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Five lichen species new to Poland

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Abstract: *Athallia cerinelloides*, *Caloplaca ulcerosa*, *Flavoplaca arcis*, *Lecanora sinuosa* and *Sclerophora amabilis* are reported for the first time from Poland. Descriptions, notes on similar species, habitat preferences and general distribution are provided for each species.

Keywords: lichenized fungi, distribution, Poland

INTRODUCTION

Lichens can be considered one of the best studied groups of fungi in Poland. Lichenological research on Polish territories began over 200 years ago and is being carried out with a constantly growing intensity to this day. The last edition of the list of Polish lichens (Fałtynowicz & Kossowska, 2016) includes 1624 taxa; nevertheless, species new for Poland are still recorded (e.g., Kubiak & Wilk, 2016; Kukwa et al., 2017; Matura et al., 2017; Szczepańska et al., 2019; Szczepańska, 2020). The list of species is also enriched by taxa described as new to science (Guzow-Krzemińska et al., 2017, 2018, 2019; Czarnota & Guzow-Krzemińska, 2018; Ertz et al., 2018; Ossowska et al., 2021). In this article, we present five additional species that are reported from Poland for the first time.

MATERIAL AND METHODS

Specimens studied were collected by authors during various lichenological investigations and are deposited in following herbaria: OLTC, UGDA and hb. Kossowska. The taxa were identified by classical techniques, using dissecting and light microscopes and standard chemical reagents: 10% potassium dioxide (K), sodium hypochlorite (C), and p-phenylenediamine in ethanol (Pd). Descriptions of the species are based on own observations and measurements. Nomenclature of lichens follows van Herk & Aptroot (1999), Tibell (1999), Arup (2006), Vondrák et al. (2013) and Nimis (2016). Localities of each species are placed in ATPOL grid square system (Zając, 1978) modified by Cieśliński & Fałtynowicz (1993).

THE SPECIES

ATHALLIA CERINELLOIDES (Erichsen) Arup, Frödén & Søchting (syn. *Caloplaca cerinelloides* Erichsen) Thallus crustose, grey, thin, in parts immersed in the bark, smooth. Apothecia up to 0.4 mm diam., circular, grouped. Proper margin persistent, yellow; thalline margin inconspicuous, grey-yellow to yellow. Disc flat, yellow to pale orange-yellow. Hypothecium up to 43 µm thick. Asci 8-spored. Ascospores polarilocular, (8–)10–14 × (5–)6–7 µm, ellipsoid, septum 4–5(–6) µm wide. Thallus K negative, apothecial margin and discs K+ purple (see also Arup, 2009; Fletcher & Laundon, 2009).

The recently recognised genus *Athallia* Arup, Frödén & Søchting corresponds to the *Caloplaca holocarpa* group and contains mainly species with crustose thalli (Arup et al., 2013). *Athallia cerinelloides* is morphologically very similar

to *A. cerinella* (Nyl.) Arup, Frödén & Søchting, which differs in mostly 12–16-spored asci (Arup, 2009; Fletcher & Laundon, 2009). The species may also be confused with *A. pyracea* (Ach.) Arup, Frödén & Søchting; however, thalli of the latter species usually consist of slightly convex, greyish to pale orange areoles and produce larger (0.5–1 mm diam.), yellow-orange to orange apothecia, surrounded by thin, grey or yellowish grey thalline margin (Arup, 2009). Rare epiphytic or epixylic form of *A. holocarpa* (Hoffm.) Arup, Frödén & Søchting can also be similar to *A. cerinelloides*, but that species develops crowded-angular, larger apothecia (0.3–0.6(−1.0) mm) with usually darker discs (yellow-orange to orange, rarely yellow) and higher hypothecium (50–80 µm) (Arup, 2009; Fletcher & Laundon, 2009).

