The lichen genus *Lecidella* (Lecanoraceae), with special reference to the Tasmanian species

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Introduction

In continuing our review of *Lecidea*-like crustose lichens in temperate Australia (e.g. Kantvilas & Elix 1994, 2007; Kantvilas *et al.* 1999, 2005; Kantvilas 2001, 2008a, 2008b, 2009, 2011; Kantvilas & La Greca 2008), we have turned our attention to the genus *Lecidella* Körb. This genus of approximately 50 species (Kirk *et al.* 2001) is well represented in all major regions of the world including Antarctica (Øvstedal & Lewis Smith 2001). It occurs mostly in cold or cool temperate climates where it colonises rocks, bark, wood and soil, as well as man-made substrata such as concrete; several species are particularly adapted to eutrophicated habitats.

Although *Lecidella* has not been the subject of a comprehensive revision in Australia, four species were treated by Rambold (1989) in his account of mainland Australian lecideoid lichens. Australian taxa and collections have also been studied in the course of a series of papers by J.-G. Knoph and co-workers, who greatly advanced the chemotaxonomic knowledge of the genus (Knoph 1990; Knoph *et al.* 1999; Knoph & Leuckert 2000). Miscellaneous reports of species from Australia, including new state records, have also been added by Allen *et al.* (2001), Elix (2006, 2008, 2010), Elix and Kantvilas (1995), Hertel (1985, 1989, 1990) and Kantvilas *et al.* (2008). In his checklist of Australian lichens, McCarthy (2012) records eight species for Australia, of which four occur in Tasmania. Meanwhile, Galloway (2007) treats nine species for New Zealand and provides a good overview of the genus, which is of particular relevance to the Australasian region.

The present study is essentially Tasmanian in focus, although we have also studied many additional collections from elsewhere in southern Australia in order to provide a context for our work. We recognise eight species, of which three are described as new, and transfer to *Lecidella* a further taxon previously included within *Lecidea*.

Abstract

Eight species of *Lecidella* (Lecanoraceae, lichenised Ascomycetes) are recorded for Tasmania: *L. destituta* Kantvilas & Elix *sp. nov., L. elaeochroma* (Ach.) Hazsl., *L. flavovirens* Kantvilas & Elix *sp. nov., L. granulosula* (Nyl.) Knoph & Leuckert, *L. stigmatea* (Ach.) Hertel & Leuckert, *L. sublapicida* (C. Knight) Hertel and *L. xylogena* (Müll. Arg.) Kantvilas & Elix *comb. nov.* (all present in mainland Australia), and the Tasmanian endemic *L. montana* Kantvilas & Elix *sp. nov.* All species are described in full, and notes on their characterisation, inter-relationships, distribution and ecology are provided. The status of the names *Lecidea minutula* Müll. Arg. and *L. leptolomoides* Müll. Arg., based on collections from Victoria, is discussed briefly.

Key words: biodiversity, *Lecidea*, lichenised Ascomycetes, temperate Australia

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Materials and methods

The study is based chiefly on collections by the authors, housed mainly in the Tasmanian Herbarium (HO) and on selected collections from other herbaria as cited in the text. Diagnostic characters of non-Tasmanian species, studied for comparative purposes, were determined from reference herbarium material (mainly from HO), and from published descriptions.

Descriptions are based on hand-cut sections of the thallus and ascomata, examined with high-power light microscopy. Mounting media included water, 15% KOH (K), Lugols Iodine after pretreatment with K, Lactophenol Cotton Blue after pretreatment with K and washing with water, and 50% HNO_3 (N). Dimensions of asci and ascospores are based on 25 and 60–100 observations respectively. The latter are presented in the format: 5th percentile–*mean*–95th percentile; outlying extreme values are given in parentheses. Routine chemical analyses using thin-layer chromatography follow standard methods (Orange *et al.* 2001). Critical extracts of a representative selection of specimens of each taxon were analysed using high-performance liquid chromatography (Elix *et al.* 2003).

Characteristics of the genus and species

Lecidella is characterised by: a crustose thallus containing a trebouxioid photobiont with ± globose cells 6–18 µm diam.; biatorine apothecia that are typically a shade of brown or black and include blue-green, N+ crimson pigments [essentially *cinereorufa green* of Meyer and Printzen (2000)]; a persistent, typically annular proper excipulum composed of radiating, thick-walled hyphae *c.* 3–5 µm thick that become expanded to *c.* 5–10 µm and increasingly paraplectenchymatous and internally pigmented towards the outer edge; clavate, eight-spored asci with the outer wall amyloid, a well-developed, intensely amyloid tholus, almost but not completely penetrated by a weakly amyloid, ± conical *masse axiale* with a rounded apex, and a poorly developed ocular chamber; mostly simple paraphyses that usually separate readily in KOH; and simple, hyaline, non-halonate ascospores with a distinct, thin, single-layered wall when mature. In the literature, the asci are mostly referred to as '*Lecanora*-type' although they are more accurately described as *Lecidella*-type, as illustrated by Hafellner (1984). In *Lecanora*, the asci differ subtly by having the tholus penetrated *entirely* by the cylindrical to barrel-shaped *masse axiale*. Chemistry of the genus is variable and very frequently includes a suite of xanthones.

At generic rank, *Lecidella* is usually not difficult to recognise, although there are some superficially similar genera, including *Carbonea* (Hertel) Hertel, *Japewiella* Printzen, *Mycoblastus* Norman, *Megalaria* Hafellner, *Tasmidella* Kantvilas, Hafellner & Elix and *Ramboldia* Kantvilas & Elix, with which it has some features in common. Salient features of these taxa are summarised in Table 1. In the course of the present study, we found that the genus most likely to be confused with *Lecidella* was *Japewiella*, which has ± identical asci, a lax hymenium and, frequently, a xanthone-dominated thallus chemistry. The main difference between the two genera is that the excipulum of *Japewiella* consists of a loose reticulum of radiating, branched and anastomosing hyphae *c.* 1 µm thick in a gelatinous matrix (Printzen 1999; Kantvilas 2011). Several undescribed species of *Japewiella* were recognised during the present work and await study in the future.

Thallus morphology and chemistry, apothecial pigmentation and ascospore dimensions are the chief characters by which species of *Lecidella* are circumscribed. Chemistry is particularly critical, complicated by the fact that identification of the many xanthones present, as well as distinguishing such key compounds as vicanicin and diploicin, is difficult and essentially requires high-performance liquid chromatography. Determination of the chemistry of each specimen was an essential aspect of this study. Yet, having circumscribed the species, it was found that each can usually be identified without difficulty using morphological and anatomical characters, and so distinguishing the different species is not necessarily limited to the practitioner with access to specialist laboratory equipment.

Taxonomy

1. ***Lecidella destituta*** Kantvilas & Elix, ***sp. nov.***

MycoBank No.: MB803599

Lecidellae elaeochromae *aemulans sed atranorinum solum continenti et hymenio guttis olei crystalisque insperso differt*.

Table 1. Comparison of salient features of *Lecidella* and superficially similar genera (based on observation of selected specimens and literature)

	Lecidella	***Mycoblastus* s. str. (*M. sanguinarius* group)**[1]	***Mycoblastus dissimulans* group**[1]	***Megalaria* s. lat.**[2,3,4]	***Tasmidella***[5]	***Ramboldia***[6,7]	***Japewiella***[8,9,10]	***Carbonea***[11,12]
excipulum	persistent, composed of radiating, thick-walled hyphae that become paraplectentchymatous and internally pigmented at the outer edge	reduced, soon excluded, composed of short-celled, reticulate hyphae	reduced, soon excluded, composed of branched and anastomosing hyphae similar to paraphyses	persistent, two-layered, composed of branched and anastomosing, radiating hyphae	persistent, composed of branched and anastomosing, radiating hyphae	typically reduced and soon excluded, composed of branched and anastomosing, radiating hyphae	persistent, composed of branched and anastomosing hyphae	persistent to excluded, typically opaque and carbonised
apothecial pigments	cinereorufa-green	cinereorufa-green, subapothecial red pigments	cinereorufa-green, fucatus-violet	cinereorufa-green, atra-red, hypnorum-blue	cinereorufa-green, hypnorum-blue	mostly brown, K± olive, N–, or red, K+ purple anthraquinones in some species	red-brown, K± olive, N–	various blue-green, red-brown and brown pigments
paraphyses	mostly simple and separating easily in KOH	branched and anastomosing, coherent in KOH	branched and anastomosing, coherent or separating in KOH	simple, or occasionally branched and anastomosing	mainly simple and separating easily in KOH	sparsely branched and anastomosing, coherent or separating in KOH	mainly simple, separating in KOH	simple to sparsely branched, coherent in KOH
asci	*Lecidella*-type, 8-spored; *masse axiale* ± conical with a rounded apex	*Mycoblastus*-type, 1-spored; *masse axiale* reduced to a pale border to the ocular chamber	*Mycoblastus*-type, or *Biatora*- to *Lecidella*-type, 2(–4)-spored; *masse axiale* barrel-shaped to conical	± *Lecanora*-type with *masse axiale* barrel-shaped (*M. grossa*) or *Biatora*-type with *masse axiale* conical; 2–8-spored	± *Lecanora*-type, 8-spored; *masse axiale* ± conical	*Lecanora*-type, 8-spored; *masse axiale* cylindrical to broadly diverging	*Lecidella*-type, 8-spored; *masse axiale* ± conical with a rounded apex	*Lecanora*-type, 8-spored; *masse axiale* cylindrical
ascospores	simple, broadly ellipsoid to oblong, single-walled, mostly ≤ 17 µm (to 24 µm in *L. montana*)	simple, ellipsoid to oblong, double-walled, mostly 60–100 µm long	simple or rarely 1-septate, ellipsoid to ovate, double-walled, mostly 30–60 µm long	ellipsoid to ovate, 1-septate, single-walled, to 45 µm long	simple or rarely 1-septate, narrowly ellipsoid, double-walled, to 20 µm long	simple, narrowly ellipsoid, single-walled, to 14 µm long	simple, ellipsoid, single-walled, to 20 µm long	simple, ellipsoid, single-walled, to 17 µm long
chemistry	mostly xanthones, ± atranorin, ± zeorin, ± depsidones	atranorin, ± depsides, ± depsidones, ± fatty acids	perlatolic acid, ± depsidones, ± fatty acids	nil, ± atranorin, ± zeorin, ± depsidones	atranorin or xanthones	usually depsides or depsidones, rarely xanthones or fatty acids	atranorin, ± xanthones, ± depsides	atranorin, ± xanthones, ± zeorin, ± depsides, ± depsidones

