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The genus *Ramboldia* (*Lecanoraceae*): a new species, key and notes

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Abstract: The new species *Ramboldia blastidiata* Kantvilas & Elix, from Tasmania and mainland Australia is described, and the new combination, *R. elabens* (Fr.) Kantvilas & Elix is proposed. The South American *R. petraeoides* var. *concava* (Müll. Arg.) Fryday is considered a synonym of *R. petraeoides* (Nyl. ex C. Bab. & Mitt.) Kantvilas & Elix *s. str.*, and *R. crassithallina* Kalb and *R. sorediata* Kalb, both previously considered endemic to Western Australia, are recorded from Tasmania for the first time. A key to the 11 species of *Ramboldia* is presented.

Key words: Australia, blastidia, lichens, *Pyrrhospora, Ramboldia*, Tasmania

Introduction

The genus *Ramboldia* was introduced by Kantvilas & Elix (1994) to accommodate crustose lichens with a green, trebouxioid photobiont, lecideine apothecia, an internally unpigmented excipulum composed of radiating, branched and anastomosing hyphae, asci of the *Lecanora*-type with an amyloid tholus and broadly diverging masse axiale, sparsely branched and anastomosing paraphyses, and simple, hyaline, non-halonate ascospores. Species of the genus are lignicolous, saxicolous or corticolous; one species is lichenicolous. *Ramboldia* is very closely related to *Pyrrhospora* Körb. with which it shares an identical ascus structure and ascospore size and shape (Kantvilas & Elix 1994; Hafellner 1993). The two genera appear to differ solely by the presence of K+ crimson or purple anthraquinone pigments in the apothecia of the latter (Elix & Kantvilas 2005). Other genera that can be compared to *Ramboldia* include *Miriquidica* Hertel & Rambold, *Lecidella* Körb., *Carbonea* (Hertel) Hertel and the *Lecanora symmicta* (Ach.) Ach. group, all of which differ from *Ramboldia* chiefly by their ascus structure. In *Miriquidica*, the masse axiale is relatively poorly differentiated; in *Lecidella*, it has a ± rounded apex and does not fully penetrate the tholus, whereas in *Carbonea* and *Lecanora symmicta*, it is ± cylindrical with parallel (rather than divergent) flanks. *Carbonea* differs further by its opaque, carbonized excipulum. It remains to be seen how the distinction between these genera and the placement of individual species will stand up to scrutiny using DNA sequence data.

The genus initially included five taxa: the Australasian *R. brunneocarpa* Kantvilas & Elix, *R. plicatula* (Müll. Arg.) Kantvilas & Elix, *R. stuartii* (Hampe) Kantvilas & Elix and *R. subnexa* (Stirt.) Kantvilas & Elix, and the widespread *R. petraeoides* (Nyl. ex C. Bab. & Mitt.) Kantvilas & Elix, which is known from Australasia, southern South America, South Africa and the Mediterranean.

Subsequently three further Australian species were described: *R. crassithallina* Kalb and *R. sorediata* Kalb (Kalb 2001), and *R. farinosa* Kalb (Kalb 2004), whereas Hafellner & Türk (1995) introduced the new combination *R. insidiosa* (Th. Fr.)

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Hafellner for a parasitic lichen that infects *Lecanora varia* (Hoffm.) Ach. in Europe. South American populations of *R. petraeoides* were recognized as a distinct variety, *R. petraeoioides* var. *concava* (Müll. Arg.) Fryday by Fryday (2002). The genus clearly attains its greatest species richness in temperate Australasia where open *Eucalyptus*-dominated woodlands, with an abundance of decorticated, dead wood and exposed rock outcrops, provide a wide range of ideal habitats. In this paper, we provide a key to the 11 species currently recognized, describe a further new species from Australia and Tasmania, and give additional information for several other species.

Material and Methods

The study is based on material in CANB and HO, collected mostly by the authors, and on selected material and exsiccata from other herbaria as indicated in the text. Specimens were examined using light microscopy. Anatomical features were studied on hand-cut sections mounted in water, 10% KOH and Lugol's Iodine solution after pretreatment with KOH. Chemical analyses were performed using standard methods of thin-layer chromatography (Elix & Ernst-Russell 1993) and high performance liquid chromatography (Elix *et al.* 2003).

