

Vegetation of the Hunter Valley

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Introduction

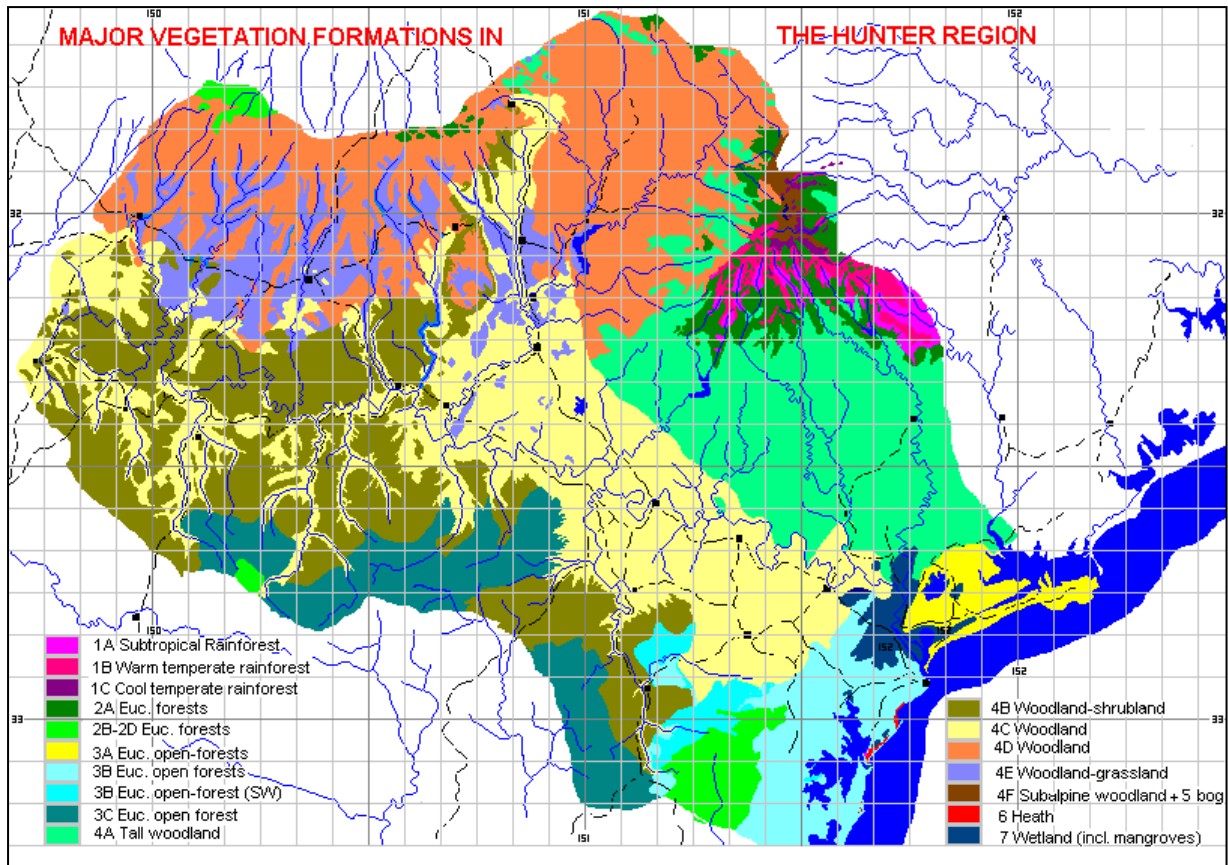
The Hunter Valley has a diverse range of rock and soil types, with wide altitudinal and rainfall variations. These physical factors, combined with recent climatic fluctuations have produced a range of plant responses and vegetation types. This classification and description of the vegetation formations of the Hunter Valley has as its basis the account by R. Story in the *Land Systems of the Hunter Valley*, C.S.I.R.O, 1963. It is a broad view of the vegetation on a moderate scale at the regional level. Within any formation a number of sub-formations, alliances and communities ('units') may be identified when working at larger scales, the larger the scale the greater the number of 'units' that may be recognised. In all vegetation description and mapping a decision has always to be made on the scale and the number of workable 'units' that can be described and mapped.

The Major Vegetation Formations

- Evergreen Closed-forests
- Evergreen Very Tall Open-forests
- Evergreen Open-forests
- Evergreen Woodlands
- Heath
- Grassland, Sedgeland and Wetland

Map of Major Vegetation Formations in the Hunter Valley

The vegetation map shows the extent of the major formations, as recognised in this account, before clearing. Some formations, in particular the 4C, 4D, 4A and 4E woodlands have been extensively cleared.



