

Distribution and diversity of lichens in Schirmacher Oasis, and neighbouring Nunataks, East Antarctica

SANJEEVA NAYAKA & DALIP KUMAR UPRETI
Lichenology laboratory, National Botanical Research Institute
Rana Pratap Marg, Lucknow – 226 001
(*sanjeeva_n@yahoo.com, upretidk@rediffmail.com*)

Abstract—The paper deals with the occurrence of 35 species of lichens in 31 sites in Schirmacher Oasis and seven neighbouring Nunataks. *Buellia illaetabilis*, *Carbonea assentiens*, *Lecanora geophila*, *L. orosthea*, *Lecidella stigmataea*, *Lepraria cacuminum*, *Rhizocarpon nidificum*, *Rinodina endophragma*, *Sarcogyne privigna*, *Umbilicaria africana*, and *Verrucaria holizoa* were described as new records for Schirmacher Oasis region, East Antarctica.

Key words—Lichen, new records, Schirmacher Oasis, East Antarctica

Introduction

The successful symbiotic association between the alga and fungus resulted in a new life form called lichen. The peculiar qualities of lichens empower them to exploit a wide range of habitat. Lichens are remarkable in their ability to survive in a wide range of temperature. They occur in the hottest deserts where temperature exceeds 55° C and also found in Antarctica where temperature goes down more than – 50° C.

Lichens are the major floristic element in Antarctica along with bryophytes. Because of their high degree of adaptation to the harsh climatic condition they are most interesting group of organisms, both for taxonomic and ecological studies. Antarctic lichens were first studied by James Eight in 1830, who visited South Shetland area of Antarctica. Out of the 20,000 lichen species known in the world Antarctica is represented by about 450 species of which 200 are endemic to the continent. The Antarctic Peninsula, Victoria Land and other localities in the western regions of Antarctica were explored lichenologically in the past hundred years and a good account of information on the lichens of that area are available. However, the Queen Maud Land area in East Antarctica where Indian Research Station ‘Maitri’ is situated in Schirmacher Oasis area, only a few reports on the lichens are available

Schirmacher Oasis is a small ice-free landmass of 35 sq. km area, situated in Queen Maud Land Area, East Antarctica at the intersection of coordinates 70.8° South latitude and 11.8° East longitude. The lichens of the Schirmacher Oasis are earlier studied by Golubkova & Simonov (1972), Gupta *et al.* (1999), Pandey & Upreti (2000), Richter (1995), Upreti (1996, 1997), Upreti & Pant (1995) and so far around 40 species of lichens have been described from the region.

Methodology

Around 250 lichen specimens were collected from 7 Nunataks and 31 sites in Schirmacher Oasis (Fig. 1, Table 1) during the 22nd Indian Antarctic Expedition (2002-03). Lichen samples were collected from rock, moraine and moss tufts. The lichen specimens were dried and preserved in Herbarium of National Botanical Research Institute (LWG). The specimens were identified by studying their morphology, anatomy, chemistry and following the recent literature on Antarctic

lichens (Øvstedal & Smith, 2001). Distribution pattern and abundance of different lichen species in Schirmacher Oasis region were studied.

Result and Discussion

The study revealed the occurrence of 35 species belonging to 20 genera and 11 families in the Schirmacher Oasis and neighbouring Nunataks (Table 2). The lichen flora of the Schirmacher Oasis is dominated by crustose lichens represented by 26 species. The foliose lichens in the area are represented by *Physcia caesia*, *Umbilicaria africana*, *U. africana*, *U. aprina*, *U. deccussata*, *Xanthoria candelaris*, *X. elegans*, while only two fruticose lichens are *Pseudephebe miniscula*, and *Usnea antarctica*.

The status of each lichen species occurring in the Schirmacher Oasis is also studied, based on the frequency, density and abundance of the taxa. In the present study a total of 21 species are rare, eight are frequent, while *Lecidea andersonii*, *L. cancriformis*, *Leproloma cacuminum*, *Rinodina olivaceobrunnea*, are common and *Acarospora gwynii*, and *Candelariella flava*, are the most common lichens in the region.

The different localities surveyed for collection exhibit variation in the occurrence of lichen species. The sites near lake L50 (11 species), Vettiyya (11 species) and Hauglandtoppen (10 species) have the maximum concentration of lichens species while the sites near the lake L70-71 (1 species), behind Trishul (2 species) and near lake E2 (2 species) were poorly represented by lichens (Table 1).

The substratum plays a major role in determining the lichen colonization in a given locality. In Schirmacher Oasis rock, soil (moraine) and moss are the major substratum available for lichens. A total of 19 species restrict their niche to rock only followed by leprose species of *Lecanora*, and *Buellia grimmiae* restricted to moss cushions while *Sarcogyne privigna* found growing only on soil. The soil and rock share five species, rock and soil share three species while *Physcia caesia* is the only species shared between rock and moss. The species *Carbonea vorticosa*, *Candelariella flava*, *Xanthoria candelaris* and *X. elegans* are found growing in all the three substratum (Fig. 2).

