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Lichen-Moss associations in plant communities of the Southwest Admiralty Bay, King George Island, Antarctica

Filipe C. Victoria[1]
victoriafilipe@hotmail.com

Margéli P. Albuquerque[1]

Antônio B. Pereira[2]

Abstract

The phytosociology of plant communities in the Admiralty Bay ice-free areas (King George Island, South Shetland Islands, Antarctica) was investigated during the 2003/04 summer seasons. In this study associations among lichens and mosses were found, where the lichen species are dominant in the samples. A total of 10 associations are identified. For each association found in this work, descriptions are given and comments about their ecology and distribution in the study area are made.

Key words: Antartic plants, phytosociology, ecology.

Introduction

Considering the physiognomy and the floral composition of plant communities of the Admiralty Bay ice-free areas (62° 03' 40" – 62° 05' 40" S and 58° 23' 30" – 58° 24' 30" W), evidences are found that these communities are very different from those found in other islands of the coastal Antarctica, as the self-contained environment of this region (Figure 1) turns out to put plant communities under the influence of very different clime conditions from those found in exposed areas, specially for winds and the sea breeze, creating a micro-clime of singular characteristics (Ferron *et al.*, 2001).

According to Rakusa-Suszczewski e*t al*. (1993), the geographic localization of Admiralty Bay, along with the geomorphologic aspect of the adjoining areas – with hills of 150 to 600 meters high – both influence local meteorology and clime conditions. The clime of the region is also influenced by ocean currents and winds coming from west (Marsz and Rakusa-Suszczewski, 1987).

In Antarctica, summer is short and cold, with a maximum temperature around zero °C. During this time, permanent rain fall and pronounced snow precipitations are common (Cygan, 1981; Rakusa-Suszczewski *et al.*, 1993).

For Pereira and Putzke (1994), these conditions, along with those imposed by a long dark winter, do limit the occurrence of plant species in the region, especially flowering plants, since such conditions inhibit the reproductive cycle. Be-

[1] Escola Nacional de Botânica Tropical, Instituto de Pesquisas Jardim Botânico do Rio de Janeiro. Rua Pacheco Leão, 915, Horto, Rio de Janeiro, RJ, Brasil/ Laboratório de Micologia e Briologia, Universidade Luterana do Brasil-ULBRA. Av. Farroupilha, 8801, Prédio 14, Bairro São José, Canoas, RS, Brasil.
[2] Programa de Pós-graduação em Ensino de Ciências e Matemática e Curso de Biologia da Universidade Luterana do Brasil-ULBRA. R. Duque de Caxias, 766, ap. 20, Canoas, RS, Brasil.

cause of that, only two species of Angiosperms are known in Antarctica, *Deschampsia antarctica* Desv. and *Colobanthus quitensis* Kunth. On the other hand, moss and lichen species, are more strong, developing quite well in polar conditions, being for that reason, the main representatives of the Antarctic flora (Ochyra and Vãna, 1989; Putzke and Pereira, 2001).

Lichens are very representative in Antarctica and, if we take into account their contribution to the floral composition of Antarctica ice-free areas, we will find they have not been studied very much (Pereira, 1990). Taxonomic and phytosociologic studies are usually narrow, except for Redon (1985), which is more extensive, allowing the identification of most species.

Lichen communities are well represented in the Antarctic tundra, being fruticulose lichens their main component (Ochyra, 1998; Pereira and Putzke, 1994). In the Admiralty Bay, those communities are floristically very diverse (Ochyra, 1998), consisting of lichens and lichen-moss associations vastly distributed in the region, usually living in rocky outcrops of marine emerged tablelands (Schaeffer, 2002) as well as on rocks next to bird colonies. (Pereira and Puztke, 1994). According to Giminghan and Lewis-Smith (1970), a characteristic of these associations is the almost absence of mosses. When present, they are usually cushion like nitrophilic species which often develop in cracks of rocks, for example, *Hennediella antarctica* (Ångstron) Ochyra and Matteri, *Syntrichia princeps* (De Not.) Mitt., *Schistidium antarctici* (Card.) L.I. Savicz and Smirnova (Ochyra,1998), or yet other species with similar niches (Lewis-Smith and Corner , 1973).

