

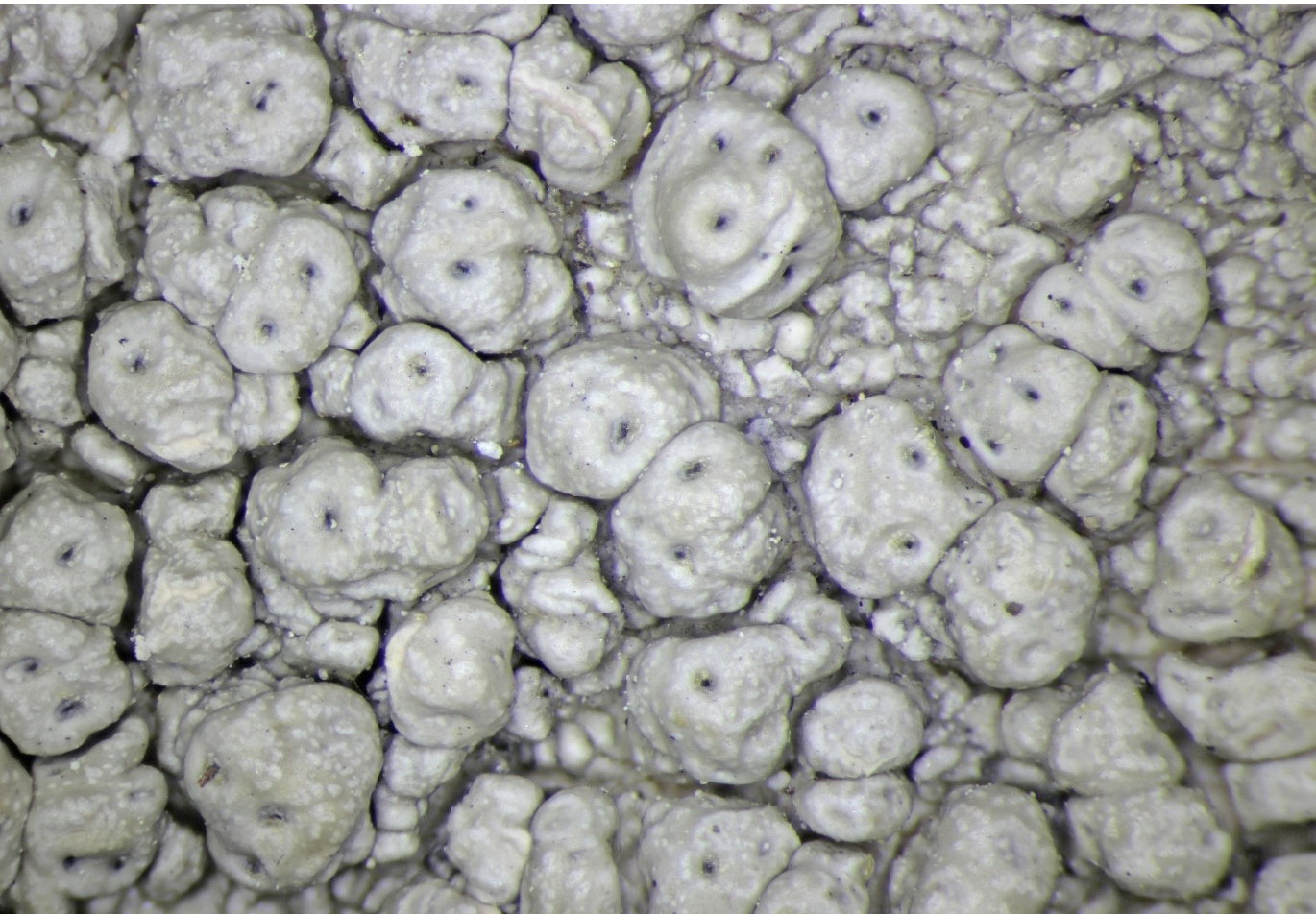
Revisions of British and Irish Lichens



British
Lichen
Society

Volume 6

January 2021



Pertusariales: Pertusariaceae

Cover image: *Pertusaria pertusa*, on bark of *Acer pseudoplatanus*, near Pitlochry, E Perthshire.

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to compile new printed editions of the entire lichen biota of Britain and Ireland is extensive, and many parts are out-of-date even as they are published.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

Editorial Board

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

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

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

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

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

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

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

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

Made available under Creative Commons Licence  CC BY-SA

ISSN 2634-7768

© British Lichen Society, 7 January 2021

Revisions of British and Irish Lichens vol. 6

Pertusariales: Pertusariaceae

including the genus *Pertusaria*

by

Paul Cannon

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

Steve Chambers

7 Cefn Melindwr, Capel Bangor, Aberystwyth, Ceredigion SY23 3LS, UK

Brian Coppins

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

Neil Sanderson

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

Janet Simkin

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

This publication can be cited as:

Cannon, P., Chambers, S., Coppins, B., Sanderson, N. & Simkin, J. (2021). Pertusariales: Pertusariaceae, including the genus *Pertusaria*. *Revisions of British and Irish Lichens* **6**: 1-13.

PERTUSARIACEAE Körb. (1855)

Thallus crustose, superficial and moderately thick or thin and \pm immersed, rarely appearing subfruticose (in *Thamnochrolechia*). **Soralia** or **isidia** frequent. **Cortex** thin, cartilaginous, composed of thick-walled septate agglutinated hyphae. **Photobiont** chlorococcoid. **Ascomata** apothecia, almost closed and perithecium-like with one or several immersed within fertile warts, rarely irregular with a thin thalline margin (in *Loxosporopsis*) or stipitate and proliferating (in *Thamnochrolechia*). **Hamathecium** of paraphyses, lax, branched and richly anastomosed. **Asci** 1- to 8-spored, broadly cylindrical, apex with a broad ocular chamber, outer sheath K/I+ blue, otherwise K/I–, with an inner extensible layer, *Pertusaria*-type, rarely with an amyloid tholus (in *Thamnochrolechia*). **Ascospores** to more than 250 μm in length, thick-walled, mostly ellipsoidal to fusiform and aseptate but rarely narrow with inconspicuous septa (in *Loxosporopsis*); wall usually laminar in construction, sometimes with radiating canals to the surface, rarely ornamented. **Conidiomata** pycnidia, rare. **Conidia** straight, \pm acicular or bacilliform. **Chemistry**: xanthonenes, fatty acids, depsides or depsidones present in many species. **Ecology**: varied, not on pure limestone or other strongly calcareous substrata.

The Pertusariaceae as currently circumscribed contains three genera (Lücking *et al.* 2016), of which only *Pertusaria* itself occurs in Great Britain and Ireland. Of the others, *Loxosporopsis* (Brodo & Henssen 1995) is a monotypic genus from conifer bark in western North America and *Thamnochrolechia* (Aptroot & Sipman 1991) is also monotypic and from montane forests in New Guinea. *Pertusaria* is now considered to be much restricted compared with the account in the second edition of this publication, with the exclusion of *Leptra* and *Varicellaria* – genera that now belong to the Ochrolechiaceae (Wei *et al.* 2017).

Literature

Aptroot & Sipman (1991), Archer & Elix (2018), Brodo & Henssen (1995), Chambers *et al.* (2009), Dibben (1980), Hafellner & Türk (2016), Hanks (1983), Lendemer & Harris (2017), Lücking *et al.* (2016), Lumbsch *et al.* (1993), Schmitt & Lumbsch (2004), Schmitt *et al.* (1994, 2003, 2006, 2012), Spribille *et al.* (2020), Wei *et al.* (2017).

