

# Revisions of British and Irish Lichens



*British  
Lichen  
Society*

**Volume 30**

**December 2022**



**Lecanorales: Sphaerophoraceae**

Cover image: *Sphaerophorus globosus*, thallus on mossy bark of *Quercus petraea*, Bryn Engan, Capel Curig, Caernarvonshire, Wales.

*Revisions of British and Irish Lichens* is a free-to-access serial publication under the auspices of the British Lichen Society, that charts changes in our understanding of the lichens and lichenicolous fungi of Great Britain and Ireland. Each volume will be devoted to a particular family (or group of families), and will include descriptions, keys, habitat and distribution data for all the species included.

#### Key to map date classes

- 2000–
- 1960 - 1999
- 1650 - 1959

The maps are based on information from the BLS Lichen Database, that also includes data from the historical Mapping Scheme and the *Lichen Ireland* database. Conservation assessments use the [codes](#) listed in the BLS website. The four-digit number at the end of each description refers to BLS numbers which are part of the recording scheme; they link to species rather than names, and are unchanged (with rare exceptions)

when names alter following improvements in taxonomy.

To date, accounts of lichens from our region have been published in book form. However, the time taken to compile new printed editions of the entire lichen biota of Britain and Ireland is extensive, and many parts are out-of-date even as they are published. Issuing updates as a serial electronic publication means that important changes in understanding of our lichens can be made available with a shorter delay. The accounts may also be compiled at intervals into complete printed accounts, as new editions of the *Lichens of Great Britain and Ireland*.

#### Editorial Board

Dr P.F. Cannon (Department of Taxonomy & Biodiversity, Royal Botanic Gardens, Kew, Surrey TW9 3AB, UK)

Dr A. Aptroot (Laboratório de Botânica/Liquenologia, Instituto de Biociências, Universidade Federal de Mato Grosso do Sul, Avenida Costa e Silva s/n, Bairro Universitário, CEP 79070-900, Campo Grande, MS, Brazil)

Dr B.J. Coppins (Royal Botanic Garden, Inverleith Row, Edinburgh EH3 5LR, UK)

Dr A.M. Fryday (Department of Plant Biology, Michigan State University, 612 Wilson Rd., East Lansing, MI 48824, USA)

Mr A. Orange (Department of Natural Sciences, National Museum of Wales, Cardiff CF10 3NP, UK)

Mr N.A. Sanderson (3 Green Close, Woodlands, Southampton, Hampshire SO40 7HU, UK)

Dr J.A. Simkin (School of Natural and Environmental Science, Newcastle University, Newcastle upon Tyne NE1 7RU, UK)

Dr R. Yahr (Royal Botanic Garden, Inverleith Row, Edinburgh EH3 5LR, UK)

Downloads can be obtained from the British Lichen Society website at

<https://www.britishlichensociety.org.uk/content/lgbi3>

Made available under Creative Commons Licence  CC BY-SA

ISSN 2634-7768

© British Lichen Society, 25 December 2022

# *Revisions of British and Irish Lichens* vol. 30

## **Lecanorales: Sphaerophoraceae**

including the genera *Bunodophoron*, *Gilbertaria* and *Sphaerophorus*.

by

Paul Cannon

Royal Botanic Gardens, Kew, Surrey TW9 3AB, UK; email p.cannon@kew.org

Alan Fryday

Herbarium, Department of Plant Biology, Michigan State University, East Lansing, MI 48824-1312, USA

Måns Svensson

Museum of Evolution, Uppsala University, Norbyvägen 16, SE-752 36 Uppsala, Sweden

Mats Wedin

Department of Botany, Naturhistoriska Riksmuseet, Box 50007, SE-104 05 Stockholm, Sweden

André Aptroot

Laboratório de Botânica/Liquenologia, Instituto de Biociências, Universidade Federal de Mato Grosso do Sul, Avenida Costa e Silva s/n, Bairro Universitário, CEP 79070-900, Campo Grande, MS, Brazil

