

A NOTE ABOUT NEW AND RARELY RECORDED TAXA  
OF THE GENUS *CLADONIA*  
FROM THE ARCTIC ISLAND SPITSBERGEN (SVALBARD)

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ABSTRACT

The paper is based on field studies dealing with the lichen genus *Cladonia* Hill ex P. Browne (Cladoniaceae) carried out by the author in the region of Spitsbergen in 2002 as well as taxonomical work and revision of herbarium material, collected during several earlier Polish polar expeditions to this part of the Arctic. As the result not reported so far from the island species *Cladonia stygia* (Fr.) Ruoss, *C. trassii* Ahti, *C. verticillata* (Hoffm.) Schaer. have been determined. Besides, the presence of very rarely recorded taxa *C. crispata* var. *cetariiformis* (Delise) Vain., *C. merochlorophaea* Asahina and *Cladonia symphyrcarpia* (Flörke) Fr. is confirmed and their new localities are given. Furthermore, the presence of *C. coccifera* s.str. is also substantiated.

KEY WORDS: the Arctic, Svalbard, Spitsbergen, *Cladonia*, lichenized fungi, lichens, taxonomy, distribution.

INTRODUCTION

Svalbard (74°-81° N and 10°-35° E) is the group of arctic islands situated almost midway between Greenland and Novaya Zemlya. It consists of five large islands: Spitsbergen, North-East Land (Nordaustlandet), Edge Island (Edgeøya), Barents Island (Barentsøya) and Prince Charles Foreland (Prins Karls Forland) and approximately 150 small islands and islets divided by straits from the main group. The largest island is Spitsbergen. Nearly 60% of the land area of Svalbard is covered by glaciers (Hisdal 1985) and in the remaining polar desert and tundra areas bryophytes and lichens often play a dominant role. Actually, almost 600 lichen species are known for this region (Elvebakk and Hertel 1996).

Species of the genus *Cladonia* Hill ex P. Browne are widespread on Svalbard, being significant components of the arctic tundra. Almost 40 species of the *Cladonia* were recorded so far. The genus in this part of the Arctic, besides the lichen genera *Caloplaca* and *Rhizocarpon*, is one of the richest in species (Elvebakk and Hertel 1996). Some representatives of the genus, such as: *Cladonia amaurocraea* (Flörke) Schaer., *C. borealis* S. Stenroos, *C. macroceras* (Delise) Hav., *C. mitis* Sandst. (= *C. arbuscula* ssp. *mitis* (Sandst.) Ruoss), *C. pocillum* (Ach.) Grognot, *C. pyxidata* (L.) Hoffm., *C. rangiferina* (L.) F.H. Wigg., are common

on Svalbard. Some other taxa have been reported only from single or few localities. This could either be explained by the lack of sufficient data about their occurrence or real rarity of these taxa in the region. It should be noted that representatives of the genus *Cladonia* are often strongly modified by the severe climate conditions, i.e. long periods of freezing temperatures, snow cover, strong wind, ice and mineral particle abrasion.

MATERIALS AND METHODS

Field investigations were carried out by the author during the summer of 2002 and covered several areas of west coast of Spitsbergen: Hornsund, Bellsund, Adventfjorden (Isfjorden), Petuniabukta (Billefjorden) and Kaffiøyra (Oscar II Land). Field research comprised various habitats located on plains of raised marine terraces, on nival moraine ridges, in valley of pronival and proglacial streams, on storm ridges, at bottoms and on slopes of mountain massifs. In addition, specimens belonging to the genus *Cladonia* collected during earlier Polish polar expeditions were determined or verified. These herbarium materials were mainly gathered by M. Olech from Sørkapp Land, Hornsund and Grønfjorden (Isfjorden), by W. Gugnacka-Fiedor from Kaffiøyra (Oscar II Land) and by F. Świąż from Bellsund.