Out of the total 35 species 13 are endemic to Antarctica, 10 are bipolar while 11 species are cosmopolitan in distribution. *Buellia illaetabilis*, *Carbonea assentiens*, *Lecanora geophila*, *L. orosthea*, *Lecidella stigmatea*, *Leproloma cacuminum*, *Rhizocarpon nidificum*, *Rinodina endophragmia*, *Sarcogyne privigna*, *Umbilicaria africana*, and *Verrucaria holizoa*, are recorded for the first time from Schirmacher Oasis.

Conclusion

The addition of 11 new records in the present study clearly indicates the further scope for lichenological investigation in the Schirmacher Oasis. The frequency, density and abundance are calculated first time for the lichens of the region. The ecological data will be useful in monitoring the changes in lichen population and diversity in the Schirmacher Oasis region.

The enumeration of new records

Buellia illaetabilis I.M. Lamb., *Br. Antarct. Surv. Sci. Rep.* **61**: 29 (1968). **Fig.: 3**

Family : Physciaceae

Buellia illaetabilis is characterized by crustose, effuse, areolate thallus; black apothecia with pale brown hypothecium, prominent aeruginose, N⁺ red epithecium and brown, two celled, *Buellia* type of spores.

Specimens examined : **EAST ANTARCTICA**. Queen Maud Land Area, Schirmacher Oasis, behind 'Maitri', near cap ice, alt. 115 m, on rock near water flowing area, 13-02-2003, S. Nayaka 03-002057 (LWG); South of Priyadarshini lake, near lake L52, alt. 115 m, on rock, 29-01-2003, S. Nayaka 03-001910 (LWG).

Remark : Øvstedal & Smith (2001) described this species from coastal rocks. In the present study the specimens were obtained away from coast and from main land of Schirmacher Oasis.

Distribution : *Buellia illaetabilis* is endemic to Antarctica and earlier recorded from Northern Antarctic peninsula (Øvstedal & Smith, 2001).

Carbonea assentiens (Nyl.) Hertel, *Lecideaceae exsiccatae*, Fascicle **VI** (nos 101-120) (München): no. 103 (1984). **Fig.: 4**

Family : Lecanoraceae

Carbonea assentiens is characterized by crustose, greyish-white thallus; black apothecia with protruding margin, black exciple, green-brown to black brown epithecium, colourless hymenium, colourless hypothecium but with orange pigmented cells in the upper part and simple, colourless, spores.

Specimen examined : **EAST ANTARCTICA**. Queen Maud Land Area, Schirmacher Oasis, Vettiyya Nunatak, alt. 180 m, on rock, 04-02-2003, S. Nayaka 03-001970 (LWG).

Remark : *Carbonea assentiens* is one of the rare lichen species in Schirmacher Oasis region and found growing on exposed rocks and boulders.

Distribution : *Carbonea assentiens* is an endemic species to Antarctica and was earlier reported from Islands of sub-Antarctic region and Antarctic peninsula (Øvstedal & Smith, 2001).

Lecanora geophila (Th. Fr.) Poelt, *Int. J. Mycol. Lichenol.* **3**(1): 57 (1986). **Fig.: 5**

Family : Lecanoraceae

Lecanora geophila is characterized by crustose, thick, yellow-grey thallus; apothecia with yellow-grey margin, flat, pale brown disc when young, greenish epithecium, simple, colourless spores; usnic acid and zeorin in TLC.

Specimens examined : **EAST ANTARCTICA**. Queen Maud Land Area, Schirmacher Oasis, behind workshop of 'Maitri', near lake P11, alt. 115 m, on soil along with moss, 28-01-2003, S. Nayaka 03-001901 (LWG); near lake P7, alt. 120 m, 12-02-2003, S. Nayaka 03-002050 (LWG).

Remark : *Lecanora geophila* is a rare species in Schirmacher Oasis region and found growing on soil and moss.

Distribution : *Lecanora geophila* is bipolar in distribution and known from North America, Greenland, Siberia. In Antarctica it was earlier reported from Victoria Land (Øvstedal & Smith, 2001).

Lecanora orosthea (Ach.) Ach., *Lich. Univ.*: 400 (1810). **Fig.: 6**

Family : Lecanoraceae

Lecanora orosthea is characterized by crustose, areolate, yellow-grey, sorediate thallus; black apothecia with margin thin, pale brown-green epithecium, colourless hymenium and hypothecium, with small oil drops and simple, colourless spores; usnic acid, atranorin and zeorin in TLC.

Specimen examined : **EAST ANTARCTICA**. Queen Maud Land Area, Schirmacher Oasis, Hauglandtopen Nunatak, alt. 150 m, on rock, 26-02-2003, S. Nayaka 03-002113/B (LWG).

Remark : *Lecanora orosthea* is rare lichen in the Schirmacher Oasis region and found growing in exposed rocks.

Distribution : *Lecanora orosthea* is bipolar in distribution and known from Europe, North America. In Antarctica the species was earlier recorded from South Orkney Island, South Shetland Island, Antarctic Peninsula, Victoria Land and Dronning Maud Land (Øvstedal & Smith, 2001).

