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Lepraria glaucosorediata sp. nov. (*Stereocaulacae*, lichenized *Ascomycota*) and other interesting records of *Lepraria*

Martin Kukwa[1] & Adam Flakus[2]

[1]*dokmak@univ.gda.pl*
Department of Plant Taxonomy and Nature Conservation, University of Gdańsk
Al. Legionów 9, PL–80–441 Gdańsk, Poland

[2]*a.flakus@botany.pl*
Laboratory of Lichenology, W. Szafer Institute of Botany
Polish Academy of Sciences, Lubicz 46, PL–31–512 Kraków, Poland

Abstract — *Lepraria glaucosorediata* is described as new to science from Bolivia. It is characterized by a thick, stratified thallus with external, farinose soredia bearing bluish gray pigment and by the presence of alectorialic, lecanoric, and protocetraric acids. *L. zeorinica* stat. et comb. nov. is raised to the species level and reported for the first time for Europe (France). *L. coriensis* is reported as new to Yemen, *L. impossibilis* as new to Costa Rica, *L. lobificans* as new to Jamaica and Vietnam, *L. pallida* as new to Asia (North Korea), *L. vouauxii* as new to Jamaica and *L. yunnaniana* as new to Bolivia.

Key words — chemotaxonomy, neglected habitats, new species, sterile lichens

Introduction

Lepraria Ach. is a cosmopolitan lichen genus comprising currently ca 60 species. However, investigations in poorly known regions continue to reveal new species, and extensions of the known distribution range of many taxa are being recorded continuously. The tropics remain among the least studied regions and it is very likely that more new species of *Lepraria* will be described from its ecosystems, the world's biologically richest (see Flakus & Kukwa 2007 and literature cited therein, Saag et al. 2009).

This paper presents new information on the distribution and taxonomy of *Lepraria*, mainly from tropical regions. One species is described as new to science from the Bolivian high Andes and one is raised to species level. Additionally, several new records are provided from Asia (Yemen, North Korea, Vietnam), Europe (France), South America (Bolivia), and Central America (Costa Rica, Jamaica).

Material and methods

This study is based on collections deposited in B, BR, DUKE, KRAM, LPB, S, UGDA and the private herbaria of P. Diederich and A. Flakus. Morphology was studied using a stereomicroscope. Anatomy was examined by compound microscope on squash preparations mounded in water or KOH solution, with or without pre-treatment with acetone. Chemical analyses were carried out by thin layer chromatography (TLC) in solvent systems A, B and C according to the methods of Orange et al. (2001a). When the secondary metabolite was always present it is marked with (+); when the substance was absent from a proportion of the specimens (±) is used.

The taxa

Lepraria coriensis (Hue) Sipman, Herzogia 17: 28. 2004.
≡ *Crocynia coriensis* Hue, Bull. Soc. Bot. France 71: 386. 1924.
≡ *Lecanora coriensis* (Hue) J.R. Laundon, Nova Hedwigia 76: 97. 2003.

Morphology: This species develops a greenish to yellowish grey thallus, often forming irregular rosettes with farinose granules on the surface. The edge of the thallus has small, regular lobes with usually raised, or rarely flat margin (see also Laundon 2003, Sipman 2004, Elix 2006).

Chemistry: Usnic acid (+) and zeorin (+) were detected as major secondary compounds. Also Laundon (2003) and Sipman (2004) reported these lichen substances. More detailed chemistry was presented by Elix (2006). The thallus does not react with C, K or P.

Ecology — *Lepraria coriensis* may grow on soil, rocks, tree bark or mosses (Laundon 2003, Sipman 2004, Elix 2006). The specimen reported here was found on a tree branch.

Distribution — So far the species has been reported from South Korea, India, China and Australia (Laundon 2003, Sipman 2004, Elix 2006). Here it is reported as new to Yemen.

