

## An enlarged concept of *Llimoniella* (lichenicolous *Helotiales*), with a revised key to the species and notes on related genera

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**Abstract:** The new lichenicolous *Llimoniella phaeophysciae*, known from Italy, Spain and the USA (Arizona) on *Phaeophyscia*, resembles *Geltingia associata* in the subcylindrical asci with uniseriate, shortly ellipsoid ascospores, but is distinguished by several important characters. *Gelatinopsis acarosporicola*, *G. heppiae*, *Geltingia groenlandiae* and *Psorotichia terricola* (syn. nov. *Gelatinopsis leptogii*) are considered to be congeneric with *L. phaeophysciae*, although some of them have elongate clavate and not subcylindrical asci and they are consequently combined in *Llimoniella*. These five species are distinguished from *Llimoniella* s.str. by a different excipular and epihymenial pigmentation not reacting with KOH and are treated as the informal *L. phaeophysciae* group. The new *L. placopsidis* is described from *Placopsis* in New Zealand. More complex pigmentation patterns are documented for *L. pyrenulae* and *L. ramalinae*. A revised key to the species of *Llimoniella* is presented. *Gelatinopsis ericetorum* and *G. roccellae* are combined in *Rhymbocarpus*. A redescription of *Geltingia associata* is given.

**Key words:** Ascomycota, lichenicolous fungi, pigments, lichens, taxonomy

### Introduction

An apparently undescribed, helotialean lichenicolous fungus has been collected several times on thalli and apothecia of *Phaeophyscia* species. Because of the subcylindrical asci with uniseriate, shortly ellipsoid ascospores, it strongly resembles the monotypic genus *Geltingia* Alstrup & D. Hawksw. (Alstrup & Hawksworth 1990). However, the general macroscopical appearance is not that of *Geltingia associata* (Th. Fr.) Alstrup & D. Hawksw., and the asci and the excipular structure are different. Several further species from other genera are considered to be congeneric with the new fungus on *Phaeophyscia*. All these species were compared with the similar helotialean genus *Gelatinopsis* Rambold & Triebel, the type species of which differs by strongly convex, immarginate, poorly delimited ascomata, a

different excipular structure and pigmentation, and slightly different asci. They are most reminiscent of the genus *Llimoniella* Hafellner & Nav.-Ros., but differ by the absence of typical excipular and epihymenial pigments characterizing that genus. However, other morphological and anatomical characters suggest that these species should be included in an enlarged concept of *Llimoniella*. The aim of this paper is therefore to describe or combine these species in *Llimoniella*. Several additional species of *Llimoniella* have been studied, and a revised key to all known *Llimoniella* species is provided. As a detailed study of *Geltingia associata* was necessary to support the distinctiveness of the two genera, a redescription and illustrations of *G. associata* are also presented.

### Material and Methods

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The specimens examined are located in the institutional herbaria ASU, BCN, BG, BR, C, E, HBG, LE, M, MSC, NY, OTA and UPS, and in the personal collections of A. Aptroot, P. Diederich, J. Etayo, M. G. Halici, K. Kalb and P. van den Boom. The morphological characters of dry herbarium specimens have been studied and illustrated using a dissecting microscope.

The microscopical examination was carried out using hand-cut sections mounted in water, 5% KOH (K), concentrated nitric acid (N), Congo Red, lactophenol Cotton Blue (LCB), or Lugol's reagent, without (I) or with (K/I) pre-treatment with KOH. For macroscopical and some microscopical photographs (e.g., asci, paraphyses), several images with different parts in focus were combined into one picture using the free software CombineZP (developed by Alan Hadley). Photographs of ascumatal sections were obtained by stitching together many photos representing parts of the section examined at a high magnification.

The following specimens have been examined and compared with the species studied: *Gelatinopsis geoglossi*: **USA: Connecticut:** Sharon Audubon Center, 2 miles SE of Sharon, on *Trichoglossum farlowii*, 1969, C. Rogerson & G. Smith (NY). **North Carolina:** Blue Ridge Mountains, Highlands Biological Station, Highlands, Macon Co., 1961, R. H. Petersen & C. Rogerson (NY).

*Llimoniella fuscatae*: **Great Britain: Wales: VC 43,** Radnor, N of Rhayader, Gilfach Farm, on *Acarospora fuscata*, 1997, S. P. Chambers (E, hb. Diederich).

## Results

### The new *Llimoniella phaeophysciae* group

The informal *Llimoniella phaeophysciae* group, including *L. phaeophysciae* and four related species are introduced here, and the relationships between these species and *Llimoniella* s.str. discussed.

### *Llimoniella phaeophysciae* Diederich, Ertz & Etayo sp. nov.

*Llimoniella* species in thallis *Phaeophysciae* vigenis, insignis excipulo et epihymenio brunneo K<sup>-</sup>, hymenio non insperso, ascis subcylindricis apice applanato pariete apicaliter tenui 8-spore, et ascosporis uniseriatis subglobosis ad breviter ellipsoideis 7–11 × 6–9 μm.

Typus: USA, Arizona, near San Francisco Peaks, on side of hwy 89 just N of Sunset Crater, 35.4029° N, 111.5762° W, alt. c. 6500 feet, on sheltered *Juniperus* bark, on *Phaeophyscia hirsuta* s. lat., 9 June 2008, J. Hollinger 20080609.12 (ASU—holotypus; hb. Diederich— isotypus).

(Figs 1A, 2A & B, 3)

*Ascomata* erumpent, sessile, roundish, dispersed or more frequently in groups of up to 15, 120–350 μm diam., with a distinct, prominent, blackish, matt or slightly shiny margin of 40–60 μm and a dark reddish brown to blackish, matt, applanate disc. *Exciple* reddish to orange-brown, K<sup>-</sup> or slightly

darker, N<sup>+</sup> brighter orange, laterally of thick-walled, elongate, rarely branched, radiating hyphae with swollen end cells, 25–65 μm thick, basally of conglutinated, thick-walled and more or less isodiametric cells 7–11.5 μm diam., 25–60 μm thick, occasionally prolonged into a brown, immersed 'stipe'; without hairs; externally sometimes bordered by a thin, hyaline necrotic layer. *Subhymenium* colourless. *Epihymenium* pale to orange-brown, K<sup>-</sup>, N<sup>+</sup> brighter orange. *Hymenium* colourless to yellowish, not inspersed, 100–130 μm tall, I<sup>-</sup>, K/I<sup>-</sup>. *Paraphyses* septate, simple or more rarely branched in the upper part, apically not or slightly swollen, 1.5–3 μm thick, cells with many small oil guttules. *Asci* subcylindrical, apically more or less applanate, (3–)8-spored, wall laterally c. 0.4–0.6 μm thick, apically distinctly thinner, c. 0.3–0.4 μm, without ocular chamber, without croziers, 55–75 × 7.5–9 μm, I<sup>-</sup>, K/I<sup>-</sup>. *Ascospores* uniseriate in the ascus, non-septate, colourless, subglobose to shortly ellipsoid, with 1(–3) large lipid guttule(s), 7–11 × 6–9 μm, wall smooth, c. 0.3 μm thick, without perispore.

*Conidiomata* unknown.

The new species is distinguished from most *Llimoniella* species discussed below by the broad ascospores, more than 6 μm in width, and from *L. acarosporicola* by the constantly rounded ascumata. Macroscopically, *L. phaeophysciae* could be confused with *Buelliella physciicola* Poelt & Hafellner, a lichenicolous fungus confined to *Phaeophyscia* species, which is readily distinguished by the eventually brownish, 1-septate ascospores (Hafellner 2004). The new species should also be compared with *Phaeopyxis muscigenae* Alstrup & E. S. Hansen, described from *Physcomia muscigena* in Greenland (Alstrup & Hansen 2001). That species has similar more or less globose, but slightly smaller ascospores, c. 5–8 μm diam., but they are biseriata in much broader, clavate asci, 48–54 × 14–20 μm, ascumata are larger, up to 0.7 mm diam., and the hymenium is lower, 55–60 μm tall.

