

Lichen Flora around the Korean Antarctic Scientific Station, King George Island, Antarctic

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As part of the long-term monitoring projects on Antarctic terrestrial vegetation in relation to global climate change, a lichen floristical survey was conducted around the Korean Antarctic Station (King Sejong Station), which is located on Barton Peninsula, King George Island, in January and February of 2006. Two hundred and twenty-five lichen specimens were collected and sixty-two lichen species in 38 genera were identified by morphological characteristics, chemical constituents, TLC analysis and ITS nucleotide sequence analysis.

Keywords: antarctic, lichens, flora, king george island, KOLRI

The Antarctic has undergone significant environmental changes, including the greatest increases in ultraviolet-B radiation levels in the world and significant temperature increases in the maritime region during recent decades (Robinson *et al.*, 2003). Antarctic vegetation lives at the physiological limits of survival; consequently, even slight changes in growth conditions are likely to have a large effect. The Antarctic environment probably offers the most significant baseline with which global atmospheric changes may be compared. In addition, growing tourism, interest in global biodiversity and a need for more active conservation have led to the recognition that modern floristical studies are essential for this region.

The Korean Antarctic Scientific Station, King Sejong Station, is located at Barton Peninsula, King Gorge Island, which is the largest island in the South Shetland Islands belonging to Maritime Antarctic zone. There are only two native phanerogams (Antarctic hairgrass, *Deschampsia Antarctica* Desv. and Antarctic pearlwort, *Colobanthus quitensis* (Kunth) Bartl.). While the greatest diversity of bryophytes and lichens also occurs in this biological zone, lichens are the dominant life-form throughout much of it. Lichens are therefore visually the most important organisms in the terrestrial ecosystem of this region with only the wettest

moss-, alga-, or cyanobacteria-dominated communities being devoid of lichens (Lewis Smith, 1996).

King George Island was chosen to monitor vegetation communities in relation to environmental changes on a long-term scale. This is because it is one of the most appropriate representative localities of maritime Antarctic regions that are sensitive to climate change because of their geological locality (Lewis Smith, 1984, 1990; Longton, 1988). Recently, Chung *et al.* (2004) reported that ice cliff retreats have been occurring rapidly with the current climate warming around Marian Cove and Barton Peninsula on King George Island. Since 2001, studies of vegetation communities have been conducted around Barton Peninsula by the Korea Polar Research Institute (KOPRI) with the aim of implementing long-term monitoring studies on terrestrial vegetation, including vegetation on surfaces that are newly created following the retreat of glaciers and ice fields caused by climate warming. As a part of long-term monitoring projects, this study describes the Antarctic lichen flora around the Korean Antarctic Scientific Station at Barton Peninsula on King George Island.

Materials and Methods

Study area

King George Island is located between 61°50' to 62°15' S and 57°30' to 59°01' W, and is the largest island in the South Shetland Islands archipelago. It

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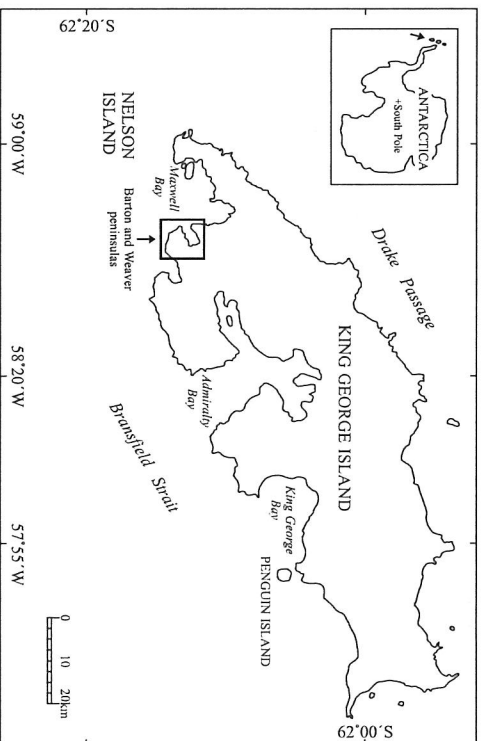


Fig. 1. Location map showing the area investigated on Barton Peninsula and Weaver Peninsula on King George Island.

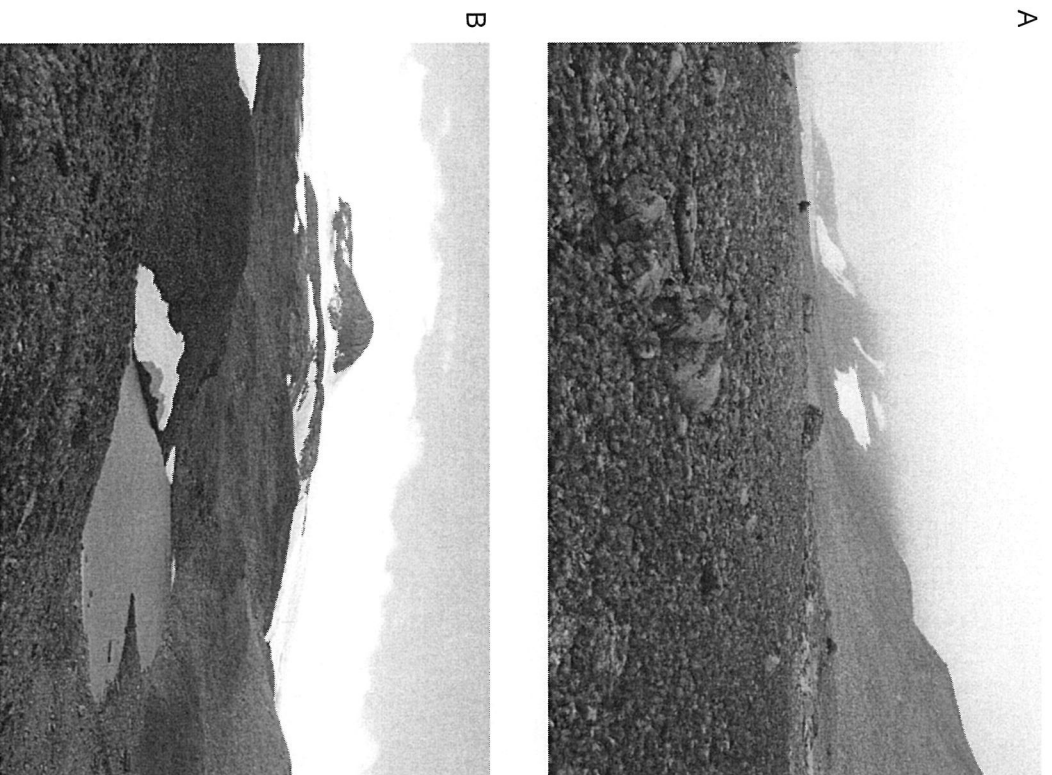


Fig. 2. The ice-free area covered by cryptogamic species in the peninsula. (A) Sea shore area and (B) hill side area.

stretches from southwest to northeast and is about 65 km long by up to 40 km wide. Most of the surface is covered by glaciers, and outcrops are exposed only along the shorelines in restricted areas. The climate is humid and relatively mild compared to the Antarctic Peninsula because of a strong maritime effect.

