomy are still poorly understood. Hence, the present investigation was carried out to assess the diversity of corticolous algae from Similipal Biosphere Reserve of Odisha state.

## Materials and Methods

### *Sampling of corticolous algae*

A visit was made to Similipal Biosphere Reserve to study the occurrence of sub-areal algal flora occurring on soil crust during May 2013. During field visit observations and collections were done randomly from various sites of Biosphere Reserve (Fig.1). Corticolous algae were collected from the tree barks from different regions of Similipal Biosphere Reserve (Plate-1). All samples were collected in sterile specimen tubes (Tarson) of 25 X 50 mm size using clean sampling bottles, forceps, polythene bags, brush, Petridis, scalpel etc. and brought to the laboratory for further analysis. For preservation the samples were dried and kept in a dark place assigned with a voucher number in P.G. Department of Botany, North Orissa University, Baripada, Mayurbhnaj, Odisha.

### *Micrometry, Photomicrography and Identification*

Samples are very difficult to identify in their natural form because of the crust or compact association with the tree bark. So these were first soaked with distilled water in petriplates and incubated under white light and the growth was observed under microscope in each at 24h interval. The pH of the soaked water was also recorded in the lab condition. After growth, each filament or colony or a consortia was taken for photomicrography. Two to 3 slides were prepared from each sample and observed under compound microscope, and the characters were enumerated. Photomicrographs were taken using Hund Wetzlar trinocular Compound Microscope with Canon-EOS 550D camera attachment. Micrometry was done using ocular and stage micrometers (Erma, Japan) to determine the cell dimensions. The algal species were identified using the monographs and standard literatures as follows: Geitler (1925), Desikachary (1959), Komárek and Anagnostidis (1999, 2005).

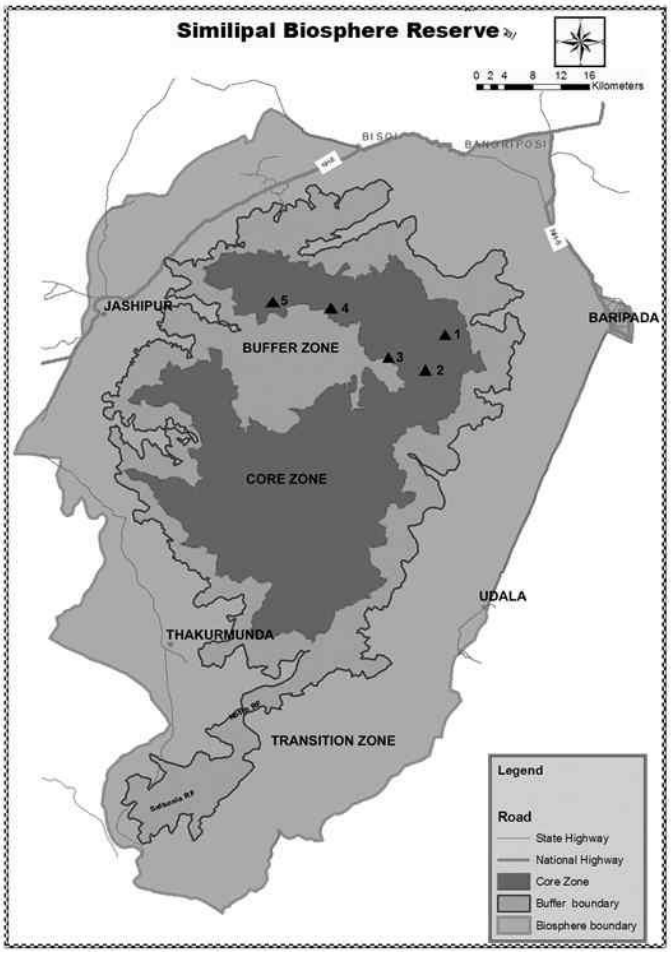


**Fig. - 1: Sampling sites of corticolous algae from Similipal Biosphere Reserve (1-5): 1.Badamakabadi, 2,3. Nawana, 4. Barehipani, 5. Chahala**.

