Peltigerales: Collemataceae

including the genera Blennothallia, Callome, Collema, Enchylium, Epiphloea, Lathagrium, Leptogium, Pseudoleptogium, Rostania and Scytinium

British Lichen Society

Revisions of British and Irish Lichens

Volume 2 **September 2020**

Peltigerales: Collemataceae

Cover image: *Scytinium turgidum,* on a limestone grave monument, Abney Park cemetery, Stoke Newington, Middlesex, England.

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. 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. The choice of subject for each volume will depend on the extent of changes in classification for the families concerned, and the number of newly recognized species since previous treatments.

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to compile new printed editions of the entire lichen biota of Britain and Ireland is extensive, and many parts are out-of-date even as they are published.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*.

Downloads can be obtained from the British Lichen Society website at
https://www.britishlichensociety.org.uk/content/lgbi3

ISSN 2634-7768

Revisions of British and Irish Lichens vol. 2

Peltigerales: Collemataceae

including the genera *Blennothallia*, *Callome*, *Collema*, *Enchylium*, *Epiphloea*, *Lathagrium*, *Leptogium*, *Pseudoleptogium*, *Rostania* and *Scytinium*

by

Paul Cannon
Royal Botanic Gardens, Kew, Surrey TW9 3AB, UK; email p.cannon@kew.org
Mónica A.G. Otálora
Institute of Integrative Biology, ETH Zürich, Universitätstrasse 16, 8092 Zürich, Switzerland
Alica Košuthová
Department of Botany, Swedish Museum of Natural History, P.O. Box 50007, SE-104 05 Stockholm, Sweden
Mats Wedin
Department of Botany, Swedish Museum of Natural History, P.O. 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, Inverleith Row, Edinburgh EH3 5LR, UK
Janet Simkin
School of Natural and Environmental Sciences, Newcastle University, Newcastle upon Tyne NE1 7RU, UK

This publication can be cited as:
Cannon, P., Otálora, M.A.G., Košuthová, A., Wedin, M., Aptroot, A., Coppins, B. & Simkin, J. (2020). Peltigerales: Collemataceae, including the genera *Blennothallia*, *Callome*, *Collema*, *Enchylium*, *Epiphloea*, *Lathagrium*, *Leptogium*, *Pseudoleptogium*, *Rostania* and *Scytinium*. *Revisions of British and Irish Lichens* **2**: 1-38. DOI: 10.34885/174.

COLLEMATACEAE Zenker (1827)

Thallus foliose, crustose, squamulose or minutely shrubby, gelatinous, sometimes swelling when wet, dark olive-green to brown-black, reddish brown or rarely grey-blue. **Upper** and **lower cortex** either absent or composed of angular brick-like cells, more rarely of flattened compressed cells, the **medulla** containing loosely interwoven narrow hyphae or compact with broad-short-celled hyphae, intermixed with the photobiont. **Upper surface** smooth to wrinkled or ridged, often glossy, rarely arachnoid. **Lower surface** smooth, arachnoid or hairy, sometimes with scattered hapters or groups of white rhizines. **Isidia** often present, soredia absent. **Photobiont** *Nostoc* (rarely *Stigonema*), cells mostly arranged in distinct chains. **Ascomata** apothecia with a pale brown, red-brown or brown-black disc, sessile to shortly stalked, mainly laminal. **Thalline margin** either persistent or becoming excluded. **True exciple** raised, ± cupular, usually composed of globose cells, colourless to reddish brown. Disc concave to flat. **Epithecium** colourless to reddish brown, sometimes indistinct, K–, N–. **Hymenium** colourless, I+ blue. **Hypothecium** shallow, colourless or pale yellowish. **Hamathecium** of paraphyses, numerous, conglutinate, separating in K, sometimes branched, apices ± swollen. **Asci** (4-) 8-spored, clavate, the apex strongly thickened; wall K/I + blue, and apical dome K/I+ pale blue with a dark blue axial tube and apical cap. **Ascospores** ellipsoidal, ovoid or fusiform, rarely cuboid, often apiculate at one or both ends, septate, usually submuriform to muriform, colourless, without any distinct surface ornamentation or perispore. **Conidiomata** pycnidia, laminal or marginal, globose, ± immersed; wall colourless. **Conidiogenous cells** slender, cylindrical. **Conidia** bacilliform, sometimes enlarged at both ends, rarely acicular, aseptate, colourless. **Chemistry**: no lichen substances detected by TLC. **Ecology**: on ± basic rocks, soil and trees, in exposed dry habitats to moist, semi-inundated sites.

In this publication, the Collemataceae is more or less as traditionally circumscribed, containing species referred to *Collema* and *Leptogium* in Smith *et al.* (2009). However, phylogenetic studies (Otálora et al. 2013a, b) have undermined the traditional distinction between these genera (i.e. with species of *Collema* having a non-corticate thallus and those of *Leptogium* possessing a cortex), and identified a series of subordinate clades that are now treated as separate genera.

The species of *Leptogium* as recognized by Gilbert & Jørgensen (2009) are now divided between *Leptogium* and *Scytinium*, which can broadly be separated morphologically on the basis of thallus growth form, with *L. diffractum* being transferred to the monotypic *Pseudoleptogium*. A few, mostly minutely squamulose species of *Collema* have also been transferred to *Scytinium*. *Collema* as currently recognized can be distinguished by its foliose habit and elongate ascospores. *Enchylium* contains the *Collema* species with distinctly swollen thalli when wet, and *Lathagrium* the foliose species with broader, often submuriform ascospores. Three further genera contain the final four species from our region; *Blennothallia* (containing *Collema crispum*), *Callome* (with *C. multipartitum*), and *Rostania* (with *C. ceraniscum* and *C. occultatum*).

Epiphloea is included in the *Collemataceae*, following Schultz *et al.* (2015), but maintained as a monophyletic genus distinct from *Leptogium* based on its widely divergent morphological features.

The species treated as *Collema fasciculare* in Edition 2 was transferred to the genus *Arctomia* (Arctomiaceae) by Otálora & Wedin (2013), and is now included in *Gabura* (Magain *et al.* 2020). Their work was based primarily on molecular phylogenetic research, but they also noted differences in features of the exciple and of paraphyses and ascospores that had previously been recognized by Degelius (1954, 1974).

Lemmopsis and *Polychidium* were contrasted with *Leptogium* (*sensu lato*) by Gilbert & Jørgensen (2009), but the former genus was assigned to the *Lichinaceae* by Schultz & Büdel (2002) and that

placement was accepted by Jørgensen (2012b) and Lücking *et al.* (2016). Species are minutely crustose with aseptate ascospores and the photobiont is not *Nostoc*. No sequence data are available. *Polychidium* was presumably considered morphologically similar to species now placed in *Scytinium*, and is now referred to the Massalongiaceae (Wedin *et al*. 2007, Lücking *et al.* 2016); species have minutely fruticose thalli and one-septate ascospores.

Literature

Degelius (1954, 1974), Gilbert *et al*. (2009), Gilbert & Jørgensen (2009), Hoffmann & Hafellner (2000), Lücking *et al*. (2016), Jørgensen (1994, 1997), Jørgensen & James (1983), Otálora *et al*. (2010, 2013a, 2013b), Otálora & Wedin (2013), Schultz & Büdel (2002), Schultz *et al*. (2015), Thüs & Schultz (2009), Wedin *et al*. (2007).

The constituent genera of the Collemataceae are recognized primarily using phylogenetic characters, which are not always closely allied with morphological features. For pragmatic reasons, we include a key directly to species, along with a table of characters for the genera. It should be noted also that the genus-level information includes only data on British and Irish species.

1 Thallus crustose or partially squamulose, without well-defined lobes, usually consisting mainly of apothecia; on bark or soil, more rarely on rocks (similar lichens on rock all have other cyanobacteria than *Nostoc* and belong to other families) 2
Thallus placodioid, squamulose, foliose or dwarf-fruticose; on bark, soil or rock 8

2(1) On bark, or on mosses on bark 3
On soil, or sometimes on rocks 5

3(2) Ascospores 13-22 × 9-15 µm, submuriform, cuboid-oblong with rounded angles; thallus crustose, granular or with minute, ± scattered lobes ..... ***Rostania occultata***
Ascospores transversely septate, thallus forming small cushions 4

4(3) Thallus, when wet, forming rounded swollen cushions to 1 cm thick of erect, wrinkled and often indistinct lobes; apothecia frequent, often covering thalli; ascospores 50–95 × 4.5–5 µm, 9- to 16-septate, worm-like and helically arranged in the asci ..... ***Gabura fascicularis*** (**Arctomiaceae**)
Thallus forming small cushions covered with apothecia; ascospores 15–24 × 3–4.5 µm, 1(-3)-septate, narrowly fusiform; very rare or extinct in the British Isles ..... ***Enchylium conglomeratum***

5(2) Thallus blue-grey to brown-black, granular to granular-areolate, forming an areolate crust; on soil ..... ***Epiphloea byssina***
Thallus brownish, squamulose, very thin when dry; on soil or sometimes on rocks 6

6(5) Squamules convex, discrete, often lobed and rosette-like, some reduced to granules; ascospores submuriform; on soil or sometimes on rocks ..... ***Scytinium biatorinum***
Squamules flat and often confluent; ascospores either muriform or aseptate; on soil 7

7(6) Asci 4-spored; ascospores muriform ..... ***Enchylium limosum***
Asci 8-spored; ascospores aseptate ..... ***Lempholemma chalazanum*** (**Lichinaceae**)

8(1) Thallus dwarf-fruticose, with thin elongate ± cylindrical and branched lobes (look deep down in the cushion; foliose species with long isidia like *Scytinium lichenoides* are often mistakenly interpreted as fruticose) 9
Thallus placodioid, squamulose or foliose 14

9(8) Branches forming dense fruticose cushions 10
Branches forming flat, radiating thalli 12

10(9) Branches erect, crowded, blackish brown; with *Nostoc* 11
Branches partly not erect, brown or blue-grey; mostly with other cyanobacteria
.....see ***Ephebe*** (**Lichinaceae**) and ***Polychidium*** (**Massalongiaceae**)

11(10) Branch tips acute ..... ***Scytinium teretiusculum***
Branch tips blunt .....cyanotrophic morphs of ***Ricasolia amplissima*** (**Peltigeraceae**)

12(9) Branches roughened, sometimes with a distinct upper cortex 13
Branches not roughened, the upper cortex indistinct; ascospores aseptate; on damp rock
..... ***Lempholemma intricatum*** (**Lichinaceae**)

13(12) Usually with isidia; surface glossy, with a distinct upper cortex; on damp limestone
..... ***Scytinium massiliense***
Without isidia; surface dull, without distinct upper cortex; in the submerged zone of rivers
..... ***Scytinium subtorulosum***

14(8) Thallus placodioid, tightly appressed to the substrate, even at the lobe tips 15
Thallus squamulose to foliose; if (almost) placodioid then cushion-like or lobe tips not tightly appressed to the substrate..... 16

15(14) Lobes 0.1–0.3 mm wide, dark brown, not corticate; on basic rock, upland ..... ***Scytinium parvum***
Thallus blackish, appressed, corticate, placodioid-areolate, marginal lobes <0.5 mm across, often forming radiating patterns; on hard limestone ..... ***Pseudoleptogium diffractum***

16(14) Thallus cushion-like placodioid or small-squamulose with marginal lobes not much different from the central part 17
Thallus squamulose or foliose with branched lobes (that may be swollen)..... 23

17(16) On bark; forming neat, foliose rosettes, the lobes distinct, flattened, often channelled
..... ***Scytinium fragrans***
On rock or mosses on soil 18

18(17) Thallus tips with hormocystangia (soralium-like structures) that burst open
..... ***Lempholemma cladodes*** (**Lichinaceae**)
Thallus without hormoscystangia or soralia 19

19(18) Lobes 0.4–0.8 mm wide, convex, white-pubescent at least at the apices; on rocks in seepage tracks
..... ***Scytinium fragile***
Lobes not white-pubescent 20

20(19) On mosses on soil in montane habitats, lobes somewhat terete with accessory lobules
..... ***Rostania ceranisca***
On rock 21

21(20) Thallus appearing ± shrubby, with ± erect lobes and similar marginal lobules, forming cushions 22
Thallus of radiating reduced thick lobes with swollen entire apices; apothecia often covering most of the thallus ..... ***Enchylium confertum***

22(21) Thallus fully dissolved into lobes, not umbilicate ..... ***Lempholemma botryosum*** (**Lichinaceae**)
Thallus attached to substratum only at the centre, not much divided into lobes... ***Scytinium callopismum***

23(16) Upper or lower surface of lobes with fine continuous white-grey tomentum 24
Upper or lower surface of lobes without a well-developed tomentum; some rhizines may be present . 28

24(23) Upper surface not tomentose; lower surface with a fine, pubescent tomentum, occasionally forming long, coarse rhizines 25
Upper surface with a ± dense grey-white arachnoid tomentum; lower surface naked but with localized tomentum in areas of attachment to the substratum ..... ***Leptogium juressianum***

25(24) Isidia present 26
Isidia absent 27

26(25) Upper surface dark olive-black, smooth, uniformly isidiate; undersurface tomentose with a few distinct, long rhizines ..... ***Leptogium saturninum***
Upper surface brownish or bluish grey, strongly wrinkled-striate, patchily isidiate; undersurface uniformly short-tomentose ..... ***Leptogium hibernicum***

27(25) Thallus forming compact, multi-lobed cushions; apothecia with abundant, marginal folioles; undersurface uniformly short-tomentose ..... ***Leptogium burgessii***
Thallus forming loose, wide-spreading rounded patches; apothecia without marginal folioles; undersurface tomentose with distinct long rhizines ..... ***Leptogium hildenbrandii***

28(23) On bark or wood (or debris), sometimes overgrowing mosses 29
On soil or rock 41

29(28) Thallus essentially squamulose or microfoliose, lobes to 1.5 mm broad without clearly discernible branching 30
Thallus foliose, with lobes >1.5 mm broad 31

30(29) Thallus smooth, without distinct wrinkles, often stellately arranged around apothecia; centre of thallus (in section) of compact broad hyphae throughout; lobes very fine, *ca* 0.1 mm broad, with terete extensions; apothecia numerous, disc orange; on rotten wood or plant debris ..... ***Scytinium subtile***
Thallus weakly wrinkled, not stellately arranged; centre of thallus (in section) of loosely interwoven hyphae; lobes 0.2–1.5 mm broad, without terete extension but shallowly incised; apothecia usually present, disc brown; on bases of mossy tree trunks ..... ***Scytinium intermedium***

31(29) Thallus blue-grey or brown-grey, never dark brown, corticate, without soralium-type structures at lobe margins 32
Thallus dark brown, not corticate (or not completely so), with or without soralium-type structures 36

32(31) Lobes smooth or finely striate or weakly wrinkled when dry 33
Lobes striate or markedly ridged and notably wrinkled when dry 35

33(32) Lobes without isidia, upper surface finely striate; apothecia frequent, ± sessile ... ***Leptogium cochleatum***
Thallus with marginal or laminal isidia 34

34(33) Thallus blue-grey, smooth with laminal (sometimes also marginal), terete or flattened and often overlapping isidia ..... ***Leptogium cyanescens***
Thallus brown-grey, lobe margins with branched, mostly cylindrical isidium-like outgrowths that are sometimes also laminal; lobe surfaces (especially below), with raised, narrow, ± vertically orientated rib-like wrinkles ..... ***Scytinium lichenoides***

35(32) Granular brownish isidia chiefly along the swollen thallus margins, contrasting with the blue-grey thallus ..... ***Leptogium brebissonii***
Cylindrical to coralloid, pale blue-grey isidia, chiefly along laminal ridges, concolorous with the thallus ..... ***Leptogium coralloideum***

36(31) Thallus minute, at most partially corticate, sometimes with yellowish to brownish soralium-like structures on the lamina ..... ***Gabura insignis*** [**Arctomiaceae**]
Thallus large and well-developed, entirely non-corticate; often isidiate 37

37(36) Thallus ± smooth, without longitudinal ridges 38
Thallus pustulate with well-developed elongate ridges or folds 39

38(37) Isidia at first globose, becoming flattened and squamule-like ..... ***Collema flaccidum***
Isidia globose to cylindrical, never becoming squamule-like ..... ***Collema subflaccidum***

39(37) Thallus with numerous cylindrical branched or unbranched isidia, especially on the ridges; apothecia rare ..... ***Collema furfuraceum***
Thallus with ± distinct coarse globose isidia, or isidia absent; apothecia frequent 40

40(39) Ascospores 3–4.5 µm diam., acicular, 5- to 12-septate; a few coarse knobbly isidia usually present ..... ***Collema nigrescens***
Ascospores 6–6.5 µm diam., clavate, 4- to 5-septate; isidia absent ..... ***Collema subnigrescens***

41(28) On calcareous soil, brick or mortar, among mosses 42
On rocks or amongst mosses on rocks 55

42(41) Thallus greenish black, not corticate, with concave squamules or squamiform isidia ..... ***Blennothallia crispa***
Thallus brownish, brownish black or rarely greyish, corticate 43

43(42) Thallus not swelling strongly when wet, then not more than twice as thick as when dry 44
Thallus swelling strongly when wet, more than twice as thick as when dry 50