The taxa were identified using methods of classical taxonomy supported by determination of lichen substances. Chemical analyses were done using thin-layer chromatography (TLC) technique according to standardized methods and procedures (Culberson and Kristinsson 1970; White and James 1985; Orange et al. 2001). Majority of examined specimens has been deposited in lichenological herbarium of the Institute of Botany of the Polish Academy of Sciences in Kraków (KRAM-L). Some small collections are present also in herbarium of the Nicolaus Copernicus University in Toruń (TRN) and herbarium of the Botanical Museum of the University of Helsinki (H).

## RESULTS AND DISCUSSION

### *Cladonia stygia* (Fr.) Ruoss (Fig. 1A)

Bot. Helv. 95: 241 (1985).

The general range of this species extends from the arctic zone across the boreal to temperate zone as well (Ahti and Hyvönen 1985). It is a frequent but often overlooked species. The species is considered to be closely related to *C. rangiferina* due to similar chemistry, morphology and DNA sequences (Ruoss and Ahti 1989; Brodo et al. 2001; Stenroos et al. 2002). These two species are often found associated or mixed together. Unlike *C. rangiferina*, however, *C. stygia* has the surface and stereome at the base of the thallus dark brown to black and contains red or pinkish slime in the conidiomata (Ahti and Hyvönen 1985; Brodo et al. 2001). *C. stygia* was found on a plain of raised marine terrace. It had overgrown a peaty substratum being accompanied with *C. rangiferina* and the moss *Racomitrium lanuginosum* (Hedw.) Brid. It is worth notice, that *C. stygia* seems to be considerably rarer than frequently occurring *C. rangiferina*. Earlier, *C. stygia* was recorded at Bjørnøya, which is remote to the south from Spitsbergen (Ahti and Hyvönen 1985).

*Specimens examined. Spitsbergen:* Hornsund, NE part of Kvarstittsletta, near the bottom of Ceglatoppen, 35 m, July 2002, *P. Osyczka* 334 (H; KRA); Hornsund, S part of Kvarstittsletta, 15 m, July 2002, *P. Osyczka* 335 (H; KRA).

### *Cladonia trassii* Ahti (Fig. 1B)

Folia Cryptog. Estonica 32: 7 (1998).

After revision of *Cladonia stricta* (Nyl.) Nyl. (Ahti 1998) this taxon was divided into three species: *C. stricta* s. str., *C. trassii* Ahti, and *C. uliginosa* (Ahti) Ahti. All three species are typically arctic to subarctic and circumpolar. However, their precise ranges are still poorly known. Localities of *C. trassii* were ascertained in many regions and various habitats of western coast of Spitsbergen. Surely, it is a widespread lichen in the whole region of Svalbard. *C. trassii* was often found in the communities dominated by *Racomitrium lanuginosum*, *Deschampsia alpina* (L.) Roem. & Schult. or *Festuca vivipara* (L.) Smith. *Cladonia stricta*, a similar arctic-alpine species, has an evanescent primary thallus, pointed or narrowly cupped podetia (often with perforated cups), with only few or a few podetial squamules and frequently does not contain atranorin (Ahti 1998; Brodo et al. 2001). *Cladonia stricta* s.str. was also found on Spitsbergen but it appears to be considerably rare (Osyczka 2003). Earlier, *C. stricta* was reported in this region by many authors (Elvebakk and Hertel 1996). How-

ever, all these reports should be treated as *C. stricta* s.lat. and they apparently mostly refer to *C. trassii*. For instance, the plate presented a distribution map of 'C. lepidota var. stricta' in Svalbard region published by Lynge (1938) assuredly must be essentially a map of *C. trassii*.

