

LICHEN FLORA OF SCHIRMACHER OASIS AND VETTIYYA NUNATAK

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Introduction

The area in and around Indian Research Station, Maitri, in Schirmacher Oasis was extensively explored lichenologically both in XI (Jan 92 - Feb 92) and XVII expedition (Jan 98 to Feb 98) but the Vettiyya nunatak area was surveyed for the first time in the XVII expedition. Apart from the above study, Air quality monitoring and Environmental Impact Assessment studies were also carried out.

The Schirmacher oasis area comprised of 19 lichen species dominated by crustose form of lichens while the Vettiyya nunatak area has luxuriant growth of fruticose lichens, *Usnea antarctica* and *Pseudephebe miniscula*. The lichen diversity was more in Schirmacher Oasis having 18 species while Vettiyya nunatak represented 11 species only. Most of the lichen species grow in compact turves, mats and small moss cushions which enable them to collect and retain more water and provide an excellent habitat for growth of a large number of muscicolous (moss inhabiting) lichens.

The distribution of lichens in Antarctica is controlled by a number of factors such as temperature, availability of water, wind, light intensity, material of substratum to grow on and the influence of animals such as birds. The Antarctic soil has very less humus content while the soil near Skua nest contain high nitrogen and phosphorous, providing luxuriant growth of nitrophilous lichen and mosses, both in dry and moist habitats. The effects of human activity is common around bases.

An extensive survey for lichen collection was made in Schirmacher oasis ranging from U3 lake (lake Zapadnoye) in the west to Russian station Novolazarevskaya in the east encompassing Dakshin Gangotri lake, Epsalon lake, Long lake; Trishul hill in Central Schirmacher oasis; behind flat top in north, around Zub lake and around Maitri station.

For the first time Vettiyya nunatak and Humboldt area was explored lichenologically. It is interesting to note that the Humboldt area was devoid of any lichen growth.

Almost all the lichens were collected from the rock outcrops, areas around lakes and streams which remain icefree during Antarctic summer. The lichens were luxuriantly growing on stones in dried up rivulets coming from glaciers, moss tufts, rock crevices, moraines in moist places and around Skua nest. About 200 lichen samples were collected. Extreme care was taken in collection of lichen samples. A very small quantity of lichens was collected, so as not to disturb their habitat. Excessive sampling was discouraged. The details of lichen species, localities, their habitat and growth form type are given in Table. 1.

The lichen specimens were identified at Lichenology laboratory, National Botanical Research Institute, Lucknow, adopting different lichenological techniques viz. colour test, and TLC. The morphological details were studied using binocular microscope and anatomical details were studied under Compound microscope Nikon (Eclipse - 400), after cutting section by microtome (Fuji, Japan). The voucher specimens of lichens are preserved in the Lichen Herbarium of National Botanical Research Institute, Lucknow.

Details of species

The details of lichen species collected from different localities and substrata are as follows:

1. *Acaropora gwynii* Dodge & Rudolph

A yellow, squamulose areolate lichen, very commonly growing

on moraine in the dry regions of Schirmacher Oasis. The lichen is generally absent in habitats very close to melt water.

2. *Buellia grimmae* R. Filson

White crustose areolate, muscicolous lichen, growing on cushion of mosses in moist places near lakes.

3. *Buellia figida* Darb.

Thallus crustose, only on rock, effigurate, a few individuals up to 20 cm diameter or often extensive patches, whitish gray to almost black, thallus surface broken into irregular areolas. Marginal lobes 0.5-1.5 mm long. Apothecia black. Sessile or subsessile, disc flat to convex.

4. *Buellia pallida* Dodge & Baker

A crustose, saxicolous lichen species with flattened to substipitate areolate umbilicate thallus, forming an amorphous mat on the rocks in depressions in dry places.

5. *Candelariella flava* (Dodge & Baker) Castello & Nimis

The thallus is granular, indeterminate, the granules spherical (upto 100µm diameter), yellow to orange-yellow. Apothecia 0.2-2.0 mm diameter, disc convex. The species is common on mosses, near Skua nest.

