

Four new species and a new record of buellioid lichens
(Caliciaceae, Ascomycota) from Australia

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Abstract

Amandinea mountmeensis Elix & H.Mayrhofer, *Buellia bularmialensis* Elix & H.Mayrhofer, *B. dayboroana* Elix & H.Mayrhofer and *B. neohalonia* Elix & H.Mayrhofer are described as new to science. In addition, *Buellia haywardii* Elix, A.Knight & H.Mayrhofer is reported from Australia for the first time.

Introduction

This paper continues our investigation of *Buellia*-like lichens in Australia. For the more recent additions, see Elix *et al.* (2017a, b) and Elix & McCarthy (2018) and references cited therein. In this paper, we describe a new saxicolous species of *Amandinea* and three species of *Buellia* in the broad sense. Methods are as described in the previous papers cited above.

The new species

1. *Amandinea mountmeensis* Elix & H.Mayrhofer, sp. nov. Figs 1, 2
Mycobank No. MB 833069

Similar to *Amandinea isabellina* (Hue) Søchting & Øvstedal, but differs in having a rimose-areolate to subsquamulose thallus with a granular upper surface and an amyloid medulla that contains calcium oxalate.

Type: Australia, Queensland, road to Mount Mee State Forest, N of Dayboro, on rocks, *H. Mayrhofer & R. Rogers 2667*, 6.x.1981 (holotype – GZU).

Thallus crustose, continuous, rimose-areolate to subsquamulose, to 60 mm wide and 0.5 mm thick; individual areoles irregular, 0.1–0.4 mm wide, sometimes becoming aggregated and imbricate to form a secondary subsquamulose crust; upper surface off-white to pale brown, granular, matt; prothallus not apparent; medulla white, containing calcium oxalate ($H_2SO_4^+$), I+ purple-blue; photobiont cells 8–20 μm diam. *Apothecia* 0.3–0.7 mm wide, lecideine, broadly adnate to sessile and constricted at the base, dispersed; disc black, epruinose, plane to convex; proper exciple thin, persistent or excluded in older convex apothecia, in section the outer zone brown-black, K–, N–, 25–38 μm thick; inner zone pale brown. *Epihymenium* 10–15 μm thick, brown to dark brown, K–, N–. *Hypothecium* brown-black, 130–250 μm thick, K–. *Hymenium* 100–125 μm thick, colourless, not interspersed; subhymenium 25–35 μm thick, colourless to pale brown, not interspersed; paraphyses 1.2–1.5(–2) μm wide, sparsely branched, with apices 4.5–5.5 μm wide and brown caps; asci of the *Bacidia*-type, with 8 spores. *Ascospores* *Buellia*-type, brown, ellipsoid, 15–[18.1]–20 \times 7–[8.7]–10 μm , \pm curved, often with acute apices, older spores constricted at septum; outer spore-wall rugulate. *Pycnidia* immersed; ostiole dark brown to black. *Conidia* filiform, curved, 16–23 \times 0.7–1 μm .

Chemistry: Thallus K–, P–, C–, UV–; no lichen substances detected.

Etymology: The species is named after the type locality.

Remarks

This species is characterized by the crustose, rimose-areolate or subsquamulose thallus with a granular, off-white to pale brown upper surface, the broadly adnate to sessile apothecia, the amyloid medulla that contains calcium oxalate, a non-interspersed hymenium, the 1-septate, *Buellia*-type ascospores, 15–20 \times 7–10 μm , curved, filiform conidia, 16–23 μm long, and the absence of lichen substances. Morphologically, it can resemble some specimens of *A. isabellina* because they have similar-sized ascospores, but *A. isabellina* has a thallus composed of congested verruculae and a non-amyloid medulla that lacks calcium oxalate (Lamb 1968; Elix & Kantvilas 2013). The two species also have very different ecological requirements. *Amandinea isabellina* grows on rocks in cool-temperate forests and alpine areas of southern Australia, Tasmania and New Zealand as well as in Antarctica, in contrast to the subtropical habitat of *A. mountmeensis*. The subsquamulose thallus of *A. mountmeensis* can resemble some free-living forms of *Monerolechia badia* (Fr.) Kalb, but that species has smaller ascospores, 10–15 \times 6–8 μm , and bacilliform conidia, 3–5 μm long.