The species is a typical epiphyte which grows on various species of bushes and trees, especially *Populus tremula*, but also e.g. *Betula*, *Fraxinus*, *Juglans*, *Juniperus*, *Picea*, *Ribes* and *Sambucus*. It has also rarely been found on wood and rocks (Arup, 2009; Fletcher & Laundon, 2009). According to Arup (2009), it is likely that *A. cerinelloides* requires dust enrichment when growing on acidic substrata. In Poland it was found on bark of roadside trees and within a grey heron colony ("Czapliniec w Wierzysku" nature reserve). Accompanying species included *Candelaria pacifica* M. Westb. & Arup, *Lecania cyrtella* (Ach.) Th. Fr., *L. naegelii* (Hepp) Diederich & van den Boom, *Myriolecis albescens* (Hoffm.) Śliwa, Zhao Xin & Lumbsch, *M. hagenii* (Ach.) Śliwa, Zhao Xin & Lumbsch, *M. sambuci* (Pers.) Clem., *Physcia tenella* (Scop.) DC., *Phaeophyscia nigricans* (Flörke) Moberg, *P. orbicularis* (Neck.) Moberg and *Xanthoria parietina* (L.) Th. Fr. *Athallia cerinelloides* is a widespread, although locally uncommon species. It has been reported from many regions, namely Eastern, Central and Western Europe, Scandinavia, British Isles, Baltic Sea Region, Iberian Peninsula, Mediterranean and Black Sea Basin (e.g. Randlane & Saag 1999; Llimona & Hladun, 2001; Aptroot et al., 2004; Liška et al., 2008; Søchting & Alstrup, 2008; Abbott, 2009; Arup, 2009; Fletcher & Laundon, 2009; Urbanavichus, 2010; Vondrák & Liška, 2013). Outside Europe, it is also known from Northern Africa (Thor & Nascimbene, 2010), Asia (Fletcher & Laundon, 2009), New Zealand (Galloway, 2007) and North America (Esslinger, 2019).

Specimens examined. Poland. Bory Tucholskie, "Czapliniec w Wierzysku" nature reserve, 54.093806°N, 17.967444°E, elev. 190 m, ATPOL grid square Bc–16, on bark of fallen *Fagus sylvatica*, 14 Apr. 2012, A. Kowalewska 2012/27 (UGDA L-21274); Pojezierze Kaszubskie, Gdańsk Łostowice, 54.313972°N, 18.575056°E, elev. 90 m, ATPOL grid square Ad–90, orchard, on *Malus* sp., 16 Apr. 2016, A. Kowalewska s.n. (UGDA L-39662); Pobrzeże Kaszubskie, Gdańsk, Kartuska street, 54.342778°N, 18.547500°E, ATPOL grid square Ad–80, on *Populus* sp., 15 Oct. 1997, B. Ciechanowicz s.n. (UGDA L-49761); Pojezierze Kaszubskie, Gdynia Orłowo, 54.482222°N, 18.565278°E, elev. 3 m, ATPOL grid square Ad–70, open place, by the beach, on *Acer platanoides*, 29 May 2010, M. Kukwa 8020 (UGDA L-15969); Pojezierze Kaszubskie, Kaszubski Landscape Park, "Żurawie Błota" nature reserve, 54.410861°N, 18.006278°E, elev. 207 m, ATPOL grid square Ac–86, on *Populus* sp., 12 May 2012, A. Kowalewska s.n. (UGDA L-38484); Pradolina Łeby i Redy, Reda, by railway station, 54.594680°N, 18.354140°E, elev. 20 m, ATPOL grid square Ac–68, trees by road, on *Acer pseudoplatanus*, 18 Feb. 2020, M. Kukwa 20872 (UGDA L-29509).