6. *Carbonea capsulata* (Dodge & Baker) Hale

Lichen thallus amorphous white mat with compressed areolate apothecia on the tops and sides of the stipes grows on rocks in small depressions, well watered after melting of snow, along with *Umbilicaria aprina*.

7. *Lecanora expectans* Darb.

Thallus crustose, granular, rugose areolate, apothecial disc

reddish brown to black, mostly found on moraine on moss tuft.

8. *Lecanora fuscobrunnea* Dodge & Baker

The lichen with crowded mats of apothecia with pale yellow - dark brown disc, growing on rocks near top in sheltered position.

9. *Lecidea cancriformis* Dodge & Baker

A very commonly distributed endolithic lichen in Schirmacher Oasis with black apothecia, growing in dry rocks, mostly on the opposite of wind facing side.

10. *Lecidea siplei* R. Filson

Dark black apotheciate species, growing on moss tufts in moist places, near Skua nest.

11. *Physcia caesia* (Hoffm.) Hampe

The peculiar white, foliose, laciniate species is fragile, heavily maculate in older parts, collected from boulders and dry stones, in water it grows very luxuriantly.

12. *Polyscaulia regalis* Murray

Thallus erect, forming tufts up to 2.0 cm in diameter, 5.0 mm tall, granular, whitish to cadmium orange, apothecia not seen, most common both in dry as well as in moist places.

13. *Psendophebe minuscula*

(Nyl.ex Arnold) Brodo & D. Hawksworth

A fruticose form of lichen growing in cracks between rocks, forms black masses with small filaments up to 0.2 mm.

14. *Rhizocarpon flavum* Dodge & Baker

Yellow-black coloured lichen, very commonly growing on rocks in well-watered area, in almost all the water rivulets in Schirmacher Oasis, along with *Umbilicaria decussaia*.

15. *Rhizoplaca melanophthalma* (Ram.) Ram.

Thallus on gravel or rock, more or less pulvinate. cerebriform, frequently imbricate squamules, apothecia numerous, the disc slightly concave. It prefers repeatedly well moistened debris and grows on nitrophile habitats, near Skua nest.

16. *Rinodina olivaceobrunnea* Dodge & Baker

A very commonly occurring lichen species of Schirmacher Oasis having crustose granular thallus with black apothecia and white margins. It grows on decaying moss tuft near Skua nest, ponds, lakes, along with *Umbilicaria aprina* and *Carbonea capsulata*.

17. *Umbilicaria aprina* Nyl.

A most commonly occurring foliose lichen in the region, attached on rocks by a central umbilicus. It grows in mostly well watered sites on stones. The size of thallus varies from a few mm (in the area at the base of Trishul Hill') to about 16 cm in diameter (at the back of 'Trishul Hill' area, rock facing the ice-shelf).

18. *Umbilicaria decussata* (Vill.) Zahlbr

Less commonly occurring than *U. aprina* having button shaped thallus, upper surface distinctly wrinkled. Mostly growing in elevated and exposed places near 'Trishul Hill' and lakes near Russian station.

19. *Usnea antarctica* Du Rietz.

Thallus erect or prostrate, 0.5-5.0 cm tall, irregularly branched, smooth to verrucose, rigid straw-colored to pale yellowish green.

The tips or the whole thallus blackened. Soredia white to grey frequent, usually more or less deep eroded.

The species does not occur in Schirmacher Oasis, but widely distributed in Vettiyya nunatak area. It prefers sheltered cavities as well as stones in sheltered positions. *U. antarctica* seems to prefer habitats with blowing snow or generally with higher relative air moisture.

