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THE LICHEN SPECIES *CLADONIA INCRASSATA* (LECANORALES, ASCOMYCOTA LICHENISATI) IN POLAND, AND NOTES ON *C. ANITAE*

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Abstract. A revision of *Cladonia incrassata* Flörke material from Poland yielded specimens from 15 localities. Two chemotypes occurred: one with didymic, squamatic and usnic acids, and one with didymic and squamatic acids. Material with morphology similar to and chemistry identical to that of *C. anitae* W. L. Culb. & C. F. Culb. and referred to as *C.* aff. *anitae* was confirmed from three localities. In Europe such individuals have been known only from Germany till now.

Key words: *Cladonia incrassata*, *Cladonia anitae*, distribution, lichen, Poland

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INTRODUCTION

Cladonia incrassata Flörke is a red-fruited member of the lichen genus *Cladonia* Hill *ex* Browne. It has podetia up to 5 mm tall, usually deformed, with corticate-granular to partly sorediate surfaces. The primary squamules are dominant and numerous, and usually have farinose to granular soredia on the underside, rarely also on the upper side. The species is chemically variable, and four chemotypes have been distinguished: (1) with usnic, squamatic and didymic acids; (2) with didymic acid replaced by barbatic acid; (3) with squamatic, thamnolic and didymic acids (Purvis & James 1992); and (4) with didymic and squamatic acids only (Motiejūnaitė 2002). These features make the species distinct within the genus (Purvis & James 1992). *Cladonia incrassata* is a widespread taxon, known from Europe, eastern North America and Asia (Purvis & James 1992). In Poland it is a subatlantic species reported from scattered localities mainly in the northwestern part of the country (Tobolewski 1983, and literature cited therein; Fałtynowicz 1992), but also from northeastern and southern Poland (e.g., Tobolewski 1983, and literature cited therein; Bielczyk & Betleja 2003; Cieśliński 2003).

In 1982 a taxon morphologically similar to *Cladonia incrassata*, *C. anitae* W. L. Culb. & C. F. Culb. was described from North America (Culberson *et al.* 1982). The main difference between these two species is the production of grayanic acid by *C. anitae*. There are also some minor morphological features discriminating *C. anitae* from *C. incrassata*. The podetia are often more than 5 mm tall and are slightly branched in the upper part. Also, the soredia are not produced so abundantly as by *C. incrassata* (Culberson *et al.* 1982; Tønsberg 1995). The species was thought to be distributed only in the eastern part of North America, in North Carolina (Culberson *et al.* 1982) and Florida (Harris 1990), but specimens with chemistry typical for that lichen were discovered in Germany by Tønsberg (1995). He referred to the material as *C.* aff. *anitae*, as it seemed strange to him that a lowland coastal species ranging no further than 35°N in southeastern North America could have stations at 53°–54°N in Europe. Tønsberg (1995) pointed to the need for further studies to clarify whether such European specimens belonged to *C. anitae* or represented a chemotype of *C. incrassata*.

During revision of some *Cladonia* specimens from northern Poland, a specimen with the chemistry of *C. anitae* was found. It was referred to as *C.* aff. *anitae* for the reasons Tønsberg (1995)

cited. This discovery prompted an examination of all available specimens of *C. incrassata* from Poland, the results of which are presented here. The paper also describes the distribution of this species and *C.* aff. *anitae* in Poland.

Materials and methods

All available specimens determined as *Cladonia incrassata* were revised from the following herbaria: GPN, KRA, KRAM, KTC, LOD, POZ, SLTC, TRN, UGDA and WA (abbreviations follow Holmgren *et al*. 2003 and Mirek *et al.* 1997). WRLS was also contacted, but no material determined as *C. incrassata* was located. First the specimens were examined with a stereomicroscope. Chemical analyses were carried out by thin layer chromatography (TLC) in solvent systems A and C (methods according to Orange *et al*. 2001). Acetone extracts of *C. grayi* G. Merr. *ex* Sandst. and *C. metacorallifera* Asahina were used as controls for grayanic acid and didymic acid, respectively. Abbreviations of the authors of plant names follow Brummit and Powell (1992), and abbreviations of exsiccates follow Triebel and Scholz (2004). Locality data for the exsiccates are cited in the original language. The distributions of Polish localities are given in the ATPOL grid square system (Cieśliński & Fałtynowicz 1993).

