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Four species of *Caloplaca* (*Teloschistaceae*, lichenized Ascomycota) new to Poland

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Abstract — The species *Caloplaca conciliascens*, *C. obliterans*, *C. percrocata* and *C. vitellinaria* are reported as new to the lichen biota of Poland. All of them were collected in the Polish Carpathians, mainly in the Tatra mountains. Detailed taxonomic descriptions and comments are provided.

Key words — lichenized fungi, taxonomy, geographical distribution

Introduction

The lichen genus *Caloplaca* Th. Fr. has been the subject of taxonomic surveys by many authors. Most recently European species of the genus were studied in detail by Giralt et al. (1992), Laundon (1992a), Nimis (1992), Roux & Navarro-Rosinés (1992), Søchting (1994), Navarro-Rosinés & Roux (1995), Navarro-Rosinés & Hladun (1996), Søchting & Stordeur (2001) and Khodosovtsev (2001, 2002), Arup (2006). North American *Caloplaca* species have been investigated by Arup (1992ab, 1993ab, 1994, 1995ab), Wetmore (1994, 1996a, 2001, 2003, 2004) and Wetmore & Kärnefelt (1998, 1999). Antarctic species are also fairly well known (e.g., Søchting & Øvstedal 1992; Olech & Søchting 1993; Søchting & Olech 1995, 2000). Polish species of the genus have not been investigated in detail, however, and are in need of taxonomic revision. Currently 67 taxa have been reported from Poland (Nowak & Tobolewski 1975, Fałtynowicz 2003), approximately 50 of which occur in the Polish Carpathians (Bielczyk 2003). New records of *Caloplaca* for Poland have recently been supplied by Kossowska (1999), Zalewska (2000), Bielczyk (2003), Sparrius (2003), and Ceynowa-Giełdon & Adamska (2005).

The paper is based mainly on collections made by the second author during fieldwork in the Polish Tatra Mts. in 2002-2004. The study area plays an important role for the preservation of biological diversity including lichens, not only in Poland but also on a European scale. Despite the long tradition of lichenological research in the Polish Tatra Mts., many species are still being discovered from the area (e.g., Bielczyk 2003, Czarnota 2004, Flakus 2004, Krzewicka 2004, Kukwa 2004, Flakus & Bielczyk 2006, Śliwa 2006).

The present paper contributes to the study of the genus *Caloplaca* in Poland and expands the knowledge of lichen diversity in the Polish Carpathians. Detailed taxonomic descriptions and comments are presented below.

Taxonomic Descriptions

Caloplaca conciliascens (Nyl.) Zahlbr. **FIGURE 1a**
Catal. Lich. Univ. 7, p. 109 (1931)

Thallus small, indistinct, areolate, greyish white. Apothecia sessile, clustered, angular, 0.5–1.0 mm diam. Disc flat to slightly convex, brownish red. Margin persistent, thin, slightly flexuose, black. Parathecium without algae, inside colourless, outside blackish green. Epihymenium brownish golden; hymenium hyaline, 60–75 µm; hypothecium hyaline, with oil drops, ca. 80 µm; paraphyses simple or with some branches in upper parts, tips with 1–2 slightly swollen cells. Spores 8 per ascus, 10–14 × 5–7 µm, isthmus 3–4(–5) µm.

Spot test reactions: thallus K–, cN+ weakly violet (lecidea green); apothecial margin K+ violet red, cN+ distinctly violet (lecidea green), H+ intensifying green; epihymenium K+ violet red; upper parts of paraphyses H+ weakly greenish.

Ecology — At the collection site, *C. conciliascens* grew on mylonitized granite rock in shady place in the subnival belt of Tatra Mts. It was accompanied by *Lecanora cenisia* Ach.

Geographical distribution — The species is known from Austria (Wunder 1974, Hafellner & Türk 2001), Italy (Nimis 1993) and Turkey (John 1996).

Comments — *Caloplaca conciliascens* is characterized by a reddish black apothecial disc and brownish black margin. Wunder (1974) treated this taxon in the study on saxicolous species of *Caloplaca* with black coloured apothecia. The group of lichens is not homogeneous and this particular species has been considered as a member of *C. ferruginea* group (Wunder 1974, Kärnefelt 1989). Wetmore (1996a) discussed C. conciliascens in his taxonomic treatment of *C. siderites* group in North and Central America. He concluded that *C. conciliascens*, *C. exsecuta* (Nyl.) Dalla Torre & Sarnth., *C. concilians* (Nyl.) H. Olivier, *C. litoricola* Brodo and *C. britzelmayri* (Hue) Zahlbr. are probably closely related and form one distinct group characterized by presence of "dark apothecial margin and lecidea green instead of thalloidima green" (Wetmore 1996a).

