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The lichen genus *Lepraria* in Poland

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Abstract: The lichen genus *Lepraria* in Poland, comprising 17 species, is reviewed: for each taxon, remarks on the chemistry, distribution and habitat preferences are provided. Distribution maps are also presented, together with a key for determination of the Polish species. *Lepraria diffusa* var. *chrysodetoides* is reduced to a synonym of *L. diffusa* s. str., a new chemotype with a new substance is reported for *L. neglecta*, and rangiformic acid is reported for the first time for chemotype III of *L. caesioalba*. *Lepraria borealis* is reported for the first time from Africa (Canary Islands) and *L. nigrocincta* from Nepal.

Key words: lichen chemistry, lichen chemotype, *Lepraria*, *Lepraria diffusa*, Poland.

Introduction

The lichen genus *Lepraria* Ach. consists of constantly sterile species and was much neglected during lichenological investigations in the last century. However, during the last *c*. 15 years much attention has been paid to the taxonomy and chemistry of *Lepraria* (e.g. Laundon 1989, 1992; Tønsberg 1992, 2002; Lohtander 1994; Leuckert *et al.* 1995; Ekman & Tønsberg 2002; Kukwa 2002*a*; Elix & Tønsberg 2004) and the genus has been comprehensively treated in some regions (e.g. Laundon 1989, 1992; Tønsberg 1992; Lohtander 1994, 1995; Lindblom 1995). Nevertheless, there were, and still are, many countries where the knowledge about *Lepraria* is still insufficient. In 1998, only 9 species of *Lepraria* were known to occur in Poland: *L. caesioalba* (de Lesd.) J. R. Laundon, *L. crassissima* (Hue) Lettau, *L. incana* (L.) Ach., *L. jackii* Tønsberg, *L. lobificans* Nyl., *L. membranacea* (Dicks.) Vain., *L. neglecta* (Nyl.) Erichsen, *L. rigidula* (de Lesd.) Tønsberg and *L. vouauxii* (Hue) R. C. Harris (Nowak & Tobolewski 1975; Laundon 1989; Fałtynowicz 1993, 1997; Guzow 1997; Kümmerling *et al.* 1993*a*, *b*, 1995*a*, *b*). Furthermore, since determinations were based mainly on morphological features and spot test reactions, they were often unreliable. In such cases, *L. incana*, *L. membranacea* and *L. neglecta* were reported as the commonest taxa. Only a few reliable records, confirmed by thin layer chromatography, existed in the literature (e.g. Kümmerling *et al.* 1993*a*, *b*, 1995*a*, *b*; Fałtynowicz 1997). More taxa were thought to occur in Poland, and this was the reason for the doctorate programme undertaken by the author (Kukwa 2003*a*), some results of which are presented here. The aims of this paper are to present the general distribution of all *Lepraria* taxa in Poland, with notes on their taxonomy and chemistry, which are so important for their identification, together with a key to their identification.

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Materials and Methods

A total of 2821 specimens from Poland deposited in the following herbaria have been studied: GPN, KRA, KRAM, KRAP, KTC, LOD, OLTC, OPUN, SLTC, TRN, UGDA (author's collection included), WA, WRSL, hb. Grochowski and hb. Wieczorek. Some additional material, including types, from foreign collections (B, BG, E, GZU, LECB, hb. Diederich) were analysed for comparison. Specimens were studied anatomically and morphologically by microscopy. The

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chemical constituents were identified using thin layer chromatography (TLC) (following Orange *et al.* 2001) and two solvents, A and C, were used. Some of the higher aliphatic acids form 'fatty acid pairs', the members of which are not separable by TLC, for example roccellic acid vs. angardianic acid, and jackinic acid vs. rangiformic acid (see Leuckert *et al.* 1995). However, as pointed out by Leuckert *et al.* (1995), most of these are confined to a single species or group of species: jackinic acid occurs only in *Lepraria jackii*, and angardianic and rangiformic acids only in the *L. neglecta* group. Only roccellic acid is produced by several taxa (e.g. *L. cacuminum*, *L. jackii* or *L. membranacea*) (Leuckert *et al.* 1995). However, in some members of the *L. neglecta* group roccellic acid may be present with angardianic acid; in such cases it is reported as 'angardianic/roccellic acid' in the remarks on the chemistry. If only one of the 'fatty acid pairs' is known to occur, only one name is reported.

For each taxon, the number of specimens examined and remarks on distribution and habitat preferences are given. All localities of the taxa examined are mapped according to the ATPOL grid square system (Cieśliński & Fałtynowicz 1993), whereby Poland is divided on the basis of geographical coordinates into 100 × 100 km squares (symbols from Ag to Gg), each of which has been subdivided into 10 × 10 km units numbered from 00 to 99. Localities based on literature records only are not included on the maps. The list of all specimens examined and Polish bibliography on *Lepraria* will be published in forthcoming papers.

Results

A total of 17 species of *Lepraria* have been recorded from Poland. Two additional species, *Botryolepraria lesdainii* (Hue) Canals, Hern.-Mariné, Gómez-Bolea & Llimona (syn. *Lepraria lesdainii* (Hue) R. C. Harris) and *Lecanora rouxii* S. Ekman & Tønsberg (syn. *Lepraria flavescens* Cl. Roux & Tønsberg), formerly included in the genus *Lepraria*, were also found (Kukwa 2000, 2002*b*); however, since they do not belong to *Lepraria* s. str. (Ekman & Tønsberg 2002), they are not included in this study.