At present *A. mountmeensis* is known from only the type collection. Known associated species are *Buellia stellulata* (Taylor) Mudd var. *stellulata* and *Heterodermia japonica* (M.Satō) Swinscow & Krog.

2. *Buellia bularmialensis* Elix & H.Mayrhofer, sp. nov. Fig. 3
Mycobank No. MB 833072

Similar to *Buellia epiaeruginosa* Elix, but differs in having a much thinner hymenium, 45–55 μm thick, and significantly smaller ascospores, 9–13 \times 5–7 μm .

Type: Australia, Western Australia, Albany Region, Stirling Ranges National Park, Bluff Knoll, [34°22'32"S, 118°15'22"E], c. 900–1000 m alt., on schist rock, *H. Mayrhofer 8457*, 24.viii.1988 (holotype – GZU).

Thallus crustose, to 35 mm wide and 0.1 mm thick, continuous, rimose, \pm plane; upper surface pale grey-brown, matt, epruinose; prothallus black, prominent at the periphery; photobiont cells 7–17 μm wide; medulla white, lacking calcium oxalate ($H_2SO_4^-$), I–. *Apothecia* 0.1–0.3 mm wide, abundant, aspicilioid then lecideine, roundish, scattered, immersed or very rarely adnate; disc black, epruinose, weakly concave to plane; proper exciple thick, black, persistent, in section 30–60 μm thick; outer part dark olive-brown to deep aeruginose, K–, N+ purple-brown; inner part brown. *Epihymenium* 10–12 μm thick, olive-brown to aeruginose, N+ purple-brown. *Hypothecium* 50–70 μm thick, dark brown, K–, N+ orange-brown. *Hymenium* 45–55 μm thick, colourless, not interspersed, I+ blue; subhymenium 10–15 μm thick, pale brown; paraphyses 1.8–2 μm wide, shortly septate, sparsely branched, with apices 3–4 μm wide and olive-brown caps; asci of the *Bacidia*-type, 8-spored. *Ascospores* *Buellia*-type, 1-septate, pale then dark brown, ellipsoid, 9–[10.7]–13 \times 5–[6.1]–7 μm , becoming constricted at the septum; outer wall finely ornamented. *Pycnidia* punctiform, immersed; ostiole brown. *Conidia* bacilliform, straight, 5–6 \times 1 μm .

Chemistry: Medulla K–, C–, P–, UV–; no lichen substances detected.

Etymology: The specific epithet refers to the type locality, Bluff Knoll, known by the indigenous Nyoongar people as Bular Mial (meaning “many eyes” — they believe that the rocks on the mountain are shaped like the eyes of an ancestral master spirit).

Remarks

The new species resembles *B. epiaeruginosa*, in that both have immersed apothecia (at least initially), an aeruginose, N+ purple-brown epihymenium and proper exciple and bacilliform conidia, and lack lichen substances. However, *B. epiaeruginosa* differs in having a much thicker hymenium, 100–130 μm thick, larger ascospores, 12–20 \times 7–11 μm , and longer conidia, 6.5–10 μm long (Elix 2016). In several respects it also resembles the common and widely distributed *B. aethalea* (Ach.) Th.Fr. in that both have initially immersed apothecia and

aeruginose epihymenia. However, in *B. aethalea* the medulla reacts K+ yellow then red due to the presence of norstictic acid, and the ascospores are much larger, 12–20 × 7–12 μm (Bungartz *et al.* 2007; Elix 2011).

At present the new species is known only from the type locality. Associated species include *Circinaria caesiocinerea* (Nyl. ex Malbr.) A. Nordin, S. Savic & Tibell, *Buellia aethalea* (Ach.) Th. Fr., *B. homophylia* (C. Knight) Zahlbr., *Lecanora mayrhoferi* Lumbsch, *Ramboldia petraeoides* (Bab. & Mitt.) Kantvilas & Elix, *Rhizocarpon geographicum* (L.) DC., *Xanthoparmelia mougeotina* (Nyl.) D.J. Galloway and several other *Xanthoparmelia* species.