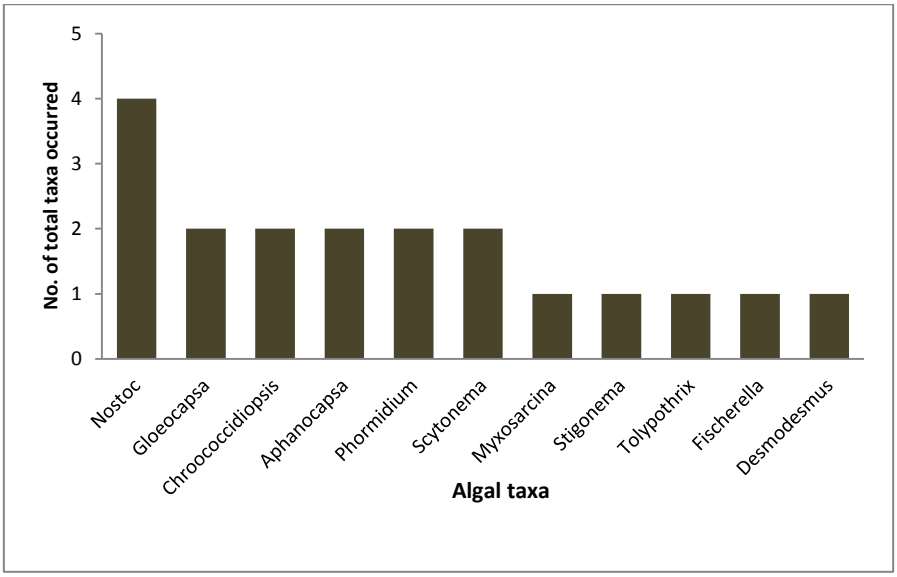


**Fig. 2: Occurrence of algal taxa under different genera of the tree barks from Similipal Biosphere reserve.**

**Plate-1(Figs. 1-5): Collection and isolation of corticolous algae from Similipal Biosphere reserve, Odisha; 1-3: mode of occurrence of algae on tree bark; 4-5: Soaking and Colony separation in agar plate.**

***Culture conditions and maintenance***

The isolated algal species were cultured in the BG-11 (+/- N) solid and broth medium (Rippka *et al.*, 1979). The unialgal species were maintained in agar slants in glass screw cap tubes containing 1.2% (W/V) agar-agar in the basal inorganic medium and in 100 ml capacity conical flasks containing 50 ml medium. They were maintained in culture racks in a temperature-controlled room at 25±1°c under continuous light intensity of 7.5 W/m² from day light fluorescent tubes and examined from time to time.

**Results**

***Systematic enumeration***

**1. *Gloeocapsa lignicola* Rabenhorst (Pl.2, Fig. 1)**

(Komárek and Anagnostidis 1999, P. 248, Fig. 320)

Thallus blackish, colony rounded to ellipsoidal contain 8-16 cells, 13.8 µm broad, 17.6 µm long, cells spherical, 4.5 µm in diameter.

Habitat: Blackish patch on tree bark surface, Voucher Number - 72, Place of collection- Barehipani, Similipal; Date of collection: 09.05.13.

**2. *Myxosarcina spectabilis* sensu Vashista (Pl.2, Fig. 2)**

(Komárek and Anagnostidis 1999, P. 427)

Thallus blackish, colony rounded to irregular, cells spherical, 4.3µm in diameter.

Habitat: Blackish patch on tree bark surface, Voucher Number - 38, Place of collection- Barehipani, Similipal; Date of collection: 09.05.13.

