THE CONSERVATION OF ORIGINAL VEGETATION REMNANTS IN THE MIDLANDS, TASMANIA

by R. J. Fensham and J. B. Kirkpatrick

(with two tables, three text-figures and an appendix)


Following 180 years of agricultural settlement, the Midlands area of Tasmania has been drastically transformed and 83% of the original area of native vegetation has been replaced. By comparing information from two recent intensive floristic surveys with historical botanical records, it was determined that 11.8% of the higher plant flora has vanished. With current rates of change and land tenure, it is probable that further extinctions will occur in this environment.

Grazing was found to increase significantly native species richness on loams and clays, although the same relationship was not evident on sandy soils. The management of grassy remnants should include regular burning and/or grazing as a means of intermittently depleting the grass sward. Many herbaceous exotics are habitat specific, and it is suggested that their passive spread is not an immediate threat to native vegetation on well-drained land. The long-term viability of native vegetation may, however, necessitate the implementation of simple management programs designed to maintain native species diversity and to minimise the spread of the more vigorous woody exotics.

Key Words: grassy vegetation, species richness, grazing, burning, exotics, Tasmanian Midlands, conservation, extinction.

THE CURRENT STATUS OF MIDLANDS VEGETATION

The Midlands area of Tasmania (fig. 1) was one of the first areas developed for agriculture in Australia and, since the early part of last century, the area has been radically transformed (Kirkpatrick et al. 1988: 17–21). Today, a vast expanse of cultivated ground extends to the base of the surrounding escarpments. Plant communities and species that were restricted to these agriculturally desirable habitats are now confined to scattered refugia that have accidentally avoided destruction. In the period from European settlement to 1985, native vegetation was reduced to 16.9% of its original area (fig. 2). With current rates of change, virtually all of the remaining vegetation of the Midlands could be destroyed by forestry and agricultural exploitation; 99.3% of land is privately owned.

The Midlands form a natural landscape unit, defined by its mountainous borders, low altitudes, dry climate, broad fertile river valleys and plains. As well as prime agricultural land, it contains dissected dolerite hills and ancient lateritised surfaces. Fensham (1989) identified 14 terrestrial plant communities that are derived from five gross formations, identifiable by their structure or overstorey dominants. These formations are Eucalyptus amygdalina forest, E. viminalis woodland, E. pauciflora woodland, E. ovata woodland and Poa labillardieri tussock grassland.

Specht (1981) identified the savannah woodlands of temperate southeastern Australia as one of seven major plant formations virtually absent from Australia’s reserve network. Surveys of Tasmania’s dry forests and grassy ecosystems (Duncan & Brown 1985, Kirkpatrick et al. 1988) have found all of the major dryland Midlands communities, with the exception of E. viminalis woodlands, to be poorly reserved or unreserved.

Most of the Midlands consisted of sparsely wooded plains dominated by E. pauciflora and/or E. ovata. These formation survive only in very small areas and are extremely vulnerable to further landscape change. Many roadside remnants continue to be damaged or destroyed by road widening, rerouting and herbicide spraying. In 1985, the Campbell Town cemetery was in excellent native condition and represented one of the last woodland remnants on basalt soils. However, recent “clean up” attempts have excised half of its area into the adjoining paddock, poisoned much of the remainder and disturbed the ground, destroying one of the three known populations of one of Australia’s rarest plant species Colobanthus aff. strictus.
FIG. 1 — Locality map.
FIG. 2 — Native vegetation remnants, including regenerated clearfell coupes and native pasture with depleted overstoreys; c. 1988.
Eucalyptus amygdalina forest covered large areas of the Midlands on poorer soils. However, in recent decades it has been rapidly cleared (fig. 2). The grasslands of the river flats have all been cultivated, with the exception of a small area on the Macquarie River surrounded by steep rocky banks, and a few fragments heavily invaded by exotics. The number of extinct Midlands plant species that were known only from such habitats (appendix) suggests that the full range of these communities has not survived.

The riparian shrub communities are still relatively intact on the edges of the study area at the Macquarie and Elizabeth Rivers and Cataract Gorge. Apart from these peripheral areas riparian communities have virtually disappeared, with the exception of a few small fragments in moderately grazed or rocky situations. The riparian habitat seems particularly susceptible to invasion by woody weeds, especially gorse (Ulex europaeus) and willows (Salix alba), and the native communities have probably been eliminated by grazing.

The aquatic communities still have apparently original complements of native plants as well as many exotic taxa. There is no evidence of the eutrophication that has so seriously affected waterways of intensively cultivated areas in other parts of the world.

Thirty-four per cent of the area under wetlands has been drained, while a further 23% has been affected by artificial changes of water level (fig. 3). Most of the wetlands have suffered from drainage attempts, although Smiths Lagoon (wetland no.30) has been impounded and Bar Lagoon (wetland no.42) has deepened as a result of increased runoff following clearance and gravel scraping in nearby Verwood Forest (G. Dowling, pers. comm. 1986). Of the remaining wetlands, the infrequently inundated margins are susceptible to exotic invasion following disturbance by introduced grazing animals. Many of these communities have depleted native species complements and are dominated by the exotic herb Plantago coronopus.

A search of botanical records and herbarium collections (see appendix for these references) revealed the native species that have been recorded from the Midlands; those not found at these localities in the course of the surveys of Fensham (1989) and Kirkpatrick & Harwood (1983a,b) are indicated. Where possible, the localities of old records were checked for evidence of the existence of a plant species. However, most old records refer to localities where the chances of finding native species is slight, such as R.C. Gunn's collections from Penquie — now a part of suburban Launceston (Gunn 1842). Some ephemeral species, particularly orchids, may still be present in the Midlands. Herbarium collections marked with the general locality “Launceston” were not included, as they may have occurred outside the study area. Based on this estimate, 59 of the 499 higher native plant species recorded from the Midlands are extinct. Full details of these historical records can be found in Fensham (1985).

