Volume 15: 111–117
Publication date: 10 October 2013
dx.doi.org/10.7751/telopea2013015

TELOPEA
Journal of Plant Systematics

The Royal Botanic Gardens & Domain Trust

plantnet.rbgsyd.nsw.gov.au/Telopea • escholarship.usyd.edu.au/journals/index.php/TEL • ISSN 0312-9764 (Print) • ISSN 2200-4025 (Online)

New species of *Pertusaria* (Pertusariaceae) from Australia and New Zealand

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Abstract

Four new species, ***Pertusaria ambigua*** (with lichesterinic acid), ***P. humilis*** (characterised by very flattened apothecia), ***P. queenslandica*** (with two-spored asci) and ***P. submalvinae*** (with confluentic acid), are reported from Australia and two new species, ***Pertusaria allosorodes*** (with two large, rough-walled ascospores per ascus) and ***P. wirthii*** (with barbatic acid), are reported from New Zealand.

Introduction

The lichen genus *Pertusaria* in Australia was the subject of a monograph in 1997 (Archer 1997) and since then additional taxa and distribution data have been published (Archer 2004); the latest account of the genus is available on line (Archer 2012). The genus was divided into 3 subgenera; *Monomurata*, *Pionospora* and *Pertusaria* (Archer 1997) but recent molecular work on the phylogeny of *Pertusaria* and allied taxa indicate that *Pertusaria* is polyphyletic, comprising three well-supported clades viz: (1) *Pertusaria* sensu stricto group (including the subgenera *Pertusaria* and *Pionospora*); (2) *Monomurata* group; and (3) *Varicellaria* group (Schmitt 2002; Schmitt & Lumbsch 2004). The two subgenera, *Pertusaria* and *Monomurata*, are distinguished by the morphology of the apothecia (verruciform in *Pertusaria* and disciform in *Monomurata*) and chemistry (chloroxanthones sometimes present in *Pertusaria, whereas* absent in *Momomurata*). In Australia, a total of 119 species of *Pertusaria* are described and of these, 25 are in subgenus *Monomurata* and the remainder in subgenus *Pertusaria*.

A comprehensive account of *Pertusaria* in New Zealand was given by Galloway (2007) who reported a total of 54 species, with 18 species in subgenus *Monomurata* (including Section *Digitatae*) and the remaining 36 species in subgenus *Pertusaria*.

As part of a continuing study of *Pertusaria*, some older collections of previously unidentified *Pertusaria* specimens from Australia and New Zealand were re-examined and found to include six new species. Four of these new species, *Pertusaria allosorodes P. humilis, P. queenslandica* and *P. submalvinae,* belong to subgenus *Pertusaria* and *P. ambigua,* with its unique chemistry, is also tentatively placed in the same subgenus. *Pertusaria wirthii*, with disciform apothecia, is placed in subgenus *Monomurata*.

In the present work chemical constituents were identified by thin-layer chromatography (Elix & Ernst-Russell 1993), high performance liquid chromatography (Elix et al. 2003) and comparison with authentic samples. MycoBank identifiers (MB) are given below the species names.

New species

Pertusaria allosorodes Elix & A.W.Archer, ***sp. nov.*** Fig.1.

MB 805235

Diagnosis: similar to *Pertusaria sorodes* Stirt., but containing norstictic and 2-*O*-methylstenosporic acids.

Type: New Zealand, North Island: Northland: 5 km NW of where Mangamuka River crosses Highway No. 1, at wayside stop labelled "Forest View", [35°12'S, 173°30'E], on twig, *W.E. Ewers 2700*, 6 April 1988; holotype CANB.

Thallus pale fawn, surface smooth and dull, somewhat cracked, lacking isidia and soredia, corticolous. Apothecia verruciform, flattened, sometimes becoming concave, scattered or confluent. 1.5–3 mm diam. Ostioles black, conspicuous, 1–3 per apothecia. Ascospores 2 per ascus, ellipsoid, hyaline with a rough inner wall, 175–210 µm long, 50–70 µm wide.