3. *Buellia dayboroana* Elix & H. Mayrhofer, sp. nov. Fig. 4
Mycobank No. **MB 833070**

Similar to *Buellia straminea* Tuck., but differs in having an areolate thallus that lacks lobate margins, and apothecia with a colourless hypothecium.

Type: Australia, Queensland, Woodford Road, N of Dayboro, Terrors Creek, 27°09'S, 152°50'E, c. 300 m alt., on greenstone boulders, *J. Hafellner 15646 & N. Stevens*, 13.viii.1986 (holotype – GZU).

Thallus crustose, discontinuous, to 15 mm wide, areolate; areoles crowded or dispersed, 0.05–0.15 mm wide; upper surface pale yellow, dull; prothallus absent; medulla white, lacking calcium oxalate (H₂SO₄–), I–; photobiont cells 6–14 μm wide. *Apothecia* c. 0.1 mm wide, lecideine, immersed to just adnate, 1 per areole, round; disc black, epruinose, plane to convex; proper exciple thin, excluded in convex apothecia, in section 15–20 μm thick; outer zone dark brown, K–, N–; inner zone pale brown. *Epithymenium* 10–12 μm thick, brown to dark olive-brown, K–, N–. *Hypothecium* colourless, 35–50 μm thick, K–. *Hymenium* 35–45 μm thick, colourless, not interspersed; paraphyses 1.5–2 μm wide, sparsely branched, with apices 3–4 μm wide and brown caps; asci of the *Bacidia*-type, with 8 spores. *Ascospores* *Buellia*-type, brown, ellipsoid, 10–[11.5]–13 × 5–[5.4]–7 μm, the older spores rarely constricted at the septum; outer spore-wall weakly ornamented. *Pycnidia* not seen.

Chemistry: Thallus K–, P–, C+ orange, UV+ orange; containing arthothelin.

Etymology: The specific epithet refers to the type locality of Dayboro.

Remarks

The species is characterized by the crustose thallus consisting of minute, pale yellow areoles, the immersed to adnate, lecideine apothecia, the non-amyloid medulla, a non-interspersed hymenium, the ellipsoid, 1-septate, *Buellia*-type ascospores, 10–13 × 5–7 μm, and the presence of arthothelin. Chemically, it is identical to *B. straminea*, but the latter has a brown to dark brown hypothecium and an areolate thallus that is usually lobate at the margins (Bungartz 2019).

Buellia dayboroana is known only from the type collection. Associated species are *Lecidella buelliastrum* (Müll. Arg.) Knoph & Rambold and *Rinodina oxydata* (A. Massal.) A. Massal.

4. *Buellia neohalonia* Elix & H. Mayrhofer, sp. nov. Fig. 5
Mycobank number: **MB 833071**

Similar to *Buellia halonia* (Ach.) Tuck., but differs in having *Buellia*-type ascospores and an amyloid medulla that contains calcium oxalate.

Type: Australia, Victoria, Gippsland, Agnes Falls Reserve, NW of Welshpool, 38°38'S, 146°22'E, c. 150 m alt., on sandstone, *H. Mayrhofer 11532 & E. Hierzer*, 29.vii.1992 (GZU – holotype).

