The natural vegetation of the Sydney 1:100 000 map sheet

Doug Benson and Jocelyn Howell

Benson, Doug & Howell, Jocelyn (National Herbarium of New South Wales, Royal Botanic Gardens Sydney, New South Wales, Australia 2000) 1994. The natural vegetation of the Sydney 1:100 000 map sheet. Cunninghamia *3(4): 677–787.* The composition and extent of the present natural vegetation on the Sydney 1:100 000 map sheet 9130 (bounded by latitudes 33° 30' and 34° 00' S and longitudes 151° 00' and 151° 30' E) are mapped and described in terms of structure and characteristic species. Sixteen map units covering 42 plant communities are recognised and related to geology and physiography. The most extensive unit is the well-known Hawkesbury Sandstone vegetation, which has been broadly subdivided into Sydney Sandstone Gully Forest (Map unit 10ag), Sydney Sandstone Ridgetop Woodland (Map unit 10ar) and Coastal Sandstone Heath (Map unit 21g). Along the coast north of Long Reef more clayey soils, developed on the Narrabeen Formation, carry tall open-forest, open-forest and coastal heath vegetation. There are patches of scrub on Pleistocene sand deposits at Bouddi and La Perouse, and remnants of open-forest on Wianamatta Shale further west. A map of the vegetation of Ku-ring-gai Chase National Park and Muogamarra Nature Reserve (1:40 000 scale) showing 21 plant communities is provided on the back of the Sydney map.

Twenty-three major conservation reserves for the Sydney map area are briefly described, with species lists for most. Seventy-eight significant plant species are listed for the area, 41 of which are listed as nationally rare or endangered species (Briggs & Leigh 1988 with current ROTAP updatings); others are of regional significance. Species listed are either rare, threatened or of botanical significance in terms of geographic distribution. Regional affinities, historical changes, Aboriginal and European impacts, and conservation of vegetation are discussed.

Introduction

In January 1788 the ships of the First Fleet, sent from England with convicts to found a penal colony in New South Wales, entered Birra Birra, the land of the Aboriginal people. They had sailed into the lower reaches of what we now know as Sydney Harbour. As the colonists proceeded westwards towards Sydney Cove, Captain Watkin Tench of the Marines was amongst those 'enjoying the luxuriant prospect of its shores, covered with trees to the water's edge, among which many of the Indians were frequently seen'. George Worgan, surgeon of the *Sirius*, observed 'Here, a romantic rocky, craggy Precipice over which, a little purling stream makes a Cascade There a soft vivid-green, shady Lawn attracts your Eye.' Having found Botany Bay unsuitable for settlement, the fleet's captain, Captain Arthur Phillip, was now searching for a better site further north, at the inlet named Port Jackson by

Captain Cook in 1770. He found this an ideal harbour for the ships, and noted glowingly that: 'The necks of land that form the different coves, and near the water for some distance, are in general so rocky that it is surprizing such large trees should find sufficient nourishment, but the soil between the rocks is good, and the summits of the rocks, as well as the whole country round us, with few exceptions, are covered with trees' (Tench 1979, Worgan 1978, Phillip 1789).

In no time, trees were cut down, the ground cleared, and huts constructed. 'The abode of silence and tranquillity was now changed to that of noise, clamour, and confusion', observed David Collins, legal officer of the new settlement (Collins 1798).

Using historical and contemporary sources, Benson and Howell (1990a), in *Taken for granted: the bushland of Sydney and its suburbs*, described the original vegetation patterns in the County of Cumberland in terms of eight major vegetation types, and discussed the changes that followed the European-style agricultural and urban development of the area over the next two centuries. Particular emphasis was given to each of the 40 local government areas. The present paper, part of the Sydney Region Vegetation Map Series, describes the current condition and extent of the natural vegetation of the north-eastern half of the County of Cumberland, on the Sydney 1:100 000 map sheet, just over 200 years after the beginning of European settlement. As far as practicable, this work does not repeat *Taken for granted*, and only a small amount of historical material is included. Instead, the emphasis is on describing the present-day vegetation in terms of 16 map units, identifying significant areas and species, and includes floristic lists, brief descriptions and references to the major National Parks.

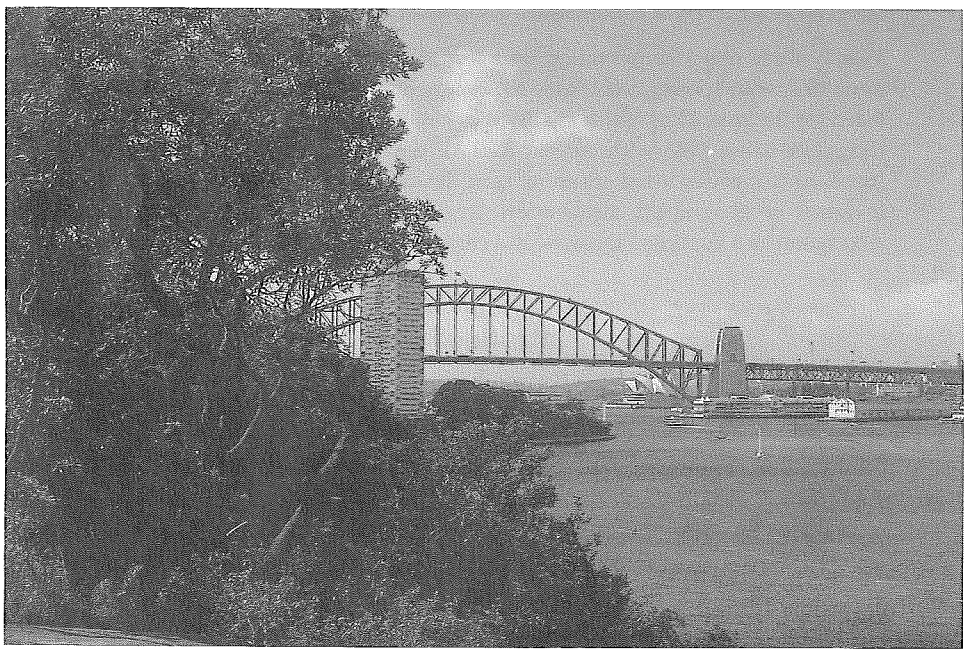


Figure 1. Sydney is probably one of the few great cities of the world where natural vegetation still survives so close to the heart of the city. Here *Banksia integrifolia* grows on the rocky Harbour foreshore at Balls Head.

Figure 2. Exposures of Hawkesbury Sandstone such as this at North Head form the prominent headlands around Sydney Harbour. These 'craggy precipices' delighted the first settlers until they found that this country was so difficult to farm.

The current work updates and enlarges a previous draft report (Benson 1980a) and provisional map (1980). The Sydney 1:100 000 vegetation map sheet is located inside the back cover. A vegetation map of Ku-ring-gai Chase National Park and Muogamarra Nature Reserve at 1:40 000 scale (originally prepared at 1:25 000 scale) is also provided. This map, taken from the vegetation surveys of Thomas and Benson (1985a,b), has not been readily available before, and provides a detailed picture of an important conservation and recreation area.

Location, physiography and climate

The Sydney 1:100 000 Vegetation Map Sheet (based on the Sydney 1:100 000 Topographic Sheet 9130, AUSLIG, Canberra) is bounded by latitudes, 33° 30' and 34° 00' S, and longitudes, 151° 00' and 151° 30' E. It includes the city of Sydney and suburban areas as far west as Parramatta, and the coastline from the Bouddi Peninsula and Broken Bay in the north to Botany Bay and the Georges River in the south. Natural vegetation is almost all confined to the northern half of the sheet, which includes Ku-ring-gai Chase National Park, Marramarra National Park, Muogamarra Nature Reserve, and parts of Brisbane Water and Bouddi National Parks.

Topographically, the northern half of the Sydney map sheet area is a dissected plateau of Hawkesbury Sandstone, the south-eastern corner of the Hornsby Plateau (Herbert 1983), generally 20–50 m elevation near Sydney and rising to 200 m high around

Glenorie in the north-west corner of the map. The major inlets, Broken Bay, Port Jackson and Georges River/Botany Bay are drowned river valleys. Most of the National Parks and remaining natural vegetation are on this Hawkesbury Sandstone landscape, as its thin sandy soils have made it useless for agriculture in comparison with the more fertile Wianamatta Shale soils of the southern half of the map sheet (Chapman & Murphy 1989). The Wianamatta Shale landscapes are gently undulating, covering the higher ridgelines of the Hornsby Plateau in the settled areas of northern Sydney. South of the harbour they are low-lying and extend from the city of Sydney westward to Parramatta, and from there across the Cumberland Plain to the Hawkesbuy River and the foot of the Blue Mountains. Being topographically less rugged and having more fertile soils than those on the Hawkesbury Sandstone, these areas were settled and cultivated early in the nineteenth century. In the twentieth century extensive suburban development has followed.

The Narrabeen Group (Newport and Garie Formation, and Terrigal Formation) underlies the Hawkesbury Sandstone and outcrops north of Sydney along the Warringah Peninsula (now part of Pittwater Council area) and north of Broken Bay (Herbert 1983). This has interbedded laminites, shales and sandstones, and forms higher-nutrient soils than the adjacent Hawkesbury Sandstone landscapes. In contrast, in the Eastern Suburbs between Botany Bay and Bondi, the extensive sand deposits of Holocene and Pleistocene age overlying the Hawkesbury Sandstone have extremely low nutrient status, but the original vegetation here has been almost completely destroyed by suburban development.

A few volcanic outcrops occur in the area as diatremes or dykes. Soils have been mapped and discussed by Walker (1960) and Corbett (1972), and most recently a Soil Landscapes Map at 1:100 000 scale has been produced (Chapman & Murphy 1989). This describes 25 soil landscapes and relates closely to the vegetation map units.

Rainfall is related to elevation and coastal influence and occurs throughout the year, but is heaviest in June. It is highest (above 1400 mm p.a.) along the crest of the upper North Shore (e.g. Pymble 1444 mm p.a.) and on the coast (generally 1200–1400 mm p.a.) (e.g. Sydney — Observatory Hill 1209 mm p.a., Narrabeen 1278 mm p.a.). On the lower-lying country around Botany Bay it is about 1100 mm and decreases westward with increasing distance from the coast (Ashfield–Burwood about 1000 mm, Parramatta about 900 mm p.a.). Similar decreases in rainfall occur on the higher sandstone country further north (e.g. Hornsby about 1200 mm, Glenorie 900 mm p.a.) (Bureau of Meteorology 1979).

Mean monthly maximum temperatures for January are 25.9° C at Sydney and 28.1° C at Parramatta, while mean monthly minimum temperatures for July are 7.8° at Sydney and 4.6° C at Parramatta. The lowest (screen) minimum temperatures recorded are 2.1° C for Sydney, -2.9° C for Parramatta, and -4.6° C for Pennant Hills. The lowest terrestrial (i.e. ground level) minimum temperature recorded is -4.4° C for Sydney (the screen minimum was 3.7° C at this time). Frosts very rarely occur near the coast, the frost period increasing with distance from the coast and with elevation. The average severe frost period (i.e. screen minimum temperature less than 0° C), for example, is 85 days at Pennant Hills, 38 days at Parramatta and 46 days at Bankstown.

Average soil temperatures at Sydney, at 25 mm depth, range from 11.3° C in July to 21.4° C in February (data from Bureau of Meteorology 1979).

Methods

Areas of vegetation with similar structure (Specht 1970) and floristics (dominant species) were grouped to form the map units on the basis of aerial photopatterns and recognisable geological and landscape characteristics. Aerial photography from the New South Wales Department of Lands (Sydney 1982 1:16 000 colour) was used. Geology was based on geological maps (NSW Dept of Mines 1966, NSW Dept of Mineral Resources 1983). Compilation maps were prepared at 1:25 000 scale and subsequently reduced to 1:100 000 scale with little loss of detail.

Present-day (i.e. 1982) naturally-occurring vegetation is mapped; presumed vegetation formerly covering cleared agricultural and suburban areas is shown in Figure 1 and as an inset on the map sheet. An alphanumeric code is used to distinguish individual plant communities. The numeric code represents the structural form of the plant community and the alphabetic code represents the characteristic species. The codes used are consistent throughout the Sydney Region 1:100 000 Vegetation Map Series, allowing map units to be cross-referenced (Benson 1986a, Keith & Benson 1988, Benson & Keith 1990, Benson 1992a).

There are a number of constraints in reducing the complex pattern of natural vegetation to a map format. The map units recognised are not all of equivalent rank. Some are essentially land-units made up of several groupings of plant species, termed plant communities associated with a particular geological or physiographic type (e.g. map units 4a, 10ag, 10ar), whereas others are more early plant associations (*sensu* Beadle & Costin 1952) (map units 6b, 9o). Generally the term 'plant community' is used for the basic vegetation unit. For ease of reference, map units have also been provided with common names based loosely on habitat and composition.

The vegetation map is a diagrammatic attempt to simplify, over an extensive region, the distributional patterns of an often rich and varied flora. It is scale-dependent and map units will almost invariably include unmapped areas of other map units too small to be shown separately. Similarly, most plant communities do not have clear-cut boundaries, but grade into each other, often over a broad ecotone. For mapping purposes such boundaries have to be approximated to a line.

Field checking has been carried out intermittently between 1975 and 1990 and has included recording notes on structure, characteristic species of major strata and associated environmental factors. As major patterns necessary for mapping purposes are generally well known, broadscale computer analyses of floristic data have not been necessary. Floristic analyses of a number of local areas have been carried out and are referred to in the descriptions e.g. coastal vegetation (Adam, Stricker et al. 1989), Ku-ring-gai Chase National Park (Outhred et al. 1985), Lane Cove River National Park (Clarke & Benson 1987), and Garigal National Park (Sheringham & Sanders 1993). Extensive species lists have been compiled for some areas, generally during the course of specific local vegetation studies.

Species recorded for major conservation areas are provided (see Table 3). Species lists for other sites have not been presented, though some may be listed in the bibliographies of floristic lists (Pickard 1972; Bryant & Benson 1981; Keith 1988; Benson & Melrose 1993). Botanical names used are those currently recognised at the National Herbarium of New South Wales. For authorities see Harden (1990–93).

Review of vegetation studies

Aboriginal people left no written records of the vegetation that supported them for thousands of years, though some of their names for plants and their uses were recorded by nineteenth century botanists such as Joseph Maiden (1889). Surprisingly, only a handful of Aboriginal names for Sydney plants have survived in current usage. Examples include Waratah, Geebung, Gymea, Mugga, Burrawang and Bangalay.

The scientific study of plants in the Sydney region began at Botany Bay in April 1770 when Joseph Banks and Daniel Solander landed from Captain Cook's *Endeavour* and described the 'rich and diverse flora'. The influence of the botanist Joseph Banks was crucial in the selection of Sydney as the site for a settlement. His ongoing interest ensured continuing concern for accurate botanical study and plant collection in the colony. Other professional botanists and botanical collectors were often based with colonial governors and included in exploring parties. Among these were George Caley, who was employed in the colony from 1800–1810 by Joseph Banks, and Allan Cunningham, collector for the Royal Botanic Gardens at Kew from 1817 and Colonial Botanist and Superintendent of the Sydney Botanic Gardens in 1837. As botanical collector Cunningham accompanied John Oxley and Philip King on early expeditions (1817–1822), and later himself explored parts of northern New South Wales and the Darling Downs of Queensland. Being primarily botanical collectors for overseas herbaria, such workers published very little themselves, but some of the diaries they kept have been subsequently published e.g. see Lee (1925) for Cunningham, and Andrews (1984) and Currey (1966) for Caley.

The European explorers and settlers were concerned with the agricultural value of the new country and used the vegetation as an indicator of its potential. They were also concerned with any likely vegetable products such as timber or food plants that could be of use to them. Most of the published accounts of explorers and visitors to the colony contain some references to the vegetation, though these accounts are of variable quality. Botanical names are used infrequently and identification of plant species is often difficult or impossible.

Baron Ferdinand von Mueller was the outstanding colonial botanist of the second half of the nineteenth century, and collectors sent many specimens to him in Melbourne. Among local Sydney collectors were the Reverend William Woolls, who published a number of lists of local Parramatta species, and Louisa Atkinson, who made collections at Berrima and Kurrajong, though most of their collections went either to Europe or Melbourne. Most of the collections now readily available to researchers in New South Wales date from the establishment of the National Herbarium of New South Wales in the 1880s by the Director of the Sydney Botanic Gardens, Charles

Moore. Moore's successor, Joseph Henry Maiden, was a very active botanist and enthusiastically developed the National Herbarium of New South Wales as a national collection. He concentrated on taxonomic work, and in particular the eucalypts, but also published papers on aspects of ecology. Sydney botanists published mainly through the journals of the Linnean Society of New South Wales and the Royal Society of New South Wales.

A.A. Hamilton's *Topographical, ecological and taxonomic notes of the ocean shoreline vegetation of Port Jackson* (1918) and *Ecological study of the saltmarsh vegetation in the Port Jackson district* (1919) are probably the first major descriptive ecological papers for the Sydney area. These were followed by papers on the ecology of the vegetation at Mount Wilson (Brough, McLuckie & Petrie 1924; Petrie 1925; McLuckie & Petrie 1926), Bulli (Davis 1936, 1941a, 1941b) and on the New South Wales Central Coast (Pidgeon 1937, 1938, 1940, 1941). In a series of major papers, Ilma Pidgeon described the general differences in vegetation on Wianamatta Shale and Hawkesbury Sandstone in terms of a series of plant communities in various stages of succession, the

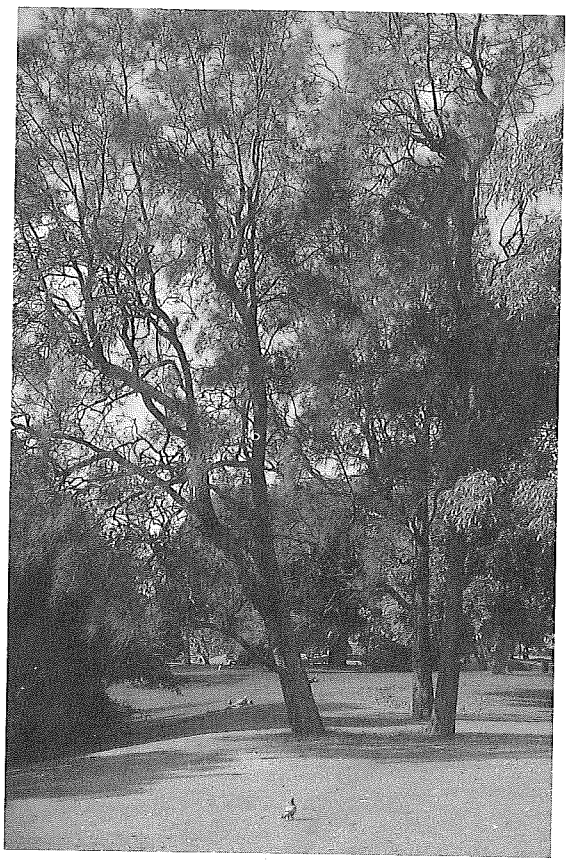


Figure 3. J. H. Maiden, an early Director of the Royal Botanic Gardens Sydney, saw the value of conserving native vegetation, and it is largely due to his foresight that these remnant *Casuarina glauca* trees still survive in the Sydney Gardens today. This species rootsuckers vigorously, and these trees are probably genetically identical with the pre-1788 trees here.

stages being related to physiographic and moisture conditions. She did not include maps, but provided detailed descriptions of the plant communities, in particular of the Hawkesbury Sandstone of the Hornsby Plateau. Phillips (1947) complemented this work with descriptions of the main plant communities of the Wianamatta Shale.

Interest then turned towards the role of soil nutrients. Nola Hannon (1956, 1958) examined the role of soil nitrogen. N.C.W. Beadle (1953, 1962, 1966) demonstrated that the distribution of major vegetation types around Sydney relates largely to the differing levels of soil nutrients, particularly phosphorus, essentially derived from the parent material. Smaller-scale variation was related to physiographic factors. Rainforest vegetation is generally confined to soils with higher phosphorus levels while the sclerophyll vegetation occurs on soils with very low phosphorus levels. Increased soil nutrients in run-off from disturbed areas may promote exotic weed invasion in naturally low-nutrient sites (Clements 1983).

Recent interest in Sydney vegetation, as a result of the general awareness of conservation issues, has led to many local vegetation surveys and inventories (see Pickard 1972, Bryant & Benson 1981, Keith 1988, National Trust 1991, Benson & Melrose 1993), and to the vegetation surveys in the Sydney Region Vegetation Map Series. Accounts of the vegetation with particular reference to changes over the past 200 years include Benson and Howell (1990b) and in particular *Taken for granted* (Benson & Howell 1990a). As the present map sheet deals with about half of the area covered by Benson and Howell (1990a), the relationship between the eight general vegetation types described there and the map units described here is given in Table 1. A modified section of their map showing the extent of natural vegetation in 1788 for the Sydney map area is given in Figure 1.

As well as survey and descriptive studies, there has also been increasing and much-needed work on problems associated with conservation biology and natural area management. In particular, aspects such as fire (e.g. Bradstock & Myerscough 1981), soil nutrients and the spread of exotic weeds, and studies on the ecology of individual species (e.g. Auld & Myerscough 1986, Auld 1986) are now receiving due attention. We also hope to make ecological data on individual plant species more accessible through the Ecology of Sydney Plant Species project (Benson & McDougall 1993).

Table 1. Vegetation types in *Taken for granted*, Benson and Howell (1990a) (in bold type) with corresponding Sydney map sheet map units and codes.

Blue Gum High Forest
Blue Gum High Forest 6b

Turpentine–Ironbark Forest
Turpentine–Ironbark Forest 9o

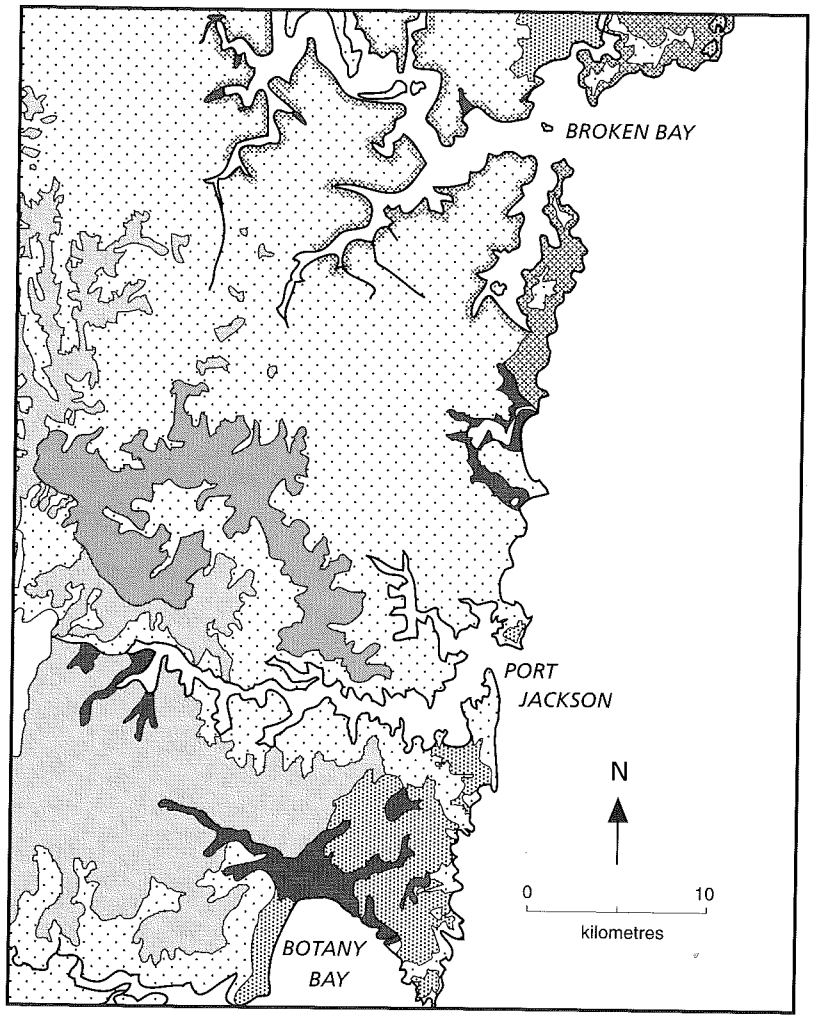
Cumberland Plain Woodlands
Transition Forest 9d

Sandstone heaths, woodlands and forests
Sydney Sandstone Gully Forest 10ag
Sydney Sandstone Ridgetop Woodland 10ar
Duffys Forest 9sf
Coastal Clay Heath 21a
Coastal Sandstone Heath 21g

Eastern Suburbs Banksia Scrub
Coastal Dune Forest 9t
Coastal Dune Heath 21b

Freshwater and Estuarine wetlands
Estuarine Complex 4a
Coastal Swamp Forest Complex 27a
Freshwater Reed Swamps 28a

Glen Forest 6c, Spotted Gum–Blackbutt Forest 9g and Narrabeen Slopes Forest 9h were not treated separately in *Taken For Granted.*



Natural Vegetation 1788

- Blue Gum High Forest (map unit 6b)
- Turpentine–Ironbark Forest (map unit 9o)
- Cumberland Plain Woodlands (map unit 9d)
- Eastern Suburbs *Banksia* Scrub (map units 9t, 21b)
- Estuarine and Freshwater Wetlands (map units 4a, 27a, 28a)
- Sandstone Heaths, Woodlands and Forests (map units 9sf,10ag,10ar, 21g)
- Narrabeen Group Forests (map units 9g, 9h, 21a)

Figure 4. Presumed 1788 or pre-European pattern of natural vegetation of the Sydney map sheet area.

Table 2. Map unit, common name, structure, main canopy species, geology and occurrence for plant communities in the area covered by the Sydney 1:100 000 map sheet

Map unit description

Map unit	Structure	Main canopy species	Geology	Occurrence
4a	**Estuarine Complex**			
	Open-scrub	*Avicennia marina* *Aegiceras corniculatum*	Holocene alluvium	Estuarine mudflats, regular tidal inundation
	Herbland	*Sarcocornia quinqueflora* *Suaeda australis*	"	Occasional tidal inundation
	Rushland	*Juncus kraussii* *Phragmites australis*	"	Infrequent tidal inundation; brackish water
	Low open-forest	*Casuarina glauca* *Baumea juncea*	"	Poorly-drained, some saline influence
6b	**Blue Gum High Forest**			
	Tall open-forest/ Open-forest	*Eucalyptus pilularis* *Eucalyptus saligna*	Wianamatta Shale	Broad ridges with residual shale soils North Shore to Hornsby
6c	**Glen Forest**			
	Tall open-forest	*Eucalyptus saligna*	Diatremes	Isolated valleys
	Tall open-forest	*Eucalyptus agglomerata* *Angophora floribunda*	"	"
9d	**Transition Forest**			
	Open-forest	*Eucalyptus fibrosa* *Eucalyptus moluccana* *Melaleuca decora*	Wianamatta Shale	Auburn
9g	**Spotted Gum–Blackbutt Forest**			
	Open-forest	*Eucalyptus gummifera* *Eucalyptus maculata* *Eucalyptus pilularis*	Narrabeen Group	Bouddi Peninsula
	Open-forest	*Eucalyptus maculata* *Eucalyptus paniculata*	"	Lower hillslopes, Warringah Peninsula
	Woodland	*Eucalyptus umbra* *Eucalyptus paniculata*	"	Exposed slopes, Bouddi Peninsula
	Open-forest	*Archontophoenix cunninghamiana*	"	Deep gullies, Bouddi Peninsula
9h	**Narrabeen Slopes Forest**			
	Open-forest	*Eucalyptus deanei* *Angophora floribunda*	Narrabeen Group	Lower hillslopes, Broken Bay–Hawkesbury River
	Open-forest	*Angophora floribunda* *Allocasuarina torulosa*	"	"

Map unit	Structure	Main canopy species	Geology	Occurrence
9o	**Turpentine–Ironbark Forest**			
	Open-forest	*Syncarpia glomulifera* *Eucalyptus paniculata*	Wianamatta Shale soils	Inner western Sydney, lower rainfall between Glenorie and Ryde; often near junction with sandstone
9sf	**Duffys Forest**			
	Open-forest	*Eucalyptus sieberi* *Eucalyptus capitellata* *Eucalyptus gummifera* *Angophora costata*	Wianamatta Shale–Hawkesbury Sandstone	Residual plateau remnants with ironstone gravels
9t	**Coastal Dune Forest**			
	Open-forest	*Eucalyptus botryoides* *Eucalyptus pilularis* *Angophora costata*	Holocene Sand	Ramsgate La Perouse
Sydney Sandstone Complex				
10ag	**Sydney Sandstone Gully Forest**			
	Open-forest/ woodland	*Eucalyptus piperita* *Angophora costata* *Eucalyptus gummifera*	Hawkesbury Sandstone	Sheltered hillsides, gullies
	Tall open-forest	*Eucalyptus pilularis* *Syncarpia glomulifera*	"	Gullies sheltered aspects
	Closed-forest	*Ceratopetalum apetalum* *Tristaniopsis laurina*	"	Sheltered gullies
Sydney Sandstone Complex				
10ar	**Sydney Sandstone Ridgetop Woodland**			
	Woodland/ Low woodland	*Eucalyptus gummifera* *Eucalyptus haemastoma* *Eucalyptus sparsifolia* *Eucalyptus racemosa*	Hawkesbury Sandstone	Ridges, plateaus and dry, exposed hillsides
	Woodland/ Low woodland	*Eucalyptus eximia* *Eucalyptus gummifera* *Angophora bakeri*	"	Ridges, plateaus, northwest of area
	Open-scrub	*Banksia ericifolia* *Hakea teretifolia*	"	Poorly-drained sites
21a	**Coastal Clay Heath**			
	Open-heath	*Allocasuarina distyla*	Narrabeen Group	Long Reef to Bouddi
	Grassland	*Themeda australis*	"	"
21b	**Coastal Dune Heath**			
	Open-heath	*Banksia aemula*	Pleistocene Sand	Coastal dunes, Bouddi, North Head, La Perouse
	Open-scrub	*Monotoca elliptica*	"	"

Map unit	Structure	Main canopy species	Geology	Occurrence
	Open-scrub	*Banksia integrifolia* *Leptospermum laevigatum*		
21g	**Coastal Sandstone Heath**			
	Shrubland	*Baeckea imbricata*	Hawkesbury Sandstone	Shoreline heath
	Open-heath/ Closed-scrub	*Banksia ericifolia* *Darwinia fascicularis*	"	Coastal heath, sandy shallow, soils
	Open-heath/ closed-scrub	*Allocasuarina distyla* *Banksia ericifolia*	"	Widespread, shallow sandy, often poorly-drained soils
	Open-heath	*Baeckea diosmifolia* *Baeckea brevifolia*	"	Rocky outcrop heath
	Open-heath	*Hakea teretifolia* *Banksia oblongifolia*	"	Wet heath, poorly-drained
	Sedgeland/ shrubland	*Banksia robur* *Viminaria juncea* *Gymnoschoenus sphaerocephalus*	"	Swamps, impeded drainage
	Open-scrub	*Angophora hispida*	"	Drier areas
	Shrubland (mallee)	*Eucalyptus luehmanniana*	"	Shallow soils, permanent seepage
27a	**Coastal Swamp Forest Complex**			
	Open-forest	*Eucalyptus botryoides* *Eucalyptus robusta*	Holocene stream alluvium & estuarine sediment	Creekflats or impeded drainage, Warringah Peninsula
	Open-forest	*Livistona australis*	"	"
	Scrub	*Melaleuca linariifolia* *Melaleuca styphelioides*	"	"
	Reedland	*Phragmites australis* *Typha orientalis*	"	"
	Herbland	*Persicaria strigosa* *Blechnum camfieldii* *Triglochin procera* *Baumea juncea*	"	Impeded drainage
28c	**Coastal Freshwater Swamp**			
	Open-sedgeland	*Eleocharis sphacelata* *Baumea juncea* *Persicaria decipiens*	Holocene marine sand & sandy peat	Botany Swamps, Centennial Park
	Low open-forest	*Melaleuca quinquenervia*	"	"

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These areas are mostly suburban development. Small remnants of vegetation too small to map may occur here.

Description of map units

A summary of the plant communities recognised in the Sydney 1:100 000 sheet area, their structural formation, main canopy species and geological substrate and occurrence is given in Table 2. The map unit numbering system applies to all maps in the Sydney Region Vegetation Map Series, missing numbers being communities which do not occur in the Sydney map area.

Map unit 4a
Estuarine Complex

Small patches of estuarine vegetation are found on alluvial mudflats (Holocene sand, silt and clay deposits) subject to varying degrees of tidal inundation. 'For it is strikingly singular that three such noble harbours as Botany Bay, Port Jackson, and Broken Bay, alike end in shallows and swamps, filled with mangroves' wrote Watkin Tench in 1788 (Tench 1979). Today such vegetation still occurs in Broken Bay and the lower Hawkesbury River, Port Jackson and the Parramatta and Lane Cove Rivers and Botany Bay and the Georges River. It generally consists of a sequence of zones of different structure and floristics related to duration of tidal inundation and salinity. The following zones may be recognised, though not all will necessarily occur at any one site.

i) Open-scrub of *Avicennia marina–Aegiceras corniculatum*, confined to the seaward edge of the mudflat and made up of mangroves (1–5 m high) of the Grey Mangrove, *Avicennia marina* and the smaller, River Mangrove, *Aegiceras corniculatum*. Mangroves generally receive daily tidal inundation.

ii) Herbland of *Sarcocornia quinqueflora–Suaeda australis*, a zone of saltmarsh, a herbland dominated by the succulent stemmed members of the Chenopodiaceae, *Sarcocornia quinqueflora* and *Suaeda australis*.

iii) Rushland of *Juncus kraussii* and *Phragmites australis*. These areas have brackish water and receive infrequent tidal inundation.

iv) Low open-forest of *Casuarina glauca* and *Baumea juncea*. Areas with saline soils and periodic flooding. Swamp forest with *Eucalyptus robusta* may occur on alluvium at the landward end of the zonation (see Map Unit 27a Coastal Swamp Forest Complex).

The nature of the surrounding country may influence the floristic composition. Estuarine areas on the southern side of the Parramatta River drain from low-relief country with clay soils from Wianamatta Shale. The clayey alluvium originally supported saltmarsh interspersed with broad bare mudflat areas, only infrequently flooded and described at Homebush Bay as the dry salt plain by Hamilton (1919). The senior author remembers these sites from his schoolday explorations in the early 1960s. These clay rich mudflats, remnants of which still survive at Homebush Bay, included species such as *Lampranthus tegens*, *Wilsonia backhousei* and *Halosarcia pergranulata* subsp. *pergranulata*, not generally found in other saltmarsh areas (Clarke & Benson 1988). For example the major saltmarsh reserves at Towra point are on more sandy alluvium and do not include these dry salt-plain species. Extensive areas of these estuarine mudflats in the upper Parramatta River in Concord and Auburn municipalities and along the Cooks River in Marrickville, were destroyed by landfill between 1920 and 1970. A potential longterm threat to saltmarsh vegetation comes from the spread of the weed *Juncus acutus*, now established at Homebush Bay and Saltpan Creek.

Along the Lane Cove River and the northern side of the Parramatta River, as well as Broken Bay and the Hawkesbury River, including the lower reaches of its tributary creeks downstream from Wisemans Ferry, much of the alluvial material is sandy, being derived from the nearby Hawkesbury Sandstone. The adjacent hillslopes are generally much steeper, and estuarine areas are much more limited; mangroves predominate, saltmarsh areas are of only limited extent. Where sandstone hillsides drop sharply into the water with no build-up of alluvium, the zonation may be truncated to a line of

mangroves and a few trees of *Casuarina glauca*. In the Lane Cove River agricultural and particularly urban development in the catchment has increased sedimentation and allowed mangroves, particularly *Avicennia marina* populations to expand seawards (McLoughlin 1985, Thorogood 1985), though similar expansion of saltmarsh has not been recorded. Saltmarsh and landward vegetation such as *Juncus kraussii* and *Casuarina glauca* has generally declined as a result of landfilling.

Coastal lagoons at Narrabeen and Dee Why (Coveny g), have some small remaining areas, principally of rushland, while limited stands of estuarine low open-forest persist at Warriewood.

Within the Sydney map area, descriptions of estuarine vegetation have been compiled for Brisbane Water National Park (Benson & Fallding 1981); Muogamarra Nature Reserve (Thomas & Benson 1985b); Ku-ring-gai Chase National Park (Thomas & Benson 1985a) Calna and Berowra Creeks (Pickard 1974), Smiths Creek, Terrey Hills (Kratochvil et al. 1973), Port Jackson and the Cooks River (Hamilton 1919), Bantry Bay (Upper Middle Harbour Conservation Committee 1974), Homebush Bay (Centre for Environmental Studies, 1978; Clarke & Benson 1988, Adam 1991, Kachka 1993), the Lane Cove River (McLoughlin 1985), Wolli Creek (Allaway & Clarke 1987, Brown et al. 1988).

A wealth of observations on the behaviour of saltmarsh species, together with descriptions of vegetation in areas where it has long since been removed, such as Cooks River, are given in Hamilton (1919). Detailed studies of mangrove and saltmarsh communities and individual species at Towra Point, an important estuarine area on the southern shore of Botany Bay but outside the Sydney map area, have been carried out by Clarke and Hannon (1967, 1969, 1970, 1971).

Map Unit 6b

Blue Gum High Forest

Tall open-forest–open-forest: *Eucalyptus pilularis–Eucalyptus saligna*

This was the original vegetation of the higher rainfall (above 1100 mm p.a.) Wianamatta Shale soils of Sydney's north shore suburbs (Benson & Howell 1990a). The original forest was composed of big trees, probably over 40 m in height, and it was obviously a valuable source of timber last century. For example Raymond (1832) describes land near Pennant Hills let on lease for the purpose of cutting timber: 'Their leases are nearly expired. Much fine timber still remains, the trees along this range being in general of an uncommonly large size, perhaps more so than in any other part of Cumberland, and therefore very advantageously situated so near a rapidly increasing town.'

Eucalyptus pilularis and *Eucalyptus saligna* are the main trees, originally probably in excess of 30 m tall. Other tree species include *Angophora costata*, *Eucalyptus paniculata, Eucalyptus globoidea* and *Syncarpia glomulifera*. An open, small-tree layer of saplings of canopy tree species and mature individuals of *Allocasuarina torulosa* is often present on drier sites, or *Pittosporum undulatum* on moister ones.

Shrubs are common, and often form a dense cover. Common species on drier sites are *Platylobium formosum*, *Leucopogon juniperinus*, *Dodonaea triquetra* and *Hibbertia aspera*. On moister sites and in depressions these shrubs are replaced by ferns, particularly *Calochlaena* (*Culcita*) *dubia*, *Adiantum aethiopicum* and *Doodia aspera*, and shrubs with softer leaves, such as *Breynia oblongifolia* and *Polyscias sambucifolius*.