Brian Coppins

Royal Botanic Garden Edinburgh, 20A Inverleith Row, Edinburgh EH3 5LR, UK

Alan Orange

52 Insole Grove East, Llandaff, Cardiff CF5 2HP, UK

Neil Sanderson

3 Green Close, Woodlands, Southampton, Hampshire, SO40 7HU, UK

Janet Simkin

School of Natural and Environmental Science, Newcastle University, Newcastle upon Tyne NE1 7RU, UK

**This publication can be cited as:**

**Cannon, P., Fryday, A., Svensson, M., Wedin, M., Aptroot, A., Coppins, B., Orange, A., Sanderson, N. & Simkin, J. (2022).** Lecanorales: Sphaerophoraceae, including the genera *Bunodophoron*, *Gilbertaria* and *Sphaerophorus*. *Revisions of British and Irish Lichens* **30**: 1-7.

## SPHAEROPHORACEAE Fr. (1831)

**Thallus** in most species shrubby, erect or decumbent, but in others squamulose, peltate or crustose. When fruticose, **branches** rounded or  $\pm$  flattened,  $\pm$  brittle, sometimes with differentiated fertile branches. When crustose, squamulose, granular-areolate or filmy. **Photobiont** chlorococcoid. **Ascomata** apothecia, forming prominent sooty mazaedia in the fruticose genera, terminal or rarely lateral on the underside of fertile branches, or distinctly stalked and podetium-forming in some non-British genera, or  $\pm$  sessile on crustose/squamulose thalli. **Thalline margin** persistent and forming irregular flaps around the apothecium, lost early in development, or entirely absent. **True exciple** not differentiated in most species, present but poorly differentiated in one crustose species. **Hamathecium** disintegrating in mazaedial species, or in crustose species with conglutinated paraphyses that are sometimes branched near the apex, and not or only slightly widened at the apex. **Asci** 8-spored, cylindrical, *Calicium*-type in mazaedial taxa, *Biatora*-type in crustose taxa. **Ascospores** aseptate or 1-septate, globose or ellipsoidal to dacryoid, smooth or with irregular, amorphous or granular ornamentation; colourless when young, sometimes later darkening. **Conidiomata** pycnidia situated in tips and along the lower side of terminal branches, ? or immersed in crustose thalli. **Conidia** filiform to rod-shaped or ellipsoidal.

Seven genera (Wedin & Döring 1999, Lücking *et al.* 2016, Svensson & Fryday 2022), of which three occur in Great Britain and Ireland. The family, traditionally including fruticose and mazaediate taxa, was shown to include two small squamulose Southern Hemisphere genera (Wedin & Döring 1999) and recently the crustose *Gilbertaria* (Svensson & Fryday 2022). Indications were that the Sphaerophoraceae is related to the Psoraceae and Ramalinaceae (Ekman & Wedin 2000, Prieto *et al.* 2012) or the Pilocarpaceae (Miądlikowska *et al.* 2014), and the analysis by Svensson & Fryday (2022) now confirms a close relationship to the Psoraceae and Ramalinaceae.

### Literature

Ekman & Wedin (2000), Kantvilas (2022), Lücking *et al.* (2016), Miądlikowska *et al.* (2014), Prieto *et al.* (2012), Svensson & Fryday (2022), Wedin (1993), Wedin & Döring (1999), Wedin *et al.* (2000).

- 1      Thallus crustose, thin and filmy or granular-areolate; asci persistent ..... *Gilbertaria*  
 Thallus fruticose, richly branched; asci evanescent, the apothecia mazaedial..... 2
- 2(1)   Thallus at least partly flattened; apothecia losing the enclosing thalline exciple early and  
 exposing the mazaedia ventrally; spores globose, colourless to dark grey ..... *Bunodophoron*  
 Thallus terete throughout; apothecia globose with thalline exciple persisting and at least partly  
 enclosing the mazaedia which are exposed apically; spores broadly ellipsoidal, dark violet  
 to black ..... *Sphaerophorus*

