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PRELIMINARY STUDIES ON ORNITHOCOPROPHILOUS LICHENS OF THE ARCTIC AND ANTARCTIC REGIONS

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Abstract: Floristical and phytosociological studies on the effect of large bird colonies on lichen vegetation with particular reference to epilitic lichens were performed in Spitsbergen (Arctica) and on King George Island (Antarctica). Although many species were found in both areas, great differences were also found in community composition and flora.

1. Introduction

Very little has been published about studies on the effect of large bird colonies on lichen vegetation in the Arctic and especially in the Antarctic. Some information can be found in works of EUROLA and HAKALA (1977), FOLLMANN (1965), BROSSARD *et al.* (1984), but no plant communities were distinguished. Studies on Arctic plant communities associated with the location of bird colonies were performed by DUBIEL and OLECH (1989, 1990).

2. Sites and Methods

In the Arctic research on the occurrence and differentiation of lichen vegetation directly influenced by bird colonies was conducted in the Hornsund region (SW Spitsbergen) in 1982 and 1985. In this area the most important colonial sea-bird species nesting on rock are: *Plautus alle*, *Rissa tridactyla*, *Uria lomvia*, among others. This research concerns epilitic lichen communities associated with the sites inhabited by big colonies of *Plautus alle*.

In the Antarctic, studies on ornithocoprophilous lichens were carried out in the Admiralty Bay region (King George Island, South Shetland Islands) in 1987 and 1988. Among nesting birds in the Admiralty Bay area, most abundant are penguins, which are represented by three species of the genus *Pygoscelis: P. adeliae*, *P. antarctica* and *P. papua*. Also numerous are petrels, especially *Macronectes giganteus* and *Daption capensis*. Floristical and phytosociological studies were performed in the vicinity of large penguin rookeries.

Phytosociological studies were carried out strictly according to the method of BRAUN-BLANQUET (1964). The work is based on 36 phytosociological relevés, of which 15 were made in the Hornsund area and 21 in King George Island. For each species in a relevé the cover was estimated to a six degree scale. On the ground of analysis of the phytosociological relevés arranged in tables, ornithocoprophilous lichen communities

Table 1. Ornithocoprophilous lichen species (f—facultative).

	Antarctica	Arctica		Antarctica	Arctica
Acarospora macrocyclos	+		*Lecanora contractula*		+
Acarospora molybdina		+	*Lecanora dispersa* (f)	+	+
Aspicilia cf. *bennettii*		+	*Lecidea atrobrunnea*	+	+
Aspicilia caesiocinerea (f)		+	*Mastodia tesselata*	+	+
Bacidia stipata	+		*Parmelia infumata*		+
Buellia anisomera (f)	+		*Phaeophyscia sciastra*		+
Buellia augusta	+		*Physcia caesia*	+	+
Buellia cladocarpiza	+		*Physcia dubia*	+	+
Buellia coniops	+	+	*Physconia muscigena*	+	+
Buellia granulosa	+		*Ramalina terebrata*	+	
Buellia isabellina	+		*Rhizoplaca aspidophora*	+	
Buellia latemarginata	+		*Rhizoplaca melanophtalma*	+	+
Buellia russa	+		*Rinodina balanina*		+
Caloplaca regalis	+		*Rinodina deceptionis*	+	
Caloplaca sublobulata	+		*Rinodina petermannii*	+	
Candelariella arctica		+	*Tephromela atra* (f)	+	+
Candelariella hallettensis (f)	+		*Umbilicaria arctica* (f)		+
Candelariella vitellina (f)	+	+	*Usnea acromelana*	+	
Catillaria corymbosa	+		*Usnea antarctica* (f)	+	
Microglaena antarctica	+		*Xanthoria candelaria*	+	+
Haematomma erythromma	+		*Xanthoria elegans*	+	+
Lecania brialmontii	+		*Xanthoria sorediata*		+

Table 2. Community of Candelariella arctica (*Spitsbergen, Arctica*).

Slope	5–30°
Exposure	S, SE, SW
10 relevés	Presence
Candelariella arctica	V
Rinodina balanina	V
Physcia caesia	V
Aspicilia cf. *bennettii*	IV
Buellia coniops	IV
Acarospora molybdina	III
Rhizoplaca melanophtalma	III
Physcia dubia	III
Umbilicaria arctica	II
Lecidea atrobrunnea	II
Aspicilia caesiocinerea	II
Schistidium apocarpum	II
Tortula ruralis	II
Prasiola crispa	II

Sporadic species: *Lecanora polytropa, Phaeophyscia sciastra, Lecidea lepicida* v. *lactea.*

Table 3. Community of Xanthoria elegans (*Spitsbergen, Arctica*).