Lecidella stigmatea (Ach.) Hertel & Leuckert, *Willdenowia*, Annals of the Botanic Garden and Botanic Museum Berlin-Dahlem **5**: 375 (1969). **Fig.: 7**

Family : Lecanoraceae

Lecidella stigmatea is characterized by whitish thallus in small irregular clumps; black apothecia with thin margin when young, greenish-black epithecium, colourless hymenium and hypothecium and colourless, simple, broadly elliptic spores.

Specimens examined : **EAST ANTARCTICA**. Queen Maud Land Area, Schirmacher Oasis, Tallaksenvarden Nunatak, alt. 150 m, on rock, 26-02-2003, S. Nayaka 03-002103 (LWG); Sonstebynuten Nunatak, alt. 150 m, on rock, 14-02-2003, S. Nayaka 03-002074 (LWG).

Remark : Øvstedal & Smith (2001) reported the presence of atranorin and zeorin in the TLC, however, in the present study both the specimens are lacking lichen substances. *Lecidella stigmatea* is a rare lichen in the region and found growing on exposed rock and boulders.

Distribution : *Lecidella stigmatea* is bipolar in distribution and known from North Europe and North America. In Antarctica it was earlier reported from South Shetland Island, Antarctic Peninsula and continental Antarctica (Øvstedal & Smith, 2001).

Lepraria cacuminum (A. Massal.) Kümmerl. & Leuckert, in Leuckert, Kümmerling & Wirth, *Biblio. Lichenol.* **58**: 252 (1995). **Fig.: 8**

Family : Family imperfectii

Lepraria cacuminum is characterized by whitish-grey to bluish-grey, effuse, leprose thallus, with an indistinct white medulla, diffuse to indistinctly lobate margin; atranorin and yellowish brown spot at Rf class 4 in TLC.

Specimens examined (selected list) : **EAST ANTARCTICA.** Queen Maud Land Area, Schirmacher Oasis, around Priyadarshini lake, alt. 118 m, on moss, 01-02-2003, S. Nayaka 03-001929 (LWG); Flat Top mountain, alt. 152 m, on soil, 07-02-2003, S. Nayaka 03-001982/A (LWG); near lake L50, alt 120 m, on soil and moss, 11-02-2003, S. Nayaka 03-002014, 03-002017 (LWG); on way to Russian Research Station Novo, alt. 120 m, on moss, 02-02-2003, S. Nayaka 03-001942 (IWG); eastern side of Russian Station, near lake L85, alt. 115 m, on soil and moss, 09-02-2003, S. Nayaka 03-002003 (LWG); western end, alt. 115 m, on soil, 11-03-2003, S. Nayaka 03-002148 (LWG); Vettiyya Nunatak, alt. 180 m, on moss, 04-02-2003, S. Nayaka 03-001960 (LWG); Hauglandtopen Nunatak, alt. 150 m, on soil, 26-02-2003, S. Nayaka 03-002113/A (LWG).

Remark : *Lepraria cacuminum* is the most common lichen species in Schirmacher Oasis region and found growing on soil, moss along with other lichens such as *Rinodina olivaceobrunnea* C.W. Dodge & G.E. Baker, and *Acarospora williamsii* Filson. This species is similar to *Leproloma membranaceum* (Dickson) Vain., which differs in having pannaric, roccellic acids and often subfoliose, distinctly lobed margins.

Distribution : *Lepraria cacuminum* is cosmopolitan in temperate regions and in Antarctica earlier it was reported from South Sandwich Island, South Orkney Island, South Shetland Island, Antarctic Peninsula and continental Antarctica (Øvstedal & Smith, 2001).

Rhizocarpon nidificum (Hue) Darb., in *National Antarctic Expedition, Natural History* **5**, Zoology & Botany: 1 (1910). **Fig.: 9**

Family : Rhizocarpaceae

Rhizocarpon nidificum is characterized by crustose, pale yellowish-green, flat to convex areoles, thick, prominent, black prothallus; black apothecia, brown-red epithecium, colourless to pale violet hymenium and greenish-brown spores with 1-3 transverse septa, and one longitudinal septum (submuriform).

Specimen examined : **EAST ANTARCTICA.** Queen Maud Land Area, Schirmacher Oasis, on the way to 'Trishul' hill, alt. 125 m, on rock, 03-02-2003, S. Nayaka 03-001951 (LWG).

Remark : *Rhizocarpon nidificum* grows along with *R. geographicum* (L.) DC, on the rocks in the drying up riverlets.

Distribution : *Rhizocarpon nidificum* is endemic to Antarctica and earlier reported from South Georgia, South Shetland Islands and Antarctic Peninsula (Øvstedal & Smith, 2001).

Rinodina endophragma I.M. Lamb., *Br. Antarct. Surv. Sci. Rep.* **61**: 71 (1968). **Fig.: 10**

Family : Physciaceae

Rinodina endophragma characterized by crustose, verrucose thallus, black apothecia, slightly raised above the verrucae, with thalline margin, brown epithecium, colourless hymenium and hypothecium and brown, two celled, *Bicincta*-type of spores.

Specimen examined : **EAST ANTARCTICA**. Queen Maud Land Area, Schirmacher Oasis, south of Priyadarshini lake, near lake L52, alt. 115 m, on rock, 29-01-2003, S. Nayaka 03-001907 (LWG).