Thallus crustose, continuous, rimose-areolate, to 30 mm wide and 0.6 mm thick; individual areoles 0.3–1 mm wide; upper surface off-white to pale yellow, dull, appearing granular, crystalline or maculate, esorediate; prothallus not apparent; photobiont cells 9–14 μm wide; medulla white, containing calcium oxalate (H₂SO₄+), I+ purple-blue. *Apothecia* 0.3–1.4 mm wide, cryptolecanorine then lecideine, initially erumpent, separate or commonly crowded, ± round or distorted by mutual pressure, immersed to broadly adnate or sessile; disc black, epruinose or grey-white-pruinose, plane to weakly convex; proper exciple thick, persistent, in section 50–70 μm thick, the outer zone brown, K–, paler within. *Hypothecium* 120–150 μm thick, brown to dark brown, K–, N–. *Epithymenium* 15–20 μm thick, brown, K–, N–. *Hymenium* 110–140 μm thick, colourless, not interspersed with oil droplets; subhymenium 15–20 μm thick, pale brown; paraphyses 1.5–2.0 μm wide, simple to sparsely branched, with apices 3–5 μm wide and pale brown caps; asci of the *Bacidia*-type, with 8 spores. *Ascospores* of the *Buellia*-type, 1-septate, brown, ellipsoid, 12–[15.0]–18 × 7–[8.2]–10 μm, becoming constricted at the septum; outer spore-wall microrugulate. *Pycnidia* punctiform, immersed; ostiole brown-black. *Conidia* bacilliform, 5–6 × 1 μm.

Chemistry: Cortex K+ pale yellow, C+ yellow-orange, KC+ orange, P–, UV+ dull orange; containing arthothelin (major), 4,5-dichloronorlichexanthone (trace).

Etymology: The epithet is derived from the similarity of the species to *Buellia halonia*.

Remarks

Morphologically, *B. neohalonia* closely resembles *B. halonia*, a widespread saxicolous species known from Australia, North America, South America and South Africa (Bungartz *et al.* 2007; Elix 2011). Both are characterized by the presence of arthothelin or isoarthothelin, and they have similar-sized ascospores. However, *B. neohalonia* differs in having an amyloid medulla, a granular, crystalline or maculate upper surface (smooth and waxy in *B. halonia*) and *Buellia*-type ascospores that become constricted at maturity (*Physconia*-type and non-constricted in *B. halonia*). The two species also differ chemically. Whereas *B. halonia* contains isoarthothelin and roccellic acid as major substances and lacks medullary calcium oxalate, *B. neohalonia* contains arthothelin as a major substance and has high concentrations of calcium oxalate. The new species also resembles *Buellia halonioides* Elix, in that both have a granular upper surface and similar-sized *Buellia*-type ascospores, and contain medullary calcium oxalate and arthothelin. However, *B. halonioides* has a partially aeruginose epithymenium and excipulum (N+ red-violet) and a non-amyloid medulla (Elix *et al.* 2017b).

At present, the new species is known from Victoria and the South Island of New Zealand, where it occurs on siliceous rocks in coastal and hinterland regions. Associated species include *Amandinea isabellina* (Hue) Søchting & Øvstedal, *Buellia stellulata* (Taylor) Mudd var. *stellulata*, *Paraporpidia leptocarpa* (C. Bab. & Mitt.) Rambold & Hertel, *Rhizocarpon geographicum* (L.) DC., *Tephromela atra* (Huds.) Hafellner and *Xanthoparmelia australasica* D.J. Galloway.

SPECIMEN EXAMINED

New Zealand: ● South Island, Nelson, Boulder Bank, near oxidation ponds, NZMS 260 027:370003, 41°12.3'S, 173°19.3'E, 2 m alt., on exposed rounded cobbles on lee side of bank, *W. Malcolm 3318*, 10.x.2015 (CANB) [growing together with *Buellia stellulata*].

New record for Australia

Buellia haywardii Elix, A. Knight & H. Mayrhofer, *Teloepa* **20**, 77 (2017)

This species was previously known from northern New Zealand (Elix & Mayrhofer 2017). It is characterized by the crustose, rimose-areolate, white to grey-brown thallus, the immersed to adnate apothecia that are initially lecanorine, then biatorine and ultimately lecideine, the 1-septate, *Buellia*-type ascospores, 10–16 × 5–9 μm, which become constricted at the septum, the bacilliform or weakly fusiform conidia, 6–10 × 1–1.5 μm, and the presence of norstictic acid. A detailed description and illustration are given in Elix & Mayrhofer (2017).

SPECIMEN EXAMINED

Victoria: ● Brisbane Ranges, Little River Gorge, c. 25 km S of Bacchus Marsh, 37°51'S, 144°22'E, on rock, R. Filson & H. Mayrhofer 3021, 18.x.1981 (GZU).

