

Tasmania's Threatened Lichens: Species and Habitats

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Abstract Knowledge of Tasmania's lichen flora has increased rapidly in the past two decades as a result of systematics research, ecological studies, floristic surveys of particular areas and habitats, and targeted species-based mapping studies. This has enabled lichens to be included in conservation assessments. Currently 28 lichen species are listed under the *Tasmanian Threatened Species Protection Act 1995* but many additional species are likely to be listed in the future. Criteria for listing, the listing process, and problems of applying these to lichens are discussed briefly. Major lichen habitats in Tasmania are described. Although more than 40% of Tasmania's land area is in formal reserves, these do not capture all significant lichen habitats or the rarest lichen species. Some of the rarest Tasmanian lichens, and those in greatest need of protection are found in fragmented, relict, often degraded vegetation types of low aesthetic appeal, occur in poorly reserved vegetation types targeted for economic development, or represent genuinely isolated and very unusual records.

Key words: Tasmania, lichen, conservation, threatened species.

Introduction

Tasmania is an island which, together with New Zealand and the southern part of South America, is one of three significant land masses that lie in the Southern Ocean, in the path of the prevailing winds known as the Roaring Forties. The island has a rich flora that reflects its ancient origins in the super-continent of Gondwana and its subsequent isolation as part of Australia (Hill & Orchard, 1999). The flora also displays significant tropical, bipolar, pantemperate and cosmopolitan elements (Kantvilas, 1996). Tasmania's complex and variable geology, highly dissected topography, and steep west to east climatic gradient provide it with an intricate mosaic of habitats and vegetation types, including a diverse range of cool temperate rainforest and sclerophyll forest types, heathlands, moorlands, sedgeland and grasslands.

Since European settlement in 1803, much of the Tasmanian landscape has been significantly modified by pastoralism, forestry, agriculture, mining, industrialisation and urbanisation. Even so, very large, unpopulated, natural areas are found in the mountainous and often inhospitable terrain mainly in the west, whilst the relatively low population of approximately 480 000 inhabitants is concentrated very much in the northern and south-eastern lowlands. More than 40% of Tasmania is under legislative protection as national parks and wilderness areas (Fig. 1), with the majority of this area listed by UNESCO as a World Heritage Area (Whitlam, 1993). The Reserves are predominantly in the western and south-western parts of the island where rainfall exceeds 2000 mm annually. Here the main vegetation types are buttongrass moorland, alpine communities and cool temperate rainforest. The area of reserved land in the drier, eastern half of the

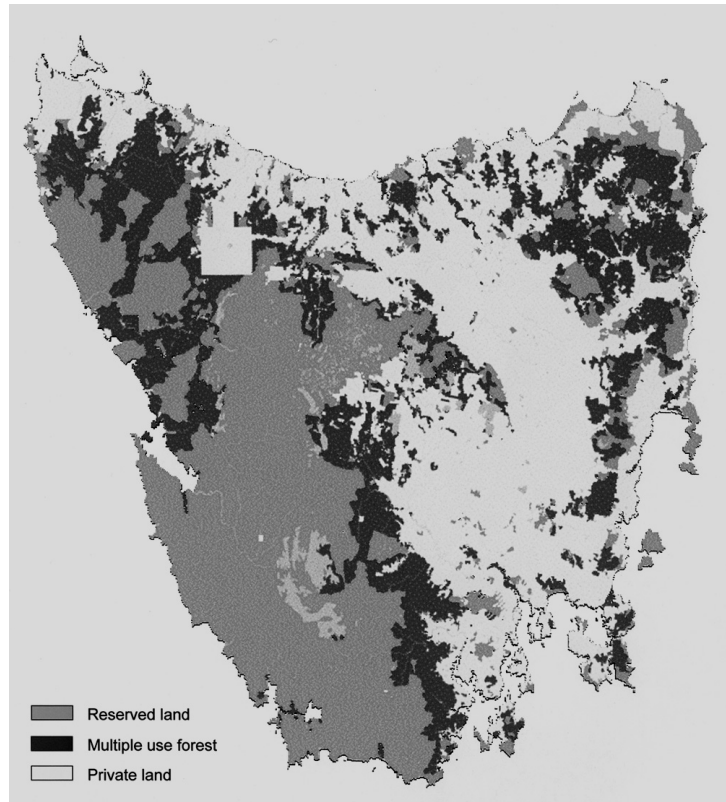


Fig. 1. Summary of major land tenure categories in Tasmania. Map courtesy of Forestry Tasmania.

state where dry forest, grassland and heathland ecosystems occur is comparatively low. The delimitation of reserve boundaries was initially determined mainly on scenic and aesthetic criteria (Brown & Hickey, 1990; Harris & Whinam, 1993), and in this way many extensive highland areas were reserved. More recently, biological values have also been considered, as for example in the review of Tasmania's forests (Tasmanian Public Land Use Commission, 1997). Nevertheless, significant areas of controversy and conflict remain, and further adjustments to the reserve system are inevitable as the knowledge of the biota and other natural values increases, and practices such as the harvesting of native forest or the conversion of natural vegetation to plantations or arable land is refined and reviewed.

Synopsis of the Tasmanian Lichen Flora

The Tasmanian lichen flora consists of approximately 1000 named species (McCarthy, 2003; Kantvilas unpublished data). However, there is a large number of undetermined taxa, especially amongst the crustose lichens, as well as many poorly studied habitats and areas. Hence the total diversity of the flora is certain to be revised upwards in the future.

Some of the most species-rich genera in the Tasmanian lichen flora include *Cladonia* (c. 60 taxa), *Collema* (16), *Menegazzia* (c. 25), *Micarea* (c. 25), *Pertusaria* (17), *Porina* (25), *Pseudocyphellaria* (18), *Verrucaria* (22) and *Xanthoparmelia* (61). Tasmania also appears to be a centre of speciation for some smaller genera, for example *Bactrospora*, *Cladia*, *Fuscidea*, *Rimularia*,

Roccellinastrum and *Siphula*. However, in the case of some of the less conspicuous or poorly known taxa, this apparent diversity is probably a result of the local, detailed studies that have been undertaken.