Key to the species of *Ramboldia*

1 Thallus not sorediate, smooth, verruculose to papillate 2
Thallus sorediate or blastidiate 9

2(1) Thallus saxicolous 3
Thallus corticolous or lignicolous 4

3(2) Containing norstictic acid, detectable by the formation of needle-like, red crystals after the addition of KOH to squash preparations of sections of the apothecia or thallus; Southern Hemisphere and the Mediterranean . . . **R. petraeoides**
Containing baeomycesic and squamatic (±) acids (thallus and apothecia K−); mainland Australia and Tasmania . . . . . **R. plicatula**

4(2) Lichenicolous on the thallus of *Lecanora varia*; Europe . . . . . **R. insidiosa**
Thallus corticolous or lignicolous, not parasitising other lichens 5

5(4) Apothecia reddish brown; containing norstictic acid (K+ red; crystals); mainland Australia and Tasmania . . . . . **R. brunneocarpa**
Apothecia black; norstictic acid not present 6

6(5) Thallus ± absent or endophloeodal; hypothamnolic acid present, detectable by the K+ purple reaction of crystals in the subhypothecium; mainland Australia, Tasmania and New Zealand . . . . . **R. stuartii**
Thallus comprising contiguous or scattered, pale grey to yellowish grey areoles; lacking hypothamnolic acid but containing thamnolic or fumarprotocetraric acids 7

7(8) Containing thamnolic acid (thallus and subhypothecium K+ yellow); mainland Australia and Tasmania 8
Containing atranorin and fumarprotocetraric acid; cool temperate Northern Hemisphere . . . . . **R. elabens**

8(7) Areoles plane to convex, mostly <0·2 mm wide; paraphyses irregularly swollen to 5 µm thick and containing oil inclusions; alpine in mainland Australia and Tasmania . . . . . **R. subnexa**
Areoles convex to bullate, mostly 0·2–0·5 mm wide; paraphyses slender, mostly 1·5–2 µm thick, lacking oil inclusions; lowland in mainland Australia and Tasmania . . . . . **R. crassithallina**

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9(1) Thallus brownish; apothecia reddish brown; containing norstictic acid (K+ red; crystals); occurring mostly on rock and only rarely on wood; mainland Australia and Tasmania . . . . . **R. blastidiata**
Thallus pale grey or yellowish grey; apothecia black; containing thamnolic or hypothamnolic acids; occurring invariably on wood or bark 11

10(9) Thallus UV+ white, K−, containing hypothamnolic acid; mainland Australia . . . . . **R. farinosa**
Thallus UV−, K+ yellow, containing thamnolic acid; mainland Australia and Tasmania . . . . . **R. sorediata**

Taxonomy

Ramboldia blastidiata Kantvilas & Elix sp. nov.

Ramboldiae petraeoidi (Nyl. ex C. Bab. & Mitt.) Kantvilas & Elix similis et item vulgo saxicola, acidum norsticticum continens et apotheciis rufo-brunneis, sed thallo blastidiato, mox grosse granulari sorediato differt.

Typus: Tasmania, Flinders Island, western slopes of Strzelecki Peaks, 40°12′S 148°03′E, 150 m altitude, on granite boulder in dry sclerophyll forest, 27 December 1997, *G. Kantvilas* 301/97 (HO—holotypus; BM—isotypus).

(Fig. 1A)

Thallus crustose, forming extensive, irregular, ± continuous patches to 30 cm or more wide, pale grey-green, olive-green to dull olive-brown, rimose-areolate at first, with the areoles, plane to convex, *c.* 0·1–0·3 mm wide and to *c.* 0·35 mm thick, soon becoming blastidiate, abraded and sorediate, and forming a rather coarse, cracked, granular crust to 0·75 mm thick; soralia pale green to pale fawn-brown, discrete and at first rather punctiform, becoming diffuse; cortex absent; photobiont a unicellular, green, *Trebouxia*-like alga with cells