Caloplaca ulcerosa Coppins & P. James

Thallus thin, flat, smooth to uneven, sometimes with shallow pustules, grey-white. Soralia scattered, discrete, flat to concave and ulcerose, with greenish soredia; exposed soredia never pigmented grey-green. Apothecia with thin, grey-white thalline margin, orange proper margin and orange discs. Ascospores eight in ascus, polarilocular, 9–12 × 5–6.5 µm, septum 4–5 µm. Thallus and soralia K negative, disc and proper margin K+ purple (see also Coppins & James 1979; Fletcher & Laundon, 2009). According to Kondratyuk et al. (2018) the species belongs to the genus *Coppinsiella* S. Y. Kondr. & L. Lőkös (as *C. ulcerosa* (Coppins & P. James) S. Y. Kondr. & L. Lőkös). This genus has been recently described and comprises four species (one still undescribed), which form a well-supported sister clade to *Athallia* (Kondratyuk et al., 2018). Whether the genus should be considered as separate entity or be synonymized with *Athallia* (as suggested by Wijayawardene et al., 2022), requires further research. *Caloplaca ulcerosa* can be easily confused with *C. obscurella* (J. Lahm ex Körb.) Th. Fr., which develops similar soralia,

but differs mainly in the presence of brown apothecia (Fletcher & Laundon, 2009). Both species often occur in sterile state and can then be distinguished by the colour of external soredia, which are blue-grey (exposed hyphae with grey, K negative or rarely K+ violet, N± reddish pigment) in *C. obscurella* and unpigmented in *C. ulcerosa* (Fletcher & Laundon, 2009). *Caloplaca substerilis* Vondrák, Palice & van den Boom is another species with similar morphology but can be separated by its endophloeodal or minutely squamulose thallus and soralia formed in bark crevices or on margins of squamules (Vondrák et al., 2013). *Caloplaca* aff. *ulcerosa* (as *C.* "*ulcerosa*" in Vondrák et al., 2013) known from Austria and North America is morphologically more similar to *C. substerilis* than to *C. ulcerosa* (Vondrák et al., 2013), although North American records were previously subsumed under the latter name (Wetmore, 2005; Vondrák et al., 2009a, 2013). This material may represent another, as yet undescribed species (Vondrák et al., 2013).

The species grows on bark of various deciduous trees and shrubs (*Limonium*); it was also reported from shaded limestone rock in the Czech Republic (Vondrák et al., 2009a). In Europe, Middle East and North Africa it was found mainly in the areas up to 50 km from a sea coast; however, in North America it was reported from further inland (Vondrák et al., 2009a). In Poland the species was recorded few meters from the sea shore on bark of *Populus* × *canadensis*. It was accompanied by *Phaeophyscia orbicularis*, *Physcia tenella*, *Polycauliona phlogina* (Ach.) Arup, Frödén & Søchting and *Xanthoria parietina*. *Caloplaca ulcerosa* is a widely distributed species. It is known from Northern Africa (Vondrák et al., 2009a; Thor & Nascimbene, 2010), the Middle East (Seaward et al., 2008; Vondrák et al., 2009a) and many regions of Europe, including Iberian Peninsula, British Isles, Scandinavia, Baltic Sea Region, Mediterranean and Black Sea Basin, as well as Western, Central and Eastern Europe (e.g. Randlane & Saag 1999; Llimona & Hladun, 2001; Aptroot et al., 2004; Abbott, 2009; Fletcher & Laundon, 2009; Vondrák et al., 2009a; Urbanavichus, 2010; Westberg et al., 2021). The species is also known from the Southern Hemisphere, namely Australia (Wetmore, 2005) and French Southern and Antarctic Lands in the southern Indian Ocean (Aptroot et al., 2011); however, due to the core occurrence of the species in the Northern Hemisphere, these records may belong to other similar species. Records from North America (Wetmore, 2005, 2009; Esslinger, 2019) probably represent an undescribed species (see comments above and Vondrák et al., 2009a, 2013).

Specimens examined. Poland. Mierzeja Helska, Nadmorski Landscape Park, SE of Chałupy, forest section No. 9H, 54.752491°N, 18.533442°E, elev. 5 m, ATPOL grid square Ad–40, group of *Populus* × *canadensis* and *Sorbus aucuparia* by dunes, on *Populus* × *canadensis*, 15 Aug. 2019, M. Kukwa 20647 & 20649 (UGDA L-29149 & 29151).

