



Three lecideoid lichens new to Svalbard, Norway

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Abstract

We report three lichen species, *Lecidea apochroeella* Nyl., *Lecidea leucothallina* Arnold, and *Porpidia contraponenda* (Arnold) Knoph & Hertel, as new additions to the Arctic flora of the Svalbard archipelago. Morphological and chemical descriptions are provided of these species based on the specimens collected from Svalbard, and we consider their global distribution.

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1. Introduction

The importance of lichens in polar ecosystems is commonly discussed, given their dominance and diversity relative to other organisms in these regions (Longton, 1988; Miles and Walton, 1993). The Svalbard high Arctic is a well-studied polar area in this regard: previous taxonomic studies have documented the existence of approximately 600 lichen species in this area at the end of the 20th century (Elvebakk and Hertel, 1996). However, recent reports indicate a need for further investigations of the crustose genera, such as *Lecanora* (Osyczka and Węgrzyn, 2008), *Rhizocarpon* (Ihlen and Fryday, 2004), and *Acarospora* and *Pycnothelia* (Krzewicka and Maciejowski, 2008).

In the present study, we collected lichen specimens from the glacier foreland of Austre Brøggerbreen, Svalbard archipelago, in 1994, 2000, and 2007. Examination of these specimens revealed that some belong to the species *Lecidea apochroeella* Nyl., *Lecidea leucothallina* Arnold, and *Porpidia contraponenda* (Arnold) Knoph & Hertel, which were previously unknown from Svalbard. The purpose of this study is to describe the morphology and chemistry of these new specimens and to discuss their global distribution.

2. Materials and methods

Lichen specimens were collected from the glacier foreland of Austre Brøggerbreen (78°55'N, 11°50'E), 2 km southwest of Ny-Ålesund, Svalbard archipelago, in July 1994, August 2000 (in an area of approximately 1700 × 2000 m for the field work in 1994 and 2000), and July 2007 (in an area of approximately 450 × 300 m) (Fig. 1). From 2001 to 2008, the annual mean air

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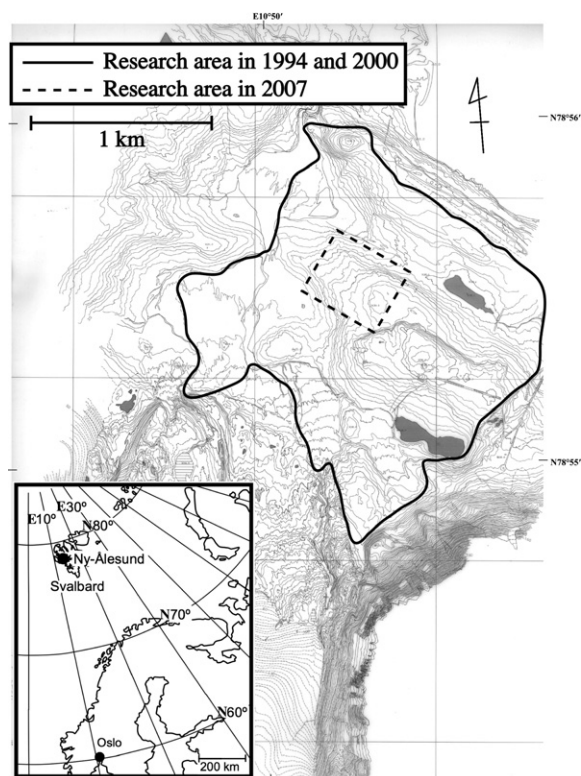


Fig. 1. Map of the Austre Brøgger glacier foreland, southwest of Ny-Ålesund, Svalbard archipelago, showing the location of the study areas in 1994, 2000, and 2007. The contour interval is 2 m.

temperature in this area was $-4.2\text{ }^{\circ}\text{C}$ and the mean annual precipitation was 433 mm (Uchida et al., 2010).

More than 300 specimens were collected during the study period, subsequently deposited in the herbarium of the National Institute of Polar Research (NIPR), Japan. The external morphology of each specimen was studied using a stereomicroscope (Nikon SMZ1500; Nikon Co., Tokyo, Japan) and the anatomical details were examined using a biological microscope (Nikon Eclipse E400; Nikon Co.). Chemical analyses of the specimens were performed using thin-layer chromatography (TLC) according to White and James (1985), and the hyphae of the medulla were tested for amyloid reactions employing 1.3% Lugol's iodine solution (Asahina, 1936). The results of the amyloid reactions are indicated in the following species descriptions (see Section 3(Results)) as 'I–' for a negative reaction or 'I+' for a positive reaction.