Chemistry: 2-*O*-methylstenosporic acid (major), 4,5-dichlorolichexanthone (minor), norstictic acid (minor) and 2-*O*-methylperlatolic acid (trace).

Pertusaria allosorodes resembles *P. sorodes* Stirt. in that both species are corticolous and have flattened, multi-ostiolate apothecia, asci with two large ascospores, c. 200 µm long, with rough inner walls. The two species differ chemically: *P. sorodes* contains stenosporic and perlatolic acids whereas *P. allosorodes* contains the *O*-methylated analogues, 2-*O*-methylstenosporic and 2-*O*-methylperlatolic acids. The somewhat similar species, *Pertusaria southlandica* A.Knight, Elix & A.W.Archer (Knight et al. 2011) (Fig. 2) also from New Zealand, contains conhypoprotocetraric acid and 2-chlorolichexanthone whereas another somewhat similar species, *P. subsorodes* Elix & A.W.Archer from Papua New Guinea, contains 2'-*O*-methylperlatolic acid (Elix et al. 1997).

The new species also resembles *P. wattiana* Müll.Arg., from India (Müller 1892). This species has flattened, multi-ostiolate apothecia, two rough-walled ascospores per ascus and contains norstictic and 2-*O*-methylstenosporic acids as major compounds but the ascospores are smaller (110–137 × 37–45 µm) than those of *P. allosorodes* (175–210 × 50–70 µm). At present the new species is known only from the type specimen.

The epithet is from the Greek *allo,* another, and the epithet *sorodes*, a reference to the similarity of the two species.

Pertusaria ambigua A.W.Archer & Elix, ***sp. nov.*** Figs 3 & 4

MB 805236

Diagnosis: similar to *Pertusaria montpittensis* A.W.Archer but differs in the isidia becoming ecorticate and in containing lichesterinic acid.

Type: Australia, New South Wales: Werrikimbe National Park: Brushy Mountain rest area, 31°09'S, 152°22'E, alt. c. 900 m, on tree, *A.W. Archer P630*, 21 Oct 1993; holotype: NSW.

Fig. 1. *Pertusaria allosorodes*, holotype. Scale bar = 2 mm
Fig. 2. *Pertusaria southlandica*, holotype. (OTA).

Fig. 3. *Pertusaria ambigua*, holotype. Scale bar = 5 mm
Fig. 4. *Pertusaria ambigua*, holotype. Scale bar = 1 mm

Thallus off-white to pale fawn (pale olive green when collected), surface smooth, somewhat shiny, cracked, isidiate, lacking soralia, corticolous. Isidia initially corticate, concolourous with the thallus, 0.5–0.6 mm tall, 0.2–0.3 mm wide, becoming ecorticate and resembling soredia. Apothecia not seen.

Chemistry: lichesterinic acid (major).

Pertusaria ambigua is characterised by the isidiate thallus, the lack of apothecia and the presence of lichesterinic acid. It is differentiated from other Australian isidiate *Pertusaria* species by the ecorticate surface of the isidia and the presence of lichesterinic acid. Relatively few corticate isidia were seen. The species is so far known only from the type specimen.

Lichesterinic acid is also found in *Pertusaria kinigiensis* A.W.Archer, Eb.Fischer, Killmann & Sérus., as a minor compound, and in *P. krogiae* A.W.Archer, Eb.Fischer, Killmann & Sérus. as a major compound (Archer et al. 2009). The substance is also found in the genus *Ochrolechia.* The epithet is from the Latin *ambiguus*, unclear, a reference to the unusual appearance and the presence of the aliphatic acid, lichesterinic acid.

Pertusaria humilis Elix & A.W.Archer ***sp. nov.*** Fig. 5

MB 805239

Diagnosis: similar to *Pertusaria plana* Vain., but with smooth walled ascospores, lacking norstictic acid and saxicolous.

