Six new species, a new variety, a new report and two new records in the Australian Pertusariaceae (Pertusaria, lichenized Ascomycota)

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Abstract
Three species of Lepra (L. elatinica A.W.Archer & Elix and L. perlacericans A.W.Archer & Elix from New South Wales and L. arida A.W.Archer & Elix from Victoria) and four taxa of Lepra subventosa (Malme) I.Schmitt & Lumbsch, but differs in growing on bark and in containing elatnic acid rather than lichexanthone, picrolichenic and thamnolic acids.

Introduction
This paper continues our work on the Australian Pertusariaceae (Archer & Elix 2009a, 2010, 2014, 2016, 2017a, 2017b, 2019). Three new species of Lepra Scop. and four new taxa of Pertusaria (P. alloisidiosa A.W.Archer & Elix from the Northern Territory and Queensland, P. capiocarpa A.W.Archer & Elix from Victoria, P. macroides from New South Wales and Tasmania and P. microstoma var. deficiens from Queensland) are described as new to science. The new combination Lepra leuwenii (Zahlbr.) A.W.Archer & Elix is proposed for Pertusaria leuwenii Zahlbr. Pertusaria expolita R.C. Harris is reported as an earlier name for P. balekensis A.W.Archer & Elix, originally described from Papua New Guinea. Lepra dactyлина (Ach.) Haflerner and Pertusaria simoneana A.W.Archer & Elix are reported for the first time from Australia.

New taxa
1. Lepra arida A.W.Archer & Elix, sp. nov. Figs 1–3 MycoBank no. MB 832123

Similar to Lepra thamnolica (A.W.Archer) A.W.Archer & Elix, but differs in having larger ascospores, 44–62 × 20–30 µm, and in containing 5-O-methylisicic acid.


Thallus corticolous, very pale olive-green; surface smooth, somewhat cracked, sorediate, lacking isidia. Soralia conspicuous, numerous, crowded, off-white, sessile, becoming substipitate, 0.2–0.35 mm diam. Apothecia and ascospores not seen.

Chemistry: Elatnic acid (minor), lichesterinic acid (major) and protolichesterinic acid (major).

Etymology: the epithet elatnic refers to the elatinic acid present in the species.

Remarks
Lepra arida is characterized by its conspicuous disciform apothecia and chemistry. It is distinguished from similar eight-spored Lepra species found in Australia, viz. L. thamnolica and L. truncata (Kremp.) A.W.Archer & Elix, by its chemistry and the size of its ascospores. Lepra thamnolica contains thamnolic acid and L. truncata contains picrolichenic acid; furthermore, the ascospores of the two species are 22–32 µm and 19–27 µm long, respectively, compared to those of L. arida, which are 44–62 µm long.

At present the new species is known only from the type locality.

2. Lepra elatinica A.W.Archer & Elix, sp. nov. Fig. 4 MycoBank no. MB 832124

Similar to Lepra subventosa (Malme) I.Schmitt & Lumbsch, but differs in growing on bark and in containing elatnic acid rather than lichexanthone, picrolichenic and thamnolic acids.


Thallus corticolous, very pale olive-green; surface smooth, somewhat cracked, sorediate, lacking isidia. Soralia conspicuous, numerous, crowded, off-white, sessile, becoming substipitate, 0.2–0.35 mm diam. Apothecia and ascospores not seen.

Chemistry: Elatnic acid (minor), lichesterinic acid (major) and protolichesterinic acid (major).

Etymology: the epithet elatnic refers to the elatinic acid present in the species.

Remarks
Lepra elatinica is characterized by the sorediate thallus and the presence of elatnic acid. It is distinguished from other Australian sterile, sorediate species by its chemistry and particularly by the presence of elatnic acid. Lepra subventosa is the most common sorediate species of Lepra in eastern Australia, but always occurs on rocks and differs in containing lichexanthone, picrolichenic acid and thamnolic acid. Elatnic acid has been observed as a minor substance in a chemical race of Lepra tropica Vain. (Elix et al. 2002), but L. tropica differs from L. elatinica in having an esorediate thallus and in containing lichexanthone and hypolichexanthone acid as major substances.

3. Lepra perlacericans A.W.Archer & Elix, sp. nov. Figs 5, 6 MycoBank no. MB 832125

Similar to Lepra lacericans (A.W.Archer) A.W.Archer & Elix, but differs in having larger ascospores, 220–328 × 60–88 µm, and in containing additional caperatic acid.

