



South Australian lichens — A Kangaroo Island case study

Gintaras Kantvilas

Tasmanian Herbarium, Tasmanian Museum and Art Gallery, PO Box 5058, UTAS LPO, Sandy Bay, Tasmania 7005
Email: Gintaras.Kantvilas@tmag.tas.gov.au

Abstract: An eight-year study of the lichens of Kangaroo Island, based on extensive field work and a review of herbarium records, has revealed a diverse flora of more than 350 species. Of these, 24, including 15 that are endemic to the island, have been described as new to science. Many other species are new records for South Australia, Australia or the Southern Hemisphere. Most species recorded are shared with mainland southern Australia, and/or with Tasmania and its off-shore islands. A large number are uncommon on Kangaroo Island and restricted to highly specialised habitats. Land clearing, fire and other disturbances have fragmented some vegetation types and reduced the lichen flora drastically. Hence rocks, isolated trees and small wooded copses provide important but highly fragile lichen refugia in an otherwise severely modified landscape. *Melaleuca*-dominated swampy woodland, *Callitris*-dominated woodland, mallee woodland and calcareous soil communities are discussed briefly as examples where fragmentation has been particularly severe. The rare and locally endangered *Pseudocyphellaria aurata* (Ach.) Vain. and the seemingly extinct *Cladia ferdinandii* (Müll.Arg.) Filson are two examples of the depletion of the lichen flora.

Keywords: conservation, diversity, habitat fragmentation, lichenised fungi, rare species

Introduction

South Australia is relatively poorly explored lichenologically, largely due to there being no lichenologist active or resident in the State. Thus, most floristic lichen data are the result of fortuitous collecting and visits by lichenologists from other jurisdictions and often based on specimens held in the herbaria of other states or territories. As a result, McCarthy (2017) records only approximately 570 taxa for South Australia, compared to Tasmania's 1200 and Queensland's almost 2000 taxa.

With an area of approximately 4400 km², Kangaroo Island, off South Australia's south-eastern coast, is Australia's third largest island. In 2008, a project to catalogue the lichens of Kangaroo Island commenced and the results of this work will be reported in detail in a forthcoming publication. The present paper

offers an introduction and overview of this work and demonstrates the diversity of lichens that awaits discovery given a thorough investigation.

Outline of the KI Lichen Catalogue Project

Prior to the commencement of the project, the lichens of Kangaroo Island had been investigated only cursorily (Table 1). The author's interest in the island's flora commenced in 2008 with some opportunistic holiday collecting that resulted in the discovery of *Ochrolechia insularis* Kantvilas & Elix (Lumbsch *et al.* 2011). Further annual visits and field work ensued, followed by a review of every herbarium specimen that could be located (chiefly in the herbaria of Adelaide, Brisbane, Canberra and Melbourne, although several others were searched or consulted) and targeted exploration of particular habitats and areas.

Table 1. Lichenological exploration of Kangaroo Island since first European contact in 1802.

period	herbarium specimens collected	major collectors	number of first records for the island
up to 1900	2	Tepper	2
1900–1980	c. 125	Cleland, Seppelt, Jackson	47
1980–2007	c. 460	Stove, Elix, Lumbsch, Streimann, Rogers	119
2007–present	930	Kantvilas	182+

Floristic results

At present, more than 350 taxa have been recorded. This figure includes 24 species newly described based on recent collections from the island (Table 2), more than 85 new records for South Australia and a further 16 additional species that represent new records for Australia and, in some cases, the Southern Hemisphere; these will be reported separately. Research on herbarium specimens is ongoing and further new species and new records are anticipated by the time the catalogue is published. A complete list of lichens for an area as large as Kangaroo Island is an impossible goal, as there will always be areas and habitats that will not have been comprehensively examined. However, more than 400 taxa is considered a reasonable estimate of the island's lichen species richness.

