

VEGETATION OF THE MERRIWA AREA, NEW SOUTH WALES

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ABSTRACT

McRae, R.H.D. & Cooper, M.G. (National Herbarium of New South Wales, Royal Botanic Gardens, Sydney, New South Wales, Australia 2000) 1985. Vegetation of the Merriwa area, New South Wales. Cunninghamia 1(3), 351-369. The vegetation of the Merriwa area (covered by the Merriwa 1:100 000 map sheet, and bounded by latitudes 32° 00' and 32° 30'S and longitudes 150° 00' and 150° 30'E) lies in the botanical subdivision of the Central Western Slopes but has affinities with the vegetation of five others. Inland elements of the flora co-exist here with those normally associated with the Coast or the Tablelands. The plant communities strongly reflect the dry climate and the geology — different groups of communities were recognized on soils derived from basalt, sandstones and alluvium. Several communities and a number of species are restricted to the area. Traditional land use has involved the clearing of the basalt plains and river flats for cattle and sheep grazing, and the growing of wheat and other crops. Much of the vegetation on the sandstone has remained reasonably undisturbed and large areas have recently been conserved within national parks.

INTRODUCTION

The Merriwa area, covered by the Merriwa 1:100 000 topographic map (sheet no. 8933, Division of National Mapping, 1970), is bounded by latitudes 32° 00' and 32° 30'S and by longitudes 150° 00' and 150° 30'E, and covers about 2600 square kilometres. It lies east of the Great Divide, between the highlands at the northern end of the Sydney Basin and the foothills of the Liverpool Range, and includes part of the valley of the Goulburn River, the western branch of the Hunter River (Figure 1). Major towns in or near the area include Bylong, Cassilis, Denman, Merriwa, Sandy Hollow and Ulan (Figure 1).

The flora of the Goulburn River district was first studied by Allan Cunningham who, in the 1820s, collected plant specimens along the edge of the Goulburn River valley. Seventy years later the Sydney botanist R.T. Baker, assisted by a Rylstone surveyor, J. Dawson, collected to the south-west of the Goulburn River (Baker, 1896). Other botanists who have made collecting trips to the area include J.L. Boorman, early this century, and L.A.S. Johnson, in the 1950s. Dorman (1972) prepared a species list for Mt Dangar, "Murrumbo", the Bylong River valley, Lees Pinch and Wollar, all frequently visited sites with road access. Vegetation reports on the conservation potential of the Goulburn River have been prepared by the New South Wales National Parks and Wildlife Service (e.g. Ingram, n.d.). Regional overviews of the vegetation, such as those by Burley (1961), Story (1963), Forster (1981) and the Soil Conservation Service (n.d.), are very generalized and provide little floristic information.

THE STUDY AREA

Climate

The climate is temperate, with mean annual rainfall up to 660 mm, but the lower sandstone areas and the basalt plains are drier, with mean annual rainfall between 500 mm and 600 mm (based on a regional rainfall map in Tweedie, 1963). The distribution of rainfall is strongly influenced by the highlands to the north and

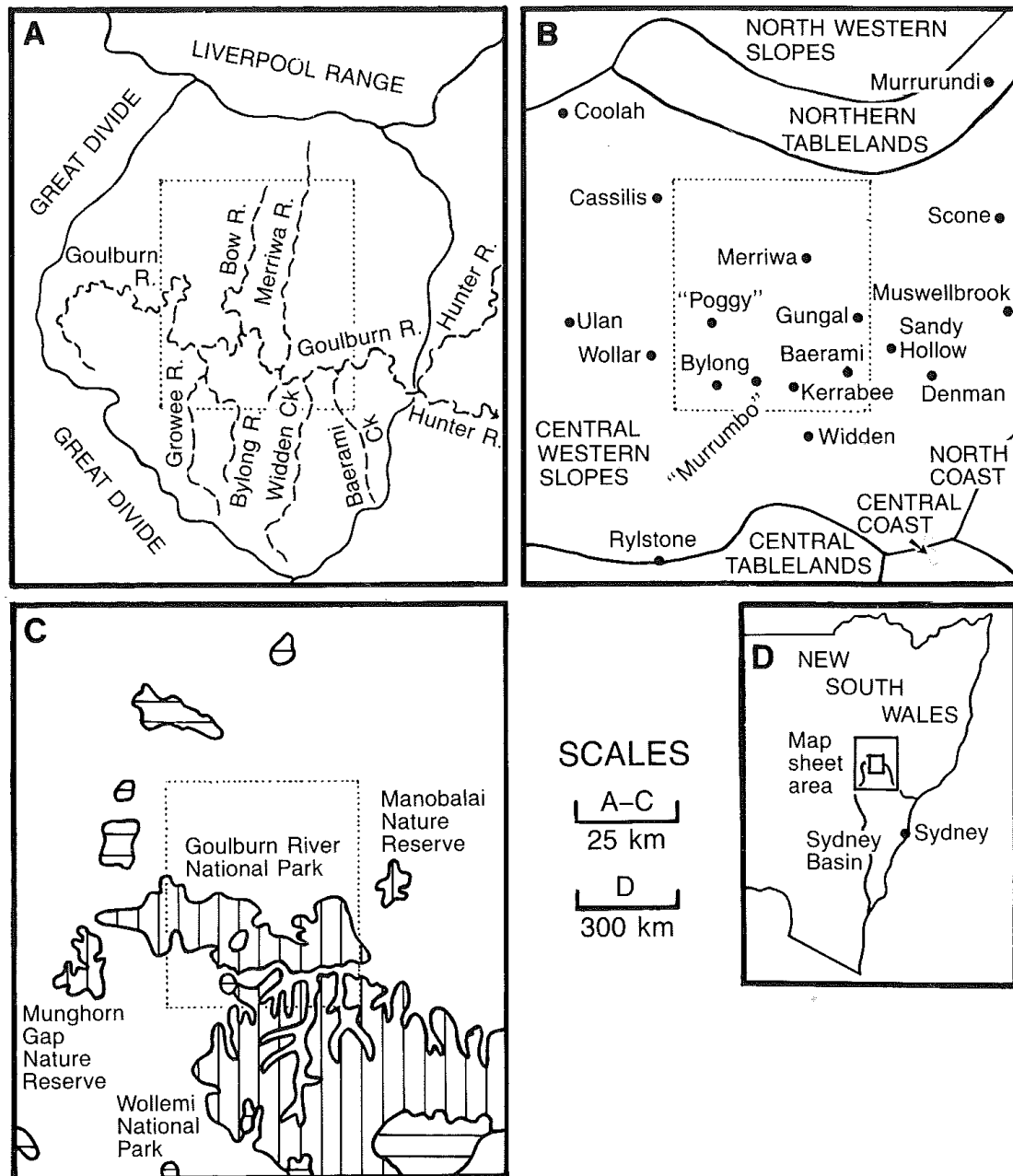


Figure 1. Location map, showing (A) the locations of watersheds and rivers; (B) main towns and botanical subdivisions of the region; (C) location of National Parks, Nature Reserves and State Forests and (D) location of the Merriwa Sheet in the State.

south, which often divert thunderstorms away from the lower areas, and by the lack of a prominent Great Divide. The pattern of monthly rainfall is generally uniform, but with a peak in summer and another lesser peak in winter. The lowest mean monthly rainfall is about 60 per cent of the highest (based on figures for Cassilis in Bureau of Meteorology, 1975).