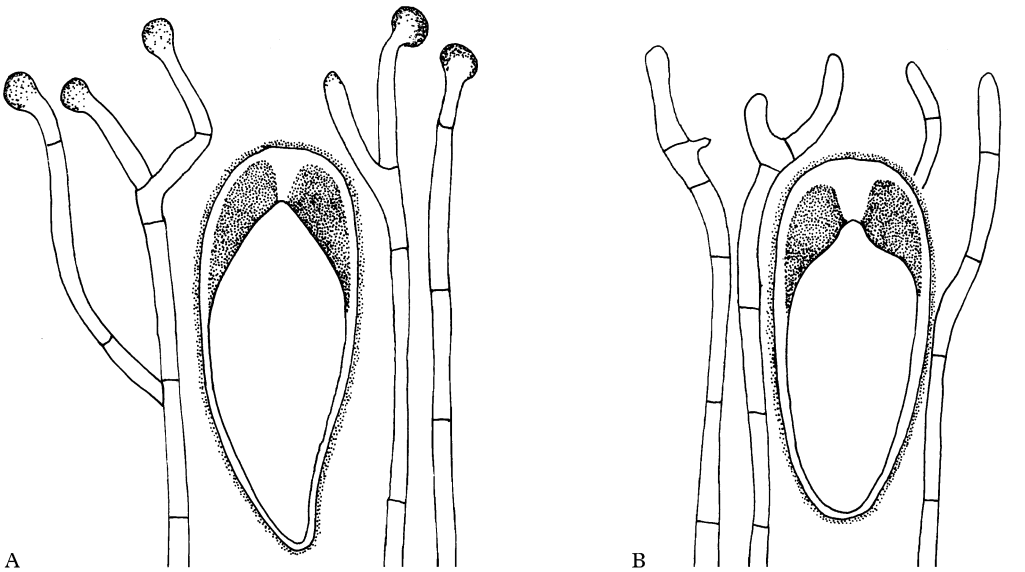


FIG. 1. *Ramboldia* species, portion of hymenium with amyloid parts of asci stippled. A, *R. blastidiata* (holotype); B, *R. elabens* (H. Hertel: *Lecideaceae Exsiccatae* 67). Scale=20 μm.

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roundish, 6–18 µm wide. *Prothallus* not developed but actively growing margins of the thallus sometimes ± blackened and thickened.

Apothecia lecideine, round to rather irregularly rhomboid, single or sometimes with adjacent ones fused, bright to dull red-brown to dark brown, 0·2–1 mm wide, basally constricted but generally nestled amongst soredia and/or blastidia and appearing rather sunken; margin very thin, concolorous with disc or a little paler, mostly soon excluded; disc plane, undulate to ± convex, epruinose. *Excipulum* in section annular, 20–60 µm thick, composed of conglutinated, radiating, branched and anastomosing hyphae 1·5–2 µm thick, colourless to pale orange, K+ yellow→red and developing needle-like red crystals (norstictic acid). *Hypothecium* colourless, 70–140 µm thick, sometimes becoming massive, in the lower part likewise K+ yellow→red and developing red crystals. *Hymenium* 30–45 µm thick, colourless but with a red-brown, K+ olive-brown epithecial layer *c.* 10 µm thick, composed of the pigmented apices of the paraphyses. *Asci* broadly clavate, 28–40 × 12–17 µm, of the *Lecanora*-type, with well-developed amyloid tholus and a broad, non-amyloid masse axiale with divergent flanks. *Paraphyses* sparsely branched and anastomosing, separating readily in KOH, (1–)1·5–2 µm thick, with apices distinctly capitate, rounded, olive-brown (after the addition of KOH), 2–4(–4·5) µm thick. *Ascospores* colourless, ellipsoid to fusiform-ellipsoid, simple but sometimes with a plasma bridge and appearing spuriously septate, 8·5–12 × 3·5–5·5 µm.

Pycnidia not located.

Chemistry. Thallus and apothecia containing norstictic and connorstictic acid, easily detected in squash preparations which are K+ yellow→red and develop needle-like red crystals.

Remarks. This new species is very closely related to *R. petraeoides*, and anatomically and chemically the two species are identical [see descriptions by Kantvilas & Elix (1994) and Elix (2004)]. The two taxa differ solely by their thallus: blastidiate-sorediate in *R. blastidiata* and esorediate, smooth, verruculose to ± papillate in *R. petraeoides*. They frequently occur together and the morphological distinction between the two is clearly evident; also in such cases, the apothecia of the former may frequently be a little smaller. Fertile material of the new taxon is generally not common, and even where apothecia are abundant, there appear to be few well-developed asci with ascospores present. In this respect, material from the Australian mainland is particularly poor, despite the abundance of the species there.

Blastidia as lichen structures were first described by Poelt (1980) for *Physcia opuntiella* Buschardt & Poelt [=*Agonimia opuntiella* (Buschardt & Poelt) Vězda], but have since been noted in other species. They are globose to clavate, very coarsely granular, vegetative propagules that form by budding in a yeast-like manner from the upper surface of the thallus. The common saxicolous, south-eastern Australasian, coastal lichen *Rinodina blastidiata* Matzer & H. Mayrhofer is characterized by blastidia and excellent illustrations of these structures are provided by Matzer & Mayrhofer (1994). In *Ramboldia blastidiata*, the blastidia soon become abraded and sorediate, with the soredia being pale green to pale fawn-brown and thus paler in colour than the thallus.