*Distribution and hosts.* The new species is known from Europe (Italy and Spain) and

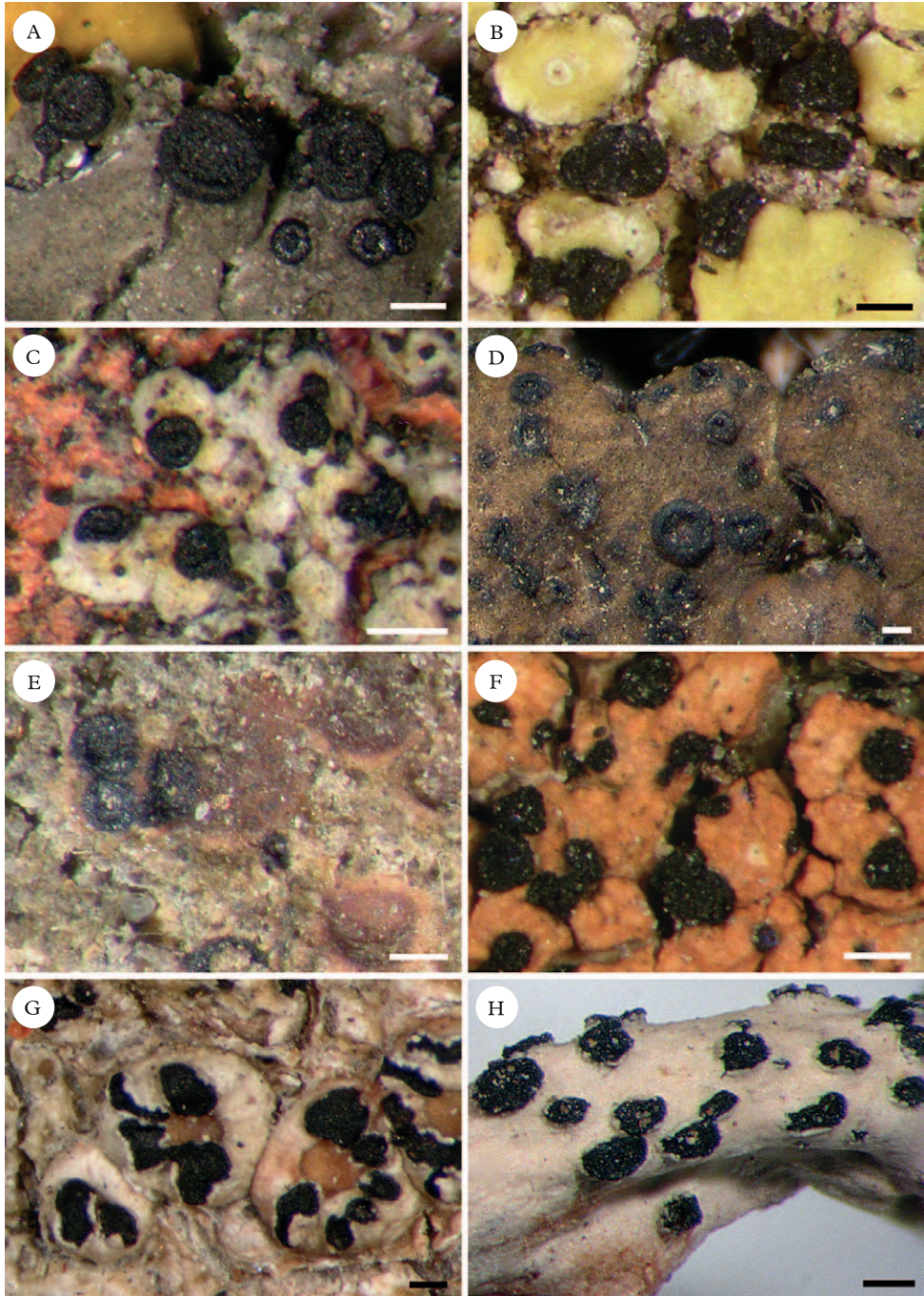


FIG. 1. A–E, *Llimoniella phaeophysciae* group, ascomata of the five species of the group; A, *L. phaeophysciae* on *Phaeophyscia hirsuta* (holotype); B, *L. acarosporicola* on *Acarospora socialis* (isotype); C, *L. groenlandiae* on thallus squamules of *Caloplaca* group *holocarpa* (F. Berger 14961); D, *L. heppiae* on *Heppia despreauxii* (holotype); E, *L. terricola* on *Epiphloea byssina* (isotype of *Gelatinopsis leptogii*). F, *L. placopsidis* on *Placopsis elixii*, ascomata (holotype). G & H, *Geltingia associata* ascomata; G, on *Ochrolechia* sp. (T. Tønsberg 24700); H, on *Thamnolia vermicularis* (M. Zhurbenko 95307). Scales: A – H = 200  $\mu$ m.

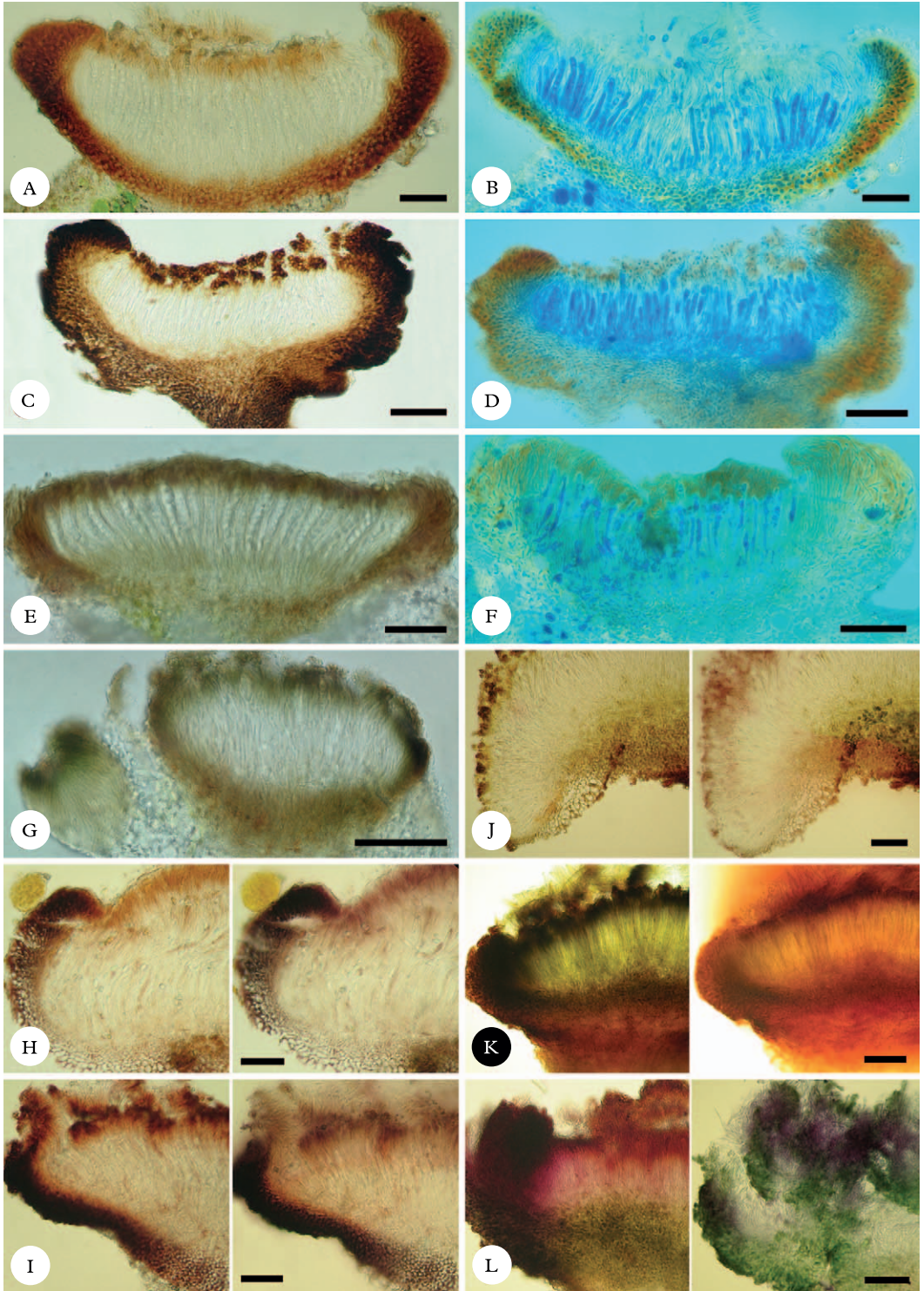




FIG. 3. *Llimoniella phaeophysciae*, asci, paraphyses and ascospores. A, D & E, in water (holotype). B & C, in Congo Red after pre-treatment with 5% KOH (*P. Conklin*). Note the subcylindrical asci with a more or less applanate apex and an apically thinner wall. Scale = 10  $\mu$ m.

the USA (Arizona) and appears to be confined to *Phaeophyscia* species (thallus and apothecia), on which it does not cause any visible damage. The known hosts are *P. ciliata*, *P. hirsuta* s. lat. (incl. *P. cernohorskyi*) and *P. nigricans*. Marcos Laso (2001) reported *Geltingia associata* (as *Lecidea associata*) from Salamanca (Spain) on *P. nigricans* (material in SALA). Although we did not examine any corresponding material, it is very likely to belong to *Llimoniella phaeophysciae* as well.

*Additional specimens examined. Italy:* Calabria: N of Catanzaro, W of Pagliarelle, along road Pagliarelle to

Petto di Mandra, on *Phaeophyscia ciliata*, 1990, *P. van den Boom* 10306 (hb. van den Boom).—**Spain:** Aragón: Zaragoza, Biel, alt. 690 m, encinar de Callau, on *Tilia*, on *P. nigricans*, 2004, *J. Etayo* 22087 (hb. Etayo). Castilla y León: Soria, Soria capital, paseo por el Duero camino a S. Saturio, olmeda, alt. 900 m, on *Aesculus hippocastanum*, on *P. nigricans*, 2001, *J. Etayo* 18371 & *E. Ros* (hb. Etayo).—**USA:** Arizona: c. 60 miles SE of Flagstaff, Navajo, 34.6155° N, 110.5469° W, on *P. cernohorskyi*, 2002, *P. Conklin* (ASU).

