

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

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Abstract

Keith*, D. A., & Benson, D. H. (*National Herbarium of New South Wales, Royal Botanic Gardens, Sydney, Australia* 2000) 1988. *The natural vegetation of the Katoomba 1:100 000 map sheet. Cunninghamia* 2(1): 107–143. — The composition and extent of the present natural vegetation in the area covered by the Katoomba 1:100 000 map sheet 8930 (lat. 33°30' – 34°00'S, long. 150°00' – 150°30'E) is described and mapped from aerial photography and field traverses. The structure, characteristic species and associated environmental factors for 32 map units with 45 plant communities are described. These include small areas of rainforest and eucalypt tall open-forest, extensive tracts of open-forest and woodland, and patches of sclerophyllous heath and sedge-swamp.

Vegetation patterns are influenced by geology (mainly sedimentary and metasedimentary with limited igneous rocks), soil types (mainly low nutrient acid soils with variable texture), physiography (dissected sandstone plateaux and deep gorges), and by trends in elevation (ranging from 100 m to 1360 m above sea level) and rainfall (ranging from 750 mm to 1450 mm per annum).

Significant plant communities and rare species are listed. Plant communities needing conservation protection occur particularly in the Coxs River valley while rare localized species are concentrated in the wet habitats of the Upper Blue Mountains. Future management problems will relate to stream pollution and exotic weed invasion from increasing urban runoff, and changes in fire regimes near urban areas. There is a need for further botanical research into these problems.

Introduction

'Lofty, densely-timbered, mountainous ranges now appeared before us, peering over each other . . . their peculiar faces overhanging deep ravines as to seem to defy all further attempt to penetrate westerly.' Allan Cunningham (King's Botanist) 27th November 1823, quoted in Lee (1925).

Allan Cunningham's romantic vision from the slopes of Mt Tomah epitomises the outstanding elements of the Blue Mountains landscape: grand scenery and inaccessibility. His reference to 'lofty, densely-timbered, mountainous ranges', probably relating to forests on the basalt-capped peaks of the northern Blue Mountains, contrasts starkly with a later description of nearby sandstone vegetation — 'scanty and miserably stunted and gnarled timber' (Eccleston du Faur 1879). Such remarkable contrasts in vegetation occur within the area covered by the Katoomba 1:100 000 sheet.

The Katoomba 1:100 000 Vegetation Sheet (based on Katoomba 1:100 000 Topographic Sheet 8930, Division of National Mapping) is bounded by latitudes

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33°30' – 34°00'S and longitudes 150°00' – 150°30'E. It covers the Upper Blue Mountains, from Mt Wilson south to Lake Burragorang and the Coxs River, and west from Woodford to the Great Dividing Range. Elevation ranges from 100 to 1360 metres above sea level. This is the second sheet to be published in the Sydney Region Vegetation Map Series (See Figure 1).

Native vegetation in Blue Mountains National Park and Warragamba Catchment Area covers most of the map sheet. The main population centres are the chain of Blue Mountains towns along the Western Railway Line and Great Western Highway, including Woodford, Lawson, Wentworth Falls, Leura, Katoomba, Blackheath and Mt Victoria. There are small rural settlements in the Coxs River valley.

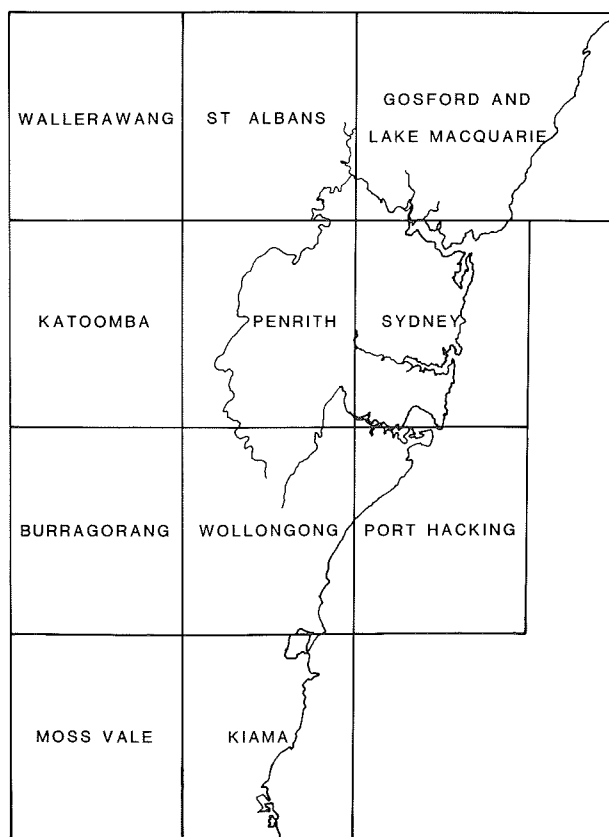


Figure 1. Key map for the 1:100 000 sheets in the Sydney Region Vegetation Map Series.

Climate

Average maximum temperatures relate strongly to altitude (Bureau of Meteorology 1979). Average January maxima are highest (28°C) around Lake Burragorang (150 m), decreasing to 23°C at Mt Victoria (1050 m) and 22°C at Jenolan State Forest (1150 m). Average minimum temperatures generally decrease

from east to west. Average July minima range from 2 to 3°C at Wentworth Falls (900 m) to 0°C at Jenolan State Forest (1150 m). Temperatures as low as -3°C and -11°C have been recorded for Katoomba and Jenolan Caves respectively.

Winds from the west or northwest predominate all year round, though there are significant easterly and northeasterly winds during the summer months, November to April (data from Mt Victoria, Bureau of Meteorology 1979).

Rainfall patterns relate to elevation and distance from the coast (Bureau of Meteorology 1979). Average annual rainfall increases from 1100 mm near Woodford to 1400 mm at Leura and 1450 mm at Mt Tomah. There is a rainshadow effect in the Coxs River Valley, Little Hartley and Bowenfels receiving 750 mm and 780 mm respectively. Further west, at higher elevation, Jenolan State Forest receives 1150 mm annually. The driest months are generally July to September and the wettest are December to March, although the drier areas show little seasonality (Table 1).

Fogs occur frequently on the higher Blue Mountains, with Katoomba and Mt Victoria recording 55 and 90 fog days per year respectively. Frosts occur on 35 to 40 days of the year, mostly between April and November, half of these are regarded as 'severe' (Bureau of Meteorology 1979). Snow falls most frequently in July and August, Katoomba and Mt Victoria have an average of 3 and 10 snow days respectively per year.

Table 1: Average monthly rainfall (mm).

Station (altitude)	J	F	M	A	M	J	J	A	S	O	N	D	Total
Leura P.O. (975 m)	158	177	146	131	106	132	87	75	74	93	100	125	1401
Little Hartley (810 m)	79	73	69	59	55	66	62	53	45	55	59	73	748
Jenolan S.F. (1158 m)	113	115	99	81	86	117	80	93	71	96	93	105	1149

Geology and geomorphology

'These walls or cliffs rise . . . perpendicularly above the road, and their summits, broken and fissured in various fantastic forms, exactly resemble a ruined castle crowning the brow of the sheer precipice, with here and there a stunted tree or graceful shrub growing from crevices in the dark rock.' Louisa Ann Meredith at Hassans Walls (Meredith 1844).

The map sheet area lies on the western edge of the Sydney Basin. The Great Dividing Range traverses its northwestern edge and almost all of the area drains into the Hawkesbury-Nepean River System. Major watercourses include: Coxs River, flowing south then east into Lake Burragorang; Jenolan, Kanangra and Kowmung Rivers which drain the southwestern part of the area and join the Cox; the Kedumba River, flowing south into Lake Burragorang; and the Grose River which drains most of the Blue Mountains plateau and flows east to join the Nepean River. The highest parts of the area are in the southwest, with Mt Bindo (west of Hampton) reaching 1363 m and Ben Lomond (on the Boyd Plateau) reaching 1330 m.

The Blue Mountains, an extensive, dissected Triassic sandstone plateau, dominate the eastern half of the map sheet area. They rise from 500 to 600 m on

the eastern edge of the map area to 1100 m near Mt Victoria, terminating in a spectacular north-south line of cliffs along the eastern side of the Hartley, Kanimbla and Megalong Valleys (Bembrick 1980). Hawkesbury Sandstone covers the eastern margin of the map area, with residual Wianamatta Shale capping the Bilpin Ridge and outcropping on Mt Tomah. Strata of the Narrabeen Group make up the main plateau. These consist of massive sandstone strata interbedded with narrow claystone bands, outcrops of which are associated with the formation of swamps in headwater valleys (Holland 1972).

Major peaks in the Blue Mountains, including Mt Wilson, Mt Haystack, Mt Tomah, Mt Bell, Mt Banks, Mt Caley and Mt Hay, are capped by remnants of Tertiary basalt. In a few places, most notably at Murphys Glen, diatremes or volcanic necks have intruded through the sandstone, though these are more common to the north and east of the map sheet area (Crawford *et al.* 1980).

At the base of the Triassic sandstone escarpment the Permian Illawarra Coal Measures are exposed. These include shales, sandstones, conglomerates and chert with coal and torbanite seams (New South Wales Department of Mines 1966). The rapid weathering of these softer rocks undercuts the more resistant Triassic sandstones which collapse along joint lines to leave spectacular cliffs. While the Illawarra Coal Measures are mostly restricted to a narrow band below the cliff lines, the Permian Shoalhaven Group, which underlies the coal measures, outcrops over larger areas beyond the escarpment as well as a number of residual cappings in the west of the area. Shoalhaven Group rocks include shales, conglomerates and sandstones. Both Permian rock types are exposed in the deeply entrenched Grose River gorge.

There is a large Carboniferous igneous intrusion, the Kanimbla Batholith, on much of the northwestern part of the map area, including the upper Cocks River valley and three outliers in the southwest. Uniform weathering of the adamellites, granites and granodiorites of this unit has given rise to the characteristically undulating 'granite country'. Smaller intrusions of gabbro and diorite are found in the western part of the map area (New South Wales Department of Mines 1966).

The Devonian Lambie Group underlies the Permian sediments, occupying a large area in the southwest of the map area. Smaller outcrops are exposed west of Lithgow, south of Hartley and in the Kedumba Valley. The quartzites, sandstones, siltstones and claystones of this group have been sculptured into very rugged country with mazes of deep gorges, steep slopes and narrow ridges. The Kanangra Gorge, for example, is up to 500 m deep.

The oldest rocks in the area are Devonian rhyolites and rhyo-dacites and Silurian tuff, limestones, siltstones, phyllites and slates which both outcrop in the Boyd Plateau-Jenolan Caves area (New South Wales Department of Mines 1966).

Soils

Soil types in the area covered by the Katoomba map sheet are described by Hamilton (1976). Soils derived from Triassic Sandstones in areas of high relief are grey-brown and yellow-brown uniform sands. Sandy yellow leached gradational soils (with ironstone gravel) are found on flatter parts of the plateau, particularly from Katoomba to Mt Victoria. These 'sandstone soils' are rapidly permeable, very acid and very infertile.

Hardsetting loamy red and yellow texture-contrast soils (with ironstone gravel) are found on remnants of Wianamatta Shale on the Bilpin Ridge. These are moderately to slowly permeable, very acid and relatively infertile. Small areas of Tertiary basalt on the plateau have given rise to brown and red friable clay loams with moderate to slow permeability, slightly acid to neutral with high fertility.

Hardsetting yellow texture-contrast sandy loams occur on the Permian

sandstone, shale and conglomerate deposits. These are moderately to slowly permeable, acid and relatively infertile.

Red-brown gradational sandy loams in the Coxs River valley are derived from Carboniferous granites. These soils are deep, rapidly permeable in their upper horizons, acid and have low to moderate fertility.

On the Devonian and Silurian substrates in the southwest of the map area are yellow leached gradational loams with moderate to slow permeability, acid with low fertility.

Land Use

Aborigines first occupied the Blue Mountains at least 14 000 years ago, and at various times three tribes may have used the area: the Gangangara people from the south; the Wiradjuri from the west; and the Daruks from the east (Robertson 1985).

Today much of the country still has natural vegetation and is protected within Blue Mountains National Park which covers most of the eastern half of the map area. Additional natural areas are found in Kanangra-Boyd National Park and Warragamba Catchment Area in the south, most of which is managed jointly by the National Parks and Wildlife Service and the Metropolitan Water, Sewerage and Drainage Board. A ribbon of tourist resorts and residential development has grown along the Main Western Railway.

Early European travellers found 'a wild and barren country' (Louisa Ann Meredith) though 'quite novel and extremely magnificent' (Charles Darwin). Less flattering was Barron Field, who at Blackheath saw hills, 'thrown together in a monotonous manner, and their clothing is very unpicturesque — a mere sea of harsh trees' (all quoted in Mackness 1980). The spectacular landscapes of the Blue Mountains have inspired tourists from the mid-nineteenth century until the present.

There has been grazing in the Coxs River valley since the first road across the Blue Mountains was constructed in 1815. Orchards are a minor agricultural use on the Bilpin Ridge and Shipley Plateau.

Major forestry operations are associated with extensive pine plantations in Hampton and Jenolan State Forests. Native forests here, and on the Boyd Plateau (formerly Konangaroo State Forest), have been heavily logged, mainly for *Eucalyptus fastigata*.

Underground mining of the Illawarra Coal Measures is a major industry in the Bell-Lithgow area and there are small abandoned mines where the coal seams outcrop below the escarpment as far south as Mt Solitary. There are also major sand extraction sites on the plateau at Clarence.

