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THE SOREDIATE *PUNCTELIA* SPECIES WITH LECANORIC ACID IN EUROPE

Kok van HERK* and André APTROOT‡

Abstract: A revision is presented of the sorediate, lecanoric acid-containing *Punctelia* species occurring in Europe. Two species are common in western and central Europe, viz. *Punctelia subrudecta* s. str. and *Punctelia ulophylla* comb. nov. They differ in several morphological characters, most notably in the colour and pruinosity of the margin. Both species occur sympatrically, often together on one tree. A third species, *Punctelia perreticulata*, is known in Europe only from the Mediterranean.

History

Species of the genus *Punctelia* have recently received considerable attention. Until the 1950s, only one sorediate, grey, lecanoric acid-containing member of this genus (at that time called the *Parmelia dubia*-group) was recognized, viz. *Parmelia dubia* (Wulfen) Schaer.

Asahina (1951) described *Parmelia pseudoborreri* Asah., characterized by the presence of gyrophoric acid, another medullary substance reacting C positive. Culberson (1962) subsequently adopted the older name *Parmelia borreri* (Sm.) Turner for *Parmelia dubia*, not realizing that *Parmelia borreri* has a different chemistry and morphology.

Hale (1965), in his revision of what was then called the *Parmelia borreri*-group, recognized that the type of *Parmelia borreri* contains gyrophoric acid, and therefore had to be applied to what was at the time called *Parmelia pseudoborreri*. He realized that the combination *Parmelia dubia* (Wulfen) Schaer. (dating from 1840), based on *Lichen dubius* Wulfen (in Jacquin, dating from 1790, non Smith, dating from 1814), could not be used for a *Parmelia*, as it was antedated by the combination *Parmelia dubia* (Ach.) Roehl. (dating from 1813), based on *Parmelia caesia* var. *dubia* Ach. (dating from 1803), which is a *Physcia* species. Therefore he introduced the oldest name he regarded as being synonymous, viz. *Parmelia subrudecta* Nyl., for the common lecanoric acid-containing sorediate *Punctelia*. In addition, he recognized two rare species in this group: *Parmelia helenae* B. de Lesd. and *Parmelia perreticulata* (Räsänen) Hale.

The genus *Punctelia* was introduced by Krog (1982) to accommodate all *Parmelia* species with round pseudocyphellae. She synonymized both *Parmelia*

*Lichenologisch Onderzoekbureau Nederland, Goudvink 47, NL–3766 WK Soest, The Netherlands.
‡Centraalbureau voor Schimmelcultures, P.O. Box 273, NL–3740 AG Baarn, The Netherlands.

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helenae and *Parmelia perreticulata* with *Punctelia subrudecta* (Nyl.) Krog, and thus recognized only one sorediate, lecanoric acid-containing *Punctelia* with atranorin in the upper cortex.

Wilhelm & Ladd (1987) resurrected *Punctelia perreticulata* (Räsänen) G. Wilh. & Ladd, based on numerous collections from America, and provided the necessary combination in *Punctelia*. Later these authors (Wilhelm & Ladd 1992) described an additional American species in the group, viz. *Punctelia missouriensis* G. Wilh. & Ladd.

More recently Adler & Ahti (1996) accepted the resurrection of *Punctelia perreticulata*, but amended the description and expanded its known distribution.

Materials and Methods

The present study is based primarily on field observations by the authors in Belgium, France, Germany, Luxembourg, the Netherlands and Switzerland. In addition, material was studied from the following herbaria: ABL, B, BP, H, IMI, L, hb. Seaward, hb. Van Herk and hb. Sparrius. Thin-layer chromatography (TLC) was applied using the standard technique of White & James (1985). Specimens tested chemically are marked '(TLC)'.

Taxonomy

While investigating the increase of *Punctelia borreri* (Sm.) Krog in the Netherlands (Spier & van Herk 1997), it was perceived that two other distinct, sorediate species of *Punctelia* were present in several western European countries, often found growing side by side on the same tree but without any intermediates. Both taxa appeared to contain lecanoric acid and both key out to *Punctelia subrudecta* in all recent floras. The two species retain their integrity even when they grow in close contact (Fig. 1). They can be distinguished, even from a distance, by their different thallus colours, which are most obviously seen under wet conditions. This is correlated with a number of other characters, especially with the colour and the pruinosity of the extreme lobe margins. The first taxon has mineral grey thalli with non-pruinose, glossy, dark brown lobe margins, whereas the latter has greenish grey thalli with dull brownish, pruinose lobe margins. The non-pruinose species is often covered by secondary lobes in the central part of the thallus, especially when growing on exposed trees. These lobes are indistinguishable from the marginal lobes. Lobate specimens of the second taxon show a marked difference between the marginal and the central lobes, the latter being much smaller and sorediate along the margin.

Nomenclature

After recognizing that two closely related, sorediate, lecanoric acid-containing species of *Punctelia* are widely distributed over western and central Europe, it became desirable to link these taxa to existing names. Although this group has recently received much attention (e.g. Adler & Ahti 1996; Wilhelm & Ladd 1987, 1992), it still proved necessary to examine the relevant type material, as

the characters that separate these taxa are not consistently mentioned or depicted in the respective publications.

As already mentioned, the type of the oldest available epithet (*dubius* Wulfen) was not available, and this name cannot be used for any of the recognized taxa, although it can still serve as an informal name for the whole group.

