

New species and new records of *Micarea* (Pilocarpaceae) from Australia

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Abstract

Micarea crassa P.M. McCarthy & Elix sp. nov. (Pilocarpaceae) is described from bark in the wet tropics of the Northern Territory, and the corticolous *M. queenslandica* P.M. McCarthy & Elix sp. nov. is described from rainforest in north-eastern Queensland. *Micarea synotheoides* (Nyl.) Coppins and *M. ternaria* (Nyl.) Vězda are reported for the first time from Australia (both from New South Wales), while new state and territory records are provided for four other species.

Introduction

The predominantly temperate lichen genus *Micarea* Fr. (Pilocarpaceae) includes approximately 110 species, occurring mainly on acidic bark, decorticated wood, siliceous rock, soil and plant detritus as well as moribund bryophytes. An outstanding monographic revision of the European species by Coppins (1983), was followed by improved national flora treatments (Czarnota 2007; Coppins, 2009; Galloway 2009; Brand *et al.* 2014) as well as progress towards the clarification of phylogeny, the recognition of generic segregates, accounts of new species and reassessments of the taxonomy of species and species groups (Coppins 1999; Czarnota & Guzew-Krzemińska 2010; Ekman & Svensson 2014; van den Boom *et al.* 2017; Konoreva *et al.* 2018; Guzew-Krzemińska *et al.* 2019; Launis *et al.* 2019a, b; and others). Until very recently, a more gradual improvement in our understanding of the Australian *Micarea* species saw the description of new species and the recognition of previously Northern Hemisphere taxa in the Australian lichen flora (Coppins & Kantvilas 1990; Coppins, 2009; McCarthy & Elix 2016a, b; Elix & McCarthy 2018; Kantvilas 2018; and others). However, a substantial revision, mainly of the Tasmanian taxa, documented ten newly described species, six other additions to the Australian flora and a key to the 35 Tasmanian representatives (Kantvilas & Coppins 2019). This brings the known total for Australia and its island territories to 42 species (McCarthy 2020).

In the current contribution, two corticolous species are described as new from the Australian wet-tropics (Northern Territory and Queensland), two others, both from montane localities in New South Wales, are reported for the first time from Australia, while new state and territory records are provided for four other species.

Methods

Observations and measurements of photobiont cells, thalline and apothecial anatomy, asci, ascospores, pycnidial anatomy and conidia were made on hand-cut sections mounted in water and treated with 10% potassium hydroxide (K), 50% nitric acid (N) and 5% sodium hypochlorite (C). Calcium oxalate was detected by treatment of thalline and apothecial sections with a 10% aqueous solution of sulfuric acid; it forms colourless, needle-shaped crystals. Asci were also observed in Lugol's Iodine (I), with and without pretreatment in K. Chemical constituents were identified by thin-layer chromatography (Elix 2014) and by comparison with authentic samples.

The species

1. *Micarea albournii* Coppins, *Lichenologist* **31**, 559 (1999)

This lichen was initially described from sandstone in South Africa (Coppins 1999). It was subsequently reported from consolidated soil in northern New South Wales (Elix 2012) and, most recently, from soil in dry sclerophyll woodland in Tasmania (Kantvilas & Coppins 2019).

SPECIMENS EXAMINED

Australian Capital Territory. ● Canberra Nature Park, Aranda Bushland, Powerline Track, c. 4 km W of Canberra, 35°16'00"S, 149°04'54"E, 650 m alt., on consolidated, siliceous soil bank in dry *Eucalyptus* woodland, *P.M. McCarthy* 4872, 4874, 4875, 14.viii.2019 (CANB); ● *loc. id.*, *J.A. Elix* 46818, 14.viii.2019 (CANB).

2. *Micarea argopsinosa* P.M. McCarthy & Elix, *Telopea* **19**, 32 (2016)

This species was first described from montane granite in the A.C.T. (McCarthy & Elix 2016a), and later from compacted soil in dry sclerophyll woodland in Tasmania (Kantvilas & Coppins 2019). Remarkably, while McCarthy & Elix (2016a) reported macroconidia in the type specimen to be narrowly oblong to filiform, straight, curved or arcuate, with (1–)3 septa and 10–19 × 1–1.5 µm, microconidia and mesoconidia were not observed. However, while the newly reported specimen from New South Wales (below) lacks macroconidia, it produces both narrower microconidia (oblong to filiform and 6–9 × 0.7–1 µm) and broader mesoconidia (oblong to bacilliform and 3.5–6 × 1.2–1.8 µm).