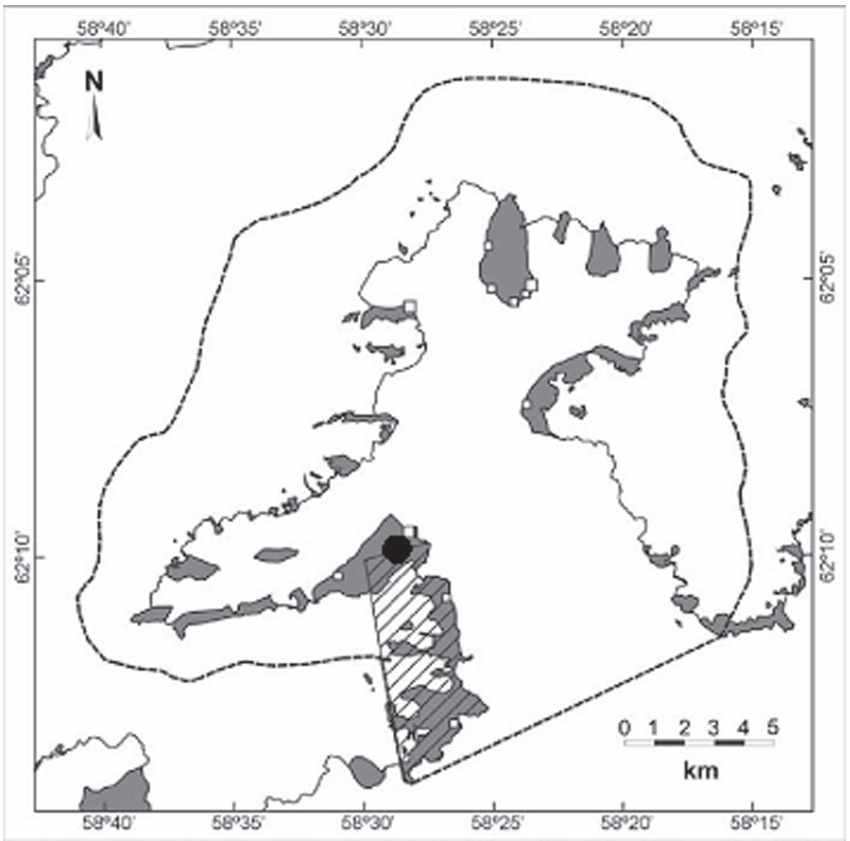

Figure 1. Studied region (dark dot) at Admiralty Bay, King George Island, Antarctica, showing the perimeter of the Antarctic Special Managed Area (hatched line) and the limits of the Special Scientific Interest Area (parallel lines). (Adapted from Simões *et al*. 2004).

In order to complement the knowledge of plant communities in the ice-free areas of Admiralty Bay, communities of lichens and mosses observed during a phytosociologic study of the region are presented and described here.

Materials and Methods

During 2003/2004 austral summer, plant communities present at the adjoining areas of Henri Artowski Antarctic station were studied. This study started from a survey of phytosociologic data, using Braun-Blanquet (1964) quadrats method, adapted to Antarctic conditions (Kanda, 1986; Putzke *et al*. 1995). After throwing 240 quadrats of 25 x 25 cm, within an altitude gradient varying from sea level up to about 350 meters high, the associations found were characterized based on the minimum quadrats (3-10) where lichens were the dominant covering species. For the highest regions of the study area (above the 500 meters) where the diversity of plants is very low and the substratum is removed easily, samples for the current study are not presented. Whenever possible, samples of lichens with highly developed ascomas (presence of apothecia or perithecia) were made. Saxicolous species were pulled out with the help of a geologist hammer, and muscicolous and/or terricolous species, with the help of a knife, to make sure the individuals would come out with some substrate. High coverage moss species or moss species that showed high frequency of associations with the dominant lichen species were also sampled. Identification of the species was based on the work of Dodge (1973), Redon (1985), Ochyra (1998), Putzke *et al.* (1995) and Putzke and Pereira (1990).

The material was herborized and kept at the Instituto de Pesquisas Jardim Botânico do Rio de Janeiro herbaria (RB). The description of the lichen-moss associations followed Kanda (1986), Pereira and Putzke (1994) and Putzke *et al.* (1995), with some modifications done by Hu (1998).