1. Evergreen Closed-Forests

This formation is defined by having the canopies touching or overlapping with a crown cover of > 90%. It includes the rainforests, which in the Hunter Region includes the sub-formations of Subtropical Rainforest, Warm Temperate Rainforest and Cool Temperate Rainforest; as well as the depauperate and lower Dry Rainforest. The closed mangroves are also included in this formation as Low Closed-forest.

Distribution

Rainforests occur mostly around the southern and south-eastern slopes of the Barrington Plateau and in sheltered valleys on the plateau, to the north of Dungog, and in sheltered valleys of the Watagan Mountains. A few isolated patches occur on the Liverpool Range and in the mountains of the southern watershed. Patches of dry rainforest occur in protected sites westwards to the centre of the Valley and further westward to the Widden Valley in the southern mountains. In the driest sites vine thickets occur. They have a different suite of taxa to the dry rainforests. Mangroves are not classified as rainforest, however, they generally have a closed canopy and are included here as low closed-forests. They are confined to coastal enclosures and estuarine areas.

Climatic and edaphic factors

They occur in the higher rainfall (1000 - 1500 mm) areas on the rich soils associated with the Tertiary basalts and the Carboniferous shales of the Mt. Royal Range and Liverpool Ranges, and the Permian shales and Tertiary basalts and alluvium in the Watagan Mountains and Hunter Range.

Sub formations

1A. Subtropical Rainforest

In the Subtropical Rainforest the upper canopy averages about 30 m tall with scattered emergents, typically usually of *Eucalyptus* or *Ficus* species. A lower sub-canopy, about 7 m tall, may be present, and epiphytes and lianas are common, but the floor is usually relatively open. They occur in the deep valleys, usually with a southern to eastern aspects and at lower altitudes where richer soils have accumulated. Numerous species are present, producing a high species richness, and the trees and shrubs have relatively large and soft mesophytic leaves.



Subtropical Rainforest in the Williams River valley.

1B. Warm Temperate (Submontane) Rainforest

In this sub-formation emergents are fewer, the canopy is not as high and a sub-canopy may also be present. Epiphytes are fewer, but lianas are common and ferns are often present on the floor. Tree and shrub leaves are also smaller. They generally occur at altitudes above the STRf and may merge with the CTRf at the upper limit. They also occupy the less favourable areas of lower moisture and/or greater exposure or lower temperatures. Many of the same species that are present in the STRf also occur here but the species richness is reduced.



Warm Temperate Rainforest in Bow Wow Gorge

1C. Cool Temperate (Montane) Rainforest

The Cool Temperate Rainforest canopy is relatively even, lianas are absent and the floor is often dense with mosses, ferns and tree ferns. They occur in similar aspects to the WTRf but at higher altitudes where the average temperatures are lower. The number of species is few, *Nothofagus moorei* is dominant, and *Doryphora sassafras* may be locally common. The tree ferns are *Dicksonia antarctica*.



Cool Temperate Rainforest in a south facing gully on Barrington Tops.

1D. Dry Rainforest (Low Closed-forest)

In drier sheltered situations with a south-eastern aspect, or amongst rocky outcrops, where there is sufficient moisture Dry Rainforest may be found. The trees are lower, to about 10 m high and the canopy is often dense, emergents are common and there is often a discontinuous shrubby understory. Ground cover may be herbaceous and/or ferny, or open. In the moister areas rainforest species are common, where as in the drier areas the softer mesophytic species are replaced by hardier genera, such as: *Trema*, *Geijera*, *Ficus*, *Clerodendrum*, *Notelaea*, *Breynia*, *Citrobatus*, *Myoporum*, *Canthium*, and *Rhagodia*. Small vines and twinnings, such as species of *Cissus*, *Pandorea*, *Parsonsia* and *Marsdenia* are common. A few scattered grasses may occur.

1E. Mangrove Low Closed-forests

Along waterways and on mud flats in the intertidal zone, mangroves form narrow bands of small trees of uniform height with a dense canopy. One or two species, *Avicennia marina* and less frequently *Aegiceras corniculatum*, only are present. *Sarcocornia quinqueflora* and other halophytes and the sedge *Juncus kraussii* may occur on the tidal areas to the landward side of the mangroves. Whilst not classified as "rainforest", mangroves usually have a closed canopy.