Type: Australia. New South Wales, Mt Gibraltar, Marsh State Forest, 24 km NNW of Taree, 31°38′ S, 152°25′ E, 850 m alt., on semi-exposed scrub branches in Melaleuca and Eucalyptus scrub on side of hill, H. Streimann 60510, 17.iv.1998 (holotype – CANB).

Thallus corticolous, pale olive-green; surface smooth, conspicuously rimose, with numerous immature, white, disciform apothecia, lacking soredia and isidia. Apothecia rarely mature, disciform, white, 0.7–1.1 mm diam., margins lacerate, disc white. Ascospores 1 per ascus, ellagellate-ellipsoid, with single smooth walls, 220–328 µm long and 60–88 µm wide, filled with fine, pale brown granules.

Chemistry: Protocetraric acid (major) and caperatic acid (major).

Etymology: From the Latin, per, very, and lacericans, from the species Lepra lacericans, which the new species resembles but from which it differs in having larger ascospores.
Remarks

Leprula perlacericans is characterized by the numerous immature apothecia, rarely mature, disciform apothecia with large ascospores and the presence of protocetraric and caperatic acids. It is distinguished from the somewhat similar Leprula lacericans (Archer 1997; Archer & Elix 2018) by the larger ascospores, 220–328 µm long in L. perlacericans compared to 170–180 µm long in L. lacericans, and the presence of additional caperatic acid, which is absent from L. lacericans.

At present the new species is known from only two collections from northern New South Wales. Two other Lepra species are known to have disciform apothecia and large ascospores and to contain protocetraric acid, namely Leprula sejalaensis (Q.Ren) I.Schmidt, B.P.Hodk. & Lumbsch from China, with ascospores (190–320–240(−250) × 60–90 µm (Ren 2014), and Leprula leeuwenii (Zahlbr.) A.W.Archer & Elix (Zahlbrucker 1928, as Pertusaria leeuwenii) from Indonesia, with ascospores 220–225 × 40–45 µm. The ascospores in both species are smaller than those in L. perlacericans, and neither species contains caperatic acid.

SPECIMEN EXAMINED

New South Wales: • North Coast, Muldia, 10 km NW of Dorrigo, 30°18’S, 152°37’E, 750 m alt., on upper trunk of fallen tree in poor disturbed, shrubby forest with dense privet (Ligustrum) infestation, H. Streimann 63659, 14.vi.1999 (B, CANB, NY).

4. Pertusaria alloisidiosa A.W.Archer & Elix, sp. nov. Figs 7–9

MycoBank no. MB 832126

Similar to Pertusaria isidiosa A.W.Archer, but differs in having 8-spored asci, smaller ascospores, 50–64 × 20–26 µm, and containing 5-O-methylhiasic and gyrophoric acids.


Thallus corticolous, off-white to pale yellow, thin, forming patches on the substratum, isidiate. Isidium numerous, short, simple, up to 0.2 mm tall. Apothecia flattened-hemispherical, constricted at the base, scattered, isidiate, rarely confluent, 0.5–0.75 mm diam. Ostioles 2–8 per apothecium, inconspicuous, pale orange to almost colourless. Ascospores 8 per ascus, imbricate, 1-seriate, narrowly ellipsoid, hyaline, inner spore wall smooth, 50–64 µm long and 20–26 µm wide.

Chemistry: 5-O-Methylhiasic acid (major), gyrophoric acid (minor).

Etymology: from the Latin allo, another, and isidiosa, a previously used epithet.

Remarks

This species is characterized by the thin, off-white to pale yellow-white or fawn thallus with scattered isidia, flattened-hemispherical apothecia with pale orange ostioles, 8-spored asci, smooth-walled ascospores and the presence of 5-O-methylhiasic and gyrophoric acids. Morphologically, it resembles the isidiate Australian Pertusaria isidiosa A.W.Archer and Pertusaria subsidiosa A.W.Archer (Archer 1991). Pertusaria isidiosa differs in having 2-spored asci, larger ascospores, 100–112 × 30–35 µm, and in containing lichenanhexane, stictic and 2’-O-methylperlatolic acid, whereas P. subsidiosa has 4-spored asci, larger, rough-walled ascospores 80–95 × 30–35 µm, and contains stictic acid and 2,5-dichlorolichexanthone, 2,4-dichlorolichexanthone, 2,5-dichlorolichexanthone and 2-chlorolichexanthone. 5-O-Methylhiasic acid is also found as a major lichen acid in two non-isidiate species, Pertusaria flavospessa Kantvilas & Elix from Tasmania (Kantvilas & Elix 2008) [1 spore/ascus, spores 130–220 × 40–110 µm] and P. mccroryae C.R.Björk, Goward & T.Sprib. [with additional stictic acid, 8 spores/ascus, spores 32–54 × 15–20 µm] from Alaska (Spribille et al. 2010).