*Selected specimens examined. Spitsbergen:* Sørkapp Land, storm ridge between Suffolkpynten and Raksodden, 8 m, August 1985, *M. Olech* (KRA); Sørkapp Land, Kulmstranda, near the Lisbetelva stream, 40 m, August 1985, *M. Olech* (KRA); Sørkapp Land, Hohenloheskardet pass, 75 m, July 1985, *M. Olech* (KRA); Hornsund, NE part of Kvarstittsletta, marine terrace between Bratteggdalen and Wrocławvika, 25 m, July 2002, *P. Osyczka* 283 (KRA); Hornsund, Bratteggdalen, W bank of Myrktjörn lake, the bottom of Gulliksenfjellet, 100 m, July 2002, *P. Osyczka* 286 (KRA); Hornsund, Angellfjellet, rocky cliffs of NW slope, 220 m, July 2002, *P. Osyczka* 287 (H; KRA); Hornsund, valley of the Revvelva stream, 30 m, July 2002, *P. Osyczka* 282 (H; KRA); Bellsund, SW part of Lognedalen, towards N from the Logna River, 70 m, August 1988, *F. Święs* 2514 (H; KRA); Bellsund, NW part of Lognedalen, below SW slope of Hamarhø massif, 60 m, August 1988, *F. Święs* 2512 (KRA); Bellsund, W part of Lognedalen, towards NE from the Logna River, 60 m, August 1988, *F. Święs* 2511 (KRA); Bellsund, SW part of Lognedalsflya, towards S from the Logna River, 70 m, August 1988, *F. Święs* 2513 (KRA); Bellsund, SE part of Activekammen, Tomtodden, the bottom of hilltop (538 m), 300 m from the seacoast, 20 m, August 1988, *F. Święs* 2519 (H; KRA); Isfjorden, Grönfjorden, Barentsburg, 200 m, June 1982, *M. Olech* (KRA); Kaffiøyra, the highest marine terrace towards W from the Waldemarbreen glacier, 100 m, July 1997, *W. Gugnacka-Fiedor* (TRN); Kaffiøyra, Bjørneskanka, lateral moraine of the Dahlbreen glacier, 50 m, July 1997, *W. Gugnacka-Fiedor* (TRN).

### *Cladonia verticillata* (Hoffm.) Schaer. (Fig. 1C)

Lich. Helv. Spic. 1 (1): 31 (1823).

*Cladonia cervicornis* ssp. *verticillata* (Hoffm.) Ahti  
Lichenologist 12: 126 (1980).

According to van Herk and Aptroot (2003), *C. verticillata* (Hoffm.) Schaer. is a separate species in the light of recent taxonomical status of the *Cladonia cervicornis* group. These authors proposed to treat the three Dutch taxa of the group at the species level: *C. cervicornis* s. str., *C. verticillata* (Hoffm.) Schaer. and *C. pulvinata* (Sandst.) van Herk and Aptroot. The first two species can be distinguished mainly due to different characters of the basal squamules: their colour, shape, size and orientation (van Herk and Aptroot 2003). In addition, *C. verticillata* is characterized by boreo-montane distribution while *C. cervicornis* has rather a Mediterranean and subatlantic type of distribution (Nimis 1993; van Herk and Aptroot 2003). *Cladonia verticillata* has not been reported from Svalbard until now. Its locality was found on slightly acid soil and it was associated with *Cladonia macroceras*, *C. pocillum*, *C. pyxidata* and the liverwort *Gymnomitrium coralloides* Nees.

*Specimen examined. Spitsbergen:* Hornsund, N bottom of Jahnfjellet, 220 m, July 2002, *P. Osyczka* 311 (KRA).

### *Cladonia coccifera* (L.) Willd. (Fig. 1D)

Fl. Berol. Prodr. 361 (1787).

After the description of the new species *Cladonia borealis* S. Stenroos and its separation from *C. coccifera* group by Stenroos (1989), it turned out that *C. coccifera* s.str. has a more limited worldwide distribution. The distribution map of *C. coccifera* (L.) Willd. presented by Stenroos (1989) did not include any locality in the region of Svalbard. On the other hand, on this map only one locality of *C. borealis* was included. The most important morphological characteristics of *C. coccifera* comprise relatively large size of primary squamules and scaly plates, which appear