Remark : *Rinodina endophragma* is a rare species in Schirmacher Oasis and found growing on exposed rocks.

Distribution : *Rinodina endophragma* is bipolar in distribution and reported from North America, Greenland and in Antarctica it was earlier known from Antarctic Peninsula, Basen and Dronning Maud Land (Øvstedal & Smith, 2001).

***Sarcogyne privigna* (Ach.) A. Massal, *Geneacaena Lich.*: 10 (1854). Fig.: 11**

Family : Acarosporaceae

Sarcogyne privigna is characterized by inconspicuous to crustose, brownish thallus; dark red to black apothecia with black exciple, colourless hymenium, colourless to pale brown hypothecium, multispored ascus and colourless, simple spores.

Specimens examined : **EAST ANTARCTICA**. Queen Maud Land Area, Schirmacher Oasis, eastern side of Russian Station Novo, near lake L85, alt. 120 m, on soil, 09-02-2003, S. Nayaka 03-001995 (LWG); behind Russian Station Novo, alt. 120 m, on soil, 02-02-2003, S. Nayaka 03-001930, 03-001938 (LWG); south-east of 'Maitri', near lake L56, alt. 115 m, on soil, 10-02-2003, S. Nayaka 03-002008 (LWG); west of S. Oasis, near lake L5, towards shelf ice, alt. 115 m, on soil, 21-02-2003, S. Nayaka 03-002090 (LWG); Sonstebynuten Nunatak, alt. 150 m, on soil, 14-02-2003, S. Nayaka 03-002073 (LWG).

Remark : *Sarcogyne privigna* is a common species in Schirmacher Oasis, mainly found growing on soil.

Distribution : *Sarcogyne privigna* is cosmopolitan in distribution and in Antarctica it was earlier recorded from Antarctic Peninsula, southern Victoria Land, Marie Byrd Land, Bunge Hills and Vestfold Hill area (Øvstedal & Smith, 2001).

***Umbilicaria africana* (Jatta) Krog & Swinscow, *Nordic J. Bot.* 6(1): 79 (1986). Fig.: 12**

Family : Umbilicaceae

Umbilicaria africana is characterized by mono to polyphyllous thallus, up to 5 cm diam., pale grey-brown, rimose upper surface, coal-black lower surface, pale grey, simple to dichotomously or irregularly branched rhizines and multicellular thallospores.

Specimens examined : **EAST ANTARCTICA**. Queen Maud Land Area, Schirmacher Oasis, near lake P1, alt. 120 m, on rock, 12-02-2003, S. Nayaka 03-002028/A, 03-002028/B (LWG); near lake P2, 120 m, on rock, 12-02-2003, S. Nayaka 03-002036,

03-002038 (LWG); near lake L2, alt. 120 m, on rock, 12-02-2003, S. Nayaka 03-002053 (LWG); near lake L52, alt. 115 m, on rock, 29-01-2003, S. Nayaka 03-001913 (LWG); on way to Trishul, alt. 125 m, on rock, 03-02-2003, S. Nayaka 03-001953 (LWG); behind 'Maitri' near cap ice, alt. 115 m, on rock, 13-02-2003, S. Nayaka 03-002056 (LWG).

Remark : *Umbilicaria africana* found growing on the rocks in water flowing areas along with *U. antarctica*. It is a common species in Schirmacher Oasis region and probably mistaken for *U. aprina* Nyl., which differs in having unicellular thallose spores.

Distribution : *Umbilicaria africana* found to occur in mountains of East Africa, South America and in Antarctica it was earlier reported from South Georgia, South Shetland Islands and Continental Antarctica.

Verrucaria holizoa Leight, *Lichen Flora of Great Britain and Ireland* (London): 461 (1871). **Fig.: 13**

Family : Verrucariaceae

Verrucaria holizoa is characterized by thin, smooth to cracked, brown-green, crustose thallus; black, emergent perithecia, involucrellum in upper half brownish, pale in lower part and colourless, simple, ellipsoid spores.

Specimen examined : **EAST ANTARCTICA**. Queen Maud Land Area, Schirmacher Oasis, Near lake E2, alt. <100 m, on rock, mostly under water, 12-02-2003, S. Nayaka 03-002051 (LWG).

Remark : *Verrucaria holizoa* forms circular patches on the rocks, exposed or under flowing water near the shelf ice.

Distribution : *Verrucaria holizoa* is bipolar in distribution, known from Europe, North America, Japan, Chile, Falkland Island and in Antarctica it was earlier reported from South Orkney Islands and Antarctic Peninsula (Øvstedal & Smith, 2001).

Acknowledgements

We are thankful to the Director, National Botanical Research Institute, Lucknow, for providing necessary facilities to work, to Director, National Centre for Antarctic and Ocean Research, Goa for selecting one of the authors (S.N) for the 22nd Indian Antarctic Expedition, and to expedition leader, Dr. A.N. Hanchinal, Indian Institute of Geomagnetism, New Mumbai for his cooperation during the research.