44(43) Lobe margins revolute, forming tube-like structures; apothecia absent ..... ***Scytinium palmatum***
Lobe margins not revolute 45

45(44) Thallus pale grey, lobes very thin and tissue-like, wavy and crinkled, uneven, without isidia; restricted to coastal areas ..... ***Leptogium britannicum***
Thallus brownish, lobes either with entire margin or deeply lacerate or branched, with or without isidia; not restricted to coastal areas 46

46(45) Lobes smooth to finely wrinkled when dry, centre of thallus (in section) of compact broad hyphae throughout 47
Lobes strongly wrinkled when dry, centre of thallus (in section) of loosely interwoven hyphae 48

47(46) Lobes imbricate, forming dense cushions; in montane calcareous grassland ..... ***Scytinium imbricatum***
Lobe margins usually fimbriate, deeply divided almost with coralloid outgrowths; among bryophytes in calcareous grassland ..... ***Scytinium tenuissimum***

48(46) Thallus rarely fertile, when fertile without abundant apothecia, lobes branched ... ***Scytinium pulvinatum***
Thallus usually fertile with abundant apothecia, lobes not much branched 49

49(48) Thallus foliose, lobes > 2 mm broad ..... ***Scytinium gelatinosum***
Thallus minutely, lobes < 2 mm broad ..... ***Scytinium intermedium***

50(43) Thallus surface wrinkled when dry 51
Thallus not wrinkled when dry 52

51(50) Thallus repeatedly branched ..... ***Scytinium turgidum***
Thallus sparingly branched ..... ***Scytinium schraderi***

52(50) Thallus large; greenish-brown, with a few thick, rounded, ear-like lobes bearing numerous spherical isidia. Lobes minutely striate when dry ..... ***Lathagrium auriforme***
Lobes ± numerous, not striate when dry; isidia, if present, recalling adventive lobes 53

53(52) Ascospores aseptate ..... ***Lempholemma chalazanellum*** and ***L. polyanthes*** (**Lichinaceae**)
Ascospores septate (when apothecia absent, identification uncertain, but *Enchylium tenax* is by far the most common) 54

54(53) Thalline exciple ± smooth, even; ascospores 6–10.5 µm diam., colourless; pycnidia usually present; conidia 4–6 × 1–2 µm ..... ***Enchylium tenax***
Thalline exciple coarsely crenulate; ascospores 10–15 µm diam., usually pale yellow-brown; conidia 11–13 × 2–3 µm, formed in internal locules ..... ***Enchylium bachmanianum***

55(41) Thallus pustulate, with well-developed, longitudinal ridges or folds, not corticate; rare saxicolous occurrences of corticolous species ..... (go back to) 39
Thallus smooth or wrinkled, without longitudinal ridges but sometimes striate 56

56(55) Thallus isidiate or upright lobe tips rounded, isidium-like, with or wihout cortex; usually sparingly or not fertile 57
Thallus without isidia, without cortex; usually abundantly fertile when mature 68

57(56) Isidia initially globular but becoming flattened and squamule-like 58
Isidia or lobules remaining globose (rarely flattening in some specimens) or cylindrical 60

58(57) Lobes rather few, large, wavy, sparingly and not deeply divided ..... ***Collema flaccidum***
Lobes numerous, ± extended and deeply divided into lobules 59

59(58) Lobules corrugate-bullate, with markedly wavy margins; ascospores 13–16 (–18) × 10–12 µm, ± cuboid; rare, on serpentine ..... ***Lathagrium latzelii***
Lobules smooth, with ± wavy margins; ascospores 26–34 × 13–15 µm, subellipsoidal; common, often on mortar ..... ***Blennothallia crispa***

60(57) Lobes concave, often with elevated nodulose or lobulate margins ..... ***Lathagrium cristatum***
Lobes flat, or if concave, without lobulate margins 61

61(60) Lobes ± rounded, large, few, sparingly and not deeply divided ..... ***Collema subflaccidum***
Lobes ± elongate and deeply divided 62

62(61) Mature isidia cylindrical, simple or branched, often forming a continuous sward .. ***Collema glebulentum***
Mature isidia ± globose to coralloid, rarely forming a continuous crust 63

63(62) Thallus convoluted or channeled; ascospores aseptate or 3-septate 64
Lobe margins flat or often wavy, downturned when dry, with laminal isidia; ascospores submuriform where known 65

64(63) Isidia globose to clavate, clustered in the centre of the thallus; ascospores aseptate ..... ***Lempholemma radiatum*** (**Lichinaceae**)
Lobe margins strongly undulate, with granular isidia; ascospores 3-septate ..... ***Lathagrium undulatum***

65(63) Thallus closely appressed to the rock, not strongly swollen when wet 66
Thallus large, with a few thick, rounded ear-like lobes, swollen and pulpy when wet 67

66(65) Thallus often perceptibly pustulate-bullate, not corticate; isidia small, scurfy when wet; apothecia sometimes frequent ..... ***Lathagrium fuscovirens***
Thallus not pustulate, corticate; isidia granular to coralloid, at lobe margins; mature apothecia unknown ..... ***Scytinium magnussonii***

67(65) Lobes to 3 mm wide, the surface matt, blackish, with an indistinct cortex; isidia wart-like ..... ***Scytinium plicatile***
Lobes to 1 cm wide, the upper surface minutely striate when dry, not corticate; isidia numerous, spherical ..... ***Lathagrium auriforme***

68(56) Lobes concave, channelled or with ± ascending, uneven margins 69
Lobes flat or convex, not channelled, the margins not or little raised, often fan-shaped 71

69(68) Lobe margins strongly undulate, uplifted, also in the central part of the thallus; ascospores 3-septate ..... ***Lathagrium undulatum***
Lobe margins not strongly undulate; ascospores 3-sepatate or submuriform 70

70(69) Thallus pulvinate, lobes mostly channelled at the apices; ascospores 3-septate.... ***Enchylium polycarpon***
Thallus not pulvinate, lobes channelled throughout; ascospores submuriform (3- to 6-celled) ..... ***Lathagrium cristatum***

71(68) Thallus blackish olive-green to brown-black, radiating and richly branched, finely striate; terrestrial ..... ***Callome multipartita***
Thallus bright to dark green, not striate; branches splayed out at their ends; submerged in streams ..... ***Lathagrium dichotomum***

Table of characters for genera of the *Collemataceae*									
	Former position	Thallus	Thallus lobes	Cortex	Medulla	Photobiont	Apothecia	Ecology	Constituent taxa
Blennothallia	*Collema*	Medium to large, foliose, greenish black	Broad, folded	Absent	Compact, of broad short-celled hyphae	In clusters or short chains (<3 cells)	Infrequent, spores ± cylindrical, transversely septate to submuriform	Calcareous rocks, mortar, soil	*crispa*
Callome	*Collema*	Small to medium, foliose, dark olive green to brown-black	Narrow, contorted, often fan-shaped	Absent	Lax, of narrow long-celled hyphae	In chains	Common, spores ellipsoidal-fusiform, transversely septate	Hard limestone (rarely siliceous rock with shell sand)	*multipartita*
Collema	*Collema*	Medium to large, foliose, dark olive green to brown-black	Broad, rounded	Absent	Lax, of narrow long-celled hyphae	In chains	Common in some species, spores fusiform to elongate, transversely septate	Bark or damp siliceous rocks	*flaccidum, furfuraceum, glebulentum, nigrescens, subflaccidum, subnigrescens*
Enchylium	*Collema*	Small to medium, foliose to squamulose or crustose, much swollen when wet, dark olive green to brown-black	Narrow, contorted, sometimes radiating	Absent	Lax, of narrow long-celled hyphae	In chains	Common in some species, spores varied, transversely septate to muriform	Soil, sand, calcareous rocks or mortar; one species on nutrient-rich bark	*bachmanianum, confertum, conglomeratum, limosum, polycarpon, tenax*
Epiphloea	*Epiphloea*	crustose-areolate, becoming granular, blue-grey to dark brown	None	Present	Compact, of broad short-celled hyphae, at least in the centre	In clusters or short chains (<3 cells)	Immersed in the thallus or becoming sessile, spores ellipsoidal, muriform	Bare clay or sandy ± alkaline soils	*byssina*
Lathagrium	*Collema*	Medium to large, foliose, sometimes swollen when wet, dark olive-green to brown-black, rarely grey-blue	Narrow to broad, sometimes ridged or folded	Absent	Lax, of narrow long-celled hyphae	In chains	Numerous to sparse, spores transversely septate to submuriform	Rock (mostly but not exclusively calcareous) often amongst mosses, sometimes sand or soil	*auriforme, cristatum, dichotomum, fuscovirens, latzelii, undulatum*

Table of characters for genera of the *Collemataceae* contd.

	Former position	Thallus	Thallus lobes	Cortex	Medulla	Photobiont	Apothecia	Ecology	Constituent taxa
Leptogium	*Leptogium*	Medium to large, foliose, blue-grey to olive-brown, sometimes tomentose	Irregular, usually thin, often convoluted or branched	Present	Lax, of narrow long-celled hyphae	In chains	Absent to prominent, spores submuriform to muriform	Mossy trees and rocks, one species on soil	*brebissonii, britannicum, burgessii, cochleatum, coralloideum. cyanescens, hibernicum, hildenbrandii, juressianum, saturninum*
Pseudoleptogium	*Leptogium*	Small, placodioid-areolate, olive brown to black	Narrow, radiating	Present	Globose to angular cells	In clusters or short chains (<3 cells)	Rare, spores septate to submuriform	Hard limestone	*diffractum*
Rostania	*Collema*	Small, minutely foliose to crustose, dark olive green to dark brown	Poorly defined, narrow, smooth to ridged	Absent (sometimes with a pseudocortex)	Lax, of narrow long-celled hyphae	In chains or clusters	Frequent to rare, spores subglobose to cuboid, muriform	Soil, often with mosses, or on basic bark	*ceranisca, occultata*
Scytinium	*Collema, Leptogium*	Usually small, crustose, squamulose, minutely foliose or minutely shrubby, dark brown, blueish grey or olive green	Spreading, sometimes elongate and ± cylindrical	Present (sometimes with a pseudocortex); in a few cases absent	Variable	In chains or clusters	Common to rare, spores mostly ellipsoidal and submuriform to muriform	Hard limestones, siliceous rock, soil, nutrient-rich bark amongst mosses	*biatorinum, callopismum, fragile, fragrans, gelatinosum, imbricatum, intermedium, lichenoides, magnussonii, massiliense, palmatum, parvum, plicatile, pulvinatum, schraderi, subtile, subtorulosum, tenuissimum, teretiusculum, turgidum*

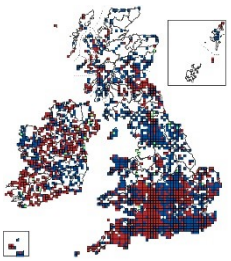
BLENNOTHALLIA Trevis. (1853)

Thallus foliose, medium to large (usually 2–5 (–7) cm diam.), greenish black, without a cortex, with a compact medulla mostly composed of broad short-celled hyphae, with the photobiont interspersed in clusters or short chains of fewer than three cells. Lobes deep and broad, 0.5–4 mm diam., often imbricate or folded, smooth, not tomentose. **Isidia** present, becoming flattened and squamule-like. **Apothecia** infrequent, appressed, the disc flat, reddish brown, the thalline margin granulose or lobulate. **Ascospores** varied in size, broadly cylindrical to ellipsoidal, transversely septate or submuriform. **Conidiomata** pycnidia, frequent.

Blennothallia is a small genus with three currently accepted species, only one of which has been reported from Europe. It was found to be clearly distinct in phylogenetic terms from other genera of the *Collemataceae* by Otálora *et al*. (2013a, 2013b), and Jørgensen (2012a) observed that *B. crispa* (as *Collema crispum*) is a "unique species, not closely related to any other in our region." Its most distinctive morphological feature is its thallus anatomy which is composed mostly of compact broad hyphae, rather than the lax hyphal tissue found in most other genera of the Collemataceae.

Blennothallia crispa (Huds.) Otálora, P.M. Jørg. & Wedin (2013) **LC**

Collema crispum (Huds.) Weber ex F.H. Wigg. (1780)



Thallus medium to large, usually 2–5 (–7) cm diam., foliose, rather thin, deeply lobed, often forming rosettes, slightly swollen when moist; lobes 2–6 mm wide, sometimes rather few and almost ear-like, ± rounded at the apices, concave, frequently overlapping, often with ± ascending wavy and sometimes convoluted margins; margins entire or crenate, occasionally somewhat lacerate, but never swollen; upper surface olive-green-brown to black, smooth or isidiate; lower surface often with white rhizines, sometimes forming ± scattered hapters. Isidia usually copious, at first globular, soon flattened and squamule-like. Conidiomata infrequent, immersed, laminal or marginal. Conidia 5–6 × 1.5–2 µm, bacilliform, slightly swollen at the apex, colourless. Apothecia infrequent, appressed; disc 1–2 (–2.5) mm diam., flat; thalline exciple often bearing lobules. Ascospores 26–34 × 13–15 µm, 3-septate or submuriform, rarely 4- or 5-septate, ± ellipsoidal or ovoid, with rounded ends. **BLS 0440**.

On calcareous rocks and walls, particularly on old crumbling mortar, often in damp, shaded places, more rarely on calcareous soils and shell-sand; abundant. Throughout Great Britain and Ireland.

Distinguished by the numerous rounded or ear-like, often overlapping lobes and laminal flattened squamule-like isidia which can resemble small lobes. The isidia are sometimes so numerous that they obscure the thallus. In very shaded habitats the thallus can become glaucous and tinged with emerald green.

Collema crispum var. **metzleri** (Arnold) Degel. (1954) was considered to be a diminutive morph of *B. crispa*, with an almost crustose, weakly gelatinous thallus to 3 mm diam. of scattered, ± overlapping lobes to 0.5 mm wide. It is chiefly associated with shaded chalk outcrops, and intermediates with *B. crispa* are frequent. It was not referred to by Otálora *et al.* (2013b) and its status is uncertain.

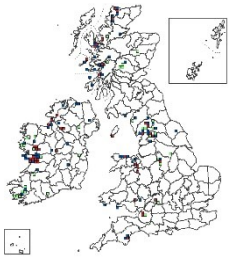
CALLOME Otálora & Wedin (2013)

Callome is a monotypic genus, corresponding to the *Collema multipartitum* group as defined by Degelius (1954), and is the phylogenetic sister group to *Rostania* (Otálora *et al*. 2013b). In morphological terms, *Callome* has some similarities to *Lathagrium*, species of which also have foliose

thalli with repeatedly branching lobes that do not swell significantly when wet, but the thallus of *Callome* is smaller and the lobes are convex rather than concave. The narrow, transversely septate ascospores of *Callome* invite comparison with those of *Collema* [s. str.] but these species have larger thalli and lobes.

Callome multipartita (Sm.) Otálora, P.M. Jørg. & Wedin (2013) **Nb**

Collema multipartitum Sm. (1814)



Thallus 1– to 3– (to 5–) cm diam., foliose, rounded or irregular, deeply lobate and richly branched, loosely appressed to partly ascending, very fragile, not swollen when wet, the central part sometimes degrading and resulting in very irregular thalli; lobes (0.5–) 1–1.5 mm wide, often remaining partly separate, often fan-shaped, ± contorted, nodular and irregular, convex and sometimes almost cylindrical, repeatedly branched. Cortex absent, the thallus composed of a homogenous layer of hyphal cells interspersed with chains of photobiont cells. Upper surface ± dark olive-green to brown-black, matt, without isidia, smooth or minutely longitudinally striate, not tomentose, ± swollen and semi-transparent when moist. Conidiomata frequent, immersed, usually laminal. Conidia 5–7 × 1–1.5 µm, bacilliform, slightly swollen at the apex, colourless. Apothecia common, scattered, laminal; disc 1–2 mm diam., dark brown, flat to convex with a ± thick entire, crenulate, or lobulate thalline margin. Asci 70–100 × 15–20 µm, 8-spored. Ascospores 25–45 × 4.5–6.5 µm, ellipsoidal-fusiform, sometimes curved, 3- to 4-septate, colourless. **BLS 0452**.

On hard, sunny and exposed limestones, rarely on siliceous rock associated with shell-sand, often associated with *Enchylium polycarpon*; local. Throughout the western parts of Great Britain and Ireland.

Readily distinguished from all other species of Collemataceae by the loosely attached, much-branched thallus with narrow, often partially discrete, notably convex-rounded and sometimes minutely striate lobes and the characteristic ellipsoidal-fusiform ascospores. When well-developed the thallus appears to be dendritically branched.