Lepraria borealis Lohtander & Tønsberg

in Lohtander, *Ann. Bot. Fennici* **31:** 224 (1994).

The species belongs to the *Lepraria neglecta* group and produces atranorin and the higher aliphatic acids, rangiformic (usually with norrangiformic acid) and angardianic/roccellic acids (Lohtander 1994). In Poland, the main fatty acids occur in three variants: (i) rangiformic acid only, (ii) both acids, and (iii) angardianic/roccellic acid only. The last chemical variant was mentioned by Lohtander (1994) as belonging to *L. cacuminum*; however, as reported by Prigodina *et al.* (2003), it should be placed in *L. borealis* rather than in *L. cacuminum* or *L. caesioalba*. Furthermore, according to Lohtander (1995; after Laundon 1992) there was a difference in the morphology between *L. borealis* and *L. cacuminum* (lobate *versus* diffuse thallus margins, respectively). However, since lobate specimens of *L. cacuminum* have been found in Poland, this morphological character can no longer be considered useful. In general, lobate and non-lobate thallus margins in the *L. neglecta* group seem to be environmentally modified: specimens from horizontal and rain exposed surfaces with strong insolation always have small lobes, whereas those growing on more shaded surfaces, slightly protected from direct rain and sloping habitats are non-lobate or have only obscurely developed lobes. Because of the typical granular thallus, there was no doubt that the specimens belong to the *L. neglecta* group.

In Poland the species is known only from mountainous regions in the south (Fig. 1A), where it occurs almost exclusively on rocks or saxicolous mosses.

During the revision of some material deposited in GZU, a specimen from the Canary Islands was found to belong to *L. borealis*; to the author's knowledge, it is the first record from Africa.

Number of specimens examined. 13.

Additional specimen examined. **Canary Islands:** *Tenerife*: Ayosa (Road from Cañadas to La Esperanza), 2200 m, 1984, *P. L. Nimis* (GZU).

Lepraria cacuminum (A. Massal.) Lohtander

Ann. Bot. Fennici **32:** 52 (1995)—*Diploicia cacuminum* A. Massal., *Symm. Lich. Nov.*: 52. (1855).—*Leproloma cacuminum* (A. Massal.) J. R. Laundon, *Lichenologist* **21:** 345 (1992).

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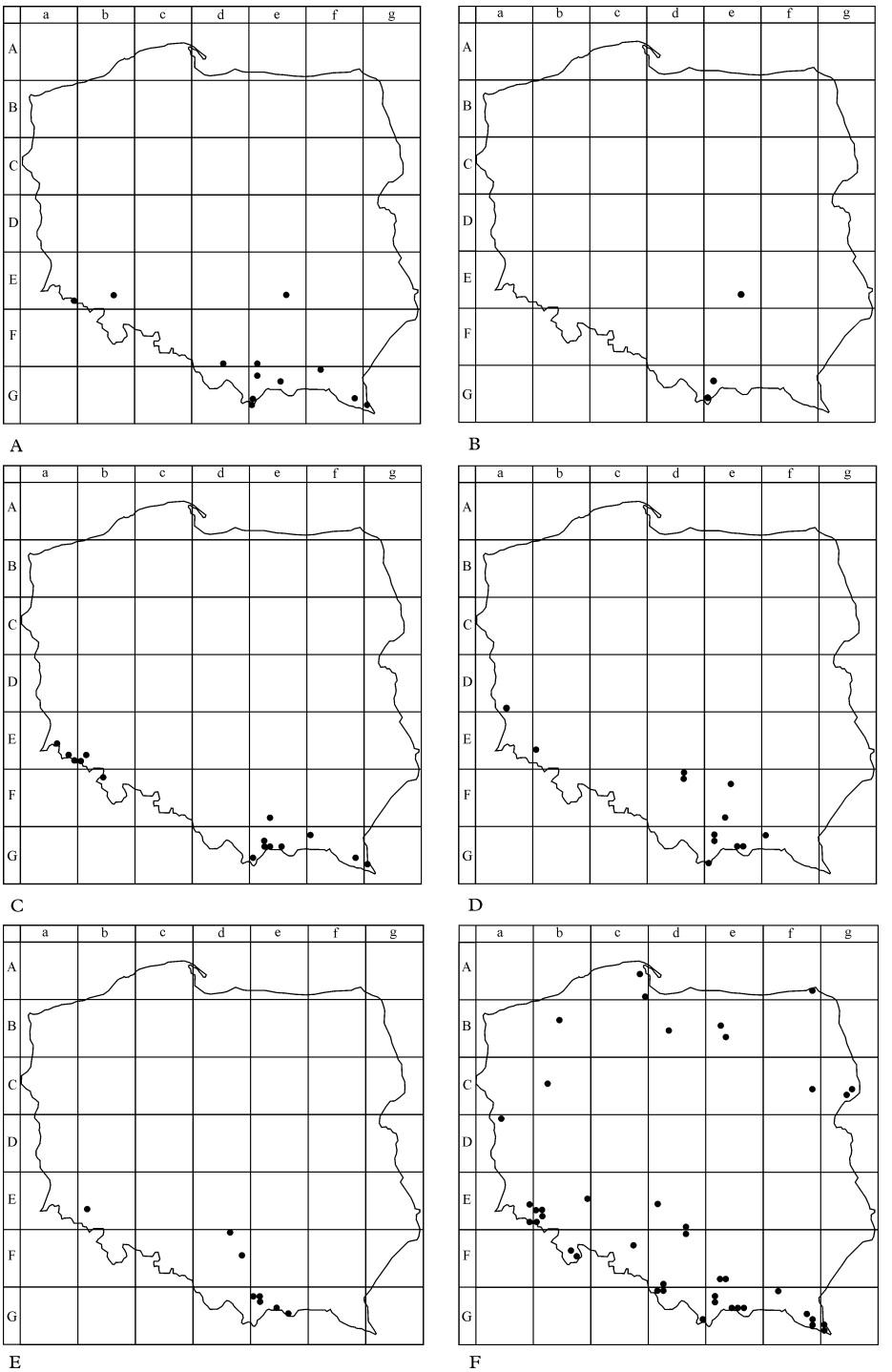