[1] Kantvilas (2009); [2] Ekman & Tønsberg (1996); [3] Fryday & Lendemer (2010); [4] Kantvilas (2008b); [5] Kantvilas *et al.* (1999); [6] Kantvilas & Elix (1994); [7] Kantvilas & Elix (2007); [8] Printzen (1999); [9] Spribille & Printzen (2007); [10] Kantvilas (2011); [11] Chambers *et al.* (2009); [12] Knoph *et al.* (2004)

Type: **NEW SOUTH WALES.** Gillenbah State Forest, 8 km S of Narrandera, 34°47′51″S 146°30′00″E, 170 m alt., on *Callitris* in mallee scrub, 16 April 2009, *J.A. Elix 39928* (holotype: HO; isotype: CANB).

Thallus typically areolate, deeply cracked, rather lumpy and uneven, more rarely very thin, effuse and revealing a blue-black prothallus beneath, pale pinkish brown, grey-brown to whitish grey, undelimited, esorediate, forming irregular patches *c*. 1–5 cm wide. *Apothecia* 0.2–0.9 mm wide, sessile, basally constricted; disc mostly persistently plane, sometimes becoming undulate but only rarely convex, black, matt, epruinose. *Proper excipulum* black, matt to glossy, persistent, entire, in section 20–40 µm thick, ± opaque brown within, unchanged in K, N+ intensifying orange-brown, also with additional blue-green, N+ crimson pigment, especially at the upper and outer edges. *Hypothecium* 40–90 µm thick, pale yellow-brown to yellow-orange, intensifying yellow-orange in K and N. Hymenium 60–90 µm thick, separating easily in K, not overlain by epihymenial granules but densely inspersed, especially towards the base, with minute, colourless crystals and oil droplets that do not dissolve in K, in the upper part intensely greenish blue, K ± grey-green, N+ crimson, towards the base mostly colourless, often K± very faint pinkish. Asci 45–60 × 14–22 µm. *Paraphyses* 1.5–2.5 µm thick, simple; apices usually expanded to 2–4.5 µm thick, mostly with an external, blue-green, N+ crimson cap but sometimes unpigmented. *Ascospores* broadly ellipsoid, occasionally slightly bent, 11–*13.7*–16(–17) × (5.5–)6–*7.2*–9 µm. *Conidiomata* not observed. Fig. 1A

Chemical composition: atranorin , ±chloroatranorin; thallus K± yellowish, P–, KC–, C–, UV–.

Remarks: This species is characterised chiefly by the combination of the thallus containing atranorin only, and by the conspicuously inspersed hymenium. In other respects, such as disposition of pigments and the yellow-brown hypothecium, it is very similar to *Lecidella elaeochroma*. Additional, more subtle characters that distinguish *L. destituta* from *L. elaeochroma* include the apothecia, which generally do not become markedly convex with an excluded exciple, and the lack of brownish epihymenial granules; the ecology of the two taxa (see below) is also starkly different. Although the ascospores of *L. destituta* fall within the size range of *L. elaeochroma*, they are nevertheless slightly longer and broader (as demonstrated by mean values). It is probably due to the lack of epihymenial granules that the blue-green apothecial pigment in *L. destituta* often appears relatively bright. The characteristic inspersion of the hymenium is most pronounced in New South Wales and South Australian specimens, whereas in Tasmanian material, this is mostly restricted to the base of the hymenium. The crystals and droplets do not fluoresce in polarised light, nor dissolve in KOH or HNO_3, but they yield a curious pinkish reaction in the former reagent. In the field, *L. destituta* is most likely to be confused with species of the *Buellia disciformis* (Fr.) Mudd group.

A thallus chemistry comprising atranorin only is unusual in *Lecidella*. In some Northern Hemisphere accounts (e.g. Poelt & Vězda 1981; Fletcher *et al.* 2009), *L. euphorea* (Flörke) Hertel is alluded to as being a xanthone-deficient relative of *L. elaeochroma*. Initially we entertained the notion that this could be an appropriate name for our Australian collections. However, every herbarium specimen labelled as *L. euphorea* that we were able to study (from Europe and North America) invariably contained xanthones (when examined by h.p.l.c). Furthermore, in their account of Sonoran species, Knoph and Leuckert (2004) consider *L. euphorea* as containing either atranorin only or atranorin plus xanthones. In their concept, the species also lacks an inspersed hymenium. Another species examined was the European *L. achristotera* (Nyl.) Hertel & Leuckert. This species is very similar to *L. destituta* in that it has the same apothecial pigmentation, ± identical-sized ascospores and, most importantly, an inspersed hymenium; however, it differs by containing xanthones (Nimis & Poelt 1987), including 2,5,7-trichloro-3-*O*-methylnorlichexanthone (our analyses). Similarly the saxicolous *L. patavina* (A. Massal.) Knoph & Leuckert also has an inspersed hymenium but differs chemically by containing atranorin and lichexanthone (Fletcher *et al.* 2009). Hence we concluded that the best outcome was to describe a new species.

Distribution and ecology: *Lecidella destituta* is an infrequently collected but almost certainly frequently overlooked species. It has been recorded from west of the Great Dividing Range in New South Wales, south-western Western Australia and from Kangaroo Island, South Australia. In Tasmania, herbarium collections suggest it is quite rare, ranging from lowland to subalpine altitudes and colonising twigs and small branches of shrubs and young trees in open eucalypt-dominated woodland. Associated species include *Buellia dissa* (Stirt.) Zahlbr., *Caloplaca wilsonii* S.Y.Kondr. & Kärnefelt, *Menegazzia subpertusa* P. James & D.J. Galloway, *Pertusaria pertractata* Stirt., *Usnea inermis* Motyka and various crustose lichens.

Specimens examined: **TASMANIA.** Trevallyn State Recreation Area, 41°27'S 147°06'E, 200 m alt., 22.viii.1992, *A.V. Ratkowsky s.n.* (HO); Johnsons Lagoon, 41°59'S 146°23'E, 1040 m alt., 9.xii.2007, *G. Kantvilas 399/07* (HO); Derwent River above New Norfolk, 42°44'S 146°55'E, 40 m alt., 28.ix.2000, *G. Kantvilas 382/00* (HO); Pelion Plains, *c.* 0.5 km E of New Pelion Hut, 41°50'S 146°03'E, 850 m alt., 13.iii.1992, *G. Kantvilas 145/92* (HO). **NEW SOUTH WALES.** Ingalba Nature Reserve, 9 km W of Temora, 34°26'11"S 146°26'01"E, 315 m alt., 16.iv.2009, *J.A. Elix 39732* (CANB); Lachlan Range State Forest, 15 km NW of Rankins Springs, 33°47'S 146°07'E, 260 m alt., 12.vi.1990, *H.Streimann 44806* (CANB). **SOUTH AUSTRALIA.** KANGAROO ISLAND, Corner of Playford Hwy, Birchmore Hwy and road to Kingscote aerodrome, 35°42'S 137°31'E, 1982, *K. Stove 1789 p.p.* (AD); Weir Cove, 2 km E of Cape de Couedic, 36°03'S 136°43'E, 40 m alt., 28.ix.1994, *H. Streimann 54981* (CANB, HO); 3 km E of Seal Bay, 36°00'S 137°21'E, 30 m alt., 25.x.1985, *J.A. Elix 19589 & L.H. Elix* (CANB, HO); West Bay, 35°53'S 136°33'E, 10 m alt., 27.ix.2011, *G. Kantvilas 297/11* (AD, HO). **WESTERN AUSTRALIA.** Dally

Key to the Tasmanian species of *Lecidella*

1 Growing on rock or on bryophytes overgrowing rock **2**

1: Growing on bark or wood **4**

2 Hypothecium colourless or at most pale yellowish brown at the base **3**

2: Hypothecium yellow-brown to dark brown, with the colour intensifying in K and N .... ***7. L. sublapicida***

3 Thallus granular, containing xanthones (K–, C+ orange); apothecia to 0.6 mm wide; colonising siliceous rocks .... ***4. L. granulosula***

3: Thallus rimose-areolate to rather lumpy and verruculose, containing atranorin and zeorin (K+ yellowish, C–); apothecia to 1.5 mm wide; mostly on calcareous substrata .... ***6. L. stigmatea***

4 Thallus not sorediate **5**

4: Thallus sorediate **8**

5 Thallus containing xanthones (C+ orange); hymenium not inspersed, or at most with an epihymenial layer of granules that dissolve in K **6**

5: Thallus containing atranorin only (C–); hymenium inspersed with oil droplets and crystals that do not dissolve in K .... ***1. L. destituta***

6 Hypothecium pale yellow-brown to yellow-orange, colour intensifying in K; apices of paraphyses unpigmented or with an *external* cap of blue-green, N+ crimson pigment **7**

6: Hypothecium colourless to pale brownish; apices of paraphyses with an *internal* cap of pigment .... ***8. L. xylogena***

7 Ascospores 15–24 × 8–13 µm; excipulum in section mainly opaque brown, with blue-green, N+ crimson pigment at the edges .... ***5. L. montana***

7: Ascospores 9–15 × 5–8 µm; excipulum in section mainly colourless to dilute brown, with blue-green, N+ crimson pigment at the edges .... ***2. L. elaeochroma***

8 Ascospores 12–18 × 6–10 µm; apices of paraphyses unpigmented or with an *external* cap of blue-green, N+ crimson pigment; excipulum in section opaque dark brown, lacking blue-green pigment; soredia arising in discrete soralia .... ***3. L. flavovirens***

8: Ascospores 7–14 × 4.5–9 µm; apices of paraphyses with an *internal* cap of pigment; excipulum in section grey-green to pale brownish, usually with blue-green pigment towards the outer edge; soredia not in discrete soralia, arising from a dissolution of the thallus .... ***8. L. xylogena***

(Dalwallinu) North Road, 14 km SE of Wubin, 30°13′40″S 116°44′50″E, 305 m alt., 30.iv.2004, *J.A. Elix 33568* (CANB).