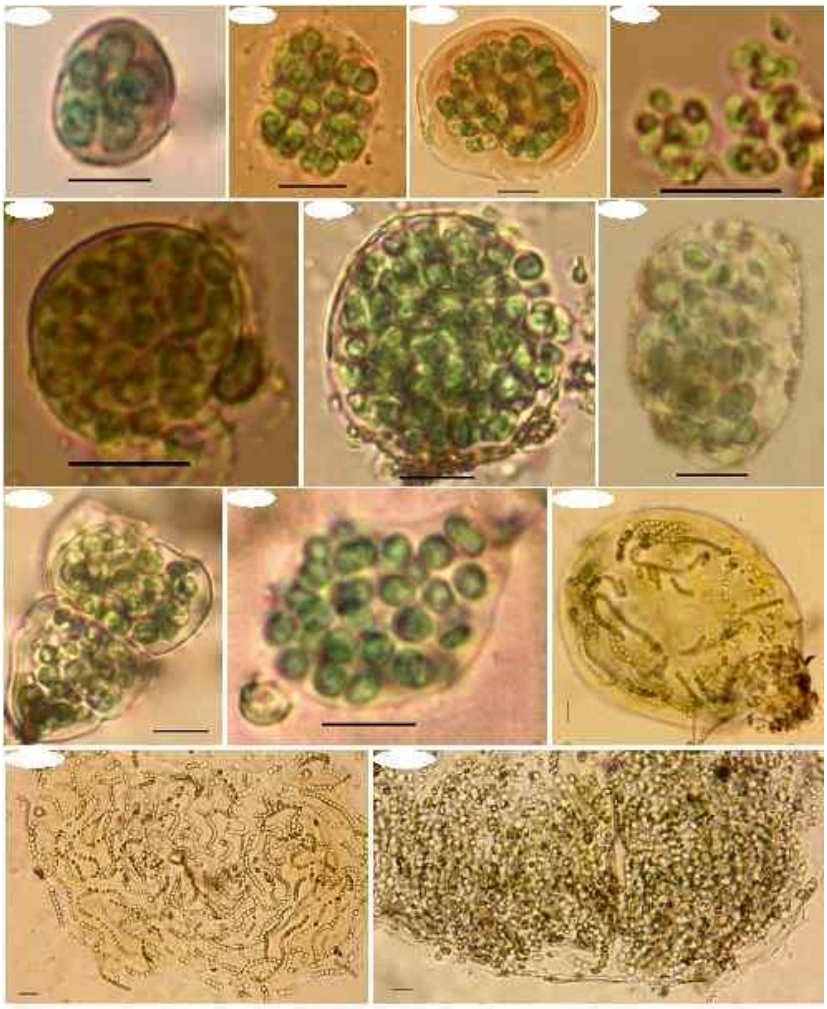

**Plate-2 (Figs. 1- 12): 1. *Gloeocapsa lignicola* 2. *Myxosarcina spectabilis* 3. *Gloeocapsa alpine,* 4. *Chroococcidiopsis indica* 5 and 6, *Chrococcidiopsis kashayi* 7. *Aphanocapsa testacea* 8. *Aphanocapsa grevillei* 9. *Nostoc punctiforme* 10. *Nostoc commune* 11. *Nostoc piscinale* 12. *Nostoc parmelioides***

**3. *Gloeocapsa alpina* (Nägeli) Brand (Pl.2, Fig. 3)**

(Synonym: *Gloeocapsa ambigua* Nägel in Kützing)

Komárek and Anagnostidis 1999, P. 248, Fig. 323

Colony rounded to oval, 7.3µm wide, cells rounded 5.5µm in diameter. Habitat: Blackish patch on tree bark surface, Voucher Number - 64, Place of collection - Chahala, Similipal; Date of collection: 10.05.13.

**4. *Chroococcidiopsis indica* (Pl.2, Fig. 4)**

(Desikachary, 1959, P. 167, Pl.31, Fig. 29)

Colony with 4-16 cells arranged loosely, cells spherical, 2.3 µm in diameter.

Habitat: Blackish patch on tree bark surface, Voucher Number - 46, Place of collection- Barehipani, Similipal; Date of collection: 09.05.13.

**5. *C. kashaypi* Friedmann (Pl.2, Fig. 5, 6)**

(Komárek and Anagnostidis 1999, P. 423, Fig. 553)

Colony spherical to oval 20-30 µm wide, cells rounded, 3-3.5 µm in diameter. Habitat: Blackish patch on tree bark surface, Voucher Number - 48, Place of collection- Barehipani, Similipal; Date of collection: 09.05.13.

**6. *Aphanocapsa testacea* Nägeli (Pl.2, Fig. 7)**

(Synonym: *Microcystis testacea* (Nägeli) Elenkin

(Komárek and Anagnostidis 1999, P. 423, Fig. 553)

Colony oval to irregular, 5.3 µm in diameter.

Habitat: Blackish patch on tree bark surface, Voucher Number - 46, Place of collection- Barehipani, Similipal; Date of collection: 09.05.13.