Mesic shrubs may line shallow water courses but 'rainforest-type' understorey rarely occurs on the shale soils, as the deep, sheltered gullies required for the best development of these species cut through the thin shale capping to the low nutrient Hawkesbury Sandstone soils below. 'Rainforest-type' gully vegetation in the area is therefore generally on sandstone though this may be enriched by shale material washed down from the ridges. On the shale soils there were patches of wetter understorey on sheltered hillsides, but localised rainforest understorey patches only occur at Brush Farm at Eastwood where an unusual combination of rich soils, unusually deep, sheltered gullies, and a high rainfall allowed rainforest species to survive. Species here include *Acmena smithii*, *Cryptocarya glaucescens* , *Guioa semiglauca*, *Schizomeria ovata*, *Rhodamnia rubescens* and *Euodia micrococca* (Coveny a, Broadbent & Buchanan 1984, Benson 1986b).

Blue Gum High Forest was an important resource to the timber-getters who cut out much of the valuable Blackbutt and Blue Gum in the nineteenth

Figure 5. Remnant Blue Gum High Forest, map unit 6b, with *Eucalyptus saligna* at Dalrymple–Hay Nature Reserve, St Ives.

century (Hawkins 1994). Clearing and agricultural development led to dairy farms and orchards and then suburban development. Most of Sydney's Blue Gum High Forest has now been destroyed; Benson and Howell (1990b) estimated that only 0.9% of the original 11 000 ha found in the County of Cumberland remained in 1980). There are still some small remnants. In particular, in two reserves, Dalrymple Hay Nature Reserve at St Ives (Benson & Keith 1984a) and Ludovic Blackwood Memorial Sanctuary at Beecroft (Buchanan 1977, 1978), and in a number of smaller areas, such as Sheldon Forest, Turramurra; Darvall Park, Denistone (Coveny e); Brush Farm Park, Eastwood where there is an important remnant of rainforest (Coveny a, Broadbent & Buchanan 1984, Benson 1986b); Observatory Park, Beecroft; and Edna May Hunt Reserve, Eastwood (Benson 1979b). In addition, patches too small to map at the present scale [may] persist on roadsides or creek edges; it is important to protect these as they add to the areas of scarce habitat available for perpetuation of the forest's species.

Along creeks and drainage lines where remnants of this community still persist, there is often dense exotic weed growth invading and crowding out the native species. *Ligustrum sinense* and *L. lucidum* (Privet species) are the main culprits, while *Tradescantia albiflora* (Wandering Jew) is another major problem species. This ground-cover plant smothers native ground species, prevents seedling recruitment and is very difficult to eradicate. The most effective control in bushland areas appears to be hand-weeding and careful herbicide use. Many native understorey species can persist as propagules in the soil, able to re-establish when conditions for germination and regrowth are favourable.

Map Unit 6c
Glen Forest

Small volcanic necks or diatremes are scattered throughout the Sydney region, about 25 being shown on the Sydney 1:100 000 geology map (Herbert 1983). These sites have higher-nutrient soils than surrounding areas (Chapman & Murphy 1989) and their vegetation generally contrasts markedly with that on the adjacent sandstone or shale soils. Where the surrounding rock is low-nutrient sandstone these differences are particularly distinctive because of the differences in soil

nutrients, and because many such diatremes often occur in sheltered valley positions. Unfortunately most natural vegetation on diatremes in the immediate Sydney area has been destroyed, either because their fertile soils were cleared for agriculture, or because the basaltic rocks, a convenient source of blue metal aggregate, have been extensively quarried. Remnant diatreme vegetation indicates that considerable local differences in vegetation composition occurred between sites, mainly as a result of variations in soil type and exposure conditions; two sub-units are recognised below.

i) Tall open-forest: *Eucalyptus saligna*

Eucalyptus saligna dominated vegetation, very similar to the Blue Gum High Forest of the North Shore (map unit 6b), grew on high-nutrient volcanic soils under similar high rainfall conditions (1200–1400 mm p.a.). Old Mans Valley at Hornsby, probably the largest diatreme in the area, has been extensively quarried for blue metal aggregate, but remnant vegetation on nearby Joes Mountain in Berowra Valley Bushland Park (too small to map at 1:100 000 scale) has *Eucalyptus saligna* as the dominant tree species with less frequent trees of *Eucalyptus pilularis* and *Angophora floribunda*. Native understorey species include *Calochlaena dubia*, *Blechnum cartilagineum*, *Adiantum aethiopicum*, *Pteridium esculentum*, *Smilax australis*, *Pandorea pandorana* and *Poa affinis* (Smith & Smith 1990). Weeds constituted 14% of the species recorded in the survey plot including *Lonicera japonica*, which was codominant with *Calochlaena* in the dense fern layer, and *Ligustrum lucidum*, *Ligustum sinense* and *Cinnamomum camphora* that were codominant in the shrub and low tree layers.

Similar high rainfall vegetation probably occurred on other diatremes such as at Browns Field (South Turramurra Environment Protection 1980), Dundas, Burwood and Lugarno. Volcanic necks in the Blue Mountains with similar vegetation are known as Glens e.g. Murphys Glen, Tobys Glen (Keith & Benson 1988).

ii) Tall open-forest: *Eucalyptus agglomerata–Angophora floribunda*

In Ku-ring-gai Chase, the amphitheatre-shaped valley of Campbells Crater contains tall open-forest to open-forest with trees 15–35 m tall with a mid-dense canopy cover. On the slopes of the crater the understorey is shrubby but the floor supports small trees, palms and tree ferns with a ground cover of monocotyledons and ferns. Vines are common (Thomas & Benson 1985a). Main tree species are *Eucalyptus agglomerata, Angophora floribunda, Allocasuarina torulosa,* also with *Angophora costata* and *Eucalyptus umbra*. Small trees include *Acacia floribunda*, *Synoum glandulosum* and the palm *Livistona australis*. Understorey species include shrubs; *Pultenaea flexilis*, *Prostanthera denticulata*, *Astrotricha floccosa*, and ground species; *Dianella caerulea*, *Oplismenus imbecillis*, *Calochlaena dubia*, *Hypolepis muelleri*, *Cyathea australis*, *Pteridium esculentum*, *Pseuderanthemum variabile*, *Hydrocotyle acutiloba*, *Goodenia ovata*, *Helichrysum elatum*, *Cissus hypoglauca*, *Smilax australis*, *Pandorea pandorana* and *Cayratia clematidea*.

At Campbells Crater variation relates to slope, soil and aspect. The understorey changes between the sides and the floor of the crater. On the sides a sandy topsoil lies over a clay sub-soil and this tends to support a denser shrub layer than the hard clay soil on the crater floor. The lower south-facing slope of the crater has a dense fern understorey, while the east- and north-facing slopes have a more open understorey. Weed infestation is heavy on the crater floor where the soil is more fertile. Species that are absent or uncommon elsewhere in Ku-ring-gai Chase National Park are *Eucalyptus agglomerata*, *Toona ciliata*, *Seringia arborescens*, *Asterolasia correifolia*, *Rulingia dasyphylla* and *Rubus rosifolius*.

Remnants of similar vegetation occur at Dillons Crater in Brisbane Water National Park (Benson & Fallding 1981) and Peats Crater in Muogamarra Nature Reserve, though much of the volcanic areas have been cleared. Blanch and Marramarra Craters in Marramarra National Park, and one north of Fiddletown (Smith & Smith 1990), probably still have similar vegetation.

Volcanic dykes also occur, but are generally too narrow to support a distinct plant community, though understorey species may show local variations indicative of the more clayey, higher-nutrient soils. Sanders (1983) found that wide variation occurred within the vegetation associated with dykes and that soil and topographic position were important factors for species distribution; soil move-

ment downslope from the dyke accounts for 'dyke' vegetation growing on sandstone. On soils associated with a dyke at West Head is open-forest with trees of *Eucalyptus paniculata, Eucalyptus umbra, Angophora floribunda, Eucalyptus scias* subsp. *scias, Syncarpia glomulifera* and *Allocasuarina torulosa*. Six species were found to characterise the vegetation on the ridge: *Macrozamia spiralis, Xylomelum pyriforme, Lomatia silaifolia, Pultenaea daphnoides, Notelaea ovata* and *Breynia oblongifolia;* and three to characterise the basalt soil in the creek; *Cissus hypoglauca, Doodia aspera* and *Livistona australis*.

Map Unit 9d
Transition Forest

Open-forest: *Eucalyptus fibrosa–Eucalyptus moluccana–Melaleuca decora*

Found in the Bankstown–Regents Park area, small patches of this vegetation still exist around Duck River, Auburn and Rookwood Cemetery, occurring on lower rainfall Wianamatta Shale (rainfall at Lidcombe is about 800 mm p.a.) on soils often associated with ironstone gravels, generally red podzolics or relict red podzolics. These are of low fertility and support vegetation with a shrubby understorey rather than the grasses that are characteristic of the more fertile soils of the Cumberland Plain with a similar rainfall. Floristically this vegetation is similar to the open-forest on transitions from Wianamatta Shale to the Tertiary alluvium in the Castlereagh–Penrith area and mapped (map unit 9d) on the Penrith Sheet (Benson 1992a), although here it is on Wianamatta Shale. It is likely that similar soil and drainage conditions here support this vegetation.

Structure is open-forest with an understorey ranging from a dense shrub layer about 3 m high to open and grassy with scattered shrubs. In the Bankstown–Regents Park area the main canopy tree species are *Eucalyptus fibrosa* and *Eucalyptus moluccana*. *Eucalyptus longifolia* and *Eucalyptus globoidea* occur sporadically and do not appear to be in any particular habitat. *Eucalyptus tereticornis* is found in the lower rainfall areas generally on lower hill slopes and depressions. *Syncarpia glomulifera* is usually found in higher-rainfall areas. *Angophora bakeri* was recorded only from near Duck River at Auburn, and *Eucalyptus parramattensis* from Bass Hill. Dense shrubs are found along watercourses. *Melaleuca decora* is common in depressions and on poorly-drained flats. *Melaleuca styphelioides* is less common and found along creek channels. Other shrub species along creeks include *Rapanea variabilis* and *Breynia oblongifolia*. Shrubs also predominate on dry gravelly rises. Of the larger shrubs *Bursaria spinosa*, *Melaleuca nodosa* and *Acacia decurrens* are most common. Smaller shrubs include *Lissanthe strigosa*, *Daviesia ulicifolia*, *Dillwynia juniperina*, *Callistemon pinifolius*, *Acacia pubescens* and *Dodonaea triquetra*. Ground plants, grasses such as *Themeda australis* and *Aristida vagans*, sedges such as *Lepidosperma laterale* and *Lomandra longifolia* and herbs such as *Vernonia cinerea*, *Pratia purpurascens* and *Hardenbergia violacea* are interspersed with the shrubs or are more conspicuous on the sides of gravelly ridges.

Price (1979) studied the remnants of native vegetation in the Auburn area. He found that the original forest structure at Duck River and Rookwood Cemetery has been largely modified by fire, since european settlement, into grasslands, *Melaleuca* and eucalypt scrub, and low woodland. Grasslands dominated by *Themeda australis* occur in areas cleared long ago and little interfered with other than by regular burning. Other species associated with them *include Patersonia longifolia*, *Hypoxis hygrometrica*, *Xanthorrhoea* and *Lomandra* species and ground orchid species of *Diuris*, *Microtis* and *Thelymitra*.

Melaleuca and eucalypt scrub is common on land that has been partly cleared or left to recolonise naturally. *Melaleuca decora*, *Melaleuca nodosa* and *Melaleuca styphelioides* are the most abundant shrub species here and may be accompanied by small trees of *Eucalyptus fibrosa*, *Eucalyptus moluccana*, *Eucalyptus resinifera*, *Angophora bakeri*, *Syncarpia glomulifera* and *Eucalyptus longifolia*. Depending on the density of the *Melaleuca* canopy, there may be scattered herbs or open grassy places in between. Herb species include *Stylidium graminifolium*, *Lomandra* species, *Dianella* species, *Calotis cuneifolia* and *Vernonia cinerea*. Shrubs of open places such as *Daviesia ulicifolia*, *Dillwynia juniperina*, *Indigofera australis*, *Pimelea linifolia*, *Olearia microphylla*, *Ozothamnus diosmifolius*, *Bursaria spinosa*, *Callistemon linearis*, *C. pinifolius*, and the low-growing *Melaleuca* species, *Melaleuca erubescens* and *Melaleuca thymifolia*, are usually

more common than species found in more shady habitats, such as *Polyscias sambucifolius*, *Pittosporum undulatum* and *Breynia oblongifolia*. Fire modifies the structure and floristics of these *Melaleuca* scrubs. When the canopy is opened to light, short-lived herbs such as *Pelargonium inodorum*, *Polymeria calycina*, *Senecio hispidulus* and shrub species *Cassinia arcuata*, *Ozothamnus diosmifolius*, *Olearia microphylla*, *Pimelea linifolia*, *Pultenaea villosa*, *Acacia falcata* and *Acacia longifolia*, establish.

The understorey of shrubs and tall herbs in the low woodland remnants include shade-tolerant or moisture-requiring species, many of them having seeds that are probably spread by birds. Species able to survive fires by suckering, such as *Breynia oblongifolia*, *Phyllanthus gasstroemii*, *Rapanea variabilis*, *Notelaea longifolia* and the exotic weed species *Asparagus officinalis* and *Myrsiphyllum asparagoides* are most abundant; other species include *Glochidion ferdinandi*, *Pittosporum undulatum*, *P. revolutum* and *Omalanthus populifolius*. For the Auburn area Price recorded 292 native species, a considerable number in view of the degree of disturbance the area has suffered.

This vegetation occurs on very poor agricultural soils. It remained largely undisturbed until the expansion of suburban development in the Bankstown–Liverpool district following the Second World War. Remnants still survive on State, Commonwealth and local council land. Probably the best example in the map area is along Duck River at Auburn. There are also remnants at Rookwood Cemetery, Carysfield Park at Bass Hill, Norfolk Reserve, Greenacre, and Airport and Ashford Reserves, Milperra. A nationally listed rare species, *Acacia pubescens*, is almost completely restricted to this community and has been recorded at a number of sites in the area including Carysfield Park and Rookwood Cemetery and along the railway line near Punchbowl and Yagoona. Trees of *Eucalyptus longifolia* with *Melaleuca decora* still survive beside Parramatta Road at its intersection with Hill Road, Granville. These are significant because they are the last naturally occurring native trees along Parramatta Road between Sydney and Parramatta.

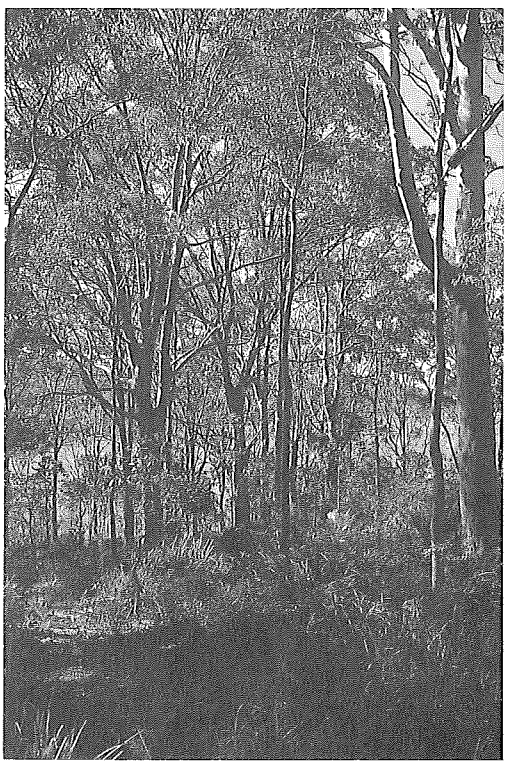


Figure 6. *Eucalyptus maculata* open-forest, map unit 9g(ii), on the lower slopes at Elvina Bay, western Pittwater.

Map unit 9g
Spotted Gum–Blackbutt Forest

Spotted Gum–Blackbutt Forest is a very extensive and varied community on the Gosford map sheet area (Benson 1986a). It is an important component of the forestry activities of the Wyong district and extends south along the coast into the Bouddi and Warringah Peninsulas on the Sydney map sheet, where *Eucalyptus maculata*, Spotted Gum, is particularly conspicuous. Here, spotted Gum–Blackbutt Forest is found along the entrance to Brisbane Water between Wagstaff and The Rip (McRae 1990), along the Warringah Peninsula, on Scotland Island, and on the foreshores of Pittwater (Pidgeon 1937; Thomas & Benson 1985a). It is found on lower hillslopes on the Narrabeen Group–Terrigal Formation and coastal occurrences of the Newport Formations (interbedded laminite, shale and sandstones), on shallow to deep lithosols and podzolics of the Watagan Soil Landscape (Chapman & Murphy 1989). Annual rainfall here is up to 1500 mm with no winter frosts or seasonal drought (Kartzoff 1969). A number of sub-units can be recognised.

i) Open-forest: *Eucalyptus gummifera–Eucalyptus maculata–Eucalyptus pilularis*

Occurs mainly in the Wyong area on the Gosford map sheet (Benson 1986a).

ii) Open-forest: *Eucalyptus maculata–Eucalyptus paniculata*

Eucalyptus maculata, Spotted Gum, is the most characteristic tree, e.g. making up 46% of a sample of 150 trees in Hudson Park, Avalon (Smith & Smith 1993), forming an open-forest 15–30 m high with a mid-dense canopy cover. Associated trees at Hudson Park are *Angophora costata* (16%), *Eucalyptus gummifera* (13%), *Eucalyptus umbra* (9%), *Eucalyptus punctata* (6%), *Eucalyptus paniculata* (4%), *Syncarpia glomulifera* (3%), *Eucalyptus botryoides* (2%) and *Angophora floribunda* (1%). Small trees include *Allocasuarina torulosa*, *Glochidion ferdinandi* and *Livistona australis*. The understorey varies according to aspect. On dry sites there is a very sparse small tree and shrub layer with *Allocasuarina littoralis*, *Dodonaea triquetra*, *Platylobium formosum*, *Macrozamia communis* and *Pultenaea flexilis*, a mid-dense low shrub layer and an open ground cover of herbs and graminoids. In sheltered aspects the small tree layer is denser, including *Elaeocarpus reticulatus* and *Pittosporum undulatum*, there are few low shrubs, and ferns such as *Adiantum aethiopicum* and *Doodia caudata*, and vines such as *Cissus hypoglauca*, *Pandorea pandorana*, *Cayratia clematidea*, *Geitonoplesium cymosum* and *Eustrephus latifolius* may form a 'rainforest type' understorey. Small rainforest trees may occur, particularly on the Warringah Peninsula, including *Diospyros australis*, *Synoum glandulosum*, *Cassine australis* var. *australis*, *Euodia micrococca*, *Commersonia fraseri* and *Alphitonia excelsa*. *Livistona australis* is locally abundant around Bilgola.

Floristic lists have been compiled for Angophora Reserve and Hudson Park, Avalon (Table 3, Smith & Smith 1993), the National Trust's Burley Griffin Lodge at Avalon (Buchanan 1979b), western Pittwater (Thomas & Benson 1985a), and Loquat Valley, Bayview (Costin 1986).

iii) Woodland: *Eucalyptus umbra–Eucalyptus paniculata*

Related vegetation is found on the south-eastern side of the Bouddi Peninsula on slopes running from the main ridge to the coast (McRae 1990). Here the slopes are steep, from 10° to 35°, the aspect varies around south-east and there is always some degree of exposure to coastal winds and saltspray. Where the coastal exposure is greatest, the structure is reduced to a tall shrubland in which the canopy merges with the shrub layer. Elsewhere it is woodland structure.

The main tree species, *Eucalyptus umbra*, *Eucalyptus paniculata*, *Angophora costata* and *Syncarpia glomulifera* form a layer that varies from a height of 25 m and a cover of 25% to a height of 3 m with 10% cover, with increasing exposure. The shrub layer (3 m high with 20% cover) has a variable composition with common species including *Macrozamia communis*, *Dodonaea triquetra* and *Pultenaea flexilis*. The tall ground layer (1.5 m high with 30% ground cover) is dominated by *Lomandra longifolia*, *Imperata cylindrica*, *Gahnia melanocarpa* and *Pteridium esculentum*. The variablility in all strata is due to aspect and soil, the latter arising from the variable nature of the parent rocks (McRae 1990).

iv) Open-forest: *Archontophoenix cunninghamiana*

On slopes below Mt Bouddi are deep gullies with marginal rainforest dominated by Bangalow Palm, *Archontophoenix cunninghamiana,* with scattered *Eucalyptus deanei* and *Allocasuarina torulosa* (McRae 1990). Structurally this is open-forest with the trees up to 30 m high and reaching 60% canopy cover. There is a small tree layer, 10 m high, with Cabbage Palm, *Livistona australis, Duboisia myoporoides, Glochidion ferdinandii, Ficus coronata, Pittosporum undulatum, Schizomeria ovata,* and *Acmena smithii,* scattered shrubs including *Notelaea venosa, Wilkiea huegliana, Eupomatia laurina* and *Citriobatus pauciflorus,* and ground cover species including *Cissus antarctica, Rubus moorei, Morinda jasminoides, Gymnostachys anceps* and *Blechnum cartilagineum. Lantana camara* is usually abundant in the surrounding eucalypt woodland and in time could increase from its currently isolated thickets within the palm-forests.

Map unit 9h
Narrabeen Slopes Forest

Narrabeen Slopes Forest is particularly characteristic of the foreshores of Broken Bay and Pittwater (communities 6 and 7 of Thomas & Benson 1985a) and along the Hawkesbury River and its tributaries, Mangrove and Mooney Mooney Creeks (Benson & Fallding 1981; Benson 1986a). Similar vegetation is found on lower slopes of the islands of Broken Bay — Spectacle Island (Webb 1981), Bar Island (Benson 1984), Milson Island (Cleland 1914) Lion Island (Benson 1981a), Long Island (Coveny & McDougall 1990) and Dangar Island, and Scotland Island in Pittwater. All of these islands, with the exception of Bar Island, have Hawkesbury Sandstone vegetation (map unit 10ar) on their crests.

Narrabeen Slopes Forest is found on strata of the Narrabeen Group–Newport Formation (interbedded shale, laminite and medium-grained quartz sandstone) that outcrop on lower slopes and hillsides below cliffs and ridges of Hawkesbury Sandstone. Vegetation structure and floristic composition are particularly influenced by aspect. South-facing slopes are steeper, cooler and moister than north-facing slopes, which are less steep, but drier and more sunny. Two sub-units are recognised.

i) Open-forest: *Eucalyptus deanei–Angophora floribunda*

Sheltered south-facing aspects generally have open-forest with trees of *Eucalyptus deanei* and *Angophora floribunda* and may be associated with pockets of rainforest. This is found mainly on the northern side of Broken Bay in Mooney Mooney and Mullet Creeks on the Gosford map sheet (Benson 1986a), with one small occurrence at the southern end of Brisbane Water National Park and near Patonga (community 2B of Benson & Fallding 1981). There is generally a mesic understorey with climbers — *Hibbertia scandens, Hibbertia dentata, Cissus hypoglauca*; ferns — *Calochlaena dubia, Doodia aspera, Pteridium esculentum*; and other ground species — *Themeda australis, Imperata cyclindrica, Hydrocotyle* and *Lomandra* species.

ii) Open-forest: *Angophora floribunda–Allocasuarina torulosa*

On dry north- to west-facing slopes and on slopes open to sea breezes, open-forest is characterised by *Angophora floribunda, Eucalyptus punctata* and *Allocasuarina torulosa*. This occurs on the eastern sides of Mooney Mooney and Mullet Creeks in Brisbane Water National Park (community 2A of Benson & Fallding 1981), but is most common on the southern shore of Broken Bay on the foreshores of Cowan Creek, Coal and Candle Creek, Smiths Creek and the Hawkesbury River (Thomas & Benson 1985a, Community 7). Here it is from 15–25 m high with a mid-dense to open canopy cover. The main tree species are *Angophora floribunda, Eucalyptus punctata* and *Allocasuarina torulosa*, with *Eucalyptus botryoides, Eucalyptus umbra* and *Eucalyptus paniculata*. The understorey is usually dry with an open shrub layer and a ground cover dominated by grasses and herbs. Shrubs include *Pultenaea flexilis, Acacia ulicifolia, Astrotricha floccosa, Cassinia denticulata, Playsace linearifolia, Prostanthera denticulata* and *Persoonia linearis*. Grasses include *Entolasia* species and *Themeda australis*, and may predominate in frequently burned sites. On very sheltered aspects there may be moister species such as *Synoum glandulosum* and *Calochlaena dubia.*

Thomas and Benson (1985a) indicate that *Eucalyptus botryoides* and *Eucalyptus paniculata* occur with *Angophora floribunda* along the foreshores of Western Pittwater from McCarrs Creek to West

Head on deeper, heavier soils in sheltered sites (described as their community 6). This variant commonly has an understorey of *Calochlaena dubia* and vines, particularly *Smilax australis* and *Geitonoplesium cymosum,* and has been included within this map unit. *Eucalyptus botryoides* may extend beyond the Narrabeen Group soils and is commonly found with *Angophora costata* on coastal sandstone headlands but rarely occurs away from the coast. *Eucalyptus maculata* rarely occurs in this unit. However, it is found around Pittwater where Narrabeen Slopes Forest is similar to and intergrades with Spotted Gum–Blackbutt Forest (map unit 9g).

Map unit 9o
Turpentine–Ironbark Forest

Open-forest: *Syncarpia glomulifera–Eucalyptus paniculata*

Turpentine–Ironbark Forest was the characteristic forest vegetation of the inner western part of Sydney from St Peters west to Peakhurst and sporadically as far as Lansdowne. It occurred on Wianamatta Shale, on shallow to deep podzolic soils of the Blacktown Soil Landscape (Chapman & Murphy 1989). It was also found north of the Parramatta River, from Ryde to Castle Hill and along shale-capped ridges around Glenorie and Arcadia, and on the transition zone between the Wianamatta Shale and the underlying Hawkesbury Sandstone, particularly on soils formerly known as the Hammondville Association (Walker 1960).

Turpentine–Ironbark Forest was first described by Phillips (1947) as a sub-association (*Eucalyptus pilularis–Eucalyptus resinifera*) of her *Eucalyptus pilularis–Eucalyptus saligna* Association, but is distinctive enough to map and discuss as a separate unit. With a moderate rainfall of between 900 mm and 1100 mm per annum, the vegetation, an intermediate, is part of the shale-vegetation gradient from the higher-rainfall Blue Gum High Forest (*Eucalyptus pilularis–Eucalyptus saligna* tall open-forest, map unit 6b), to the low rainfall Grey Box Woodland (*Eucalyptus moluccana–Eucalyptus tereticornis* woodland, map unit 10c, Benson 1992) further west on the Cumberland Plain.

Most of the Turpentine–Ironbark Forest has now gone, having been replaced by suburbs in the nineteenth and early twentieth centuries (Benson & Howell 1990a). Part of the Inner Western area, north of the Cooks River, in the Ashfield–Canterbury area was designated the *Kangaroo Ground* by Watkin Tench (Tench 1979), and was sought for early settlement. Collins (1798) wrote: 'The lieutenant-governor [Grose] proposing to open and cultivate the ground commonly known by the name of the Kangaroo Ground, situate to the westward of the town of Sydney between that

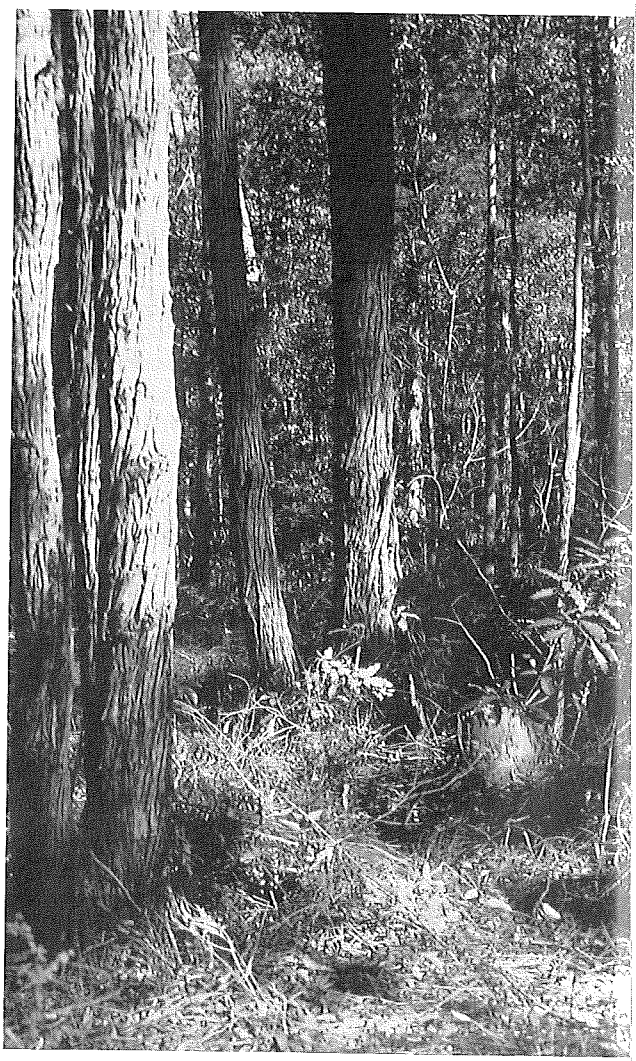


Figure 7. There are only a few surviving remnants of Turpentine–Ironbark Forest, map unit 9o, such as here at Fagan Park, Galston.

settlement and Parramatta, a gang of convicts was sent from the latter place for that purpose. The soil here was much better for agriculture than that immediately adjoining to the town of Sydney, and the ground lay well for cultivation; but it had hitherto been neglected, from its being deficient in the very essential requisite of water; on which account Parramatta had been preferred to it.'

This area would appear to have been eucalypt open-forest or woodland with an open understorey suitable for kangaroo habitat (Pratten 1993). There would, however, have been local variation in vegetation composition, and other early writers mention 'heavy timber and brush' (i.e. a dense understorey of shrubs). Peter Cunningham (1827) described Parramatta Road between Annandale and Ashfield bordered by land '... thickly covered with heavy timber and brush, the soil being usually a poor shallow reddish or ironstone clay, the contemplation whereof presents but little pleasure to the agriculturalist'.

Characteristic tree species were probably *Syncarpia glomulifera*, the Turpentine, and *Eucalyptus paniculata*, the Grey Ironbark. These would have been accompanied by a range of other species including *Eucalyptus globoidea*, *Eucalyptus punctata*, *Eucalyptus resinifera*, *Eucalyptus pilularis* and *Angophora floribunda*. Remnant trees of *Syncarpia glomulifera*, *Eucalyptus pilularis*, *Eucalyptus resinifera* and *Eucalyptus globoidea* still survive in Ashfield (Pratten 1993) and there are old herbarium collections of *Eucalyptus siderophloia* from Burwood and Belmore. A notice in the Sydney Morning Herald in December 1834, advertising allotments of the Burwood estate mentions 'timber: Shingle Oak, Iron and Stringy Bark, Mahogany, Blue Gum' etc. 'Blue Gum' here may refer to *Eucalyptus saligna*, which may have occurred locally in gullies or depressions, or *Eucalyptus tereticornis*, which may also have occurred.

Estimated canopy heights in remnant stands north of the Harbour, surveyed in the 1970s, ranged from 10 to 20 m with canopy cover from 30 to 67%, all figures characteristic of open-forest formation (D. Benson unpub. data). Most of these remnants are on the least favourable agricultural sites and have generally been logged, grazed and burnt at varying intensities. Plant densities for these stands, (mean = 719 ± 383 plants/ha), indicate a considerable amount of sapling and small tree regeneration. *Syncarpia glomulifera* was the most important species, accounting for 16% of total basal area and 35% of total plant density, probably because of its ability to withstand disturbance by resprouting, and its slow growth. Seven other tree species each accounted for between 4 and 14% of total basal area and between 2 and 10% of total plant density. A further eight species were recorded contributing to total site basal area.

The understorey was variously shrubby or grassy. Common shrub species in remnants now are *Dodonaea triquetra*, *Polyscias sambucifolia* and *Acacia falcata*, and grass and herb species include *Themeda australis*, *Echinopogon caespitosus*, *Pseuderanthemum variable* and *Pratia purpurascens*. In the early 1840s Mrs Charles Meredith described the forest at Homebush and mentions native species including *Hardenbergia violacea*, *Kennedia rubicunda*, *Pandorea pandorana* and other species likely to be *Oxylobium scandens*, *Dillwynia juniperina*, *Daviesia ulicifolia*, *Platylobium formosum*, *Viola hederacea*, *Wahlenbergia* species, *Lissanthe strigosa* and *Leucopogon juniperinus* (Meredith 1844, quoted in Benson & Howell 1990a). Most of these species can still be found near Homebush Bay, where an important remnant of this vegetation survives in land used for storage of naval munitions (Clarke & Benson 1988; Kachka 1993), or in the Yaralla Bushland in nearby Concord Municipality (Benson 1983).

There is also a small yet important remnant of native vegetation on the banks of the Cooks River at the end of Third Avenue, Campsie (Benson 1992b). The vegetation has patches of scrub, grassland and some trees. Most of the vegetation is of plants native to the site, many of which are growing very vigorously. In particular, in some of the more open areas there is a rich flora of ground cover species in particular grasses and prostrate small shrubs, such as *Astroloma humifusum*, *Calotis cuneifolia* and *Goodenia hederacea*. There was a patch of the orchid *Microtis unifolia* and some very impressive clumps of *Xanthorrhoea media*. Populations of *Calotis cuneifolia*, *Hibbertia serpyllifolia* and *Oxylobium ilicifolium* are probably the only natural occurrences surviving in inner western Sydney. Patches of shrubs include *Kunzea ambigua*, *Leptospermum trinervium* and shrubby trees of *Syncarpia glomulifera*. One of the reasons for the vigorous native plant growth is that the natural soils are essentially unmodified and have

not received nutrients in run-off from other areas. In comparison, adjacent areas with dumped soil have a significant number of weeds. This vegetation is the only remnant of Turpentine–Ironbark Forest vegetation for many kilometres, and is virtually the only remnant of native vegetation on the banks of the Cooks River. The only other native vegetation in the Cooks River valley is along Wolli Creek, in Girrahween Park, associated with outcropping sandstone and having a different species composition from this remnant on shale at Campsie.

On the northern side of the Harbour remnants occur at Ryde in Wallumatta Nature Reserve (Benson 1984, see below) and Fagan Park at Galston (Benson & Keith 1984b) including a good local stand of *Eucalyptus acmenoides*, a species which reaches its southern distributional limit at the Parramatta River — a few trees survive in Maze Park, West Ryde.

Turpentine–Ironbark Forest vegetation extended onto the transition zone between the shale and the underlying Hawkesbury Sandstone, on soils formerly known as the Hammondville Association (Walker 1960). Some of this transitional vegetation still survives as narrow edgers to cleared land on private property and on the margins of sandstone bushland reserves in northern Sydney, where there are remnants of shale overlying sandstone, e.g. Pennant Hills Park, Lane Cove National Park (formerly State Recreation Area) (Clarke & Benson 1987) and Garigal National Park (formerly Davidson State Recreation Area), Ku-ring-gai Chase National Park (Thomas & Benson 1985a), Marramarra National Park, and a number of Council parks. These patches are generally too small to map at the present scale. The vegetation of these areas differs from that on the deeper shale by including sandstone species. Structure is generally open-forest and tree species may be *Syncarpia glomulifera*, *Eucalyptus punctata*, *Eucalyptus paniculata* and *Eucalyptus globoidea*.

Protection of all small remnants of this shale-based flora is important since many of the smaller-growing species in particular are becoming rare, and many of the sites are in very vulnerable positions close to urban development and susceptible to weed invasion and nutrient-enriched run-off. Because shale areas are small and frequently on the margins of reserves, they may need particular and careful management.

Map unit 9sf
Duffys Forest

Open-forest: *Eucalyptus sieberi–Eucalyptus capitellata–Eucalyptus gummifera–Angophora costata*

On sandstone ridgetops in the Duffys Forest–Terrey Hills area are shale remnants from lenses within the Hawkesbury Sandstone (Herbert 1983), often with characteristic ironstone gravels, referred to as 'laterite' cappings. Soils are part of the Somersby Soil Landscape (Chapman & Murphy 1989), moderately deep yellow earths and deep red earths overlying laterite gravels and clays. A distinctive open-forest vegetation occurs on these.

At Duffys Forest, open-forest is 7–18 m high with a mid-dense canopy with trees of *Eucalyptus sieberi, Eucalyptus gummifera, Eucalyptus oblonga, Eucalyptus haemastoma* and *Angophora costata* (Benson 1974, 1979a; Thomas & Benson 1985a: community 10B). The understorey is of mid-dense shrubs often with emergent taller shrubs with a ground cover of low shrubs and monocots. Understorey species include *Telopea speciosissima, Xylomelum pyriforme, Ceratopetalum gummiferum, Banksia spinulosa, Persoonia levis, Micrantheum ericoides, Leptospermum trinervium, Pimelea linifolia, Acacia myrtifolia, Boronia pinnata* and *Cyathochaeta diandra*. Variation appears related to soil depth and type. Deeper soils carry more *Eucalyptus sieberi* with the occasional *Eucalyptus pilularis* and *Syncarpia glomulifera* and the understorey shrub *Bossiaea obcordata*, while thinner soils tend to support more sandstone woodland species. The central part of the original 'Duffys Forest' was cleared many years ago but Kartzoff (1969) reports that much blackbutt, *Eucalyptus pilularis*, was logged at Duffys Forest and that as a result of logging and burning, it is now extinct there, where it had been common 30 years before.