Table 1. Lichens of Schirmacher Oasis

Species	Location	Habitat	Type	Condition
<i>Acawspora gwynii</i>	Zub lake, East of Maitri, behind Maitri, W. of Maitri, Dakshin Gangotri lake, W. of Long lake, Trishul hill, behind flat top	Moraine & Rock	Squamulose	Dry & Moist
<i>Buellia frigida</i>	East of Maitri, near Russian station, Dakshin Gangotri lake	Rocks	Crustose	Moist
<i>Buellia frigida</i>	Epsalon lake, behind flat top	Rock	Crustose	Dry
<i>Buellia grimmae</i>	N.E. Zub lake, base of Trishul hill, Dakshin Gangotri lake	Moss tuft	Crustose	Moist
<i>Buellia pallida</i>	W. of long lake, Russian station, Zub lake	Rock	Crustose	dried rivulets
<i>Candelariella flava</i>	Central S.O.W. of Maitri Behind Maitri, around zub lake, epsalon lake, East of Maitri, around Dakshin Gangotri lake W. of long lake	Moraine on moss	Crustose	Moist
<i>Carbonea capsulata</i>	Behind Maitri, near Russian station	Rocks	Crustose	Dry
<i>Lecanora expectans</i>	Behind Maitri, around Zub lake, epsalon lake, east of Maitri	Moraine on moss	Squamulose	Moist
<i>Lecanora fuscobrunnea</i>	Zub lake, Maitri, W. of Maitri east of Maitri, Russian station.	Moraine & Rock	Crustose	Dry

<i>Lecidea cancriformis</i>	W. of Maitri, N.W. of Maitri near Russian station, east of Maitri, around zub lake, epsalon lake, N.W.of Dakshin Gangotri lake, W.of long lake	Rocks	Cruslose	Dry
<i>Lecidea siplei</i>	Central S.O. N.W. Side, N.W. of Maitri, N.E.of Zub lake, W. of long lake	Moraine	Crustose	Moist
<i>Physcia caesia</i>	Behind flat top, near Trishul hill	Rock	Foliose	Dry
<i>Polycaulonia regalis</i>	feast of Maitri, near Russian station, N.E. Schirmacher oasis, behind Maitri, behind flat top, W. of Maitri, Russian station, N.W. of Maitri	Rocks	Fruticose	Dry & Moist
<i>Pseudophebe minisciila</i>	Zub lake, near Russian station	Stones	Fruticose	Underwater
<i>Rhizocarpon flavum</i>	N.E. Schirmacher oasis, east of Maitri near Russian station, W. of Maitri, Dakshin Gangotri lake, near Trishul hill	Rocks	Crustose	Underwater and Moist
<i>Rhizoplaca melanophthalma</i>	N.E. Schirmacher oasis"	Stones	Squamulose	Moist
<i>Rinodina olivaceobnmea</i>	N.W. of Maitri, behind Maitri, N. of Zub lake, Central S.O..W. of Maitri, lakes around Russian station	Moraine on Moss	Crustose	Moist
<i>Umbilicaria aprina</i>	Around Zub lake, around epsalon lake, near Russian station, in central S.O. near lakes, ponds and streams	Rocks	Foliose	Moist
<i>Umbilicaria decussata</i>	East of Maitri, near Russian station, around Trishul hill	Rocks	Foliose	Dry

Table 2. Lichens from Vettiyya Nunatak

Lichen species	Habitat	Type	Condition
<i>Acarospora gwynii</i>	Moraine and Rock	Crustose	Dry & Moist
<i>Buellia frigida</i>	Rock	Crustose	Moist
<i>Buellia pallida</i>	Rock	Crustose	Dried rivulets
<i>Candelariella flaya</i>	Moraine on moss	Crustose	Moist
<i>Carhonia capsulata</i>	Rock	Crustose	Dry
<i>Lecanora fuscobrunnea</i>	Moss tuft	Crustose	Dry
<i>Lecidea cancriformis</i>	Rock	Crustose	Dry
<i>Pseudephebe miniscula</i>	Stones	Fruticose	Under water
<i>Rinodina olivaceobrunnea</i>	Moraine on moss	Crustose	Moist
<i>Umbilicaria decurva</i>	Rock	Foliose	Dry
<i>Usnea antarctica</i>	Rock crevices on stones	Fruticose	Dry

Conclusion

The Schirmacher Oasis had higher lichen diversity than Vettiyya nunatak area owing to large number of lakes, ponds, melt-water streams, moss tufts, Skua nests, rocks and moraines. On the other hand Vettiyya nunatak area has only few meltwater streams and the area is more or less dry. Due to high elevation, surface moisture is very less and snow blast events are very common. These factors lead to the restricted occurrence of lichens. Only one lichen species, *Usnea antarctica* grows luxuriantly in Vettiyya nunatak area and is not present in Schirmacher Oasis. Rest of the species are common at both the sites.