SPECIMENS EXAMINED

New South Wales. ● Central Tablelands, Gillindich Nature Reserve, 10 km N of Binda, 34°12'59"S, 149°20'09"E, 830 m alt., on sandstone in dry *Eucalyptus* woodland, *P.M. McCarthy* 4897, 30.ix.2019 (CANB).

Victoria. ● Strzelecki State Forest, Whitelaws Rd, 29 km S of Traralgon, 38°28'S, 146°31'E, 520 m alt., on siliceous rock in wet sclerophyll forest, *J.A. Elix* 29898, 14.iv.1993 (CANB).

3. *Micarea byssacea* (Th.Fr.) Czarnota, Guzew-Krzemińska & Coppins, *in* Czarnota & Guzew-Krzemińska, *Lichenologist* **42**, 17 (2010)

According to Kantvilas & Coppins (2019), this name is applicable to most of the Tasmanian specimens previously ascribed to *M. prasina* Fr. and *M. micrococca* (Körb.) Gams ex Coppins. The Lord Howe Island specimen of *M. byssacea* is typical in having, *inter alia*, a thallus with methoxymicareic acid and apothecia containing the pigment Sedifolia-grey [see Czarnota & Guzew-Krzemińska (2010), Launis & Myllys (2014) and Kantvilas & Coppins (2019)].

SPECIMEN EXAMINED

Lord Howe Island. ● between Little Island and The Cross, 31°24'20"S, 159°04'30"E, 10 m alt., on base of dead palm on *Ficus* etc.-dominated slope with very large basalt boulders, *H. Streimann* 50118, 24.vi.1992 [B (*n.v.*), CANB].

4. *Micarea crassa* P.M. McCarthy & Elix, sp. nov.

Figs 1 & 2

Mycobank No.: **MB834688**

Thallus corticolous, olive-green, to 1(–1.5) mm thick, minutely granulate or composed of gonocysts and containing methoxymicareic acid. Apothecia innate to adnate, dark greyish brown to dull jet-black, solitary and 0.12–0.28 mm wide or clustered; proper excipulum mainly pale, annular; hypothecium very pale; hymenium not interspersed, 33–50 µm thick, it and the epihymenium containing Sedifolia-grey. Asci 27–35 × 9–12 µm; ascospores 0–1-septate, narrowly ellipsoid to narrowly oblong or oblong-fusiform, 5.5–10 × 2–3.5 µm.

Type: Australia. Northern Territory, Baroalba Creek, 16 km SSE of Jabiru airfield, 12°49'S, 132°55'E, 210 m alt., on bark of dead *Syncarpia* in poor remnant vegetation in an area of large

boulders and outcrops with a westerly aspect, *H. Streimann* 42317, 21.iv.1989 (holotype – CANB; duplicates: B, ESS, *n.v.*).

Thallus crustose, epiphloeodal, determinate and forming colonies to *c.* 30 mm wide, pale (in patches) to predominantly medium olive-green (bright green when wetted), granular-verrucose or of goniocysts that are (20–)30–50(–60) μm wide and compacted to form a crust to 1(–1.5) mm thick, dull, continuous to pseudoareolate, non-amyloid (I–), not containing calcium oxalate (H_2SO_4 –), K–, C–, i.e. probably not containing Sedifolia-grey pigment (Meyer & Printzen 2000), ecorticate; soredia and isidia absent. *Algae* dominating the thallus; cells micareoid, greyish green to bright green, \pm globose to broadly ellipsoidal, thin-walled, 4–7 (–10) μm wide; interstitial hyphae 1.5–2(–2.5) μm wide, short-celled, thin-walled and richly branched. *Medulla* poorly delimited. *Prothallus* not apparent or patchy and whitish. *Apothecia* moderately numerous, innate among goniocysts to adnate, very dark greyish brown to, usually, dull jet-black (slightly paler when wetted), rounded, ellipsoid or rounded-irregular, immarginate in surface view, mostly solitary and (0.12–)0.19(–0.28) mm wide [$n = 40$], or clustered-tuberculate and in tight, proliferating groups of up to 5(–10) and measuring (0.3–)0.48(–0.66) mm wide; disc slightly, moderately or very strongly convex, dull, \pm smooth to somewhat undulate, epruinose. *Proper excipulum* (in section) annular, 15–25 μm thick laterally and with a dark brown outer edge subtended by radiating, simple to anastomosing hyphae that are hyaline and 1.5–2 μm wide; excipulum 15–20 μm thick at the apothecial base, K+ violet-brown, N–, C–. *Hypothecium* hyaline to very pale yellowish brown, 40–70 μm thick in the centre, 30–40 μm thick laterally, paraplectenchymatous below, distally with short-celled, deeply pigmented, anticlinal hyphae 1.5–3(–4) μm wide, not interspersed with granules or oil globules, K+ intensifying, N–, C–. *Hymenium* hyaline, 33–45(–50) μm thick, not interspersed, K+ pale violet (Sedifolia-grey, the colour slow to develop), N–, C–; subhymenium not apparent. *Epithymenium* olive-brown, 6–10 μm thick, or the pigment more diffuse but visible to mid-way into the hymenium, K+ violet-brown (Sedifolia-grey), N–, C–. *Paraphyses* uniform, conglutinate in water, loosening and separating abruptly in K, richly furcate-branched towards the apices, or laterally branched and with sparse to numerous anastomoses, long-celled, (0.8–)1–1.2 μm wide, not constricted at the septa; apices not pigmented, not swollen. *Asci* mostly narrowly to cylindroclavate, 27–35 \times 9–12 μm [$n = 15$], 8-spored, *Byssoloma*-type, i.e. with an amyloid outer coat, the tholus well-developed, predominantly amyloid, with or usually without a minute, conical ocular chamber subtending a paler, apical cushion bounded by a more darkly amyloid tube structure. *Ascospores* colourless, 0–1-septate, narrowly ellipsoid to narrowly oblong or oblong-fusiform, usually straight, occasionally slightly bent or curved, irregularly massed or obliquely stacked in the asci, not or slightly constricted medially (when the spore is simple) or at the septum, (5.5–)7.5(–10) \times (2–)2.6(–3.5) μm [$n = 65$], thin-walled, lacking a perispore at maturity (very thin and faint when immature); apices rounded to subacute; contents clear. *Pycnidia* not seen.