Slope	80–90°
Exposure	W, E, SE
5 relevés	Presence
Xanthoria elegans	V
Physcia caesia	IV
Candelariella vitellina	IV
Physcia dubia	III
Lecidea atrobrunnea	III
Xanthoria sorediata	II
Rhizoplaca melanophtalma	II
Phaeophyscia sciastra	II
Lecanora dispersa	II

Sporadic species: *Acarospora molybdina, Umbilicaria arctica, Aspicilia caesiocinerea, Lecanora polytropa, Rhizocarpon polycarpum, Schistidium apocarpum, Tortula ruralis, Orthotrichum pylaisii.*

Table 4. *Community of* Mastodia tesselata (*King George Island, Antarctica*).

	Slope 20–70°
	Exposure SW, SE
	5 relevés Presence
Mastodia tesselata	V
Caloplaca cirrochrooides	IV
Lecania brialmontii	III
Verrucaria tesselatula	III
Prasiola crispa	II
Xanthoria candelaria	II

Sporadic species: *Verrucaria dispartita*, *Xanthoria elegans*, *Lecanora* cf. *lavae*, *Rinodina petermannii*, *Physcia caesia*.

Table 5. *Community of* Xanthoria elegans-Caloplaca regalis (*King George Island, Antarctica*).

	Slope 70–80°
	Exposure E
	5 relevés Presence
Caloplaca regalis	V
Xanthoria elegans	V
Physcia caesia	IV
Buellia coniops	III
Rinodina petermannii	III
Xanthoria candelaria	III
Rhizoplaca aspidophora	II
Prasiola crispa	II
Buellia latemarginata	II
Usnea antarctica	II

Sporadic species: *Physcia dubia*, *Haematomma erythromma*, *Lecania brialmontii*.

Table 6. *Community of* Haematomma erythromma (*King George Island, Antarctica*).

	Slope 5–60°
	Exposure S, SE
	6 relevés Presence
Haematomma erythromma	V
Usnea antarctica	V
Usnea acromelana	IV
Acarospora macrocyclos	IV
Buellia coniops	IV
Xanthoria elegans	III
Tephromela atra	III
Buellia anisomera	III
Xanthoria candelaria	III
Rhizoplaca aspidophora	III
Buellia augusta	II
Ramalina terebrata	II
Rhizoplaca melanophtalma	II
Microglaena antarctica	II

Sporadic species: *Buellia latemarginata*, 3.3 *Lecidea sciatrapha*, *Rinodina petermannii*, *Galoplaca sublobulata*, *Candelariella hallettensis*.

Table 7. *Community of* Ramalina terebrata (*King George Island, Antarctic*).

	Slope 75–90°
	Exposure S, SW
	5 relevés Presence
Ramalina terebrata	V
Xanthoria candelaria	IV
Xanthoria elegans	III
Buellia latemarginata	II
Buellia augusta	II
Acarospora macrocyclos	II

Sporadic species: *Caloplaca sublobulata*, *Haematomma erythromma*, *Buellia granulosa*.

were distinguished. The basis for the differentiation of communities was above all their floristic individuality. The names of communities are formed from the names of the differential species, which are also fairly often predominant. For each community a simplified phytosociological table was prepared (Tables 2–7).

3. Results and Discussion

Ornithocoprophilous lichens develop on rocks (very often on sea cliffs) occupied

by bird colonies which use the sea as a source of nourishment. The nutrients originally contained in the sea are transported as sea bird excrement to the terrestial vegetation on bird rocks. Sea-birds enrich the tundra in basic nutrients (mainly N and P). Excessive concentrations of such biogenes result in the occurrence of a peculiar group of very interesting nitrophilous lichens, which are able to tolerate very high concentrations of N and P. Most of these lichens are vividly colored (orange, yellow), *e.g. Xanthoria elegans, X. sorediata, Caloplaca regalis, Candelariella arctica*—differing from other usually dark thalli polar lichens. Although many species were found in both Arctic and Antarctic regions (Table 1), great differences were found in community composition and flora.

4. The Arctic Area

In the Hornsund area the most abundant ornithocoprophilous lichen species are: *Physcia caesia, Ph. dubia, Rinodina balanina, Buellia coniops, Aspicilia* cf. *bennettii, Acarospora molybdina, Candelariella arctica, Xanthoria elegans, X. sorediata, Lecidea atrobrunnea, Rhizoplaca melanophtalma*, and other species which grows on mosses and soil is *Physconia muscigena.* Some of them are also frequent in the Antarctic region (Table 1).

Ornithocoprophilous influence is seen not only in the composition of lichenoflora but also in the increased size of lichen thalli, *e.g.* thalli of *Umbilicaria arctica* in ornithocoprophilous localities are several times larger than thalli in other sites.