Flavoplaca arcis (Poelt & Vězda) Arup, Frödén & Søchting (syn. *Caloplaca arcis* (Poelt & Vězda) Arup)

Thallus crustose-subsquamulose, yellow, consisting of undulate, sometimes rosette-like areoles and minutely but distinctly lobate at the margins. Areoles rather thick, 0.4–2 mm in diam., some covered with coarse, globose blastidia, which are concolorous with thallus. Blastidia on both surface and margin of areoles, especially abundant in the centre of thalli. Apothecia absent in examined specimens; if present, zeorine, adnate to sessile, yellow and 0.3-1.5 mm wide. Thallus K+ purple (see Arup 2006). *Flavoplaca arcis* is a member of *F. citrina* group, easily distinguished by blastidiate thalli and the presence of short lobes at the margins. According to Arup (2006), this species is often fertile; while it may be true for Nordic populations, only 37% of specimens collected in the Black Sea region bore apothecia (Vondrák et al., 2009b). Polish specimens were sterile, covered with abundant vegetative propagules. Other features of the collected specimens are consistent with the description of Arup (2006). This species was formerly described as a variety within *Caloplaca citrina* complex by Poelt and Vězda (Vězda, 1990), but later raised to the species level by Arup (2006). As a result of multi-gene phylogenetic analyses of *Teloschistaceae*, *Caloplaca arcis* (Poelt & Vězda) Arup and other related taxa were transferred into newly established genus *Flavoplaca* Arup, Søchting & Frödén (Arup et al., 2013). *Flavoplaca arcis* may be confused with other similar members of *F. citrina* group, especially *F. dichroa* (Arup) Arup, Frödén & Søchting and *F. limonia* (Nimis &

Poelt) Arup, Frödén & Søchting. The former was reported from Poland by Wilk (2011); the latter is known from the neighbouring countries, i.e. Germany (Wirth et al., 2013) and Czech Republic (Vondrák et al., 2009b), and its occurrence in Poland is very probable. Both these taxa produce true soredia, developing from either cracked or eroded blastidia, and lack short lobes at the thallus margins (Arup, 2006; Vondrák et al., 2009b). *Flavoplaca flavocitrina* (Nyl.) Arup, Frödén & Søchting is another similar species. It is common in Poland (Wilk, 2011) and is truly sorediate with distinct, often labriform soralia developing from smaller (0.1–1.0(–1.5) mm across), somewhat squamulose areoles (Arup, 2006; Vondrák et al., 2009b).

Flavoplaca arcis grows on base-rich silicate and calcareous rocks and stones (Arup, 2006; Vondrák at al., 2009b; Wirth et al., 2013). The species often inhabits also man-made substrata (Arup, 2006; Malíček et al., 2014; Wirth et al., 2013). It grows in rather exposed places on both vertical and horizontal surfaces (Arup, 2006). In Poland *Flavoplaca arcis* has been found on walls of an old mountain fortress, built in 18th century in the Sudety Mts (SW Poland). It grew there on vertical surfaces of brick walls facing south and south-east. Accompanying lichen species included *Candelariella aurella* (Hoffm.) Zahlbr., *Circinaria contorta* (Hoffm.) A. Nordin, Savić & Tibell, *Caloplaca teicholyta* (Ach.) J. Steiner, *Lathagrium fuscovirens* (With.) Otálora, P.M. Jørg. & Wedin, *Myriolecis albescens*, *M. dispersa* (Pers.) Śliwa, Zhao Xin & Lumbsch, *Phaeophyscia orbicularis*, *Protoparmeliopsis muralis* (Schreb.) M. Choisy, and *Xanthoparmelia verruculifera* (Nyl.) O. Blanco et al. The species is widespread in Europe, although not frequently recorded. It may be rare, or included in the wide concept of similar *F. citrina* (Hoffm.) Arup, Frödén & Søchting. Known localities include Western and Central Europe, Scandinavia, the Mediterranean together with the Balkan Peninsula, and the Canary Islands (Arup, 2006; Vondrák at al., 2009b).

