LICHEN MOSS ASSOCIATION FREQUENTLY FOUND IN MARITIME ANTARCTIC

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Abstract: The aim of this work was to report on the lichen-moss association in the ice-free areas of Elephant Island, King George Island, Nelson Island and Deception Island. The study started with the classification and description of the plant communities based primarily on phytosociological and biodiversity data. All data were obtained from 2003-2004 to 2011-2012 austral summers. 12 most frequent lichen-moss association species based on all island records were found. The most frequent association in both studied areas involved foliose-crustose lichen with a moss carpet species, such as *Psoroma cinnamomeum* Malme with *Sanionia uncinata* (Hedw.) Loesk. The occurrences for each island as well as the common association found in all sampled islands are demonstrated.

Keywords: lichen ecology, bryophytes, South Shetlands archipelago, Maritime Antarctic

Introduction

The composition, abundance and distribution of the plant communities in Antarctica is directly related with the changes in the climatic conditions and the effects of climate warming, resulting in alterations including changes in populations (Frenot *et al.*, 2005; Convey, 2006).

Lichens is the group that has the highest species diversity, meeting the conditions best adapted in Antarctica, having an important contribution in floristic composition in these areas, and their existence is dependent on ice-free regions, climate and a stable substrate (Redon, 1985; Kappen & Schroeter, 1997). Lewis-Smith (2001) in a phytosociological study found that many species of mosses are associated with dominant species in the formation, reflecting the dependence of these species of mosses because if the dominant species become endangered, the dependent one will become endangered too.

Studies on the coexistence of terrestrial algae species and lichenized fungi were also published, such their relationship within the growth habit and ecological adaptation in the Antarctic environment. Associations are reported between mosses and lichens species, and plant formations growing in associations at King George Islands, Nelson Island and

Elephant Island (Allison & Lewis-Smith, 1973; Pereira & Putzke, 1994; Victoria *et al.*, 2006). A mapping of these plant formations is being conducted to infer the environmental changes as well the human impact over the years of the plant composition in the Antarctic ice-free areas.

In order to complement the knowledge of plant communities in the ice-free areas of Maritime Antarctic, associations between lichens and mosses observed during the phytosociological survey made since 2003-2004 up to 2011-2012 austral summers are presented here, as well as the strongest associations found in each surveyed island together with their coverage and frequencies.

Materials and Methods

Using the phytosociological data obtained since 2003/2004 up to 2011/2012 austral summers all records from lichens found associated to moss species were analyzed. The data was obtained from a survey using Braun-Blanquet phytosociological methods (Braun-Blanquet, 1964), adapted to Antarctic conditions (Kanda, 1986). 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 samples would come out with some substrate. Identification of the species was based on the work of Redon (1985), Ochyra (1998), Pereira & Putzke (1994) and Putzke & Pereira (1990). The records were ordered in a frequency range, by the most to the less frequent species found in association.

Results

Based on the phytosociological data it was possible to verify the occurrence of 12 of the most frequent lichen-moss associations in ice-free areas in Maritime Antarctic (Figure 1). Only three associations were observed in all the sampled islands, being represented by thalose-foliose lichens. The lichen *Psoroma cinnamomeum* Malme was found as being the most frequent lichen found associated with mosses, mainly with species where the cushion is the most frequent life form. *Leptogium* spp. were also found frequently associated with moss species, but the opposite to that was observed for the previous association, these lichens were found commonly associated with moss carpets such *Sanionia uncinata* (Hedw.) Loeske.

When comparing the records of all the islands a lower occurrence of fruticose lichens associated with mosses

is observed, probably due to this lichen life form being found often in rocky sites where both lichen and moss species are well adapted to colonize rock outcrops directly (Victoria *et al.*, 2006). Cushion mosses occur mainly in rocky terrains in higher places (more than 100mts), often without the need for an early-colonized substrata, growing directly on outcrops (Ochyra, 1998). This moss life form can spread to uncovered lower terrains and then are immediately available for the muscicolous lichen colonization, such as *Ochrolechia frigida* (Sw.) Lynge. This lichen species was found in several sites in association with *Andreaea* spp. (Figure 2a) in the sampled islands, except for Deception Island, frequently found in beach plateaus. This association is one of the most frequent in Nelson Island along with *Usnea antarctica*-*Cladonia* spp. - *Polytrichum juniperinum* and *Huea coralligera* - *Sphaerophorus globosus* - *Usnea aurantiacoatra* - *Syntrichia saxicola* association (Figure 2b and 2c, respectively).

The same association was the most frequently found in Elephant Island (Pereira & Putzke, 1994; Putzke & Pereira, 2012). Two associations were found only in a single island, one composed by a fruticose lichen (*Usnea* spp.-*Polytrichastrum alpinum*) and the other by a dimorphic lichen (*Cladonia metacorallifera* - *Sanionia uncinata*, Figure 2d) both in lower frequencies in the King George Island. The association between *Psoroma cinnamomeum*

Figure 1. The most lichen-moss associations found in the northern Maritime Antarctic and their frequencies in each island sampled.

Figure 2. Examples of lichen-moss associations found in the northern Maritime Antarctic. a) *Ochrolechia frigida*-*Andreaea* association. b) *Usnea antarctica*-*Cladonia* spp.-*Polytrichum juniperinum* association. c) *Huea coralligera*-*Sphaerophorus globosus*-*Usnea aurantiacoatra*-*Syntrichia saxicola* association. d) *Cladonia metacorallifera*-*Sanionia uncinata* association. e) *Psoroma cinnamomeum*-*Andreaea gainii* association. f) *Cladonia metacorallifera*-*Sphaerophorus globosus*-*Polytrichastrum alpinum* association.

and *Andreaea gainii* Cardot (Figure 2e) and *Leptogium puberulum* with *Ptychostomum pseudotriquetrum* (Hedw.) J.R. Spence & H.P. Ramsay were the most frequent association observed in the Admiralty Bay area (King George Island). Dimorphic lichen was also found associated with other fruticose lichens, often in higher plateau (Øvstedal & Lewis-Smith, 2001; Victoria *et al.*, 2009), the latter being found in Elephant, Nelson and King George Islands in the *Cladonia metacorallifera*-*Sphaerophorus globosus*-*Polytrichastrum alpinum* association (Figure 2f).

Discussion

The plants and lichen species found in Antarctica were developing, mainly, on rocks or moist soils, the rocks being fragmented since the soil had a higher ornithogenic influence. Thus the lichen and moss association were often found in terrain types where both organisms are adapted, corroborating the reports made from several studies on plant communities in Antarctica (Gimingham & Lewis-Smith, 1970; Putzke & Pereira, 1990; Victoria *et al.*, 2006, 2009). Several studies reported lichen and mosses growing

at relatively successful growth rates in Polar Regions when compared with other environments (Scott, 1990).

These findings can be related with the human impacts in the area, to decreasing diversity along the two summer seasons (Victoria & Pereira, 2007). For Sancho *et al.* (2007) these changes can be a climate change indicator, because that lichen species found in the studied region are susceptible to extreme temperature variation, increasing or decreasing their growth (Sancho *et al.*, 2007), but the fast development and death of the foliose muscicolous lichen cannot be discarded, as certain types of foliose lichens are among the fastest-growing species which have the ability to grow up to one centimeter per year, and this growth rate is unusual in most lichen species (Bednarik, 2004).

Conclusion

The lichen moss association observed in all plant communities distributed in the South Shetlands Islands can be used as a indicator of plant succession on the ice-free areas. Further monitoring studies are needed to clarify these diversity changes in plant associations in the Maritime Antarctic.

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