Results and discussion

The material comprised 36 specimens of *Cladonia incrassata*, of which 25 were from Poland and 11 from other countries. Seven specimens from Poland were chemically identical with *C. anitae* and are referred to as *C.* aff. *anitae.* One specimen from Germany contained grayanic and squamatic acids only, and no usnic acid. Usnic acid-deficient specimens of *C. anitae* from North America or of *C.* aff. *anitae* from Europe have not been reported before. As neither podetia nor apothecia nor pycnidia were present, its identity could not be settled.

Cladonia incrassata Flörke

Clad. Comm.: 21. 1828.

All foreign specimens and 24 Polish specimens represented the chemotype with didymic, squamatic and usnic acids. Only one specimen differed chemically in that it did not contain usnic acid. An identical chemotype was reported from Lithuania by Motiejūnaitė (2002).

Literature records of *C. incrassata* from Poland include Tobolewski (1983), Fałtynowicz (1992), Leśniański (1999), Cieśliński (2003) and Fałtynowicz (2003, and literature cited therein), but some of these records, mainly among those from the 19th century, were not documented by herbarium specimens and should be excluded.

According to Tobolewski (1983), *C. incrassata* is a subatlantic species in Europe. A comparison of the known distribution in Poland with that presented by Tobolewski (1983) makes it evident that the species is more frequent in eastern Poland than previously reported (Fig. 1). According to Fałtynowicz (1997) and the label data for the specimens studied, *C. incrassata* seems closely associated with somewhat degenerated, drained bogs with decaying peat supporting planted or semi-natural pine. However, not all is known about the ecology of the species in Poland; more field work is needed to determine its habitat requirements.

Specimens examined. Chemotype with didymic, squamatic and usnic acids: Ab–86 – POLAND. Po-

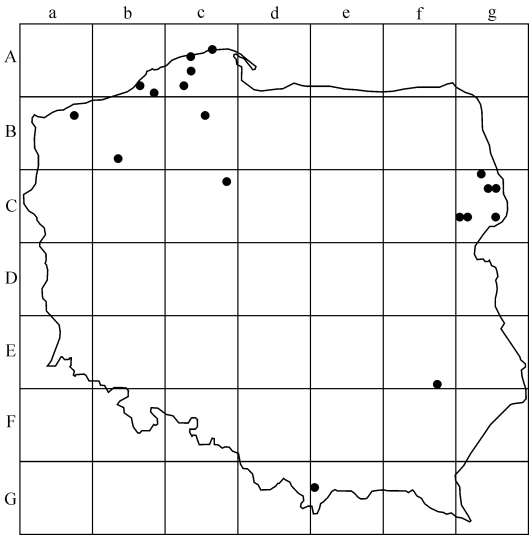

Fig. 1. Known distribution of *Cladonia incrassata* Flörke in Poland.

