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Lecanora microloba, a new saxicolous species from Poland

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Abstract: A new lichenized fungus, *Lecanora microloba* Śliwa & Flakus, is described from the subnival belt of the Polish Tatra Mountains. It is characterized by small, saxicolous thalli with minutely lobulate marginal areoles and mostly broadly sessile and constantly pale coloured apothecia that are grouped predominantly in the centre of the thallus. Anatomically the species is distinguished by coarse granules in the epithecium which are distinctly bright in polarized light. The species contains gyrophoric and usnic acids, zeorin and an unknown terpene as secondary metabolites.

Key words: Central Europe, lichen chemistry, *Lecanorales*, *Lecanora polytropa* group, lichens, taxonomy, Western Carpathians

Introduction

According to Pérez-Ortega *et al.* (2010), and based on the literature cited therein, *Lecanora* Ach. seems to be one of the best-studied microlichen genera. However, many new species, representing various taxonomic groups of this large, diverse genus, and originating from different parts of the world, are still reported relatively frequently (e.g., Martínez & Aragón 2004; Ryan *et al.* 2004; Blaha & Grube 2007; Sipman 2007; van den Boom 2007; van den Boom & Brand 2008; Lendemer & Knudsen 2009; Knudsen & Lendemer 2009; Brodo 2010; de la Rosa *et al.* 2010). This indicates that the biodiversity of the lichen group is still not well recognized worldwide.

The *Lecanora polytropa* group, including saxicolous species containing usnic acid as a main secondary metabolite, has received the least attention within *Lecanora*, and to date no taxonomic treatment of the group is available. Only *L. polytropa* (Ehrh.) Rabenh., one of the most widely distributed species of the group apart from *L. intricata* (Ach.) Ach., has been investigated in advanced studies. Huneck (1966) examined its chemistry, and Pawlik-Skowrońska *et al.* (2006) and Purvis *et al.* (2008) its ecophysiology. The species has also been included in molecular studies on various assemblages of species (Arup & Grube 1998; Pérez-Ortega *et al.* 2010).

A species similar in appearance to *L. polytropa* and *L. intricata* was discovered during studies on lichens of the subnival belt in the Polish Tatra Mountains. Its chemical properties, however, did not agree with either of these species. It is described here as *Lecanora microloba*, based on the combination of the morphological and chemical evidence.

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Material and Methods

The voucher specimens were collected as part of a survey of the lichens of the subnival belt in the Polish High Tatra Mountains conducted by the second author between 2003 and 2006. Reference material was from KRAM and NY herbaria. Morphology was studied using standard techniques, with preparations mounted in water or a *c.* 25% solution of potassium hydroxide (K). Tissue measurements were made in water, and ascospores in K. Granulations were observed in polarized light (pol). The solubility of granules and/or crystals was tested with K and 65% nitric acid (N). Chemical analyses were carried out using thin-layer chromatography (TLC) on aluminium TLC plates in solvent systems A, B and C, following Orange *et al.* (2001).