PERTUSARIA DC. (1805)

Thallus crustose, superficial and moderately thick or thin and \pm immersed, continuous to rimose-cracked, fissured-areolate or warted. **Soralia** or **isidia** frequent. **Cortex** thin, cartilaginous, composed of thick-walled septate agglutinated hyphae. **Photobiont** chlorococcoid. **Ascomata** apothecia, almost closed and perithecium-like with one or several immersed within fertile warts, rarely \pm immersed in the thallus. **Hamathecium** of paraphyses, lax, branched and richly anastomosed. **Asci** 1- to 8-spored, broadly cylindrical, the apex with a broad ocular chamber, outer sheath K/I+ blue, otherwise K/I–, with an inner extensible layer, *Pertusaria*-type. **Ascospores** to more than 250 μm in length, thick-walled; wall laminar in construction, sometimes with radiating canals to the surface, rarely ornamented. **Conidiomata** pycnidia, rare. **Conidia** straight, \pm acicular or bacilliform. **Chemistry**: xanthonenes, fatty acids, depsides or depsidones present in many species. **Ecology**: varied, not on pure limestone or other strongly calcareous substrata.

Leptra and *Varicellaria*, two genera segregated from *Pertusaria* (see Schmitt *et al.* 2012, Hafellner & Türk 2016, Wei *et al.* 2017) have apothecia with discs that are usually exposed at an early stage

and may develop from soralia, in contrast to those of *Pertusaria* sensu stricto which develop within thalline warts. They are placed here in the Ochrolechiaceae rather than the Pertusariaceae. *P. geminipara* has recently been transferred to the quite unrelated genus *Toensbergia* (Sporastatiaceae, Rhizocarpaceae) by Spribille *et al.* (2020).

Pertusaria is distinguished from *Ochrolechia* which has a thick, amyloid ascus wall, thinner-walled spores and, to some extent, a different chemistry. *Ochrolechia xanthostoma*, with ascocarps enclosed in warts, closely resembles a *Pertusaria*. *Coccotrema* (Coccotremataceae) differs in having a non-layered ascospore wall and periphysoids arising from the inner exciple near the ostiole.

A few species included within *Pertusaria* by Chambers *et al.* (2009) have not been sequenced, and their phylogenetic position remains uncertain. They include *P. flavocorallina*, *P. pluripuncta* and *P. polythecia*. They are retained in *Pertusaria* here for convenience, and the key below also includes species of *Lepra* and *Varicellaria*. *P. hutchinsiae* has been found to belong to *L. ophthalmiza*.

- | | | |
|--------|--|-----------------------------------|
| 1 | Isidia or soralia present; apothecia often absent | 2 |
| | Isidia and soralia absent; apothecia often present | 27 |
| 2(1) | Isidia present, fine granule-like to coarse and papilla-like | 3 |
| | Soredia present, delimited punctiform to wide-spreading and effuse | 11 |
| 3(2) | Thallus entirely composed of conspicuous finger-like isidia; on soil or mosses (rarely on rock);
montane | 4 |
| | Thallus clearly crustose, ± developing isidia; on rock or bark; lowland or montane | 5 |
| 4(3) | Isidia 0.4–1 mm diam., uniformly white; asci 1-spored | <i>Lepra dactylina</i> |
| | Isidia 0.3–0.5 mm diam., white, ± browned at the apices; asci 8-spored | <i>Pertusaria oculata</i> |
| 5(3) | Thallus green-yellow, C+ orange | 6 |
| | Thallus white, grey or dark grey, C– | 7 |
| 6(5) | Isidia distinct, cylindrical, not abrading into soredia; on rocks, upland | <i>Pertusaria flavocorallina</i> |
| | Isidia small, sometimes abrading into sorediate patches; on trees, lowland | <i>Pertusaria flavida</i> |
| 7(5) | Isidia 2–3 × 0.5–2 mm, often predominant; often ± abraded; thallus dark grey, taste very bitter;
medulla KC+ magenta-pink (fleeting) | <i>Lepra melanochlora</i> |
| | Isidia to 2 × 0.1–0.5 mm, not dominant; thallus white to grey, taste mild; medulla KC± yellow to red | 8 |
| 8(7) | Thallus and medulla Pd+ orange, K+ yellow→red (crystals) | 9 |
| | Thallus and medulla Pd± yellow, K± yellow-orange or K– (no crystals) | 10 |
| 9(8) | Isidia constricted at the base, rounded or top-shaped, ± browned at the apices, leaving non-sorediate
distinct pits when shed; usually saxicolous | <i>Pertusaria pseudocorallina</i> |
| | Isidia not constricted at the base, elongate, the apices light grey-green tinged, leaving pale faint
scars when shed; usually corticolous | <i>Pertusaria coccodes</i> |
| 10(8) | On rock; isidia hard, the surface ± shiny, UV– | <i>Lepra corallina</i> |
| | On bark; isidia soft and fragile, the surface matt, UV+ orange | <i>Pertusaria coronata</i> |
| 11(2) | Thallus ± yellow-grey to yellow-green, C+ orange | 12 |
| | Thallus white, grey to dark grey, C± red | 14 |
| 12(11) | On bark; soralia derived from eroded areas of isidia | <i>Pertusaria flavida</i> |
| | On rock; soralia present from the start | 13 |

- 13(12) Thallus thin, minutely cracked-areolate, grey, in patches \pm yellow-grey, Pd+ orange; soralia 0.1–0.3 mm, fleck-like, pale grey-white *Pertusaria amarescens*
Thallus thick, smooth to coarsely warted-areolate, yellow- or green-grey, Pd–; soralia 0.3–0.8 mm, \pm rounded, pale yellow-green *Pertusaria flavicans*
- 14(11) Thallus and/or soralia C+ red 15
Thallus and/or soralia C– 17
- 15(14) Thallus pale blue-grey; prothallus prominent, white; soralia 1–1.5 (–2) mm diam., concolorous with the thallus, convex *Varicellaria hemisphaerica*
Thallus white to grey or pale brown; prothallus not distinctive; soralia 0.3–1.5 mm diam., white or pale brown 16
- 16(15) On soil; thallus granular-warted, grey (becoming brown in dried collections), Pd+ yellow-orange; soralia rounded, \pm elevated *Toensbergia geminipara* [Sporastatiaceae, Rhizocarpaceae]
On rock; thallus smooth, regularly areolate cracked, grey-white, Pd–; soralia rounded, white, \pm flat, immersed *Varicellaria lactea*
- 17(14) Soralia KC+ purple-violet; tastes very bitter 18
Soralia KC \pm yellow, orange or red; tastes mild 19
- 18(17) Thallus forming \pm compact cushions; upper surface warted-papillate, the apices and ridges breaking down into small elevated punctiform soralia *Lepra pulvinata*
Thallus \pm flat, \pm smooth; soralia discrete, scattered over the thallus *Lepra amara*
- 19(17) Soralia Pd–, K–, rounded-disc-like to warted 20
Soralia Pd+ yellow to rust-red, K \pm yellow to red 21
- 20(19) Thallus of columnar warts, bursting apically producing soralia *Pertusaria polythecia*
Thallus crustose to uneven, soralia not apical in warts, excavate or irregular *Lepra albescens*
- 21(19) Soralia Pd+ rust-red, K \pm dirty brownish, rounded, \pm punctiform on a thin grey to dark grey thallus ... 22
Soralia or crater-like depressions Pd+ yellow to orange-red, K+ yellow to red on a thick warted pale grey to grey thallus 24
- 22(21) Thallus thin, \pm immersed *Pertusaria pupillarlis*
Thallus thick, superficial, grey 23
- 23(22) On rock *Lepra aspergilla*
On bark or wood *Lepra borealis*
- 24(21) Soralia absent, with small non-sorediate depressions; usually with peg-like, brown-tipped isidia *Pertusaria pseudocorallina*
Soralia present; isidia, if present, inconspicuous, soon eroded and becoming sorediate 25
- 25(24) Medulla and soredia K \pm dirty brown (no crystals); Pd+ rust-red *Lepra leucosora*
Thallus and soredia K+ yellow \rightarrow red (crystals); Pd+ yellow or yellow-red 26
- 26(25) Soralia conspicuous, white; thallus thick, rough, coarsely cracked-areolate, pale grey-white to grey *Lepra excludens*
Soralia inconspicuous, derived from the breakdown of coarse low papillae; thallus thin to medium thick, sparingly areolate-cracked, in part greenish grey *Pertusaria lactescens*