*Discussion.* *Llimoniella phaeophysciae* resembles the monotypic lichenicolous genus *Geltingia* [type species: *G. associata*] by the subcylindrical asci, the uniseriate, shortly

FIG. 2. A & B, *Llimoniella phaeophysciae*, sections through ascoma (holotype); A, observed in water; B, examined in LCB (staining asci and lumina of excipular cells), pre-treated with N (holotype); note the hyaline outer layer and the radiating cells of the lateral exciple. C & D, *L. placopsidis* (holotype), same methods of examination; note the strong pigmentation of the paraphyses apices in water. E & F, *Geltingia associata* (*T. Tonsberg* 24700); E, examined in K; F, in LCB, pre-treated with N; note the thick, dark epihymenium, the lateral exciple made of more or less parallel or slightly interwoven hyphae with poorly stained lumina in LCB, and the pale, sometimes almost indistinct lower exciple. G, *Rhymocarpus roccellae* observed in water (*T. H. Nash* III 26361, hb. Diederich), note the exciple made of almost parallel or slightly interwoven hyphae, especially visible in the left, young ascoma, and the greenish epihymenial pigment. H & I, sections through ascomata of *Llimoniella* s.str. in young (left), and K-reaction (right); H, *L. adnata* (*M. Zhurbenko* 92198, hb. Diederich); I, *L. scabridula*, the generic type (*Santesson Fungi Lichenicoli Exsiccati* 211, hb. Diederich); note the pale purplish violet reaction of the epihymenium and the upper exciple, and the dark brown lower exciple in K. J–L, *Llimoniella ramalinae*, sections through ascomata showing variability of infraspecific pigmentation; J, poorly pigmented ascoma, pale K+ purplish reaction (New Zealand, South Island, Allisson Reserve, on *R. unilateralis*, *J. Bannister* s. n., OTA); K, greenish hymenium and reddish brown exciple, strong orange red to purplish reaction (dissolving in K) (New Zealand, South Island, on *R. unilateralis*, *J. Bannister* 1793, OTA); L, deep purplish epihymenium and upper exciple, greenish lower exciple, giving a strong green and partly an additional violet K-reaction (pigments not dissolving in K, shown here in a squash preparation several minutes after adding K) (New Zealand, South Island, on *R. celastri*, *J. Bannister* 1278, OTA). Scales: A–L = 50  $\mu$ m.

ellipsoid ascospores and the same excipular and epihymenial pigment. Both taxa differ nevertheless by several important characters. Asci of *L. phaeophysciae* are apically applanate, the wall is uniformly thin and apically even thinner, and an ocular chamber is always missing (Fig. 3A & B); those of *G. associata* are apically rounded, the wall is thickened near the apex, and a distinct ocular chamber is usually visible (Fig. 5A & B). Ascospores are smooth and very thin-walled in *L. phaeophysciae* (Fig. 3E), but verruculose in *G. associata* with a distinctly thicker wall (Fig. 5D & E). Although the excipular pigment appears to be the same in both genera, the excipular anatomy differs: the lateral exciple of *L. phaeophysciae* consists of strongly conglutinated radiating hyphae with more or less isodiametric cells and with enlarged or swollen end cells [= outer cells of exciple], comparable to the exciple of typical *Llimoniella* species (Diederich & Etayo 2000) (Fig. 2A & B); the lateral exciple of *G. associata* consists of elongate, filiform, more or less parallel or irregularly arranged, but never radiating hyphae, without swollen end cells (Fig. 2E & F). The basal exciple of *L. phaeophysciae* is strongly developed and dark (pigmentation comparable to the lateral exciple), sometimes prolonged into an immersed, dark stipe; that of *G. associata* is pale, often poorly distinct. Finally, ascomata in *L. phaeophysciae* are always rounded, regular in shape and size, more or less superficial, with a more or less matt disc and a prominent margin (Fig. 1A), whilst those of *G. associata* are frequently elongate, especially when growing on the margin of the host apothecia, often irregular in size and form, immersed to erumpent, with a typically shiny disc and a less prominent, sometimes almost undulate margin (Fig. 1G & H). *Llimoniella phaeophysciae* is distinguished from almost all other known lichenicolous helotialean fungi with dark ascomata by the subcylindrical asci with an applanate apex and no visible internal apical structures, and uniseriate, shortly ellipsoid ascospores (Fig. 3).

After carefully comparing the new species with other lichenicolous members of *Helotiales*, we realized that *Llimoniella phaeophysciae* is not

only superficially, but also microscopically very similar to *Gelatinopsis leptogii* Ertz & Diederich (Ertz & Diederich 2006). The ascomata of *G. leptogii* are reminiscent of those of *L. phaeophysciae*, although sometimes slightly immersed in the host thallus (Fig. 1E), the excipular anatomy and pigmentation are the same, the asci are subcylindrical, thin-walled and frequently apically applanate, and the ascospores are shortly ellipsoid. There is little doubt that both species are congeneric. Similarly, the very recently described *G. acarosporicola* Kocourk. & K. Knudsen has comparable ascomata (they differ in being frequently elongate or angular) (Fig. 1B), a similar exciple, subcylindrical to clavate asci with a thin wall, and 1(–2)-seriate, shortly ellipsoid ascospores (Kocourková & Knudsen 2009). Although asci of *G. acarosporicola* are apically not applanate, the species is so close to *G. leptogii* that it must be considered as congeneric. *Gelatinopsis heppiae* Nav.-Ros., Hladun & Llimona, recently described from Spain (Navarro-Rosinés et al. 2008) (Fig. 1D), is very similar to the *Llimoniella* species discussed here, but differs in the more deeply pigmented orange to reddish brown exciple and epihymenium, and the distinctly swollen (up to 6 µm) and pigmented paraphyses apices. These differences hardly justify a distinct genus. In conclusion, these three lichenicolous *Gelatinopsis* species are congeneric with the new *Llimoniella phaeophysciae* forming an obviously natural group of fungi (hereafter called the *Llimoniella phaeophysciae* group) that also includes species in which asci are apically larger and rounded.

There are two other known lichenicolous *Gelatinopsis* species, *G. ericetorum* (Körb.) Rambold & Triebel and *G. roccellae* Etayo, Paz-Bermúdez & Diederich. The type of the latter species differs in the immersed, immarginate ascomata growing on the thallus of *Roccella*, clavate to subcylindrical asci that are apically not applanate, and ellipsoid to ovoid, 1–2-seriate ascospores. The exciple and epihymenium in the type specimen are brownish, K– (Etayo et al. 2001). In a Mexican specimen of the same species (*T. H. Nash III* 26361), an additional olivaceous pigment is present in the epihymenium and

the upper exciple. The same olivaceous pigment is also present in the epihymenium of *G. ericetorum*, a lichenicolous species developing blackish ascomata over the thallus of *Dibaeis baeomyces*. Both species differ from the *Llimoniella phaeophysciae* group by the presence of the olivaceous epihymenial pigment (absent in some specimens of *G. roccellae*), more or less immersed and immarginate ascomata with a flat disc, and an exciple entirely made up of more or less parallel to interwoven hyphae. Asci in both species are clavate to subcylindrical, never with a flattened apex, and the wall in *G. ericetorum* is apically slightly thickened (Baral & Marson 2001). The ascomata of both are never concave, like those of all non-lichenicolous *Gelatinopsis* species, including the type *G. geoglossi* (Ellis & Everh.) Rambold & Triebel (Baral & Marson 2001). This is not the case with *Llimoniella*, in which all species have a slightly to strongly prominent margin at least when young. The ascomata of *G. roccellae* might appear concave, as they are sometimes deeply immersed and surrounded by the host thallus, but the hymenial disc is always flat and immarginate. *Gelatinopsis ericetorum* was included in *Gelatinopsis* by Rambold & Triebel (1990) with some hesitation, a decision that was eventually accepted by Baral & Marson (2001). All other, non-lichenicolous *Gelatinopsis* species studied by Baral & Marson (2001), including the generic type *G. geoglossi* (Ellis & Everh.) Rambold & Triebel, have an apically distinctly thickened ascus wall. The type species has black (when dry), superficial ascomata that are strongly convex, irregularly delimited and often conglutinated, and always immarginate (several specimens studied by us, see under Material and Methods), and are macroscopically very distinct from those of *G. ericetorum* and *G. roccellae*. Instead, these two lichenicolous taxa are very similar to several species of *Rhymbocarpus* Zopf with a reduced exciple, including the generic type *R. geographicus* (J. Steiner) Vouaux, and they will consequently be included in *Rhymbocarpus* below.