Caloplaca conciliascens is very similar to *C. exsecuta*, which is a fairly common species distinguished by a very thin, sometimes almost disappearing thallus, flat to strongly convex apothecia, higher hymenium (65–135 µm) and a hypothecium (50–125 µm), which is always brownish coloured with numerous oil drops and wider spores (5.5–8.0 µm) (Wunder 1974).

Other related species are: *C. concilians* that differs from *C. conciliascens* in having abundant algae in the apothecial margin, *C. britzelmayri* with dirty yellowish apothecium disc, larger spores that occupies calcareous rocks, and *C. litoricola*, which besides distinctive characters of the apothecia is a maritime species known from western coast of North America (Wetmore 1996a,b). Clauzade & Roux (1985) regarded the taxon as closely related to *C. conversa* (Kremp.) Jatta. *Caloplaca conversa* in comparison with *C. conciliascens* produces smaller apothecia of different anatomy – margins usually lecanorine, with distinct oval cells, never black or greenish coloured (Wunder 1974). The two species differ also due to their chemistry (see Wetmore 1996a).

SPECIMEN EXAMINED — POLAND, Western Carpathians, Tatry Wysokie Mts., Ciemnosmreczyńska Przełączka pass, N aspect, slope 30°, mylonite area, subnival belt, alt. 2115 m, 49°11'21"N, 20°02'59"E, on mylonite rock, 7 August 2004, *A. Flakus 3046* (KRAM).

Caloplaca obliterans (Nyl.) Blomb. & Forssell **FIGURE 1b**
Points-Förteckning, p. 69 (1880)

Thallus small, more or less irregularly shaped in outline, areolate, pale to dark orange. Areoles irregularly shaped, often minutely lobed, plane to convex, scattered or huddled in groups. Hypothallus thin, concolorous with thallus, characterized by dendritic extensions to rock cracks. Soralia in the centre of thallus, concave and eroded, yellowish orange. Apothecia numerous in the centre of thallus, partially innate or adnate, small, up to 0.5 mm diam. Disc flat to slightly convex, orange, surrounded by thin, concolorous or slightly lighter margin. Amphithecium with algae. Epihymenium brownish golden; hymenium hyaline, 50–65 µm; hypothecium hyaline, 40–50 µm; paraphyses with some branches, tips with 1–2 swollen cells, up to 5 µm diam. Spores 10–11.5 × 4 µm, isthmus 2–3 µm.

Spot test reactions: thallus K+ violet red; apothecial margin cN–; epihymenium K+ violet red.

Ecology — At the collection site the species occupied a typical niche, viz.: an overhanging granite wall, in moist and shady place. It was accompanied by *Buellia alboatra* (Hoffm.) Th. Fr., *Lecanora dispersa* (Pers.) Sommerf., *Pseudosagedia chlorotica* (Ach.) Hafellner & Kalb and *Xanthoria elegans* (Link.) Th. Fr. The species is characteristic for the silicate community *Caloplacetum obliterantis* Wirth 1972 (see Wirth 1972, Obermayer 1993).

Geographical distribution — According to Wirth (1995) the species occurs in Europe in boreal to montane and high montane zones of temperate zone. It was reported from Iceland (Orange 1990), Norway, Sweden, Finland, Russian Fennoscandia (Nordin 1972), United Kingdom (Wade 1965, Laundon 1992b, Coppins 2002), Denmark (Søchting & Alstrup 2002), Czech Republic (Vězda & Liška 1999), Slovakia (Pišút 1995, Pišút et al. 1996, Lisická 2005), Ukraine (Kopachevskaya 1986, Oksner 1993), Germany (Wirth 1995), Austria (Obermayer 1993), Romania (Kondratyuk et al. 2003), Hungary (Verseghy 1971), Bulgaria (Mayrhofer et al. 2005), Italy (Nimis 1993), France (Harmand 1913, Ozenda & Clauzade 1970), Portugal (Llimona & Hladum 2001) and Spain (Etayo 1990). Besides Europe it occurs in Southwest Asia in Israel (Alon & Galun 1971) and Jordan (El-Oqlah 1992), in North America (Esslinger 1997, Fryday et al. 2001) and in Australia (Kalb 1996).

