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CHECKLIST

Cercidospora parva new for Poland and some other noteworthy records of lichen-forming and lichenicolous fungi from the Karkonosze Mountains

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Abstract

Three noteworthy epilithic lichens species, *Porpidia flavocruenta*, *P. thomsonii* and *Rhizocarpon cinereovirens*, and two lichenicolous fungi, *Cercidospora parva* and *Abrothallus* aff. *caerulescens* were recently recorded in the Polish part of the Karkonosze Mountains. *Cercidospora parva* is reported from Poland for the first time. *Abrothallus* aff. *caerulescens* and *Porpidia thomsonii* are new for the Western Sudetes. *Rhizocarpon cinereovirens* has been rediscovered in the Karkonosze Mountains after over a century. *Porpidia flavocruenta* is known in Poland only from the Karkonosze Mountains, it is reported here from a new substrate, hornfels. Descriptions, notes on similar species, habitat preferences, and distribution of each species are provided.

Keywords

lichenized fungi; lichenicolous fungi; lichen diversity; Sudety Mountains

Dedicated to Professor Lucyna Śliwa

1. Introduction

The highest mountain range in the Sudetes, the Karkonosze (Giant) Mountains, has long attracted the attention of naturalists specializing in various groups of organisms. The lichen biota has also been studied for a long time and seems to be well-known. So far, approximately 600 species have been found there (Kossowska, 2006, 2014). However, the list of species is not and probably will never be complete; intensive field research, especially in the highest parts of the range, as well as modern taxonomical revisions constantly enrich it with new species (e.g., Halda et al., 2011; Jabłońska, 2010; Kossowska, 2008a, 2011; Ossowska, 2021; Palice, 1999; Szczepańska & Staniaszek-Kik, 2012). In addition to species new to the range, new localities of rare lichens are also found, some of which had not been recorded for a long time and were considered “lost” species (e.g., Kossowska, 2011; Kossowska et al., 2016).

The biota of lichenicolous fungi occurring in the Polish part of the Karkonosze Mountains is much less known. Information about them is scattered across various publications (e.g., Kossowska, 2008b, 2009; Kukwa, 2005; Kukwa & Czarnota, 2006; Kukwa & Flakus, 2009; Kukwa & Jabłońska, 2008); the only comprehensive list (Kossowska, 2006) contains 22

species with few localities, but it is certainly incomplete and out of date.

This publication presents three particularly interesting epilithic lichens that were recently found on granite and hornfels rocks above the tree line, as well as two lichenicolous fungi. One of them, *Cercidospora parva*, is reported from Polish territory for the first time.

2. Material and methods

The specimens studied were collected during various lichenological investigations in the Karkonosze Mountains. The taxa were identified by classical techniques, using a Nikon Eclipse E600 light microscope, a Nikon SMZ-U stereoscopic microscope, and standard chemical reagents: 10% potassium dioxide (K), sodium hypochlorite (C), p-phenylenediamine in ethanol (Pd), and Lugol's iodine (I). The content of secondary metabolites was determined by a thin-layer chromatography (TLC) in solvent C (Orange et al., 2001).

Descriptions of the species are based on own observations and measurements of the collected specimens. Nomenclature of lichens follows Fałtynowicz et al. (2024); names of lichenicolous fungi are given according to Lawrey and Diederich (2018). Lichenicolous fungi are marked with an asterisk (*).

The herbarium material is deposited in the author's private collection (Hb. Kossowska).

Localities of each species are placed in an ATPOL grid square system (Zajac, 1978) modified by Cieśliński and Fałtynowicz (1993). GPS coordinates use the World Geodetic System (WGS84) datum.

3. The species

3.1. **Abrothallus aff. caerulescens* Kotte

Description – Ascomata apothecia, superficial on host thallus, emarginate and strongly convex, 0.2–0.3 mm in diam.; discs black, epruinose. Hymenium ca. 50 µm, greenish in upper part; epihymenium greenish brown, K+ green; hypothecium brownish. Ascospores brown, 1-septate, 14–15 × 5 µm. Vegetative hyphae of the examined specimen I– (see comments).

Host – *Xanthoparmelia conspersa* (Ach.) Hale (thallus).

Distribution and habitat – *Abrothallus caerulescens* is a commensal fungus that grows exclusively on the thalli of yellow-green *Xanthoparmelia* species and, therefore, is associated with siliceous rocks. It is widely distributed, being reported from Northern and Southern America (Diederich, 2004), the Middle East (Seaward et al., 2008) and many regions of Europe (e.g., Czyżewska & Kukwa, 2009; Kondratyuk et al., 2021; Roux et al., 2020; Savić et al., 2006; Schiefelbein et al., 2017; Varga et al., 2021; Westberg et al., 2021; Zhurbenko & Notov, 2015).