COLLEMA F.H. Wigg. (1780)

Thallus medium to large (3–10 (–20) cm diam.), foliose, membranous, lobed, not swelling noticeably when wet, upper surface dark olive-green to brown-black, not tomentose. Thallus lobes (2–) 5–15 mm broad, rounded, usually entire, flat or partially ascending, smooth or pustulate with elongate ridges or folds. **Upper** and **lower cortex** absent. **Isidia** present or absent, soredia absent. **Photobiont** *Nostoc*; cells distributed in chains throughout the thallus and not forming a discrete layer. **Ascomata** apothecia, flat to convex, with a pale brown to red-brown disc. **Thalline margin** entire, sometimes isidiate. **True exciple** composed of isodiametric or elongate cells. **Epithecium** indistinct, colourless or pigmented. **Hymenium** colourless, I+ blue. **Hypothecium** ± colourless. **Hamathecium** of paraphyses, separating in K, unbranched or branched, often anastomosed, especially near the apices, apices often clavate or subglobose, sometimes yellowish to reddish brown. **Asci** clavate, apex strongly thickened, apical dome I+ blue, with a downwardly projecting I+ blue annulus and apical cap, 8-spored. **Ascospores** narrowly ellipsoidal to fusiform or ± cylindrical, transversely septate. **Conidiomata** pycnidia, immersed, marginal or laminal, with a pale ostiole. **Conidia** bacilliform, slightly enlarged at the apex. **Chemistry**: lichen products not detected by TLC. **Ecology**: on nutrient-rich bark or ± siliceous/calcareous rocks in humid environments.

Collema in its new, restricted circumscription contains around 40 species worldwide (Otálora *et al*. 2013b), of which six occur in Great Britain and Ireland. These are characterized especially by their large, foliose and membranous non-corticate thalli and their ascospores which have only transverse septa.

1 Thallus ± smooth, irregularly folded, without longitudinal ridges 2
Thallus pustulate with well-developed, elongate ridges or folds 4

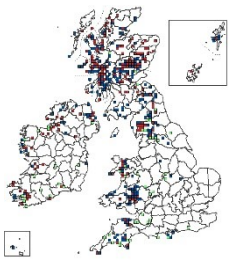
2(1) On base-rich, periodically inundated rocks; isidia forming a dense coarsely areolate crust in the thallus centre ..... ***glebulentum***
On bark or rock; isidia globose, cylindrical or squamule-like, irregularly distribute in the thallus, never forming a crust in the thallus centre 3

3(2) Isidia at first globose, becoming flattened and squamule-like; usually on rock ..... ***flaccidum***
Isidia globose to cylindrical, never becoming squamule-like; usually on bark ..... ***subflaccidum***

4(1) Thallus with numerous cylindrical simple or branched isidia, isidia especially on the thallus ridges; apothecia rare or absent ..... ***furfuraceum***
Thallus with sparse ± distinct coarse globose isidia, or isidia absent; apothecia frequent 5

5(4) Ascospores 3–4.5 µm wide, acicular, 5-to 12-septate; a few coarse knobbly isidia usually present ..... ***nigrescens***
Ascospores 6–6.5 µm wide, clavate, 4- to 5-septate; isidia absent ..... ***subnigrescens***

Collema flaccidum (Ach.) Ach. (1810) **LC**

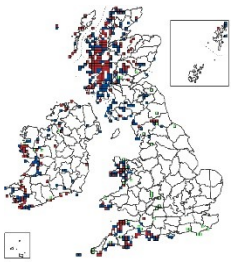


Thallus 3–6 cm diam., foliose, smooth, membranous, often forming extensive colonies, ± deeply and irregularly lobate; lobes 5–15 mm wide, few, thin, ± rounded, loosely attached, often partly ascending, irregularly folded, rumpled and wavy; margin entire or rarely coarsely lacerate, sometimes ± revolute. Upper surface dark olive-green to black, with numerous, often crowded isidia on surface and margins. Isidia concolorous, globose when young, becoming flattened and squamule-like, ± horizontal or ascending. Apothecia very rare, laminal; disc 1.5–2.5 mm diam., flat; thalline margin smooth or ± striate. Ascospores 26–34 × 6–6.5 µm, ellipsoidal to fusiform, 3- to 5-septate. **BLS 0445**.

On sheltered damp siliceous rocks, more rarely on calcareous substrata, often amongst mosses or in sheltered seepage tracks, beside lakes and streams, particularly by waterfalls; more rarely on bark; frequent. N. & W. Britain and Ireland.

Distinguished by the large, sometimes rather ragged, membrane-like thallus with squamule-like isidia. *Leptogium cyanescens* has similar, flattened isidia but the thallus is blue-grey and thinner, with a well-developed upper cortex.

Collema furfuraceum (Arnold) Du Rietz (1929) **LC**

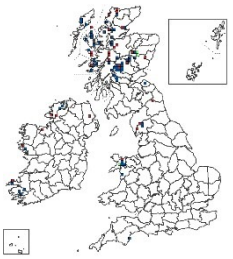


Thallus 3–6 (–10) cm diam., foliose, membranous, thin, closely appressed, conspicuously lobed; lobes 5–10 mm wide, few, rounded or extended, ± overlapping; upper surface dark olive-green to black, paler and ± transparent when moist, markedly ridged, the ridges radiating, in young parts of thallus short, sometimes ± rounded, becoming long, narrow and flexuous, 0.1–0.3 mm wide, *ca* 1.5 mm tall, simple or branched; isidia present on ridges, abundant, terete, cylindrical, to 0.3 mm long, simple or branched and coralloid when old. Apothecia very rare; disc 0.5–1.5 mm diam., flat, with a densely isidiate thalline exciple. Ascospores 40–80 × 3–6.5 µm, 4- to 5-septate, fusiform to acicular, often curved. **BLS 0449**.

On bark, often of horizontal boughs and occasionally rock in humid, well-lit situations; rather frequent. N. & W. Britain and Ireland, extending to S. England (Dorset) but rare and decreasing in the east of its range.

Similar to *C. nigrescens* and *C. subnigrescens* in its membranous ('bat's wing'-like) thallus; however, the characteristic ridges of *C. furfuraceum* become ± densely isidiate. *C. subflaccidum* is also ± densely isidiate but completely lacks ridges.

Collema glebulentum (Nyl. ex Cromb.) Degel. (1952) **Nb**

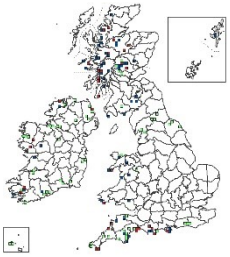


Thallus 3–6 cm diam., foliose, membrane-like, rounded or irregular, closely appressed, ± deeply lobate; lobes 5–8 (–10) mm wide, 0.1–0.25 mm thick, often numerous, rounded or extended, ± overlapping or with contiguous, ascending margins; upper surface dark olive-green to black, folded and conspicuously wavy, margin entire or at times crenate or isidiate, never swollen; isidia *ca* 0.1 mm diam., to 1.5 mm long, terete, branched, globose when young, rarely becoming flattened, usually numerous, often forming a dense, coarsely areolate crust on older parts of thallus. Apothecia unknown. **BLS 0450**.

On siliceous, basaltic and other base-rich rocks in the uplands which are periodically inundated, along lake shores and in seepages. Very local in N. Wales, Lake District, Scotland (Highlands), S. & W. Ireland.

An often overlooked species similar to *C. flaccidum* and *C. subflaccidum*, but distinguished by the rosette-forming, more markedly appressed and divided thallus and swards of rather large, terete or coralloid, finger-like isidia. *C. furfuraceum* occurs predominantly on bark and is pustulate and ridged with smaller, terete isidia.

Collema nigrescens (Huds.) DC. (1805) **NT**

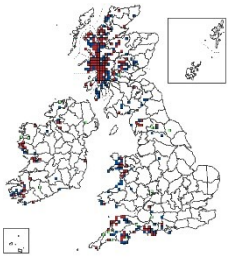


Thallus orbicular, to 10 cm diam., and often more stunted and convoluted, with lobes to 10 mm wide, densely pustulate and ridged, dark olive-green to brown-black, with coarse, nodular-granular isidia to 0.2 mm diam. sometimes present on the upper surface and margins. Apothecia usually very numerous, often covering most of the thallus; disc 0.4–1 mm diam., flat or convex, with a narrow, at times isidiate thalline margin. Ascospores needle-shaped, 50–90 × 3–4.5 µm, (4-) 5- to 12-septate. **BLS 0453**.

On ± nutrient-rich bark, occasionally on seepage tracks on rocks, especially on the coast; rather local, decreasing. N & W. Britain and Ireland. eastwards to Dorset and the New Forest; formerly in Sussex and East Yorkshire.

Similar to *C. subnigrescens*, but usually smaller, densely pustulate and at least slightly isidiate. The spores of *C. nigrescens* are narrower and have more septa than those of *C. subnigrescens*.

Collema subflaccidum Degel. (1974) **LC**



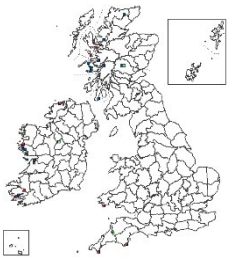
Thallus dark, often tinged brown. Lobes 2–6 mm broad, flat to undulate, not pustulate; the numerous globose to cylindrical isidia give a scurfy appearance to the upper surface. Apothecia very rare, laminal, to 2 mm diam. with a persistent, densely isidiate thalline margin; disc red-brown, flat. Ascospores 42–55 × 4.5–6.5 µm, 5- to 7-septate, narrowly fusiform or ± acicular, straight or slightly curved. **BLS 0457**.

On bark, especially old *Fraxinus,* in relatively moist, shady places, more rarely on siliceous rock; rather frequent. N. & W. Britain and Ireland, also E. to the New Forest.

Like *C. flaccidum*, but with smaller, densely distributed laminal isidia, which are mostly globular. *Leptogium saturninum* is similar but has a corticate thallus with white-grey tomentum on the lower surface.

Host to the small perithecial fungus *Myxophora leptogiophila* (Hoffmann & Hafellner 2000), which causes galls on the thallus and in Britain at least, appears to be restricted to *C. subflaccidum*.

Collema subnigrescens Degel. (1954) **Nb**



Thallus 2–6 (–20) cm diam., orbicular, foliose, thin and membranous, ± closely appressed to the substratum, deeply lobed; lobes broad, 5–15 mm wide, few, rounded or ± extended, overlapping, often folded; upper surface dark olive-green to black, ridged; ridges radiating, short in young parts of the thallus, in old parts becoming long and narrow, to 1.5 mm tall and 0.1–0.3 mm wide; isidia absent; lower surface with depressions corresponding to the ridges, paler green. Apothecia often present; disc 0.8–1.5 mm diam., rarely ± white-pruinose, pale to dark brown, flat with a narrow, smooth margin. Ascospores 40–75 × 6–6.5 µm, 4- to 5-septate, acicular-fusiform, usually curved, often thickened at one end. **BLS 0458**.

On ± nutrient-rich bark, less often on rock; rare. W. Britain and Ireland.

Separated from *C. nigrescens* by the absence of isidia and the broader ascospores with fewer septa.

ENCHYLIUM (Ach.) Gray (1821)

Thallus foliose, sometimes reduced and squamulose or ± crustose, gelatinous, swelling considerably when wet, upper surface dark olive-green to black; the lobes radiating or elongate, flat to ascending, smooth to ridged or plicate, not tomentose. **Upper** and **lower cortex** absent, the thallus with intertwined hyphae interspersed with chains of photobiont cells. **Isidia** present or absent, soredia absent. **Ascomata** apothecia, numerous in most species, with a red-brown flat to convex disc. **Thalline margin** smooth, granular or isidiate, usually persistent. **True exciple** composed of parallel vertically oriented hyphae. **Epithecium** indistinct, colourless or pigmented. **Hymenium** colourless, I+ blue. **Hypothecium** ± colourless. **Hamathecium** of paraphyses, separating in K, unbranched or branched, often anastomosed, especially near the apices, apices often clavate or subglobose, sometimes yellowish to reddish brown. **Asci** clavate, apex strongly thickened, apical dome I+ blue, with a downwardly projecting I+ blue annulus and apical cap, (2-) 4- to 8-spored. **Ascospores** varied, transversely septate or submuriform. **Conidiomata** immersed, marginal or laminal, with a pale ostiole. **Conidia** bacilliform or acicular. **Chemistry**: lichen products not detected by TLC. **Ecology**: most species terricolous or saxicolous.

Enchylium as currently defined corresponds to the *Collema tenax* group recognized by Degelius (1974), and contains species formerly referred to *Collema* with thalli that swell noticeably when wet. Most are pioneer species growing on soil or rocks, especially in high light levels (Otálora *et al*. 2013b).

1 Thallus large and copiously isidiate, the isidia large and globose to clavate; apothecia rare, the true exciple composed of isodiametric cells ..... ***Lathagrium auriforme***
Thallus small to medium, not conspicuously isidiate; apothecia usually frequent, the true exciple composed of vertically oriented hyphae 2

2(1) On calcareous soils and mortar 3
On limestone, rarely on bark 5

3(2) Thallus ± crustose, membranous, without distinct lobes, often almost invisible when dry; asci (2-) 4-spored; ascospores muriform ..... ***limosum***
Thallus foliose, well-developed, multi-lobed; asci mostly 8-spored; ascospores septate or submuriform 4

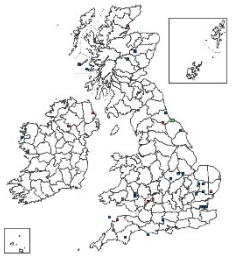
4(3) Apothecia with multi-lobed, crenulate thalline margins; ascospores 26–36 × 10–15 µm, submuriform, becoming pale brown; conidia acicular ..... ***bachmanianum***
Apothecia with entire margins; ascospores 17–26 × 6.5–10.5 µm, transversely septate or submuriform, remaining colourless; conidia bacillar ..... ***tenax***

5(2) On bark; thallus minute, < 10 mm diam.; ascospores 3–4.5 µm broad, mostly 1-septate, narrowly fusiform; probably extinct in the British Isles ..... ***conglomeratum***
On calcareous rocks; thallus larger; ascospores 6.5–12 µm broad 6

6(5) Thallus 2–6 cm diam., with thick ascending lobes; ascospores 18–28 × 6.5–8.5 µm, 1- to 3- septate ..... ***polycarpon***
Thallus 1–1.5 cm diam., cushion-like with short radiating lobes; ascospores 13–22 × 8–12 µm, 3-septate to submuriform ..... ***confertum***

Enchylium bachmanianum (Fink) Otálora, P.M. Jørg. & Wedin (2013) **NT IR**

Collema bachmanianum (Fink) Degel. (1954)



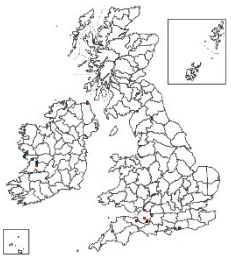
Like *E. tenax*, but the apothecia have a coarsely crenate, thalline margin with warts or lobules and larger, broadly ellipsoidal, submuriform ascospores 26–36 × 10–15 µm in size, colourless but sometimes becoming straw-coloured or pale brown; pycnidia absent, but conidia formed in internal locules, 10.5–13 × 2–3 µm. **BLS 0434**.

On sandy ± basic disturbed soils such as cliffs, quarry floors, tracks and associated with shell-sand dunes; rare but easily overlooked. Throughout Britain and Ireland.

The conidia are few in number and much larger than in most other species of the Collemataceae. They develop from the ends and sides of hyphae in locules deep in the thallus and remain on the conidiophores forming small groups or bundles of up to 15 conidia; similar internal conidia are also known in *Callome multipartita*.

Enchylium confertum (Arnold) Otálora, P.M. Jørg. & Wedin (2013) **Nb**

Collema confertum Arnold (1867)



A small species, cushion-like to subumbilicate; thallus 1–1.5 cm diam. with short radiating, plane to convex, olive-black lobes 0.5–1.5 mm wide, apices swollen; isidia absent. Apothecia numerous, covering most of the thallus, disc plane to convex, red-brown to black, exciple entire, later becoming excluded. Ascospores short and broad, 13–22 × 8–12 µm, 3-septate to submuriform. **BLS 0438**.

On calcareous rocks; rare, possibly overlooked. Most records are from Ireland (Co. Clare - The Burren), with scattered occurrences in S.W. England, Sussex and Durham.

The reduced, thick lobes without isidia but with numerous small apothecia are characteristic, as is its ecology.

Enchylium conglomeratum (Hoffm.) Otálora, P.M. Jørg. & Wedin (2013) **Ex**

Collema conglomeratum Hoffm. (1796)

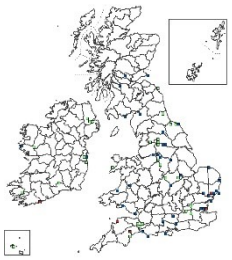
Thallus <1 cm diam., squamulose or ± crustose, forming well-developed rounded gelatinous cushions, often attached by a central point; lobes 0.5–1.5 mm wide, short, olive-black, few, free or overlapping, ± flattened, distinctly swollen with a smooth or sometimes verrucose surface and lobulate margins. Apothecia mostly numerous, crowded and predominating, together often forming a ball, sessile; disc 0.5–1.5 (–2) mm diam., flat to convex, with a rather thin, entire thalline margin. Ascospores 15–24 × 3–4.5 µm, narrowly fusiform with acute apices, 1 (-3)-septate, never with longitudinal septa. **BLS 0439**.

On bark (*Ulmus*, *Fraxinus*) in wayside, nutrient-rich sites. S. England (W. Sussex; Upper Beeding), C. S. Scotland (Perthshire; Aberfeldy); last collected over 100 years ago, no recent records.