A further lichenicolous helotialean fungus, *Geltingia groenlandiae* Alstrup & D. Hawksw., was initially described in an enlarged concept

of *Geltingia* Alstrup & D. Hawksw. (Alstrup & Hawksworth 1990), and then transferred to *Llimoniella* (Kümmerling et al. 1993). When Diederich & Etayo (2000) revised the genus *Llimoniella*, they considered that the species did not belong to that genus because of the lack of excipular and epihymenial pigments characteristic of *Llimoniella*. They proposed that the available material might represent poorly developed ascomata of a species of *Unguiculariopsis*, in which excipular hairs were missing. The species was consequently transferred to that genus. With the discovery of more material, it became evident that ascomata of this species are usually blackish and never have excipular hairs (Fig. 2C) and that it cannot remain in *Unguiculariopsis*. Macroscopically, this species is a typical member of the *Llimoniella phaeophysciae* group. It also has the same excipular anatomy and pigmentation, and entirely thin-walled asci. The main differences are the slightly broader, subcylindrical to elongate clavate asci with a rounded apex, the narrowly ellipsoid 2-seriate ascospores and a hymenium that is interspersed in the upper half. We conclude that this species also belongs to the *L. phaeophysciae* group and that the narrowly ellipsoid form of the ascospores does not allow them to be uniseriate in the asci, which as a consequence are not subcylindrical but elongate claviform.

The *Llimoniella phaeophysciae* group is therefore characterized as follows: ascomata dark brown to blackish, more or less matt, with an often prominent margin, at least when young; excipulum of shortly elongate to isodiametric cells, sometimes laterally radiating with enlarged end cells; an orange-brown excipular and epihymenial pigment not reacting in K and N (but becoming brighter in N); entirely thin-walled, elongate clavate to subcylindrical asci, in some species with a flattened apex, that are I- and K/I-, and smooth- and thin-walled and, simple, colourless ascospores. The differences from *Geltingia* and *Gelatinopsis* are discussed above. The genus *Rhymbocarpus* is distinguished by a greenish, K+ olivaceous epihymenial and occasionally excipular pigment, a lateral exciple made of elongate, narrow, almost filiform hyphae, the presence

of excipular hairs in some species and ascomata in several species (including the generic type) more or less immersed with a punctiform disc, in other species becoming superficial, the disc often partly or mostly covered by the exciple (Diederich & Etayo 2000).

*Llimoniella* s. str. is distinguished by a K+ violet epihymenial and excipular pigment. In several species of *Llimoniella* s. lat., a more reddish or purplish pigment, and sometimes an additional, pale olivaceous, K+ bright green pigment occurs. In a few species, a slight, but distinct thickening of the apical ascal wall or even an ocular chamber have been observed, and several species (possibly not closely related to the generic type) have very long and narrow, multiguttulate and/or septate ascospores (Diederich & Etayo 2000). The different pigmentation of the species of the *Llimoniella phaeophysciae* group and the absence of a positive K-reaction might suggest a distinct genus. However, within many genera, the observed pigmentation of the different species is variable (e.g., *Skyttea*, see Diederich & Etayo 2000), and this character alone does not justify the distinction of two genera. As all other characters are in agreement with the type of *Llimoniella*, we propose to include the species of the *L. phaeophysciae* group within *Llimoniella* s. lat.

***Llimoniella acarosporicola* (Kocourk. & K. Knudsen) Diederich & Ertz comb. nov.**

Basionym: *Gelatinopsis acarosporicola* Kocourk. & K. Knudsen, *Bryologist* 112: 364 (2009); type: USA, California, Orange County, Santa Ana Mountains, Fremont Canyon, 33°47'14" N, 117°43'03" W, alt. 294 m, on *Acarospora socialis* on sandstone slab, 15 x 2007, K. Knudsen 9236 (UCR—holotype; MSC, PRM, hb. Diederich—istotype!).

(Fig. 1B)

For a description and illustrations, see Kocourková & Knudsen (2009).

*Notes.* This species differs mainly from *L. phaeophysciae* by the more irregular, often angular or laterally compressed ascomata. It is very similar to *Llimoniella fuscatae* Hafellner & Obermayer, a species confined to the same

host genus *Acarospora*, but differs by the entirely K– epihymenium and exciple (in *L. fuscatae*, a pale, but distinct violaceous reaction is visible, at least in thick sections), the more irregular and often angular ascomata, the less prominent ascomatal margin and a different host selection (*Acarospora socialis*, versus *A. fuscata*).

*Distribution and host.* Known from two localities in California, always on the thallus of *Acarospora socialis*, on which the fungus does not cause any visible damage.

***Llimoniella groenlandiae* (Alstrup & D. Hawksw.) Triebel & Hafellner**

In Kümmerling *et al.*, *Bibl. Lichenol.* 53: 156 (1993).—*Geltingia groenlandiae* Alstrup & D. Hawksw., *Meddr Grønland, Biosci.* 31: 33 (1990).—*Unguiculariopsis groenlandiae* (Alstrup & D. Hawksw.) Etayo & Diederich, *Lichenologist* 32: 472 (2000); type: Greenland, Narsaq distr., 1 km S of Qagssiarsuk, 61°08' N, 45°32' W, alt. 140 m, on *Caloplaca citrina* s.l., viii 1980, V. Alstrup 801120 (C—holotypus!).

=? *Llimoniella caloplacae* S.Y. Kondr. & Khodos., *Mycologia Balcanica* 3: 96 (2006); type: Ukraine, Khersons oblast, Belozersky district, near Shirokaya Balka village, on loess slopes, on *Caloplaca borysthenica* areoles and apothecia, 7 May 2002, A. Khodosovtsev (KW—holotypus; LD, KHER—istotypi, n.v.).

(Fig. 1C)

For a description and additional illustrations, see Alstrup & Hawksworth (1990: 33–35).

*Notes.* The two recent collections both have a hymenium that is strongly inspersed with small oil droplets in the upper half. However, we did not re-examine the very small type specimen (studied by Diederich & Etayo 2000), and thus cannot confirm if the hymenium in the type is also inspersed. This character, also present in *L. pyrenulae*, seems to distinguish *L. groenlandiae* from all other known species of the *Llimoniella phaeophysciae* group and should be carefully checked in additional specimens. A Dutch specimen of *L. groenlandiae* (*A. Aproot* 50330) is unusual within the *L. phaeophysciae* group in possessing paler ascomata, but all other characters, including the inspersed hymenium and the host selection, confirm that it does belong to



*L. groenlandiae*. *Llimoniella caloplacae*, described from the same host genus, is probably a synonym of *L. groenlandiae*, but unfortunately our request for the loan of any original material was unsuccessful (no answer from KW and LD).

*Distribution and hosts*. Known from Austria, Greenland, The Netherlands and Sweden, possibly also Ukraine (type of *L. caloplacae*). Commensalistic on *Caloplaca citrina* s. lat., *C. flavocitrina* and an unidentified specimen of the *C. holocarpa* group with pale yellowish, convex thallus squamules; possibly also on *C. borysthena* (see above). An additional specimen of *L. groenlandiae*, mentioned by Alstrup & Hawksworth (1990) on *Lepraria neglecta*, proved to be typical *Rhymbocarpus neglectus* (Vain.) Diederich & Etayo on *Lepraria alpina* (Kümmerling et al. 1993). Diederich & Etayo (2000) also mentioned two specimens on *Fulgensia bracteata* and *F. fulgens* (thalli). We were able to re-examine one of these [**Greenland**: CW, Søndre Strømfjord Airport, S-slope of Mt. Hassel, NE of airport, alt. 150 m, on a sterile thallus of *F. bracteata*, 1991, V. Alstrup 91072 (C 1212)]. The specimen is in an extremely poor condition, and we did not observe any healthy asci or ascospores. The hymenium is not interspersed, and thus it is not certain if the specimen really belongs to *L. groenlandiae*. The second specimen from Sweden could not be located. We would therefore prefer to examine additional material on *Fulgensia* before definitely including such specimens in *L. groenlandiae*.

*Additional specimens examined*. **Austria**: Oberösterreich: Aschbach an der Donau, Bahnhofgelände, Gleis vor Lagerhaus, on *Caloplaca* gr. *holocarpa*, 2000, F. Berger 14961 (hb. Berger).—**The Netherlands**: Gelderland: Betuwe, Ingen, on brick wall of church, on *C. flavocitrina*, 2001, A. Aptroot 50330 (hb. Aptroot).

**Llimoniella heppiae (Nav.-Ros., Hladun & Llimona) Diederich & Ertz comb. nov.**

Basionym: *Gelatinopsis heppiae* Nav.-Ros., Hladun & Llimona, *Revista Catalana de Micologia* 30: 60 (2008); type: Spain, Aragón, prov. Zaragoza, Osera, carretera a Monegrillo, lomas a la derecha de la carretera, 41°33'35" N, 0°33'20" E, alt. 200–210 m, en el talo

de *Heppia despreauxii*, suelos arcilloso-yesosos, 3 June 2003, X. Llimona (BCN-lich. 15840—holotype!; 15841—isotype).