Majority of the lichens in both the areas colonised mostly on the rocks followed by mosses and moraine (Fig. 1). The crustose growth form types of lichen dominated the available substrata (Fig. 2).

Some interesting observations on different lichen species are summarised below:

- (i) *Pseudephebe miniscula* and *Usnea antarctica* show luxuriant growth only in the higher elevation of Vettiyya nunatak and *Usnea antarctica* being confined to only at Vettiyya nunatak. The two *Umbilicaria* species dominated the lower altitudes, growing luxuriantly on rocks as well as moss tufts.
- (ii) The dry and exposed rocks are inhabited by *Lecidea cancriformis* and *Buellia pallida*.
- (iii) The moss tufts in moist areas harbour *Buellia siplei*, *B. grimmae* and *Candelariella flava*.
- (iv) The moraine and stones in moist slopes exhibit growth of *Acarospora gwynii*.
- (v) *Rhizocarpon flavum* grows on rocks inside the rivulets.
- (vi) Dry rivulets are best habitats for growth of a large number of lichen species of *Umbilicaria Lecanora* and *Buellia*.

Air quality monitoring around Maitri

Air quality monitoring was carried out around Maitri research station having several big generator sets for providing electricity and heat to the station. At a particular time, two generators operate simultaneously. The monitoring for sulfur dioxide and nitrogen dioxide was carried out by Autocal Multigas monitor, U.S.A. The instrument gives out reading in ppm and its detection limit is 0.01 ppm. The instrument is easy to carry and is battery operated. The concentration of NO₂ and SO₂ around Generator Hut

Complex and Summer hut toilet module is given in Table 3.

Table - 3. Air Quality Monitoring around Maitri

Site	Direction	Distance Leeward	Windward/ ppm	SO, ppm	NO,
Generator Hut Complex	East	10m-50m	Leeward	N.D.	N.D.
Generator Hut Complex	North-East	25m	Leeward	N.D.	0.2ppm
Generator Hut Complex	North	50m	Leeward	N.D.	0.1ppm
Generator Hut Complex	North-North West	50m	Windward	N.D.	0.3ppm
Generator Hut Complex	West	10m	Windward	N.D.	0.3ppm
Generator Hut Complex	West	50m	Windward	N.D.	0.7ppm
Generator Hut Complex	West	100m	Windward	N.D.	0.1ppm
Generator Hut Complex	South-South West	25m	Windward	N.D.	N.D.
Generator Hut Complex	South-East	25m	Leeward	N.D.	N.D.
Around Summer Hut Toilet module	-	-	Leeward	N.D.	N.D.

Environmental Impact Assessment Studies of Lichen flora around Maitri station

. The icy continent Antarctica has abundant lichen flora which over the centuries have grown in pristine and salubrious environment. But the advent of man on the continent and man made activities, has its negative impact on the lichen flora.

The impact can be both physical and chemical. The physical impacts include construction of research station, helipad, movement of vehicles etc. The chemical effect include generator fumes, incinerator fumes and vehicular exhaust fumes.

The entire stretch from Maitri to Zub lake (which includes 2 helipads and Summer huts), the area west of Maitri which include storage tanks and workshop, the area around generator hut complex

and a dirt road; are devoid of lichen species. Since there is no prior account of lichen occurrence on the site where Maitri station is now situated, it can not be said whether absence of lichens from Maitri area is due to physical activities. But to know the effect of generator fumes on lichens (chemical effect), the lichen transplant method was followed. In lichen transplant method, the common lichen species collected from pollution free areas are kept around pollution source and the effect is seen after some time. In the present study, three common lichen species namely *Umbilicaria aprina*, *Buellia pallida* and *Rhizocarpon flavum* were collected from far flung healthy areas of Schirmacher Oasis and were kept at different sites around generator hut complex near Maitri station. The lichens were kept in February 98 and were collected after 12 months in February '99. The estimation work is in progress.