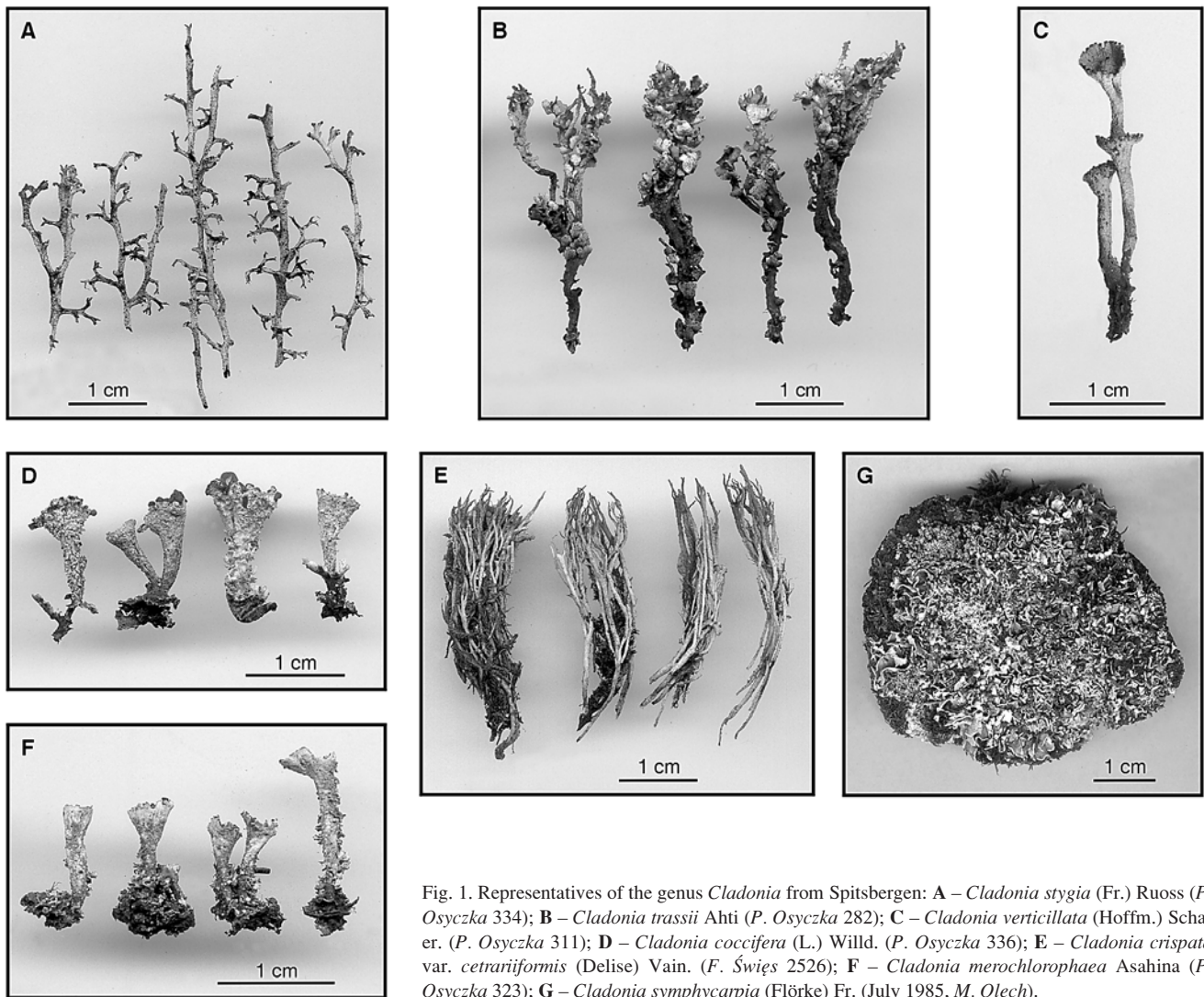


Fig. 1. Representatives of the genus *Cladonia* from Spitsbergen: **A** – *Cladonia stygia* (Fr.) Ruoss (*P. Osyczka* 334); **B** – *Cladonia trassii* Ahti (*P. Osyczka* 282); **C** – *Cladonia verticillata* (Hoffm.) Schaer. (*P. Osyczka* 311); **D** – *Cladonia coccifera* (L.) Willd. (*P. Osyczka* 336); **E** – *Cladonia crispata* var. *cetrariiformis* (Delise) Vain. (*F. Świąż* 2526); **F** – *Cladonia merochlorophaea* Asahina (*P. Osyczka* 323); **G** – *Cladonia symphyrcarpia* (Flörke) Fr. (July 1985, *M. Olech*).