Thomas & Benson (1985a) also describe a slightly different community (community 10A) on low slope areas on shale-derived soils (possibly lateritic) and on deeper soils than the floristically similar *Eucalyptus sieberi* community. Structure is open-forest 0–17 m tall with a mid-dense canopy cover of trees of *Eucalyptus capitellata, Eucalyptus gummifera, Eucalyptus sieberi, Eucalyptus haemastoma*. The understorey has a sparse tall shrub layer, an open to mid-dense mid-height shrub

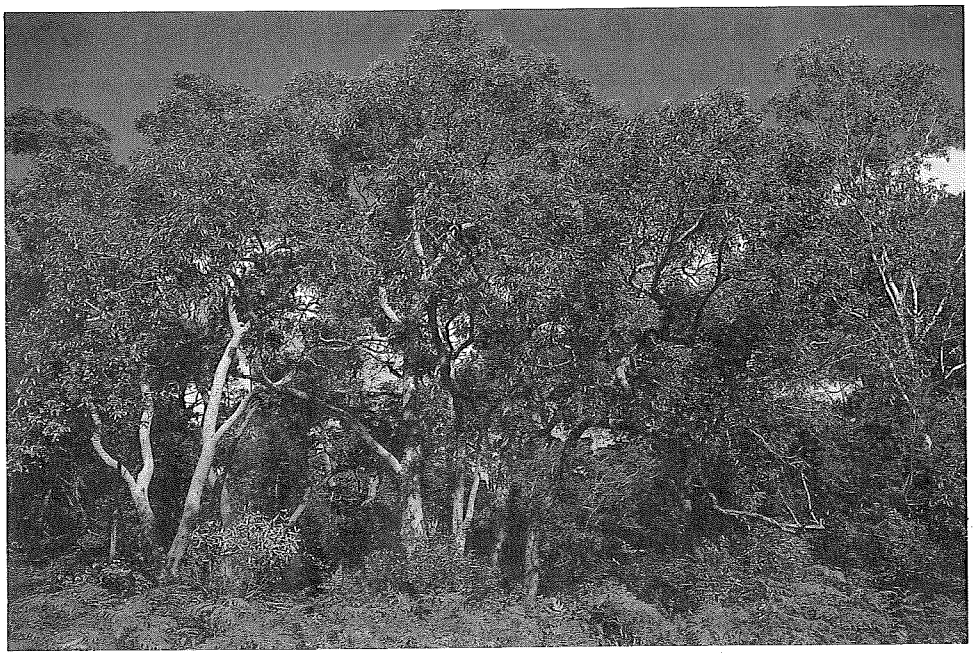


Figure 8. In the Leo Smith Reserve at Ramsgate there is an important remnant of Coastal Dune Forest, map unit 9t, with *Angophora costata* and a dense ground cover of Bracken and shrubs.

layer and an open to mid-dense ground cover of low shrubs, herbs and monocotyledons. Main species are *Ceratopetalum gummiferum*, *Persoonia levis*, *Acacia myrtifolia*, *Bossiaea obcordata*, *Banksia spinulosa*, *Lomatia silaifolia*, *Pultenaea elliptica*, *Micrantheum ericoides*, *Patersonia glabrata* and *Cyathochaeta diandra*. The shale influence on this community is distinctive and several species occur which are uncommon in the rest of the park (e.g. *Persoonia laurina*, *Pultenaea linophylla* form *b*. The threatened *Grevillea caleyi* occurs at the start of the Ryland Track. This community is very restricted in Ku-ring-gai Chase National Park. Similar vegetation also occurs at the junction of Forest Way and Mona Vale Rd, now part of Garigal National Park.

Also included in this map unit is open-forest with a very restricted distribution on remnant shale outcrops in the south of Brisbane Water National Park (mapped as community 4S, Benson & Fallding 1981). Trees here include *Eucalyptus gummifera, Angophora costata, Eucalyptus globoidea, Eucalyptus umbra, Eucalyptus punctata* and *Syncarpia glomulifera*. The shrub understorey is dominated by members of the Fabaceae family, and ground cover species include *Poa affinis, Entolasia stricta* and species of *Lomandra*.

Map unit 9t
Coastal Dune Forest

Open-forest: *Eucalyptus botryoides–Eucalyptus pilularis–Angophora costata*

Coastal Dune Forest occurred on the quartz sand of the Holocene beach ridges that extend along the western shore of Botany Bay, and on the northern side of Broken Bay between Pearl Beach, Umina and Woy Woy (New South Wales Department of Mineral Resouces 1983). It may also have occurred in sheltered sites on the 'marine' sands in Sydney's eastern suburbs, though most of this area appears to have had heath vegetation (Benson & Howell 1990a). Almost all has been destroyed by housing, with the exception of a small remnant on Botany Bay in the Leo Smith Reserve at Ramsgate, some low woodland with *Angophora costata* and *Eucalyptus botryoides* on the sheltered slopes of some dunes in Golf Courses at La Perouse, and a few remnants at Umina, too small to map.

Vegetation structure was originally open-forest to low woodland. *Eucalyptus botryoides, Eucalyptus pilularis* and *Angophora costata* appear to have been the main tree species, though *Angophora floribunda* is common in the Woy Woy occurrence.

Angophora floribunda, *Eucalyptus botryoides* and *Eucalyptus punctata* occur at Pearl Beach (Benson & Fallding (1981). The understorey was shrubby with such native species as *Banksia serrata*, *Elaeocarpus reticulatus*, *Hibbertia scandens*, *Leucopogon ericoides*, *Monotoca elliptica*, *Breynia oblongifolia*, *Glochidion ferdinandi* and *Pomax umbellata*. A species list for Leo Smith Reserve has been prepared by Benson & Keith (1985). This small area of open-forest at Ramsgate is the sole remnant of native sand vegetation of the beach ridge system (Outer Barrier) of western Botany Bay (nearby low-lying area has *Casuarina glauca* forest–Map unit 4a). It is different from the Eastern Suburbs *Banksia* Scrub of the transgressive dunes (map unit 21b), but has similarities to vegetation at Kurnell. Studies of intact vegetation on similar sand dune systems at Myall Lakes (Myerscough & Carolin 1986) demonstrate the complex nature of such vegetation systems.

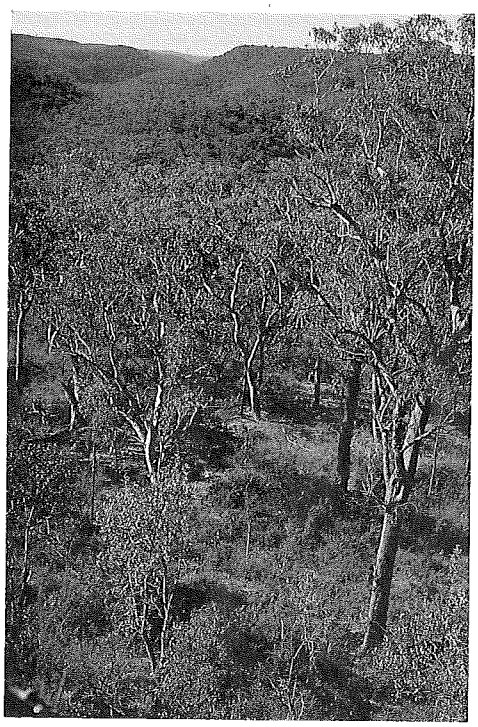


Figure 9. Some of the different habitats provided by the rugged sandstone topography are evident here in Ku-ring-gai Chase National Park — distant level ridgetops, exposed and sheltered hillsides and narrow valley floors each support different groupings of plant species.

Burges and Drover (1952) related vegetation patterns on the Holocene beach ridges between Umina and Woy Woy to increasing podzolisation and beachridge age (up to 4 000 years). Along the beach-front typical foredune colonisers were found, backed by a *Leptospermum laevigatum–Banksia integrifolia* thicket about 100 m wide. Isolated trees of *Eucalyptus botryoides* began to occur about 150 m from the beach and increased in number to form, with *Angophora floribunda*, a fairly open woodland on an area of iron podzol sands. Nearer to Woy Woy, on well-defined humus podzols, *Angophora floribunda* was replaced by *Angophora costata*. The swampy areas between the sand ridges had a range of vegetation from open water with *Typha*, to *Melaleuca quinquenervia* woodland. Remnant trees of *Angophora floribunda*, *Angophora costata*, *Eucalyptus pilularis*, *Glochidion ferdinandii* and a few conspicuous *Macrozamia communis* along the road verges around Ettalong and Umina are generally all that remains of this vegetation.

Sydney Sandstone Complex (map units 10ag and 10ar)

This widespread vegetation complex occupies extensive areas of the Hawkesbury Sandstone plateaus and associated gullies. Depending on topographic position and aspect, there is considerable local variation in floristics and structure. Thomas and Benson (1985a), mapped 12 units for Hawkesbury Sandstone in Ku-ring-gai Chase National Park. Two broad sub-units have been recognised. These are a moist forest type, generally associated with sheltered hillsides and moist gullies (map unit 10ag), and a dry woodland type, generally associated with dry plateaus and ridges (map unit 10ar). These units have been used on the Katoomba, Wallerawang and Penrith sheets but not on the Gosford and Lake Macquarie map sheet (Benson 1986a), where a composite Hawkesbury Sandstone unit (map unit 10a) was used.

Sydney Sandstone Complex (map units 10ag and 10ar) ranges from tall open-forest to low woodland and open-scrub. It corresponds with part of the Mixed *Eucalyptus* Forest Association of Pidgeon (1937, 1938). In the map units described in this paper, Map Unit 10ag is essentially Pidgeon's High Forest, Map Unit 10ar includes scrub, tree-scrub, low scrub-forest and tall scrub-forest, and Map Unit 21g includes extensive areas

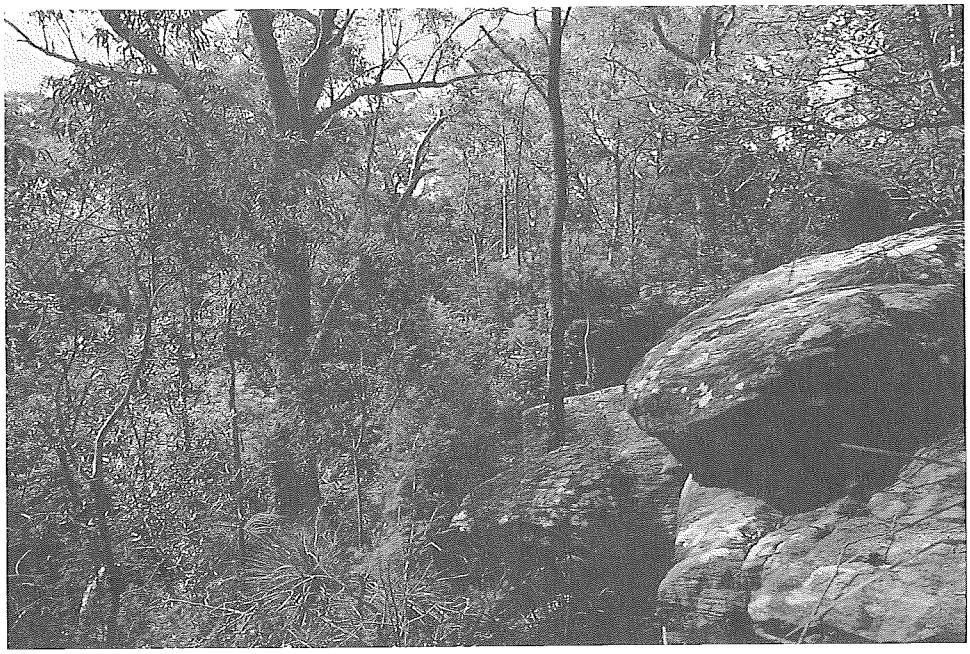


Figure 10. This open-forest in Pennant Hills Park, map unit 10ag(i), is typical of the vegetation on sheltered sandstone slopes in many of Sydney's bushland reserves.

of scrub, as well as sedge and shrub swamp. In terms of the floristic survey of Ku-ring-gai Chase by Outhred et al. (1985), Map Unit 10ag includes many of the M (particularly M4–M7), MT, and R series, while map unit 10ar covers the S, L and M (M1–M3) series.

Map unit 10ag
Sydney Sandstone Gully Forest

Sydney Sandstone Gully Forest has a widespread geographic distribution. It is found on the Hawkesbury Sandstone topography of the coast, Hornsby Plateau, lower Blue Mountains and Woronora Plateau. Map unit 10ag, open-forest to woodland, is generally confined to gullies and sheltered hillsides, particularly on southern to eastern aspects. Soils are shallow lithosols and siliceous sands, yellow earths and yellow podzolics (Hawkesbury Soil Landscape of Chapman & Murphy 1989), with deeper podzolic soils enriched by downwash material on lower slopes and in narrow valleys. Average height of the trees is 25 m, though varying from 18–30 m. Three sub-units are recognised.

i) Open-forest/woodland: *Eucalyptus piperita–Angophora costata–Eucalyptus pilularis*

The main trees are *Eucalyptus piperita*, *Angophora costata* and *Eucalyptus gummifera*. *Allocasuarina littoralis* is a common smaller tree. The understorey is dominated by a variety of shrubs, 0.5–2 m high, the main families being Proteaceae, Fabaceae and Myrtaceae. Pidgeon (1938) and Thomas and Benson (1985a) both list the following as frequent species: *Persoonia pinifolia*, *Acacia terminalis*, *Pultenaea daphnoides* and *Dodonaea triquetra*. There is considerable local variation in this community. For example localised occurrences of podzols on the Hornsby Plateau (Buchanan & Humphreys 1980), are characterised by the inclusion of a particular group of species, *Ceratopetalum gummiferum*, *Xylomelum pyriforme*, *Xanthorrhoea arborea*, *Ricinocarpos pinifolius* and *Gompholobium latifolium*.

Woodland of the more exposed parts of hillsides grades into open-forest as conditions become more sheltered, forming the vegetation characteristic of extensive tracts of sheltered sandstone slopes and gullies.

ii) Tall open-forest: *Eucalyptus pilularis–Syncarpia glomulifera*

Tall open-forest with trees over 30 m tall is found on the lower slopes of sandstone gullies in the Berowra Creek area, and on lower slopes where there is a localised enrichment from downwashed shale soils such as in the Lane Cove Valley. The

main trees are *Eucalyptus pilularis* and *Syncarpia glomulifera* but also occurring are trees of *Eucalyptus piperita* and *Angophora costata* generally associated with adjacent open-forest. Allocasuarina torulosa is a common smaller tree in the understorey

iii) Closed-forest: *Ceratopetalum apetalum–Tristaniopsis laurina*

This is the distinctive riparian flora occurring in narrow bands along perennial creeks. It may be locally of closed-forest structure, but is most commonly scrub, spaced out amongst boulders of the sandstone banks. It is generally an understorey to open-forest of *Eucalyptus piperita* or *Angophora costata*. Characteristic species are *Tristaniopsis laurina*, *Callicoma serratifolia*, *Lomatia myricoides*, *Leptospermum polygalifolium*, and *Austromyrtus tenuifolia*, with *Ceratopetalum apetalum* occurring in more favourable sites. The rare *Leptospermum deanei* is found only along Middle Harbour Creek and the upper Lane Cove River. In sheltered gullies that receive downwash from ridges with Wianamatta Shale there may be tall open-forest with *Eucalyptus saligna*, and occasional rainforest species such as *Schizomeria ovata*, with ferns in the understorey.

Vegetation on soils on small volcanic intrusions are included in this map unit. For example, open-forest with *Eucalyptus agglomerata* and *Angophora floribunda* at Campbells Crater, and open-forest with *Eucalyptus paniculata* and *Eucalyptus umbra* on a dyke at West Head, both within Ku-ring-gai Chase National Park. Such sites have characteristic understorey species related to the generally more clayey and higher nutrient status of the volcanic soils (Thomas & Benson 1985a; Sanders 1983).

Map unit 10ar
Sydney Sandstone Ridgetop Woodland

Sandstone Ridgetop Woodland is found on the more exposed ridges and plateau tops with shallower soils interrupted by outcrops of rock. Soils are shallow lithosols and earthy sands, yellow earths and yellow podzolics (Faulconbridge, Lucas Heights, Hawkesbury and Lambert Soil Landscapes of Chapman & Murphy 1989). There may be an average depth of 5–10 cm in some habitats but tree roots penetrate the deeper pockets of soil amongst the underlying rocks (Pidgeon 1938).

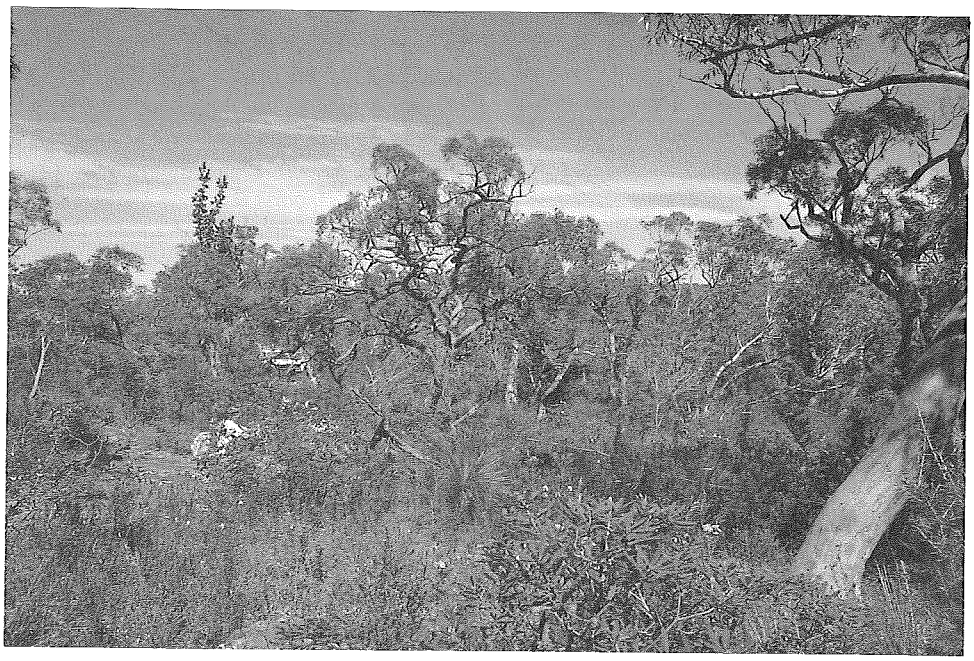


Figure 11. Low open woodland, map unit 10ar(ii), with *Angophora bakeri* and *Eucalyptus haemastoma* in Muogamarra Nature Reserve.

i) Woodland/Low woodland: *Eucalyptus gummifera–Eucalyptus haemastoma–Eucalyptus sparsifolia–Eucalyptus racemosa*

This is structurally very variable and includes areas of woodland, open-woodland, low woodland and low open-woodland, depending on local aspect, soil and drainage conditions, as well as the time since the last fire. Characteristic tree species are *Eucalyptus gummifera*, *Eucalyptus sparsifolia*, *Eucalyptus haemastoma* and *Eucalyptus racemosa*, sometimes with some intergradation between the latter two scribbly gum species. *Eucalyptus piperita* and *Angophora costata* may also occur. Localised patches of mallee eucalypts, *Eucalyptus luehmanniana*, *Eucalyptus obtusiflora*, *Eucalyptus camfieldii* and *Eucalyptus multicaulis*, may be responding to locally moister sites, or shallow rock platforms. *Eucalyptus capitellata* occurs on some more clayey ridges in the Terrey Hills area.

These dry, exposed communities have a rich sclerophyllous shrubby understorey, particularly with species of Proteaceae, Fabaceae, Epacridaceae and Myrtaceae. Common shrubs in Ku-ring-gai Chase National Park include species of *Pultenaea*, *Isopogon*, *Hibbertia*, *Hakea*, *Banksia*, *Boronia*, *Leucopogon*, *Grevillea*, *Gompholobium* and *Tetratheca*, as well as *Dillwynia retorta*, *Phyllota phylicoides*, *Leptospermum trinervium*, *Petrophile pulchella* and *Platysace linearifolia* (Thomas & Benson 1985a).

ii) Woodland/low woodland: *Eucalyptus eximia–Eucalyptus gummifera–Angophora bakeri*

This vegetation is found on dry hillsides and ridges in the north-west of the map sheet area, west of Berowra Creek, and is particularly widespread in Marramarra National Park. Rainfall is generally less than 1000 mm p.a., in contrast to the higher-rainfall (1000–1200 mm) country of Ku-ring-gai Chase and Brisbane Water National Parks. Characteristic trees include *Eucalyptus eximia* and *Angophora bakeri*, as well as the more widespread *Eucalyptus gummifera* and *Angophora costata*. Similar vegetation extends west to the lower Blue Mountains (Benson 1992a) and north into the MacDonald (Sanders et al. 1988) and Colo River areas.

iii) Open-scrub: *Banksia ericifolia–Hakea teretifolia*

In sites with shallow poorly-drained soil, patches of open-scrub with tall shrubs of *Banksia ericifolia* and *Hakea teretifolia* occur. Within the ridgetop woodland small patches of Coastal Sandstone Heath (Map Unit 21g) may occur, in particular coastal heath with *Banksia ericifolia* and *Darwinia fascicularis*, Open-heath with *Allocasuarina* and *Banksia ericifolia*, Rocky outcrop heath with *Baeckea diosmifolia* and *Baeckea brevifolia*, Wet heath with *Hakea teretifolia* and *Banksia oblongifolia*, and Open-scrub with *Angophora hispida*.

As mentioned earlier, floristic differences between gully forest and ridge woodland can be distinguished in Outhred's floristic analysis of Ku-ring-gai Chase vegetation, though there is considerable overlapping of species distributions. However, differences between the scrub or shrub-dominated vegetation and the taller woodland/forest vegetation are perhaps more marked. In particular, many species are essentially confined to the scrub vegetation or very open low tree vegetation, e.g. *Allocasuarina distyla*, *Phebalium squamulosum*, *Banksia oblongifolia*, *Kunzea capitata*, *Mirbelia rubiifolia*, *Stylidium lineare*, *Epacris microphylla*, and *Grevillea speciosa*. In contrast, very few species (e.g. *Micrantheum ericoides*), are essentially confined to the woodland, which is mainly made up of species that occur in both woodland and scrub, or woodland and forest. The woodland appears to be an ecotone between the heath and the forest.

Vegetation surveys of major Sydney sandstone areas include Brisbane Water National Park (Benson & Fallding 1981), Bouddi National Park (McRae 1990), Muogamarra Nature Reserve (Thomas & Benson 1985b), Ku-ring-gai Chase National Park (Thomas & Benson 1985a, Outhred et al. 1985, Rose 1982), Berowra Valley Bushland Park (Smith & Smith 1990), Pennant Hills Park (Beecroft–Cheltenham Civic Trust 1976), Lane Cove River State Recreation Area (Clarke & Benson 1987), Garigal National Park (McDougall & Conroy 1988–90, Sheringham & Sanders 1993) and Angophora Reserve and Hudson Park (Smith & Smith 1993). Brief reports and species lists are available for some of the islands of Broken Bay — Lion Island (Benson 1981, McDougall 1989), Spectacle Island (Webb 1981), Milson Island (Cleland 1914), Bar Island (Benson 1984) and Big Bay Island (Benson et al. 1989). Many of these lists have been included in Table 3.

Vegetation descriptions and/or species lists have been compiled for many other areas including the

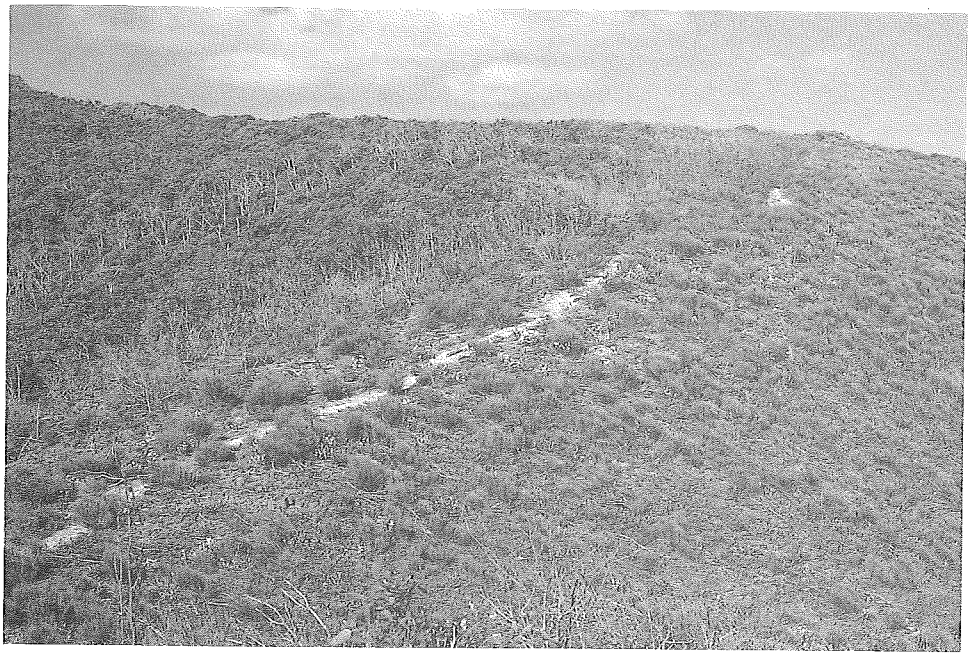


Figure 12. Coastal heath with *Allocasuarina distyla* at Bouddi National Park, map unit 21a(i), grades into woodland where there is shelter from onshore winds.

following ('V' indicates vegetation description included, 'F' indicates floristic list, 'M' indicates map): Elouera Bushland Reserve, Coveny (h) F, Benson (1980b) V; Katandra Sanctuary, Mona Vale, Coveny (l) F; Cheltenham, Coveny (b) F; Deep Creek, Narrabeen, McKern (1962) F, Coveny (f) F, Benson (1979a) V; Dee Why Lagoon, Coveny (g) F; Cumberland State Forest, Coveny (d) F; Lake Parramatta Reserve, Workers' Education Association Plant Ecology Group (1959) F, Coveny (m) F; Mowbray Park, Buchanan (1979a) VFM; Bantry Bay, Upper Middle Harbour Conservation Committee (1974) VFM; Manly Reservoir, Coveny (o) F; Vineyard Creek, Telopea, Benson (1980c) VF; Rawson Park, Mosman, Bradley & Bradley (1966–74) F, Benson (1975) VF; Garden Island, Rodd & Benson (1977) F; Outer Domain, Maiden (1902) also in Wilson (1985); Vaucluse, Holland (1980); Wolli Creek–Undercliffe–Bexley North, Benson (1978b) VF; Robinson (1986, 1987); Long Bay, Benson 1978a VF; Glebe Gully, Randwick, Coveny (j) F; La Perouse, Armstrong et al. (1976) VF.

Map unit 21a

Coastal Clay Heath

Coastal Clay Heath vegetation occurs on coastal headlands on shales and sandstones of the Narrabeen Group, mostly interbedded laminite and shale with quartz to lithic quartz sandstone. These are found along the coastline in Bouddi National Park (McRae 1990) and along the Warringah Peninsula between Long Reef and Barrenjoey. Further north Coastal Clay Heath is found at Norah Head and from Munmorah State Recreation Area to Catherine Hill Bay (Benson 1986a, Adam, Stricker et al. 1989). Vegetation here is low and scrubby, both because of the low nutrient status of its soils, and because it is exposed to winds from the ocean which restrict tree growth. Soils are variable, with lithosols, siliceous sands and yellow podzolics on the sandstone, and brown and red podzolics on the shale strata (Chapman & Murphy 1989). Heath vegetation occurs on the more sandy soils, while those with more clay tend to support grassy vegetation.

i) Open-heath: *Allocasuarina distyla*

Heath vegetation at Bouddi may range from open-heath to closed-heath 1.5m high and with up to 95% canopy cover depending on time since fire (McRae 1990). Similar vegetation occurs on Barrenjoey Head. The most characteristic canopy species is *Allocasuarina distyla*; other heath species include *Hakea teretifolia*, *Banksia ericifolia*,

Lasiopetalum ferrugineum and *Platysace linearifolia*. The ground stratum is poorly developed, including *Lomandra longifolia*, or absent. Fire kills the *Allocasuarina*, which relies on seed for reestablishment, and for a number of years its seedlings cannot attain dominance over those of other species or over species relying on lignotubers for regrowth. During this phase the local species richness is increased and abundant species include *Hakea teretifolia, Banksia ericifolia, Isopogon anemonifolius, Isopogon anethifolius, Woollsia pungens, Actinotus helianthi, Cyathochaeta diandra* and *Themeda australis* (McRae 1990).

Allocasuarina distyla open-heath appears to be part of the *Banksia serrata–Allocasuarina distyla* community of Adam, Stricker et al.(1989) who comment that in overall diversity and species composition, stands on Hawkesbury Sandstone in the Sydney region and on Permian sandstone around Jervis Bay are very similar. It is also similar to their *Banksia ericifolia–Westringia fruticosa* community.

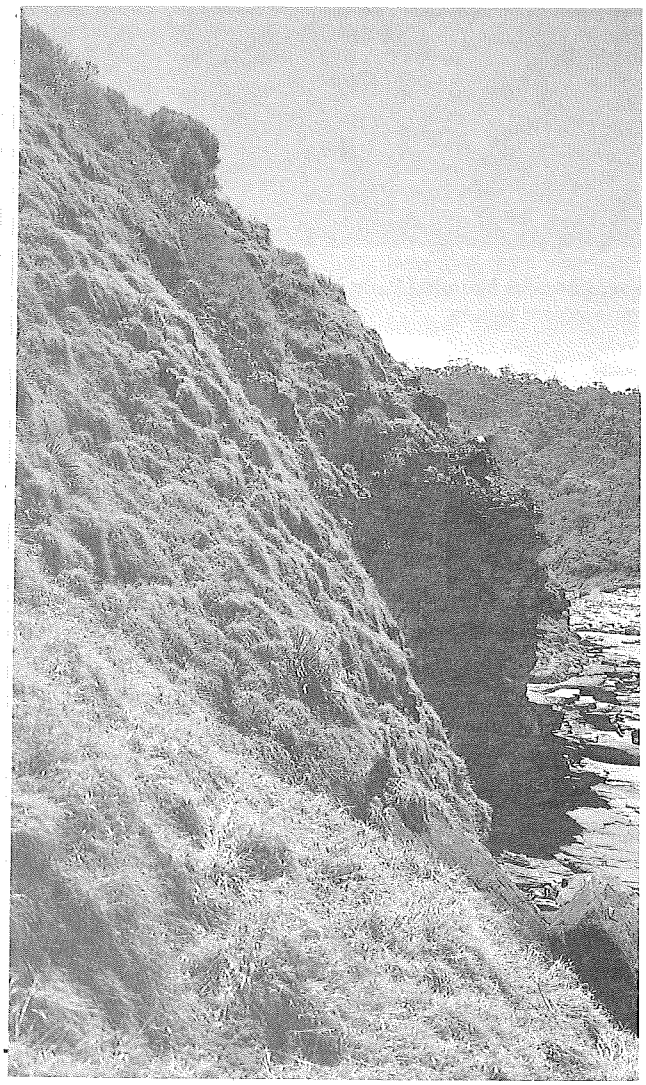


Figure 13. Grassland with *Themeda australis*, map unit 21a(ii), is characteristic of exposed coastal headlands of the Narrabeen Group shales and sandstone.

ii) Grassland: *Themeda australis*

Grassland dominated by *Themeda australis* occurs on exposed sites below coastal cliffs at Bouddi (McRae 1990) and on the Warringah Peninsula. It varies in height from 0.1 to 1 m with about 70% cover. *Themeda australis* is the main species, but there may also be a mixture of severely windswept shrubs such as *Westringia fruticosa, Banksia integrifolia* and *Baeckea imbricata*, smaller plants such as *Isolepis nodosus, Apium prostratum* and *Carpobrotus glaucescens* and the ferns, *Gleichenia rupestris* and the introduced *Cyrtomium falcatum*. *Themeda australis* grassland generally occurs on the most fertile headland soils possibly reflecting the long history of use and disturbance to which such sites have been subject (Adam, Stricker et al. 1989).

Map Unit 21b
Coastal Dune Heath

Coastal Dune Heath is found sporadically along the New South Wales coast. Major occurrences include Myall Lakes (Myerscough & Carolin 1986). On the Sydney map sheet Coastal Dune Heath is found on Mourawaring and Bombi Moors in Bouddi National Park (McRae 1990), at North Head, and in the Eastern Suburbs of Sydney. *Banksia aemula* open-heath is found on disjunct patches of highly leached, perched Pleistocene dune sand. The other community occurs on 'marine' sands of Holocene age. Coastal Dune Heath vegetation is often found associated with low woodland of *Angophora costata* and *Eucalyptus botryoides* on the sheltered slopes of steeper dunes (see Map unit 9t Coastal Dune Forest).

i. Open-heath: *Banksia aemula*

Banksia aemula open-heath is found on disjunct patches of highly leached, perched Pleistocene dune sand, on the Bombi and Mourawaring Moors in Bouddi National Park, on North Head and at La Perouse. Such sites are normally away from the immediate coastal environment and receive little salt-spray, but are on very low nutrient-status soils. This vegetation is discussed by Siddiqi et al. (1972) at Bouddi as dry *Banksia serratifolia* [=*aemula*] heath and by Adam, Stricker et al. (1989) as the *Banksia aemula–Hypolaena fastigiata* community.

At Bouddi, the shrub layer is up to 1.5 m high, with 20% canopy cover, and often merges with the low ground stratum, with 80% cover, dominated by graminoids (McRae 1990). The dominant shrub is *Banksia aemula* and common shrubs include *Allocasuarina distyla*, *Lambertia formosa*, *Platysace linearifolia*, *Isopogon anemonifolius*, *Persoonia lanceolata*, *Leptospermum polygalifolium* and low-growing *Eucalyptus umbra* and *Angophora costata*. Common understorey species include *Hypolaena fastigiata, Bossiaea ensata*, *Woollsia pungens* and *Lepidosperma* species. On the edges of the dunes a low open-woodland, 3 to 8 m high, dominated by *Angophora costata*, *Eucalyptus umbra* and *Allocasuarina distyla*, develops.

Pleistocene sand at North Head occupies the central part of the plateau but has been largely cleared of vegetation by the Army. A fringe of vegetation remains, some of which is in Sydney Harbour National Park. Most of this has been protected from fire for at least 30 years and now forms a dense scrub 8 m high dominated by the taller-growing *Leptospermum laevigatum* (Horton 1986). There are smaller shrubs of *Banksia aemula*, *Kunzea ambigua* and *Leptospermum*, many of which are now senescent or dying. Invasion of heathland by *Leptospermum laevigatum* in the absence of fire has been reported by Burrell (1981). An interesting aspect of the vegetation at North Head is the deterioration and death of individuals of the species *Eucalyptus camfieldii*, evidently in response to the lack of fire.

Small remnants of *Banksia aemula* open-heath, described as part of the Eastern Suburbs Banksia Scrub (Benson & Howell 1990a) occur at La Perouse, near Jennifer Street. This is the southern limit of distribution of *Banksia aemula* open-heath.

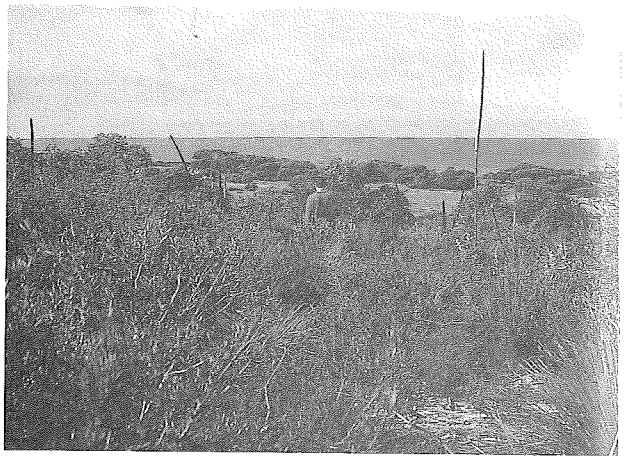


Figure 14. A small patch of the Eastern Suburbs Banksia Scrub, map unit 21b(i), survives at Jennifer St, La Perouse. The tall flowering spikes of *Xanthorrhoea resinosa* are conspicuous, particularly after fire.

Common shrub species here are *Banksia aemula*, *Monotoca elliptica*, *Eriostemon australasius*, *Ricinocarpos pinifolius* and *Xanthorrhoea resinosa*. There are many other species here and protection of the area is an important ongoing conservation issue. It has been burned frequently.

ii. Open-scrub: *Monotoca elliptica–Banksia integrifolia–Leptospermum laevigatum*

This occurs on 'marine' sands of Holocene age and occasionally on in situ weathering of Hawkesbury Sandstone. Floristically not very diverse, *Monotoca elliptica* is the only constant (Adam, Stricker et al. 1989), but *Banksia integrifolia*, *Leptospermum laevigatum*, *Melaleuca armillaris*, *Pimelea linifolia* and *Acacia sophorae* are widespread. The shrub layer is frequently wind-pruned, but in sheltered locations *Monotoca elliptica* and *Leptospermum laevigatum* may be 3–4 m tall.

Map Unit 21g
Coastal Sandstone Heath

James Atkinson provided this excellent description of coastal heath in 1826. 'The barren scrubs almost every where border the sea coast, and extend to various distances inland; in some places two or three miles; in others, lands of a better description approach close to the water's edge. The soil in these scrubs is either sandstone rock or sterile sand or gravel, covered, however, with a

Figure 15. Coastal scrub with *Banksia integrifolia*, map unit 21b(ii), near Pearl Beach on the northern side of Broken Bay.

profusion of beautiful shrubs and bushes, producing the most elegant flowers, and affording a constant succession throughout the whole year, but most abundant in winter and spring; the shrubs and plants growing in these places furnish the Colonists with materials for brooms, but produce little else that can be converted to any useful purpose. – The grass tree, with its lofty flower stalk, is a conspicuous object in these wastes; of the hard and woody but light stalk of this plant the natives make the shaft of their spears, and shooting or fish gigs. Very few trees grow in these places, except a few stinted (sic) gum trees, in situations sheltered from the sea winds. Much honey might probably be collected from these scrubs, were bees plentiful in the Colony, and some small profit may possibly be thus made of them hereafter; but with this exception, they scarcely seem susceptible of any improvement'.

Coastal Sandstone Heath is found on Hawkesbury Sandstone headlands along the coast from Long Reef to La Perouse, and on nearby sandstone plateaus and ridges, particularly in the Deep Creek catchment and the Lambert Peninsula in Ku-ring-gai Chase National Park. Habitats include broad ridges, gently to moderately inclined slopes, wide rock benches with low broken scarps, small hanging valleys and areas of poor drainage. Soils are shallow, discontinuous earthy sands and yellow earths, siliceous sands, lithosols, leached sands, grey earths and gleyed podzolics (Lambert and Hawkesbury Soil Landscapes of Chapman & Murphy 1989).

Vegetation structure is variable, ranging through open-heath, shrubland, mallee, and sedgeland. Structure is influenced by fire frequency and the time since the last fire. Particularly important are the large, relatively quick-growing, but fire-sensitive (i.e. killed by fire) species (e.g. *Banksia ericifolia*, *Hakea teretifolia*, *Allocasuarina distyla*, *Petrophile pulchella*) that may readily predominate in a range of habitats under particular fire regimes. The interaction between these species and the generally slower-growing, more long-lived resprouter species (e.g. *Banksia oblongifolia*, *Angophora hispida*, *Lambertia formosa*) is an important consequence of the particular fire regimes in an area, with subsequent effects on vegetation structure and floristics. This is a potential area for future research. The other major factor in heath composition is soil moisture, and different communities are recognisable across the full range of drainage conditions.