FIG. 1. Distribution of *Lepraria* species in Poland. A, *L. borealis*; B, *L. cacuminum*; C, *L. caesioalba*; D, *L. crassissima*; E, *L. diffusa*; F, *L. eburnea*.

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This member of the *Lepraria neglecta* group can produce atranorin, porphyrilic acid (usually with conporphyrilic acid) and the two higher aliphatic acids, rangiformic and angardianic/roccellic acid (Leuckert *et al.* 1995). In Poland, four specimens were found, two of which did not possess any fatty acid, whereas two contained angardianic/roccellic acid.

Lepraria cacuminum is a very rare montane species known only from a few localities in Poland (Fig. 1B), where it grows on saxicolous mosses or directly on rocks.

Number of specimens examined. 4.

Lepraria caesioalba (de Lesd.) J. R. Laundon

Lichenologist **24:** 324 (1992).—*Crocynia caesioalba* de Lesd., *Bull. Soc. Bot. France* **61:** 84 (1914).—*Leproloma caesioalba* (de Lesd.) M. Choisy, *Bull. mens. Soc. linn. Lyon II* **19:** 12 (1950).

This member of the *Lepraria neglecta* group produces atranorin (sometimes absent), higher aliphatic acids and depsidones. Three chemotypes have been distinguished (Leuckert *et al.* 1995), all of which were found in Poland. Chemotype I is the commonest one (22 specimens) and chemically very variable in terms of atranorin and fatty acids; chemotype II is known only from one specimen; and chemotype III is known from 8 specimens, in 7 of which rangiformic acid was found (accompanied once by angardianic/roccellic acid). Rangiformic acid is reported here for the first time from this chemotype.

According to molecular analyses by Ekman & Tønsberg (2002), *L. caesioalba* is not monophyletic and, as for the whole *L. neglecta* group, needs further study. However, as there is no nomenclatural segregation, the chemotypes are still placed in *L. caesioalba*.

Lepraria caesioalba is a montane species in Poland (Fig. 1C), which grows on rocks or on saxicolous mosses.

Number of specimens examined. 31.

Lepraria crassissima (Hue) Lettau

Rep. Sp. Nov. Regni Veg., Beih. **61:** 125 (1958).—*Crocynia crassissima* Hue, *Bull Soc. Bot. France* **71:** 393 (1924).

Lepraria crassissima produces zeorin, divaricatic acid and nordivaricatic acid in large amounts. The high concentration of the last substance together with a rather thick and stratified thallus, are the diagnostic features of the species (e.g. van den Boom *et al.* 1994). In some specimens zeorin was found only in traces or in considerably smaller concentrations than in others. Some authors (e.g. Leuckert *et al.* 1995) considered this species to be a synonym of *L. incana*, however the two taxa differ in their chemistry, morphology and DNA sequences (van den Boom *et al.* 1994; Ekman & Tønsberg 2002).

This species occurs only in southern Poland (Fig. 1D), mainly in upland and mountainous areas (with only one lowland locality). Its distribution seems to be related to natural rocky outcrops and it grows on various types of rocks or on saxicolous mosses, more rarely on soil. According to Leuckert *et al.* (2004), the species does not occur on limestone rocks; however, in Poland it was found on pure limestone, as well as on mosses on limestone.

Number of specimens examined. 17.

Lepraria diffusa (J. R. Laundon) Kukwa

Ann. Bot. Fennici **39:** 226 (2002).—*Leproloma diffusum* J. R. Laundon, *Lichenologist* **21:** 16 (1989).

Lepraria diffusa (J. R. Laundon) Kukwa var. *chrysodetoides* (J. R. Laundon) Kukwa, *Ann. Bot. Fennici* **39:** 226 (2002).—*Leproloma diffusum* J. R. Laundon var. *chrysodetoides* J. R. Laundon, *Lichenologist* **21:** 18 (1989).

Lepraria diffusa produces 4-oxypannaric acid 2-methylester in large amounts (with some related substances, mostly in traces), which is a diagnostic feature (e.g. Laundon 1989; Leuckert *et al.* 1995; Elix & Tønsberg 2004). Based on thallus colour, two varieties have been distinguished, namely var. *diffusa*

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and var. *chrysodetoides* (Laundon 1989). Laundon (1989) pointed out, that var. *chrysodetoides* contained an unidentified pigment in the thallus, but in his sections on chemistry he mentions only dibenzofurans to be present. Orange (1999) noted that it differed from the typical variety by the presence of a yellow, acetone-insoluble pigment. Tønsberg (2002) analysed one of the isotypes of *L. diffusa* var. *chrysodetoides* and did not find any pigments, but in some Norwegian specimens he found pigments, probably anthraquinones. When analysing specimens from Poland, dibenzofurans were demonstrated by TLC, but no additional pigments were found. However, it was found that the major substance, 4-oxypannaric acid 2-methylester, when in large amounts, had a brownish colour in daylight on plates before spraying with sulphuric acid. Similar pigmented spots of dibenzofurans on TLC plates, when in high concentration, were also found in *L. membranacea* and *L. vouauxii*. Thus, dibenzofurans, if highly concentrated, can determine the colour.