2. *Lecidella elaeochroma* (Ach.) Hazsl.

Magy Birod. Zuzmo-Flor.: 197 (1884); *Lecidea parasema* β *elaeochroma* Ach., *Methodus*: 35: (1803).

Thallus smooth, rimose-areolate to papillate, pale grey to cream-grey, often rather discontinuous and revealing a thin, blue-black prothallus beneath, esorediate, forming irregular, extensive, undelimited patches typically along twigs and small branches. *Apothecia* 0.2–0.8 mm wide, sessile, basally constricted; disc plane at first, later often becoming convex, typically black, but rarely also pale to dark brown or mottled, matt to glossy, epruinose. *Proper excipulum* black, glossy, mostly persistent but sometimes ± excluded in the most convex apothecia, entire, in section 20–50 µm thick, colourless to dilute reddish brown within, unchanged in K, N+ intensifying orange-brown, mostly with additional blue-green, N+ crimson pigment, especially at the upper and outer edges. *Hypothecium* 50–90 µm thick, pale yellow-brown to yellow-orange, intensifying yellow-orange in K and N. *Hymenium* 50–90 µm thick, separating easily in K, mostly not inspersed, in the upper part intensely to dilutely greenish blue, K ± grey-green, N+ crimson, towards the base mostly colourless, typically overlain by a layer of brownish granules to *c*. 5–10 µm thick that dissolve in K. *Asci* 40–60 × 12–18 µm. *Paraphyses* 1.5–2.5 µm thick, simple; apices usually expanded to 2–4 µm thick, mostly with an external, blue-green, N+ crimson cap but sometimes unpigmented. *Ascospores* broadly ellipsoid, (9–)10–*12.1*–14(–15) × (5–)5.5–*6.4*–7.5(–8) µm. *Conidiomata* not observed. Fig. 1B

Chemical composition: As discussed by Knoph and Schmidt (1995) and Knoph and Leuckert (2004), this widespread species contains a complex range of xanthones. Material from mainland Australia and Tasmania revealed 2,5,7-trichloro-3-*O*-methylnorlichexanthone (major) together with arthothelin (±), isoarthothelin (±) atranorin (±), 5,7-dichloro-3-*O*-methylnorlichexanthone (±), 2,5-dichloronorlichexanthone (±), 4,5-dichloronorlichexanthone (±), 2,4-dichloronorlichexanthone (±), 4,5-dichloro-3-*O*-methylnorlichexanthone (±) and thuringone (±); thallus K–, KC–, C+ orange, P–, UV± weak orange.

Remarks: This distinctive species is recognised by the combination of the esorediate thallus containing xanthones, the presence of blue-green pigment in the excipulum and hymenium, the yellow-orange, K+ intensifying hypothecium, the hymenium that is very lax in KOH, and the relatively small ascospores. Australian material concurs well with a wide a range of specimens from the Northern Hemisphere that were examined, as well as with published descriptions (Knoph & Leuckert 2004; Fletcher *et al.* 2009). However, unlike European specimens, the apices of the paraphyses of Australian specimens are almost always pigmented.

There are two additional species recognised in this account which have previously been included in a broad and very loosely defined concept of *Lecidella elaeochroma*. In drier, sclerophyll forests, there is *L. destituta*, which differs chiefly by containing atranorin only and having an inspersed hymenium. In highland areas of Tasmania, in habitats similar to those where *L. elaeochroma* might occur, there is *L. montana*, which differs by having larger ascospores and a persistent, opaque brown excipulum, and typically contains thiophanic acid and arthothelin.

Distribution and ecology: This very widespread, ± cosmopolitan species is very localised in Tasmania, where it is known from only a few collections, all from high, cold elevations, especially in relatively low-rainfall areas. Significantly, all specimens studied, even those from mainland Australia, grew on the twigs of the low, highly branched shrub, *Hymenanthera dentata* R.Br. ex DC. (Violaceae), where it forms a very extensive cover, colonising seemingly every centimetre of the small twigs and branchlets. Although in most cases it forms pure colonies, in one Tasmanian specimen it was associated with *Teloschistes velifer* F.Wilson, *Ramalina glaucescens* Kremp. and a tiny species of *Caloplaca*. In contrast, in the Northern Hemisphere, *L. elaeochroma* appears to be a widespread and broadly ecologically tolerant species found in woodland, heathland and on wayside trees.

Specimens examined: **TASMANIA.** Summit of Mount Wellington, 42°54′S 147°14′E, 1200 m alt., 9.i.1989, *M. Allen s.n.* (HO); Jacks Creek, 2 km NW of Lagoon of Islands, 42°04′S 146°54′E, 880 m alt., 27.ii.1984, *A. Moscal 6538 p.p.* (HO); Mt Ossa summit, 41°52′S 146°02′E, 1600 m alt., 14.iii.1992, *G.*

Kantvilas 116/92 (HO); unnamed quartzite summit E of Mt Eliza, 42°57′S 146°25′E, 1300 m alt., 21.i.2012, *G. Kantvilas 9/12* (HO). **VICTORIA.** Dargo High Plains, 37°06′S 147°09′E, 1620 m alt., 17.xii.1993, *H. Streimann 53196* (CANB, HO, MEL). **NEW SOUTH WALES.** Johnnies Plain, 36°26′S 148°21′E, 1750 m alt., 2.xii.1992, *G. Kantvilas 442/92 & J.A. Elix* (HO). **AUSTRALIAN CAPITAL TERRITORY.** Mt Clear, 35°53′S 158°05′E, 1590 m alt., 1.x.1980, *H. Streimann 10589* (*H. Hertel: Lecid. Exsicc.* nr. 150) (HO).

3. *Lecidella flavovirens* Kantvilas & Elix, *sp. nov.*

MycoBank No.: MB803600

Lecidellae xylogenae *similis sed acidum thiophanicum continenti, sorediis primum in soraliis discretis, 0.2–0.5 mm latis enatis, excipulo atrofusco, pigmentum aeruginosum destituto et ascosporis grandioribus, 12–18 µm longis, 6–10 µm latis differt*.

Type: **TASMANIA.** Ship Stern Bluff, 43°12′S 147°45′E, 80 m alt., on *Banksia marginata* in coastal scrub, 2 May 2011, *G. Kantvilas 185/11* (HO: holotype; BM, CANB: isotypes).

Thallus effuse, scurfy, pale grey, undelimited, lacking a prothallus, sorediate; soredia yellowish or greenish yellow, at first arising in discrete, roundish soralia *c.* 0.2–0.5 mm wide or, more rarely, irregularly in cracks in the thallus, soon spreading and coalescing, and the whole thallus becoming a rather thick, cracked sorediate mass, spreading in irregular, undelimited patches to 10 cm wide; soredia coarsely granular, with individual grains 20–30 µm wide. *Apothecia* 0.3–1 mm wide, sessile, basally constricted to rather adnate and nestling deeply amongst the soredia; disc plane or occasionally becoming convex, black, matt to glossy, epruinose. *Proper excipulum* concolorous with the disc, black, glossy, persistent, entire or occasionally flexuose, in section 30–60 µm thick, ± opaque dark brown, unchanged in K, N+ intensifying orange-brown, lacking blue-green pigments. *Hypothecium* 50–80 µm thick, colourless to pale yellow-brown, occasionally yellowish orange, more intensely coloured towards the base, intensifying yellow-orange in K and N. *Hymenium* 50–80 µm thick, in the upper part intensely to dilutely greenish blue, K± grey-green, N+ crimson, towards the base mostly colourless, not inspersed or overlain by granules, remaining rather coherent in K. *Asci* 45–55 × 15–24 µm. *Paraphyses* (1–)1.5 µm thick, simple; apices not markedly capitate, sometimes expanded to 2.5–4 µm, unpigmented or coated with blue-green, N+ crimson pigment. *Ascospores* (12–)13–*15.2*–17(–18) × (6–)7–*8.3*–10 µm, broadly ellipsoid, sometimes a little apiculate at one or both apices. *Conidiomata* not observed. Fig. 1C

***Chemical composition*:** thiophanic acid (major), 4,5-dichloronorlichexanthone (± minor), asemone (± minor), isoarthothelin (± trace), arthothelin (± trace), argopsin (± minor), 5,7-dichloronorlichexanthone (± trace), atranorin (± minor), norlichexanthone (±); thallus K–, C+ orange, KC–, P–, UV+ orange. The array of compounds, especially xanthones, can be quite complex but thiophanic acid is invariably present.