The distribution and composition of the island's lichen flora is determined chiefly by vegetation type

and geology and is generally typical for the relatively dry, lowland or maritime areas of southern Australia that enjoy a Mediterranean-type climate. Most of the common species are widely distributed across this region. The largest genera present include *Caloplaca* Th. Fr. (31 species), which is responsible for the conspicuous orange and yellow banding of the littoral zone, whereas in dry sclerophyll woodland, the foliose genus, *Xanthoparmelia* (Vain.) Hale (38 species) predominates. Other species-rich genera include *Lecanora* Ach. (17 taxa), *Rinodina* (Ach.) S.F.Gray (11), *Buellia* De Not. s. lat. (22), *Verrucaria* Schrad. (9) and *Lecidella* Körb. (8). Curiously, several conspicuous components of the southern Australian flora have not been recorded, such as the genus *Hypogymnia* Nyl. and the common, yellowish, littoral crustose species, *Lecanora subcoarctata* (C.Knight) Hertel. While being represented by 11 taxa, the genus *Cladonia* Hill ex P.Browne is rarely abundant, despite the apparent abundance of suitable habitat in woodlands and heathlands.

Table 2. Lichens based on type specimens from Kangaroo Island.

taxon	reference	distribution
<i>Amandinea devilliersiana</i> Elix & Kantvilas	Elix & Kantvilas (2013a)	KI, Tas
<i>Amandinea dudleyensis</i> Kantvilas & Elix	Elix & Kantvilas (2013a)	KI
<i>Amandinea lignicola</i> var. <i>australis</i> Elix & Kantvilas	Elix & Kantvilas (2013a)	south-eastern Australia, Tas
<i>Anisomeridium austroaustraliense</i> McCarthy & Kantvilas	McCarthy & Kantvilas (2016a)	KI
<i>Arthonia caliciae</i> Kantvilas & Wedin	Kantvilas & Wedin (2015)	KI
<i>Arthonia insularis</i> Kantvilas & Wedin	Kantvilas & Wedin (2015)	KI
<i>Bacidia brigittae</i> Kantvilas	Kantvilas (2017)	KI
<i>Buellia extenuatella</i> Elix & Kantvilas	Elix & Kantvilas (2013b)	southern mainland Australia
<i>Buellia subadjuncta</i> Elix & Kantvilas	Elix <i>et al.</i> (2017)	KI
<i>Caloplaca aggregata</i> Kantvilas	Kantvilas (2016)	KI
<i>Caloplaca gilfillaniorum</i> Kantvilas & S.Y.Kondr.	Kantvilas & Kondratyuk (2013)	KI
<i>Caloplaca piscatorica</i> Kantvilas & S.Y.Kondr	Kantvilas & Kondratyuk (2013)	KI
<i>Caloplaca sergeyana</i> Kantvilas	Kantvilas (2016)	KI
<i>Catillaria austrolittoralis</i> Kantvilas & van den Boom	Kantvilas & van den Boom (2013)	south-eastern Australia, Tas.
<i>Lecania maritima</i> Kantvilas & van den Boom	Kantvilas & van den Boom (2015)	south-eastern Australia, Tas.
<i>Lecidella granulosa</i> var. <i>lecanorina</i> Kantvilas & Elix	Kantvilas & Elix (2014)	KI, NSW, Tas
<i>Lecidella leucomarginata</i> Kantvilas & Elix	Kantvilas & Elix (2014)	KI, WA
<i>Ochrolechia insularis</i> Kantvilas & Elix	Lumbsch <i>et al.</i> (2011)	KI
<i>Pertusaria melanospora</i> var. <i>sorediata</i> Elix & Archer	Elix & Archer (2013)	south-eastern Australia, Tas
<i>Psoroglaena halmaturina</i> McCarthy & Kantvilas	McCarthy & Kantvilas (2013a)	KI
<i>Sarcogyne meridionalis</i> McCarthy & Kantvilas	McCarthy & Kantvilas (2013b)	KI, SA, Flinders Island
<i>Tephromela baudiniana</i> Kantvilas & Elix	Kantvilas & Elix (2017)	KI
<i>Thelidium robustum</i> McCarthy & Kantvilas	McCarthy & Kantvilas (2016b)	KI
<i>Xanthoparmelia wisangerensis</i> Elix & J.Johnst.	Elix & Johnston (1987)	KI