Literature Cited

- Golubkova, N.S. and Simonov, I.M. 1972. Lishayniki Oazisa Shirmakhera. *Trudy Sovet Skoy Antarkti Cheskoj Eksfeditzii Leningrad* **60**: 317-327.
- Gupta, R.K., Sinha, G.P. and Singh, D.K. 1999. A note on lichens of Schirmacher Oasis, East Antarctica. *Indian Journal of Forestry* **22(3)**: 292-294.
- Øvstedal, D.O. and Smith, R.I.L. 2001. *Lichens of Antarctica and South Georgia : A guide to their Identification and Ecology*. Cambridge University Press, U.K.

- Pandey, V. and Upreti, D.K. 2000. Lichen flora of Schirmacher Oasis and Vettiyya Nunatak. In *Scientific Report - Seventeenth Indian Expedition to Antarctica*. Technical Publication No. 15. Department of Ocean development. New Delhi. pp 185-201.
- Richter, W. 1995. Biology. In *The Schirmacher Oasis, Queen Maud Land, East Antarctica and its Surroundings*. (Eds. Bormann, P, and Fritzsche, D.) Germany. pp. 321-347.
- Upreti, D.K. and Pant, G. 1995. Lichen flora in and around Maitri region, Schirmacher Oasis, East Antarctica. In *Scientific Report – Eleventh Indian Expedition to Antarctica*. Technical Publication No. 9. Department of Ocean development, New Delhi. pp. 229-241.
- Upreti, D.K. 1996. Lecideoid lichens from the Schirmacher Oasis, East Antarctica. *Willdenowia* **25**: 681-686.
- Upreti, D.K. 1997. Notes on some crustose lichens from Schirmacher Oasis, East Antarctica. *Feddes Repertorium* **108(3-4)**: 281-286.

Table 1 : Different sites surveyed for lichens in Schirmacher Oasis and neighbouring Nunataks, site number, the altitude and number of species

Site No.	Name of the sites	Altitude (m)	No. of species	Site No.	Name of the sites	Altitude (m)	No. of species
1	Around Priyadarshini lake	118	3	20	Near lake L70-71	115	1
2	Behind Maitri, near Cap Ice	115	4	21	Near lake L85	115	8
3	Behind Russian Station Novo	120	7	22	On way to Trishul Hill	120	6
4	Behind Trishul Hill	200	2	23	Near lake P1	120	6
5	DG snout	115	5	24	Near lake P10	115	6
6	Eastern edge of lake E10	115	6	25	Near lake P11	115	5
7	Near lake E13	120	3	26	Near lake P2	120	3
8	Near lake E2	100	2	27	Near lake P5	120	5
9	Near lake E9	115	5	28	Near lake P7	120	4
10	Flot Top hill	152	4	29	Near lake P8-P9	120	8
11	Island near E10	115	3	30	Trishul Hill	200-210	7
12	Near lake L15	115	4	31	Vettiyya Nunatak	180	11
13	Near lake L2	115	8	32	Western End	115	7
14	Near lake L33	120	7	33	Baalsrudfjellet Nunatak	150	4
15	Near lake, L5 towards shelf ice	115	3	34	Hauglandtoppen Nunatak	150	10
16	Near lake L50	120	11	35	Shivaling Nunatak	130	3
17	Near lake L52	115	8	36	Sonstebynuten Nunatak	150	8
18	Near lake L56	115	4	37	Starheimtind Nunatak	180	4
19	Near lake L60	125	3	38	Tallksenvarden Nunatak	150	4

Sl. No.	Lichen Taxa	GF	Family	Localities (See Table 1)																																													
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38								
19	<i>Lepraria cacuminum</i> (A. Massal) Kümmerl. & Leuckert	CR	C	+	-	-	-	-	-	+	-	+	+	-	+	+	+	-	+	+	+	-	-	+	+	-	-	+	-	+	-	+	-	+	+	-	+	-	-	-	-								
20	<i>Physcia caesia</i> (Hoffm.) Furner.	FO	G	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	+	-	+	+	-	-	-	-	-	-	-	-	-								
21	<i>Pseudephebe miniscula</i> (Nyl. Ex Arnold) Brodo & Hawk. #	FR	F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	+	-	-	-								
22	<i>Rhizocarpon geographicum</i> (L.) DC	CR	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
23	<i>R. nidificum</i> (Hue) Darb.*	CR	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
24	<i>Rhizoplaca melanophthalma</i> (Ram.) Leuckert & Poelt	CR	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-					
25	<i>Rinodina endophragma</i> I.M. Lamb. #	CR	G	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
26	<i>R. olivaceobrunnea</i> C.W. Dodge & G.E. Baker #	CR	G	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	+	+	-	+	-	+	-	-	+	-	-	-	-	-	-	+	+	+	+	-	-	+	-	-			
27	<i>Sarcogyne privigna</i> (Ach.) A. Massal.	CR	A	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-		
28	<i>Umbilicaria africana</i> (Jatta) Krog & Swinscow	FO	J	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
29	<i>U. antarctica</i> Frey & I.M. Lamb.*	FO	J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
30	<i>U. aprina</i> Nyl. #	FO	J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
31	<i>U. deccussata</i> (Vill.) Zahlbr.	FO	J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
32	<i>Usnea antarctica</i> Du. Rietz	FR	F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
33	<i>Verrucaria holizoa</i> Leight #	CR	K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
34	<i>Xanthoria candelaris</i> (L.) Th. Fr.	FO	I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
35	<i>X. elegans</i> (Link) Th. Fr.	FO	I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