The vegetation

(i) Methods

The vegetation has been classified into structural forms using the system proposed by Specht (1970). The structural forms are further subdivided into plant communities characterized by the dominant species. An alphanumeric code is used to identify individual map units. The numeric code represents the structural form of the plant community as determined from Specht (1970); (see Benson 1986) and the alphabetic code represents the characteristic species. The codes used are consistent throughout the Sydney region 1:100 000 vegetation map series,

allowing the communities to be cross-referenced between maps. This system has been used in Queensland for the Moreton Region Vegetation Map Series (e.g. McDonald & Whiteman 1979).

Areas of vegetation with similar structural and floristic characteristics were grouped on the basis of aerial photopatterns, current geological mapping and limited field checking to form the map units. Black and white 1979/80 aerial photography by the New South Wales Department of Lands (approx. scale 1:40 000) was used. Only present day (that is, 1979/80) natural vegetation is mapped, though comments on the original vegetation of some cleared areas are provided. Compilation maps were prepared at 1:25 000 scale and subsequently reduced to 1:100 000 scale. Dye-line copies of the 1:25 000 compilation map sheets (Hartley, Mt Wilson, Hampton, Katoomba, Jenolan, Jamison, Kanangra and Bimlow) are available on request from the Royal Botanic Gardens, Sydney.

There are a number of constraints in reducing the complex pattern of natural vegetation to a map format. The map units recognized are not all of equivalent rank. This is because a number of them are essentially land units made up of several plant communities associated with a particular geological or physiographic type (e.g. map unit 10a), whereas others are more clearly plant associations (*sensu* Beadle & Costin 1952; e.g. map unit 26a). Generally the term 'plant community' is used for the basic vegetation unit. Where vegetation boundaries are relatively distinct, they are mapped with an unbroken line and where more diffuse, with a broken line. Communities have also been provided with common names based loosely on habitat and composition, for ease of reference.

Fieldwork was mostly conducted during the period 1983 to 1985. The descriptions of map units include notes on habitat, vegetation structure and the characteristic species of major strata. Reference has been made to any available descriptions or species lists.

Botanical names are those currently recognized at the National Herbarium of New South Wales. Recent nomenclatural changes include a revision of *Banksia* (George 1981), *Tristania* and allied genera (Wilson & Waterhouse 1982) and the separation of *Allocasuarina* from *Casuarina* (Johnson 1982).

General descriptions of the vegetation of Triassic sandstone areas were included in Pidgeon's (1937, 1938, 1940, 1941) vegetation study of the Central Coast of New South Wales. A broader view of vegetation patterns can be obtained from Beadle (1981). There have also been short studies done for environmental impact assessment work or university studies, copies of which are often very difficult to obtain. Dyson (1969), for example, surveyed the forests of the inner Warragamba Catchment, Black (1976, 1982) described and mapped the vegetation of the Boyd Plateau, while Duncan (1974) studied the vegetation of Kanangra Walls and Ti-Willa Plateau. An extensive species list for the map sheet area is being compiled by the National Herbarium and is available on request (for other lists see Pickard 1972, Bryant & Benson 1981 and Keith 1988). More generalized accounts of the vegetation of the Blue Mountains include those of Armstrong (1981) and Morrison (1985).

A summary of the plant communities recognized here, their structural formation, main canopy species, altitudinal range and geological substrate are given in Table 2. The vegetation map sheet is located inside the back cover.

(ii) Descriptions of map units

The map unit numbering system applies to the complete vegetation map series. Missing numbers are those used for plant communities that are not found on the Katoomba sheet.

Map unit 6c 'Glen Forest'.

Tall open-forest: *Eucalyptus deanei*-*Syncarpia glomulifera*.

In the lower Blue Mountains there are a number of diatremes, small amphitheatre-shaped valleys formed from eroded volcanic necks of Jurassic age, described in detail by Carne (1908). Murphys Glen is the best example on the Katoomba 1:100 000 map sheet, though others occur on Kings and Bimlow Tablelands. The soils in diatremes are deep, moist, sandy loams, derived from the mixing of sandstone and basalt or breccia substrates. This results from ring-faulting and collapse of the sandstone wall-rocks into the volcanic intrusion and the subsequent deposition of sand eroded from the surrounding sandstone ridges (Crawford *et al.* 1980).

The vegetation is tall open-forest dominated by trees of *E. deanei* and *Syncarpia glomulifera* with some *Angophora costata* ssp. *costata*. The understorey has tall shrubs of *Notelaea longifolia*, *Acacia obtusifolia*, *Pultenaea flexilis*, *Hakea dactyloides* and *Polyscias sambucifolia*. Climbers and scramblers are common including *Smilax australis*, *Tylophora barbata*, *Eustrephus latifolius*, *Cissus hypoglauca*, *Hibbertia dentata*, *Clematis aristata* and *Comesperma volubile*. The ground cover is dominated by *Culcita dubia*, *Dianella caerulea*, *Lomandra longifolia* and *Pteridium esculentum*.

Map unit 6d 'Camden White Gum Forest'.

Tall open-forest: *Eucalyptus benthamii*-*E. deanei*.

This community is restricted to the sandy loams of the narrow alluvial plain of the lower Kedumba River. *Eucalyptus benthamii* and *E. deanei* are dominant with the occasional *Angophora floribunda*. The understorey includes large shrubs of *Acacia parramattensis*, *A. filicifolia* and *Leptospermum flavescens* with a ground cover of *Imperata cylindrica*. Smaller, unmapped areas of Community 6d include a regenerating stand on cleared land at Reedy Creek and a small stand at Hayes Crossing on Cedar Creek. Other stands along the lower Coxs River were inundated following the construction of Warragamba Dam.

Eucalyptus benthamii was also originally found along the Nepean River, but with much of the Nepean Plain now cleared for agriculture, the *E. benthamii* community is known there only from Bents Basin near Wallacia where it occurs with *E. elata* (Benson 1985). A scattering of trees persists along the banks of the Nepean River between Wallacia and Camden.

Map unit 6g 'Moist Basalt Cap Forest'.

Tall open-forest: *Eucalyptus viminalis*-*E. blaxlandii*-*E. fastigata*.

'Upon entering the forest, the traveller is struck with the change in the appearance of the timbers from the Eucalypti [*sic*] of the open country, the stupendous size and extra-ordinary windings of the climbers . . . and with the magnificence of the tree ferns.' Allan Cunningham quoted in Lee (1925).

The Tertiary basalt caps of Mt Wilson, Mt Tomah, Mt Bell, Mt Banks, Mt Caley and Mt Hay in the Blue Mountains weather to a fertile clay-loam soil. At elevations of 800 to 1000 m this supports a tall open-forest on the summits and slopes, and rainforest (map unit 8c) in the moist, sheltered gullies, particularly those associated with the larger basalt areas of Mt Wilson and Mt Tomah.

In the tall open-forest on Mt Wilson *E. viminalis* and *E. blaxlandii* predominate with some *E. cypellocarpa*. On the other smaller peaks *E. viminalis* is replaced by *E. fastigata*, while *E. oreades* frequently inhabits more rocky slopes on the edges of the basalt.

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

Map unit	Structure	Main canopy species	Geology	Altitude	Habitat
6c	'Glen Forest' TALL OPEN- FOREST	<i>Eucalyptus deanei</i> <i>Syncarpia glomulifera</i>	Jurassic diatremes	<650 m	Amphitheatre- shaped gullies
6d	'Camden White Gum Forest' TALL OPEN- FOREST	<i>E. benthamii</i> <i>E. deanei</i>	Recent alluvium	<150 m	Banks of Kedumba River
6g	'Moist Basalt Cap Forest' TALL OPEN- FOREST	<i>E. viminalis</i> <i>E. blaxlandii</i> <i>E. fastigata</i>	Basalt caps	>800 m	Ridges and slopes of residual basalt
6h	'Escarpment Complex' TALL OPEN- FOREST	<i>E. deanei</i> <i>E. cypellocarpa</i> <i>Syncarpia glomulifera</i>	Illawarra Coal Measures	120-850 m	Escarpment slopes
			Shoalhaven Group	120-850 m	Undulating country below escarpment slopes
			Illawarra Coal Measures	120-850 m	Sheltered gullies on escarpment slopes
8c	'Montane Rainforest' CLOSED- FOREST	<i>Ceratopetalum apetalum</i> <i>Doryphora sassafras</i> <i>Quintinia sieberi</i>	Illawarra Coal Measures, Tertiary basalt	600-1000 m	Sheltered gullies on escarpment slopes. Also found on basalt caps
8d	'Kowmung Dry Rainforest' CLOSED- FOREST	<i>Toona australis</i> <i>Ehretia acuminata</i> <i>Brachychiton populneum</i>	Devonian Lambie Group	300-700 m	Sheltered lower slopes in deeply dissected Kowmung area
9a	'Shale Cap Forest' OPEN- FOREST	<i>Eucalyptus notabilis</i> <i>E. globoidea</i> <i>Syncarpia glomulifera</i>	Wianamatta Shale	<750 m	Ridgetop, Berambing to Bilpin
9i	'Blue Mountains Sandstone Plateau Forest' OPEN- FOREST	<i>E. sieberi</i> <i>E. piperita</i>	Narrabeen Group	800-1150 m	Dissected sandstone plateaux
9j	'Montane Gully Forest' OPEN- FOREST	<i>E. fastigata</i> <i>E. cypellocarpa</i> <i>E. dalrympleana</i>	Narrabeen Group	850-1100 m	Gorges and sheltered escarpment slopes
9m	'Megalong Forest' OPEN- FOREST	<i>Angophora costata</i> <i>E. punctata</i> <i>E. sieberi</i>	Shoalhaven Group	400-750 m	Undulating country below escarpment slopes
9n	'Montane Moist Forest' OPEN- FOREST	<i>E. fastigata</i> <i>E. dalrympleana</i> <i>E. viminalis</i>	Lambie Group, Carboniferous granites	>700 m	Steep slopes and moist sheltered gullies

Map unit	Structure	Main canopy species	Geology	Altitude	Habitat
9x	'River Oak Forest' OPEN-FOREST	<i>Casuarina cunninghamiana</i>	Alluvium	<800 m	Along major watercourses
10ag	'Sydney Sandstone Complex' OPEN-FOREST	<i>Angophora costata</i> <i>E. piperita</i> <i>E. agglomerata</i> <i>Syncarpia glomulifera</i>	Narrabeen Group, Hawkesbury Sandstone	<800 m	Dissected plateau in gullies
10ar	'Sydney Sandstone Complex' WOODLAND	<i>E. gummifera</i> <i>E. sclerophylla</i> <i>E. oblonga</i>	Narrabeen Group, Hawkesbury Sandstone	<800 m	Dissected plateau on ridges
10h	'Tablelands Grassy Woodland Complex' WOODLAND	<i>E. dives</i> <i>E. mannifera</i> <i>E. eugenioides</i>	Shoalhaven Group	>800 m	Undulating to hilly country
	WOODLAND	<i>E. pauciflora</i> <i>E. rubida</i>		>800 m	Valleys with frost hollows
	WOODLAND	<i>E. aggregata</i> <i>E. mannifera</i> <i>E. stellulata</i>		>800 m	Poorly drained depressions
10l	'Snow Gum Woodland' WOODLAND	<i>E. pauciflora</i> <i>E. dalrympleana</i>	Lambie Group, Carboniferous granites	>1100 m	Undulating country on Great Dividing Range
	WOODLAND	<i>E. pauciflora</i> <i>E. rubida</i> <i>E. stellulata</i>		>1100 m	Poorly drained hollows
10m	'Mount Walker Complex' WOODLAND	<i>E. macrorhyncha</i> <i>E. melliodora</i>	Devonian Lambie Group	>600 m	Rugged country around Mt Walker and south of Hartley
10o	'Yellow Box Woodland' WOODLAND	<i>E. melliodora</i> <i>E. viminalis</i>	Carboniferous granites	250–850 m	Coxs River Valley
10p	'Kowmung Wilderness Complex' WOODLAND	<i>E. tereticornis</i> <i>E. melliodora</i>	Devonian Lambie Group	<900 m	Dissected country of the lower Cox and Kowmung Rivers. Gullies and moist slopes
	WOODLAND	<i>E. fibrosa</i> <i>E. crebra</i> <i>E. eugenioides</i> <i>E. punctata</i>		Devonian Lambie Group	<900 m
10q	'Burratorang Ironbark Woodland' WOODLAND	<i>E. crebra</i> <i>E. eugenioides</i> <i>E. punctata</i> <i>E. fibrosa</i>	Shoalhaven Group	<500 m	Undulating country