Broad communities are recognised here, but there is considerable overlap and variation depending

on the scale of the study. Small areas of this vegetation have also been mapped in unit 10ar.

i) Shoreline shrubland

Shrubland: *Baeckea imbricata*

On coastal sandstone headlands low shrubland of *Baeckea imbricata* frequently provides the most seaward zone of continuous vegetation. It is rarely more than 20 m wide, though *Baeckea* can be found as a component of communities considerably further inland (Adam, Stricker et al. 1989). The low-growing shrub, *Baeckea imbricata*, predominates in this community — *Westringia fruticosa* is frequent, but not abundant. High inputs of salt-spray are experienced and saltmarsh species occur — *Sporobolus virginicus*, *Samolus repens*, *Zoysia macrantha*. At more inland localities *Baeckea imbricata* dominates communities in wet hollows, where the community is a form of wet heath. Associated species include *Epacris obtusifolia*, *Callistemon citrinus* and *Sprengelia incarnata*. Good examples occur at North Head (Horton 1986), Long Bay and La Perouse. A detailed account of seacliff and headland vegetation is given in Adam, Stricker et al. (1989).

ii) Coastal heath

Open-heath/closed-scrub: *Banksia ericifolia–Darwinia fascicularis*

On the landward side of the *Baeckea* low shrubland, Adam, Stricker et al. (1989) describe a *Banksia ericifolia–Westringia fruticosa* community and then a more extensive (up to 1 km inland) *Banksia ericifolia–Darwinia fascicularis* closed-heath community. Frequent species include *Allocasuarina distyla*, *Hakea teretifolia*, *Melaleuca nodosa*, *Dillwynia floribunda*, *Lasiopetalum ferrugineum*, *Baeckea imbricata*, *Leucopogon microphyllus*, *Lepidosperma viscidum*, *Eriostemon buxifolius* and *Epacris microphyila*. Drainage is an important factor in determining the presence of particular species, Clemens and Franklin (1980) recognising differences in heath vegetation on North Head related to soil depth and drainage.

Banksia ericifolia–Darwinia fascicularis closed-heath occurs extensively at North Head (Clemens & Franklin 1980, Horton 1986), Long Bay and La Perouse, and is widespread on Hawkesbury Sandstone on the Central Coast of NSW as well as on soils from Permian Sandstone near Jervis Bay.

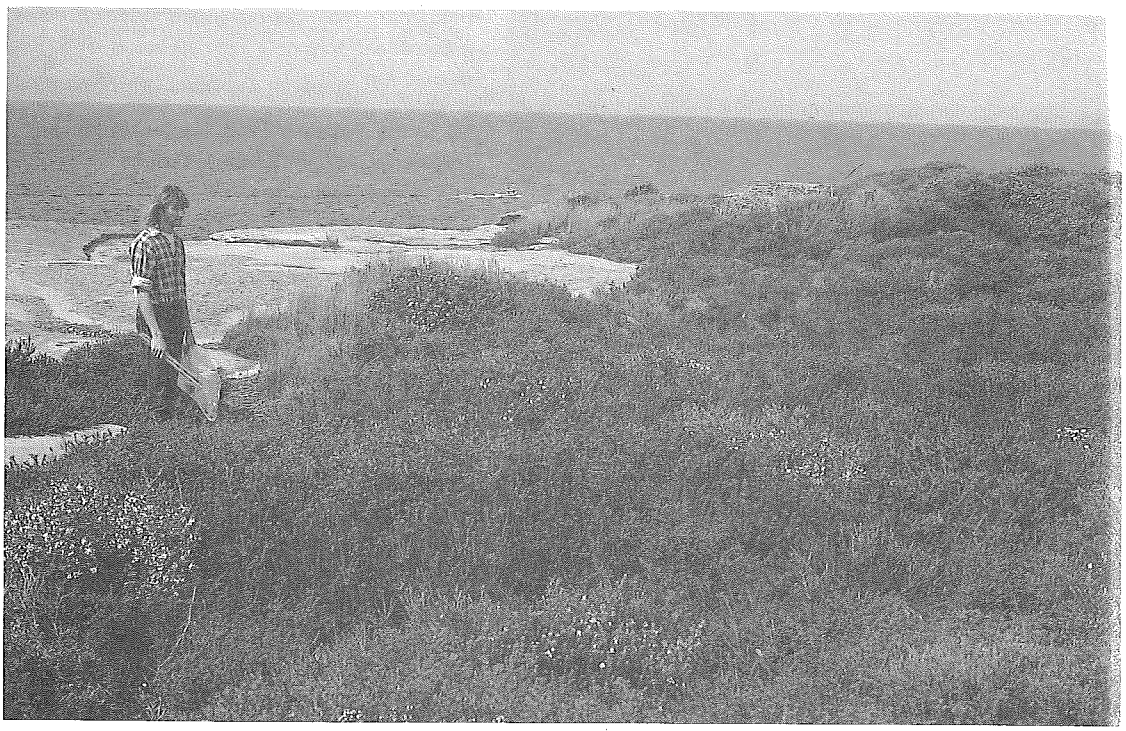


Figure 16. Coastal heath on sandstone rock platforms at Long Bay (map unit 21g(ii)).

iii) Open-heath/closed scrub: *Allocasuarina distyla–Banksia ericifolia*

This is similar to the previous community but occurs away from the immediate coastal influence and is widespread in Brisbane Water, Ku-ring-gai Chase and Garigal National Parks. It ranges from closed-scrub up to 4 m high to open-heath, with species such as *Banksia ericifolia*, *Allocasuarina distyla*, *Leptospermum trinervium*, *Phebalium squamulosum*, *Phyllota phylicoides*, *Angophora hispida* and *Pultenaea elliptica*.

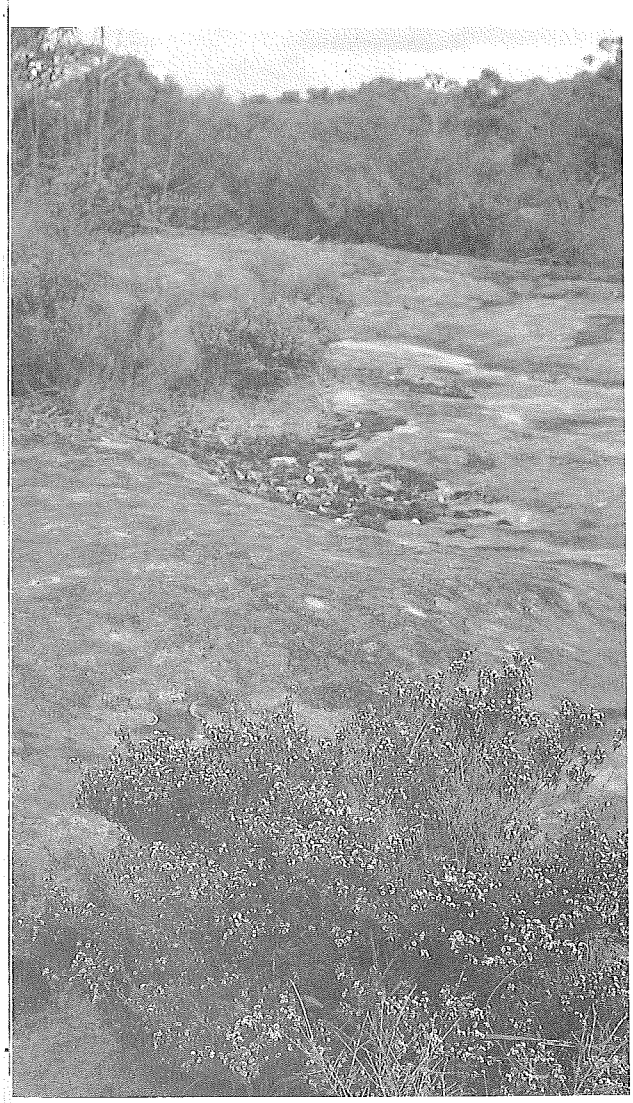


Figure 17. Extensive rocky outcrops with pockets of heath, map unit 21g(iv), occur in Brisbane Water National Park.

iv) Rocky outcrop heath

Open-heath: *Baeckea diosmifolia–Baeckea brevifolia*

Vegetation with a dense shrub cover to 1.5 m high among scattered, stunted emergent trees, occurs on broad, flat sandstone ridges with extensive rock outcrops, sometimes with occasional dense bonsai-like mats of *Baeckea* species (Sheringham & Sanders 1993). Shrubs include *Baeckea diosmifolia*, *Baeckea brevifolia*, *Allocasuarina distyla*, *Darwinia fascicularis*, *Kunzea capitata* and *Dillwynia sericea*. Such vegetation occurs commonly in Brisbane Water, Ku-ring-gai Chase and Garigal National Parks and in smaller parks in the Warringah area, for example at Bantry Bay (Upper Middle Harbour Conservation Committee 1974), and Manly-Warringah War Memorial Park (Benson 1981b).

v) Wet heath

Closed heath: *Hakea teretifolia–Banksia oblongifolia*

Closed-heath to 2 m high dominated by shrubs including *Banksia oblongifolia*, *Banksia ericifolia*, *Hakea teretifolia*, *Dillwynia floribunda*, *Epacris obtusifolia*, *Leptospermum squarrosum*, *Baeckea imbricata* and *Sprengelia incarnata* occurs on poorly-drained sandstone.

vi) Sedgeland/shrubland: *Banksia robur–Viminaria juncea–Gymnoschoenus sphaerocephalus*

Swamps form where drainage is permanently impeded. In the wettest areas these may be sedge swamps dominated by species of Cyperaceae and Restionaceae, or in drier sites, shrub swamps (Pidgeon 1938). Buchanan (1980) describes four distinct but intergrading swamp types for the Lambert Peninsula in Ku-ring-gai Chase National Park. Keith and Myerscough (1993) provide an excellent study of similar swamp vegetation on the Woronora Plateau.

vii) Open-scrub: *Angophora hispida*

Small patches of open-scrub with *Angophora hispida* occur in Marramarra National Park, either on ridges or associated with rock platforms. Characteristic species of these sites include *Calytrix tetragona*, *Dillwynia floribunda*, *Grevillea buxifolia*, *Petrophile pulchella* and *Platysace*

ericoides. This vegetation probably represents a low-rainfall variant (annual rainfall about 800 mm) of the more coastal sandstone heaths (annual rainfall 1000–1200 mm). Heath is rare in low rainfall sandstone areas where it is replaced by woodland, indicating the importance of high moisture and poor drainage in preventing tree growth in heath areas.

viii) Shrubland (mallee): *Eucalyptus luehmanniana*

Small localised occurrences of *Eucalyptus luehmanniana* mallee shrubland or woodland occur in Garigal and Ku-ring-gai National Parks. These occur on sheltered upper to mid slopes on south-westerly to south-easterly aspects where drainage is poor and often associated with patches of wet heath (Sheringham & Sanders 1993).

Map Unit 27a
Coastal Swamp Forest Complex

i) Open-forest: *Eucalyptus botryoides–Eucalyptus robusta*

This occurs on poorly-drained sites in the Pittwater area, such as the Warriewood wetlands, but has been extensively disturbed, and very little remains.

ii) Open-forest: *Livistona australis*

Localised patches of *Livistona australis*, Cabbage Palm, occur in open-forest along the Warringah Peninsula from Palm Beach to Avalon, and along sections of Deep and Middle Creeks, particularly near Wakehurst Parkway. It also formerly occurred along the southern foreshores of Port Jackson in Sydney's eastern suburbs between Woolloomooloo and Rose Bay, but no naturally occurring palms are known to survive there now.

iii) Scrub: *Melaleuca linariifolia–Melaleuca styphelioides*

Paperbark swamp 5–18 m high with mid-dense to sparse cover of trees of *Melaleuca linariifolia* and *Melaleuca styphelioides*, small trees of *Callicoma serratifolia* and *Acacia longifolia* and sedges and ferns, *Gahnia clarkei*, *Gahnia sieberiana* and *Blechnum camfieldii* are found on floodplain alluvium along Deep Creek on better-drained areas surrounding herbland (Sheringham & Sanders 1993).

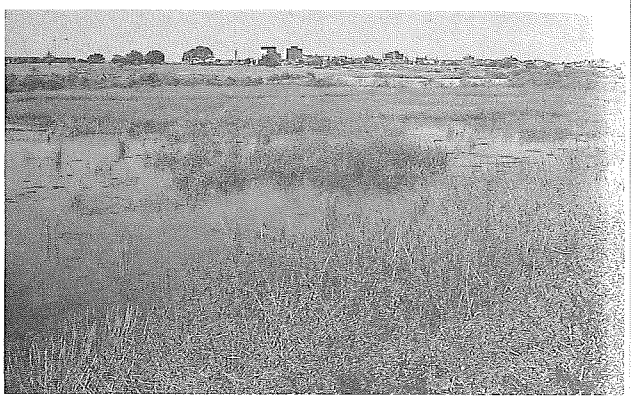


Figure 18. Remnants of the Botany Swamps at Eastlakes, map unit 28c(i) — sedgeland and open water provide important habitat for waterbirds and other wildlife.

iv) Reedland: *Phragmites australis–Typha orientalis*

Patches of reedland up to 3 m high, dominated by mainly *Phragmites australis* or *Typha orientalis*, grow on alluvial soils in estuaries and creeks in areas inundated with water for long periods and often brackish.

v) Herbland: *Persicaria strigosa–Blechnum camfieldii–Triglochin procera–Baumea juncea*

Waterlogged soil on alluvial floodplain of Deep and Middle Creeks has dense cover of herbs and sedges up to 2 m high. Ground species include *Persicaria strigosa*, *Blechnum camfieldii*, *Triglochin procera*, *Baumea juncea*, *Hypolepis muelleri*, *Viola hederacea*, *Isachne globosa* and *Villarsia exaltata*. Emergent shrubs include *Melaleuca styphelioides*, *Melaleuca linariifolia*, *Acacia longifolia* and *Leptospermum juniperinum* (Sheringham & Sanders 1993).

Map Unit 28c
Coastal Freshwater Swamp

This unit occurs in coastal freshwater swamp habitats, most of which have now been reclaimed, dammed or badly disturbed. They were particularly abundant on the sand deposits of the Eastern Suburbs (see Benson & Howell 1990a), with smaller swamps in the Woy Woy–Umina area. The main surviving examples are the Lachlan Swamp in Centennial Park and the Botany Swamps at Eastlakes and Botany.

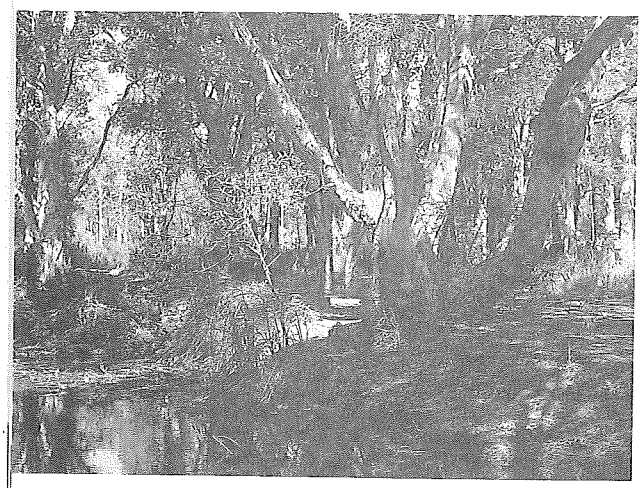


Figure 19. Old paperbarks, *Melaleuca quinquenervia*, with a ferny understorey in the Lachlan Swamp Reserve in Centennial Park (map unit 28c(ii)).

i) Open-sedgeland: *Eleocharis sphacelata–Baumea juncea–Persicaria decipiens*

Damming of the Botany Swamps last century provided one of Sydney's water supplies. Today there are lakes with open water and patches of tall emergent sedges, particularly *Eleocharis sphacelata*.

Areas of native vegetation are in the Millstream section of the Botany Swamps adjacent to Wentworth Avenue. Here, with patches of low woodland of *Melaleuca quinquenervia*, is sedgeland with Baumea articulata, *Baumea rubiginosa, Baumea juncea* and *Gahnia sieberiana*. There are also herbaceous species *Persicaria decipiens, Persicaria strigosa, Philydrum lanuginosum* and *Ludwigia peploides* subsp. *montevidensis*, and shrubs of *Leptospermum juniperinum, Callistemon citrinus* and *Viminaria juncea*. Unfortunately, as a result of disturbance, there is a considerable amount of exotic weed, in particular the shrub *Ludwigia peruviana*. The Water Board is taking steps to alleviate this problem and to rehabilitate the Wetlands.

ii) Low forest: *Melaleuca quinquenervia*

At the Lachlan Swamp Reserve in Centennial Park is a dense forest of *Melaleuca quinquenervia* with fern-banks of *Gleichenia dicarpa* and *Hypolepis muelleri*, and *Gahnia sieberiana*, still much the same as when described by Hamilton in 1919. 'These ferns [*Gleichenia dicarpa* and *Hypolepis muelleri*] may be observed engaged in such a competition in a peaty swamp in Centennial Park'. Extensive *Melaleuca* forest also occurred across the peaty flats behind Rose Bay (Hamilton 1919), whereas only a few individual trees survive today.

Major conservation areas

The rugged and inhospitable nature of the sandstone environments restrict development. As a result, many areas of natural vegetation remain, giving bushland surroundings to many Sydney suburbs. The importance of this urban bushland is now appreciated and a body of knowledge concerned with its management and protection is being developed by the various land management organisations together with input from research and teaching institutions and community groups.

A brief description of the vegetation of the major national parks and other conservation areas is given below. Plant species lists for most of these areas are compiled in Table 4, but it should be noted that the information available for different areas varies considerably. Many of the smaller urban bushland areas are described in Benson and Howell (1990a).

Angophora Reserve and Hudson Park

This is a reserve of about 18 ha at Avalon on Hawkesbury Sandstone capping and underlying Narrabeen Group (Newport Formation) interbedded shales and sand-

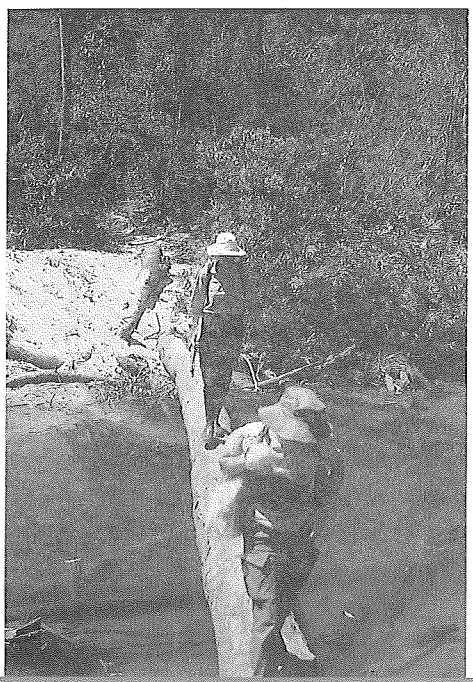
stones. Vegetation is *Angophora costata–Eucalyptus gummifera* woodland (about 8 ha), with a small area of fern swamp, *Gleichenia dicarpa* and sedge swamp, with *Lepyrodia scariosa* and *Epacris microphylla* on the Hawkesbury Sandstone; *Eucalyptus maculata* open-forest (about 8 ha) and a small area (about 0.5 ha) of *Livistona australis* palm stands on the Narrabeen Group soils (Smith & Smith 1993). A total of 293 vascular plant species have been recorded (227 native and 66 exotic), and the reserve includes the only known site around Sydney for the rare *Arthrochilus prolixus* (Smith & Smith 1993).

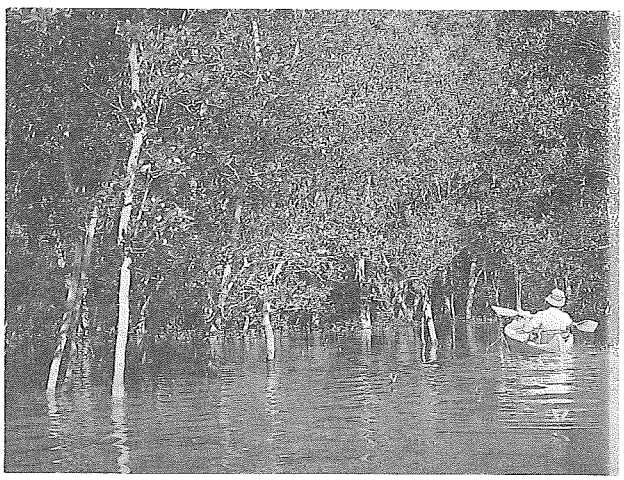
Barrenjoey Head

Barrenjoey Head at the southern entrance to Broken Bay is an isolated headland with a capping of Hawkesbury Sandstone overlying Narrabeen Group shales and sandstones. It is connected to the mainland by the thin strip of sand of Palm Beach. Woodland with *Eucalyptus botryoides* and *Banksia integrifolia* covers at least half of the headland extending from shore to ridgetop, particularly on the western half. Shrubs commonly found in the woodland understorey are *Pultenaea ferruginea* var. *deanei*, *Pultenaea daphnoides*, *Oxylobium ilicifolium* and *Jacksonia scoparia*.

Pockets of rainforest with *Acmena smithii* occur on shale soils in sheltered southerly aspects. Other species include *Backhousia myrtifolia*, *Syzigium oleosum*, *Pararchidendron pruinosum*, *Rhodomyrtus psidioides* (southern limit), *Diospyros australis*, *Guioa semiglauca*, *Cassine australis* var. *australis* and *Marsdenia rostrata*. *Tristaniopsis collina* is frequent in sheltered places and in the woodland, with occasional occurrences in heathland sheltered by large sandstone outcrops.

Allocasuarina distyla heathland occurs on clay soils on the upper parts of the headland and on the eastern end where it is more stunted. Common shrubs include *Hakea gibbosa*, *Acacia myrtifolia*, *Banksia ericifolia*, *Leptospermum trinervium*, *Lasiopetalum*





Figures 20 & 21. Conservation reserves have various forms of access that allow visitors to explore and experience the Sydney bush.

macrophyllum, *Isopogon anethifolius* and *Kunzea ambigua*. The small shrub *Mirbelia rubiifolia* and the sedge *Schoenus melanostachys* are very common in the lower stratum. *Leptospermum laevigatum* shrubland occurs on the lower southern slopes.

Berowra Valley Bushland Park

Berowra Valley Bushland Park (3880 ha in area) includes bushland along Berowra Creek and its tributaries from Pennant Hills to Berowra Waters. It was established as a reserve in its present form in 1987, but the southern part (640 ha south of Hornsby Rifle Range) has been a reserve, Elouera Bushland Natural Park, since 1964. The Park is administered by Hornsby Shire Council.

Smith and Smith (1990) carried out a detailed survey of the Park. They distinguished 17 plant communities; forest, woodland, heath and swamp communities associated with the dominant Hawkesbury Sandstone geology; taller eucalypt and low rainforest associated with more fertile soils; and eucalypt, *Casuarina*, mangrove and saltmarsh communities associated with the wider, tidal reaches of Berowra Creek. Several communities in the Park are poorly represented in other reserves. Especially important are taller forest communities characterised by *Eucalyptus saligna* and *Eucalyptus pilularis*.

Berowra Valley Bushland Park has a very rich flora, as is typical of vegetation on Hawkesbury Sandstone. A total of 517 native vascular plant species have been recorded. Ten of these species are on the national list of rare and threatened plants, including three species classified as vulnerable: *Eucalyptus camfieldii*, *Darwinia biflora* and *Tetratheca glandulosa*. Another four rare or threatened species have been recorded nearby and may also occur in the Park.

Bicentennial Park/Homebush Bay

Originally, Homebush Bay had the largest expanse of estuarine vegetation in Sydney Harbour, but this has been gradually reduced by extensive landfill projects beginning in the 1890s (Kachka 1993, Clarke & Benson 1988). Mangrove and some other wetland vegetation has been protected in Bicentennial Park, where boardwalks and an active environmental awareness program make these areas accessible. However, more important and undisturbed wetlands with extensive areas of saltmarsh, including populations of *Wilsonia backhousei*, *Halosarcia pergranulata* var. *pergranulata* and *Lampranthus tegens*, together with remnant Turpentine–Ironbark Forest (Map unit 9o) survive on military land at Silverwater. These areas are important because they have been protected from human disturbance — reports indicate a particularly high and abundant reptile fauna in the woodland — and should be maintained as limited access areas.

Botany Bay National Park (Cape Banks)

Vegetation at Cape Banks, Henry Head and La Perouse is part of Botany Bay National Park. Vegetation is mainly heath and open-forest on Hawkesbury sandstone,

Figure 22. Mangroves, *Avicennia marina*, and saltmarsh, *Sarcocornia quinqueflora*, along Haslems Creek in Homebush Bay (map unit 4a). It is hoped that these will be retained during the development of the Olympic Games site.

and open-scrub of *Banksia integrifolia* on beach sand (Armstrong, Benson & Coveny 1976). The area is rich in native species, though the exotic weed, *Chrysanthemoides monilifera*, originally introduced to stabilise sand dunes, is a major problem in some areas. A small remnant of Pleistocene sand at Jennifer Street, La Perouse has *Banksia aemula* heath as well as important associated wetland vegetation, and has been recommended for conservation.

Bouddi National Park

Bouddi National Park is situated on the northern headland of Broken Bay, 45 km north of Sydney. Its vegetation has been described and mapped by McRae (1990), who described 15 plant communities related to habitat elements such as geology, geomorphology, climate and soil. The main components of the geology are Hawkesbury Sandstone and Narrabeen Series and the Park is important for the extensive areas of coastal vegetation on the latter. These include coastal grassland, heath and woodland and palm-dominated open-forest. A good account of the landscape, natural history and landuse is given in Strom (1986).

Brisbane Water National Park

The vegetation of Brisbane Water National Park has been described and mapped by Benson, J.S. and Fallding (1981). They described 15 plant communities; low open-forest, low open-woodland and open-woodland with dry or moist shrub understorey

Figure 23. The effect of different drainage conditions can be seen here in Brisbane Water National Park — sedgeland on shallow poorly-drained soil in the foreground contrasts with woodland on better-drained soil.

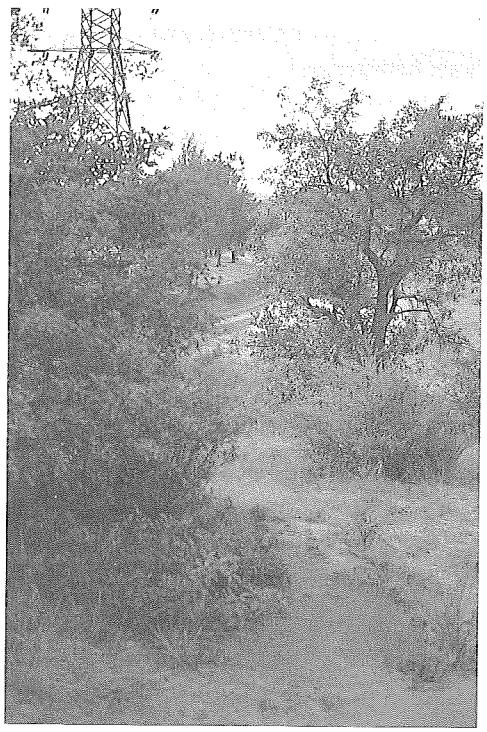


Figure 24. There is a small remnant of Turpentine Ironbark Forest on the clay soil above Cooks River at Campsie — a rare survivor of native vegetation along the River.

on the ridges and slopes of Hawkesbury Sandstone; open-forest on cooler aspects and on Narrabeen Group outcrops along the watercourses; sedgelands and open-scrub in higher, poorly-drained sites; coastal heath and rock outcrops with pockets of heath; closed-forest with rainforest species in valleys or along creeks, mainly on the Narrabeen group; and mangroves and rushland along tidal watercourses. A total of 657 native and exotic plant species were recorded. This includes ten considered to be rare or at risk.

Cooks River–Wolli Creek Valley

Though not primarily conserved as a nature reserve, remnants of native vegetation in Cooks River–Wolli Creek are the only remaining natural areas in inner south-western Sydney and need careful management. Cooks River includes very small localised patches of mangroves and reedland of *Phragmites australis*, and remnants of Turpentine–Ironbark Forest at Campsie (Benson 1992b) (see also Map unit 9o description). Vegetation at Wolli Creek includes eucalypt forest and heath on Hawkesbury Sandstone, freshwater marsh, saltmarsh and mangroves (Benson 1978b, Robinson 1986, 1987, Brown et al. 1988).

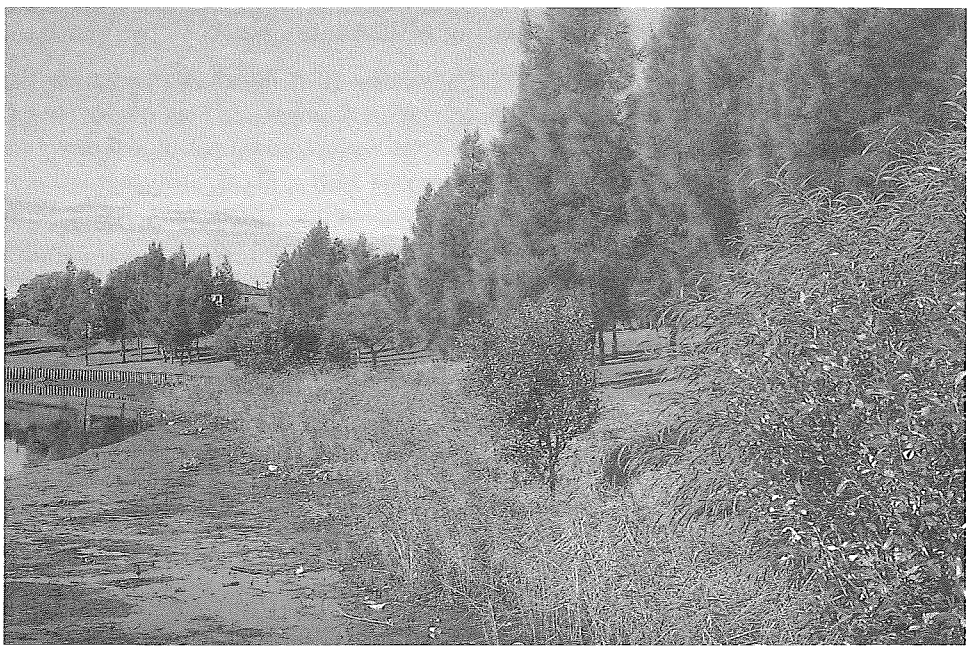


Figure 25. The Cooks River is mainly confined to a concrete or iron-lined channel, but here at Canterbury native reeds *Phragmites australis* grow on the bank. The rehabilitation of other bank sections using native species and the development of semi-natural vegetation with adjacent tree and shrub planting will provide much-needed wildlife habitat along the River and improve its appearance.

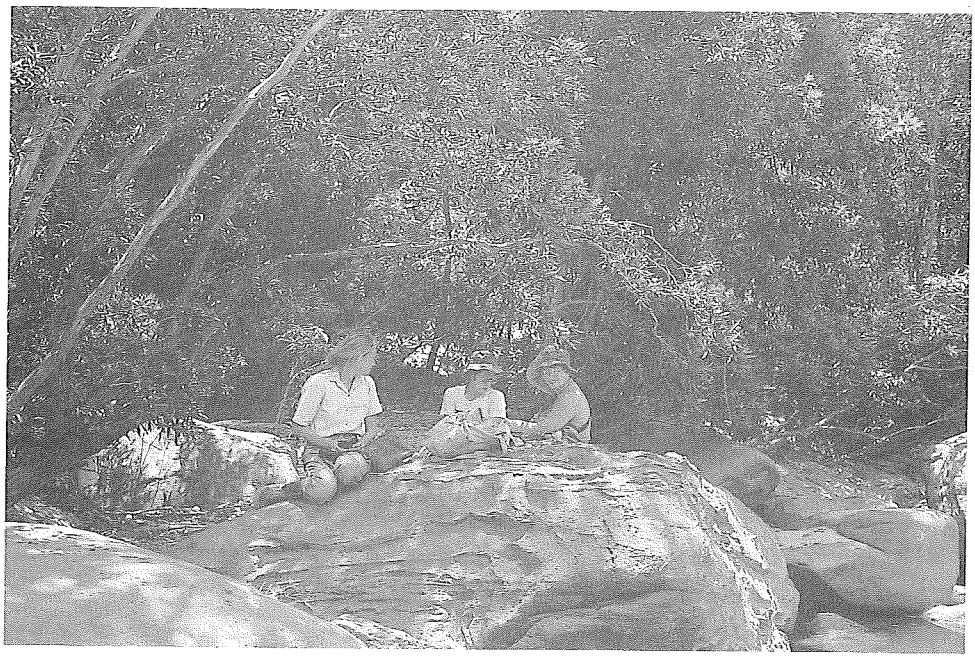


Figure 26. Creeks in sandstone gullies such as this in Garigal National Park provide sheltered and pleasant conditions. *Tristaniopsis laurina* is a frequent streamside species.

Cumberland and Darling Mills State Forests

These two forest areas together with the adjoining IBM Forest, demonstrate the influence of soil and geological changes on vegetation. Cumberland State Forest (40 ha) at West Pennant Hills has Wianamatta Shale soils with remnants of Blue Gum High Forest (Map unit 6b). Tree species include *Eucalyptus saligna, Eucalyptus paniculata, Eucalyptus tereticornis, Eucalyptus acmenoides* and *Angophora floribunda.* Darling Mills State Forest (50 ha) at North Rocks, 2 km further south and adjacent to Excelsior Park is dominated by massive outcrops of Hawkesbury Sandstone forming significant cliff faces, rock ledges and overhangs with a succession of sandstone terraces and escarpments. Vegetation here includes dry woodland of *Angophora bakeri* and *Eucalyptus gummifera* with shrubs of *Acacia linifolia, Leptospermum polygalifolium, Banksia serrata* and *Hakea sericea* as well as heath. Moist forest with *Eucalyptus pilularis–Eucalyptus saligna* and *Eucalyptus pilularis–Angophora costata–Eucalyptus piperita* is restricted to alluvial flats and sheltered hillsides. Details of these areas are given in the Forestry Management Plan (Forestry Commission of NSW 1984).

Dalrymple–Hay Nature Reserve

The need to conserve some remnants of such an impressive plant community as the Blue Gum High Forest (Map unit 6b) was recognised as far back as the 1930s when most of the forest had already been destroyed for farming or suburbs. At that time the NSW Forestry Commission planned to subdivide part of their Dalrymple–Hay State Forest at St Ives, but as a result of local action this Forest was preserved and later transferred to the National Parks and Wildlife Service as the Dalrymple–Hay

Nature Reserve. This Reserve has an area of 11 ha of *Eucalyptus pilularis, Eucalyptus paniculata, Angophora costata* and *Syncarpia glomulifera* trees with a shrub understorey on higher ground, and *Eucalyptus saligna* with a fern understorey along the main watercourse (Benson & Keith 1984a).

Garigal National Park — Narrabeen Lagoon catchment

The vegetation of Garigal National Park (Narrabeen Lagoon catchment) (approx. 820 ha) has been recently described and mapped by Sheringham and Sanders (1993) in an excellent report for the NSW National Parks and Wildlife Service. They describe and map 21 plant communities. These include extensive areas of heathland, woodland and open-forest on Hawkesbury Sandstone (Map units 10ar, 10ag, 21g) as well as much more limited and restricted areas of forest on remnant shale sites (9sf) and freshwater and estuarine reedland herbfield, paperbark swamp and swamp forest (27a).

Sheringham and Sanders (1993) found that differences in the major geological types, alluvial–sedimentary, were the main environmental influence on vegetation distribution, but that differences between shale and sandstone were less important. For vegetation on alluvial areas the depth, period of inundation and salinity of water are the major factors influencing species composition. The types with the highest conservation significance were the freshwater wetlands and swamps along the Deep Creek floodplain, and shale and lateritic forests restricted to the ridge along Forest Way and Mona Vale Road. Many of the wetlands are outside the Park boundary and have been recommended for addition to the Park as a matter of priority.

A list of over 600 species (both native and exotic) has been compiled for the National Park (Narrabeen Lagoon catchment) and surrounding Crown lands including species of national significance — *Grevillea caleyi, Tetratheca glandulosa, Eucalyptus luehmanniana, Lomandra brevis, Lomandra fluviatilis, Platysace stephensonii, Darwinia procera, Persoonia hirsuta, Genoplesium baueri, Hibbertia nitida* and *Angophora crassifolia* (Sheringham & Sanders 1993).

Garigal National Park — Middle Harbour Creek catchment

The vegetation types represented within the Middle Harbour Creek part of Garigal National Park (former Davidson State Recreation Area) include forest, woodland, heathland, scrubland, mangrove and saltmarsh, and vegetation of creek banks containing mesic species. Vegetation of particular importance includes areas of Coastal Sandstone Heath (map unit 21g), now scarce in Sydney due to urban spread. Examples may be seen on ridgetop areas of the Park — along the Cook St trail, parallel to Wakehurst Parkway above Bantry Bay, at the end of Matthews St, Davidson, and along part of the Stone Parade track to the Cascades. There is a significant stand of the rare mallee *Eucalyptus luehmanniana* in woodland on a south aspect slope beneath The Bluff.

There are also small remnants of ridgetop vegetation on the shale–sandstone transition, with soils rich in ironstone gravels. These remnants contain relatively uncommon species such as *Boronia rigens, Baeckea ramosissima* and *Leucopogon appressus*.

Vegetation along Bare Creek and upper Middle Harbour Creek includes the nationally significant species *Lomandra fluviatilis* and what is probably the largest known population of *Leptospermum deanei*. Further down Middle Harbour Creek are *Hibbertia nitida* and *Darwinia procera*. In upper-level creek sites, with more exposure to sunlight, are relatively uncommon plants with specific habitat requirements such as *Symphionema paludosum* and *Sprengelia incarnata*.

Gullies contain locally uncommon plant species such as *Cymbidium suave, Leucopogon lanceolatus* and *Boronia thujona* on the slopes. *Dracophyllum secundum, Rimacola elliptica* and *Epacris crassifolia* are found in crevices of rocky overhangs. Closer to the creeks are *Stenocarpus salignus, Lomatia myricoides, Drosera binata, Leucopogon amplexicaulis, Lycopodium deuterodensum, Blechnum ambiguum, Austromyrtus tenuifolia,* and *Hymenophyllum cupressiforme*. The very restricted shrub *Haloragodenron lucasii* occurs on an upper slope near Barra Brui.

Mangrove and saltmarsh are found in Bantry Bay and in Middle Harbour Creek and along tributaries from Roseville Bridge, upstream.

Georges River National Park

Hawkesbury Sandstone outcrops along the foreshores of the Georges River below East Hills. Downstream from here the river has the typical 'drowned valley' appearance characteristic of Sydney Harbour and Broken Bay. Georges River National Park includes foreshores downstream from Salt Pan Creek. Natural vegetation here is mostly woodland of *Angophora costata, Eucalyptus gummifera* and *Eucalyptus punctata*. On drier slopes are *Angophora bakeri* and *Allocasuarina littoralis*, while small patches of heath with *Angophora hispida* are found on some of the gravelly ridge-tops (Benson & Howell 1990a). Salt Pan Creek has areas of mangroves and saltmarsh.