Chemistry: Containing methoxymicareic acid (major) by TLC (Elix 2014).

Etymology: The epithet *crassa* refers to the comparatively thick thallus of the new species.

Remarks

Micarea crassa is characterized by the combination of a greenish thallus of granules or goniocysts containing methoxymicareic acid, as well as very small, blackish apothecia, a hymenium that lacks granules but contains Sedifolia-grey pigment and very small 0–1-septate ascospores. This pigment is probably present in low concentrations, because while the hymenium and epihymenium turn violet on application of K, no such reaction was observed with C. The occurrence of thalline methoxymicareic acid rather than micareic or superlatolic (= prasinic) acids distinguishes *M. crassa* from *M. prasina* Fr. and its close allies, while diminutive, blackish apothecia separate it from the *M. byssacea* complex of species. Furthermore, very small apothecia with Sedifolia-grey, but which are blackish rather than creamy white or pale grey, separates the new Australian species from broadly similar taxa in the *M. micrococca* (Körb.) Gams ex Coppins complex (Czarnota & Guzew-Krzemińska 2010; Launis & Myllys

2014; Launis *et al.* 2019a, b). Among the latter, *M. czarnotae* Launis, v.d.Boom, Sérus. & Myllys, from northern Europe, has a similar thallus, similar-sized apothecia and equally minute ascospores. However, the apothecia are creamy white, pale brown or pale grey (Launis *et al.* 2019b). The bipolar to subtropical *M. byssacea* has a thallus that contains Sedifolia-grey (K+ violet), as well as larger, paler and mostly greyish apothecia, and somewhat larger ascospores, *viz.* (7–)8–14 \times 2.5–4 (–5) μm (Kantvilas & Coppins 2019) or (6–)8–12(–13) \times 2.7–3.5(–4.2) μm (Czarnota & Guzew-Krzemińska 2010).

Micarea crassa is known only from the type locality in the wet tropics of the Northern Territory.

5. *Micarea deminuta* Coppins, *Bibliotheca Lichenologica* 58, 58 (1995)

Known principally as a lignicolous species in Europe, North America and Japan (Coppins 1995, 2009), *M. deminuta* also occurs on consolidated soil and rotting logs in Tasmania (Kantvilas & Coppins 2019).

SPECIMEN EXAMINED

New South Wales. • Central Tablelands, Gillindich Nature Reserve, 10 km N of Binda, 34°12'59"S, 149°20'09"E, 830 m alt., on consolidated, siliceous soil in dry *Eucalyptus* woodland, *P.M. McCarthy* 4911, 30.ix.2019 (CANB).

6. *Micarea queenslandica* P.M. McCarthy & Elix, sp. nov.

