Observations on some calcicolous species of Lecania A.Massal. (lichenised Ascomycetes: Ramalinaceae) in southern Australia

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Abstract

Four species of Lecania A.Massal. occurring on calcareous substrata in southern Australia are treated. Lecania maritima Kantvilas & van den Boom is described as new to science and is recorded from Kangaroo Island and Flinders Island. Lecania polycarpa (Müll.Arg.) Kantvilas & van den Boom, comb. nov., is an Australian endemic, known from Kangaroo Island, Flinders Island and the Victorian coast. Two further species are widely distributed, chiefly in temperate areas of the world: L. inundata (Hepp ex Körb.) M.Mayrhofer and L. turicensis (Hepp) Müll.Arg. are both reported for Tasmania for the first time; the former is also a new record for Victoria. The salient features of these four taxa are compared.

Keywords: biodiversity, Catillaria, lichens, new taxa, Kangaroo Island, Tasmania, Victoria.

Introduction

This paper continues the investigation of the lichens of Kangaroo Island in anticipation of a checklist for the island; earlier contributions to this project include Elix & Kantvilas (2013a, b), Kantvilas & Elix (2014), Kantvilas & Kondratyuk (2013), Kantvilas & van den Boom (2013), Kantvilas & Wedin (2015) and McCarthy & Kantvilas (2013a, b). This paper deals with Lecania A.Massal., a genus of crustose lichens in the family Ramalinaceae that contains about 40 described species (Kirk et al. 2001), including eight that have been recorded for Australia (McCarthy 2015).

Lecania is characterised by a green, coccoid photobiont, biatorine to lecanorine apothecia, Bacidia-type asci and hyaline, non-halonate, ± ellipsoid, trans-septate ascospores. Identification and delimitation of species of Lecania is generally regarded as difficult (Fletcher et al. 2009), especially due to highly variable attributes of the thallus and apothecial margin. As a result of this last feature in particular, species can be confused with the unrelated genus Catillaria A.Massal., which shares with Lecania 1-septate, hyaline ascospores, but has different excipular and hymenial anatomy, including markedly different asci (Catillaria-type; Hafellner 1984). There are several regional, Northern Hemisphere treatments of the genus (e.g. Mayrhofer 1988, Fletcher et al. 2009, van den Boom & Ryan 2004) that greatly assist in the identification of Australian collections. A synopsis of the species recorded for Australia has also been published (van den Boom & Mayrhofer 2007).

Species of Lecania are found mostly in temperate to subtropical latitudes and occur on a wide range of substrata, including rocks, bark, wood, soil, shell or bone fragments, and man-made materials such as concrete. Four calcicolous, Australian taxa are documented in the present study.

Methods

The study is based chiefly on collections of the first author, housed in the Tasmanian Herbarium (HO) with duplicates distributed to the State Herbarium of South Australia (AD), the Australian National Herbarium (CANB), herb. van den Boom (Netherlands) and elsewhere, and on comparison with herbarium material from the Northern Hemisphere. The descriptions are based exclusively on the Australian material studied, and significant deviations from existing descriptions (essentially from Northern Hemisphere studies) are highlighted. Hand-cut sections of the thallus and ascomata were mounted in water, 15% KOH (K), Lugols Iodine after pretreatment with K (IKI), ammoniacal erythrosin and 50% HNO3 (N) for examination by high-power light microscopy. Dimensions of asci and ascospores are based on 20 and at least 50 observations respectively. The latter are presented in the format: 5th percentile–average–95th percentile; outlying extreme values are given in parentheses. Nomenclature of asci follows Hafellner (1984); that of pigments follows Meyer & Printzen (2000).