BRZEŻE KOSZALIŃSKIE COAST. Równina Sławieńska plateau: Słowińskie Błoto peat bog, vicinity of Sławno village, peat bog, on decaying peat, 26 Sept. 1986, *leg. W. Fałtynowicz* (UGDA-L 2945; Fałtynowicz 1997); Ab–98 – POBRZEŻE KOSZALIŃSKIE COAST. Równina Sławieńska plateau: *ca* 3 km SW of Janiewice village, by Janiewickie Bagno peat bog, on soil, 16 Aug. 1950, *leg. Z. Tobolewski* (POZ; Tobolewski 1983); Janiewickie Bagno Nature Reserve, peat bog pine forest, on peat, 14 Aug. 1963, *leg. S. Król* (KRAM-L 28831); ibid. young peat bog pine forest, on decaying peat, 06 Aug. 1988, *leg. M. Herbichowa* (UGDA-L 6109); Ac–36 – POBRZEŻE GDAŃSKIE COAST. Pobrzeże Kaszubskie coast: Wielkie Błoto Wierzchucińskie peat bog, vicinity of Wierzchucino village, among *Calluna vulgaris*, on peaty soil, Aug. 1950, *leg. Z. Tobolewski* (POZ; Tobolewski 1983); Ac–43 – POBRZEŻE KOSZALIŃSKIE COAST. Wybrzeże Słowińskie coast: vicinity of Łeba town, Wielkie Bagno peat bog, E part of peat bog, on decaying wood, Aug. 1950, *leg. Z. Tobolewski* (POZ; Tobolewski 1983); Ac–63 – POBRZEŻE KOSZALIŃSKIE COAST. Pradolina Łeby i Redy: Lębork forest inspectorate, Janowice forest division, Czarne Bagno projected nature reserve, *ca* 2 km WNW of Żelazkowo village, on decaying peat, 1970, *leg. M. Herbichowa* (UGDA-L 781; Tobolewski 1983); Ac–82 – POBRZEŻE KOSZALIŃSKIE COAST. Wysoczyzna Damnicka upland: Łupawa forest inspectorate, forest tract no. 336, E of Łabiszewo village, probably on peat at base of birch, 18 Nov. 1991, *leg. E. Szeflińska & I. Izydorek* (SLTC); Ba–27 – POBRZEŻE SZCZECIŃSKIE COAST. Równina Gryficka plateau: Wielkie Smogorze peat bog, vicinity of Przybiernówko village, moor, on peat, Aug. 1950, *leg. Z. Tobolewski* (POZ: two specimens; Tobolewski 1983); Bb–83 – POJEZIERZE POŁUDNIOWOPOMORSKIE LAKELAND. Pojezierze Wałeckie lakeland: Wierzchowo forest inspectorate, Torfowiska forest division, vicinity of gamekeeper's cottage, in part of peat bog covered with *Calluna vulgaris*, on peat, Aug. 1950, *leg. Z. Tobolewski* (POZ: two specimens; Tobolewski 1983); Bc–25 – POJEZIERZE POŁUDNIOWOPOMORSKIE LAKELAND. Bory Tucholskie forest: S of lake Motowęże, Kościerzyna forest inspectorate, forest tract no. 793, peat bog pine forest, on decaying wood, 1 Aug. 1981, *leg. W. Fałtynowicz* (UGDA-L 1626; Tobolewski 1983); Cc–18 – DOLINA DOLNEJ WISŁY VALLEY. Dolina Fordońska valley: N of Dąbrowa Chełmińska town, Linie Nature Reserve, peat bog, on decaying peat, 10 April 2003, *leg. M. Ceynowa-Giełdon* (TRN); Cg-03 – NIZINA PÓŁNOCNOPODLASKA LOWLAND. Wysoczyzna Białostocka highland: Puszcza Knyszyńska forest, Stare Biele Nature Reserve, peat bog, on peaty soil, 4 Aug. 1994, *leg. S. Cieśliński* (KTC; Cieśliński 2003); Cg-24 – NIZINA PÓŁNOCNOPODLASKA LOWLAND. Wysoczyzna Białostocka highland: Gorbacz Nature Reserve, on peat, 15 Aug. 1992, *leg. S. Cieśliński* (KTC; Cieśliński 2003); Cg-25 – NIZINA PÓŁNOCNOPODLASKA LOWLAND. Wysoczyzna Białostocka highland: S of Żubry village, edge of fresh pine forest, drainage ditch, on peat, 15 Aug. 1992, *leg. S. Cieśliński* (KTC); Cg-60 – NIZINA PÓŁNOCNOPODLASKA LOWLAND. Równina Bielska plateau: *ca* 0.5 km S of Olszewo village, small planted pine forest probably on former peat bog, on humid decaying peat and pieces of pine bark, 29 Aug. 1991, *leg. S. Cieśliński* (KTC; Cieśliński 2003); Cg-61 – NIZINA PÓŁNOCNOPODLASKA LOWLAND. Równina Bielska plateau: 1.5 km N of Malinniki village, on peaty soil, 13 Aug. 1992. *leg. S. Cieśliński* (KTC; Cieśliński 2003); Cg–65 – NIZINA PÓŁNOCNOPODLASKA LOWLAND. Równina Bielska plateau: Puszcza Białowieska forest, forest tract no. 572, Michnówka Nature Reserve, peat bog pine forest, on humus, 11 Aug. 2002, *leg. P. Czarnota* (GPN 2989, UGDA-L 8141); Ef–97 – KOTLINA SANDOMIERSKA BASIN. Równina Biłgorajska plateau: Lasy Janowskie forest, group of ponds, between two most northern ponds, 50°37′N/22°27′E, on wood, 08 Sept. 1999, *leg. U. Bielczyk, R. Kozik, L. Lipnicki & H. Wójciak* (KRAM-L 44922); Ge–30 – OBNIŻENIE ORAWSKO-PODHALAŃSKIE DEPRESSION. Obni)enie Orawsko-Nowotarskie depression. Bór na Czerwonem Nature Reserve, alt. *ca* 630 m, 20°20′–20°04′N/49°26′–49°28′E, on plant remains, 15 Dec. 2000, *leg. U. Bielczyk* (KRAM-L 46465; Bielczyk & Betleja 2003), ibid., on bark of *Betula* sp., 15 Dec. 2000, *leg. U. Bielczyk* (KRAM-L 46458; Bielczyk & Betleja 2003).