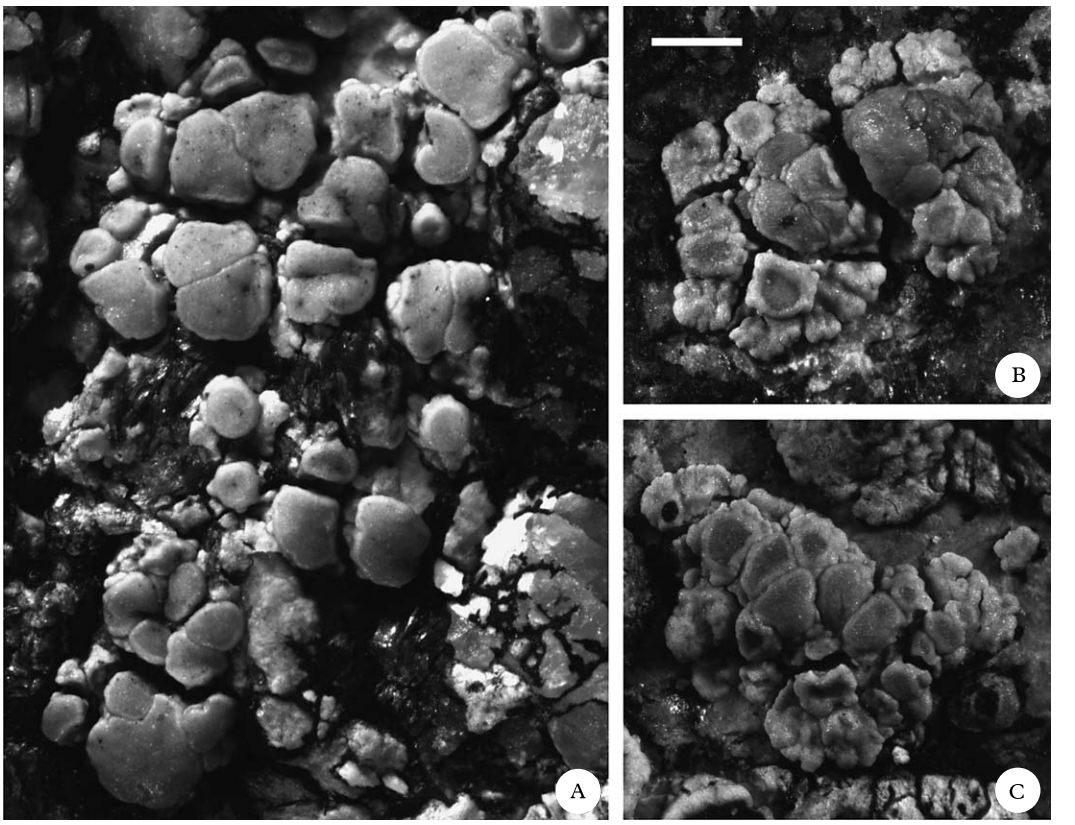

FIG. 1. *Lecanora microloba* (holotype). A–C, habitus. Scale = 0·5 mm.

The Species

Lecanora microloba Śliwa & Flakus sp. nov.

MycoBank no.: MB518742

Species *Lecanorae polytropae* et *L. intricatae* similis; thallus crustaceus, tenuis, areolae dispersae vel rosulae minutae formans; areolae externae margine crenulato et minute lobulato. Apothecia aggregata, sessilia, non elevata nec immersa, plana, 0·3–0·6(–0·8) mm in diametro. Epithecium grosse granulatum, granulis in K solubilibus, in N insolubilibus. Ascosporae (10–) 11·2 (–13) × (5–) 5·8 (–7) µm. Acidum gyrophoricum, acidum usnicum, zeorinum et terpenum ignotum continens.

Typus: Poland, Western Carpathians, High Tatra Mts., Hińczowy Żleb gully, alt. 2200 m, 49°11′10″N, 20°03′21″E, subnival belt vegetation, on mylonitized granite rock, 22 July 2004, *A. Flakus* 2804 (KRAM-L—holotypus; B, hb. Flakus—isotypi).

(Fig. 1)

Thallus crustose, composed of well-developed, flat areoles that remain single and dispersed (Fig. 1A) or form small rosules (Fig. 1B & C), 1–3(–5) mm diam.; marginal areoles crenate to minutely lobulate, *lobules c.* 0·05–0·15 mm long and 0·05–0·1 mm wide, somewhat raised from the substratum; surface smooth, corticated, grey-green to yellow-green. *Photobiont* a chlorococcoid green alga, cells up to 15 µm diam.

Apothecia occurring singly on the areoles, or more often clustered and grouped predominantly in the centre of rosules, broadly sessile to slightly constricted at base, flat, only slightly convex when older, 0·3–0·6 (–0·8) mm diam.; *disc* plane, smooth, yellowish grey to yellowish green, epruinose; margin faintly prominent, or level with the disc, smooth, entire, even, uniform, epruinose, concolorous with the thallus, rarely

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concolorous with the disc. *Thalline exciple* becoming excluded with only clusters of algae present on both sides of the apothecial section; cortex indistinctly delimited, ± uniform in thickness, up to 30 µm, more or less obscured by granules (pol+; insoluble in K, soluble in N); *parathecium* distinct, well delimited, prosoplectenchymatous, 35–60 µm wide, obscured entirely or in the uppermost part by granules (pol+; soluble in K, insoluble in N); *epithecium* shades of yellow or pale brown, granular (pol+), granules abundant, superficial and between paraphyses tips, fine to coarse (soluble in K and insoluble in N); *hymenium* hyaline, 50–70 µm high; subhymenium indistinct; *hypothecium* hyaline or almost so, 60–90 µm high, composed of adglutinated hyphae. *Paraphyses* thick, septate, simple to sparsely branched, apices slightly expanded, up to 2 (–2·5) µm wide, not pigmented, free in K. *Asci Lecanora*-type, clavate, 8-spored; *ascospores* colourless, non-septate, ellipsoid, (10–) 11·2 ± *1·01* (–13) × (5–) 5·8 ± *0·69* (–7) µm [*n* = 25].

Pycnidia not seen.