(Fig. 1D)

For a description and illustrations, see Navarro-Rosinés et al. (2008).

*Notes*. This species is distinguished from the other members of the *Llimoniella phaeophysciae* group by its more strongly pigmented epihymenium, and especially by the strongly swollen and brown paraphyses apices.

*Distribution and host*. Known only from the type locality in Spain on the thallus of *Heppia despreauxii*, on which the fungus does not cause any visible damage.

**Llimoniella terricola (Rehm ex Arnold) M. Schultz, Diederich & Ertz comb. nov.**

Basionym: *Physma terriculum* Rehm ex Arnold, *Flora* 68: 216 (1885).—*Psorotichia terricola* (Rehm ex Arnold) Lettau, *Hedwigia* 52: 179 (1912).—*Biatora terricola* Rehm ex Arnold, *Flora* 51: 521 (1868), nom illegit. [later homonym of *Biatora terricola* (Anzi) Th. Fr., *Lichenes Spitsbergenses*: 37 (1867)]; type: [Germany, Bavaria,] auf Erde eines schattigen Waldgrabens bei Sugenheim in Franken, [on *Epiphloea byssina*,] Sommer 1867, H. Rehm, in Arnold *Lich. Exs.* 387 (M—lichenicolous ascomata—lectotypus, hic designatus!).

Syn. nov.: *Gelatinopsis leptogii* Ertz & Diederich, *Lichenologist* 38: 515 (2006); type: Belgium, Oret (près de Mettet), hameau de Coroy, alt. 245 m, carrière de sable, sol argilo-sablonneux, on *Epiphloea byssina*, 9 February 2003, D. Ertz 3040 & J.-P. Duvivier (BR—holotype!; hb Diederich—!isotype!).

(Fig. 1E)

For a description and additional illustrations, see Ertz & Diederich (2006).

*Notes*. *Physma terriculum*, described as a terricolous lichen, is identical to the recently described *Gelatinopsis leptogii*, and is lichenicolous on a reduced thallus of *Epiphloea byssina*. As the epithet *terriculum* was used for these two organisms, and as the original description clearly refers to the lichenicolous ascomata and not to the sterile host thallus, we herewith lectotypify the name on the lichenicolous fungus.

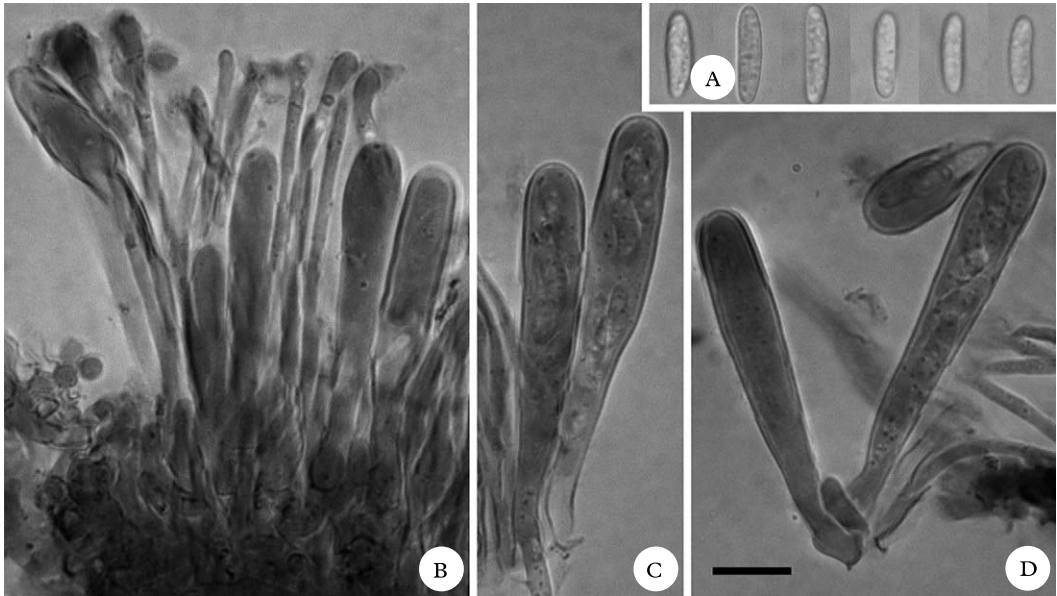


FIG. 4. *Llimoniella placopsidis*, asci, paraphyses and ascospores (holotype). A, in water. B–D, in Congo Red after pre-treatment with 5% KOH. Note the multiguttulate ascospores and the reduced pigmentation of paraphysis apices after KOH. Scale = 10  $\mu$ m.

**Distribution and host.** Known from Belgium and Germany, always on the thallus of *Epiphloea byssina* (= *Leptogium byssinum*), on which the fungus does not cause any visible damage.

#### A new species of *Llimoniella* and new observations on *L. pyrenulae* and *L. ramalinae*

##### *Llimoniella placopsidis* Diederich & Fryday sp. nov.

*Llimoniella* species in thallis *Placopsidis* vigens, insignis excipulo et epihymenio brunneo K+ purpureo, hymenio non insperso, paraphysibus apicaliter incrassatis brunneis, ascis elongate clavatis apice rotundato pariete apicaliter tenui 8-spore, et ascosporis 1–2-seriatis anguste ellipsoideis 9–9.5  $\times$  2.5–3  $\mu$ m.

Typus: New Zealand, South Island, W of Makarora, Lake Lucidus, 44°15' S, 168°53' E, alt. 780 m, on *Placopsis elixii*, [no date indicated; c. 2000], A. Knight s. n. (OTA—holotypus; hb. Diederich—istotypus).

(Figs 1F, 2C & D, 4)

**Ascomata** erumpent, sessile, roundish or slightly elongate, often irregular in form, dis-

persed or more rarely in groups, 100–300 (–350)  $\mu$ m diam., with a distinct, prominent, blackish, matt or slightly shiny, often uneven or cracked margin of 45–65  $\mu$ m, sometimes almost disappearing when old, and a blackish, matt, applanate disc with a rough surface. **Exciple** dark orange to reddish brown, K+ purplish, N+ orange-brown, laterally of thick-walled, elongate, rarely branched, radiating hyphae, or sometimes of almost isodiametric cells, 25–50  $\mu$ m thick, basally of conglutinated, thick-walled cells that are internally elongate, centrally and externally more or less isodiametric, 3.5–6  $\mu$ m diam., 35–70  $\mu$ m thick, occasionally prolonged into a brown, immersed 'stipe' and up to 100  $\mu$ m; without hairs. **Subhymenium** colourless. **Epihymenium** dark brown, K+ purplish, N+ orange-brown. **Hymenium** colourless to yellowish or brownish, not inspersed, 45–70  $\mu$ m tall, I–, K/I–. **Paraphyses** septate, simple or more rarely branched in the upper part, 1–1.5  $\mu$ m thick, apically distinctly swollen and brown, up to 4.5  $\mu$ m thick. **Asci** elongate clavate to subcylindrical, apically rounded, 6–8-spored, wall laterally and apically c. 0.5

thick, without ocular chamber, without croziers,  $35\text{--}58 \times 6\text{--}8 \mu\text{m}$ , I–, K/I–. *Ascospores* 1–2-seriate in the ascus, non-septate, colourless, narrowly ellipsoid, multiguttulate,  $9\text{--}12 \times 2.5\text{--}3 \mu\text{m}$ , wall smooth, very thin, without perispore.

*Conidiomata* unknown.

The new species is distinguished from the *Llimoniella* species with narrow, aseptate ascospores and a positive K-reaction of the exciple and epihymenium (mainly *L. pertusariae* Diederich & Etayo and *L. pyrenulae* Diederich & Etayo), and by the shorter ascospores. *Llimoniella pyrenulae* is furthermore distinguished by the inspersed hymenium, and *L. pertusariae* by the larger apothecia,  $300\text{--}600 \mu\text{m}$  diam. Galloway (2001) reported a lichenicolous fungus with “small, scattered, coal-black apothecia (to 0.1 mm diam.), with a brown hypothallus (sic!) and epithecium, and cylindrical, colourless, simple ascospores  $10\text{--}13.5 \times 1.5\text{--}2.5 \mu\text{m}$ ” on thalli of *Placopsis elixii* in New Zealand. Although we did not examine these specimens, they are likely to belong to *L. placopsidis* as well.

*Distribution and hosts.* *Llimoniella placopsidis* is known from two localities in New Zealand (South Island), where it grows on the thallus and the cephalodia (but not on the apothecia) of *Placopsis elixii* and *P. fuscidula* that are not visibly damaged.

*Additional specimen examined.* **New Zealand:** South Island: Otago, rain forest along Morrison Creek, Leith Valley Road, north side of Dunedin, Waikouaiti County, 500–800 ft., on *Placopsis fuscidula*, 1972, H. A. Imshaug 55944 (MSC).