ring on the upper surface of the podetia and the interior part of the cup (Stenroos 1989). Chemically, *C. coccifera* contains zeorin rather than barbatic acid (Stenroos 1989). The presence of zeorin is very helpful to distinguish *C. coccifera* from *C. borealis*, especially in the case of specimens originating from the arctic zone. As a consequence of severe climate the scaly plates typical of *C. coccifera* may be feebly developed or mechanically plucked. In the field the species might be easily overlooked. However, it seems that *C. coccifera* is really rare on Svalbard, contrary to *C. borealis*, which is very common (Osyczka 2003). Localities of *C. coccifera* are situated on denuded mineral soil within a solifluction tongue zone and one of them is connected with bird colonies. It is noteworthy that on Svalbard the taxa belonging to the *C. coccifera* group demonstrate tendency to appear in the neighbourhood of places relevant to nesting birds (Osyczka 2003). *Cladonia coccifera* was found associated with *C. macroceras*, *C. mitis*, *C. borealis*, *Thamnia vermicularis* (Sw.) Schaer. and the bryophyte *Tetraplodon mnioides* (Hedw.) B.S.G.

*Specimens examined. Spitsbergen:* Hornsund, W part of Steinvikdalen, near the bank of the Steinvikbekken stream, 120 m, July 2002, *P. Osyczka* 336 (KRA); Hornsund, W bottom of Jahnfjellet, 230 m, July 2002, *P. Osyczka* 337 (H; KRA).

*Cladonia crispata* var. *cetrariiformis* (Delise) Vain. (Fig. 1E) in Olivier, Rev. Bot. Bull. Mens. 4: 238 (1886).

*Cladonia crispata* (Ach.) Flot. from Svalbard was reported by Lyngé (1938) from Prins Karls Forland but the record was not later confirmed. However, *C. crispata* var. *cetrariiformis* was reported from several localities of Spitsbergen at Sørkapp Land by Olech (1990). However, some specimens of this collection belong to *C. squamosa* Hoffm. Nevertheless, it proves that *C. crispata* var. *cetrariiformis* is quite often present in this part of the Arctic. Besides Sørkapp Land, several more northward localities at Hornsund and Bellsund areas were found. This taxon can be found in the *Flavocetraria nivalis*–*Cladonia rangiferina* community and the *Racomitrium lanuginosum* community as well (Dubiel and Olech 1990).

*Selected specimens examined. Spitsbergen:* Sørkapp Land, W bottom of søre Sergeijevfjellet, 30 m, July 1985, *M. Olech* (KRA); Hornsund, NE part of Kvartsittletta, the bottom of Ceglatoppen, 35 m, July 2002, *P. Osyczka* 313 (KRA); Hornsund, Skjerstranda, near Gangpasset, 20 m, August 1985, *M. Olech* (KRA); Bellsund, SE part of Dunderdalen, the bottom of Lijfjellet, 110 m, August 1992, *F. Świąż* 2524 (KRA); Bellsund, SW part of Lognedalsflya, near Kvitfiskpynten, 5 m, August 1988, *F. Świąż* 2528 (KRA); Bellsund, SW part of Vestervagøyra, 40 m, August 1987, *F. Świąż* 2527 (KRA); Bellsund, Dunderdalen, NE slope of Kongleratfjellet, 95 m, August 1992, *F. Świąż* 2523 (KRA); Bellsund, SW

part of Relinholmen, 7 m, August 1987, *F. Świąż* 2525 (KRA); Bellsund, SE part of Chamberlinpasset, the slope of hill (575 m), 180 m, July 1988, *F. Świąż* 2526 (KRA); Bellsund, Chamberlindalen, NE part of Vestliknauasane, 30 m, July 1987, *F. Świąż* 2522 (H; KRA).