- 27(1) Fertile warts soralium-like, each with a single apothecium; disc \pm widely exposed, densely white-granular pruinose 28
 Fertile warts not resembling soralia, containing a single or several apothecia; disc pore-like or becoming \pm exposed, not or lightly pruinose 31
- 28(27) Disc C+ carmine-red, medulla UV+ bright orange *Varicellaria velata*
 Disc C-, thallus UV+ white, grey-yellow or UV- 29
- 29(28) Thallus K+ red (crystals); on rock *Lepra monogona*
 Thallus K \pm yellow; on bark or associated mosses 30
- 30(29) Fertile warts white, Pd+ rust-red, K+ yellow; disc wide; true exciple continuous, \pm even *Lepra multipuncta*
 Fertile warts grey, concolorous with the thallus, Pd-, K-; disc narrow; true exciple irregular, crenate *Lepra ophthalmiza*
- 31(27) On bark or overgrowing mosses and low vegetation 32
 On rock 39
- 32(31) Overgrowing mosses and low vegetation; montane 33
 On bark; montane or lowland 35
- 33(32) Disc expanded to 1 mm diam.; asci 1-spored; epithecium K+ violet *Pertusaria bryontha*
 Disc pore-like; asci (2-) 4-spored; epithecium K- 34
- 34(33) Thallus Pd+ orange-red, K+ red (crystals); ascospores 70–125 \times 25–50 μ m *Pertusaria glomerata*
 Thallus Pd-, K- (no crystals); ascospores 55–70 (–85) \times 30–40 μ m *Ochrolechia xanthostoma*
- 35(32) Asci 8-spored; epithecium K+ violet; disc \pm pore-like, often becoming expanded, one per wart *Pertusaria hymenea*
 Asci 2- to 4 (-6)-spored; epithecium K-; disc remaining pore-like 36
- 36(35) Fertile warts semi-globose, \pm constricted at the base, with 1-7 pore-like discs; asci 2-spored; ascospores 140–230 (–330) \times 40–80 (–90) μ m *Pertusaria pertusa*
 Fertile warts usually conical, spreading at the base, rarely semiglobose and then pale pink, generally with a single apical pore-like disc; asci 2- or 4-spored; ascospores 55–125 (–140) \times 20–40 (–45) μ m 37
- 37(36) Asci 2-spored; ascospores walls \pm faintly ornamented, at least the fertile warts C+ yellow *Pertusaria pustulata*
 Asci 4-spored; ascospores walls smooth, thallus C- 38
- 38(37) Thallus even, continuous, grey-white to yellow- or green-grey; fertile warts low, spreading at the base, widely dispersed on smooth bark *Pertusaria leioplaca*
 Thallus irregular in patches grey-white; fertile warts semi-globose, constricted at the base, often crowded; usually on old *Calluna* stems *Ochrolechia xanthostoma*
- 39(31) Asci 8-spored; disc \pm expanded or irregularly stellate; epithecium K+ violet 40
 Asci <8-spored; disc remaining pore-like; epithecium K- or rarely violet 41
- 40(39) Apothecia *Aspicilia*-like, immersed, the warts inconspicuous; disc irregularly stellate; ascospores 25–42 \times 11–24 μ m; thallus dark grey *Pertusaria chiodectionoides*
 Apothecia raised in distinct warts; disc pore-like to widened and rounded; ascospores 60–110 (–120) \times (20–) 30–50 μ m; thallus pale to dark green-grey or yellow-grey *Pertusaria hymenea*

- 41(39) Ascospores colourless to dark brown; wall thickened, elaborately channelled; apothecia inconspicuous, little elevated 42
 Ascospores colourless; wall undifferentiated; apothecia ± elevated 43
- 42(41) Ascospores colourless, K⁻; thallus yellow-green-grey, C⁺ orange *Pertusaria pluripuncta*
 Ascospores ± dark brown, K⁺ violet; thallus grey, C⁻ *Pertusaria lactescens*
- 43(41) Thallus Pd⁻, K⁻; fertile warts with a single pale, pore-like disc *Ochrolechia xanthostoma*
 Thallus Pd⁺ yellow to orange, K⁺ yellow to red; fertile warts with 1-7 dark, pore-like discs 44
- 44(43) Thallus K⁺ red (crystals), grey-white to light brown *Pertusaria pseudocorallina*
 Thallus K⁺ yellow to orange (no crystals), greenish grey *Pertusaria pertusa*

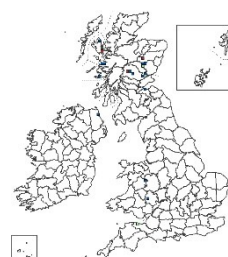
***Pertusaria amarescens* Nyl. (1874)**

Like *P. flavicans* but thallus pale primrose-yellow to dull olive-grey, much thinner and more delicately rimose-cracked; areoles smooth or roughened; soralia at first very small, fleck-like, becoming ± diffuse and contiguous. Apothecia unknown. Thallus C⁺ orange, K⁺ yellow, KC⁺ orange, Pd⁺ orange, UV⁺ overall pale orange and ± spotted blue-white (thiophaninic, stictic, menegazziaic and ± norstictic acids and *O*-methylmonochlornor-lichexanthone, UV⁺ orange and pale blue unknowns). **BLS 1059.**

On ± basic schistose rocks, upland; very local. Scotland, C. Wales (Montgomeryshire).

The status of material named as this species in Britain needs further investigation. In Britain *P. amarescens* invariably hosts the black apothecia of the lichenicolous fungus *Sclerococcum (Dactylospora) saxatile* (Schaer.) Ertz & Diederich (2018), the presence of which is virtually diagnostic.