### ***Llimoniella pyrenulae* Diederich & Etayo**

Several atypical specimens have been examined. In *R. C. Harris* 41988, ascospores are particularly short,  $8\text{--}10 \times 2.5\text{--}3 \mu\text{m}$ , compared to  $15\text{--}25 \times 2.5\text{--}3.5 \mu\text{m}$  in typical *L. pyrenulae* (Diederich & Etayo 2000). Asci in all specimens have rounded apices, except in *R. Santesson* 27716, in which they are apically slightly flattened, and even strongly flattened when damaged (similar to those of *L. phaeophysciae*).

The pigmentation is variable and more complex than indicated by Diederich & Etayo (2000). A greenish pigment (probably K–, but difficult to examine, as it is intermixed with other pigments giving a strong reaction) is present in two specimens (*R. Santesson* 27716 and *R. C. Harris* 25030A). Three specimens recently examined by us react K+ violet and K+ aeruginose green (both pigments not dissolving in K; the K+ violet reaction is stronger than that observed in *L. adnata* and *L. scabridula* and not disappearing and probably represents a distinct pigment) (isotype in hb. Diederich, *R. C. Harris* 15729A and 41988). Two other specimens react K+ orange to purplish red (pigment dissolving) (*R. C. Harris* 15729A and 25030A). One specimen appears K– (*R. Santesson* 27716), similar to species of the *L. phaeophysciae* group, possibly due to a very low concentration of pigments.

There is one taxonomically important character, an inspersed hymenium, that all these specimens have in common and this is a strong argument that they all belong to the same species, which is much more variable than initially believed.

*Distribution and hosts.* The species is known from Australia, the Dominican Republic, Kenya, Panama and the USA (Florida and Missouri), and is likely to be widespread in the Tropics. All known specimens are lichenicolous on *Pyrenula* species on which the fungus does not cause any visible damage. In specimen *R. C. Harris* 41988, the fungus grows exclusively on *P. concatervans*, and not on contiguous thalli of *P. leucostoma*.

*Additional specimens examined.* **Dominican Republic:** *Prov. La Vega:* Island in N branch of Yaque River, 1 km from Monabao on road to La Angostura, on *Pyrenula quassiaecola*, 1982, *R. C. Harris* 15729A (NY).—**Panama:** Veraguas, Bahia Honda, Cascada beach, way from the beach to the waterfall, 0–20 m, on *Pyrenula* sp., 2001, *J. Etayo* 18589 (hb. Etayo).—**USA:** *Florida:* Lee Co., Sanibel Island, ‘Ding’ Darling National Wildlife Refuge, on *Pyrenula* sp., 1977, *R. Santesson* 27716 (UPS); De Soto Co., along CR 760 at Peace River, 1.2 miles W of US 17 at Nocatee,  $27^{\circ}09' \text{N}$ ,  $81^{\circ}54' \text{W}$ , floodplain forest, on *P. concatervans*, 1998, *R. C. Harris* 41988 (NY); Liberty Co., swamp forest, Ochlockonee River at W side of Forest Service Hwy. 13 crossing, Apalachicola National Forest, on *P. thelomorpha*, 1990, *R. C. Harris* 25030A (NY).

**Llimoniella ramalinae (Müll. Arg.)  
Etayo & Diederich**

(Fig. 2J–L)

Examination of the rich material of this species (see below) revealed a great variability in pigmentation. The hymenium observed in water can be almost colourless, yellowish brown, purplish or greenish, and the brown exciple can have a reddish or greenish tinge. In K, the entire ascomatal section can turn strongly orange to purplish red (pigment dissolving), or pale to strongly violet (pigment not dissolving), and an additional K+ aeruginose green pigment (not dissolving) might be absent or present, and then frequently gives a strong reaction. As all other characters are the same in all the material, it rapidly became clear that this is a variable species in which chemical variability does not reflect the presence of several taxa. The variable pigmentation is similar to that observed in *L. pyrenulae* (see above), suggesting that both might be closely related.

*Distribution and hosts.* This species was reported by Diederich & Etayo (2000) from two Australian localities (Victoria and

Western Australia), both on *Ramalina celastri*. Dr J. Bannister kindly sent us many *Ramalina* specimens from New Zealand (all kept in OTA) infected by lichenicolous fungi, and these provided more accurate information on frequency, distribution and host selection. A total of 38 specimens infected by *L. ramalinae* have been examined. Amongst them, 23 are on *R. celastri*, whilst 15 grow on *R. unilateralis*, suggesting that the fungus is confined to these two hosts. Eleven specimens have been collected in the North Island and 27 in the South Island. A further specimen on *R. unilateralis* is a new record for Tasmania. As *R. celastri* has a palaeotropical distribution and *R. unilateralis* is also known from S Africa and S America (Galloway 2007), *L. ramalinae* should be carefully searched for in other parts of the world where the known hosts occur.

*Selected specimens examined. New Zealand:* North Island: White Pine Bush Reserve, on *R. celastri*, 1999, *J. Bannister* 1571 (OTA 61312); Esk Forest, on *R. unilateralis*, 2000, *J. Bannister* 1611 (OTA 61315); Whakamaru, on *R. celastri*, 2000, *J. Bannister* 1646 (OTA 61313); Ueka Scenic Reserve, on *R. celastri*, 2000, *J. Bannister* 1681 (OTA 61314). South Island: Akatore, on *R. unilateralis*, 2000, *J. Bannister* 1588 (OTA 61316).

**A revised key to the species of Llimoniella**

- 1    Ascomatal sections with a brown excipular and epihymenial pigment (no other pigment visible), not distinctly reacting with K (*Llimoniella phaeophysciae* group) . . . . . 2
- Ascomatal sections frequently with an additional purplish, orange brown or more rarely greenish pigment, K+ violet, purplish, reddish and/or green (reactions sometimes weak) . . . . . 6
- 2(1) Paraphyses apically strongly swollen, 5–6 µm thick, deep orange to reddish brown; ascospores 10·5–13(–13·5) × (4–)4·5–5·5 µm; on *Heppia* . . . . . **L. heppiae**
- Paraphyses apically not or slightly swollen, up to 3 µm thick, hyaline or rarely pale brown; ascospores mostly shorter. . . . . 3
- 3(2) Ascospores narrowly ellipsoid, 8·5–10(–11) × 2·5–3(–3·5) µm; upper part of the hymenium inspersed with numerous oil droplets; on *Caloplaca* and possibly *Fulgensia*. . . . . **L. groenlandiae**
- [rare forms of *L. pyrenulae* with ascomatal sections not reacting in KOH may key out here; they also have an inspersed hymenium, but are distinguished by usually much longer ascospores, (8–)15–25 × 2·5–3·5 µm and a different host selection (*Pyrenula* spp.)]
- Ascospores subspherical to ellipsoid, at least 4·5 µm broad; hymenium not inspersed . . . . . 4

- 4(3) Ascospores (6–)7–8(–9) × (4–)4·5–5·5(–6); on *Epiphloea* . . . . . **L. terricola**  
Ascospores at least 6 µm broad, often longer . . . . . 5
- 5(4) Ascomata always rounded; ascus apex appanate; on *Phaeophyscia* . . . . .  
. . . . . **L. phaeophysciae**  
Ascomata rounded or more often elongate, typically angular; ascus apex rounded; on  
*Acarospora* . . . . . **L. acarosporicola**
- 6(1) Epihymenium and upper exciple K<sup>+</sup> shortly violet (reaction distinct, but sometimes  
pale) (Fig. 2H & I); basal exciple K<sup>+</sup> dark brown (reddish tinge disappearing);  
never K<sup>+</sup> green; ascospores 1–2(–3)-guttulate, broadly ellipsoid, aseptate,  
9–13 × 4–7 µm; on terricolous hosts (*Llimoniella* s. str.) . . . . . 7  
Epihymenium and exciple K<sup>+</sup> purplish (dissolving) (Fig. 2J), reddish (Fig. 2K) or  
violet (reaction frequent, but not always strong); basal exciple usually not dark  
brown in K (often with a red tinge); frequently with an additional K<sup>+</sup> green  
pigment (Fig. 2L); ascospores multiguttulate, narrowly ellipsoid, elongate, fusi-  
form or sigmoid, septate or not, (8–)12–32 × 2·5–4 µm (except in *L. fuscatae*, in  
which ascospores are broadly ellipsoid; distinguished from *Llimoniella* s. str. by an  
exciple remaining reddish brown in K and multiguttulate ascospores); on corti-  
colous or saxicolous hosts (*Llimoniella* s. lat.) . . . . . 9
- 7(6) Ascospores relatively narrow, 9–11 × 4–5 µm; ascomatal margin scabrous; on terri-  
colous *Acarospora nodulosa* and *A. placodiiformis* . . . . . **L. scabridula**  
Ascospores at least 5·5 µm broad; ascomatal margin not scabrous. . . . . 8
- 8(7) Hymenium 100–120 µm; asci 80–90 × 8–9 µm; ascospores 11–13 × 6–7 µm, 1–2-  
guttulate; ascomata regularly roundish; on *Placidium* (border of squamules) . .  
. . . . . **L. adnata**  
Hymenium 60–80 µm; asci 50–70 × 12–16 µm; ascospores slightly shorter,  
9–12 × 5·5–7·5 µm, multiguttulate; ascomata more irregular in form, never  
roundish; on *Acarospora fuscata* . . . . . see 9 [*L. fuscatae*]
- 9(6) Ascospores broadly ellipsoid, 9–12 × 5·5–7·5 µm; on *Acarospora fuscata* . **L. fuscatae**  
Ascospores narrowly ellipsoid, elongate, fusiform or sigmoid, septate or not,  
(8–)12–32 × 2·5–4 µm . . . . . 10
- 10(9) Hymenium inspersed; ascospores aseptate, (8–)15–25 × 2·5–3·5 µm; on *Pyrenula*  
. . . . . **L. pyrenulae**  
Hymenium not inspersed . . . . . 11
- 11(10) Ascospores 1–3-septate, sigmoid, 15–32 × 3–4 µm; on *Ochrolechia* and *Pertusaria*  
*cf. borealis* . . . . . **L. vinosa**  
Ascospores septate or not, straight or curved, but never sigmoid, less than 17 µm long  
. . . . . 12
- 12(11) Ascospores 1-septate, straight or slightly curved, 12–16 × 3–4 µm; on *Ramalina*  
*celastris* and *R. unilateralis* . . . . . **L. ramalinae**  
Ascospores aseptate (exceptionally up to 3-septate when overmature) . . . . . 13
- 13(12) Ascospores 12–17 × 2·5–4 µm; ascomatal margin smooth or concentrically stri-  
ate; ascomata 300–600 µm diam.; on *Pertusaria glaucomela* and *P. ophthalmiza*  
. . . . . **L. pertusariae**  
Ascospores 9–12 × 2·5–3 µm; ascomatal margin often uneven or cracked; ascomata  
150–300(–350) µm diam.; on *Placopsis* . . . . . **L. placopsisid**