The mean monthly temperatures are highest in December and January, with 32°C mean monthly maximum and 18°C mean monthly minimum at Sandy Hollow and 30°C mean monthly maximum and 14°C mean monthly minimum at Cassilis (Bureau of Meteorology, 1975). There is little variation in mean temperatures throughout the district, except with distance inland and differences in altitude

(Tweedie, 1963). Humidity is high in the winter months (up to 90 per cent mean monthly relative humidity based on data for Cassilis in Tweedie, 1963) and lower in summer (less than 60 per cent). There are between 18 and 26 weeks of the year with sufficient moisture for unrestricted plant growth (Tweedie, 1963).

Geology

The two main components are the sedimentary series of the northwestern Sydney Basin and the basalt flows of the Liverpool Range (New South Wales Department of Mines, 1969). In the valleys the geology is obscured by alluvium and colluvium.

In the southern half of the area the sedimentary strata are predominantly of the Triassic Narrabeen Group, mainly siltstones and sandstones, with underlying Permian beds of sandstone, siltstone and coal exposed in the deeper valleys. These strata have a local dip of about one degree to the north. Small outliers of the Jurassic Pilliga Sandstone occur near Merriwa.

In the northern half of the area volcanic activity in the Tertiary period covered the sedimentary strata with very deep basalt flows forming the Merriwa Plains and the foothills of the Liverpool Range. A number of volcanic necks are exposed today (e.g. at "Murrumbo", 10 km west of Kerrabee; Stony Pinch, 8 km west of "Murrumbo"; and "Poggy", 25 km south-west of Merriwa). A later series of basaltic flows filled in the entrenched valley of the Goulburn River (Galloway, 1967).

Geomorphology

The geomorphology is largely determined by the extent of the basalt deposits and by the differential erosion rates between the Triassic and Permian sedimentary strata. The Narrabeen Group is fairly resistant to erosion, and forms plateaux and narrow, cliff-lined valleys. At Morrisons Flat (10 km north-east of Bylong) and above its junction with Mt Misery Creek (8 km north of Bylong), the Goulburn River cuts into the softer underlying Permian strata, leading to undercutting of the sandstone cliffs and resulting in pronounced valley widening, with colluvium and talus slopes. Downstream from Drummers Flat (7 km north-west of Kerrabee) the valley is mature, and little talus occurs. South of the river, talus is again absent where the slope of the ridgetops matches the dip of the strata.

The Merriwa Plains are gently undulating, with major valleys about 10 km wide and with local relief of 100 to 150 m. The basalts south of the river have mostly eroded, and since the Tertiary the river beds have dropped about 50 m, with only local changes in course. Through relief reversal, remnant basalt caps are now found on many sandstone spurs overlooking the Goulburn River and most of its tributaries. North of the Goulburn River, most of the streams have cut through the thick basalt flows to expose the underlying Triassic and Jurassic strata.

Soils

The sandstone plateaux have coarse-textured, often skeletal, sandy soils of variable depth, with a clay component where claystones or siltstones have contributed to them. The soils on the steeper sandstone are often composed of colluvium or talus. On the Merriwa Plains there are shallow cracking clays and fine-textured, skeletal sandy soils. The alluvial regosols found in all main valleys are of a variable nature, depending on the local geology (Van de Graaff, 1963). The edges of these deposits are often covered by colluvium derived from weathering of the low sandstone cliffs.

Land use

Woodland or open-woodland communities appear to have been the characteristic vegetation before European settlement. These helped to support a relatively large population of Aborigines, as evidenced by the many art and habitation sites near the river. The effects that these earliest inhabitants had upon the area are unclear, and have been obscured by recent changes. Today, there are a variety of land uses. The alluvial soils support cattle grazing, stud farms and a low intensity of timber cutting. The woodlands on the Merriwa Plains basalt have been largely cleared for cattle and sheep grazing, and the growing of cereal crops. The sandstone ridges are virtually unused for agriculture. Merriwa is the main service town, with facilities for rail transport of grain. The coal railway from Gulgong to Sandy Hollow traverses the area, and the basalt quarries, used for track ballast and for roadworks, are situated near Bylong. The sandstone ridges to the south are included in the Wollemi National Park. Major new land uses include the Goulburn River National Park, new mines being planned for the coal reserves that underlie the plateaux, and a 500 kV power transmission line that will traverse the area from east to south-west.

METHODS

Areas of vegetation with similar structural and floristic characteristics, with associated geological and physiographic characteristics, were recognized using aerial photopatterns (photographs from the Water Resources Commission, Kerrabee Dam Series, 1980, circa 1:15 000 scale and the New South Wales Lands Department, Merriwa Series, 1977, 1:75 000 and 1:53 000 scales) and used to form the map units. These are not all of equivalent rank as a number are made up of several plant communities associated with particular geologic or physiographic types, whereas others are more clearly plant associations (*sensu* Beadle & Costin, 1952). Generally the term "plant community" is used for the basic vegetation unit. Vegetation was classified into structural forms based on the system of Specht (1970).

The central area of the map was examined in the most detail with community habitat, structure and composition being recorded in 20 m × 20 m quadrats at 19 sites. The locations of these sites and the full data, collected between December 1980 and March 1981, and during September 1981, are available from the National Herbarium of New South Wales. Community distribution patterns within the valleys of the Goulburn and Merriwa rivers were studied along transects ranging up to 3 km in length (see map). In other areas, roads and fire trails were traversed and floristic data collected to complement the data from the central section. Appendix 1 lists the species found in the various communities.

VEGETATION

Generally, the vegetation of the area is a woodland dominated by *Eucalyptus* species, particularly species of box, ironbark and red gum. *Callitris* pines are common, as are acacias. Understorey shrubs are generally scarce, but in scattered exposed sites with skeletal soils they become dominant. Ground cover was very sparse throughout the survey period, as a result of drought and grazing. In scattered sheltered sites, usually near cliffs and often with some basalt influence, rainforest shrubs occur, mostly in a stunted form. They are more frequent to the south, east and north, where the rainfall is higher.

The major map units or map unit groups recognized are:

1. open-woodland on basalt
2. woodland on basalt of foothills of Liverpool Range



Figure 2. Open-woodland of *Eucalyptus albens*-*E. moluccana* intergrade (Community 1) on a basalt residual near Morrisons Flat. Note the characteristically open understorey with **Opuntia stricta*.

3. woodland/open-woodland on alluvium
4. woodland in sandstone gullies
5. woodland/low open-woodland/low shrubland on shallow soils on Narrabeen Group
6. woodland/open-woodland/open-scrub on deeper soils on Narrabeen Group.

1. Open-woodland on basalt

This group of map units contains four communities, each physiographically distinct. They occur on the Merriwa Plains, on basalt remnants near the Goulburn River, on remnants towards Nullo Mountain, and on Mt Dangar. All are characterized by widely spaced trees 8 to 15 m high, very little to no shrub cover, and a sparse ground cover consisting mainly of perennial species. The main tree, *Eucalyptus albens*-*E. moluccana*[†], is an intergrade between two related box species, the former species being found commonly to the west, the latter in the Hunter Valley (Figure 2).

An open-woodland of *Eucalyptus albens*, *E. melliodora* and *Brachychiton populneus* occurs on the Tertiary basalt of the foothills of the Liverpool Range, the Merriwa Plains and also on large isolated basalt residuals, for example at "Poggy", "Mogo" (19 km north-west of Bylong), Stony Pinch and "Murrumbo". The usual landforms are broad valleys and rounded hills with an altitudinal range of from 400 to 500 m above sea level (ASL) and slopes mostly less than 15 degrees. The deep, rocky, basaltic soils, which have largely been cleared for agriculture, support *E. melliodora*, common elsewhere. Other trees present include *E. dealbata* and *E.*

[†]There have been some recent changes in the nomenclature of the eucalypts (L.A.S. Johnson, pers. comm.). The intergrade *Eucalyptus albens*-*E. moluccana* is called *E.* "albemol"; the intergrade *E. blakelyi*-*E. tereticornis* is called *E.* "blaketer"; and *E. oblonga* here is to be called *E. sparsifolia*.

moluccana. The understorey is usually affected by grazing or clearing, and **Opuntia stricta* is abundant.