Nb



***Pertusaria bryontha* (Ach.) Nyl. (1861)**

Thallus thin to moderately thick, continuous, white-grey, smooth to wrinkled-nodulose, rarely tuberculate, margin entire, not zoned. Isidia absent, but small coarse papillae are occasionally present. Fertile warts abundant, crowded with a single expanded, roughened apothecial disc (0.2–) 1 (–2.5) mm diam., yellow-brown to dark brown-black, at first sunken, later flat-convex, with a persistent smooth or somewhat warted irregular flexuous thalline margin; epithecium brown-black, K⁺ violet. Asci 1-spored. Ascospores (110–) 150–210 (–230) × (40–) 60–90 (–100) μm, wall (10–) 15 (–25) μm thick, smooth, with an outer, uniformly thickened layer and an unequal inner layer. Thallus C⁺ red, K⁺ yellow, KC⁺ red, Pd⁺ orange-red, UV[±] glaucous or orange (xanthone, stictic acid and accessory substances, gyrophoric acid). **BLS 1061.**

Encrusting mosses and low alpine vegetation in ± calcareous habitats; very rare. N. Scotland (Highlands); only one report since 1980 (Coire Cheap, Ben Alder).

Characterized by the papillate grey thallus and abundant apothecia with an expanded disc. *P. oculata* has a coralloid, isidiate thallus, apothecia with black discs and Pd⁺ rust-red thallus.

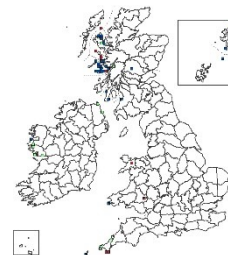
CR(D)



***Pertusaria chiodectonoides* Bagl. ex A. Massal. (1856)**

Thallus in small patches or sometimes widely spreading, thin to moderately thick, the margin ± entire, not zoned; upper surface dark grey, blue- or brown-grey, smooth or roughened, distinctly cracked-areolate; areoles ± flat. Fertile warts (0.2–) 0.7 (–1.5) mm diam., numerous and well dispersed, rarely confluent, flat. Asci 8-spored; apothecia 1-3 (-8) per wart; discs (0.1–) 0.3 (–0.6) mm diam., black or dark grey, immersed, ± widened and *Aspicilia*-like when mature, often roughened and grey-white pruinose and appearing irregular or stellate with a paler, irregular, not or slightly raised common margin; epithecium dark brown-black, K[±] deep violet. Ascospores (20–) 25–42 × 11–24 μm, wall 3–4 (–5) μm thick, even, smooth. Conidia 7–10 × 0.5–1 μm. Thallus C⁻, KC⁺ yellow, K⁺ yellow, Pd⁺ orange-red, UV⁻ (stictic, ± norstictic and ± constictic acids). **BLS 1063.**

Nb



On sunny siliceous and ultrabasic rocks, especially serpentine and basalt, mainly in coastal sites; very local. W. Scotland N. to Orkney, with outliers in Cornwall, Pembrokeshire and W. Ireland (Clare Is.).

Characterized by the flat dark grey areolate K⁺ yellow thallus, the fertile warts containing 1-3 (-8) black discs and the K⁺ violet epithecium. Superficially resembling the *Circinaria cinerea* agg., which has more tuberculate areoles and more elevated, rounded apothecia.

Two unidentified lichenicolous fungi have been found: a *Lichenodiplis* with dark brown, 1-septate conidia, 6–8.3 (–9.5) × 3.6–4 μm; and a *Sclerococcum* (*Dactylospora*) with 1-septate ascospores, 9.5–12 × 4.5–5 μm.

***Pertusaria coccodes* (Ach.) Nyl. (1857)**

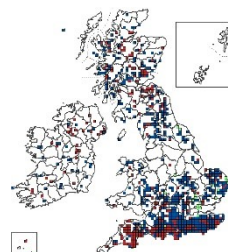
Thallus dull greenish or brownish grey, thin to moderately thick, continuous, often bordered by a pale brown or white prothallus, not zonate; upper surface smooth to ± warty, ± rimose-cracked; isidia often densely covering parts of the thallus, <0.5 mm diam., globose to ovoid-elongate, rather coarse, ± erect, smooth and firm, often with distinctly darkened grey to grey-green apices, occasionally branched-coralloid, leaving faint pale scars when shed. Apothecia 1–1.5 mm diam., very rare, in smooth convex-globular warts; discs punctiform. Asci 2-spored. Ascospores 100–180 (–200) × 30–60 μm. Thallus C[–], K⁺ yellow turning red, KC[–], Pd⁺ orange, UV[–] (norstictic acid). **BLS 1064.**

On ± well-lit, often somewhat nutrient-rich bark of deciduous trees in wayside, woodland and parkland sites, rarely on lignum or smooth, siliceous stonework; frequent. Widespread in S. & E. Britain, rare in W. & N. and Ireland.

Characterized by the usually conspicuously isidiate thallus and K⁺ red reaction. Fertile thalli are often only sparingly isidiate. The ‘pepper-pot’-like fertile warts resemble those produced by *P. pertusa*. Shade forms develop longer, more delicate isidia. *Ochrolechia subviridis* has softer, whitish isidia often dissolving into soredia and is K[–], C⁺ orange-red. When on rocks, typically overhung by trees, *P. coccodes* is distinguished from *P. pseudocorallina* by the greener grey thallus and the more regular, smooth, distinct isidia without brownish tips. *P. coronata* is K⁺ yellow-orange and UV⁺ orange.

The commensalistic to mildly pathogenic *Acolium sessile* is occasionally found on this species; less often recorded are *Marchandiomyces corallinus* (Roberge) Diederich & D. Hawksw. (1990), *Sclerococcum* (*Dactylospora*) *parasiticum* (Flörke) Ertz & Diederich (2018) and *Sphinctrina turbinata* (Pers.) De Not. (1846).

LC



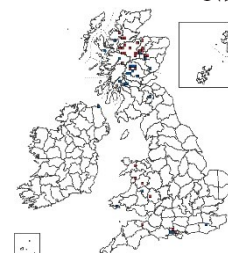
***Pertusaria coronata* (Ach.) Th. Fr. (1871)**

Like *P. coccodes*, but the isidia tend to be longer, more cylindrical and often thinner with a matt surface, ca 50 μm diam., decumbent and unoriented; thallus greenish-grey to pale or yellowish grey. Not known fertile in Britain & Ireland. Thallus C[–], K⁺ yellow-orange, KC⁺ yellow, Pd⁺ orange, UV± pale to dark orange (coronaton, stictic, ± norstictic and ± constictic acids). **BLS 1068.**

On wayside, more rarely woodland broad-leaved trees; very local. S. & W. Britain, very rare in Ireland, most frequent in C. Scotland.

Sterile specimens of *Caloplaca herbidella*, although somewhat similar, are K[–] or slightly K⁺ purple and Pd[–]. *P. coccodes* contains norstictic acid and is K⁺ yellow turning red (crystals in slide preparations), and is UV[–].

Nb



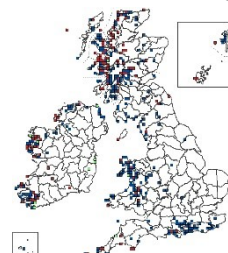
***Pertusaria flavicans* Lamy (1878)**

Thallus wide-spreading, rather thick, smooth to irregularly coarsely warty, often ± deeply cracked-areolate with an indistinct margin, yellowish or greenish grey; areoles to 1 mm diam., irregularly round or angular, convex or flat; soralia ± numerous, 0.4–1 mm diam., discrete or ± confluent, paler than the thallus, greenish yellow, coarsely to finely granular. Apothecia rather rare, the small dark ostioles expanding with tumid margins; epithecium K⁺ violet. Asci 8-spored. Ascospores ca 65 × 27 μm. Thallus C⁺ orange, K[–], KC⁺ orange, Pd[–], UV⁺ orange, soralia UV⁺ bright orange (thiophaninic acid and ± *O*-methylmonochloronorlich exanthone). **BLS 1072.**

On mildly base-rich siliceous rocks, typically coastal but also inland and montane; frequent. N., W. and S. Britain, also western Ireland.