## Excluded species

### *Llimoniella muralicola* Halici

*Mycotaxon* 105: 204 (2008); type: Turkey, Denizli, Dikmen village, Babadağ, 38°43' N, 28°52' E, 2065 m, on the thallus of saxicolous *Lecanora muralis*, 14 June 2007, M. Kocakaya (hb. M.G. Halici 0.5268, Erciyes University, Science & Art Faculty, Biology Department, Kayseri, Turkey—holotype!).

The type specimen is relatively small (one large and more than ten smaller ascomata) and in a poor condition (the hymenium of the large ascoma is parasitized by a fungus with a brown mycelium, and a smaller ascoma examined by us was immature). Thus we did not see any healthy asci. As the ascomata are strongly urceolate, initially almost closed, later with a relatively thin undulating margin mostly covering the disk, the species certainly does not belong to *Llimoniella* s. lat. Macroscopically, the ascomata are reminiscent of those of some *Unguiculariopsis* species [e.g., *U. thallophila* (P. Karst.) W. Y Zhuang], but the excipular hairs characteristic of *Unguiculariopsis* are poorly developed. We prefer therefore to exclude the species from *Llimoniella*, and to await the discovery of richer material before transferring it to *Unguiculariopsis*.

### New combinations in *Rhymbocarpus*

From the discussion above, and after examination of specimens of the generic type *Gelatinopsis geoglossi*, it became clear that the two remaining lichenicolous species of *Gelatinopsis* should best be included in the genus *Rhymbocarpus*. Both have brown to blackish ascomata that are entirely or half immersed and without any visible margin, a relatively thin and reduced, poorly pigmented exciple made of elongate, more or less parallel hyphae, a brown excipular pigment and a greenish pigment in the upper exciple and epihymenium (observed in all specimens, except the type of *G. roccellae*) (Fig. 2G). They are both very similar to the generic type, *Rhymbocarpus geographicus* (J. Steiner) Vouaux.

### *Rhymbocarpus ericetorum* (Körb.) Etayo, Diederich & Ertz comb. nov.

Basionym: *Nesolechia ericetorum* Körb., *Parerga Lich.* 461 (1865).—*Lecidea ericetorum* (Körb.) H. Olivier, *Princ. Par. Lich. Fr.*, Suppl.: 6 (1907).—*Phacopsis ericetorum* (Körb.) Vouaux, *Bull. Soc. Mycol. France* 30: 144 (1914).—*Gelatinopsis ericetorum* (Körb.) Rambold & Triebel, *Notes RBG Edinb.* 46: 376 (1990); type: Poland, Silesia, prope praedium Paulinum circa Hirschbergam, on *Dibaeis baeomyces*, 1862, G. W. Körber (Körber *Lich. Sel. Germ.* 300, sub *Nesolechia ericetorum*) (M—lectotype, selected by Rambold & Triebel 1990: 376, n.v.; E—isolectotype!).

For a modern description and illustrations, see Rambold & Triebel (1990) and Baral & Marson (2001).

### *Rhymbocarpus roccellae* (Etayo, Paz-Bermúdez & Diederich) Etayo, Diederich & Ertz comb. nov.

Basionym: *Gelatinopsis roccellae* Etayo, Paz-Bermúdez & Diederich, *Lichenologist* 33: 473 (2001); type: Spain, A Coruña, Illa de Sálvora, Praia do Almacén, on granite, on *Rocella phycopsis*, June 1996, G. Paz-Bermúdez (SANT-Lich 9862—holotype!; hb. Diederich, hb. Etayo—isoatypes!).

(Fig. 2G)

For a description and illustrations, see Etayo *et al.* (2001).

*Additional specimens examined.* **Canary Islands:** *Fuerteventura:* Parc Natural de Jandia, on *Rocella*, 2001, P. & B. van den Boom 25917 (hb. van den Boom).—**Mexico:** *Baja California Sur:* Punta Abreojos, on *Rocella babingtonii*, 1985, T. Nash 26361 (ASU, hb. Diederich).

### Redescription of *Geltingia associata*

The genus *Geltingia* was described for three species of lichenicolous fungi (Alstrup & Hawksworth 1990), two of which were later considered not to be congeneric with the type species (Diederich & Etayo 2000). After the exclusion of these two species, the genus *Geltingia* became monotypic. Although a modern description of *G. associata* was given by Rambold & Triebel (1990), we present here a re-description, based on the study of recent material, and focusing on the



FIG. 5. *Geltingia associata*, asci, paraphysis and ascospores (*T. Tønsberg* 24700). A & C, in Congo Red after pre-treatment with 5% KOH; B & E, in Lugol's reagent after pre-treatment with 5% KOH, note the thickened apical ascus wall with a distinct ocular chamber in B; D, ascospore in water (left in optical section, showing thick wall; right in surface view, showing verruculose ornamentation). Scale = 10  $\mu$ m.

characters that distinguish the genus from *Llimoniella phaeophysciae*. The type specimen of *Geltingia associata* has not been examined by us, but was studied by Rambold & Triebel (1990), who also gave a list of synonyms and specimens. The genus *Geltingia* belongs to the *Helotiales*, but currently cannot be assigned to any family.

***Geltingia associata* (Th. Fr.) Alstrup & D. Hawksw.**

*Lecidea associata* Th. Fr., *Kongl. Svensk Vetenskapsakad. Handl.* 7 (2): 42 (1867); type: Spitsbergen, Danskøn,

1861, *A. J. Malmgren* (UPS—lectotype, selected by Rambold & Triebel 1990: 380, n.v.).

(Figs 1G & H, 2E & F, 5)

*Ascomata* immersed, occasionally erumpent and breaking through the host cortex, margins frequently covered by fragments of that cortex, roundish or more often elongate to irregular in form, sometimes with an undulate margin, dispersed, 200–600(–800)  $\times$  (100–)150–250  $\mu$ m, with a more or less distinct, sometimes prominent, dark reddish or blackish, matt to slightly shiny margin of 25–50  $\mu$ m and a dark reddish,

very shiny, applanate or uneven disc. *Exciple* orange-brown, K-, N-, laterally of thick-walled, elongate, rarely branched, more or less parallel or slightly interwoven hyphae of 3.5–5.5 µm diam., 20–50 µm thick, basally paler, of conglutinated, thick-walled and more or less isodiametric cells, 20–50 µm thick, sometimes almost indistinct; without hairs. *Subhymenium* colourless or brownish. *Epilhymenium* relatively thick, orange-brown, K-, N-. *Hymenium* colourless to yellowish, not inspersed, 75–90 µm tall, I-, K/I-. *Paraphyses* septate, simple or more rarely branched, apically slightly swollen, 1.5–2.5 µm thick, with few oil guttules. *Asci* subcylindrical, apically rounded, 8-spored, wall laterally thin, apically thickened, always with a distinct ocular chamber, without croziers, 55–80 × 7–12 µm, I-, K/I-. *Ascospores* uniseriate in the ascus, non-septate, colourless, subglobose to shortly ellipsoid, with one large lipid guttule, 6–10 × 5–7.5 µm, wall finely verruculose (when observed in surface view at × 1000), 0.5–1 µm thick, without perispore.