The paleoclimate and deglaciation history of the South Shetland Islands have been intensively studied (Barsh and Mäusbacher, 1986; Sugden and Clapperton, 1986; Björck *et al.*, 1991; Yoon *et al.*, 2000). The results of these studies imply that the deglaciation of King George Island occurred approximately 6000 years ago and that a climatic optimum occurred between ca. 4000 and 3000 year BP (Björck *et al.*, 1991; Yoon *et al.*, 2000). Our main study area, Barton Peninsula, is in the southwestern part of King George Island and is 4 km wide and extends 4 km to the southwest (Fig. 1). Marian and Potter Coves are fjords into which outlet glaciers are currently calving, producing icebergs. The peninsula has a rugged topography, with a wide and gentle slope in the central belts that have elevations of 90–180 m above sea level. Permafrost is present 1 m below the surface (Jeong and Yoon, 2001). Soils of the peninsula are subdivided into four suites based on bedrock type: soils on granodiorite, basaltic andesite, lapilli tuff, and the Sejong formation (Lee *et al.*, 2004). Soils are generally poor in organic material and available nutrients, apart from near seabird colonies and penguin rookeries. Most of the ice-free area of the peninsula is covered by substantial vegetation, dominated by cryptogamic species (Fig. 2).

Lichen collection and identification

Two hundred and twenty-five specimens were collected in early February, 2006. The expedition for lichen collection was officially permitted by the Korean Ministry of Foreign Affairs and Trade through the Korea Polar Research Institute (KOPRI). This collection was deposited in the Korean Lichen Research Institute (KoLRI) at Sunchon National University in Korea.

Identification was mainly based on the keys and illustrations provided by Øvstedal and Lewis Smith (2001). For this study, morphological and anatomical examinations were made. Thin-layer chromatography (TLC) was also performed to identify the chemical compounds within lichen with three developing solvent systems (Culbertson, 1972, 1974). Where appropriate, scientific names follow the IndexFungorum (<http://www.indexfungorum.org/Names/>).

Analysis of the ribosomal DNA sequence of the internal transcribed spacer (ITS) region was also attempted in some lichen species for molecular identification. Fresh lichen thalli were fractioned with cryo-tissue-crasher (SK200, Tokken, Japan). This device

effectively fractioned crustose lichen thallus tightly adhering to rock surface. Total DNA was extracted using DNeasy Plant Mini Kit (Qiagen, Germany), which was originally intended for extraction from small amounts of tissue from green plants (Ekman, 1999). Dilutions (10^{-1}) of the total DNA were used for PCR amplification of the nuclear rDNA ITS and 5.8S genes. Primers for amplification were: ITS4 (5'-TCCTCCGCTTATT GATATGC-3'; White *et al.*, 1990) and ITS5 (5'-GGAAAGTAAAAAGTCGRACCAAGG-3'; White *et al.*, 1990). Conditions for PCR amplification and cycle sequencing have been described previously (Arup, 2002). The resulting sequences were compared with other ITS sequences from lichen-forming fungi available from NCBI (<http://www.ncbi.nlm.nih.gov/BLAST>), and the identification of the lichen specimens tested were verified.

Results and Discussion

Lichen flora

Sixty-two lichen species in 38 genera were identified in this study. They are arranged in alphabetical order in the following list; bold letters represent the lichen species endemic to Antarctic. Illustrations of some lichen species are shown in Fig. 3.

Acarospora austrosheilanica (C.W. Dodge) Øvstedal (Fig. 3)

Barton Peninsula, on volcanic rock near the shore, HUR ANT050835 (10 m, 62°13'12.2"S, 58°46'07.8"W); det. Andreev, 2006.

Acarospora macrocyclos Vain. (Fig. 3)

Weaver Peninsula, on rock near the shore, HUR ANT050940 (5 m, 62°12'34.7"S, 58°47'29.8"W); det. Andreev, 2006.

Bryoria sp. (Fig. 3)

Barton Peninsula, on dry rock faces, inland hill sides, HUR ANT050861 (85 m, 62°13'25.7"S, 58°46'52.7"W); det. Wang, 2006.

This species is very similar to *B. chalybeiformis* (L.) Brodo and Hawksw., but is controversial because of the lack of soralia and fumarprotocetraric acid.

Buellia anisomera Vain. (Fig. 3)

Barton Peninsula, on rock near the shore, HUR ANT050881 (5 m, 62°14'11.0"S, 58°46'09.9"W); det. Andreev, 2006.

Buellia rassa (Hue) Darb.

Weaver Peninsula, on coastal rock near the shore, HUR ANT050942 (5 m, 62°12'34.7"S, 58°47'29.8"W); det. Andreev, 2006.

Caloplaca holocarpa (Hoffm.) Wade (Fig. 3)
Barton Peninsula, on rock near the shore, HUR ANT050807 (5 m, 62°13'59.6"S, 58°46'58.8"W); det. Andreev, 2006.

Caloplaca johnstonii (C.W. Dodge) Søchting and Olech
Barton Peninsula, on rock near the shore, HUR ANT050806 (5 m, 62°13'59.6"S, 58°46'58.8"W); det. Andreev, 2006.

Caloplaca regalis (Vain.) Zahlbr. (Fig. 3)
Barton Peninsula, widespread and locally abundant on coastal cliffs and boulders, HUR ANT050908 (5 m, 62°14'24.4"S, 58°44'37.0"W); det. Andreev, 2006.