## BUNODOPHORON A. Massal. (1861)

**Thallus** shrubby, erect or decumbent. **Branches** usually  $\pm$  flattened, often with differentiated, subterete fertile branches protruding from a carpet of shorter sterile ones. **Photobiont** trebouxoid. **Ascomata** apothecia, terminal or rarely lateral on the underside of fertile branches, forming prominent sooty mazaedia. **Thalline margin** lost early in development. **Asci** 8-spored, cylindrical, *Calicium*-type. **Ascospores** uniseriate in the ascus, aseptate, globose, with irregular, amorphous ornamentation; colourless when young, later darkening. **Conidiomata** pycnidia, situated in branch tips and along the

lower side of terminal branches. **Conidia** rod-shaped. **Chemistry**: sphaerophorin,  $\beta$ -orcinol depsidones, usnic acid, dibenzofuranes. **Ecology**: on siliceous rocks.

For separation from the closely related *Sphaerophorus* see that genus. Only one species occurs in our region.

#### Literature

Soto Medina *et al.* (2018), Wedin (1995), Wedin & Gilbert (2009a).

#### **Bunodophoron melanocarpum** (Sw.) Wedin (1995)

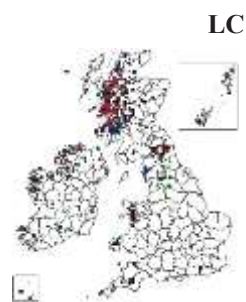
Thallus forming grey to grey-green patches or dense carpets of small sterile branches, often with larger (to 6 cm) protruding fertile ones irregularly intermingled; sterile branches *ca* 1 mm broad, usually flattened to subterete. Fertile branches to 3 mm broad, subterete to narrowly compressed, often broadly flattened towards the base; sparingly branched, often lined with abundant bundles of short, fragile isidioid branchlets. Apothecia infrequent, at the apices of the fertile branches, often lined with short, isidioid branchlets; mazaedia soon exposed  $\pm$  ventrally by breakdown of the thalline margin. Ascospores globose, 5.5–8  $\mu$ m diam., colourless to dark grey. Medulla C–, K+ yellow, KC–, I–, Pd+ orange, UV+ blue-white (sphaerophorin, stictic acid complex; the latter is often the main component in apothecia). **BLS 1334**.

On mossy rocks, trees and occasionally on soil, often in rather sheltered situations; local. N. & W. Britain and Ireland.

The taxonomy and nomenclature of *Bunodophoron melanocarpum* s. lat., a primarily tropical group, is still in need of clarification (Soto Medina *et al.* 2018). The European taxon is probably not conspecific with *B. melanocarpum* s. str., which was described from Jamaica.

When thalli are dense and cushion-like it may be necessary to pull them apart to expose branches that are flattened towards the base; this is the best field character to separate British *Bunodophoron* and *Sphaerophorus*.

A species of *Abrothallus* similar to *A. cladoniae* R. Sant. & D. Hawksw. (1990) has been reported from *B. melanocarpum* on Mull.



### GILBERTARIA M. Svensson & Fryday (2022)

Thallus granular-areolate, grey or very thin, gelatinous; rarely with solitary soralia. Photobiont chlorococcoid; frequently associated with tufts of filamentous cyanobacteria (*Stigonema* sp.) that occur between areoles or in the vicinity of apothecia. **Apothecia** black, lecideine,  $\pm$  flat to strongly convex, usually without any discernible margin, not pruinose, without crystals refracting polarized light. **True exciple** absent or composed of sparsely branched, radiating hyphae. **Hamathecium** of paraphyses, comparatively broad, not or only slightly thickened apically, without a pigmented cap, slightly branched above, sometimes anastomosing below, conglutinate in a hymenial gel. **Hypothecium** colourless or dilute brown, rarely darker brown, massively developed. **Asci** persistent, *Biatora*-type, 8-spored, cylindrical to clavate; tholus KI+ blue with a narrow conical masse axiale, the border of the surrounding tholus KI+ darker blue. **Ascospores** (0–)1(–3) septate. **Conidiomata** ? absent (not observed by Svensson & Fryday 2022). **Chemistry**: Thallus K–, C–, UV– or UV+ faintly grey. No secondary metabolites detected by HPTLC. **Ecology**: overgrowing bryophytes in montane ecosystems.