Chemistry. Gyrophoric acid (major), usnic acid (major), zeorin (major), and an unidentifed terpenoid (Rf classes A 3, B 2–3, C 2–3; minor). Thallus (cortex) K± yellowish, C+ rose, KC+ rose, P−, UV−; apothecial disc and margin K± yellowish, C+ rose, KC+ rose, P−, UV−.

Etymology. The epithet denotes the minutely lobulate marginal areoles formed by the new species.

Taxonomic notes. The presence of gyrophoric acid in the cortex of the thallus, at the apothecial margin, and the disc is an important diagnostic character of this new species. *Lecanora microloba* is also distinguished by the minutely lobulate marginal areoles of the thallus, and the apothecia that are clustered several together and grouped predominantly in the centre of the rosules. The apothecia of the species are up to 0·6(–0·8) mm diam., sessile, flat and constantly pale in colour. Anatomically the species is characterized by coarse granules in the epithecium that are distinctly bright in polarized light.

Lecanora polytropa and *L. intricata* are the most closely related species and are most likely to be confused with *L. microloba*. However, they clearly differ from it both in morphology and in chemistry. *Lecanora polytropa* is characterized by its thallus that is composed of dispersed granules or areoles with even margins and apothecia that are quite large, up to 1(–1·5) mm diam., sessile but often becoming strongly constricted at the base, raised, and convex. The chemistry of *L. polytropa* is also significant. The species produces usnic and rangiformic acids, zeorin, and ± eulecanoral. *Lecanora intricata* is clearly distinguished by its contiguous crustose thallus with crenate margins and numerous, sessile to immersed apothecia, 0·4–1(–1·5) mm diam. that are often darkened. Additionally, *L. intricata* contains exclusively usnic acid and zeorin.

Anatomically, *L. microloba* shares with *L. polytropa* and L. *intricata* apothecial margins with a well-developed parathecium, a granular epithecium with granules that are soluble in K, thick, simple to sparsely branched paraphyses with slightly expanded apices and ellipsoid ascospores. However, the new species is relatively easily distinguished by the epithecial granules, those of *L. polytropa* and *L. intricata* being fine, negative or ± bright in polarized light, whereas those of *L. microloba* are coarser and distinctly bright in polarized light. Although this character is very helpful in delimiting the latter species, it is worth noting that its taxonomic value must be evaluated based on a global, urgently needed revision of the *L. polytropa* group.

Because of its chemistry, *L. microloba* is also reminiscent of *L. gyrophorica* Lendemer. The last species produces usnic and gyrophoric acids, zeorin, 3 unidentified terpenoides and leucotylin (Knudsen & Lendemer 2009). However, *L. gyrophorica* is a typical member of the *L. muralis* group with a placodioid thallus, forming large rosettes, up to 1–2 cm diam. and therefore the separation of the two taxa is obvious. Additionally, gyrophoric acid is located in the medulla of the latter species.

Discussion. Secondary metabolites produced by different groups of taxa within *Lecanora* have been examined in detail. Studies by Elix *et al*. (1989), Elix & Crook (1992), Brodo & Elix (1993), Lumbsch *et al*. (1994, 1995), Poelt *et al*. (1995), and Elix & Lumbsch (1996) are especially noteworthy and provided new, interesting data. For example, Elix & Crook (1992) discovered a joint occurrence of chloroxanthones in several *Lecanora* species, Poelt *et al*. (1995) presented data on the chemical content of a few members of the *L. dispersa* group that were considered to lack lichen products, Brodo & Elix (1993) argued against a formal taxonomic recognition of species groups based on chemical data, Lumbsch *et al*. (1994) discussed chemical variation in selected representatives of the *L. subfusca* group, and finally Lumbsch *et al*. (1995) contributed to the recognition of numerous new species of the group that contain usnic acid in addition to atranorin. Based on those studies the taxonomic importance of chemical variation in the genus may be considered controversial. However, the chemical content of taxa is often successfully used to support a new species circumscription (e.g. Printzen 2001).

Gyrophoric acid is a rare lichen product in *Lecanora* and was known to occur only in a few species. *Lecanora salina* H. Magn. (Elix & Crook 1992; Śliwa 2007) and *L. congesta* Clauzade & Vězda (Clauzade & Vězda 1969; Edwards *et al*. 2009) are the members of the *L. dispersa* group containing the substance. Gyrophoric acid as a minor metabolite was also recorded in *L. epibryon* subsp. *broccha* (Nyl.) Lumbsch, a taxon that belongs to the *L. subfusca* group (Lumbsch *et al*. 1994). The most recent report of two new species producing the substance: *L. gyrophorica* representing the *L. muralis* group, and *L. munzii* K. Knudsen & Lendemer representing the *L. saligna* group (Knudsen & Lendemer 2009), as well as the discovery of the new species of *L. polytropa* group described here indicate that gyrophoric acid is a more common lichen product in the genus than previously thought. More detailed studies of even common species may uncover additional *Lecanora* species producing it.

