

## The Lichen Flora of Oases of Continental Antarctic, and the Ecological Adaptations of Antarctic Lichens

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### Abstract

Author have studies lichen flora of the most important ice-free areas of Continental Antarctic: Bunger Hills, and the vicinity of Prudz Bay (Larsemann Hills, and Radok Lake in Prince Charles Mountains).

Totally 44 lichen species from 22 genera were reported for Bunger Hills and 50 lichen species from 22 genera and 10 families: *Acarosporaceae*, *Lecanoraceae*, *Lecideaceae*, *Parmeliaceae*, *Pertusariaceae*, *Physciaceae*, *Rhizocarpaceae*, *Stereocaulaceae*, *Theloschistaceae*, and *Umbilicariaceae* were reported for the Prudz Bay Region. 20 lichen species were found in the region for the first time.

Phytogeographic analysis indicated a relatively high proportion of species with bipolar distribution - about 50% of recorded lichen species. About 30% of lichens normally don't extend into maritime zone occurring in continental Antarctic only. The most common lichen families in the region are *Buelliaceae*, *Lecanoraceae* and *Teloschistaceae*.

The water supply and not a temperature is the critical factor for lichens in the Continental Antarctic. Moisture appears to be supplied for lichens not only from snow-melt water but mainly from air. In Maritime Antarctic, due to high air humidity macrolichens form communities everywhere (*Himantormia*, *Usnea* and *Umbilicaria*). In oases of Continental Antarctic extensive sites are lacking in lichen cover, even if the ground is normally snow free. Lichens occur at humid sites with moisture which were brought by winds over the ice cap and poorly developed or absent in dry areas.

Of particular significance for lichens are substrate characteristics, animals influence and salinity brought by wind in coastal areas. Most rich lichen vegetation developed in oases around nests of snow petrels, where the melt water is enriched by nutrients. In contrast, the most pure vegetation is on mobile sand and gravel and in salted coastal habitats.

### Short introduction

Lichens are the major component of Antarctic and Subantarctic terrestrial flora (380 species) among vascular plants (66 sp.) and mosses (104 sp.). They are found luxuriantly growing on rocks, boulders, moraine and decaying cushions of moss tufts in ice free area. 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 are being

studied since 1830. Previously much of the work has been carried out in Antarctic Peninsula, than the East Antarctic region. Last decades the author have studied the lichen flora and vegetation of some very important areas in Continental Antarctic: Bunger Hills in eastern part of the Queen Mary Land, and in the region of Prudz Bay and Prince Charles Mountains (Larsemann Hills and the vicinity of Radok Lake).

### Materials and Methods

The collection of lichens and the determination were carried out during Antarctic summers from 1988-1989 to 2004-2005. Research has concerned the main part of the oases. Specimens were collected with the purpose to reflect the whole diversity of conditions in habitats and the whole specific diversity of lichens. More than 2000 specimens of lichens were collected in different localities at different attitude, coast, mountains, slopes and at different exploitation, chosen in the most typical habitats and areas with the richest vegetation. During brief visits some other small rocks, areas and oases were skin-deep studied. Collected specimens are kept now in Lichen Herbarium of the Komarov Botanical Institute (LE) of the Russian Academy of Sciences in St. Petersburg (Russia).

### Results and Discussion

Cryptogams - lichens, algae, mosses, and fungi are the major components of the flora and vegetation of Polar regions. They are growing on rocks, boulders, moraine and on cushions of moss tufts in ice free area. Because of their high degree of adaptation to the harsh climatic condition they are most interesting group of organisms, both for taxonomic and for ecological studies.

Lichens are very tolerant to the environmental condition. They occur almost everywhere, from the northernmost part of Greenland to the latitude 86° in Antarctic.

The lichen flora of Antarctic, according to first fundamental work of C. Dodge consisted of 424 species, nearly 50% of which were described by C. Dodge himself as endemic species. The modern revisions of separate taxonomic groups of Antarctic lichens reduce the number of species in groups sometimes at once on 80%. H. Hertel (Hertel, 1984) estimated the number of Antarctic lichens not more than 160 species, and about half of them has bipolar or wide distribution. Now the most important publication of D. Øvstedal and R. Levis-Smith (2001) includes 380 species. The whole lichen flora of Antarctic including Subantarctic islands could be estimated as not more then 400-500 lichen species.

The largest specific diversity is known in Subantarctic regions and in Maritime Antarctic. Number of species, known in Continental Antarctic is insignificant. It amounts about 25% of the whole Antarctic lichen flora (about 100-120 species). The composition of species is almost identical for different and distant regions.

The most sensitive tool to estimate and to compare the biodiversity of regions is the local flora - rather good investigated flora of an area near 100 square km, which includes all possible habitats of the region. The comparison of local flora can display the peculiarities and tendencies of the whole regional flora. The local lichen flora of the rather big and most investigated areas of the Continental Antarctic (Bunger Hills, Radok Lake, Larsemann Hills and Syova Station) counts near 50 species each. The flora of single nunataks and small coast oases and islands counts even less - about 20 species.