During the revision of Polish and a few foreign specimens of *L. diffusa* s. lat., some individuals intermediate between *L. diffusa* s. str. and *L. diffusa* var. *chrysodetoides* were found, which led one to believe that the two taxa might not be clearly separated. The types of *L. diffusa* var. *chrysodetoides* deposited in BM and GZU were also examined and found to have only the external soredia pigmented, the inner being greenish-grey. It would appear that this is due to the large amounts of 4-oxypannaric acid 2-methylester present, higher concentrations of which might be caused by more intensive insolation. Such a situation was also observed in *L. membranacea* and *L. vouauxii*: the sunnier the position, the greater the intensity of thallus colour observed. Additional examples can also be found among other lichens containing pigments, such as in *Lecanora expallens* Ach. and *Lecidella flavosorediata* (Vězda) Poelt & Leuckert (Tønsberg 1992 and personal observation). Since it would appear that both varieties are only extreme forms caused by the different intensities of insolation, it is proposed to subsume *L. diffusa* var. *chrysodetoides* within var. *diffusa*.

The distribution of *L. diffusa* in Poland is similar to that of *L. crassissima* occurring only in the southern part (Fig. 1E), where it is rather rare, but might be overlooked. It grows directly on calcareous rocks or over mosses, more rarely on soil.

Number of specimens examined. 11.

Lepraria eburnea J. R. Laundon

Lichenologist **24:** 331 (1992).

Lepraria frigida J. R. Laundon, *Lichenologist* **24:** 332 (1992).

The species has a powdery thallus and produces alectorialic and barbatolic acids and in two of three chemotypes also depsidones (Laundon 1992; Tønsberg 1992; Orange 1997). In Poland, only chemotypes I (with protocetraric acid) and III (no depsidones) have been found (e.g. Kukwa 2003*a*, 2004*a*).

Lepraria eburnea seems to be quite common in Poland (Fig. 1F), but is probably under-collected. It grows on a wide range of basic to moderately acidic substrata; however, chemotype I has wider habitat amplitude than chemotype III, which grows directly on limestone or calcicolous mosses. Due to its habitat preferences, chemotype III is restricted to calcareous rocky outcrops in southern Poland.

Number of specimens examined. 77.

Lepraria elobata Tønsberg

Sommerfeltia **14:** 197 (1992).

Lepraria elobata has a powdery thallus and produces atranorin, zeorin and the stictic acid complex (Tønsberg 1992). It was considered to be a synonym of *L. lobificans* (Leuckert *et al.* 1995), but that species has a different thallus morphology (Tønsberg 1992; see also key). Its molecular distinctiveness has been recently proved by Ekman & Tønsberg (2002).

Lepraria elobata is rather common in Poland (Fig. 2A). It prefers tree bark, but

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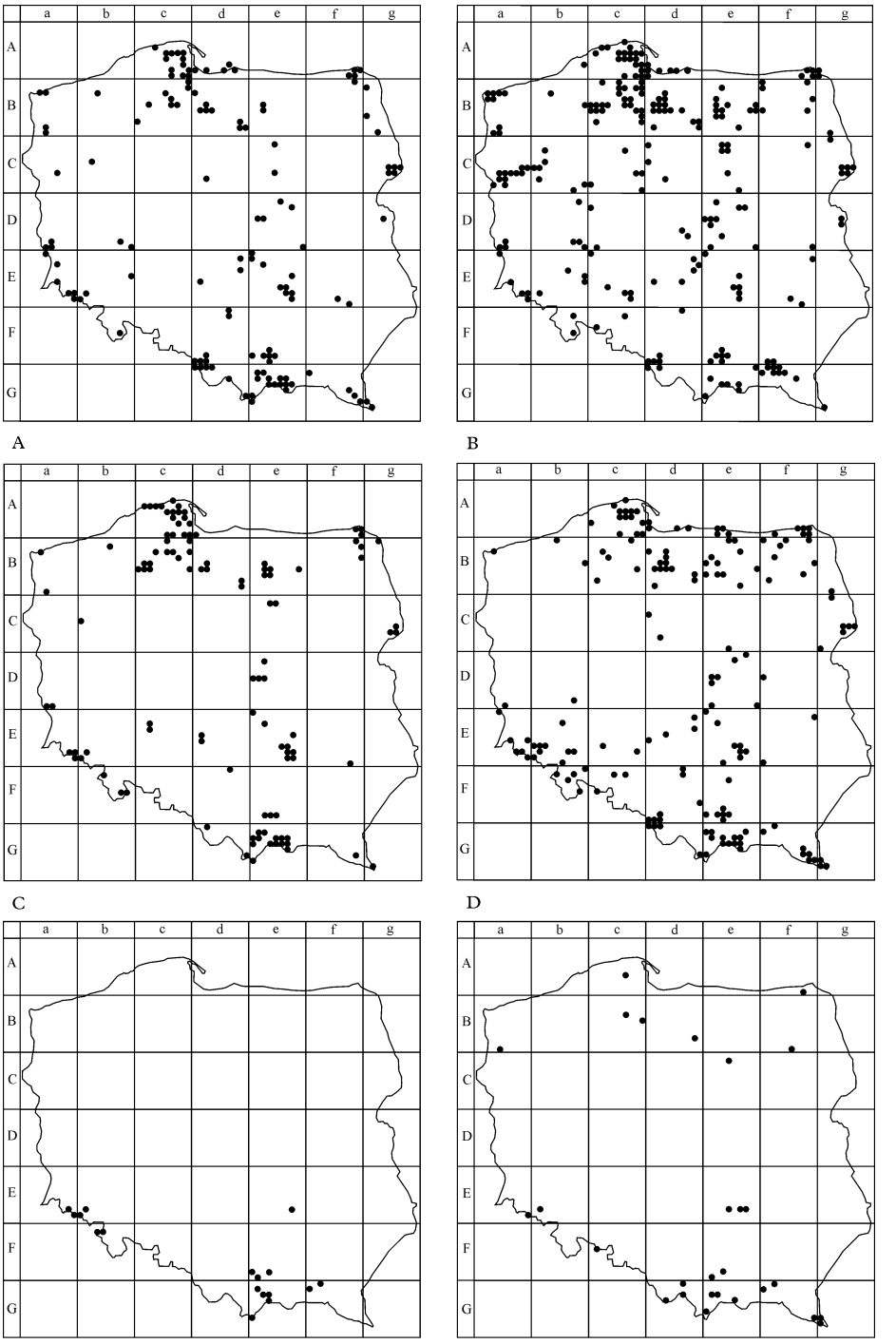