Distribution and ecology. This appears to be a widespread but infrequently collected species in temperate Australia and Tasmania. It is rare on wood but relatively common on rocks in open, rather exposed situations from lowland to alpine altitudes, especially in dry sclerophyll vegetation. Although most collections are from Devonian granite and Triassic sandstone, it has been recorded from other rock types as well, including Precambrian metamorphosed sediments, Ordovician conglomerate and Jurassic dolerite. It is typically part of a very species-rich community of saxicolous lichens including *R. petraeoides, Lecanora farinacea* Fée, species of *Rhizocarpon* and *Buellia*, and *Xanthoparmelia mougeotina*

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(Nyl.) D.J. Galloway. In Tasmania, its thallus is sometimes host to an undescribed species of *Rimularia* (G. Kantvilas & J. A. Elix unpublished). It is noteworthy that *R. blastidiata* is markedly less common and has a much narrower geographical distribution than its non-sorediate relative, *R. petraeoides*.

Selected specimens examined. **Australia:** *Tasmania*: Track to Mt Cameron, 40°59′S 147°56′E, 300 m alt., 1995, *G. Kantvilas* 38/95 (HO); *c.* 2 km W of Long Point, 42°20′S 147°48′E, 305 m alt., 2006, *G. Kantvilas* 15/06 (HO); summit of Mt Pearse, 41°30′S 145°37′E, 1000 m alt., 2006, *G. Kantvilas* 104/06 (HO); Tanina Bluff, 42°39′S 147°02′E, 890 m alt., 2005, *G. Kantvilas* 209/05 (HO); Mt Murray, 42°28′S 147°59′E, 315 m alt., 2006, *G. Kantvilas* 179/06 (HO); Mt Campbell, 41°39′S 145°59′E, 1972, *G. C. Bratt* 72/1227 (HO); summit of Black Bluff, 41°27′S 145°57′E, 1330 m alt., 2000, *G. Kantvilas* 146/00 (HO); summit of Mt Maurice, 41°18′S 147°35′E, 1120 m alt., 2001, *G. Kantvilas* 608/81 (HO); Cape Hauy, 43°09′S 148°00′E, 110 m alt., 2006, *G. Kantvilas* 342/06 & *P. D. Crittenden* (HO). *New South Wales*: Track to Snowball, Tallaganda State Forest, 35°57′S 149°35′E, 880 m alt., 1998, *H. Streimann* 60306 (B, CANB); Dilgry Circle Road, Barrington Tops State Forest, 31°52′S 151°31′E, 1240 m alt., 1990, *J. A. Elix* 24921 (CANB); Hanging Mountain, 36°01′S 149°52′E, 700 m alt., 1989, *H. Streimann* 42562A (CANB); Rutherfords Creek, 11 km SE of Nimmitabel, 36°34′S 149°36′E, 850 m alt., 1994, *J. A. Elix* 40861 & *K. Kalb* (CANB); Blue Mtns, Evans Lookout on trail to Grand Canyon, 33°39′S 150°20′E, 1060 m alt., 2002, *G. Kantvilas* 176/02 (HO); *c.* 6 km SW of Ebor, 30°27′S 152°19′E, 1350 m alt., 2002, *G. Kantvilas* 520/02 (HO); Molonglo River Falls, 2 km S of Captains Flat, 35°37′S 149°27′E, 870 m alt. (on wood), 1993, *J. A. Elix* 30040 (CANB, HO). *Australian Capital Territory*: Bruce Ridge, 35°15′S 149°05′E, 640 m alt., 1990, *J. A. Elix* 25067 (CANB). *Queensland*: Boolimba Bluff, 25°03′S 148°14′E, 580 m alt., 1993, *H. Streimann* 52137A (CANB, ESS). *South Australia*: Kangaroo Island, Waterfall Creek, 35°42′S 136°54′E, 140 m alt., 1994, *H. Streimann* 54949 (CANB). *Western Australia*: Stirling Range, trail to Toolbrunup Peak, 34°23′S 118°03′E, 700 m alt. (on wood), 1994, *J. A. Elix* 41452 (CANB, HO); Stirling Range, Bluff Knoll, 34°23′S 118°15′E, *c.* 1000 m alt., 1986, *G. Rambold* 5414 (*H. Hertel: Lecideaceae Exsciccatae* Nr 195) (HO); Sullivan Rock, 32°23′S 116°15′E, 320 m alt., 1994, *J. A. Elix* 40866, *H. T. Lumbsch & H. Streimann* (CANB, HO, PERTH).