3. Results

Among the collected specimens, several were identified as the lecideoid lichens *Lecidea apochroella* Nyl., *Lecidea leucothallina* Arnold, and *Porpidia contraponenda*

(Arnold) Knoph & Hertel, based on comparisons with related type specimens, as described below.

3.1. *Lecidea apochroella* Nyl

Flora 48: 6 (1865). Holotype: Finland, Nylandia, Borgoae, leg. Th. Saelan (August 1860), (H-NYL 20697; isotype in H-NYL).

Thallus thin (0.1–0.2 mm), continuous, verrucose-areolate, white with grey or green tinge; medulla I–; hypothallus whitish, visible between the areolae. Apothecia appressed-adnate, 0.2–0.4 mm wide, dark or blackish-brown; apothecial disc flat at the beginning, then becoming slightly convex, epruinose, with slender margins. Excipulum 125–150 μm thick, brown to reddish-brown internally, changes gradually to colourless externally; hyphae radiating, 3–4 μm thick, with a thin wall. Epithecium colourless or pale. Hymenium 50–60 μm high; subhymenium 20–35 μm high, brown to reddish-brown. Hypothecium 70–80 μm high, dark brown to reddish-brown. Paraphyses firmly coherent. Ascospores not seen.

Chemistry: no lichen substances detected by TLC.

Habitat: grows on moss or humus.

Range: Finland (Vitikainen et al., 1997), Norway (Holien, 2005), Portugal (van den Boom and Giralt, 1999), Russia (Andreev et al., 1998), and Spain (Llimona and Hladun, 2001).

Distinguishing features: *Lecidea apochroella* is characterized by (1) the hyphal structure of the excipulum (Fig. 2b) and (2) a dark brown to reddish-brown hypothecium (Fig. 2b). The morphological and chemical features of the specimen examined are similar to those of the type specimens. Therefore, we identified the specimens as *Lecidea apochroella*.

Specimen: Norway, Svalbard Islands, Ny-Ålesund, Austre Brøggerbreen, on moss or humus, 1994, coll. H. Kanda, nos. P05-01457, P05-01458, P05-01459.

3.2. *Lecidea leucothallina* Arnold

Verh. Zool. –Bot. Ges. Wien 29: 382 (1879). Holotype: Austria, Tirol, leg. Arnold, F. (August 1878), (Arnold, Lich. Exs no. 760 in M).

Thallus well developed, to several centimeters across, to 1 mm thick but commonly only 0.4–0.5 mm thick or less, areolate to squamulose-areolate, whitish-grey to grey or tan to pale brown, with an epinecral layer; hypothallus variable, black, largely continuous between the areoles or forming a reticulum of hyphal strands among the areoles. Apothecia black; apothecial disc slightly concave to planar to moderately convex, smooth, matt, and pruinose, rarely nearly epruinose. Excipulum not always well differentiated

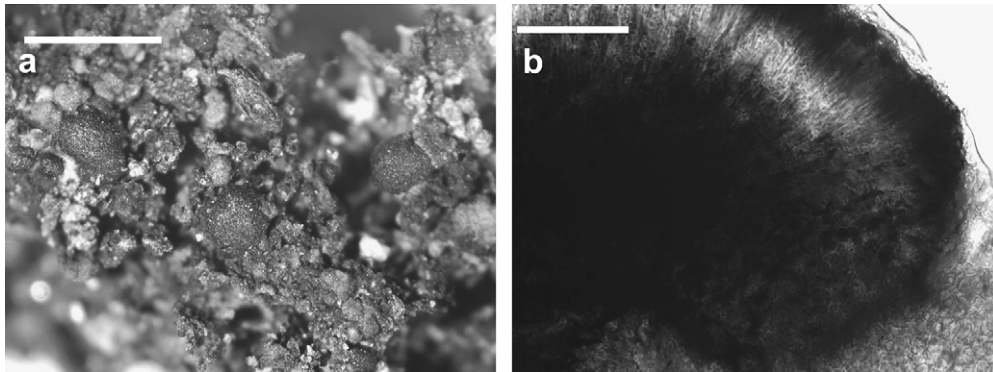


Fig. 2. *Lecidea apochroella* Nyl. (P05-01457, National Institute of Polar Research, Japan). (a) Thallus and apothecia; (b) cross-section of apothecium. Scale: (a) = 1.0 mm; (b) = 50 μ m.

into ectal and medullary regions, violet-brown, darker in the ectal region, usually blue-green in a thin line above externally, 80 μ m thick laterally and 140 μ m along the flank; parallel-radiate hyphae of the ectal excipulum 2.5–4.0 μ m thick, with a thin wall. Epithecium brown or olive-brown. Hymenium 50–60 μ m high; subhymenium 25–35 μ m high, brown to reddish-brown. Hypothecium 20–35 μ m high, brown to reddish-brown. Paraphyses firmly coherent. Asci narrowly clavate, 35–45 \times 8–10 μ m. Ascospores oblong-ellipsoid, 8–9 \times 4–5 μ m. Chemistry: no lichen substances detected by TLC.