Taxonomy

1. Lecania inundata (Hepp ex Körb.) M.Mayrhofer

Thallus crustose, areolate, often minutely papillate,
yellowish brown to grey-brown or dark brown, epruinose, not delimited by a prothallus; individual areoles contiguous or dispersed, loosely attached to the substratum, to 0.6 mm thick, with a cortex to c. 50 µm thick, sometimes becoming granular, rarely very sparse and the thallus then dominated by apothecia; photobiont cells broadly ellipsoid to ± globose, 7–23 × 5–20 µm. Apothecia lecanorine, superficial, basally constricted, to 0.8 mm diam., typically very numerous, scattered or crowded together and ± obscuring the thallus; disc pale brown, orange-brown to dark brown, sometimes mottled, rarely grey-pruinose, plane at first, soon becoming convex; thalline excipulum pale grey to pale grey-brown, entire, crenulate or radially fissured, epruinose, becoming inapparent and excluded in more convex apothecia, in section (40–) 70–100 µm thick, cupular, densely packed with photobiont cells, usually with a hyaline outer layer 10–20 µm thick, becoming reflexed in more convex apothecia. Hypothecium 50–80 µm thick, hyaline to pale yellowish, not inspersed. Hymenium 55–70 µm thick, hyaline, not inspersed, overlain with an orange-brown to purple-brown epihymenial layer to 10–20 µm thick, K–, N± orange-brown. Asci 8-spored, 40–50 × 12–15 µm, clavate, of the Bacidia-type, with a prominent amyloid tholus and a conical, weakly amyloid masse axiale; ocular chamber lacking or weakly developed. Paraphyses simple, 2.5–3 µm wide; most apices prominently enlarged to 3–7 µm, with the terminal cells coated with pigment. Ascospores ellipsoid, hyaline, thin-walled, non-halotanate, (10–) 11–13.6–17 (–19) × (4–) 4.5–5.2–6 (–7) µm, (0–) 1-septate. Pycnidia not found. Chemistry: no substances detected by t.l.c. Fig. 1A, 2C.

Remarks. Lecania inundata is widely distributed in the Northern Hemisphere [for example, see Fletcher et al. (2009) and van den Boom & Ryan (2004), who also provide descriptions]. In Australia, van den Boom & Mayrhofer (2007) record this species for South Australia and New South Wales; it is recorded here for Tasmania and Victoria for the first time. It is characterised by a pale greyish or brownish, areolate, rather nodular, epruinose thallus with minute papillae, and by the usually clustered, epruinose apothecia that are initially lecanorine but at length become strongly convex and with an excluded margin. The individual papillae are
Table 1. Comparison of salient features of calcicolous Lecania species.

<table>
<thead>
<tr>
<th></th>
<th>L. inundata</th>
<th>L. maritima</th>
<th>L. polycarpa</th>
<th>L. turicensis</th>
</tr>
</thead>
<tbody>
<tr>
<td>thallus</td>
<td>areolate, minutely papillose, yellowish brown to grey-brown, epruinose</td>
<td>endolithic, inapparent</td>
<td>endolithic, inapparent</td>
<td>granular-areolate, grey to brown, pruinose</td>
</tr>
<tr>
<td>apothecia</td>
<td>lecanorine, to 0.8 mm diam.</td>
<td>biatorine, to 0.8 mm diam.</td>
<td>biatorine, to 0.6 mm diam.</td>
<td>lecanorine, to 1 mm diam.</td>
</tr>
<tr>
<td>apothecial margin</td>
<td>pale greyish, epruinose, 40–100 µm thick, becoming excluded</td>
<td>black, pruinose, 50–80 µm thick, opaque in section, persistent</td>
<td>black, mostly epruinose, 30–80 µm thick, becoming excluded</td>
<td>grey-brown, pruinose, 70–100 µm thick, persistent or becoming excluded</td>
</tr>
<tr>
<td>apothecial disc</td>
<td>pale to dark brown, rarely pruinose</td>
<td>black, pruinose</td>
<td>black to brown-black, mostly epruinose</td>
<td>red-brown to dark brown, pruinose</td>
</tr>
<tr>
<td>ascospores</td>
<td>10–19 × 4–7 µm, (0–) 1-septate</td>
<td>10–16 × 4.5–6 µm, (0–) 1-septate</td>
<td>10–15 × 4–6 µm, (0–) 1-septate</td>
<td>10–20 × 4–6 µm, (0–) 1-septate</td>
</tr>
</tbody>
</table>

larger than blastidia, have a smooth upper surface and well-developed, algal-free zone that can in part be transformed into a layer of dead cells (Mayrhofer 1988). There are several related or at least superficially similar species with which it can be confused, as discussed by Fletcher et al. (2009) and van den Boom & Ryan (2004) in their accounts of the genus in Britain and North America, respectively. Of these, two have been recorded for Australia (van den Boom & Mayrhofer 2007): L. erysibe (Ach.) Mudd, which differs from L. inundata by its blastidiate thallus, and L. rabenhorstii (Hepp) Arnold, which has a thallus of smooth areoles. When poorly developed, these three taxa can be difficult to distinguish. Salient features that distinguish L. inundata from the other species studied are summarised in Table 1.