Ramboldia elabens (Fr.) Kantvilas & Elix comb. nov.

Lecidea elabens Fr., *Vet. Akad. Handl.* **1822:** 256 (1822).—*Pyrrhospora elabens* (Fr.) Hafellner, *Herzogia* **9:** 731 (1993); type not seen.

(Fig. 1B)

For a full description, see Ryan *et al.* (2004). The chemical composition of this species comprises atranorin (major), fumarprotocetraric acid (major), chloroatranorin (minor), protocetraric acid (minor), confumarprotocetraric acid (minor), succinprotocetraric acid (trace) and an unknown depside (minor). With its areolate thallus and glossy, black apothecia, *R. elabens* displays all the typical features for *Ramboldia* (see above) as well as having an epihymenium that gives the distinctive K+ olive reaction, seen in the other species of the genus. Its habitat, on dead wood, is also typical. The placement of this distinctive taxon in *Pyrrhospora* has always seemed somewhat enigmatic, given that it lacks any anthraquinone pigments. Research underway by Dr K. Kalb and co-workers indicates that *Pyrrhospora* as currently defined is heterogeneous and further supports the placement of *P. elabens* in *Ramboldia*. *Ramboldia elabens* is widespread in cool temperate areas of the Northern Hemisphere including Europe, North America and Japan (Hafellner 1993). Records of this species from Australia (e.g. Weber & Wetmore 1972) refer to *R. subnexa* and *R. stuartii*.

Specimens examined. **Austria:** Ostalpen, Hohe Tauern, Salzburg, zwischen Weißsee und Grünsee oberhalb Enzinger Boden, *c.* 1900 m alt., 1974, *K. Kalb* (*Plantae Graecenses*, Lich. 7) (CANB); Kärnten, Gurktaler Alpen, Nockgebiet, St. Oswald, 46°50′N, 13°46′E, 1400 m alt., 1996, *R. Türk* 21312 (W. Obermayer: *Lichenotheca Graecensis*, Fasc. 4, no. 74) (CANB).—**Finland:** Kuusamo, Koillismaa, Mt Konttainen, 66°13′N 29°13′E, 300 m alt., 7 vii 1981, *L. E. Muhr* (H. Hertel: *Lecideaceae Exsiccatae* 67) (CANB, HO).—**United States of America:** Maine, Lubec, July 1893, *C. E. Cummings & E. A. Teller* (CANB).

Ramboldia petraeoides (Nyl. ex C. Bab. & Mitt.) Kantvilas & Elix

Bryologist **97:** 298 (1994).—*Lecidea petraeoides* Nyl. ex C. Bab. & Mitt., in J. D. Hooker, *Fl. Tasman.* **2:** 352, tab. CC. fig. D (1859); type: Tasmania, St Patricks River, *R. C. Gunn* (BM!—holotype; H—isotype).

Ramboldia petraeoides var. *concava* (Müll. Arg.) Fryday, *Mycotaxon* **82:** 423 (2002).—*Lecidea concava*

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Müll. Arg., *Nuovo Giorn. Bot. Ital.* **21:** 45 (1889); type not seen.

Fryday (2002) considered South American populations of *R. petraeoides* to be sufficiently distinct from Australasian material to warrant recognition at infra-specific rank. Comparison of a large number of specimens (from Australia, Tasmania and New Zealand) with some collections from South America (Falkland Islands) suggests that they cannot be separated. Sessile, innate, concave to flat apothecia that characterize var. *concava* are also found in Australasian specimens, albeit uncommonly, especially those from exposed alpine habitats, and represent a continuum of variation in this common, widespread and highly variable lichen. Other characteristics noted by Fryday (2002), such as the pale thallus, reduced exciple, distinctly capitate paraphyses and somewhat broadly elliposid ascospores, are also found consistently in *R. petraeoides* s. str.

Specimens examined. **Falkland Islands:** Weddell Island, 1100 ft alt., 1968, *H. A. Imshaug* 41973 *& R. C. Harris* (HO, MSC); West Falklands, summit of Fox Bay Mt, 1008 ft alt., 1968, *H. A. Imshaug* 42154 *& R. C. Harris* (HO, MSC).