FIG. 2. Distribution of *Lepraria* species in Poland. A, *L. elobata*; B, *L. incana*; C, *L. jackii*; D, *L. lobificans*; E, *L. membranacea*; F, *L. neglecta* (chemotype I, with alectorialic acid).

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occasionally occurs on soil, wood and rocks (but never calcareous). Its distribution is related to the presence of forests and parks.

Number of specimens examined. 398.

Lepraria incana (L.) Ach.

Method. Lich.: 4 (1803).—*Byssus incana* L., *Spec. Plant.* **2:** 1169 (1753).

Lepraria incana produces divaricatic acid with traces of nordivaricatic acid and zeorin (Laundon 1992; Tønsberg 1992). Rarely atranorin has been found, probably as a contaminant. It is chemically similar to *L. crassissima*, but differs in the concentration of nordivaricatic acid and thallus morphology (van den Boom *et al.* 1994; see also key).

It is the commonest member of the genus in Poland (Fig. 2B). It also has the widest habitat amplitude, growing in open situations as well in deeply shaded forest on a wide range of substrata (not only calcareous); it also occurs in cities, being toxitolerant to pollution. A list of all known localities in Poland is published in Kukwa (2004*b*).

The species has been reported from Nepal and New Zealand (see Kümmerling *et al.* 1991); however, a revision of specimens deposited in GZU proved that the records belonged to other taxa. The collection from Nepal has a characteristically blackish hypothallus, does not possess zeorin, and belongs to *L. nigrocincta* Diederich, Sérus. & Aptroot (Aptroot *et al.* 1997). An additional specimen of the species was located among undetermined material of leprarioid taxa. A specimen from New Zealand (*H. Mayrhofer* 1930, GZU) does not belong to any known species. Morphologically it is similar to *L. crassissima*, but it lacks zeorin and contains only traces of nordivaricatic acid. A similar specimen was collected on limestone in Poland (*M. Kukwa* 2805, UGDA). Both specimens require further investigation.

Number of specimens examined. 846.

Specimens of Lepraria nigrocincta *examined.* **Nepal:** *Khumbakarna-Himal*: Dhankuta Distr., Janglee Alm, 3700 m alt., 1972, *T. Wraber* (GZU, mixed with *L. nivalis*); ibid., Janglee Alm im Barun Tal, 3670 m alt., 1972, *T. Wraber* (GZU).

Lepraria jackii Tønsberg

Sommerfeltia **14:** 200 (1992).

Lepraria jackii has a powdery thallus and produces atranorin, jackinic and/or roccellic acids, commonly accompanied by traces of norjackinic acid (Tønsberg 1992; Lohtander 1994; in both papers as rangiformic and norrangiformic acids, see Leuckert *et al.* 1995). In Poland, both fatty acids are usually present; however, rarely only jackinic acid and very rarely only roccellic acid were detected, and norjackinic acid was found only occasionally.

Lepraria jackii is common in Poland (Fig. 2C), especially in pine or spruce forests in both lowland and mountainous areas. It grows only in forest conditions, mainly in sunlit places, and prefers acidic substrata, mostly bark of coniferous trees and birch; it also occurs on wood, soil and rocks.

Number of specimens examined. 423.

Lepraria lobificans Nyl.

Flora **56:** 196 (1873).—*Leproloma lobificans* (Nyl.) Boistel, *Nouv. Flore Lich.* **2:** 318 (1902).

Lepraria lobificans has a thick stratified thallus containing atranorin, zeorin and stictic acid complex (Tønsberg 1992; Leuckert *et al.* 1995).

The species is widely distributed and common in Poland (Fig. 2D) and prefers shaded and humid stands. Most commonly it grows on tree bark in forest condition, but has also been found on rocks, soil and wood, usually on mosses overgrowing these substrata.

Number of specimens examined. 513.

Lepraria membranacea (Dicks.) Vain.