Avicennia marina mangroves along the Hunter River.

1F. Other Minor Closed Forests

In near coastal areas a number of small areas are occupied by *Livistona australis* closed forest. These normally contain other co-canopy or emergent species and generally occur on moist sites in the Open-forest formations.



Along some of the streams on the Barrington Tops dense stands of *Leptospermum montanum* may occur.



2. Evergreen Very Tall Open-Forests

With canopies touching to slightly separated and a crown cover of 40%-70%, the Open-forests may be grouped into Very Tall Open-forest (over 20 m tall) and Tall Open-forests (12 m - 20 m tall). The former occur in the higher rainfall areas on better soils, while the latter tend to occur on the lower nutrient soils where rainfall is sufficient.

Distribution: the Very Tall Open-forests occur on the higher parts of the Liverpool and Mt. Royal Ranges in the north and north-east, and on the Watagans and higher parts of the Hunter Range and Mt. Nullo area in the south-west. The Mid-high to Tall Open-forests occur along the coast, to the north and south of the Hunter River estuary, and in the lowlands of the lower Hunter Valley and on the higher and better watered parts of the southern mountains.

Structure: of the Very Tall Open-forest, tall to very tall trees, 20 - 40 m, with a mid-dense canopy and a moist understory of shrubs, or herbs, grasses or ferns may be present. In the Mid-high to Tall Open-forests the canopy is more open and lower, 10 - 20 m, and usually with a lower sclerophyllous shrub layer. A herbaceous ground cover may also be present.

Climatic and edaphic factors: the Very Tall Open-forests occur mostly in the higher rainfall areas (up to 1500 mm) on the better soils, mostly of basalts and Carboniferous shales, while the Mid-high to Tall Open-forests are found in areas of rainfall of 600 - 1000 mm on sands and clays.

Sub-formations and Alliances

2A. On the Tomalla plateau and parts of the Liverpool Range, Very Tall Open-forests of trees 30 - 40 m tall, usually with a sparse shrub layer and ferny or grassy floor, occur on basalts where the rainfall is 750 - 1500 mm. Main tree species include *Eucalyptus laevopinea*, *E. viminalis* and *E. fastigata*. *E. pauciflora* may be dominant in localised areas. Other eucalypts include, *E. dalrympleana*, *E. obliqua* (Tomalla - Barrington Tops area), *E. stellulata*, *E. nobilis* and *E. saligna*. Shrubs are common and *Acacia dealbata* subsp. *subalpina* often occurs in fire promoted thickets. *Poa labillardieri* is the dominant ground cover.



Very Tall Open-forest of *E. fastigata* and *E. obliqua* on Tomalla Plateau



and *E. dalrympleana* on the Barrington Tops.



Mixed eucalypts forest with a tree fern understory on the Barrington plateau.



Tall open-forest of *E. laevopinea* on the Coolah plateau.

2B. On Mt. Nullo and the other high areas of the southern watershed, Tall to Very Tall Open-forests, up to 20 m or more, with a sparse shrub layer, occur in the higher rainfall areas on remnant basalts. Important canopy species include *E. laevopinea*, *E. globulus* subsp. *bicostata*, *E. blaxlandii*, and *E. mannifera*. Species of *Poa* with tussocks of Cyperaceae and *Themeda australis* are the dominant ground cover.

2C-D. In the mountainous areas of the Mt. Royal Ra., with S to SE aspects at altitudes from 200 - 1800 m, and in the Watagan mountains, Very Tall Open-forests with trees to 30 (-40) m also occur.

2C. In the former area on the Tertiary basalts and Carboniferous shales, where the rainfall is high, 1000 - 1200 mm, *E. companulata* and *E. microcorys* are the dominant species with *Angophora floribunda* and *Allocasuarina torulosa* forming a sparse lower layer. Generally shrubs are rare, but in the wetter areas the more hardy rainforest species, as well as tree ferns may form a shrub layer, while the ground cover is mostly of grasses such as species of *Poa*, *Eragrostis*, *Themeda australis* and *Imperata cylindrica*, with Cyperaceae and *Pteridium* and *Adiantum* ferns. At higher altitudes, other tree species include *E. viminalis*, *E. fastigata* and *E. obliqua*, while at lower altitudes, *E. acmenoides*, *E. canaliculata*, *E. eugenioides*, *E. globoidea* and *E. propinqua* are found where the forest merges with the woodland formations. In cleared areas at these lower altitudes *Paspalum dilatatum*, *Sporobolus indicus* var. *capensis*, *Themeda australis* and species of *Lomandra* and *Trifolium* occur.