On perched basalt residuals near the Goulburn River is an open-woodland dominated by *Eucalyptus albens*-*E. moluccana*. These residuals, found between Baerami and Lees Pinch (13 km north of Kerrabee and 13 km north-west of Bylong, respectively), mostly less than 2 km from the river, and at altitudes around 300 m ASL, are situated on the ends of low sandstone ridges, usually 50 to 100 m above the present river bed. Other trees present are *E. albens* s. str. and occasionally *Acacia doratoxylon*, *A. linearifolia*, *Allocasuarina*[†] sp. aff. *distyla* and *E. crebra*. *Notelaea microcarpa* dominates the sparse shrub cover and *Cheilanthes tenuifolia* is common on the rocky ground surface. *Eucalyptus dealbata* is the common eucalypt on the tops, which have slopes less than five degrees and very little soil. *E. albens*-*E. moluccana* is abundant on the margins on sites that exceed 15 degrees in slope and have deeper soils than the tops. Occasionally all the basalt rock in a residual has weathered and on these sites only *E. moluccana* occurs. In some deeper sandstone gullies, for example at Honeysuckle Creek (near "Murrumbo") and south of Morrisons Flat, small, highly weathered basalt residuals occur, usually on the steep base of a spur. *Eucalyptus moluccana* is found here also.

In the south, in the highlands of the northern portion of Wollemi National Park, are similar residuals associated with the basalt flows of Nullo Mountain. *Eucalyptus albens* is dominant. These residuals have deeper soils and higher altitude than they have elsewhere (around 500 m ASL, and 150 m above the valley floor), and *E. dealbata* and the integrade *E. albens*-*E. moluccana* do not occur.

Mt Dangar, a conical basalt peak, rising from 400 to 673 m ASL, supports a woodland of *Eucalyptus albens* and *Allocasuarina* sp. aff. *distyla*. The steep slopes (up to 30 degrees) support a shallow rocky soil. Other common species include *Callitris endlicheri*, *Myoporum montanum* and **Opuntia stricta*. *Acacia* sp. aff. *decurrens* is endemic to Mt Dangar. There is a narrow band of *E. dawsonii* (see Community 4) at the base of the basalt, possibly indicating an underlying layer of siltstone. The exact geology of the hill is uncertain; the basalt possibly differs from that of the other flows in the valley (Galloway, 1967).

2. Woodland on basalt of foothills of Liverpool Range

At the northern edge of the study area, on the foothills of the Liverpool Range (up to 640 m ASL) is a woodland of straight-trunked trees 15 to 30 m high. The main species are *Eucalyptus melliodora*, *E. laevopinea*, *E. viminalis* and *Allocasuarina torulosa*, and occasionally *E. moluccana* and *Brachychiton populneus*. The main shrubs are *Cassinia cunninghamii*, *Acacia implexa* and *Pittosporum undulatum*, with understorey species including *Indigofera australis* and *Clematis aristata*. This community occurs on deep basaltic soils on slopes up to 40 degrees, usually with a southerly aspect. It represents the southern limit of a major Northern Tablelands alliance, found on the Liverpool and Mount Royal ranges, and on the Great Divide south of Walcha, but is only a minor element of the vegetation of the Merriwa district. Grazing and partial clearing have altered its structure and species composition.

3. Woodland/open-woodland on alluvium

The riparian forests are a distinctive feature of the area. The stands have mostly been modified by selective logging and partial clearing for grazing and, as some stands

[†]Nomenclature for the Casuarinaceae follows the recent revision of Johnson (1982).

are regrowth, original densities are difficult to estimate. Shrubs are scarce, and are mainly in rocky situations. The ground cover is often grazed, especially during drought and, after rain, is dominated by fast-growing and short-lived weed species.

The nature of the parent material has a marked influence on the species composition, and various mixtures of species occur. On alluvium derived mainly from sandstones, the woodland or open-woodland is dominated by *Angophora floribunda*, with other species including *Eucalyptus crebra*, *Casuarina cunninghamiana* and *Callitris endlicheri* and, less frequently, *Acacia linearifolia*, *E. blakelyi* and *E. melliodora*. Infrequent species are *E. camaldulensis*, *E. trachyphloia*, *Allocasuarina* sp. aff. *distyla* and *Callitris preissii*. Of the many shrub species, none are dominant. Major ground cover species are **Echium plantagineum*, *Tribulus terrestris* and **Cirsium vulgare*. Each species tends to occur within a range of distances from the river, possibly related to the depth of the water-table and of the alluvium (Figure 3). This community occurs widely to the south of the Merriwa Plains, between 100 and 300 m altitude, and on slopes of zero to 20 degrees.

The vegetation on alluvium, derived wholly or in part from basalt, is structurally similar. The main tree species is *Eucalyptus albens*-*E. moluccana* with *E. conica*, *E. melliodora* and *Brachychiton populneus* and occasionally *Callitris preissii* and *E. dealbata*. The main shrub is **Opuntia stricta*. This community is found mainly in the Growee and Bylong rivers, and also through the Merriwa Plains, near "Murrumbo" and "Poggy" and occasionally near lower basalt residuals adjacent to the Goulburn River. Due to erosion of most of the basalt, its influence may be very localized and it may be of colluvial origin. The river flats in the south-west, with soils derived from extensive basalt flows, are the best agricultural soils in the district, and are largely cleared.

This map unit has affinities with riparian vegetation throughout the State, but the species composition here, reflecting the local climate and geology, is distinctive.



Figure 3. Open-woodland of *Eucalyptus melliodora* and *Angophora floribunda* (Community 3) on broad river flats surrounded by cliffs. Note the almost dry river. Near Morrisons Flat.

4. Woodland in sandstone gullies

In smaller valleys and deeper gullies in the sandstone, grows a woodland in which the main tree species are *Eucalyptus punctata*, *Acacia linearifolia* and *E. oblonga* and other tree species include *E. fibrosa*, *E. trachyphloia*, *Acacia doratoxylon* and *Allocasuarina torulosa*. There is a tall, open shrub layer dominated by *Phebalium squamulosum*, *Bursaria spinosa*, *Persoonia linearis* and *Dodonaea triangularis*, and a very sparse ground cover with *Cheilanthes tenuifolia* dominant.

Where the alluvium is derived mainly from siltstone the dominant trees are *Eucalyptus dawsonii* and *Acacia linearifolia*, with *E. crebra* also present. Shrubs include *Dodonaea triangularis*, *Cassinia cunninghamii*, **Opuntia stricta* and the local endemic *Helichrysum tessellatum*. The sparse ground cover contains a diverse mixture of native species, including the very restricted *Goodenia stephensonii*, and agricultural weeds (Figure 4). This form of the community is found generally throughout the sandstone areas, on slopes of 15 degrees, at altitudes of 100 to 350 m, and where exposure of the Permian strata has led to marked widening of the valleys. It is part of Beadle's (1981) *Eucalyptus dawsonii* alliance.

The soil is usually skeletal and sandy, with occasional small alluvial or colluvial deposits. The directions of the creeks are often controlled by joints in the sandstone. Where a creek flows southward or where a valley is deepest and providing good shelter, dense stands of *Backhousia myrtifolia* may occur, for example at Poggy Creek. The overall elevation range is from 150 to 600 m ASL and the slopes can be up to 30 degrees.