Type: Australia, Queensland: Conway State Forest: 16 km E of Proserpine, 20°21'S, 148°44'E, alt. 160 m, on rocks beside stream in lowland rainforest, *J.A. Elix 20805*, 29 June 1986; holotype CANB.

Thallus pale fawn, surface smooth and slightly cracked, lacking isidia and soralia, saxicolous. Apothecia verruciform, very flattened, scarcely rising above the thallus surface, scattered, rarely confluent, 0.8–1.5 mm diam., concolorous with the thallus. Ostioles conspicuous, pale brown, translucent, 0.4–0.6 mm diam. Ascospores 4 per ascus, hyaline, ellipsoid, with a smooth inner wall, 95–107 µm long, 30–37 µm wide.

Chemistry: 4.5-dichlorolichexanthone only (major).

Pertusaria humilis is characterised by the saxicolous habit, the markedly flattened apothecia, the conspicuous ostioles and the presence of 4,5-dichlorolichexanthone. The new species resembles the corticolous species *P. plana* Vain. (Wainio 1899) (Fig.6), from Guadeloupe, in that both have distinctly flattened apothecia (cf. Figs 5 and 6), and ascospores of similar size (90–120 × 25–34 µm in *P. plana* and 95–107 x 30–37 µm in *P. humilis*). However, the ascospores in *P. plana* have rough inner walls in contrast to the smooth inner walls present in *P. humilis.* The species also differ in distribution, substrate preference (corticolous versus saxicolous), and chemistry. *Pertusaria plana* contains norstictic acid and *P. humilis* contains 4,5-dichlorolichexanthone.

Flattened apothecia with conspicuous dark ostioles are also present in *P. platycarpiza* Zahlbr., from Taiwan (Zahlbruckner 1933) and in *P. brasiliana* Zahlbr. from Brazil (Zahlbruckner 1928) [= *P. laevigata* Müll. Arg., *nom inval.* non (Th.Fr.) Anzi], but these species can be distinguished from *P. humilis* by the number of ascospores per ascus and chemistry. Thus *P. platycarpiza* has two ascospores per ascus and contains divaricatic

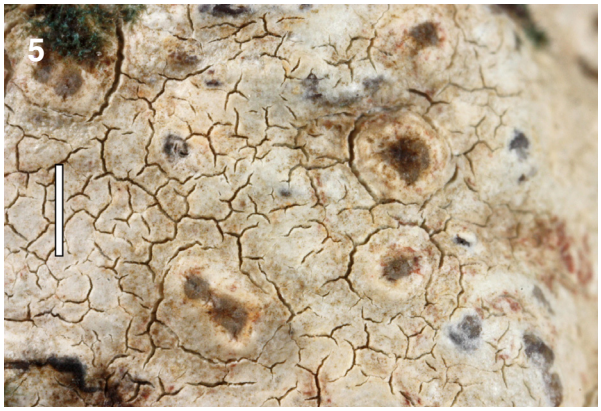

Fig. 5. *Pertusaria humilis.* Scale bar = 1 mm
Fig. 6. *Pertusaria plana* Vain. holotype (TUR-V 6902). Scale bar = 1 mm

acid, whereas *P. brasiliana* has eight ascospores per ascus and lacks lichen substances.

The saxicolous species *P. aleianta* Nyl. (Nylander 1877) from Cape Verde also has asci containing 4 ascospores and produces 4,5-dichlorolichexanthone as the sole lichen compound present, but the ascospores in *P. humilis* are longer than those in *P. aleianta* (95–107 µm compared to 70–90 µm in *P. aleianta*) and the apothecia are flattened in *P. humilis* in contrast to the raised, almost disciform, apothecia present in *P. aleianta.* Nylander (1877) reported the apothecia to be 'more or less protruding and separate, sometimes subconfluent'.

At present this species is known only from the type specimen.

The epithet is derived from the Latin *humilis*, low, a reference to the markedly flattened apothecia.