Characterized by the rather thick yellowish green UV⁺ orange sorediate thallus. Other saxicolous *Pertusaria*

LC



spp. which are C+ orange, UV+ orange include the coastal species *P. pluripuncta*, which lacks isidia and soralia; see also *P. amarescens* and *Lecanora alboflavida*.

Lichenicolous fungi records are single occurrences of *Sclerococcum (Dactylospora) parasiticum* and *Rhizocarpon advenulum* (Leight.) Hafellner & Poelt.

***Pertusaria flavida* (DC.) J.R. Laundon (1963)**

Thallus pale or bright sulphur yellow to yellow-green-grey or yellow-brown, sometimes with a pale to dark grey margin, rather thick and uneven, ± coarsely rimose; upper surface coarsely warted, flat, smooth or somewhat roughened; isidia numerous, globose or shortly cylindrical-clavate, occasionally dissolving into soredia and obscuring the thallus, leaving faint cortical scars when shed. Apothecia very rare, 2-5 immersed in hemispherical sorediate-isidiate warts; disc black-brown, punctiform. Asci (4-) 8-spored. Ascospores 60–100 × 25–40 µm, wall 7–10 µm thick, less than 20 µm thick at the ends. Thallus C+ orange, K–, KC+ orange, Pd–, UV+ bright orange or yellow-orange (thiophaninic and an unidentified substance). **BLS 1073.**

On smooth and rough bark of well-illuminated mature broad-leaved trees, especially old *Quercus*, in open woodlands, parklands and on wayside trees. Throughout S. and E. Britain, central and N. Wales, scattered in Scotland, rare in Ireland.

Distinguished by the thick, abundantly isidiate yellow-tinged thallus and C+ and UV+ orange reactions. Three yellow-green C+ orange crustose species can cause confusion: *Lecanora expallens* has a less robust, thinner, distinctly sorediate thallus containing usnic, zeorin and thiophaninic acids, and is UV+ dull orange; *Pyrrhospora querneae* has a brownish tinge, is ± continuously finely sorediate, and has arthothelin and thiophaninic acid; *Lecanora alboflavida* has convex bright ± discrete yellowish-grey efflorescent soralia and contains atranorin as well as arthothelin.

A single occurrence of *Sphinctrina turbinata* is the only lichenicolous fungus reported.

***Pertusaria flavocorallina* Coppins & Muhr (1992)**

Nb IR

Similar to *Leptra corallina*, but thallus pale yellowish-grey, with longer yellowish isidia to 0.6 mm tall, which are C+ orange, UV+ dark red (thiophaninic acid). **BLS 1786.**

On tops of calcareous schistose boulders and on damp basalt; very rare. Single sites in E. & W. Scotland (Caenlochan, Skye).

This species has the same reactions as *Lecanora alboflavida*, which is sorediate. It has not been sequenced, so its phylogenetic position is unclear.

***Pertusaria glomerata* (Ach.) Schaer. (1826)**

Thallus thin to moderately thick; upper surface white-grey to yellow-white, occasionally tinged reddish, smooth, nodulose or tuberculate, often ± shining. Fertile warts *ca* 1 (–1.5) mm diam., almost globose, often crowded, regular, ± constricted at the base; apothecia 1 (–3) per wart; disc 0.1–0.2 mm diam., punctiform and ostiole-like, ± protruding; epithecium K+ violet. Asci (2-) 4-spored. Ascospores 70–125 × 25–50 µm, with a thin outer wall, uniformly thickened, inner wall unequal, combined wall 5–8 µm thick laterally and 13–15 µm apically. Pycnidia occasional, immersed with a small black ostiole; conidia 8–11 × *ca* 0.5 µm, spindle-shaped. Thallus C–, K+ yellow→red, KC+ yellow-red, Pd+ orange-red, UV+ glaucous (norstictic and ± stictic acid; no constictic acid). **BLS 1074.**

Overgrowing mosses, detritus, plant stems and soil in ± calcareous habitats above *ca* 900 m; very rare. Scottish Highlands (Ben Hope, Ben Alder, Ben Lawers and Craigh Calliach).

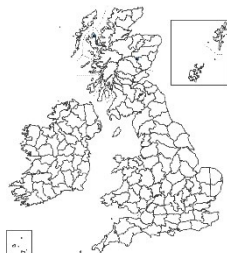
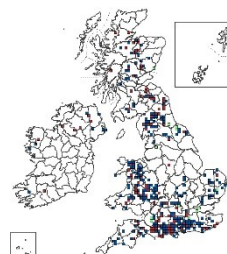
Characterized by the numerous globose regular fertile warts with ± extended punctiform ostiole-like discs, the K+ red thallus and habitat.

***Pertusaria hymenea* (Ach.) Schaer. (1836)**

LC

Thallus superficial, in small patches or widely spreading, thin to moderately thick, continuous, somewhat waxy, margin ± entire, rarely zoned; upper surface grey to yellow-green-grey or dark grey, smooth in young thalli, becoming roughened and ± tuberculate, often with deep rimose cracks. Fertile warts to 2 mm diam., often numerous and crowded, obscuring the thallus, semi-globose, often distorted (plicate-deformed), ± constricted

LC



VU(D2)

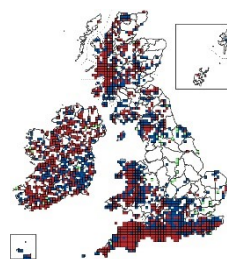


at the base, containing 1 (-4) apothecia; discs (0.3-) 0.6 (-1.8) mm diam., rounded or rather irregular, often widening, the surface brown- or grey-black, often \pm grey-white pruinose, surrounded by an uneven, often somewhat elevated thalline margin; epithecium K+ violet. Asci 8-spored. Ascospores 60-110 (-120) \times (20-) 30-50 μ m, wall 6-9 (-29) μ m thick, zoned, not striate. Pycnidia immersed, ostiole pale; conidia 13-25 \times ca 0.5 μ m, straight or somewhat curved. Thallus C+ yellow, K-, KC+ orange, Pd-, UV \pm pale orange (thiophanic acid, \pm *O*-methylmonochlororlichexanthone and \pm gyrophoric acid). **BLS 1076.**

On bark of woodland, wayside and parkland broad-leaved trees, often in rather shaded sites, rarely on sheltered rocks in woodland; frequent. Throughout Britain & Ireland.

In shaded sites the apothecia of this rather variable species can develop widely exposed, pale discs which are *Lecanora*-like; in more exposed sites the disc is darker, less exposed and more punctiform. The thallus varies from yellow in warm, sheltered but sunny sites, to greenish grey in shaded ones. *P. pertusa* has more rounded, smooth warts, each with several dark punctiform discs, a consistently lighter and greyer thallus and prefers better lit situations.

The type host for *Sphaeropezia pertusariae* (Etayo *et al.*) Baloch & Wedin (2013) and *Tremella pertusariae* Diederich (1996). The most common lichenicolous fungus on this host is *Sclerococcum (Dactylospora) parasiticum*, and others recorded are *Acolium sessile*, *Marchandiomyces corallinus*, *Sphinctrina turbinata* and an unidentified *Lichenochora* with 3-septate ascospores ca 20 \times 6.5 μ m in size.