Caloplaca sublobulata (Nyl.) Zahlbr. (Fig. 3)
Widespread and common on maritime cliffs, rocks and stones, usually close to bird colonies; Barton Peninsula, HUR ANT050886 (5 m, 62°14'11.0"S, 58°46'09.9"W), HUR ANT050891 (5 m, 62°14'19.5"S, 58°45'34.5"W), HUR ANT050906 (5 m, 62°14'23.0"S, 58°44'42.9"W), HUR ANT050913 (5 m, 62°14'25.2"S, 58°44'30.8"W); Weaver Peninsula HUR ANT050943 (5 m, 62°12'34.7"S, 58°47'29.8"W); det. Andreev, 2006.

Carbonea assegniens (Nyl.) Hertel
Barton Peninsula, on dry exposed rock outcrops, boulders and stones in fell field, HUR ANT050892-1 (5 m, 62°14'11.0"S, 58°46'09.9"W), HUR ANT050976 (95 m, 62°13'50.6"S, 58°46'44.5"W); det. Andreev, 2006.

Carbonea vorticosa (Flörke) Hertel
Barton Peninsula, on rock, HUR ANT050972 (110 m, 62°13'33.7"S, 58°46'45.5"W); det. Andreev, 2006.

Catillaria contristans (Nyl.) Zahlbr. (Fig. 3)
Barton Peninsula, on rock, HUR ANT050801 (70 m, 62°13'57.0"S, 58°46'31.5"W); det. Andreev, 2006.

Catillaria corymbosa (Hue) I.M. Lamb (Fig. 3)
Barton Peninsula, widespread and locally abundant on dry rock faces and overhangs, HUR ANT050798 (70 m, 62°13'57.0"S, 58°46'31.5"W), HUR ANT050867 (85 m, 62°13'25.1"S, 58°46'52.7"W), HUR ANT050872 (95 m, 62°13'26.1"S, 58°46'45.1"W); det. Andreev, 2006.

Cetraria aculeata (Schreb.) Fr. (Fig. 3)
Frequent in small amounts on moss (*Chorisodontium aciphyllum* and *Polytrichum strictum*) turf banks; Barton Peninsula, HUR ANT050760 (15 m, 62°13'22.5"S, 58°47'29.2"W), HUR ANT050766 (10 m, 62°13'22.6"S, 58°47'37.3"W), HUR ANT050797 (70 m, 62°13'57.0"S, 58°46'31.5"W), HUR ANT050812 (15 m, 62°13'16.3"S, 58°47'02.4"W), HUR ANT050917 (20 m, 62°14'25.6"S, 58°44'28.3"W), HUR ANT050970, 971

(80 m, 62°13'24.8"S, 58°46'52.1"W); Weaver Peninsula, HUR ANT050957 (90 m, 62°12'20.0"S, 58°47'31.6"W); det. Andreev, 2006.

Cladonia borealis S. Stenroos (Fig. 3)
Widespread and frequently on moss (*Chorisodontium aciphyllum* and *Polytrichum strictum*) turf banks; Barton Peninsula, HUR ANT050790, 794 (70 m, 62°13'57.0"S, 58°46'31.5"W), HUR ANT050813 (10 m, 62°13'16.3"S, 58°47'02.4"W), HUR ANT050855 (75 m, 62°13'26.2"S, 58°46'53.5"W), HUR ANT050862 (80 m, 62°13'25.7"S, 58°46'53.5"W), HUR ANT050862 (85 m, 62°13'25.1"S, 58°46'52.7"W); Weaver Peninsula HUR ANT050965 (15 m, 62°12'30.7"S, 58°47'55.6"W); det. Hur, 2006.

Cladonia chlorophaea (Flörke ex Sommerf.) Spreng. (Fig. 3)
Barton Peninsula, on gravelly soil, HUR ANT050813-1 (10 m, 62°13'16.3"S, 58°47'02.4"W), HUR ANT050826 (15 m, 62°13'14.9"S, 58°46'56.3"W), HUR ANT050833 (10 m, 62°13'13.9"S, 58°46'30.2"W); det. Hur, 2006.

Cladonia furcata (Huds.) Schard. (Fig. 3)
Barton Peninsula, on gravelly soil or on mosses (*Chorisodontium aciphyllum* and *Polytrichum strictum*) turf banks, HUR ANT050826 (15 m, 62°13'14.9"S, 58°46'56.3"W), HUR ANT050856, 857 (75 m, 62°13'26.2"S, 58°46'53.5"W); det. Andreev, 2006.
This species is still very controversial. Olech (1989 a, b) reported *C. furcata* from King George Island, but Øvstedal and Lewis Smith (2001) omitted it from their checklist of Antarctic lichens.

Cladonia gracilis (L.) Willd. (Fig. 3)
Barton Peninsula, widespread and frequent on mosses, especially *Chorisodontium aciphyllum* and *Polytrichum strictum* turf banks or on gravelly soil, HUR ANT050816 (10 m, 62°13'16.3"S, 58°47'02.4"W), HUR ANT050834 (10 m, 62°13'13.9"S, 58°46'30.2"W), HUR ANT050873 (95 m, 62°13'26.1"S, 58°46'45.1"W); Weaver Peninsula HUR ANT050964 (15 m, 62°12'30.7"S, 58°47'55.6"W); det. Andreev, 2006.

Cladonia lepidophora Ahti and Kashiw. (Fig. 3)
Barton Peninsula, uncommon, on gravelly soil, HUR ANT050817 (10 m, 62°13'16.3"S, 58°47'02.4"W); det. Andreev, 2006.

Cladonia pleurota (Flörke) Schaer.
Barton Peninsula, widespread and frequent on mosses, especially *Chorisodontium aciphyllum* and *Polytrichum strictum* turf banks, HUR ANT050858 (75 m, 62°13'26.2"S, 58°46'53.5"W), HUR ANT050865 (85 m, 62°13'25.7"S, 58°47'52.7"W); det. Andreev, 2006.