At present, the new species is known from two localities in the Northern Territory and Queensland.

SPECIMEN EXAMINED

Queensland: • Charleys Creek, 18 km NNE of Proserpine, 19°15’S, 148°39’E, 50 m alt., on tree trunk in scrubby forest on rocky hillside, H. Streimann 37621 pr.p., 30.vi.1986 (CANB - growing with Pertusaria flavosidiosa A.W.Archer & Elix).

5. Pertusaria copiofructa A.W.Archer & Elix, sp. nov. Figs 10, 11

MycoBank no. MB 832127

Similar to Pertusaria neolecanina Lumbsch & T.H.Nash, but differs in having crowded apothecia and in lacking thiophanic acid.

Type: Australia. Victoria, Wyperfeld National Park, collected near main camping ground along bitumen road into main camping area, along 9 mile Square Road, 35°26’S, 141°58’E, on twig, W.H. Ewers 1115B, 21.iv.1987 (holotype – CANB).

Thallus corticolous, off-white; surface smooth, rimose, lacking isidia and soralia. Apothecia conspicuous, numerous, crowded, verruciform, initially flattened-hemispherical, becoming distorted when crowded, 0.5–0.75 mm wide. Ostioles conspicuous, black, 1 per apothecium, 0.25–0.3 mm diam. Ascospores 2 per ascus, hyaline, ellipsoid, with a smooth inner wall, 90–125 µm long and 36–45 µm wide.

Chemistry: Norstictic acid (major) and connorstictic acid (trace).

Etymology: From the Latin copio, plenty and fructa, fruit, a reference to the crowded apothecia.

Remarks

Pertusaria copiofructa is characterized by the crowded apothecia, ascii with 2, smooth-walled ascospores and the presence of norstictic acid. It closely resembles P. neolecanina from North America and Australia (Lumbsch et al. 1999) which also has conspicuous black ostioles and ascii with 2 ascospores, similar in size to those of P. copiofructa, viz. 95–118 × 35–40 µm, but contains norstictic acid and thiophanic acid. It also resembles P. luteola Boqueras from Spain, but the latter has smaller ascospores, 70–95 × 25–35 µm, and contains additional thiophanic acid.

At present the new species is known from only the type locality in Victoria.

6. Pertusaria macroioides A.W.Archer & Elix, sp. nov. Figs 12–14

MycoBank no. MB 832128

Similar to Pertusaria macra Müll.Arg., but differs in lacking lichen substances.

Type: Australia. New South Wales, Cooma–Dry Plains road, 15 km NW of Cooma, 36°09’S, 148°59’E, 800 m alt., on basalt in grazed grassland on flats with small basalt outcrops, H. Streimann 50506, 24.xii.1992 (holotype – CANB; isotype – B).

Thallus saxicolous, off-white to pale grey, conspicuously areolate, the areoles irregular in shape, 0.5–1 mm wide, most with an immature or mature apothecium. Apothecia flattened-hemispherical, constricted at the base, scattered, isidiate, rarely confluent, 0.5–1 mm diam. Ostioles 2–8 per apothecium, inconspicuous, pale orange to almost colourless. Ascospores 8 per ascus, imbricate, 1-seriate, narrowly ellipsoid, hyaline, inner spore wall smooth, 50–64 µm long and 20–26 µm wide.

Chemistry: 5-O-Methylhiasic acid (major), gyrophoric acid (minor).

Etymology: from the Latin macroioides, large, another epithet, relating to Pertusaria macra Müll.Arg.

Remarks

Pertusaria macroioides is characterized by the saxicolous, areolate thallus, 8 small, ovoid ascospores per ascus and by the absence of lichen substances. The areolate, saxicolous thallus...
and the small ascospores are similar to those in the Australian endemic Pertusaria macra Müll.Arg. (Müller 1893), which has ascospores measuring 32–36 × 17–20 µm, but it differs from P. macrodes in containing stictic acid. The two species also differ in their distribution. Pertusaria macra was collected on Thursday Island, in tropical northern Australia, in contrast to the Southern Tablelands of New South Wales and Tasmania.