Map unit	Structure	Main canopy species	Geology	Altitude	Habitat
	WOODLAND	<i>E. sclerophylla</i> <i>Angophora bakeri</i>	Shoalhaven Group	<500 m	Western aspect of ridges in Kedumba Valley
10r	'Residual Sandstone Woodland'				
	WOODLAND	<i>E. sieberi</i> <i>E. blaxlandii</i>	Shoalhaven Group	>900 m	Rocky, high altitude ridges
10s	'Montane Woodland'				
	WOODLAND	<i>E. radiata</i> <i>E. dalrympleana</i>	Lambie Group, Carboniferous granites, Shoalhaven Group	>900 m	Gentle slopes, ridges & undulating country
	WOODLAND	<i>E. ovata</i> <i>E. stellulata</i>			Poorly drained depressions
10t	'Mount Blaxland Complex'				
	WOODLAND	<i>E. sieberi</i> <i>E. pulverulenta</i>	Devonian metamorphic & igneous rocks	700-1000 m	Mt Blaxland, Wentworths Sugarloaf
10u	'Jenolan Granite Woodland'				
	WOODLAND	<i>E. punctata</i> <i>E. sp. nov. 'MAHEK'</i> <i>E. sieberi</i>	Carboniferous granites	300-1100 m	Steep north-facing slopes
17a	'Black Range Scrub'				
	OPEN-SCRUB	<i>E. mannifera</i> <i>Leptospermum myrtifolium</i> <i>L. sp. nov. 'A'</i> <i>Patersonia fragilis</i>	Devonian Lambie Group	1050-1150 m	Soaks on southerly aspects of Black Range
20a	'Newnes Plateau Shrub Swamps'				
	CLOSED-HEATH	<i>Leptospermum lanigerum</i> <i>Baeckea linifolia</i> <i>Grevillea acanthifolia</i> <i>Xyris ustulata</i>	Narrabeen Group	>1000 m	Shrub-swamps in narrow headwater valleys
20b	'Coxs River Swamps'				
	CLOSED-HEATH	<i>Leptospermum obovatum</i> <i>L. juniperinum</i> <i>Grevillea acanthifolia</i>	Illawarra Coal Measures	>600 m	Valleys and headwaters of creeks
21c	'Montane Heath'				
	OPEN-HEATH	<i>E. stricta</i> <i>Allocasuarina nana</i> <i>Leptospermum attenuatum</i> <i>Phyllota squarrosa</i> <i>Eriostemon obovalis</i>	Narrabeen Group	>850 m	Exposed rocky ridges on shallow sandy soils, often on western aspects
	OPEN-HEATH	<i>Epacris reclinata</i> <i>Dracophyllum secundum</i> <i>Gleichenia rupestris</i>		>850 m	Moist rock faces
21d	'Pagoda Rock Complex'				
	OPEN-HEATH	<i>Allocasuarina nana</i> <i>Leptospermum arachnoides</i> <i>Lepidosperma viscidum</i>	Narrabeen Group	>750 m	Exposed sites on rock outcrops with shallow soils. Associated with extensive rocky platforms and 'Pagoda' rock formations

Map unit	Structure	Main canopy species	Geology	Altitude	Habitat
21f	OPEN- SCRUB	<i>Eucalyptus</i> sp. nov. 'MOKII'		>750 m	
	WOODLAND	<i>E. sieberi</i> <i>E. piperita</i>		>750 m	Small sheltered gullies between rocky knolls
	'Lower Blue Mountains Heath'				
21f	OPEN- HEATH	<i>E. stricta</i> <i>Allocasuarina nana</i> <i>Leptospermum attenuatum</i> <i>Phyllota phyllicoides</i> <i>Eriostemon hispidulus</i>	Narrabeen sandstone	<850 m	Exposed rocky ridges on shallow sandy soils, often on western aspects
	OPEN- HEATH	<i>Epacris reclinata</i> <i>Dracophyllum secundum</i> <i>Gleichenia rupestris</i>		<850 m	Moist rock faces
26a	'Blue Mountains Sedge Swamps'				
	CLOSED- SEDGELAND	<i>Gymnoschoenus sphaerocephalus</i> <i>Lepidosperma limicola</i> <i>Xyris ustulata</i> <i>Baeckea linifolia</i>	Narrabeen sandstone with peaty sand	<1000 m	In headwater gullies or on hillsides
26b	'Boyd Plateau Bogs'				
	CLOSED- SEDGELAND	<i>Carex appressa</i> <i>C. gaudichaudiana</i> <i>Juncus holoschoenus</i> <i>Baeckea utilis</i>	Carboniferous granite with acid peats	>1200 m	In headwater gullies
	CLOSED- HEATH	<i>Leptospermum myrtifolium</i> <i>L. obovatum</i> <i>L. lanigerum</i>		>1200 m	In headwater gullies
C	Cleared	Native vegetation has been largely removed for agricultural, industrial or urban development but remnant vegetation of varying sizes and condition may remain.			

The understorey generally has scattered shrubs including *Acacia melanoxyton*, *A. penninervis*, *Polyscias sambucifolia*, *Astrotricha floccosa*, *Daviesia ulicifolia* and *Leucopogon lanceolatus* var. *lanceolatus*, and occasional tree ferns, *Cyathea australis*. There is a continuous ground cover of herbs such as *Libertia paniculata*, *Dianella laevis*, *Geranium solanderi* var. *solanderi*, *Viola betonicifolia*, *Centella asiatica* and *Stellaria pungens*, with ferns including *Blechnum cartilagineum*, *B. nudum*, *Doodia aspera* and *Pteridium esculentum*.

On the Boyd Plateau at Whalanian Heights and south of Cunynghame Hill, basalt outcrops at much higher elevations (above 1200 m) but supports similar tall open-forest with *E. viminalis* and *E. fastigata*. Occasional shrubs in the understorey here include *Pultenaea altissima*, *Acacia dealbata*, *A. melanoxyton* and *Rubus parvifolius*, together with herbs such as *Geranium potentilloides* var. *abditum*, *Epilobium billardieranum* ssp. *cinereum*, *Acaena novae-zelandiae* and *Luzula flaccida*, and ferns including *Polystichum proliferum* and *Blechnum nudum*.

Ingram (1972) recounts the botanical history of Mt Tomah and provides a species list, while Brough, McLuckie & Petrie (1924), Petrie (1925) and McLuckie & Petrie (1926) give detailed descriptions of the vegetation of Mt Wilson.

Map unit 6h 'Escarpment Complex'.

Tall open-forest: *Eucalyptus deanei*-*E. cypellocarpa*-*Syncarpia glomulifera*.

Open-forest: *Angophora costata* ssp. *costata*-*E. piperita*-*E. punctata*.

Closed-forest: *Ceratopetalum apetalum*-*Doryphora sassafras*.

This map unit is a mosaic of three communities found on the moderate to steep slopes below the Triassic sandstone escarpments at low to moderate altitudes (120 to 850 m). The soils are relatively deep, moist but well-drained sandy loams with colluvial material from shales, sandstones and conglomerates of the Permian Illawarra Coal Measures and, to a lesser extent, the Shoalhaven Group.

The most widespread community in this unit is a tall open-forest dominated by *E. deanei*, *Syncarpia glomulifera*, *Angophora costata* ssp. *costata* and *Acacia elata*. *Eucalyptus cypellocarpa* replaces *E. deanei* at higher altitudes (above about 650 m), particularly along the slopes around Narrow Neck Peninsula (Figure 2). *Eucalyptus oreades* may be present on the upper slopes. There is a sparse small-tree stratum of *Callicoma serratifolia*, *Hakea salicifolia* and *Allocasuarina littoralis*. The understorey has a dense fern cover of *Culcita dubia*, *Pteridium esculentum* and *Blechnum cartilagineum*, with occasional emergent shrubs of *Platylobium formosum*, *Oxylobium ilicifolium*, *Bursaria longisepala*, *Leucopogon lanceolatus* var. *lanceolatus* and *Pultenaea scabra* var. *scabra*. Herbs and twiners include *Dianella caerulea*, *Clematis aristata*, *Smilax glycyphylla*, *Lomandra longifolia*, *Viola hederacea*, *Pratia purpurascens* and *Helichrysum scorpioides*. Blue Gum Forest in the Grose Valley is a good example of this community, though here *Eucalyptus deanei* occurs as a pure stand.

On the less sheltered, undulating terrain of the Kedumba and Grose Valleys, away from the escarpment, there is an open-forest community with *Angophora costata* ssp. *costata*, *E. piperita* ssp. *piperita*, *E. punctata*, *E. gummifera*, *E. oblonga* and *E. sieberi* in various combinations. This occurs on drier, more sandy soils on the sandstones and conglomerates of the Shoalhaven Group. While larger stands are mapped separately as 'Megalong Forest', small areas of this vegetation are associated with the 'Escarpment Complex'. Floristically this resembles the 'Sydney Sandstone Complex' vegetation on the Hawkesbury Sandstone (map units 10ag/10ar). The understorey is shrubby, 1 to 2 m tall and includes a diversity of proteaceous, myrtaceous and fabaceous shrubs such as *Banksia spinulosa* var. *spinulosa*, *B. serrata*, *Lambertia formosa*, *Persoonia linearis*, *Leptospermum attenuatum*, *Dillwynia retorta* and *Oxylobium ilicifolium*.

In moist, sheltered gullies running down the steep escarpment slopes (for example below Little Cedar Gap and below the Horseshoe Falls at Govetts Leap), a closed-forest community dominated by rainforest species, *Ceratopetalum apetalum*, *Acmena smithii* and *Doryphora sassafras* occurs. These narrow bands of rainforest are usually overtopped by eucalypt emergents, *E. deanei*, *E. cypellocarpa* or *E. oreades*. Small trees include *Backhousia myrtifolia*, *Tristaniopsis collina*, *Callicoma serratifolia*, *Elaeocarpus reticulatus*, *Pittosporum revolutum*, *Eupomatia laurina*, *Rapanea howittiana*, *Hedycarya angustifolia* and *Notelaea longifolia*. The understorey consists of occasional ferns such as *Blechnum cartilagineum*, *B. patersonii*, *Polystichum proliferum*, *Doodia aspera* and *Cyathea australis*, with vines of *Pandorea pandorana*, *Morinda jasminoides*, *Smilax australis*, *Eustrephus latifolius* and *Cissus hypoglauca* also present.

Map unit 8c 'Montane Rainforest'.

Closed-forest: *Ceratopetalum apetalum*-*Doryphora sassafras*-*Quintinia sieberi*.

Larger areas of Warm Temperate rainforest are found on sheltered southerly and south-easterly aspects of Mt Wilson and Mt Tomah and in the adjacent sandstone gullies with an elevational range from 600 to 1000 m. The soils here are



Figure 2. Looking north along the western escarpment of the Narrow Neck peninsula. Tall open-forest of *Eucalyptus cypellocarpa* dominates the slopes above Megalong Valley, with narrow bands of closed-forest in the heads of the gullies (map unit 6h). 'Montane Heath' (map unit 21c), foreground, predominates on the plateau surface.

deep, moist, fertile clay loams derived from the Tertiary basalt that caps these peaks. The adjacent sandstone gullies receive clay and nutrients in downwash from the basalt. More exposed areas of basalt support eucalypt tall open-forest (map unit 6g). Rainforest is also found in the sheltered gully of Pulpit Hill Creek, west of Blackheath, where the soils are enriched from shale bands of the Illawarra Coal Measures.

The dominant trees are *Ceratopetalum apetalum* and *Doryphora sassafras* with *Quintinia sieberi*, *Acmena smithii*, *Hedycarya angustifolia* and *Atherosperma moschatum*, the last two species indicating a Cool Temperate influence at the highest elevations. *Callicoma serratifolia* is abundant in the sandstone gullies but absent from the basalt (McLuckie & Petrie 1926).

The understorey also varies depending on the bedrock. The tree ferns, *Dicksonia antarctica* and *Cyathea australis* predominate on the basalt soil with a very sparse and patchy groundcover of herbs such as *Geranium solanderi* var. *solanderi* and *Centella asiatica* and smaller ferns including *Blechnum cartilagineum*, *Polystichum proliferum*, *Pellaea falcata* var. *falcata*, *Doodia aspera*, *Pteridium esculentum* and *Sticherus flabellatus*. There are also a number of climbers including *Pandorea pandorana*, *Tylophora barbata*, *Clematis aristata* and *Smilax australis*. In sandstone gullies the tree fern stratum is less important, allowing a more diverse understorey to develop. The shrubs *Polyscias sambucifolia*, *Elaeocarpus reticulatus*, *Lomatia myricoides* and *Prostanthera lasianthos* are more common. Detailed descriptions of this community at Mt Wilson are given by Brough, McLuckie & Petrie (1924), Petrie (1925), McLuckie & Petrie (1926) and Floyd (1984).

Less species-rich rainforests occur as narrow bands along creeks on the escarpment slopes. These are too small in area to be mapped at 1:100 000 scale and are included in the 'Escarpment complex' (unit 6h).

Map unit 8d 'Kowmung Dry Rainforest'.

Closed-forest: *Toona australis*-*Ehretia acuminata*-*Brachychiton populneum*.

Small patches of dry rainforest are found in the Kowmung wilderness, a deeply dissected, low-rainfall area of Devonian metamorphic rocks in the south-western part of the map sheet. The rainforest is restricted to small patches on the lower sheltered slopes of gorges between 300 and 700 m elevation. The largest stand occupies the south-facing slopes of Kanangra Gorge and resembles rainforest described by Floyd (1984) at Mt Colboyd further south. Numerous occurrences along the Kowmung River and its tributaries are too small to be mapped at 1:100 000 scale and are included within the 'Kowmung Wilderness Complex' (map unit 10p).

The major tree species are *Toona australis*, *Ehretia acuminata* and *Brachychiton populneum*, though a number of others are frequent. These include *Ficus rubiginosa*, *Dendrochne excelsa*, *Alectryon subcinereus*, *Claoxylon australe* and *Backhousia myrtifolia*. The understorey contains shrubs of *Hymenanthera dentata*, *Rapanea howitteana*, *Notelaea longifolia*, *Trema aspera*, *Derringia amaranthoides*, *Pomaderris aspera* and *Seringia arborescens*. There are few vines, the main species being *Eustrephus latifolius*, *Aphanopetalum resinolum*, *Celastrus australis*, *Pandorea pandorana*, *Marsdenia flavescens* and *M. rostrata*. The sparse groundcover includes the ferns *Adiantum aethiopicum*, *Asplenium flabellifolium*, *Doodia aspera*, *Pteris tremula* and *Pellaea falcata*, herbs *Urtica incisa*, *Stellaria flaccida*, *Plectranthus parviflorus*, *Sigesbeckia orientalis*, *Hydrocotyle geraniifolia* and the grass, *Oplismenus aemulus*.