The genus was introduced by Svensson & Fryday (2022) to accommodate the “*Catillaria*” *contristans* aggregate along with *Toninia squalescens*; these were considered to be excluded from the Ramalinaceae s.l. by Kistenich *et al.* (2018), and their phylogenetic affinities are only now clear. Their morphology contrasts markedly with other British and Irish members of the Sphaerophoraceae but their systematic position is strongly supported by molecular data.

### Literature

Cannon *et al.* (2021, 2022), Fletcher & Coppins (2009), Hitch *et al.* (2009), Kistenich *et al.* (2018), Svensson & Fryday (2022).

- 1      Thallus granular-areolate to squamulose.....2  
       Thallus at most a thin, gelatinous film ..... *holomeloides*
- 2(1)   Thallus of grey, bullate squamules; ascospores usually < 10 µm long.....*squalescens*  
       Thallus granular-areolate; ascospores usually > 10 µm long.....*contristans*

### *Gilbertaria contristans* (Nyl.) M. Svensson & Fryday (2022)

LC

*Catillaria contristans* (Nyl.) Zahlbr. (1926)

Thallus warty-granular, thick, verrucose, deeply cracked, sometimes with discrete ± globose areoles 0.05–0.3 (–0.5) mm diam., white or usually pale to dark grey or grey-brown, rarely with isolated soralia. Apothecia 0.2–0.6 (–1) mm diam., convex to subglobose, black, often clustered, glossy, sometimes (especially when young) with a white byssoid collar at the base; true exciple reflexed, only visible when young, colourless or pale green or brown in part, the hyphae coherent in K, 2–2.5 µm diam., some extending as loose hyphae to form the byssoid collar; epithecium dark blue, K+ greenish blue, N+ magenta; hymenium 60–70 µm tall, colourless or pale blue, olivaceous to aeruginose in the upper part, colourless or pale brown in the lower part; hypothecium colourless or pale fuscous brown (especially the upper part), K–; paraphyses 1.5–3 µm diam., unbranched or many with short lateral branches, coherent in K, each surrounded by a gel coat; apices not or only slightly swollen, colourless or covered with dark blue epithecial material. Asci *Biatora*-type. Ascospores 9–15 (–18) × 2.5–4.5 (–6) µm, (0–)1(–3)-septate, ellipsoidal or ovoid-cylindrical, often ± dacryoid with one end rounded and the other tapering to a narrow, rounded point, sometimes slightly constricted at the septum. Pycnidia black, ± immersed, the wall dark green; conidiogenous cells in chains; conidia 3.5–4 × 0.7–1 µm, bacillar. Lichen products not detected by TLC. **BLS 0309.**



On bryophytes or plant debris on rocks or on the ground, in ‘acid’ habitats especially above 500 m; scarce. England (N. Pennines), N. Wales, Scotland (Highlands), Ireland.

Early molecular phylogenetic studies (Andersen & Ekman 2005) suggested a close relationship to *Micarea* (Pilocarpaceae), but the specimen upon which this was based was incorrectly identified. Also similar are *M. lignaria* and small morphs of *Protomicarea limosa* (Psoraceae), which both occur in the same habitats, but can be separated microscopically on the basis of ascospore septation and Pd reaction of the thallus (Pd– in *C. contristans*).

Pycnidia were reported for this species by Fletcher & Coppins (2009), but they were not observed by Svensson & Fryday (2022) and it is not clear whether the reports were in error or that Scottish populations are distinct in some way from those in Scandinavia.