Comments — *Lepraria coriensis* is characterized by the presence of rounded lobes and the production of usnic acid and zeorin. Only *L. usnica* Sipman produces the same secondary metabolites in combination with lobes. However, in the latter the lobes are squamulose and smaller (rarely up to 0.2 mm wide), somewhat irregular (not rounded as in *L. coriensis*), and lack a marginal rim (Sipman 2004, Elix 2006). *Lepraria usnica* differs also chemically, because it produces additionally contortin in minor amounts, a rare metabolite absent in *L. coriensis* (Elix 2006). Also *L. ecorticata* (J.R. Laundon) Kukwa, *L. leuckertiana* (Zedda) L. Saag (syn. *Lecanora leuckertiana* Zedda), *L. straminea* Vain. and *L. texta* K. Knudsen et al. produce usnic acid and zeorin, but those species

never develop regular and rounded lobes (Zedda 2000, Kukwa 2006a, Flakus & Kukwa 2007, Knudsen & Elix 2007, Saag et al. 2009).

Recently the phylogenetic position of *Lepraria coriensis* was studied, and it does not belong to *Lepraria* s.str., but its phylogenetic position remains unclear (Nelsen et al. 2008). As the species is morphologically very similar to other species of *Lepraria*, it is still included in this paper.

Specimen examined—**YEMEN. Gov. Al. Mahra**, coastal mountains between Al. Faydami and Hawf, N of Jadib, steep slopes with boulders directly below the J. Chatan escarpment, alt. 850–920 m, 16°34'N, 52°48'E, dense semideciduous woodland, on branch—13.10.2000, P. Hein 8131b (B).

Lepraria glaucosorediata Flakus & Kukwa, **sp. nov.** PLATE 1

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= *Lepraria* sp. 1 sensu Flakus & Kukwa, Lichenologist 39: 471. 2007.

Thallus crustaceus, leprosus, stratosus, effusus, virido-griseus usque ad glauco-griseus; medulla discreta, alba; soredia externa farinosa, ex hyphis cum pigmento glauco-griseo vel hyphis hyalinis, sine hyphis filamentosis projectis; acida alectoricum, lecanoricum et protocetraricum continens.

Typus: Bolivia. East Cordillera, Dept. La Paz, Prov. Murillo, near Cumbre pass, 16°21'59"S, 68°02'37"W, alt. 4604 m, on siliceous schist and saxicolous bryophytes, 13.05.2006, A. Flakus 5785 (KRAM-L–**holotypus**, LPB–isotypus).

Etymology: The epithet refers to the distinctly bluish external soredia.

Description: Thallus crustose, episubstratal, thick, leprose, with well delimited border, but non-lobate, green grey to bluish grey, sometimes white in areas with exposed medullary layer; true medulla absent, but a thick layer of whitened and compacted soredia resembling medulla present; hypothallus not well differentiated, thin, of white or brownish hyphae; soredia farinose, rounded, up to ca. 30 μm in diam., of two types, one with single large algal cell (up to 10–17 μm in diam.), the second with several smaller algal cells (ca. 5 μm in diam.), external soredia of both types hyaline or with bluish-grey pigment; consoredia rarely developed, up to 100 μm in diam.; soredial wall very well developed, complete, up to ca 5 μm thick, of 1–4 cell layers, hyaline or partly to entirely pigmented, projecting hyphae not observed; pigment situated in fungal cells, C+ orange to orange brown, K+ olivaceous brown; photobiont chlorococcoid, with rounded, green cells up to 10–17 μm in diam.

Chemistry: Alectorialic (+), lecanoric (+), and protocetraric (+) acids. The chemistry was checked in 5 different places of the specimen to avoid possible contaminants of other superficially similar taxa, and the chemistry appeared to be constant. Thallus C+ carmine red, P+ orange, in most parts K+ yellow.

Ecology — The species was found on rock and saxicolous mosses in a humid and shaded place in high Andean puna.

Distribution — So far it is known only from the type locality in Bolivia.