Apart from the Orchidaceae, most of the extinct species were associated with riverine habitats — an indication of the degree of native vegetation displacement in these environments. Deyeuxia lawrenctii, Goodenia amplexans, Isotes drummondii, Myriophyllum glomeratum, Prostanthera cuneata and Senecio macrocarpus may now be extinct in Tasmania, although the record for the Goodenia amplexans may refer to a collection in the Melbourne Herbarium marked “Nile Rivulet”, which could be a mainland locality. Temporary displacement of aquatic species has been documented for both lentic (Holmes & Whitton 1977) and lotic water (Millar 1973) and, given that not all waters were thoroughly surveyed, it is probable that the aquatic species Trithuria submersa and Utricularia australis still occur in the Midlands. Chenopodium pumilio and Euphrasia scabra have been germinated recently from soil collected near Ross (L. Gilfedder, pers. comm. 1988), although these annuals have not been observed in the field.

It is unlikely that the full range of plant communities in the Midlands has survived. Dimmock & Loveday (1953) described a hummocky complex north of Campbell Town as a “complex of low mounds and self-mulching depressions”. This is physically comparable to the gilgai complex described by Leeper (1952). The mainland gilgai complexes have been documented as having particular plant associations corresponding to their micro relief features (Williams 1955). The former extent of these formations is unknown. The “hummocky” complexes in the Campbell Town area have nearly all been cultivated and none were located in the study area with native plant cover.
Conservation of original vegetation remnants in the Midlands, Tasmania

FIG. 3 — (A) Distribution of wetlands in the Midlands showing areas covered by (B), (C) and (D); (B) status of wetlands in area 1; (C) status of wetlands in area 2; (D) status of wetlands in area 3.
STRATEGIES FOR CONSERVATION

While conservation of major structural formations is desirable, detailed botanical surveys allow for the determination of areas that most efficiently conserve the maximum number of species. This survey discovered several species not previously known from Tasmania, which indicates the importance of survey work in endangered habitats. The appendix shows the Midlands species that are unreserved in Tasmania. The species reservation status was established from herbarium and literature searches and discussion with M. Brown, F. Duncan and L. Giffedder.

Reservation of areas of Epping Forest would preserve Eucalyptus amygdalina forest and could include the unreserved species Amphibromus macrorhinus, A. neesii, Apoidea gracilis, A. pumilio, Brunonia australis, Caesia parvifolia var. viitata, Caladenia clavigera, Calochilus imberbis, Centipeda minima, Cyperus tenellus, Eragrostis benthamii, Glycine latrobeana, Haloragis aspera, Helipterum australe, Danthonia carphoides longifolia, Isoetopsis graminifolia, Lomandra hollandiae, Poa hookeri, Prasophyllum odoratum, Pterostylis biseta, Scleranthus diander, Stipa rotundifolia, and the endemic species Wilsonia gaimardi (Taylor 1988).

The Tunbridge tip site is on Crown Land and most of it has recently been informally declared a refuge area. The area has been subject to some bulldozing and is probably less desirable for reservation than some of the private paddocks in the area. The case for a reserve in Epping Forest is strengthened by its unusually high concentrations of the restricted endemic marsupial Bettongia gaimardi (Taylor 1988).

The Elizabeth River gorge has already been identified as an area of high priority for plant conservation because of its large healthy populations of the rare endemic species Acacia axillaris (Brown et al. 1983). The area also includes another unreserved endemic Epacris exserta and the unreserved Pimelea pauciflora.

Cataract Gorge in Launceston provides another opportunity of protecting vulnerable species. The presence of the unreserved species Anogramma leptophylla, Doodia media, Helichrysum aff. semipapposum, Micranthemum hexandrum and the unreserved endemic species Callitris oblonga and Epacris exserta make this area of public land extremely suitable for reservation.

The wetlands in the study were not identified as high priority areas for plant species conservation by Kirkpatrick & Harwood (1983b) but since their work the endemic species Ranunculus prasinus has been described (Menadue & Crowden 1985). This species is only known from Near Lagoon (wetland no.49) and White Lagoon (wetland no.50). Near Lagoon has a population of Bolboschoenus caldwellii and both lagoons have populations of Schoenoplectus validus and extensive herbfields dominated by Wilsonia rotundifolia, all of which are unreserved in the State. A recent analysis of significant wetlands of Tasmania includes Near Lagoon (Kirkpatrick & Tyler 1988).

Other unreserved species of isolated occurrence on private land or small refuge areas in the Midlands may require protection. While control by the appropriate government body is the most desirable means of protecting valuable natural areas, private ownership is not necessarily incompatible with nature conservation. A private trust fund, for purchasing private land for nature conservation, has been established by the Tasmanian Conservation Trust. However, the owners of valuable Midlands regions have proven reluctant to relinquish even the smallest areas (D. Watts, pers. comm. 1987). The reluctance of governments to purchase, and private owners to part with land suggests alternative means of protection may be necessary. The introduction of legislation such as in South Australia, Victoria and New South Wales, where private landholders receive incentives to protect and preserve natural environments and are required to abide by a suitable management plan (Leigh et al. 1984), would be extremely appropriate for an area like the Midlands. Several landowners have indicated their interest, given some financial incentive, in protecting native vegetation on their land. One small area of land of a sympathetic landowner is inhabited by three rare plant species; it could be simply protected by a relatively short fence.
VIABILITY AND MANAGEMENT OF SMALL RESERVES IN GRASSY VEGETATION

Problems

The viability of small reserves has been the subject of international debate (e.g. Diamond 1975, Simberloff & Abele 1976, Higgs 1981, Brown & Hopkins 1983). Whatever the theoretical implications of this discussion, it is certain that the suitability of a particular area as a nature reserve will be idiosyncratic, depending on its significance, the availability of alternatives, the size and shape of the area, the behaviour of the particular vegetation type in the face of surrounding land-use, management problems and the aims of the conservation effort.

One of the most serious problems affecting native vegetation in small reserves in agricultural districts is the edge effect of management practices on adjacent land. The use of herbicides is particularly hazardous; other practices may have less dramatic effects, but nonetheless be deleterious. Drift from fertiliser application has the most serious effect on native vegetation on infertile substrates. However, few remnants on any substrate were observed adjacent to improved pasture. Specht & Cleland (1961) suggest that buffer zones should be established to absorb the effects of adjacent land-use patterns.