Differs from other small species of Collemataceae in the narrow, fusiform, mostly 1-septate ascospores. Appears as a cushion, the surface of which is entirely covered by small red-brown apothecia.

Enchylium limosum (Ach.) Otálora, P.M. Jørg. & Wedin (2013) **Nb**

Collema limosum (Ach.) Ach. (1810)



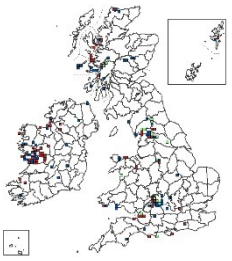
Thallus thin, membrane-like, without distinct lobes, best-developed around apothecia, forming a dark olive-green, blue-grey to brown-black crust, the surface smooth or verrucose, swelling when wet but shrinking and almost disappearing when dry. Apothecia frequent, often numerous, immersed or sessile; discs chestnut brown, large, 2–3 mm diam., flat, with a smooth or ± verrucose thalline margin. Asci (2-) 4-spored. Ascospores 26–34 × 10–15 µm, ovoid-ellipsoidal, muriform. **BLS 0451**.

On damp clay or sandy soils, especially pathways, eroding cliffs and urban wasteland; rather rare. Scattered throughout Great Britain, with an eastern bias.

Differs from *E. tenax* by the (2-) 4-spored asci, larger, more muriform ascospores and the poorly developed, crustose thallus without distinct lobes.

Enchylium polycarpon (Hoffm.) Otálora, P.M. Jørg. & Wedin (2013) **Nb**

Collema polycarpon Hoffm. (1796)



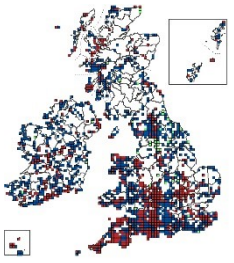
Thallus 2–6 cm diam., forming rosette-like cushions, foliose, deeply lobed, rather thick; lobes 1–2.5 mm wide, numerous, crowded, ± radiating, ± flattened, contiguous, often ascending at the centre of the thallus, often channelled towards the apices with raised margins, swollen, somewhat contorted; upper surface dark olive-green to black, without isidia. Apothecia numerous, terminal and on raised margins, ± elevated, crowded and frequently covering thallus except outermost parts of lobes, mostly appearing stalked; disc 0.5–1.5 mm diam., flat to convex, with rather thin, smooth thalline margin. Ascospores 18–28 × 6.5–8.5 µm, 1- to (2-) 3-septate, fusiform, with acute apices. **BLS 0455**.

On hard, moist, exposed limestone, often associated with *Callome multipartita*; local, in most limestone districts of Great Britain and Ireland.

Recognized by the thick, often ascending lobes with terminal apothecia. Fertile thalli of *Lathagrium cristatum* may appear similar but have canaliculate lobes and submuriform spores.

Enchylium tenax (Sw.) Gray (1821) **LC**

Collema tenax (Sw.) Ach. (1810)



Thallus 2–4 (–10) cm diam., very variable, foliose, rounded in small rosettes, or irregular, closely or loosely attached or partly ascending, rather thick, much swollen when moist; lobes often numerous, mostly radiating from the centre, with parallel sides or widening towards the swollen apices, to 6 mm across; contiguous and overlapping or discrete, entire or crenate, flattened or more usually ± concave, smooth; upper surface dark olive-green to brownish black; isidia, when present, large, globose, recalling adventive lobes. Apothecia often present, sometimes predominating, on the surface or margins of lobes; disc to 3 mm diam., flat, with an entire thalline margin, becoming convex. Asci (4- or 6-) 8-spored. Ascospores 17–26 × 6.5–10.5 µm, 3-septate or submuriform, fusiform to ellipsoidal with pointed or rounded ends, persistently colourless. Pycnidia 100–200 µm diam., rather common, immersed, ± globose; conidia 4–6 × 1–2 µm in size. **BLS 0459**.

On basic clay, sandy and calcareous soils and mortar; abundant, frequently with anthropogenic association. Throughout Great Britain and Ireland.

The most frequent *Collema*-like lichen and also the most variable. Differs from *E. bachmanianum* in having apothecia with a smooth thalline exciple, shorter conidia and narrower, persistently colourless spores. It is host to the lichenicolous *Didymellopsis pulposi* (Zopf) Grube & Hafellner (1990).

Three divergent morphs of *E. tenax* have been distinguished in the British Isles, recognized as varieties of *Collema tenax* by Degelius (1974) and accepted at that rank by Gilbert *et al.* (2009) and Jørgensen (2012a). However, they were not treated by Otálora *et al.* (2013b) and no combinations into *Enchylium* have been made. They are as follows:

Collema tenax var. **ceranoides** (Borrer) Degel. (1954) [**BLS 0460**] with ± compacted or loosely tufted thalli of simple or often branched, digitate, erect, cylindrical lobes, to 1.5 cm tall and 1–2 mm diam., rarely fertile; on unstable sandy, basic, soils, particularly the middle of country roads, widespread.

Collema tenax var. **corallinum** (A. Massal.) Degel. (1954) [**BLS 0461**] is almost crustose with very few lobes that often form a coralloid crown around the disc of the apothecia; on bare sandy soil, not often separated but believed to be rare.

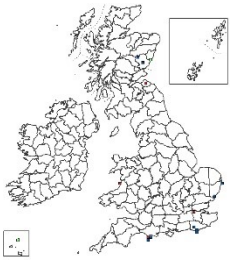
Collema tenax var. **vulgare** (Schaer.) Degel. (1954) [**BLS 0462**] has chunky, short, swollen convex lobes in small confluent rosettes and is usually abundantly fertile; widespread on mortar and damp basic soil..

EPIPHLOEA Trevis. (1880)

Thallus crustose, areolate to small-squamulose, olive-grey; cellular throughout or with a multilayered cellular upper cortex; attached to the substratum by hyphae. **Prothallus** absent or indistinct. **Photobiont** cyanobacterial, *Nostoc* or *Stigonema*. **Ascomata** apothecia, immersed to ± sessile, flat, rounded. **Disc** red-brown with a narrow true exciple ± obscured by a persistent thalline margin. **Asci** clavate, apex strongly thickened, apical dome I+ blue, with a downwardly projecting I+ blue annulus and apical cap. **Ascospores** colourless, ellipsoidal, muriform. **Conidiomata** unknown. **Chemistry**: lichen substances not detected by TLC. **Ecology**: ephemeral pioneer species on disturbed (commonly clay) soils, mostly short-lived and seasonal.

An overlooked and misunderstood genus, previously assigned to the Heppiaceae, characterized by a crustose-areolate thallus that becomes granular and is composed of compact, broad hyphae. The asci were thought to be prototunicate, but are typical of the Collemataceae according to Schultz *et al.* (2015). These authors placed *Epiphloea* into synonymy with *Leptogium*, but that genus has large foliose thalli with a lax medulla. *Epiphloea* is monophyletic as currently circumscribed, and *Leptogium* could well be further subdivided based on both morphological and phylogenetic criteria.

Epiphloea byssina (Hoffm.) Henssen & P.M. Jørg. (2007) **Nb**



Thallus 0.5–5 cm diam., forming a ± continuous thin blue-grey to brown-black crust of minute granules which divide to form an areolate crust, areoles to 3 mm across, each containing one to several apothecia; thallus anatomy compact, composed of ± broad hyphae throughout. Apothecia to 2 mm diam., common, immersed among the thallus granules or becoming sessile; thalline margin narrow, smooth or with a few granules; initially concave but later flat with a distinct margin. Asci often with irregular spore formation, 4-, 6- or 8-spored. Ascospores ellipsoidal, muriform, 16–28 × 7–15 µm. **BLS 0831**.

An ephemeral, pioneer species of bare clay or sandy, more or less alkaline soils. Distribution in the British Isles poorly known with scattered records from S. and S.E. England, E. Anglia, Wales (Ceredigion) and Scotland (Angus, Kincardine & E. Lothian).

The almost crustose thallus and different apothecia separate *Ephphloea byssina* from small-squamulose *Scytinium* spp. The thallus of *E. byssina* is more reminiscent of *Moelleropsis nebulosa*, with which it often grows; the latter has a more pulverulent bluish grey thallus, notably superficial, convex apothecia and asci with aseptate spores.

LATHAGRIUM (Ach.) Gray (1821)

Thallus foliose, medium to large, gelatinous, sometimes swelling when wet, upper surface dark olive-green to brown-black, rarely grey-blue; lobes narrow to broad, often extended and repeatedly branched, flat to concave, the surface smooth to markedly ridged or folded, not tomentose. **Upper** and **lower cortex** absent, the thallus composed of intertwined hyphae intermixed with chains of photobiont cells. **Isidia** absent to frequent, soredia absent. **Ascomata** apothecia, with a pale brown, red-brown or brown-black disc. **Thalline margin** present, usually persistent. **True exciple** composed of isodiametric cells. **Epithecium** indistinct, colourless or pigmented. **Hymenium** colourless, I+ blue. **Hypothecium** ± colourless. **Hamathecium** of paraphyses, separating in K, unbranched or branched, often anastomosed, especially near the apices, the apices often clavate or subglobose, sometimes yellowish to reddish brown. **Asci** clavate, apex strongly thickened, apical dome I+ blue, with a downwardly projecting I+ blue annulus and apical cap, 8-spored. **Ascospores** septate, mostly submuriform, rarely fusiform to cylindrical with transverse septa only. **Conidiomata** pycnidia, mostly immersed, marginal or laminal, with a pale ostiole. **Conidia** bacilliform, sometimes ± enlarged at the apex. **Chemistry**: lichen products not detected by TLC. **Ecology**: on calcareous rocks, often amongst mosses, more rarely on siliceous or serpentine rocks, mortar or soil.

Lathagrium is a somewhat disparate group when field characters only are observed. It corresponds to the *Collema cristatum* and *C. durietzii* groups of Degelius (1974), and is monophyletic (at least based on the species sampled) according to Otálora *et al.* (2013b). Species of *Collema sensu stricto* tend to have larger thalli, have transversely septate ascospores and are corticolous. *Enchylium* species have conspicuously swollen thalli and the structure of their apothecia differs.

Lathagrium auriforme is atypical in that the thallus swells markedly when wet; it is therefore keyed out also under *Enchylium*. From the limited data set available, it appears that *L. auriforme* is the phylogenetic sister group to the main body of *Lathagrium* species, and may include more than one species. More research is needed. Sequencing of *L. dichotomum* and *L. latzelii*, both species of conservation concern in our region, should also be encouraged.

1 On ± basic siliceous rocks in streams, usually completely submerged; isidia absent; thallus repeatedly branched ..... ***dichotomum***
Terrestrial; on calcareous rocks, mortar or soil; isidia present or absent; thallus various 2

2(1) Thallus large, with lobes to 10 mm wide, swelling when wet, striate when dry; isidia copious, globose to clavate, often partially obscuring the thallus ..... ***auriforme***
Thallus usually smaller with lobes usually < 5 mm wide with wavy margins, not swelling when wet, smooth or pustular when dry; isidia, if present, small 3

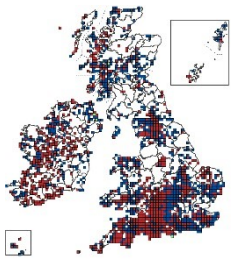
3(2) Isidia becoming flattened and squamule-like; ascospores 13–16 (–18) × 10–12 µm, ± cuboid; rare, on serpentine rocks ..... ***latzelii***
Isidia (if present) ± globose; ascospores ellipsoidal or fusiform, distinctly longer than wide 4

4(3) Thallus lobes concave, often with elevated nodulose or lobulate margins ..... ***cristatum***
Lobes flat, or if concave, without lobulate margins 5

5(4) Thallus convoluted, lobe margins strongly undulate; granular isidia confined to the wavy ascendant margins may be present; ascospores 3-septate ..... ***undulatum***
Thallus frequently dispersed in discrete lobes, with laminal isidia, lobe margins flat or often wavy, downturned when dry; ascospores submuriform ..... ***fuscovirens***

Lathagrium auriforme (With.) Otálora, P.M. Jørg. & Wedin (2013) **LC**

Collema auriforme (With.) Coppins & J.R. Laundon (1984)



Thallus 2–4 (–10) cm diam., foliose, ± rounded, ± loosely attached and partly ascending, ± deeply and irregularly lobed, rather thick, notably swollen and pulpy (*ca* 0.5 mm thick) when wet; lobes to 10 mm wide, few, large and ear-like, often rounded, minutely striate or wrinkled when dry, with an entire or sometimes indented margin; upper surface dark olive-green to brownish black, rarely blue-grey; isidia often numerous, crowded, globose or clavate, rarely branched, particularly conspicuous when wet. Apothecia rather rare, often ± immersed when young; disc 2–3 mm diam., with an entire, granular-isidiate thalline margin. Ascospores 26–36 × 8.5–13 µm, ellipsoidal to ovoid, submuriform. **BLS 0433**.

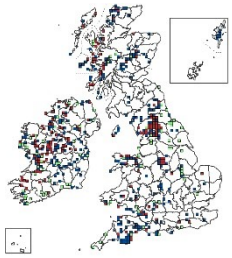
Amongst mosses and on highly calcareous rocks, mortar and soil, chalk paths and shell-sand dunes, in rather moist, mostly shaded situations; often common. Throughout Great Britain and Ireland.

Similar to *L. fuscovirens* but with a thicker, generally brownish, non-olivaceous, non-bullate but ± wrinkled thallus; *L. fuscovirens* generally grows directly on rocks. When wet the thallus of *L. auriforme* is thicker, more pulpy and the globose isidia larger. *L. auriforme* has a wider ecological amplitude, growing on a wide variety of basic substrata; it prefers moister habitats than *L. fuscovirens* and often occurs on or amongst mosses. *Scytinium plicatile* may be confused with *L. auriforme*, but it remains cartilaginous when wet.

Host to the lichenicolous *Endococcus caudisporus* J.C. David & Etayo (1995) and *Didymellopsis pulposi* (Zopf) Grube & Hafellner (1990).

Lathagrium cristatum (L.) Otálora, P.M. Jørg. & Wedin (2013) **LC**

Collema cristatum (L.) Weber ex F.H. Wigg. (1780)



Thallus 2–5 (–10) cm, foliose, rounded, semi-circular or irregular, often dying away in the centre when old, deeply lobed; the lobes to 3 mm wide, rather thin, narrow, radiating, notably concave, irregularly branched, contiguous or discrete; lobe margins elevated, wavy, ± entire or ± incised, distinctively dentate to sinuously lobulate, not swollen; upper surface dark olive-green-brown to black; lower surface with rounded hapters forming large white tufts. Apothecia often densely crowded, sometimes absent, ± marginal, sessile or stalked; disc to 5 mm diam., flat, with an even thalline margin. Asci 4- to 6 (-8)-spored. Ascospores 18–32 × 8–13 µm, ellipsoidal with ± acute ends, submuriform. **BLS 0442**.

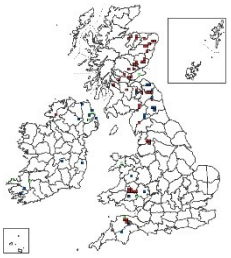
Usually firmly attached to calcareous rocks or more rarely soil. Throughout Great Britain and Ireland.

Very variable; morphs are recognized at the varietal level, although intermediates do occur. **Collema cristatum** var. **marginale** (Huds.) Degel. (1954) [**BLS 0443**] has extended, furcate lobes which are less incised, their margins carrying sparse to numerous globose to clavate isidia. Apothecia are often numerous, to 2 mm diam. It occurs on calcareous rock, with a more southerly distribution than var. *cristatum*. The combination into *Lathagrium* has not yet been made. Densely isidiate and wide-lobed morphs of var. *marginale* may resemble *L. auriforme* but differ in the non-striate thallus with distinctly branched, narrow concave lobes, usually with abundant apothecia.

L. cristatum is usually firmly attached to rocks, forming distinctive, complete or incomplete, radially spreading rosettes; however morphs occur which are detached, these collect in moist declivities in rock where they form irregular, rather spiky, contorted thalli that sometimes have narrow, attenuated, curled lobes.

Lathagrium dichotomum (With.) Otálora, P.M. Jørg. & Wedin (2013) **VU(B)**

Collema dichotomum (With.) Coppins & J.R. Laundon (1984)



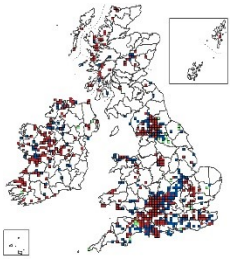
Thallus to 2.5 cm diam., often circular but sometimes forming more extensive patches, bright green to olive-green when wet. Thallus lobes rather thin, often ascending, composed of repeatedly branched, strap-like lobes that splay out at their ends; without isidia. Apothecia sparse, rarely numerous, superficial; disc 0.7–1 mm diam., flat, with a thin, entire, smooth thalline margin. Ascospores 20–30 × 8.5–13 µm, 3-septate or submuriform with one longitudinal septum. Pycnidia 300–550 µm diam., rather frequent, superficial, often similar to young urceolate apothecia, with a small 'disc' and a thick thalline margin, reddish yellow with blackened apex, appearing as swollen low tubercles with a prominent opening; conidia 5–6.5 (–8) × 1.2–1.5 µm. **BLS 0446**.