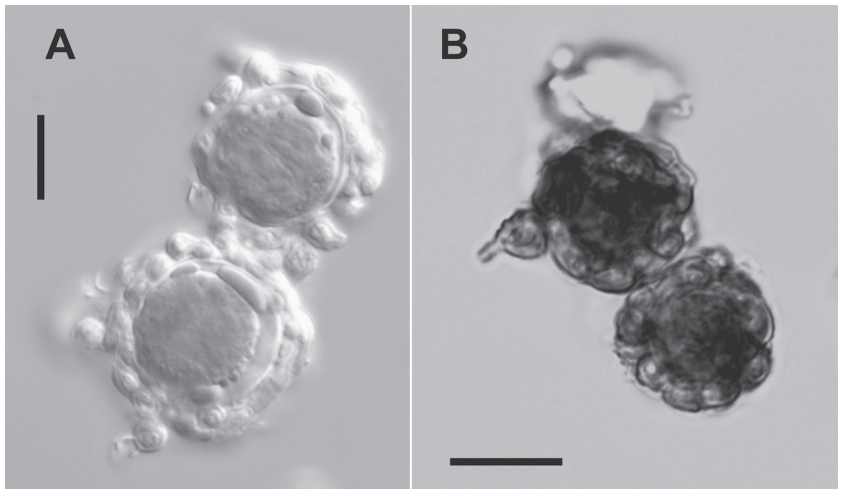

Plate 1. Soredia of *Lepraria glaucosorediata*, with unpigmented (A) and pigmented soredial walls (from the holotype; scale 10 µm for A & B).

Comments — *Lepraria glaucosorediata* has been already recognized as a distinct taxon by Flakus & Kukwa (2007), who hesitated to describe it formally. Recently we re-examined the collection and found some diagnostic morphological characters not observed before: soredia with thick soredial wall, absence of projecting hyphae on the soredia, presence of a bluish grey pigment in external soredia, and two types of soredia, one with several algal cells, the other with a single large algal cell. The combination of the unusual chemistry and morphology makes the species unique in the genus, and therefore, we have decided to described it here as new to science.

Chemically the species is similar to *L. achariana* Flakus & Kukwa, in the presence of lecanoric acid, and to *L. eburnea* J.R. Laundon in the presence of alectorialic and protocetraric acids (Laundon 1992, Tønsberg 1992, Orange 1997, Flakus & Kukwa 2007). However, both lack a bluish pigment in the soredial wall, their soredial wall and thallus are thinner, and, as far it is known, they do not produce soredia with one large algal cell as in *L. glaucosorediata*. Additionally, the soredial wall in *L. eburnea* is usually incomplete (Tønsberg 1992, Flakus & Kukwa 2007, Kukwa unpubl.). Morphologically *L. glaucosorediata* resembles *L. incana* (L.) Ach. The latter often has a similar thick thallus and many specimens have the same bluish pigment in the soredia. The taxa can be separated predominantly by the chemistry, as *L. glaucosorediata* produces alectorialic, lecanoric and protocetraric acids, whereas *L. incana* has divaricatic acid and zeorin (Tønsberg 1992, Flakus & Kukwa 2007). Additionally, we have never observed two distinct types of soredia in *L. incana* so far.

Lepraria impossibilis Sipman, Herzogia 17: 30. 2004.

Morphology: This species is rather variable in thallus colour. It is greenish grey to grey-brown with an orange tinge. It is leprose or may develop more or less thick and stratified, irregular rosettes with diffuse or obscurely lobed margin. It is morphologically very similar to *L. vouauxii* (e.g. Sipman 2004, Flakus & Kukwa 2007).

Chemistry: Lecanoric acid (+), pannaric acid-6-methylester (+), 4-oxypannaric acid-6-methylester and traces of additional dibenzofurans were detected in the specimen from Costa Rica. Flakus & Kukwa (2007) reported also 'vouauxii unknown 1' and traces of unidentified anthraquinones as uncommon accessory substances. The thallus reacts C+ red.

Ecology — *Lepraria impossibilis* was reported on soil, rocks, tree bark or mosses (Sipman 2004, Flakus & Kukwa 2007). The Costa Rican specimen was found on tree bark.

Distribution — So far the species has been reported from one locality in El Salvador in Central America (Sipman 2004), Bolivia, Chile and Peru in South America (Flakus & Kukwa 2007) and one locality in Asia (Iran) (Kukwa & Sohrabi 2008). Here it is reported as new to Costa Rica. It is the second record from Central America.