Adjacent dry slopes often support a 'blue bush' scrub with *Acacia binervia*, *A. falciformis* and the rare *A. clunies-rossii*.

Map unit 9a 'Shale Cap Forest'.

Open-forest: *Eucalyptus notabilis*-*E. globoidea*-*Syncarpia glomulifera*.

Along the Bilpin ridge are the most western remnants of the Wianamatta Shale cappings. Here, on the deep, relatively well-drained clay soils is an open-forest with *E. notabilis*, *E. globoidea* and *Syncarpia glomulifera*. *Eucalyptus piperita* ssp. *piperita* may be common where there is some sandstone influence. Wetter sites support *E. cypellocarpa* at the higher western end, while *E. deanei* and *E. punctata* occur further east. The understorey contains shrubs of *Acacia parramattensis*, *Indigofera australis*, *Hibbertia aspera* and *Helichrysum diosmifolium* with a moderately dense groundcover of the grasses *Entolasia marginata*, *Dichelachne rara*, *Echinopogon ovatus*, the herbs *Helichrysum elatum*, *Poranthera microphylla*, *Dichondra repens*, *Dianella caerulea*, and twiners including *Hardenbergia violacea*, *Kennedia rubicunda*, *Tylophora barbata* and *Eustrephus latifolius*. Because of their reasonably good agricultural soils, the natural vegetation of these shale cappings has been largely cleared for orchards and small farms.

Map unit 9i 'Blue Mountains Sandstone Plateau Forest'.

Open-forest: *Eucalyptus sieberi*-*E. piperita*.

Much of the Triassic sandstone plateau at higher altitudes (800 to 1150 m) is covered by an open-forest dominated by *E. sieberi* and *E. piperita* ssp. *piperita*. The soils are shallow, sandy, low in nutrients, well-drained and derived from Narrabeen Group sandstones. Taller variants of this community with *E. oreades*, *E. piperita* ssp. *piperita*, *E. sieberi* and *E. radiata* ssp. *radiata* occur in more sheltered situations, while *E. sieberi*, *E. sclerophylla*, *E. oblonga* and *E. mannifera* ssp.

gullickii dominate more exposed areas. The understorey is shrubby and includes such species as *Leptospermum attenuatum*, *Petrophile pulchella*, *Banksia ericifolia*, *B. spinulosa* var. *spinulosa*, *B. spinulosa* var. *cunninghamii*, *Persoonia chamaepitys* and *Acacia terminalis*.

The lower altitudinal limit of 800 m where this unit adjoins map unit 10a is concurrent with the margins of the higher elevation plateau and coincides with the distributional limits of a number of species. For example low altitude species such as *Angophora costata* ssp. *costata*, *E. gummifera*, *Syncarpia glomulifera*, *Acacia linifolia* and *Hibbertia empetrifolia* are common in map unit 10a but not in 9i, while higher altitude species such as *E. oreades*, *E. mannifera* ssp. *gullickii*, *E. radiata* ssp. *radiata*, *Banksia spinulosa* var. *cunninghamii*, *Persoonia chamaepitys*, *P. myrtilloides*, *Boronia microphylla* and *Stellaria pungens* occur in map unit 9i but not in 10a.

Escarpsments associated with the Coxs, Kedumba and Grose River valleys form a more distinct boundary to this community. Species such as *E. oreades*, *E. dendromorpha*, *E. radiata* ssp. *radiata* and *Banksia spinulosa* var. *cunninghamii* are often associated with cliffines and may extend over the escarpment edge for varying distances.

Map unit 9j 'Montane Gully Forest'

Open-forest: *Eucalyptus fastigata*-*E. cypellocarpa*-*E. dalrympleana*.

This community occupies moderate to steep, sheltered slopes and narrow gorges below the Triassic sandstone escarpments at elevations of 850 to 1100 m. It is a high altitude variant of map unit 6h and occurs on similar soils and geology (Illawarra Coal Measures). The boundary between these communities is poorly defined and for mapping purposes the 850 m contour has been used. This approximates the upper distributional limits of *Angophora costata* ssp. *costata* and *Syncarpia glomulifera* in map unit 6h, and the lower limits of *E. fastigata*, *E. dalrympleana* ssp. *dalrympleana* and *E. blaxlandii* in the higher altitude map unit 9j. The boundary has been mapped arbitrarily to the west of Mt Victoria township.

Eucalyptus fastigata, *E. cypellocarpa* and *E. dalrympleana* ssp. *dalrympleana* are dominant with *E. oreades*, *E. blaxlandii*, *E. radiata* ssp. *radiata* and *E. sieberi* in various combinations. The understorey is moderately shrubby with *Acacia terminalis*, *A. buxifolia*, *Oxylobium ilicifolium* and *Leptospermum flavescens* together with grasses and ferns such as *Calcitra dubia*.

Disturbances in Community 9j include selective logging, numerous small coal and shale mines (now mostly abandoned) and landslides, particularly near Hassans Walls.

Map unit 9m 'Megalong Forest'

Open-forest: *Angophora costata*-*Eucalyptus punctata*-*E. sieberi*.

This occurs on well-drained sandy loams derived from sandstones, conglomerates and shales of the Permian Shoalhaven Group. It covers undulating country beyond the escarpment slopes of Narrow Neck Peninsula at 400 to 750 m elevation and is also found around Mt Cookem. *Angophora costata* ssp. *costata*, *E. punctata* and *E. sieberi* are dominant with *E. piperita* ssp. *piperita*, *E. agglomerata*, *E. oblonga*, *E. eugenioides* and *E. sclerophylla* in various combinations.

The understorey includes scattered shrubs of *Persoonia linearis*, *P. levis*, *Banksia spinulosa* var. *spinulosa*, *Acacia obtusifolia*, *A. linifolia*, *Lomatia silaifolia*, *Isopogon anemonifolius* and *Leptospermum attenuatum* with a more continuous ground cover of *Lomandra longifolia*, *Styandra glauca*, *Lepidosperma laterale* and grasses such as *Stipa pubescens*, *Echinopogon caespitosus*, *Dichelachne rara* and *Microlaena stipoides* var. *stipoides*. A more mesic understorey with occasional trees of *E. cypellocarpa* may be found in

sheltered situations and where this community adjoins map unit 6h. On more clayey soils at lower elevations it is replaced by 10q.

Map unit 9n 'Montane Moist Forest'.

Open-forest: *Eucalyptus fastigata*-*E. dalrympleana*-*E. viminalis*.

The predominant plant communities at high altitudes west of Coxs River may be found on several geological formations. On moist, fertile, relatively deep clay loams and sandy loams is an open-forest characterized by *E. fastigata* and *E. dalrympleana* ssp. *dalrympleana*, occasionally with *E. viminalis*, *E. radiata* ssp. *radiata* and *E. bicostata* (Figure 3). *Eucalyptus viminalis* occurs sporadically on undulating terrain, but is mainly confined to creeks, while *E. radiata* ssp. *radiata* may be found on some ridgetops and where this map unit (9n) adjoins 10s. *Eucalyptus bicostata* is only found in small localized patches, for example on Binomea Ridge, above Jenolan Caves.

The understorey includes scattered shrubs of *Acacia melanoxylon*, *Lomatia myricoides*, *Indigofera australis* and *Swainsona galegifolia*, with a continuous groundcover of herbs such as *Geranium potentilloides* var. *abditum*, *Stellaria pungens*, *Hydrocotyle acutiloba*, *Lomandra longifolia*, *Gnaphalium gymnocephalum*, *Polystichum proliferum* and numerous grasses including *Poa labillardieri* and *Dichelachne rara*. Black (1976) recorded *E. obliqua* on the lower slopes of gullies on the eastern part of the Boyd Plateau, while the rare *E. macarthurii* can be found around the Boyd Crossing.

Community 9n may occur on Devonian rhyolites and rhyo-dacites, folded Devonian quartzites, siltstones and claystones of the Lambie Group, Silurian tuff, limestone, siltstone, phyllite and shale, and occasionally on Carboniferous adamellites, granites and granodiorites of the Kanimbla Batholith. It is most widespread on steep, sheltered slopes and gullies on the folded Devonian rocks, but also occurs on more gentle slopes of the Boyd Plateau where *E. fastigata* has been extensively logged.

Map unit 9x 'River Oak Forest'.

Open-forest: *Casuarina cunninghamiana*.

Narrow bands of *Casuarina cunninghamiana* can be found along the alluvial banks of the Coxs River. These consist of mobile gravels and sands, periodically flooded, and support little other plant life apart from short-lived exotic species such as *Conyza albida* and *Hypochoeris radicata*. The banks have a number of exotic species most notably *Conium maculatum* and *Rubus fruticosus*. The surrounding land has almost always been cleared for agriculture.

Map unit 10a 'Sydney Sandstone Complex'.

This widespread vegetation complex is found on the low elevation (<800 m) sandstone plateaux. Floristics and structure vary, depending on physiography, rainfall, altitude, aspect and local soil conditions. Two subunits have been recognized: 10ag, moist forests associated with sheltered hillsides and gullies; and 10ar, drier woodlands associated with the more exposed ridges and plateau tops. There is considerable overlap between these subunits and both grade into the higher altitude sandstone vegetation (map unit 9i) above 800 m elevation. The transition between map units 10a and 9i is discussed in the description of the latter.

Subunit 10ag Open-forest: *Angophora costata*-*Eucalyptus piperita*-*E. agglomerata*-*Syncarpia glomulifera*.

This subunit occurs in sheltered gullies with moist, well-drained, shallow sandy loams on Hawkesbury and Narrabeen Group sandstones. Open-forest is common on upper slopes and in the more shallow gullies. Tree species include



Figure 3. 'Montane Moist Forest' (map unit 9n) with rough-barked *Eucalyptus fastigata* and ribbons of decortivating bark on *E. dalrympleana* ssp. *dalrympleana* (on the right) on the Boyd Plateau near Krungle Bungle Range. The small trees are regrowth after logging. The herbaceous understorey includes the fern *Blechnum cartilagineum*.

Angophora costata ssp. *costata*, *E. piperita* ssp. *piperita*, *E. agglomerata* and *Syncarpia glomulifera* occasionally with *E. gummifera*. The understorey includes small trees of *Allocasuarina torulosa* and *Acacia elata* with shrubs *Hakea dactyloides* (single-stemmed form), *Pultenaea flexilis* and *Dodonaea triquetra*. Tall open-forest is restricted to the more sheltered gorges and is dominated by *E. deanei* with *Syncarpia glomulifera*, *Acacia elata*, *Ceratopetalum apetalum*, *Callicoma serratifolia* and *Angophora floribunda*. There is a distinctive riparian scrub of *Tristaniopsis laurina* and *Backhousia myrtifolia* along the larger watercourses.

Subunit 10ar Woodland: *Eucalyptus gummifera*-*E. sclerophylla*-*E. oblonga*.

This subunit is widespread on ridges and open slopes on shallow, well-drained, sandy soils on Hawkesbury and Narrabeen Group sandstones. Structurally, it is woodland or low woodland with trees of *E. gummifera*, *E. sclerophylla* and *E.*

oblonga, though *E. punctata*, *E. piperita* ssp. *piperita* and *Angophora costata* ssp. *costata* may also be present in more sheltered sites. *Eucalyptus sclerophylla* is particularly common in damper soils. The understorey is rich in shrubs of the Proteaceae, Myrtaceae and Fabaceae including *Banksia spinulosa* var. *spinulosa*, *Hakea dactyloides* (multi-stemmed form), *Persoonia levis*, *Leptospermum attenuatum*, *Kunzea ambigua*, *Pultenaea elliptica* and *Acacia linifolia*.

Map unit 10h 'Tablelands Grassy Woodland Complex'.

Woodland: *Eucalyptus dives*-*E. mannifera*-*E. eugenoides*.

Woodland: *E. pauciflora*-*E. rubida*.

Woodland: *E. aggregata*-*E. mannifera*-*E. stellulata*.

Above 800 m elevation on the undulating country of the upper Coxs River valley, on Shoalhaven Group geology, is a toposequence of communities. Woodland is widespread on well-drained gentle slopes and low hills. It is dominated by *E. dives*, *E. mannifera* ssp. *mannifera* and *E. eugenoides* with some *E. cytellocarpa* from the adjoining escarpment slope vegetation (map unit 9j). Grasses dominate the understorey, particularly *Dichelachne rara*, *Danthonia pilosa*, *Aristida ramosa* and *Stipa mollis* with emergent shrubs of *Acacia buxifolia*, *A. falciformis*, *Banksia marginata*, *Exocarpos cupressiformis* and *Daviesia latifolia*.

Eucalyptus pauciflora ssp. *pauciflora* and *E. rubida* occur in frost hollows, while the more poorly drained depressions, for example at Butlers Creek, may support a woodland of *E. aggregata*, *E. mannifera* ssp. *mannifera* and *E. stellulata* with *Leptospermum myrtifolium* in the understorey. *Eucalyptus viminalis* is common along creek banks.

This map unit has been mostly cleared for agriculture in the Hartley-Hartley Vale area.

Map unit 10i 'Snow Gum Woodland'.

Woodland: *Eucalyptus pauciflora*-*E. dalrympleana*.

Woodland: *E. pauciflora*-*E. rubida*-*E. stellulata*.

This unit is found at the highest altitudes on the map sheet (above 1100 m), on shallow to moderately deep loams and sandy loams derived from a variety of parent rock types, particularly acidic igneous rocks of the Kanimbla Batholith, quartzites of the Devonian Lambie Group, and more rarely on sandstones of the Shoalhaven Group.