On mostly permanently submerged, flat bedding planes of ± basic siliceous rock in the middle reaches of rivers; rare. Widely scattered from S.W. England to N. Scotland, Wales, Ireland.

A distinctive, rather small species with a characteristic repeatedly forked branching pattern, branches fan-shaped at the ends; resembles a small seaweed. Apothecia small, pycnidia unusually large. The only *Collema* s.l. which occurs in ± permanently inundated habitats. Sensitive to eutrophication but tolerant of moderate silting. *Porocyphus kenmorensis* may grow in similar habitats but the lobes are less well-defined and randomly arranged so that the radiating character is ± obscured; however, the coarse terminal nodules are always present.

Lathagrium fuscovirens (With.) Otálora, P.M. Jørg. & Wedin (2013) **LC**

Collema fuscovirens (With.) J.R. Laundon (1984)



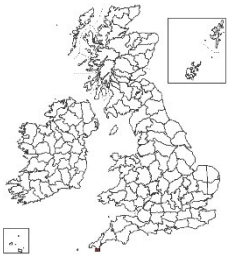
Thallus 3–5 cm diam., foliose, ± rounded or irregular, deeply lobed, appressed; lobes 2–6 mm wide, rather few, extended, often repeatedly branched, ± rounded with ± ascending, wavy margins, never swollen; upper surface dark olive-green to nearly black, paler and ± transparent when moist; usually distinctly pustulate, sometimes greyish or bluish; isidia on surface and margins, globular, often numerous and partly covering the thallus to give a scurfy appearance, concolorous with the thallus. Apothecia numerous to sparse; disc 0.5–1.5 mm diam., flat or with a ± thick thalline margin, smooth or isidiate. Ascospores 15–24 × 6.5–13 µm, submuriform, often with 3 transverse and 1 longitudinal septa, ovoid or ellipsoidal. **BLS 0463**.

On hard, exposed to moist calcareous rocks, walls and occasionally asbestos roofs; frequent. Throughout Great Britain and Ireland, although rare over most of Scotland.

Similar to *L. auriforme*, but with a thinner, darker thallus which is often pustulate and not noticeably swollen when wet, with narrow, more wavy lobes and smaller isidia; when dry, the minute, crowded isidia give the thallus a scabrid, matt appearance.

Lathagrium latzelii (Zahlbr.) Otálora, P.M. Jørg. & Wedin (2013) **VU (D2)**

Collema latzelii Zahlbr. (1909)



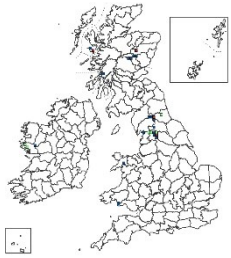
Thallus to 1.5 cm diam., foliose, firmly attached to the rock, forming small contorted, rounded or irregular dark cushions, deeply lobed; lobes numerous, 1–3 mm wide, radiating, ± extended, repeatedly branched, contiguous, often overlapping with ascending, ± entire, markedly wavy margins, never swollen; upper surface dark olive-green to black, ± smooth, matt; isidia, when present, coarsely globose or squamule-like. Apothecia not frequent, small, scattered or crowded, inconspicuous, often submarginal; disc 0.3–0.8 mm diam., flat to concave. Asci 8-spored, ascospores 13–16 (–18) × 10–12 µm, ovoid, subglobose or ± cuboid, submuriform, with 4–6 cells. **BLS 1589**.

On vertical sunny coastal serpentine rock faces. S.W. England (W. Cornwall, Lizard).

The contorted, plicate-lobed thallus with coarse, granular isidia resembles *Scytinium plicatile*, which is more red-brown. The often quadrately divided ovoid to subglobose spores are diagnostic.

Lathagrium undulatum (Laurer ex Flot.) Otálora, P.M. Jørg. & Wedin (2013) **Nb**

Collema undulatum Laurer ex Flot. (1850)



Thallus 3–6 cm diam., foliose, rounded or irregular, appressed, deeply lobed; lobes 2–4 mm wide, channelled, with ascending, entire or sparingly incised, wavy margins, overlapping, never swollen when wet; upper surface dark olive-green to black, smooth, not isidiate. Apothecia usually numerous, often densely crowded; disc 1–1.5 mm diam., flat or ± convex, with a thick thalline margin, level with or below the level of the disc. Ascospores 17–30 × 6.5–9 µm, 3-septate, fusiform-ellipsoidal. **BLS 0464**.

On hard, exposed upland limestone; very local. N. England, N. Wales, Scotland.

Distinguished by the 3-septate spores, the dark thallus with densely compacted, concave, markedly wavy lobes with apothecia and a thalline exciple level with, or below that of, the disc.

Specimens with numerous globose to granular isidia, 0.1–0.2 mm diam., mainly on the older parts of the thalli, have been referred to **Collema undulatum** var. **granulosum** Degel. (1954) [**BLS 0465**]; the combination into *Lathagrium* has not been made. Its status is uncertain (resulting in a "Data Deficient" conservation assessment for both varieties). It is believed to be rare, on basic rocks and growing with bryophytes in depressions of limestone pavements.

LEPTOGIUM (Ach.) Gray (1821)

Thallus foliose, gelatinous, blue-grey to olive-brown or blackish; upper and lower cortex of a single row of ± isodiametric cells; medulla with loosely interwoven hyphae interspersed with chains of the photobiont cells. **Upper surface** smooth to wrinkled or ridged, often glossy, rarely arachnoid. **Lower surface** smooth, arachnoid or hairy, sometimes with scattered groups of white rhizines. **Isidia** often present. **Photobiont** *Nostoc*. **Ascomata** apothecia, sessile to shortly stalked, mainly laminal. **Thalline margin** persistent or becoming excluded, sometimes lobulate. **True exciple** raised, cupular, mostly composed of periclinally arranged hyphae, colourless to reddish brown. Disc concave to flat. **Epithecium** colourless to reddish brown, K–, N–. **Hymenium** colourless, I+ blue. **Hypothecium** shallow, colourless or pale yellowish. **Hamathecium** of paraphyses, numerous, conglutinate, ± unbranched, apices ± swollen. **Asci** (4-) 8-spored, clavate; wall K/I + blue, and apical dome K/I+ pale

blue with a dark blue axial tube. **Ascospores** ellipsoidal, ovoid or fusiform, often apiculate at one or both ends, septate, submuriform to muriform, colourless, occasionally becoming faintly ornamented in old spores. **Conidiomata** unknown. **Chemistry**: no lichen substances detected by TLC. **Ecology**: most species corticolous or soil-dwelling, often amongst mosses; sometimes on rocks in humid environments.

Species formerly assigned to *Leptogium* are now divided between that genus, *Pseudoleptogium* and *Scytinium*. *Leptogium sensu stricto* contains primarily corticolous species with relatively large foliose, broad-lobed thalli. The cortex is always present and composed of ± isodiametric cells, sometimes tomentose on one or other surface, and the medulla is hyphal in construction with chains of the *Nostoc* photobiont cells.

Literature

Bjelland *et al*. (2017), Kitaura & Marcelli (2013), Otálora *et al*. (2013b), Stone *et al*. (2016).

1 Thallus tomentose on the lower and/or upper surface 2
Thallus without tomentum 6

2(1) Upper surface not tomentose; lower surface with a fine, pubescent tomentum, occasionally forming long, coarse rhizines 3
Upper surface with a ± dense, grey-white, arachnoid tomentum; lower surface naked but with localized tomentum in areas of attachment to substratum ..... ***juressianum***

3(2) Isidia present 4
Isidia absent 5

4(3) Upper surface dark olive-black, smooth; uniformly isidiate; undersurface tomentose with a few distinct, long rhizines ..... ***saturninum***
Upper surface brownish or bluish grey, strongly wrinkled-striate; patchily isidiate; undersurface uniformly short-tomentose ..... ***hibernicum***

5(3) Thallus forming compact, multi-lobed cushions; apothecia with abundant, marginal folioles; undersurface uniformly short-tomentose ..... ***burgessii***
Thallus forming loose, wide-spreading rounded patches; apothecia without marginal folioles; undersurface tomentose with distinct, long rhizines; considered to be extinct in Great Britain and Ireland..... ***hildenbrandii***

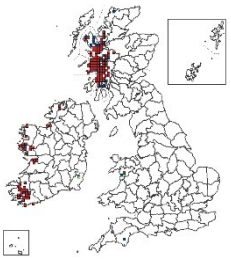
6(1) Lobes markedly swollen when wet, thin, markedly ridged and wrinkled when dry; isidia cylindrical-coralloid or granular..... 7
Lobes only slightly swollen when wet, smooth or striate when dry 8

7(6) Granular, brownish isidia chiefly along the swollen thallus margins contrasting with blue-grey thallus ..... ***brebissonii***
Cylindrical to coralloid, pale blue-grey isidia, chiefly along laminal ridges, concolorous with the thallus ..... ***coralloideum***

8(6) Margin of lobes ± lacerate-fimbriate or cylindrical; surface with abundant flattened isidia ...***cyanescens***
Margins of lobes entire; isidia absent 9

9(8) Thallus pale grey, lobes very thin, tissue-like, wavy, crinkled, uneven; apothecia very rare, top-shaped with short, pale stalks ..... ***britannicum***
Thallus dark grey to greenish blue, lobes rather thick, upper surface clearly striate; apothecia frequent, ± sessile ..... ***cochleatum***

Leptogium brebissonii Mont. (1840) **NT IR**

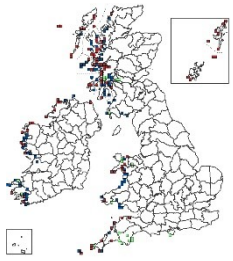


Thallus forming conspicuous tufts 1–5 cm wide, notably pulpose when moist, with markedly ridged and swollen, indistinct lobes, shrinking to an irregular flattened but still markedly ridged thallus when dry; upper surface dark green-grey when wet, becoming grey-black when dry, strongly rugose and uneven; lower surface similar but paler, without tomentum; lobes partly fenestrate, ridges towards the margin ± isidiate; isidia granular, brownish, contrasting with the greyish thallus, often loosely scattered, mainly along swollen margins of the thallus. Apothecia not observed in British or Irish material. **BLS 0828**.

On deciduous trees and mossy rocks; local. W. Britain, especially W. Scotland, W. Wales, W. Ireland.

When well-developed, easily identified by the dark, much swollen thallus when wet, the ridged lobes when dry, and the presence of isidia. *L. hibernicum* usually has better defined lobes which are finely tomentose below. For differences from *L. coralloideum* see that species.

Leptogium britannicum P.M. Jørg. & P. James (1983) **Nb IR**

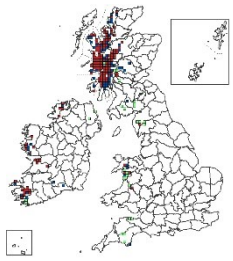


Thallus to 10 cm diam., in loose tufts or as irregularly dispersed lobes; lobes (3–) 5–10 (–15) mm wide and 10–15 (–35) mm long, irregular, crinkled, very thin (50–70 µm thick), tissue-paper-like, often ascending, often contorted, ± revolute at the margins; upper surface pale blue-grey when wet, becoming somewhat darker when dry, wavy, ± bullate-honeycombed, convoluted, matt, ± smooth, isidia absent; lower surface slightly paler than the upper; rhizines and tomentum absent. Apothecia very rare, laminal; disc (0.5–) 0.8–1.2 (–1.5) mm diam., ± top-shaped with a distinct, short, pale, longitudinally furrowed stalk; disc at first concave, later becoming flat or convex, red-brown or brown; thalline margin distinct, whitish brown to pale buff, soon becoming occluded; true exciple of narrow, periclinal hyphae. Ascospores (18–) 20–30 (–34) × (5–) 6–7 (–8) µm, 3- to 4-septate or submuriform with a single longitudinal septum, elongate-clavate to ellipsoidal, the apices ± pointed. **BLS 0829**.

On exposed coasts, in pockets of bare earth, short grass and low vegetation amongst rocks, wall tops; local. W. Britain and Ireland, Channel Islands.

Characterized by the very thin, papery, blue-grey lobes, absence of isidia, the rare occurrence of apothecia and restriction to coastal areas. Similar to *L. cyanescens* which is, however, isidiate.

Leptogium burgessii (L.) Mont. (1840) **Nb IR**



Thallus to 10 cm diam., forming rounded tufts or rosettes of numerous rounded or wavy lobes, often raised in the centre; lobes 3–5 (–8) mm wide, much convoluted, overlapping, crisped, with abundant folioles arising from the margins and surface; upper surface blackish brown or blackish olive-green; lower surface uniformly shortly grey-tomentose, paler than the upper surface. Apothecia fairly frequent; disc 1–3 mm diam., red-brown to blackish brown, concave; thalline margin thick with abundant folioles. Ascospores 30–40 × 13–17 µm, 5- to 7-septate, ellipsoidal or fusiform, muriform. **BLS 0830**.

On mossy trunks, especially of *Corylus* and *Fraxinus*, also on mossy rocks, in sheltered moist woodlands, often by lakesides or on mossy rocks in valley bottoms; locally abundant. W. Britain and Ireland.

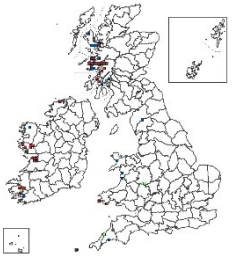
The number of secondary folioles on the lobes is variable. Distinguished from *L. cyanescens* and *L. cochleatum* by the thin, even, pubescent tomentum on the lower surface and by the thalline margin with abundant folioles.

Leptogium cochleatum (Dicks.) P.M. Jørg. & P. James (1983) **VU (C2, D1) IR**

Thallus forming extensive patches, to 10 cm diam.; lobes to 1 cm wide, 100–150 µm thick, numerous, wavy, overlapping, margins ± ascending, rounded, entire, intricately folded, particularly towards the centre; upper surface dark grey, matt, ± distinctly finely striate, not wrinkled. Apothecia to 3 mm diam., usually present, sessile; thalline margin thin, persistent, pale, ± wrinkled; true exciple parenchymatous. Ascospores (20–) 25–30 (–37) × (12–) 14–16 (–17) µm, faintly ornamented, muriform. **BLS 0832**.

On sheltered trunks of old deciduous trees, particularly *Fraxinus* and *Corylus*, especially near streams, also on mossy rocks; local and rare. W. Scotland, W. Ireland, a few scattered localities in N. England (Cumbria) and W. Wales (Merioneth).

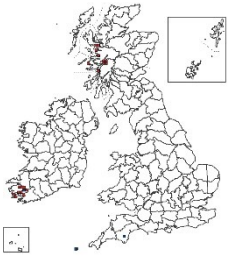
When well-developed, this species forms elegant, spreading patches with numerous, overlapping lobes with raised, entire margins and an upper surface studded with very regular, sessile apothecia. When juvenile or less well-developed, it forms more compacted, sterile tufts of ascending, curled lobes; isidia are never present. The similar *L. cyanescens* is isidiate. Closely related to the non-British *L. azureum* (Sw.) Mont. (1840).



Leptogium coralloideum (Meyen & Flot.) Vain. (1921) **VU (D1)**

Like *L. brebissonii* but the isidia are cylindrical, coralloid, pale blue-grey, concolorous with the thallus, copious and mainly along ridges on the upper surface. Apothecia not observed in British material. **BLS 1660**.

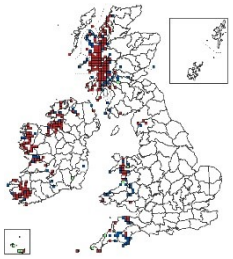
On mossy bases of trees, often *Salix*, occasionally also on mossy rocks. Strongly western in Britain and Ireland; rare. Scotland (Skye and Westerness), England (Devon), Isles of Scilly, Ireland (Co. Kerry).



Leptogium cyanescens (Rabenh.) Körb. (1855) **Nb IR**

Thallus to 10 cm diam., forming irregularly spreading patches or small tufts; lobes to 10 mm diam., ± overlapping, rather thin, surface smooth, somewhat undulate; isidia abundant, laminal and sometimes also marginal, cylindrical or flattened; folioles occasionally present; upper surface pale bluish grey; lower surface pale grey, naked. Apothecia rare, sessile from the beginning; disc to 2 mm diam., red-brown; true exciple paler, of narrow, periclinal hyphae. Ascospores (15–) 19–23 (–25) × (6–) 7–9 (–10) µm, submuriform. **BLS 0834**.

In old woodlands, on mossy trees and rocks or directly on rock when near water; locally frequent. W. Britain and Ireland, especially W. Scotland, W. Ireland.

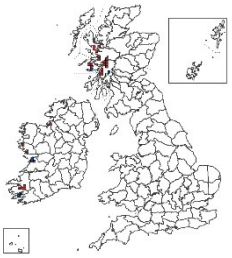


Separated from *L. cochleatum* by the thinner thallus with abundant flattened or cylindrical isidia, the scarcity of apothecia, and the pale bluish grey colour. Young specimens may be distinguished from *L. burgessii* by the presence of isidia and the smooth lower surface. *L. britannicum* lacks isidia. *Collema flaccidum* has similar, flattened isidia but it is olive-green to black and does not have a cellular cortex.