### *Gilbertaria holomeloides* (Nyl.) M. Svensson & Fryday (2022)

NE

Thallus wide-spreading but effuse, at most a thin, pale greyish to brown gelatinous film may be present; apothecia arising directly from underlying bryophytes. Apothecia black, lecideine, sessile with a ± constricted base, strongly convex even when immature, becoming orbicular, 0.2–0.3 (–0.5) mm diam., true exciple not apparent; hymenium 45–70 µm tall, colourless or rarely light blue-green; paraphyses mostly (1–) 1.5–2.5 µm diam., occasionally with solitary thicker paraphyses (to ca 3.5 µm diam.) interspersed, often forked towards the apices, which are not swollen and immersed in a hymenial gel; upper 5–10 µm (epithecium) patchily blue (K+ brighter greenish blue, N+ magenta), the pigment often confined to a gel matrix above the apices of the paraphyses; hypothecium massively developed (ca 250 µm deep), patchily light brown, rarely darker brown (K–), often with numerous dark blue-black streaks and spots (K+ blue-black, N+ magenta). Asci *Biatora*-type. Ascospores colourless, (0–) 1-septate, (9–) 10–12.5 (–15) × (2.0–) 2.5–4 (–4.5) µm, straight or slightly curved, narrowly ellipsoidal with bluntly pointed apices. Conidiomata not observed. **BLS 2831.**

On the ground (usually overgrowing *Gymnomitrium* mats), Scotland (Mid Perthshire, Ben Lawers). Records of *G. contristans* from areas of late snow-lie probably belong here.

An inconspicuous species due to its filmy thallus, previously included in the synonymy of *G. contristans* but separated from that species in the field by its lack of a visible thallus and smaller, more convex apothecia. *G.*

*contristans* grows in more dry situations on dying bryophytes on, for example, sloping rock-walls, whereas *G. holomeloides* tends to grow in more humid situations on the ground. In the field, most similar to the rare *Micarea viridiatra*, which differs in having thinner, branched and anastomosing paraphyses and lacking any brown pigments internally.

### **Gilbertaria squalescens** (Nyl.) M. Svensson & Fryday (2022)

*Toninia squalescens* (Nyl.) Th. Fr. (1874)

Thallus of grey bullate squamules 0.3–0.5 (–0.8) mm diam. forming a ± contiguous crust to 2–3 cm across and *ca* 0.1 mm thick. Apothecia black, strongly convex and marginless even when young, with a more or less constricted base; mature apothecia (0.3–) 0.5–0.8 mm diam., often appearing to be formed from several confluent apothecia, and then 1.0–1.2 mm across. In section, true exciple not apparent. Hymenium 50–70 µm tall; paraphyses 2–3 (–4) µm diam., slightly branched only towards the apices, which are not swollen and are immersed in a hymenial gel; upper 5–10 µm (epithecium) patchily blue (K+ brighter greenish-blue, N+ magenta), the pigment extending down through the hymenium in broad streaks. Hypothecium merging imperceptibly with the hymenium, of randomly organized colourless hyphae *ca* 3 µm diam., the upper 50–75 µm dilute brown (K–, N+ dilute golden-brown) with darker spots, lower part ± colourless. Asci *Biatora*-type, cylindrical, 20–35 × *ca* 10 µm, becoming somewhat clavate and to 15 µm diam.; ascospores colourless, (0–)1(–3)-septate, (5–) 8.5–12 (–14) × (2.5–) 3.5–4 (–5) µm, broadly ellipsoidal, often with one end rounded and the other narrowing to a rounded point, sometimes ± dacryoid. Conidiomata not observed. Thallus K–, C–, Pd–, UV– or UV+ faintly grey or white. **BLS 1426.**

On mosses on siliceous rocks, montane; very local. N. Scotland (Central Highlands, N.W. Highlands (Kintail)). The areoles are often overgrown by a dark hyphal net that may represent a species of *Moriola*, and this also sometimes infects the apothecia, which become brown and distorted.