Habitat: grows on non-calcareous rocks (siliceous rocks).

Range: Arctic (Hertel, 1991), Greenland (Alstrup et al., 2000), Europe (Vězda and Liska, 1999), North America (Goward et al., 1996; Thomson, 1997), Norway (Elvebakk and Bjerke, 2006), and Russia (Andreev et al., 1998).

Distinguishing features: *Lecidea leucothallina* is characterized by (1) the presence of an areolate to squamulose-areolate thallus, which is whitish-grey to grey or tan to pale brown (Fig. 3a), (2) the presence of an epinecral layer (Fig. 3b) and (3) no detectable presence of confluent acid. The morphological and chemical features of the specimen examined are similar to those of the type specimens. Therefore, we identified the specimens as *Lecidea leucothallina*.

Specimens: Norway, Svalbard Islands, Ny-Ålesund, Austre Brøggerbreen, 78°55.2'N, 10°50.0'E, 30 m altitude, on exposed rock face, 2007, coll. T. Inoue, no. P05-01463; northern foot of Mt. Zeppelinfjellet, ca. 40–70 m altitude, coll. M. Inoue, no. 28203.

3.3. *Porpidia contraaponenda* (Arnold) Knoph and Hertel

Mitt. Bot. München 20: 477 (1984). *Lecidea contraaponenda* Arnold Verh. Zool. –Bot. Ges. Wien, 36: 79

(1886), Lectotype: Austria, Tirol, Finsterthal, coll. F. Arnold (Arnold, Lich. Exs no. 1055 in M; isoelectotype in H-NYL 5126 p.m.).

Thallus contiguous, whitish to white with grey tinge, thin to medium, cracked-areolate; medulla I–; hypothallus indistinct. Apothecia up to 0.8–1.0 mm wide, appressed-adnate to adnate, solitary or congregated; apothecial disc epruinose, has a largely obliterated margin. Excipulum 150–170 μ m thick, dark brown; hyphae radiating 3–4 μ m thick, meso- to pachydermatous. Epithecium greenish-brown. Hymenium 80–100 μ m high; subhymenium 40–50 μ m high, colourless. Hypothecium 65–75 μ m high, dark brown. Paraphyses slender, 1.5–2.0 μ m thick, coherent, branched, anastomosed; apices not slightly thickened. Asci clavate, 70–80 \times 15–20 μ m; tholus medium to thick. Ascospores hyaline, ellipsoid, simple, (15) 17–21 \times (6) 8–11 μ m, with halo.

Chemistry: confluent acid was not detected by TLC.

Habitat: grows on non-calcareous rocks.

Range: Australia (Filson, 1996; Rambold, 1989), Austria (Hertel and Andreev, 2003), Canada (Gowan, 1989), Finland (Gowan and Ahti, 1993), Greenland (Alstrup et al., 2000), Ireland (Fryday, 2005), Russia (Andreev et al., 1998; Gowan and Ahti, 1993; Zhdanov, 2004), U.K. (Purvis et al., 1992), U.S.A. and Canada (Bennett, 2006; Glew, 1998; Gowan, 1989).

Fryday (2005) indicated that *Porpidia contraaponenda* is related to *Porpidia cinereoatra*, *Porpidia diversa*, *Porpidia lowiana*, and *Porpidia pachythallina*. In particular, the hyphal structure of the excipulum in *Porpidia contraaponenda* is similar to that in *Porpidia cinereoatra*.

Distinguishing features: *Porpidia contraaponenda* is characterized by (1) a strongly carbonaceous excipulum

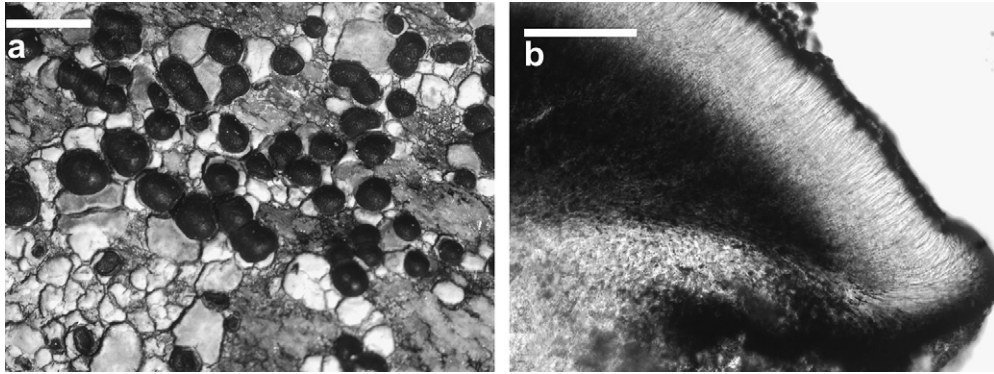


Fig. 3. *Lecidea leucothallina* Arnold (P05-01463, National Institute of Polar Research, Japan). (a) Thallus and apothecia; (b) cross-section of apothecium. Scale: (a) = 2.0 mm; (b) = 100 μ m.