Specimens examined. Poland. Sudety Mts, Kotlina Kłodzka Basin, Kłodzko Fortress, 50.442250°N, 16.652250°E, elev. 345 m, ATPOL grid square Fb–26, on brick walls, 15 August 2019, M. Kossowska & W. Fałtynowicz s.n. (hb. Kossowska 1569, 1579).

LECANORA SINUOSA Herk & Aptroot

Thallus thick, whitish-grey. Apothecia sessile. Thalline margin thick, sinuous, crenulate, 0.12–0.2 mm in section, with angular groups of large crystals (amphithecium *pulicaris*-type). Hymenium ca. 70 µm high. Epihymenium brown, *pulicaris*-type, sparsely filled with tiny, pale brownish crystals between the paraphyses (well-visible in polarised light). Asci 8-spored. Ascospores hyaline, broadly ellipsoidal, 12–14 × 6–7.5 µm. Thallus and thalline margin C and Pd negative, K+ yellow (see also van Herk & Aptroot, 1999). *Lecanora sinuosa* is a member of *L. subfusca* group. The species is morphologically similar to *L. argentata* (Ach.) Malme (syn. *L. subrugosa* Nyl.) and *L. chlarotera* Nyl. Both these species have *pulicaris*-type amphithecium, but differ in *glabrata*-type and *chlarotera*-type epihymenium, respectively (Brodo, 1984; Jüriado, 1998; van Herk & Aptroot, 1999). *Lecanora pulicaris* (Pers.) Ach. shares the same type of amphithecium and epihymenium with *L. sinuosa*, but in the former species the apothecia have thinner and smooth (rarely coarse) thalline margin, which very often reacts Pd+ red due to the presence of fumarprotocetraric acid (Brodo, 1984; Jüriado, 1998; van Herk & Aptroot, 1999; Malíček, 2014). Anatomically *Lecanora sinuosa* resembles *L. hybocarpa* (Tuck.) Brodo, but the latter species has thinner thallus and regular and relatively thinner thalline margin (van Herk & Aptroot, 1999). *Lecanora sinuosa* is a typical epiphytic species found on well-lit and exposed trunks of roadside trees (*Acer*, *Quercus*, *Populus*, *Ulmus*) (van Herk & Aptroot, 1999; Wirth et al., 2013). In Poland it was found on bark of *Populus balsamifera* growing between the road and Pucka Bay in a well-lit situation. Van Herk and Aptroot (1999) reported that the lichen associations with *Lecanora sinusoa* are often extremely rich in species. It is also the case of Polish locality, where it was accompanied by several lichens: *Alyxoria varia* (Pers.) Ertz & Tehler, *Athallia cerinella*, *Polycauliona phlogina*, *Calogaya saxicola* (Hoffm.) Vondrák s.l., *Lecania cyrtella*, *Lecania erysibe* (Ach.) Mudd, *Lecanora carpinea* (L.) Vain., *Myriolecis dispersa*, *M. hagenii*, *M. persimilis* (Th. Fr.) Śliwa, Zhao Xin & Lumbsch, *Lecidella elaeochroma* (Ach.) M. Choisy, *Phaeophyscia orbicularis*, *Physcia adscendens* H. Olivier, *Rinodina pyrina* (Ach.) Arnold and *Xanthoria parietina*. So far, the species has been reported from scattered localities in

Western Europe, namely in Belgium, Germany and the Netherlands (van Herk & Aptroot, 1999; de Bruyn et al., 2000; Aptroot et al., 2004; Van den Broeck et al., 2006).

Specimen examined. Poland. Mierzeja Helska, Nadmorski Landscape Park, SE part of Kuźnica, 54.729167°N, 18.594722°E, elev. c. 2 m, ATPOL grid square Ad–40, roadside trees, on *Populus balsamifera*, 14 July 2019, M. Kukwa 20246a (UGDA L-29027).