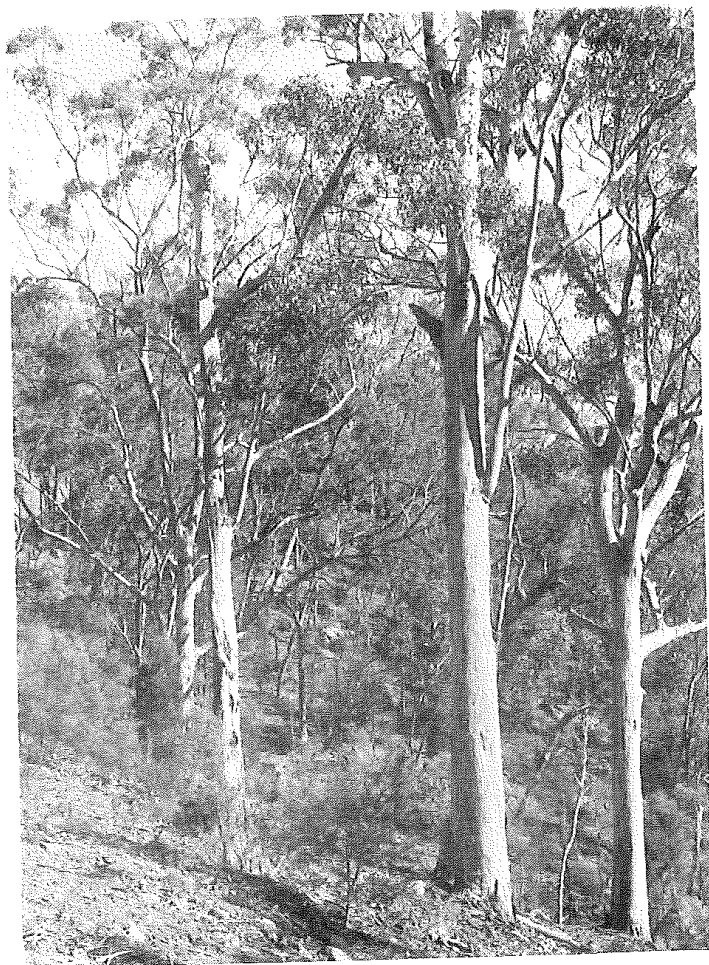


Figure 4. Open-woodland of *Eucalyptus dawsonii* (Community 4) in a siltstone gully near Morrisons Flat. Shrub species are *Cassinia cunninghamii* and *Dodonaea triangularis*.

5. Woodland/low open-woodland/low shrubland on shallow soils on Narrabeen Group

This map unit group contains four communities, three mapped separately.

5a. The shallow soils on the less eroded sandstone ridges and outcrops support a quite distinctive woodland vegetation, characterized by a high density of thin-stemmed trees up to about 12 m high with an open shrub layer. The dominant tree species are *Eucalyptus caleyi* and *Acacia doratoxylon*, commonly associated with *E. trachyphloia* and *Callitris endlicheri*, and occasionally with *E. dwyeri* and *Allocasuarina* sp. aff. *distyla* (Figure 5). *Acacia crassa* replaces *A. doratoxylon* at altitudes over 300 m. The main shrub species are *Persoonia linearis*, *Leptospermum parvifolium*, *Cassinia cunninghamii*, *Leucopogon muticus* and *Philotheca salsolifolia*, while the main ground cover species are *Lomandra glauca*, *Macrozamia communis* and *Cheilanthes tenuifolia*. The altitude of the low sandstone ridges ranges from 150 to 350 m and the convex slopes and numerous rock ledges may be up to 20 degrees in slope, with the steepest slopes below rock ledges. The distribution is generally in the south of the area, from about 10 km south of the Merriwa Plains to Widden, and between Sandy Hollow and Lees Pinch.

5b. On very shallow soils, on watersheds, above cliff-lines and on other exposed sites is a low shrubland dominated by *Philotheca salsolifolia*, *Baeckea densifolia*, *Phebalium squamulosum*, *Calytrix tetragona* and *Leptospermum parvifolium*, often with only two or three species present at any site (Figure 6). This community occurs in small stands scattered throughout the three other associated communities.



Figure 5. Woodland of *Eucalyptus caleyi* and *Acacia doratoxylon* (Community 5a) on a sandstone ridge near Morrisons Flat. Note the typical open understorey and high stem densities.



Figure 6. Low shrubland of *Baeckea densifolia*, *Calytrix tetragona* and *Leptospermum parvifolium* (Community 5b, foreground) on a sandstone ridge near Morrisons Flat. In the background, on a better drained soil, is a woodland of *Callitris endlicheri*, *Acacia doratoxylon* and *Eucalyptus caleyi* (Community 5a).



Figure 7. Low woodland of *Eucalyptus dwyeri*, with *Phebalium squamulosum* in the understorey (Community 5c), on an exposed sandstone hill near "Murrumbo".

5c. Skeletal soils on very exposed hilltops and on jointed residuals of higher strata of the Narrabeen Group support a low open-woodland dominated by *Eucalyptus dwyeri* and *E. oblonga*, with other species such as *Callitris endlicheri*, *E. caleyi*, *E. punctata*, *Acacia doratoxylon* and *A. linearifolia* (Figure 7). The understorey is similar to the low shrubland on very shallow soils, described above, but also with *Platysace lanceolata*, *Eriostemon myoporoides* and *Lomandra* sp. aff. *longifolia*. The species composition of the community varies with soil depth and the degree of exposure. It occurs north of the Goulburn River near Kerrabee and also to the south, extending into the highlands of Wollemi National Park, at altitudes usually over 400 m, and west of the Great Divide.

5d. Around the gorge of the Goulburn River to the west and north-west of Lees Pinch, where the soils are possibly finer textured, is a woodland, in which the dominant trees are *Eucalyptus trachyphloia* and *E. rossii*. Other trees present are *Callitris endlicheri* and *Allocasuarina* sp. aff. *distyla*. This community, found on slopes up to 10 degrees and at 300 to 400 m altitude, occurs widely along the Great Divide in the northwestern corner of the Sydney Basin. The Merriwa district is on the eastern edge of its range.

6. Woodland/open-woodland/open-scrub on deeper soils on Narrabeen Group

This map unit group contains four communities, three of which are mapped separately.

6a. The deeper soils on talus slopes derived from weathered rocks of the Narrabeen Group support a woodland community with a medium density of single-trunked trees up to 15 m high and an open shrub layer. The dominant tree species is *Eucalyptus fibrosa* and, on deeper soils, others such as *Callitris endlicheri*, *E. punctata* and, occasionally, *E. oblonga* occur. The main shrub species are *Dodonaea triangularis*, *Acrotriche rigida*, *Grevillea sericea*, *Hibbertia monogyna*, *Acacia triptera* and *A. paradoxa*, while the main ground cover species is *Lomandra glauca*. The distribution is throughout the sandstone areas where the Narrabeen Group is being undercut by the Goulburn River eroding the Permian strata and causing accelerated valley widening. Where this widening occurs north of the Goulburn River, the strata dip into the plateau surfaces and fairly extensive bands of talus develop. To the south of the river, the strata parallel the ridgetops and only the steeper slopes have talus. The altitude ranges from 200 m ASL in the east up to 600 m ASL in the west.