Comments – *Abrothallus caerulescens* was described by Kotte (1909) based on relatively large ascospores and positive iodine reaction of vegetative hyphae, which was even pointed out in the epithet of the species. However, the taxonomical value of this feature is debatable, as at least some specimens found on *Xanthoparmelia* were reported as I–. Diederich (2003, 2004) treated all *Abrothallus* specimens on yellow-green *Xanthoparmelia*, both I+ and I–, as *A. caerulescens*, while Ihlen and Wedin (2008) included I– morphs to another species, *A. parmeliarum*. Cole and Hawksworth (2001) described I– specimen found in Canada as a new species, *A. tulasnei*, reported later also from Turkey (Halici & Cansaran Duman, 2008) and New Zealand (Hafellner & Mayrhofer, 2007). Apart from the I-reaction of mycelium, *A. tulasnei* differs from *A. caerulescens* by a slightly taller hymenium and bigger ascospores (Cole & Hawksworth, 2001).

The material collected in the Karkonosze Mountains matches the descriptions of *Abrothallus caerulescens*, except for the iodine reaction of the hyphae. It was found on a summit of the exposed granite rock surrounded by a spruce forest in the lower montane belt. *A. caerulescens* has not been reported from this mountain range until now; in Poland, it is known from scattered localities in the Carpathians (Kukwa & Czarnota, 2006), Sudety Foreland (Kossowska & Szczepańska, 2013) and the lowland parts of the country (Czyżewska et al., 2008; Kukwa & Flakus, 2009; Kukwa & Jabłońska, 2008; Kukwa & Kowalewska, 2007).

Specimen examined: ATPOL grid square Ea–79, Sudety Mts, Karkonosze Mts, Pogórze Karkonoskie Foothills, Patelnia rock on the slope of the Grabowiec Mt., 50.8039°N, 15.7331°E, alt. 725 m, on *Xanthoparmelia conspersa* growing on granite, 7.07.2013, leg. M. Kossowska, herb. Kossowska 1367.

3.2. **Cercidospora parva* Hafellner & Ihlen

Description – Ascomata perithecia, immersed in the host thallus, black, 0.1–0.2 mm in diam. Peridium in the upper part greenish blue, in the lower part, hyaline. Paraphysoids thin, ca. 2 µm, branched and anastomosing. Asci cylindrical, thin-walled, 45–63 × 7–10 µm. Ascospores arranged ± uniseriately, deltoid-ellipsoid, 1-septate, with the upper cell slightly bigger than the lower, hyaline, 12–15 × 4–5 µm. The fungus causes the darkening of infected lichen thalli to grey or dark olive.

Host – *Baeomyces rufus* (Huds.) Rebert. (thallus)

Distribution and habitat – This is a rare lichen parasite, growing exclusively on *Baeomyces* (*B. rufus* and *B. platyphyllus*). It is known mainly from northern regions of Europe and Asia: Norway, Iceland, arctic Russia (Taymyr Peninsula), and Scotland (Ihlen, 1998; von Brackel, 2010a; Zhurbenko, 2009). In Central Europe, this species has been previously reported only in southern Germany (von Brackel, 2009, 2010b). Here, it is reported as new for Poland.

The first Polish record of *Cercidospora parva* was located in the alpine belt of the Karkonosze Mts. The host lichen *Baeomyces rufus* grew there on bare siliceous soil in the loose plant community dominated by *Festuca airoides* and *Calluna vulgaris*.

Comments – Polish specimen of *Cercidospora parva* strictly corresponds to the species description given by Ihlen (1998). This is the only known member of the genus *Cercidospora*, parasitizing *Baeomyces* spp. It is closely related to *C. tryptotheliza* (Nyl.) Hafellner and Obermayer infecting thalli of another terricolous lichen, *Arthrorhapis alpina*. The main differences include the pigment of the upper part of the peridium and the size of ascomata, asci, and ascospores (Ihlen, 1998). Because both hosts may grow together and the distinguishing features between these two *Cercidospora* species are not always clear, Zhurbenko (2009) suggested their taxonomic re-examination. However, *C. tryptotheliza* is a rare lichenicolous fungus, in Europe known only from Spitsbergen, Faroe Islands, Scandinavia, and high elevations of the Alps (Hafellner & Obermayer, 1995; Zhurbenko & von Brackel, 2013). Its range is limited by the arctic-alpine type of distribution of the host.