Comments — The production of lecanoric acid, pannaric acid-6-methylester and the diffuse or obscurely lobed thallus are the distinguishing characters of *Lepraria impossibilis*. Only *L. vouauxii* is chemically and morphologically similar, however it produces only dibenzofurans with pannaric acid-6-methylester as a major secondary metabolite and lacks lecanoric acid. The only other species containing pannaric acid-6-methylester is *L. sipmaniana* (Kümmerl. & Leuckert) Kukwa, but that taxon develops regular lobes with raised rim and does not contain lecanoric acid (Leuckert & Kümmerling 1991, Sipman 2004, Flakus & Kukwa 2007). In the presence of lecanoric acid, *L. impossibilis* is similar to *L. achariana*, *L. cupressicola* (Hue) J.R. Laundon (syn. *L. atrotomentosa* Orange & Wolseley), *L. goughensis* Elix & Øvstedal and *L. lecanorica* Tønsberg. Predominantly they differ in chemistry, as none of them has substances related to pannaric acid-6-methylester (Orange et al. 2001, Sipman 2004, Tønsberg 2004, Elix et al. 2005, Flakus & Kukwa 2007).

Specimen examined—**COSTA RICA. Cartago Prov.** 10 km NE of Cartago, 4 km N of Cot, 09°56'N, 83°52'W, 2500 m, on bark—07.01.1979, R. Santesson 28820 (S–F53695).

Lepraria lobificans Nyl., Flora 56: 196. 1873.

Morphology: *Lepraria lobificans* has an obscurely lobed, woolly thallus with well developed medullary layer. Its soredia with incomplete wall are often

grouped in consoredia, and bear usually long and well visible projecting hyphae (Tønsberg 1992, Sipman 2004, Flakus & Kukwa 2007).

Chemistry: Atranorin (+), stictic acid complex (+), and zeorin (+), sometimes with possible traces of unidentified terpenoids (±) or fatty acids (±) were detected in the studied specimens. Notes on the chemistry are presented by Tønsberg (1992), Leuckert et al. (1995), Sipman (2004), and Flakus & Kukwa (2007). Thallus C–, KC–, K– or + yellow and P+ orange.

Ecology — *Lepraria lobificans* has a very wide ecological amplitude, but seems to prefer humid places (e.g. Tønsberg 1992, Sipman 2004, Kukwa 2006b, Flakus & Kukwa 2007). It may grow on a very wide range of substrates. The here presented specimens were collected from rock and mosses.

Distribution — The species is very widely distributed, cosmopolitan, very common at least in some areas. It is known from all continents except Antarctica (e.g. Laundon 1992, Kümmerling et al. 1993, Sipman 2004, Flakus & Kukwa 2007). Here it is reported for the first time from Jamaica and Vietnam.

Comments — *Lepraria lobificans* is characterized by a thick, stratified and usually woolly thallus and the presence of atranorin, zeorin, and the stictic acid complex. The species is chemically similar to *L. elobata* Tønsberg, *L. leprolomopsis* Diederich & Sérus., *L. multiacida* Aptroot and *L. santosii* Argüello & A. Crespo by the production of atranorin and the stictic acid complex (Tønsberg 1992, Aptroot et al. 1997, Aptroot 2002). However, all these species are morphologically or chemically easily distinguished from *L. lobificans*: *L. elobata* has a thallus with diffuse margin and soredia with well developed, complete wall lacking projecting hyphae, *L. leprolomopsis* produces an unidentified terpenoid instead of zeorin, *L. multiacida* contains additionally salazinic and consalazinic acids and *L. santosii* develops lobate margin with slightly raised rim (Tønsberg 1992, Aptroot et al. 1997, Aptroot 2002, Crespo et al. 2006, Flakus & Kukwa 2007).

Specimens examined—**JAMAICA. Blue Mountain District.** Portland, just beyond Hardwar Gap, underhand of the rock by stream beside road, on rock— 17–27.12.1968, W.L. Culberson 13914, C.F. Culberson (DUKE). **VIETNAM. Son La Prov. Moc Chau District**. Van Ho Municipality, off Hwy 6 at 180 km mark SE of Moc Chou, 1225 m, 20°46'30"N/104°47'74"E, on moss—06.10.2000, D.E. Stone (DUKE).