Mechanical ground disturbance and herbicide spraying seriously affect all native vegetation in the Midlands, particularly grassy vegetation on infertile substrates (Kirkpatrick 1977), particularly where aerial spreading techniques are employed. Thus, a viable reserve on relatively infertile substrates, such as those supporting Eucalyptus amygdalina forest in the Midlands, would need to be larger than one on fertile substrates. However, few remnants on any substrate were observed adjacent to improved pasture. Specht & Cleland (1961) suggest that buffer zones should be established to absorb the effects of adjacent land-use patterns.

Species Richness

The maintenance of species richness in grassy vegetation on fertile soils in southeastern Australia seems to require some mechanism for regularly reducing the biomass of the perennial grasses (Stuwe & Parsons 1977, Kirkpatrick 1986, Dickinson & Kirkpatrick 1986). This hypothesis was tested for the Midlands quadrat data set (Fensham 1989) on substrates with a range of fertilities. Quadrats were placed into three broad groups, using the soil textural classes of McDonald et al. (1984): those on dolerite with loams or heavier soils, those on depositional material with light sandy clay loams or lighter soils, and a third intermediate group containing quadrats that could not be defined by these criteria. The Cressy Research Farm and all private property with the exception of two areas not subjected to grazing for several years (as confirmed by the owners) constituted the grazing group. In addition to these two areas the ungrazed group comprised the road and rail reserves, cemeteries, ungrazed Crown Land and city parks. Native species richness was determined for each of the 180 10 x 1 m quadrats. The percentage frequencies of the individual species were compared between the grazed and ungrazed plots using Student's t-test.

The abundances of grasses, sedges, annual herbs, perennial herbs and shrubs were each compared between grazed and ungrazed sites. Only species with a percentage frequency of more than 10% in any one comparison were included in the following analysis. Each 20% difference between the grazed and the ungrazed groups was regarded as a unit. Thus, if a species had a frequency of 75% in the ungrazed group and 30% in the grazed group, the abundance of that species in the ungrazed groups was 250% greater than the grazed group and the species received a score of 12. Where a species was absent from a group it was given a percentage frequency equivalent to it occurring in one quadrat. The units for all species in each life-form were totalled for both the grazed and the ungrazed treatment. If the importance of grazing did not vary between life-forms, it would be expected that the proportions of units in each treatment for a particular life-form would be equal to the proportion of units in each treatment for the total number of species. The significance of the deviation from the expected value was tested using the chi-squared test.

The comparison between mean native species richness on grazed and ungrazed sites revealed different effects on different soil types and differing life-form groups. It appears that native species richness is increased by grazing on fertile dolerite soils (t = 5.8, P < 0.001) and other clays and loams (t = 2.5, P < 0.02), but not on infertile sandy soils. While grazing does not dramatically affect species richness in the grassy heath understoreys on infertile ground, it can influence community composition. Leucopogon virgatus has been
virtually excluded from some areas of forest, leaving *Ribbertia riparia* as the single dominant shrub. When a fence separates an area of forest where grazing has been less intense, *Leucopogon virgatus* is a codominant member of the understorey.

The percentage frequencies of species of the understorey that were most affected by grazing on fertile soil (all sites except those on sandy soils) are shown in table 1. Small annual herbs and geophytes decline most significantly (chi-squared = 16, $P < 0.001$ and chi-squared = 3.3, $P < 0.1$ respectively) in the absence of grazing. The larger (*Helichrysum apiculatum*, *Dianella* spp.) or twining (*Asperula conferta*, *Convolvulus erubescens*) growth-forms may allow some herbaceous species to compete successfully in the ungrazed grass sward.

Grasses showed varying responses, with *Deyeuxia quadriseta* and most of the shorter *Agrostis aemula*, *Danthonia laevis*, *D. tenuior*, *D. carphoides var. angustior* and

<table>
<thead>
<tr>
<th>TABLE 1</th>
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<tbody>
<tr>
<td>Percentage Frequency of Species in Ungrazed and Grazed Treatment Groups* for Quadrats Located on Fertile Ground</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Ungrazed</th>
<th>Grazed</th>
<th>Ungrazed</th>
<th>Grazed</th>
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</thead>
<tbody>
<tr>
<td>Grasses</td>
<td></td>
<td></td>
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<tr>
<td><em>D. revoluta</em></td>
<td>15.9</td>
<td>5.9</td>
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<tr>
<td><em>Helichrysum apiculatum</em></td>
<td>50</td>
<td>17.6</td>
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<tr>
<td><em>Vitadinia muelleri</em></td>
<td>18.2</td>
<td>0</td>
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<tr>
<td><em>Acana echinata</em></td>
<td>36.4</td>
<td>82.4</td>
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<tr>
<td><em>Arthropodium milleflorum</em></td>
<td>6.8</td>
<td>14.7</td>
<td></td>
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<tr>
<td><em>Dichordra repens</em></td>
<td>18.2</td>
<td>82.4</td>
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<tr>
<td><em>Galiurn gaudichaudii</em></td>
<td>4.6</td>
<td>14.7</td>
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<tr>
<td><em>Hydrocyctyle stibhorpioides</em></td>
<td>2.3</td>
<td>14.7</td>
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<td><em>Hypericum gramineum</em></td>
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<td>67.7</td>
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<td><em>Hypoxis hygrometrica</em></td>
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<td>11.8</td>
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<tr>
<td><em>Leucopogon quadrijidus</em></td>
<td>34.1</td>
<td>55.9</td>
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<td><em>Lomandra longifolia</em></td>
<td>27.3</td>
<td>64.7</td>
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<td><em>Ptilotus spathulatus</em></td>
<td>11.5</td>
<td>23</td>
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<tr>
<td><em>Solenogyne dominii</em></td>
<td>13.6</td>
<td>38.2</td>
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<tr>
<td><em>S. gunnii</em></td>
<td>15.9</td>
<td>35.3</td>
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<tr>
<td><em>Veronica calycina</em></td>
<td>6.8</td>
<td>14.7</td>
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<tr>
<td><em>V. gracils</em></td>
<td>9.1</td>
<td>26.5</td>
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<td><em>Viola hederacea</em></td>
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<tr>
<td><em>Wurmbea dioica</em></td>
<td>6.8</td>
<td>14.7</td>
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<td><em>Acacia mearnsii</em></td>
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<td><em>Banksia marginata</em></td>
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<td>20.6</td>
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<tr>
<td><em>Bursaria spinosa</em></td>
<td>40.9</td>
<td>73.5</td>
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<tr>
<td><em>Eucalyptus viminalis</em></td>
<td>27.3</td>
<td>73.5</td>
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<tr>
<td><em>Hibbertia hirsuta</em></td>
<td>25</td>
<td>61.8</td>
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<tr>
<td><em>Lissanthe strigosa</em></td>
<td>36.4</td>
<td>70.6</td>
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</table>