Kistenich *et al.* (2018) noted that molecular data places this species outside of the Ramalinaceae and close to *Catillaria contristans*, and this relationship was confirmed by Svensson & Fryday (2022). In addition to similarities with other *Gilbertaria* species, *G. squalescens* could be mistaken for *Frutidella caesioatra* (Lecanoraceae), which likewise grows on dying bryophytes on acid rock in montane situations. However, the thallus of the latter species is not composed of bullate areoles but of more or less isidioid granules and the apothecia are usually blue-grey pruinose.

Separated from *G. contristans* by its better developed thallus, more convex apothecia and shorter ascospores. British material was reported by Hitch *et al.* (2009) as having a K+ yellow thallus (stictic acid), but all material studied by Svensson & Fryday (2022) was K–; the Scottish material needs re-examination.



**Nb**

## **SPHAEROPHORUS** Pers. (1794)

**Thallus** fruticose, erect or decumbent. **Branches** numerous, rounded, often rather brittle. **Photobiont** trebouxiod. **Ascomata** apothecia, terminal, globose, forming prominent sooty mazaedia. **Thalline margin** persisting, eventually torn and forming irregular flaps surrounding the mazaedia. **Asci** 8-spored, cylindrical, *Calicium*-type; wall soon disintegrating. **Ascospores** uniseriate in the ascus, aseptate, broadly ellipsoidal, violet-blue, almost completely covered by a thick dark granular ornamentation. **Conidiomata** pycnidia, situated in thallus tips and along the lower sides of terminal branchlets. **Conidia** ellipsoidal. **Chemistry**: sphaerophorin (UV+ blue-white), β-oricinol depsides, xanthones. **Ecology**: mainly on acid rocks or acid, mossy bark in humid situations.

Distinguished from the closely related *Bunodophoron* by the young spores being ellipsoidal and distinctly violet and becoming broadly ellipsoidal and black when mature, also the conidial shape and chemistry. In the field, the rounded basal branches of *Sphaerophorus* distinguish it from the flattened branches in *Bunodophoron*.

### Literature

Högnabba & Wedin (2003), Wedin & Gilbert (2009b), Wedin *et al.* (2009).

- 1 Sterile branches all  $\pm$  of equal breadth (fertile branches may be distinctly larger than sterile ones), grey to grey-brown; medulla I–; on rocks ..... *fragilis*  
 All branches with distinctly wider main stems, usually  $\pm$  brownish; medulla  $\pm$  I+ violet-blue; on bark, rock, or acid soil and turf ..... *globosus*

### *Sphaerophorus fragilis* (L.) Pers. (1794)

Like *S. globosus* but forming dense pale grey-brown tufts to 4 cm tall, without any red-brown tinge but often with a pinkish tinge when wet; branches fragile, erect or partially decumbent, equally dichotomous, sterile branches all of similar width, 0.6–0.8 mm diam., fertile branches often distinctly larger and wider than sterile ones and often also with  $\pm$  coralloid branchlets, surface dull grey-brown or grey, often somewhat roughened. Apothecia very rare, 1–2 mm diam. Ascospores ellipsoidal, 8–10  $\mu$ m diam., deep violet to blue-black. Medulla C–, K–, KC–, I–, Pd–, UV+ blue-white (sphaerophorin,  $\pm$  hypothamnolic and  $\pm$  squamatic acids). **BLS 1332.**

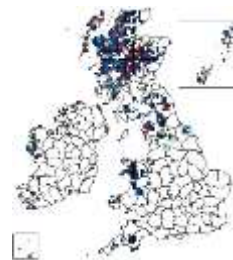
On mountain outcrops, scree and boulders, generally at higher altitudes than *S. globosus*; locally common. N. Scotland (Highlands), extending locally to C. & N. Wales, N. & S.W. England, W. Ireland.

*S. globosus* has a more richly branched, often reddish brown thallus with branches with a distinct main stem and an I+ blue medulla. *S. fragilis* may take on a pinkish tinge when wet.

Care is needed to distinguish from immature, stunted or heavily grazed *S. globosus*. Conversely, well-developed, fertile thalli of *S. fragilis* may actually produce rather coralloid branchlets along the apothecia-carrying branches, and thus can be mistaken for *S. globosus*.