Lepraria pallida Sipman, Herzogia 17: 33. 2004.

Morphology: *Lepraria pallida* has a rather thick thallus consisting of whitish grey soredia produced on a black hypothallus. The thallus margin is more or less diffuse or obscurely lobed (see also Sipman 2004 and Flakus & Kukwa 2007).

Chemistry: Atranorin (+), zeorin (+), and an unidentified fatty acid (+) were detected. For information on the chemistry see also Sipman (2004) and Flakus & Kukwa (2007). The thallus does not react with C, K or P.

Ecology — The species was reported from rock, humus, tree bark, and soil (Sipman 2004, Flakus & Kukwa 2007). The two specimens reported here were collected on a granite block and on soil.

Distribution — So far *Lepraria pallida* has been reported from Bolivia (Flakus & Kukwa 2007), Brazil, Madagascar, and the Seychelles (Sipman 2004). Here it is reported from Asia (North Korea) for the first time. This is also the northernmost locality of the species. Most probably *L. pallida* is a widely distributed species.

Comments — *Lepraria pallida* differs from other morphologically similar taxa of *Lepraria* with lobes and/or a black, tomentose hypothallus by the production of atranorin and zeorin, sometimes with accessory fatty acids (Sipman 2004, Flakus & Kukwa 2007). Only *L. caesiella* R.C. Harris contains the same set of secondary substances, but that species can be easily distinguished by its non-lobate, diffuse thallus (Lendemer 2005, Flakus & Kukwa 2007).

Specimens examined—**NORTH KOREA. Kumgangsan**, Manmulsan, on soil—30.09.1988, S. Huneck KDVR88-65 (B). **Rjongaksan**, etwa 12 km N von Pyongyang, auf senkrechter Fläche eines Granitblockes im Wald—23.09.1986, S. Huneck K86-27 (B).

Lepraria vouauxii (Hue) R.C. Harris, Bryologist 90: 163. 1987.
≡ *Crocynia vouauxii* Hue, Bull. Soc. Bot. France. 71: 392. 1924.

Morphology: This species has a quite variable morphology; its thallus may be unstratified, with diffuse margin and totally leprose surface or it may form stratified and irregular rosettes, which sometimes are obscurely lobed. The thallus colour is pale greenish grey, yellowish green or brownish yellow (e.g. Tønsberg 2004, Baruffo et al. 2006, Flakus & Kukwa 2007).

Chemistry: Pannaric acid-6-methylester (+) with related dibenzofurans and 'vouauxii unknown 1' (+) (see Tønsberg 1992) were found in the lichen. That agrees with the results presented by Leuckert & Kümmerling (1991), Tønsberg (1992), Kukwa (2006b) and Flakus & Kukwa (2007). Thallus C–, KC–, K–, and P+ orange or P–.

Ecology — *Lepraria vouauxii* was found on various types of substrate (Laundon 1989, Tønsberg 1992, Kukwa 2006b, Flakus & Kukwa 2007). The two specimens examined for this study were collected on rock.

Distribution — The species is known from all continents. It is very common in Europe, and most probably it is also common in other regions, also in the Neotropics, but so far rarely collected (e.g. Laundon 1989, Leuckert & Kümmerling 1991, Tønsberg 1992, Kukwa 2006b, Flakus & Kukwa 2007). Here it is reported as new to Jamaica.

Comments — *Lepraria sipmaniana* and *L. impossibilis* are the most similar species to *L. vouauxii* as both also contain pannaric acid-6-methylester. The

first species is easily distinguished by its broadly lobate thallus and the latter by the additional production of lecanoric acid. *L. vouauxii* also recalls *L. diffusa* (J.R. Laundon) Kukwa, but that species differs in the presence of large amounts of the dibenzofuran 4-oxypannaric acid-2-methyl ester (Laundon 1989, Sipman 2004, Tønsberg 2004, Flakus & Kukwa 2007).