* Only species occurring in greater than 10% of either treatment group, where the difference between treatments is more than double or greater than 20%, are included.
EXOTIC SPECIES

Some exotic species occur in a wide range of Midlands environments. Particularly widespread are the grasses *Aira carvophyllea*, *Briza minor*, *Holcus lanatus* and *Vulpia bromoides*, and the herbs *Centaurium erythraea*, *Hypocharis radicata* and *Trifolium dubium*. However, many of the exotic species seem to have strict environmental preferences. For example, *Briza maxima* prefers well-drained non-clayey substrates and *Hypocharis glabra* is widespread but apparently less frequent in the groups of low-lying habitats. By contrast, *Juncus articulatus* and *Lotus tenuis* occur in those communities associated with depressions, while *Lysimachia nummularia* was only seen growing by streams, where it is particularly prolific. *Agrostis capillaris*, *Anthoxanthum odoratum* and *Filago gallica* did not occur in any of the quadrats that comprise groups 8, 9 and 10. These groups are associated with the lowest rainfall zones, and these three species are probably limited by the frequency of drought in the most extreme Midlands environments.

There are virtually no areas in the Midlands without some naturalised exotic species. While the factors that influence most such species are only poorly understood (Weir 1977 cf. Gleadow 1982, Gleadow & Ashton 1981, Gleadow & Rowan 1982, Gleadow et al. 1983 for *Pittosporum undulatum*), the ubiquity of exotic species throughout the Midlands probably reflects the dissected nature of the remnant vegetation and the ready transport of disseminules by a variety of herbivores and machinery.

When the imposed conditions are not detrimental to native vegetation, most exotic species seem to co-exist without causing declines in native species richness (Fensham 1989). This is so for non-woody species in well-drained fertile habitats (Kirkpatrick 1986) and probably also in well-drained infertile substrates in the Midlands, where herbaceous exotic populations appear to be relatively stable. In favourable environments, woody weeds, such as gorse (*Ulex europaeus*) and blackberries (*Rubus fruticosus*) may be capable of invading native vegetation where disturbance phenomena are restricted to those that can be assumed for pre-European conditions. Once established, their ability to form dense thickets excludes native vegetation. The control of these species in the early stages of their invasion is of paramount importance in maintaining the effectiveness of areas of native vegetation for long-term nature conservation.
TABLE 2
Percentage Frequencies of Exotic Species in the Classificatory Groups* of Fensham (1988)

<table>
<thead>
<tr>
<th>Species†</th>
<th>Community‡</th>
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<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Juncus articulatus</td>
<td>-</td>
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<tr>
<td>Anthoxanthum odoratum</td>
<td>-</td>
</tr>
<tr>
<td>Agrostis capillaris</td>
<td>-</td>
</tr>
<tr>
<td>Cynosurus cristatus</td>
<td>-</td>
</tr>
<tr>
<td>Filago gallica</td>
<td>-</td>
</tr>
<tr>
<td>Briza maxima</td>
<td>-</td>
</tr>
<tr>
<td>Agra caryophylla</td>
<td>67</td>
</tr>
<tr>
<td>Anagallis arvensis</td>
<td>-</td>
</tr>
<tr>
<td>Centaurium erythraea</td>
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<tr>
<td>Vulpia bromoides</td>
<td>67</td>
</tr>
<tr>
<td>Leonodon taraxacoides</td>
<td>-</td>
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<tr>
<td>Trifolium glomeratum</td>
<td>-</td>
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<tr>
<td>Hypochaeris glabra</td>
<td>-</td>
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<tr>
<td>Romulea rosea</td>
<td>-</td>
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<tr>
<td>Hypochaeris radicata</td>
<td>67</td>
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<tr>
<td>Briza minor</td>
<td>-</td>
</tr>
<tr>
<td>Poa annua</td>
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<tr>
<td>Cerastium fontanum</td>
<td>33</td>
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<tr>
<td>Cirsiurn arvense</td>
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</tr>
<tr>
<td>Trifolium dubium</td>
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<tr>
<td>Rosa rubiginosa</td>
<td>-</td>
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<tr>
<td>Ulex europarvs</td>
<td>-</td>
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<tr>
<td>Rubus fruticosus</td>
<td>-</td>
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<tr>
<td>Trifolium subterraneum</td>
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</tr>
<tr>
<td>Cynornus echniatus</td>
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<tr>
<td>Holcus lanatus</td>
<td>50</td>
</tr>
<tr>
<td>Taraxacum officinale</td>
<td>-</td>
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<tr>
<td>Agrostis stolonifera</td>
<td>50</td>
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<tr>
<td>Linum trigynum</td>
<td>-</td>
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<tr>
<td>Hordeum maritimum</td>
<td>-</td>
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<tr>
<td>Daicytis glomerata</td>
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<tr>
<td>Geranium dissectum</td>
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<tr>
<td>Vicia sativa</td>
<td>-</td>
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<tr>
<td>Erodium cicutarium</td>
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<tr>
<td>Lolium perenne</td>
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<tr>
<td>Plantago lanceolata</td>
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<td>Sonchus asper</td>
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<td>Plantago coronopus</td>
<td>-</td>
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<tr>
<td>Rumex obtusiflora</td>
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<td>Bromus hordeaceus</td>
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<td>Petrorhagia prolifer</td>
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<td>Silene gallica</td>
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<td>Bromus sterilis</td>
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</tr>
<tr>
<td>Carduus tenuiflorus</td>
<td>-</td>
</tr>
<tr>
<td>Myosotis discolor</td>
<td>-</td>
</tr>
<tr>
<td>Tragopogon porrifolius</td>
<td>-</td>
</tr>
<tr>
<td>Lysimachia nummularia</td>
<td>-</td>
</tr>
</tbody>
</table>
Notes to Table 2
* Only species with >10% in any group are included.
† Species nomenclature follows Buchanan et al. (1989).
(1) *Eucalyptus amygdalina* open forest on dolerite hills. (2) *E. ovata* woodlands on infertile sandy depressions.
(3) Grasslands on moderately fertile sandy depressions. (4) *E. amygdalina* open forest on flat sandy ground.
(5) *E. amygdalina* forest on infertile sands. (6) *E. amygdalina* forest on mixed substrates with moderate rainfall.
(7) *E. amygdalina* forest on mixed substrates with high rainfall. (8) *E. pauciflora* woodland on doleritic clay loams.
(9) *E. pauciflora* woodland on basaltic loams. (10) *E. pauciflora* woodland on sand.
(11) *E. viminalis* woodland on dolerite hills. (12) *E. ovata* woodlands on clayey depressions.
(13) Grasslands on clayey depressions. (14) Grasslands on riverine flats.