- Cladonia pyxidata* (L.) Hoffm. (Fig. 3)
Barton Peninsula, on gravelly soil, HUR ANT050825 (15 m, 62°13'14.9"S, 58°46'56.3"W); det. Hur, 2006.
- Cladonia scabriuscula* (Deise) Leight.
Barton Peninsula, on damp moss turf, HUR ANT050792 (70 m, 62°13'57.0"S, 58°46'31.5"W); det. Andreev, 2006.
- Cystocoleus* aff. *ebeneus* (Dillw.) Thwaites (Fig. 3)
Widespread on soil but infrequent on dry soil; Weaver Peninsula HUR ANT050949 (15 m, 62°12'25.8"S, 58°47'09.2"W); HUR ANT050960 (90 m, 62°12'20.1"S, 58°47'50.4"W); Barton Peninsula HUR ANT050974 (50 m, 62°13'50.6"S, 58°46'44.5"W); det. Andreev, 2006.
- Haematomma erythroma* (Nyl.) Zahlbr. (Fig. 3)
Barton Peninsula, widespread and locally abundant on rock surfaces, especially close to the shore, HUR ANT050804, 810 (3 m, 62°13'59.6"S, 58°46'58.8"W); det. Hur, 2006.
- Himantornia lugubris* (Hue) I.M. Lamb (Fig. 3)
Barton Peninsula, common and locally very abundant on most acidic rock surfaces, HUR ANT050762 (10 m, 62°13'22.5"S, 58°47'29.2"W); HUR ANT0508774 (80 m, 62°13'34.3"S, 58°46'55.6"W); HUR ANT050851 (55 m, 62°13'26.2"S, 58°46'53.5"W); HUR ANT050928 (5m, 62°14'21.5"S, 58°43'40.5"W); det. Hur, 2006.
- Huea cernuata* (Hue) C.W. Dodge and G.E. Baker
Weaver Peninsula, on coastal rock, HUR ANT050945 (10 m, 62°12'33.5"S, 58°47'27.6"W); det. Andreev, 2006.
- Huea coralligera* (Hue) C.W. Dodge and G.E. Baker (Fig. 3)
Barton Peninsula, widespread and frequent on rock, HUR ANT050837 (3 m, 62°13'02.2"S, 58°46'04.6"W); det. Andreev, 2006.
- Lecania brialmontii* (Vain.) Zahlbr. (Fig. 3)
Common on moist shaded coastal rocks and weathered whale bone; HUR ANT050839 (5 m, 62°13'02.2"S, 58°46'04.6"W), HUR ANT050903 (3 m, 62°14'22.0"S, 58°45'10.5"W); Weaver Peninsula, HUR ANT050934 (3 m, 62°12'34.7"S, 58°47'29.8"W); det. Andreev, 2006.
- Lecania gerlachii* (Vain.) Darb. (Fig. 3)
On rock surfaces; Barton Peninsula, HUR ANT050910, 911 (5 m, 62°14'24.4"S, 58°44'37.0"W); HUR ANT050930 (5 m, 62°14'31.5"S, 58°43'40.5"W); Weaver Peninsula, HUR ANT050939 (3 m, 62°12'34.7"S, 58°47'29.8"W), HUR ANT050950 (15 m, 62°12'25.8"S, 58°47'09.2"W); det. Andreev, 2006.
- Lecanora epibryon* (Ach.) Ach. (Fig. 3)
Barton Peninsula, on moist coastal rocks and weathered whale bone, HUR ANT050903 (3 m, 62°14'22.0"S, 58°45'10.5"W), HUR ANT050912 (5 m, 62°14'24.4"S, 58°44'37.0"W); det. Andreev, 2006.
- Lecanora parmelinoides* Lumbsch (Fig. 3)
Weaver Peninsula, uncommon, on moist rock surface, HUR ANT050951 (65 m, 62°12'26.7"S, 58°47'26.8"W); det. Andreev, 2006.
- Lecanora polytropa* (Hoffm.) Rabenh. (Fig. 3)
Barton Peninsula, frequent on rock, HUR ANT050752 (3 m, 62°13'19.4"S, 58°47'34.9"W); det. Andreev, 2006.
- Lecidea cancriformis* C.W. Dodge and G.E. Baker (Fig. 3)
Barton Peninsula, on coastal rock, HUR ANT050751 (3 m, 62°13'19.4"S, 58°47'34.9"W); det. Andreev, 2006.
- Lecidella carpatica* Körb. (Fig. 3)
Barton Peninsula, on coastal rock, HUR ANT050771 (10 m, 62°13'22.5"S, 58°47'29.2"W); det. Andreev, 2006.
- Leptogium puberulum* Hue (Fig. 3)
Weaver Peninsula, widespread and locally abundant, on moist stony ground, HUR ANT050958 (90 m, 62°12'17.2"S, 58°47'50.4"W); det. Hur, 2006.
- Massalongia carnosa* (Dicks.) Körb. (Fig. 3)
Barton Peninsula, widespread on mosses (especially *Andreaea* spp.), HUR ANT050761, 768 (10 m, 62°13'22.5"S, 58°47'29.2"W); det. Andreev, 2006.
- Ochrolechia frigida* (Sw.) Lynge (Fig. 3)
Barton Peninsula, widespread and common on living and dead mosses, especially *Andreaea* spp., and *Chorisodontium aciphyllum* and *Polytrichum strictum* turf banks, HUR ANT050765, 769, 770 (10 m, 62°13'22.5"S, 58°47'29.2"W), HUR ANT050819 (15 m, 62°13'15.3"S, 58°47'56.8"W), HUR ANT050860 (60 m, 62°13'26.2"S, 58°46'53.5"W), HUR ANT050888, 889 (5 m, 62°14'11.0"S, 58°46'09.9"W), HUR ANT050923 (5 m, 62°14'21.5"S, 58°43'40.5"W); det. Hur, 2006.
- Pannaria austro-orcadensis* Øvstedal
Widespread and locally abundant on moist gravelly soil; Weaver Peninsula, HUR ANT050963 (15 m, 62°12'30.7"S, 58°47'55.6"W); Barton Peninsula, HUR ANT050973 (70 m, 62°13'50.6"S, 58°46'44.5"W); det. Andreev, 2006.
- Parmelia saxatilis* (L.) Ach. (Fig. 3)
Barton Peninsula, widespread and locally abundant on dry to moist rock faces, HUR ANT050925 (5 m,

62°14'21.5"S, 58°43'48.7"W); det. Hur, 2006.

Pertusaria excludens Nyl. (Fig. 3)

Barton Peninsula, on the moist rock or weathered whale bone, HUR ANT050902, 905 (5 m, 62°14'22.0"S, 58°45'10.5"W); det. Andreev, 2006.