Specimen examined—**JAMAICA. Blue Mountain District.** St. Andrew, trail from Clydesdales National Forest Camp to Morce's Gap and St. Helen's Gap, 1060–1220 m., Cloud Forest, on rock—17–27.12.1968, W.L. Culberson 13757 & 13759, C.F. Culberson (DUKE).

Lepraria yunnaniana (Hue) Zahlbr., in Handel-Mazzetti, Symb. Sin. 3: 244. 1930.
≡ *Crocynia yunnaniana* Hue, Bull. Soc. Bot. France 71: 396. 1924.
= *Lepraria nigrocincta* Diederich, Sérus. & Aptroot, in Aptroot et al., Biblioth. Lichenol. 64: 78. 1997.

Morphology: This species is characterized by a whitish to blackish prothallus on which whitish green soredia are formed (see Aptroot et al. 1997, Laundon 2008). In most Bolivian specimens the prothallus was extremely well developed and almost entirely blackish as in the specimens from Nepal cited by Kukwa (2006). Soredia were also more sparsely developed than in the type collection of *L. nigrocincta*, but the variability might be caused by the different habitat conditions. A picture of the specimen almost identical to our samples is presented by Aptroot & Sparrius (2008).

Chemistry: Divaricatic acid (+) with a trace of nordivaricatic acid (+) was detected. This agrees with the information provided by Aptroot et al. (1997) and Elix (2007). The thallus does not react with C, K or P; UV+ bluish.

Ecology — The Bolivian specimens were discovered in the montane cloud forests. The species is considered to be common in tropical mountains, where it grows on bark or corticolous bryophytes (e.g. Aptroot et al. 1997).

Distribution — This species can be considered as rather widely distributed. It was reported, mostly as *Lepraria nigrocincta*, from Africa (Burundi), Papua New Guinea (Aptroot et al. 1997), Australia (Elix 2007), Bhutan (Aptroot & Feijen 2002), China (Laundon 2008; type locality of *L. yunnaniana*), India (Upreti et al. 2003) and Nepal (Kukwa 2006b) in Asia and Costa Rica (Nelsen & Gargas 2008) and Ecuador (Nöske et al. 2007) in Latin America. Here it is reported as new to Bolivia.

Comments — Only three *Lepraria* species produce divaricatic acid, *L. crassissima* (Hue) Lettau, *L. incana* and *L. yunnaniana*. However, only *L. yunnaniana* produces a thick and dark hypothallus and lacks zeorin (Aptroot et al. 1997, Kukwa 2006, Laundon 2008). Some other taxa may also develop a blackish hypothallus, e.g. *L. cupressicola* (syn. *L. atrotomentosa*; see Laundon

2008) or *L. pallida*, but they do not produce divaricatic acid (Orange et al. 2001b, Sipman 2004, Flakus & Kukwa 2007).

The name *Lepraria yunnaniana* was forgotten for a very long time and the species was better known as *L. nigrocincta*. However, Laundon (2008) recently proved both taxa to be conspecific.

Specimen examined—**BOLIVIA. East Cordillera.** Dept. Cochabamba, Prov. Chapare, near Incachaca village, 17°14'17"S, 65°48'54"W, alt. 2400 m, on bryophytes—10.06.2006, A. Flakus 7890 (KRAM, LPB, herb. Flakus). Prov. Carrasco, Carrasco National Park, between Sehuencas and Monte Punku villages, on saxicolous bryophytes—27.07.2008, A. Flakus 10702, M. Kukwa 6574 & 6582 & P. Rodriguez (KRAM, LPB, UGDA, herb. Flakus).

Reference material examined—**BURUNDI.** Galerie forestière de la Siguvyaye un peu en aval du pont de la route Rumonge-Bururi. env. 1750 m. Dans le bas d'un gros tronc de Carapa—20.09.1974, J. Lambinon 74/1266 (**isotypi** of *Lepraria nigrocincta*, BG-L, herb. Diederich).

Lepraria zeorinica (L. Saag) Kukwa, **stat. et comb. nov.**

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Basionym: *Lepraria alpina* var. *zeorinica* L. Saag, in Saag et al., Mycotaxon 102: 68. 2007.