The type material of *Punctelia subrudecta*, which originated from St. Paul Island in the Indian Ocean, proved to be identical to one of the common European taxa, viz. the one with non-pruinose lobes. On the other hand, the type material of *Parmelia caperata* var. *ulophylla* Ach. was identical with the pruinose taxon in Europe. Therefore a new combination in *Punctelia* is proposed below.

One other sorediate, lecanoric acid-containing European *Punctelia* is currently recognized, namely *Punctelia perreticulata*, a species that is reported to differ from *Punctelia subrudecta* by narrower lobes and a foveate surface (Wilhelm & Ladd 1992) or only by longer conidia (Adler & Ahti 1996). Examination of the isoepitype in B (and several additional collections) shows that *P. perreticulata* differs not only in its longer conidia, but also in other morphological characters, for example, the usually rugulose, occasionally scrobiculate thallus surface and the well-developed, numerous marginal soralia.

The type material of *Parmelia maculato-sorediosa* (Gyeln.) Gyeln. and *Punctelia helenae* (B. de Lesd.) Hale ex DePriest & B. Hale proved to be identical with *Punctelia subrudecta*.

Examination of an isotype of *Punctelia missouriensis* in IMI showed that this is not a closely related species, as it has much broader lobes, and it might even be the sorediate counterpart of *Punctelia rudecta* (Ach.) Krog, a species distinguished by the presence of isidia.

Description of the species

Punctelia subrudecta (Nyl.) Krog

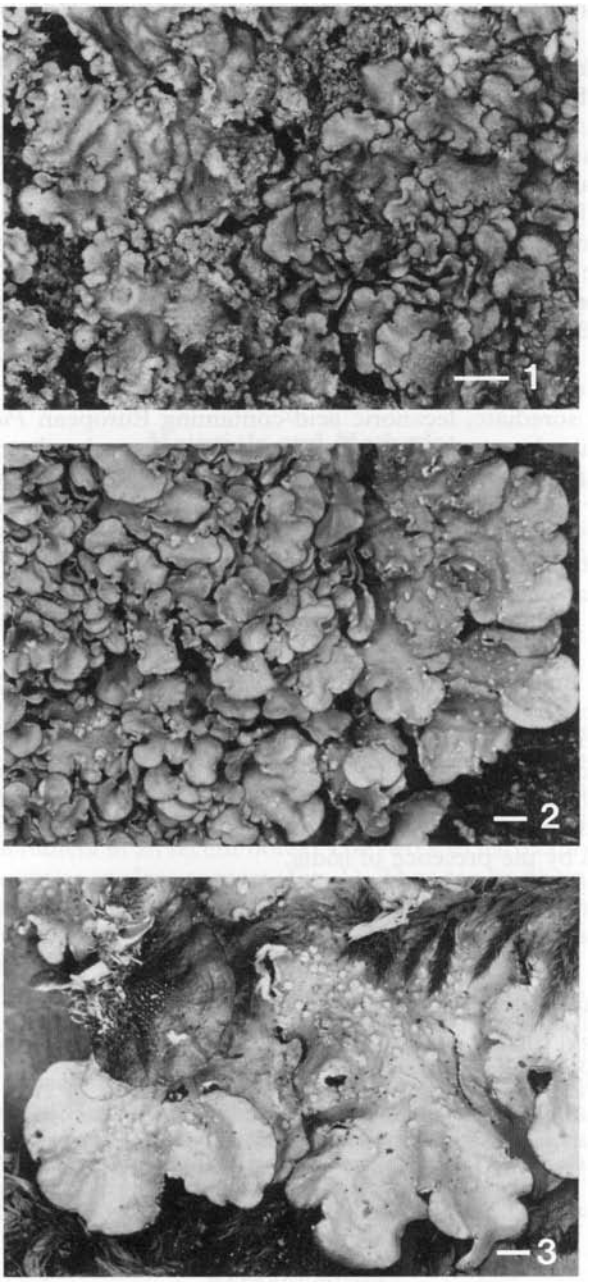
Nord. J. Bot. **2:** 291 (1982).—*Parmelia subrudecta* Nyl., *Flora* **69:** 320 (1886); type: St. Paul Island, *Fenzl* (H-NYL 35033—lectotype, selected by Hale, 1965).

Parmelia maculato-sorediosa (Gyeln.) Gyeln., *Revue bryol. lichénol.* **7:** 219 (1935).—*Parmelia dubia* var. *maculato-sorediosa* Gyeln., *Annls mycol.* **30:** 442 (1932); type: Austria [formerly Hungary], Jormannsdorf ['Gyrmótfalva'], on *Carpinus*, July 1916, *F. Fóriss* 4237 (BP—holotype).

Punctelia helenae (B. de Lesd.) Hale ex DePriest & B. Hale, *Mycotaxon* **67:** 205 (1998).—*Parmelia helenae* B. de Lesd., *Bull. Soc. bot. Fr.* **84:** 283 (1937); type: Italy, Liguria, Spotorno, saxicolous, August 1935, *C. Sbarbaro* (H—isolectotype, selected by Hale, 1965).