Katandra Bushland Sanctuary

Katandra Bushland Sanctuary is a small reserve (11.5 ha) at Ingleside managed by a Department of Conservation and Land Management trust. Geology is Hawkesbury Sandstone with minor shale lenses, the aspect is easterly and the vegetation is mostly open-forest with closed-forest along the major creek lines. Main tree species include *Angophora costata, Eucalyptus gummifera, Eucalyptus piperita, Eucalyptus punctata* and *Eucalyptus umbra* (Map unit 10ag). The vegetation is generally moist and sheltered and includes species that are generally uncommon in Sydney including *Eucalyptus scias*, a tall tree in this habitat, the rainforest trees *Cryptocarya glaucescens, Cryptocarya microneura* and *Endiandra sieberi*, the shrubs *Bertya brownei, Boronia mollis, Boronia thujona, Prostanthera denticulata, Eupomatia laurina, Wilkiea huegeliana, Maytenus silvestris, Oxylobium ilicifolium, Correa reflexa*, and a vine *Passiflora cinnabarina*. *Cetatopetalum apetalum* is common along the creek lines with *Trochocarpa laurina, Livistona australis*, the tree fern *Cyathea australis* and the cycad *Macrozamia communis*. The uncommon, primitive fern *Tmesipteris truncata* grows on trunks of *Todea barbara*, while *Psilotum nudum* is often found in rock crevices, and *Hymenophyllum cupressiforme* and *Grammitis billardieri* are found on damp rock surfaces. There are a large number of orchids including several species of *Acianthus, Pterostylis* and *Cryptostylis*, also *Gastrodia*

sesamoides, Chiloglottis reflexa, Corybas aconitiflorus, Dendrobium speciossisima and *Dendrobium linguiforme* on rocks, *Lyperanthus suaveolens* on damp rocks and *Cymbidium suave* in trees.

On the upper slope are sandstone woodland species including *Banksia ericifolia* and *Banksia serrata, Xanthorrhoea media, Xanthorrhoea arborea, Phebalium dentatum* and *Acacia oxycedrus*. With *Gahnia clarkei*, three species of *Gleichenia* form dense thickets in a hanging swamp.

Ku-ring-gai Chase National Park

Ku-ring-gai Chase National Park (14 709 ha) is one of the major national parks of the predominantly sandstone Hornsby Plateau north of Sydney.

The nature and distribution of the vegetation is strongly related to geology, soil, drainage and aspect. Thomas and Benson (1985a) recognised 21 plant communities. There is considerable variation within some communities and intergradation between communities is a common feature. A floristic analysis of the vegetation has been carried out by Outhred et al. (1985).

As a conservation area, Ku-ring-gai Chase National Park is particularly important for its large area of relatively undisturbed vegetation of the type that gives Sydney bushland its distinctive character. It is also important for conserving vegetation types that are significant in a regional and local context. These tend to be of limited size and are associated with unusual or remnant geological and topographical

Figure 27. Extensive areas of sandstone country with woodland, heath and forest make up Ku-ring-gai Chase and Brisbane Water National Parks — here looking from Warrah Lookout towards Patonga Beach.

features e.g. Duffys Forest vegetation (map unit 9sf) and *Eucalyptus maculata–Eucalyptus paniculata* open-forest (part of map unit 9g).

A total of 566 native species from 119 families were recorded by Thomas and Benson (1985a), though Rose (1982) recorded 975 species, both native and exotic, over a longer period. Significant species recorded in Ku-ring-gai Chase include *Lomandra brevis, Genoplesium baueri, Leucopogon amplexicaulis, Austromyrtus tenuifolia, Darwinia biflora, Darwinia procera, Eucalyptus leuhmanniana, Eucalyptus squamosa, Grevillea caleyi, Boronia fraseri, Rulingia hermannifolia, Tetratheca glandulosa, Cryptostylis hunterana, Eucalyptus camfieldii, Blechnum ambiguum* and *Kunzea rupestris* (Thomas & Benson 1985a).

Fire is an important factor affecting vegetation in many Sydney bushland areas. Many species have adaptive mechanisms that enable them to survive individual fires, but frequent fires with only short periods between them may lead to possible long-term changes to vegetation with some species being lost; fire-free periods of at least 10 years are desirable for much of the vegetation to allow replenishment of plant seedbanks etc. (Thomas & Benson 1985a, Benson 1985).

As for other 'urban' national parks, weed invasion in Ku-ring-gai Chase is a serious problem, and is associated with run-off from urban development, areas of past habitation within the Park, tracks, watercourses, border areas, specific areas of high public usage and some small areas of undisturbed bushland.

The map showing the vegetation of Ku-ring-gai Chase National Park and the adjacent Muogamarra Nature Reserve prepared by Thomas and Benson (1985a) has been reproduced without change at a reduced scale (1:40 000 scale, 2 cm = 1 km), on the back of the Sydney 1:100 000 Vegetation Map Sheet. It shows more detail than the 1:100 000 sheet, for example map unit 10ar is divided into five units. Relationships between the two maps are given in Table 3.

Table 3. Plant communities in Ku-ring-gai Chase National Park and Muogamarra Nature Reserve

Summarised descriptions give map code, structure, habitat, geology and dominant species based on Thomas and Benson, 1985, *Vegetation survey of Ku-ring-gai Chase National Park* (Royal Botanic Gardens Sydney). Code in brackets at end shows relevant map unit for Sydney 1:100 000 map sheet.

1 **Closed-forest**

Tristaniopsis laurina, Ceratopetalum apetalum

Gully Rainforest in sheltered gullies close to sea level, Hawkesbury Sandstone soils **(10ag)**.

2 **Low closed-forest/Closed-forest with emergent trees**

Acmena smithii, Glochidion ferdinandi, Livistona australis, emergents —*Eucalyptus botryoides, Angophora floribunda*

Rainforest with emergent eucalypts. Sheltered slopes, mostly western Pittwater, Narrabeen Group soils **(9h).**

3 **Tall open-forest/Open-forest**

Eucalyptus agglomerata, Angophora floribunda, Allocasuarina torulosa

Confined to breccia in Campbells Crater **(6c)**.

4 Open-forest

Eucalyptus paniculata, Eucalyptus umbra, Eucalyptus scias, Syncarpia glomulifera, Angophora floribunda

Clay soils from weathered volcanic dyke at West Head **(6c)**.

5 Open-forest

Eucalyptus maculata, Eucalyptus paniculata, Syncarpia glomulifera, Allocasuarina torulosa

Western Pittwater, on Narrabeen Group shales **(9g)**.

6 Open-forest

Angophora floribunda, Eucalyptus paniculata, Eucalyptus botryoides, Eucalyptus scias, Syncarpia glomulifera, Allocasuarina torulosa

Sheltered slopes, Western Pittwater, Narrabeen Group shales and sandstones **(9h)**.

7 Open-forest

Angophora floribunda, Eucalyptus punctata, Allocasuarina torulosa

Footslopes above saltwater estuaries and foreshores of Cowan Creek, Coal and Candle Creek, Smiths Creek and Hawkesbury River. Mostly Narrabeen Group **(9h)**.

8 Open-forest

Eucalyptus pilularis, Eucalyptus resinifera, Angophora costata, Syncarpia glomulifera

Upper Cockle Creek valley on Wianamatta Shale soils **(9o)**.

9 Open-forest

Eucalyptus piperita, Angophora costata, Eucalyptus gummifera, Eucalyptus umbra, Syncarpia glomulifera

Sheltered aspects on slopes, particularly steep south-facing slopes, Hawkesbury Sandstone soils including podsols **(10ag)**.

10A Open-forest

Eucalyptus capitellata, Eucalyptus gummifera, Eucalyptus sieberi, Eucalyptus haemastoma

Along Mona Vale Road on 'lateritic' soils from shale lenses now exposed as cappings on plateaus over Hawkesbury Sandstone **(9sf)**.

10B Open-forest/Low open-forest

Eucalyptus sieberi, Eucalyptus gummifera, Eucalyptus sparsifolia, Eucalyptus haemastoma

At Duffys Forest on 'lateritic' soils from shale lenses now exposed as cappings on plateaus over Hawkesbury Sandstone **(9sf)**.

11 Low open-forest

Eucalyptus racemosa, Eucalyptus gummifera, Eucalyptus sparsifolia, Eucalyptus sieberi

On flat ridgetops e.g. Windybanks Ridge, on Hawkesbury Sandstone with yellow-earth soils, clay sub-soils and ironstone fragments **(10ar)**.

12 Low open-forest with patches of Grassland

Allocasuarina torulosa, Allocasuarina littoralis, Banksia integrifolia, emergent trees: *Angophora costata, Eucalyptus botryoides*

Exposed sites on headlands with clay soils from the Narrabeen Group **(21a)**.

13 Woodland

Angophora costata, Eucalyptus gummifera, Eucalyptus umbra, Allocasuarina littoralis and (west of Cowan Creek) *Eucalyptus eximia*

Moderate to steep slopes, exposed aspects on Hawkesbury Sandstone **(10ar)**.

14 Low woodland

Eucalyptus camfieldii, Eucalyptus haemastoma, Eucalyptus gummifera

Clay soil with ironstone fragments on Hawkesbury Sandstone. Very restricted, West Head Road/ Elvina Bay Track **(10ar)**.

15 Low woodland/Low open-woodland

Eucalyptus gummifera, Eucalyptus haemastoma, Eucalyptus sparsifolia, Eucalyptus eximia (west of Cowan Creek), *Angophora bakeri* (in Muogamarra Nature Reserve). Low slope plateau areas: crests, spurs and upper slopes on Hawkesbury Sandstone **(10ar)**.

16 Low open-woodland (mallee)

Eucalyptus luehmanniana

Seepage zones on upper slopes with southerly aspects on Hawkesbury Sandstone. Uncommon **(10ar)**.

17 Closed scrub/Scrub-heath

Banksia ericifolia, Hakea teretifolia, Allocasuarina distyla, Leptospermum trinervium, Angophora hispida, emergents — *Eucalyptus haemastoma, Eucalyptus gummifera*

Poorly-drained areas on the plateaus, low slope areas on ridges, hillsides and sandstone benches and thin skeletal soils on ridgetops. Hawkesbury Sandstone **(21g)**.

18 Pockets of Heath on rocky outcrops

Baeckea brevifolia, Baeckea diosmifolia, Kunzea capitata, Calytrix tetragona, Darwinia fascicularis subsp. *fasicularis, Allocasuarina distyla*

Exposed rock platforms with shallow depressions, Hawkesbury Sandstone **(21g)**.

19 Tall open-scrub

Avicennia marina, Aegicerus corniculatum

Mangroves along tidal watercourses and mud flats. Mainly limited to Upper Cowan Creek, Smiths Creek, Cockle Creek and Porto Bay, Kimmerakong Bay, Joe Crafts Bay and Peats Bight **(4a)**.

20 Reedland/Rushland and *Casuarina* Woodland

Juncus kraussii, Phragmites australis, Sarcocornia quinqueflora, Baumea juncea, Sporobolus virginicus, Casuarina glauca

Alluvial flats associated with tidal creeks, on landward side of Mangroves (Community 19) **(4a)**.

21 Sedgeland/Shrubland

Gahnia sieberiana, Empodisma minus, Leptocarpus tenax, Schoenus brevifolius, Gymnoschoenus sphaerocephalus, Xyris operculata, shrubs — *Banksia robur, Sprengelia incarnata, Viminaria juncea, Callistemon citrinus*

Areas of impeded drainage with a consistently high watertable, Hawkesbury Sandstone **(21g)**.

Lane Cove River National Park

The Lane Cove River has incised a narrow valley through Ashfield Shale and Hawkesbury Sandstone. Since the rise in sea level about 6 000 years ago, the river and its tributaries have deposited alluvium in the lower river and estuary. Microclimatic variations resulting from differences in solar radiation due to aspect, slope and horizon factors have a major role in influencing vegetation patterns within various landscape types.

Lane Cove River National Park (formerly State Recreation Area) (400 ha in area) occupies a 10 km strip along the Lane Cove River from Browns Waterhole to Fullers Bridge. Surrounded by suburbs, it is probably one of the most intensively used bushland parks in Sydney.

Historical changes affecting fire regimes and vegetation patterns in the Lane Cove valley, particularly since the arrival of Europeans, have been studied by McLoughlin (1985) and Clark and McLoughlin (1986). The present vegetation of the National Park has been described by Clarke and Benson (1987), who recognise 15 plant

communities and record the occurrence of approximately 360 native species. Species of significance include *Darwinia biflora, Leptospermum deanei, Eucalyptus squamosa, Austromyrtus tenuifolia, Epacris crassifolia, Boronia polygalifolia* and *Leucopogon amplexicaulis.*

The lower valley is characterised by wide alluvial flats that are often intertidal and saline. Vegetation types include mangrove, saltmarsh and rushland. Although the alluvial deposits along the river have always been high in nutrient status they have probably been significantly enriched by run-off and siltation from urbanisation. Alluvial deposits become extensive in the middle section of the river where minor floodplains occur. Vegetation types include tall forest of *Eucalyptus pilularis–Eucalyptus saligna* (Map unit 6b) and *Eucalyptus pilularis–Eucalyptus piperita–Syncarpia glomulifera* (Map unit 10ag). Flooding of the Lane Cove River is a major factor influencing the alluvial vegetation, with minor floods depositing fine silt and weeds onto river flats.

Lower slopes and hills below Ashfield Shale have Hawkesbury Sandstone as their parent material and consist mainly, though not exclusively, of coarse sandstone. Minor shale and laminite lenses occur. These produce benches and breaks in the boulder-strewn landscape. Nutrient deficient lithosols are the main soil type on Hawkesbury Sandstone, although deeper yellow podzolic soils and red podzolic soils may develop on shale lenses. Open-forest of *Angophora costata–Eucalyptus piperita–Eucalyptus gummifera,* closed shrubland of *Banksia ericifolia–Leptospermum trinervium–Angophora hispida,* riparian shrubland of *Tristaniopsis laurina–Callicoma serratifolia–Lomatia myricoides* and woodland of *Eucalyptus racemosa–Eucalyptus gummifera–Allocasuarina littoralis* (Map unit 10ar) occur on these Hawkesbury Sandstone soils. The nutrient levels in some of these soils have been increased by urban run-off (Clements 1983).

Wianamatta Group Ashfield Shale (laminite and dark grey siltone) occurs on upper ridges, forming an undulating landscape with gentle slopes. Soils vary between brown and red podzolics on upper slopes to red and yellow podzolics on lower slopes and valleys. Open-forest of *Eucalyptus resinifera–Syncarpia glomulifera* (Map unit 9o) occurred here but has been mostly cleared. Numerous shale fragments near the surface of these soils are often a feature where they overlie Hawkesbury Sandstone.

As an area of natural vegetation containing this variety of habitats and plant communities within the suburban context, Lane Cove provides environmental experiences and education for a significant local and regional population. The range of landscapes in Lane Cove River National Park differ from those in the national parks of the upper Hornsby plateau and the Woronora Plateau; in particular the alluvial valley soils have more clay influence from the Wianamatta Shale of the surrounding ridgetops. With the added influence of the higher rainfall at this location, these valleys support types of tall forest now rare in the metropolitan area.

Lion Island Nature Reserve

Lion Island (8 ha), situated at the entrance to Broken Bay, is similar geologically to the nearby Brisbane Water National Park, with a Hawkesbury Sandstone capping on the eastern end and strata of the underlying Narrabeen Group exposed else-

Figure 28. Woodland with the twisted limbs of *Angophora costata* and understorey of *Xanthorrhoea arborea* on Lion Island in Broken Bay.

where. The main vegetation on the eastern end is low woodland of *Angophora costata* and *Eucalyptus botryoides*, with shrubs of *Banksia serrata, Exocarpos cupressiformis, Xanthorrhoea arborea, Platysace lanceolata, Hakea sericea, Dodonaea triquetra* and *Acacia ulicifolia* (Benson 1981a).

At the western end of the island is low open-forest of *Banksia integrifolia* and *Allocasuarina littoralis*. On more exposed sites this grades into scrub with *Leptospermum laevigatum* and *Banksia integrifolia*. The exotic *Lantana camara* is common in these situations.

On scree slopes at the eastern end of the island and exposed to the ocean is herbland with *Commelina cyanea, Lobelia alata* and *Dichondra repens*. Shrubs of *Westringia fruticosa* are found in cracks between large sandstone boulders and higher up in cracks and ledges on the cliff faces. Benson (1981a) gives a species list for the island.

Long Island Nature Reserve

Long Island Nature Reserve (73 ha), adjacent to Brooklyn, is a long narrow east-west oriented ridge and has similar vegetation to other Hawkesbury Sandstone islands such as Spectacle Island, although it has very little plateau vegetation.

Manly–Warringah War Memorial Park

Manly-Warringah War Memorial Park (480 ha), managed by Warringah Shire Council, is mostly catchment of Manly Reservoir and is surrounded by the suburbs of Frenchs

Forest, Allambie Heights, North Manly and Balgowlah; Wakehurst Golf Course and Garigal National Park. The geology is Hawkesbury Sandstone with some shale lenses. Much of the vegetation is woodland of *Eucalyptus gummifera* and *Eucalyptus haemastoma; Angophora crassifolia*, a small tree or mallee found only in the eastern parts of the Hornsby Plateau, is in low woodland near Frenchs Forest and there are small patches of *Eucalyptus obstans* in heath near Allambie Heights. On shallow soil on the ridges is heathland (Map unit 21g); shrubs are *Leptospermum trinervium, Darwinia fascicularis, Kunzea ambigua, Angophora hispida*, with *Actinotus helianthi, Blandfordia nobilis, Leucopogon* and *Epacris* species. *Allocasuarina distyla* and *Banksia ericifolia* are dominant in taller shrubland with *Banksia oblongifolia* and *Hakea teretifolia* in poorly-drained soil. In sheltered gullies is open-forest, mainly *Eucalyptus piperita* and *Angophora costata*. Shrub species in woodland/open-forest include *Dodonaea triquetra, Acacia terminalis, Persoonia pinifolia, Persoonia linearis, Pultenaea flexilis, Dillwynia retorta, Boronia pinnata, Crowea saligna, Eriostemon australasius, Ceratopetalum gummiferum*, and *Telopea speciosissima*. Some species restricted to creek lines are *Tristaniopsis laurina, Ceratopetalum apetalum, Callicoma serratifolia, Baeckea linifolia, Austromyrtus tenuifolia* and an uncommon sedge *Restio tetraphyllus* subsp. *meiostachys*. An uncommon orchid *Rimicola elliptica* was recorded on a moist rock ledge. Important wetland vegetation with *Eleocharis sphacelata, Juncus* species, *Baumea nuda, Philydrum lanuginosum, Persicaria decipiens, Schoenus melanostachys*, and *Schoenus brevifolius* provides habitat for birds at the northern end of the reservoir.

Marramarra National Park

Marramarra National Park is a major reserve (11 760 ha) northwest of Sydney, between the Hawkesbury River, Old Northern Road and Berowra Creek. It is mainly Hawkesbury Sandstone plateau country with some narrow cappings of Wianamatta Shale, mostly cleared, and several volcanic necks. The area is generally drier than Ku-ring-gai Chase National Park further east.

Mangroves, *Avicennia marina* and *Aegiceras corniculatum* grow in saline conditions on mudflats in bays and tidal stretches of creeks. These often have *Duboisia myoporoides* on the banks. Creek vegetation above the tidal limit, includes *Tristaniopsis laurina, Backhousia myrtifolia, Trochocarpa laurina, Leptospermum grandifolium* and occasionally *Leptospermum deanei*. The rare local endemic *Asterolasia elegans* is found on sheltered slopes near creeks, though *Asterolasia correifolia* is more common here. *Boronia fraseri, Boronia anemonifolia, Darwinia peduncularis, Prostanthera rhombea, Zieria involucrata*, and *Lasiopetalum macrophyllum* occur occasionally on creekbanks.

In gullies approaching Coba Bay, possibly with volcanic influence, there is tall open-forest of *Eucalyptus agglomerata*, with *Angophora floribunda* extending to the flats. *Platysace clelandii* is occasional on lower sheltered slopes here with *Allocasuarina torulosa*. In gullies, and on slopes with east to southerly aspects, is open-forest of *Eucalyptus piperita, Angophora costata* and *Allocasuarina littoralis* (map unit 10ag) with *Eucalyptus gummifera* and *Eucalyptus sparsifolia* in low open-forest on the edge of ridges (map unit 10ar).

Vegetation on dry ridges (and slopes with north to westerly aspect) is low-woodland to woodland of mainly *Eucalyptus eximia* and *Eucalyptus haemastoma*, often with *Eucalyptus punctata* and *Eucalyptus gummifera*. *Hakea bakeriana* occurs in small patches in woodland on ridges, *Doryanthes excelsa* also occurs north of Canoelands Ridge. There are occasional occurrences of *Eucalyptus squamosa* and patches of *Angophora bakeri*. On rocky parts, *Eucalyptus eximia* is interspersed with low shrubland, often with patches of *Grevillea linearifolia* (narrow-leaved form) and *Dillwynia sericea*. Common shrubs are *Zieria laevigata*, *Gompholobium grandiflorum*, *Leucopogon muticus* and less commonly *Eriostemon hispidulus*. A disjunct population of the south coast species, *Dampiera scottiana* occurs in *Eucalyptus haemastoma* woodland. Populations of *Kunzea rupestris* are rare on rock platforms and *Micromyrtus blakelyi* has been found in a similar habitat. There are some rocky ridgetops in the Park but only very limited areas of heath and sedgeswamp vegetation. Marramarra National Park is an important link between the coastal sandstone vegetation e.g. in Ku-ring-gai, and the more inland vegetation of the Blue Mountains and Wollemi regions.

Muogamarra Nature Reserve

Muogamarra Nature Reserve (2 234 ha) lies north of the suburbs of Cowan and Berowra Heights, and is bounded by Berowra Creek, the Hawkesbury River, the Pacific Highway and Main Northern Railway. To the east and west lie Ku-ring-gai Chase and Marramarra National Parks respectively, while north of the Hawkesbury is Brisbane Water National Park. Muogamarra forms an integral part of the landscape of northern Sydney and conserves a significant portion of the Sydney sandstone bushland.

The vegetation of Muogamarra has been described by Thomas and Benson (1985b) and mapped with the Ku-ring-gai map (see map on back of Sydney 1:100 000 sheet). The nature and distribution of the vegetation is strongly related to geology, soil, drainage and aspect. Within Muogamarra 11 plant communities were recognised including closed-forest, open-forest, low open-forest, woodland, low woodland/low open-woodland, closed scrub/scrub-heath, pockets of heath on rocky outcrops, tall open-scrub, reedland/rushland with woodland, and sedgeland/shrubland. There is considerable variation within some communities and intergradation between communities is a common feature.

Weed invasion is generally of minor significance, with the exception of the Peats Crater area, and is restricted to a few localised sites and some general occurrences along tracks.

Over 400 species from 95 families were recorded by Thomas and Benson (1985b). Significant species include *Lomandra brevis*, *Tetratheca glandulosa*, *Boronia fraseri*, *Micromyrtus blakelyi*, *Platysace clelandii*, *Austromyrtus tenuifolia*, *Eucalyptus squamosa* and *Blechnum ambiguum*.

Spectacle Island Nature Reserve

Spectacle Island Nature Reserve (36 ha) is a small island in the Hawkesbury River, near its junction with Mooney Mooney Creek. It is about 1 200 m long and 600 m wide, up to 120 m high, and capped with Hawkesbury Sandstone which overlies Narrabeen strata that outcrop along the lower slopes. Vegetation, described by Webb (1981), is similar to that of the nearby Brisbane Water and Ku-ring-gai Chase National Parks. On the flat sandstone top of the island is open-woodland with trees of *Eucalyptus gummifera* and *Angophora costata* with an open understorey of *Imperata cylindrica* and scattered shrubs of *Banksia marginata, Xylomelum pyriforme, Gompholobium latifolium* and *Kunzea ambigua* (map unit 10ar). This extends onto the steep, upper sandstone slopes. On the lower slopes, on soils from Narrabeen strata, trees of *Angophora floribunda* with a grassy understorey predominate on the north-facing slopes, *Eucalyptus punctata* on the relatively flat western end of the island, and denser vegetation with *Acacia elata, Allocasuarina torulosa* and *Allocasuarina littoralis* on the steep southern slopes. There are mesic gully species at the base of the sandstone cliffs on the southern side. This is all part of the Narrabeen Slopes Forest (map unit 9h).

Sydney Harbour National Park

Sydney Harbour National Park includes a number of significant areas of vegetation associated with the Harbour foreshores and islands. Substantial areas of North Head including the former Quarantine Station, Dobroyd Head, Middle Head, Bradleys Head and Ashton Park, parts of South Head and Nielsen Park, and Shark, Clark and Rodd Islands are included, though the original bushland on the islands has generally been cleared. Many of these areas were formerly military land and include a scattering of military relics within the bushland.

Remaining vegetation is almost all on Hawkesbury Sandstone, with the soils and degree of exposure to salt-laden sea spray together determining the structure and floristic composition. Exposed sites on shallow soils particularly on North Head and Dobroyd Head have Coastal Sandstone Heath (map unit 21g) which, because of the immediate coastal influence, includes shoreline species such as *Baeckea imbricata, Westringia fruticosa, Olearia tomentosa* and *Melaleuca hypericifolia* (see Adam, Stricker et al. 1989) as well as coastal heath of *Banksia ericifolia–Darwinia fascicularis*. In more sheltered sites open-forest and woodland with *Angophora costata, Eucalyptus botryoides, Eucalyptus gummifera* occur. A very restricted patch of Coastal Dune Heath (map unit 21b) with *Eucalyptus camfieldii* (Horton 1986) occurs on North Head.

Wallumatta Nature Reserve

Wallumatta Nature Reserve is a small reserve (about 5 ha) in East Ryde that retains an example of the Turpentine-Ironbark Forest of the Wianamatta Shale in areas of moderate rainfall (i.e. 900–1100 mm p.a.). In the metropolitan area only about 0.5% of this forest remains. Wallumatta includes over 90 plant species of the shale flora with a transition zone from shale to sandstone vegetation (Benson & Keith 1984c). The nearby Field of Mars Reserve includes good areas of sandstone but very little shale vegetation.

The National Parks and Wildlife Service, in association with the Ryde–Hunters Hill Flora and Fauna Preservation Society, has established a joint committee to oversee Wallumatta. Because it is a particularly important example of Sydney's remnant vegetation it will be used mainly for education, research and nature study.

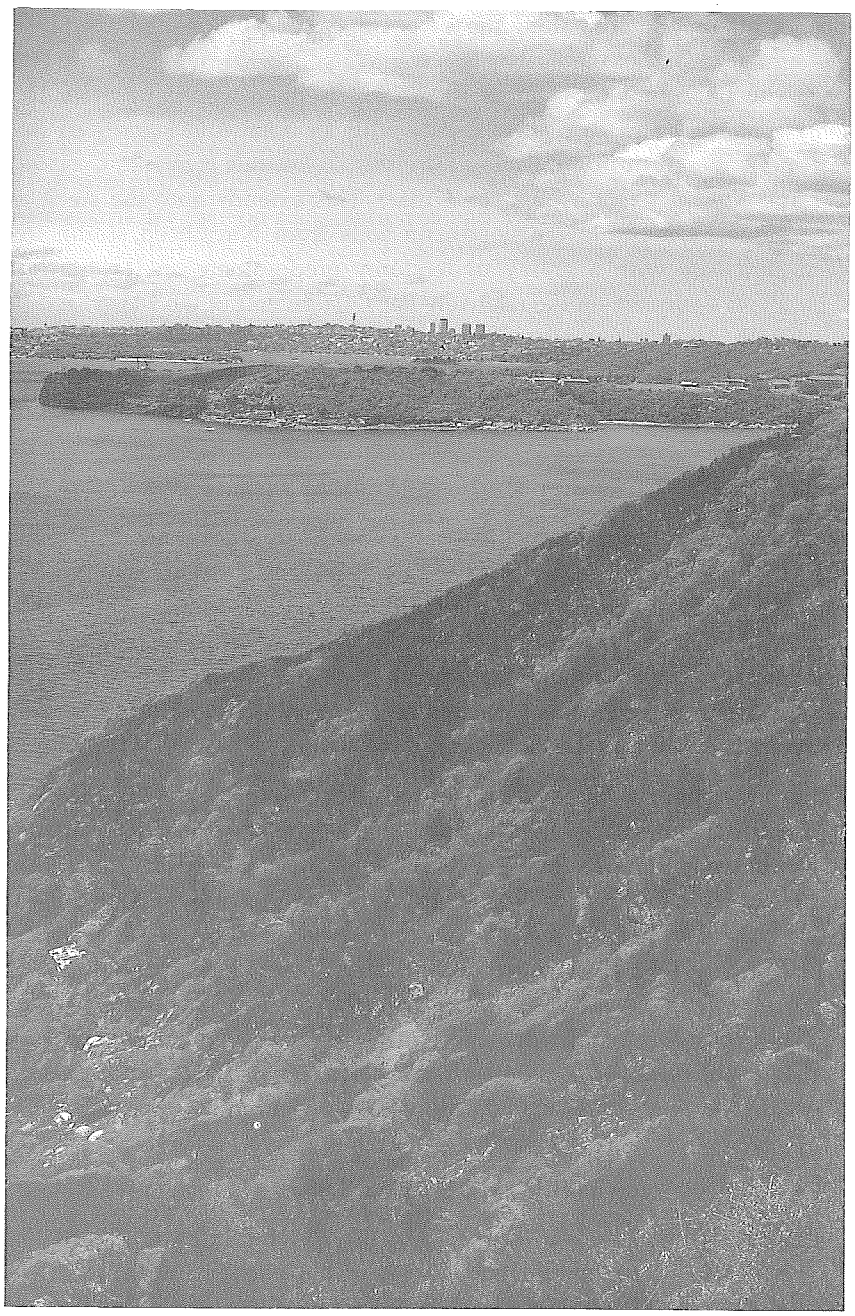
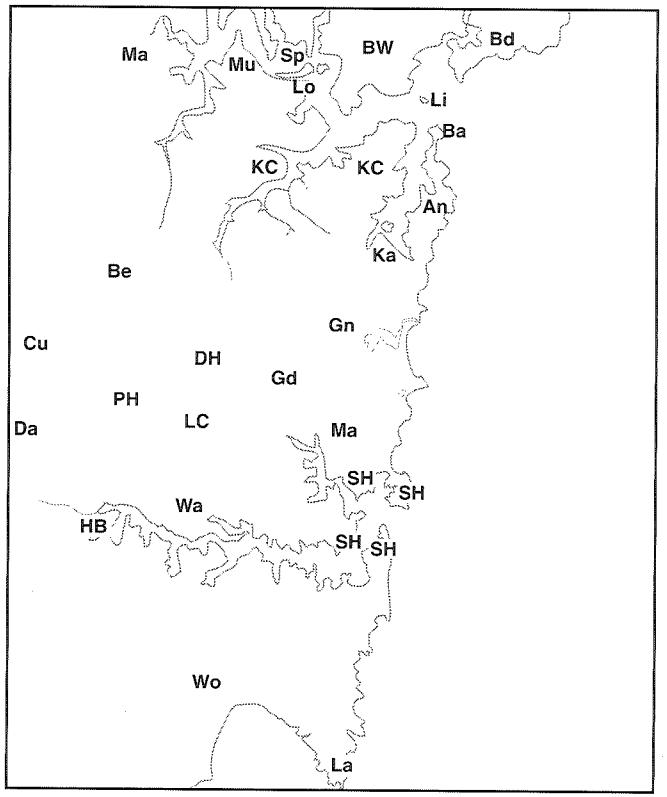


Figure 29. Heath and woodland at Dobroyd Head in Sydney Harbour National Park after an extensive fire in 1990. Periodic fire is an important factor in maintaining species composition in heathland.

Table 4. Native plant species recorded from major conservation areas in the Sydney map sheet area

Species are arranged alphabetically within families and major groups. List is based on various references (see below) with some additions by Doug Benson and Lyn McDougall. Areas are ordered north to south, with codes as follows.

Bd	Bouddi National Park (McRae 1990)
BW	Brisbane Water National Park (Benson & Fallding 1981)
Li	Lion Island Nature Reserve (Benson 1981a, McDougall 1989)
Sp	Spectacle Island Nature Reserve (Webb 1981)
Lo	Long Island Nature Reserve (Coveny & McDougall 1990)
Ma	Marramarra National Park (Benson et al. 1989, NPWS n.d., McDougall 1993)
Mu	Muogamarra Nature Reserve (Thomas & Benson 1985b)
Be	Berowra Valley Bushland Park (Smith & Smith 1990)
KC	Ku-ring-gai Chase National Park (Thomas & Benson 1985a)
Ba	Barrenjoey (McDougall 1994)
An	Angophora Reserve and Hudson Park (Smith & Smith 1993)
Ka	Katandra Bushland Sanctuary (Coveny, I.)
Gn	Garigal National Park: Deep Creek Catchment (Sheringham & Sanders 1993)
Gd	Garigal National Park: Davidson Park (McDougall & Conroy 1988–90)
Cu	Cumberland State Forest (Forestry Commission of NSW 1984)
PH	Pennant Hills Park (Beecroft Cheltenham Civic Trust 1976)
DH	Dalrymple Hay Nature Reserve (Benson & Keith 1984a)
Da	Darling Mills State Forest (FC of NSW 1984)
LC	Lane Cove National Park (Clarke & Benson 1987)
Ma	Manly Dam Memorial Park (Benson 1981)
Wa	Wallumatta Nature Reserve (Benson & Keith 1984c)
SH	Sydney Harbour National Park: includes North Head, Dobroyd Head, Bradleys Head, Nielsen Park (Holland 1980, NPWS n.d., Horton 1986)
HB	Homebush Bay (Kachka 1993)
Wo	Wolli Creek Valley (Robinson 1987)
La	La Perouse (Armstrong et al. 1976)



Botanical name	Bd	BW	Li	Sp	Lo	Ma	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH	DH	Da	LC	Ma	Wa	SH	HB	Wo	La
Ferns and fern allies																									
Adiantaceae																									
Adiantum aethiopicum	Bd	BW	Li		Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu		DH	Da	LC			SH		Wo	La
Adiantum formosum		BW							KC																
Adiantum hispidulum	Bd	BW					Mu	Be				Ka	Gn		Cu			Da	LC						
Adiantum silvaticum		BW							KC										LC						
Aspidiaceae																									
Polystichum australiense	Bd							Be																	
Aspleniaceae																									
Asplenium australasicum		BW							KC			Ka										SH		Wo	
Asplenium difforme			Li							Ba															La
Asplenium flabellifolium	Bd	BW	Li		Lo	Mm	Mu	Be	KC	Ba		Ka	Gn	Gd				Da	LC			SH		Wo	
Blechnaceae																									
Blechnum ambiguum		BW				Mm	Mu	Be	KC			Ka	Gn									SH			
Blechnum camfieldii	Bd	BW										Ka	Gn												
Blechnum cartilagineum	Bd	BW			Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu		DH	Da	LC			SH		Wo	La
Blechnum indicum													Gn												
Blechnum nudum		BW					Mu	Be						Gd					LC			SH			
Blechnum wattsii		BW																							
Doodia aspera	Bd	BW				Mm	Mu	Be	KC	Ba	An				Cu			Da	LC						
Doodia caudata		BW						Be	KC	Ba			Gn					Da				SH			
Cyatheaceae																									
Calochlaena dubia	Bd	BW			Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu		DH	Da	LC	Ma	Wa	SH		Wo	La
Cyathea australis		BW			Lo	Mm	Mu	Be	KC		An	Ka	Gn	Gd			DH			Ma				Wo	La
Davalliaceae																									
Arthropteris tenella									KC																
Davallia pyxidata	Bd	BW	Li		Lo	Mm	Mu	Be	KC			Ka	Gn							Ma		SH			
Dennstaedtiaceae																									
Dennstaedtia davallioides																			LC						
Histiopteris incisa		BW	Li			Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu			Da	LC	Ma		SH		Wo	La

Hypolepis muelleri		BW			Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu			LC	Ma		SH		Wo	La
Hypolepis punctata		BW																					
Pteridium esculentum	Bd	BW	Li	Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu		DH	Da	LC	Ma	Wa	SH		Wo	La
Dryopteridaceae																							
Lastreopsis decomposita	Bd	BW																					
Lastreopsis microsora		BW			Mm	Mu		KC															
Gleicheniaceae																							
Dicranopteris linearis					Mm	Mu																	
Gleichenia dicarpa	Bd	BW		Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd				LC	Ma		SH		Wo	La
Gleichenia microphylla		BW		Lo	Mm	Mu	Be	KC			Ka	Gn	Gd			Da				SH			
Gleichenia rupestris	Bd	BW			Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd							SH			La
Sticherus flabellatus		BW		Lo	Mm	Mu	Be	KC			Ka	Gn				Da	LC			SH			
Grammitidaceae																							
Grammitis billardieri		BW					Be				Ka												
Hymenophyllaceae																							
Hymenophyllum cupressiforme		BW			Mm	Mu	Be	KC			Ka	Gn	Gd			Da	LC						
Lindsaeaceae																							
Lindsaea dimorpha		BW																Ma					
Lindsaea linearis	Bd	BW		Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu		Da	LC	Ma	Wa	SH			La
Lindsaea microphylla		BW		Lo	Mm	Mu	Be	KC	Ba		Ka	Gn	Gd	Cu	DH	Da	LC			SH			
Lycopodiaceae																							
Lycopodium cernuum		BW																					
Lycopodium deuterodensum		BW				Mu		KC					Gd										
Lycopodium laterale		BW			Mm	Mu	Be						Gd				LC						
Osmundaceae																							
Todea barbara	Bd	BW		Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd			Da		Ma		SH		Wo	
Polypodiaceae																							
Dictmia brownii		BW					Be																
Microsorium scandens		BW																					
Platycerium bifurcatum	Bd	BW		Lo	Mm		Be		Ba		Ka			Cu						SH			
Pyrrosia rupestris		BW		Lo	Mm	Mu	Be	KC			Ka	Gn	Gd	Cu			LC			SH			