Results

From those 240 quadrats thrown to the southwest of Admiralty Bay, 55 had lichen-moss associations. Most of the dominant lichens were fruticulose, but stalky and fruticulose lichens were also found. Such associations usually occur in stony and rocky land, with good drainage, except for the associations with lichen *Leptogium* sp, which were often next to drainage lines. Described below are the 10 associations found.

Usnea aurantiacoatra - Andreaea gainii association

Frequent in the slopes of Jersak Hills, between or on rocks, being limited to well drain areas, this association was observed only above 250 meters. The region presents an alpine relief, with some peaks, making it difficult to accumulate snow, thus contributing for a good drainage of the area. *Usnea aurantiacoatra* (Jacq.) Bory was found in all thrown quadrats (10) in this region, with a coverage of 25-50%, usually on rocky outcrops (Figure 2A). The stems of this lichen, quite visible, stand out from the other lichen species of the area. The moss *Andreaea gainii* Card. was observed together with the dominant lichen in most of the samples, with a coverage of about 20%, often growing in cushions, although some tufts of it were also found between rocks. Other mosses like *Schistidium antartici* (Card) L.I. Savicz and Smirnova and *Pohlia cruda* (Hedw.) Lindb. were also found next to this association, occurring usually in cracks, what made it difficult estimating their actual coverage.

Usnea antarctica - Polytrichum juniperinum - Andreaea gainii association

From 150 meters down to the direction of the sea level, it was observed that *U. aurantiacoatra* reduced its frequency being gradually substituted by *Usnea antarctica*. Du Rietz. Between 150 and 30 meters, samples of this lichen associated to *Polytrichum juniperinum* Hedw. and *Andreaea gainii* (Figure 2B) came to be frequent, usually on slopes, or yet on rocky outcrops of the marine emerged tablelands of the region. The lichen was dominant in the samples, showing close to 50% coverage, occurring on rocks or fragment of those buried in the substrate. Mosses with coverage next to 25% were associated, being *P. juniperinum* growing in tufts like, on soil and between rocks, and *A. gainii* growing in cushions like, directly on the rocks. This association usually occurred in well drained land, sometimes on rocks inside the drainage lines, often on the highest parts of Skua Cliff. The dominant lichen occurred directly on rocks, next to cushions of *A. gainii,* in a significative lower coverage compared to the quadrats sampled in drained areas. *P. juniperinum* occurred inside the drainage line, usually at the base of the rocks where the lichen was fixed, associated to small tufts of *Sanionia uncinata* (Hedw.) Loesk. showing coverage never higher than 10%. Besides the dominant species, eventually other species were observed in the 5 quadrats where this association was found. In more wet areas *Chorisodontium acyphyllum* and *Cephaloziella varians* (Gottsche) Steph., were found, both species showing lower than 1% coverage. In drier areas *Bryum amblyodon* Müll. Hal. and *Cladonia* sp also occurred, with relatively low coverage, around 5% each.

Usnea spp - *Syntrichia princeps – Polytrichastrum alpinum* association

A frequent association found in lower areas of Skua Cliff (aprox. 50 m), being present at sea level, especially next to Papua-Penguin colonies (*Pygoscelis papua*). The lichens *U. antarctica* and *U. aurantiacoatra* are abundant on rocks and on slopes of this region, both sharing about 45% coverage in the samples (7 quadrats). In the quadrats that were thrown closer to the penguin colonies (Figure 3A), those species of lichens decreased their frequency and