Leptogium hibernicum M.E. Mitch. ex P.M. Jørg. (1973) **NT IR**

Thallus to 5 cm diam., becoming markedly swollen when wet; lobes 5–10 mm wide, overlapping with raised, rounded or partly dissected margins; swelling markedly when wet; upper surface brownish or bluish grey, ± transversely wrinkled-striate; isidia coarse, nodular, in patches, or lobules developing along margins and on the surface; lower surface paler, uniformly finely pubescent-tomentose; tomental hairs *ca* 20 µm long with globose end cells. Apothecia not known in British material. **BLS 0836**.

On trunks, especially of *Corylus* and *Fraxinus*, in sheltered moist old woodlands, more rarely on wayside trees in sheltered valleys; local. W. Scotland, W. Ireland.



Characterized by the coarse thalline striations often running in parallel lines, the warted upper surface with nodular isidia, and pruina-like, short-tomentose lower surface. Recognized as a species complex by Bjelland *et al*. (2017), with three clades including the newly described *H. krogiae* from East Africa and an unnamed entity from the Americas.

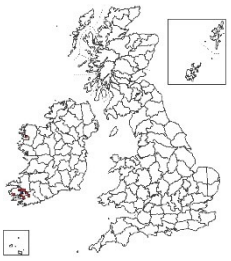
Leptogium hildenbrandii (Garov.) Nyl. (1856) **Ex**

Thallus large, to 6 cm diam., often forming rounded patches; lobes rounded, to 6 mm wide, partly overlapping, rather thick; upper surface deep blue- or black-grey, wrinkled, minutely and irregularly striate; lower surface with a thick, white tomentum and tassels of rhizines. Apothecia laminal, often numerous and contiguous, immersed when young, becoming emergent; thalline margin thin; disc 2–3 mm diam., red-brown. **BLS 0837**.

On deciduous trees; apparently extinct. Collected only once in C. Scotland (E. Perth) in the 19th century.

Differs from *L. hibernicum* and *L. saturninum* which are isidiate, and rarely fertile. *L. burgessii* has numerous, thinner lobes and the thalline margin has conspicuous folioles.

Leptogium juressianum Tav. (1950) **NE**

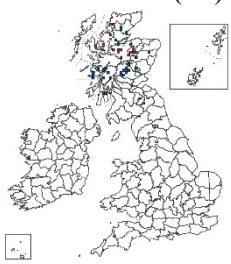


Thallus to 4 cm diam., thin, forming cushions, loosely attached; lobes to 5 mm diam., rounded, spreading, margins distinctly revolute, mostly entire; upper surface blue-grey, often tinged brown, matt, partly covered by thin, dense, grey-white, arachnoid tomentose hyphae with cylindrical cells; isidia marginal or laminal, granular to sublobulate; lower surface paler, naked but with a localized tomentum in areas of attachment to the substratum. Apothecia unknown. **BLS 1612**.

On thick moss cushions, particularly those of *Isothecium myosuroides*, on very shaded deciduous trees in old woodlands, more rarely on mossy rocks; rare. A hyperoceanic species. W. Ireland.

Characterized by the downwardly revolute margins, granular isidia and, particularly, the ± dense grey-white arachnoid tomentum on the upper surface of the lobes. *Scytinium lichenoides* has lobes which have ascending margins which are finely isidiate or fimbriate, but the upper surface is shiny, non-tomentose and lacks isidia.

Leptogium saturninum (Dicks.) Nyl. (1856) **VU (C2)**



Like *L. hibernicum* but the lobe ends more regularly rounded, the surface even, not wrinkled and densely covered with small globose, cylindrical or branched isidia; thallus to 8 cm across, dark olive-black; lobes 3–10 (–15) mm wide; lower surface with white-grey tomentum; tomental hairs to *ca* 100 µm long with cylindrical cells 6–12 × 4–4.5 µm in size. Apothecia unknown in Britain. **BLS 0844**.

On bark of old trees and on mossy, calcareous rocks and associated soil; rare. C. & N. Scotland, extinct in England.

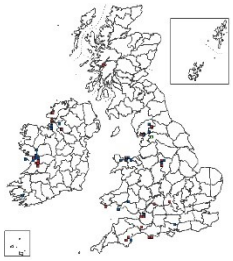
Collema subflaccidum is similar, but has a smooth non-tomentose under-surface and lacks a cellular cortex.

PSEUDOLEPTOGIUM Müll. Arg. (1885)

Pseudoleptogium is a monotypic genus. The only species forms small crustose placodioid patches with radiating marginal lobes, with an upper cortex of isodiametric cells, and a compact medulla composed of short-celled broad hyphae interspersed with the *Nostoc* photobiont with cells in clusters.

Pseudoleptogium diffractum (Kremp.) Müll. Arg. (1885) **NT**

Leptogium diffractum Kremp. (1865)



Thallus delicate, often discrete, 0.5–1.0 cm diam., sometimes confluent and forming larger patches, placodioid areolate with entire closely appressed radiating marginal lobes; lobes 0.4–1.1 mm long and 0.2–0.5 mm wide, convex or flat, often of about equal length, contiguous for most of their length; surface matt but never pubescent or tomentose, often wrinkled and glossy at the lobe ends, brown-olive to ± black; middle of the thallus with convex areoles or granules 0.1–0.2 (–0.3) mm diam., or the middle part degrading to leave areas of radiating marginal lobes. Thallus composed of short-celled broad compact hyphae throughout, with a distinct cortex and the *Nostoc* photobiont cells in clusters. Isidia absent. Apothecia rare; disc 0.2–0.5 mm diam, olivaceous brown. Ascospores 15–30 × 8–12 µm, ellipsoidal, septate or weakly muriform. Conidiomata unknown. **BLS 0835**.

On hard limestones including damp niches such as in scree and the base of outcrops; very local. S.W. & C. England, N. & C. Wales, one record in W. Scotland, W. Ireland.

The radiating marginal lobes are reminiscent of *Placynthium subradiatum* which has a different photobiont (*Scytonema*), not chains of *Nostoc*; see also *Scytinium parvum*.

ROSTANIA Trevis. (1880)

Thallus subcrustose to minutely foliose, rather small (0.3–2.5 cm diam.), dark olive green, black or brownish, either forming an effuse granular crust or with poorly developed lobes to 1 (–2) mm broad, smooth to ridged, without a true cortex, the medulla hyphal in construction and interspersed with chains of *Nostoc* photobiont cells; tomentum absent. **Isidia** absent or with accessory teretiform lobules developing from lobes. **Apothecia** laminal, sessile, urceolate and appearing perithecial when young; disc very pale brownish to dark red-brown. **Thalline margin** distinct and smooth, entire or lobulate, sometimes becoming excluded. **Epithecium** colourless to reddish brown, K–, N–. **Hymenium** colourless, I+ blue. **Hypothecium** shallow, colourless or pale yellowish. **Hamathecium** of paraphyses, numerous, conglutinate, ± unbranched, the apices ± swollen. **Asci** (2-) 4- or 8-spored, clavate; wall K/I+ blue and apical dome K/I+ pale blue with a dark blue axial tube. **Ascospores** broadly cylindrical to subglobose, often cuboid, muriform. **Conidiomata** sometimes present, immersed in the thallus. **Conidia** bacilliform, hyaline. **Chemistry**: no lichen substances detected by TLC. **Ecology**: primarily corticolous, sometimes lignicolous, with one soil-inhabiting species.

Rostania is equivalent to the *Collema occultatum* group as defined by Degelius (Degelius 1954, Otálora *et al.* 2013b). In the restricted sense, there are three species currently known worldwide (Košuthová *et al*. 2019), of which two occur in our region. The taxonomy of *R. occultata s. lat.* is still not clarified (Košuthová *et al*. 2020). Fully diagnostic features are sparse, but the minute thalli composed of hyphal tissue without a separate cortex, and the ± cuboid ascospores, serve to characterize the genus in morphological terms.

Literature

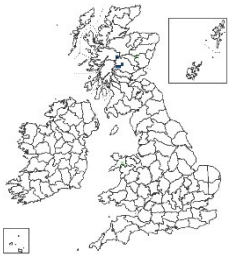
Degelius (1954), Košuthová *et al*. (2019, 2020), Otálora *et al*. (2013b).

1 Thallus a small to medium cushion (to *ca* 30 mm diam.) of dense narrow ± erect lobes 0.5–2 mm wide, the terminal branches ± terete; on soil amongst decaying mosses ..... ***ceranisca***
Thallus degenerating into an effuse granular crust; corticolous ..... ***occultata***

Rostania ceranisca (Nyl.) Otálora, P.M. Jørg. & Wedin (2013) **VU (D1, D2)**

Collema ceraniscum Nyl. (1865)

Thallus to 3 cm diam., ± rounded, compact, forming intricate cushions; lobes 0.5–2 mm wide, ± erect, densely packed and of about equal length, richly branched, the lower part flattened, with ± erect accessory finger-like lobules that grow from the edge of the main lobes; upper surface black, matt, smooth or somewhat verrucose, without isidia. Apothecia rare in Britain, numerous and crowded when present; disc 0.4–0.8 mm diam., urceolate, with a ± thick, entire or lobulate thalline margin. Asci (2-) 4-spored. Ascospores 20–36 × 13–22 µm, ± ovoid or subglobose, muriform. **BLS 0437**.

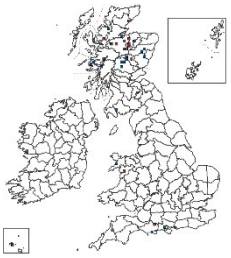


On soil, often growing on living and decaying carpets of lichens and bryophytes on calcareous and schistose cliffs above *c*. 1000 m alt.; very rare. Central Scotland (Ben Alder, Ben Lawers).

Distinguished by the very dark, richly branched, thin, ascending lobes with accessory finger-like lobules, which form compact cushions on decaying mosses.

Rostania occultata (Bagl.) Otálora, P.M. Jørg. & Wedin (2013) **NT**

Collema occultatum Bagl. (1861)



Thallus small, crustose, of widely scattered to ± contiguous granules, often covering rather large areas, sometimes forming a thin or ± thick, often minute, effuse crust; granules 50–100 µm diam., ± globose, black to greenish black, rarely with very small somewhat flattened lobes. Apothecia rather frequent, globose or perithecium-like when young; disc 0.1–0.3 mm diam., very pale brownish to dark red-brown, somewhat exposed when mature. Ascospores 13–22 × 9–15 µm, ± cubic-cylindrical with rounded angles or ± globose, submuriform. **BLS 0454**.

On ± basic bark, especially of *Acer*, *Ulmus* and *Sambucus*; local, most frequent in Scotland, very rare in the New Forest and N. Wales.

Readily distinguished by the poorly developed thallus of minute granules, the small perithecium-like apothecia and ± cuboid, submuriform spores. The small, rosette-like cushions with ± raised, channelled lobes with numerous terminal apothecia are diagnostic.

SCYTINIUM (Ach.) Gray (1821)

Thallus crustose, squamulose, minutely foliose or minutely shrubby, gelatinous, rarely swelling significantly when wet, dark brown, bluish grey or olive-green, the lobes spreading, sometimes elongate and ± cylindrical. **Upper** and **lower cortex** either absent or composed either of ± cuboid cells or flattened degraded tissue, the **medulla** containing loosely interwoven hyphae or compact with broad short-celled hyphae, intermixed with the photobiont. **Upper and lower surfaces** smooth to wrinkled or ridged, matt, not tomentose. **Isidia** present or absent, soredia absent. **Photobiont** *Nostoc*, cells mostly arranged in distinct chains. **Ascomata** apothecia with a red-brown disc, sessile, laminal or marginal. **Thalline margin** smooth to granulose, isidiate to lobulate, often persistent. **True exciple** raised, cupular, usually composed of isodiametric cells, colourless to reddish brown. Disc concave to flat. **Epithecium** colourless to reddish brown, sometimes indistinct, K–, N–. **Hymenium** colourless, I+ blue. **Hypothecium** shallow, colourless or pale yellowish. **Hamathecium** of paraphyses, numerous, conglutinate, separating in K, sometimes branched, apices ± swollen. **Asci** 8-spored, clavate, the apex strongly thickened; wall K/I + blue, and apical dome K/I+ pale blue with a dark blue axial tube and apical cap. **Ascospores** mostly ellipsoidal, muriform, colourless, without any distinct surface ornamentation or perispore. **Conidiomata** pycnidia, infrequent. **Chemistry**: no lichen substances detected by TLC. **Ecology**: on ± basic rocks, soil and trees, sometimes associated with mosses.

Scytinium is very heterogeneous regarding morphology and ecology, but the species share the same type of ascospores (shape, septation), they have a small to medium size thallus, and have at least a partial cortex (Degelius 1954; Otálora *et al.* 2013b). It is the only genus of those currently recognized to contain species from both *Collema* and *Leptogium* in their traditional circumscriptions.

1 Thallus ± fruticose, lobes mostly cylindrical.....2
Thallus foliose, the lobes often deeply divided, or small-squamulose 5

2(1) Branches forming dense fruticose cushions 3
Branches forming flat, radiating thalli 4

3(2) Branches coarse, deeply furrowed and wrinkled when dry, glossy brown to reddish black, mostly in calcareous grassland or on walls ..... ***schraderi***
Branches fine, erect, crowded, cylindrical, smooth when dry, blackish brown; mostly on trees (sometimes on rocks) ..... ***teretiusculum***

4(2) Branches glossy, roughened, with distinct upper cortex; on dry, calcareous outcrops or scree ..... ***massiliense***
Branches dull, with indistinct upper cortex; in the submerged zone of rivers ..... ***subtorulosum***

5(1) Thallus with at least an upper cortex composed of angular, brick-like cells 6
Thallus without a true cortex, usually with a pseudocortex of flattened cells 16

6(5) Thallus small-squamulose or minutely foliose, the lobes <2 mm wide 7
Thallus robust, distinctly foliose; lobes >2 mm wide 12

7(6) Lobes or squamules ± smooth; centre of thallus (in section) of compact broad hyphae throughout 8
Lobes or squamules weakly to distinctly wrinkled when dry; centre of thallus (in section) of loosely interwoven hyphae 11

8(7) Squamules with coralloid outgrowths or lacerated at the margins 9
Squamules entire or shallowly incised, without marginal lacerations 10

9(8) Apothecia ± globose, 0.2–0.5 mm diam., numerous, disc orange; thallus minute, often arranged stellately around the apothecia; lobes very fine, *ca* 0.1 mm wide, with terete extensions; on rotten wood or plant debris ..... ***subtile***
Apothecia concave, to 1.2 mm diam., disc red-brown; thallus cushion-forming, single lobes to 2 mm wide, margin usually fimbriate, deeply divided; among bryophytes in calcareous grassland ..... ***tenuissimum***

10(8) Squamules flat, imbricate, forming dense cushions, apothecia very rare; in alpine calcareous grasslands ..... ***imbricatum***
Squamules convex, discrete, often lobed and rosette-like, some reduced to granules, apothecia common; on calcareous soils and stone in the lowlands ..... ***biatorinum***

11(7) Thallus blue-grey to brown, weakly wrinkled when dry, medulla swelling little when wet.. ***intermedium***
Thallus brown, shiny, heavily wrinkled when dry, medulla grossly swelling when wet ..... ***turgidum***

12(6) Margin of lobes ± lacerate-fimbriate, with flattened isidium-like outgrowths or cylindrical isidia..... 13
Margins of lobes ± entire; isidia absent or in isolated clusters 14

13(12) Lobe margins branched, mostly with cylindrical, isidium-like outgrowths which are sometimes also on the surface; lower surface with raised narrow rib-like wrinkles; apothecial margins isidiate ..... ***lichenoides***
Lobes margins deeply divided with flattened outgrowths which are never laminal; lower surface smooth or wrinkled, rarely with a few raised ribs; apothecial margins smooth ..... ***pulvinatum***

14(12) Lobes ± erect, the margins revolute and forming tube-like structures; apothecia very rare ..... ***palmatum***
Lobes undulate or decumbent with ascending margins, not forming tube-like structures 15

15(14) Lobes decumbent with ascending margins; isidia absent; apothecia frequent ..... ***gelatinosum***
Lobes rounded with undulate margins, isidia in granular or coralloid clusters; apothecia absent ..... ***magnussonii***

16(5) On bark, or on mosses on bark; thallus forming neat, foliose rosettes, the lobes distinct, flattened, often channelled ..... ***fragrans***
On rock, soil, and mortar, or on mosses on rock 17

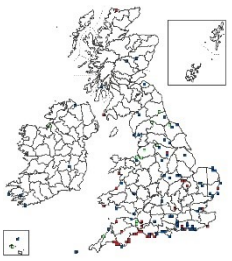
17(16) Thallus squamulose or of radiating lobes, broadly attached 18
Thallus ± crustose, attached to substratum only at the centre; rare ..... ***callopismum***

18(17) Thallus lobes 2–3 mm wide, tough and rigid, swelling when wet, with ascending, often divided and pleated margins ..... ***plicatile***
Thallus lobes <1 mm wide, not swelling greatly when wet 19

19(18) Thallus lobes 0.4–0.8 mm wide, convex, linear to contorted; white-pubescent at least at the apices ..... ***fragile***
Lobes 0.1–0.3 mm wide, not white-pubescent ..... ***parvum***

Scytinium biatorinum (Nyl.) Otálora, P.M. Jørg. & Wedin (2013) **Nb**

Leptogium biatorinum (Nyl.) Leight. (1879)



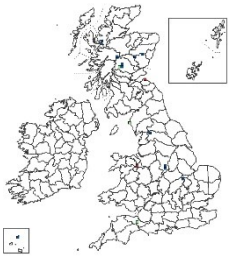
Thallus often wide-spreading, forming a thin crust of small, rosette-like, discrete, convex squamules 0.3–0.5 (–0.8) mm diam. with crenulate margins, some reduced to granules 60–100 µm diam.; thallus with a distinct cortex composed of angular cells, medulla compact, of broad short-celled hyphae throughout. Photobiont in clusters. Apothecia common, concave, soon becoming sessile, with a thick true exciple. **BLS 0827**.