New Records

Ramboldia crassithallina Kalb

Bibliotheca Lichenologica **78:** 160 (2001); type: Australia, Western Australia, Gorge Rock, *c.* 24 km SE of Corrigin, 32°25′S 118°00′E, alt. 300 m, on decorticated twigs of shrubs in depressions of a huge granitic boulder, 18 August 1994, *K. & A. Kalb s.n.* (CANB!—holotype; hb Kalb—isotype).

Full descriptions of this species are provided by Kalb (2001) and Elix (2004). It is characterized by having an areolate-bullate, grey to pale yellowish grey thallus containing thamnolic acid (thallus and sub-apothecial tissues K+ intense yellow), glossy black apothecia and slender paraphyses [2–3 µm thick according to Kalb (2001) but only 1·5–2 µm in the Tasmanian specimen]. This species is closely related to *R. subnexa*, which likewise contains thamnolic acid but differs in having plane and not bullate areoles and distinctive, irregularly swollen (to 5 µm) oil paraphyses. The two lichens differ further in their ecology: *R. crassithallina* is a species of dry, lowland habitats whereas *R. subnexa* is a subalpine to alpine species. The single Tasmanian specimen of the former contains barbatic acid in addition to thamnolic acid.

Ramboldia crassithallina was previously known only from Western Australia. In Tasmania, it has been recorded in littoral, scrubby vegetation, just above the spray zone, where it grew on dead wood (of probably *Myoporum insulare* R. Br.) associated with *Xanthoria ligulata* (Körb.) P. James, *Rinodina australiensis* Müll. Arg., *Flavoparmelia rutidota* (Hook.f. & Taylor) Hale and species of *Opegrapha* and *Physcia*.

Specimen examined. **Australia:** *Tasmania*: Flinders Island, Cave Beach, 40°01′S 147°53′E, 5 m alt., 2006, *G. Kantvilas* 83/06 (HO).

Ramboldia sorediata Kalb

Bibliotheca Lichenologica **78:** 161 (2001); type: Australia, Western Australia, Yilliminning Rock, *c.* 12 km E of Narrogin, 32°50′S 117°23′E, altitude 350 m, on decorticated twigs of shrubs growing in depressions of a huge granitic boulder, 16 August 1994, *K. & A. Kalb* s.n. (CANB!—holotype; hb Kalb, HO!—isotypes).

Full descriptions of this species are provided by Kalb (2001) and Elix (2004). Together with *R. crassithallina* and *R. subnexa*, it is one of three species of *Ramboldia* that contain thamnolic acid, easily detected in squash preparations by the intense K+ yellow reaction of the subhypothecial and thalline tissues. *Ramboldia sorediata* is distinguished from these two species by having a sorediate thallus. Although Kalb (2001) suggests that it may be the sorediate counterpart of *R. subnexa*, its slender paraphyses (rather than irregularly thickened oil paraphyses) and ecology would indicate that it is the sorediate counterpart of *R. crassithallina*.

The type collection of *R. sorediata* has an areolate thallus with discrete, rounded, grey-green to somewhat bluish green soralia that gradually spread across the whole thallus. In that respect, the Tasmanian specimens differ

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in that their thallus is composed of contiguous, coarse, ecorticate granules *c.* 0·1–0·25 mm wide that dissolve into coarse, pale grey-green soredia. However, scattered small areoles are also present, and so this morphological disparity is not considered significant, especially given the few specimens available for study. Another superficially similar species is *R. farinosa*, which has a finely sorediate, whitish thallus and contains hypothamnolic acid (Kalb 2004).

Previously this species was known only from Western Australia. In Tasmania, it has been collected in eucalypt forest where it grew on the cut stumps of eucalypts and on decomposing, decorticated logs. Associated species include *Micarea* aff. *melanobola* (Nyl.) Coppins, *M. intersociella* (Stirt.) Coppins, *Lecanora symmicta* (Ach.) Ach. aggr., *R. stuartii* and species of *Caloplaca* and *Buellia*.

Selected specimens examined. **Australia:** *Tasmania*: West of Tahune Bridge, Big Coupe in the Warra SST, 43°06′S 146°41′E, 120 m alt., 2006, *G. Kantvilas* 213/06 (HO); 2 km W of New Norfolk along Glenora Road, 42°47′S 147°02′E, 90 m alt., 1997, *G. Kantvilas* 59/97 (HO).

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