Comments — *Caloplaca obliterans*, as a minutely lobate species containing anthraquinones, was included by Nordin (1972) in the *Caloplaca* subgen. *Gasparrinia*. More recently, Wetmore & Kärnefelt (1998) carried out a revision of the lobate and subfruticose species of *Caloplaca* in North and Central America. The authors discussed the species in the paper but did not find any specimens of that taxon in the studied material.

According to Wetmore & Kärnefelt (1998), *C. obliterans* should not be included in subgen. *Gasparrinia* as it does not develop distinct elongated lobes.

Caloplaca obliterans resembles *C. cirrochroa* (Ach.) Th. Fr., *C. proteus* Poelt and *C. decipiens* (Arnold) Blomb. & Forssell, but those species occur on calcareous substrate. There are also some morphological differences between the taxa: *C. cirrochroa* and *C. proteus*, have a thallus consisting of more convex and longer lobes in comparison with *C. obliterans* and *C. decipiens* has rather lip-shaped or capitate soralia.

Moreover, Arup (1993a, 1995a) compared *C. obliterans* with two other sorediate species, i.e. *C. flavogranulosa* Arup and *C. citrina* (Hoffm.) Th. Fr. However, *C. obliterans* is well distinguishable due to the dark orange colour of thallus, concave and eroded soralia as well as distinct, dendritic hypothallus (Arup 1993a, 1995a).

Caloplaca obliterans has been reported from many European countries where it is usually collected in sterile form. The apothecia, which develop very rarely, are small, only up to 0.5 mm diam. Our collection of *C. obliterans* has a lower hymenium and hypothecium when compared to those provided by Alon & Galun (1971) – 70–90 µm and ca. 90 µm, respectively. Moreover, it is worth noting that our specimen is partly fertile and so has more aggregated areoles lacking soralia and a poorly developed hypothallus.

SPECIMEN EXAMINED — **POLAND, Western Carpathians**, Tatry Wysokie Mts., Dolina Rybiego Potoku valley, Mokra Wanta, in moist and shaded place, WWN aspect, alt. 1750 m, on overhanging granite wall, 17 August 2002, *A. Flakus 83* (KRAM).

REFERENCE MATERIAL EXAMINED — J. J. Havaas, Lich. Norv. Occid. 218 (KRAM).

Caloplaca percrocata (Arnold) J. Steiner **FIGURE 1c**

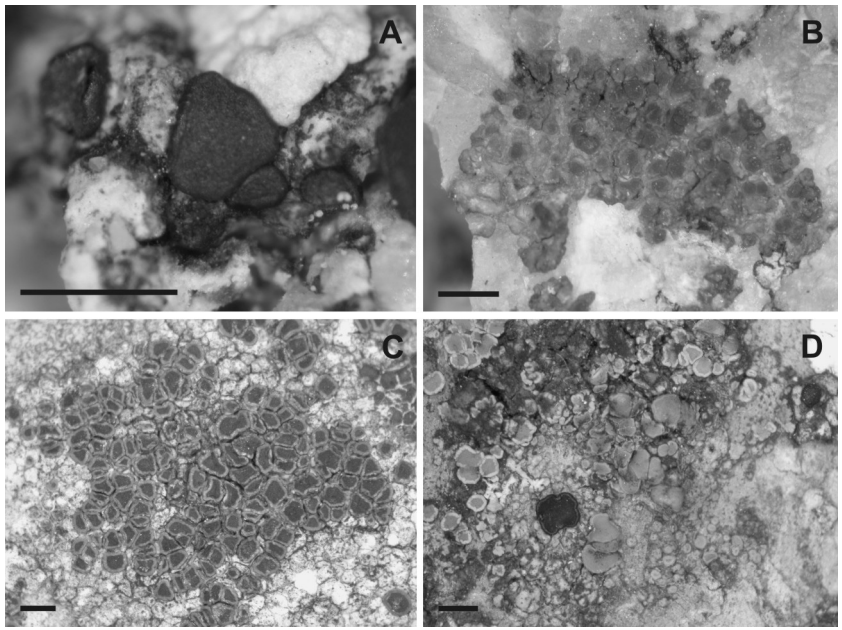
Halácsy in Denkschrift. Math.-naturw. Classe Kais. Akad. Wiss. Wien, vol. LXI, p. 523 (1894)

Thallus thick or thin, areolate, whitish grey, sometimes with a tinge of bluish or brownish. Areoles irregular, with uneven surface, subfarinose, plane to convex, up to 3 mm diam. Hypothallus thin, dark grey and rather rarely visible. Apothecia numerous in the centre of thallus, aggregated in groups, 0.4 to 1.3 mm diam, often angular to flexuose, sessile from the beginning. Disc flat, dark, brownish orange to brownish red, contrasting with pale, yellowish orange, thick margin. Thalline margin pale yellow, soon excluded (only sometimes good visible). Parathecium with radiating hyphae; amphithecium with numerous algae. Epihymenium brownish golden; hymenium hyaline, up to 100 µm; hypothecium hyaline, with oil droplets, ca. 60 µm; paraphyses with some branches. Spores 15–18(–20) × 8–10(–12.5) µm, isthmus 3–4(–5) µm.