*Conidiomata* unknown.

*Distribution and hosts.* *Geltingia associata* is usually found on *Ochrolechia* species (Fig. 2G), including *O. androgyna*, *O. frigida*, *O. inaequatula*, *O. tartarea* and *O. upsaliensis*, more rarely on *Pertusaria dactylina*, and exceptionally on *Thamnolia* (see below) (Fig. 2H). It is known from Greenland, Iceland, Norway, Russia, Scotland, Sweden, Spitsbergen and the USA (Alaska and Washington) (Alstrup & Hawksworth 1990; Rambold & Triebel 1990; Zhurbenko *et al.* 1995; Zhurbenko & Santesson 1996; Zhurbenko & Himelbrant 2002; Santesson *et al.* 2004; Svane & Alstrup 2004). Walker (1970) reported the species (as *Nesolechia associata*) from Scotland on *Thamnolia vermicularis*; unfortunately, we were not able to locate and check the identity of the corresponding specimen (not in BM, E, or K). Similarly, Zhurbenko & Santesson (1996) published material from Russia on *T. vermicularis*. We checked these Russian specimens and can confirm that they are correctly identified. In one specimen, the fungus develops mainly over terricolous *Ochrolechia*, whilst a few ascomata grow on

*Thamnolia*, and the second specimen contains a small, decaying, infected thallus of *Thamnolia*. Although this is very much unexpected, we can thus confirm that *G. associata* sometimes develops over thalli of *Thamnolia*. This lichen often grows together with some humicolous *Ochrolechia* species that are very invasive over bryophytes, small plants and other lichens. Possibly, these thalli of *Thamnolia* are covered by a very thin thalline layer of a humicolous *Ochrolechia*, and thus the *Ochrolechia* thallus, and not the underlying *Thamnolia*, is attacked by the fungus. The species was also reported from Spain over *Phaeophyscia nigricans* (Marcos Laso 2001), but this almost surely refers to material of the new *Llimoniella phaeophysciae* (see above).

*Specimens examined.* On *Ochrolechia*: **Iceland:** Eyjafjarðarsysla, Öxnadalshéiði, 65°28' N, 18°44' W, 450 m, on *O. upsaliensis*, 1992, S. Svane 92SS9133D (C); S-Píngeyjarsysla, Grenjadarstaður, 65°50' N, 17°20' W, 50 m, on *O. frigida*, 1992, S. Svane 92SS9161A (C); N-Múlasysla, Borgarfjarður, Hofströnd, 65°31' N, 13°46' W, on detritus, 1997, U. Søchting US7509 (C).—**Norway:** Troms; Storfjord, between Luhcájávri and Stuoraaoivi, 69°16' N, 20°25' E, alt. c. 700 m, on *O. frigida*, 2002, V. Alstrup N-195 (C 6338).—**Sweden:** Torne Lappmark; Gemeinde Kiruna, Torneträsk-Gebiet, oberhalb Björkliden, 1970, K. Kalb 15163 (hb. Kalb).—**USA:** Alaska: Cordova, N of Copper River Hwy, along Saddlebag Glacier Trail, at the creek from Saddlebag Lake, 12°28.3' N, 145°07.5' W, 2001, T. Tønsberg 29800 (Santesson *Fungi Lich. Exs.* 379, UPS). Washington: Kitsap Co., Blake Island, N shore along the path on the bluff, 47°33' N, 122°30' W, alt. 10 m, 1997, T. Tønsberg 24700 (BG); Jefferson Co., c. 9.5 km NE of the Pacific coast at Ruby Beach, along Noland Rd 200–300 m from Hwy 101/Nolan Rd junction, at Nolan Creek, 47°45' N, 124°19' W, alt. 40 m, 1995, T. Tønsberg 23371 (BG).

On *Pertusaria dactylina*: **Greenland:** W Disko Island, Mellemfjord, Enoks Havn, 1950, P. Gelting (C).

On *Thamnolia vermicularis* var. *subuliformis*: **Russia:** N Siberia, Taimyr Peninsula: mouth of Ragozinka River, 72°48' N, 80°53' E, on *Ochrolechia* and *Thamnolia*, 1990, M. Zhurbenko 90358 (LE 207274a); N of Levinson-Lessing Lake, 74°31' N, 98°36' E, alt. 250 m, 1995, M. Zhurbenko 95307 (LE 233024).

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## REFERENCES

- Alstrup, V. & Hansen, E. S. (2001) New lichens and lichenicolous fungi from Greenland. *Graphis Scripta* **12**: 41–50.
- Alstrup, V. & Hawksworth, D. L. (1990) The lichenicolous fungi of Greenland. *Meddelelser om Grønland, Bioscience* **31**: 1–90.
- Baral, H.-O. & Marson, G. (2001) Monographic revision of *Gelatinopsis* and *Calloriopsis* (*Calloriopsidae*, *Leotiales*). *Micologia* 2000, Centro Studi Micologici, pp. 23–46.
- Diederich, P. & Etayo, J. (2000) A synopsis of the genera *Skyttea*, *Llimoniella* and *Rhymbocarpus* (lichenicolous Ascomycota, Leotiales). *Lichenologist* **32**: 423–485.
- Ertz, D. & Diederich, P. (2006) *Gelatinopsis leptogii* (Helotiales, Ascomycota), a new lichenicolous fungus on *Leptogium byssinum* from Belgium and Germany. *Lichenologist* **38**: 515–518.
- Etayo, J., Paz-Bermúdez, G. & Diederich, P. (2001) *Gelatinopsis roccellae* (Leotiales, Ascomycota), a new lichenicolous fungus on *Roccella* from NW Spain. *Lichenologist* **33**: 473–476.
- Galloway, D. J. (2001) *Placopsis elixii*, a new lichen from New Zealand, with notes on some other species of *Placopsis* (Nyl.) Linds. (Agyriaceae) in New Zealand. *Bibliotheca Lichenologica* **78**: 49–63.
- Galloway, D. J. (2007) *Flora of New Zealand Lichens. Revised Second Edition Including Lichen-forming and Lichenicolous Fungi. Vols 1 and 2*. Lincoln, New Zealand: Manaaki Whenua Press.
- Hafellner, J. (2004) *Buelliella*. In *Lichen Flora of the Greater Sonoran Desert Region. Vol. 2*. (T. H. Nash III, B. D. Ryan, P. Diederich, C. Gries & F. Bungartz, eds): 633–635. Tempe: Lichens Unlimited, Arizona State University.
- Kocourková, J. & Knudsen, K. (2009) *Gelatinopsis acarosporicola* (Helotiaceae), a new lichenicolous fungus on *Acarospora socialis* from western North America. *Bryologist* **112**: 363–367.
- Kümmerling, H., Triebel, D. & Rambold, G. (1993) *Lepraria neglecta* and its lichenicolous fungi. *Bibliotheca Lichenologica* **53**: 147–160.
- Marcos Laso, B. (2001) Biodiversidad y colonización líquénica de algunos monumentos en la ciudad de Salamanca (España). *Botanica Complutensis* **25**: 93–102.
- Navarro-Rosinés, P., Hladun, N. L. & Llimona, X. (2008) *Gelatinopsis heppiae* sp. nov. (Leotiales, Ascomycota) un hongo liquenícola sobre *Heppia despreauxii* de Aragón (NE de España). *Revista Catalana de Micologia* **30**: 57–64.
- Rambold, G. & Triebel, D. (1990) *Gelatinopsis*, *Geltingia* and *Phaeopyxis*: three helotielean genera with lichenicolous species. *Notes from the Royal Botanic Garden Edinburgh* **46**: 375–389.
- Santesson, R., Moberg, R., Nordin, A., Tønsberg, T. & Vitikainen, O. (2004) *Lichen-Forming and Lichenicolous Fungi of Fennoscandia*. Uppsala: Museum of Evolution, Uppsala University.
- Svane, S. J. & Alstrup, V. (2004) Some lichenicolous fungi from Iceland. *Acta Botanica Islandica* **14**: 53–58.
- Walker, A. K. (1970) A discomycete parasitic on *Thamnolia vermicularis*. *Transactions and Proceedings of the Botanical Society of Edinburgh* **41**: 59–60.
- Zhurbenko, M. P. & Himelbrant, D.E. (2002) Lichenicolous fungi from the Kandalaksha Gulf, Karelia Keretina, Russia [Kandalaksha lahe ümbruse (Karejala) lihhenikooldes seened]. *Folia Cryptogamica Estonica* **39**: 51–59.
- Zhurbenko, M. & Santesson, R. (1996) Lichenicolous fungi from the Russian Arctic. *Herzogia* **12**: 147–161.
- Zhurbenko, M., Santesson, R., Walker, D. A., Auerbach, N. A. & Lewis, B. (1995) New and interesting lichenicolous fungi and lichens from Alaska. *Evansia* **12**: 92–97.