Most major habitats and substrates for lichens are well represented in Tasmania. Epiphytic habitats include a wide range of bark types, as well as very old trees (in the order of 1000 years or more), very tall trees (up to *c.* 90 m tall), and trees in very ancient forests, such as coniferous forests dominated by *Athrotaxis* and *Lagarostrobos*. There is a wide range of soil types and peats, but calcareous soils are uncommon and consist mostly of those derived from Permian mudstones with a high content of fossilised shell material. Extensive areas of dry steppe or rangeland soils are uncommon. Tasmania is a very rocky place and major rock types include Precambrian metamorphosed sediments and quartzites, Ordovician conglomerate, Devonian granite, Permian mudstone, Triassic sandstone, Jurassic dolerite and Tertiary basalt. Limestones are uncommon and much of the outcropping limestone in Tasmania is overlain by acidic peat. Relatively few foliicolous lichens (25 species; McCarthy *et al.*, 2001) are present in Tasmania and this habitat is restricted to only a few hosts plants in very localised areas. There are also extensive areas of man-made or man-influenced habitats and substrates on concrete, bitumen, roofing tiles and similar materials. Lichens occur from the subtidal zone to the highest peaks. One very specialised lichen habitat well represented in Tasmania is submerged rock in highland lakes and streams; here many unusual lichens, including endemic species of *Verrucaria* and *Lichina*, have been recorded.

Lichenology in Tasmania

Knowledge of the lichen flora has increased dramatically in the last two decades. Systematics research has been undertaken on many families and genera, most recently *Hertelidea* (Printzen & Kantvilas, 2004), *Siphula* (Kantvilas, 2002), *Rimularia* (Coppins & Kantvilas, 2001), the Fuscideaceae (Kantvilas, 2001), the Roccellaceae (Kantvilas, 2004) and *Porina* (McCarthy & Kantvilas, 2000) (see also Kantvilas, 2000 and McCarthy, 2003 for additional references). In addition, there have been extensive ecological studies that have generated many new taxa or new records for Tasmania; for example in rainforest (Kantvilas, 1995a; Jarman & Kantvilas, 1995a) and, more recently, in wet eucalypt forest (Jarman & Kantvilas, 2001a, b). Floristic surveys of particular areas and habitats in Tasmania (e.g. Jarman & Kantvilas, 1994, 1995b; Kantvilas, 1995b; Kantvilas & Jarman, 1991, 1998), and species mapping studies in conjunction with systematic revisions have also been undertaken. The latter work has concentrated on the Parmeliaceae (Kantvilas *et al.*, 2002), but other families, including Sphaerophoraceae and Cladoniaceae are also being surveyed and mapped (Kantvilas & Jarman, in prep). The mapping work provides the basis for lichens to be included in conservation assessments.

Conservation of Lichens in Tasmania

Conservation of plant and animal taxa in Tasmania is governed by the *Tasmanian Threatened Species Protection Act 1995*. The *Act* allows for taxa to be listed or delisted through a system of public nominations that are vetted by an independent Scientific Advisory Committee (SAC). The SAC evaluates nominations against strict guidelines (<http://www.dpiwe.tas.gov.au/inter.nsf/ThemeNodes/RLIG-53KUPV?open>) and, after a period of public comment, makes a recommendation to the Minister to either accept or reject each nomination (Fig. 2).

The schedules of listed vascular plants are comprehensive and comprise several hundred

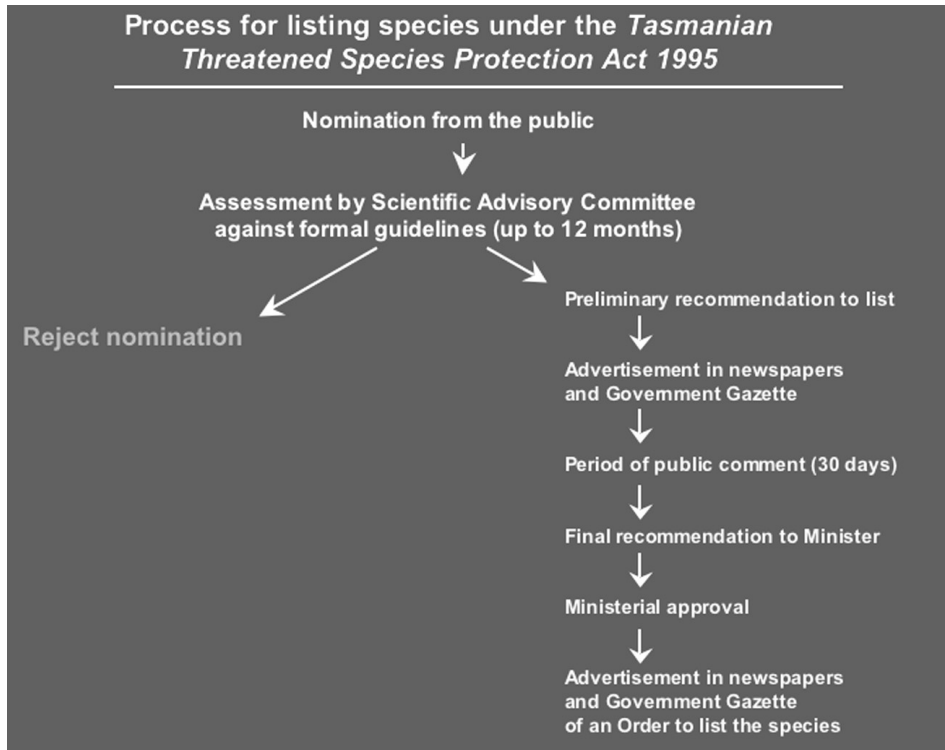


Fig. 2. Formal procedures for listing of species on the schedules of the *Tasmanian Threatened Species Protection Act 1995*.

species. They are based on a very good knowledge of the flora, accumulated over 200 years of botanical endeavour, and on the contribution of a large community of amateur and professional people in Tasmania. Conservation awareness with respect to the vascular flora has essentially arisen out of this broad knowledge of species, habitats and distribution patterns. In the case of lichens, however, the goals of conservation pre-date the compilation of comprehensive taxonomic, floristic and ecological data upon which a conservation strategy can be based. In addition, there is only one individual in Tasmania who is active in lichenology, and who is sufficiently experienced to provide this background data (see also Brown *et al.*, 1994; Kantvilas, 2000).