Lecania inundata grows on naturally-occurring or man-made calcareous substrata including concrete, mortar and asbestos tiles, as well as on more acidic rocks in nutrient-enriched habitats. Some of the specimens studied here (Kantvilas 270/13, 333/13) are from coastal sites affected by eutrophication from birds. Others are from old concrete in urban areas (Kantvilas 161/98, 270/13) and slag outcrops in pasture, 19 Sep. 2013, G. Kantvilas 281/13 (holo: HO; iso: AD, herb. v.d. Boom).

Specimens examined:

**South Australia. Kangaroo Island:** northern end of Antechamber Bay, 35°46′ S 138°04′ E, 5 m alt., 22 Sep. 2013, G. Kantvilas 270/13 (herb. v.d. Boom, HO); the old Cannery, American R., c. 1 km SW of Ballast Head, 35°46′ S 137°48′ E, 2 m alt., 14 Sep. 2013, G. Kantvilas 333/13 & B. de Villiers (herb. v.d. Boom, HO).


**Victoria. South Yarra, Royal Botanic Gardens, 37°49′ 52′ S 144°58′ 37′ E, 28 Jun. 2011, V. Stajsic 6203 (HO, MEL).**

**New South Wales.** Sydney, Aug. 1988, J. MacDonald s.n. (HO).

2. *Lecania maritima* Kantvilas & van den Boom, sp. nov.

Thallo endolithicō inconspicuoque, apothecis pruinosis, biatorinis, excipulo proprio persistenti, in sectione opaque rubro-brunneo, cellularibus algharum destituito, ascis tipo Bacidiae pertincentibus et ascosporis uniseptatis, 10–16 µm longis, 4.5–6 µm latis distinguibilis. **Mycobank no.:** MB814786.

**Typus:** **South Australia.** Kangaroo Island, near Pelican Lagoon, summit of hill above the Tiger Simpson memorial, 35°50′ S 137°49′ E, 60 m alt., on limestone outcrops in pasture, 19 Sep. 2013, G. Kantvilas 281/13 (holo: HO; iso: AD, herb. v.d. Boom).

Thallus endolithic, inapparent, undelimited, not causing any discoloration of the substratum, rarely very thin, scurfy and discontinuous, whitish and concolorous with the substratum; photobiont cells globose to ellipsoid, 7–13 × 8–18 µm. *Apothecia* biatorine, superficial, basally constricted, 0.3–0.6 (–0.8) mm diam., scattered; disc black, at first plane to concave, then plane to undulate, sometimes becoming markedly convex, mostly lightly grey-pruinose, rarely epruinose; proper excipulum concolorous with the disc, grey pruinose, inrolled and ± obscuring the disc when young, mostly remaining prominent and persistent through later stages of development, becoming obscure only in very convex apothecia, in section 50–80 µm thick, ± annular but sometimes almost continuous beneath the hymenium, entirely opaque reddish brown at the sides, somewhat paler reddish brown centrally beneath the hymenium, unchanged or somewhat purplish brown.
in K, N+ orange-brown, composed of a reticulum of highly branched hyphae 2.5–3.5 µm wide, entirely lacking any photobiont cells. Hypothecium 20–50 µm thick, poorly differentiated, hyaline or, more often, discoloured at least in part by adjacent excipular and hymenial pigments, occasionally inspersed with scattered oil droplets. Hymenium 60–75 µm thick, not inspersed, coherent in water and KOH, mostly hyaline but overlain with an olive-grey epihymenial layer c. 10 µm thick, K–, N+ rather fleetingly crimson, the coloration often diffusing through the entire hymenium. Asci 8-spored, 40–55 × 10–17 µm, clavate, of the Bacidia-type, with a prominent amyloid tholus and a conical, weakly amyloid masse axiale; ocular chamber lacking or weakly developed. Paraphyses simple, 1.5–2.5 (–3) µm wide; apices prominently enlarged to 3–6 µm, with the terminal cells coated with pigment, sometimes also internally pigmented. Ascospores ellipsoid, hyaline, thin-walled, non-halonate, 10–12.5–15 (–16) × 4.5–5.3–6 µm, (0–1) 1-septate. Pycnidia minute, speck-like, immersed in shallow pits in the substratum; conidia strongly curved, 10–20 × 1 µm. Chemistry: no substances detected by t.l.c.