(Note : * = endemic, # = bipolar, GF = Growth Form; CR = Crustose, FO = Foliose, FR = Fruticose. Family; A = Acarosporaceae, B = Candelariaceae, C = Family imperfectii, D = Lecanoraceae, E = Lecideaceae, F = Parmeliaceae, G = Physciaceae, H = Rhizocarpaceae, I = Teloschistaceae, J = Umbilicariaceae, K = Verrucariaceae. + = present, - = absent)

Table 3 : Relative frequency, density and abundance and status of lichens growing in Schirmacher Oasis region

Lichen taxa					Lichen taxa						
	Relative Frequency	Relative density	Relative abundance	Status		Relative Frequency	Relative density	Relative abundance	Status		
1	<i>Acarospora gwynii</i>	14.7781	15.2610	2.9105	M	19	<i>Leproloma cacuminum</i>	8.8670	8.4337	2.6808	C
2	<i>A. williamsii</i>	1.4778	1.2048	2.2978	R	20	<i>Physcia caesia</i>	1.9704	2.0080	2.8722	R
3	<i>Amandinea petermannii</i>	0.4926	0.4016	2.2978	R	21	<i>Pseudephebe miniscula</i>	0.9852	2.0080	5.7445	R
4	<i>Buellia grimmiae</i>	0.4926	0.4016	2.2978	R	22	<i>Rhizocarpon geographicum</i>	0.9852	0.8032	2.2978	R
5	<i>B. illaetabilis</i>	0.9852	0.8032	2.2978	R	23	<i>R. nidificum</i>	0.4926	0.4016	2.2978	R
6	<i>Caloplaca citrina</i>	3.4483	4.0161	3.2826	F	24	<i>Rhizoplaca melanophthalma</i>	0.4926	0.4016	2.2978	R
7	<i>Candelariella flava</i>	12.8079	12.0482	2.6513	M	25	<i>Rinodina endophragma</i>	0.4926	0.4016	2.2978	R
8	<i>Carbonea assentiens</i>	0.4926	0.4016	2.2978	R	26	<i>R. olivaceobrunnea</i>	5.9113	5.2209	2.4893	C
9	<i>C. vorticosa</i>	3.9409	4.8192	3.4467	F	27	<i>Sarcogyne privigna</i>	2.4631	2.4096	2.7573	F
10	<i>Lecanora</i> sp.	0.4926	0.4016	2.2978	R	28	<i>Umbilicaria africana</i>	2.9557	3.2129	3.0637	F
11	<i>L. expectans</i>	2.9557	2.8112	2.6808	F	29	<i>U. antarctica</i>	1.4778	1.6064	3.0637	R
12	<i>L. geophila</i>	1.4778	1.2048	2.2978	R	30	<i>U. aprina</i>	0.4926	0.8032	4.5956	R
13	<i>L. orosthea</i>	0.4926	0.4016	2.2978	R	31	<i>U. decussata</i>	2.4631	3.2128	3.6765	F
14	<i>L. polytropa</i>	0.4926	0.4016	2.2978	R	32	<i>Usnea antarctica</i>	0.4926	0.8032	4.5956	R
15	<i>Lecidea andersonii</i>	8.3744	6.8273	2.2978	C	33	<i>Verrucaria holizoa</i>	0.4926	0.4016	2.2978	R
16	<i>L. cancriformis</i>	7.8818	9.2369	3.3031	C	34	<i>Xanthoria candelaris</i>	0.9852	0.8032	2.2978	R
17	<i>Lecidella siplei</i>	2.4631	2.0080	2.2978	F	35	<i>X. elegans</i>	2.4631	3.2129	3.6765	F
18	<i>L. stigmatea</i>	0.9852	1.2048	3.4467	R						

(Note : M = most common, C = common, F = frequent, R = rare)