The most common lichenicolous fungus on *S. fragilis* is the small ‘pyrenomycete’ *Sphaerellothecium minutum* Hafellner (1993) which causes the infected thalli to become darker due to its network of surface mycelium (dark grey thalli are usually heavily infected); it is often difficult to find material of *S. fragilis* which is not infected.

LC



### *Sphaerophorus globosus* (Huds.) Vain. (1903)

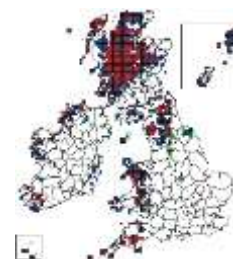
Thallus to 1.5–5 cm,  $\pm$  erect, forming spreading tufts or cushions, often richly and irregularly branched; main branches rather coarse, 0.8–1.5 mm diam., rounded, branching unequally dichotomous, with few to very numerous thinner side branches, often appearing coralloid, with blunt apices, grey (in shade), pale brown or brown-grey, usually tinged red-brown, smooth. Apothecia infrequent, 1–3 mm diam. Ascospores broadly ellipsoidal, 8–12  $\times$  7–11  $\mu$ m, greenish to dark violet-blue-black. Medulla C–, K $\pm$  yellow, KC–, I+ blue, Pd $\pm$  yellow, UV+ blue-white (sphaerophorin, squamatic,  $\pm$  thamnolic and  $\pm$  hypothamnolic acids). **BLS 1333.**

On rocks, often amongst other lichens and mosses, also on acid-barked mossy trees, more rarely on moorland soils; locally abundant. N. Scotland (Highlands), Ireland, extending locally to N. and S.W. England, Wales.

Characterized by the distinct, coarse rounded main branches and thinner, smaller secondary branches, a tendency to form lax to compacted, often  $\pm$  pale or reddish brown tufts and the I+ blue medulla. The iodine reaction may be faint or absent in old dried specimens.

*Opegrapha sphaerophoricola* commonly forms random or localized groups of lirellae on the thallus of *S. globosus*. Also occasionally infected by the small ‘pyrenomycete’ *Sphaerellothecium minutum* Hafellner (1993) and the polyphagous *Lichenocodium erodens* M.S. Christ. & D. Hawksw. (1977).