Acta Soc. Fauna Flora fenn. **49:** 265 (1921).—*Lichen membranaceus* Dicks. *Fasc. Pl. Crypt. Brit.* **2:** 21, tab. VI fig. 1 (1790).—*Leproloma membranaceum* (Dicks.) Vain., *Természetr. Füz.* **22:** 293 (1899).

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Lepraria membranacea has a widely lobate thallus and produces pannaric and roccellic acids, rarely accompanied by atranorin (Laundon 1992; Tønsberg 1992; Leuckert *et al.* 1995). Laundon (1992) reported zeorin, but it has never been reported since (e.g. Tønsberg 1992; Leuckert *et al.* 1995). In some Polish specimens, a brownish pigmented substance was noted at the TLC starting point, which may have been pannaric acid or a new substance.

The species was reported in the past as a very common lichen throughout Poland, but after the revision of existing material it has become clear that it is only a montane taxon (Fig. 2E). The specimens from lowland localities belong to *L. lobificans* and *L. vouauxii* (see also Kukwa 2002*b*). In Poland *L. membranacea* grows predominantly on rocks, very rarely on birch bark.

Number of specimens examined. 40.

Lepraria neglecta (Nyl.) Erichsen

In Lettau, *Feddes Repert.* **61:** 127 (1958).—*Lecidea neglecta* Nyl., *Not. Sällsk. Fauna Fl. fenn. Förh.* **4:** 233 (1859).

This species belongs to the *Lepraria neglecta* group and produces alectorialic (with traces of satellite compounds) and angardianic acids as common substances (Kümmerling *et al.* 1993*b*), and more rarely rangiformic acid and atranorin (probably as a contaminant) are present (Kümmerling *et al.* 1993*b*; Leuckert *et al.* 1995). In Polish material fatty acids were commonly absent, as is the case for specimens from Finland (Lohtander 1994).

When analysing material of the *L. neglecta* group, one old specimen was found to contain an unknown substance which was chromatographically very similar in colour in day light and UV-light to alectorialic acid. Those two metabolites differed only in Rf classes (alectorialic acid: A 3–4 (4), C 4–5, the unknown substance: A 3, C 2; Fig. 3). The specimen was checked several times by TLC to avoid misidentification and not even a trace of alectorialic acid was found. There

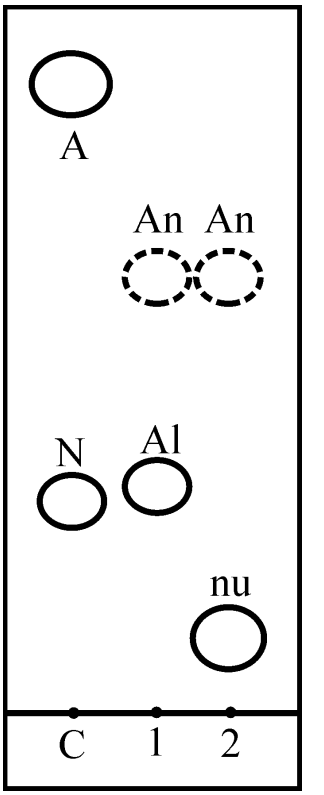


FIG. 3. Chromatogram in solvent C showing chemotypes of *Lepraria neglecta*. C, control of *Cladonia symphycarpa*; 1, chemotype I with alectorialic acid; 2, chemotype II with 'neglecta unknown'. Abbreviations of compounds: A=atranorin; Al=alectorialic acid; An=angardianic/roccellic acid; N=norstictic acid; nu='neglecta unknown'.

was a note in the herbarium packet that the thallus had reacted pinkish with KC; however, this reaction could not be confirmed. As the morphology and some chemical properties of the thallus (lack of atranorin and the presence of angardianic/roccellic acid) of this specimen agrees with *L. neglecta*, it is proposed to place it in *L. neglecta* as a new, second chemotype and to name the diagnostic substance 'neglecta unknown' following the procedure after Tønsberg (1992).

Chemotype II of *L. neglecta*, collected only once in the last century in the Świętokrzyskie Mts. (Fig. 4A), has not been found again, despite several specimens of *L. neglecta* being

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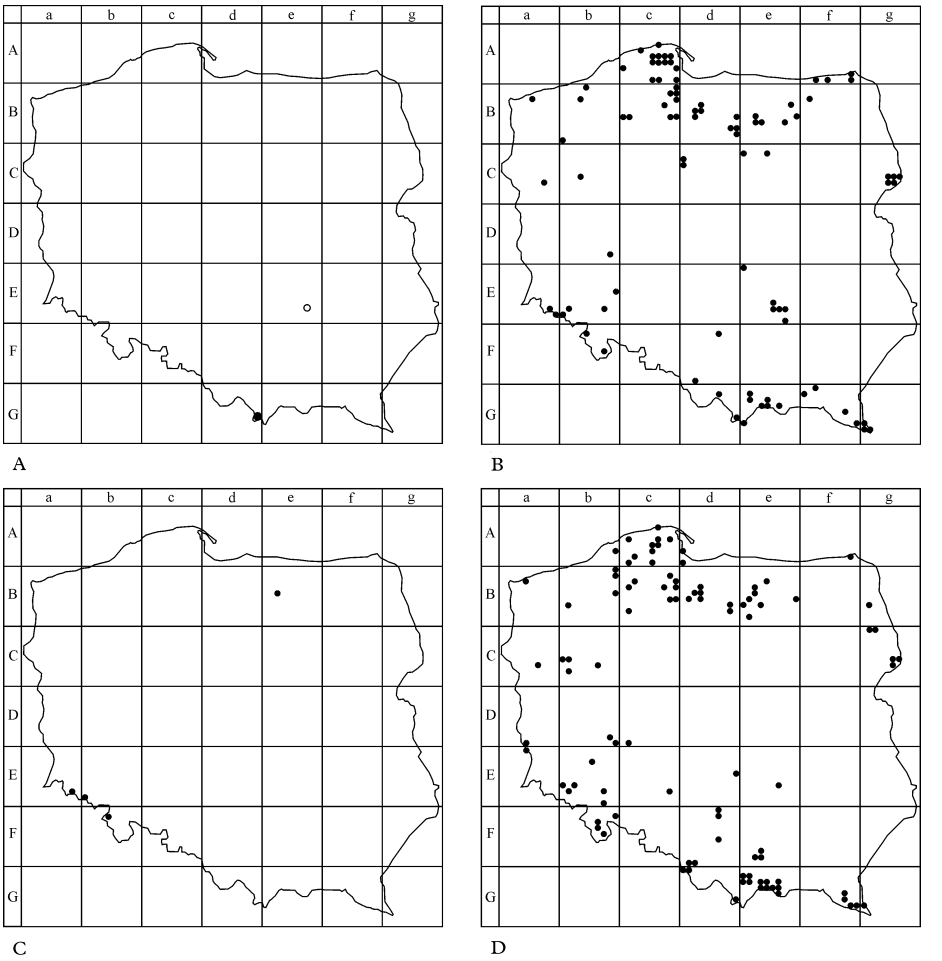