Specimen examined: ATPOL grid square Ea–88, Sudety Mts, Karkonosze Mts, above the Śnieżne Kotły glacial cirques, 50.7794°N, 15.5538°E, alt. 1477 m, on the soil in high-mountain grassland *Carici-Festucetum airoidis*, 08.2015, leg. B. Wojtuń & L. Żołnierz, herb. Kossowska 1516.

3.3. *Porpidia flavocruenta* Fryday & Buschbom

Description – Thallus crustose, rather thick, cracked, yellow-orange, surrounded by a thin, black prothallus. Apothecia large, to 2 mm in diam., sessile, with persistent proper margin, becoming flexuose in mature apothecia; discs black, slightly pruinose. Exciple orange-brown to brown, containing K+ crimson pigment. Epihymenium olive-green to pale olive-brown; hymenium hyaline, ca. 110 µm tall; hypothecium dark brown. Ascospores 8 per ascus, hyaline, 16–17 × 7–8 µm. No lichen substances detected by TLC (see also Fryday, 2005).

Distribution and habitat – *Porpidia flavocruenta* is an epilithic species growing on various siliceous rocks. It seems to be

widespread in Europe, being known from many sites in the British Isles, as well as from scattered localities in Scandinavia, Svalbard, Harz Mountains, Sudetes, and Alps (Fryday, 2005; Jabłońska, 2012; Øvstedal et al., 2009; Schiefelbein et al., 2017). It has also been reported from Alaska (Fryday, 2005) and Newfoundland (McCarthy & Fryday, 2014) in the northern part of North America.

Comments – *Porpidia flavocruenta* in Poland occurs exclusively in the Karkonosze Mountains. So far, it has only been found on basalt (on the so-called „basalt vein”) in Mały Śnieżny Kocioł glacial cirque (Jabłońska, 2010, 2012; Kossowska et al., 2016). Here, it is reported from a new site on the slope of Śnieżka Mt. in the eastern part of the range. The lichen grew there on a metal-enriched hornfels stone among the rush sward of the alpine belt, together with *Lecidea soralifera*, *L. intricata*, *L. polytropha*, and *Rhizocarpon geographicum*.

Porpidia flavocruenta belongs to the *macrocarpa* subgroup in a *Porpidia macrocarpa* group of species, characterized by thick excipular hyphae and a secondary metabolite chemistry of the stictic/norstictic acid chemosyndrome or no substances (Fryday, 2005). The features that make it easy to distinguish include the truly orange thallus (not rusty red due to iron compounds, as sometimes occurs in other members of the group), and the presence of an unidentified pigment in the exciple, realising a K⁺ intense crimson solution. A similar pigment occurs also in *P. nigrocruenta*, which, however, possesses a grey thallus. The also orange *P. flavicunda* differs in lack of the mentioned pigment in the exciple and the presence of stictic and/or norstictic acids in the thallus (Fryday et al., 2009).

Specimen examined: ATPOL grid square Eb–80, Sudety Mts, Karkonosze Mts, east slope of Śnieżka Mt., 50.7374°N, 15.7414°E, alt. ca. 1570 m, on hornfels, 6.08.2021, leg. M. Kossowska, herb. Kossowska 1622.

3.4. *Porpidia thomsonii* Gowan

Description – Thallus crustose, rather thin, continuous to slightly areolate, pale grey with a beige tinge. Apothecia frequent, ca 0.6–1 mm in diam., sessile, surrounded by a thick and tumid proper margin; discs black, epruinose. Exciple with blue-black cortex, sharply contrasting with the paler, brown medulla, composed of thick hyphae. Epithymenium olive-brown; hymenium hyaline, ca 110 µm tall; hypothecium dark brown, distinctly darker than exciple. Ascospores 8 per ascus, hyaline, 17–20 × 7–9 µm. Thallus K⁺ yellow to orange, Pd⁺ orange. Stictic acid as a main secondary metabolite detected by TLC.

Distribution and habitat – *Porpidia thomsonii* is an epilithic species, growing on siliceous rocks in exposed high-altitude situations (Fryday et al., 2009). It is probably widespread but not distinguished and undercollected. Known localities include arctic and hemiarctic parts of North America (Gowan, 1989; Hansen, 2002), as well as Scandinavia (Gowan & Ahti, 1993; Øvstedal et al., 2009), the British Isles (Fryday, 2005) and mountainous regions of Central Europa (Jabłońska, 2012).

Comments – This species was reported from Poland only by Jabłońska (2012) and Matura (2020). To date, only sin-

gle localities in the Carpathians (Tatra Mountains, Beskid Sądecki Mountains) and the eastern part of the Sudetes (Śnieżnik Massif) have been known. The reported site in the Karkonosze Mountains is the first one in the Western Sudetes. The lichen grew on a granite stone within the boulder field on Wielki Szyszak (Vysoké Kolo) Mt., in severe conditions of the alpine belt.