Spot test reactions: thallus K–, C–, cN+ weakly violet (thalloidima green); epihymenium K+ violet red. The thallus contains the anthraquinone 7-chloroemodin (detected by U. Søchting).

Ecology — At the collection site the lichen occurred on base-rich siliceous shale on steep slopes in exposed places in the alpine belt. It was accompanied by *Aspicilia* sp., *Eiglera flavida* (Hepp) Hafellner, *Polyblastia cupularis* A. Massal. and *Thelidium* sp.

Geographical distribution — The species was reported from Norway (Santesson et a1. 2004), Austria (Poelt 1960, Hoffmann et al. 1998, Türk & Berger 1999), Hungary (Verseghy 1994), Bulgaria (Mayrhofer et al. 2005), Ukraine (Kopachevskaya 1986,



Figs. 1 A-D. Species of *Caloplaca*. **A**: *C. conciliascens* (*A. Flakus 3046* KRAM); **B**: *C. obliterans* (*A. Flakus 83* KRAM); **C**: *C. percrocata* (*A. Flakus 151* KRAM). **D**: *C. vitellinaria* (*A. Flakus 5120* KRAM). Scale bar = 1 mm.

Oksner 1993), Croatia (Kušan 1953), Italy (Nimis 1993), France (Ozenda & Clauzade 1970, Roux 1976, Houmeau & Roux 1991), Spain (Egea 1984) and Portugal (Llimona & Hladun 2001). Additionally, the species was reported by Kondryatuk et al. (2004) from France, Byelorussia, Turkey and North Africa.

Comments — According to Magnusson (1944a) *C. percrocata* belongs to the *C. ferruginea* group which consists of taxa closely related to *C. ferruginea* (Huds.) Th. Fr. and united by ferrugineous coloured apothecia. Moreover, the species of the *C. ferruginea* group are characterized by containing the chemosyndromes based on 7-chloroemodin (see Søchting & Tønsberg 1997, Elix et al. 2000). This group is rather large and includes species representing all ecological groups of lichens, for example corticolous, lignicolous, muscicolous and saxicolous (Magnusson 1944a,b, Clauzade & Roux 1985, Roux & Navarro-Rosinés 1992).

More recently Wetmore (1996a) established a more restricted *C. siderites* group in which *C. percrocata* was included. This group consists of exclusively saxicolous species characterized by grey, whitish or brown thalli that lack anthraquinones with apothecia that are red or orange and do contain anthraquinones. Furthermore, Wetmore (1996a) reported the non-crystallizing pigment thalloidima green in most of the treated species, including *C. percrocata*. This pigment reacts with K, cN, 10% N, C and concentrated HCl giving a violet colour.

Caloplaca percrocata is a rather characteristic taxon due to the prominent apothecia and the usually distinct areolate thallus. It could be confused with *C. teicholyta* (Ach.) J. Steiner, which has a scurfy-granular to sorediate surface of thallus (not at all or weakly areolate), uniformly red coloured apothecia with usually well visible white thalline margin.

Caloplaca erythrocarpa (Pers.) Zwackh differs in producing smaller and also uniformly red apothecia.

The species *C. atroflava* (Turner) Mong. and *C. submergenda* (Nyl.) H. Olivier may also be considered similar to *C. percrocata* but they differ in ecological preferences (both are acidophilous and hygrophilous) and some morphological details. *Caloplaca atroflava* forms dark grey thallus and apothecia without any thalline margin while *C. submergenda* has apothecia with persistent, greyish thalline margins and produces considerably smaller spores (Clauzade & Roux 1987).

Another acidophilous species, *C. limitosa* (Nyl.) H. Olivier, was also considered as possible to be mistaken with *C. percrocata* (see Nimis 1993). A detailed description of *C. percrocata* is available in several papers, e.g. Magnusson (1944a), Oksner (1993), Wetmore (1996a) and Kondryatuk et al. (2004).