Remarks: This is a very distinctive species on account of its rather bright, eye-catching, yellowish to yellowish green sorediate thallus. It is commonly encountered as sterile thalli only, although fertile specimens are not infrequent. Whilst the nature and disposition of the apothecial pigmentation (blue-green in the hymenium, brown in the excipulum, yellow-brown in the hypothecium) is constant, their intensity is highly variable. Specimens from exposed microhabitats have very intensely pigmented apothecia, whereas those from shaded, moist sites can be very dilutely coloured.

Lecidella flavovirens has some superficial similarities to *L. xylogena*, which often has a similar, yellowish sorediate thallus. However, that species appears much finer, but this impression is due not to a difference in size of the soredia (these are ± the same in both taxa) but due to the soredia being very thick and agglomerated in *L. flavovirens* but rather thinly dispersed in *L. xylogena*. There are further, more fundamental differences between the two species. Unlike *L. xylogena*, *L. flavovirens* lacks blue-green pigment in the excipulum. In *L. flavovirens*, pigment occurs on the outside of the paraphyses (not as an internal cap), and it is probably due to this that they remain more conglutinated in KOH. The two species also differ in that *L. xylogena* has smaller ascospores and contains thiophaninic acid. Indeed *L. flavovirens* is probably most similar to the chiefly Northern Hemisphere taxon, *L. scabra* (Taylor) Hertel & Leuckert, which has a similar gross morphology, displays a similar disposition of apothecial pigments, has similar-sized ascospores but differs chemically in containing atranorin and arthothelin (Knoph 1990), plus additional xanthones (our analyses).

Distribution and ecology: *Lecidella flavovirens* is a common and widespread species, recorded from Tasmania, Victoria, New South Wales, the Australian Capital Territory, South Australia (Kangaroo Island) and south-western Western Australia. In Tasmania, it is most commonly seen in coastal scrub and woodland, especially on *Banksia marginata* Cav., where it forms an extensive cover on trunks, young branches and twigs. It is also found in open, dry sclerophyll, eucalypt-dominated communities where it colonises logs, the bases of eucalypts, and the bark of understorey trees such as *Allocasuarina*. In such habitats, it is commonly associated with *Austroparmelina pseudorelicina* (Jatta) A.Crespo *et al.*, *Flavoparmelia rutidota* (Hook.f. & Taylor) Hale, *Pertusaria pertractata* Stirt., *P. trimera* (Müll.Arg.) A.W.Archer, *Tephromela atra* (Huds.) Hafellner, *T. sorediata* Kalb & Elix and *Usnea inermis* Motyka, as well as with its relative, *L. xylogena*. However, unlike that species, *L. flavovirens* has a broader ecological amplitude, extending into wet forests where it colonises understorey trees. In such habitats, associated lichens include *Mycoblastus campbellianus* (Nyl.) Zahlbr., *M. coniophorus* (Elix & A.W.Archer) Kantvilas & Elix and *Thelotrema lepadimum* (Ach.) Ach.

Selected specimens examined: **TASMANIA.** Coles Bay Conservation Area, 42°06′S 148°15′E, 50 m alt., 17.vi.2007, *G. Kantvilas 255/07* (HO); W of Tahune Bridge in the Warra SST, 43°06′S 146°41′E, 26.v.2008, *G. Kantvilas 209/08* (HO); N of Paradise Gorge, 42°33′S 147°50′E, 180 m alt., 12.vii.2009, *G. Kantvilas 291/09* (HO); *c.* 7 km E of Lake Leake, 42°01′30″S 147°55′00″E, 400 m alt., 24.iv.1996, *G. Kantvilas s.n.* (HO); South Sister, 41°32′S 148°10′E, 750 m alt., 11.xi.2004, *G. Kantvilas 283/04* (CANB, HO); Henty Sand Dunes, 42°04′S 145°17′E, 40 m alt., 21.i.2000, *G. Kantvilas 42/00* (HO); Fishers Point, 43°35′S 146°55′E, 1 m alt., 17.i.2004, *G. Kantvilas 77/04* (HO); Meredith Range, *c.* 3.5 km SE of Mt Meredith, 41°35′S 145°17′E, 750 m alt., 2.ii.2011, *G. Kantvilas 22/11* (HO); Levendale, 360 m alt., 1.viii.1981, *G. Kantvilas 440/81* (BM, HO); 1 km NW of Cockle Bay Lagoon, 42°42′S 147°56′E, 50 m alt., 24.vii.2011, *G. Kantvilas 222/11* (HO). **NEW SOUTH WALES.** Bermagui Trig Station, 36°25′S 150°05′E, 15 m alt., 14.vi.2006, *J.A. Elix 36604* (CANB); Goonoo State Forest, Mogriguy Forest Road, 5 km E of Mogriguy, 23 km NNE of Dubbo, 32°04′16″S 148°42′53″E, 330 m alt., 11.x.2005, *J.A. Elix 36776* (CANB); Bago Bluff National Park, Scrub Road, 7 km W of Wauchope, 31°28′45″S 152°39′36″E, 25 m alt., 8.viii.2008, *J.A. Elix 43275* (CANB). **VICTORIA.** Errinundra National Park, Goonmirk Rocks Road, 20 km SE of Bonang, 37°16′29″S 148°53′06″E, 910 m alt., 16.iv.2008, *J.A. Elix 39865* (CANB). **AUSTRALIAN CAPITAL TERRITORY.** Brindabella Range, N of summit of Mt Coree, 31 km W of Canberra, 35°18′S 148°49′E, 1400 m alt., 18.xii.1985, *J.A. Elix 19802B* (CANB). **SOUTH AUSTRALIA.** KANGAROO ISLAND, Creek Bay Farm, headwaters of Lubra Creek, 35°49′S 138°06′E, 40 m alt., 19.ix.2011, *G. Kantvilas 374/11*, *377/11* (AD, HO). **WESTERN AUSTRALIA.** The Cascades, 4 km S of Pemberton, 34°29′S 116°02′E, 180 m alt., 13.ix.1994, *J.A. Elix 28929* (CANB); Drovers Cave National Park, Jurien Road, 6 km NE of Jurien Bay, 30°15′44″S 115°06′43″E, 42 m alt., 6.v.2004, *J.A. Elix 28928* (CANB); Badgingarra National Park, Bibby Road, Drummond Reserve, 30°29′15″S 115°26′07″E, 200 m alt., 6.v.2004, *J.A. Elix 28947* (CANB); Burma Road Flora Reserve, 14 km SE of Walkaway-Nangetty Road, 28°59′26″S 115°03′35″E, 200 m alt., 4.v.2004, *J.A. Elix 33770* (CANB); Caves Road near Mammoth Cave turnoff, 34°05′S 115°02′E, 9.x.1992, *G. Kantvilas 311/92* & *J. Jarman* (HO, PERTH).

4. ***Lecidella granulosula*** (Nyl.) Knoph & Leuckert

Herzogia 14: 9 (2000); *Lecidea granulosula* Nyl., in Cromb., *J. Bot.* 14: 21 (1876).

Thallus granular, continuous or in part dispersed, pale cream to yellowish grey, undelimited, lacking a prothallus, esorediate, forming patches to *c.* 10 cm wide. *Apothecia* 0.3–0.6 mm wide, sessile, basally constricted, scattered; disc persistently plane or becoming convex with age, black, matt, epruinose. *Proper excipulum* black, matt to glossy, entire, usually becoming rather obscure in the most convex apothecia, in section 25–40 µm thick, pale brown to brown within, intensifying in N, mostly together with blue-green, N+ crimson pigment that becomes more intense at the outer edge. *Hypothecium* 60–100 µm thick, colourless, becoming slightly yellowish in K. *Hymenium* 50–70 µm thick, separating easily in K, not inspersed, in the upper part dilutely to intensely blue-green, K± grey-green, N+ crimson, with or without epihymenial granules that dissolve in K. *Asci* 40–55 × 12–18 µm. *Paraphyses* 1–2 µm thick, simple or occasionally bifurcate near the apices; apices mostly expanded, with an external, blue-green, N+ crimson cap 3–5 µm wide. *Ascospores* broadly ellipsoid to rather oblong, (9–)10–*11.5*–14 × (4.5–)5–*6.1*–7(–8) µm. *Conidiomata* not seen. Fig. 1D

Chemical composition: chodatin, demethylchodatin, thiophanic acid, 2,5,7-trichloro-3-*O*-methylnorlichexanthone (minor), thiophaninic acid (± minor), isoarthothelin (± minor), 2,4-dichloronorlichexanthone (± trace), 2,5,7-trichlorolichexanthone (± minor), 5,7-dichloro-3-*O*-methylnorlichexanthone (± trace), isoarthothelin (± minor); thallus K–, C+ orange, KC–, P–, UV+ orange.