A feature of the flora is that despite the large number of taxa recorded, most are relatively uncommon and have narrow ecological niches and/or limited distribution. An excellent example is *Ephebe ocellata* Henssen (Fig. 1A), which is restricted to semi-inundated rocks in fast flowing fresh water. This is a very uncommon habitat on Kangaroo Island, but it is potentially rich in aquatic lichens, such as species of the Lichinaceae. Similarly, the dry, bleached lignum of old, dead eucalypt trees has yielded several unusual records, such as *Schismatomma dirinellum* (Nyl.) Zahlbr. (Fig. 1B) (the first record for the Southern Hemisphere). Also present in this habitat are several taxa of calicioid lichens, a group that is frequently associated with old trees in old growth forests in many parts of the world (Selva 1998). The minute, temperate Northern Hemisphere species, *Strangospora pinicola* (A.Massal.) Körb. (another first for the Southern Hemisphere), was recorded from *Melaleuca* in old mallee woodland, whereas the widespread, temperate Northern Hemisphere forest species, *Micarea prasina* Fr. (Fig. 1C), is but one of several remarkable records from remnant *Callitris* woodland. *Pannaria obscura* Müll.Arg. (Fig. 1D), although not rare on the island, is one of relatively few cyanobacterium-containing

species present and tends to be an indicator of moister, undisturbed sites where other unusual species may be present. Fifteen species are endemic to the island (Table 2), although this is most likely the consequence of detailed, localised study and, with further exploration, these species could be expected to be found further afield.

Conservation status of the flora

With its small population, relative isolation and having one quarter of its land area in nature reserves, it is indisputable that Kangaroo Island has retained a significant element of its natural environment. At the same time, the island has been hugely modified by man and land clearing has been extensive (Fig. 2). Fire has been a recurring phenomenon (Peace & Mills 2012) and is potentially very severe in the absence of natural boundaries such as large rivers or mountains. Apart from its immediate impact, fire affects the lichen flora by removal or reduction in the age of the understorey. A large component of the lichen flora is epiphytic and shows a preference for subdominant trees and shrubs such as *Allocasuarina*, *Exocarpos* and species