**7.** ***A. grevillei*** **(Berkeley) Rabenhorst (Pl.2, Fig. 8)**

(Synonym: *Microcystis grevillei* (Berk) Elenkin)

(Komárek and Anagnostidis 1999, P. 159, Fig. 194)

Colony irregular, clavate shaped, cells rounded, 5.4µm diameter.

Habitat: Blackish patch on tree bark surface, Voucher Number - 48, Place of collection- Barehipani, Similipal; Date of collection: 09.05.13.

**8.** ***Nostoc punctiforme*** **(Kütz) Hariot (Pl.2, Fig. 9)**

(Desikachary, 1959, P.374, Pl. 69, Fig.1)

Thallus colonial, mucilaginous, mucilage irregular, heterocystus, heterocyst each side of the colony, filaments compactly arranged in the colony, cells rounded to barrel shaped, 4.7µm in diameter.

Habitat: Blackish patch on tree bark surface, Voucher Number - 73, Place of collection- Barehipani; Date of collection: 16.05.13.

**9.** ***N. commune*** **Vaucher ex Born. et Flah. (Pl.2, Fig. 10)**

(Desikachary, 1959, P.387, Pl. 68, Fig.3)

Colony 150µm long,102.5 µm broad, oval, filaments entangled, cell rounded,2.5µm in diameter.

Habitat: Blackish patch on tree bark surface, Voucher Number - 64, Place of collection- Chahala, Similipal; Date of collection: 10.05.13.

**10.** ***N. piscinale*** **Kützing ex Born. et Flah. (Pl.2, Fig. 11)**

(Desikachary, 1959, P.377, Pl. 69, Fig.3)

Thallus with a firm mucilaginous layer, trichomes densly coiled, clearly visible, trichome 2-5µm broad, cells barrel shaped.

Habitat: Blackish patch on tree bark surface, Voucher Number - 64, Place of collection- Chahala, Similipal; Date of collection: 10.05.13.

**11.** ***N. parmelioides*** **Kützing ex Born. et Flah. (Pl.2, Fig. 12)**

(Desikachary, 1959, P.389, Pl. 70, Fig.3)

Trichomes densely coiled, clearly visible, 2-5µm broad, cells barrel shaped.

Habitat: Blackish patch on tree bark surface, Voucher Number - 48, Place of collection- Chahala, Similipal; Date of collection: 10.05.13.

**12.** ***Phormidium rubritericola*** **Gardner (Pl. 3, Fig. 1)**

(Komárek and Anagnostidis 2005, P. 242, Fig. 312)

Filament sheathed, solitary, not constricted at cross walls, cells 2.2µm broad, 3.3µm long, apical cell conical.

Habitat: Blackish patch on tree bark surface, Voucher Number - 74, Place of collection- Barehipani, Date of collection: 16.05.13.

**13.** ***P. holdenii*** **(Forti) Anagnostidis (Pl. 3, Fig. 2)**

(Synonym: *Lyngbya subtilis* Holden)

(Komárek and Anagnostidis 2005, P. 425, Fig. 612 )

Trichome not sheathed, constricted at cross walls, apical cell truncated, cells 6.25µm broad, 5µm long.

Habitat: Blackish patch on tree bark surface, Voucher Number - 74, Place of collection- Barehipani, Date of collection: 16.05.13.

**14.** ***Stigonema turfaccum*** **Cooke (Pl. 3, Fig. 3)**

(Geitler, 1925, P. 186, Fig. 220)

Thallus pale brown to bluish green filament truly branched, multiseriate, 20-25µm broad, cells rounded to barrel shaped,7.5µm in diameter.

Habitat: Blackish patch on tree bark surface, Voucher Number - 30, Place of collection- Nawana, Similipal; Date of collection: 9.05.13.

**15.** ***Tolypothrix byssoidea*** **(Berk.) Kirchner (Pl. 3, Fig. 4)**

(Desikachary, 1959, P. 502, Pl. 103, Figs. 3,4 & 7)

Filaments pseudo branched, heterocystous, heterocyst intercalary, elliptical to rectangular, 6.6µm long,10µm wide, cells barrel shaped to elliptical, 12-16.5µm broad,10-13.2µm long.

Habitat: Blackish patch on tree bark surface, Voucher Number - 30, Place of collection- Nawana, Similipal; Date of collection: 9.05.13.