6b. Between the Bow River and Munmurra Brook on low level ridges and broad shallow gullies on deeper sandy soils, at altitudes of 300 to 400 m, is a mixed ironbark community. The dominant species are *Eucalyptus crebra*, *E. sideroxylon*, *E. punctata* and *E. fibrosa* with other species including *E. beyeri*, *E. dwyeri*, *Callitris endlicheri* and *Allocasuarina luehmannii* present also. Common shrub species are *Acacia triptera*, *Melaleuca erubescens*, *M. uncinata*, *Baekkea cunninghamii*, *Grevillea sericea* and *Melichrus urceolatus*. A common ground cover species is *Triodia irritans* var. *laxispicata*. The number of tree species at any site varies, reflecting differences in soil, topography and fire history. While this community is locally restricted in distribution, similar vegetation occurs elsewhere in the Western Slopes. *Eucalyptus punctata* and *Allocasuarina luehmannii* are found near watercourses, and this could perhaps be considered physiographically as an extreme variation of the woodland in sandstone gullies (Community 4).

6c. Poorly drained sites support an open-scrub of *Melaleuca uncinata*, *Allocasuarina* sp. aff. *distyla*, *Acacia triptera* and *Kunzea ambigua*, with *Lomandra glauca* and *Hibbertia monogyna* dominating the ground cover. This open-scrub is found

occasionally north of the Goulburn River, and to the south in the Bylong River valley. It is more abundant in the Bow River valley at 300 to 400 m altitude, associated with Narrabeen Group strata that weather to form a clayey soil.

6d. South-east of "Poggy" is a woodland of *Eucalyptus maculata*, *E. crebra* and *Callitris endlicheri* on sandstone soil, adjacent to a large basalt flow. With two other similar sites, at Cassilis and Gulgong, this represents the furthest inland extent of the very widespread coastal species, *E. maculata*, which is abundant in the Hunter Valley. The altitude is between 360 and 400 m ASL and the aspect is generally southeasterly.

DISCUSSION

Though the Merriwa district lies in the Central Western Slopes botanical subdivision of the State (see p. 396), its vegetational affinities are with those of five others nearby. As well, the area contains a number of rare, restricted or vulnerable species.

Communities

The plant communities have affinities with those of the Central and North Western Slopes, those of the Central and North Coast and those of the Northern Tablelands. This is a result of the juxtaposition, within the Goulburn River valley, of communities with differing climatic, and thus geographic, ranges. This is a feature of the Goulburn River valley absent from nearby areas. It is caused by a number of physiographic characteristics: the low height of the Great Divide; the low local relief of the plateau (dissected by valleys that have broad river flats); the cliff-lines that are generally not as abrupt as they are elsewhere in the Sydney Basin; and the boundary between the basalt flows and the underlying sedimentary strata that forms a more indistinct margin to the Sydney Basin here, than is usual elsewhere.

Counter to these factors that act to merge the plant communities, the present fire regimes are acting to reinforce the distinctions between the mapped units. There are three distinct fire regimes in the area, of which only the second is not artificially imposed.

Firstly, fires are rare in the remnant vegetation of the basalt plains and the broad river flats, which are subject to the same fire regime as the surrounding agricultural lands.

Secondly, fires are infrequent in the vegetation of the low dissected sandstone plateaux near the Goulburn River; perhaps at intervals of up to 20 years. Evidence for this can be seen in the lack of fire scars on tree trunks and in the absence of charcoal in the leaf litter and in the presence of full skirts of dead leaves on individuals of *Xanthorrhoea johnsonii*. Limited observations suggest that some of the dominant tree species, such as *Eucalyptus caleyi* and *Acacia doratoxylon*, do not resprout after fire, and are thus not fire tolerant.

Thirdly, the highest fire frequencies are in the vegetation on the steeper sandstone slopes separating the alluvial flats from the plateaux. The dominant tree species, such as *E. fibrosa*, *E. oblonga* and *E. dwyeri*, readily recover from fires. Most fires here start on the edge of the river flats and travel upslope, and are often lit to protect agricultural land or to provide soft regrowth for cattle fodder.

The only vegetation type restricted to the area is that on shallow soils on the Narrabeen Group, dominated by *Eucalyptus caleyi* and *Acacia doratoxylon* (Community 5a). It occurs only near the Goulburn River from Sandy Hollow to Lees Pinch.

With the proclamation of the Wollemi and Goulburn River National Parks, in 1980 and 1983 respectively, the conservation status of the flora was greatly improved. These parks, which are generally restricted to those communities that occur on the Narrabeen Group, are large enough to ensure their long-term conservation. Before this, two smaller nature reserves (Manobalai and Munghorn Gap) and a number of State forests (especially Bylong, Durrigere, Nullo Mountain and Turill) were the only lands in the district that included conservation as an objective. The remaining lands are generally unsuitable for conservation and it is unlikely that the current conservation status of the flora will change appreciably in the future.

Species

Many of the species in the area are also found in other parts of the State, and reflect the distribution patterns of the communities in which they occur. The temperate but dry climate influences the local floristic composition of the widespread communities. For example, few of the "rainforest" species found on alluvium along the Hunter River occur along the Goulburn River, while those species on sedimentary strata that are widespread elsewhere in wetter areas, tend to be restricted to gullies, while those from drier areas tend to occur on exposed ridges and plateaux.

The eucalypts show a range of distribution patterns. Two species, *Eucalyptus conica* and *E. trachyphloia*, found on the Narrabeen Group here, are not found elsewhere in the Sydney Basin. There are three common integrations between related taxa: between *E. blakelyi* (SNEEFA, coding from Pryor & Johnson, 1971) from the west and *E. tereticornis* (SNEEB) from the east; between *E. albens* (SUL:G) and *E. moluccana* (SUL:B), depending on local topography and soil; and between the two subspecies of *E. fibrosa*, subsp. *fibrosa* (SUP:AA) and subsp. *nubila* (SUP:AB). Some minor discontinuities in distribution occur — *E. maculata*, which is generally on the coast and in the nearby Hunter Valley, occurs in the district as a number of isolated populations. To the south, *E. sideroxylon* is not found until the Tertiary alluvium in the Nepean River valley is reached.

Of the 24 species of *Acacia* in the area, nine, including many of the more abundant species, are only found west of Denman or Scone, and most of these are distributed through the North Western Slopes and south-east Queensland. They are *Acacia armata*, *A. crassa*, *A. deanei* subsp. *deanei*, *A. decora*, *A. doratoxylon*, *A. gladiiformis*, *A. ixiophylla*, *A. muellerana* and *A. subulata*.

Callitris preissii subsp. *preissii* has a notably large disjunction in its distribution; it is found in Victoria, South Australia and Western Australia, but in New South Wales only in the Goulburn River valley.

Rare and restricted species. A number of rare or restricted species have been recorded for the study area. Species that have a restricted distribution and are considered to be endangered because of their small population sizes include:

- *Cynanchum elegans* (Asclepiadaceae), a vine recorded from only three locations (though not found during this study): Native Vineyard, north of Cobbitty; Kooragang ("Ash") Island and in the lower Hunter River; and Mt Dangar, in the Goulburn River National Park. The first two sites have been largely disturbed, and the species may now be extinct there (A.N. Rodd, pers. comm.).
- *Kennedia retrorsa* (Fabaceae), a large vine recorded from the slopes below Mt Dangar on sandstone soil and colluvium. The other recorded location, the Blacktown Tablelands in central Queensland, being so remote from Mt Dangar, suggests that the two locations are relicts of a once wider range.

• *Rylstonea cernua* (Myrtaceae), an erect shrub found on level sandy ridgetop areas, amongst rocky outcrops, in low open-woodland of *E. fibrosa*, *Callitris endlicheri* and *E. dwyeri*. Known localities are: Goonoo State Forest near Dubbo; near Widden; and Lees Pinch. It is endangered because its small populations are vulnerable to general developments such as road works.

Rare species with a very restricted distribution, but which are not endangered or vulnerable at present include:

• *Acacia* sp. aff. *decurrens* (Mimosoideae), a newly recognized and as-yet undescribed species, occurring only on the basalt slopes of Mt Dangar, where it grows as a common small tree up to 8 m high with *E. albens*.