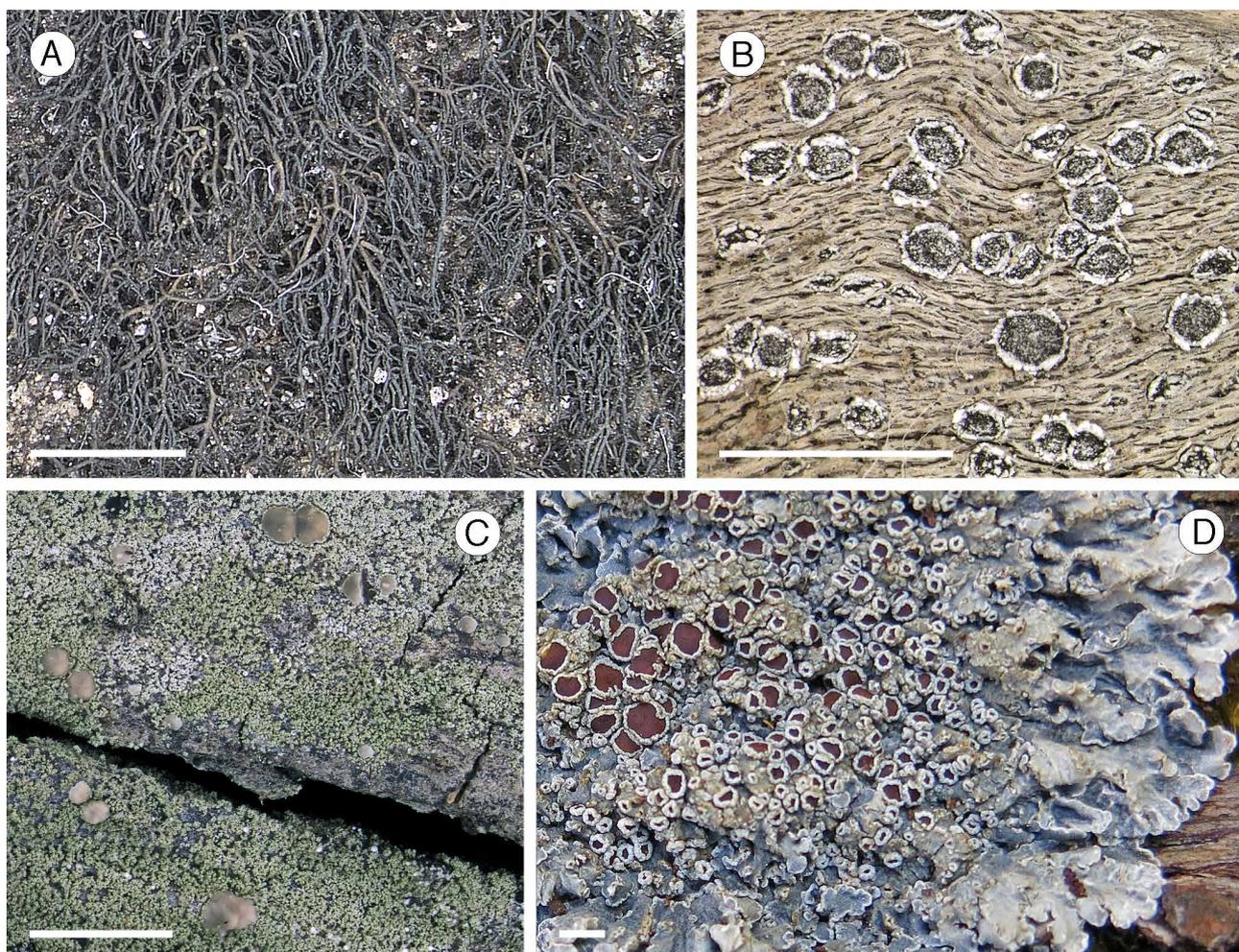


Fig. 1. Noteworthy Kangaroo Island lichens. **A** *Ephebe ocellata*; **B** *Schismatomma dirinellum*; **C** *Micarea prasina*; **D** *Pannaria obscura*. Scale = 2 mm. Photos: J. Jarman.

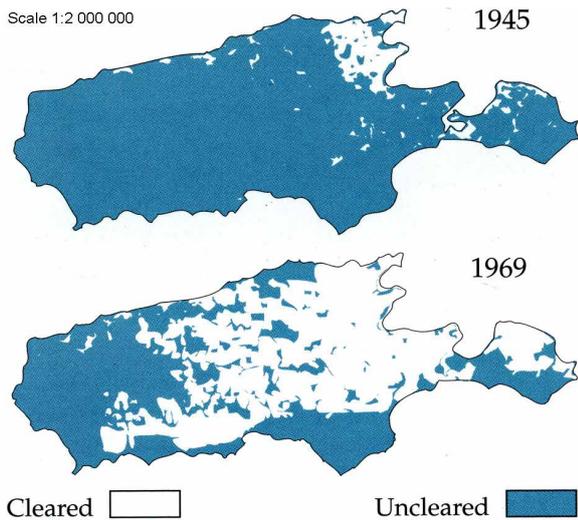


Fig. 2. Changes in natural vegetation cover on Kangaroo Island (taken from Barker & McCaskill 2007).

of Myrtaceae. Whilst this vascular component of the vegetation may recover quickly after fire, its stems are invariably too young to support diverse associations of epiphytes. The blaze of 2007 destroyed about 20% of the island, especially reserved areas. The fire was clearly very hot and after more than seven years, recovery of lichens has been minimal.