Botanical name	Bd	BW	Li	Sp	Lo	Ma	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH	DH	Da	LC	Ma	Wa	SH	HB	Wo	La
Psilotaceae																									
Psilotum nudum		BW	Li				Mu	Be	KC	Ba	An	Ka	Gn	Gd					LC	Ma				Wo	
Tmesipteris truncata		BW										Ka	Gn												
Pteris tremula								Be				Ka			Cu										
Pteris umbrosa									KC																
Schizaeaceae																									
Schizaea bifida							Mu	Be	KC			Ka	Gn	Gd				Da	LC			SH			
Schizaea dichotoma		BW					Mu	Be					Gn	Gd											
Schizaea rupestris		BW				Mm	Mu					Ka	Gn	Gd											
Selaginellaceae																									
Selaginella uliginosa	Bd	BW									An	Ka	Gn	Gd						Ma		SH			La
Sinopteridaceae																									
Cheilanthes distans		BW			Lo		Mu	Be				Ka						Da							
Cheilanthes sieberi	Bd	BW	Li		Lo	Mm	Mu	Be	KC	Ba			Gn	Gd					LC		Wa	SH	HB		
Pellaea falcata		BW			Lo	Mm	Mu	Be	KC	Ba					Cu				LC			SH			
Thelypteridaceae																									
Christella dentata	Bd													Gd								SH			
Cycads																									
Zamiaceae																									
Macrozamia communis	Bd	BW	Li		Lo				KC		An	Ka	Gn											Wo	La
Conifers																									
Cupressaceae																									
Callitris rhomboidea								Be	KC					Gd											
Podocarpaceae																									
Podocarpus spinulosus	Bd	BW	Li					Be					Gn	Gd				Da	LC			SH		Wo	

Dicotyledons

Acanthaceae																									
Brunoniella australis				Sp					KC														HB		
Brunoniella pumilio									KC			Ka							LC						
Pseuderanthemum variabile	Bd	BW	Li	Sp	Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn		Cu	PH	DH		LC		Wa				
Aizoaceae																									
Carpobrotus glaucescens	Bd	BW	Li																			SH			La
Tetragonia tetragonoides	Bd		Li		Lo			Be	KC					Gd					LC			SH	HB	Wo	
Amaranthaceae																									
Alternanthera denticulata							Mu	Be																	
Apiaceae																									
Actinotus helianthi	Bd	BW	Li	Sp	Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd		PH		Da	LC	Ma	Wa	SH		Wo	La
Actinotus minor	Bd	BW				Mm	Mu	Be	KC			Ka	Gn	Gd		PH			LC	Ma		SH			La
Apium prostratum	Bd	BW	Li		Lo	Mm		Be	KC																La
Centella asiatica	Bd	BW								Ba		Ka					DH				Wa	SH	HB	Wo	La
Daucus glochidiatus		BW				Mm																			
Hydrocotyle geraniifolia					Lo	Mm			KC																
Hydrocotyle laxiflora		BW				Mm	Mu	Be	KC		An	Ka			Cu				LC						
Hydrocotyle peduncularis					Lo	Mm			KC	Ba												SH	HB	Wo	
Hydrocotyle tripartita							Mu	Be							Cu										
Hydrocotyle verticillata																						SH			
Platysace clelandii						Mm	Mu																		
Platysace ericoides						Mm		Be										Da							La
Platysace lanceolata	Bd	BW	Li	Sp		Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd				Da	LC	Ma		SH		Wo	La
Platysace linearifolia	Bd	BW	Li	Sp	Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd		PH		Da	LC	Ma		SH		Wo	
Platysace stephensonii									KC				Gn												La
Trachymene incisa											An								LC		Wa				
Xanthosia dissecta		BW																							
Xanthosia pilosa	Bd	BW		Sp	Lo	Mm	Mu	Be	KC			Ka	Gn	Gd		PH		Da	LC	Ma		SH		Wo	La
Xanthosia tridentata	Bd	BW			Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd				Da	LC	Ma		SH		Wo	La
Apocynaceae																									
Parsonsia brownii								Be																	
Parsonsia straminea	Bd	BW	Li						KC	Ba	An	Ka	Gn		Cu				LC				HB		

Botanical name	Bd	BW	Li	Sp	Lo	Ma	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH	DH	Da	LC	Ma	Wa	SH	HB	Wo	La
Araliaceae																									
Astrotricha crassifolia		BW																							
Astrotricha floccosa		BW		Sp	Lo	Mm	Mu	Be	KC		An	Ka	Gn	Gd				Da	LC			SH			
Astrotricha latifolia	Bd	BW				Mm													LC						
Polyscias murrayi		BW																							
Polyscias sambucifolia	Bd	BW						Be	KC		An	Ka	Gn	Gd	Cu	PH	DH	Da	LC		Wa	SH	HB	Wo	La
Asclepiadaceae																									
Marsdenia rostrata							Mu		KC	Ba	An											SH			
Marsdenia suaveolens	Bd	BW			Lo	Mm	Mu	Be		Ba		Ka	Gn	Gd		PH		Da	LC			SH			
Tylophora barbata						Mm		Be				Ka			Cu		DH		LC				HB		
Asteraceae																									
Actites megalocarpa														Gd											
Brachycome angustifolia				Sp					KC		An						DH		LC		Wa				
Brachycome multifida						Mm																			
Bracteantha bracteata																			LC						
Calotis dentex						Mm																			
Calotis lappulacea																							HB		
Cassinia aculeata		BW	Li													PH	DH				Wa				
Cassinia arcuata																							HB		
Cassinia aureonitens	Bd					Mm								Gd											
Cassinia compacta						Mm	Mu																		
Cassinia denticulata		BW			Lo		Mu	Be	KC					Gd		PH						SH			
Cassinia longifolia	Bd	BW						Be																	
Cassinia quinquefaria																PH									
Cassinia uncata	Bd									Ba	An	Ka													
Chrysocephalum apiculatum							Mu									PH		Da					HB		
Cotula australis																						SH	HB		La
Epaltes australis	Bd	BW			Lo			Be												Ma					La
Helichrysum elatum		BW							KC			Ka		Gd		PH			LC			SH			
Helichrysum scorpioides																PH	DH				Wa	SH			
Lagenifera stipitata		BW			Lo			Be			An	Ka	Gn				DH					SH		Wo	
Leptinella longipes		BW																					HB		La
Olearia microphylla								Be							Cu	PH			LC					Wo	
Olearia tomentosa	Bd	BW					Mu		KC	Ba		Ka	Gn	Gd					LC			SH			

Olearia viscidula															Cu										
Ozothamnus diosmifolius	Bd	BW		Sp		Mm	Mu	Be			An	Ka	Gn	Gd	Cu	PH	DH	Da	LC		Wa	SH	HB	Wo	
Pseudognaphalium luteoalbum			Li						KC																La
Senecio amygdalifolius																							HB		
Senecio bipinnatisectus	Bd					Mm	Mu		KC																
Senecio glomeratus																				Ma					La
Senecio hispidulus	Bd	BW						Be	KC				Gn		Cu						Wa	SH	HB	Wo	La
Senecio lautus															Cu				LC			SH	HB	Wo	La
Senecio linearifolius	Bd						Mu	Be	KC																
Senecio minimus		BW	Li					Be	KC						Cu										
Senecio quadridentatus								Be															HB		
Senecio vagus																									
subsp. *eglandulosus*	Bd									Ba			Gn												
Sigesbeckia orientalis		BW				Mm	Mu	Be	KC				Gn		Cu		DH								
Solenogyne bellioides																			LC						
Vernonia cinerea var. *cinera*	Bd					Mm			KC		An	Ka					DH						HB		
Vittadinia muelleri																							HB		
Avicenniaceae																									
Avicennia marina																									
subsp. *australasica*		BW		Sp	Lo	Mm	Mu	Be	KC					Gd					LC				HB	Wo	
Bauera microphylla																									La
Bauera rubioides	Bd	BW				Mm	Mu	Be	KC			Ka	Gn	Gd		PH			LC	Ma		SH			
Bignoniaceae																									
Pandorea pandorana	Bd	BW	Li	Sp	Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH	DH	Da	LC		Wa	SH	HB	Wo	
Callitrichaceae																									
Callitriche muelleri								Be																	
Campanulaceae																									
Wahlenbergia communis																							HB		
Wahlenbergia gracilis	Bd			Sp	Lo	Mm		Be		Ba	An	Ka	Gn		Cu							SH	HB	Wo	La
Wahlenbergia stricta																									
subsp. *stricta*			Li			Mm											DH		LC						
Caryophyllaceae																									
Stellaria flaccida						Mm																			

Botanical name	Bd	BW	Li	Sp	Lo	Ma	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH	DH	Da	LC	Ma	Wa	SH	HB	Wo	La
Casuarinaceae																									
Allocasuarina distyla	Bd	BW	Li			Mm	Mu	Be	KC	Ba		Ka	Gn	Gd					LC	Ma		SH			La
Allocasuarina littoralis	Bd	BW	Li	Sp	Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH		Da	LC	Ma	Wa	SH		Wo	
Allocasuarina nana													Gn												
Allocasuarina portuensis																						SH			
Allocasuarina torulosa	Bd	BW		Sp	Lo	Mm	Mu	Be	KC		An	Ka	Gn	Gd	Cu	PH	DH	Da	LC		Wa	SH	HB		
Casuarina glauca		BW		Sp	Lo	Mm	Mu	Be	KC	Ba			Gn	Gd					LC			SH	HB	Wo	La
Celastraceae																									
Cassine australis var. *australis*		BW								Ba													HB		
Celastrus subspicata																PH									
Maytenus silvestris	Bd	BW					Mu	Be	KC			Ka			Cu		DH								
Chenopodiaceae																									
Atriplex australasica																							HB		
Atriplex semibaccata																							HB		
Chenopodium glaucum		BW											Gn										HB		
Einadia hastata													Gn												
Einadia nutans subsp. *linifolia*																							HB		
Einadia nutans subsp. *nutans*							Mu												LC						
Einadia polygonoides			Li					Be																	
Einadia trigonos subsp. *trigonos*															Cu										
Halosarcia pergranulata																							HB		
Rhagodia candolleana			Li																						
Sarcocornia quinqueflora		BW			Lo			Be	KC					Gd					LC			SH	HB	Wo	
Suaeda australis								Be	KC										LC				HB	Wo	
Chloanthes stoechadis	Bd	BW				Mm	Mu	Be	KC			Ka	Gn	Gd		PH						SH			La
Clusiaceae																									
Hypericum gramineum				Sp	Lo		Mu					Ka	Gn					Da				SH	HB		La
Hypericum japonicum		BW		Sp				Be							Cu				LC						
Convolvulaceae																									
Calystegia marginata													Gn												
Calystegia soldanella																									La

Cuscuta australis						Mm																		
Dichondra repens	Bd	BW	Li		Lo	Mm	Mu	Be	KC	Ba	An	Ka			Cu		DH		LC		Wa	SH	HB		La
Polymeria calycina	Bd				Lo		Mu		KC				Gn										HB		
Wilsonia backhousei																							HB		
Crassulaceae																									
Crassula helmsii		BW																							
Crassula sieberiana	Bd	BW	Li		Lo	Mm		Be	KC	Ba	An	Ka							LC			SH		Wo	La
Cunoniaceae																									
Callicoma serratifolia		BW				Mm	Mu	Be	KC			Ka	Gn	Gd	Cu	PH		Da	LC	Ma		SH		Wo	
Ceratopetalum apetalum	Bd	BW		Sp		Mm	Mu	Be	KC			Ka	Gn	Gd		PH		Da	LC	Ma				Wo	
Ceratopetalum gummiferum		BW		Sp	Lo	Mm	Mu	Be	KC			Ka	Gn	Gd		PH		Da	LC	Ma		SH		Wo	La
Schizomeria ovata	Bd	BW				Mm	Mu		KC			Ka	Gn						LC			SH			
Dilleniaceae																									
Hibbertia acicularis																									La
Hibbertia aspera	Bd	BW				Mm	Mu	Be	KC				Gn		Cu		DH		LC		Wa		HB	Wo	
Hibbertia bracteata	Bd	BW				Mm	Mu	Be	KC			Ka	Gn	Gd					LC						
Hibbertia circumdans						Mm	Mu																		
Hibbertia cistiflora	Bd	BW				Mm	Mu	Be	KC				Gn	Gd					LC	Ma		SH			
Hibbertia dentata	Bd	BW	Li		Lo	Mm		Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH	DH	Da	LC			SH		Wo	
Hibbertia diffusa					Lo	Mm			KC		An					PH			LC			SH		Wo	
Hibbertia empetrifolia	Bd	BW	Li		Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu			Da	LC	Ma		SH			La
Hibbertia fasciculata	Bd	BW						Be				Ka	Gn	Gd		PH				Ma		SH	HB		La
Hibbertia linearis		BW					Mu	Be	KC			Ka	Gn	Gd					LC	Ma		SH			
Hibbertia monogyna	Bd						Mu		KC																
Hibbertia nitida													Gn	Gd											
Hibbertia obtusifolia	Bd	BW	Li	Sp			Mu	Be			An							Da							
Hibbertia riparia	Bd							Be	KC														HB		
Hibbertia rufa		BW																				SH			
Hibbertia scandens	Bd	BW	Li					Be	KC	Ba			Gn	Gd	Cu		DH		LC			SH		Wo	La
Hibbertia serpyllifolia													Gn												
Droseraceae																									
Drosera auriculata	Bd	BW		Sp		Mm	Mu		KC			Ka	Gn	Gd		PH		Da	LC	Ma		SH		Wo	
Drosera binata	Bd	BW					Mu	Be	KC		An	Ka	Gn							Ma		SH			
Drosera peltata		BW				Mm	Mu	Be	KC			Ka	Gn	Gd				Da		Ma		SH			La
Drosera pygmaea		BW				Mm		Be	KC																La
Drosera spatulata	Bd	BW			Lo	Mm	Mu	Be	KC		An	Ka	Gn	Gd		PH			LC	Ma		SH			La

Botanical name	Bd	BW	Li	Sp	Lo	Ma	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH	DH	Da	LC	Ma	Wa	SH	HB	Wo	La
Ebenaceae																									
Diospyros australis	Bd									Ba															
Elaeocarpaceae																									
Elaeocarpus reticulatus	Bd	BW		Sp	Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd		PH		Da	LC	Ma	Wa	SH		Wo	La
Sloanea australis												Ka										SH			
Elatinaceae																									
Elatine gratioloides													Gn												La
Epacridaceae																									
Acrotriche divaricata	Bd	BW						Be	KC			Ka	Gn	Gd			DH								
Astroloma humifusum	Bd							Be										Da				SH	HB	Wo	
Astroloma pinifolium	Bd	BW							KC													SH			La
Brachyloma daphnoides	Bd	BW			Lo	Mm	Mu	Be	KC				Gn	Gd		PH			LC	Ma		SH		Wo	La
Dracophyllum secundum		BW		Sp	Lo	Mm	Mu	Be	KC				Gn	Gd		PH			LC						
Epacris crassifolia		BW					Mu	Be	KC				Gn	Gd					LC	Ma		SH			
Epacris longiflora	Bd	BW		Sp		Mm	Mu	Be	KC	Ba		Ka	Gn	Gd		PH			LC	Ma		SH		Wo	La
Epacris microphylla	Bd	BW					Mu	Be	KC		An		Gn	Gd		PH			LC	Ma		SH		Wo	La
Epacris obtusifolia		BW					Mu	Be	KC			Ka	Gn	Gd						Ma		SH			La
Epacris pulchella	Bd	BW		Sp	Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd		PH		Da	LC	Ma	Wa	SH		Wo	
Epacris purpurascens var. *purpurascens*		BW					Mu	Be								PH									
Epacris rigida																PH									
Leucopogon amplexicaulis		BW					Mu	Be	KC			Ka	Gn	Gd		PH			LC	Ma		SH		Wo	
Leucopogon appressus	Bd					Mm	Mu		KC				Gn	Gd											
Leucopogon deformis	Bd																								
Leucopogon ericoides	Bd	BW				Mm	Mu	Be	KC			Ka	Gn	Gd		PH			LC	Ma		SH			La
Leucopogon esquamatus	Bd	BW					Mu	Be	KC	Ba			Gn	Gd						Ma		SH			La
Leucopogon juniperinus	Bd							Be							Cu	PH	DH	Da	LC		Wa		HB	Wo	
Leucopogon lanceolatus								Be	KC			Ka	Gn	Gd	Cu	PH	DH	Da	LC					Wo	
Leucopogon margarodes		BW																							
Leucopogon microphyllus		BW				Mm	Mu	Be	KC				Gn	Gd		PH			LC	Ma		SH			
Leucopogon muticus						Mm		Be																	
Leucopogon parviflorus	Bd	BW								Ba															
Leucopogon setiger						Mm	Mu	Be	KC				Gn	Gd					LC						

Leucopogon virgatus															PH										La
Lissanthe sapida																		LC							
Lissanthe strigosa						Mm			KC				Gn	Gd					Ma	Wa	SH	HB			
Melichrus procumbens		BW									An						Da	LC							
Monotoca elliptica	Bd	BW	Li		Lo		Mu		KC	Ba		Ka	Gn	Gd				LC			SH		Wo	La	
Monotoca scoparia	Bd	BW	Li			Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd				LC	Ma		SH			La	
Sprengelia incarnata	Bd	BW					Mu	Be	KC			Ka	Gn	Gd							SH			La	
Styphelia laeta subsp. *laeta*	Bd	BW							KC									LC						La	
Styphelia laeta subsp. *latifolia*		BW																							
Styphelia longifolia		BW							KC			Ka	Gn	Gd		PH					SH				
Styphelia triflora								Be	KC				Gn	Gd		PH		Da		Ma		SH			La
Styphelia tubiflora	Bd	BW	Li				Mu	Be	KC				Gn	Gd		PH		Da	LC	Ma		SH		Wo	
Styphelia viridus subsp. *viridus*																									La
Trochocarpa laurina	Bd	BW				Mm	Mu	Be	KC			Ka				PH			LC						
Woollsia pungens	Bd	BW			Lo	Mm	Mu	Be	KC			Ka	Gn	Gd		PH		Da	LC	Ma		SH			La
Escalloniaceae																									
Abrophyllum ornans		BW							KC																
Euphorbiaceae																									
Amperea xiphoclada	Bd	BW				Mm	Mu	Be	KC		An	Ka	Gn	Gd	Cu			Da	LC			SH			La
Bertya brownii												Ka	Gn												
Breynia oblongifolia	Bd	BW			Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu		DH	Da	LC		Wa	SH	HB	Wo	La	
Glochidion ferdinandi	Bd	BW			Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu				LC	Ma	Wa	SH		Wo	La	
Micrantheum ericoides	Bd	BW	Li			Mm	Mu	Be	KC	Ba		Ka	Gn	Gd					LC	Ma	Wa	SH		Wo		
Monotaxis linifolia		BW					Mu					Ka	Gn	Gd						Ma		SH			La	
Omalanthus populifolius	Bd								KC	Ba	An	Ka	Gn	Gd	Cu				LC		Wa	SH		Wo	
Phyllanthus gasstroemii		BW				Mm																	HB	Wo	
Phyllanthus hirtellus	Bd	BW	Li		Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd				Da	LC	Ma	Wa	SH	HB	Wo	
Poranthera corymbosa	Bd					Mm	Mu	Be	KC				Gn						LC						
Poranthera ericifolia	Bd	BW					Mu	Be	KC			Ka	Gn	Gd								SH			La
Poranthera microphylla		BW		Sp	Lo	Mm	Mu	Be	KC			Ka	Gn		Cu		DH				Wa	SH	HB	Wo	La
Pseudanthus orientalis	Bd																					SH			La
Pseudanthus pimeleoides		BW											Gn												
Ricinocarpos pinifolius	Bd	BW						Be	KC		An	Ka	Gn	Gd		PH			LC	Ma		SH			La
Eupomatiaceae																									
Eupomatia laurina	Bd	BW				Mm					An	Ka													

Botanical name	Bd	BW	Li	Sp	Lo	Ma	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH	DH	Da	LC	Ma	Wa	SH	HB	Wo	La
Fabaceae–Faboideae																									
Almaleea paludosa		BW							KC																
Aotus ericoides	Bd	BW					Mu	Be	KC		An		Gn	Gd											La
Bossiaea ensata	Bd	BW						Be	KC		An		Gn											Wo	La
Bossiaea heterophylla	Bd	BW	Li			Mm	Mu	Be	KC			Ka	Gn	Gd		PH		Da	LC	Ma		SH			La
Bossiaea lenticularis						Mm																SH		Wo	La
Bossiaea obcordata		BW				Mm		Be	KC				Gn	Gd		PH		Da	LC		Wa				
Bossiaea prostrata																							HB		
Bossiaea rhombifolia								Be																	
Bossiaea scolopendria	Bd	BW				Mm	Mu	Be	KC				Gn	Gd		PH			LC	Ma		SH			La
Bossiaea stephensonii		BW				Mm																			
Daviesia alata		BW							KC																
Daviesia corymbosa	Bd					Mm	Mu	Be																	
Daviesia ulicifolia	Bd	BW					Mu	Be							Cu					Ma	Wa	SH	HB		
Desmodium brachypodum	Bd					Mm																			
Desmodium rhytidophyllum		BW			Lo		Mu		KC		An		Gn				DH								
Desmodium varians		BW			Lo	Mm	Mu	Be	KC	Ba		Ka	Gn		Cu										
Dillwynia acicularis							Mu																		
Dillwynia floribunda var. *floribunda*	Bd	BW		Sp		Mm	Mu	Be	KC			Ka	Gn	Gd						Ma		SH			La
Dillwynia floribunda var. *teretifolia*						Mm	Mu	Be	KC				Gn	Gd		PH									
Dillwynia glaberrima	Bd															PH						SH			La
Dillwynia parvifolia																							HB		
Dillwynia retorta	Bd	BW	Li		Lo	Mm	Mu	Be	KC		An	Ka	Gn	Gd	Cu	PH		Da	LC	Ma	Wa	SH			La
Dillwynia sericea (D. rudis)	Bd	BW				Mm		Be					Gn	Gd					LC						
Glycine clandestina species complex		BW		Sp	Lo	Mm	Mu	Be	KC	Ba	An	Ka				PH			LC		Wa	SH	HB		La
Glycine microphylla													Gn												
Glycine tabacina species complex	Bd							Be	KC		An			Gd		PH	DH					SH	HB		
Gompholobium glabratum		BW				Mm	Mu	Be	KC					Gd		PH		Da	LC	Ma					La
Gompholobium grandiflorum	Bd	BW				Mm	Mu	Be	KC			Ka	Gn	Gd		PH			LC			SH			
Gompholobium latifolium	Bd	BW		Sp	Lo	Mm	Mu	Be	KC		An	Ka	Gn	Gd		PH			LC	Ma		SH			
Gompholobium minus									KC														HB		
Gompholobium pinnatum					Lo														LC						

Gompholobium virgatum	Bd																							
Goodia lotifolia						Mm																		
Hardenbergia violacea	Bd	BW	Li	Sp	Lo	Mm	Mu	Be	KC		An	Ka	Gn	Gd	Cu	PH	DH	Da	LC	Ma	Wa	SH	HB	Wo	La
Hovea lanceolata								Be																
Hovea linearis		BW		Sp	Lo	Mm	Mu	Be	KC		An	Ka	Gn	Gd		PH		Da	LC	Ma	Wa	SH			
Hovea longifolia								Be					Gn										HB		
Hovea purpurea						Mm																			
Indigofera australis	Bd	BW				Mm		Be							Cu		DH						HB		
Jacksonia scoparia	Bd					Mm				Ba															
Kennedia rubicunda	Bd	BW	Li	Sp		Mm	Mu	Be	KC	Ba	An	Ka	Gn		Cu	PH	DH	Da	LC		Wa	SH	HB	Wo	La
Mirbelia rubiifolia		BW	Li	Sp		Mm	Mu		KC	Ba			Gn	Gd					LC		Wa	SH			La
Mirbelia speciosa																									
subsp. *speciosa*						Mm			KC																
Oxylobium cordifolium																									La
Oxylobium ilicifolium	Bd	BW	Li			Mm			KC	Ba	An	Ka	Gn					Da					HB		
Oxylobium scandens																									
var. *scandens*							Mu								Cu										
Phyllota grandiflora								Be	KC			Ka		Gd				Da							
Phyllota phylicoides		BW				Mm	Mu	Be	KC				Gn	Gd		PH			LC	Ma		SH			
Platylobium formosum	Bd	BW			Lo		Mu	Be	KC		An	Ka	Gn	Gd	Cu	PH	DH	Da	LC	Ma	Wa	SH	HB	Wo	
Pultenaea daphnoides	Bd	BW				Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd		PH		Da	LC	Ma	Wa	SH		Wo	La
Pultenaea dentata																									La
Pultenaea elliptica	Bd	BW				Mm	Mu	Be	KC		An	Ka	Gn	Gd		PH			LC	Ma		SH			
Pultenaea ferruginea																									
var. *deanei*	Bd	BW	Li			Mm				Ba															
Pultenaea ferruginea																									
var. *ferruginea*						Mm	Mu																		
Pultenaea flexilis	Bd	BW		Sp	Lo	Mm	Mu	Be	KC			Ka	Gn	Gd		PH		Da	LC	Ma					
Pultenaea hispidula									KC				Gn							Ma					
Pultenaea linophyila							Mu	Be	KC				Gn	Gd						Ma				Wo	La
Pultenaea microphylla													Gn												
Pultenaea paleacea																PH									
Pultenaea polifolia							Mu		KC				Gn	Gd						Ma					
Pultenaea retusa				Sp				Be													Wa	SH			
Pultenaea rosmarinifolia		BW				Mm			KC	Ba						PH									
Pultenaea scabra								Be														SH			
Pultenaea stipularis								Be	KC				Gn	Gd		PH			LC	Ma		SH			
Pultenaea villosa								Be															HB		

Botanical name	Bd	BW	Li	Sp	Lo	Ma	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH	DH	Da	LC	Ma	Wa	SH	HB	Wo	La
Sphaerolobium vimineum		BW						Be	KC							PH									La
Viminaria juncea		BW			Lo		Mu	Be	KC				Gn	Gd		PH			LC	Ma	Wa	SH		Wo	La
Zornia dyctiocarpa var. *dyctiocarpa*																PH									
Fabaceae–Mimosoideae																									
Acacia binervia													Gn	Gd					LC					Wo	
Acacia brownii						Mm														Ma					
Acacia buxifolia subsp. *buxifolia*								Be											LC						
Acacia decurrens						Mm	Mu	Be								PH		Da					HB		
Acacia echinula							Mu												LC						
Acacia elata	Bd	BW		Sp		Mm								Gd		PH			LC						
Acacia elongata var. *elongata*								Be												Ma					
Acacia falcata															Cu			Da			Wa		HB	Wo	
Acacia filicifolia	Bd					Mm																			
Acacia fimbriata		BW																							
Acacia floribunda		BW				Mm	Mu	Be	KC		An				Cu	PH	DH	Da						Wo	
Acacia hispidula						Mm		Be						Gd					LC					Wo	
Acacia implexa	Bd	BW			Lo	Mm	Mu		KC	Ba			Gn				DH					SH			La
Acacia irrorata subsp. *irrorata*	Bd	BW						Be					Gn	Gd											
Acacia linifolia		BW				Mm	Mu	Be				Ka	Gn	Gd		PH		Da	LC	Ma	Wa	SH		Wo	
Acacia longifolia		BW	Li	Sp	Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH		Da	LC	Ma	Wa	SH	HB	Wo	
Acacia longissima						Mm		Be	KC			Ka	Gn	Gd		PH	DH			Ma		SH	HB		
Acacia maidenii	Bd	BW		Sp											Cu										
Acacia myrtifolia	Bd	BW				Mm	Mu	Be	KC	Ba	An		Gn	Gd				Da	LC	Ma	Wa	SH	HB	Wo	La
Acacia oxycedrus	Bd	BW		Sp			Mu	Be	KC			Ka	Gn			PH									
Acacia parramattensis		BW				Mm		Be			An			Gd	Cu	PH			LC		Wa		HB	Wo	
Acacia parvipinnula								Be							Cu										
Acacia prominens		BW																							
Acacia quadrilateralis	Bd																								
Acacia schinoides		BW																							
Acacia sophorae	Bd																						HB		La
Acacia stricta													Gn		Cu	PH					Wa		HB		
Acacia suaveolens	Bd	BW	Li	Sp	Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd		PH	DH	Da	LC	Ma	Wa	SH	HB	Wo	La
Acacia terminalis		BW				Mm	Mu	Be	KC			Ka	Gn	Gd		PH			LC	Ma	Wa	SH		Wo	La
Acacia ulicifolia	Bd	BW	Li		Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH		Da	LC	Ma	Wa	SH	HB	Wo	La
Pararchidendron pruinosum										Ba															

Flacourtiaceae																									
Scolopia braunii	Bd																								
Gentianaceae																									
Centaurium spicatum																							HB		
Geraniaceae																									
Erodium crinitum																									La
Geranium homeanum					Lo		Mu		KC						Cu				LC			SH			
Geranium potentilloides						Mm																			
Geranium solanderi var. *solanderi*		BW						Be							Cu		DH								
Pelargonium australe	Bd	BW																							La
Pelargonium inodorum	Bd	BW								Ba		Ka												Wo	
Goodeniaceae																									
Dampiera purpurea						Mm	Mu	Be	KC										LC						
Dampiera scottiana						Mm																			
Dampiera stricta	Bd	BW				Mm	Mu	Be	KC		An	Ka	Gn	Gd		PH		Da	LC	Ma		SH			La
Goodenia bellidifolia	Bd	BW	Li				Mu	Be	KC			Ka	Gn	Gd		PH			LC	Ma		SH			La
Goodenia dimorpha var. *dimorpha*		BW							KC										LC	Ma	Wa				
Goodenia hederacea					Lo				KC							PH		Da	LC		Wa		HB	Wo	
Goodenia heterophylla	Bd	BW		Sp	Lo	Mm	Mu	Be	KC		An	Ka	Gn	Gd	Cu	PH	DH	Da	LC			SH			
Goodenia ovata		BW	Li		Lo	Mm		Be	KC	Ba	An	Ka	Gn						LC				HB		La
Goodenia paniculata		BW			Lo								Gn										HB		
Goodenia stelligera						Mm							Gn			PH				Ma		SH			La
Scaevola albida								Be																	
Scaevola ramosissima	Bd	BW	Li	Sp	Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd		PH		Da	LC	Ma					La
Selliera radicans																									La
Velleia lyrata		BW						Be	KC													SH			
Haloragaceae																									
Gonocarpus micranthus		BW					Mu	Be			An	Ka	Gn	Gd					LC	Ma		SH			La
Gonocarpus salsoloides		BW						Be												Ma		SH			La
Gonocarpus tetragynus		BW					Mu	Be	KC					Gd				Da			Wa	SH	HB		La
Gonocarpus teucrioides	Bd	BW			Lo	Mm	Mu	Be	KC	Ba		Ka	Gn	Gd	Cu			Da	LC	Ma		SH		Wo	La
Haloragodendron lucasii														Gd											

Botanical name	Bd	BW	Li	Sp	Lo	Ma	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH	DH	Da	LC	Ma	Wa	SH	HB	Wo	La
Lamiaceae																									
Hemigenia purpurea		BW					Mu	Be	KC				Gn	Gd		PH			LC	Ma		SH			
Lycopus australis							Mu																		
Plectranthus graveolens				Sp																					
Plectranthus parviflorus	Bd	BW		Sp	Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn		Cu		DH					SH			
Prostanthera denticulata									KC	Ba		Ka	Gn	Gd											
Prostanthera incana							Mu																		
Prostanthera linearis	Bd	BW				Mm	Mu	Be	KC				Gn	Gd					LC						
Prostanthera ovalifolia s. lat.					Lo	Mm	Mu	Be																	
Prostanthera rhombea		BW				Mm																			
Westringia fruticosa	Bd	BW	Li							Ba												SH			La
Lauraceae																									
Cassytha glabella	Bd		Li		Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd		PH			LC			SH	HB		La
Cassytha pubescens		BW	Li		Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd		PH	DH	Da	LC	Ma	Wa	SH	HB		La
Cryptocarya glaucescens		BW										Ka													
Endiandra sieberi	Bd	BW	Li		Lo				KC			Ka	Gn									SH			La
Lentibulariaceae																									
Utricularia biloba																									La
Utricularia dichotoma		BW						Be	KC											Ma		SH			La
Utricularia lateriflora	Bd	BW						Be				Ka													
Utricularia uliginosa		BW																							La
Lobeliaceae																									
Lobelia alata	Bd	BW	Li		Lo	Mm	Mu		KC	Ba	An			Gd					LC	Ma		SH		Wo	La
Lobelia dentata		BW						Be	KC			Ka	Gn	Gd				Da		Ma		SH			
Lobelia gibbosa		BW										Ka				PH									
Lobelia gracilis																					Wa	SH		Wo	
Pratia purpurascens	Bd	BW		Sp	Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH	DH	Da	LC		Wa	SH	HB	Wo	
Loganiaceae																									
Logania albiflora	Bd	BW		Sp	Lo	Mm	Mu	Be	KC			Ka	Gn	Gd		PH				Ma		SH		Wo	
Logania pusilla							Mu					Ka													
Mitrasacme polymorpha	Bd	BW			Lo	Mm	Mu	Be	KC		An	Ka	Gn	Gd				Da	LC	Ma		SH			La

Loranthaceae																						
Amyema congener														PH		LC				Wo		
Amyema gaudichaudii																	HB					
Amyema miquelii		BW																				
Amyema pendulum																						
subsp. *pendulum*	Bd																					
Dendrophthoe vitellina	Bd						Mu	Be						PH		LC		SH	HB	Wo		
Muellerina celastroides		BW	Li		Lo		Mu			Ba								SH				
Muellerina eucalyptoides	Bd	BW					Mu						Gd									
Lythraceae																						
Lythrum hyssopifolia																			HB			
Malvaceae																						
Hibiscus diversifolius												Gn										
Howittia trilocularis	Bd	BW																				
Meliaceae																						
Melia azedarach								Be	KC			Gn		Cu								
Synoum glandulosum	Bd	BW		Sp	Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn				LC		SH				
Toona ciliata (Toona australis)									KC													
Menispermaceae																						
Sarcopetalum harveyanum	Bd	BW		Sp	Lo		Mu	Be	KC	Ba	An	Ka	Gn		Cu		LC		SH	HB	Wo	La
Stephania japonica																						
var. *discolor*	Bd	BW	Li		Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn			PH	LC		SH			La
Menyanthaceae																						
Villarsia exaltata												Gn										
Monimiaceae																						
Doryphora sassafras		BW																				
Palmeria scandens		BW						Be														
Wilkiea huegeliana	Bd	BW							KC	Ba	An	Ka										
Moraceae																						
Ficus coronata	Bd	BW					Mu	Be	KC	Ba			Gn				LC					
Ficus rubiginosa	Bd	BW	Li	Sp	Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd		PH			SH		Wo	
Ficus superba var. *henneana*		BW																				
Malaisia scandens	Bd																					

Botanical name	Bd	BW	Li	Sp	Lo	Ma	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH	DH	Da	LC	Ma	Wa	SH	HB	Wo	La
Myoporaceae																									
Eremophila debilis																							HB		
Myoporum acuminatum	Bd	BW					Mu																		
Myoporum insulare	Bd	BW													Cu								HB		
Myrsinaceae																									
Aegiceras corniculatum	Bd	BW			Lo	Mm	Mu	Be	KC										LC				HB		
Rapanea howittiana	Bd	BW	Li				Mu			Ba		Ka										SH			La
Rapanea variabilis	Bd	BW	Li		Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH	DH					SH	HB	Wo	La
Myrtaceae																									
Acmena smithii	Bd	BW	Li	Sp		Mm	Mu	Be	KC	Ba	An	Ka	Gn			PH		Da	LC			SH			La
Angophora bakeri					Lo	Mm	Mu	Be										Da	LC		Wa				
Angophora costata	Bd	BW	Li	Sp	Lo	Mm	Mu	Be	KC		An	Ka	Gn	Gd	Cu	PH	DH	Da		Ma	Wa	SH		Wo	La
Angophora crassifolia									KC				Gn	Gd					LC	Ma					
Angophora floribunda	Bd	BW		Sp	Lo	Mm	Mu	Be	KC		An				Cu		DH		LC				HB	Wo	
Angophora hispida	Bd	BW				Mm	Mu	Be	KC				Gn	Gd		PH			LC	Ma		SH			
Austromyrtus tenuifolia		BW				Mm	Mu	Be	KC				Gn	Gd		PH			LC	Ma					
Backhousia myrtifolia	Bd	BW		Sp	Lo	Mm	Mu	Be	KC	Ba		Ka	Gn	Gd		PH		Da	LC						
Baeckea brevifolia	Bd	BW				Mm	Mu	Be	KC				Gn						LC			SH			
Baeckea densifolia													Gn	Gd		PH				Ma					
Baeckea diosmifolia	Bd	BW				Mm	Mu	Be	KC				Gn	Gd					LC	Ma		SH			
Baeckea imbricata	Bd	BW	Li				Mu	Be	KC	Ba			Gn	Gd						Ma		SH			La
Baeckea linifolia		BW				Mm	Mu	Be	KC		An	Ka	Gn	Gd		PH				Ma					
Baeckea ramosissima	Bd												Gn	Gd					LC			SH			
Baeckea virgata					Lo			Be					Gn						LC						
Callistemon citrinus	Bd	BW					Mu	Be	KC		An		Gn	Gd		PH			LC	Ma		SH		Wo	La
Callistemon linearifolius			Li	Sp			Mu		KC				Gn												
Callistemon linearis	Bd	BW					Mu	Be	KC	Ba		Ka	Gn	Gd					LC	Ma	Wa	SH		Wo	La
Callistemon pinifolius													Gn												La
Callistemon rigidus												Ka	Gn							Ma					
Callistemon salignus													Gn						LC			SH			
Calytrix tetragona	Bd	BW				Mm	Mu	Be	KC				Gn	Gd		PH			LC	Ma		SH			La
Darwinia biflora						Mm		Be	KC										LC						
Darwinia fascicularis		BW				Mm	Mu	Be	KC		An	Ka	Gn	Gd					LC	Ma		SH			La
Darwinia glaucophylla		BW																							

