

A new species of *Megalaria* (lichenized Ascomycota, Ramalinaceae) from north-eastern Queensland, Australia

Patrick M. McCarthy
64 Broadsmith St, Scullin, A.C.T. 2614, Australia
e-mail: pmcc2614@hotmail.com

John A. Elix
Research School of Chemistry, Building 137
Australian National University, Canberra, A.C.T. 2601, Australia
e-mail: john.elix@anu.edu.au

Abstract: *Megalaria coralloidea* sp. nov. is described from a fallen log at a rainforest margin in north-eastern Queensland, Australia. It has a well-developed, olive-green, isidiate thallus containing atranorin and zeorin, large, sessile apothecia with a uniformly hyaline, cupulate proper excipulum, a red-brown hypothecium, a nondescript epihymenium, comparatively small, 1-septate ascospores, and pycnidia that are immersed in the apices of isidia.

Megalaria Hafellner (Ramalinaceae), an almost cosmopolitan genus of c. 40 mostly corticolous species, is recognised by its usually pale, crustose thallus with a unicellular green photobiont, large, mainly black apothecia lacking a thalline margin but with a thick, cupulate proper excipulum, an amyloid hymenium with *Biatora*- or *Bacidia*-type asci or a variant of the *Lecanora*-type (*sensu* Hafellner 1984), simple, sparingly branched or somewhat anastomosing paraphyses, the apices with or without dark, pigmented caps, and 1-septate ascospores (Hafellner 1984; Ekman & Tønsgberg 1996; Kalb 2007; Kantvilas 2008, 2016; Sanderson 2009; Fryday & Lendemer 2010; Fryday 2016; McCarthy & Elix 2016). Kalb (2007) described the genus *Catillochroma* for several, mostly tropical species of *Megalaria* with a bilayered proper excipulum and zeorin in the thallus. However, this entity was convincingly rebutted by Fryday & Lendemer (2010), who demonstrated these characters to be variable and sometimes contradictory, with a number of intermediate character states being known in *Megalaria*. Those authors also synonymized *Lopezaria* Kalb & Hafellner with *Megalaria*, the type of *Lopezaria* being closely related to that of *Catillochroma*.

In this contribution, we describe *M. coralloidea*, a new species from a rainforest margin in north-eastern Queensland, Australia.

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 10% hydrochloric acid (H). Sections of apothecia were also observed in Lugol's Iodine (I), with and without pre-treatment in K. Chemical constituents were identified by thin-layer chromatography (Elix 2014) and comparison with authentic samples.

Megalaria coralloidea P.M.McCarthy & Elix, sp. nov.
Mycobank No.: MB817684

Figs 1, 2

Characterized by the thick, olive-green, globose-isidiate to coralloid-isidiate thallus containing atranorin (major) and zeorin (major); apothecia adnate to sessile, 1–2.9 mm wide, with a thin, pale margin and a blackish convex disc; proper excipulum cupulate, bilayered, lacking pigments; hypothecium red-brown, K+ greenish black, H+ intensely reddish, N+ deeper red-brown or maroon, I-; epihymenium nondescript; hymenium pale brown, amyloid; ascospores 1-septate, 12–19 × 5–7.5 μm; pycnidia completely immersed in the apices of isidia; conidia 2.5–6 × 0.8–1.2 μm.

Type: Australia, Queensland, Atherton Tableland, Danbulla State Forest, 24 km NE of Tolga, Danbulla Forest Drive, Kauri Creek, 17°08'02"S, 145°35'55"E, alt. 660 m, on a fallen log by a creek at a rainforest margin, J.A. Elix 44230, 4.viii.2006 (holotype – CANB, isotype – BRI).