composed of radiating hyphae (Fig. 4b), (2) branched paraphyses (Fig. 4b), (3) a thick subhymenium (Fig. 4b), and (4) no detectable presence of confluent acid. The morphological and chemical features of the specimen examined are similar to those of the type specimens. Therefore, we identified the specimens as *Porpidia contraponenda*.

Specimens: Norway, Svalbard Islands, Ny-Ålesund, Austre Brøggerbreen, 78°55.3'N, 11°50.2'E, 26 m altitude, on exposed rock face, 2007, coll. T. Inoue, no. P05-01461; 78°55.2'N, 10°50.0'E, 30 m altitude, on exposed rock face, 2007, coll. T. Inoue, no. P05-01462; 78°55.2'N, 11°50.0'E, 30 m altitude, on exposed rock face, 2007, coll. T. Inoue, no. P05-01463.

4. Discussion

According to a recent checklist (Elvebakk and Hertel, 1996) and the latest information available on the Internet (Svalbard Lichen Database: http://www.nhm.uio.no/botanisk/nxd/sval_L/sld_e.htm), the Svalbard archipelago contains 38 species of *Lecidea* and 14 species

of *Porpidia*. Our results show that in addition to these species, three more lecideoid lichen species—*Lecidea apochroeella* Nyl., *Lecidea leucothallina* Arnold, and *Porpidia contraponenda* (Arnold) Knoph & Hertel—are present in the archipelago. Elvebakk and Hertel (1996) indicated that there are no lichen species endemic to Svalbard, which is consistent with the present results.

Lecidea apochroeella is reportedly distributed in Portugal (van den Boom and Giralt, 1999), Spain (Llimona and Hladun, 2001), Norway (Holien, 2005), Lappi in Finland (Vitikainen et al., 1997), and Karelia in Russia (Andreev et al., 1998). These areas are situated at latitudes lower than that of the present study area. Therefore, our results indicate an extension of the northern limit of this species.

The distribution of *Lecidea leucothallina* and *Porpidia contraponenda* has already been reported in the high Arctic area (Alstrup et al., 2000). Moreover, these species are distributed in the circum-Arctic regions of Canada (Gowan, 1989), Russia (Andreev et al., 1998), and Greenland (Alstrup et al., 2000). Therefore, the discovery of these two species in Svalbard was an

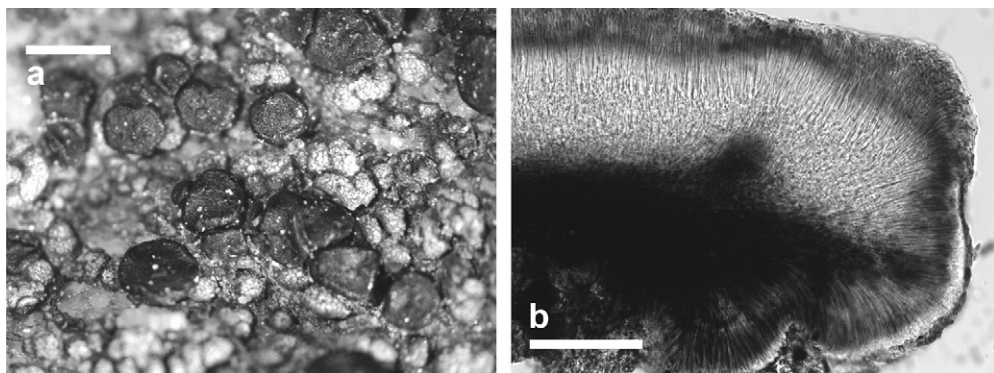


Fig. 4. *Porpidia contraponenda* (Arnold) Knoph and Hertel (P05-01461, National Institute of Polar Research, Japan). (a) Thallus and apothecium; (b) cross-section of excipulum. Scale: (a) = 1.0 mm; (b) = 100 μ m.

expected result, although in this region the species are extremely small in size and difficult to distinguish in the field without specialized knowledge. Further taxonomic studies on lecideoid genera in Polar Regions are needed to elucidate the biodiversity of the harsh polar environment, as noted by Elvebakk and Hertel (1996).

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