ADDITIONAL SPECIMEN EXAMINED

Tasmania: • c. 1 km W of Circular Marsh, on eastern side of Pine River, 41°59'S, 146°28'E, 50 m alt., on dolerite boulders, G. Kantvilas 75/14.ppr., 20.ii.2014 (HO).

7. Pertusaria microstoma var. deficiens A.W.Asher & Elix, var. nov. MycoBank no. MB 832129

Morphologically similar to Pertusaria microstoma Müll.Arg. var. microstoma, but differs in lacking stictic acid and in containing planaric acid.

Type: Australia. Queensland, Port Curtis District, 1 km S of Raglan along Bruce Highway, c. 52 km SE of Rockhampton, 23°44'S, 150°49'E, on Alphitonia excelsa trunk in broad gully in Eucalyptus-Acacia woodland, D. Verdon 5481B, 26.ii.1983 (holotype – CANB).

Thallus corticolous, off-white, subtuberculate and cracked, lacking soralia and isidia. Apothecia verruciform, hemispherical, numerous, scattered, rarely confluent, 0.5–1.0 mm diam. Ostioles conspicuous, black, punctiform, 1 per apothecium. Ascospores 4 per ascus, ellipsoid, hyaline, inner ascospore wall rough, 80–84 µm long and 28–36 µm wide.

Chemistry: 4,5-dichlorolichexanthone (minor), 2'-O-methylperlatolic acid (major), planaric acid (minor).

Etymology: From the Latin deficiens, lacking, a reference to the absence of stictic acid.

Remarks

Pertusaria microstoma var. deficiens is morphologically identical to P. microstoma var. microstoma Müll.Arg. with four (but sometimes 2–3) ascospores per ascus with rough walls (Müller 1882). Recent chemical analysis showed that this species contains 4,5-dichlorolichexanthone, 2'O-methylperlatolic and stictic acids (Archer 1997). Pertusaria microstoma var. microstoma is a tropical species first described from Indonesia, but also occurs in Papua New Guinea, New Caledonia and northern Queensland. Pertusaria microstoma var. deficiens is the southernmost collection of P. microstoma sens. lat. in Australia. Pertusaria javanica Müll.Arg. from Indonesia also has 4-spored asci and ascospores with rough inner walls, but its ascospores are considerably larger, 95–125 × 35–45 µm wide, and it contains only stictic acid (Müller 1884).

At present the new species is known only from the type collection.

New combination

Lepra leeuwenii (Zahlbr.) A.W.Asher & Elix, comb. nov.

MycoBank No MB 832130

Basionym: Pertusaria leeuwenii Zahlbr., Annales de Cryptogamie Exotique 1, 190 (1928)

Type: Indonesia, Java, Mount Gede [Gedeh], corticolous at margin of primary forest, W. van Leeuwen 248 ppr. (holotype – W).

New report

Pertusaria expolita R.C.Harris, Some Florida Lichens: 60 (1990) Fig. 17


Pertusaria expolita is a sterile, corticolous, sorediate species containing 4,5-dichlorolichexanthone and stictic acid, known originally from a single collection from Florida (Harris 1990). Pertusaria baleakensis from Papua New Guinea is chemically and morphologically identical to P. expolita, and is here reduced to synonymy with the latter. This greatly increases the known distribution of P. expolita, which now appears to be almost pantropical, which being known from Florida, Thailand, Papua New Guinea, Fiji, Norfolk Island, Lord Howe Island and mainland Australia. It is both corticolous and saxicolous (vide infra).

SPECIMENS EXAMINED

Australia. New South Wales: • Lord Howe Island, track to Intermediate Hill via North Hummock, 31°32'45"S, 159°04'55"E, 120 m alt., on basalt in lowland forest, J.A. Elix 42036, 5.ii.1995 (CANB); • Lord Howe Island, track from Smoky Tree Ridge to Rocky Run, 31°33'20"S, 159°05'15"E, 80 m alt., on tree trunk in lowland forest, J.A. Elix 42446, 10.ii.1995 (CANB).


Papua New Guinea. • Central Province, Varirata National Park, c. 22 km E of Port Moresby, 9°26'S, 147°21'55"E, 800 m alt., A. Aptroot 39605, 23.x.1995 (herb. Aptroot).

Thailand: • Trat Province, Ban-Dan Kao Island, 12°21'N, 102°55'55"E, 5 m alt., on bark in mangrove forest, F. Schumm 17743, 15.ii.2012 (herb. Schumm).