LC





## Literature

- Cannon, P., Ekman, S., Kistenich, S., LaGreca, S., Printzen, C., Timdal, E., Aptroot, A., Coppins, B., Fletcher, A., Sanderson, N. & Simkin, J. (2021). Lecanorales: Ramalinaceae, including the genera *Bacidia*, *Bacidina*, *Bellicidia*, *Biatora*, *Bibbya*, *Bilimbia*, *Cliostomum*, *Kiliasia*, *Lecania*, *Megalaria*, *Mycobilimbia*, *Phyllopsora*, *Ramalina*, *Scutula*, *Thalloidima*, *Toninia*, *Toniniopsis* and *Tylothallia*. *Revisions of British and Irish Lichens* **10**: 1–82.
- Cannon, P., Orange, A., Aptroot, A., Coppins, B., Fletcher, A., Fryday, A., Sanderson, N., Simkin, J. & Van den Boom, P. (2022). Caliciales: Catillariaceae, including the genera *Catillaria* and *Solenopsora*. *Revisions of British and Irish Lichens* **22**: 1–13.
- Ekman, S. & Wedin, M. (2000). The phylogeny of the families Lecanoraceae and Bacidiaceae (lichenized Ascomycota) inferred from nuclear SSU rDNA sequences. *Plant Biology* **2**: 350–360.
- Fletcher, A. & Coppins, B.J. (2009). *Catillaria*. In *Lichens of Great Britain and Ireland* (Smith, C.W., Aptroot, A., Coppins, B.J., Fletcher, A., Gilbert, O.L., James, P.W. & Wolseley, P.A. eds): 282–288. London: British Lichen Society.
- Hitch, C.J.B., Timdal, E. & James, P.W. (2009). *Toninia*. In *Lichens of Great Britain and Ireland* (Smith, C.W., Aptroot, A., Coppins, B.J., Fletcher, A., Gilbert, O.L., James, P.W. & Wolseley, P.A. eds): 895–903. London: British Lichen Society.
- Högnabba, F. & Wedin, M. (2003). Molecular phylogeny of the *Sphaerophorus globosus* species complex. *Cladistics* **19**: 224–232.
- Kantvilas, G. (2022). The trouble with *Neophyllis pachyphylla* (lichenized Ascomycetes). *Swainsona* **36**: 1–7.
- Kistenich, S., Timdal, E., Bendiksby, M. & Ekman, S. (2018). Molecular systematics and character evolution in the lichen family Ramalinaceae (Ascomycota: Lecanorales). *Taxon* **67**: 871–904.
- Lücking, R., Hodkinson, B.P. & Leavitt, S.D. (2016). The 2016 classification of lichenized fungi in the Ascomycota and Basidiomycota – approaching one thousand genera. *Bryologist* **119**: 361–416.
- Miądlikowska, J. and 31 co-authors (2014). A multigene phylogenetic synthesis for the class Lecanoromycetes (Ascomycota): 1307 fungi representing 1139 infrageneric taxa, 317 genera and 66 families. *Molecular Phylogenetics & Evolution* **79**: 132–168.
- Prieto, M., Baloch, E., Tehler, A. & Wedin, M. (2012). Mazaedium evolution in the Ascomycota (Fungi) and the classification of mazaediate groups of formerly unclear relationship. *Cladistics* **29**: 296–308.
- Soto Medina, E., Prieto, M. & Wedin, M. (2018). A new *Bunodophoron* species (Sphaerophoraceae, Lecanorales) from the Neotropics. *Lichenologist* **50**: 255–266.
- Svensson, M. & Fryday, A.M. (2022). *Gilbertaria*, a first crustose genus in the Sphaerophoraceae (Lecanoromycetes, Ascomycota) for *Catillaria contristans*, *Toninia squalescens* and related species. *Mycological Progress* **21**: 90 [23 pp.].
- Wedin, M. (1993). A phylogenetic analysis of the lichen family Sphaerophoraceae (Caliciales); a new generic classification and notes on character evolution. *Plant Systematics and Evolution* **187**: 213–241.
- Wedin, M. (1995). *Bunodophoron melanocarpum*, comb. nov. (Sphaerophoraceae, Caliciales s. lat.). *Mycotaxon* **55**: 383–384.
- Wedin, M. & Döring, H. (1999). The phylogenetic relationship between the Sphaerophoraceae, *Neophyllis* and *Austropeltum* (lichenized Ascomycota). *Mycological Research* **103**: 1131–1137.
- Wedin, M., Döring, H. & Ekman, S. (2000). Molecular phylogeny of the lichen families Cladoniaceae, Sphaerophoraceae, and Stereocaulaceae (Lecanorales, Ascomycotina). *Lichenologist* **32**: 171–187.
- Wedin, M. & Gilbert, O.L. (2009a). *Bunodophoron*. In *Lichens of Great Britain and Ireland* (Smith, C.W., Aptroot, A., Coppins, B.J., Fletcher, A., Gilbert, O.L., James, P.W. & Wolseley, P.A. eds): 238–239. London: British Lichen Society.
- Wedin, M. & Gilbert, O.L. (2009b). *Sphaerophorus*. In *Lichens of Great Britain and Ireland* (Smith, C.W., Aptroot, A., Coppins, B.J., Fletcher, A., Gilbert, O.L., James, P.W. & Wolseley, P.A. eds): 846–847. London: British Lichen Society.
- Wedin, M., Högnabba, F. & Goward, T. (2009). A new species of *Sphaerophorus*, and a key to the family Sphaerophoraceae in western North America. *Bryologist* **112**: 368–374.