The criteria for listing species under the *Tasmanian Threatened Species Protection Act 1995* are based on IUCN criteria, but recognise Tasmanian legislative responsibilities, local knowledge of geography and biology, and expert assessment of threatening processes. For non-vascular plants, the criteria also recognise that information on population size and numbers may be limited and impossible to quantify. Instead, the evaluation of nominations of such taxa takes into account expert knowledge of known distributions, inferred habitat and an assessment of likely threats. A similar approach has been recommended for bryophytes in Europe by Hallingbäck *et al.* (1995, 1998) who considered that the most relevant data included population decline, decline in habitat quality, present distribution, number of locations, and numbers of individuals in the population (see also Hodgetts, 2000).

At present (December 2004), 28 species of lichens are listed on the schedules of the *Tasmanian Threatened Species Protection Act 1995* (Table 1; Fig. 3). An additional 20 species (Table 2) are yet to be nominated but appear to fulfill the criteria for nomination. They are being targeted

Table 1. Lichens listed on the schedules of the *Tasmanian Threatened Species Protection Act 1995*. Extinct, Endangered, Vulnerable and Rare are formal categories under the *Act*. The figures in column 3 indicate the number of discrete reserves in which a species has been recorded.

<i>Bunodophoron notatum</i> (Tibell) Wedin	Vulnerable	Reserved (2)
<i>Calycidium cuneatum</i> Stirt.	Rare	Reserved (2)
<i>C. polycarpum</i> (Colenso) Wedin	Vulnerable	Unreserved
<i>Cetraria islandica</i> subsp. <i>antartica</i> Kärnefelt	Rare	Reserved (2)
<i>Erioderma solediatum</i> D. J. Galloway & P. M. Jørg.	Endangered	Unreserved
<i>Hypotrachyna immaculata</i> (Kurok.) Hale	Rare	Reserved (1)
<i>H. laevigata</i> (Sm.) Hale	Vulnerable	Unreserved
<i>Melanelia piliferella</i> (Essl.) Essl.	Vulnerable	Unreserved
<i>Menegazzia minuta</i> P. James & Kantvilas	Endangered	Unreserved
<i>Neofuscelia graniticola</i> Elix & Kantvilas	Rare	Unreserved
<i>N. subloxodella</i> Elix & Kantvilas	Endangered	Unreserved
<i>Parmelina pallida</i> Elix & Kantvilas	Endangered	Reserved (2)
<i>P. whinrayi</i> (Elix) Kantvilas & Elix	Rare	Reserved (2)
<i>Parmeliopsis abigua</i> (Wulf.) Nyl.	Rare	Reserved (1)
<i>P. hyperopta</i> (Ach.) Arnold	Rare	Reserved (1)
<i>Parmotrema crinitum</i> (Ach.) M. Choisy	Rare	Unreserved
<i>Punctelia subflava</i> (Taylor) Elix & J. Johnston	Extinct	Unreserved
<i>Roccellinastrum neglectum</i> Henssen & Vobis	Endangered	Unreserved
<i>Teloschistes flavicans</i> (Sw.) Norman	Rare	Reserved (1)
<i>Xanthoparmelia amphixantha</i> (Müll. Arg.) Hale	Endangered	Unreserved
<i>X. jarmaniae</i> Elix & Kantvilas	Vulnerable	Reserved (1)
<i>X. mannumensis</i> (Elix) Elix & J. Johnston	Vulnerable	Unreserved
<i>X. microphyllizans</i> Elix	Rare	Reserved (1)
<i>X. molliuscula</i> (Ach.) Hale	Endangered	Unreserved
<i>X. oleosa</i> (Elix & P. Armstr.) Elix & T. H. Nash	Rare	Unreserved
<i>X. vicaria</i> Elix & J. Johnston	Rare	Unreserved
<i>X. vicariella</i> Elix & Kantvilas	Rare	Unreserved
<i>X. willisii</i> (Kurok. & Filson) Elix & J. Johnston	Endangered	Unreserved

Table 2. Lichen species that appear to fulfill the criteria for listing under the *Tasmanian Threatened Species Protection Act 1995* but are yet to be nominated.

<i>Bactrospora metabola</i> (Nyl.) Egea & Torrente	Unreserved
<i>Cladonia tasmanica</i> Ahti	Unreserved
<i>Coccocarpia erythroxyli</i> (Sprengel) Swinscow & Krog	Reserved (1)
<i>C. pellita</i> (Ach.) Müll. Arg	Unreserved
<i>Degelia calcicola</i> P. M. Jørg. & Kantvilas	Reserved (1)
<i>Lecanographa nothofagi</i> Kantvilas	Reserved (1)
<i>Leioderma solediatum</i> D. J. Galloway & P. M. Jørg.	Unreserved
<i>Leptogium coralloideum</i> (Meyen & Flot.) Vain.	Unreserved
<i>Megaloblastenia flavidoatra</i> (Nyl.) Sipman	Unreserved
<i>Megalospora gompholoma</i> subsp. <i>fuscolineata</i> Sipman	Reserved (1)
<i>Parmelia tarkinensis</i> Elix & Kantvilas	Reserved (2)
<i>Polysporina terricola</i> Kantvilas	Unreserved
<i>Pseudocyphellaria aurata</i> (Ach.) Vain.	Reserved (2)
<i>Pyxine nubila</i> Moberg	Unreserved
<i>Ramalea cochleata</i> Müll. Arg.	Unreserved
<i>Santessoniella rugosa</i> Henssen & Kantvilas	Unreserved
<i>Umbilicaria decussata</i> (Vill.) Zahlbr.	Reserved (2)
<i>Usnea angulata</i> Ach.	Reserved (2)
<i>Usnea baileyi</i> (Stirt.) Zahlbr.	Unreserved
<i>Xanthoparmelia canobolasensis</i> Elix	Unreserved