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Umbilicaria aprina - on rocks in crevices



Umbilicaria decussata-on exposed rocks



Buellia pallida - on rocks under water



Candelariella flava - growing around skua nest



Umbilicaria aprina - on moss (*Bryum* tuft)



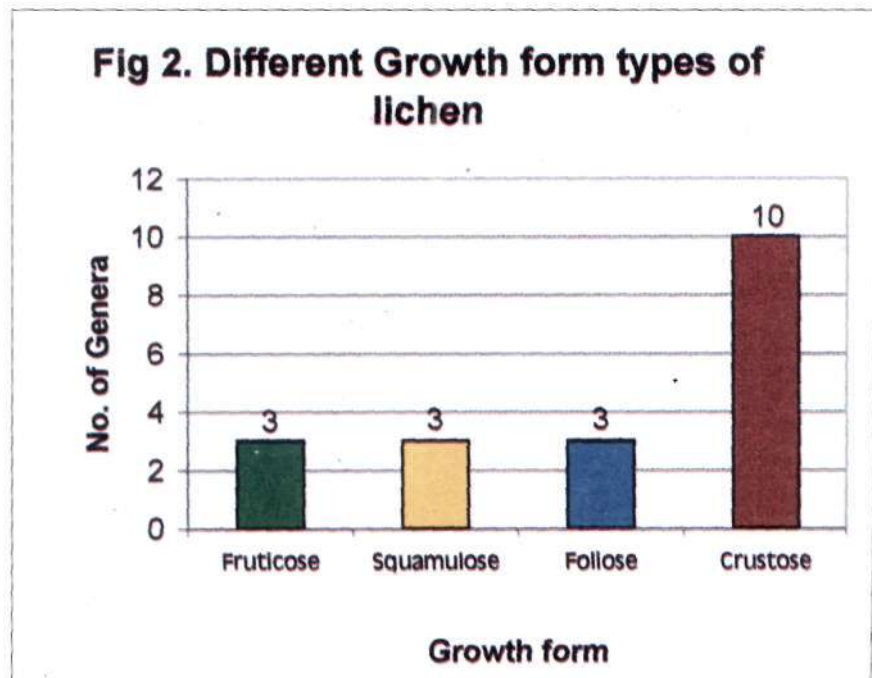
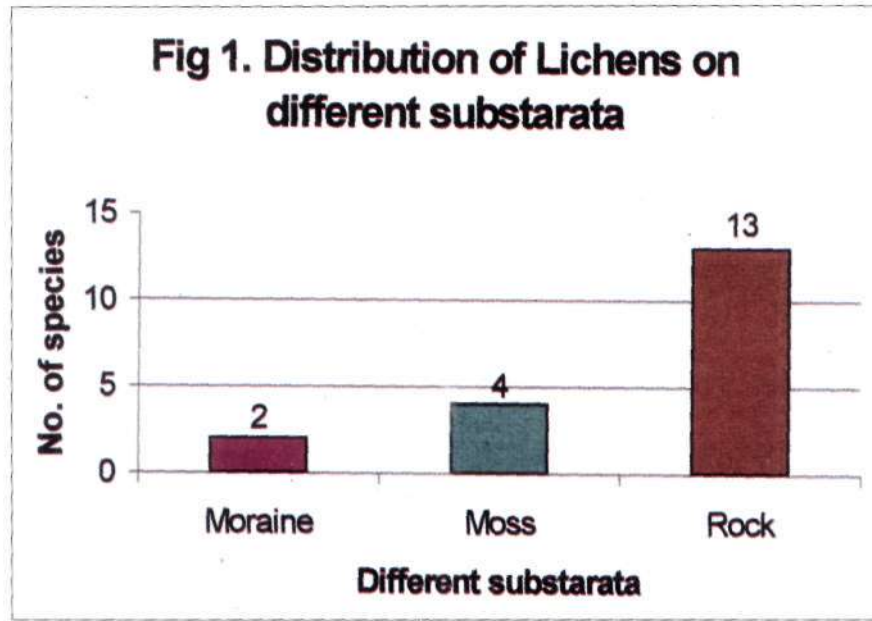
Lecidea cancriformis - on dry exposed rocks



Rhizocarpon flavum on rocks under water



vettiyya nunatak





AUTOCAL MULTIGAS MONITOR



GENERATOR HUT COMPLEX - MAITRI