Figs 3 & 4

Mycobank No.: **MB834689**

Thallus corticolous, scurfy, granular-verruculose, pale grey to pale grey-brown, continuous to sparingly rimose, 70–120 μm thick, containing methoxymicareic acid. Apothecia adnate to subsessile, dark grey-brown, 0.24–0.60 mm diam.; proper excipulum annular, 30–50 μm thick laterally, 50–90 μm thick at the base, medium to dark brown; hypothecium brown-black (Laurocerasi-brown), 70–180 μm thick; hymenium not interspersed, 30–40 μm thick, K–; epihymenium hyaline, indistinct. Asci 28–37 \times 8–14 μm ; ascospores 3(–5)-septate, elongate, 9–17 \times 2–3 μm . Microconidia bacilliform, 3–5 \times 0.5–0.8 μm .

Type: Australia. Queensland, Kareeya Power Station, Tully River Falls, 49 km NW of Tully, 17°46'03"S, 147°34'48"E, 220 m alt., on vine in rainforest along river, *J.A. Elix* 37456, 28.vii.2006 (CANB).

Thallus crustose, epiphloeodal, effuse to determinate and forming well-delimited colonies to *c.* 5(–10) mm wide, scurfy, granular-verruculose, pale grey to pale grey-brown, dull, continuous to sparingly rimose, 70–100(–120) μm thick, non-amyloid (I–), not containing calcium oxalate (H_2SO_4 –); thallus ecorticate, but the uppermost 6–10 μm a greyish, alga-free zone of non-descript anatomy; soredia and isidia absent. *Algae* dominating the thallus either as a continuous layer or clustered in compacted and ill-defined goniocysts 30–50 μm wide; cells micareoid, greyish green, \pm globose to broadly ellipsoidal, thin-walled, 6–10 μm wide; interstitial hyphae 1.5–2.5 μm wide. *Medulla* poorly delimited; hyphae 2–3.5 μm wide, short-celled, thin-walled and richly branched. *Prothallus* not apparent or whitish and effuse. *Apothecia* numerous, adnate to subsessile, occasionally sessile, dark grey-brown, becoming blackish when wetted, rounded, ellipsoid, rounded-irregular (often due to mutual pressure among clustered apothecia) or faintly lobulate, solitary or proliferating in groups of up to 4(–6), and often appearing tuberculate, (0.24–)0.40(–0.60) mm diam. [$n = 70$]; compound, tuberculate ascomata only slightly larger; disc moderately to very strongly convex, dull, smooth, epruinose; proper margin scarcely apparent in surface view or very thin (when immature) and slightly darker than the disc. *Proper excipulum* (in section) annular, 30–50 μm thick laterally, 50–90 μm thick at the apothecial base, of outwardly radiating, simple to anastomosing hyphae that are 1.5–2.5 μm wide, medium to dark brown, K+ intensifying, N+ red-brown, C–; the lowermost 10–20 μm much paler. *Hypothecium* brown-black [Laurocerasi-brown of Meyer & Printzen (2000)], 70–120(–180) μm thick, paraplectenchymatous below, distally with short-celled, deeply pig-

mented, anticlinal hyphae 1.5–2.5(–3) μm wide, not interspersed with granules or oil globules, K+ intensifying, N+ deep red-brown, C–. *Hymenium* hyaline, 30–40 μm thick, not interspersed, K–, N–, C–; subhymenium not apparent. *Epihymenium* hyaline, indistinct and scarcely distinguishable from the hymenium, K–, N–, C–. *Paraphyses* uniform, conglutinate in water, loosening slightly to markedly in K, richly furcate-branched towards the apices, or laterally branched and with sparse anastomoses, long-celled, (0.8–)1–1.2(–1.5) μm wide, not constricted at the septa; apices not pigmented, not swollen. *Asci* mostly narrowly to broadly clavate, occasionally cylindroclavate, 28–37 \times 8–14 μm [$n = 35$], 8-spored, *Byssoloma*-type, i.e. with an amyloid outer coat, the tholus well-developed, predominantly amyloid, with or usually without a minute, conical ocular chamber subtending a paler, apical cushion bounded by a more darkly amyloid tube structure. *Ascospores* colourless, 3(–5)-septate (fewer than 1 percent of spores are 4- or 5-septate), narrowly oblong, bacilliform or oblong-fusiform, rarely subfiliform, usually straight, occasionally slightly curved or sigmoid, irregularly massed, irregularly biseriolate or obliquely stacked in the asci, not constricted at the septa. (9–)13(–17) \times (2–)2.5(–3) μm [$n = 100$], thin-walled, lacking a perispore at maturity, although some immature spores (when simple or 1-septate) have a perispore $c. 0.5 \mu\text{m}$ thick; apices rounded to subacute or the proximal apex more sharply pointed; contents clear. *Pycnidia* sparse, inconspicuous, semi-immersed to almost completely immersed in the thallus, globose, brown-black above, somewhat paler below, 80–100 μm diam.; conidiogenous layer simple; conidiophores 8–15 \times 1 μm . *Microconidia* simple, bacilliform, straight, (3–)3.5–5 \times 0.5–0.8 μm ; mesoconidia and macroconidia not seen.