FIG. 4. Distribution of *Lepraria* species in Poland. A, *L. neglecta* (chemotype II, with 'neglecta unknown'; circle) and *L. nivalis* (black dot); B, *L. rigidula*; C, *L. umbricola*; D, *L. vouauxii*.

collected from the same locality or from the neighbouring area.

Lepraria neglecta has been reported many times from Poland. However, after the revision it appeared to be a montane species, with scattered localities in the lowlands in the area of the last glaciation (Figs 2F & 4A) with a distribution similar to that of some vascular plants (Zając 1996). It prefers open habitats and grows predominantly on non-calcareous rocks, very rarely on a thin layer of soil or tree bark.

Specimen of chemotype II of Lepraria neglecta examined. **Poland:** *Świętokrzyskie Mts.*: Łysa Góra Mt, boulder field, 1957, *B. Halicz & S. Kuziel* (KTC).

Number of specimens examined. 68.

Lepraria nivalis J. R. Laundon

Lichenologist **24:** 327 (1992).

Six chemotypes have been distinguished within *Lepraria nivalis* (Leuckert *et al.* 1995, 2004), but in Poland only chemotype I has been recorded (Czarnota & Kukwa 2004; Kukwa 2004*a*). The species is very rare in Poland (Fig. 4A), being known from only three collections from pure limestone.

Number of specimens examined. 3.

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Lepraria rigidula (de Lesd.) Tønsberg

Sommerfeltia 14: 205 (1992).—*Crocynia rigidula* de Lesd., in Hue, *Bull. Soc. Bot. France* **71:** 331 (1924).

Lepraria rigidula is highly characteristic owing to its chemistry (nephrosteranic acid and atranorin) and morphology (rather whitish thallus and at least some soredia and consoredia with long projecting hyphae) (Tønsberg 1992; Leuckert *et al.* 1995). However, sometimes specimens from very open localities do not have clearly visible projecting hyphae under the dissecting microscope, but they were demonstrated in squash preparation as a net of hyphae rolled around a soredium. This phenomenon is probably caused by strong wind.

Sometimes the basionym is cited as '*Crocynia rigidula* de Lesd. ex Hue' (e.g. Leuckert *et al.* 1995). However 'de Lesd. in Hue' seems more appropriate as it was used by Tønsberg (1992) and discussed by Harris (1985) for the similar case of *C. finkii* de Lesd., the basionym for *Lepraria finkii* (de Lesd.) R. C. Harris.

The species is probably common in Poland (Fig. 4B), but at present it is under-collected. It usually grows on rather nutrient-rich and medium acidic to basic tree bark, rarely on rocky substrata, soil and wood, and more rarely on thalli of other lichens. It prefers open stands, especially free-standing trees, being rare within forests.

Number of specimens examined. 180.

Lepraria toensbergiana Bayerová & Kukwa

in Bayerová *et al.*, *Bryologist* **108:** 132 (2005).

Lepraria toensbergiana, recently recognized as new to science (Bayerová *et al.* 2005), is morphologically very similar to *L. jackii*, but differs in the presence of toensbergianic acid.

It is a montane species, preferring acid substrata. Details of its distribution and habitat preferences, together with a list of all specimens examined are provided in Bayerová *et al.* (2005).

Number of specimens examined. 21.

Lepraria umbricola Tønsberg

Sommerfeltia **14:** 206 (1992).

Lepraria umbricola has a more or less green thallus containing thamnolic acid (Tønsberg 1992; Leuckert *et al.* 1995); atranorin and roccellic acid have also been reported for that species (Leuckert *et al.* 1995), but they have not been found in Polish specimens.

Jørgensen (1996) tentatively considered *L. umbricola* to be an oceanic species, but since it has been discovered in Estonia (Saag & Saag 1999), Poland (Kukwa 2003*b*) and Slovakia (Kukwa 2001) it cannot be considered as such. It appears to be rare, but widely distributed.