(Figs 1–6)

Thallus mostly corticolous, occasionally saxicolous, closely attached, 3–5 cm diam., but sometimes up to 10 cm diam., foliose. Habit extremely variable, usually rosette-like (at sheltered stations), but sometimes (at exposed stations) completely dissolved into secondary lobes (Fig. 2), which are indistinguishable from the marginal lobes. *Lobes* flat to concave, apically smooth and rounded,



FIGS 1–3. Habitus of *Punctelia subrudecta* and *P. ulophylla*. FIG. 1. *Punctelia ulophylla* (left) and *P. subrudecta* (right) growing in close contact on wayside *Quercus* (the Netherlands, Lunteren, *Aptroot 42500*). FIGS 2–3. *Punctelia subrudecta* showing the dark brown non-pruinose margin. FIG. 2. Densely lobate morphotype from exposed wayside *Ulmus* with huge variation in lobe width (the Netherlands, Zaltbommel, *van Herk s.n.*). FIG. 3. Rosette-like morphotype from *Salix* in wet willow wood (the Netherlands, Biesbosch, *van Herk s.n.*); note the rather dark brown lower surface. Scale = 1 mm.

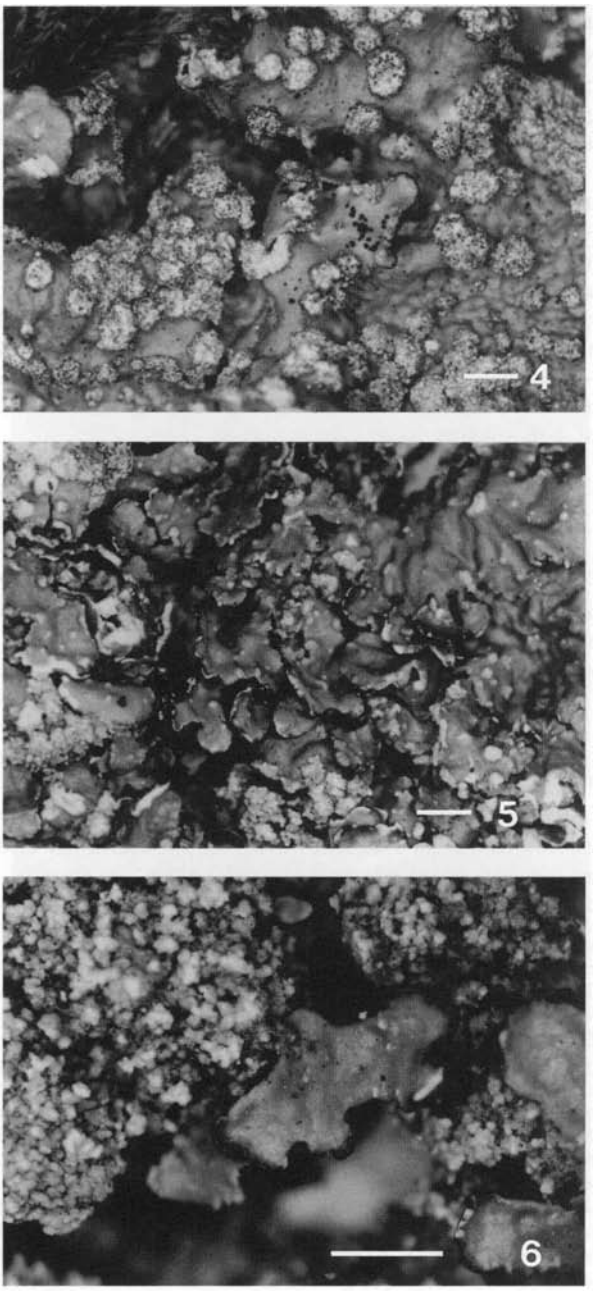
c. 0·5–3·0 mm wide, margins often seemingly downcurved. *Upper surface* medium to dark mineral grey, smooth, usually shiny, bordered by a narrow, occasionally wider, dark brown shiny margin without pruina (Figs 2–3). *Lower surface* creamish white to brown, occasionally dark brown. *Soralia* primarily laminal (Fig. 4), sometimes sparse and small (lobate morphotypes) to numerous and large (rosette-like morphotypes), arising from laminal pseudocyphellae, 0·1–1·2 mm diam., whitish to greyish. Marginal soralia often also present, mainly at the incision of secondary lobes. *Soredia* farinose to very coarse, *c.* 30–100 µm diam., usually granular. *Apothecia* rare, cupulate, brown, up to 5 mm diam; epihymenium pale yellowish, of conglutinated paraphyses with lumina up to 3 µm wide; hymenium 80–120 µm high, clear; hypothecium hyaline; excipulum cupular, densely filled with algae, also underneath the hypothecium; ascus walls 1–2 µm thick. *Ascospores* 8 per ascus, hyaline, ellipsoid, 15–18 × 8–11 µm, wall *c.* 1 µm thick. *Pycnidia* common, immersed to usually exserted, black, *c.* 0·1–0·2 mm diam. (Fig. 4). *Conidia* unciform to short-filiform, 4–6 × 1 µm.

Chemistry. Cortex C −, PD −, K+yellow, KC −, UV −; medulla C+red, PD −, K −, KC+red, UV −; lecanoric acid and atranorin detected by TLC.

Ecology. This species is mostly corticolous, on a wide variety of trees, including *Acer*, *Aesculus*, *Fagus*, *Fraxinus*, *Juglans*, *Platanus*, *Populus*, *Quercus*, *Salix*, *Sambucus*, *Tilia* and *Ulmus*. It was occasionally found to be saxicolous (so far in the type locality and in Great Britain, France, Luxembourg and Italy).