**16.** ***Scytonema mirabile*** **(Dillw.) Born (Pl. 3, Fig. 5)**

(Desikachary, 1959, P. 483, Pl. 91, Figs. 3)

Filaments pseudo branched, heterocystous, sheath thick, cells 26.4µm broad, 16.5µm long.

Habitat: Blackish patch on tree bark surface, Voucher Number - 73, Place of collection- Barehipani; Date of collection: 16.05.13.

**17. *S. pseudopunctatum* Skuja (Pl. 3, Fig. 6,7 & 8)**

(Desikachary, 1959, P. 469, Pl. 96)

Filaments pseudo branched, heterocystous, sheath thick, cells 12.5 µm broad, 2.5-3µm long.

Habitat: Blackish patch on tree bark surface, Voucher Number - 64, Place of collection- Chahala, Similipal; Date of collection: 10.05.13.

**18. *Fischerella muscicola* (Thuret) Gom (Pl. 3, Fig. 9)**

(Desikachary, 1959, P. 601)

Filaments, sheathed, true branched, heterocystous, cells multiseriated, plane of division longitudinal as well as transverse, cells rounded to barrel shaped, 8-10µm in diameter. Habitat: Blackish patch on tree bark surface, Voucher Number - 6, Place of collection- Badamakabadi, Similipal; Date of collection: 9.05.13.

**19. *Desmococcus olivaceus* (Pl. 3, Fig. 10)**

Cells with many chloroplasts, pyronoids , and cells 7-8µm in diameter.

Habitat: Green lichen like patch on tree trunk, Voucher Number - 8, Place of collection- Badamakabadi, Similipal; Date of collection: 9.05.13.