In Poland it is a very rare species, known only from four localities. It prefers acidic substrata of conifer bark and soil. Since its occurrence in Poland was only briefly mentioned (e.g. Kukwa 2003*b*), supplementary details are provided herewith.

Specimens examined. **Poland:** *Karkonosze Mts.*: Szklarki Waterfall, 2000, *M. Kossowska* (WRSL); Sowia Dolina valley, 2000, *M. Kossowska* (WRSL); *Stołowe Mts.*: 'Wielki Szczeliniec' nature reserve, vicinity of Karłów, 2000, *K. Jando* (UGDA); *Olsztyn Lakeland*: Olsztyn, Las Miejski, 2000, *D. Kubiak* (OLTC, UGDA).

Number of specimens examined. 4.

Lepraria vouauxii (Hue) R. C. Harris

Bryologist **90:** 163 (1987).—*Crocynia vouauxii* Hue, *Bull. Soc. Bot. France* **71:** 392 (1924).—*Leproloma vouauxii* (Hue) J. R. Laundon, *Lichenologist* **21:** 13 (1989).

Lepraria vouauxii produces pannaric acid 6-methylester as a main diagnostic substance, which is accompanied by traces of additional related dibenzofurans (Leuckert *et al.* 1995) and 'vouauxii unknown 1' (Tønsberg 1992; Elix & Tønsberg 2004). Some additional metabolites (e.g. roccellic acid) were also reported by Laundon (1989) and Leuckert *et al.* (1995), but they have not been found in Polish material.

The species is rather common in Poland, but probably still under-collected. It prefers

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medium acidic to basic and nutrient-rich substrata. It is mostly found on tree bark, but collections from rocks are also frequent; very rarely it has been collected from soil and the thallus of *Pyrenula nitida*. It grows usually in open areas, rarely occurring under forest conditions.

Number of specimens examined. 172.

Key to *Lepraria* species occurring in Poland

1 Thallus granular, soredia coarse, in habitats exposed to direct rain (the *Lepraria neglecta* group) 2
Thallus powdery, sometimes weft-like, in habitats protected from direct rain . 5

2(1) Alectorialic acid (chemotype I, thallus KC+ red) or 'neglecta unknown' (chemotype II, KC −?) and ± angardianic acid present . . . . . **L. neglecta**
Alectorialic acid or 'neglecta unknown' absent, thallus never KC+ red 3

3(2) Depsidones: fumarprotocetraric acid with traces of protocetraric acid (chemotype I), stictic acid complex (chemotype II) or psoromic acid (chemotype III), ± rangiformic acid, ± angardianic/roccellic acid and commonly atranorin present, thallus Pd+ red, red-orange or lemon-yellow . . . . **L. caesioalba**
Depsidones absent, thallus not reacting with Pd or reaction different 4

4(3) Porphyrilic acid, atranorin and ± fatty acids present . . . . . **L. cacuminum**
Porphyrilic acid absent, atranorin and fatty acids present . . . . . **L. borealis**

5(1) Divaricatic acid present, thallus UV+ white 6
Divaricatic acid absent, thallus UV − 7

6(5) Soredia C −, nordivaricatic acid only in traces, thallus with or without rather thin white medulla, mainly on acidic substrata . . . . . **L. incana**
Soredia C+ red, nordivaricatic acid present in large amounts, thallus well delimited, usually minutely lobed, mature thalli with thick white medulla, mainly on calcareous or basic substrata . . . . . **L. crassissima**

7(5) Dibenzofurans present 8
Dibenzofurans absent 10

8(7) Pannaric (major) and roccellic acid present, sometimes with atranorin, thallus with wide lobes, usually protruding from substratum . . . . . **L. membranacea**
4-oxypannaric acid 2-methylester or pannaric acid 6-methylester present as major dibenzofurans, ± other related substances and ± pannaric acid in traces . . 9

9(8) 4-oxypannaric acid 2-methylester as a major dibenzofuran present . **L. diffusa**
Pannaric acid 6-methylester present as major dibenzofuran . . . . **L. vouauxii**

10(7) Alectorialic and barbatolic acids present, protocetraric acid present (chemotype I) or absent (chemotype III), thallus KC+ red . . . . . **L. eburnea**
Alectorialic and barbatolic acids absent, thallus KC not red 11

11(10) Protocetraric acid present . . . . . **L. nivalis**, chemotype I
Protocetraric acid absent 12

12(11) Thamnolic acid present . . . . . **L. umbricola**
Thamnolic acid absent 13

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13(12) Stictic acid present 14
Fatty acids present 15

14(13) Thallus thick, stratified, with well developed hypothallus, in many cases weft-like, delimited, usually minutely lobed, soredia (consoredia) hairy, without well developed wall and with long projecting hyphae (sometimes adhering to the soredium, but still clearly visible in squash preparations), fresh thallus in shades of green . . . . . **L. lobificans**
Thallus usually thin, unstratified, without well developed hypothallus, not delimited, non-lobate, in older specimens thallus thick, sometimes with layer of bleached soredia, soredia (consoredia) with well developed wall, without projecting hyphae, thallus in shades of grey . . . . . **L. elobata**

15(13) Nephrosteranic acid present, thallus whitish, at least part of soredia with long projecting hyphae . . . . . **L. rigidula**
Nephrosteranic acid absent, soredia without long projecting hyphae 16

16(15) Jackinic, ± norjackinic (in traces) and ± roccellic acids present (very rarely only roccellic acid present), widely distributed in Poland . . . . . **L. jackii**
Toensbergianic acid present, found only in mountains . . . **L. toensbergiana**

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