Thallus crustose, determinate, to at least 10 cm wide, pale to medium olive-green, densely isidiate, robust, 0.3–2(–3) mm thick (including isidia). *Isidia* dominating the thallus, initially verrucose projections that become subglobose to globose, constricted at the base and 100–250 μm diam.; subsequently forming erect to oblique, bead-like strings of 2–4 subglobose elements, or terete, simple or coralloid stalks that branch dichotomously or laterally, the branch tips swollen, often slightly paler and faintly byssoid, many with immersed pycnidia (see below); detached isidia leaving concave, rimmed scars. *Cortex* 20–35 μm thick, uniformly hyaline, amorphous or of short prosoplectenchymatous hyphae near the surface, this subtended by a palisade of 3–6 μm wide, thicker-walled cells. *Algal layer* continuous, 25–50 μm thick. *Photobiont* green, chlorococcoid; cells 4–8(–10) μm wide; interstitial hyphae anticlinal, short-celled, thin-walled, 2.5–4.5 μm wide. *Medulla* loose, almost byssoid; hyphae variously orientated, long-celled, ±thin-walled, 3–6 μm wide. *Prothallus* white, byssoid under the thallus, up to 4 mm wide and fimbriate at the thallus margin, of individual hyphae and radiating, white cords of conglutinate hyphae 0.1–0.2 mm wide; hyphal cords later enclosed within a cortex and an algal layer and forming an irregular matrix of branching and overlapping “lobes” 0.2–0.4 mm wide from which isidia and apothecia develop. *Apothecia* rounded or irregular in outline, solitary or forming rosettes that proliferate from a single apothecium, (1–)1.9(–2.9) mm wide [*n* = 22], adnate or sessile and attached to the thallus by no more than c. one-third to half of its lower surface; margin at first hyaline, smooth and entire, later hyaline to pale brown, 50–80 μm thick, finally thinner but persistent, or becoming excluded by the most convex discs; disc initially concave, later plane, finally moderately to strongly convex or undulate, dull greenish black to black, smooth, epruinose. *Proper excipulum* cupulate in section, bilayered, lacking pigments, K-, H-, N-, I-; outer layer (30–)50–70(–100) μm thick, appearing waxy and hyaline on the cut surface of a sectioned apothecium, the hyphae radiating outwards laterally and downwards basally, anastomosing, tightly coherent, basally 6–10 μm wide, thick-walled (the lumina 1–2 μm wide), laterally 3–6 μm wide, thick-walled (the lumina c. 1 μm wide); inner layer 120–180 μm thick, appearing white on the cut surface of a sectioned apothecium; hyphae loosely arranged, unaligned (*textura intricata*) to periclinal, thin-walled, 3–6 μm wide, the walls heavily encrusted with crystals that dissolve in K; in the transition to the outer layer, the hyphae of the lower inner layer become considerably thicker, thicker-walled and tend towards anticlinal. *Hypothecium* medium to dark reddish brown, bilayered, not interspersed with oil droplets or granules, or with sparse granules distally, 70–120 μm thick, K+ greenish black with a faint bluish tone, H+ more intensely reddish, N+ deeper red-brown or maroon, I-; upper layer darker and thinner, the cells ±paraplectenchymatous or prosoplectenchymatous and anticlinal, thicker-walled, 2–5(–6) μm wide; lower layer paler red-brown and thicker, of ±periclinal hyphae. *Hymenium* 55–75 μm thick, not interspersed with granules or oil globules, hyaline to pale brown, the pigment dissolving in N; K-, H-, I+ blue (pre-treated with K) or I+ blue-black, turning dark red-brown (not pre-treated). *Epilhymenium* very poorly defined, pale brown and scarcely distinguishable from the rest of the hymenium, K-, H-, I+ blue, the pale brown pigment dissolving in N. *Paraphyses* simple to sparingly branched, with occasional anastomoses, not very tightly conglutinate in water, loosening further in K, 1–1.5(–2) μm thick; apices neither swollen nor pigmented. *Asci* narrowly clavate to clavate-cylindrical, mostly 8-spored, occasionally with up to 4 spores aborted, the spores biserial, irregularly arranged, or massed in the distal half of the ascus, 55–70 × 10–16 μm [*n* = 15], ±*Biatora*-type; tholus weakly to strongly amyloid, penetrated almost to the ascus wall by a conical *masse axiale*, this often bordered by a narrow,

more deeply amyloid zone; ocular chamber convex to conical; ascoplasm non-amyloid. *Ascospores* narrowly ellipsoid or oblong-ellipsoid, hyaline, 1-septate (a few 2-septate), not constricted at the median, slightly thickened septum, straight, occasionally slightly curved or bent at the middle, (12–)16(–19) × (5–)6.5(–7.5) μm [*n* = 100]; apices rounded or subacute; wall to 1 μm thick, lacking an epispore; contents clear. *Pycnidia* common, completely immersed in subglobose or globose isidia or in the swollen branch apices of coralloid isidia, 80–110 μm wide and 100–130 μm tall, mostly obpyriform or broadly ellipsoid, with a minute, nondescript or pale brown ostiole 15–25 μm wide, the apex faintly byssoid, with hyaline, thick-walled hyphae c. 10 μm long and 2.5 μm wide projecting from the cortex; pycnidial wall hyaline, long-celled, 5–8 μm thick; conidiogenous layer not convoluted; conidiogenous cells unbranched, 15–25 μm long and 1–1.5 μm wide (Type II *sensu* Vobis 1980); conidia produced in series from the tips of the conidiogenous cells, narrowly ellipsoid to bacilliform, 2.5–6 × 0.8–1.2 μm.
Chemistry: Thallus K–, C–, KC–, PD–, UV–; atranorin (major) and zeorin (major) by TLC.

Etymology: The epithet *coralloidea* refers to the coralloid isidia of the new species.