Physcia caesia (Hoffm.) Fűrnr. (Fig. 3)

Widespread and locally abundant on dry rock, often associated with *Xanthoria candelaria* and *X. elegans*; Barton Peninsula, HUR ANT050907 (5 m, 62°14'23.3"S, 58°44'42.9"W); Weaver Peninsula, HUR ANT050938 (5 m, 62°12'34.7"S, 58°47'27.6"W), det. Hur, 2006.

Physcia dubia (Hoffm.) Lettau

Barton Peninsula, widespread and frequent, mainly on coastal rocks, HUR ANT050843 (5 m, 62°13'08.8"S, 58°46'01.0"W), HUR ANT050930-1 (5 m, 62°14'21.5"S, 58°43'48.7"W); det. Hur, 2006.

Physconia muscigena (Ach.) Poelt (Fig. 3)

Widespread and occasionally locally abundant on moss (especially *Santonia uncinata*), soil and rock ledges; Barton Peninsula, HUR ANT050909 (5 m, 62°14'24.4"S, 58°44'37.0"W), HUR ANT050924, 926 (5 m, 62°14'21.5"S, 58°43'48.7"W); Weaver Peninsula, HUR ANT050936 (5 m, 62°12'34.7"S, 58°47'29.8"W), det. Hur, 2006.

Placopsis contortuplicata I.M. Lamb (Fig. 3)

Widespread and locally abundant on stone, frequently at margins of stone strips and solifluction lobes on gently sloping fell field areas, where it is typically an early colonist; Barton Peninsula, HUR ANT050773 (15 m, 62°13'22.5"S, 58°47'29.2"W), HUR ANT050784 (90 m, 62°13'44.9"S, 58°46'50.7"W), HUR ANT050823 (10 m, 62°13'15.3"S, 58°46'56.8"W); Weaver Peninsula HUR ANT050946 (10 m, 62°12'33.5"S, 58°47'27.6"W), det. Hur, 2006.

Porpidia austrosheilandica Hertel

Barton Peninsula, widespread and locally common on stones, boulders and rock outcrops, HUR ANT050878 (140 m, 62°13'29.6"S, 58°46'16.8"W); det. Andreev, 2006.

Pseudophebe pubescens (L.) M. Choisy (Fig. 3)

Frequently and locally abundant on moss (especially *Andreaea* spp.) and gravelly soil in fell field; Barton Peninsula, HUR ANT050779 (90 m, 62°13'44.9"S, 58°46'80.7"W), HUR ANT050829 (10 m, 62°13'15.1"S, 58°46'55.0"W), HUR ANT050860 (70 m, 62°13'26.2"S, 58°46'53.5"W); Weaver Peninsula HUR ANT050954 (95 m, 62°12'22.5"S, 58°47'31.0"W), det. Hur, 2006.

Ramalina terebrata Hook. f. and Taylor (Fig. 3)

Barton Peninsula, widespread and locally abundant on coastal cliffs and large boulders, HUR ANT050809 (10 m, 62°13'59.6"S, 58°46'58.8"W), HUR ANT050901 (5 m, 62°14'22.0"S, 58°45'10.5"W); det. Hur, 2006.

Rhizocarpon geographicum (L.) DC.

Barton Peninsula, widespread and often abundant on dry exposed rock faces, boulders and stones in fell field areas, HUR ANT050894 (3 m, 62°14'11.0"S, 58°46'09.9"W); det. Hur, 2006.

Rhizocarpon nidificum (Hue) Darb.

Barton Peninsula, on dry exposed rock faces, HUR ANT050894-1 (3 m, 62°14'11.0"S, 58°46'09.9"W); det. Hur, 2006.

Rhizoplaca aspidophora (Vain.) Redon (Fig. 3)

Barton Peninsula, widespread and common on rock surfaces, HUR ANT050836 (7 m, 62°13'03.5"S, 58°46'07.8"W); det. Andreev, 2006.

Rinodina olivaceobrunnea C.W. Dodge and G.E. Baker

Barton Peninsula, on dry mosses and soil, HUR ANT050811 (5 m, 62°13'16.3"S, 58°47'02.4"W); det. Andreev, 2006.

Sphaerophorus globosus (Huds.) Vain. (Fig. 3)

Common on *Chorisodontium scaphyllum* and *Polytrichum strictum* turf banks, and on other mosses (e.g. *Andreaea* spp.) with lichens (e.g. *Cladonia* spp.) in fell fields community with high moss and lichen cover; Barton Peninsula, HUR ANT050776-1 (90 m, 62°13'44.9"S, 58°46'50.7"W), HUR ANT050793 (50 m, 62°13'57.0"S, 58°46'31.5"W), HUR ANT050887 (5 m, 62°14'11.0"S, 58°46'09.9"W); Weaver Peninsula, HUR ANT050935 (5 m, 62°12'34.7"S, 58°47'29.8"W), HUR ANT050956 (80 m, 62°12'20.0"S, 58°47'31.6"W), det. Hur, 2006.

Stereocaulon alpinum Laurer

Weaver Peninsula, among mosses (especially *Andreaea* spp.), also on stony fell field, HUR ANT050947 (10 m, 62°12'28.7"S, 58°47'11.3"W); det. Andreev, 2006.

Tephromela atra (Huds.) Hafellner ex Kalb

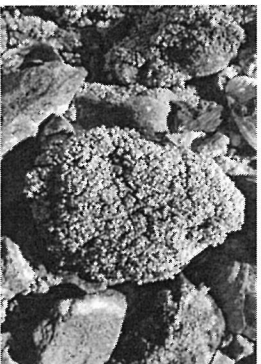
Barton Peninsula, widespread on dry to moist rock surfaces, HUR ANT050900 (5 m, 62°14'20.7"S, 58°45'22.3"W); det. Andreev, 2006.

Tremolecia atrata (Ach.) Hertel

Barton Peninsula, frequently on dry rock outcrops and stones in exposed fell field, HUR ANT050975 (50 m, 62°13'58.9"S, 58°46'31.5"W); det. Andreev, 2006.