In this area the most important ornithocoprophilous, epilitic lichen communities are; the community with *Candelariella arctica* and the community with *Xanthoria elegans.* The communities are differentiated according to the morphology of the bird rocks. A community with *Candelariella arctica* (Table 2) develops frequently on nearly flat or only slightly inclined rock and block of rock surfaces. The physiognomy of stands is formed by yellow thalli of *Candelariella arctica*, the dominant species. It is accompanied by *Rinodina balanina, Buellia coniops, Aspicilia* cf. *bennettii, Lecidea atrobrunnea, Rhizoplaca melanophtalma* and others. Together with lichens, mosses (mostly *Schistidium apocarpum* and *Tortula ruralis*) occur in small numbers and the alga *Prasiola crispa.* Such a community formation has not so far been reported. Another community of epilitic lichens develops on vertical or greatly inclined surfaces (80–90° slopes) of rock walls. The influence of water with bird excrements flowing down from rock ledges is pronounced. This community of *Xanthoria elegans* (Table 3) differs from that previously described. The species *Xanthoria* and *Physcia*, particularly *Xanthoria elegans* and *Physcia caesia* and *Ph. dubia* are dominant. The physiognomy of the community is formed by the orange thalli of *Xanthoria* spp. Fairly frequent are: *Lecidea atrobrunnea, Candelariella vitellina, Rhizoplaca melanophtalma.* Representatives of genus *Xanthoria* (*Xanthoria elegans* and *X. sorediata*) can be regarded as species characteristic of the community. Communities comprising *Xanthoria elegans* have been mentioned in earlier literature, *e.g.* EUROLA and HAKALA (1977), BROSSARD *et al.* (1984).

5. The Antarctic Region

In the vicinity of penguin rookeries very characteristic lichen flora occurs: *e.g. Acarospora macrocyclos*, *Rinodina petermannii*, *R. deceptionis*, *Lecania brialmontii*, *Caloplaca regalis*, *Xanthoria elegans*, *Buellia coniops*, *B. russa*, *B. latemarginata* among others. Ornithocoprophilous influence appears not only in the increased size of lichen thalli, but also in other interesting phenomenon, which is a tendency among normal crustose genera towards adopting a fruticose habit, *e.g. Caloplaca regalis*, *Lecania brialmontii*, *Catillaria corymbosa*, *Bacidia stipata*. Some lichenologists suppose this phenomenon is an effect of strongly manured habitat (JACOBSEN and KAPPEN, 1988).

Ornithocoprophilous lichen communities in maritime Antarctica were characterized by vertical zonation. Community with *Mastodia tesselata* (Table 4) develops not far from sea level, on the lower parts of rock walls with south-west or south-east exposure. This community is not very rich in species. Most components of this community appear to be not only nitrophilous but also halophilous. The dominant species *Mastodia tesselata* forms the physiognomy of the community.

The most common community in the Admiralty Bay region is a community with *Xanthoria elegans* and *Caloplaca regalis* (Table 5), which occurs in the higher parts of the rocks. It develops on vertical or greatly inclined rock walls with north exposure. It is one of the most beautiful plant communities in Antarctica. It occupies very large surfaces of rock walls and the physiognomy of the community is determined by vividly orange thalli of *Xanthoria elegans* and yellow-orange *Caloplaca regalis*—two dominant species. "Orange rocks" are striking phenomenon in the grey-black gloomy Antarctic landscape. Other frequent lichens in the community are: *Buellia conipos*, *Physcia caesia* and *Rinodina petermannii*.

On the highest parts of rocks in coastal areas, community with *Haematomma erythromma* (Table 6) and community with *Ramalina terebrata* (Table 7) have developed—according to the morphology of these rocks. Community with *Haematomma erythromma* covers slightly inclined or nearly flat surfaces of rocks in places with most frequent southern exposure. Its physiognomy results from the presence of the crustose thalli of *Haematomma erythromma* and fruticose lichens *Usnea antarctica* and *U. acromelana*. They are accompanied by *Acarospora macrocyclos*, *Buellia coniops*, *Xanthoria elegans*, *X. candelaria*, *Rhizoplaca aspidophora* and a few others. This is a community rather rich in lichen species. It often occurs on the flat tops of rocks. Community with *Ramalina terebrata* develops on vertical or greatly inclined surfaces. It often occurs on vertical rock slopes with south-west or west exposure. Its physiognomy results from the presence of the large fruticose thalli of a dominant lichen—*Ramalina terebrata*. In some of the stands a proportion of *Xanthoria candelaria* and *X. elegans* is noted.

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