ACKNOWLEDGEMENTS

We thank Chris Harwood and Steve Harris who conducted much of the field work in the wetlands and Louise Gilfedder and Fiona Coates for a large part of the herbarium searching and for checking a draft of this manuscript. Alex Buchanan, Winifred Curtis, Mary Cameron, Dennis Morris and Tony Orchard drew our attention to important botanical records.

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(accepted 18 August 1989)
APPENDIX

List of Known Midlands Higher Plant Species, showing those presumed to be extinct in the region (*), those unreserved in Tasmania (†)

Numbers refer to references confirming the previous existence of an extinct species.
(1) Spicer (1878)  (2) Rodway (1903)
(7) Queen Victoria Museum, Herbarium  (8) Melbourne Herbarium
(9) D. Morris, pers. comm. 1986 (specimen held at Kew Herbarium, London)
(10) A. Buchanan, pers. comm. 1989 (specimen held at N.S.W. Herbarium).
Nomenclature follows Buchanan et al. 1989.

PTERIDOPHYTA

ADIANTACEAE
Adiantum aethopicum L.

ASPIDIACEAE
Polystichum proliferum (R.Bl) C. Pres!

ASPLENIACEAE
Asplenium flabellifolium Cay.

AZOLLACEAE
Azalia filiculoides Lam.

BLECHNACEAE
Doodia media R. Br. †

DICKSONIACEAE
Dicksonia antarctica Labill.

ISOETACEAE
Isoetes drummondii A. Braun † * 6
I. eliator F. Muell. †
I. muelleri A. Braun † * 6

MARSILEACEAE
Pilularia novae-hollandiae A.Br. †

OPHIOGLOSSACEAE
Botrychium lunaria (L.) Swartz † * 6
Ophioglossum luzitanicum L.

SELAGINELLACEAE
Selaginella uliginosa (Labill.) Spring

GYMNOSPERMAE

CUPRESSACEAE
Callitris oblonga A. & L.C. Rich †

ANGIOSPERMAE — MONOCOTYLEDONAE

ALISMATACEAE
Alisma plantago-aquatica L.

CENTROLEPIDACEAE
Aphelia gracilis Sonder †

A. pumilio F. Muell. ex Sonder †
CENTROLEPIS aristata (R.Br.) Roem & Schult.
C. glabra (F. Muell.) Hieron. * 2
C. strigosa (R. Br.) Roem. & Schult.

CYPERACEAE
Baumea arthrophylla (Nees) Bocck.
B. gunni (Hook. f.) S.T. Blake † * 1,2
Bolboschoenus caldwellii (V. Cook) Sojak
Carex appressa R. Br.
C. bichenoviana Boott † * 6
C. breviculmis R. Br.
C. chlorantha R. Br. † * 1,6
C. fascicularis Soland. ex Boott
C. gaulichaudiana Kunth.
C. inversa R. Br. †
C. fynx E. Nelmes
C. tasmanica Kuk. † * 6
C. tereicicaulis F. Muell.

CHORISANDRA cymbaria R. Br.
Cyperus gunni Hook f.
C. lucidus R. Br. †
C. sanguinolentus Vahl †
C. tenellus L. †
Eleocharis acuta R. Br.
E. pusilla R. Br.
E. sphaelata R. Br.
Gahnia filum (Labill.) F. Muell.
G. grandis S.T. Blake
I. cerna (Vahl.) Roem. & Schult.
I. crassicaula Hook. f.
I. flavicans (L.) R. Br.
I. hookeriana Bocck
I. inundata R. Br.
I. marginata (Thunb.) A. Dietr.
I. montivaga (S.T. Blake) K.L. Wilson
I. nodosa (Rothb.) R. Br.
I. platycarpa (S.T. Blake) Sojak
I. stellata (C.B. Clarke) K.L. Wilson † * 6
Lepidosperma concavum R. Br.
L. filiforme Labill. * 1
L. laterale R. Br.
L. lineare R. Br.
L. longitudinale Labill.
Schoenoplectus pungens (Vahl) Palla
S. valdiius (Vahl) A. & D. Love†
Schoenopus apogon Roem. & Schult.
S. fistulos L.
S. latimarginatus Kuekenth.†
S. mastrilatus Roem. & Schult.
S. nitens (R.Br.) Poir.
S. testiforun J.M. Black

HYDATELLACEAE
Tristaria submersa Hook. f. † * 2,6

HYDROCHARITACEAE
Vallisnertia gigasite Graebner

HYPOXIDACEAE
Hypoxis hygrometrica Labill.
H. vaginata Schldl.