Chemistry: Containing methoxymycareic acid (major) by HPLC and TLC (Elix 2014).

Etymology: The species epithet refers to the type locality of the new species.

Remarks

Micarea queenslandica is characterized and distinguished from all other *Micarea* species by having a thallus that produces methoxymycareic acid combined with predominantly 3-septate ascospores. Thus, this particular diphenyl ether is typical of species in the *M. byssacea* or *M. micrococca* complexes of the *M. prasina* group, all of which have simple and/or 1-septate ascospores (Czarnota 2007; Guzow-Krzemińska *et al.* 2019; Kantvilas & Coppins 2019; Launis *et al.* 2019a, b). Comparison with other temperate Australian species having dark apothecia and 3-septate ascospores confirms the distinctiveness of the new species, with the yellowish *M. isabellina* Coppins & Kantvilas containing C+ orange xanthenes, the saxicolous *M. argopsinosa* with argopsin, the terricolous *M. magellanica* (Müll.Arg.) Fryday having alectorialic acid and the Tasmanian *M. sandyana* Kantvilas lacking lichen substances (Coppins & Kantvilas 1990; McCarthy & Elix 2016a; Kantvilas & Coppins 2019).

The new species is known only from the type locality in north-eastern Queensland.

7. *Micarea synotheoides* (Nyl.) Coppins, in Topham & Walker, *Lichenologist* **14**, 67 (1982)
Lecidea synotheoides Nyl., *Lichenes Japoniae* 63 (1890)

Thallus crustose, effuse or forming a continuous colony to 15 mm in maximum extent, to 50–70(–100) μm thick, pale olivaceous to darker greenish grey, granular-scurfy to rimose, slightly gelatinous when wetted, ecorticate. *Algae* micareoid, 4–7(–9) μm wide; interstitial hyphae 2–2.5 μm wide. *Medulla* poorly defined. *Prothallus* absent. *Apothecia* dull to glossy black, adnate, rounded to irregular, slightly to moderately convex, smooth, immarginate from early in their development, solitary and (0.17–)0.26(–0.35) mm diam. [$n = 50$] or forming irregular, tuberculate clusters (0.30–)0.48(–0.67) mm wide. [$n = 20$]. *Proper excipulum* cupulate but rather indistinct in thin section, pale greenish brown, 15–25 μm thick. *Hypothecium* hyaline, 50–80(–120) μm thick, not interspersed with granules or oil globules, K–, C–. *Hymenium* dark greenish above, hyaline below, 45–55 μm thick, not interspersed, I+ dark blue, K+ pale violet, C+ pale violet (Sedifolia-grey); upper parts dark greenish, the pigmentation continuous with that of the epihymenium. *Epihymenium* dark olive-green to greenish black, 10–20 μm thick. *Paraphyses* loose or tightly conglutinate in water, very loose in K, 1–1.5(–2) μm thick, sparingly to richly furcate-branched above; apical cells not swollen, hyaline or pale greenish.

Asci broadly clavate, 35–45 \times 9–13 μm , *Byssoloma*-type, 8-spored, the ascospores usually arranged side-by-side in a single fascicle. *Ascospores* colourless, (1–)3(–5)-septate at maturity, narrowly oblong to oblong-fusiform or bacilliform to \pm filiform, usually slightly or strongly curved, occasionally straight or faintly sigmoid, (17–)23(–31) \times (2–)2.5(–3) μm [$n = 50$]. *Pycnidia* sparse, inconspicuous, black, semi-immersed in the thallus, 70–100(–120) μm wide; wall dark greenish brown in thin section, K+ violet. *Macroconidia* simple, elongate-filiform, curved, arcuate, sigmoid or otherwise contorted, (20–)25–33(–38) \times 0.7–1 μm ; microconidia and mesoconidia not seen.

Chemistry: No substances detected by TLC. (Fig. 5).