Remarks: This species is readily recognised by the combination of the saxicolous habit, the finely granular thallus, the rather small apothecia and the colourless hypothecium (see also Knoph & Leuckert 2004). The morphology of the thallus can resemble that of *Lecidella sublapicida*, but that species has a yellow-brown to reddish brown hypothecium and differs chemically in containing vicanicin in addition to a suite of xanthones;

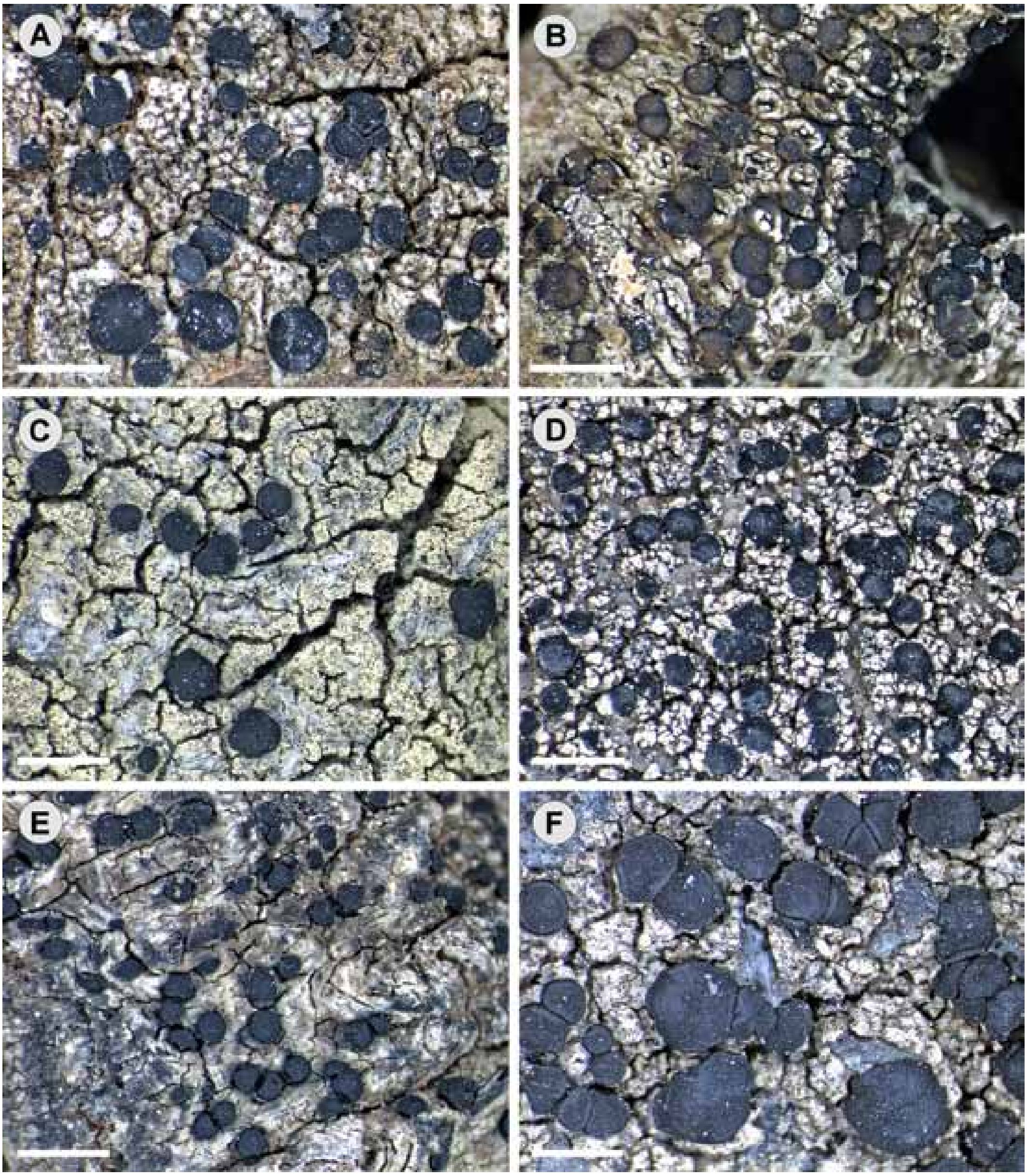

Figure 1. Habit of *Lecidella* species. **A.** *L. destituta* (holotype); **B.** *L. elaeochroma (Kantvilas 116/92);* **C.** *L. flavovirens* (holotype); **D.** *L. granulosula (Elix 28764 & Kantvilas)*; **E.** *L. montana (Kantvilas 142/00);* **F.** *L. stigmatea (Kantvilas 168/98)*. Scale = 1 mm.

furthermore the thallus of *L. sublapicida*, although often rather granular and warty, is much coarser. Of the species studied, *L. stigmatea* is the only other saxicolous species that has a colourless hypothecium, but it differs from *L. granulosula* by having much larger apothecia, a thicker thallus containing atranorin and zeorin, and a predominantly brown to purple-brown epihymenium.

Distribution and ecology: This species is widespread in both hemispheres and in Australia has previously been recorded from New South Wales (Knoph 1990; Knoph & Leuckert 2000) and Tasmania (Elix 2006). It appears to be quite uncommon (or overlooked). In Tasmania, it was recorded from rocks in rough pasture in a very low rainfall (*c.* 500 mm per annum) area, where it was associated with species of *Xanthoparmelia, Acarospora* and other crustose lichens. On Kangaroo Island, it was collected from eutrophicated coastal rocks in a penguin colony.

Specimens examined: **TASMANIA.** Lower Marshes Road, *c.* 1 km SW of Northumbria Hill, 42°23′S 147°15′E, 450 m alt., 9.xi.2004, *J.A. Elix 28764 & G. Kantvilas* (HO); Clarke Island, 40°30′S 148°10′E, 186 m alt., 1.iv.1980, *J.S. Whinray 1466* (HO, MEL). **NEW SOUTH WALES.** Goonoo State Forest, Cashels Dam Road, 31 km SE of Gilgandra, 31°55′57″S 148°52′17″E, 390 m alt., 12.x.2005, *J.A. Elix 37979* (CANB); Gibraltar Range State Forest, 49 km E of Glen Innes, 29°36′17″S 152°10′34″E, 1020 m alt., 2.v.2005, *J.A. Elix 39406* (CANB). **SOUTH AUSTRALIA.** KANGAROO ISLAND, Northern end of Antechamber Bay, 35°47′S 138°04′E, 5 m alt., 19.ix.2011, *G. Kantvilas 399/11* (HO).

5. *Lecidella montana* Kantvilas & Elix, *sp. nov.*

MycoBank No.: MB803598

Lecidellae elaeochromae commonita sed hymenio potius cohaerenti, ascosporis magnioribus, 15–24 µm longis, 8–13 µm latis, et acidum thiophanicum continenti differt.

Type: **AUSTRALIA, TASMANIA**. Falling Mountain, 41°55′S 146°06′E, 1480 m alt., on twigs of *Diselma archeri* in alpine heathland, 11 March 2011, *G. Kantvilas 137/11* (holotype: HO).

Thallus mostly rather patchy and discontinuous, revealing a thin blue-black prothallus beneath, effuse, smooth to rimose-areolate, rarely a little papillate, pale yellowish grey to cream-grey, esorediate, forming irregular, undelimited patches, sometimes to 10 cm wide but typically much smaller. *Apothecia* 0.2–0.7 mm wide, sessile, basally constricted; disc plane or occasionally becoming convex, black, matt to glossy, very rarely brown to dark brown, epruinose. *Proper excipulum* black, glossy, persistent, entire or occasionally flexuose or crenulate, in section 30–50 µm thick, pale to opaque dark brown within, unchanged in K, N+ intensifying orange-brown, sometimes also with blue-green, N+ crimson pigment at the inner edge. *Hypothecium* 30–100 µm thick, pale yellow-brown to yellow-orange, more intensely coloured towards the base, intensifying yellow-orange in K and N. *Hymenium* 70–100 µm thick, not inspersed, remaining rather coherent in K, in the upper part intensely to dilutely greenish blue, K± grey-green, N+ crimson, towards the base mostly colourless, commonly overlain by a layer of brownish granules to *c.* 10 µm thick that dissolve in K. *Asci* 55–70 ×18–30 µm. *Paraphyses* 1.5–2 µm thick, simple or with occasional branches and anastomoses; apices usually expanded to 2.5–5 µm thick, usually coated with blue-green, N+ crimson pigment. *Ascospores* 15–*18.1*–22(–24) × 8–*10.3*–12(–13) µm, broadly ellipsoid, frequently discoloured pale olive-brown. *Conidiomata* not observed. Fig. 1E

Chemical composition: thiophanic acid (major), isoarthothelin (± minor), 2,5,7-trichloro-3-*O*-methylnorlichexanthone (±), asemone (± trace); thallus K–, C+ orange, KC–, P–, UV+ orange.

Remarks: With its abundant black apothecia, pale yellowish-tinged, xanthone-containing thallus and predominantly twig habitat, this species is superficially similar to *Lecidella elaeochroma*. Like that species, it also has a K+ yellow-orange intensifying hypothecium and a granular epihymenium. It differs chiefly by its incrementally larger ascospores: in *L. elaeochroma* these are not known to exceed 17 µm in length, whereas in *L. montana* they are seldom shorter than that. Additional distinguishing features of *L. montana* include the relatively coherent hymenium in KOH, and the excipulum which is typically opaque brown in section and largely lacks blue-green pigment. Furthermore, the excipulum in the new species tends to be persistent, whereas in *L. elaeochroma* it is eventually excluded as the apothecia become very convex. The intensity of apothecial pigmentation appears to be linked to the degree of exposure. In extreme shade, such as within a dense shrub, the apothecia can have a brownish disc. In exposed habitats, the apothecia are jet black, and the blue-green pigment saturates the hymenium and clothes the upper parts of the paraphyses. The thallus varies from being almost absent, to consisting of rather dispersed, pale areoles, to being darker and ± continuous; again this variation is attributed to habitat factors.