***Cladonia merochlorophaea*** Asahina (Fig. 1F)  
J. Jap. Bot. 16: 713 (1940).

Elvebakk and Tønberg (1992) reported this species as new to Svalbard based on one specimen from Hornsund, previously published by Lyng (1938) as *C. grayi*, and only one new collection from the Isfjorden area (Colesbukta). However, probably it occurs much more frequent than hitherto reported. Additional localities of *C. merochlorophaea* in Hornsund, Bellsund and at Sørkapp Land were noticed. The species occurred in company of *C. chlorophaea* or *C. pyxidata* and it is probable that *C. merochlorophaea* was often overlooked or confused with these taxa in the past. At Sørkapp Land *C. merochlorophaea* appeared in the *Tetraplodon mnioides* community, which is coprophilous (based on material previously published as *C. pyxidata*; Dubiel and Olech 1990).

*Specimens examined. Spitsbergen:* Sørkapp Land, the bottom of Nordre Sergeijevfjellet, 50 m, August 1982, *M. Olech* (KRA); Hornsund, Ralstranda, between Jakobsenpynten and Låkpynten, 20 m, July 2002, *P. Oszycza* 323 (KRA); Hornsund, NE part of Kvartsittsletta, near lake Pike-dammen, 50 m, July 2002, *P. Oszycza* 325 (KRA); Bellsund, SE part of Vestervagøyra, the slope of hill (105 m), 40 m, July 1987, *F. Świąż* 2536 (KRA); Bellsund, SE part of Vestervagøyra, 10 m, July 1987, *F. Świąż* 2535 (KRA).

***Cladonia symphyrcarpia*** (Flörke) Fr. (Fig. 1G)  
Sched. Crit. Lich. Suec. 8-9: 20 (1826).

The species was found on Spitsbergen (Van Keulenfjorden), Amsterdamøya and Nordaustlandet (S. Korsøya, Wargentindalen) and published as *C. subcervicornis* (Vain.) Kernst. by Lyng (1938). After revision by Ahti the material belongs to *C. symphyrcarpia* (after Elvebakk and Hertel 1996). The present localities of the species were known only from Sørkapp Land (Olech 1990). *Cladonia symphyrcarpia* was also found in several localities in the Bellsund region. The examined specimens have only squamules of the primary thallus and belong to the norstictic strain. They overgrew slightly alkaline substratum. Climate factors of Svalbard region (e.g. snow cover) may be a cause why primary thallus of the species might be poorly developed or pressed into the soil. Then *C. symphyrcarpia* could be overlooked or mistakenly determined. In the Bellsund region *C. symphyrcarpia* appears mostly in the mesophilous type of tundra.

*Specimens examined. Spitsbergen:* Sørkapp Land, Liddalen, 75 m, July 1985, *M. Olech* (KRA); Bellsund, NE part of Calypsostranda, the edge of a cliff coast, S side of the Scott River outlet, 20 m, July 1987, *F. Świąż* 2549 (KRA); Bellsund, SW part of Calypsostranda, near moraine of the Renardbreen glacier, 85 m, August 1987, *F. Świąż* 2548 (KRA); Bellsund, NW part of Dunderdalen, the bottom of Dunderfjellet, central part of rangr, 60 m, July 1992, *F. Świąż* 2551 (KRA); Bellsund, NW part of Dunderdalen, S slope of hill (670 m), 160 m, July 1992, *F. Świąż* 2564 (KRA); Bellsund, NW part of Dunderdalen, the bottom of hill (540 m), 65 m, July 1992, *F. Świąż* 2552 (KRA); Bellsund, SE part of Lyellstranda, NE bottom of Wijkanderberget, 120 m, July 1988, *F. Świąż* 2547 (KRA).

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