This usually corticolous species is known from Europe, Macaronesia, the west coast of the U.S.A. and Japan (Coppins 1983, 2009; Czarnota 2007). Coppins (1983) reported microconidia of 3.8–4.8 \times 0.8–1 μm and mesoconidia measuring 4.5–6 \times 1.2–1.5 μm in European material of *M. synotheoides*; macroconidia have not been documented previously. The endemic *M. eucalypti* P.M. McCarthy & Elix also grows on the bark and wood of snow gum (*Eucalyptus pauciflora*), but in the Australian Capital Territory and at an altitude of $c. 1800 \text{ m}$ (McCarthy & Elix 2016b). It has a rather similar thallus and apothecial dimensions and anatomy to *M. synotheoides*, and the elongate ascospores are 3-septate, although broader and 2.5–4 μm wide. However, the apothecia of *M. eucalypti* lack the Sedifolia-grey pigment of *M. synotheoides* (they are K– and C–), and its macroconidia are (1–)3-septate and 12–22 \times 0.5–1 μm .

SPECIMEN EXAMINED

New South Wales. • Central Tablelands, Mount Canobolas State Conservation Area, summit plateau of Mt Canobolas, 13 km SW of Orange, 33°20'40"S, 148°58'56"E, $c. 1350 \text{ m alt.}$, on branch of solitary snow gum (*Eucalyptus pauciflora*), P.M. McCarthy 4889, 5.iv.2016 (CANB).

8. *Micarea ternaria* (Nyl.) Vězda, *Schedae Lichenes Selecti Exsiccati* 3 [858] (1970)

Lecidea sabuletorum f. *ternaria* Nyl., *Notiser ur Sällskapet pro Fauna et Flora Fennica Förhandlingar* **8**, 151 (1866)

Thallus superficial on peat and overgrowing bryophytes, forming extensive colonies, dull pale to medium grey, with patchy greenish or cream tints, 0.2–0.5(–0.8) mm thick; rimose to convex-areolate, the surface coarsely rugose to granular-verrucose; thallus ecorticate, but with an upper, hyaline, necral layer 10–30 μm thick. *Algal layer* 70–150 μm thick; cells micareoid, 4–7(–9) μm wide. *Medulla* thick, white, a loose network of anastomosing hyphae. *Prothallus* not apparent. *Apothecia* numerous, adnate to sessile, dull to slightly glossy black, rounded, ellipsoid, rounded-irregular or faintly lobate, solitary or proliferating in tuberculate clusters of up to 10; individual apothecia 0.3–0.8(–1.1) mm diam.; clusters 1.2–2.5 mm wide; disc moderately or very strongly convex to subglobose; margin usually excluded at maturity. *Proper excipulum* (in section) persistent, annular, pale to dark blue-green, 30–50 μm thick, of outwardly radiating, simple to anastomosing hyphae, K+ intensifying, N+ pale purple, C becoming decolourized. *Hypothecium* 150–250 μm thick, upper half deep red-brown, slightly or markedly paler (to almost hyaline) below, not interspersed, K–, N+ orange-brown, C–. *Hymenium* hyaline or with traces of dark epihymenial pigment, 50–70 μm thick, not interspersed, K–, N–, C–. *Epihymenium* deep blue-green to almost black, 10–15 μm thick, K+ intensifying, N+ purple, C+ pale brown, then decolourized. *Paraphyses* mainly simple below to richly branched near the apices, with few anastomoses, 1–1.5(–2) μm wide; apices not pigmented, slightly to more distinctly swollen and up to 2.5 μm wide. *Asci* mostly narrowly to broadly clavate, 8-spored, *Byssoloma*-type. *Ascospores* colourless, 1–3-septate, oblong-fusiform to fusiform, straight, slightly curved or, occasionally, sigmoid, 14–22 \times 4–6 μm . *Pycnidia* not seen. According to Coppins (1983), these are sessile, black, 100–140(–200) μm diam.; walls dark olive-green above and at the sides, becoming hyaline towards the base; conidia (mesoconidia) cylindrical or oblong-ellipsoid, sometimes faintly biguttulate and slightly constricted in the middle, 4.6–6.3 \times 1.2–1.7 μm .

Chemistry: No substances detected by TLC. (Fig. 6)

Micarea ternaria occurs on peat, plant debris and bryophytes in North America, Iceland and northern Europe (Coppins 1983, 2009; Thompson 1997). Along with other Australian species in the *M. lignaria*-*M. ternaria* group, it has solitary or clustered, black, convex apothecia with a K- and C- hymenium and mostly 3-septate ascospores. However, it can be distinguished from *M. argopsinosa*, *M. isabellina* and *M. magellanica* by the absence of lichen substances, and from *M. sandyana* which has ascospores $7\text{--}13.5 \times 3.5\text{--}6 \mu\text{m}$ (Coppins & Kantvilas 1990; Fryday 2004; McCarthy & Elix 2016a; Kantvilas & Coppins 2019).