SPECIMENS EXAMINED — **POLAND, Western Carpathians,** Tatry Zachodnie Mts., Twardy Upłaz, N slope below Ciemniak Mt., alt. 1900 m, 49°14'12"N 19°54'12"E, on siliceous shale contains calcium, 30 August 2002, *A. Flakus 151* (C, KRAM, MIN); and 9 July 2004, *A. Flakus 2251* with *K. Palka* & *B. Cykowska* (KRAM; the duplicates of the specimen will be distributed by Wetmore in Telosch. Exs. Fasc. 4).

REFERENCE MATERIAL EXAMINED — Poelt, Lich. Alp. no. 50 (KRAM).

Caloplaca vitellinaria Szatala **FIGURE 1d**

Ann. Hist.-Nat. Mus. Natl. Hungarici, ser. nov. 7, p. 276 (1956)

Thallus absent or very scanty, pale orange, over the thallus or apothecia of the host *Candelariella vitellina* (Hoffm.) Müll. Arg. Apothecia numerous, usually grouped and then angular, up to 1 mm diam. Disc flat to slightly convex, orange. Margin thin, paler than disc, flush and only in young apothecia slightly raised. Parathecium with radiating hyphae; amphithecium with numerous algae. Epihymenium brownish golden; hymenium hyaline, 60–70 µm; hypothecium hyaline, ca. 30 µm; paraphyses with branches, tips with 1–2 swollen cells, up to 5 µm diam.; spores 9–14 × 5–8 µm, isthmus (3–)4–5 µm.

Spot test reactions: thallus K+ violet red; epihymenium K+ violet red; hymenium I+ blue; hypothecium, parathecium and amphithecium I–.

Ecology — At the collection site the lichen colonized the thallus of *Candelariella vitellina* on sandstone and shale containing calcium in lower montane and alpine belts of Polish West Carpathians. It was accompanied by *Acarospora* sp., *Lecanora dispersa* and *Lecidella stigmatea* (Ach.) Hertel & Leuckert.

Geographical distribution — The species is known from Slovakia (Pišút et al. 1996, Lisická 2005), Austria (Hafellner & Türk 2001), Hungary (Szatala 1956), the Iberian Peninsula (Llimona & Hladun 2001) and Turkey (John 1996).

Comments — *Caloplaca vitellinaria* is a parasitic species occurring on the thallus of *Candelariella* spp., e.g. *C. vitellina*, *C. coralliza* (Nyl.) H. Magn. (Szatala 1956, Poelt

1969, Wirth 1995, Hafellner 2001). *Caloplaca grimmiae* (Nyl.) H. Olivier is another taxon colonising *Candelariella* spp., but it differs significantly by the colour of apothecia, which have reddish brown discs with blackish brown margins.

Caloplaca vitellinaria was treated by Clauzade & Roux (1985) in connection with the *C. ferruginea* group and was accepted by the authors at variety level of *C. holocarpa* (Hoffm.) A.E. Wade. The primary differences between *C. vitellinaria* and *C. holocarpa* apparently are their ecology, although there are some other distinguishing characters such as size and arrangement of apothecia (bigger and aggregated in case of *C. vitellinaria*).

Caloplaca vitellinaria is similar to *C. insularis* Poelt but the latter taxon has better developed thallus and smaller apothecia (up to 0.8 mm diam.) with medulla reacting distinctly I+ violet. Moreover, *C. insularis* is parasitic on the *Aspicilia* spp., i.e. *A. candida* (L.) Körb. (Poelt 1960), *A. polychroma* Anzi (Clauzade & Roux 1985).

It is worth noting that in the specimens of *C. vitellinaria* examined, both collected by us and A. Vězda, a considerably low hymenium (ca. 80 μm) was observed compared to the original description where it reaches ca. 100–125 μm (Szatala 1956).

SPECIMENS EXAMINED — POLAND, Western Carpathians: Beskid Śląski Mts., Pasmo Baraniej Góry range, Pietraszyna village, Koczy Zamek Mt., in open, sunny place, alt. 847 m, 49°32'54"N 18°58'32"E, on calcareous sandstone, 9 September 2005, *K. Wilk 3838* (KRAM); Tatry Zachodnie Mts., Twardy Upłaz, N slope below Ciemniak Mt., alt. 1900 m, 49°14'14"N 19°54'13"E, on siliceous shale contains calcium, 30 July 2005, *A. Flakus 5120* (KRAM).

REFERENCE MATERIAL EXAMINED — HUNGARY, Vesprem: supra balneas Tihany prope lacum Balaton, alt. 220 m, 17 August 1964, *A. Vězda* (KRAM-L–28050).

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