Distribution. Probably cosmopolitan, but insufficiently known due to confusion with *Punctelia perreticulata*. The species is so far known from western and central Europe, and we have seen material ourselves in the field in Belgium, France, Germany, Luxembourg, the Netherlands and Switzerland. The enumeration of selected specimens below is mostly restricted to co-occurrences with *Punctelia ulophylla*.

Additional selected material studied: **Belgium:** *Ardennes*: Stavelot, on *Tilia*, 1977, *A. Aptroot* 2904 (ABL). *Limburg*: Neerharen, Hochter Bampd, on *Salix*, 1998, *A. Aptroot* 42348 & *C. M. van Herk* (ABL, hb. van Herk, with *P. ulophylla*).—**France:** *Ardennes*: Chooz, Petit-Chooz, on *Quercus*, 1999, *A. Aptroot* 44900 (ABL, with *P. ulophylla*); same locality and date, saxicolous, *A. Aptroot* 44987 (ABL). *Brittany*: Huelgoat, on *Platanus*, 1978, *A. Aptroot* 8463 (ABL). *Loire-Atlantique*: Nantes, on *Quercus*, 1998, *C. Brochard* (hb. Sparrius, with apothecia).—**Germany:** *Niedersachsen*: Ostfriesland, Westerstede, Wiefelstede, on *Quercus* near farm, 1998, *A. Aptroot* 42122 & *C. M. van Herk* (ABL, hb. van Herk, with *P. ulophylla*, TLC).—**Great Britain: V.C. 54,** *N Lincolnshire*: Stainfield, on *Juglans*, 1984, *M. R. D. Seaward* (hb. Seaward MRDS 104887). **V.C. 70,** *Cumberland*: Ireby, on *Aesculus*, 1978, *M. R. D. Seaward* (hb. Seaward MRDS 102362).—**Luxembourg:** Enscherange, Val d'Or, saxicolous, 1975, *A. Aptroot* B24 (ABL).—**The Netherlands:** *Drenthe*: Hoogeveen, Noordseschut, on *Quercus robur* along road, 1998, *C. M. van Herk* & *A. Aptroot* 41890 (ABL, hb. van Herk, with *P. ulophylla*, TLC). *Flevoland*: Oostvaardersplassen, on *Salix*, 1993, *A. Aptroot* 33759 (ABL, TLC). *Friesland*: Heeg, on *Populus*, 1999, *A. Aptroot* 45650 & *C. M. van Herk* (ABL, hb. van Herk, with *P. ulophylla*). *Gelderland*: Laren, on *Quercus*, 1999, *A. Aptroot* 44660 & *C. M. van Herk* (ABL, hb. van Herk, with *P. ulophylla*); Lunteren, on *Quercus*, 1998, *A. Aptroot* 42500 & *C. M. van Herk* (ABL, hb. van Herk, with *P. ulophylla*); Zaltbommel, on *Ulmus*, 1999, *C. M. van Herk* (hb. van Herk). *Limburg*: Herkenbosch, Meinweg, on *Salix*, 1998, *A. Aptroot* 42459 & *C. M. van Herk* (ABL, hb. van Herk,



FIGS 4–6. Habitus of *Punctelia subrudecta*. FIG. 4. Thallus showing laminal soralia and pycnidia (the Netherlands, Hilversum, *Aptroot 34059*). FIGS 5–6. Holotype. FIG. 5. Thallus with laminal soralia. FIG. 6. Close-up of coarse soredia in central part of thallus. Scale = 1 mm.

with *P. ulophylla*). *Noord-Brabant*: Biesbosch, on *Salix*, 1999, *C. M. van Herk* (hb. van Herk); Soerendonkse Goor, on *Salix*, 1996, *A. Aptroot* 39056 (ABL). *Noord-Holland*: Hilversum, Laarder Waschmeer, on *Populus*, 1994, *A. Aptroot* 34059 & *C. M. van Herk* (ABL, hb. van Herk, with *P. ulophylla*). *Overijssel*: Dalfsen, Rechterense Veld, on *Quercus*, 1999, *C. M. van Herk* (hb. van Herk, with *P. ulophylla*). *Utrecht*: Leusden, on *Quercus*, 1998, *A. Aptroot* 44123 (ABL).—**Poland:** Bieszczady Zachodnie, Berežki, on *Alnus*, 1958, *K. Glanc*, distributed in *Tobolewski, Lichenotheca Polonica* 220 (hb. Seaward MRDS 109120, as *Parmelia dubia*).—**Switzerland:** Berner Mittelland, Schwarzwasserbrücke, on *Quercus*, 1994, *A. Aptroot* 33845 & *W. O. van der Knaap* (ABL, with *P. ulophylla*).

Punctelia ulophylla (Ach.) van Herk & Aptroot comb. nov.

Parmelia caperata var. *ulophylla* Ach., *Lichenogr. Univ.*: 458 (1810).—*Parmelia borreri* var. *ulophylla* (Ach.) Nyl., *Flora* **55:** 547 (1872).—*Parmelia ulophylla* (Ach.) F. Wilson, *Pap. Proc. R. Soc. Tasm.* **1872:** 172 (1893); type: Switzerland, *Schleicher* (H-Ach 1338, left-hand specimen—lectotype, selected by Hale, 1965).