• *Callistemon* sp. aff. *shiressii* (Myrtaceae), possibly a new species (J. Powell, pers. comm.), is found only on the banks of the Goulburn River near Kerrabee, mostly within the National Park (two records at National Herbarium of New South Wales).

• *Helichrysum tessellatum* (Asteraceae), an erect shrub found in woodlands of *Eucalyptus dawsonii* or *E. punctata*, on talus of Narrabeen sandstone or Permian siltstone. Herbarium collections are all within the study area: "Murrumbo" (type locality, status unknown); Coxs Gap (in Wollemi National Park, near a road easement); and "Goulburn River, north of 'Murrumbo'", which includes Morrisons Flat, where it is common. Though it is in places threatened by grazing, agriculture and logging, it is well represented in the National Park.

• *Lasiopetalum longistamineum* (Sterculiaceae) is a shrub found only on or near Mt Dangar (not recorded during this study).

Two vulnerable species with broad ranges but specific habitats were recorded:

• *Goodenia stephensonii* (Goodeniaceae) is an erect woody herb found in open-forests on Permian siltstones under *E. dawsonii*. Localities for herbarium collections are Denman-Baerami; Lees Pinch; Wollar-Muswellbrook; "Goulburn River"; Gosford; and Maffra in Victoria (the last possibly an inaccurately labelled specimen). The distribution is remarkably disjunct, and whether the species still occurs outside the Goulburn Valley is uncertain. It is common at Morrisons Flat, but must be considered a vulnerable species due to its scattered occurrences.

• *Grevillea johnsonii* (Proteaceae) is a tall, spreading shrub found in open areas above or below cliff-lines and in canyons; in open-woodland (Community 4) or low open-woodland (Community 5) respectively. It is known from Bylong to Sandy Hollow, including Widden and Mt Dangar, and near Capertee. This species is vulnerable due to its specific habitats and the effects of possible land use changes.

Additionally, certain taxa recorded in the area might be assigned to new species. These are:

• *Lomandra confertifolia* (Xanthorrhoeaceae) is widespread, but might contain a new species (A. Lee, pers. comm.), which could be confined to the study area, in which case it would be a restricted species.

• *Eucalyptus* sp. aff. *oblonga* (MAHEO; Myrtaceae) was found in two locations in the west of the area — Kellys Gap and the head of Councils Creek. The species occurs in limited stands near the western margin of the Narrabeen Group, from Kellys Gap to Capertee, Megalong and Kanimbla valleys (L.A.S. Johnson & D. Blaxell, pers. comm.). As it only occurs in small scattered populations it could be rare or vulnerable.

One species, *Acacia murrumboensis*, which was previously considered to be rare and restricted, is now considered to be a form of *A. linearifolia* (M. Tindale, pers. comm.).

Many of these species occur on Mt Dangar or Morrisons Flat, two areas that offer unusual habitats, the former being an isolated hill and the latter an area of incipient valley widening. The former and part of the latter are in the Goulburn River National Park, while part of the latter is leasehold grazing land.

Species richness. A total of 306 species was recorded during this study (Appendix 2). As most of the collecting was during the summer and during a prolonged drought, and also as the study was directed at identifying species associations, this species list is incomplete. It is probably comprehensive for the shrub and tree species, but incomplete for the herbaceous species. Further coverage is provided by Dorman (1972), who recorded 340 species, over nine years from a number of specific locations.

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REFERENCES

- Baker, R.T. (1896). On the botany of the Rylstone and the Goulburn River Districts. Part I. *Proc. Linn. Soc. N.S.W.* **21**, 427-466.
- Beadle, N.C.W. (1981). *The vegetation of Australia*. Cambridge University Press, Cambridge.
- Beadle, N.C.W. & Costin, A.B. (1952). Ecological classification and nomenclature. *Proc. Linn. Soc. N.S.W.* **77**, 61-82.
- Bureau of Meteorology (1975). *Climatic averages, New South Wales*. Australian Government Publishing Service, Canberra.
- Burley, T.M. (1961). *Land use research in the Hunter Valley: the land cover pattern*. Monograph No. 9. The Hunter Valley Research Foundation, Newcastle.
- Division of National Mapping (1970). *Merriwa 1:100 000 topographic map sheet*. Canberra.
- Dorman, H.C. (1972). Lees Pinch-Murrumbo area flora and bird list. *Hunter Nat. Hist.* **4**, 269-282.
- Forster, G.R. (1981). *Conservation values and vegetational changes — Upper Hunter, Ulan and Western Coalfields*. Department of Environment and Planning, Sydney.
- Galloway, R.W. (1967). Pre-basalt, sub-basalt and post-basalt surfaces of the Hunter Valley, New South Wales. In *Landform studies from Australia and New Guinea* (Eds J.N. Jennings & J.A. Mabbutt), pp. 293-314. Australian National University Press, Canberra.
- Ingram, C.K. (n.d.). Flora of Lees Pinch, Upper Goulburn River, New South Wales. Unpublished report. National Parks and Wildlife Service, New South Wales.

- Jacobs, S. & Pickard, J. (1981). *Plants of New South Wales*. Government Printer, Sydney.
- Johnson, L.A.S. (1982). Notes on Casuarinaceae II. *J. Adelaide Bot. Gards.* **6**, 73–87.
- New South Wales Department of Mines (1969). *Singleton 1:250 000 geological series sheet*. Edition 1. Sydney.
- Pryor, L.D. & Johnson, L.A.S. (1971). *A classification of the Eucalypts*. Australian National University Press, Canberra.
- Soil Conservation Service of New South Wales (n.d.). *Merriwa District technical manual*.
- Specht, R.L. (1970). Vegetation. In *The Australian environment* (Ed. G.W. Leeper), Ed. 4, pp. 44–67. CSIRO & Melbourne University Press, Melbourne.
- Story, R. (1963). Vegetation of the Hunter Valley. In *General report on the lands of the Hunter Valley*, pp. 136–149. Land Research Report No. 8. CSIRO, Melbourne.
- Tweedie, A.D. (1963). Climate of the Hunter Valley. In *General report on the lands of the Hunter Valley*, pp. 62–80. Land Research Report No. 8. CSIRO, Melbourne.
- Van de Graaff, R.H.M. (1963). Soils of the Hunter Valley. In *General report on the lands of the Hunter Valley*, pp. 103–135. Land Research Report No. 8. CSIRO, Melbourne.

APPENDIX 1

Floristic list for the Merriwa 1:100 000 map sheet, compiled from field records from this survey only. Other lists for the district are Baker (1896) and Dorman (1972). The major groups are arranged systematically — Pteridophyta, Gymnospermae and Angiospermae, and within the latter, Monocotyledons and Dicotyledons. Families, genera and species are arranged alphabetically. Exotic species are marked with an asterisk (*). The map units in which each species was found are indicated, and are numbered as in the text. Bold type indicates that the species is important in that unit. Growth habit codes are: F=fern; H=herb; S=shrub; T=tree; V=vine; and any left-hand character indicates size: L=large; S=small (e.g. ST=small tree). Species names are those currently recognized at the National Herbarium of New South Wales (mostly as in Jacobs & Pickard, 1981).