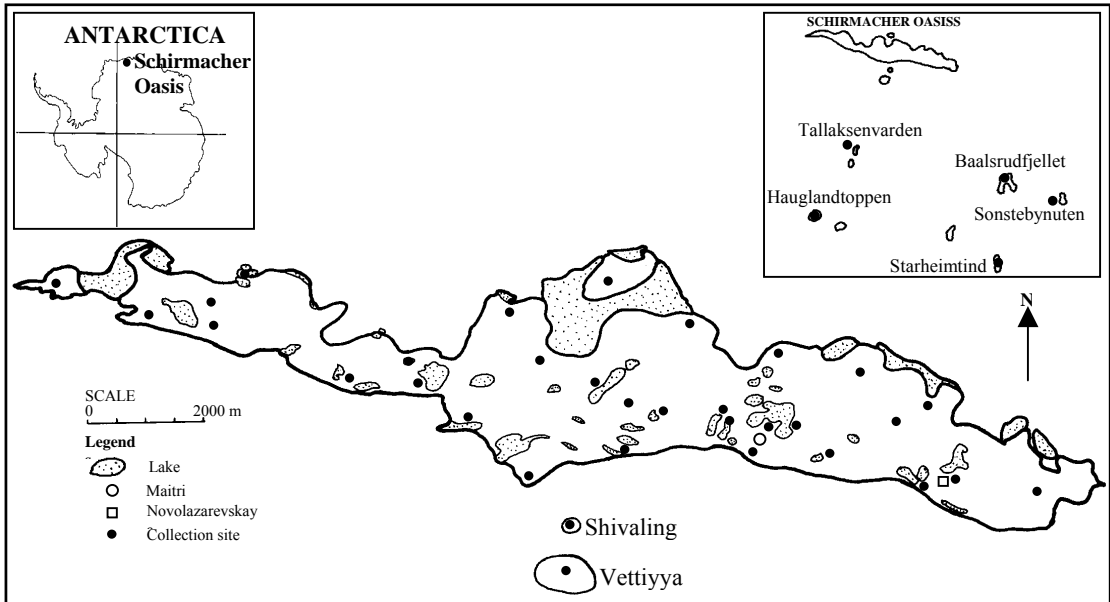


Figure 1. Map of sites surveyed for lichen collection in Schirmacher Oasis and neighbouring nunataks

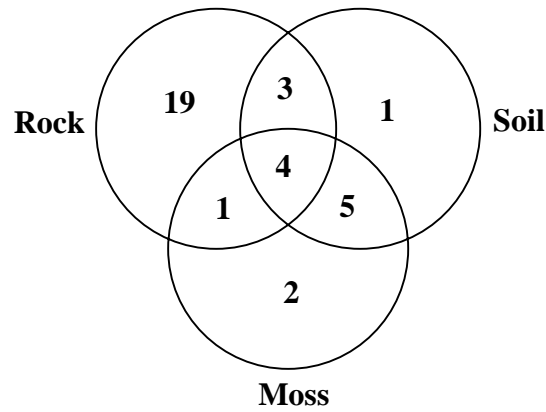


Figure 2 : Venn diagram showing the sharing of species between three substratum in Schirmacher Oasis region