(Figs 1, 7–10)

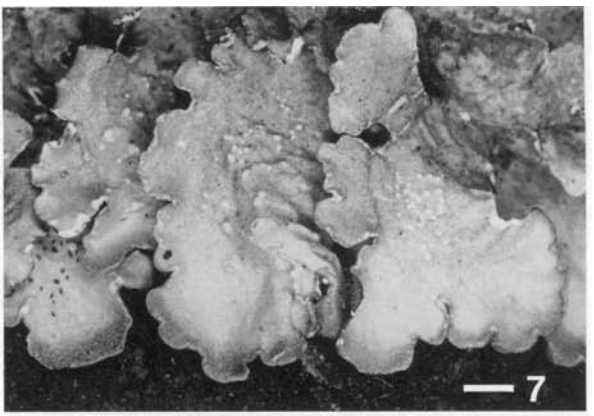
Thallus corticolous, closely attached, usually 3–5 cm diam., but sometimes up to 10 cm diam., foliose. *Lobes* flat to concave, somewhat contorted, *c.* 1·0–3·0 mm wide, outline apically often irregular, margins seemingly upcurved. *Upper surface* (when fresh) pale greenish grey and slightly shiny in the centre, turning to pale brownish grey and usually pruinose near the margin (Fig. 7). Young thalli entirely brownish to brownish grey. Outer margin always pruinose, dull light to medium brown. Pruina crystals *c.* 2–10 µm. *Lower surface* creamish white to pale brown. *Soralia* numerous, primarily marginal along secondary lobes, whitish (Figs 8 & 9). Laminal soralia often also present, punctiform, whitish, 0·4–1·2 mm diam. *Soredia* farinose to granular, *c.* 25–50 µm diam. *Apothecia* unknown. *Pycnidia* rare, immersed, brown, *c.* 0·1–0·2 mm diam. *Conidia* unciform to short-filiform, 3–5 × 1 µm.

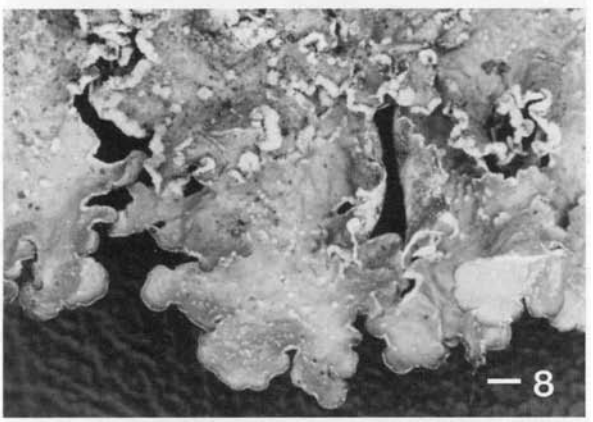
Chemistry. cortex C −, PD −, K+yellow, KC −, UV −; medulla C+red, PD −, K −, KC+red, UV −; lecanoric acid and atranorin detected by TLC.

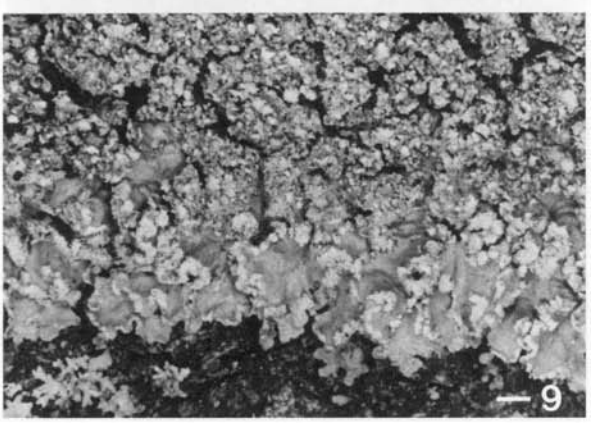
Ecology. This species is only known to be corticolous, occurring on a wide variety of trees, including *Acer*, *Cydonia*, *Fraxinus*, *Larix*, *Populus*, *Tilia*, *Quercus*, *Salix* and *Sambucus*.

Distribution. The species is so far known from western and central Europe, and we have seen material ourselves in the field in Belgium, France, Germany, Luxembourg, the Netherlands and Switzerland. The enumeration of selected specimens below is mostly restricted to co-occurrences with *Punctelia subrudecta*.

Selected additional material studied. **Belgium:** *Limburg*: Neerharen, Hochter Bampd, on *Salix*, 1998, *A. Aptroot* 42348a & *C. M. van Herk* (ABL, hb. van Herk, with *P. subrudecta*).—**France:** *Ardennes*: Chooz, Petit-Chooz, on *Quercus*, 1999, *A. Aptroot* 44901 (ABL, with *P. subrudecta*).—**Germany:** *Niedersachsen*: Ostfriesland, Westerstede, Wiefelstede, on *Quercus* near farm, 1998, *A. Aptroot* 42122a & *C. M. van Herk* (ABL, hb. van Herk, with *P. subrudecta*, TLC).—**Great Britain: V.C. 40,** *Shropshire*: Caer Caradoc, on *Sambucus*, 1982, *M. R. D. Seaward* (hb. Seaward MRDS 104128). **V.C. 65,** *NW Yorkshire*: Thorp Perrow Arboretum, on *Cydonia*, 1998, *M. R. D.*







FIGS 7–9. Habitus of *Punctelia ulophylla*. FIG. 7. Morphotype from sheltered *Quercus* in forest showing pruinose margins (the Netherlands, Herkenbosch, *van Herk s.n.*). FIG. 8. Morphotype from sheltered *Quercus* in forest showing the marginal soralia (the Netherlands, Dalfsen, *van Herk s.n.*). FIG. 9. Morphotype from exposed wayside *Quercus* showing marginal soralia dissolving entirely in the central part of the thallus (the Netherlands, Leusden, *van Herk 4052*). Scale = 1 mm.