The generic placement of this new species remains somewhat uncertain. The combination of its gross morphology, general pigmentation of the apothecia, structure of the excipulum and thallus chemistry are all consistent with *Lecidella*. However, the coherent hymenium is not, and the asci, although mostly of the *Lecidella*-type, may also tend towards the *Lecanora*-type, where the *masse axiale* penetrates the tholus ± entirely. However, at this point, there appears to be no better taxonomic placement for this lichen. The genus *Carbonea* was considered, but to place this epiphytic species into an essentially saxicolous genus seems inappropriate.

Distribution and ecology: This species is common and widespread in highland areas in Tasmania, where it is found on living and dead twigs and small branches of various trees and shrubs in heathland and woodland, for example, species of *Orites* R.Br., *Microstrobos niphophilus* J.Garden & L.Johnson, *Diselma archeri* Hook.f., *Nothofagus cunninghamii* (Hook.) Oersted and *Epacris serpyllifolia* R.Br. It is commonly the dominant lichen in such habitats, clothing the entire length of the substrate and consequently occurs in pure colonies rather than in association with other lichens. It also colonises the fibrous bark of the trunks of the conifer *Athrotaxis cupressoides* D.Don. It is typically quite conspicuous, with its abundant black apothecia contrasting with the pale colour of the bleached twigs on which it grows.

Specimens examined: **TASMANIA.** Lake Skinner, 42°56'S 146°41'E, 970 m alt., 17.v.2008, *G. Kantvilas 200/08* (HO); summit of Rodway Range, 42°41'S 146°34'E, 1375 m alt., 17.iv.2006, *G. Kantvilas 206/06* (HO); foot of Adam Peak, 41°44'S 146°41'E, 1210 m alt., 24.i.2009, *G. Kantvilas 3/09* (HO); Blue Peaks, northern summit, 41°43'S 146°22'E, 1340 m alt., 20.xi.2006 (HO), *G. Kantvilas 526/06* (HO); Lake Esperance, 43°14'S 146°46'E, 980 m alt., 30.xii.1999, *G. Kantvilas 461/99* (HO); Meredith Range, *c.* 3.5 km SE of Mt Meredith, 41°35'S 145°17'E, 750 m alt., 2.ii.2011, *G. Kantvilas 27/11* (HO); near the summit of Black Bluff, 41°27'S 145°57'E, 1300 m alt., 26.iii.2000, *G. Kantvilas 142/00* (HO); southern summit of Mt Wright, 42°37'S 146°20'E, 1110 m alt., 26.i.2008, *G. Kantvilas 31/08* (HO); Mt Sprent, 42°48'S 145°58'E, 900 m alt., 17.ii.1987, *G. Kantvilas 73/87* (HO, M); Little Horn, 41°41'S 145°58'E, 1320 m alt., 16.ix.1995, *G. Kantvilas 90/95* (HO); summit of Clear Hill, 42°41'S 146°16'E, 1198 m alt., 27.xii.2011, *G. Kantvilas 499/11* (HO); Turrana Bluff, 41°46'S 146°21'E, 1450 m alt., 16.ii.2012, *G. Kantvilas 50/12* (HO).

6. *Lecidella stigmatea* (Ach.) Hertel & Leuckert

Willdenowia 5: 375 (1969); *Lecidea stigmatea* Ach., *Lich. Univ.*: 161 (1810).

Thallus rimose-areolate to rather lumpy and verruculose, continuous or dispersed, pale cream- to grey-brown, sometimes discoloured brownish, undelimited, lacking a prothallus, esorediate, forming extensive patches to *c.* 20–30 cm wide. *Apothecia* 0.4–1.5 mm wide, sessile, basally constricted, scattered or crowded together; disc plane, becoming undulate to convex in the oldest, largest apothecia, black, matt, epruinose. *Proper excipulum* black, matt to glossy, mostly persistent although occasionally rather obscure in the most convex apothecia, entire, in section 35–*50*(–80) µm thick, blue-green, K± grey-green, N+ crimson at the outer edge, increasingly dilute blue-green to colourless within. *Hypothecium* 60–150 µm thick, colourless or occasionally pale yellow-brown at the base. *Hymenium* 60–100 µm thick, separating easily in K, not inspersed, in the upper part brownish to purple-brown, intensifying in K, typically also with at least some blue-green, N+ crimson pigment, towards the base mostly colourless, not overlain by epihymenial granules. *Asci* 45–60 × 13–20 µm. *Paraphyses* 1–2 µm thick, simple; apices unpigmented and not expanded or, more commonly, with an external, blue-green, N+ crimson cap 2.5–5 µm wide. *Ascospores* broadly ellipsoid to rather oblong, (10–)11–*13.4*–15(–16) × (6–)6.5–*7.8*–9(–10) µm. *Conidiomata* rare, located in only one specimen, immersed; conidia thread-like, curved, *c.* 12–20 × 1 µm. Fig. 1F

Chemical composition: atranorin and zeorin; thallus K+ weakly yellow, KC–, C–, P–, UV–.

Remarks: This species is characterised by the relatively wide-spreading, well-developed thallus containing atranorin and zeorin (an unusual chemistry for the genus), the relatively large apothecia that become convex at maturity, and the often-massive, mainly colourless hypothecium (see also Knoph & Leuckert 2004; Fletcher *et al.* 2009). Of the saxicolous species studied, *Lecidella stigmatea* shares a colourless hypothecium with *L. granulosula*, but that species differs by its granular thallus containing xanthones (C+ orange) and by its smaller apothecia. It differs starkly from *L. sublapicida*, which has a brownish hypothecium and also contains xanthones.

Distribution and ecology: *Lecidella stigmatea* is a very widespread species in both hemispheres, occurring mainly on calcareous substrates. Its Tasmanian distribution ranges from limestone outcrops in natural vegetation to concrete in a suburban garden. Several collections are also from dolerite, a siliceous rock type, in sites subject to nutrient enrichment, such as boulders in rough sheep-grazing land. Associated species include *Lecanora dispersa* (Pers.) Sommerf., *Candelariella aurella* (Hoffm.) Zahlbr., *C. vitellina* (Hoffm.) Müll.Arg. and species of *Caloplaca*. It was first reported for Tasmania by Hertel (1989).

Specimens examined: **TASMANIA.** Lune River Lagoon mouth, 43°26'S 146°55'E, 1968, *G.C. Bratt 68/523* (HO); Glen Morey Saltpan near Tunbridge, 42°09'S 147°29'E, 175 m alt., 1984, *A. Moscal 8793* (HO); Giblin River, *c.* 7 km SW of Hardwood Hill, 70 m alt., 1985, *G. Kantvilas 182/85* (HO); Cascades, Hobart, 42°54'S 147°17'E, 130 m alt., 1998, *G. Kantvilas 168/98* (HO); Bisdee Tier, 42°26'S 147°17'E, 640 m alt., 2009, *G. Kantvilas 171/09* (HO). **AUSTRALIAN CAPITAL TERRITORY.** Brindabella Range, summit of Mt Aggie, 35°28'S 148°46'E, 22.xi.1989, *W.H. Ewers 4610* (CANB).

7. *Lecidella sublapicida* (C. Knight) Hertel

Mitt. Bot. München 19: 444 (1983); *Lecidea sublapicida* C. Knight, *Trans. N.Z. Inst.* 8: 316 (1876).

Thallus rimose-areolate to rather granular-verruculose, continuous or dispersed, pale pinkish brown, cream-grey to grey-brown, undelimited, sometimes very thin to absent, lacking a prothallus, esorediate, forming irregular patches to *c.* 10 cm wide. *Apothecia* 0.2–0.8 mm wide, scattered or crowded together, sessile, basally constricted; disc mostly persistently plane, sometimes a little undulate but only rarely convex, black, matt to glossy, epruinose. *Proper excipulum* black, matt to glossy, entire to a little flexuose, mostly persistent or becoming inconspicuous and excluded, especially in more convex apothecia, in section 15–50 µm thick, opaque red-brown within, unchanged in K, N+ intensifying orange-brown, also with additional blue-green, N+ crimson pigment, particularly at the edges, rarely ± entirely deep blue-green. *Hypothecium* 20–100 µm thick, yellow-brown to deep brown, intensifying yellow-orange in K and N, typically subtended by a darker red-brown layer continuous with the excipulum. *Hymenium* 55–90 µm thick, separating easily in K, in the upper part intensely greenish blue, K ± grey-green to blue-green, N+ crimson, towards the base mostly colourless, occasionally overlain by brownish granules that dissolve in K. *Asci* 40–60 × 12–20 µm. *Paraphyses* 1–2 µm thick, simple to sparsely branched; apices unpigmented and only slightly expanded to 2–2.5 µm wide or, more commonly, with an external, blue-green, N+ crimson cap 2–4 µm wide. *Ascospores* broadly ellipsoid to ovate, (9–)10–*12.3*–15(–17) × (4.5–)6–*6.9*–8(–9) µm. *Conidiomata* not observed. Fig. 2A

Chemical composition: vicanicin, 2,5,7-trichloro-3-*O*-methylnorlichexanthone, 5,7-dichloro-3-*O*-methylnorlichexanthone, isoarthothelin (minor), arthothelin (± minor), atranorin (± minor), vicanicin methyl ether (± minor), 5,7-dichlorolichexanthone (± minor), 3-*O*-methylasemone (± minor), 3-*O*-methylthiophanic acid (± minor), thiophanic acid (± minor), 2,5,7-trichlorolichexanthone (± minor); thallus K–, KC–, C+ orange, P–. The suite of xanthones present is highly variable and not easily detected by thin-layer chromatography; however, vicanicin is inevitably present. In specimens where the thallus is extremely thin to absent, thin-layer chromatography may not detect any substances.