Note: Edvard Vainio (1852–1929), originally E. Lang until 1877, after that he used the spelling 'Wainio' until 1919, and then changed it to 'Vainio' (Stafleu and Cowan 1986, p. 636)

Pertusaria queenslandica Elix & A.W.Archer ***sp. nov.*** Fig. 7.

MB 805240

Diagnosis: chemically similar to *Pertusaria striolata* Räsänen, but with larger ascospores and paler ostioles.

Type: Australia, Queensland; on mangroves near walkway, Cairns airport, 16°53'S, 145°46'E, *W.H. Ewers 8708*, 2 Oct 1991; holotype: CANB.

Thallus pale fawn, surface smooth and somewhat shiny, cracked, lacking isidia and soralia, corticolous. Apothecia verruciform, conspicuous, scattered, subhemispherical, concolorous with the thallus, 0.7–1.6 mm diam. Ostioles inconspicuous, pale or more rarely black, punctiform, in a pale translucent zone, c. 0.1 mm diam. or slightly mammiform. Ascospores elongate ellipsoid, hyaline, 2 or rarely 3 per ascus, with a smooth inner wall, (112–)137–160 µm long, 30–37(–50) µm wide.

Chemistry: 4,5-dichlorolichexanthone (minor), 2'-*O*-methylperlatolic acid (major), stictic acid (major) and constictic acid (minor).

Specimen examined; Fiji: Viti Levu: Nasori Highlands, Nadi–Sigatoro Road, 13 km E of Vanturu Dam turn-off, *J.A. Elix 15233*, 27 Aug 1983 (CANB).

Spores 2(or 3) ascus, 125–165 × 37–50 µm.

Pertusaria queenslandica is characterised by the corticolous habit, the asci with two smooth-walled ascospores and the chemistry. It resembles the corticolous species *P. striolata* Räsänen (Fig. 8.) from Mindanao in the Philippines (Räsänen 1949), which also has asci with two smooth-walled ascospores and an identical chemistry, but differs in having significantly shorter ascospores, in having conspicuous dark ostioles and in containing traces of peristictic acid. The ascospores in the Philippine species were reported to be 65–80 µm long but on re-examination of the holotype they were found to be slightly longer, to 90 µm long but still significantly shorter than those of *P. queenslandica*.

The new species is chemically identical to the sterile, isidiate, Australian species, *P. pilosula* A.W.Archer & Elix (Archer 1997), and the tropical species *P. microstoma* Müll.Arg. (Müller 1882), but the latter have four rough-walled ascospores per ascus.

At present this species is known from the type locality in northern Queensland, and Fiji.

The epithet *queenslandica* refers to the type locality.

Fig. 7. *Pertusaria queenslandica* holotype. Scale bar = 1 mm
Fig. 8. *Pertusaria striolata* Räs. holotype (H). Scale bar = 1 mm

Pertusaria submalvinae A.W.Archer & Elix, ***sp. nov.*** Fig. 9.

MB 805241

Diagnosis: similar to *Pertusaria malvinae* Messuti & A.W. Archer but differs in having smaller ascospores and in containing norstictic acid.

Type: Australia: New South Wales: by side of Mill Creek, c. 55 km NW of Sydney, 33°23'S, 151°02'E, alt. c. 100 m, on exposed sandstone rock, *A.W. Archer P157*, 11 May 1991; holotype: NSW.

Thallus pale fawn, thin, surface smooth, lacking isidia and soralia, saxicolous. Apothecia verruciform, subhemispherical, scattered or crowded, sometimes confluent, 0.5–1.5 mm diam. Ostioles black, c. 0.05 mm diam, in a grey translucent zone, 0.2 mm diam. Ascospores ellipsoid, hyaline, with a smooth inner wall, 4 per ascus, 70–92 µm long, 30–40 µm wide.

Chemistry: confluentic acid (major), norstictic acid (minor), 2'-*O*-methylperlatolic acid (minor), stictic acid (trace) and 2'-*O*-methylstenosporic acid (trace).