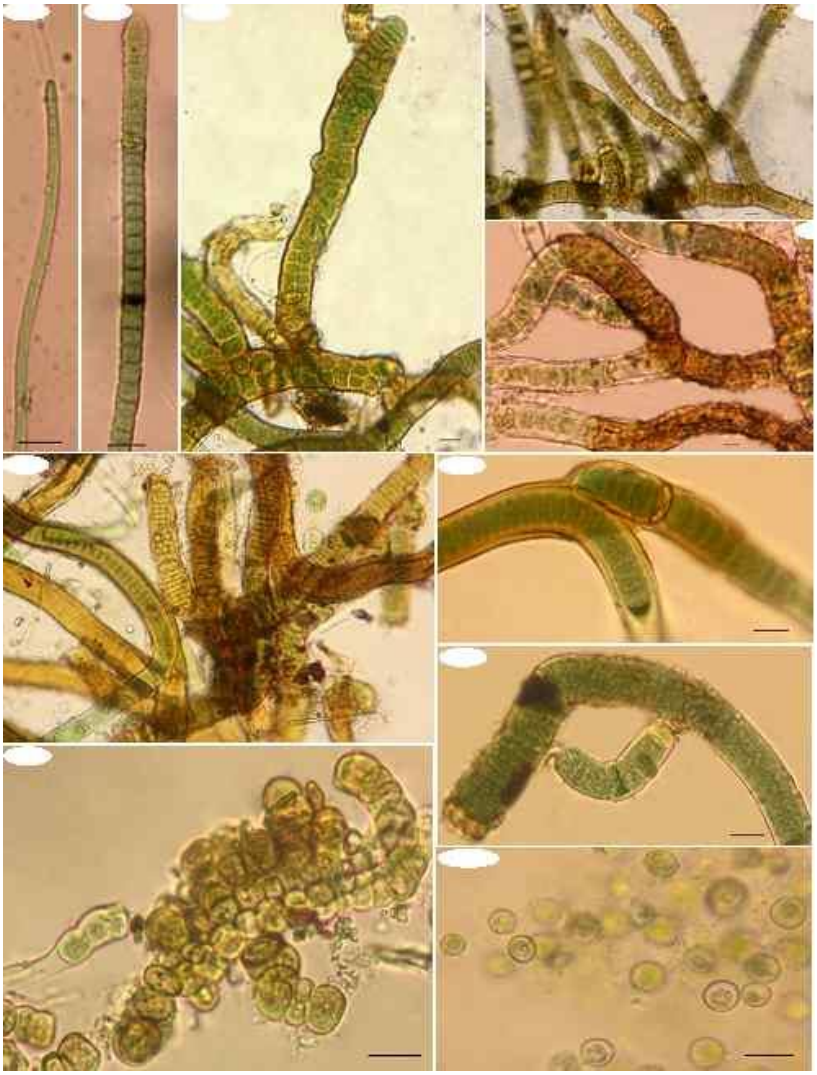

**Plate-3 (Figs. 1-10): 1. *Phormidium rubriterricola* 2. *Phormidium holenii* 3. *Stigonema turfaceum* 4. *Tolypothrix byssoidea* 5. *Scytonema mirabile* 6-8. *Scytonema pseudopunctatum*. 9. *Fischerella muscicola* 10. *Desmococcus olivaceus.***

**Discussion**

The results from this study show that the most important inhabitants of the tree bark are cyanobacteria forming a blackish biofilms on the tree trunks followed by green algae. A total of 19 algal taxa were recorded from the different sampling sites of Similipal Biosphere Reserve. Cyanobacteria show the occurrence of maximum taxa of 18 species under 10 genera followed by single green alga under genera *Desmococcus*. Similar works was also carried out on species richness

dynamics of bark algae and cyanobacteria in rain forest mountainous habitats of South-East Asia (Neustupa and Škaloud, 2008). Further, the effect of habitat type on species composition was detected as the samples from the closed forest under growth differed considerably from the samples taken from trees growing in the synantropic habitat and there is no effects of a host tree species or bark roughness on algal species composition (Cox and Hightower, 1972, Handa and Nakano, 1988, Nakano *et al.*, 1991, Mikhailyak *et al.*, 2001).

Many sub aerial algae inhabiting tree bark under genera *Nostoc, Phormidium, Scytonema, Stigonema* (Cyanophyceae); *Chlorella, Cylindrocystis, Euglena, Mesotaenium, Physolmum, Pleurococcus, Trentepohila* (chlorophyceae), *Characiopsis chlorothesium, Ophiocytium* (Xanthophyceae) and diatoms such as *Cymbella, Hantzschia, Navicula, Nitzschia* and *Pinnularia* are responsible for the variety of color and textures of the bark surface. They receive moisture either solely from the atmosphere or a fairly steady source of water seeping through the moss mats. However, in present study the dominant cyanobacteria comprised of 18 species under genera *Gloeocapsa, Myxosarcina, Chroococcidiopsis, Aphanocapsa, Nostoc, Phormidium, Stigonema, Tolypothrix, Scytonema, Fischerella*. Among cyanobacteria one heterocystous and two non heterocystous genera were found aboundantly, viz. *Nostoc* (4), *Phormidium* (2) and *Gloeocapsa* (2). All other genera are occurred with a single species each (Fig.2).

A single species of green algae named *Desmococcus olevaceoous* was reported during the study from the tree barks. Green algae are also successful in colonizing terrestrial habitats though reports on occurrence of cyanobacteria is very well represented in tropical and subtropical regions with other algal group e.g. Bacillariophyta can be eventually found in such environment (Hoffmann, 1989; Nakano *et al.*, 1991). Among the green algae, members of Trentepohliales are the major components of terrestrial flora in the world living on tree trunks, rocks, leaves and fruits and occurring at high abundance and diversity in tropical regions (Islam, 1960; Akiyama, 1971). Apart from Trentepohliales that dominated primarily in open space samples, the other frequent taxa belonged to the genera *Pseudococcomyxa, Dictyochloropsis*, and *Nostoc. Apatococcus* like green algae that very often dominate temperate bark growing algal assemblages were missing possibly harbor an important part of the global pool of bark inhabiting species of algae and cyanobacteria (Ettl and Gärtner, 1995).

Moreover, the analysis of data revealed that there is significant effect of ecological niches on species composition. Samples collected from the tree barks of core region give rise to a greater representation of cyanobacteria where as the samples collected from trees growing in the buffer region gives rise to green algae. The distribution may be due to the subtropical climate of the Similipal Biosphere Reserve which is comparable with similar works carried out by (Cox and Hightower, 1972, Handa and Nakano, 1988, Nakano *et al.*, 1991, Mikhailyak *et al.*, 2001). These results indicate that probably the micro habitat conditions, especially humidity and illumination, may play a crucial role in determining diversity and species composition of sub tropical bark growing algal assemblages.

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