Darwinia leptantha																								SH			La
Darwinia peduncularis						Mm		Be																			
Darwinia procera		BW				Mm			KC				Gn	Gd													
Eucalyptus acmenoides		BW				Mm									Cu												
Eucalyptus agglomerata						Mm			KC																		
Eucalyptus beyeriana						Mm																					
Eucalyptus botryoides	Bd	BW	Li						KC	Ba	An		Gn											SH		Wo	La
Eucalyptus camfieldii								Be	KC															SH			
Eucalyptus capitellata	Bd	BW						Be	KC				Gn	Gd								Ma					
Eucalyptus deanei	Bd	BW																									
Eucalyptus eugenioides						Mm																					
Eucalyptus eximia		BW				Mm	Mu	Be	KC	Ba																	
Eucalyptus fibrosa																									HB		
Eucalyptus globoidea		BW				Mm		Be								PH		Da			Wa	SH	HB			
Eucalyptus grandis													Gn														
Eucalyptus gummifera	Bd	BW		Sp	Lo	Mm	Mu	Be	KC		An	Ka	Gn	Gd	Cu	PH		Da	LC	Ma	Wa	SH	HB	Wo	La		
Eucalyptus haemastoma	Bd	BW				Mm	Mu	Be	KC		An	Ka	Gn	Gd		PH			LC	Ma	Wa	SH	HB	Wo			
Eucalyptus longifolia																							HB				
Eucalyptus luehmanniana		BW							KC				Gn	Gd													
Eucalyptus maculata	Bd	BW							KC		An																
Eucalyptus moluccana																							HB				
Eucalyptus multicaulis	Bd	BW						Be						Gd													
Eucalyptus oblonga		BW						Be	KC				Gn	Gd						Ma							
Eucalyptus obstans													Gn							Ma		SH					
Eucalyptus paniculata	Bd	BW	Li					Be	KC		An	Ka	Gn	Gd	Cu	PH	DH		LC		Wa		HB				
Eucalyptus pilularis	Bd					Mm		Be	KC					Gd	Cu	PH	DH	Da					HB	Wo			
Eucalyptus piperita	Bd	BW		Sp	Lo	Mm	Mu	Be	KC		An	Ka	Gn	Gd		PH		Da	LC	Ma	Wa	SH		Wo			
Eucalyptus punctata	Bd	BW		Sp	Lo	Mm	Mu	Be	KC		An	Ka	Gn	Gd						Ma	Wa	SH	HB				
Eucalyptus racemosa						Mm	Mu	Be	KC				Gn	Gd						Ma							
Eucalyptus resinifera		BW		Sp		Mm		Be	KC						Cu	PH			LC		Wa		HB				
Eucalyptus robusta	Bd										An		Gn									SH		Wo	La		
Eucalyptus saligna								Be						Gd	Cu		DH	Da	LC								
Eucalyptus scias subsp. *scias*	Bd	BW							KC			Ka	Gn														
Eucalyptus sclerophylla						Mm																					
Eucalyptus sieberi		BW					Mu	Be	KC				Gn	Gd						Ma							
Eucalyptus sparsifolia						Mm																					
Eucalyptus squamosa		BW				Mm	Mu	Be	KC				Gn														
Eucalyptus tereticornis						Mm									Cu				LC			SH					

Botanical name	Bd	BW	Li	Sp	Lo	Ma	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH	DH	Da	LC	Ma	Wa	SH	HB	Wo	La
Eucalyptus umbra	Bd	BW		Sp	Lo		Mu		KC		An	Ka	Gn	Gd				Da		Ma		SH			
Kunzea ambigua	Bd	BW	Li	Sp	Lo		Mu	Be	Kc	Ba	An	Ka		Gd	Cu	PH		Da	LC	Ma	Wa	SH	HB	Wo	La
Kunzea capitata		BW				Mm	Mu	Be	KC				Gn	Gd					LC	Ma		SH			
Kunzea rupestris						Mm			KC																
Leptospermum arachnoides		BW				Mm	Mu	Be	KC				Gn	Gd		PH			LC	Ma		SH			La
Leptospermum deanei						Mm								Gd		PH									
Leptospermum grandifolium		BW				Mm		Be					Gn	Gd						Ma					
Leptospermum juniperinum	Bd	BW					Mu		KC		An	Ka	Gn	Gd						Ma		SH			La
Leptospermum laevigatum	Bd	BW	Li							Ba				Gd					LC			SH			La
Leptospermum parvifolium		BW				Mm			KC					Gd						Ma					
Leptospermum polygalifolium	Bd	BW				Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd		PH		Da	LC	Ma		SH		Wo	La
Leptospermum scoparium	Bd	BW																							
Leptospermum squarrosum	Bd	BW				Mm	Mu	Be	KC	Ba		Ka	Gn	Gd					LC	Ma		SH			La
Leptospermum trinervium	Bd	BW	Li	Sp	Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd		PH		Da	LC	Ma	Wa	SH		Wo	La
Melaleuca armillaris																						SH			La
Melaleuca biconvexa	Bd																								
Melaleuca deanei		BW						Be						Gd											
Melaleuca decora																					Wa				
Melaleuca ericifolia					Lo																			Wo	
Melaleuca hypericifolia										Ba								Da				SH			
Melaleuca linariifolia	Bd						Mu	Be					Gn											Wo	La
Melaleuca nodosa																PH						SH	HB	Wo	La
Melaleuca quinquenervia					Lo																	SH			
Melaleuca squamea																									La
Melaleuca styphelioides	Bd	BW											Gn	Gd							Wa		HB	Wo	
Melaleuca thymifolia	Bd															PH								Wo	La
Micromyrtus blakelyi						Mm	Mu																		
Micromyrtus ciliata	Bd					Mm	Mu	Be	KC					Gd					LC	Ma					
Rhodamnia rubescens	Bd					Mm			KC								DH								
Rhodomyrtus psidioides										Ba															
Syncarpia glomulifera	Bd	BW			Lo	Mm	Mu	Be	KC		An	Ka		Gd	Cu	PH	DH	Da	LC		Wa	SH	HB	Wo	
Syzigium australe																						SH			
Syzigium oleosum	Bd	BW								Ba			Gn												
Syzygium paniculatum																								Wo	
Tristania neriifolia		BW					Mu	Be					Gn	Gd		PH									
Tristaniopsis collina	Bd				Lo			Be	KC	Ba				Gd								SH		Wo	
Tristaniopsis laurina	Bd	BW		Sp		Mm	Mu	Be	KC			Ka	Gn	Gd		PH		Da	LC					Wo	

Olacaceae																									
Olax stricta		BW				Mm	Mu	Be	KC				Gn	Gd				LC	Ma		SH				
Oleaceae																									
Notelaea longifolia	Bd	BW	Li	Sp	Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu		DH	Da	LC		Wa	SH	HB	Wo	La
Notelaea ovata								Be	KC				Gn									SH		Wo	
Notelaea venosa	Bd	BW				Mm			KC																
Onagraceae																									
Epilobium billardierianum								Be	KC														HB	Wo	
Ludwigia peploides																							HB		
Oxalidaceae																									
Oxalis exilis																	DH								
Oxalis rubens													Gn												
Oxalis thompsoniae										Ba															
Passifloraceae																									
Passiflora cinnabarina												Ka													
Passiflora herbertiana							Mu		KC						Cu				LC						
Peperomiaceae																									
Peperomia blanda var. *floribunda*					Lo																				
Peperomia tetraphylla		BW																							
Pittosporaceae																									
Billardiera scandens var. *scandens*	Bd	BW	Li		Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH	DH	Da	LC	Ma	Wa	SH	HB	Wo	La
Bursaria spinosa var. *spinosa*		BW		Sp	Lo	Mm	Mu	Be	KC			Ka	Gn		Cu	PH	DH				Wa		HB	Wo	
Citriobatus pauciflorus	Bd	BW				Mm									Cu										
Pittosporum revolutum	Bd	BW				Mm	Mu	Be	KC	Ba	An	Ka	Gn		Cu	PH	DH	Da	LC			SH	HB	Wo	La
Pittosporum undulatum	Bd	BW	Li		Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH	DH	Da	LC	Ma	Wa	SH	HB		La
Rhytidosporum procumbens						Mm	Mu	Be	KC				Gn	Gd		PH			LC						
Plantaginaceae																									
Plantago debilis		BW																							
Plantaginaceae																									
Plantago hispida	Bd		Li																						

Botanical name	Bd	BW	Li	Sp	Lo	Ma	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH	DH	Da	LC	Ma	Wa	SH	HB	Wo	La
Polygalaceae																									
Comesperma defoliatum									KC										LC						
Comesperma ericinum	Bd	BW				Mm	Mu	Be	KC			Ka	Gn	Gd		PH		Da	LC	Ma		SH			La
Comesperma sphaerocarpum		BW							KC			Ka	Gn												
Comesperma volubile		BW				Mm	Mu	Be	KC			Ka	Gn			PH		Da							
Polygonaceae																									
Muehlenbeckia gracillima		BW					Mu							Gd											
Persicaria decipiens		BW					Mu	Be	KC		An		Gn									SH	HB	Wo	La
Persicaria hydropiper								Be			An		Gn												
Persicaria lapathifolia									KC															Wo	
Persicaria praetermissa							Mu																		
Persicaria strigosa													Gn											Wo	
Polygonum plebeium																							HB		
Rumex brownii		BW	Li				Mu	Be																	
Portulacaceae																									
Calandrinia pickeringii			Li		Lo	Mm			KC			Ka							LC			SH			
Portulaca oleracea		BW						Be																	
Primulaceae																									
Samolus repens		BW			Lo	Mm	Mu	Be	KC				Gn	Gd					LC				HB		La
Proteaceae																									
Banksia aemula	Bd																					SH			La
Banksia ericifolia var. ericifolia	Bd	BW	Li			Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd		PH			LC	Ma		SH			La
Banksia integrifolia	Bd	BW	Li	Sp	Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd		PH			LC			SH		Wo	La
Banksia marginata				Sp		Mm	Mu	Be	KC				Gn	Gd		PH			LC	Ma		SH			
Banksia oblongifolia	Bd	BW				Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd		PH			LC	Ma		SH		Wo	La
Banksia robur		BW							KC													SH			La
Banksia serrata	Bd	BW	Li	Sp	Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd		PH		Da	LC	Ma	Wa	SH		Wo	La
Banksia spinulosa var. *collina*	Bd							Be																	
Banksia spinulosa var. *spinulosa*		BW		Sp	Lo	Mm	Mu	Be	KC		An	Ka	Gn	Gd		PH		Da	LC	Ma	Wa	SH		Wo	
Conospermum longifolium	Bd	BW				Mm	Mu	Be	KC			Ka	Gn	Gd		PH				Ma		SH			
Conospermum taxifolium	Bd	BW						Be	KC				Gn	Gd		PH			LC	Ma		SH			La
Conospermum tenuifolium		BW							KC																

Grevillea buxifolia subsp. *buxifolia*		BW				Mm	Mu	Be	KC			Ka	Gn	Gd		PH		Da	LC	Ma		SH		Wo	
Grevillea buxifolia subsp. *sphacelata*																						SH			
Grevillea caleyi									KC				Gn	Gd											
Grevillea linearifolia	Bd	BW						Be	KC		An		Gn	Gd		PH		Da	LC	Ma		SH	HB		
Grevillea linearifolia (*G. parviflora*)						Mm																			
Grevillea mucronulata						Mm			KC													SH			
Grevillea sericea		BW		Sp		Mm	Mu	Be	KC		An	Ka	Gn			PH		Da	LC	Ma	Wa	SH		Wo	
Grevillea shiressii		BW																							
Grevillea speciosa		BW				Mm		Be	KC		An		Gn	Gd		PH		Da	LC	Ma		SH			
Hakea bakeriana						Mm		Be											LC						
Hakea dactyloides	Bd	BW	Li	Sp	Lo	Mm	Mu	Be	KC		An	Ka	Gn	Gd		PH			LC	Ma		SH		Wo	La
Hakea gibbosa	Bd	BW				Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd		PH			LC	Ma		SH			La
Hakea propinqua		BW				Mm	Mu	Be	KC				Gn	Gd					LC						
Hakea salicifolia		BW						Be			An		Gn	Gd				Da	LC						
Hakea sericea	Bd	BW	Li			Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH		Da	LC		Wa	SH		Wo	
Hakea teretifolia	Bd	BW	Li			Mm	Mu	Be	KC	Ba		Ka	Gn	Gd		PH			LC	Ma		SH			La
Isopogon anemonifolius	Bd	BW				Mm	Mu	Be	KC		An		Gn		Cu	PH		Da	LC					Wo	La
Isopogon anethifolius	Bd	BW	Li				Mu	Be	KC	Ba			Gn	Gd	Cu	PH		Da	LC	Ma		SH			
Lambertia formosa	Bd	BW				Mm	Mu	Be	KC		An	Ka	Gn	Gd		PH		Da	LC	Ma		SH		Wo	La
Lomatia myricoides		BW				Mm	Mu	Be	KC				Gn	Gd		PH			LC						
Lomatia silaifolia	Bd	BW			Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH		Da	LC	Ma	Wa	SH		Wo	La
Persoonia hirsuta subsp. *hirsuta*							Mu																		
Persoonia isophylla	Bd	BW							KC																
Persoonia lanceolata	Bd	BW				Mm	Mu	Be	KC			Ka	Gn	Gd					LC	Ma	Wa	SH			La
Persoonia laurina subsp. *laurina*						Mm		Be	KC				Gn			PH		Da	LC	Ma	Wa			Wo	
Persoonia levis	Bd	BW	Li	Sp	Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd		PH	DH	Da	LC	Ma	Wa	SH		Wo	La
Persoonia linearis	Bd	BW	Li	Sp	Lo	Mm	Mu	Be	KC		An	Ka	Gn	Gd	Cu	PH	DH	Da	LC	Ma	Wa	SH		Wo	
Persoonia mollis subsp. *mollis*									KC																
Persoonia pinifolia		BW				Mm	Mu	Be	KC			Ka	Gn	Gd		PH			LC	Ma					
Petrophile pulchella	Bd	BW	Li			Mm	Mu	Be	KC		An	Ka	Gn	Gd		PH		Da	LC	Ma		SH			La
Petrophile sessilis	Bd																		LC						
Stenocarpus salignus		BW				Mm	Mu	Be	KC			Ka	Gn	Gd				Da	LC						
Symphionema paludosum		BW												Gd											
Telopea speciosissima	Bd	BW					Mu	Be	KC			Ka	Gn	Gd		PH		Da	LC	Ma		SH			
Xylomelum pyriforme	Bd	BW		Sp	Lo	Mm	Mu	Be	KC		An	Ka	Gn	Gd		PH		Da	LC	Ma	Wa	SH		Wo	La

Botanical name	Bd	BW	Li	Sp	Lo	Ma	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH	DH	Da	LC	Ma	Wa	SH	HB	Wo	La
Ranunculaceae																									
Clematis aristata	Bd	BW			Lo	Mm	Mu	Be	KC		An	Ka	Gn	Gd	Cu	PH	DH	Da	LC			SH	HB		
Clematis glycinoides																									
var. glycinoides							Mu	Be	KC	Ba	An				Cu	PH	DH		LC		Wa	SH	HB	Wo	
Ranunculus inundatus													Gn												
Ranunculus plebeius							Mu							Gd											
Rhamnaceae																									
Alphitonia excelsa		BW				Mm	Mu		KC			Ka													
Cryptandra amara var. *amara*						Mm	Mu	Be		Ba			Gn	Gd								SH			La
Cryptandra ericoides		BW							KC				Gn	Gd								SH			
Pomaderris aspera								Be								PH									
Pomaderris discolor						Mm		Be											LC					Wo	
Pomaderris eliptica		BW		Sp				Be					Gn	Gd		PH				Ma		SH			
Pomaderris ferruginea	Bd	BW				Mm			KC				Gn	Gd	Cu							SH	HB		
Pomaderris intermedia		BW	Li		Lo	Mm	Mu	Be					Gn	Gd									HB	Wo	
Pomaderris lanigera	Bd						Mu	Be	KC	Ba	An	Ka	Gn										HB		
Pomaderris ligustrina		BW																							
Rosaceae																									
Rubus hillii	Bd	BW				Mm	Mu		KC		An		Gn									SH			
Rubus parvifolius		BW	Li			Mm				Ba							DH								
Rubus rosifolius	Bd					Mm			KC						Cu										
Rubiaceae																									
Canthium coprosmoides		BW							KC			Ka													
Coprosma quadrifida								Be																	
Galium binifolium		BW						Be	KC			Ka			Cu			Da							
Galium propinquum		BW				Mm	Mu																		
Morinda jasminoides	Bd	BW		Sp			Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH		Da				SH			
Opercularia aspera	Bd	BW			Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu			Da	LC	Ma		SH	HB	Wo	La
Opercularia diphylla									KC														HB		
Opercularia hispida					Lo		Mu		KC																
Opercularia varia		BW					Mu	Be	KC			Ka	Gn					Da	LC	Ma		SH	HB		La
Pomax umbellata	Bd	BW			Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu			Da	LC	Ma	Wa	SH	HB	Wo	La
Psychotria loniceroides	Bd																								

Rutaceae																											
Acronychia oblongifolia																											
Asterolasia correifolia	Bd	BW				Mm	Mu		KC			Ka	Gn										SH				
Asterolasia elegans						Mm																					
Boronia anemonifolia		BW				Mm																					
Boronia floribunda								Be	KC					Gd		PH											
Boronia fraseri		BW				Mm	Mu	Be	KC																		
Boronia ledifolia		BW				Mm	Mu	Be	KC		An	Ka	Gn	Gd		PH				LC	Ma		SH				
Boronia mollis								Be				Ka															
Boronia parviflora		BW						Be																			La
Boronia pinnata		BW				Mm	Mu	Be	KC			Ka	Gn	Gd		PH				LC	Ma						
Boronia polygalifolia		BW																		LC							
Boronia rigens							Mu																				La
Boronia serrulata		BW				Mm	Mu	Be	KC				Gn														
Boronia thujona												Ka	Gn	Gd													
Correa alba var. *alba*										Ba													SH				La
Correa lawrenciana																											
var. *macrocalyx*		BW																									
Correa reflexa	Bd	BW		Sp	Lo	Mm	Mu	Be	KC	Ba		Ka	Gn			PH		Da	LC			SH				La
Crowea saligna	Bd	BW							KC			Ka	Gn	Gd							Ma	SH				
Eriostemon australasius	Bd	BW	Li			Mm	Mu	Be	KC			Ka	Gn	Gd				Da			Ma	SH				La
Eriostemon buxifolius		BW	Li						KC					Gd								SH				La
Eriostemon hispidulus	Bd					Mm	Mu	Be																			
Eriostemon myoporoides																											La
Eriostemon scaber																											
subsp. *scaber*																										Wo	
Phebalium dentatum		BW					Mu	Be	KC			Ka	Gn	Gd		PH				LC							
Phebalium diosmeum								Be															SH			Wo	
Phebalium squamulosum																											
subsp. *argenteum*		BW																									
Phebalium squamulosum																											
subsp. *squamulosum*		BW				Mm	Mu		KC				Gn	Gd							Ma						
Philotheca salsolifolia		BW					Mu	Be	KC				Gn	Gd						LC	Ma		SH				La
Zieria involucrata						Mm																					
Zieria laevigata		BW				Mm	Mu	Be	KC				Gn	Gd							Ma		SH				La
Zieria pilosa	Bd	BW				Mm	Mu	Be	KC			Ka	Gn	Gd		PH				LC			SH			Wo	La
Zieria smithii subsp. *A*	Bd	BW						Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH	DH	Da		LC				HB		Wo	

Botanical name	Bd	BW	Li	Sp	Lo	Ma	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH	DH	Da	LC	Ma	Wa	SH	HB	Wo	La
Sambucaceae																									
Sambucus gaudichaudiana								Be																	
Santalaceae																									
Exocarpos cupressiformis	Bd	BW	Li	Sp	Lo	Mm	Mu		KC		An	Ka			Cu		DH	Da	LC		Wa	SH	HB	Wo	La
Exocarpos strictus								Be																	
Leptomeria acida		BW			Lo		Mu	Be	KC			Ka	Gn			PH			LC						
Sapindaceae																									
Alectryon subcinereus		BW																							
Cupaniopsis anacardioides																						SH			
Dodonaea camfieldii		BW																							
Dodonaea pinnata		BW				Mm	Mu		KC				Gn												
Dodonaea triquetra	Bd	BW	Li			Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH	DH		LC	Ma	Wa	SH	HB	Wo	La
Guioa semiglauca	Bd	BW								Ba															
Scrophulariaceae																									
Veronica calycina								Be														SH		Wo	
Veronica plebeia		BW				Mm	Mu	Be			An			Gd	Cu		DH	Da	LC		Wa	SH	HB		
Solanaceae																									
Duboisia myoporoides	Bd	BW				Mm							Gn												
Solanum americanum																									
(S. nodiflorum)		BW	Li			Mm		Be		Ba	An	Ka			Cu	PH									La
Solanum campanulatum		BW					Mu		KC																
Solanum opacum																									
(S. nigrum)								Be					Gn		Cu							SH			La
Solanum prinophyllum		BW				Mm	Mu	Be	KC		An	Ka			Cu										
Solanum pungetium		BW				Mm									Cu										
Stackhousiaceae																									
Stackhousia monogyna		BW																							
Stackhousia nuda		BW							KC				Gn			PH									La
Stackhousia viminea		BW				Mm	Mu	Be	KC			Ka	Gn	Gd					LC	Ma			HB		

Sterculiaceae																								
Brachychiton populneus	Bd																				HB			
Lasiopetalum ferrugineum	Bd	BW		Sp		Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd		PH		Da		Ma	Wa	SH			La
Lasiopetalum macrophyllum		BW		Sp		Mm			KC	Ba														
Lasiopetalum parviflorum								Be										Da					HB	
Lasiopetalum rufum						Mm	Mu		KC					Gd										
Rulingia dasyphylla									KC				Gn						LC					
Rulingia hermanniifolia	Bd																					SH		La
Seringia arborescens									KC															
Stylidiaceae																								
Stylidium graminifolium																								La
Stylidium lineare		BW					Mu	Be	KC				Gn	Gd					LC	Ma		SH		
Stylidium productum		BW	Li		Lo	Mm	Mu	Be	KC			Ka	Gn	Gd		PH			LC	Ma	Wa		Wo	
Symplocaceae																								
Symplocos thwaitesii		BW																						
Thymelaeaceae																								
Pimelea curviflora var. *curviflora*																				Ma				
Pimelea curviflora var. *gracilis*							Mu																	
Pimelea glauca		BW																						
Pimelea latifolia subsp. *hirsuta*		BW							KC															
Pimelea linifolia subsp. *linifolia*	Bd	BW					Mu	Be	KC	Ba	An	Ka	Gn	Gd		PH		Da	LC	Ma	Wa	SH	Wo	La
Wikstroemia indica	Bd	BW	Li							Ba												SH		
Tetratheca ericifolia	Bd	BW					Mu	Be	KC			Ka	Gn	Gd						Ma				
Tetratheca glandulosa						Mm	Mu	Be	KC				Gn	Gd				Da	LC	Ma				
Tetratheca shiressii		BW																						
Tetratheca thymifolia	Bd	BW				Mm	Mu	Be	KC		An	Ka	Gn											
Ulmaceae																								
Trema aspera		BW				Mm	Mu	Be	KC		An	Ka	Gn						LC				Wo	
Urticaceae																								
Urtica incisa								Be																
Verbenaceae																								
Clerodendrum tomentosum	Bd	BW		Sp	Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu		DH		LC			SH	HB	

Botanical name	Bd	BW	Li	Sp	Lo	Ma	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH	DH	Da	LC	Ma	Wa	SH	HB	Wo	La
Violaceae																									
Hybanthus monopetalus	Bd	BW	Li	Sp	Lo	Mm	Mu	Be	KC							PH			LC						La
Hybanthus vernonii subsp. *vernonii*						Mm	Mu	Be				Ka	Gn	Gd											
Hymenanthera dentata								Be																	
Viola betonicifolia	Bd																								
Viola hederacea		BW				Mm	Mu	Be	KC		An	Ka	Gn	Gd	Cu	PH		Da	LC			SH	HB		La
Viola sieberiana							Mu						Gn	Gd											
Vitaceae																									
Cayratia clematidea	Bd	BW		Sp	Lo	Mm	Mu	Be	KC		An				Cu	PH							HB		
Cissus antarctica	Bd	BW	Li						KC	Ba												SH			
Cissus hypoglauca	Bd	BW		Sp	Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd		PH			LC			SH			La
Winteraceae																									
Tasmannia insipida		BW							KC																
Monocotyledons																									
Agavaceae																									
Doryanthes excelsa		BW				Mm																			
Amaryllidaceae																									
Crinum pedunculatum			Li																						La
Anthericaceae (Liliaceae)																									
Alania endlicheri		BW																							
Arthropodium milleflorum									KC						Cu										
Arthropodium minus		BW			Lo																				
Caesia parviflora								Be					Gn	Gd		PH			LC					Wo	
Caesia vittata		BW	Li	Sp		Mm			KC		An	Ka					DH	Da		Ma					
Laxmannia gracilis		BW						Be						Gd					LC	Ma			HB		
Sowerbaea juncea	Bd	BW							KC					Gd						Ma					La
Thysanotus juncifolius	Bd	BW			Lo		Mu		KC		An			Gd		PH		Da				SH			
Thysanotus tuberosus		BW		Sp			Mu						Gn			PH		Da	LC	Ma		SH			La
Tricoryne elatior		BW			Lo		Mu																		
Tricoryne simplex								Be										Da	LC						

Araceae																								
Gymnostachys anceps	Bd	BW			Lo	Mm	Mu		KC			Ka												
Archontophoenix cunninghamiana	Bd																							
Livistona australis	Bd	BW				Mm	Mu		KC	Ba	An	Ka	Gn								SH		Wo	
Asphodeliaceae (Liliaceae)																								
Bulbine bulbosa								Be																
Centrolepidaceae																								
Centrolepis fascicularis												Ka									SH			La
Centrolepis strigosa								Be						Gd							SH		Wo	La
Colchicaceae (Liliaceae)																								
Burchardia umbellata		BW					Mu	Be	KC		An	Ka		Gd		PH			LC	Ma	SH		Wo	La
Commelinaceae																								
Aneilema acuminatum						Mm																		
Commelina cyanea	Bd		Li		Lo	Mm	Mu	Be	KC	Ba	An		Gn			PH			LC		SH	HB	Wo	La
Cyperaceae																								
Baumea acuta		BW																			SH			La
Baumea articulata					Lo								Gn											
Baumea gunnii																								La
Baumea juncea		BW		Sp	Lo	Mm	Mu		KC				Gn	Gd					LC		SH			La
Baumea muelleri												Ka												
Baumea nuda (Schoenus nudus)												Ka								Ma				La
Baumea rubiginosa		BW					Mu		KC		An			Gd					LC					La
Baumea teretifolia																								La
Bolboschoenus caldwelli																						HB		
Carex appressa	Bd	BW					Mu														SH			
Carex breviculmis									KC						Cu									
Carex fascicularis							Mu																	
Carex pumila																								La
Caustis flexuosa	Bd	BW		Sp	Lo	Mm	Mu	Be	KC			Ka	Gn	Gd		PH		Da	LC	Ma	SH			
Caustis pentandra	Bd	BW	Li			Mm	Mu	Be	KC				Gn	Gd					LC	Ma	SH			La
Chorizandra cymbaria		BW											Gn	Gd										La
Chorizandra sphaerocephala		BW																						La

Botanical name	Bd	BW	Li	Sp	Lo	Ma	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH	DH	Da	LC	Ma	Wa	SH	HB	Wo	La
Cyathochaeta diandra	Bd	BW			Lo	Mm	Mu	Be	KC			Ka	Gn	Gd		PH		Da	LC	Ma	Wa	SH	HB		La
Cyperus laevis		BW							KC		An											SH			
Cyperus polystachyos		BW			Lo			Be	KC		An											SH	HB		La
Cyperus sanguinolentus																							HB		
Cyperus tetraphyllus															Cu										
Eleocharis gracilis							Mu						Gn												
Eleocharis minuta																									La
Eleocharis sphacelata		BW											Gn							Ma					La
Fimbristylis dichotoma								Be			An													Wo	
Gahnia aspera		BW				Mm	Mu	Be	KC	Ba															
Gahnia clarkei	Bd	BW			Lo	Mm	Mu	Be	KC		An	Ka	Gn	Gd								SH			
Gahnia erythrocarpa		BW	Li		Lo		Mu	Be	KC	Ba		Ka	Gn	Gd						Ma					
Gahnia melanocarpa	Bd	BW						Be	KC	Ba		Ka													
Gahnia microstachya								Be	KC																
Gahnia radula		BW																							
Gahnia sieberiana		BW				Mm	Mu	Be	KC			Ka	Gn	Gd	Cu			Da	LC			SH			La
Gymnoschoenus sphaerocephalus		BW							KC																La
Isolepis cernua																									La
Isolepis inundata		BW					Mu	Be				Ka		Gd					LC			SH	HB		La
Isolepis nodosa	Bd	BW	Li		Lo	Mm	Mu		KC	Ba	An		Gn	Gd					LC			SH	HB		La
Lepidosperma concavum		BW			Lo	Mm	Mu		KC	Ba		Ka										SH			La
Lepidosperma elatius		BW																							
Lepidosperma filiforme		BW					Mu	Be	KC				Gn	Gd						Ma		SH			La
Lepidosperma forsythii																									La
Lepidosperma laterale	Bd	BW	Li	Sp	Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH		Da	LC	Ma	Wa	SH	HB	Wo	
Lepidosperma limicola		BW							KC									Da							
Lepidosperma neesii		BW					Mu					Ka	Gn	Gd						Ma		SH			La
Lepidosperma urophorum		BW																							
Lepidosperma viscidum	Bd	BW					Mu	Be	KC				Gn	Gd						Ma		SH			
Ptilothrix deusta	Bd	BW					Mu	Be	KC		An		Gn	Gd		PH		Da	LC	Ma		SH			La
Schoenoplectus validus		BW											Gn						LC				HB		
Schoenus apogon					Lo						An		Gn						LC			SH	HB		La
Schoenus brevifolius	Bd	BW						Be	KC			Ka	Gn	Gd					LC	Ma		SH			La
Schoenus ericetorum	Bd	BW					Mu							Gd				Da	LC	Ma					La
Schoenus imberbis		BW	Li	Sp	Lo	Mm	Mu	Be	KC			Ka	Gn	Gd		PH			LC	Ma		SH			

Schoenus lepidosperma		BW						Be	KC														
Schoenus maschalinus								Be												SH			
Schoenus melanostachys	Bd	BW	Li			Mm	Mu	Be		Ba	An	Ka	Gn	Gd		Da	LC	Ma	Wa			Wo	
Schoenus moorei														Gd				Ma					
Schoenus nitens																							La
Schoenus paludosus		BW					Mu	Be					Gn	Gd						SH			La
Schoenus turbinatus		BW				Mm		Be															
Schoenus villosus		BW						Be															
Tetraria capillaris		BW																		SH			
Tricostularia pauciflora		BW							KC				Gn							SH			La
Dioscoreaceae																							
Dioscorea transversa	Bd	BW							KC														
Eriocaulaceae																							
Eriocaulon scariosum																							La
Haemodoraceae																							
Haemodorum corymbosum		BW					Mu	Be	KC				Gn	Gd				Ma					La
Haemodorum planifolium	Bd	BW					Mu	Be	KC		An	Ka		Gd	PH		LC	Ma		SH			
Hydrocharitaceae																							
Ottelia ovalifolia																	LC						La
Hypoxidaceae																							
Hypoxis hygrometrica																	LC						
Iridaceae																							
Libertia paniculata	Bd	BW																					
Patersonia fragilis		BW						Be												SH			La
Patersonia glabrata	Bd	BW		Sp	Lo		Mu	Be	KC	Ba		Ka	Gn	Gd	PH	Da	LC	Ma		SH			La
Patersonia longifolia		BW				Mm	Mu	Be														Wo	
Patersonia sericea	Bd	BW				Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd	PH	Da	LC	Ma		SH			
Juncaceae																							
Juncus continuus	Bd				Lo		Mu	Be			An	Ka	Gn	Gd				Ma		SH			
Juncus kraussii																							
subsp. *australiensis*	Bd	BW			Lo	Mm	Mu	Be	KC	Ba			Gn	Gd			LC				HB		La

Botanical name	Bd	BW	Li	Sp	Lo	Ma	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH	DH	Da	LC	Ma	Wa	SH	HB	Wo	La
Juncus pallidus																						SH			La
Juncus planifolius	Bd	BW					Mu	Be	KC			Ka							LC	Ma		SH			La
Juncus prismatocarpus		BW						Be					Gn							Ma		SH			
Juncus subsecundus								Be																	
Juncus usitatus		BW				Mm	Mu	Be	KC	Ba												SH	HB		La
Juncaginaceae																									
Triglochin procerum		BW											Gn									SH	HB		
Triglochin striatum	Bd	BW						Be						Gd					LC				HB	Wo	La
Lemnaceae																									
Spirodela punctata						Mm																			
Lomandraceae																									
Lomandra brevis		BW						Be					Gn												
Lomandra confertifolia	Bd	BW		Sp	Lo		Mu	Be	KC																
Lomandra cylindrica		BW					Mu	Be	KC			Ka		Gd				Da	LC						
Lomandra filiformis	Bd	BW	Li		Lo	Mm	Mu	Be	KC		An	Ka	Gn	Gd	Cu			Da	LC	Ma	Wa	SH		Wo	La
Lomandra fluviatilis						Mm		Be					Gn	Gd											
Lomandra glauca	Bd	BW		Sp	Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd		PH		Da	LC	Ma		SH	HB		La
Lomandra gracilis				Sp	Lo		Mu	Be				Ka	Gn	Gd	Cu			Da	LC						
Lomandra longifolia	Bd	BW	Li	Sp	Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH	DH	Da	LC	Ma	Wa	SH	HB	Wo	La
Lomandra micrantha								Be																	
Lomandra multiflora	Bd	BW				Mm	Mu	Be	KC	Ba	An	Ka		Gd	Cu	PH			LC	Ma	Wa				La
Lomandra obliqua	Bd	BW		Sp	Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH		Da	LC	Ma	Wa	SH		Wo	La
Luzuriaceae (Philesiaceae)																									
Eustrephus latifolius	Bd	BW	Li		Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH	DH	Da	LC			SH	HB	Wo	La
Geitonoplesium cymosum	Bd	BW				Mm	Mu	Be	KC	Ba	An	Ka	Gn		Cu				LC			SH			La
Orchidaceae																									
Acianthus caudatus																									
var. caudatus		BW				Mm		Be				Ka	Gn			PH				Ma					
Acianthus exsertus						Mm		Be				Ka	Gn		Cu	PH			LC						
Acianthus fornicatus		BW				Mm	Mu	Be				Ka	Gn			PH						SH			La
Arthrochilus proxilus											An	Ka													
Bulbophyllum crassulifolium		BW																							

Bulbophyllum exiguum		BW				Mm			KC																		
Caladenia caerulea						Mm							Gn			PH				Ma							
Caladenia carnea var. *carnea*		BW		Sp		Mm		Be			An	Ka	Gn			PH			LC			SH					
Caladenia catenata (C. alba)		BW				Mm	Mu	Be	KC		An		Gn	Gd	Cu	PH	DH					SH					
Caladenia deformis						Mm																					
Caladenia testacea						Mm		Be																			
Caleana major	Bd	BW				Mm			KC			Ka	Gn	Gd		PH											La
Calochilus campestris		BW				Mm					An	Ka	Gn			PH		Da	LC			SH	HB				
Calochilus paludosus		BW				Mm							Gn														La
Calochilus robertsonii			Li			Mm							Gn	Gd				Da									La
Chiloglottis diphylla													Gn														
Chiloglottis reflexa						Mm		Be			An	Ka	Gn			PH									Wo		
Chiloglottis trapeziformis											An		Gn									SH					
Corybas aconitoflorus						Mm						Ka	Gn			PH											
Corybas pruinosus															Cu	PH											
Corybas unguiculatus													Gn														
Cryptostylis erecta	Bd	BW	Li			Mm		Be	KC		An	Ka	Gn	Gd		PH			LC		Wa	SH				La
Cryptostylis subulata						Mm	Mu	Be	KC	Ba		Ka	Gn	Gd		PH			LC			SH					
Cymbidium suave	Bd	BW			Lo	Mm	Mu	Be	KC			Ka	Gn	Gd		PH			LC								
Cyrtostylis reniformis		BW							KC																		
Dendrobium aemulum		BW										Ka															
Dendrobium linguiforme	Bd	BW	Li	Sp	Lo	Mm	Mu	Be	KC	Ba		Ka	Gn	Gd		PH						SH					
Dendrobium speciosum	Bd	BW	Li			Mm	Mu	Be	KC			Ka	Gn	Gd		PH						SH					
Dendrobium striolatum									KC																		
Dendrobium teretifolium						Mm																					
Dipodium punctatum	Bd	BW	Li			Mm	Mu	Be	KC		An	Ka	Gn	Gd	Cu	PH						SH					
Dipodium variegatum													Gn	Gd													
Diuris aurea	Bd	BW				Mm			KC		An		Gn			PH		Da	LC								
Diuris brevifolia																						SH					
Diuris sulphurea						Mm																					
Eriochilus cucullatus		BW				Mm							Gn														
Galeola cassythoides																						SH					
Gastrodia sesamoides		BW						Be				Ka										SH					
Genoplesium baueri						Mm							Gn			PH											
Genoplesium fimbriatum											An		Gn														
Genoplesium pumilum													Gn														
Glossodia major		BW				Mm							Gn			PH											
Glossodia minor		BW				Mm	Mu	Be	KC				Gn	Gd		PH			LC	Ma							

Botanical name	Bd	BW	Li	Sp	Lo	Ma	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH	DH	Da	LC	Ma	Wa	SH	HB	Wo	La
Liparis reflexa	Bd	BW			Lo	Mm	Mu	Be	KC			Ka	Gn	Gd											
Lyperanthus nigricans		BW				Mm																			
Lyperanthus suaveolens		BW				Mm	Mu						Gn					Da							La
Microtis parviflora											An		Gn												
Microtis rara													Gn												
Microtis unifolia		BW				Mm		Be				Ka	Gn					Da							La
Orthoceras strictum						Mm			KC				Gn									SH			
Plectorrhiza tridentata		BW																							
Prasophyllum aureoviride		BW														PH									
Prasophyllum australe																									
Prasophyllum elatum		BW				Mm	Mu		KC				Gn			PH			LC	Ma					
Prasophyllum fimbriatum		BW												Gd		PH									
Prasophyllum morrissii		BW				Mm																			
Prasophyllum ruppii var. *ruppii*																PH									
Prasophyllum striatum								Be					Gn												
Pterostylis acuminata						Mm		Be			An	Ka	Gn			PH									
Pterostylis baptistii													Gn												La
Pterostylis coccinea																			LC						
Pterostylis concinna													Gn									SH			
Pterostylis curta		BW				Mm				Ba			Gn									SH			
Pterostylis daintreana						Mm							Gn												
Pterostylis grandiflora												Ka	Gn			PH									
Pterostylis longifolia		BW						Be				Ka	Gn	Gd		PH									
Pterostylis nutans		BW		Sp					KC		An	Ka	Gn			PH					Wa	SH			
Pterostylis obtusa						Mm																			
Pterostylis ophioglossa			Li																						
Pterostylis parviflora						Mm										PH									
Pterostylis pedunculata		BW											Gn		Cu										
Rimacola elliptica		BW											Gn	Gd					LC	Ma					
Sarcochilus australis						Mm										PH									
Spiranthes sinensis subsp. *australis*		BW						Be					Gn												
Thelymitra carnea													Gn												
Thelymitra ixioides var. *ixioides*		BW		Sp		Mm	Mu	Be	KC		An	Ka	Gn	Gd		PH			LC			SH			
Thelymitra media									KC							PH									
Thelymitra nuda													Gn												
Thelymitra pauciflora						Mm							Gn												La
Thelymitra rubra var. *rubra*																PH									