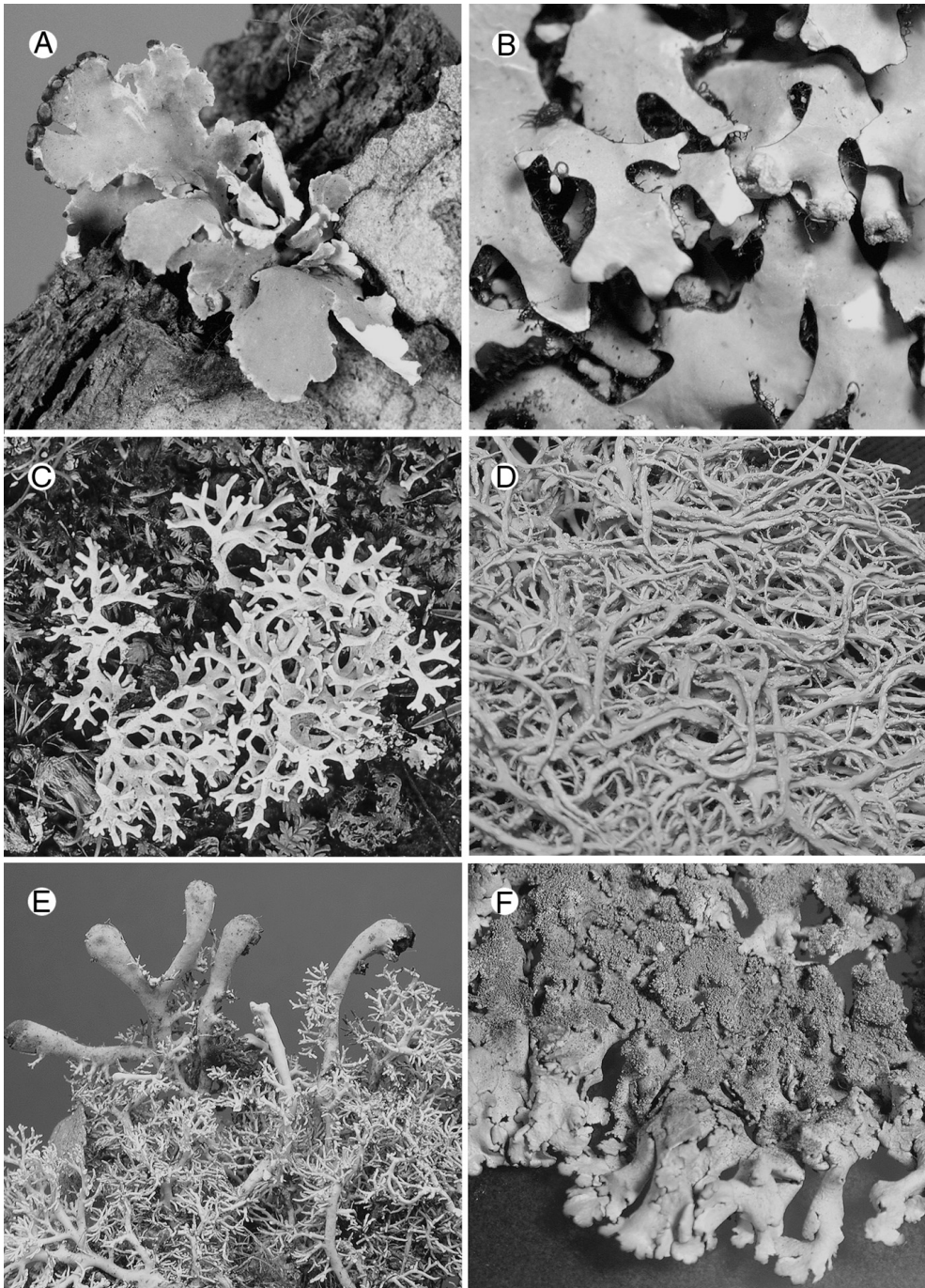


Fig. 3. Selected lichens that are currently listed under the *Tasmanian Threatened Species Protection Act 1995*. A: *Calycidium polycarpum*; B: *Hypotrachyna laevigata*; C: *Xanthoparmelia willisii*; D: *Teloschistes flavicans*; E: *Bunodophoron notatum*; F: *Xanthoparmelia vicariella*.

for further detailed study. However, knowledge of large sections of the Tasmanian lichen flora remains very incomplete, and consequently it is impossible to assess the conservation status of every species. The recent account of the Tasmanian Parmeliaceae (Kantvilas *et al.*, 2002) provides a good example of this. Of 148 taxa treated, 79 (53%) are known to be widespread, common and not under any perceived threat; these have been classified as being of 'least concern'. In general, such species were required to have been recorded from at least ten 10 km×10 km grid cells of the standard Australian Map Grid System. Forty-eight taxa (32%) are regarded as being insufficiently well known to be assessed and are classed as 'data deficient'; these are priorities for future work. As such an analysis is undertaken for other lichen families, one could expect similar proportions for each conservation category.

The extensive reservation system in Tasmania means that, by default, many lichens are well represented within secure reserves (Kantvilas, 2000). However, it is significant that despite 40% of Tasmania being in National Parks or other formal reserves, a large proportion of listed or targeted lichens (62.5%) is not captured by the reserve system. This is because the criteria by which reserves are determined, notably wilderness values, aesthetic values and other biological values, do not necessarily provide good surrogates for lichens. Thus of the 48 lichen species that are either listed or being considered for listing, some occur outside reserves essentially by chance, because of their intrinsic rareness, whereas others are unreserved because their habitat falls outside of the reserve system.

The occurrence and reservation status of rare lichens in each of the major Tasmanian vegeta-

Table 3. The occurrence of rare lichens in major Tasmanian vegetation types. Species not recorded from any reserves are indicated with an asterisk.