Acarospora austrosheilandica



Acarospora macrocyclos



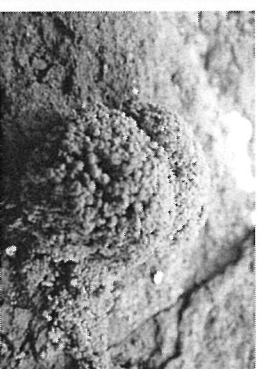
Bryoria sp.



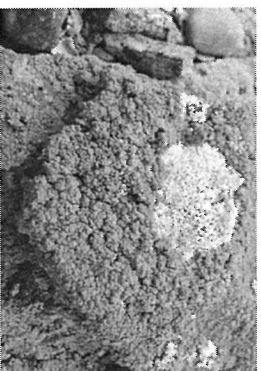
Buellia anisomera



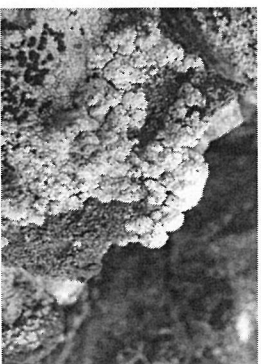
Caloplaca holocarpa



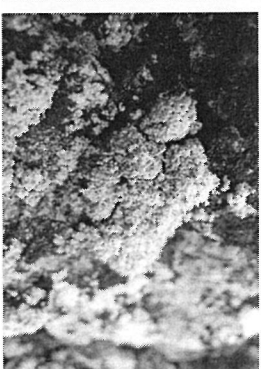
Caloplaca regalis



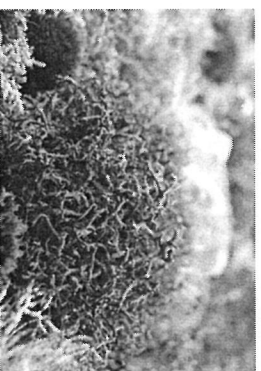
Caloplaca sublobulata



Caillaria contristans



Caillaria corymbosa



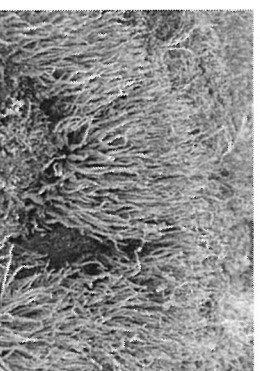
Cetraria aculeata



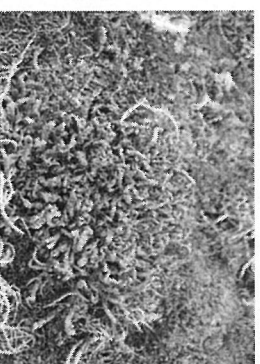
Cladonia borealis



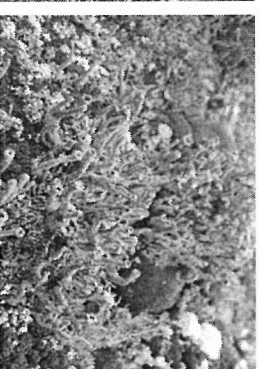
Cladonia chlorophaea



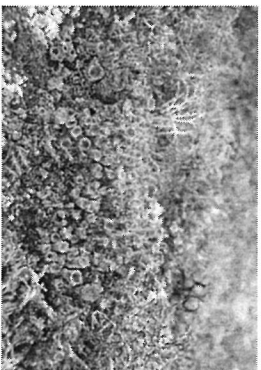
Cladonia furcata



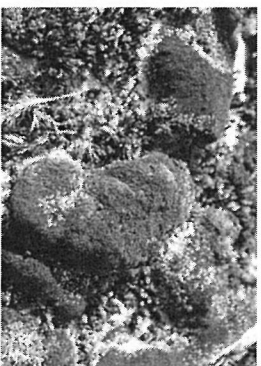
Cladonia gracilis



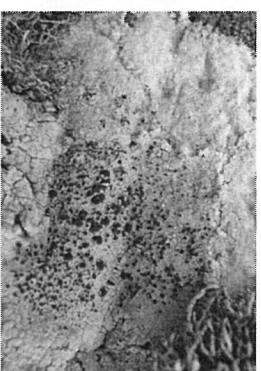
Cladonia leptophora



Cladonia pyxidata



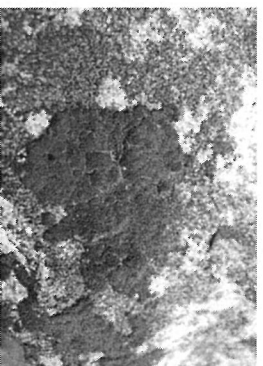
Cystocleus aff. *eberens*



Haematomma erythromma



Himantornmia lugubris



Haera coralligera



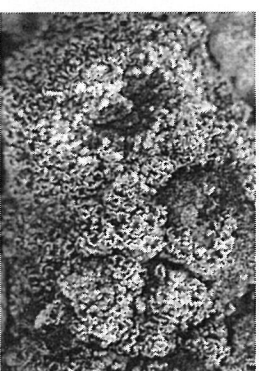
Lecania brachnontii



Lecania gerlachii



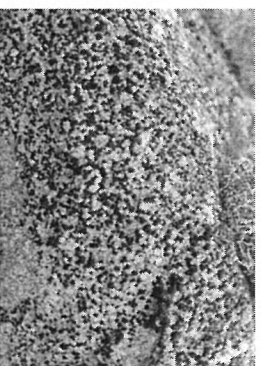
Lecanora epibryon



Lecanora parnelioides



Lecanora polytropa



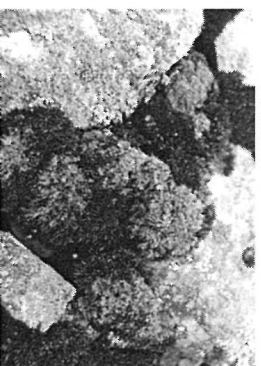
Lecidella carpatica



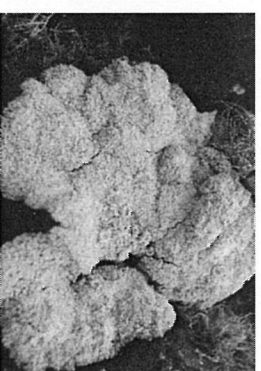
Lecidea canortiformis



Leptogium puberulum



Massalongia carnosa



Ochrolechia frigida

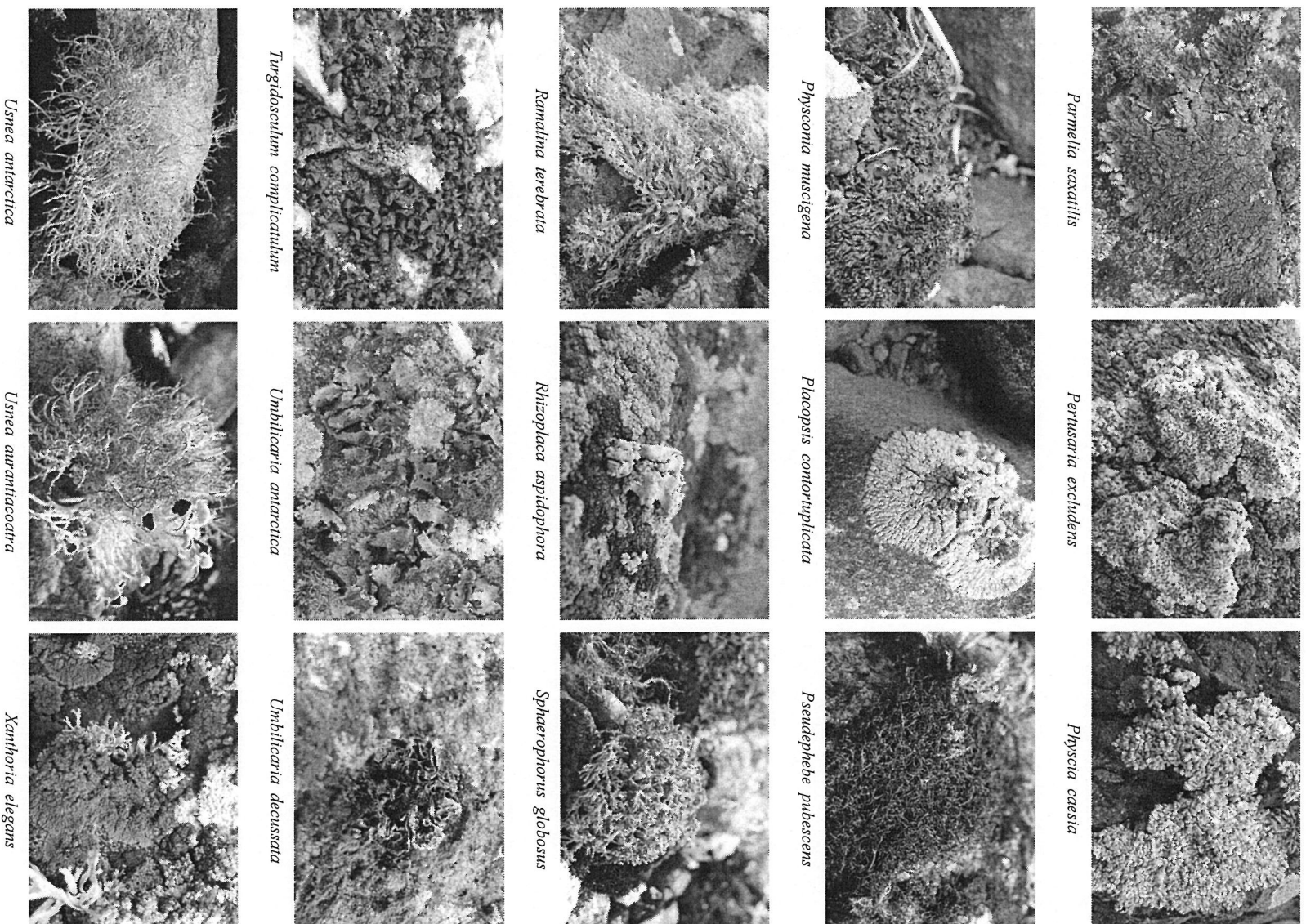


Fig. 3. Illustration of Antarctic lichen species reported in this study.

Table 1. Comparison of ITS and 5.8S rDNA sequences of some lichen species collected in this study with those registered in NCBI

Species	Collection number	Access number	Registered sequences in NCBI	Homology (%)
<i>Acarospora austrosheilandica</i>	ANT050835	DQ534451	<i>Acarospora molybdina</i>	94
<i>Bryoria</i> sp.	ANT050861	DQ534452	<i>Bryoria fuscescens</i>	99
<i>Buellia anisomera</i>	ANT050881	DQ534453	<i>Buellia geophila</i>	94
<i>Buellia russa</i>	ANT050942	DQ534454	<i>Buellia frigida</i>	94