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References

- Bungartz, F (2019): Lichens of the Galapagos Islands. *Buellia straminea* Tuck. <http://galapagoslichens.myspecies.info/file-colorboxed/3>
- Bungartz, F; Nordin, A; Grube, U (2007): *Buellia* De Not. in Nash III, TH; Gries, C; Bungartz, F (eds) *Lichen Flora of the Greater Sonoran Desert Region* 3, 113–179. Lichens Unlimited, Arizona State University, Tempe.
- Elix, JA (2011): *Australian Physciaceae (Lichenised Ascomycota)*. Australian Biological Resources Study, Canberra. Version 18 October 2011. <http://www.anbg.gov.au/abrs/lichenlist/PHYSICIACEAE.html>
- Elix, JA (2016): New species of *Buellia sens. lat.* (Physciaceae, Ascomycota) from southern mainland Australia. *Australasian Lichenology* 78, 32–45.
- Elix, JA; Kantvilas, G (2013): New species and new records of *Amandinea* (Physciaceae, Ascomycota) in Australia. *Australasian Lichenology* 72, 3–19.
- Elix, JA; Mayrhofer, H (2017): New species and new records of buellioid lichens (Physciaceae, Ascomycota) from New Zealand. *Telopea* 20, 75–84.
- Elix, JA; Mayrhofer, H; McCarthy, PM (2017a): New species and a new record of buellioid lichens (Ascomycota, Physciaceae) in Australia. *Australasian Lichenology* 80, 28–37.
- Elix, JA; Kantvilas, G; McCarthy, PM (2017b): Thirteen new species and a key to buellioid lichens (Caliciaceae, Ascomycota) in Australia. *Australasian Lichenology* 81, 26–67.
- Elix, JA; McCarthy, PM (2018): Three new species and four new records of buellioid lichens (Caliciaceae, Ascomycota) from south-eastern Australia. *Herzogia* 31, 444–452.
- Lamb, IM (1968): Antarctic lichens II. The genera *Buellia* and *Rinodina*. *British Antarctic Survey Reports* 61, 1–129.



Figure 1. *Amandinea mountmeensis* (holotype in GZU). Bar = 1 mm.



Figure 2. Ascospore ontogeny of *A. mountmeensis*. Bar = 10 µm.

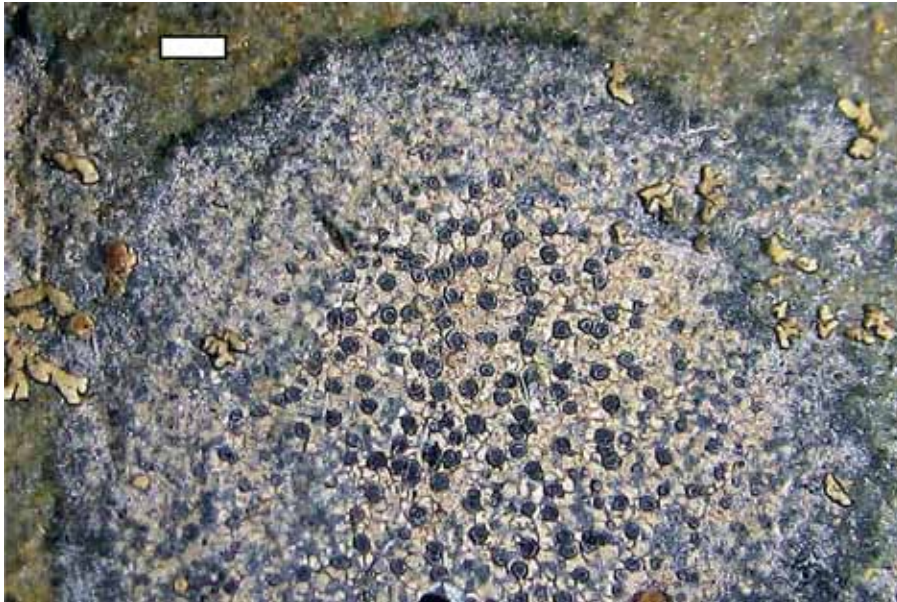


Figure 3. *Buellia bularmialensis* (holotype in GZU). Bar = 1 mm.