On calcareous soils, stones and walls. Scattered throughout lowland areas of Great Britain and Ireland.

A variable species previously often confused with *Epiphloea byssina* which also has a ± crustose thallus but with immersed apothecia of a different type and thin-walled asci. The more crustose granular forms of *S. biatorinum* growing on dry calcareous rock have been separated as a distinct species, *Leptogium cretaceum* (Sm.) Nyl.; this needs further study before transfer to *Scytinium* is justified.

Scytinium callopismum (A. Massal.) Otálora, P.M. Jørg. & Wedin (2013) **Nb**

Collema callopismum A. Massal. (1856)



Thallus to 0.5 cm diam., crustose, becoming ± tufted, rounded or angular in coarsely areolate, squamulose patches, ± deeply lobed, fixed to the substratum only at the centre; lobes to 0.2 mm diam., of equal length, usually repeatedly branched, ± contiguous, flat or swollen, at times partly ascending and crowded; upper surface dark olive-green or blackish, smooth or with very small isidium-like granules; cortex only present as a layer of compressed flattened cells, medulla hyphal in construction. Apothecia infrequent; disc 0.3–0.7 mm diam., flat or concave, with a thin thalline margin, smooth or slightly lobed. Ascospores 17–26 × 8.5–10.5 µm, ± ellipsoidal, submuriform, rarely 3-septate. **BLS 0435**.

On limestone, rare. Scattered, mostly in upland habitats.

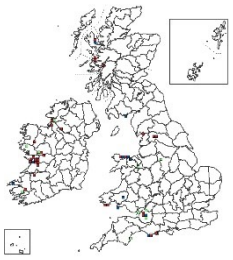
Rather variable in the degree of thallus lobation and areolation. The thallus is often reduced to a poorly defined crust lacking distinct lobes. **Collema callopismum** var. **rhyparodes** (Nyl.) Degel. (1954) [**BLS 0436**] differs in having a more distinctly squamulose thallus and larger ascospores, 26–43 × 12–15 mm in size. On mica-schist and epidiorites in montane situations; very rare. Central Scotland (Ben Lawers, Ben Alder, Caenlochan). The combination into *Scytinium* has not been made.

Scytinium fragile (Taylor) Otálora, P.M. Jørg. & Wedin (2013) **VU (B)**

Collema fragile Taylor (1836)

Thallus to 2 cm diam., of ± radiating crowded convex knobbly closely attached lobes 0.4–0.8 mm wide, which are furcate and ± white-pubescent at their apices, forming small cushions, rosettes or crust-like patches with a ± radiating margin; upper surface dark green-brown to black, matt, with few to numerous globose isidia 0.1–0.2

mm diam.; cortex only present as a layer of compressed flattened cells, medulla hyphal in construction. Apothecia very rare; disc 0.5–0.8 mm diam., at first with a rather thick thalline margin that later becomes excluded. Ascospores 26–30 × 13–17 µm, ellipsoidal-ovoid, submuriform with 4 transverse septa and 1 or 2 longitudinal septa. **BLS 0447**.



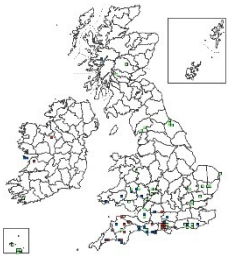
Directly on lightly shaded, often steeply inclined, limestone rocks and walls; rather rare. W. Britain and Ireland, especially Co. Clare (The Burren), N. Wales (Great Orme) and the Mendip Hills. It reaches its northern limit in Europe on the Isle of Raasay.

Distinguished by the closely attached, often partly fragmentary thallus directly on hard limestones, sometimes forming extensive colonies in seepage tracks. Only the tips of actively growing lobes are finely pubescent. This species has the aspect of *Lempholemma botryosum* (Lichinaceae) which has unicellular spores. *S. parvum* has smaller, more appressed lobes without white pubescence.

Scytinium fragrans (Sm.) Otálora, P.M. Jørg. & Wedin (2013) **EN (A, C) IR**

Collema fragrans (Sm.) Ach. (1814)

Thallus to 0.5 cm diam., often numerous and crowded together, foliose, deeply lobed, forming ± rounded rosettes or cushions, usually fixed to the substratum in the centre; lobes 0.3–1.5 mm wide, free or imbricate, channelled, ± flattened, not swollen, often crenate, appressed or ascending to erect or somewhat spreading; upper surface dark olive-green to blackish, smooth or with globose, isidium-like papillae or terete to flattened lobules on the margins and on the upper surface; cortex ± absent, with patches of compressed flattened cortical cells, the medulla hyphal in construction. Apothecia often numerous and crowded in the centre of the thallus; disc 0.4–0.7 mm diam., ± immersed at first, flat to concave with a thin to moderately thick thalline margin, smooth or papillate. Asci (4-) 8-spored. Ascospores 16–30 × 8.5–17 µm, submuriform, with 2-5 transverse and 2-5 longitudinal septa, ovoid or ± ellipsoidal. **BLS 0448**.



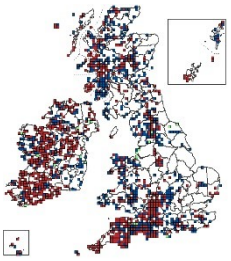
On nutrient-enriched bark, especially of *Ulmus*, in old parkland, very rarely on rocks; rare and declining. S. England, S. Wales, very rare in Scotland.

This species forms small scattered or ± contiguous neat rosettes of ± stellately arranged lobes, often with abundant apothecia towards the thallus centre. *S. fragrans* has decreased dramatically in recent years due to the impact of Dutch elm disease; its centre of distribution is now S. England (Hampshire, New Forest), where it colonizes wound-seepage tracks on mature *Fagus*.

Scytinium gelatinosum (With.) Otálora, P.M. Jørg. & Wedin (2013) **LC**

Leptogium gelatinosum (With.) J.R. Laundon (1984)

Thallus very variable, of numerous overlapping or erect convoluted rounded lobes, forming compact tufts 2.5–4.5 (–8) cm diam.; lobes 1–3 (–5) mm wide, with ± erect, entire, crenate or divided margins; upper surface dark brown or reddish brown, becoming greyish in sheltered situations, distinctly wrinkled; isidia absent; thallus with a distinct cortex composed of angular cells, the medulla of intertwined hyphae. Apothecia frequent; disc to 2 mm diam., smooth, concave or flat; true exciple raised, concolorous, smooth. Ascospores 22–42 × 11–17 µm, muriform, with 5-7 (-9) transverse septa. **BLS 0846**.

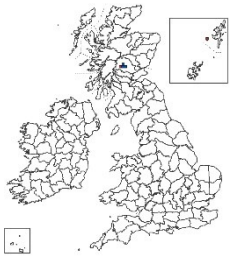


Amongst mosses on basic to highly calcareous substrata including limestone soils, dunes and mortar, rarely at the base of old trees; locally abundant. W. Britain and Ireland, extending locally eastwards.

Much confused in the past with *S. lichenoides*, owing to supposed morphs where the lobes are small and very richly divided; these are now recognized as *S. pulvinatum*. The marginal outgrowths or extensions are always flattened, never cylindrical as in *S. lichenoides*, and the lower surface of the lobes is less markedly ridged. Check diminutive forms of *S. gelatinosum* and *S. pulvinatum* against *S. intermedium*. The blue-green morphotype of *Peltigera venosa* may resemble reduced forms of *S. gelatinosum*.

Scytinium imbricatum (P.M. Jørg.) Otálora, P.M. Jørg. & Wedin (2013) **NT**

Leptogium imbricatum P.M. Jørg. (1994)



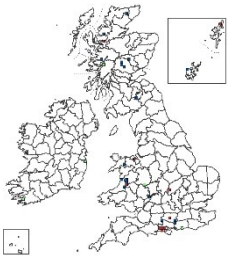
Thallus composed of flat to more or less erect, usually imbricate squamules, forming a dense crust or cushion to 3 cm diam.; individual squamules minute, (0.1–) 0.2–0.5 (–1.0) mm wide; thallus with a distinct cortex composed of angular cells, the medulla compact, of broad short-celled hyphae throughout; upper surface smooth, blue-grey or usually dark brownish, particularly apically; margins indented to incised, lower surface usually blue-grey with occasional, irregular tufts of long-celled hairs. Apothecia very rare, laminal, sessile, to 1 mm diam.; thalline margin distinct, paler than the brown disc; spores 20–35 × 7–15 µm, ellipsoidal, muriform. **BLS 1874**.

A species of montane calcareous grasslands and cliff ledges, often among moss; rare. Scotland, only on the highest mountains in the Breadalbanes (Ben Lawers, Ben Chonzie).

Usually easily recognisable by the dense, cushion-like growth form and imbricate lobes, rather like extreme forms of *S. pulvinatum*, but composed of compact hyphae throughout. May resemble forms of *S. tenuissimum* but this species has deeply dissected lobes that appear almost coralloid. The blue-green morphotype of *Peltigera venosa* is similar and may occur in similar habitats.

Scytinium intermedium (Arnold) Otálora, P.M. Jørg. & Wedin (2013) **Nb**

Leptogium intermedium (Arnold) Arnold (1885)



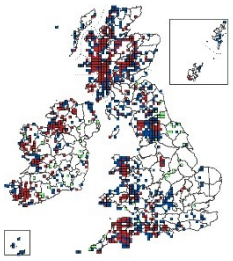
Thallus of numerous spreading to more rarely imbricate squamules forming colonies to 3 cm across, scarcely swelling when wet; lobes shallowly incised, to 1 mm wide; upper surface weakly wrinkled, brown or more rarely tinged blue-grey; lower surface similar to the upper, but paler and with scattered tufts of long-celled hairs; thallus with a distinct cortex composed of angular cells, the medulla of intertwined hyphae. Apothecia common, laminal, sessile, to 0.5 mm diam.; thalline margin distinct, paler than the concave, brown disc. Spores 20–35 × 8–12 µm, ellipsoidal, muriform. **BLS 1773**.

Among short vegetation on calcareous soil, occasionally on bases of mossy tree trunks; uncommon. Thinly scattered in the lowlands and uplands from Sussex to Orkney. Not known from Ireland.

Resembles a diminutive form of *S. gelatinosum*, which has much larger (up to 5 mm wide) lobes that are shiny and markedly wrinkled. *S. imbricatum* also has a different thallus anatomy (composed of compact broad hyphae throughout).

Scytinium lichenoides (L.) Otálora, P.M. Jørg. & Wedin (2013) **LC**

Leptogium lichenoides (L.) Zahlbr. (1924)



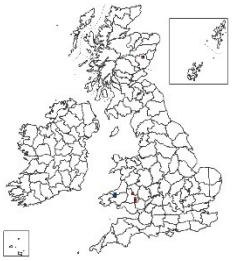
Like *S. gelatinosum* but the margins and sometimes the surface of lobes with small, simple or branched tufts of cylindrical isidium-like extensions which may be very densely produced giving the appearance of fibrillose margins; upper surface smooth to wrinkled or with a few ridges, shiny; lower surface usually conspicuously ridged, often with vertically orientated ribs, sometimes arachnoid towards the base; thallus with a distinct cortex composed of angular cells, the medulla of intertwined hyphae. Apothecia 0.3–1 mm diam., rare; thalline margin isidiate. Ascospores (26–) 33–45 (–50) × 12–15 µm, muriform, with (5-) 7 (-9) transverse septa. **BLS 0839**.

Amongst mosses particularly at the base of old trees, especially *Fraxinus*, also on rocks, walls and soil in rather damp situations, slightly calcicole, predominantly in old woodlands and old parkland. Throughout Great Britain and Ireland, although rare in east and central England.

Less frequent overall than *S. gelatinosum* and much rarer in highly calcareous situations. Often confused with *S. pulvinatum*, which was once regarded as a morph of *S. lichenoides*; the distribution map reflects these historical inaccuracies. The persistently cylindrical, marginal isidia are diagnostic in *S. lichenoides*; in *S. pulvinatum* the marginal extensions are flattened. Check diminutive forms against *L. tenuissimum*.

Scytinium magnussonii (Degel. & P.M. Jørg.) Otálora, P.M. Jørg. & Wedin (2013) **Nb**

Leptogium magnussonii Degel. & P.M. Jørg. (1994)



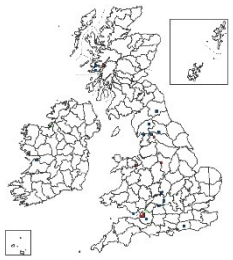
Thallus foliose, to 5 cm broad; lobes rounded, irregular, 2–3 mm wide (to only 1.2 mm in GB material), the margins undulate; upper surface smooth, partially finely striate, dark blue-grey, often brownish, with clusters of granular or coralloid isidia, usually brown apically; lower surface similar to the upper but paler, without rhizines or tomentum; thallus with a distinct cortex composed of angular cells, the medulla of intertwined hyphae. Apothecia very rare, known only in an immature state. **BLS 2620**.

In freshwater seepage areas and on unshaded siliceous rocks in riverine habitats. Central Wales, with a single record from Scotland (Angus).

Similar in many respects to *S. gelatinosum*, but with clusters of isidia on upper surface.

Scytinium massiliense (Nyl.) Otálora, P.M. Jørg. & Wedin (2013) **NT**

Leptogium massiliense Nyl. (1879)



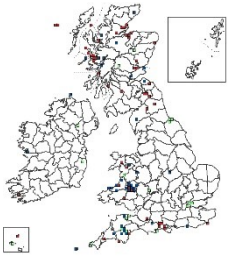
Thallus forming small, flat rosettes to 1 cm diam., with irregularly spreading, closely appressed lobes 0.1–0.2 (–0.3) mm wide, cylindrical and horizontally radiating, dichotomously branched, glossy, often with nodular isidium-like extensions along the lobes; upper surface pale grey-brown, often furrowed and irregularly ridged; thallus with a distinct cortex composed of angular cells, the medulla of intertwined hyphae. Apothecia not observed. **BLS 0840**.

On moist or shaded limestone, including loose stones and scree; rare. England (Mendips, Cotswolds, Peak District, Cumbria), also W. Scotland and W. Ireland.

Distinguished from *S. schraderi* by the fan-like, radiating and closely appressed thallus. Separated from *S. subtorulosum* primarily on habitat.

Scytinium palmatum (Huds.) Gray (1821) **NT**

Leptogium palmatum (Huds.) Mont. (1846)



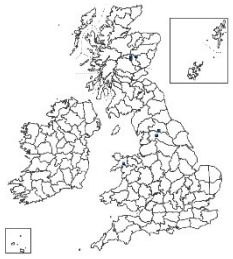
Like *S. gelatinosum*, but lobes larger, to 5 mm wide, ± erect, the margins characteristically downturned and forming tube-like structures; upper surface brownish, sometimes with a reddish tinge, smooth and shiny or slightly wrinkled; thallus with a distinct cortex composed of angular cells, the medulla of intertwined hyphae. Apothecia very rare in the British Isles; a single occurrence of these from Moray has been documented. **BLS 0842**.

On mosses amongst boulders, on the ground in old dunes, disused airfields, occasionally on tree trunks; scattered, rare. Mainly W. & N. Britain.

Characterized by the margins of the lobes which markedly curl inwards, becoming ± tubular, especially towards the apices.

Scytinium parvum (Degel.) Otálora, P.M. Jørg. & Wedin (2013) **VU (D)**

Collema parvum Degel. (1954)



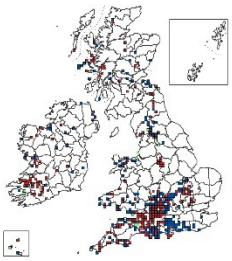
Thallus small, to 1.5 cm diam., squamulose to placodioid forming small black, appressed rosettes. Lobes neat, radiating, convex to plane, 0.1–0.3 mm broad. Central parts with few to dense ball-bearing-like globular to coralloid isidia, 50–100 µm diam. Cortex only present as a layer of compressed flattened cells, medulla hyphal in construction. Apothecia unknown. **BLS 1751**.