Seaward (hb. Seaward MRDS 108457).—**The Netherlands:** *Drenthe*: Hoogeveen, Noordseschut, on *Quercus robur* along road, 1998, *C. M. van Herk* & *A. Aptroot* 41890 (ABL, hb. van Herk, with *P. subrudecta*, TLC). *Flevoland*: Oostelijk Flevoland, De Abbert, on *Salix*, 1994, *A. Aptroot* 34227 (ABL). *Friesland*: Heeg, on *Populus*, 1999, *A. Aptroot* 45651 & *C. M. van Herk* (ABL, hb. van Herk, with *P. subrudecta*). *Gelderland*: Laren, on *Quercus*, 1999, *A. Aptroot* 44660a & *C. M. van Herk* (ABL, hb. van Herk, with *P. subrudecta*); Lunteren, on *Quercus*, 1998, *A. Aptroot* 42500 & *C. M. van Herk* (ABL, hb. van Herk, with *P. subrudecta*). *Limburg*: Herkenbosch, Meinweg, on *Salix*, 1998, *A. Aptroot* 42459a & *C. M. van Herk* (ABL, hb. van Herk, with *P. subrudecta*). *Noord-Holland*: Hilversum, Laarder Waschmeer, on *Populus*, 1994, *A. Aptroot* 34056 & *C. M. van Herk* (ABL, hb. van Herk, with *P. subrudecta*). *Overijssel*: Dalfsen, Rechterense Veld, on *Quercus*, 1999, *C. M. van Herk* (hb. van Herk, with *P. subrudecta*). *Utrecht*: Leusden, on *Larix*, 1995, *A. Aptroot* 36026 (ABL); Leusden, on *Quercus*, 1998, *C. M. van Herk* 4052 (hb. van Herk).—**Poland:** Bieszczady Zachodnie, Wetlina, on *Tilia*, 1956, *K. Glanc*, distributed in *Tobolewski, Lichenotheca Polonica* 170 (hb. Seaward, MRDS 109119, as *Parmelia dubia* var. *ulophylla*).—**Slovakia:** Záhorská nížina, on *Quercus*, 1968, *J. Franclová & I. Pišút*, distributed in *Pišút, Lichenes Slovakiae Exsiccatae* 146 (hb. Seaward MRDS 109123, as *Parmelia borreri*).—**Switzerland:** Berner Mittelland, Schwarzwasserbrücke, on *Quercus*, 1994, *A. Aptroot* 33846 & *W. O. van der Knaap* (ABL, with *P. subrudecta*).

Punctelia perreticulata (Räsänen) G. Wilh. & Ladd

Mycotaxon **28:** 249 (1987).—*Parmelia dubosquii* var. *perreticulata* Räsänen, in Sbarbaro, *Annali Mus. civ. Stor. nat. Giacomo Doria* **41:** 40 (1941).—*Parmelia perreticulata* (Räsänen) Hale, *SWest. Nat.* **3**: 212 (1959); type: Italy, Liguria, Spotorno, saxicolous, December 1936, *C. Sbarbaro*, distributed in *Gyelnik, Lichenotheca parva* 72 (B—isoepitype, selected by Adler & Ahti, 1996, TLC).

(Figs 11–13)

For a description and discussion of this species, see Wilhelm & Ladd (1987) and Adler & Ahti (1996).

Selected additional material studied: **Australia:** *Australian Capital Territory*: 21 km S of Canberra, saxicolous, 1983, *J. A. Elix* 10911 *& M. J. Elix*, distributed in *Elix, Lichenes Australasici Exsiccati* 49 (B, hb. Seaward MRDS 109121, TLC, as *Punctelia subrudecta*). *Queensland*: Lamington National Park, saxicolous, 1988, *A. Aptroot* 22036 & *M. Aptroot* (ABL, TLC). *Tasmania*: Hobart, along Derwent river, on *Casuarina*, 1988, *A. Aptroot* 22771 & *M. Aptroot* (ABL, TLC); *ibid.*, on *Prunus*, *A. Aptroot* 22766 & *M. Aptroot* (ABL, TLC).—**USA:** *Wisconsin:* Washburn, St. Croix National Scenic Riverway, 1990, *C. M. Wetmore* 66866 (ABL, TLC).

Extra-European species

Punctelia missouriensis G. Wilh. & Ladd

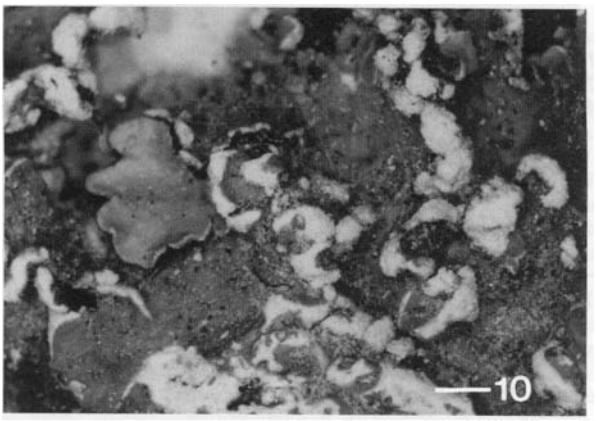
Mycotaxon **44:** 495 (1992); type: USA, Missouri, Crawford, on *Juniperus virginiana*, December 1991, *D. Ladd & G. Wilhelm* 15879 (IMI—isotype).