<p>Nothofagus-dominated cool temperate rainforest: <i>Bunodophoron notatum</i>, *<i>Calycidium polycarpum</i>, *<i>Erioderma solediatum</i>, *<i>Hypotrachyna laevigata</i>, <i>Lecanographa nothofagi</i>, *<i>Leioderma solediatum</i>, *<i>Menegazzia minuta</i>, <i>Parmelia tarkinensis</i>, *<i>Roccellinastrum neglectum</i>.</p>
<p>Wet eucalypt forest: *<i>Megaloblastenia flavidoatra</i>, <i>Megalospora gompholoma</i> subsp. <i>fuscolineata</i>.</p>
<p>Dry eucalypt forest: *<i>Coccocarpia pellita</i>, <i>Hypotrachyna immaculata</i>, *<i>Melanelia piliferella</i>, *<i>Neofuscelia graniticola</i>, *N. <i>subloxodella</i>, *<i>Parmelina pallida</i>, *<i>Polysporina terricola</i>, *<i>Pyxine nubila</i>, *<i>Ramalea cochleata</i>, *<i>Xanthoparmelia canobolasensis</i>, <i>X. jarmaniae</i>, *<i>X. mannumensis</i>, *<i>X. oleosa</i>, *<i>X. vicaria</i>, *<i>X. vicariella</i>.</p>
<p>Montane vegetation: <i>Calycidium cuneatum</i>, <i>Cetraria islandica</i> subsp. <i>antartica</i>, <i>Degelia calcicola</i>, <i>Parmeliopsis abigua</i>, <i>P. hyperopta</i>, <i>Umbilicaria decussata</i>.</p>
<p>Lowland grassland or grassy woodland: *<i>Xanthoparmelia amphixantha</i>, *<i>X. molliuscula</i>, *<i>X. willisii</i>.</p>
<p>Buttongrass moorland: *<i>Santessonella rugosa</i></p>
<p>Wet gully forest communities (Notelaea-dominated): <i>Coccocarpia erythroxyli</i>, <i>Usnea angulata</i>.</p>
<p>Melaleuca ericifolia swamps: *<i>Bactrospora metabola</i>, *<i>Leptogium coralloideum</i>, *<i>Parmotrema crinitum</i>, <i>Pseudocyphellaria aurata</i>, *<i>Punctelia subflava</i>.</p>
<p>Coastal vegetation: <i>Parmelina whinrayi</i>, <i>Teloschistes flavicans</i>, <i>Xanthoparmelia microphyllizans</i>.</p>

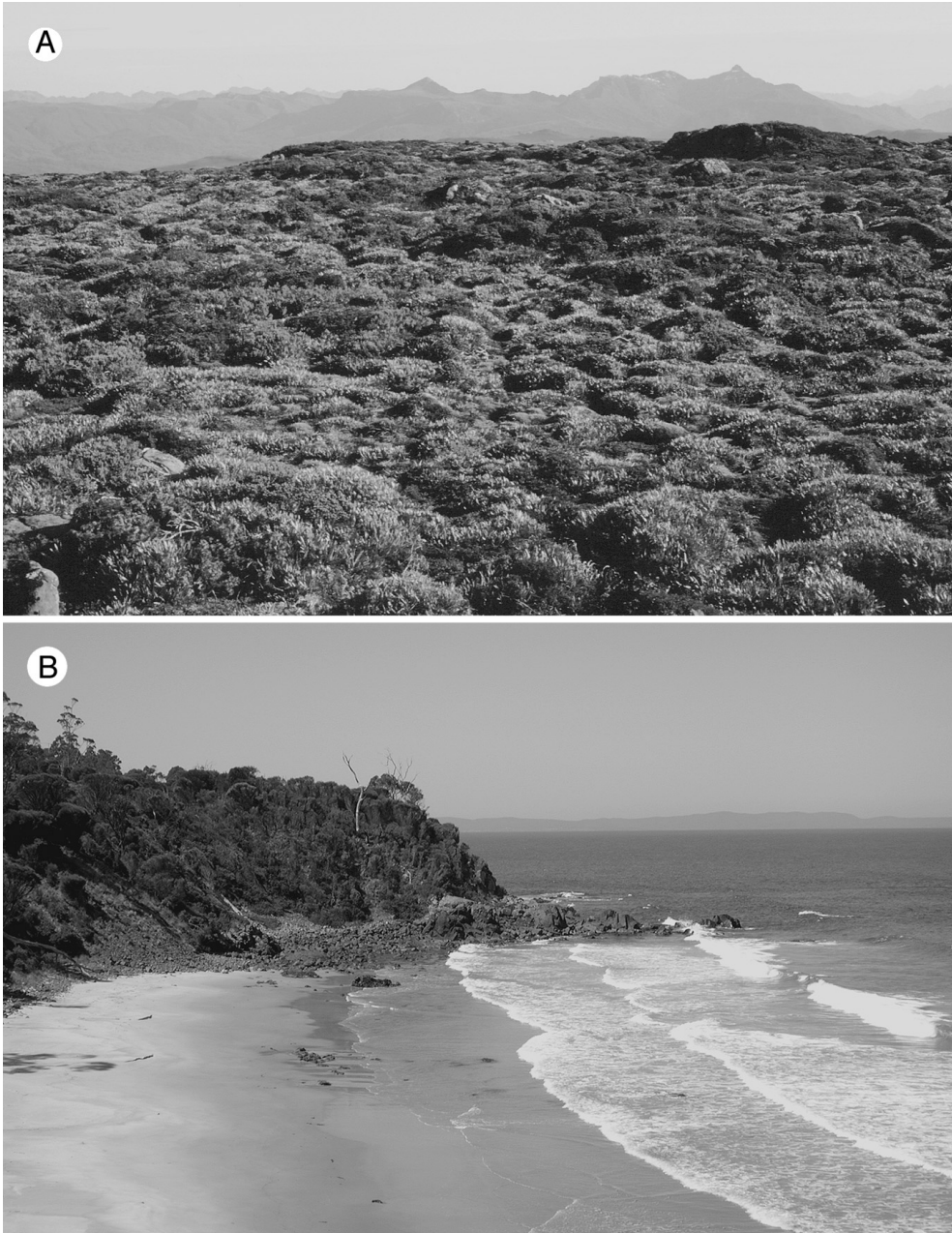


Fig. 4. Tasmanian vegetation types I. A: montane vegetation. B: coastal communities.

tion types is summarised in Table 3. *Cladonia tasmanica* and *Usnea baileyi* are considered extinct and, as no information on their habitat, actual or inferred, is available, they are excluded from this analysis. It is only in montane environments (Fig. 4A) that rare lichens occur consistently within reserves. Similarly, existing reserves capture the rare lichen species that are known from coastal vegetation (Fig. 4B). Vegetation types that are relatively poorly represented in the reserve system, notably *Melaleuca ericifolia* swamps (Fig. 5A), dry eucalypt forest (Fig. 5B),