Chemotype with didymic and squamatic acids: Ba–27 – POBRZEŻE SZCZECIŃSKIE COAST. Równina Gryficka plateau: Wielkie Smogorze peat bog, vicinity of Przybiernówek, on peat, Aug. 1950, *leg. Z. Tobolewski, conf. T. Ahti* (POZ; Tobolewski 1983).

ADDITIONAL SPECIMENS SEEN. CZECH REPUBLIC. Bohemia merid., Karlovy Vary: in turfosis prope pag. Lauterbach ad pedem merid. collis Spitzberg, alt. *ca* 780 m, 1932, *leg. J. Suza*, Suza, Lich. Bohemoslov. Exs. 195 (POZ); Bohemia merid., Třeboň: prope pag. Staňkov in turfosis ad piscinam 'Staňkovský rybnik' alt. *ca* 470 m, 1934, *leg J. Suza*, Suza, Lich. Bohemoslov. Exs. 258 (POZ), Bohemia merid., Třeboň: in turfosis apud piscinam 'Staňkovský rybnik' prope pag. Staňkov, alt. *ca* 470 m, 1934, *leg. J. Suza*, Suza, Lich. Bohemoslov. Exs. 259 (POZ); FRANCE. Brittony, ad terram in nemore dicto Lostcat prope Guengat (Finistère), Picquenard, *leg. H. de Abbayes*, Abbayes,

Lich. Armor. Exs. 23 (POZ); GERMANY. Oberbayern, Haspelmoor, Kr. Fürstenfeldbruck, 540 m, auf Torf, July 1958, *leg. H. Doppelbaur*, Poelt, Lich. Alp. 76 (POZ); SWEDEN. Västergötland, Mt. Hunneberg, Flo Pfarre, Laggemossen, an senkrechten Torfwänden eines drainierten Moores, 24 Sept. 1961, *leg. R. Santesson 14402*, Passauer, Crypt. Exs. 4314 (POZ); ibid. 24 Sept. 1961, *leg. R. Santesson 14402* (WA, POZ); Småland, Våxjō, on decaying *Sphagnum* sp., 28 Aug. 1937, *leg. B. Hedvall* (POZ); Östergötland, Tjällmo, Trollefiod, 09 Aug. 1947, *leg. G. Kjellmert* (POZ); Västergötland, Fägre parish, Ängelsmossen bog, peat bog, 13 July 1956, *leg. T. E. Hasselrot* (POZ).

Cladonia aff. ***anitae*** W. L. Culb. & C. F. Culb.

in Culberson, Culberson & Johnson, Mycologia **74**: 663. 1982.

Seven specimens from four localities, all from Poland, have chemistry identical to and morphology similar to *Cladonia anitae* and can be referred to as *C.* aff. *anitae*. The taxon was collected from habitats very similar to that of *C. incrassata*, but it seems to have a more western distribution (Fig. 2). However, the number of specimens is insufficient for drawing general conclusions.

Culberson *et al.* (1982) pointed out that the primary squamules of *Cladonia anitae* are sorediate, but, unlike of those of *C. incrassata*, not abundantly so. In the protologue they also report that the podetia of *C. anitae* are esorediate and branched once, rarely twice. The author's own observations agree in general with the description of Culberson *et al.* (1982), but in one (Tønsberg 23654, BG) of three analyzed specimens of *C. anitae* the podetia possess a few sorediate patches. In analyzing specimens he called *C.* aff. *anitae*, Tønsberg (1995) found that the podetia could be sparingly to distinctly sorediate or esorediate, and sometimes branched. Material of *C.* aff. *anitae* from Poland appears to be morphologically similar to that studied by Tønsberg (1995) from Germany; however, in one Polish specimen the podetia are strongly branched as seen in some specimens of *C. incrassata* (cf. Tønsberg 1995: Fig. 1B). In general there seem to be no distinct morphological differences between *C. incrassata* and *C.* aff. *anitae*. Molecular methods should be included in further studies of *C.* aff. *anitae* as well as *C. anitae*.