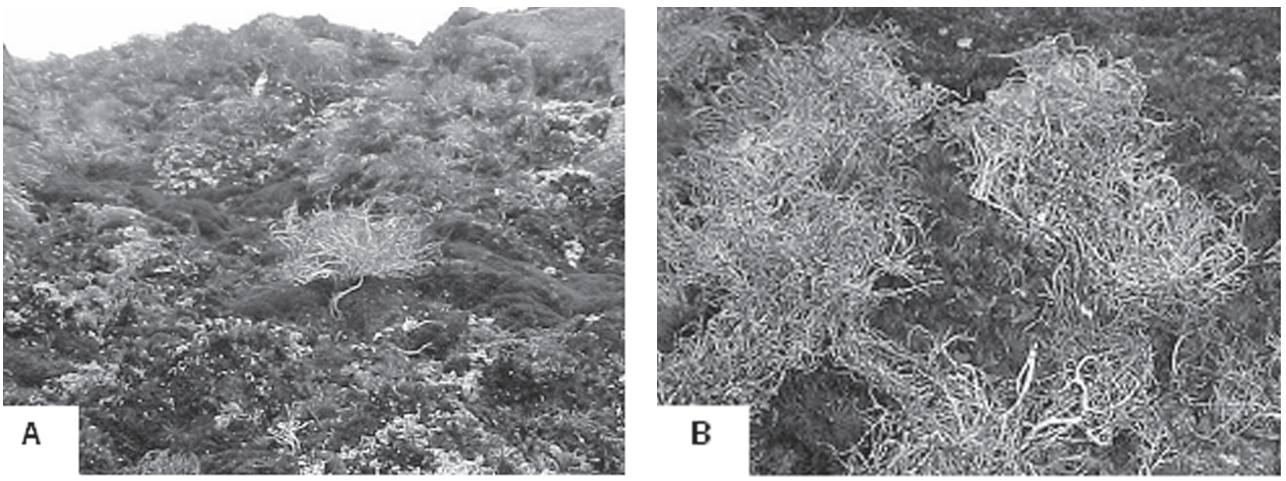

Figure 2. A) *Usnea aurantiacoatra – Andreaea gainii* association. B) *Usnea Antarctica – Andreaea – Polytrichum juniperinum* association. Photos: Filipe Victoria.

their coverage, up to 10 meters from the beginning of the penguin rookeries, and after that, they were no longer found. The most frequent mosses of this association were *Syntrichia princeps* (De Not) Mitt. and *Polytrichastrum alpinum*, showing coverage of approximately 15% and 20% respectively. Usually among the dominant species, carpets of *Sanionia uncinata* may be found and turfs of *Deschamspsia antarctica* Desv., with average coverage of 10% for each specie. The continental seaweed *Prasiola crispa* occurred in the samples that were closer to the penguin colonies, usually associated to lichens with coverage lower than 5%. However, in samples where lichens did not occur, these algae were the dominant specie, usually associated to *D. antarctica*.

Cladonia borealis – Sanionia uncinata – Polytrichastrum alpinum association

Small association found in the southwest plateau of the Polish station, next to the Puchalski Cross. Found in 3 quadrats only, but the dominat species found there not occurs associated in others quadrats samples in the same region. The most frequent species were *Cladonia borealis* S. Stenroos, *S. uncinata*, always associated (Figure 3B), and small isolated tufts of *Polytrichum juniperinum*, with coverage next to 30% and 25% respectively. Besides those dominant species, it was also found *U. antarctica,* in small stems on fragments of rocks, *Ditrichum hyalinum* (Mitt.) Kuntze*,* associated to tufts of *P. alpinum,* and *Andreaea depressinervis* Card.*,* this last one was found only in a single quadrat and with coverage lower than 10%. The other species under the same association showed between 10 and 15% coverage.

Usnea antarctica – Syntrichia princeps association

An association occurring in a discontinuous form, found from the slope of the Skua Cliff facing H. Arctowski station, to the proximities of Rakusa Point. *Usnea antarctica* occurs on rocky outcrops, with an approximate coverage of 50%, while *Syntrichia princeps* occurs associated to *Prasiola crispa,* under stony substrate. These species were observed in coverage of 15% and 5% respectively. In some of the samples (5 quadrats) *S. princeps* occurred intimately associated to *D. antarctica,* but this last specie was found rare in coverage larger than 5%. The discontinuity of this association may be related to the presence of bird colonies, since *S. princeps* and *P. crispa* occur preferably next to nesting Antarctic birds (aprox. 10 m), like in Rakusa Point. *U. antarctica* and *D. antarctica* also occur next to bird colonies, but at larger distances.