Remarks: *Lecidella sublapicida* is recognised by its often rather granular thallus, and abundant, black, usually persistently marginate apothecia with a red-brown to yellow-brown hypothecium. Unlike in most other *Lecidella* species studied, the excipulum appears to be cupular or almost so, and extends continuously beneath the hymenial and subhypothecial layers, forming a secondary, deeper brown layer of tissue. Also characteristic is the presence of vicanicin together with a suite of xanthones. The dark hypothecium is unique to *Lecidella* in Tasmania and the presence of vicanicin is diagnostic.

This species is very closely related to the widespread, chiefly Northern Hemisphere taxon, *L. carpathica* Körb., which has an identical habitat ecology, a virtually identical thallus morphology and apothecial anatomy, but differs chemically in containing diploicin (instead of vicanicin) and the xanthone thuringione (see also Knoph 1990). This subtle chemical difference requires high performance liquid chromatography for accurate determination. Although *L. carpathica* has been recorded for Tasmania, it appears to have been consistently mistaken for *L. sublapicida*, and all material studied has been determined by us as the latter.

Another anatomically similar species with a yellow-brown hypothecium and a granular-verrucose thallus containing xanthones is *L. wulfenii* (Hepp) Körb., which is widespread in the Northern Hemisphere where it grows over bryophytes and soil (Knoph & Leuckert 2004; Fletcher *et al.* 2009). It has also been recorded occasionally in the Southern Hemisphere: from New Zealand (Galloway 2007) and the Subantarctic islands (Øvstedal & Lewis Smith 2001). We originally contemplated including one unusual Tasmanian specimen (*Kantvilas 923/01*), collected from alpine bryophytes overgrowing a boulder, as this species. However, in addition to a suite of xanthones, this specimen also contains vicanicin, an unusual and diagnostic substance in *Lecidella*, and hence we have determined it as *L. sublapicida*.

Distribution and ecology: This is a very widespread, saxicolous species in the temperate Southern Hemisphere. In Tasmania, it displays a very wide ecological amplitude, ranging from the coast to the summits of the highest peaks. It is often found in nutrient-enriched habitats. For example, at alpine elevations it grows on large, bird-perch boulders where it is part of a rich lichen community that includes *Xanthoria candelaria* (L.) Th.Fr., *Candelariella vitellina* (Hoffm.) Müll.Arg., *Protoparmelia badia* (Hoffm.) Hafellner, *Xanthoparmelia loxodella* (Essl.) O.Blanco *et al.*, *Immersaria athroocarpa* (Ach.) Rambold & Pietschm, *Rimularia psephota* (Tuck.) Hertel & Rambold, *Usnea torulosa* (Müll.Arg.) Zahlbr., *Lecanora polytropa* (Ehrh.) Rabenh. and *L. rupicola* (L.) Zahlbr. It has also been recorded in areas of human-induced eutrophication, such as on rocks splashed by urine in the vicinity of bush-walkers huts. In such habitats, it may form extensive, pure colonies. In rough grazing land it occurs on boulders amongst grasses. On coastal rocks it can be found associated with species of *Xanthoparmelia* and *Caloplaca*. Although exclusively saxicolous, one specimen studied was from hardened gloss house paint. The unusual muscicolous specimen was from the moist, sheltered face of a large dolerite boulder in highland eucalypt woodland, where it was associated with *Teloschistes spinosus* (Hook.f. & Taylor) J.S.Murray, the basal squamules of *Cladonia* and incipient thalli of Parmeliaceae.

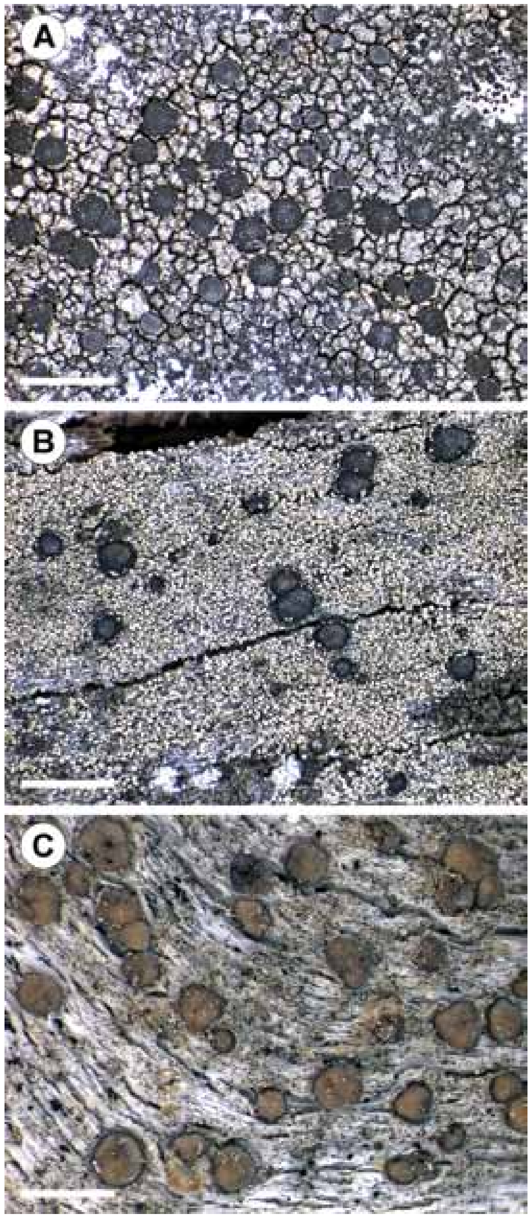

Figure 2. Habit of *Lecidella* species. **A.** *L. sublapicida (Kantvilas 570/00)*; **B.** *L. xylogena* with typical, farinose sorediate thallus and dark-pigmented apothecia (*Bastow s.n.*); **C.** *L. xylogena* with highly reduced, esorediate thallus and pallid apothecia (*Kantvilas 303/05*). Scale = 1 mm.

Specimens examined: **TASMANIA.** Mt King William I, 42°14′S 146°08′E, 1240 m alt., 31.i.1984, *G. Kantvilas 88/84B* (HO); Couta Rocks, 41°10′S 144°41′E, 9.xii.1993, *G. Kantvilas 304/93 & J. Elix* (HO); Huon Road, 42°54′S 147°17′E, 240 m alt., 30.xii.2000, *G. Kantvilas 570/00* (HO); near Temma, 41°13′S 144°42′E, 5 m alt., 21.xi.2001, *G. Kantvilas 1200/01* (HO); South Sister, 41°32′S 148°10′E, 750 m alt., 10.xi.2004, *G. Kantvilas 419/04* (HO); Mersey Crag, 41°46′S 146°20′E, 1420 m alt., 3.ii.2010, *G. Kantvilas 65/10* (HO); *c.* 2 km S of Lake Augusta, 41°54′S 146°E, 1140 m alt., 14.xii.1999, *G. Kantvilas 447/99* (HO); Lake Kaye, 41°54′S 146°31′E, 1140 m alt., 8.iii.2000, *G. Kantvilas 92/00* (HO); *c.* 8 km S of Beaconsfield, 41°14′S 146°52′E, 1984, *J. Jarman s.n.* (HO); Lake Newdegate, 42°40′S 146°34′E, 1090 m alt., 28.x.2007, *G. Kantvilas 328/07* (HO); Blue Peaks, northern summit, 41°43′S 146°22′E, 1350 m alt., 20.xi.2006, *G. Kantvilas 531/06* (HO); Bisdee Tier, 42°26′S 147°17′E, 640 m alt., 11.iii.2009, *G. Kantvilas 114/09* (HO); western slope of Table Mountain, 42°14′S 147°08′E, 1030 m alt., 6.x.2001, *G. Kantvilas 923/01* (HO); summit of Sandbanks Tier, 41°51′S 146°52′E, 1400 m alt., 24.vi.2000, *G. Kantvilas 332/00* (HO); Skullbone Plains, 42°02′S 146°19′E, 1000 m alt., 29.ii.2012, *G. Kantvilas 99/12* (HO). **VICTORIA.** Alpine National Park, Mt McKay, 16 km SSE of Mt Beauty township, 36°52′S 147°14′E, 1840 m alt., 18.ii.1994, *J.A. Elix 40605 & H. Streimann* (B, CANB); Alpine National Park, Pretty Valley, 18 km SSE of Mt Beauty township, 36°53′S 147°14′E, 1600 m alt., 18.ii.1994, *J.A. Elix 40622 & H.Streimann* (CANB). **SOUTH AUSTRALIA.** KANGAROO ISLAND, Northern end of Antechamber Bay, 35°47′S 138°04′E, 5 m alt., 19.ix.2011, *G. Kantvilas 401/11* (HO); Cape Willoughby Road, 35°50′S 138°06′E, 110 m alt., 29.ix.2011, *G. Kantvilas 325/11* (HO). **WESTERN AUSTRALIA.** Stirling Range National Park, summit of Toolbrunup Peak, 40 km SW of Borden, 34°23′S 118°03′E, 980 m alt., 17.ix.1994, *J.A. Elix 41522* (CANB, H, M).

8. *Lecidella xylogena* (Müll. Arg.) Kantvilas & Elix, *comb. nov.*

MycoBank No.: MB803601

Lecidea xylogena Müll. Arg., *Bull. Herb. Boissier* 1: 44 (1893).

Type: **VICTORIA**. On dead wood, 1892, *F.R.M. Wilson 1339* (holotype: G!; isotype: BM!).