Morphology: The thallus is typical for members of the *Lepraria neglecta* group: thick, coarsely granular, with diffuse margin, dark grey with bluish tinge. It forms irregular patches on the substrate (Saag et al. 2007).

Chemistry: Atranorin (+), angardianic/roccellic acid (+) with additional unidentified fatty acid (observed only in solvent C), porphyrilic acid (+) and zeorin (+) (Diederich 15711) or atranorin (+), porphyrilic acid (+), zeorin (+) and 2 fatty acids (+): one chromatographically very similar to rangiformic acids in solvents A and C, but in lower position in solvent B, second one identical to angardianic/roccellic acid in solvent C, but with higher Rf values in solvent A and B (all other cited specimens). The variation of fatty acids appears to be higher than that presented by Saag et al. (2007) and needs further studies.

Ecology — The specimens from France were collected on schist rich in pyrite. It is also known on bryophytes and soil, and sometimes reported from thalli of other lichens (Saag et al. 2007).

Distribution — So far, *Lepraria zeorinica* has been known from Greenland only (Saag et al. 2007). Here it is reported for the first time in Europe from France.

Comments — The delimitation of the taxa in the *Lepraria neglecta* group, based actually exclusively on chemical characters, was always problematic. The presence or absence of secondary lichen substances in some cases was considered as species diagnostic and that rank was proposed e.g. for *L. neglecta*

(Nyl.) Erichsen or *L. borealis* Loht. & Tønsberg (Lohtander 1994), but in case of *L. caesioalba* (B. de Lesd.) J.R. Laundon the differences in depsidone constituents were treated as chemical variation within one species (Leuckert et al. 1995, Tønsberg 2004). However, recent molecular approaches proved that the secondary metabolites are valuable discriminators for those superficially indistinguishable species. It was shown that a single major substance (often with biochemically closely related metabolites), especially in case of fatty acids can be considered as diagnostic for evolutionary lineages, even when the morphology does not support a distinction between two species. This is the case e.g. in *L. borealis* and *L. granulata* Slav.-Bay., differing only in fatty acids, and the chemotypes of *L. caesioalba*, perhaps each of them deserving species status (Ekman & Tønsberg 2002, Slavíková-Bayerová & Fehrer 2007). A similar relation was also proven for the *L. jackii* group, where the secondary chemistry, and not the morphology, confirms the distinction of taxa (Fehrer et al. 2008).

Lepraria zeorinica was described as a variety of *L. alpina* (B. de Lesd.) Tretiach & Baruffo, a species with porphyrilic acid, and the only difference was the presence of zeorin in the former (Saag et al. 2007). Saag et al. (2007) discussed that the presence of one additional metabolite cannot be considered as a discriminating character at species level, but only at variety level. In our opinion, however, zeorin as a unique substance not related to any other known in *L. alpina*, should be treated as a feature distinguishing species, not varieties, especially because in the morphologically uniform *L. neglecta* group the chemistry bears a great diagnostic value. Therefore, a new combination and status for *L. alpina* var. *zeorinica* is proposed above. Zeorin is also a distinguishing character between, e.g., *L. incana* and *L. yunnaniana*, and *L. lobificans* and *L. multiacida*. However, in those cases the morphology confirms the distinction indicated by the chemistry (see above under *L. lobificans* and *L. yunnaniana*).

Lepraria zeorinica is morphologically indistinguishable from other members of the *L. neglecta* group: *L. alpina*, *L. borealis*, *L. caesioalba*, *L. granulata* and *L. neglecta*; however none of these produce zeorin and porphyrilic acid together (Saag et al. 2007, 2009).

Specimens examined—**FRANCE. Ardennes.** Distr. ardennais, Fumay, roadside S of the town, on the left side of Meuse river, 125 m, outcrop of black schist and quartzite belonging to the Revinian, rich in pyrite, water almost permanently oozing, on schist—01.05.1999, P. Diederich 15711 (herb. Diederich); ibidem—23.11.2008, D. Ertz, M. Kukwa 7306 & 7408 (BR, UGDA).

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