<i>Caloplaca sublobulata</i>	ANT050886	DQ534455	<i>Xanthomendoza hassiana</i>	93
<i>Carillaria corymbosa</i>	ANT050798	DQ534457	<i>Lecania crytella</i>	94
<i>Cetraria aculeata</i>	ANT050760	DQ534458	<i>Cetraria aculeata</i>	97
<i>Cladonia borealis</i>	ANT050790	DQ534459	<i>Cladonia borealis</i>	99
<i>Cladonia chlorophaea</i>	ANT050813-1	DQ534460	<i>Cladonia furcata</i>	97
<i>Cladonia gracilis</i>	ANT050816	DQ534462	<i>Cladonia gracilis</i>	97
<i>Cladonia pyxidata</i>	ANT050825	DQ534463	<i>Cladonia gracilis</i>	94
<i>Haematomma erythroma</i>	ANT050810	DQ534465	<i>Letharia vulpina</i>	93
<i>Himantornia lugubris</i>	ANT050762	DQ534466	<i>Himantornia lugubris</i>	99
<i>Lecania brialmontii</i>	ANT050839	DQ534467	<i>Thammodecania brialmontii</i>	99
<i>Lecania gerlachei</i>	ANT050896	DQ534468	<i>Thammodecania brialmontii</i>	98
<i>Lecanora epibryon</i>	ANT050904	DQ534469	<i>Lecanora epibryon</i>	98
<i>Lecanora polytropa</i>	ANT050752	DQ534470	<i>Lecanora chlorophaeodes</i>	94
<i>Lecidella carpatica</i>	ANT050771	DQ534471	<i>Lecidea</i> sp.	95
<i>Physcia caesia</i>	ANT050907	DQ534476	<i>Physcia caesia</i>	98
<i>Physcia dubia</i>	ANT050843	DQ534477	<i>Physcia stellaris</i>	97
<i>Physconia muscigena</i>	ANT050909	DQ534478	<i>Physconia distorta</i>	97
<i>Placopsis contortuplicata</i>	ANT050784	DQ534479	<i>Placopsis contortuplicata</i>	97
<i>Pseudophebe pubescens</i>	ANT050779	DQ534480	<i>Pseudophebe pubescens</i>	98
<i>Ramalina terebrata</i>	ANT050809	DQ534481	<i>Ramalina pertusa</i>	94
<i>Rhizocarpon nidificum</i>	ANT050894-1	DQ534483	<i>Rhizocarpon geographicum</i>	92
<i>Rhizoplaca aspidophora</i>	ANT050836	DQ534484	<i>Lecanora intricata</i>	94
<i>Sphaerophorus globosus</i>	ANT050887	DQ534485	<i>Sphaerophorus globosus</i>	99
<i>Stereocaulon alpinum</i>	ANT050947	DQ534486	<i>Stereocaulon tomentosum</i>	97
<i>Usnea aurantiacoatra</i>	ANT050783	DQ534488	<i>Usnea aurantiacoatra</i>	99
<i>Xanthoria candellaria</i>	ANT050803	DQ534489	<i>Xanthoria candellaria</i>	99