The *E. pauciflora* ssp. *pauciflora*-*E. dalrympleana* ssp. *dalrympleana* woodland is found on small, exposed, rocky ridgetops west of Hampton (e.g. Mt Bindo 1364 m). The understorey consists of occasional shrubs of *Acacia dealbata* with a continuous groundcover of herbs and grasses such as *Stellaria pungens*, *Acaena novae-zelandiae*, *Poranthera microphylla*, *Geranium* spp., *Plantago* spp., *Poa sieberiana* and *P. labillardieri*. Patches of *Lomandra longifolia* and *Pteridium esculentum* may be common.

This community is more widespread on the Boyd Plateau on undulating country, particularly where cold air drainage is significant. In hollows where drainage is poor *E. stellulata*-*E. pauciflora* ssp. *pauciflora* woodland occurs. *Eucalyptus rubida* may be found on the cold, dry sites (Black 1976). This unit is related to 10h.

Map unit 10m 'Mount Walker Complex'.

Woodland: *Eucalyptus macrorhyncha*-*E. melliadora*.

This community is found west of Lithgow and south of Hartley on dissected country at altitudes above 600 m. It is mostly on well-drained sandy loams derived from quartzite, sandstone, siltstone and claystone of the Lambie Group, but also on clays derived from a small outcrop of carboniferous gabbro. West of Lithgow

E. dives, *E. viminalis* and *E. bridgesiana* characterize the gullies, while *E. rossii*, *E. mannifera* ssp. *praecox* and *E. dives* occur on the ridges. South of Hartley there are fewer tree species. Here, *E. macrorhyncha* and *E. melliodora* occur throughout, with occasional *E. mannifera* and *E. bridgesiana* on the ridges and upper slopes.

The understorey includes scattered shrubs of *Lissanthe strigosa* and *Persoonia linearis* with a discontinuous ground cover of the grasses *Poa labillardieri*, *Chionochloa pallida*, *Aristida ramosa* and *Stipa rudis* ssp. *rudis*, and herbs including *Geranium solanderi* var. *solanderi*, *Hydrocotyle laxiflora*, *Stellaria pungens*, *Senecio lautus* ssp. *dissectifolius* and *Cheilanthes sieberi*.

Map unit 10o 'Yellow Box Woodland'.

Woodland: *Eucalyptus melliodora*–*E. viminalis*.

Much of the undulating granite country supporting this community was extensively cleared for agriculture early in the nineteenth century. Remnants may be found in the Coxs River valley at elevations between 250 and 850 m on deep, well-drained sandy soils derived from Carboniferous adamellite, granite and granodiorite.

Eucalyptus melliodora and *E. viminalis* are the most characteristic tree species, although *E. eugenioides* is particularly common east of Coxs River and *E. bridgesiana* may be found in patches throughout. *Eucalyptus dalrympleana* ssp. *dalrympleana* occurs at the higher elevations, while *Angophora floribunda* is often near watercourses or on the slopes nearby. The understorey has scattered shrubs of *Exocarpos cupressiformis*, *Bursaria spinosa* and *Lissanthe strigosa* with an open ground cover of grasses such as *Themeda australis*, *Poa labillardieri*, *Cymbopogon refractus* and *Echinopogon caespitosus*, and herbs including *Geranium solanderi* var. *solanderi*, *Hypericum gramineum* and *Lomandra glauca*.

On rocky, granite sites to the north, around Lyall Dam, *Eucalyptus dives* is particularly common and the understorey includes a greater variety of shrub species including *Banksia marginata*, *Platysace lanceolata*, *Daviesia latifolia*, *Dodonaea viscosa* and *Cassinia quinquefaria*.

Most of the remaining areas of Community 10o are fragmented, grazed by stock and rabbits, and weed-infested to varying degrees.

Map unit 10p 'Kowmung Wilderness Complex'.

Woodland: *Eucalyptus tereticornis*–*E. melliodora*.

Woodland: *E. fibrosa*–*E. crebra*–*E. eugenioides*–*E. punctata*.

This unit occupies a large inaccessible area of deeply dissected country with narrow ridges, steep slopes and gullies in the lower Coxs and Kowmung valleys (Figure 4). Elevation ranges from 150 to 900 m. The soils are well-drained clay loams derived from quartzites, sandstones, siltstones and claystones of the Devonian Lambie Group.

Eucalyptus tereticornis is common on moist slopes and in gullies, often with *E. melliodora*, and occasionally *E. quadrangulata*. *Angophora floribunda* and *E. viminalis* may be found near watercourses. The understorey is variable, though typically contains shrubs of *Bursaria longisepala*, *B. spinosa*, *Breynia oblongifolia*, *Lissanthe strigosa* and *Persoonia linearis* with numerous herbs including *Dichondra repens*, *Pratia purpurascens*, *Senecio lautus* ssp. *dissectifolius* and *Wahlenbergia* spp., twiners such as *Desmodium varians* and *Glycine* spp., the ferns *Cheilanthes sieberi* and *C. distans* and grasses such as *Themeda australis*, *Dichelachne micrantha*, *Oplismenus imbecillus* and *Panicum effusum*. In the east, *E. deanei* is found in moist gullies with *Angophora floribunda*, *E. tereticornis* and *Syncarpia glomulifera*. Occasional patches of dry rainforest (map unit 8d) may include *Toona australis*, though they are more usually dominated by *Backhousia myrtifolia*. More comprehensive field traverses would provide more data on vegetation patterns in this extensive, poorly known area.

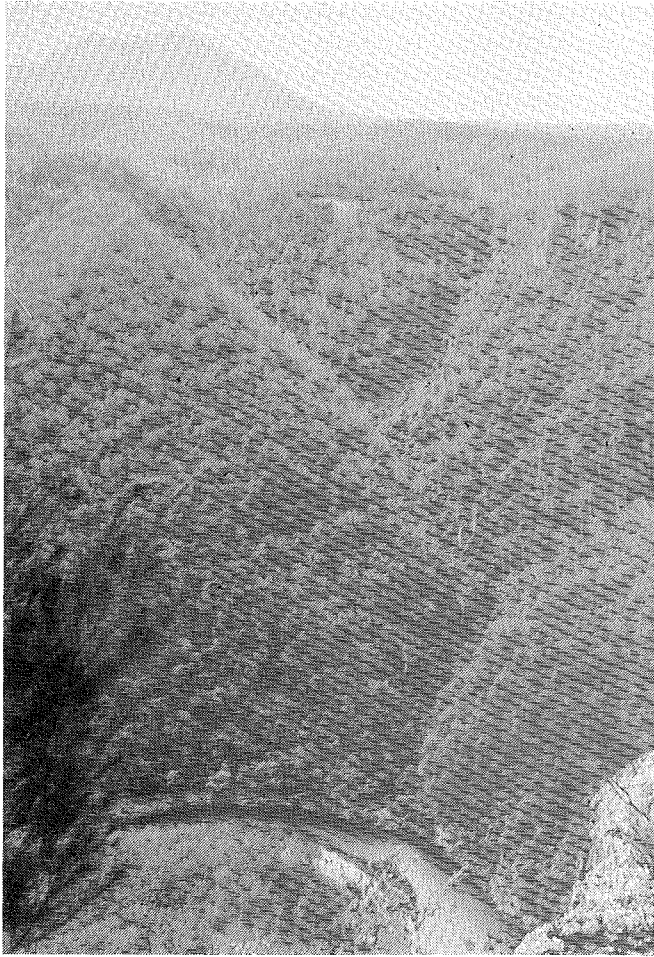


Figure 4. View northwest from Mt Cookem with Cocks River in the foreground. Eucalypt woodland in the 'Kowmung Wilderness Complex' (map unit 10p) occurs on the sides of the gorge. Note the closed canopies of *Backhousia myrtifolia* along the tributary creek, and emergent trees of *Eucalyptus deanei* nearby. The plateau surface supports 'Megalong Forest' (map unit 9m), while the slopes of the Wild Dog Mountains (background) support 'Escarpment Complex' tall open-forest (map unit 6h).

Map unit 10q 'Burraborang Ironbark Woodland'.

Woodland: *Eucalyptus crebra*-*E. eugenioides*-*E. punctata*-*E. fibrosa*.

Woodland: *E. sclerophylla*-*Angophora bakeri*.

This map unit occupies the Shoalhaven Group shales, conglomerates and sandstones below 500 m elevation, on the undulating country of the Kedumba Valley, Scotts Main Range and the Bimlow area. Gentle to moderate slopes and gullies with well-drained, loamy soils support a woodland of *E. eugenioides*, *E. crebra* and *E. punctata*, occasionally with *E. fibrosa* ssp. *fibrosa* and *E. agglomerata*. The understorey is open with scattered shrubs including *Jacksonia scoparia*, *Persoonia linearis*, *Acacia buxifolia*, *Grevillea obtusifolia* and *Lissanthe strigosa* and a ground cover of *Stypandra glauca*, *Lomandra longifolia*, *Themeda australis*, *Aristida vagans* and *Imperata cylindrica*.

Trees of *E. tereticornis*, with shrubs of *Melaleuca linariifolia* and a grassy understorey are found on damp, low-lying clay-loam soils and in gullies.

Exposed rocky ridges with shallow, sandy soils and western aspects, support woodland of *E. sclerophylla* and *Angophora bakeri* ssp. *bakeri* and an understorey of low shrubs including *Banksia spinulosa* var. *spinulosa*, *Leptospermum parvifolium*, *Dillwynia retorta*, *Mirbelia rubiifolia*, *Phyllanthus thymoides* and *Daviesia acicularis*. Grasses include *Stipa pubescens* and *Aristida warburgii*.

Map unit 10r 'Residual Sandstone Woodland'.

Woodland: *Eucalyptus sieberi*–*E. blaxlandii*.

This community is found in well-drained, shallow, sandy soils on residual sandstone cappings of the Shoalhaven Group, folded sandstones of the Devonian Lambie Group and occasionally on Carboniferous granites. There are small occurrences at elevations above 900 m along moderately exposed, rocky ridges and plateau edges west of Coxs River, for example Table Mountain and parts of Black Range. *Eucalyptus sieberi* and *E. blaxlandii* are the dominant tree species here, though the latter may be absent from some sites. *Eucalyptus cypellocarpa* occurs on parts of Gibraltar Rocks and Black Range (Figure 5). Understorey shrubs include *Leptospermum attenuatum*, *Banksia marginata*, *B. spinulosa* var. *spinulosa*, *Persoonia linearis*, *P. laurina*, *Acacia obtusifolia*, *A. obliquinervia*, *Oxylobium ilicifolium*, *Leucopogon lanceolatus* var. *lanceolatus*, *Brachyloma daphnoides*, *Monotoca scoparia* and *Platysace lanceolata*. Ground cover species include *Gonocarpus tetragynus*, *Pomax umbellata*, *Lomandra glauca*, *L. longifolia* and *Patersonia glabrata*. The shrubby understorey and low frequency of grasses distinguishes Community 10r from other high altitude vegetation types in the area.

Though more common on sandstone of the Shoalhaven Group, this community is also found on sandstone facies of the Lambie Group on narrow rocky ridges such as Krungle Bungle Range and the eastern end of Black Range. Flatter sites on the Shoalhaven Group sandstones (e.g. the western end of Black Range) are occupied by map unit 10s which is more widespread on the Lambie Group metamorphics and Carboniferous granites. Intermediate sites support *E. sieberi* and *E. radiata* ssp. *radiata* with an understorey mostly of grasses and scattered shrubs.

The most northern occurrence of Community 10r is west of Old Bowenfels where residual sandstone of the Illawarra Coal Measures caps a remnant of Shoalhaven Group sandstone. *Eucalyptus sieberi* is the only tree species on the upper part of this outcrop, while on the lower slopes it occurs with *E. dives*. The latter may be a remnant of Community 10h which probably once grew on the flat surrounding country now cleared for agriculture.

Map unit 10s 'Montane Woodland'.

Woodland: *Eucalyptus radiata*–*E. dalrympleana*.

Woodland: *E. ovata*–*E. stellulata*.

This map unit is found on flat to undulating country, west of Coxs River, at elevations above 900 m. It occurs on well-drained to damp sandy loams on various parent rocks including quartzite, sandstone, siltstone and claystone of the Lambie Group (Devonian), adamellite, granite and granodiorite of the Kanimbla Batholith (Carboniferous) and shale, conglomerate and sandstone of the Shoalhaven Group (Permian). It is most widespread on the Devonian parent material on moderate slopes, though generally more luxuriant on the Carboniferous granites. On both types of geology it grades into unit 9n in sheltered sites.