Distribution and ecology. The new species is known only from two localities in the Polish Tatra Mountains, where it was recorded on mylonitized granite rock intrusions in the highest climatic vegetation belt of the Carpathians. The small tectonic zones of the crystalline part of the Tatra Mountains are considered very important for the biodiversity of the Carpathians (see e.g. Flakus 2007). Based on a revision of extensive herbarium material of *L. polytropa* and *L. intricata* available at the KRAM herbarium, we conclude that the new species may be specific to the very special habitat described above, and it may subsequently be found in other places with this type of rock.

The accompanying species with *L. microloba* were: *Aspicilia simoënsis* Räsänen, *Bellemerea alpina* (Sommerf.) Clauzade & Cl. Roux, *B. subsorediza* (Lynge) R. Sant., *Lecanora polytropa*, *Lecidea auriculata* Th. Fr., *Porpidia macrocarpa* (DC.) Hertel & A. J. Schwab, *Rhizocarpon geographicum* (L.) DC., and *Thelidium papulare* (Fr.) Arnold. *Lecanora microloba* is a host species of the lichenicolous fungus *Muellerella erratica* (A. Massal.) Hafellner & V. John.

Additional specimens examined. **Poland:** *Western Carpathians*: High Tatra Mts., Przełączka pod Zadnim Mnichem pass, alt. 2135 m, 49°11′19″N, 20°03′06″E, subnival belt, mylonite area, 2004, *A. Flakus* 3178/1 (KRAM—paratype).

Selected reference material seen. Lecanora gyrophorica: **USA:** *Missouri*: Lawrence Co., Paris Springs Access, *c*. 3·5 miles W of Halltown, *c*. 0·5 miles N of junction of Highways 96 & 266, vicinity of Turnback Cave, 37°11′39″N, 93°41′34″W, mesic E-facing limestone bluff, on chert in overgrown glade, 2006, *J. C. Lendemer* 6460 (NY—holotype).

L. intricata: **Poland:** *Western Carpathians*: High Tatra Mts., Hińczowa Przełęcz pass, alt. 2323 m, 49°11′16″N, 20°03′19″E, subnival belt, mylonite area, on granite rock, 2003, *A. Flakus* 1154,1 (KRAM); Przełączka pod Zadnim Mnichem pass, alt. 2135 m, 49°11′19″N, 20°03′06″E, subnival belt, mylonite area, on mylonitized granite rock, 2003, *A. Flakus* 1898 (KRAM); Rysy Mt., alt. 2499 m, 49°10′46″N, 20°05′17″E, subnival belt, on vertical granite rock, 2003, *A. Flakus* 1364 (KRAM); West Tatra Mts., Dolina Chochołowska valley, Polana Chochołowska glade, alt. 1105 m, 49°14′16″N, 19°47′47″E, intensive pasture, on rock, 2004, *L. Śliwa* 3117 (KRAM); Dolina Kościeliska valley, Stare Kościeliska glade, alt. 965 m, 49°15′31″N, 19°52′08″E, intensive pasture, on rock, 2004, *L. Śliwa* 2728 (KRAM).

L. polytropa: **Poland:** *Western Carpathians*: High Tatra Mts., Hińczowy Żleb gully, alt. 2200 m, 49°11′10″N, 20°03′21″E , the subnival belt, mylonite area, on mylonitized granite rock, 2004, *A. Flakus* 2827 (KRAM); Miedziane Mt., alt. 2220 m, 49°12′07″N, 20°03′03″E, the subnival belt, on granite stone, 2003, *A. Flakus* 601 (KRAM); Szpiglasowy Wierch Mt., W ridge, alt. 2170 m, 49°11′51″N, 20°02′23″E, the subnival belt, on vertical granite rock, 2003, *A. Flakus* 687 (KRAM); West Tatra Mts., Dolina Kościeliska valley, Stare Kościeliska glade, alt. 965 m, 49°15′31″N, 19°52′08″E, intensive pasture, on rock, 2004, *L. Śliwa* 2733 (KRAM); Tatra Mts. area, Magura Witowska range, Molkówka glade, alt. 970 m, 49°15′21″N, 19°49′15″E, extensive pasture, on stone, 2004, *L. Śliwa* 2745 (KRAM).

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