**Etymology.** The specific epithet alludes to the lowland, coastal habitat of the new taxon.

**Remarks.** Lecania maritima is best characterised by the combination of an inconspicuous, endolithic thallus and biatorine, pruinose apothecia with a mostly persistent proper excipulum that is opaque red-brown in section. It bears many similarities with *L. polycarpa* (Tab. 1), which has a ± identical thallus and habit but which has an internally hyaline or only dilutely pigmented proper excipulum that becomes excluded early in development. Although overlapping in size, the conidia of *L. polycarpa* are also marginally shorter. With their persistent, prominent margin, the pruinose apothecia of *L. maritima* are also reminiscent of *L. turicensis*, but in that species the apothecial margin is clearly thalline and, when viewed in section, is packed with photobiont cells (Fig. 2C). In contrast, photobiont cells are completely absent from the excipulum of *L. maritima* (and *L. polycarpa*).

The epithecial pigments in these three species also differ. Pigmens and their disposition provide a useful taxonomic character in *Lecania* (viz. Mayrhofer 1998), but they have not been formally characterised in the manner of, for example, Meyer & Printzen (2000). The epihymenium of *L. maritima* is olive-grey and reacts N+ crimson. This pigment is not the same as the greenish, N+ crimson pigments seen in *Megalaria*, *Mycoblastus* and other genera because it has no hint of green, and the N-reaction fades rather quickly. The pigment also occurs in the upper, outer edges of the excipulum. In contrast, *L. turicensis* contains a reddish brown pigment that reacts N+ crimson. This pigment is not the same as the greenish, N+ crimson pigments seen in *Megalaria*, *Mycoblastus* and other genera because it has no hint of green, and the N-reaction fades rather quickly. The pigment also occurs in the upper, outer edges of the excipulum. In contrast, *L. turicensis* contains a reddish brown pigment that reacts N+ crimson. In *L. polycarpa*, the predominant pigment is the same N+ orange-brown one as in *L. turicensis*, although traces of the olive *maritima*-pigment can be present as well, because a fleeting, patchy N+ crimson reaction can sometimes be observed in addition to the predominant N+ orange-brown.

Interpretation of the excipular and hypothecial tissues in this new taxon is somewhat equivocal. In some sections, the opaque excipular layer is continuous or almost so beneath a clearly paler, but rather thin hypothecial layer. In other sections, the central area beneath the hypothecium is a more dilute red-brown, and it can be hard to distinguish a clear boundary between excipulum and hypothecium. The key character for this species, however, namely the opaque excipulum at the sides, is unambiguous.

The new species has been recorded from coastal limestone on Kangaroo Island and Flinders Island. Specimens from the latter locality are included under *L.
maritima with some reservation. They concur anatomically with the typical Kangaroo Island collections, yet their apothecia tend to be at the larger end of the range (commonly up to 0.8 mm wide, whereas KI specimens rarely exceed 0.6 mm), and epruinose apothecia with a convex disc and a reduced margin are also more common.

On Kangaroo Island, L. maritima is locally common on outcrops and large boulders of limestone in rough, stony pasture near the coast, whereas on Flinders Island it was recorded on outcrops in coastal heathland. The species is part of a rich calcicolous association that includes Buellia albula, Caloplaca yorkensis S.Y.Kondr. & Kärnefelt, C. johnwhinrayi S.Y. Kondr. & Kärnefelt, C. mereschkowskiana and Sarcogyne meridionalis P.M.MeCarthy & Kantvilas. It is common to see orange apothecia of Caloplaca species scattered amongst the black apothecia of the Lecania.

Specimens examined:


3. **Lecania polycarpa** (Müll.Arg.) Kantvilas & van den Boom, comb. nov.

**Mycobank no.:** MB814787


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**Remarks.** This species is characterised by the numerous black scattered apothecia, at most with a sparse, discontinuous grey pruina, which stand out starkly against the white limestone substratum, the complete lack of any detectable thallus, and, anatomically, by the complete absence of photobiont cells in the apothecial margin (Tab. 1). It is probably best compared to the European *L. sylvestris* (Arnold) Arnold, which was recorded for Australia (W.A.) by van den Boom & Mayrhofer (2007), but which differs by having paler, orange to dark brown apothecial discs and an apothecial margin that contains photobiont cells at the base (Fletcher et al. 2009).

_Lecania polycarpa_ occurs on rather dry, exposed, relatively soft limestone rocks in lowland and coastal areas. Associated species include Buellia albula, Caloplaca yorkensis, Placynthium cf. nigrum (Huds.) S.F.Gray and Sarcogyne meridionalis. It has been recorded from Victoria (the type), Kangaroo Island and Flinders Island. On Kangaroo Island, it is particularly common on limestone boulders and outcrops in roughly cleared pasture, whereas on Flinders Island it is common on coastal calcarenite. Both habitat types are common across southern Australia, suggesting that this species is likely to be more widely distributed.