Pertusaria submalvinae is characterised by the saxicolous habit, the asci with 4 ascospores and the presence of confluentic and norstictic acids. Superficially the species resembles the saxicolous *P. petrophyes* C.Knight (Knight 1881) which also occurs in eastern Australia but that species has asci with 8 ascospores and contains thiophaninic and 2-*O*-methylperlatolic acids. *Pertusaria malvinae* Messuti & A.W.Archer from the Falkland Islands (Islas Malvinas) (Messuti & Archer 1999) resembles *P. subvalvinae* in that both species are saxicolous, have asci with 4 ascospores and contain confluentic acid but the ascospores in *P. malvinae* are significantly longer (108–130 µm). In addition, *P. malvinae* lacks norstictic acid, present in P. *submalvinae*. At present this new species is known only from the type locality.

The epithet is derived from the Latin *sub*, somewhat and the epithet *malvinae*, indicative of the similarity of the two species.

Fig. 9. *Pertusaria submalvinae*. holotype. Scale bar = 1 mm

Pertusaria wirthii Elix & A.W.Archer, ***sp. nov.*** Figs 10 & 11

MB 805242

Diagnosis: similar to *Pertusaria novaezelandiae* Szatala but differs in having larger ascospores and in containing barbatic acid rather than hypothamnolic acid.

Type: New Zealand: South Island: Fiordland National Park: Milford Sound, near Visitor Centre, close to shore, on *Nothofagus*, 44°40'S, 167°56'E, alt. 1 m, *V. Wirth 27836*, 15 Nov 1995; holotype STU.

Thallus off-white, surface smooth and dull, lacking isidia and soralia, corticolous. Apothecia numerous, crowded, sometimes confluent, concolourous with the thallus, initially hemispherical, opening to become disciform, 0.5–0.8 mm diam, disc black, white pruinose. Ascospores 1 per ascus, rounded cylindrical, hyaline, 200–240 µm long, 56–70 µm wide, spore wall 4–5 µm thick. (Fig.12).

Chemistry: barbatic acid (major).

Pertusaria wirthii is characterised by the disciform apothecia, asci with a single, large ascospore with a single wall, and the presence of barbatic acid. It is distinguished from the morphologically similar *P. novaezelandiae* Szatala by the larger ascsopsores (200–240 µm long compared to 120–170 µm long in *P. novaezelandiae*) and the presence of barbatic acid; *P. novaezelandiae* contains hypothamnolic acid. Barbatic acid is an uncommon compound in the genus *Pertusaria* being known from *P. barbatica* A.W.Archer & Elix, a sterile, isidiate corticolous species from Eastern Australia and New Zealand (Archer 1997). At present the new species is known only from the type specimen.

The epithet honours Professor Volkmar Wirth (STU) who collected the type specimen.

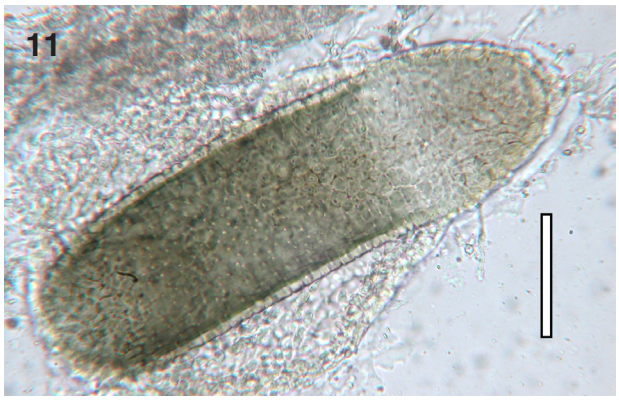

Fig. 10. *Pertusaria wirthii*. holotype. Scale bar = 1 mm
Fig. 11. *Pertusaria wirthii*, ascospore. Scale bar = 50 µm

Acknowledgments

The authors are grateful to Heino Lepp (CANB) for the photograph of *Pertusaria allosorodes* and to Allison Knight for the photograph of *Pertusaria southlandica*.

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Manuscript received 22 August 2013, accepted 19 September 2013