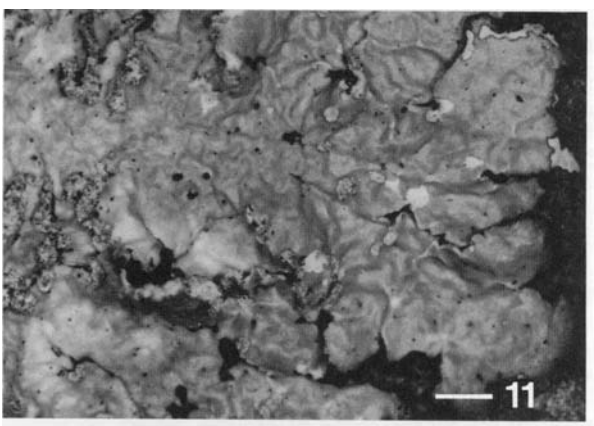
(Fig. 14)

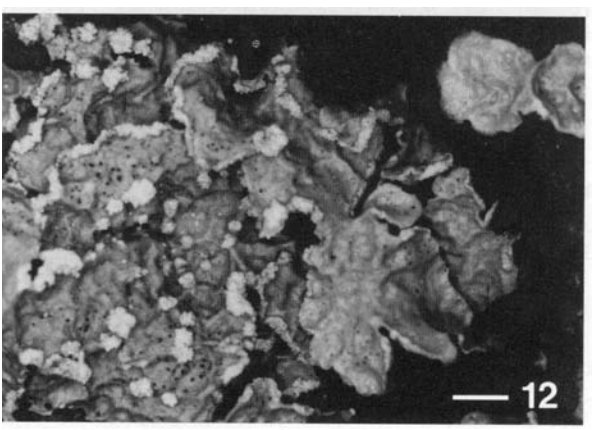
For a description and discussion of this species, see Wilhelm & Ladd (1992).

Non-applicable names

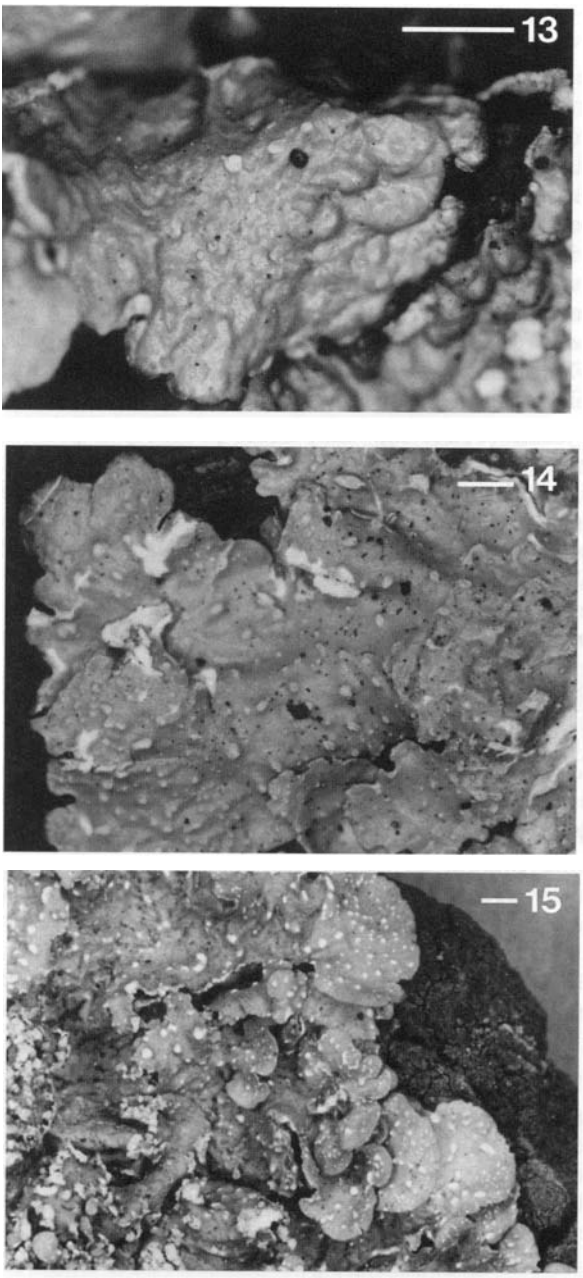
Lichen dubius Wulfen, in Jacquin, *Coll. Bot.* **4:** 275 (1790), non *Lichen dubius* Sm. (1814).—*Parmelia dubia* (Wulfen) Schaer., *Lich. Helv. Spic.* **10:** 453 (1840), non *Parmelia dubia* (Ach.)







FIGS 10–12. Habitus of *Punctelia ulophylla* and *P. perreticulata*. FIG. 10. Holotype of *Punctelia ulophylla*, showing the marginal soralia. FIGS 11–12. *Punctelia perreticulata*, showing the glossy rugulose surface and both marginal and laminal soralia. FIG. 11. Material from USA (Wisconsin, *Wetmore 66866*). FIG. 12. Isoepitype in B, showing pycnidia. Scale = 1 mm.