Specimens examined:

**South Australia. Kangaroo Island:** Red House Bay, 35°49′S 138°06′E, 15 m alt., 17 Sep. 2013, G. Kantvilas 307/13 (AD, herb. v.d. Boom, HO); near Pelican Lagoon, 35°50′S 137°49′E, 60 m alt., 19 Sep. 2013, G. Kantvilas 265/13 (herb. v.d. Boom, HO); Point Ellen, 36°00′S 137°11′E, 5 m alt., 26 Sep. 2013, G. Kantvilas 215/13 (HO).

**Tasmania, Flinders Island:** The Dock, 39°48′S 147°52′E, 10 m alt., 21 Mar. 2014, G. Kantvilas 304/14, 305/14 (CANB, herb. v.d. Boom, HO); Caves Beach, 40°01′S 147°53′E, 2 m alt., 23 Mar. 2014, G. Kantvilas 363/14 (HO); Trouers Point, 40°13′S 148°02′E, 5 m alt., 23 Mar. 2014, G. Kantvilas 361/14 (CANB, HO).

*Thallus* crustose, granular-areolate, often rather gnarled, grey to dull brown, frequently pale grey-pruinose entirely or in patches, undelimited; individual areoles contiguous or dispersed and separated by deep cracks, loosely attached to the substratum, to 0.6 mm thick, with a cortex c. 15–20 µm thick; photobiont cells globose to ellipsoid or oblong, 6–20 × 5–17 µm. *Apothecia* lecanorine, superficial, basally constricted, 0.3–1 mm diam., typically numerous, crowded together and rather mis-shapen; disc red-brown to dark brown to blackish, commonly grey-pruinose, plane at first, soon becoming undulate to convex; thalline excipulum initially prominent and entire, often grey-pruinose, becoming inapparent and excluded in more convex apothecia, in section 70–100 µm thick, cupular, densely packed with photobiont cells, with a hyaline or reddish brown outer layer, 15–20 µm thick. *Hypothecium* 50–100 µm thick, hyaline, inspersed with scattered oil droplets. *Hymenium* (50–) 55–75 µm thick, hyaline, not inspersed, overlain with a reddish brown epihymenial layer to 10–15 µm thick, K–, N± orange-brown. *Asci* 8-spored, 45–55 × 10–15 µm, clavate, of the *Bacidia*-type, with a prominent amyloid tholus and a conical, weakly amyloid masse axiale; ocular chamber lacking or weakly developed. *Paraphyses* simple, 1.5–2.5 µm wide; apices prominently enlarged to 5–7 µm, with the terminal cells coated with pigment. *Ascospores* ellipsoid, hyaline, thin-walled, non-halonate, (10–) 11.5–14.4–17 (–20) × (4–) 4.5–5.0–5.5 (–6) µm, 1-septate. *Pycnidia* not seen. *Chemistry*: no substances detected by t.l.c.

**Fig. 1D, 2C.**

**Remarks.** *Lecania turicensis* is a widespread species that has been recorded for most continents and regions of the world, excluding Antarctica [see Fletcher et al. (2009) and van den Boom & Ryan (2004), who also provide descriptions]. In Australia, van den Boom & Mayrhofer (2007) record this species for South Australia, Western Australia and New South Wales; it is recorded here for Tasmania (Flinders Island) for the first time. It is characterised chiefly by its lecanorine apothecia with greyish-pruinose discs and a pale, grey-pruinose margin (Tab. 1). The species has been reported from a wide range of natural and man-made calcareous substrata. The collections studied here have somewhat longer ascospores than reported in the literature. Northern Hemisphere workers, for example Fletcher et al. (2009), report ascospores 10.5–13 µm long, although these accounts perhaps simply re-iterate the dimensions given by Mayrhofer (1988) in her study of the genus in Europe. An examination of two European specimens found that one (A. Vězda, Lich. Sel. Exsicc. 2411) had ascospores of the same dimensions as those of Australian material. Australian specimens studied occurred on dry limestone outcrops in coastal heathland and roughly cleared pasture. Associated species included such typical calciphiles as *Buellia albula* and a diverse range of *Caloplaca* species, including *C. yorkensis*, *C. johnwhinrayi*, *C. cranfieldii*, *C. kantvilasii* and *C. meschekowskiana*.

**Specimens examined:**  
Lecania (Ramalinaceae) in southern Australia