Philydraceae																									
Philydrum lanuginosum		BW						Be	KC				Gn										Wo		
Phormiaceae (Liliaceae)																									
Blandfordia nobilis								Be	KC			Ka	Gn	Gd		PH				Ma		SH			La
Dianella caerulea var. *caerulea*	Bd	BW	Li		Lo	Mm	Mu	Be	KC		An	Ka	Gn	Gd		PH	DH	Da	LC	Ma	Wa	SH	HB		La
Dianella caerulea var. *producta*						Mm				Ba			Gn									SH		Wo	
Dianella longifolia var. *longifolia*		BW				Mm	Mu	Be															HB		
Dianella prunina						Mm							Gn	Gd					LC						
Dianella revoluta		BW	Li	Sp	Lo	Mm	Mu	Be	KC					Gd	Cu	PH		Da	LC	Ma	Wa	SH	HB	Wo	La
Stypandra glauca	Bd					Mm			KC																
Thelionema caespitosum																PH			LC	Ma		SH			
Thelionema umbellatum	Bd	BW							KC					Gd								SH			La
Poaceae																									
Agrostis aemula																							HB		
Agrostis avenacea		BW										Ka	Gn										HB		La
Agrostis billardieri																									La
Ancistrachne maidenii								Be																	
Anisopogon avenaceus	Bd	BW			Lo	Mm	Mu	Be	KC		An	Ka	Gn	Gd					LC	Ma		SH			
Aristida benthamii var. *spinulifera*		BW			Lo			Be																	
Aristida calycina var. *calycina*							Mu																		
Aristida ramosa var. *ramosa*																			LC				HB	Wo	La
Aristida vagans		BW		Sp	Lo			Be	KC		An	Ka	Gn					Da	LC		Wa	SH	HB	Wo	
Aristida warburgii		BW										Ka											HB	Wo	La
Austrofestuca littoralis	Bd																								La
Chionochloa pallida	Bd																								
Cymbopogon refractus		BW		Sp	Lo			Be	KC		An	Ka	Gn										HB	Wo	La
Cynodon dactylon		BW					Mu	Be														SH	HB		La
Danthonia linkii var. *linkii*								Be															HB		
Danthonia longifolia						Mm						Ka										SH			
Danthonia pilosa var. pilosa	Bd																								
Danthonia setacea																				Ma			HB		
Danthonia tenuior							Mu	Be	KC		An	Ka	Gn	Gd			DH	Da		Ma		SH	HB	Wo	La
Deyeuxia decipiens												Ka						Da		Ma					
Deyeuxia quadriseta	Bd											Ka													

Botanical name	Bd	BW	Li	Sp	Lo	Ma	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH	DH	Da	LC	Ma	Wa	SH	HB	Wo	La
Dichelachne crinita						Mm														Ma		SH	HB		La
Dichelachne micrantha		BW		Sp		Mm	Mu	Be	KC		An	Ka					DH	Da	LC	Ma		SH	HB		La
Dichelachne rara		BW						Be				Ka			Cu		DH	Da						Wo	
Digitaria brownii								Be																	
Digitaria didactyla	Bd												Gn									SH			La
Digitaria diffusa								Be																	
Digitaria parviflora	Bd	BW			Lo		Mu	Be	KC		An	Ka	Gn		Cu							SH		Wo	
Digitaria ramularis								Be																	
Echinopogon caespitosus	Bd	BW			Lo	Mm	Mu	Be			An	Ka	Gn	Gd			DH		LC		Wa	SH	HB	Wo	
Echinopogon ovatus							Mu	Be	KC								DH				Wa		HB		
Elymus scaber var. *scaber*																							HB		
Entolasia marginata	Bd	BW					Mu	Be	KC		An	Ka	Gn	Gd							Wa	SH	HB		
Entolasia stricta	Bd	BW	Li		Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu			Da	LC	Ma	Wa	SH	HB		La
Eragrostis benthamii				Sp				Be				Ka											HB		
Eragrostis brownii	Bd	BW			Lo	Mm	Mu	Be	KC		An	Ka	Gn					Da		Ma		SH	HB	Wo	La
Eragrostis leptostachya					Lo		Mu	Be															HB		
Hemarthria uncinata var. *uncinata*	Bd	BW																				SH			La
Imperata cylindrica var. *major*	Bd	BW		Sp	Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH	DH	Da	LC	Ma	Wa	SH	HB	Wo	La
Isachne globosa													Gn												
Microlaena stipoides var. *stipoides*		BW			Lo		Mu	Be			An	Ka	Gn	Gd	Cu		DH	Da	LC	Ma	Wa		HB	Wo	La
Oplismenus aemulus		BW				Mm		Be			An				Cu		DH	Da				SH			
Oplismenus imbecillis	Bd	BW				Mm	Mu	Be	KC	Ba	An	Ka	Gn		Cu			Da			Wa	SH			
Panicum effusum											An														
Panicum obseptum								Be			An														
Panicum simile	Bd	BW			Lo		Mu	Be	KC		An	Ka	Gn				DH		LC		Wa	SH	HB	Wo	La
Paspalidium albovillosum												Ka													
Paspalidium aversum																							HB		
Paspalidium distans	Bd	BW			Lo						An	Ka										SH			La
Paspalum distichum (*P. paspalodes*)																							HB		
Paspalum orbiculare												Ka													
Paspalum vaginatum (*P. distichum*)														Gd											
Phragmites australis	Bd	BW	Li			Mm	Mu	Be	KC				Gn	Gd					LC				HB	Wo	La

Plinthanthesis paradoxa												Ka													La
Poa affinis	Bd	BW	Li			Mm	Mu	Be	KC		An	Ka		Gd								SH			
Poa labillardieri																							HB		
Poa poiformis	Bd								KC																La
Poa queenslandica																					Wa				
Poa sieberiana var. *sieberiana*																							HB		
Sacciolepis indica																						SH			
Spinifex sericeus	Bd		Li																						La
Sporobolus elongatus															Cu										
Sporobolus virginicus var. *virginicus*				Sp	Lo	Mm	Mu	Be	KC				Gn	Gd					LC				HB		
Stipa mollis																									La
Stipa pubescens		BW			Lo		Mu	Be	KC		An	Ka									Wa		HB		
Stipa ramosissima								Be															HB		
Stipa rudis subsp. *rudis*	Bd																								
Tetrarrhena juncea		BW					Mu		KC			Ka		Gd											
Themeda australis	Bd	BW	Li		Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd		PH	DH	Da	LC	Ma	Wa	SH	HB	Wo	La
Zoysia macrantha									KC					Gd								SH	HB		La
Potamogetonaceae																									
Ruppia maritima																							HB		
Restionaceae																									
Empodisma minus		BW					Mu	Be	KC		An	Ka	Gn	Gd					LC	Ma		SH			La
Hypolaena fastigiata	Bd	BW						Be	KC				Gn							Ma		SH			La
Leptocarpus tenax		BW						Be	KC			Ka	Gn	Gd						Ma		SH			La
Lepyrodia anarthria							Mu																		
Lepyrodia scariosa	Bd	BW				Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd				Da	LC	Ma		SH		Wo	La
Restio complanatus		BW										Ka	Gn	Gd								SH			La
Restio dimorphus		BW							KC				Gn	Gd						Ma		SH			
Restio fastigiatus		BW						Be	KC			Ka	Gn	Gd						Ma		SH			
Restio gracilis		BW																							
Restio tetraphyllus	Bd	BW							KC				Gn							Ma		SH			La
Ripogonaceae (Smilacaceae)																									
Ripogonum album																PH									
Ripogonum fawcettianum	Bd																								

Botanical name	Bd	BW	Li	Sp	Lo	Ma	Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH	DH	Da	LC	Ma	Wa	SH	HB	Wo	La
Smilacaceae																									
Smilax australis	Bd	BW				Mm	Mu	Be	KC	Ba	An	Ka	Gn						LC				HB		
Smilax glyciphylla	Bd	BW	Li		Lo		Mu	Be	KC	Ba	An	Ka	Gn	Gd	Cu	PH		Da	LC	Ma		SH		Wo	La
Typhaceae																									
Typha domingensis																							HB		
Typha orientalis								Be	KC				Gn						LC			SH	HB		
Uvulariaceae (Liliaceae)																									
Schelhammera undulata	Bd	BW			Lo	Mm			KC	Ba	An	Ka	Gn						LC			SH			
Xanthorrhoeaceae																									
Xanthorrhoea arborea	Bd	BW	Li	Sp	Lo	Mm	Mu	Be	KC	Ba	An	Ka	Gn	Gd		PH			LC			SH			
Xanthorrhoea macronema	Bd	BW		Sp		Mm			KC																
Xanthorrhoea media	Bd					Mm	Mu	Be	KC			Ka	Gn	Gd		PH			LC	Ma	Wa	SH		Wo	
Xanthorrhoea minor													Gn		Cu						Wa	SH			
Xanthorrhoea resinifera (*X. resinosa*)		BW		Sp		Mm	Mu	Be	KC				Gn	Gd				Da		Ma		SH			La
Xyridaceae																									
Xyris complanata								Be																	
Xyris gracilis subsp. *gracilis*	Bd	BW		Sp	Lo			Be	KC				Gn	Gd								SH			La
Xyris gracillis subsp. *laxa*		BW		Sp					KC																
Xyris juncea								Be	KC																
Xyris operculata	Bd	BW		Sp		Mm	Mu		KC				Gn									SH			La

Discussion

Regional affinities

Sydney's Hawkesbury Sandstone vegetation is part of the world-renowned Sydney Basin sandstone flora. The flora represents probably the richest assemblage of xeromorphic species in eastern Australia and is a remnant of the xeromorphic assemblage that has spanned the continent in the past, especially in the south (Beadle 1981). Sandstone vegetation is part of Beadle's Eucalypt Woodlands and Forests on Soils of Low Fertility Chiefly on the Eastern Coastal Lowlands (Beadle 1981), and Coastal sandstone in particular of his *Eucalyptus gummifera–Eucalyptus racemosa–Eucalyptus sieberi* Alliance.

The forests on shale are part of Beadle's Tall Eucalyptus Forests of the Eastern Coastal Lowlands mostly on Soils of Higher Fertility, and generally attributable to his *Eucalyptus pilularis* Alliance, *Eucalyptus maculata* Alliance or *Eucalyptus saligna* Alliance.

The coastal sand dune remnants are probably the southern extremity of the north coastal Wallum country (and part of Beadle's *Banksia aemula* [=*B. serratifolia*] and related Alliances). Saltmarsh vegetation includes mixtures of tropical and temperate influences, while mangroves, with only two species in the Sydney area, reflect a decreasing species richness in southern Australia.

Historical changes

The vegetation map provides a picture of the distribution of vegetation at one point in the present time, and while it is obvious that these patterns have changed since 1788 as a result of clearing, it is not always appreciated that there has been considerable change in vegetation distribution as climate and geological patterns have changed over thousands and millions of years. Although our knowledge of these past conditions is still sketchy, we are beginning to see some of the patterns, at least of the more recent past. For example, during the last 1.8 million years (in the Quaternary Period) colder and warmer periods alternated (Chapman et al. 1982, Benson & Howell 1990a). Dune sands were blown inland from the coast where today's southern and eastern suburbs lie. About 20 000 years ago, during the coldest part of the last of the Pleistocene ice ages, the sea fell to its lowest level, 120–140 m below the present. As it rose again to reach its present level about 6 000 years ago, it drowned the coastal river valleys to form Broken Bay and Pittwater, Sydney Harbour, Botany Bay and Port Hacking, and swept up the offshore sands on to the modern beaches, sometimes damming smaller streams to form lagoons such as at Narrabeen and Dee Why.

Pollen and charcoal analyses of sediments from South Salvation Creek Swamp in Ku-ring-gai Chase National Park (Kodela & Dodson 1989) indicate that pollen influx has been dominated by local swamp species and dry sclerophyll heath and woodland taxa for the last 6 000 radiocarbon years, but that fluctuations in their abundances and/or distributions have occurred. These are likely to be the result of a combination of factors, including watertable fluctuations, seasonal drought, fire

activity, interspecific competition, the natural changing patterns in species distributions and the impact of Aboriginal and European people. None of these recent vegetation changes could be ascribed directly to climatic shifts, though changes in swamp and terrestrial pollen taxa around 2000 B.P. may indicate a drier climate than the present.

The impact of the Aborigines

Aboriginal people have been associated with the Sydney area for many thousands of years. Favoured living places were along the shorelines and along the Hawkesbury–Nepean River flats (Kohen & Lampert 1987, Kohen & Downing 1992).

On the coast plentiful supplies of seafood were supplemented with fruits, nectar, roots and tubers from plants growing on the extensive sand dunes and swamps that stretched from Bondi to Botany Bay and in the shrubby woodland and open-forest of the rocky harbour foreshores and nearby sandstone country (Benson & Howell 1990a). Sandstone gullies with rainforest-type vegetation would have provided further food sources, together with rocky overhangs and caves suitable for shelters and work sites.

It is hard to tell whether Aboriginal people altered the natural distribution or abundance of any food species either deliberately by planting, or accidentally by leaving remains associated with camp sites, nor is there evidence for changes in species abundance due to over-exploitation. However, Aboriginal people affected the vegetation by their use of fire and there has been a considerable amount written on this (e.g. see Nicholson, 1981). Many accounts contain very generalised statements often making reference to Aboriginal fire usage in Central and Northern Australia. Such usage does not necessarily apply to Southern Australia and, as far as the Sydney area is concerned, only limited observations were recorded before the effects of European settlement quickly overwhelmed Aboriginal society.

Possibly the most important point is that the Aborigines are likely to have managed different types of country differently. For example, they are likely to have burnt the open grassy understorey of the typical Cumberland Plain vegetation of western Sydney fairly frequently, probably with creeping or low-intensity fires. Such fires would have stimulated green shoots and provided favourable conditions for grazing animals. They would also have stimulated flowering in tuberous herbs such as orchids, which would have made them conspicuous. It is likely that such fires burnt at low intensity, as the trees were well-spaced and there would be limited fuel build-up. Such fires would be easily stopped by geographical features such as creeks, or indeed tracks, resulting in a patchy mosaic of burnt areas.

On the sandstone areas, however, it is likely that there were fewer fires, but that they burnt at higher intensities. Because of the shrubby nature of the vegetation, there would probably have been less game, and Aboriginal movement would have been more restricted by the topography than on the open Cumberland Plain. It seems less likely that deliberate burning would have been carried out on a broadscale basis, and more likely to have been localised around campsites and travelling routes to keep them clear, as well as around small-scale hunting sites such as individual

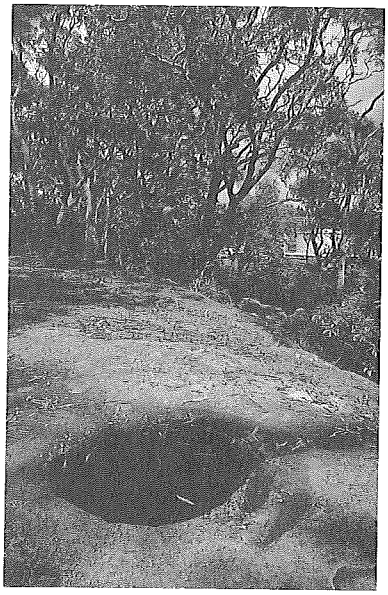


Figure 30. Signs of Aboriginal occupation, such as these axe-grinding grooves beside a rock pool, may still be found in bushland reserves within a few kilometres of the city centre.

trees. It is likely that hot summer fires would have been a feature of the sandstone areas, possibly on a 10–20 year cycle. On the sandstone the understorey is shrubby and very varied. Most species regenerate after fire, but some are killed, and it takes 3–10 years for recovery to reproductive maturity of most of these shrub species (Bradstock & Myerscough 1981, Benson 1985, Bradstock 1990). Clark & McLoughlin (1986) report similar findings for the Lane Cove valley catchment, where burning was likely to have been more frequent on the shale ridges (at 1–5 year intervals) than on the sandstone slopes (7–15 year intervals).

The impact of the Europeans

An idea of how the country around Sydney appeared to the British colonists comes through in this 1827 description by writer Peter Cunningham, not to be confused with Allan Cunningham, the botanist. 'In Cumberland, the land immediately bordering upon the coast is of a light, barren, sandy nature, thinly be sprinkled with stunted bushes; while from ten to fifteen miles interiorly, it consists of a poor clayey or ironstone soil, thickly covered with our usual evergreen forest timber and underwood. Beyond this commences a fine timbered country, perfectly clear of bush, through which you might, generally speaking, drive a gig in all directions, without any impediment in the shape of rocks, scrubs or close forest. This description of country commences immediately beyond Parramatta on one hand, and Liverpool on the other; stretching in length south easterly obliquely towards the sea, about forty miles and varying in breadth near twenty. The soil upon the immediate banks of the rivers is generally rich flooded alluvial, but in the forests partakes commonly of a poor clayey or ironstone nature, yet bearing tolerably crops, even without manure, at the outset'.

This extract clearly shows how the geology and its accompanying vegetation directed the pattern of settlement. The barren Hawkesbury Sandstone and aeolian sand deposits of the country around Port Jackson, particularly the present Eastern Suburbs, i.e. 'immediately bordering upon the coast', with its stunted sclerophyllous vegetation, was agriculturally useless to the settlers. 'Ten to fifteen miles interiorly' would have included country from Homebush and Bankstown, west to Parramatta and Liverpool which had Wianamatta Shale with ironstones and clay soil. This would have supported eucalypt open forests with shrubby understoreys including much Paperbark, *Melaleuca decora*. Beyond Liverpool and Parramatta is the 'fine timbered' Cumberland Plain, gently undulating to flat country with deep clay soils supporting an open grassy woodland community. The rich alluvial soils on the river banks are mentioned, but no reference is made of the tall open forest that this supported. Much of this forest, particularly on the Hawkesbury, had been cleared for agriculture by 1830.

From very early days some plant communitites were sought and cleared, while others were avoided. With the exception of small areas at Sydney (at Farm Cove) and at Rose Hill, the first intensively cultivated lands were the rich alluvial flats of the Hawkesbury–Nepean River at Windsor and Richmond. At the same time the grassy woodlands of the Cumberland Plain were beginning to be grazed. Sheep were the main grazing animals and were at first tended by shepherds until fencing made them redundant. The granting of land was followed by sporadic clearing of trees to encourage the growth of grass, then more extensive ring-barking or sapping. Extensive areas were often cleared of every tree. In 1844, for example, Mrs Meredith described how 'Homebush', halfway between Sydney and Parramatta, had been completely cleared of every tree for 1000 acres (Benson & Howell 1990a). Along the North Shore, and the northern suburbs from Epping to Hornsby, the tall open-forests of Blackbutt and Blue Gum were logged and then, because of the good soil and high rainfall, cleared to make way for dairy farms and orchards. In contrast, the shrubby forests and woodlands on the Hawkesbury Sandstone, because of their poor agricultural soils, remained largely undisturbed and were used only as sources of firewood, fence posts or small timber.

From the 1850s railway lines were built, radiating from Sydney. For engineering reasons these followed the most level routes. This was generally along the Wianamatta Shale country to the west and south, and later along the North Shore ridge to Hornsby. Suburbs followed the railways, and by the turn of the century extensive housing had spread from Sydney to Burwood in the west and to Hurstville in the south. Electric tramways made other areas accessible for housing, particularly in the harbourside Eastern suburbs, where the rows of stepped terrace houses which were built emphasize the steep nature of the original sandstone topography. Ferry services opened other harbourside sandstone sites to suburban development; for example Balmain, Mosman and the lower North Shore.

The North Shore railway, the car and the Sydney Harbour Bridge made the North Shore area increasingly accessible. Its remnant tall Blackbutts and Blue Gum trees, its milder climate, compared with the western suburbs of Sydney, and the adjacent

natural bushland gullies along the rugged Lane Cove River valley and upper Middle Harbour have made this one of the most sought after of Sydney`s suburban areas. Particularly since the Second World War, bushland on Hawkesbury Sandstone has been increasingly cleared for suburban housing though there has been an increasing interest in retaining native vegetation as urban bushland. By contrast, and mainly because of the gentler topography of the country and lack of obviously colourful shrubs, bushland on the shale areas of western Sydney has been cleared for suburban development with little recognition given to any native plants that manage to survive.

Rare or endangered species

The occurrence of species in the major conservation areas (Table 4) gives a measure of the floristic richness of the map sheet area. For example, 566 native species and 82 exotic species have been recorded from Ku-ring-gai Chase National Park (Thomas & Benson 1985a). Seventy-eight significant plant species are listed for the Sydney map sheet area (Table 5), forty-one of which are listed as nationally rare or endangered species (Briggs & Leigh 1988) or of regional significance. Species listed are either rare, threatened or of botanical significance in terms of geographic distribution. The list contains species of varying rarity and conservation status: for example, *Allocasuarina portuensis* is a recently discovered species restricted to Sydney Harbour National Park; a number of the *Darwinia* species have locally restricted distributions; and *Tetratheca juncea* originally occurred in the Carlton to Undercliff area but is now almost certainly extinct there (Payne 1993). *Lampranthus tegens*, possibly originating in South Africa but not able to be equated with any known African species, therefore needs protection of populations here (Benson & McDougall 1993). Other species are restricted to fragments of almost totally cleared vegetation types, e.g. Eastern Suburbs *Banksia* scrub. Vegetation surveys for major conservation reserves generally include specific lists for those areas (e.g. Thomas & Benson 1985a, b).

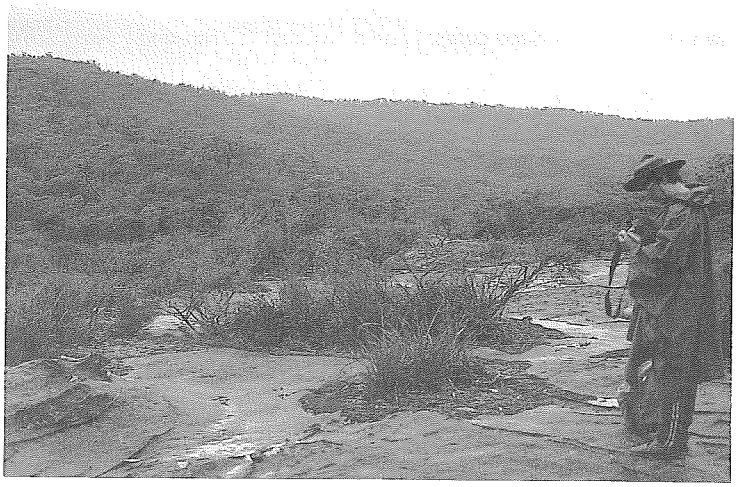


Figure 31. The rare plant *Kunzea rupestris* is confined to a few rock platforms in north-western Sydney.

Table 5. Species of particular conservation significance within the Sydney 1:100 000 map sheet area

Species listed here are either rare or threatened, or of botanical significance in terms of geographic distribution or localised populations disjunct from other occurrences. Localities refer to Sydney map sheet occurrences. Conservation codings are from Briggs & Leigh (1988) with current ROTAP updatings. Nth = northern, Sth = southern, NP = National Park, NR = Nature Reserve

Family/species	Habitat/locality	Significance
Aizoaceae		
Lampranthus tegens	Saltmarsh, Homebush Bay	Only known wild populations of this species (Benson & McDougall 1993)
Apiaceae		
Lilaeopsis polyantha	Dee Why Lagoon	Local population
Platysace clelandii	Muogamarra NR, Marramarra Creek	2RCa
Platysace stephensonii	Ridgetop, Deep Creek	3RC-
Araliaceae		
Astrotricha crassifolia	Woy Woy, Warrah	Local endemic
Casuarinaceae		
Allocasuarina diminuta	Kingsford	Local disjunct population
Allocasuarina nana	Ridgetop, Deep Creek	Local disjunct population
Allocasuarina portuensis	Nielsen Park	2ECit, local endemic
Chenopodiaceae		
Halosarcia pergranulata subsp. *pergranulata*	Saltmarsh, Homebush Bay	Local disjunct population
Convolvulaceae		
Wilsonia backhousei	Saltmarsh, Homebush Bay	Local population, rare
Dilleniaceae		
Hibbertia nitida	Thornleigh, Garigal NP, Oatley	2RC-
Hibbertia virgata	Sand dunes, Eastern Suburbs	Nth-limit
Epacridaceae		
Epacris purpurascens var. *purpurascens*	Gosford–Sydney	2KC-, local endemic
Euphorbiaceae		
Bertya brownii	Katandra, Mona Vale	2RC-, Sth-limit
Pseudanthus pimeleoides	Open-forest, ridges, Terrey Hills	Local populations, rare
Fabaceae		
Acacia bynoeana	Pennant Hills, Northbridge, Mosman, Cooks River	3VC-, probably locally extinct
Acacia quadrilateralis	Malabar	Sth-limit, locally extinct
Acacia pubescens	Bankstown, Belmore, Flemington, Rookwood	2VCa

Daviesia umbellulata	Pittwater	Rare local population
Mirbelia speciosa	Marramarra, Ku-ring-gai	Uncommon
Pultenaea dentata	Coastal heath, La Perouse Nth-limit	Local disjunct population
Pultenaea hispidula	Belrose, Allambie, shale/lateritic soils	Local populations, uncommon
Pultenaea pedunculata	Yennora	Local population, probably extinct in NSW
Pultenaea viscosa	Open-forest, Pennant Hills Park	Rare
Goodeniaceae		
Dampiera scottiana	Marramarra	Local disjunct population Nth-limit
Haloragaceae		
Gonocarpus salsoloides	North Head, Rose Bay, La Perouse	3RCa, local populations
Haloragodendron lucasii	Barra brui	2ECi, local endemic, rare
Lamiaceae		
Prostanthera denticulata	Lower hillslopes, Ku-ring-gai Chase NP Garigal NP	Local endemic, uncommon
Loganiaceae		
Logania pusilla	Muogamarra, Katandra	Local populations, rare
Myrtaceae		
Angophora crassifolia	Ridgetop, Deep Creek Frenchs Forest	2RCa, local endemic
Darwinia biflora	Hawkesbury River–Port Jackson	2VCa, local endemic
Darwinia diminuta	Terrey Hills–Manly–Sutherland–Bulli	3RCi, local endemic
Darwinia leptantha	Coastal heath, North Head–Cronulla	Local disjunct population
Darwinia peduncularis	Hornsby–Hawkesbury River	3RCi, local disjunct populations
Darwinia procera	Gosford–Manly	2RCa, local endemic
Eucalyptus acmenoides	Wianamatta Shale, Galston, Ryde	Rare, Sth-limit
Eucalyptus camfieldii	North Head, Killara, Hornsby, Ku-ring-gai Chase NP, Dural	2VCi, local populations
Eucalyptus capitellata	Residual clay cappings Brisbane Water NP St Ives, Allambie Heights	Local populations, now uncommon
Eucalyptus luehmanniana	Heath on sandstone, northern Sydney	2RCa, local populations
Eucalyptus robusta	Swamp-forest, Gosford, Pittwater	Local populations, now rare

Eucalyptus scias	Pittwater–Warringah	Local populations, rare
Kunzea rupestris	Canoelands, Ku-ring-gai Chase NP	2VCi, local endemic
Leptospermum deanei	Marramarra Creek, Pennant Hills Park, Middle Harbour Creek	2V, local endemic
Melaleuca deanei	Dry scrub, Hornsby, Pennant Hills Park, Lane Cove, Garigal NP, Earlwood	3RC-, local populations
Micromyrtus blakelyi	Rocky ridges, Muogamarra NR, Marramarra NP	2VCi-, local endemic
Syzygium paniculatum	Balgowlah, Wolli Creek	3VCi, local populations
Proteaceae		
Banksia aemula	Pleistocene sand, Bouddi, North Head, La Perouse	Local disjunct populations, southern limit
Grevillea caleyi	Terrey Hills to Belrose	2ECi, local endemic
Grevillea linearifolia (narrow-leaved form)	Marramarra, Arcadia	Local form
Hakea bakeriana	Marramarra	Rare, Sth-limit
Persoonia hirsuta	Deep Creek	3KCi
Persoonia mollis subsp. *maxima*	Hornsby	2E, local endemic subspecies
Symphionema paludosum	Brisbane Water NP, Belrose	Local populations, uncommon
Rutaceae		
Asterolasia elegans	Moist forest, north of Maroota	2ECi, restricted local endemic
Boronia floribunda	Open-forest, Pennant Hills Turramurra, Garigal NP	Uncommon
Boronia fraseri	Ku-ring-gai Chase NP Marramarra NP	2RCa, local endemic
Boronia serrulata	Brisbane Water, Arcadia, Ku-ring-gai Chase NP	2RC-, rare, once common in northern Sydney
Zieria involucrata	Marramarra Creek	2RCa
Sterculiaceae		
Lasiopetalum joyceae	Ku-ring-gai Chase NP, Arcadia	2RC-, local endemic
Lasiopetalum macrophyllum	Marramarra, Ku-ring-gai	Uncommon
Rulingia hermaniifolia	Coastal heath, Bouddi–Cronulla	3RCa, Nth-limit, rare
Tremandraceae		
Tetratheca glandulosa	Wisemans Ferry–Port Jackson	2VC-, local populations, Sth-limit
Tetratheca juncea	Sandstone, Carlton–Tempe, Rookwood	3VCi, Sth-limit, locally extinct
Tetratheca neglecta	Sandstone, Arncliffe–Como	3RC-, rare, Nth-limit

Monocotyledons		
Anthericaceae		
Alania endlicheri	Moist cliff-faces, Arcadia	Local population
Araceae		
Typhonium eliosurum	Patonga Creek	3RC-, rare
Cyperaceae		
Baumea muelleri	Damp heath, Katandra, Oxford Falls	Sth-limit
Gahnia filum	Saltmarsh, Georges River	Nth-limit
Lomandraceae		
Lomandra brevis	Ku-ring-gai Chase NP, Deep Creek, Kogarah	2RC-
Lomandra fluviatilis	Marramarra Creek, Deep Creek	3RCa
Orchidaceae		
Arthrochilus prolixus	Avalon	Rare local population, southern limit
Caladenia tesselata	Berowra, Castlecrag, Tempe, Penshurst	3V, probably locally extinct
Corybas undulatus	St Ives, Frenchs Forest	3KC-, probably locally extinct
Cryptostylis hunteriana	Ku-ring-gai Chase NP	3VC-
Genoplesium baueri	Ku-ring-gai Chase NP, Deep Creek	3RC-
Sarcochilus australis	Marramarra	Uncommon
Poaceae		
Ancistrachne maidenii	Berowra Creek	2KC-, local endemic
Deyeuxia appressa	Saltpan Creek, Killara	2E, local endemic

Conservation of vegetation

Despite the impact of the city of Sydney and its suburban sprawl, a surprising amount of natural vegetation has managed to survive. This includes large parklands on the edge of the suburban areas and many small patches within them. Survival has mainly been fortuitous, rather than planned. Because of the extent of the Hawkesbury Sandstone with its very limited agricultural capacity, many areas have remained uncleared, much as Crown land during the agricultural expansion of the nineteeth century.

The obvious attractiveness of the Hawkesbury Sandstone landscape scenery and flora and the relative uselessness of the land for farming led to pressure from the early and farsighted 'preservationists', in particular Eccleston du Faur, for the establishment of Ku-ring-gai Chase in 1892, Sydney's second major conservation area (following National Park (later Royal N.P) dedicated in 1879 for similar reasons). Lane Cove River National Park followed. Muogamarra Nature Reserve began as a private

'nature reserve' and was enlarged with Crown land. Marramarra National Park and Davidson State Recreation Area (now part of Garigal N.P.) were formed out of the considerable reserves of Crown land still available up to the 1980s. Similarly, the Commonwealth Government's holding of land on Sydney Harbour and Botany Bay for defence purposes inadvertently preserved much land that could have been built over but which was to become the nucleus for Sydney Harbour National Park. The rugged nature of the Hawkesbury sandstone landscape also resulted in small parks and reserves often being left in housing subdivisions in inaccessible sites.

Elsewhere the native vegetation disappeared. On the Wianamatta Shale soils woodland was cleared for grazing and agriculture, and then for suburban housing. Similar suburban development replaced the vegetation on the Eastern Suburbs sand dunes. Even with the far-sighted setting aside of Centennial Park, only a trifling patch of the original *Banksia* scrub survives, in the Bird Sanctuary. More extensive remnants survive at Long Bay and La Perouse, again largely because of Commonwealth Government control for military purposes. It is hoped these bushland areas will eventually be formally conserved. Reclamation programs to turn the mangrove and estuarine vegetation of the Parramatta and Georges Rivers into playing fields have been promoted for most of this century and have only just been stopped in time, leaving some remnants such as at Homebush Bay. Changes such as the cessation of landfill of mangroves have come about because of increased public awareness of the value of natural vegetation and the need to maintain biological diversity. This concern is now also directed towards the management and maintenance of reserved areas. There are two particularly pressing problems — exotic weed invasion and fire.

The invasion of urban bushland by exotic weed species was specifically highlighted by Adamson and Buchanan (1974), though the spread of weeds along watercourses into undisturbed areas is mentioned by Pidgeon (1938). *Ligustrum sinense* and *Ligustrum lucidum* (Privet species), *Lantana camara, Tradescantia albiflora* and a host of other weed species of garden escape origin, are able to invade normally resistant natural bushland where there has been some form of disturbance, particularly involving the addition of soil nutrients (Clements 1983). Characteristically these weeds form extensive thickets along creeks and drainage lines. The best method of restricting weed proliferation is to stop nutrients entering the soil from stormwater run-off and from creek floodwaters, and ways of reducing this have been suggested by Bliss et al. (1983). A method of hand-weeding was originated by Joan and Eileen Bradley in Mosman bushland (Bradley & Bradley 1966–74, Bradley 1971) and has been successfully developed as part of a bushland management strategy by the National Trust and other groups (National Trust 1991 — this also includes a list of its bushland surveys, Buchanan 1989, Bradley 1988).

The fragmentation of bushland in suburban areas and the potential fire hazard has led to the increased use of regular controlled burning for fuel reduction in some areas and decreased use of fire in others (Clark & McLoughlin 1986). Most of Sydney's native vegetation is adapted to fire, but at different frequencies for the different types and communities, because of aspect and topography. Although some species may regenerate well after fire, other species may be destroyed by frequent fire

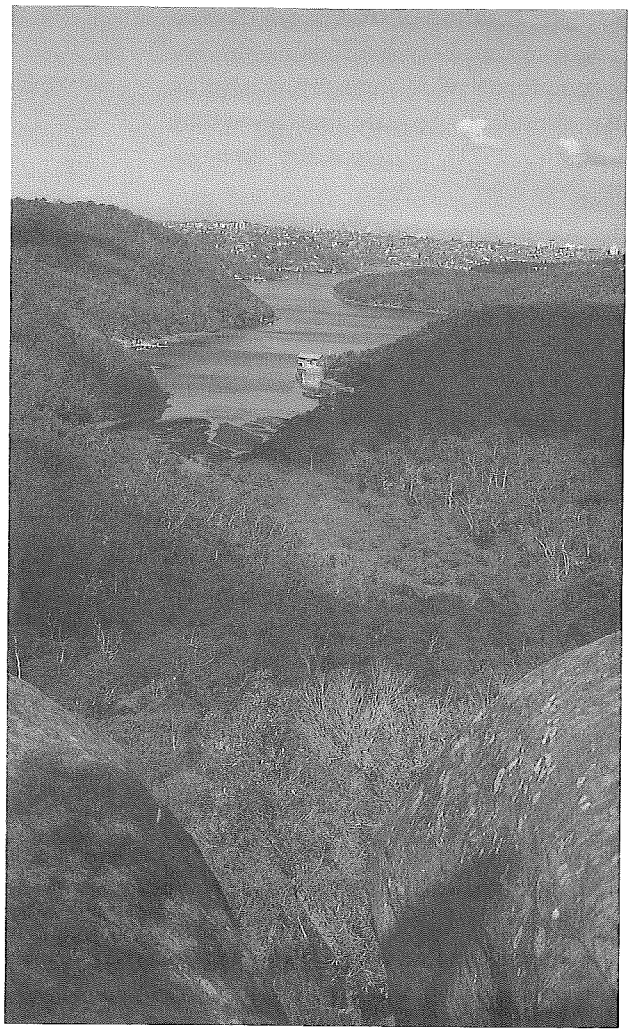
which does not allow adequate time intervals for the build-up of seed banks (Benson 1985, Bradstock 1990). This means that the length of time between fires needed for species survival varies from community to community. Fire intensity is also an important factor; low intensity burns may not stimulate adequate native seedling regeneration while allowing weed growth (Bradley 1971). Different fire management approaches are therefore needed for different communities.

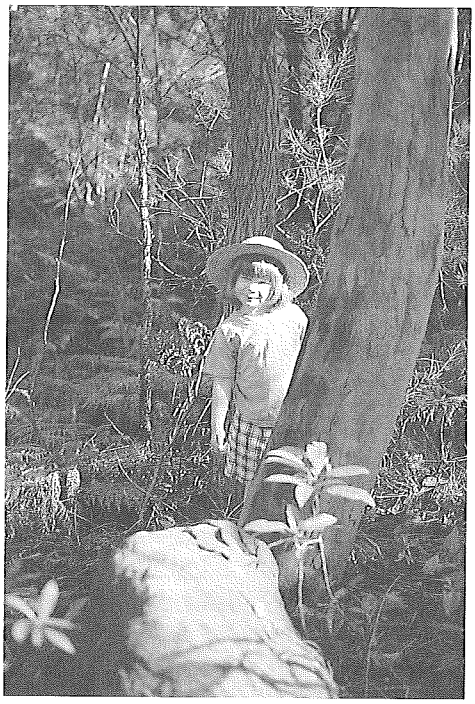
In the absence of fire, there is a tendency for species of wetter sites, such as *Pittosporum undulatum*, to predominate at the expense of those requiring fire for germination, such as members of the Fabaceae (Auld & O'Connell 1991). To achieve a balance between these factors, a long-term management program will need information based on observations on the behaviour of a wide range of species, together with a range of management options including the use of fire and selective land clearing.

The future

Sydney's bushland setting provides a major contribution to the individual character of the city. But bushland is still threatened by direct destruction for urban and recreational development, and indirectly by nutrient run-off, weed invasion, and shortsighted management. Bushland is particularly vulnerable to the 'tyranny of small decisions'. In the face of this, much of the responsibility for ensuring careful management of urban bushland has fallen to local residents and organisations keen to maintain the local identity of bushland areas. Public awareness of the need for protection and professional management of bushland is increasing, and recognition of its value needs to be supported by government policies and planning provisions at federal, state and local levels.

Such management involves the employment of professionally trained staff and the development of appropriate bushland and catchment management techniques. Management will often be constrained by lack of knowledge on the responses of plant species and vegetation. Additional supporting research is needed, as researchers are currently faced with a wide array of problems needing investigation. In the meantime, decisions will need to be made in terms of the reversibility of actions and keeping future options open. Successful conservation aims to maintain current levels of biological diversity, and this must be seen as a guiding principle.





Figures 32 & 33. Bushland slopes and gullies near urban areas provide a unique opportunity for Sydneysiders to grow up experiencing the natural world within the context of a city.

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