Sclerophora amabilis (Tibell) Tibell

Thallus crustose, immersed, photobiont *Trentepohlia*. Ascomata stalked, rather tall (0.6–1.7 mm), stalks brown to yellowish, often with yellow or white pruina in uppermost part. Capitulum spherical, 0.4–0.5 mm diam., with a small collar-like basal extension of the excipulum, usually yellowish or whitish pruinose. Pruina on ascomata initially light yellow, during maturation turn violet-red. Ascospores globose, 4–6.5 µm, with minute verrucose ornamentation of the wall (see also Tibell, 1999). *Sclerophora amabilis* is similar to *S. pallida* (Pers.) Y. J. Yao & Spooner, *S. peronella* (Ach.) Tibell and *S. farinacea* (Chevall.) Chevall., but differs from them, among other things, in the size of ascospores, which are 7–8 µm in *S. pallida* and *S. farinacea*, and 3.0–3.5 µm in *S. peronella* (for other differences see Tibell, 1999). Tibell (1999) points out that European material of *S. amabilis* differs slightly from specimens from New Zealand, from where the species was originally described, and the European material may represent a distinct species (see Schultz & Steindl, 2018). The species occurs on the bark of old deciduous trees (*Acer*, *Fagus*, *Fraxinus*, *Ulmus*, *Populus*, and *Tilia*), and wood (Tibell, 1999; Diederich et al., 2012). In Poland *Sclerophora amabilis* was found on the trunk of an old roadside *Acer negundo* growing on the edge of the wide floodplain of the Vistula River. The following lichens have been noted as accompanying species: *Alyxoria varia*, *Amandinea punctata* (Hoffm.) Coppins & Scheid., *Anisomeridium polypori* (Ellis & Everh.) M.E. Barr, *Bacidia rubella* (Hoffm.) A. Massal., *Chaenotheca trichialis* (Ach.) Hellb., *Lecania naegelii*, *Lepraria vouauxii* (Hue) R.C. Harris, *Phaeophyscia orbicularis*, *Physconia grisea* (Lam.) Poelt, and *P. perisidiosa* (Erichsen) Moberg. Some European authors consider *Sclerophora amabilis* as a good indicator of natural habitats such as old-growth beech forests (Tibell, 1999; Malíček et al., 2014). On the other hand, this species was reported from an avenue of roadside trees in a large city in Germany (Schultz & Steindl, 2018). In the newly discovered site of *S. amabilis* in Poland, several rare calicioid lichens (including *Chaenotheca brachypoda* (Ach.) Tibell, *C. stemonea* (Ach.) Müll. Arg., and *C. phaeocephala* (Turner) Th. Fr.) were noted (on willows growing nearby), which are mentioned by some authors as good indicators of ecological continuity (Cieśliński et al., 1996). It can be assumed that *S. amabilis* is a moderately hemerophilic species, perhaps spreading due to global warming.

Sclerophora amabilis was originally described from New Zealand (Tibell, 1982, 1984), but has also been discovered in North America (Goward et al., 1996) and several countries in Europe and East Asia (Tibell, 1999; Tibell & Thor, 2003). In the Baltic See Region, the species has been found in Denmark, Norway, Sweden (Tibell, 1999), Germany (Schultz & Steindl, 2018), Latvia (Plociņa, 2007), Estonia (Oja et al., 2016), and European part of Russia (Muchnik & Konoreva, 2017). According to Tibell (1994), it is an antitropical species that is widely distributed in the cool temperate to temperate areas of both hemispheres. Its northernmost position (66°53'N) has recently been found in the Murmansk region (Urbanavichus & Urbanavichene, 2021).

Specimen examined. Poland. Kotlina Toruńska. Otłoczyn, Szlak Bursztynowy str., 52.920194°N, 18.719222°E, elev. 50 m, ATPOL grid square Cd–41, on *Acer negundo*, 22 May 2011, D. Kubiak s.n. (OLTC L-3018).

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