Black (1976) described this community in her survey of the Boyd Plateau. *Eucalyptus radiata* ssp. *radiata* and *E. dalrympleana* ssp. *dalrympleana* are the

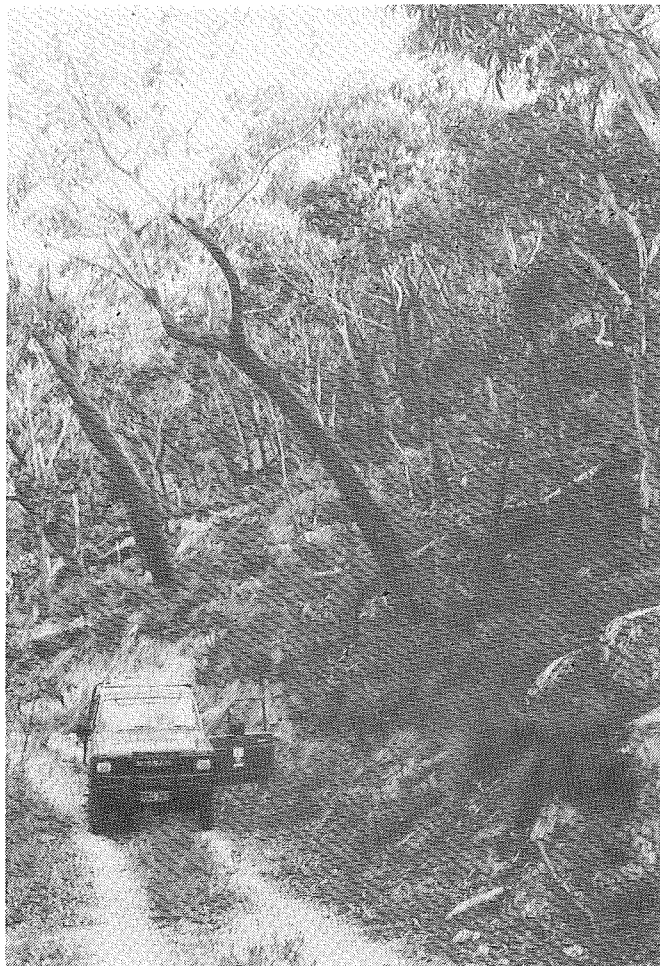


Figure 5. Woodland with *Eucalyptus sieberi*, *E. cypellocarpa* and a shrubby understorey interspersed with clumps of *Poa* sp. on granite at Moorara Boss, northern Boyd Plateau (map unit 10r).

dominant canopy species, though there are significant numbers of *E. dives* on the north-western part of the Boyd Plateau, and *E. pauciflora* ssp. *pauciflora* may be found sporadically throughout, particularly at higher elevations (Figure 6). The understorey includes scattered shrubs of *Acacia obliquinervia*, *Leucopogon lanceolatus* var. *lanceolatus*, *Lomatia myricoides* and *Persoonia oxycoccoides* with a relatively continuous ground cover of grasses such as *Poa sieberiana*, *P. labillardieri* and *Dichelachne rara* and herbs such as *Lomandra longifolia*, *Gonocarpus tetragynus*, *Wahlenbergia communis* and *Hydrocotyle* sp.

Trees of *E. ovata*, sometimes with *E. stellulata*, are found in poorly-drained depressions. The understorey includes *Leptospermum obovatum*, *Gahnia sieberiana*, *Juncus melanobasis*, *Restio fimbriatus* and *Blechnum minus*.

Map unit 10t 'Mount Blaxland Complex'.

Woodland: *Eucalyptus sieberi*-*E. pulverulenta*.

Found on shallow sandy loams, this vegetation is restricted to the steep, rocky

knolls on Mt Blaxland and Wentworths Sugarloaf (west of Hartley) and an outcrop of Devonian rhyolite near Lowther. A woodland dominated by *E. sieberi*, *E. rossii* and *E. oblonga* with the shrubby *E. pulverulenta* as an understorey species is most common, though in places the trees are absent, leaving *E. pulverulenta* in open-heath vegetation (T. J. Fatchen, pers. comm.). *Eucalyptus pulverulenta* occurs naturally only in the Hartley district and at Cowra Creek, east of Bredbo (Pryor 1981).

The understorey consists of an open shrub layer of *Persoonia linearis*, *Dodonaea viscosa*, *Bursaria spinosa*, *Platysace lanceolata*, *Acacia verniciflua*, *A. buxifolia* and *Oxylobium ilicifolium* with a ground cover of grasses including *Themeda australis*, *Poa* spp., *Danthonia* spp., and *Stipa* sp., and herbs such as *Stypandra glauca*, *Dianella revoluta*, *D. caerulea*, *Lomandra longifolia*, *L. multiflora* and *Helichrysum bracteatum* (T. J. Fatchen, pers. comm.).

Map unit 10u 'Jenolan Granite Woodland'

Woodland: *Eucalyptus punctata*-*E. sp. nov.* 'MAHEK'-*E. sieberi*.

A granite outlier of the Kanimbla Batholith on the steep, north-facing slope of Jenolan Gorge supports this distinctive and diverse woodland community which grades into Community 10r on the highest parts of the outcrop (>1000 m). The soils are relatively deep, freely draining and sandy. Open situations are occupied by *E. punctata*, *E. sp. nov.* 'MAHEK' and *E. sieberi* with some *E. goniocalyx* at higher elevations while *E. melliodora*, *E. agglomerata*, *E. cypellocarpa*, *E. punctata* and *Angophora floribunda* may be found in more sheltered situations in various combinations.

The understorey is predominantly shrubby with *Exocarpos strictus*, *Dillwynia retorta*, *D. acicularis*, *Bossiaea obcordata*, *Banksia spinulosa* var. *spinulosa*, *Grevillea arenaria*, *Platysace lanceolata*, *Leptospermum parvifolium*, *L. sp. nov.* 'X', *Leucopogon muticus*, *Teucrium corymbosum* and *Xanthorrhoea australis*. This is also an interesting disjunct Tableland locality for *Melaleuca armillaris*, essentially a coastal species, first collected from Jenolan Gorge by Blakely in 1900.

Map unit 17a 'Black Range Scrub'

Open-scrub: *Eucalyptus mannifera*-*Leptospermum myrtifolium*-*L. sp. nov.* 'A'-*Patersonia fragilis*.

On the gentle southern slopes of Black Range are several small, poorly-drained areas with rather humic, loamy soils overlying metamorphic rocks of the Devonian Lambie Group. Shrubs of *Leptospermum myrtifolium* and *L. sp. nov.* 'A' predominate here with occasional small trees of *E. mannifera* ssp. *mannifera*, *E. dalrympleana* ssp. *dalrympleana* and *E. stricta*. Sedges such as *Gahnia sieberiana*, *Schoenus apogon*, *Empodisma minus* with other moisture tolerant herbs including *Patersonia fragilis*, *Gonocarpus micranthus* ssp. *micranthus* and *Viola hederacea* comprise the ground cover.

This community resembles the swamps of the Boyd Plateau (map unit 26b), though the latter lack eucalypts and are more thickly vegetated with *Carex* spp. and *Juncus* spp., probably due to greater waterlogging.

Map unit 20a 'Newnes Plateau Shrub Swamps'

Closed-heath: *Leptospermum lanigerum*-*Baeckea linifolia*-*Grevillea acanthifolia*-*Xyris ustulata*.

In shallow headwater valleys above 1000 m elevation on the Triassic sandstone plateau, swamps with poorly-drained, acid, sandy peat soils have developed. On the Katoomba 1:100 000 map sheet these are restricted to the Bell area, although their best development is on the Newnes Plateau to the north.

These swamps are dominated by a closed-heath of *Leptospermum lanigerum*, *Baeckea linifolia*, *Grevillea acanthifolia* and *Epacris paludosa* with a ground cover

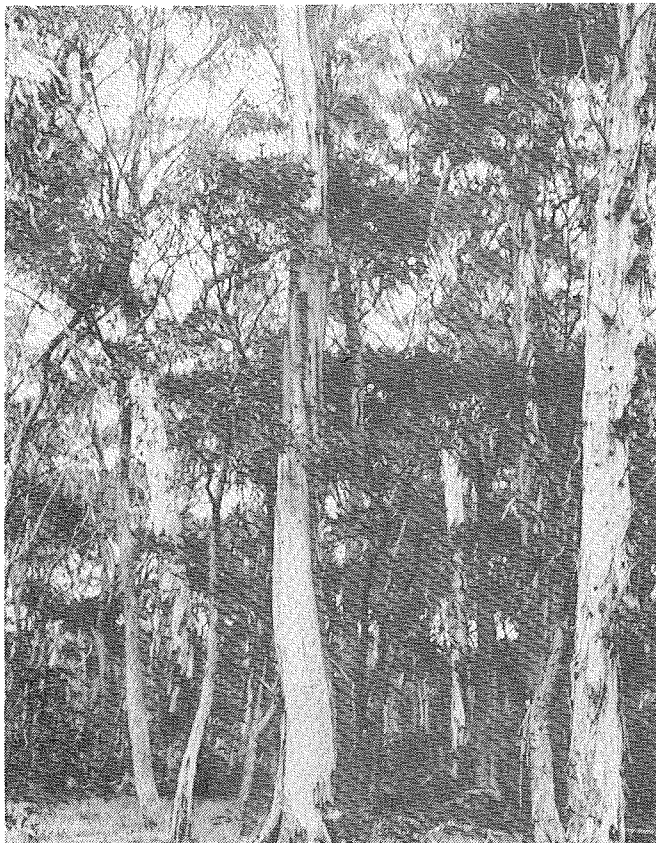


Figure 6. *Eucalyptus radiata* ssp. *radiata* (rough barked) and *E. dalrympleana* ssp. *dalrympleana* (smooth barked) with a grassy understorey of *Poa sieberiana* in 'Montane Woodland' (map unit 10s) near Sally Camp Creek on the Boyd Plateau.

of sedges including *Restio australis*, *Empodisma minus*, *Lepyrodia scariosa*, *L. anarthria*, *Lepidosperma limicola* and *Patersonia fragilis*. Floristic composition varies according to soil type and waterlogging regime. Adjacent to drainage lines there may be particularly thick growth of *Gymnoschoenus sphaerocephalus* and *Gleichenia dicarpa*, while in relatively drier, more open sites are small herbs such as *Hydrocotyle acicularis*, *Viola hederacea*, *Gonocarpus tetragynus* and *Xanthosia dissecta*.

Where the soils have a higher clay content these swamps contain a number of species also found in the swamps of the Boyd Plateau (map unit 26b) including *Leptospermum myrtifolium*, *L. flavescens*, *Callistemon sieberi*, *Juncus continuus* and, in drier places, *Lomandra longifolia*.

Map unit 20b 'Coxs River Swamps'.

Closed-heath: *Leptospermum obovatum*–*L. juniperinum*–*Grevillea acanthifolia*.

Filled with rather clayey, organic sediments derived from the Illawarra Coal Measures, these swamps occur where creeks draining the Triassic sandstone plateau dump their sediment load at the base of the escarpment. They support a simple flora dominated by *Leptospermum obovatum*, *L. juniperinum* and

Grevillea acanthifolia with a dense groundcover of *Carex* spp. and *Juncus* spp. Kerosene Creek at Hartley Vale and smaller swamps near Nellies Glen are the only examples in the area covered by the Katoomba 1:100 000 map sheet, though others are found in the headwaters of Coxs River to the north. Grazing at Kerosene Creek has led to the invasion of some exotic species and some damage due to trampling by stock.

Map units 21c & 21f 'Open-heath'.

Heath is found on exposed ridgetops, upper slopes with western aspects and often above the escarpment cliffs on the Triassic sandstone plateau (Figures 2 and 7). It occupies an altitudinal range from 600 to 1250 m. The soils are well drained to periodically damp, skeletal, pale and sandy, low in nutrients and derived from Narrabeen Group Sandstones.

Throughout the broad geographical and altitudinal range of the heath communities a number of species are common, particularly the shrubs *Eucalyptus stricta*, *Allocasuarina nana*, *Leptospermum attenuatum*, *Isopogon anemonifolius*, *Petrophile pulchella*, *Lambertia formosa*, *Conospermum taxifolium*, *Hibbertia cistiflora* and *Platysace linearifolia*, and ground cover species such as *Lepidosperma viscidum*, *Schoenus villosus*, *Entolasia stricta*, *Lomandra glauca*, *Gonocarpus tetragynus*, *Dampiera stricta*, *Goodenia bellidifolia* and *Sowerbaea juncea*. In contrast, the distributions of many other species are more restricted and form part of an overall altitudinal gradation in species composition. An elevation of 850–900 m has arbitrarily been chosen to separate the high and low altitude heath communities, coded 21c and 21f respectively.

Map unit 21c 'Montane Heath'.

Open-heath: *Eucalyptus stricta*–*Allocasuarina nana*–*Leptospermum attenuatum*–*Phyllota squarrosa*–*Eriostemon obovalis*.

Open-heath: *Epacris reclinata*–*Dracophyllum secundatum*–*Gleichenia rupestris*.

High elevation heath may be found on Narrabeen Group sandstones from Narrow Neck Peninsula to the Newnes Plateau in the north, particularly on Flat Top, Hat Hill, around Blackheath, the Mt Banks–Bell area and Hassans Walls. The dominant shrubs include *Eucalyptus stricta*, *Allocasuarina nana* and *Leptospermum attenuatum* with prominent ground cover species such as *Schoenus villosus*, *Lepidosperma viscidum*, *Patersonia sericea* and *Goodenia bellidifolia*. Species restricted to higher elevations include *Eriostemon obovalis*, *Boronia anemonifolia*, *B. microphylla*, *Acacia gunnii*, *Mirbelia platyloboides*, *Phyllota squarrosa*, *Pultenaea canescens*, *Darwinia taxifolia* ssp. *taxifolia*, *Eucalyptus mannifera* ssp. *gullickii*, *Petrophile canescens*, *Pseudanthus divaricatissimus* and *Omphacomeria acerba*.

A distinctive flora grows on the cliff faces and rock overhangs associated with the heaths of the plateau edge. These rock faces receive seepage moisture, and are particularly rich in epacrids such as *Epacris reclinata*, *Dracophyllum secundatum* and *Sprengelia monticola* and the fern, *Gleichenia rupestris*. The endangered species *Microstrobos fitzgeraldii* is a notable inhabitant of rock faces within the spray zone of waterfalls (Smith 1981).