IRIDACEAE
Diplarrena moerace Labill.

JUNCACEAE
Juncus amabilis Edgar †
J. australis Hook. f.
J. bufonius L.
J. capitatus Weig.
J. filicaulis Buch.
J. holoschoenus R. Br.
J. kraussii Hochst.
J. pallidus R. Br.
J. pauciflorus R. Br.
J. planifolius R. Br.
J. procerus E. Mey.
J. sarophorus L.A.S. Johnson
J. subsecundus N.A. Wakefield

LEMNACEAE
 Lemma disperma Hegelm
 L. trisulca L.
 Wolffia australiana (Benth.) Hartog and Plas. †

LILIACEAE
Arthropodium milleflorum (DC.) Macbride
A. minus R. Br.
Balbina glauca (Raf.) E.M. Watson
Burchardia umbellata R. Br.
Caesia parviflora R. Br.
var. parviflora
var. viitata (R. Br.) R. Henderson †
Characeae corymbosa (R. Br.) F. Muell. ex Benth.
Dianella longifolia R. Br. †
D. tasmanica Hook. f.
Dichopogon strictus (R. Br.) Baker
Thysanotus patersonii R. Br.

Tricoryne elatior R. Br.
Wurmbea dioica (R. Br.) F. Muell.

ORCHIDACEAE
Caladenia catarata (Sm.) Druce
C. caulata W.H. Nicholls
C. clavigera A. Cunn ex Lindley †
C. cucullata FitzG.
C. p. tonii R. Br.
Calochilus imberbis R.S. Rogers †
C. gnnii Lindley * 6
C. reflexa (Labill.) Druce * 6
Corbyas incurvus D. Jones & M. Clements † * 6
Dipodium punctatum (Smith) R. Br.
Diuros maculata Smith
D. sulphurea R. Br. * 6
Eriocharis cucullata (Labill.) Reichb. f.
Glossodia major R. Br.
Microtis unifolia (Forst. f.) Reichb. f.
Prasophyllum odoratum R.S. Rogers † * 6
Pterosylis biseta J.A. Blackmore & Clemesha †
P. curta R. Br.
P. furcata Lindley * 6
P. maticia R. Br. * 6
P. pedunculata R. Br.
P. rufa R. Br.
Spiranthes sinensis (Pers.) Ames * 1
Thelymitra aristata Lindley * 6
T. carnea R. Br.
T. megcalyptra R.D. FitzG.
T. punciflora R. Br.

POACEAE
Agrostis aemula R. Br.
A. avnacea J.F. Gmel.
A. billardieri R. Br.
A. venusta Trin.
Amphibromus archeri (J.D. Hook.) P.F. Morris
A. macrorhina S.W.L. Jacobs & L. LapinpuTo †
A. neessi Steud. †
A. recurvata Swallen
A. sinuata S.W.L. Jacobs & L. LapinpuTo †
Dantonia caespitosa Gauchich.
D. carphoides F. Muell, ex Benth.
var. angustior Vickery †
D. dimidiiata Vickery
D. laevis J.W. Vickery
D. penicillata (Labill.) P. Beauv.
D. pilosa R. Br.
D. popinensis D.I. Morris †
D. procera Vickery †
D. racemosa R. Br.
D. semiannularis (Labill.) R. Br.
D. setacea R. Br.
D. tenuior (Steudel) Conert
Dreyeuxia lawrencii Vickery † * 9
D. quadrirista Benth.
Conservation of original vegetation remnants in the Midlands, Tasmania

Dichelachne crinita Hook.
D. rara (R. Br.) Vickery
Dickichlis distichophylla (Labill.) Fassett
Echinopogon ovatus (G. Foster) P. Beauv.
Elymus scabrus (Labill.) A. Love
Eragrostis molybdea (Labill.) Vickery
E. distichophylla Labill.
E. stipoides (Labill.) A. Love
Ehrharta acuminata (R. Br.) Sprengel
E. distichophylla (Labill.) Fassett
E. stipoides (Labill.) A. Love
Festuca plebeia R. Br.
F. hookeriana (F. Muell.) ex J.D. Hook.
F. stipoides (Labill.) A. Love
F. angustifolia A. Cunn. ex DC.
Poa hookeri Vick.†
P. labillardieri Steud.
P. mollis Vick.†
P. pratermissa D. Lindley†
P. rodwayi Vickery
P. sieberiana Spreng.
P. stipoides (Labill.) A. Love
Phragmites australis (Cav.) Trin. ex Steudel
Poa hookeri Vick.†
P. labillardieri Steud.
P. stipoides (Labill.) A. Love
Festuca plebeia R. Br.
F. hookeriana (F. Muell.) ex J.D. Hook.
F. stipoides (Labill.) A. Love
Poa hookeri Vick.†
P. labillardieri Steud.
P. stipoides (Labill.) A. Love
Lycium pyrrhophyllum (Labill.) A. Love
P. hookeri Vick.†
P. labillardieri Steud.
P. stipoides (Labill.) A. Love
S. nodosa S.T. Blake
S. pubinodis Trinius & Rupecht
S. rudis Sprengel
ss. australis J. Everett & S. Jacobs
S. scabra Lindley†
S. semibarbata R. Br.
S. stenopoda D.K. Hughes
Themeda triandra Forsskal
Zeyus macrantha Desv.
P. australiensis A. Bennett
P. crispus L.
P. ochroleucus Raoul†
P. pectinatus L.†
P. perfoliatus L.†
P. tricarinatus F. Muell. & A. Bennett ex A. Bennet
Ruppiaceae

ANGIOSPERMAE — DICOTYLEDONS

AMARANTHACEAE
Alternanthera dentiformis (R. Br.) Hook. f. ex Vent.

APIACEAE
Apium prostratum (Labill.) Benth.

ASTERACEAE
Alternanthera dentiformis (R. Br.) Hook. f. ex Vent.