FIGS 13–15. Habitus of *Punctelia perreticulata*, *P. missouriensis* and *P. borreri*. FIG. 13. *Punctelia perreticulata*, isoepitype in B, showing the glossy, rugulose surface. FIG. 14. *Punctelia missouriensis*, isotype in IMI, showing the small laminal soralia with a few soredia each. FIG. 15. *Punctelia borreri*, showing the copious white pseudocyphellae occurring to the very margin of the thallus (the Netherlands, Deventer, *van Herk 1281*). Scale = 1 mm.

Roehl. (1813) nec *Parmelia dubia* (Ach.) Flörke (1813), both based on *Parmelia caesia* var. *dubia* Ach. (1803); type: Austria, *Wulfen* (not seen).

Iconography

In addition to the illustrations presented here, full colour illustrations are especially illustrative. Both *Punctelia subrudecta* and *Punctelia ulophylla* are illustrated on the *Parmelia* CD-ROM (British Lichen Society 1997, as *Parmelia subrudecta*). The two left-hand photographs are *Punctelia subrudecta* and the two right-hand photographs are *Punctelia ulophylla*.

Punctelia subrudecta is illustrated by Phillips (1980: 178, as *Parmelia subrudecta*) and by Aptroot & van Herk (1994: fig. 85, as *Parmelia subrudecta*).

Punctelia ulophylla is illustrated by Wirth (1995; 667, as *Parmelia subrudecta*). The illustration of *Parmelia borreri* by Jahns (1980: fig. 426) most probably depicts *Punctelia subrudecta*, whereas the illustration of *Parmelia subrudecta* by Jahns (1980: fig. 427) most probably depicts a specimen of *Parmelia saxatilis* (L.) Ach.

Punctelia perreticulata is illustrated in the *Flora of Australia* (Elix 1994: fig. 63, as *Punctelia subrudecta*).

Punctelia borreri is illustrated by McCune & Geiser (1997: 255, as *Punctelia subrudecta*).

Key to sorediate, lecanoric acid-containing *Punctelia* species

1. Soredia mostly fewer than 10 per soralium, coarsely pustular to lobulate. Soralia mainly laminal, often associated with cracks. Conidia unknown. . . . . **P. missouriensis**
   Soredia numerous in well-developed laminal and/or marginal soralia. Soredia farinose to coarsely granular. Soralia not associated with cracks 2

2(1) Extreme margin of the thallus dull brownish, pruinose. Thallus usually greenish grey (centre) to brownish grey (wide margin) when fresh. Secondary lobes with dense marginal soredia. Conidia unciform to short-filiform, 3–5 µm long . . . . . **P. ulophylla**
   Extreme margin of the thallus dark brown, glossy, not pruinose. Thallus colour, except for the dark brown margin, usually uniformly grey 3

3(2) Conidia unciform to short-filiform, 4–6 µm long. Thallus surface smooth. Soredia mainly laminal. Marginal soralia absent or only at the incision of secondary lobes . . . . . **P. subrudecta**
   Conidia long-filiform, mostly 6·5–11 µm long. Thallus surface usually rugulose, occasionally also scrobiculate. Marginal soralia well-developed, numerous, covering large parts of older thalli . . . . . **P. perreticulata**

Discussion

An elaborate discussion of the taxonomic value of various morphological characters in *Punctelia* has been provided by Adler & Ahti (1996). We concur

with most of their observations, with the following exceptions. As pointed out by Spier & van Herk (1997), too much emphasis has been given to the taxonomic importance of the colour of the lower surface in the genus *Punctelia*. In contrast, the taxonomic value of the colour and presence or absence of pruina on the extreme margin of the upper surface has so far been underestimated. In our opinion, this provides a reliable tool for distinguishing species in this group, as it proved to be highly correlated with other morphological characters. *Punctelia perreticulata* differs from *P. subrudecta* not only in its longer conidia, but also in the rugulose, rather than smooth thallus surface and alternative soralia configuration. These differences are now more apparent since *P. ulophylla* has been separated from *P. subrudecta*, which considerably diminishes the morphological variation in *P. subrudecta*.

The chemistry of all taxa mentioned in the key has been checked repeatedly and invariably found to be atranorin and lecanoric acid by TLC, in contrast with all specimens of *Punctelia borreri*, which invariably contain atranorin and gyrophoric acid. Of the four sorediate, lecanoric acid-containing *Punctelia* species examined, *P. subrudecta* is morphologically closest to *P. borreri*. Both species share a glossy, non-pruinose outer margin, a mineral grey colour of the lobes, a smooth lobe surface, and mainly laminal soralia. In addition to containing gyrophoric acid instead of lecanoric acid, *Punctelia borreri* has conspicuously white and relatively large pseudocyphellae (Spier & van Herk 1997) present over the whole lobe surface (Fig. 15), usually has a darker lower surface and is never covered by smooth secondary lobes. *Punctelia borreri* can easily be separated from *P. ulophylla* by the non-pruinose lobe margin.

Strongly lobate morphotypes of *Punctelia subrudecta* with few soralia deserve no taxonomic rank: all intermediate morphotypes between these and normal rosette-like thalli have been observed.

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