Totally 44 lichen species from 22 genera were reported from Bunger Hills. The analysis indicated a relatively high (50%) proportion of species with bipolar distribution. 32% of lichens normally don't extend into maritime zone occurring in Continental Antarctic only. The most common lichen families in Bunger Hills are *Buelliaceae*,

*Lecanoraceae* and *Teloschistaceae*.

The lichen flora of the vicinity of Radok Lak in the region of Prince Charles Mountains was first studied in 2004. 27 lichen species were discovered for the first time. Hilly, but in general rolling plain territory located 270 km away from the coastline of Prudz Bay near Amery Ice Shelf (70°48'S., alt. 0-350 m) has no permanent ice and snow cover.

The lichen flora of the Radok Lake Area is one of the richest in the Prudz Bay Region. 85% of the found lichens are crustose, 90% saxicolous. About 90% of taxa have almost equally bipolar or Antarctic distribution. *Acarospora macrocyclos*, *Amandinea petermannii*, *Carbonea aggregantula*, *Lecanora mons-nivis*, *Lecidella wulfenii*, *Ochrolechia frigida* and *Stereocaulon antarcticum* previously were known from the area of the Antarctic Peninsula only.

Some specimens of *Pleopsidium chlorophanum*, *Rhizoplaca melanophthalma* and *Carbonea vorticosa* were obtained from three nunataks located on Lambert glacier even more southern: Shaw Massif (72°01'34"S., alt. 900-1333 m), Ely Ntk. (72°07'43"S., alt. 800 m), Mt. Izabelle (72°11'44"S., alt. 800-1164 m). They are the most southern collections in this sector of Antarctic.

As a whole the lichen flora of the Prudz Bay region numbers now 50 lichen species from 22 genera and 10 families: *Acarosporaceae*, *Lecanoraceae*, *Lecideaceae*, *Parmeliaceae*, *Pertusariaceae*, *Physciaceae*, *Rhizocarpaceae*, *Stereocaulaceae*, *Theloschistaceae*, and *Umbilicariaceae*. 20 lichen species were found in the region for the first time. The list of species is not considered complete, as far as some taxa need a further study.

Obviously humidity, slope exposition and degree of protection of habitats from prevailing winds in connection with the opportunity of the snow accumulation are major factors in conditions of the dry continental climate, influencing distribution of lichens on the territory of continental oases.

Strong southern winds blow off small amount of the winter snow and the summer precipitation are almost absent. Snow accumulates only in wind shadow, where the wind abrasive processes absent, evaporation of a moisture decreases and humidity of ground raises. Besides northern slopes are warmer. Salinity, especially in seaside part of the oases, character of destruction of rocks or ground stability, and abundance or lack of nitrogen are critical for the vegetation.

The colonization of primary substrates by lichens depends on their stability, and is possible only with sufficient amount of moisture. Mobile substrates - sands and gravel are normally uninhabited or covered by young specimens, because of low growth rate of lichens. The character of vegetation there remind the sites, located near glacier, where the number of species is insignificant and the vegetative cover is undeveloped because of recent deglaciation. Elevated territories have richer flora and vegetation because of moisture, enriched with nitrogen and phosphor from snow petrel nests and also by accumulation of snow first of all on elevated sites near a glacier (Seppelt, 1986). Besides foots of hills can be much more cold than tops because of temperature inversions.

In general the water supply and not a temperature is the critical factor for lichens in the Continental Antarctic. Moisture appears to be supplied for lichens not only from snow-melt water but mainly from air. In Maritime Antarctic, due to high air humidity macrolichens form communities everywhere (*Himantormia*, *Usnea* and *Umbilicaria*). In oases of Continental Antarctic extensive sites are lacking in lichen cover, even if the ground is normally snow free. Lichens occur at humid sites with moisture which were brought by winds over the ice cap and poorly developed or absent in dry areas. Of particular significance for lichens are substrate characteristics, animals influence and salinity brought by wind in coastal areas. Most rich lichen vegetation developed in oases around nests

of snow petrels, where the melt water is enriched by nutrients. In contrast, the most pure vegetation is on mobile sand and gravel and in salted coastal habitats.

The most frequent and common species and main dominants of the vegetative cover in Continental Antarctic are: *Rhizoplaca melanophthalma*, *Candelariella flava*, *Lecidea cancriformis*, *Acarospora gwynii*, *Buellia frigida*, *Rinodina olivaceobrunnea*, *Pseudephebe minuscula*, *Umbilicaria aprina*, *U. decussata*, *Buellia pallida*, *Physcia caesia*, *Pleopsidium chlorophanum*, *Rhizocarpon flavum*, *Usnea antarctica*. All other lichen species are rather rare and do not play an essential role in formation of the vegetative cover.

The list of studied species is not considered complete, as far as some taxa need a further study.

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### Curriculum Vitae

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