Map unit 21c occurs on Shoalhaven Group sandstones on Ti Willa Plateau and Kanangra Tops, while on exposed south-eastern parts of the Boyd Plateau it may be found on metamorphic rocks of the Devonian Lambie Group. The latter is characterized by tall, thick growth of *Eucalyptus stricta*, often forming a closed-scrub with occasional shrubs of *Banksia marginata*, *Acacia dorothea*, *Isopogon anemonifolius* and *Allocasuarina nana* below. By contrast, *E. stricta* is absent from much of Kanangra Tops where thickets of *Allocasuarina nana* and



Figure 7. 'Montane Heath' on Mt Thurat (map unit 21c) showing *Banksia marginata*, *Epacris microphylla* (flowering) and *Dillwynia phyllicoides*, with clumps of *Eucalyptus stricta* in the background.

bare rock platforms alternate with *Baeckea brevifolia* on shallow humic soils in poorly-drained depressions. Several species noted on Kanangra Tops, including *Prostanthera saxicola* var. *montana* and *Leptospermum* sp. nov. 'Y' were not found on the heaths of the Blue Mountains Plateau to the east. However, these western heaths generally show lower species richness than those of the Blue Mountains.

Map unit 21d 'Pagoda Rock Complex'.

Open-heath: *Allocasuarina nana*-*Leptospermum arachnoides*-*Lepidosperma viscidum*.

Open-scrub: *Eucalyptus* sp. nov. 'MOKII'.

Woodland: *E. sieberi*-*E. piperita*.

This mosaic of vegetation types is found in the Wollangambe Wilderness amongst the 'beehive' or 'pagoda' formations of the Narrabeen Group sandstones (Benson 1984). On the exposed, rocky outcrops is an open-heath of *Allocasuarina nana*, *Leptospermum arachnoides*, *Platysace lanceolata* and *Banksia ericifolia*, sometimes interspersed with clumps of the mallee, *Eucalyptus* sp. nov. 'MOKII', though generally resembling map unit 21c. In more sheltered situations there is woodland, similar to map unit 9i, with *E. piperita* ssp. *piperita*, *E. sieberi*, *E. oblonga* and *E. sclerophylla*. Common understorey species include *Daviesia latifolia*, *Dillwynia retorta*, *Acacia terminalis*, *A. dorothea*, *Boronia microphylla*, *Hakea dactyloides* and *Allocasuarina distyla*.

Map unit 21f 'Lower Blue Mountains Heath'.

Open-heath: *Eucalyptus stricta*-*Allocasuarina nana*-*Leptospermum attenuatum*-*Phyllota phyllicoides*-*Eriostemon hispidulus*.

Open-heath: *Epacris reclinata*-*Dracophyllum secundatum*-*Gleichenia rupestris*.

This heath community occurs below 850-900 m elevation on Kings Tableland, Sublime Point, Linden Ridge and in the Mt Hay area. The most conspicuous species include many of the 'ubiquitous' heath species common in Community 21c. However, a number of small shrubs including *Epacris rigida*, *Hemigenia purpurea*, *Daviesia corymbosa*, *Phyllota phyllicoides*, *Pultenaea elliptica*, *Darwinia fascicularis* ssp. *oligantha*, and the sedge, *Lepidosperma neesii* may be regarded as typical low elevation constituents.

Cliff faces and rock overhangs support a similar flora to that described for map unit 21c.

Map unit 26a 'Blue Mountains Sedge Swamps'.

Closed-sedgeland: *Gymnoschoenus sphaerocephalus*-*Lepidosperma limicola*-*Xyris ustulata*-*Baeckea linifolia*.

In contrast to the shrub swamps of the Upper Mountains (map unit 20a), swamps in the headwater valleys of the sandstone plateau below 1000 m elevation, are dominated by sedges. These swamps occupy steep-sided basins, up to 35 ha in area. The upper boundary is often a clearly defined rim coinciding with the outcropping of a claystone stratum. This acts as an aquiclude (Holland 1974) and directs water to the surface at the rim to form a swamp below (Figure 8).

Swamps on steep valley sides (often known as hanging swamps) are intermittently waterlogged and have shallow, sandy soils with a moderate organic content. They have open-heath vegetation with shrubs of *Hakea teretifolia*, *Leptospermum squarrosus*, *Epacris obtusifolia*, *E. microphylla*, *Sprengelia incarnata*, *Hibbertia cistiflora*, *Dampiera stricta* and *Pultenaea incurvata*, and sedges such as *Ptilanthelium deustum*, *Leptocarpus tenax*, *Empodisma minus* and *Lepyrodia scariosa*. In contrast, valley bottoms support closed-sedgeland on finer grained, deeper, highly organic sediments that are frequently waterlogged and permanently wet. There are fewer species here than on the more freely-draining slopes, characteristically *Gymnoschoenus sphaerocephalus*, *Lepidosperma limicola*, *Empodisma minus* and *Xyris ustulata* with occasional shrubs of *Baeckea linifolia*, *Leptospermum lanigerum*, *Acacia ptychoclada* and *Pultenaea divaricata*.

In some cases there is a distinct wet heath/woodland (map unit 9i) vegetation boundary but in others, there is a broader transition zone from wet heath to dry heath (map unit 21f).

Map unit 26b 'Boyd Plateau Bogs'.

Closed-sedgeland: *Carex appressa*-*C. gaudichaudiana*-*Juncus holoschoenus*-*Baeckea utilis*.

Closed-heath: *Leptospermum myrtifolium*-*L. obovatum*-*L. lanigerum*.

Swamps in headwater valleys on the Boyd Plateau are entirely different to those on the Blue Mountains sandstone plateau (map unit 26a). They occur at higher altitudes (ca. 1200 m), consist of soils derived from granite parent material, probably with a higher nutrient status, and occupy relatively shallow valleys compared to the hanging swamps in the Blue Mountains.

Vegetation patterning within the Boyd swamps appears to relate primarily to waterlogging regimes, but has probably also been affected by fire and grazing. The most widespread vegetation type is a closed-sedgeland of *Carex appressa*, *C. gaudichaudiana*, *Juncus holoschoenus* ssp. *fockei*, *Restio australis*, *Agrostis hiemalis* and *Deyeuxia gunniana* with other herbs including *Patersonia fragilis*, *Asperula gunnii* and *Geranium neglectum* and emergent shrubs of *Epacris paludosa*, *Hakea microcarpa* and *Baeckea utilis*. Thickets of *Leptospermum myrtifolium*, *L. lanigerum*, *L. obovatum* and *Callistemon sieberi* may occur



Figure 8. Kings Tableland, a plateau of Narrabeen Sandstone, showing *Eucalyptus sieberi* woodland (map unit 9j) on upper slopes grading into 'Montane Heath' (map unit 21c) in right background. The 'Sedge Swamp' (map unit 26a) has a clearly defined boundary with the woodland above, related to the outcropping Wentworth Falls Claystone.

sporadically, while more open areas with *Amphipogon strictus*, *Empodisma minus*, *Lepidosperma filiforme*, *Wahlenbergia ceracea* and *Helichrysum bracteatum* can often be seen around the margins.

The presence of species such as *Celmisia* sp. aff. *longifolia*, *Wahlenbergia ceracea* and *Sphagnum* sp. indicates that the Boyd swamps share floristic affinities with the alpine and subalpine bogs of the Southern Tablelands.

Discussion

Vegetation patterns

The patterns of vegetation in the area covered by the Katoomba map sheet relate to soils, physiography and elevation, and in particular to geology. Cross-section diagrams on the map sheet depict the relationships between vegetation and geology. Many plant communities are found only on particular soil types and are directly related to their parent geology. For example, communities in map units 6d and 9x are restricted to river alluvium, those in 6c and 6g relate to diatremes and basalt flows respectively, while map unit 9a is found only on ridges capped by Wianamatta Shale, and units 26a and 26b are restricted to waterlogged soils derived from sandstone and granite respectively. Carne (1908) aptly remarked,

'The influence of geological conditions on botany is so pronounced and distinctive in insular areas on the sandstone plateau as to arrest the attention even of those unfamiliar with the cause . . .'

On the western part of the map area, however, the major map units (9n, 10r, 10s and 10l) occur on two or more different geological substrates. This may be due to the derivation of a similar range of soil types from the different rocks or the overriding effect of the cold climate restricting the number of species able to grow in this area.

Physiography influences the degree of exposure, soil formation and the availability of water at a particular site. Extreme examples are heath communities (map units 21c and 21f) found on exposed ridge crests, and rainforests (8c and 8d) which are found in moist, well sheltered gullies and slopes. Floristic differences between subunits 10ag and 10ar relate specifically to their different physiographic environments as they occur on the same parent material in similar climatic conditions.

There is a significant variation in rainfall, minimum temperatures and the occurrence of frosts and snow over the altitudinal range in the area covered by the Katoomba sheet. Groups of communities on similar soils, geology and physiography may form altitudinal series. For example, 10a-9i-10r on sandstone plateaux, 6h-9j on Permian escarpments, 10q-9m-10h on undulating Shoalhaven Group sediments, 21f-21c on exposed sandstone ridges and 26a-20a in sandstone headwater valleys. The Blue Mountains area offers excellent opportunities for research on the relationships between species distributions and altitudinal gradients.

Conservation

Large areas of natural vegetation on the Katoomba map sheet have been dedicated as reserves for nature conservation. Some 140 000 ha are included within Blue Mountains and Kanangra-Boyd National Parks (Figure 9). Smaller reserves include the Forestry Commission's proposed Forest Preserve at Beefsteak Creek near Black Range and several important Council Reserves in the Blue Mountains, including Waterfall Reserve at Mt Wilson and Coachwood Glen at Blackheath. Regrettably some of these reserves cannot always guarantee the long term protection and management of the biological resources they contain. In particular, Council Reserves and Forest Preserves may be subject to changes in zoning and local management priorities. Plant communities can only be regarded as adequately conserved if representative samples of their geographic and ecological ranges are included within Nature Reserves, National Parks or Flora Reserves, as these are protected by State legislation.

Plant communities in the Katoomba region are not evenly represented within the reserve system (Table 3). In fact five map units (9i, 10ag, 10ar, 10p and 10q) account for most of the area covered by the two National Parks. Ten of the 32 Katoomba map units are not represented in reserves at all. They are 6d, 9a, 9j, 9x, 10h, 10m, 10o, 10t, 17a and 20b. A further six (6c, 8c, 8d, 10r, 20a, 21d) are represented by only small examples in reserves.

A number of the larger poorly conserved map units persist as remnants in the Coxs River valley. 'Yellow Box Woodland' (map unit 10o) has been extensively cleared for agriculture around Hartley. Part of the largest remnant in the Little River area is the subject of the National Parks Association's proposed Little/Coxs River Addition to Kanangra-Boyd National Park (Byrne 1987). This is the only opportunity to conserve a sample of 'Yellow Box Woodland' in the Katoomba area. The 'Tablelands Grassy Woodland Complex' (map unit 10h) has also been largely cleared though small areas persist around Hartley Vale. Larger unprotected remnants are found to the north around Ben Bullen, Cullen Bullen and west of Lidsdale. 'Coxs River Swamps' (map unit 20b) have a naturally restricted distribution. Unprotected examples are found near Nellies Glen, at Kerosene

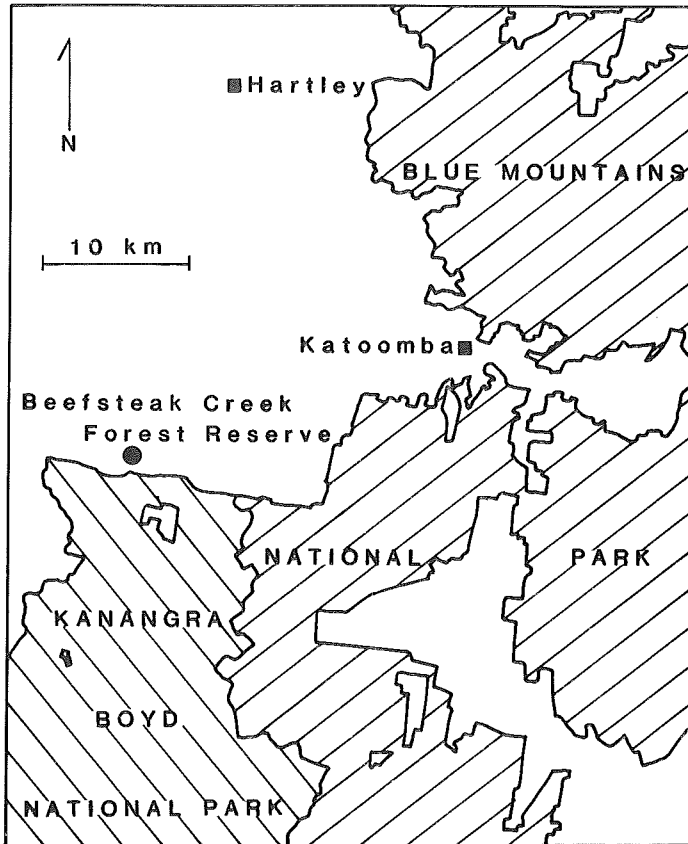


Figure 9. Location of conservation reserves in the area covered by the Katoomba map sheet.

Creek, and to the east of Cullen Bullen, further north (Benson 1984). These swamps are affected by grazing to varying degrees. 'River Oak Forest' (map unit 9x), although remnants are usually weed-infested, has survived in many places along the banks of Coxs River in the predominantly agricultural Megalong Valley. Smaller, unmapped stands occur downstream in the Blue Mountains National Park, while larger areas are found further south along the Wollondilly River.