Cyperaceae
Zannichellia palustris (L.) S. Moore

XANTHORHOEACEAE
Lomandra nana (A. Lee) A. Lee†

ZANNICHIELLACEAE
Leptulaenae androgynae (Kornicke) Benth.
L. preissii (Lehm.) F. Muell.† * 2

ZOBRYCIDACEAE
Zantedeschia australis (L.) G. Forster

ANGIOSPERMAE — DICOTYLEDONS

AMARANTHACEAE
Alternanthera dentiformis (R. Br.) Hook. f. ex Vent.

APIACEAE
Apium prostratum (Labill.) Benth.

ASTERACEAE
Alternanthera dentiformis (R. Br.) Hook. f. ex Vent.

Cyperaceae
Zannichellia palustris (L.) S. Moore

XANTHORHOEACEAE
Lomandra nana (A. Lee) A. Lee†

ZANNICHIELLACEAE
Leptulaenae androgynae (Kornicke) Benth.
L. preissii (Lehm.) F. Muell.† * 2
Olearia argophylla (Labill.) Benth.
O. ciliata (Benth.) F. Muell. ex Benth. * 1
O. flexibunda (Hook. f.) Benth.
O. raunolosa (Labill.) Benth.
O. stellulata (Labill.) DC.
O. vixosa (Labill.) Benth.
Podolpis jaceoides (Sims) Voss
Pseudognaphalium lateo-album (L.) Hilliard & B.L. Burtt.

Sepecco glomeratus Desf. ex Poir.
S. hispidulus A. Rich.
S. macrocarpus Belcher † * 4
S. quadridentatus Labill.
Solenyne domini L. Adams
S. gumin (Hook. f.) Carbara
Vittaedia cuneata DC. †
V. gracilis (Hook. f.) N. Barb. †
V. Muelleri N. Barb. †

BORAGINACEAE
Cynoglossum australe R. Br.
C. suaveolens R. Br.
Myosotis australis R. Br.

BRASSICACEAE
Barbarea australis J.D. Hook. † * 3
Cardamine tenuifolia Hook.
Hymenosolobus procumbens (L.) Nutt. ex Schinz. & Theil. * 1
Lepidium pseudosuermanicum Thell. †

BRUNONIACEAE
Brunonia australis Smith ex R. Br. †

CALLITRICHACEAE
Callitriche umbonata Hegelm. †

CAMPANULACEAE
Isotoma flaviflora (R. Br.) F. Muell. ex Benth. *
Labelia alata Labill.
L. gibbosa Labill.
L. prainoides Benth. † * 1,6
L. rhombifolia de Vriese † * 5
Pratia pedunculata (R. Br.) Benth. †
Wahlenbergia gracilenta N. Lothian
W. gracilis (Forst. f.) Schrader
W. gymnolda N. Lothian
W. multicaulis Benth.
W. stricta Sweet

CARYOPHYLLACEAE
Colobanthus apetalus (Labill.) Druce * 8
C. aff. strictus
Scleranthus biflorus (Forst. & Forst. f.) Hook. f.
S. diander R. Br. †
Spergularia media (L.) Cyrillo
Stellaria flavicida Hook.

CASSIURACEAE
Allocasuarina littoralis (Salisb.) L. Johnson
A. verticillata (Lam.) L. Johnson

CHENOPODIACEAE
Chenopodium glaucum L.
C. pumilio R. Br. † * 6

CLUSIACEAE
Hypericum gramineum Forst. f.
H. japonicum Thunb.

CONVOLVULACEAE
Convolvulus rubescens Sims
Dichondra repens Forst. & Forst. f.
Wilsonia rotundifolia Hook. †

CRASSULACEAE
Crassula helmsii (Kirk) Cockayne
C. peduncularis (SMith) Meigen * 6

DILENIACEAE
Hibbertia hisuta (Hook.) Benth.
H. prostrata Hook.
H. riparia (R. Br. ex DC.) Hoogl.
H. scorpionifolia R. Br. ex DC.

DROSERACEAE
Drosera peltata Thunb.

ELATINACEAE
Elatine gracilisoides A. Cunn.

EPACRIDACEAE
Acrotriche serrulata (Labill.) R. Br.
Astroloma humifusum (Cav.) R. Br.
Brachylium ciliatum (R. Br.) Benth.
Cyanodes parvifolia
Epacris exserta R. Br. †
E. impressa Labill.
Leucopogon collinus (Labill.) R. Br.
L. virgatus (Labill.) R. Br.
Lissanthus strigosus (Sm.) R. Br.

EPHORBIACEAE
Amperea xiphoclada (Sieber ex Spreng.) Druce
Bertia rosmarinifolia Planch. † * 1,2
Beyeria viscosa (Labill.) Miq.
Micanthium hexandrum Hook. f. †
Phylanthus australis Hook. f.
Poranthera microphylla Brongn.