PTERIDOPHYTA

ADIANTACEAE

- Adiantum aethiopicum* (F) 2
A. hispidulum (F) 1 4
Cheilanthes distans (F) 3
C. tenuifolia (F) 1 3 4 5 6
Pellaea falcata (F) 2

ASPLENIACEAE

- Asplenium flabellifolium* (F) 1 5 6

POLYPODIACEAE

- Pyrrosia rupestris* (F) 1

GYMNOSPERMAE

CUPRESSACEAE

- Callitris endlicheri* (ST) 1 2 3 5 6
C. preissii subsp. *preissii* (ST) 3 5

ZAMIACEAE

- Macrozamia communis* (S) 4 5 6
M. pauli-guilielmii subsp. *plurinervia* (S) 6

ANGIOSPERMAE

MONOCOTYLEDONS

COMMELINACEAE

- Commelina cyanea* (H) 3 4

CYPERACEAE

- Gahnia aspera* (G) 5 6
Lepidosperma laterale (G) 5 6
L. lineare (G) 6
L. viscidum (G) 6
Schoenus ericetorum (G) 6

IRIDACEAE

- Patersonia sericea* (G) 6

LILIACEAE

- Dianella revoluta* (G) 5 6
Stypanandra glauca (G) 5 6
Thysanotus tuberosus (G) 5

PHILESIACEAE

- Eustrephus latifolius* (V) 1

POACEAE

- Aristida ramosa* (G) 3
- Digitaria parviflora* (G) 3
- Echinopogon caespitosus* (G) 3
- **Eleusine indica* (G) 3
- Entolasia stricta* (G) 6
- Dimorphochloa rigida* (G) 5
- Microlaena stipoides* (G) 3
- Paspalidium radiatum* (G) 1
- Stipa* sp. (G) 3
- Triodia irritans* var. *laxispicata* (G) 6
- (Other spp. (G) 1 2 6)

XANTHORRHOEACEAE

- Lomandra confertifolia* (G) 5
- L. filiformis* (G) 5
- L. glauca* (G) 1 3 5 6
- L. sp. aff. longifolia* (G) 4 5 6
- L. multiflora* (G) 4
- Xanthorrhoea johnsonii* (S) 5
- X. media* (S) 4

DICOTYLEDONS

ACANTHACEAE

- Brunoniella* sp. (H) 1
- Rostellularia pogonantha* (H) 1

AIZOACEAE

- Tetragonia tetragonioides* (H) 4

AMARANTHACEAE

- **Amaranthus* sp. (H) 3

APIACEAE

- Actinotus helianthi* (S) 6
- Platysace ericoides* (S) 5 6
- P. lanceolata* (S) 5

APOCYNACEAE

- Parsonsia eucalyptophylla* (V) 4

ASCLEPIADACEAE

- **Gomphocarpus fruticosus* (S) 3
- Leichhardtia leptophylla* (V) 5
- Marsdenia rostrata* (V) 1

ASTERACEAE

- **Aster subulatus* (H) 3
- Brachycome* sp. (H) 1
- Calotis lappulacea* (H) 4
- Cassinia cunninghamii* (S) 2 4 5 6
- C. uncata* (S) 1
- **Centaurea solstitialis* (H) 3
- **Conyza albida* (H) 1 3 4
- **Cirsium vulgare* (H) 1 3
- Helichrysum apiculatum* (S) 3
- H. tessellatum* (S) 4
- H. viscosum* (S) 3
- Olearia elliptica* (S) 4
- Podolepis jaceoides* (H) 6
- Pseudognaphalium luteoalbum* (H) 3
- Senecio lautus* (H) 1
- S. sp.* (H) 3
- S. sp. nov.* (H) 1
- Vittadinia cuneata* sens. lat. (H) 4
- **Xanthium chinense* (H) 3
- X. spinosum* (H) 3

BIGNONIACEAE

- Pandorea pandorana* (V) 4

BORAGINACEAE

- **Echium plantagineum* (H) 3

BRASSICACEAE

- **Lepidium bonariense* (H) 3
- **Sisymbrium officinale* (H) 3

CACTACEAE

- **Opuntia aurantiaca* (H) 3 6
- **O. stricta* (SS) 1 2 3 4 5 6

CAMPANULACEAE

- Wahlenbergia gracilis* (H) 1

CARYOPHYLLACEAE

- **Petrorhagia nanteuillii* (H) 3

CASSYTHACEAE

- Cassytha melantha* (V) 5 6
- C. pubescens* (V) 5 6

CASUARINACEAE

- Allocasuarina luehmannii* (S) 4 6
- A. sp. aff. distyla* (S) 1 3 5 6
- A. torulosa* (ST) 1 2 4
- Casuarina cunninghamiana* (T) 3

CHENOPODIACEAE

- Atriplex semibaccata* (TH) 3
- **Chenopodium carinatum* (H) 3
- C. polygonoides* (H) 1 3
- Einadia hastata* (H) 3 4 6

CONVOLVULACEAE

- Dichondra repens* (H) 4 5

CRASSULACEAE

- Crassula sieberana* (H) 3

DILLENIACEAE

- Hibbertia acicularis* (S) 4 6
- H. monogyna* (S) 4
- H. obtusifolia* (S) 5

EPACRIDACEAE

- Acrotriche rigida* (S) 4
- Astroloma humifusum* (S) 5 6
- Brachyloma daphnoides* (S) 3 6
- Leucopogon muticus* (S) 4 5 6
- L. sp.* (S) 3 5
- Melichrus erubescens* (S) 4 6
- M. urceolatus* (S) 6
- Styphelia triflora* (S) 6
- S. tubiflora* (S) 6

EUPHORBIACEAE

- Bertya oleifolia* (S) 5
- B. sp.* (S) 5
- Euphorbia drummondii* (H) 3
- Poranthera corymbosa* (S) 4 6
- Pseudanthus pimeleoides* (S) 5

FABACEAE

CAESALPINIOIDEAE

- Cassia barclayana* (S) 3
- C. eremophila* (S) 6
- C. odorata* (S) 5

FABOIDEAE

- Bossiaea rhombifolia* subsp. *concolor* (S) 6
- Daviesia acicularis* (S) 4
- D. genistifolia* (S) 4
- D. squarrosa* (S) 4
- Desmodium varians* (V) 3 4
- Dillwynia juniperina* (S) 6
- D. sericea* (S) 5 6
- Glycine clandestina* (V) 1 4
- Gompholobium latifolium* (S) 4
- G. virgatum* var. *aspathoides* (S) 5 6
- Hardenbergia violacea* (V) 5 6
- Hovea lanceolata* (S) 1 4 5 6
- Indigofera australis* var. *signata* (S) 1 2 4 5
- Kennedia retrorsa* (V) 3 6
- Oxylobium ilicifolium* (S) 4 6
- Pultenaea flexilis* (S) 6
- P. foliosa* (S) 6
- P. microphylla* (S) 6
- Swainsona galegifolia* (TH) 1