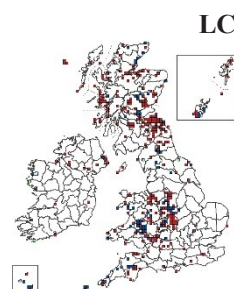


***Pertusaria lactescens* Mudd (1861)**

Thallus thin or rather thick, grey, at first smooth and continuous, later markedly rimose, the areoles \pm finely granular with crowded \pm globose isidia-like papillae ca 0.1 mm diam., which may leave numerous eroded granular-sorediate patches when dispersed; prothallus white, fimbriate. Apothecia occasional, easily overlooked, 2-5 immersed within an areole, forming flat radiating clusters surrounded by a slightly raised irregular smooth or \pm granular collar; disc \pm exposed, brownish black, very irregular, much divided; epithecium K+ violet. Asci 2 (3-4) -spored. Ascospores (70-) 80-100 (-140) \times 55-85 μ m, pale, soon becoming grey-brown or olive-black, wall 10-14 μ m thick, striate in section, three-layered, the thin outer layer K-, the inner two K+ violet-purple, outer surface with numerous minute pores. Thallus C-, K+ yellow \rightarrow red, KC+ yellow \rightarrow red, Pd+ yellow-orange, UV- (norstictic acid). The K+ purple colour change is detectable in external hyphae of thallus and soredia (and spore walls, etc.) when viewed in squashes (\times 100) but not by surface spot test as it is overwhelmed by the rapid & intense K+ red norstictic reaction. **BLS 1078.**

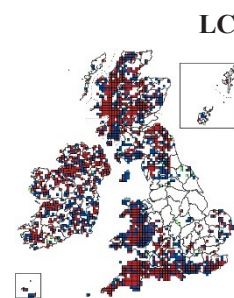
On siliceous, often basaltic rocks and sandstone walls or memorials, particularly in churchyards where it benefits from slight dust deposition. Locally common throughout Britain & Ireland, rare in E. England.

In both *Lepra excludens* and *P. lactescens* the initial granules in the soralia appear smooth and corticate and could be considered isidia. The underlying granules are looser, ecorticate, smaller and appear to be soredia when exposed by abrasion, mollusc grazing or age. The thallus of *Phlyctis argena* is similar, but no K+ violet pigment is present. Compared with *L. excludens*, *P. lactescens* has a thinner thallus (0.1-0.4 mm thick) and smaller soralia (0.2) 0.3-0.7 (-0.8) mm in size, that are more distinctly delimited.



***Pertusaria leioplaca* DC. (1815)**

Thallus superficial or partly immersed, thin, margin \pm entire and unzoned; upper surface grey-white to yellow- or green-grey, smooth, even to somewhat roughened, not or weakly rimose-cracked, densely packed with clusters of coarse crystals. Fertile warts (0.6-) 1.5 (-2.5) mm diam., scattered or occasionally 1-3-contiguous at the base, concolorous with the thallus, semi-globose or conical with a spreading base, often flat-topped; epithecium K-. Apothecia 1(-2) per wart, generally level to slightly immersed, often widely spaced; disc punctiform, ostiole-like. Asci (3-) 4 (-6)-spored. Ascospores (40-) 50-80 (-120) \times (20-) 25-40 (-50) μ m, wall rather thin (to 4-4.5 μ m), uniform. Pycnidia rare; conidia 7-10 \times 0.5-1 μ m. Thallus C-, K+ yellow, KC+ yellow, Pd+ orange-red or Pd-, UV \pm pale orange (coronaton, \pm stictic and \pm norstictic and constictic acids).



Mainly on smooth bark of broad-leaved trees and shrubs in ± sheltered, shaded sites; often frequent. Widespread except in areas impacted by sulphur dioxide pollution in the past.

Characterized by the thin continuous thallus, ± conical ± flat-topped fertile warts with a spreading base, enclosing a single apothecium opening by a minute punctiform disc, the 4-spored asci and by the presence of coronaton and stictic acid. *P. pertusa*, with 2-spored asci, has an identical chemistry but has a better developed thallus and fertile warts which are constricted and not spreading at the base. The 8-spored *P. alpina* Hepp ex Ahles. (1860), which has an identical chemistry and has been recorded from S. Uist and Rhum, is doubtfully distinct. The similar but rare *P. pustulata* has only two larger spores per asci and the fertile warts are C+ yellow.

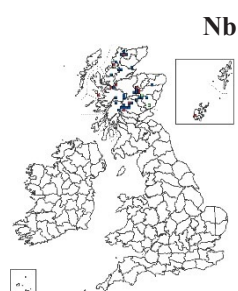
Type host to *Lichenodiplis pertusariicola* and *Opegrapha pertusariicola*. Other lichenicolous fungi with just one or a few records are *Lichenostigma alpinum* (R. Sant. et al.) Ertz & Diederich (2013), *Marchandiomyces corallinus*, *Pronectria pertusariicola* Lowen (1999), *Pyrenidium actinellum* s. lat., *Roselliniopsis tartaricola* (Linds.) Matzer (1993), *Sclerococcum (Dactylospora) parasiticum*, *Sphinctrina tubiformis* (Pers.) De Not. (1846), *S. aff. turbinata* (asci 4-spored) and *Taeniolella punctata* M.S. Christ. & D. Hawksw.(1979).

Pertusaria oculata (Dicks.) Th. Fr. (1871)

Thallus thin, inconspicuous, white-grey; isidia abundant, crowded, ± obscuring the thallus, 1–3 mm long and 0.3–0.4 mm diam., at first wart-like, becoming elongate, sometimes branched, cylindrical and often darkened, K+ violet purple at apices, fragile, never producing soralia. Apothecia 1–2 mm diam., rare; disc wide, flat or slightly concave, black, non-pruinose; thalline margin at first regular, smooth and well-developed, later more irregular and excluded; epithecium K+ violet. Asci 8-spored. Ascospores (16–) 23–28 (–30) × 10–14 μm; wall uniform, 1.5–2 μm thick, smooth. Pycnidia occasional, at ends of the isidia; conidia 3.5 × 0.5 μm, short for the genus. Thallus C± pink, K+ yellow-red, KC+ yellow-red, Pd+ rust-red, UV– or ± faint glaucous (fumarprotocetraric and ± protocetraric and ± gyrophoric acids). **BLS 1084.**

On gravelly and moorland soils, decaying vegetation or rarely directly on rock, montane, including areas of late snow-lie; occasional. N. Scotland (Highlands).

The presence of gyrophoric acids distinguishes *P. oculata* from *Lepra dactylina*, which also has thicker, white and more robust isidia, 0.4–1 mm diam.