Usnea antarctica – Schistidium spp association

They were found in an area of fragmented vegetation, where the species are distant from one another, located at west of the Polish station, about 350 m alt., in a slope that extends from Jersak Hills to the lowest part of Jardine Peak (Figure 4A). In this association there are two moss species, *Schistidium falcatum* (Hook. f. et. Wills) B. Bremer and *Schistidium urnulaceum* (Müll Hal.) B.G. Bell*,* and one lichen specie, *Usnea antarctica,* apparently, more abundant. Since it is a scattered community, with low density of individuals, the phytosociologic sampling was hard, whereas no analysis of species coverage was done.

Usnea Antarctica – Cladonia borealis – Polytrichum juniperinum association

This association is physiognomically confused with *Cladonia borealis – Polytrichum juniperinum* association, however both associations have distinct orientations. The previous one occurred in samples oriented to Punta Thomas. The association *Usnea antarctica – Cladonia borealis – Polytrichum*

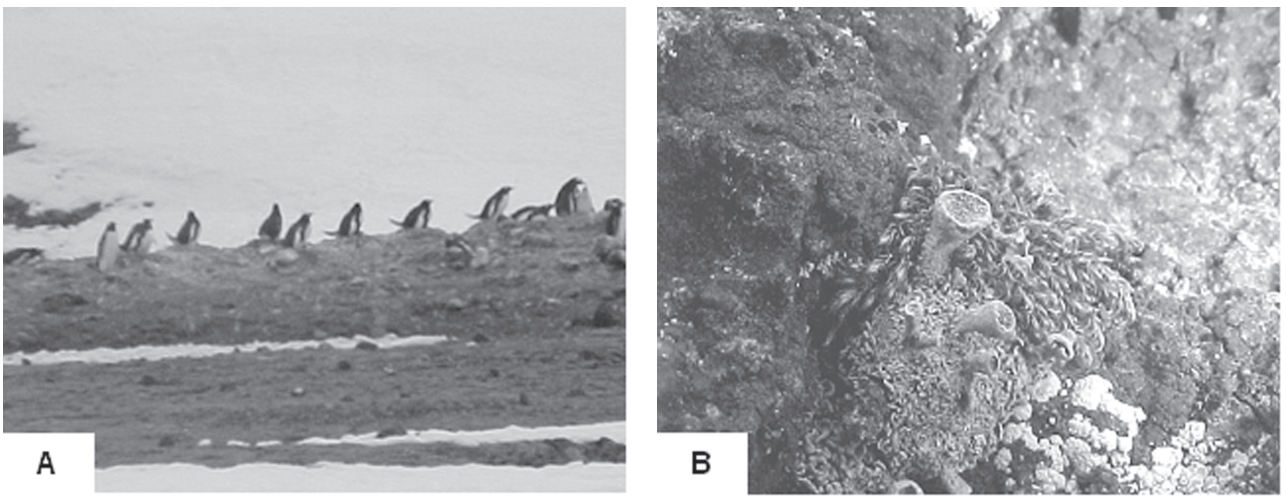

Figure 3. A) Colonies of *Pygoscelis Papua* in Ornithologist Creek, where *Usnea spp – Syntrichia princeps - Polytrichum juniperinum* association was observed. B) Stem *Cladonia borealis*, associated to *Sanionia uncinata*. Photos: Filipe Victoria.

juniperinum occurred in samples more to the south (10 quadrats), oriented to the Ecology glacier beach. Both species of lichens which dominate this association take the space between tufts of *P. juniperinum*, whether is on rocks, like in the case of *U, antarctica*, whether over other mosses like in the case of *Cladonia borealis*. This last one usually grows on dry carpets of *S. uncinata*, or even at the base of stems of *P. juniperinum*. *Cladonia borealis*. showed coverage around 50%, while *U. Antarctica* was 70%. The tufts of *P. juniperinum* have an average coverage of 20%. The other observed species do not take more than 10% coverage in the samples.

Leptogium – Sanionia uncinata – Liquens association

Association found on the side of Skua Cliff facing Rakusa Point (5 quadrats sampled), in areas where drainage is low or absent, on stony substrate. *Leptogium* sp. occurs on mosses, mainly *Polytrichastrum alpinum* and *Andreaea gainii*, presenting coverage larger than 50%, while mosses, in general, present 20% coverage. *S. uncinata* occurs associated to other lichen that usually causes necrosis in the moss. This lichen was noticed when it was in its initial developing stage, no reproductive structures was found, being impossible its identification. The coverage range of this association varied from 5% to 50%. Carpets of *S. uncinata* are also found submerged in small puddles of water coming from defrosting ice, but in smaller coverage than what it has when associated to the lichens.