Thallus scurfy or rarely composed of minute, dispersed areoles, sometimes ± absent or inapparent, pale grey to yellowish, occasionally ± esorediate, but more commonly soon dissolving ± entirely into a conspicuous, pale yellowish to greenish yellow sorediate mass, spreading in irregular, undelimited patches *c.* 10–30 mm wide; soredia farinose to coarsely granular, with individual grains 16–30 µm wide. *Apothecia* 0.3–0.7 mm wide, sessile, basally constricted to rather adnate, often nestling deeply amongst the soredia; disc plane to slightly concave, pale brownish to brown-grey, rarely dark grey to brownish black, rather waxy, typically epruinose but rarely with a thin, discontinuous, greyish pruina. *Proper excipulum* dark grey to black, more rarely pale to dark red-brown, rather glossy, persistent, entire or occasionally flexuose, in section 15–40 µm thick, grey-green to pale brownish within, usually more intensely pigmented greenish blue, N+ crimson towards the outer edge, more rarely entirely lacking pigment. *Hypothecium* 40–120 µm thick, colourless to pale brownish, unchanged or intensifying brownish yellow in K. *Hymenium* 50–70 µm thick, colourless, not inspersed, very lax and separating readily in K, overlain by an epithecium *c.* 10 µm thick consisting of brownish granules that dissolve in K and the grey-green apices of the paraphyses. *Asci* 40–55 × 13–20 µm. *Paraphyses* (1–)1.5(–2) µm thick, simple except for occasional bifurcations at the apices, markedly capitate; apices 3.5–5 µm wide, occasionally a little moniliform, with an internal cap of grey-green, N+ crimson pigment. *Ascospores* (7–)8–*10.9*–14 × 4–*6.3*–8(–9) µm, broadly ellipsoid. Conidiomata not observed. Figs 2B–C

Chemical composition: thiophaninic acid (major), thiophanic acid (± trace), 2,4-dichloronorlichexanthone (± trace), 2,5,7-trichloro-3-*O*-methylnorlichexanthone (±), asemone (± trace), isoarthothelin (± trace), isopigmentosin B (± trace), isopigmentosin C (± trace), usnic acid (± trace); thallus K–, C+ orange, KC–, P–, UV+ orange. The chemical composition of this species can be rather variable. Thiophaninic acid is the major compound in the great majority of specimens studied, including the type. Occasional specimens yielded no chemistry, but this is attributed to having attempted to extract too little thallus material. Two enigmatic specimens (*Kantvilas 131/06, 235/09*) lack thiophaninic acid but contain arthothelin as the major compound, whereas a third (*Ratkowsky s.n.*, HO 301660) contains only 2,5,7-trichloro-3-*O*-methylnorlichexanthone. Nevertheless, all display the distinctive and highly characteristic anatomical features of thiophaninic acid-containing specimens (see discussion below).

Remarks: This is a variable species morphologically and anatomically. The type specimen of *Lecidella* *xylogena* has a yellowish, finely farinose sorediate thallus containing thiophaninic acid, relatively small apothecia with a pale disc and darker, thin persistent margin, a granular, brownish epithecium that dissolves in KOH, capitate, apically pigmented paraphyses that are very lax in KOH, and rather small ascospores. The majority of specimens studied display these features. The paraphyses in particular are highly distinctive: whereas in all the other species studied, any apical pigmentation occurs as an *external* cap, in *L. xylogena*, the pigmentation is entirely *within* the markedly expanded terminal cell. The soredia in *L. xylogena* do not arise from discrete soralia but are derived from a general disintegration of the thin, scurfy thallus. In some specimens, the thallus is ± absent whereas in others, soredia are barely developed and the thallus consists of tiny yellowish granules; in these instances, the anatomy of the apothecia determine the identity of the specimens. Very occasional specimens (or parts of specimens) have entirely pale to dark reddish brown apothecia that lack almost any trace of blue-green pigment; this is attributed to the degree of exposure of the microhabitat.

In exploring the chemical variation of this species, we looked for correlations between chemistry and anatomical/morphological characters but without success, and the more specimens or apothecial sections were examined, the more any suspected correlations, for example with ascospore size, became blurred. Specimens containing 2,5,7-trichloro-3-*O*-methylnorlichexanthone (instead of thiophaninic acid) were especially problematic. For these the name *Lecidea leptolomoides* Müll.Arg (syn. *L. minutula* Müll.Arg) could be available. The isotypes of these two taxa (in NSW) both have this chemistry and represent a *Lecidella* with a very thin, inconspicuous, esorediate thallus, collected from the bark of exotic trees in Victoria. Yet anatomically both specimens display all the key characters of *L. xylogena* with respect to ascospore size, paraphyses and excipular pigmentation. At this stage we are reluctant to formally synonymise these names, but we are nevertheless placing all specimens with the characters outlined above under the name *L. xylogena* regardless of thallus chemistry.

The most similar species to *L. xylogena* is *L. flavovirens*, which differs by having a much coarser, thicker, sorediate thallus in which the soredia initially arise in discrete soralia and then spread and coalesce, and has more intensely pigmented apothecia in which there is no brown, granular epithecium, and in which the blue-green pigment is confined to the upper part of the hymenium (and does not occur in the excipulum). *Lecidella flavovirens* differs further by having larger ascospores and by containing thiophanic acid as the major compound. Also somewhat similar is the Northern Hemisphere's *L. subviridis* Tønsberg, but this contains atranorin in addition to thiophanic acid and arthothelin (our analyses), and has larger ascospores (Fletcher *et al.* 2009).

Lecidella xylogena can also rarely be confused with *Ramboldia sorediata* Kalb in that both can have an entirely sorediate thallus and occur in the same habitats. The latter species typically has a whitish thallus, but it can occasionally become a little yellowish green. Such specimens are readily identified as *Ramboldia* by their chemistry (thamnolic acid, K+ yellow). Also similar is a rather common, yellowish, entirely sorediate, sterile lichen that occurs on old worked timber in gardens; it contains usnic acid as the major compound and is likely to be a species of *Lecanora*.

Distribution and ecology: *Lecidella xylogena* is a tiny species found mainly on the lignin or bark of eucalypts or on understorey trees such as *Allocasuarina* in dry sclerophyll woodlands, especially at low elevations. There it is part of a rich association of small, mainly lignicolous lichens, including *Buellia* spp., *Candelariella reflexa* (Nyl.) Lettau, *Lecanora subtecta* (Stirt.) Kantvilas & LaGreca, *Micarea* spp., *Pertusaria pertractata* Stirt., *Punctelia pseudocoralloidea* (Gyel.) Elix & Kantvilas, *Ramboldia sorediata* Kalb, *Rinodina asperata* (Shirley) Kantvilas and *Usnea inermis* Motyka. It has also been collected from split eucalypt fence posts in pasture land and from the bark of exotic trees such as *Prunus* species in cultivated gardens. Less commonly it occurs at alpine elevations on eucalypt wood and on the twigs of shrubs such as *Richea sprengelioides* (R.Br.) F. Muell. It has been recorded in eastern and northern Tasmania, Victoria, Kangaroo Island (South Australia) and the Australian Capital Territory, but can be expected to be widespread in low rainfall areas of southern Australia.

Selected specimens examined: **TASMANIA.** Launceston, Carr Villa Cemetery, 41°28'S 147°10'E, 80 m alt., 4.ii.1992, *A.V.*

Ratkowsky s.n. (HO); Trevallyn SRA, 41°27′S 147°06′E, 200 m alt., 22.viii.1992, *A.V. Ratkowsky s.n.* (HO); Cripps Creek, 43°08′S 147°43′E, 2 m alt., 5.x.1995, *L. Cave s.n.* (HO); Brown Mountain Road near garbage tip, 42°38′S 147°28′E, 160 m alt., 18.ix.2002, *G. Kantvilas 501/02* (HO); Mayfield Point, 42°15′S 148°01′E, 10 m alt., 27.x.2002, *G. Kantvilas 584/02* (HO); Yellow Sandbanks, Moulting Lagoon, 42°05′S 148°11′E, 2 m alt., 24.xi.2004, *G. Kantvilas 4004/04* (HO); W of Tahune Bridge in the Warra SST, 43°06′S 146°41′E, 130 m alt., 28.ii.2006, *G. Kantvilas 131/06* (HO); Bisdee Tier, 42°26′S 147°17′E, 640 m alt., 22.iv.2009, *G. Kantvilas 235/09* (HO); Butlers Gorge Road near site of old township, 42°17′S 146°16′E, 720 m alt., 2.xi.2005, *G. Kantvilas 303/05* (HO); 2 km S of Howden near the Powder Jetty, 43°03′S 147°18′E. 20 m alt., 21.v.1997, *G. Kantvilas 203/97* (HO); Cascades, South Hobart, 42°54′S 147°17′E, 120 m alt., 11.v.2003, *G. Kantvilas 89/03* (HO); Passage Island, 40°31′S 148°19′E, 30 m alt., 6.i.1979, *J. Whinray 1272* (HO, MEL). **AUSTRALIAN CAPITAL TERRITORY.** Canberra Nature Park, Aranda Bushland, 4 km W of Canberra, 35°16′14″S 149°04′34″E, 580 m alt., 18.vi.2005, *J. A. Elix 28822* (CANB); Aranda, 35°16′S 149°05′E, 650 m alt., 17.vi.1998, *J.A. Elix 43021* (CANB, HO). **VICTORIA.** Kew, 37°49′S 145°03′E, 3.xi.1900, *R.A. Bastow s.n.* (HO, MEL). **SOUTH AUSTRALIA.** KANGAROO ISLAND, Mt Taylor Conservation Park, 35°56′S 137°03′E, 25.viii.1982, *K. Stove 1755 p.p.* (AD, HO); Creek Bay Farm, headwaters of Lubra Creek, 35°49′S 138°06′E, 40 m alt., 19.ix.2011, *G. Kantvilas 382/11* (HO).

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