Remarks

Unambiguously isidiate thalli are uncommon in *Megalaria*, and the six known species with such propagules all differ from *M. coralloidea* in aspects of thalline anatomy and/or chemistry, as well as apothecial structure, pigmentation and/or ascospore dimensions. Thus, *M. spodophana* (Nyl.) D.J.Galloway from New Zealand (Galloway 1985, 2007), *M. bengalensis* Jagadeesh, Aptroot, G.P.Sinha & Kr.P.Singh from India (Jagadeesh Ram *et al.* 2007) and *M. bryophila* (Müll.Arg.) Elix from south-eastern Australia (Elix 2012) have ascospores similar in size to those of *M. coralloidea*, but in all cases the isidia are more delicate or obscure, the thallus lacks the combination of atranorin and zeorin, and the proper excipulum, hypothecium and/or the epihymenium are bluish black or otherwise darkly pigmented. The possibly pantropical *M. isidiza* (Makhija & Nagarkar) Fryday & Lendemer has considerably larger ascospores (Sipman 1983, Fryday & Lendemer 2010), while the recently described *M. orokonuiana* Fryday & A.Knight, from south-eastern Australia and southern New Zealand, has a thallus that lacks lichen substances, as well as larger ascospores (20–41 × 9–17 μm) and a very different pattern of apothecial pigmentation (Fryday & Knight 2012, McCarthy & Elix 2016). Finally, the saxicolous *M. montana* P.M.McCarthy & Elix, from the Central Tablelands, New South Wales, lacks lichen substances, the proper excipulum is violet-grey to blue-black laterally and hyaline at the base, the hypothecium is very pale, the epihymenium is blackish and the ascospores are 19–40 × 8–13 μm (McCarthy & Elix 2016).

Robust, branched isidia are very distinctive in *M. coralloidea*, and this character is compounded in significance by the pycnidia immersed in the isidial apices. Pycnidia are known from only five species of *Megalaria* (Sipman 1983, Ekman & Tonsberg 1996, Sanderson 2009, Fryday & Lendemer 2010), in all cases immersed in the thallus or in thalline verrucae. More broadly, pycnidiate isidia are extremely rare in lichens and have been reported only from small numbers of Parmeliaceae and Pertusariaceae (e.g. Kantvilas & Elix 2008; Benatti 2012, 2013; Bungartz *et al.* 2015).

Megalaria coralloidea is known only from the type locality, a fallen log at a rainforest margin on the Atherton Tableland in north-eastern Queensland, Australia.

ADDITIONAL SPECIMEN EXAMINED

Queensland: type locality, J.A. Elix 44229, 4.viii.2006 (BRI, CANB).

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Figure 1. *Megalaria coralloidea* (holotype). A, Thallus margin, showing the white prothallus and the early development of the thallus and isidia. B, An older part of the same thallus with apothecia and the fully developed isidiate crust. Scales: 5 mm.

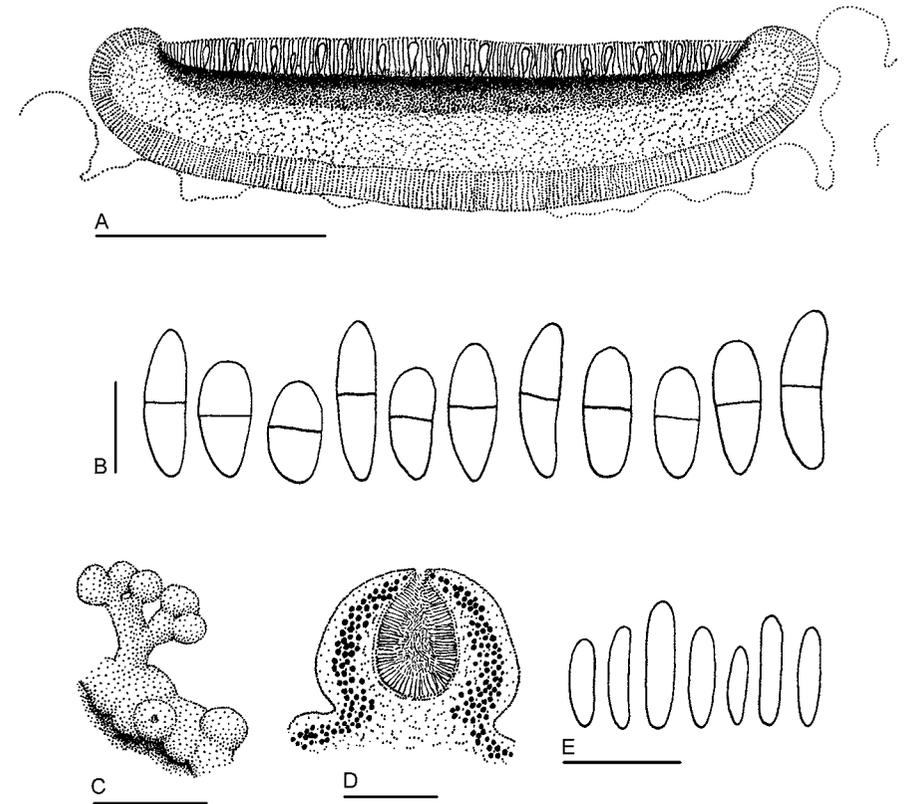


Figure 2. *Megalaria coralloidea* (holotype). A, Sectioned apothecium and adjacent thallus (semi-schematic and slightly off-centre). B, Ascospores. C, Pycnidiate isidia. D, Sectioned apex of an isidium with an immersed pycnidium (semi-schematic). E, Conidia. Scales: A, C = 0.5 mm; B = 10 μ m; D = 0.1 mm; E = 5 μ m.