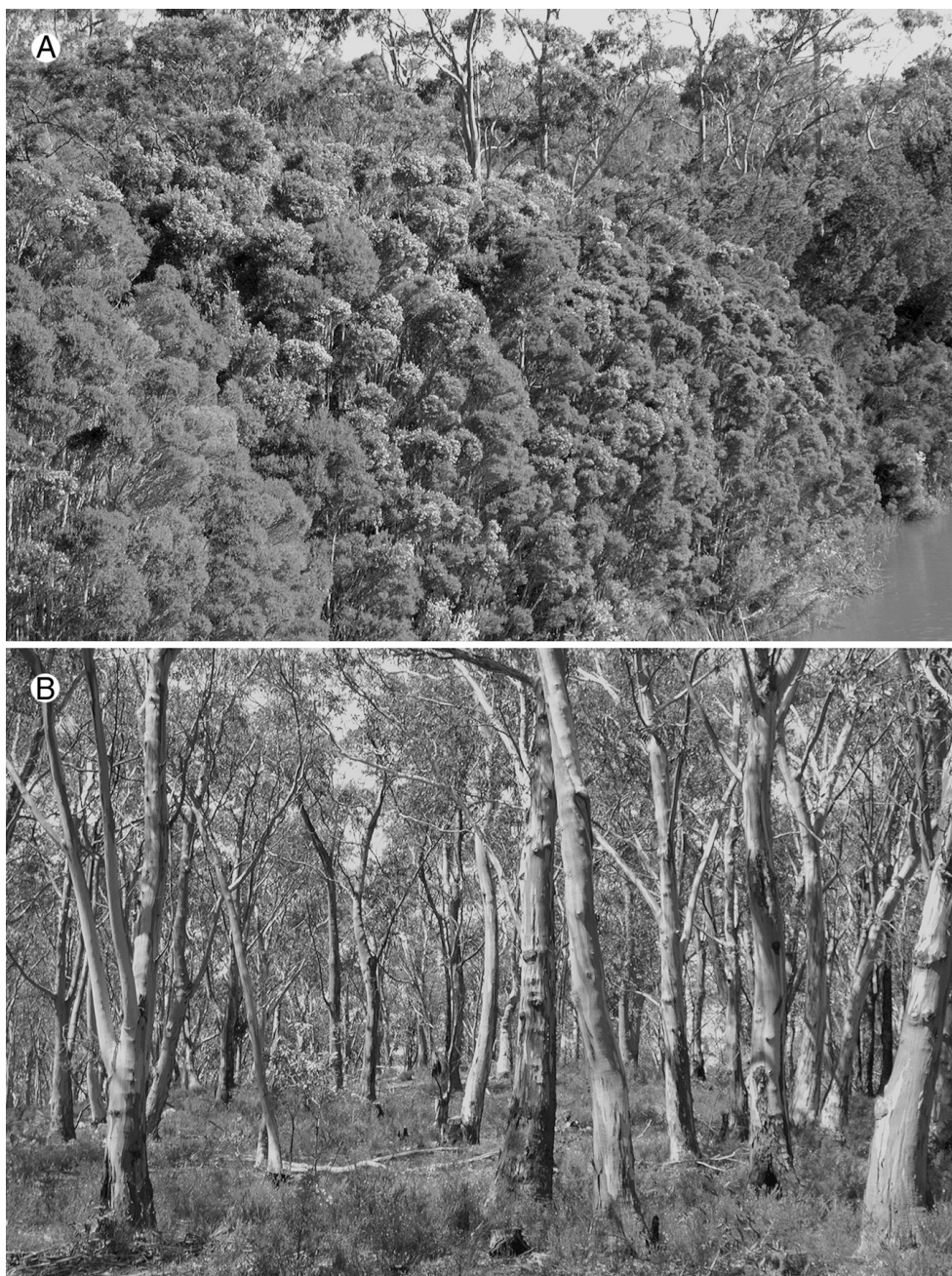


Fig. 5. Tasmanian vegetation types II. A: *Melaleuca ericifolia* swamp; B: dry eucalypt forest.

lowland grassland (Fig. 6A) and *Notelaea*-dominated wet gully forest (Fig. 6B), are conspicuous in the number of unreserved rare lichens they contain. Wet eucalypt forest (Fig. 7A), the main source of Tasmania's timber, also contains at least one unreserved lichen. However, even within buttongrass (*Gymnoschoenus*) moorland (Fig. 7B), which occurs extensively within reserves, there is one very rare, unreserved lichen, the endemic *Santessoniella rugosa*. The most remark-