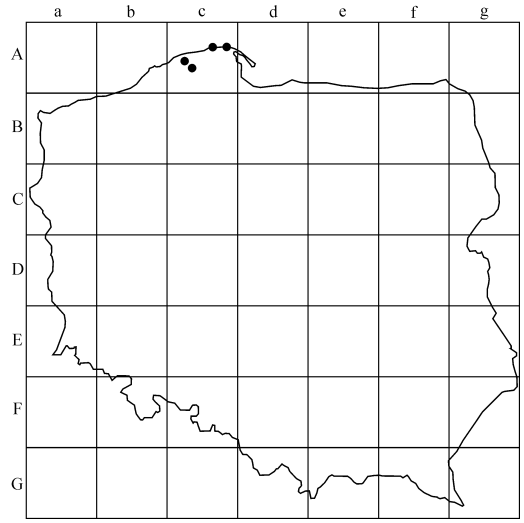

Fig. 2. Known distribution of *Cladonia* aff. *anitae* W. L. Culb & C. F. Culb. in Poland.

SPECIMENS EXAMINED. Ac–36 – POBRZEŻE KOSZALIŃSKIE COAST. Wybrzeże Słowińskie coast: peat bog E of Białogóra village, among *Calluna vulgaris*, on peat, 28 Sept. 1953, *leg. Z. Tobolewski* (POZ; Tobolewski 1983); Ac–38 – POBRZEŻE KOSZALIŃSKIE COAST. Wybrzeże Słowińskie coast: Bielawskie Błoto peat bog, on decaying peat, 25 Sept. 1981, *leg. W. Fałtynowicz* (UGDA-L 1430; Tobolewski 1983); ibid., central part of peat bog, on decaying peat, 24 July 1981, *leg. W. Fałtynowicz* (UGDA-L 1198; Tobolewski 1983); Ac–52 – POBRZEŻE KOSZALIŃSKIE COAST. Wybrzeże Słowińskie coast: S of Izbica village, Bagna Izbickie Nature Reserve, peat bog, on peat, 29 Oct. 1991, *leg. K. Bartnicka* (SLTC; Izydorek 1996); Ac–63 – POBRZEŻE KOSZALIŃSKIE COAST. Pradolina Łeby i Redy: Lębork forest inspectorate, Janowice forest division, Czarne Bagno projected nature reserve, *ca* 2 km WNW of Żelazkowo village, peat bog, on humus, 09 Oct. 1985, *leg. W. Fałtynowicz* (UGDA-L 2569, KRAM-L 21853; Tobolewski 1983); ibid., forest tract no. 393, on decaying peat, 2002, *leg. A. Kanarek* (UGDA-L 8152).

SPECIMEN OF *CLADONIA* SP. WITH GRAYANIC AND SQUAMATIC ACIDS EXAMINED. GERMANY. Bei Greifswalde, on humus, *leg. Laurer* (WA; as *Cladonia incrassata*).

SPECIMENS OF *CLADONIA ANITAE* EXAMINED. U.S.A. North Carolina, Onslow Co., NNW of Holly Ridge,

2 miles along Route 50 off Holly Ridge at US route 17 intersection, 34°31′N/77°34′W, on sand and plant remnants in a savannah with high water table, 24 Nov. 1995, *leg. T. Tønsberg 23669* (BG-L 34112); along US route 17, NE of Holly Ridge, 1.5 miles along the road NNE of Folkstone, 34°33′N/77°30′W, on sand with a high water table, roadside bank, 24 Nov. 1995, *leg T. Tønsberg 23663* (BG-L 33729); Pender Co., NNE of Wilmington, along US Route 17, 2.4 miles along the road SW of the Pender Co./Onslow Co. border, 34°27′N/77°36′W, on sand on a vertical bank of a ditch, 24 Nov. 1995, *leg. T. Tønsberg 23654* (BG-L 33720).

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