SPECIMEN EXAMINED

New South Wales. ● Mount Kosciuszko Natl Park, 7.5 km NE of Mt Kosciuszko, Blue Lake, 36°24'S, 148°19'E, 2020 m alt., on dry ground in small rock cave, *H. Streimann 47110*, 3.ii.1991 [B (*n.v.*), CANB].

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Figure 1. *Micarea crassa* (holotype). Scales: 1 mm.



Figure 3. *Micarea queenslandica* (holotype). Scale: 1 mm.

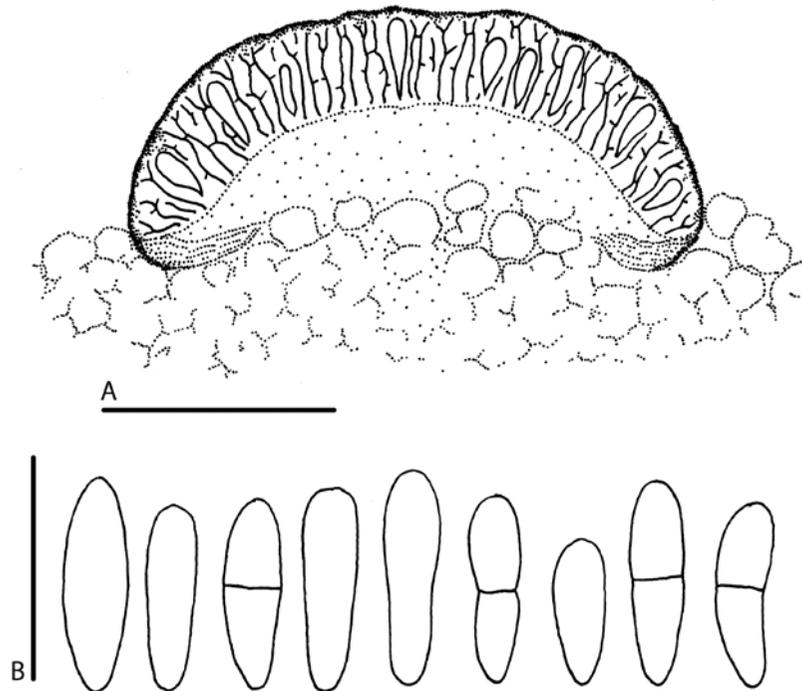


Figure 2. *Micarea crassa* (holotype). A, Vertical section of an apothecium (semi-schematic); B, Ascospores. Scales: A = 0.1 mm; B = 10 μ m.

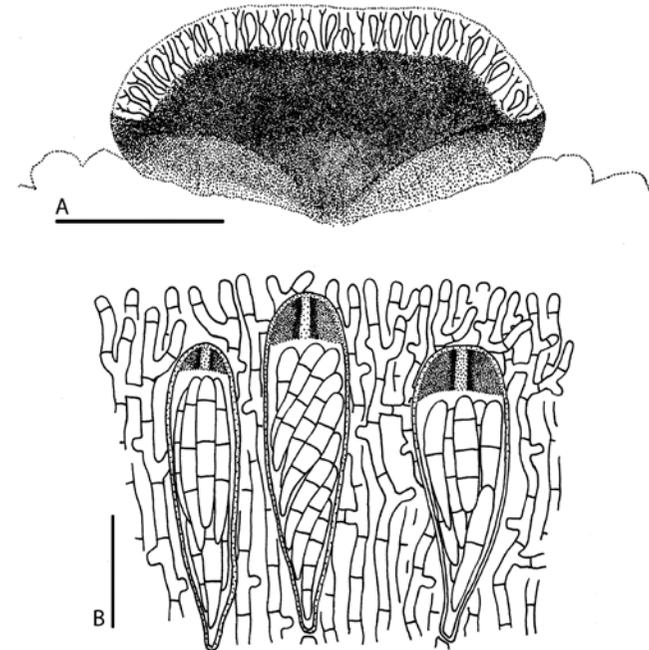


Figure 4. *Micarea queenslandica* (holotype). A, Vertical section of an apothecium (semi-schematic); B, Hymenium. Scales: A = 0.2 mm; B = 10 μ m.

Three new corticolous species and two new records of *Rinodina* (Physciaceae, Ascomycota) from subtropical and tropical Australia

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Figure 5. *Micarea synotheoides* (McCarthy 4889, CANB). Scale: 1 mm.