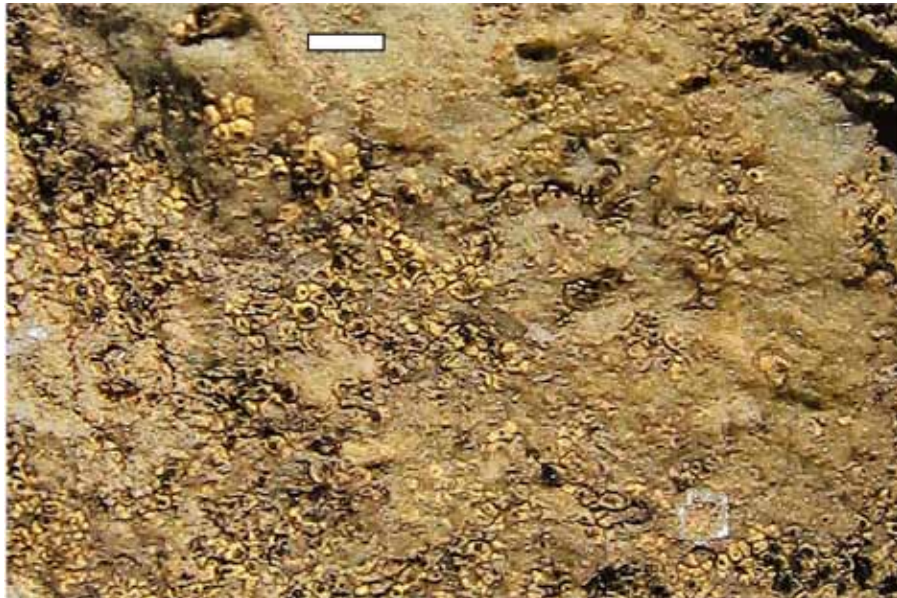


Figure 4. *Buellia dayborana* (holotype in GZU). Bar = 1 mm.

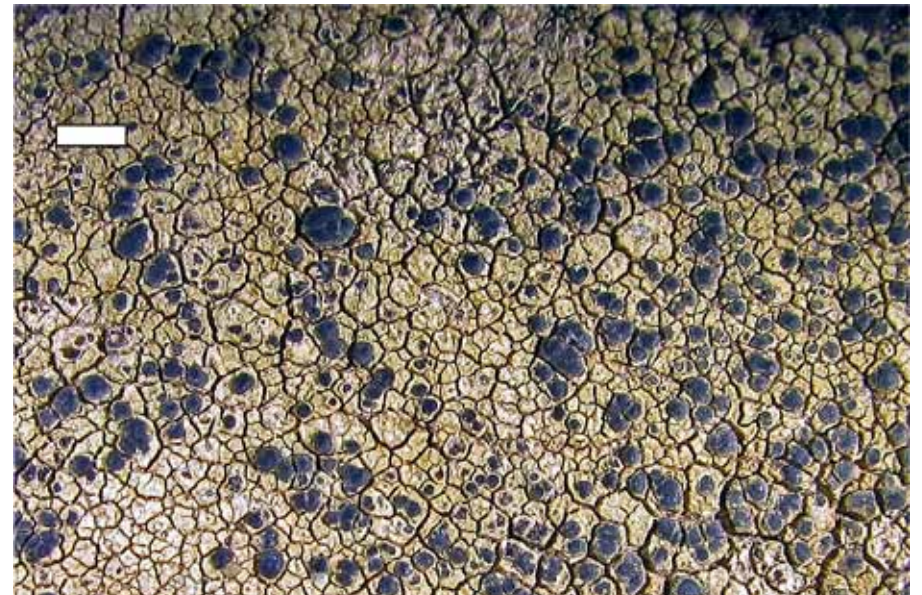


Figure 5. *Buellia neohalonia* (holotype in GZU). Bar = 2 mm.