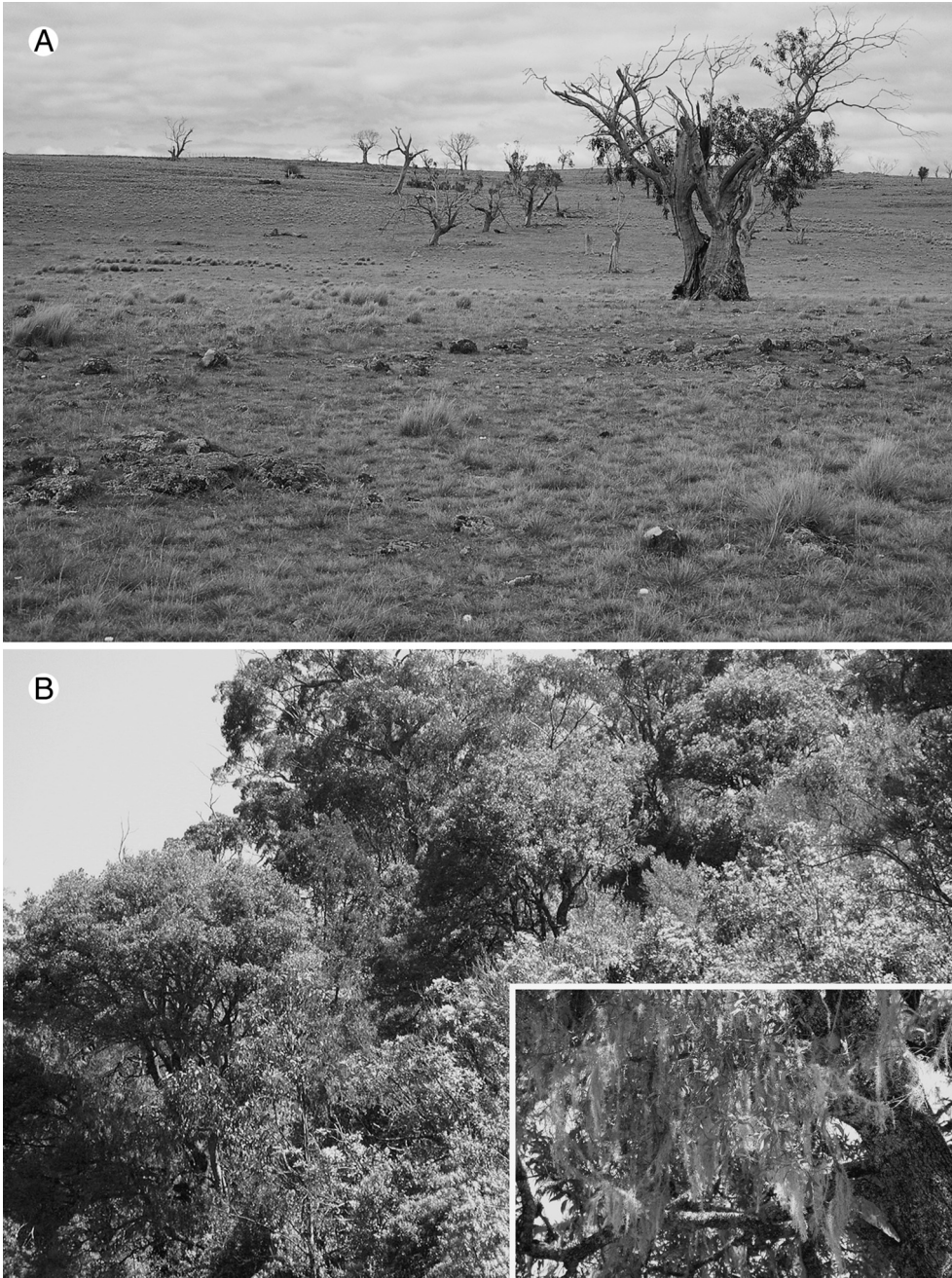


Fig. 6. Tasmanian vegetation types III. A: Lowland grassland; B: *Notelaea*-dominated wet gully forest (inset: festoons of *Usnea angulata* in the canopy).

able trend is in cool temperate rainforest (Fig. 8A). Despite about 75% of Tasmanian rainforest being reserved, several rare rainforest lichens are completely unrepresented in those reserves. Most of these are restricted to a region known as the Tarkine Wilderness, and are very localised in an area designated for wood production due to the high quality of *Nothofagus* timber growing there.

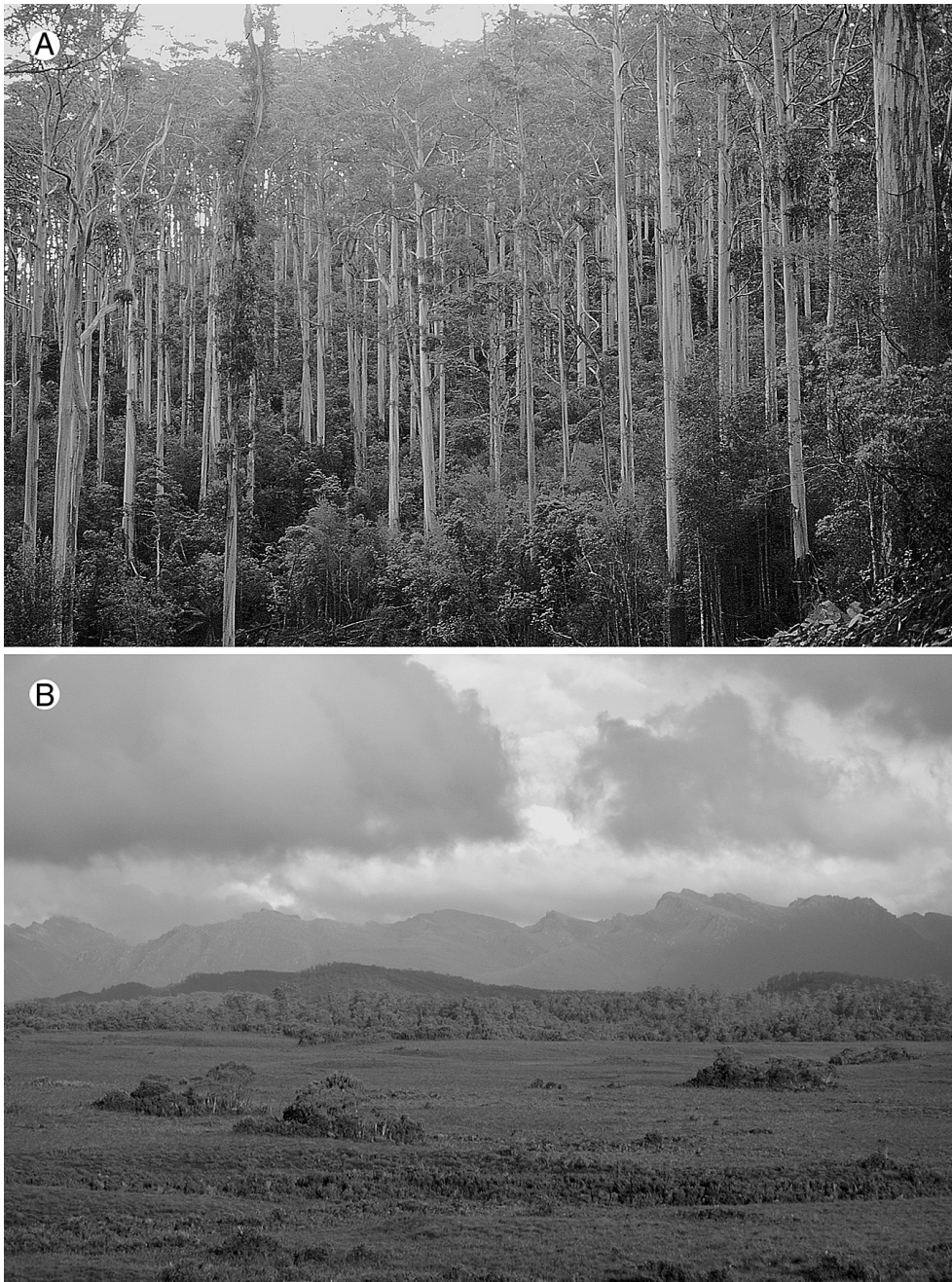


Fig. 7. Tasmanian vegetation types IV. A: wet eucalypt forest; B: buttongrass (*Gymnoschoenus*) moorland.