Fragmentation of the natural vegetation has also had a major impact on the lichens. The first European accounts of the island, for example by Peter Good (Edwards 1981) and Robert Brown (Vallance *et al.* 2001) from the *Investigator* voyage, refer to it as being “wooded”. Whilst these impressions were formed chiefly from the shoreline or the summit of Prospect Hill (one of the best vantage points on the island), one can infer that there was a more or less continuous cover of forest, woodland or heathland over much of the island. Today, there are extensive nature reserves, but



Fig. 3. *Melaleuca*-dominated swampy woodland: intact stand (above); highly fragmented and disturbed stand (below).

these are concentrated in the west and south, catering well for some vegetation formations, but less so for others. Elsewhere, large tracts of land have been cleared and converted to pasture, stretches of the coastline have been developed for housing and recreation and there are extensive areas of eucalypt and pine plantation. As a result, some woodland types that support many rarer components of the lichen flora have been severely fragmented and continue to degrade. The following serve as examples of vegetation where the effect of degradation is especially obvious.

Melaleuca-dominated swampy woodland (Fig. 3). This vegetation type occurs on the fringes of lagoons and larger estuaries. It is perhaps the closest vegetation type to a wet forest on the island and one where an exceptional lichen flora might be expected. However, although many stands appear intact from a distance,

closer inspection reveals broken, disturbed canopies, larger trees uprooted by the wind, and weed-choked understoreys. As a result, epiphytes are rare or absent and the main species present are ones with broad ecological amplitudes, such as *Austroparmelina pruinata* (Müll.Arg.) A.Crespo *et al.* and *Physcia poncinsii* Hue.

Callitris-dominated coniferous woodland (Fig. 4). These woodlands are found on the coast of the Dudley Peninsula, usually on or behind sand dunes and consist of tiny, fragmented stands that are collapsing. Here several small crustose species with world-wide distributions in temperate, oceanic woodlands were recorded; for example, *Arthonia ilicina* Taylor, *Cliostomum griffithii* (Sm.) Coppins and *Micarea prasina* Fr. All were represented by minute thalli hidden in cracks in the bark of decrepit trees where their long-term survival is unlikely.



Fig. 4. *Callitris*-dominated coniferous woodland: relatively intact stand (above); highly fragmented remnant with a weed-choked understorey (below).

Mallee woodland (Fig. 5). When occurring in continuous stands with old dominant trees and a diverse understorey, this vegetation is rich in epiphytic lichens. Standing dead, dry trees, the moist basal stockings of living trees and the understorey shrubs are potentially well colonised. Several species that contain cyanobacteria as their main photobiont have been recorded in such woodlands, including *Fuscopannaria decipiens* (P.M.Jørg. & D.J.Galloway) P.M.Jørg. and *F. minor* (Darb.) P.M.Jørg. Unfortunately, in many places, mallee has been reduced to narrow avenues where windthrow has caused canopy collapse, increased air circulation and sunlight have dried the microclimate, and browsing by stock impedes regeneration.

Consolidated, calcareous soil. Past herbarium records suggest that soil-inhabiting crustose lichen communities, dominated by *Psora decipiens* (Hedw.) Hoffm. and *Gyalolechia (Fulgensia) cranfieldii* (S.Y.

Kondr. & Kärnefelt) Søchting *et al.*, were more extensive in the past. Today these potentially species-rich communities are reduced to narrow strips between improved pasture and cliff edges, road-side remnants or simply a few square centimetres of soil between larger stones.

The result of changing land-use is that some species recorded for the island in earlier times seem to be no longer present or are exceedingly rare and that rocks, isolated trees and small wooded copses provide important but highly fragile lichen refugia in otherwise severely modified landscapes. Two conspicuous species serve as examples of these floristic changes:

Cladia ferdinandii (Müll.Arg.) Filson (Fig. 6A). This striking species of 'coral lichen' is known only from south-western Western Australia and southern South Australia (Filson 1992) and was last collected on KI



Fig. 5. Mallee woodland: extensive and continuous stand (above); remnant narrow farm corridor (below).