Turgidosculum complicatulum (Nyl.) J. Kohlm. and E. Kohlm. (Fig. 3)

Barton Peninsula, widespread and often abundant, on rock close to the shore, HUR ANT050805 (30 m, 62°14'07.3"S, 58°46'38.6"W), HUR ANT050838 (10 m, 62°13'01.6"S, 58°46'03.0"W); det. Andreev, 2006.

Umbilicaria antarctica Frey and I.M. Lamb (Fig. 3)

Barton Peninsula, widespread and abundant, especially on sheltered moist rock faces, predominantly in coastal sites, also common on dry boulders and stone, HUR ANT050795 (70 m, 62°13'57.0"S, 58°46'31.5"W), HUR ANT050868 (90 m, 62°13'25.1"S, 58°46'52.7"W), HUR ANT050875 (105 m, 62°13'26.7"S, 58°46'39.4"W),

HUR ANT050895 (5 m, 62°14'19.5"S, 58°45'34.5"W); det. Hur, 2006.

Umbilicaria decussata (Vill.) Zahlbr. (Fig. 3)

Barton Peninsula, widespread on dry rock, especially in very exposed situations, HUR ANT050969 (90 m, 62°13'25.1"S, 58°46'52.7"W); det. Hur, 2006.

Usnea antarctica Du Rietz (Fig. 3)

Barton Peninsula, widespread and abundant in most habits from sheltered to very exposed, and moist to dry situations. This lichen occurs in dense stands with various other macrolichens and many microlichens on most rock types. It also forms dense stands on fine gravel and larger stones in fell field. Common and locally abundant on mosses (*Chorisodontium aciphyllum* and *Polytrichum strictum* turf banks, and *Andraea* spp.). HUR ANT050764 (15 m, 62°13'22.5"S, 58°47'29.2"W), HUR ANT050815 (1 m, 62°13'16.3"S, 58°47'02.4"W), HUR ANT050852 (60 m, 62°13'26.2"S, 58°46'53.5"W), HUR ANT050870, 874 (90 m, 62°13'25.1"S, 58°46'52.7"W), HUR ANT050931 (5 m, 62°14'21.5"S, 58°43'40.5"W); det. Hur, 2006.

Usnea aurantiacoatra (Jacq.) Bory (Fig. 3)

Widespread and very abundant on most acid rock types, less ubiquitous than *U. antarctica*, preferring dry and usually very exposed rock surfaces. A distinct bright yellow, non-variegated, sterile form is also frequent to locally abundant on mosses (*Chorisodontium aciphyllum* and *Polytrichum strictum* turf banks); Barton Peninsula, HUR ANT050853, 854 (60 m, 62°13'26.2"S, 58°46'53.5"W); Weaver Peninsula, HUR ANT050955 (95 m, 62°12'22.5"S, 58°47'31.6"W), det. Hur, 2006.

Xanthoria candelaria (L.) Th. Fr.

Barton Peninsula, widespread on rocks and boulders, especially in sites influenced by birds, HUR ANT050803 (70 m, 62°13'57.0"S, 58°46'31.5"W), HUR ANT050841 (5 m, 62°13'01.6"S, 58°46'03.0"W), HUR ANT050899 (5 m, 62°14'20.7"S, 58°45'22.3"W), HUR ANT050915 (5 m, 62°14'25.2"S, 58°44'30.8"W); det. Andreev, 2006.

Xanthoria elegans (Link) Th. Fr. (Fig. 3)

Barton Peninsula, widespread and locally abundant on rock faces, boulders and stones, especially where influenced by birds, HUR ANT050897 (5 m, 62°14'20.7"S, 58°45'22.3"W); det. Andreev, 2006.

This is the first comprehensive floristical report on lichen at Barton and Weaver Peninsulas around the Korean Antarctic Scientific Station in King George Island. Sixty two species of 38 genera were reported in this study. Among them, 19 species (marked with

bold) were endemic to Antarctic.

Analysis of the ITS and 5.8S rDNA sequences of 30 lichen species were also attempted in this study (Table 1). The sequences of *Cetraria aculeata*, *Cladonia borealis*, *Cladonia gracilis*, *Himantornia lugubris*, *Lecania brialmontii*, *Lecanora epibryon*, *Physcia caesia*, *Placopsis contortuplicata*, *Pseudophebe pubescens*, *Sphaerophorus globosus*, *Usnea aurantiacoatra* and *Xanthoria candelaria* were similar to those registered in NCBI with high homologies of 97 to 99%. Lichen species showing relatively low homologies of 92 to 95% were identified as different species. The sequence analysis suggests that molecular confirmation can be used as a supplementary tool for lichen identification.

This floristical report will be used to monitor changes in the lichen community and biodiversity threatened by global warming and increases in UV irradiation in this region. The lichen specimens will also be used for a comparative study on lichen distribution in the Antarctic area using molecular phylogenetic techniques. Isolation of lichen-forming fungi from the ascospore or thalli of these lichen specimens is being carried out in order to obtain a potential bioresource for biologically active substances.

Acknowledgments

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