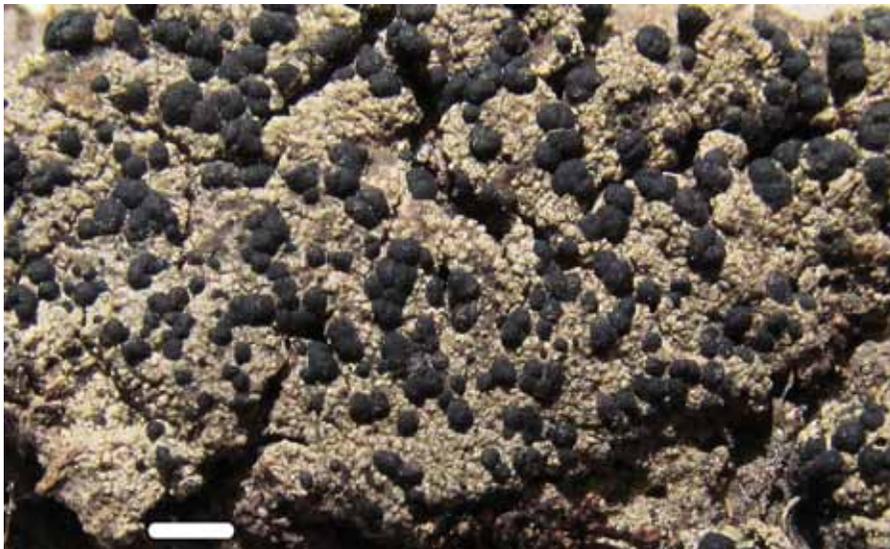


Figure 6. *Micarea ternaria* (Streimann 47110, CANB). Scale: 2 mm.

Abstract

The corticolous *Rinodina gerhardii* H.Mayrhofer & Elix and *R. heronensis* H.Mayrhofer & Elix from Queensland and *R. klauskalbii* H.Mayrhofer & Elix from New South Wales are described as new to science. In addition, *Rinodina galapagoensis* Giralto & Bungartz and *R. maculans* (Kremp.) Müll.Arg. are reported for the first time from Australia. A revised key to the corticolous species of *Rinodina* in Australia is provided.

Introduction

The corticolous and lignicolous species of *Rinodina* (Ach.) S.F.Gray in temperate Australia were revised by Mayrhofer *et al.* (1999), who recorded nine taxa, and a tenth has been recorded subsequently (Elix 2008). Those include five endemic taxa, *R. asperata* (Shirley) Kantvilas, *R. austroleprosa* Elix, *R. confusa* H.Mayrhofer & Kantvilas, *R. elixii* H.Mayrhofer & Kantvilas and *R. obscura* Müll.Arg., as well as the widespread *R. conradii* Körb. and *R. pyrina* (Ach.) Arnold. Further species include the pantropical *R. connectens* Malmé and *R. dolichospora* Malmé, the southern-temperate *R. australiensis* Müll.Arg., now known from Australia, southern Africa (Mayrhofer & Wirth 2011; Mayrhofer *et al.* 2014) and New Zealand (Elix *et al.* 2020). In this paper, we describe three new corticolous species of *Rinodina* from tropical and subtropical Australia, and we report the occurrence of *R. galapagoensis* Giralto & Bungartz and *R. maculans* (Kremp.) Müll.Arg. from Queensland.

Methods

Observations and measurements of photobiont cells, thallus and apothecium anatomy, asci and ascospores were made on hand-cut sections mounted in water and 10% KOH (K). Asci were also observed in Lugol's Iodine (I), with and without pretreatment in K. Medullary sections were treated with 10% sulfuric acid (H₂SO₄) and apothecial sections with 50% nitric acid (N).

New species

1. *Rinodina gerhardii* H.Mayrhofer & Elix, sp. nov. Figs 1, 2

Mycobank number: **MB834816**

Similar to *Rinodina asperata*, but differs in having biatorine to lecideine apothecia and smaller ascospores.

Type: Australia, Queensland, Cape Hillsborough National Park, Hidden Valley, 30 km N of Mackay, 20°55'S, 149°03'E, 10 m alt., on trees and shrubs at the edge of rainforest, *G. Rambold* 4682 pr. p., 21.ii.1986 (M – holotype).

Thallus to 15 mm wide, crustose, continuous, rimose, to 0.1 mm thick; upper surface matt, smooth, grey-brown; prothallus marginal, dark grey or black; medulla white, lacking calcium oxalate (H₂SO₄-), I-; photobiont cells 8–12 µm diam. *Apothecia* 0.1–0.4 mm wide, scattered or crowded, biatorine to lecideine, erumpent, then broadly adnate or sessile; disc dark brown to black, epruinose, weakly concave to plane or convex; thalline exciple apparent in only