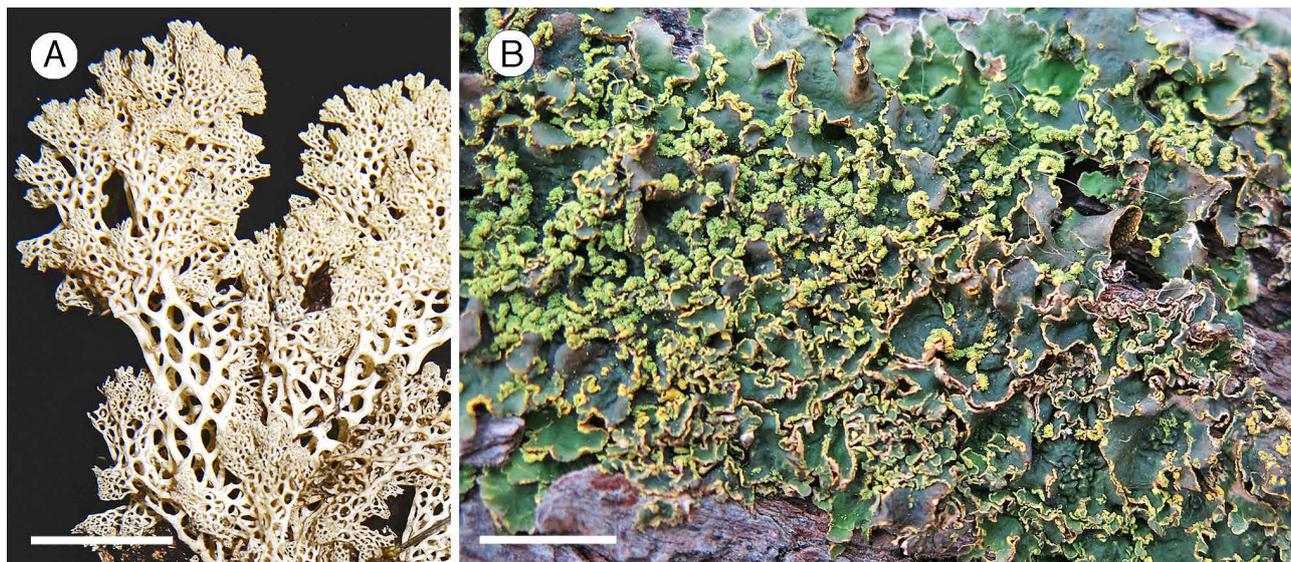


Fig. 6. Rare Kangaroo Island lichens. **A** *Cladia ferdinandii* (presumed extinct); **B** *Pseudocyphellaria aurata* (rare and at risk). Scale = 10 mm. Photo A: J. Jarman.

in the 1990s from near Kingscote Airport. It could be expected to occur near the coast on sandy open ground in heathland or beneath sparse *Melaleuca*. It was searched for extensively without success and is presumed to be now extinct on the island. Although its past known locations are rather vague, the general areas they represent have been severely modified or degraded. Elsewhere in South Australia, this species is severely threatened by development (Elix 2005).

Pseudocyphellaria aurata (Ach.) Vain. [syn. *Crocodia aurata* (Ach.) Link] (Fig. 6B). This is a cosmopolitan lichen of moist, oceanic woodlands, with a widely scattered, coastal Australian distribution. It was first recorded for Kangaroo Island in the 1970s, presumably from *Melaleuca* woodland fringing Lashmar Lagoon. This and many other sites were searched for this species and just one population, comprising a few thalli on about six, precariously leaning, older mallee stems, was found. This species is at serious risk.

Conclusion

Whether Kangaroo Island is special for lichens depends very much on one's perspective. Compared to places such as Tasmania, the island is of low relief (the highest point just 300 m above sea level), no place is more than 25 km from the coast and the annual average rainfall is only 500 to 700 mm per year. These factors lead to relatively low habitat diversity, which usually translates into low lichen species richness. On the other hand, the island has a highly variable geology and a fascinating littoral zone where siliceous and calcareous rock types occur in close juxtaposition. Despite the impact of wildfire and land clearing, small areas of exceptional lichenological interest remain intact. The Kangaroo Island Lichen Project offers an insight into the potential

lichen diversity yet to be discovered elsewhere in South Australia.

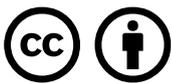
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