MIMOSOIDEAE

- Acacia brownii* (S) 5 6
- A. buxifolia* subsp. *buxifolia* (S) 6

- A. caesiella* (S) 3
A. crassa (S) 5
A. cultriformis (S) 5
A. sp. aff. decurrens (ST) 1
A. deanei subsp. *deanei* (LS) 3 6
A. decora (S) 5
A. doratoxylon (ST) 1 4 5 6
A. falcata (S) 5
A. gladiiformis (S) 6
A. implexa (S) 1 2
A. ixiophylla (S) 4
A. juncifolia var. *juncifolia* (S) 6
A. linearifolia (ST) 1 2 3 4 5 6
A. muellerana (S) 4
A. obtusifolia (S) 4
A. paradoxa (S) 6
A. penninervis (S) 5
A. subulata (S) 4 5
A. terminalis (S) 6
A. triptera (S) 6
A. ulicifolia (S) 6
A. uncinata (S) 1 4
- GERANIACEAE
Geranium sp. (H) 1
- GOODENIACEAE
Dampiera lanceolata (S) 4 6
D. purpurea (S) 4 5 6
Goodenia decurrens (H) 6
G. grandiflora (H) 1
G. hederacea (H) 6
G. stephensonii (H) 4
- HALORAGACEAE
Gonocarpus elatus (H) 5
G. longifolius (H) 5
Haloragis serra (S) 1
Myriophyllum verrucosum (H) 5
- LAMIACEAE
Ajuga australis (H) 1 4
**Marrubium vulgare* (H) 3
**Mentha × cordifolia* (H) 3
Prostanthera nivea (S) 5
P. ovalifolia (S) 4
P. prunellioides (S) 4
P. sp. (S) 5
Salvia sp. (H) 3
- LOBELIACEAE
Isotoma axillaris (H) 5
- LORANTHACEAE
Amyema cambagei (E) 3
A. miquelii (E) 5 6
A. quandang (E) 3 6
- LYTHRACEAE
**Lythrum hyssopifolium* (H) 3
- MALVACEAE
Hibiscus sturtii (H) 3 4
**Modiola caroliniana* (H) 3
Sida corrugata (H) 1 3 4
- MENISPERMACEAE
Stephania japonica (V) 4
- MORACEAE
Ficus rubiginosa (ST) 2 5
- MYOPORACEAE
Myoporum debile (SS) 3
M. montanum (SS) 1 3
- MYRTACEAE
Angophora floribunda (LT) 3 6
Baeckea cunninghamii (S) 6
B. densifolia (S) 5 6
Callistemon linearis (S) 6
C. paludosus (S) 4
C. pinifolius (S) 4
C. sp. aff. salignus (S) 4
C. sp. aff. shiressii (S) 3 4
Calytrix tetragona (S) 5
Eucalyptus albens (T) 1
E. albens-E. moluccana (T) 1 3
E. beyeri (LT) 6
E. blakelyi (LT) 3
E. caleyi (ST) 5 6
E. camaldulensis (LT) 3
E. conica (T) 3
E. crebra (T) 3 4
E. dawsonii (T) 4 6
E. dealbata (T) 1 3
E. dwyeri (ST) 1 5 6
E. fibrosa subsp. *fibrosa* (T) 4 6
E. laevopinea (T) 2
E. maculata (T) 6
E. melliodora (LT) 1 2 3
E. moluccana (T) 1 3
E. oblonga (T) 4 5 6
E. punctata (T) 2 4 5 6
E. rossii (ST) 6
E. sideroxylon (T) 6
E. sp. aff. oblonga (ST) 6
E. trachyphloia (T) 4 5 6
E. viminalis (T) 2
Kunzea ambigua (S) 4 5 6
Leptospermum attenuatum (S) 5
L. arachnoides (S) 5 6
L. parvifolium (S) 5 6
Melaleuca erubescens (S) 6
M. thymifolia (S) 6
M. uncinata (S) 6
Rylstonea cernua (S) 6
- NYCTAGINACEAE
Boerhavia diffusa (V) 3
- OLACACEAE
Olaix stricta (S) 6
- OLEACEAE
Notelaea longifolia (SS) 1 3 4
N. microcarpa (S) 1 6
- ONAGRACEAE
**Oenothera australis* (H) 3
- OXALIDACEAE
Oxalis corniculata (H) 4
- PAPAVERACEAE
**Argemone ochroleuca* (H) 3
**Eschscholzia californica* (H) 4
- PHYTOLACCACEAE
**Phytolacca octandra* (H) 3
- PITTOSPORACEAE
Billardiera scandens (V) 4
Bursaria longisepala (S) 4 6
B. spinosa (S) 1 4
Pittosporum undulatum (S) 2
- PLANTAGINACEAE
Plantago sp. (H) 1
- POLYGONACEAE
Muehlenbeckia rhyticarya (H) 3
**Polygonum aviculare* (H) 3
P. decipiens (H) 3 4
- PORTULACACEAE
Calandrinia calyptata (H) 5
Portulaca oleracea (H) 3
- PRIMULACEAE
**Anagallis arvensis* (H) 3
- PROTEACEAE
Grevillea johnsonii (S) 4 6
G. mucronulata (S) 5

- G. sericea* (S) 4 5 6
G. triternata (S) 4
Hakea dactyloides (S) 4 5 6
Isopogon dawsonii (S) 4 5 6
Persoonia linearis (S) 4 5 6
Petrophile canescens (S) 5
- RANUNCULACEAE**
Clematis aristata (V) 1 2 4
C. glycinoides (V) 3
- RHAMNACEAE**
Alphitonia excelsa (LS) 5
Cryptandra buxifolia (S) 4
C. spinescens (S) 6
Pomaderris ferruginea (S) 4
P. prunifolia (S) 4
P. sp. (S) 4
- RUBIACEAE**
Asperula scoparia (H) 1
Canthium buxifolium (S) 3
C. odoratum (S) 5
Opercularia diphylla (S) 6
Pomax umbellata (H) 6
- RUTACEAE**
Boronia anethifolia (S) 5
B. pinnata (S) 5 6
Correa reflexa (S) 1 4
Eriostemon australasicus (S) 5
E. myoporoides (S) 5
Phebalium squamulosum (S) 4 5 6
Philotheca salsolifolia (S) 5 6
Zieria aspalathoides (S) 6
Z. cytisoides (S) 4
- SANTALACEAE**
Choretrum candollei (S) 1
Exocarpos cupressiformis (ST) 5
E. strictus (ST) 6
Santalum obtusifolium (S) 5
- SAPINDACEAE**
Dodonaea boroniifolia (S) 5
D. cuneata (S) 5
D. triangularis (S) 3 4 5 6
- SCROPHULARIACEAE**
Veronica plebeia (H) 1
- SIMAROUBACEAE**
**Ailanthus altissima* (S) 3 5
- SOLANACEAE**
**Lycium ferocissimum* (S) 4
**Nicotiana glauca* (S) 3 4
Solanum aviculare (S) 3 4
S. campanula (S) 3 4
S. cinereum (S) 4
S. stelligerum (S) 1
S. vescum (S) 4
- STACKHOUSIACEAE**
Stackhousia monogyna (H) 4 6
- STERCULIACEAE**
Brachychiton populneus (T) 1 3
Lasiopetalum ferrugineum var. *cordatum* (S) 4
L. macrophyllum (S) 4
Rulingia pannosa (S) 5
- STYLIDIACEAE**
Stylidium glandulosum (S) 5
S. laricifolium (S) 5
- THYMELAEACEAE**
Pimelea hirsuta (S) 4
P. linifolia (S) 5
- URTICACEAE**
Urtica incisa (H) 3
- VERBENACEAE**
Clerodendrum tomentosum (S) 2
- VIOLACEAE**
Hymenanthera dentata (H) 1 2
- VISCACEAE**
Notothixos cornifolius (E) 1 3
- VITACEAE**
Cayratia clematidea (V) 5 6
Cissus opaca (V) 3
- ZYGOPHYLLACEAE**
Tribulus terrestris (H) 3

APPENDIX 2

Breakdown of species numbers in major taxonomic groups and the main families. A similar breakdown is given for tree species.

Group	No. of species	No. of tree species
TOTAL	306	35
Pteridophytes	7	—
Gymnosperms	4	2
Angiosperms	295	33
Monocotyledons	28	—
Poaceae	10	—
Xanthorrhoeaceae	7	—
Dicotyledons	267	33
Asteraceae	20	—
Epacridaceae	9	—
Fabaceae	44	—
Faboideae	19	—
Mimosoideae	24	—
Myrtaceae	39	22
<i>Eucalyptus</i>	21	21
Proteaceae	9	—
Rutaceae	9	—
Solanaceae	7	—
Exotics	28	—