On hard, damp, basic rock in the uplands, rare. C. Scottish Highlands, beside rivers in the Yorkshire Dales, Snowdonia.

Could be mistaken for small thalli of *Pseudoleptogium diffractum* which is cellular throughout, non-isidiate and has shinier lobes.

Scytinium plicatile (Ach.) Otálora, P.M. Jørg. & Wedin (2013) **LC**

Leptogium plicatile (Ach.) Leight. (1879)



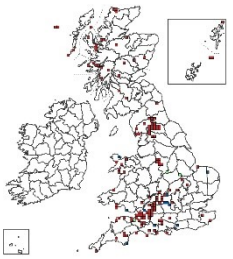
Thallus to 5 cm diam., very tough, rigid, forming closely appressed, firmly attached, untidy rosettes; lobes rounded, very thick, 2–3 mm wide, with ascending, twisted, often divided and pleated margins; upper surface dark brown-black with a reddish or olive tinge, uneven, matt, often ridged, sometimes with coarse clustered isidium-like warts; lower surface paler; thallus with a poorly developed cortex, the medulla of intertwined hyphae. Apothecia infrequent, marginal or laminal, markedly concave when young; thalline margin persistent, raised; disc 1–1.5 mm diam. Ascospores 18–25 (–30) × 8–16 µm, 3- septate to muriform. **BLS 0843**.

On hard limestone rocks, usually in damp situations, especially in seepage tracks, more rarely on siliceous rocks influenced by calcareous seepage or by mesotrophic rivers, occasionally on chest tombs and buttresses in churchyards. Throughout Great Britain and Ireland, although rare in E. England.

A very variable species, best examined when dry. Typically consists of rather ragged and scattered clusters with thick, raised, convoluted and ± cartilaginous lobes, firmly attached to rocks. May be confused with *Lathagrium auriforme*, which does not remain tough when wet. Small and immature specimens can be difficult to distinguish from the squamulose form of *S. schraderi*, but are anatomically different.

Scytinium pulvinatum (Hoffm.) Otálora, P.M. Jørg. & Wedin (2013) **LC**

Leptogium pulvinatum (Hoffm.) Otálora (2008)



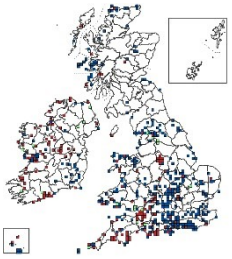
Thallus foliose, compact, pulvinate, 1–4 cm diam. Lobes erect, 2–6 mm wide, often deeply divided, elongate, laciniate and often revolute, wrinkled, shiny, greyish-brown to dark brown; isidia absent; cortex composed of a single layer of ± isodiametric cells, medulla of interwoven hyphae. Apothecia rare, 0.2–0.8 mm diam.; thalline margin well-developed, concolorous with the thallus; disc concave, brown to red-brown. Ascospores (28–) 33–42 (–47) × (12–) 14–18 µm, ellipsoidal, submuriform to muriform.

Amongst mosses at the base of trees, sometimes also on walls, rocks or soil in open calcareous habitats. Common throughout much of Great Britain, distribution in Ireland uncertain.

Similar to *S. gelatinosum* but with more compact, deeply divided lobes with laciniate margins. *S. lichenoides* has similar thalli but with cylindrical, marginal isidia. Lack of dots on the map is due to former confusion with that species.

Scytinium schraderi (Ach.) Otálora, P.M. Jørg. & Wedin (2013) **LC**

Leptogium schraderi (Ach.) Nyl. (1856)



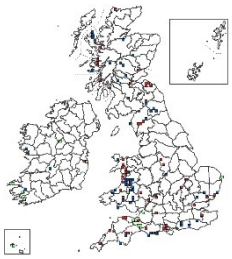
Thallus thickish, to 5 mm tall, forming small upright tufts; lobes turgid, (0.1–) 0.3–0.6 mm wide and to 2.5 mm long, cylindrical, ascending, often divided near the base; upper surface glossy, dark olive-brown or red-black, notably wrinkled to plicate when dry, concave at the circumference, often densely granular-isidiate; isidia 60–100 µm diam.; thallus with a distinct cortex composed of angular cells, the medulla of intertwined hyphae. Apothecia occasional, to 1.5 mm diam.; disc concave becoming ± flat; thalline exciple swollen, entire or sometimes slightly granular. Ascospores 23–33 × 10–12 µm, 3-septate to muriform. **BLS 0845**.

On mosses or soil in ± dry, calcareous habitats, particularly on old mortared walls, over limestones and in short, calcareous turf and shell-sand dunes; locally abundant. Throughout Great Britain and Ireland, perhaps more common in the south.

S. teretiusculum has similar dense fruticose thalli, but the lobes have ± cylindrical isidium-like extensions and that species is primarily corticolous.

Scytinium subtile (Schrad.) Otálora, P.M. Jørg. & Wedin (2013) **Nb**

Leptogium subtile (Schrad.) Torss. (1843)



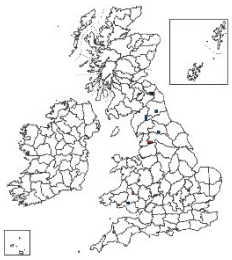
Thallus small, tubular-squamulose, blue-grey to ± brown, often arranged in rosettes, 0.5–1.5 mm diam.; lobes very small, 0.1–0.3 mm wide, ± cylindrical, ± horizontally aligned, smooth (unwrinkled), often radiating below a single or small group of rounded, orange apothecia, apices of lobes often dividing into short terete to flattened extensions, to 0.3 mm long and 60–100 µm wide; thallus with a distinct cortex composed of angular cells, the medulla of broad compact short-celled hyphae throughout. Apothecia globose, 0·2–0·5 mm diam., disc orange, usually abundant; thalline margin mostly persistent, smooth to nodulose. Ascospores 20–31 × 10–12 µm, muriform, with (3-) 5 (-7) transverse septa. **BLS 1717**.

On basic bark and rotten wood of old, usually fallen trees, especially *Fraxinus* and *Ulmus*, old stumps, aged polypore fungi, and on plant debris on the ground; local. Throughout Great Britain and Ireland, mostly in the west.

The most diminutive of the *Scytinium* species. Easily recognized by the numerous small, globose, orange apothecia surrounded by tiny, narrow, nearly cylindrical, spreading, stellate lobes. Differs from *S. teretiusculum* in the shorter, rosette-forming lobes with only a few or shorter marginal extensions, and numerous apothecia. *S. tenuissimum* has larger lobes, and scattered, larger, concave apothecia. See also *Pyrenopsis furfurea* (Lichinaceae).

Scytinium subtorulosum (Nyl. ex Stizenb.) Otálora, P.M. Jørg. & Wedin (2013) **NT**

Leptogium subtorulosum (Nyl. ex Stizenb.) Degel. (1954)



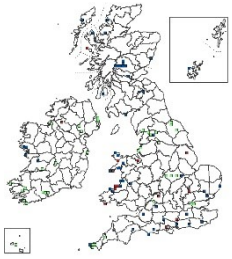
Thallus a rosette of very narrow, nearly cylindrical dark olive or greenish lobes appressed to the substratum, 1–4 mm long and 0.2–0.4 mm wide, sometimes ascending at the apices, the surface dull, roughened and uneven, sometimes with globose to subcylindrical lobule-like isidia; thallus only partially corticate, the internal hyphae irregularly arranged. Apothecia unknown in the British Isles. **BLS 0939**.

In the submerged zone of rivers, often with *Lathagrium dichotomum*; very rare. N. England (R. Tyne, R. Eden), S. Wales.

The internal anatomy places this species in the *L. plicatile* group; it may be an extreme underwater morph of that species. Specimens reported from moist limestone should be checked against *L. massiliense*.

Scytinium tenuissimum (Dicks.) Otálora, P.M. Jørg. & Wedin (2013) **Nb**

Leptogium tenuissimum (Dicks.) Körb. (1855)



Thallus of spreading to overlapping lobes, forming blue-grey to brown cushions or mats; lobes to 2 mm wide, thin, elongate, deeply incised or crenate, with clustered coralloid outgrowths, surface ± smooth, olive- or brown-green; cortex of flattened angular cells, centre of thallus lobes compact, with broad short-celled hyphae throughout. Apothecia to 1.5 mm diam., frequent; disc strongly concave to flat, reddish brown; thalline margin thick, often with attached lobules. Ascospores 20–35 × 9–12 µm, muriform, with 3-5 (-7) transverse septa. **BLS 0847**.

Amongst mosses in calcareous grassland; local. Throughout Great Britain and Ireland.

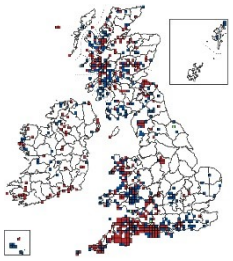
Very inconspicuous, rarely collected, and much over-recorded owing to confusion with diminutive morphs of *S. gelatinosum* or *S. lichenoides*; both these species have lax interwoven hyphae in the central part of the lobes. The larger lobes and concave to flat apothecia distinguish this species from *S. subtile*.

Scytinium teretiusculum (Wallr.) Otálora, P.M. Jørg. & Wedin (2013) **LC**

Leptogium teretiusculum (Wallr.) Arnold (1892)

Thallus brown or (in shade) grey, at first with small radiating narrow branched flat appressed lobes 0.3–1 × 0.1–0.2 mm, smooth when dry, at their margins and apices developing long, cylindrical, often coralloid isidium-like extensions 30–70 (–100) µm diam. and to 0.6 (–1) mm long, that become crowded to form dense clusters or cushions; at maturity, the primary squamules are mostly obscured except sometimes at the edge of the cushions.

Cortex of flattened angular cells, centre of thallus lobes compact, with broad short-celled hyphae throughout. Apothecia very rare, red-brown, urceolate; thalline margin thick. Ascospores 20–25 × 10 µm, muriform with 3-5 transverse septa. **BLS 0848**.

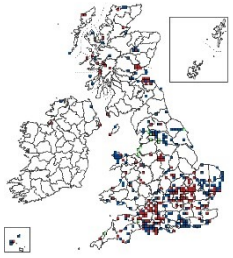


On rough, basic bark of old trees, especially *Acer*, *Fraxinus* and *Ulmus*, more rarely on basic rocks, old walls, mine workings, and coastal mossy turf, frequent but often overlooked. Throughout Britain and Ireland.

Close to *S. subtile* which has less elongated lobes with few, if any, isidium-like extensions, and numerous apothecia. Morphs with very long 'isidia' can resemble the cyanobacterial morphotype of *Ricasolia* (*Lobaria*) *amplissima*.

Scytinium turgidum (Ach.) Otálora, P.M. Jørg. & Wedin (2013) **LC**

Leptogium turgidum (Ach.) Cromb. (1870)



Thallus thickish, lobate; lobes small, (0.1–) 0.2–1 mm wide and to 2.5 mm long, turgid, sometimes ascending and appearing shrubby; upper surface dark olive- or red-black, wrinkled to plicate, concave at the circumference, often densely granular-isidiate; isidia 60–100 µm diam. Thallus with a distinct cortex composed of angular cells, the medulla compact, of broad short-celled hyphae throughout. Apothecia to 0.5–3 mm diam., absent to numerous; disc concave, becoming ± flat; thalline margin swollen, entire, or sometimes slightly granular. **BLS 0849**.

On calcareous walls, especially crumbly mortar, and calcareous soils; local. Mainly S. & E. Britain.

The status of the lichens included here requires critical study as apparently intermediate morphs exist between *S. plicatile*, with larger lobes, and *S. schraderi*, with more regular cylindrical lobes.

References

Bjelland, T., Bendiksby, M. & Frisch, A. (2017). Geographically disjunct phylogenetic lineages in *Leptogium hibernicum* reveal *Leptogium krogiae* sp. nov. from East Africa. *Lichenologist* **49**: 239-251.

Degelius, G. (1954). The lichen genus *Collema* in Europe. *Symb. Bot. upsal.* **13** (2): 1-499.

Degelius, G. (1974). The lichen genus *Collema* with special reference to the extra-European species. *Symb. Bot. upsal*. **2**0: 1-215.

Gilbert, O.L., James, P.W. & Purvis, O.W. (2009). *Collema*. In *Lichens of Great Britain and Ireland* (Smith, C.W., Aptroot, A., Coppins, B.J., Fletcher, A., Gilbert, O.L., James, P.W. & Wolselsey, P.A. eds): 345-357. London: British Lichen Society.

Gilbert, O.L. & Jørgensen, P.M. (2009). *Leptogium*. In *Lichens of Great Britain and Ireland* (Smith, C.W., Aptroot, A., Coppins, B.J., Fletcher, A., Gilbert, O.L., James, P.W. & Wolselsey, P.A. eds): 541-551. London: British Lichen Society.

Hoffmann, N. & Hafellner, J. (2000). Eine Revision der lichenicolen Arten der Sammelgattungen *Guignardia* und *Physalospora* (Ascomycotina). *Bibliotheca Lichenologica* **77**: 181 pp.

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.

Jørgensen, P.M. (1994). Further notes on European taxa of the lichen genus *Leptogium*, with emphasis on the small species. *Lichenologist* **26**: 1-29.

Jørgensen, P.M. (1997). Further notes on hairy *Leptogium* species. *Symb. Bot. upsal.* **32**: 113-130.

Jørgensen, P.M. (2012a). Collemataceae. In Ahti, T., Jørgensen, P.M., Kristinsson, H., Moberg, R., Søchting, U. & Thor, T. eds), *Nordic Lichen Flora* edn 2, **3**: 14-42. Stenungsund: Nordic Lichen Society.

Jørgensen, P.M. (2012b). Lichinaceae. In Ahti, T., Jørgensen, P.M., Kristinsson, H., Moberg, R., Søchting, U. & Thor, T. eds), *Nordic Lichen Flora* edn 2, **3**: 46-76. Stenungsund: Nordic Lichen Society.

Jørgensen, P.M. & James, P.W. (1983). Studies on some *Leptogium* species of western Europe. *Lichenologist* **15**: 109-125.

Kitaura, M.J. & Marcelli, M.P. (2013). A revision of *Leptogium* species with spherical-celled hairs (section *Mallotium* p.p.). *Bryologist* **116**: 15-27.

Košuthová, A., Westberg, M., Otálora, M.A.G. & Wedin, M. (2019). *Rostania* revised: testing generic delimitations in Collemataceae (Peltigerales, Lecanoromycetes). *Mycokeys* **47**: 17-33.

Košuthová, A., Bergsten, J., Westberg, M. & Wedin, M. (2020). Species delimitation in the cyanolichen genus *Rostania. BMC Evolutionary Biology*, in press.

Magain, N., Spribille, T., DiMeglio, J., Nelson, P.R., Miadlikowska, J. & Sérusiaux, N. (2020). Phylogenetic evidence for an expanded circumscription of *Gabura* (Arctomiaceae). *Lichenologist* **52**: 3-15.

Otálora, M., Aragón, G., Martínez, I. & Wedin, M. (2013a). Cardinal characters on a slippery slope - a re-evaluation of phylogeny, character evolution, and evolutionary rates in the jelly lichens (Collemataceae s. str.). *Molecular Phylogenetics and Evolution* **68**: 185-198.

Otálora, M.A.G. Aragón, G., Molina, M.C., Martínez, I. & Lutzoni, F. (2010). Disentangling the *Collema-Leptogium* complex through a molecular phylogenetic study of the Collemataceae (Peltigerales, lichen-forming Ascomycota). *Mycologia* **102**: 279-290.

Otálora, M.A.G., Jørgensen, P.M. & Wedin, M. (2013b). A revised generic classification of the jelly lichens, Collemataceae. *Fungal Diversity* **64**: 275-293.

Otálora, M.A.G. & Wedin, M. (2013). *Collema fasciculare* belongs in *Arctomiaceae*. *Lichenologist* **45**: 295-304.

Schultz, M. & Büdel, B. (2002). Key to the genera of the Lichinaceae. *Lichenologist* **34**: 39-62.

Schultz, M., Wedin, M., Diel, H. & Prieto, M. (2015). *Epiphloea* belongs to *Collemataceae* (Lecanoromycetes, lichenized Ascomycota). *Lichenologist* **47**: 369-378.

Smith, C.W., Aptroot, A., Coppins, B.J., Fletcher, A., Gilbert, O.L., James, P.W. & Wolselsey, P.A. (eds) (2009). *Lichens of Great Britain and Ireland*: 1046 pp. London: British Lichen Society.

Stone, D.F., Hinds, J.W., Anderson, F.L. & Lendemer, J.C. (2016): A revision of the *Leptogium saturninum* group in North America. *Lichenologist* **48**: 387-421.

Thüs, H. & Schultz, M. (2009). Fungi. Part 1: Lichens. In Büdel, B. *et al.*, Freshwater Flora of Central Europe **21**(1): 223 pp. Spektrum, Heidelburg.

Wedin, M., Jørgensen, P.M. & Wiklund, E. (2007). Massalongiaceae fam. nov., an overlooked monophyletic group among the cyanobacterial lichens (Peltigerales, Lecanoromycetes, Ascomycota). *Lichenologist* **39**: 61-67.

INDEX