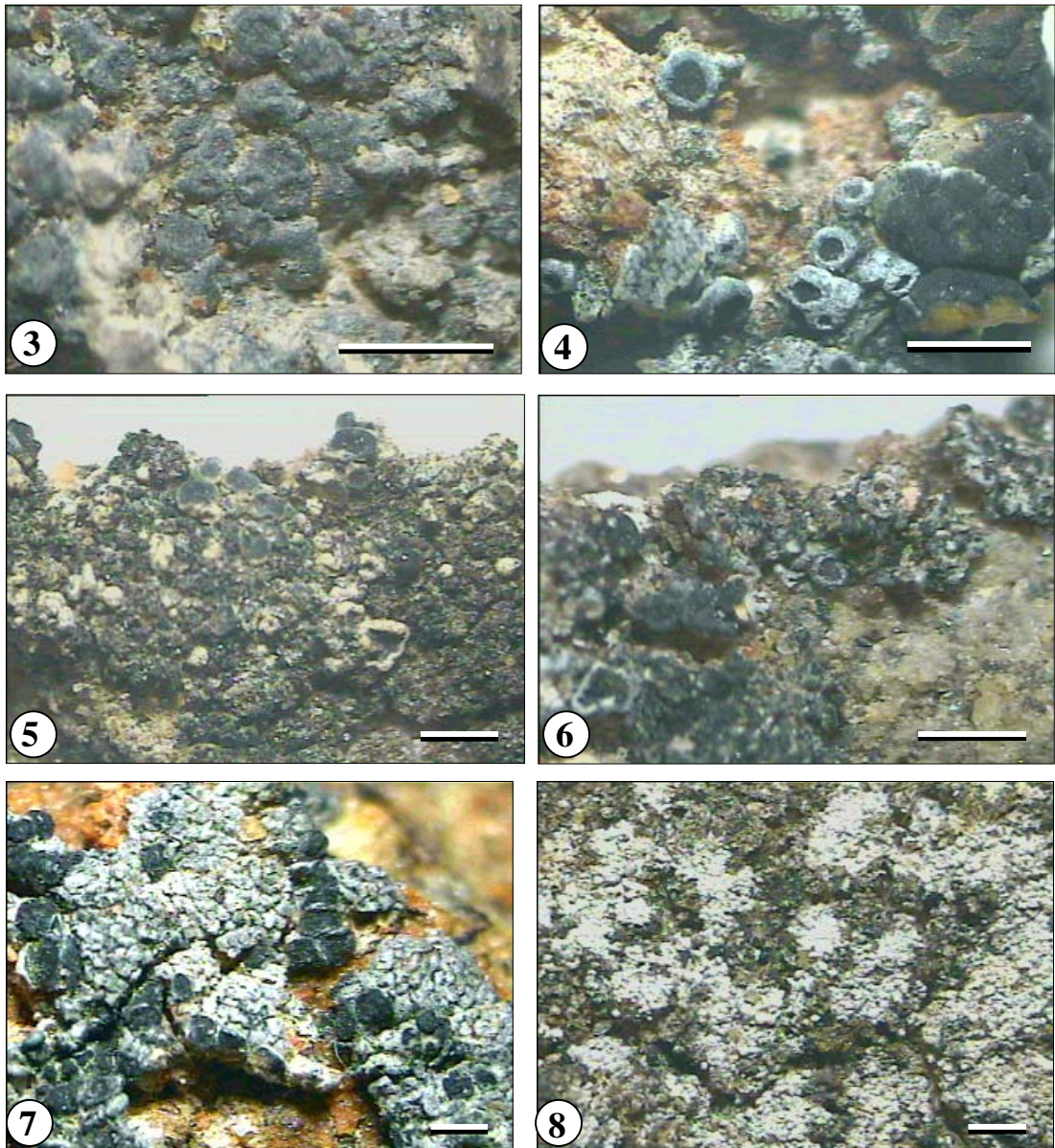


Figure 3. *Buellia illaetabilis*, 4. *Carbonea assentiens*, 5. *Lecanora geophila*, 6. *L. orosthea*, 7. *Lecidella stigmataea*, 8. *Lepraria cacuminum*, (Scale = 1 mm)

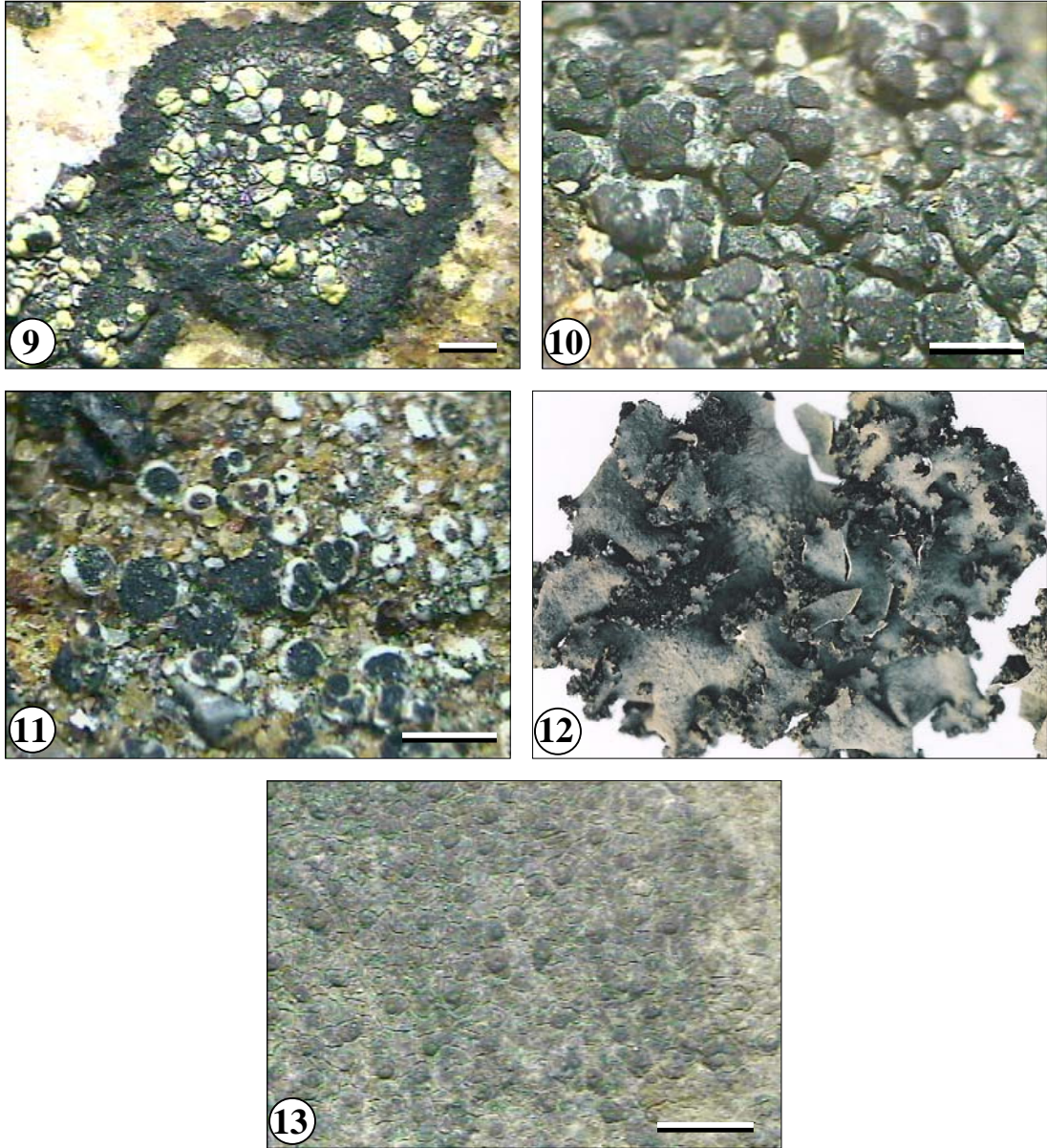


Figure 9. *Rhizocarpon nidificum*, 10. *Rinodina endophragma*, 11. *Sarcogyne privigna*, 12. *Umbilicaria africana* and 13. *Verrucaria holizoa* Leight (Scale: Fig. 9-11, 13 = 1 mm, 12 = 1 cm)