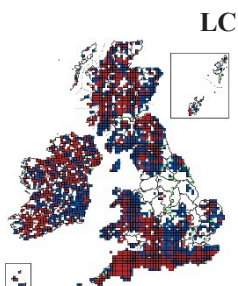


Pertusaria pertusa (Weigel) Tuck. (1845)

Thallus thin to thick; prothallus sometimes distinct, pale to white, limiting; upper surface pale grey to greenish grey, ± shiny, smooth or sparingly rimose, uneven, wrinkled or warted. Fertile warts 0.8–2 (–3) mm diam., often abundant, scattered to crowded, typically irregularly semiglobose, constricted at the base and with a slightly flattened apex; apothecia (1–) 4–7 (–15) per wart, immersed; disc black, punctiform. Asci 2(–4)-spored. Ascospores (120–) 145–230 (–330) × (35–) 40–80 (–90) μm; wall 7–15 μm thick, ends to less than 30 μm thick. Conidia 12–18 × 0.5 μm, acicular. Thallus C–, K+ yellow or yellow–orange, KC+ yellow, Pd+ orange–red, UV± pale orange (coronaton, stictic acid, ± norstictic and ± constictic acids). **BLS 1087.**

On smooth to rough bark, more rarely on rocks, especially old walls; common. Throughout Britain & Ireland. The combination of well-developed irregularly semi-globose fertile warts with constricted bases, each containing several apothecia, 2-spored asci, and presence of coronaton and stictic acid is distinctive. *P. hymenea* differs in the 8-spored asci, a K+ violet epithecium, fewer apothecia (often only one) per wart, wider discs and different chemistry. *P. leioplaca*, with similar chemistry to *P. pertusa* has 4-spored asci and ± evenly spaced, conical warts containing a single apothecium.

Host to several species of lichenicolous fungi, viz. *Cornutispora ciliata* Kalb (1993), *C. triangularis* Diederich & Etayo (1995), *Pronectria pertusariicola* Lowen (1999), *Sphinctrina leucopoda* Nyl. (1860) and *S. turbinata*.; also *Lichenocodium erodens*, *Lichenodiplis pertusariicola*, *Marchandiomyces corallinus*, *Sclerococcum (Dactylospora) parasiticum*, *Tremella pertusariae*, and an undescribed species of *Roselliniella*.



Pertusaria pluripuncta Nyl. (1883)

Thallus thin to thick, smooth, wax-like to ± wrinkled-uneven, sometimes rimose-cracked, becoming coarsely warted at the centre; prothallus thin, pale; upper surface pale to dark yellow-grey to greenish grey. Fertile warts

NT

rare, inconspicuous, low, irregular, 0.5–1 mm diam., ± conical, containing a single apothecium; disc irregular, punctiform or somewhat radiating, blackish or brownish green; epitecium K⁻. Asci (1-) 2 (-3)- spored. Ascospores 80–140 × 30–60 μm, colourless, K⁻, 12–15 μm thick, 3-zoned, outer surface patterned with crowded, minute oval pores. Thallus C⁺ orange, K⁺ yellowish, KC⁺ orange, Pd⁺ orange-red, UV⁺ deep orange-red (thiophaninic acid, stictic acid, ± norstictic, constictic and ± gyrophoric acids).

On sunny sheltered or exposed granite coastal rocks, rarely peaty soil or decayed *Armeria* tufts; locally abundant in Isles of Scilly, rare in the Channel Islands (Jersey), Cornwall (N. coast).

Very common on the Isles of Scilly, where it forms conspicuous patches in the xeric supralittoral zone on coastal rocks. The layered ascospore wall structure recalls *P. lactescens* but the ascospores are persistently colourless; fertile thalli are rarely encountered. It has not been sequenced, so its phylogenetic position is unclear.



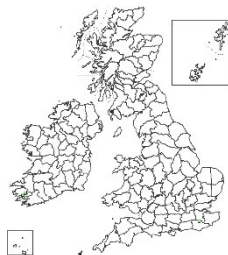
***Pertusaria polythecia* (Taylor) Erichsen (1936)**

NE

Thallus of dense pale grey columnar fertile warts, occasionally bearing 2-5 discs, bursting apically and producing soralia. Apothecial disc pruinose with sorediate margin and degenerated hymenium. Ascospores 1-2 per ascus, often poorly developed. C⁻, K⁻, KC⁻, Pd⁻, UV⁻, (fatty acids). **BLS 1088.**

Over mosses on trees; very rare. S.W. Ireland, Scilly Is. and SW Scotland.

Like *P. albescens* var. *corallina* (see *Leptra albescens*) but with a different set of fatty acids. It has not been sequenced, so its phylogenetic position is unclear.



***Pertusaria pseudocorallina* (Lilj.) Arnold (1887)**

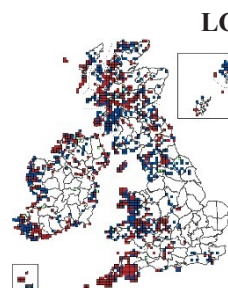
LC

Thallus rather thick, greyish white with a brownish tinge, ± smooth, wrinkled to coarsely warted; isidia usually present, scattered to crowded, several per areole, rounded, 0.5–1 mm diam., constricted at the base, apices brown-pigmented, rounded, often breaking off at the base leaving non-sorediate, crater-like depressions; when fertile, thallus warted, irregularly granular, often appearing eroded, without or with only a few isidia. Fertile warts scattered or crowded, 1–3 mm diam., rather rare, irregularly semi-globose, with 2-7 apothecia; discs punctiform, grey-black. Asci 2-spored. Ascospores 120–200 × 50–80 μm, wall 5–6 μm thick, uniform. Thallus C⁻, K⁺ yellow-red, KC⁺ yellow-red, Pd⁺ orange to yellow, UV⁻ (norstictic acid and accessory substances). **BLS 1089.**

On dry well-lit siliceous rocks in coastal and inland areas, also montane; often abundant. Thrives on slight nutrient enrichment from dust or rock composition. Throughout N. & W. Britain & Ireland, rare in S. and E. England and central Ireland.

A variable species, generally recognizable by the brown-tipped, peg-like isidia and K⁺ red (crystals) thallus. *Leptra corallina* has a uniformly pale white-grey, isidiate thallus, which is K⁺ yellow; the isidia are longer, cylindrical and lack brown apices. Fertile specimens of *P. pseudocorallina* ± lacking isidia were formerly referred to *P. ceuthocarpoides* (syn. *P. microstictica*). *L. monogona*, which is also K⁺ red, has more open white-pruinose discs and a white or pale grey, deeply rimose-areolate thallus. *Aspicilia epiglypta* can resemble fertile forms of coastal *P. pseudocorallina* but lacks isidia and has characteristically irregular discs.

Host to the lichenicolous fungi *Acolium marcianum* (B. de Lesd.) M. Prieto & Wedin (2016), *Sphinctrina tubiformis* A. Massal. (1853), *Stigidium eucline* (Nyl.) Vězda (1970), as well as *Lichenocnium erodens*, *Marchandiomyces corallinus* and an unidentified *Arthonia* with 3-septate ascospores.



***Pertusaria pupillaris* (Nyl.) Th. Fr. (1871)**

LC

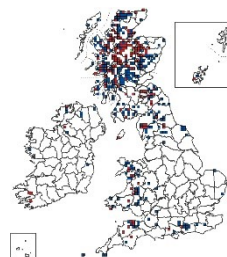
Thallus white- to green-grey, matt, usually in small patches to a few cm across, immersed to ± superficial and very thin; prothallus not distinct; soralia to 0.5 mm diam., punctiform, flat to excavate-ulcerose, pale greyish white or yellowish white, often evenly scattered, with fine granular soredia. Fertile warts 0.5–1 mm diam., rather rare, prominent, scattered; apothecia 1 per wart; disc red-black; thalline margin at first surrounding the disc, thick, wavy and later becoming ± excluded; epitecium olive-green, K⁺ violet. Asci 8-spored. Ascospores 10–14 × 7–11 μm, broadly ellipsoidal, the wall ca 1 μm thick, smooth. Thallus C⁻, K⁺ dirty reddish, KC⁺ yellow-

red, Pd+ orange-red to rust-red, UV+ glaucous-white (fumarprotocetraric acid). **BLS 1091.**

On damp acid smooth-barked trees, especially *Corylus* and *Sorbus*, also *Fraxinus*, *Quercus* and on *Pinus sylvestris* lignum in sheltered, often ancient woodland. N.W. Britain, extending locally elsewhere, rare in Ireland.