FABACEAE
Acacia axillaris Benth. †
A. dealbata Link
A. genistifolia Link
A. gunnii Benth.
A. mearnsi De Wild
A. melaleuca R. Br.
A. mucronata Wild. ex Wendl.
A. sidaliformis A. Cunn. ex Benth. * 1
A. verticillata (L’Herit.) Willd.
Aotus ericoides (Vent.) G. Don
Boscia ericoides (Vent.) G. Don
B. prostrata R. Br.
B. riparia A. Cunn. ex Benth.
Daviesia latifolia R. Br.
D. ulicifolia Andr.
Desmodium varians var. gunnii (Hook. f.) Benth. † * 6
Dillwynia cineras (Vent.) G. Don
Glycine latrobeana (Meissn.) Benth. =
Gompholobium huegelii Benth.
Hovea lanceolata R. Br.
H. linearis (Smith) R. Br.
Indigofera australis Willd.
Kennedia prostrata R. Br.
Platylobium obtusangulum Hook.
Pultenaea fasciculata Benth.
P. juniperina Benth. ex Hook. f. †
P. prostrata Benth. ex Hook. f. †
GENTIANACEAE
Sebaea ovata (Labill.) R. Br.
GERANIACEAE
Geranium sessiliflorum Cav. ssp. brevicaule (Hook.) R.C. Carolin
G. solandieri R.C. Carolin
Pelargonium australe Willd.
GOODENEACEAE
Goodenia amplexans F. Muell. † * 2,8
G. elongata Labill.
G. hemilis R. Br.
G. lanata R. Br.
G. ovata Sm.
Selliera radicans Cav.
Velletia paraodoxa R. Br. †
HALORAGACEAE
Gonocarpus micranthus Thunb.
G. tetragynus Labill.
Haloragis aspera Lindley †
Myriophyllum glomeratum Schindler † * 8
M. integrifolium (Hook. f.) Hook. f.
M. pedunculatum Hook. f.
M. sausageum Orch.
M. simulans Orch.
M. variifolium Hook. f.
LAMIACEAE
Ajuga australis R. Br.
Mentha diemenica Spreng.
Prostanthera cuneata Benth. * 2,6,7
P. rotundifolia R. Br.
Praneilla vulgaris L.
Teucrium corymbosum R. Br.
Westringia rubraefolia R. Br.
LENTIBULARIACEAE
Utricularia australis R. Br. * 1
U. dichotoma Labill.
U. monanthos Hook. f.
LARACEAE
Cassytha pubescens R. Br.
LINACEAE
Linum marginale A. Cunn. ex Planchon
LYTHRACEAE
Lythrum hyssopifolia L.
MALVACEAE
Asterotrichon discolor (Hook.) Melville
Lawrenceia spicata Hook.
MYRINTHACEAE
Villarsia reiformis R. Br.
MYRTACEAE
Baeckea ramosissima A. Cunn.
Callistemon pallidus (Bonpl.) DC.
C. viridifloras (Sims) Sweet
Calycrix tetragona Labill.
Eucalyptus amygdalina Labill.
E. obliqua Labill.
E. ovata Labill.
E. pauciflora Sieber ex Spreng.
E. rodwayi R.T. Bak. & H.T. Smith
E. rubida H. Deane & Maiden †
E. vininalis Labill.
Leptospermum lanigerum (Ait.) Sm.
L. scoparium Forst. & Forst. f.
Melaleuca ericifolia Sm.
M. gibbosa Labill.
OLEACEAE
Notelaea ligustrina Vent.
ONAGRACEAE
Epilobium billardierianum Ser. ex DC.
OXALIDACEAE
Oxalis perrenans Haw.
PITOSPORACEAE
Billardiera procumbens (Hook.) E. Bennett
B. scandens Sm.
Bursaria spinosa Cav.
Pittosporum bicolor Hook.
PLANTAGINACEAE
Plantago antarctica Dene. †
P. varia R. Br.
POLYGALACEAE
Comesperma volubile Labill.
POLYGONACEAE
Muehlenbeckia axillaris (Hook. f.) Walp.
Persicaria hydropiper (L.) Opiz.
Polygonum decipiens R. Br. † * 6
Rumex brownii Campd.
R. dumosus A. Cunn. ex Meissn. †
PORTULACACEAE
Montia australis (Hook. f.) Pax & Hoffm.
PRIMULACEAE
Samolus repens (Forst. & Forst. f.) Pers.
PROTEACEAE
Banksia marginata Cav.
Grevillea australis R. Br.
Hakea lissosperma R. Br.
H. microcarpa R. Br.
Lomatia tinctoria (Labill.) R. Br.
Persoonia juniperina Labill.

RANUNCULACEAE
Clematis aristata R. Br.
C. gentianoides DC.
C. microphylla DC.
Ranunculus decurvar (Hook. f.) Melville * 6
R. glabrifolius Hook.
R. lapaceus Sm.
R. pinnatifolius Hook. * 6
R. praetanis (Menadue & Crowden) †
R. trichophyllus Chaix

RHAMNACEAE
Cryptandra amara Sm. †
Discaria pubescens (Brongn.) Druce * 6
Pomaderris elliptica sens. Ewart
Spyridium ulcinum (Hook.) Benth.
Stenanthemum pimeleoides (Hook. f.) Benth.

ROSACEAE
Acaena agnanila Gand.
var. tenuiscarpa (Bitt.) Orch. †
A. echinata Nees
A. novae-zelandiae Kirk
A. ovina A. Cunn.
Rubus parvifolius L.

RUBIACEAE
Asperula conferta Hook. f.
A. scoparia Hook. f. * 6
A. subspicadax Hook. f. * 6
Caprosma quadrifida (Labill.) Robinson
Galium australce DC.
G. ciliata Hook. f.
G. gaudichaudii DC.
Opepularia ovata Hook. f.
O. varia Hook. f.

RUTACEAE
Eriostemon verrucosus A. Rich.

Phebalium squameum (Labill.) Engl.
ssp. retusum (Hook.) P.G. Wilson †

SANTALACEAE
Exocarpos cupressiformis Labill.
E. strictus R. Br.
Leptomeria drupacea (Labill.) Druce

SAPINDACEAE
Dodonaea filiformis Link
D. viscosa (L.) N.J. Jacq.

SCROPHULARIACEAE
Euphrasia scabra R. Br. † * 5
Glossostigma elatnoides (Benth.) ex Hook. f. * 2
Gratiola latifolia R. Br. * 6
G. nana Benth.
Limosella australis R. Br.
Manzus pamphilo R. Br.
Minulius repens R. Br.
Parahbe derwentiana (Andrews) B. Briggs &
Ehrend. † * 6
Veronica calycina R. Br.
V. formosa R. Br.
V. gracilis R. Br.
V. scutellata L. †

SOLANACEAE
Solanum nigrum L.

STACKHOUSIACEAE
Stackhousia gurnnii Hook. f. †
S. monogyna Labill.

STYLLIDACEAE
Stylistium graminifolium Rich.

THYMELEACEAE
Pimeleca cerviflora R. Br. †
P. glacuca R. Br.
P. humila R. Br.
P. nivea Labill.
P. paciflora R. Br. †

TREMANDRACEAE
Tetratheca pilosa Labill. * 6
T. procumbens Gunn ex Hook. f.

VIOLACEAE
Hymenanthera dentata R. Br. ex DC.
Viola betonicifolia Sm.
Vi. hederacea Labill.