Porpidia thomsonii is a species characterized by features that are intermediate between *P. macrocarpa* and *P. crustulata*, concerning apothecia and ascospore size, the height of hymenium, and width of excipular hyphae (Fryday, 2005). Therefore, its separation may be difficult and cause confusion. The most distinct feature allowing us to distinguish it seems to be the two-color exciple, with a rather thick, blue-black cortex and contrasting pale brown medulla.

Specimen examined: ATPOL grid square Ea–88, Sudety Mts, Karkonosze Mts, Wielki Szyszak (Vysoké Kolo) Mt., 50.7770°N, 15.5678°E, alt. 1507 m, on granite, 1.08.2008, leg. M. Kossowska, herb. Kossowska 1551.

3.5. *Rhizocarpon cinereovirens* (Müll. Arg.) Vain.

Description – Thallus crustose, cracked-areolate. Areoles small, flat to convex, pale grey with a brownish tinge. Apothecia frequent, black, sessile, with persistent, thin proper margin, 0.3–0.6 mm in diam. Exciple poorly developed, K[–]. Epithymenium olive-black, with crystals dissolving in K; hymenium hyaline, 70 µm tall; paraphyses branching and anastomosing; hypothecium dark brown. Ascospores 8 per ascus, 1-septate, hyaline, 13–15 × 6–7 µm, halonate. Thallus K⁺ yellow, Pd⁺ red, norstictic acid detected by TLC (see also Fryday, 2002).

Distribution and habitat – *Rhizocarpon cinereovirens* is a species of circumboreal distribution, known from many regions in Western, Northern and Central Europe (e.g., Fryday, 2002; Liška & Palice, 2010; Urbanavichus & Urbanavichene, 2018; Wirth et al., 2013) as well as from North America (e.g., Fryday, 2002; Talbot et al., 2007; Thomson, 1967), Russian Arctic (Andreev et al., 1996) and Asian Far East (Bi et al., 2022; Ezhkin & Schumm, 2018; Inoue et al., 2007). It inhabits exposed siliceous rocks, mainly in cool and humid climate conditions (Fryday, 2002; Wirth et al., 2013).

Rhizocarpon cinereovirens is one of the rarest elements of Polish lichen biota. It is known only from the Karkonosze Mountains (Eitner, 1911, see comments below) and a single locality in the High Tatra Mountains (Węgrzyn, 2008, 2009). The species was also reported from the Świętokrzyskie Mountains by Halicz and Kuziel (1966). However, its presence in this area is questioned (Cieśliński, 1991; Łubek, 2007). The only lowland record on a granite boulder in Rościszowice near Wrocław (Eitner, 1896, as *Catocarpus seductus*) also raises doubts.

Comments – *Rhizocarpon cinereovirens* was previously reported from the Karkonosze Mountains only by Eitner (1911, as *Catocarpus seductus* and *C. seductus* f. *turgidus*), who found it above the Pod Łabskim Szczytem shelter house in the western part of the mountain range and in upper parts of two glacial cirques, Mały Staw and Łomniczka, in the eastern part. Since then, this species has not been recorded. The new site is located in the western part of the range, below the summit of

Wielki Szyszak (Vysoké Kolo) Mt., on granite boulders in the alpine belt.

Rhizocarpon cinereovirens is a member of the *Rhizocarpon hochstetteri* group, distinguished by non-yellow thalli and hyaline, one-septate ascospores (Fryday, 2002). The diagnostic traits that allow us to recognize this species are K+ orange or red and Pd+ yellow or orange reactions of thalli due to the presence of norstictic and/or stictic acids. The other members of *Rh. hochstetteri* group with similar chemistry are *Rh. glaucescens* and *Rh. discoense*. The latter is known so far only from Greenland and differs in well-developed, K+ purple exciple (Fletcher et al., 2009; Fryday, 2002). *Rhizocarpon glaucescens* occurs in a subnival belt of the Tatra Mountains (Flakus, 2014); it differs from *Rh. cinereovirens* in K+ purple exciple and slightly smaller ascospores (Fryday, 2002).

Specimen examined: ATPOL grid square Ea–88, Sudety Mts, Karkonosze Mts, Wielki Szyszak (Vysoké Kolo) Mt., 50.7771°N, 15.5677°E, alt. 1508 m, on granite, 1.08.2008, leg. M. Kossowska, herb. Kossowska 1536, 1559.

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