Map unit 10m, although unprotected, has remained relatively undisturbed because of its rough terrain and unsuitability for agriculture. The National Parks Association of New South Wales has a Nature Reserve proposal for an area west of Lithgow. If this proceeds this vegetation will be adequately conserved. Large unprotected areas of map unit 9j remain on the escarpment slopes between Mount Victoria and Lithgow. These have been selectively logged in places, but remain relatively undisturbed due to their rough terrain. Numerous gullies supporting this vegetation are found in the south-west of Wollemi National Park.

Most of the other poorly-conserved map units have naturally restricted distributions. Map units 6d and 10t have very restricted distributions and occur only on private property in the Kedumba and Coxs River valleys respectively. 'Shale Cap Forest' (map unit 9a) is also restricted to small areas on private property and has been largely cleared for agriculture. A small stand of somewhat similar vegetation is conserved in Wollemi National Park at Culoul Range (Benson 1980).

Table 3: Major conservation reserves in the area covered by the Katoomba 1:100 000 vegetation map sheet.

Reserve	Administered by	Approximate area (ha)	Map units included
Blue Mountains National Park	NP&WS	100 000	6c*, 6g, 6h, 8c*, 8d*, 9i, 9m, 10ag, 10ar, 10p, 10q, 20a*, 21c, 21d*, 21f, 26a
Kanangra-Boyd National Park	NP&WS	40 000	9n, 10l, 10p, 10r*, 10s, 10u, 17a, 21c, 26b
Beefsteak Creek Forest Preserve (Proposed)	FC	200	9n, 10s

Map units not represented: 6d, 9a, 9j, 9x, 10h, 10m, 10o, 10t, 17a, 20b

* represented by small examples only

NP&WS = National Parks and Wildlife Service

FC = Forestry Commission of New South Wales

Other areas of this community have been almost completely cleared from the ridges around Springwood. 'Montane Rainforest' (map units 8c) and 'Moist Basalt Cap Rainforest' (map unit 6g) also have restricted distributions. Small areas are represented in Blue Mountains and Wollemi National Parks, though much of the remainder occurs in Council Reserves at Mount Wilson and Coachwood Glen (Pulpit Hill Creek, Blackheath). Similarly, small areas of map unit 10r are represented in Kanangra-Boyd National Park while a number of other remnants are found further north in forestry and agricultural areas at Black Range, Gibraltar Rocks, Table Mountain, Mount Arthur, Cheetham and Old Bownfels.

Small 'Newnes Plateau Shrub Swamps' (map unit 20a) occur in Blue Mountains National Park near Bell, though much larger examples of these interesting swamps remain unprotected on the Newnes Plateau to the north (Benson 1984). Other restricted types include 'Black Range Scrub' (map unit 17a), found only in Jenolan State Forest; 'Glen Forest' (6c), represented by very small stands in Blue Mountains National Park; and 'Kowmung Dry Rainforest' (8d), restricted to Kanangra-Boyd National Park.

Plant communities on the Triassic sandstone plateau are generally well conserved. However, the area between Wentworth Falls and the Kedumba Valley gate on Kings Tableland warrants special consideration. The heath in this area (part of map unit 21f) represents an important part of the overall altitudinal sequence in Blue Mountains heath communities. At an elevation of 830–880 m it represents an intermediate position where a number of high and low altitude heath species co-exist. Nineteen rare or significant species (Table 4) are also found in this area.

Sixty-five significant species are listed for the Katoomba map sheet area (Table 4), 41 of which are also listed by Leigh, Briggs & Hartley (1981). These species are either rare, threatened or of botanical significance in terms of geographic distribution. The list contains species of varying rarity and conservation status: *Olearia oligantha* has not been collected since 1866 and is presumed to be extinct (Leigh, Briggs & Boden 1984); *Microstrobos fitzgeraldii* is vulnerable and threatened (Smith 1981); *Melaleuca armillaris*, although common in coastal situations is restricted on the tablelands; while *Hibbertia saligna* appears to be adequately conserved with numerous populations in the Blue Mountains

National Park. There are a high number of locally restricted species for the map area, and particularly along the escarpment from Kings Tableland, through Wentworth Falls, Leura and Katoomba to Narrowneck Peninsula. Workers involved in the preparation of environmental impact statements, plans of management, conservation studies etc., should be aware of the significance of these species if present in their study area.

The number of significant plant communities and species found in the area covered by the Katoomba map sheet is high when compared with other parts of the Sydney region (lists for Gosford-Lake Macquarie, St Albans, Wallerawang, Sydney and Penrith map sheets are held at the Royal Botanic Gardens, Sydney). Twenty of the 65 significant species listed in Table 4 are endemic to the greater Blue Mountains region. Bearing in mind the strong altitudinal trends in the vegetation, the restricted distributions of many species may be related to climatic fluctuations in the past. Many species now restricted to higher elevations may have been more widespread in cooler times, particularly those which are represented by disjunct populations.

Management issues

Despite the large area set aside to protect the natural environment, the concentration of suburban development along the major linear ridge systems followed by the Great Western Highway and Bells Line of Road will have a long-term impact on a proportionally greater area. The main effects on vegetation, apart from the obvious direct impact of future clearing, will be through increasing effluent runoff from adjacent built-up areas (Bliss, Riley & Adamson 1983). This contains silt and nutrients which promote the invasion of exotic weed species, such as *Lonicera japonica* and *Ligustrum* species, into previously undisturbed bush. The heads of many creeks and gullies around Katoomba and Wentworth Falls already have a high component of exotic species. This is a serious and increasing problem that needs further documentation and treatment.

The other main effects of adjacent development are from changes in the bushfire regime, which may be either reduced or increased depending on the site. Either way the vegetation may be changed, and it is only with continuing research into the response of native plant communities and individual species to fire, that predictions and successful management of these impacts can be accomplished.

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Table 4: Species of particular conservation significance within the Katoomba 1:100 000 map sheet area.

Species listed here are either rare or threatened (Leigh, Briggs & Hartley, 1981), or of botanical significance in terms of geographic distribution. Localities refer to Katoomba map sheet occurrences. Nth. = northern, Sth. = southern, codings (2X, 2V, 2VC, 3V, 2RC, 3RC, 2K) are from Leigh, *et al.* (1981).

Species (family)	Habitat/Locality	Significance
FERNS		
ASPIDIACEAE		
<i>Lastreopsis hispida</i>	Rainforest, Mt Wilson	Local disjunct population
BLECHNACEAE		
<i>Blechnum gregsonii</i>	Lawson, Mt Wilson, Wentworth Falls	2V
HYMENOPHYLLACEAE		
<i>Hymenophyllum pumilum</i>	Rainforest, Mt Tomah	3RC, very rare
<i>Sphaerocionium lyallii</i>	Rainforest, Wentworth Falls	3RC
GYMNOSPERMS		
PODOCARPACEAE		
<i>Microstrobos fitzgeraldii</i>	Within spray of waterfalls, Wentworth Falls to Katoomba	2V, highly restricted local endemic
DICOTYLEDONS		
APIACEAE		
<i>Xanthosia dissecta</i>	Swamps, Wentworth Falls	Local disjunct population
ASTERACEAE		
<i>Celmisia</i> sp. nov. aff. <i>longifolia</i>	Wentworth Falls, Blackheath	Local disjunct population
<i>Olearia oligantha</i>	Blue Mountains	2X, local endemic
<i>Olearia quercifolia</i>	Swamps, Wentworth Falls to Clarence	2RC, local endemic
CAMPANULACEAE		
<i>Wahlenbergia ceracea</i>	Swamps, Boyd Plateau	Local disjunct population
CUNONIACEAE		
<i>Acrophyllum australe</i> (Calycomis australis)	Woodford-Linden	3V, local endemic
DILLENIACEAE		
<i>Hibbertia saligna</i>	Mt Wilson, Mt Tomah, Wentworth Falls, Springwood	2RC
EPACRIDACEAE		
<i>Epacris apiculata</i>	Rock ledges, Wentworth Falls	3RC
<i>Epacris hamiltonii</i>	Only known from Blackheath	3RC, highly restricted local endemic
<i>Epacris muelleri</i>	Damp rocks, Blackheath Mt Wilson	3RC
<i>Leucopogon</i> sp. aff. <i>appressus</i>	Rocky outcrops, Bedford Ridge	Local form
<i>Lissanthe sapida</i>	Blue Mountains	2RC
<i>Rupicola sprengelioides</i>	Blue Mountains	3RC
<i>Sprengelia monticola</i>	Wet rock ledges, upper Blue Mountains	3RC
EUPHORBIACEAE		
<i>Beyeria lasiocarpa</i>	Jenolan River gorge	Local disjunct population
<i>Pseudanthus divaricatissimus</i>	Heath, Narrow Neck & Kings Tableland	3RC

Species (family)	Habitat/Locality	Significance
FABACEAE		
<i>Acacia asparagoides</i>	Glen Davis-Lawson	Local endemic
<i>Acacia baueri</i> ssp. <i>aspera</i>	Kings Tableland, Wentworth Falls	Local disjunct population, also near Wilton
<i>Acacia bynoeana</i>	Hazelbrook-Bell	3V
<i>Acacia clunies-rossii</i>	Coxs, Kowmung Rivers, Yerranderie	2V
<i>Acacia hamiltoniana</i>	Bell to Mt Wilson	Uncommon
<i>Acacia ptychoclada</i>	Swamps & creek banks, Woodford to Mt Victoria	Local endemic
<i>Mirbelia baueri</i>	Kings Tableland	Local disjunct population Nth. limit
<i>Pultenaea echinula</i>	Kings Tableland, Mt Victoria, Cyrils Rocks	Local endemic
<i>Pultenaea glabra</i>	Wentworth Falls-Katoomba	3V
<i>Pultenaea incurvata</i>	Wentworth Falls-Clarence	2RC, local endemic
GERANIACEAE		
<i>Geranium graniticola</i>	Kanangra to Oberon	3RC
GOODENIACEAE		
<i>Goodenia rostrivalvis</i>	Lawson to Leura	2RC
<i>Scaevola hookeri</i>	Blackheath	Local population
LORANTHACEAE		
<i>Atkinsonia ligustrina</i>	Linden, Bedford Ck, Mt Wilson, Bilpin	2K
MYRTACEAE		
<i>Darwinia fascicularis</i> ssp. <i>oligantha</i>	Mt Banks-Wentworth Falls	Local endemic
<i>Eucalyptus baeuerlenii</i>	Terraces of south-facing cliffines, Wentworth Falls	3RC, local disjunct population Nth. limit
<i>Eucalyptus benthamii</i>	Alluvium, Kedumba Valley	3RC, local endemic
<i>Eucalyptus burgessiana</i>	Ridges, Linden, Mt Tomah	2VC, local endemic
<i>Eucalyptus gregsoniana</i>	Blackheath-Clarence, Budawangs	3V, local disjunct population
<i>Eucalyptus ligustrina</i>	Kings Tableland	Local disjunct population
<i>Eucalyptus macarthurii</i>	Boyd Crossing	3V, local disjunct population, Nth. limit
<i>Eucalyptus moorei</i>	Narrow Neck, Bell	Local disjunct population
<i>Eucalyptus pulverulenta</i>	Mt Blaxland, Lowther Ck.	3V, local disjunct population Nth. limit
<i>Eucalyptus rupicola</i>	Cliff edges, Wentworth Falls-Katoomba	2RC
<i>Kunzea</i> sp. nov.	Amongst rocks, Mt Cookem	Local endemic
<i>Leptospermum</i> sp. nov. 'L'	Heath, woodland, Hassans Walls	2R, local endemic
<i>Leptospermum</i> sp. nov. 'R'	Cliffs, Kings Tableland-Glen Davis	Local population
<i>Leptospermum</i> sp. nov. 'Y'	Mallee heath, Kanangra	Local endemic
<i>Melaleuca armillaris</i>	Jenolan River gorge	Local disjunct population
<i>Melaleuca squamea</i>	Wentworth Falls, Blackheath	Uncommon
PROTEACEAE		
<i>Grevillea obtusifolia</i>	Kedumba Valley, Kiaramba Ridge	3V, local endemic, Rylstone-Kedumba
<i>Grevillea rosmarinifolia</i>	Coxs River, Glenroy Crossing	Type form, now presumed extinct

Species (family)	Habitat/Locality	Significance
<i>Hakea constablei</i>	Kings Tableland, Mt Wilson–Mt Banks	3V, local endemic
<i>Isopogon fletcheri</i>	Found only at Govetts Leap, Blackheath	2VC, highly restricted, local endemic
<i>Persoonia acerosa</i>	Valley Heights–Clarence	Local endemic
RUTACEAE		
<i>Boronia deanei</i>	Swamps, Boyd Plateau	2VC, local pop., also near Newnes & Nerriga
<i>Eriostemon obovalis</i>	Blackheath–Bell	2RC
<i>Zieria</i> sp. nov. 'F'	Narrow Neck	2VC, local endemic
SCROPHULARIACEAE		
<i>Parahebe</i> sp. (Mt Colong)	Kanangra–Mt Colong, McMahons Lookout, on rocky outcrops	2RC, local endemic
MONOCOTYLEDONS		
LILIACEAE		
<i>Allania endlicheri</i>	Gullies on moist rocks, Mt Corricudgy–Linden	3RC
<i>Blandfordia cunninghamii</i>	Wentworth Falls, Mt Tomah	3RC, local population
ORCHIDACEAE		
<i>Adenochilus nortonii</i>	Woodford–Mt Victoria	3V
<i>Prasophyllum ansatum</i>	Mt Wilson–Bell	3RC
POACEAE		
<i>Deyeuxia microseta</i>	Forests, higher altitudes	3V
<i>Notochloe microdon</i>	Swamps, higher altitudes	2RC

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