Characterized by the small neat punctiform Pd+ orange-red soralia and the *Lecanora*-like apothecia. Formerly misidentified in Britain & Ireland as *Ramboldia cinnabarina*, which has K+ yellow soralia due to the additional presence of atranorin. Has also been confused with *Lepra borealis*, which has a thicker thallus and larger soralia, and with *Schizotrema quercicola*, which has *Trentepohlia* as a photobiont and pinkish grey (when fresh) soralia. Sterile specimens can resemble *Violella fucata* but in that species the soralia are ± diffuse (sometimes well-defined) and more often form a ± continuous thick patchy granular-sorediate crust.

Reported lichenicolous fungi are *Lichenostigma alpinum*, *Roselliniopsis tartaricola* and *Spirographa fusisporella* agg.



Pertusaria pustulata (Ach.) Duby (1830)

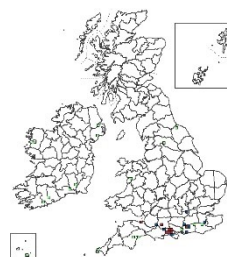
Thallus thin, ± superficial; prothallus sometimes present, ± paler, unzonated at the margin; upper surface grey or pale greenish grey, rather smooth, even, becoming fissured when old. Fertile warts 0.5–1 mm diam., flat, expanded at the base; apothecia 1(-3) per wart; disc at first punctiform, later becoming expanded, black, surrounded by the torn margin of the warts. Asci 2-spored. Ascospores (39–) 80–125 (–140) × 20–40 (–45) µm, wall 1.5–3 µm thick, ± faintly ornamented, uniform. Thallus C+ yellow, K+ yellow, KC+ yellow, Pd+ yellow-orange to orange-red, UV± faint yellow, K/UV+ bright yellow, while still wet (stictic acid, ± norstictic and ± constictic acids and a xanthone). **BLS 1092.**

On smooth bark on trunks, especially in ancient woodlands, on *Fagus* and *Ilex*, and rarely on other species; rare. S. England. Old records from Ireland may be errors.

Characterized by the apothecia being surrounded by the torn, warted margin, the 2-spored asci and a distinct xanthone. *P. hymenea* is 8-spored and contains thiophaninic acid. The combination of the K+ yellow and C+ yellow reactions distinguishes this species from the similar *P. leioplaca*, which lacks the C+ spot test; however, the C+ spot test on *P. pustulata* can be patchy and confined to the fertile wart.

Host to *Sphinctrina tubiformis* and also *Lichenodiplis lecanorae* (Vouaux) Dyko & D. Hawksw. (1979).

VU(B)



References

- Aptroot, A. & Sipman, H.** (1991). New lichens and lichen records from New Guinea. *Willdenowia* **20**: 221–256.
- Archer, A.W. & Elix, J.A.** (2018). New combinations of Australian species in the genus *Lepra* Scop. *Australasian Lichenology* **82**: 130–136.
- Brodo, I.M. & Henssen, A.** (1995). A new isidiate crustose lichen in north western North America. *Bibliotheca Lichenologica* **58**: 27–41.
- Chambers, S.P., Gilbert, O.L., James, P.W., Aptroot, A. & Purvis, O.W.** (2009). *Pertusaria*. In *Lichens of Great Britain and Ireland* (Smith, C.W., Aptroot, A., Coppins, B.J., Fletcher, A., Gilbert, O.L., James, P.W. & Wolsley, P.A. eds): 673–687. London: British Lichen Society.
- Dibben, M.J.** (1980). The chemosystematics of the lichen genus *Pertusaria* in North America north of Mexico. *Publs Biol. Geol. Milwaukee Publ. Mus.* **5**: 1–162.
- Hafellner, J. & Türk, R.** (2016). Die lichenisierten Pilze Österreichs – eine neue Checkliste der bisher nachgewiesenen Taxa mit Angaben zu Verbreitung und Substratökologie. *Stapfia* **104**(1): 216 pp.
- Hanko, B.** (1983). Die Chemotypen der Flechtengattung *Pertusaria* in Europa. *Bibliotheca lich.* **19**: 1–297.
- Lendemer, J.C. & Harris, J.C.** (2017). Nomenclatural changes for North American members of the *Variolaria*-group necessitated by recognition of *Lepra* (Pertusariales). *Bryologist* **120**: 183–190.
- 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.
- Lumbsch, H.T., Feige, G.B. & Schmitz, K.E.** (1993). *Pertusaria huneckiana*, a new Mediterranean lichen, with

- notes on some saxicolous *Pertusaria* species containing chloroxanthones. *Bibliotheca lich.* **53**: 173-178.
- Schmitt, I. & Lumbsch, H.T.** (2004): Molecular phylogeny of the Pertusariaceae supports secondary chemistry as an important secondary character set in lichen-forming ascomycetes. *Molecular Phylogenetics and Evolution* **33**: 43–55.
- Schmitt, I., Martin, M. P., Türk, R. & Lumbsch, H.T.** (2003) Phylogenetic position of the genera *Melanaria*, *Varicellaria* and *Thamnochrolechia* (Pertusariales). *Bibliotheca Lichenologica* **86**: 147–154.
- Schmitt, I., Otte, J., Parmen, S., Sadowska-Des, A.D., Lücking, R. & Lumbsch, H.T.** (2012): A new circumscription of the genus *Varicellaria* (Pertusariales, Ascomycota). *Myckeys* **4**: 23–36.
- Schmitt, I., Yoshikazu, Y. & Lumbsch, H.T.** (2006). Phylogeny of Pertusariales (Ascomycotina): resurrection of Ochrolechiaceae and new circumscription of Megasporaceae. *J. Hattori Bot. Lab.* **100**: 753-764.
- Schmitz, K.E., Lumbsch, T.H. & Feige, G.B.** (1994). Systematic studies in the *Pertusariales* II. The generic concept in the *Pertusariaceae* (lichenized *Ascomycotina*). *Acta Bot. Fenn.* **150**: 153-160.
- Spribile, T., Fryday, A.M., Pérez-Ortega, S., Svensson, M., Tønsberg, T., Ekman, S., Holien, H., Resl, P., Schneider, K., Stabentheiner, E., Thüs, H., Vondrák, J. & Sharman, L.** (2020). Lichens and associated fungi from Glacier Bay National Park, Alaska. *Lichenologist* **52**: 61-181.
- Wei, X.L., Schmitt, I., Hodkinson, B., Flakus, A., Kukwa, M., Divakar, P.K., Kirika, P.M., Otte, J., Meiser, A. & Lumbsch, H.T.** (2017) Circumscription of the genus *Lepra*, a recently resurrected genus to accommodate the “*Variolaria*”-group of *Pertusaria* sensu lato (Pertusariales, Ascomycota). *PLoS ONE* **12**(7): e0180284.