New records

1. Lepra dactylina (Ach.) Hafellner, in Hafellner & Türk, Staphia 104, 171 (2016)

This terricolous or muscicolous, arctic-alpine species is circumpolar in the Northern Hemisphere, but also occurs in New Zealand (Galloway 2007) and Macquarie Island (McCarthy 2018). It is characterized by a white to off-white, isidiate thallus with mainly simple, crowded, cylindrical isidia, 1–2.5 mm tall, 0.4–1 mm diam. It contains funarprotocetraric acid. A detailed description is given in Chambers et al. (2009 – as Pertusaria dactylina).

SPECIMENS EXAMINED


This corticolous species was previously known from New Caledonia (Archer & Elix 2009b). It is characterized by a pale olive-green, isidiate thallus with short, stubby, simple, crowded, cylindrical isidia, which sometimes become slightly swollen at the apices, 0.15–0.2 mm tall, 0.05–0.1 mm diam. It contains arthothelin (major), 6-O-methylarthothelin (minor), 4,5-dichloronorlichexanthone (minor), 2,4-dichloronorlichexanthone (minor) and 4,5-dichloro-6-O-methylnorlichexanthone (minor). A description and illustration are given in Archer & Elix (2009b).
SPECIMENS EXAMINED
Queensland: • Corner of Dalrymple and Black Roads, 6 km NE of Eungella, 21°06’S, 148°32’E, 910 m alt., on semi-exposed treelot stem in grasslands with scattered Acacia and Alphitonia, H. Streimann 64205 & T. Pocs, 19.viii.1999 (CANB). New South Wales: • Lord Howe Island, Rocky Run, 31°33’20”S, 159°06’E, 50 m alt., on bark, D.J. Ramm 30A, xi.1986 (CANB).

References
Chambers, SP; Gilbert, OL; James, PW; Aptroot, A; Purvis, OW (2009): Pertusaria DC. (1805) in Smith, CW; Aptroot, A; Coppins, BJ; Fletcher, A; Gilbert, OL; James, PW; Wolseley, PA (eds), The Lichens of Great Britain and Ireland, 673–687. British Lichen Society, London.
Müller, J (1882): Lichenologische Beiträge XV. Flora 65, 326–337.
Müller, J (1884): Lichenologische Beiträge XIX. Flora 67, 460–468.

Figure 1. Lepra arida (holotype CANB), M. Mayrhofer 2827, habit of thallus. Bar = 1 mm.
Figure 2. *Lepra arida* (holotype CANB), ascospores in ascus. Bar = 50 µm.

Figure 3. *Lepra arida* (holotype CANB), ascospore. Bar = 50 µm.

Figure 4. *Lepra elatinica* (holotype CANB). *H. Streimann 44439*, habit of thallus. Bar = 1 mm.

Figure 5. *Lepra perlacericans* (holotype CANB), *H. Streimann 60510*, habit. Bar = 1 mm.
Figure 6. *Lepra perlacericans* (holotype CANB), ascospore. Bar = 100 µm.

Figure 7. *Pertusaria alloisidiosa* (holotype CANB), *H. Streimann 42299*, habit. Bar = 1 mm.

Figure 8. *Pertusaria alloisidiosa* (holotype CANB), apothecia. Bar = 1 mm.

Figure 9. *Pertusaria alloisidiosa* (holotype CANB), ascospores. Bar = 50 µm.
Figure 10. *Pertusaria copiofructa* (holotype CANB), W. Ewers 1115B, habit. Bar = 1 mm.

Figure 11. *Pertusaria copiofructa* (holotype CANB), ascospores. Bar = 100 µm.

Figure 12. *Pertusaria macroides* (holotype CANB) H. Streimann 50506, habit. Bar = 1 mm.

Figure 13. *Pertusaria macroides* (holotype CANB), ascospores in ascus. Bar = 50 µm.
Figure 14. *Pertusaria macroides* (holotype CANB), individual ascospores. Bar = 50 µm.

Figure 15. *Pertusaria microstoma* var. *deficiens* A.W.Archer & Elix (holotype CANB) D. Verdon 5481B, habit. Bar = 1 mm.

Figure 16. *Pertusaria microstoma* var. *deficiens* A.W.Archer & Elix (holotype CANB), ascospores. Bar = 50 µm.

Figure 17. *Pertusaria expolita* R.C.Harris, H. Streimann 38285 (CANB). Bar = 1 mm.