Thus the often stated view that vascular plant communities are consistent surrogates for all lichen species and critical lichen habitats in all vegetation types, and that lichens will be 'looked after' in the course of vascular plant conservation and management appears to be unfounded. Indeed, some Tasmania's rarest lichens, and those in greatest need of protection are found in fragmented, relict, often degraded vegetation types of low aesthetic appeal, occur in poorly reserved

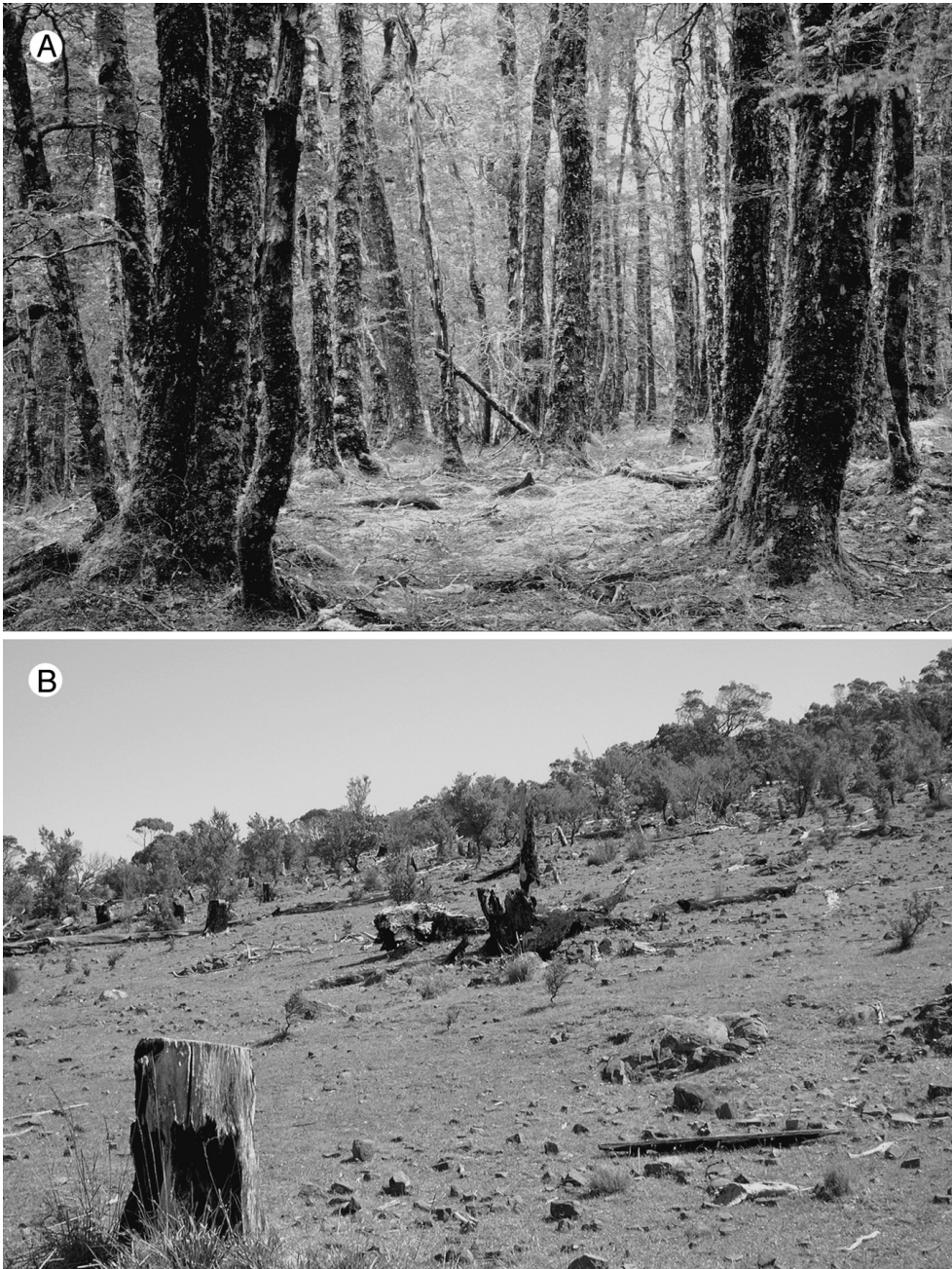


Fig. 8. Tasmanian vegetation types V. A: cool temperate rainforest; B: degraded dry woodland and pasture.

vegetation types targeted for economic development, or represent genuinely isolated and very unusual records. Roughly cleared dry grassy woodland (Fig. 8B), isolated rocks in pasture, and even solitary, remnant trees can all be of vital importance for lichen conservation.

Of course, reservation does not necessarily guarantee conservation. Occurrence in a reserve may exempt a species from direct and deliberate habitat degradation, development and resource

extraction, but destructive impacts such as wild-fires, a significant factor in the Tasmanian environment, do not respect reserve boundaries. Furthermore, reserves are invariably managed for vascular plant or other values, and not for their lichens. Certain lichen species may well need specific management prescriptions, especially those that occur in low rainfall areas in grassland or woodland where there is a long history of interaction between flora, fauna and humans. Here native marsupials and indigenous hunter gatherers have been replaced by sheep and pastoralists, and the problems of single-species management can be acute (see Kantvilas, 2000).

Conversely, occurrence outside of reserves does not exclude formal protection. For example, small isolated rainforest remnants on Tasmania's drier east coast are often unreserved, but are excluded from timber production (Kantvilas, 2000). There are also various local planning regulations and mechanisms such as Tasmania's *Forest Practices Code* for dealing with rarities on public and private land.

Conclusion: the Future

The future in Tasmania will hopefully see an ever expanding body of information on lichen systematics, distribution and ecology. Out of this data, inevitably, there will be a continuing trickle of nominations for the listing of species under the *Threatened Species Protection Act 1995*. However, the impact of such listings on human activity such as vegetation management, resource development and reserve delimitation is uncertain. To date, lichens have barely penetrated the psyche of Tasmanian resource managers, conservation biologists, ecologists, planners or other stakeholders. The present level of education on lichens or of resourcing of lichen (or indeed any cryptogam) projects does not promise a surge of interest in the near future.

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