Leptogium sp – *Polytrichastrum alpinum* association

Association well represented on the plateau just before Rakusa Point, in a swampy area due to the confluence of innumerous drainage lines. It is common to find *Leptogium* sp. sponging *Sanionia uncinata*, reaching, sometimes, the point of killing the whole individual. In the samples (10 quadrats), this lichen was found only on dead mosses (Figure 4B), where it had an average coverage of 75%. *P. alpinum* was observed growing under organic substrate, wet and blackened, probably due the deposition of organic matter coming from higher places, with the help of water from defrosting areas, or due to the competitive behavior of *Leptogium* with *S. uncinata*. This moss was observed in the area showing coverage around 20%. They may also occur associated to tufts of *P. juniperinum, Bryum pseudotrichetrum* (Hedw.) Schwaegr., *Polytrichum piliferum* Hedw., *P. juniperinum* and small turfs of *D. Antarctica,* usually with coverage below 1%.

Usnea antarctica - Polytrichum piliferum association

This association was found in Ornithologist Creek, in four quadrats that were thrown on a small strip of land between the beach and the rookeries, occurring on stony substrate in the slopes of the region. *Usnea antarctica* has coverage next to 75%, while *P. piliferum* has an average of 10%. They may also be found between the stems of lichens, *Hennediella antarctica, Bartramia patens* Brid. and *Bryum pallecens* Schelich, with a coverage around 4%. Above the slopes where these species were found, there are colonies of Giant Petrels (*Macronectes giganteus*), and at the opposite side of this formation, only associations between mosses were found, being *Usnea Antarctica – P. juniperinum* association limited to this area.

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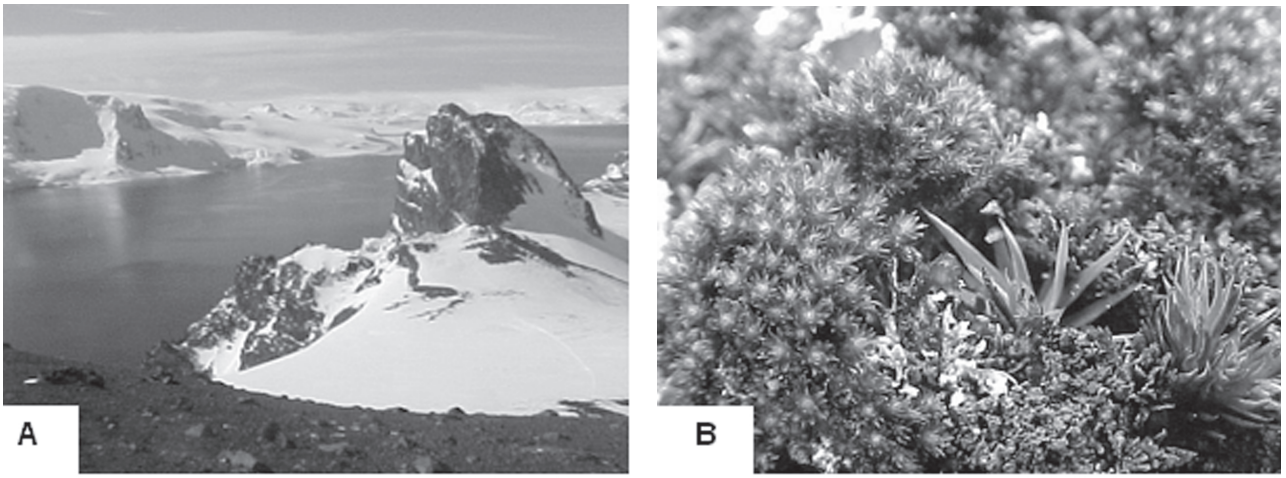

Figure 4. A) Jardine Peak (left) and Jersak Hill (right), places where *Usnea aurantiacoatra – Schistidium* spp. association was observed. B) *Leptogium* sp. (darker) associated with *Andreae gainii* (larger abundance in the picture) and *Polytrichastrum alpinum* (center). Photos: Filipe Victoria.

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