2D. In the Wattagans, there is usually a dense shrub layer where the forests occur on Triassic sandstones and Tertiary basalts in areas with rainfalls of 1150 - 1250 mm. *E. saligna* is generally the dominant species with *E. pilularis* and *Syncarpia glomulifera*. Associated trees include *E. acmenoides*, *E. agglomerata*, *E. microcorys*, *E. scias*, *E. deanei*, *E. piperita*, *E. sieberi* and *Corymbia gummifera*. Near the transition to the woodland and lower open-forests, *Angophora costata*, *A. floribunda*, *E. amplifolia* and *E. punctata* may be found.



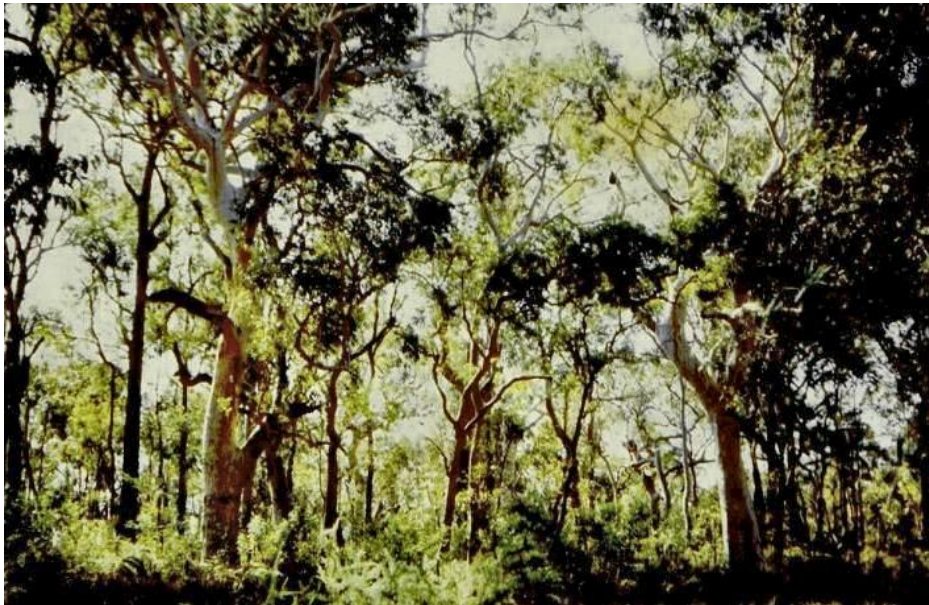
E. saligna, *E. pilularis* and *Syncarpia glomulifera* above a rainforest gully in the Wattagans

3. Evergreen Open-Forests

3A. The Mid-high to Tall Open-forests occur as three well defined alliances. On the coastal Quaternary sands north of Newcastle where the rainfall is from 900 - 1000 mm, Tall Open-forests of *Angophora costata*, *E. pilularis* and *Corymbia. gummifera* occur. The open canopy is about 20 m high and there is a sparse lower layer of small trees and a closed shrub or herb layer. Besides the three dominant species, other species include *E. globoidea*, *E. racemosa*, *E. parramattensis* subsp. *decadans* and *E. robusta*, with smaller trees such as *Banksia*, *Melaleuca* and *Persoonia*. Much of this original forest has been altered since settlement, and in disturbed areas invasion by weeds, including *Senecio lautus*, *Chrysanthemoides monilifera* and *Lantana camara* is prolific. On exposed sand dunes, *Hydrocotyle bonariensis*, *Scaevola calendulacea* and *Spinifex hirsutus* predominate.



Open-forest of Blackbutt and *Banksia* on the Quaternary sands behind Newcastle Bight



Angophora Open-forest north of Newcastle



On better soils a dense understory often occurs, as near Port Stephens

This sub-formation also includes a number of very different communities, e.g. on a headland north of Newcastle occurs this *Leptospermum* low closed-forest, and near Anna Bay is this closed-forest of *Acacia binervia*.



Low closed-forest of *Acacia binervia* near Boat Harbour

A. binervia near Anna Bay.

3B. To the south of Newcastle and in the Valley floor and low ranges to the east of Maitland and Cessnock, the open-forests have a similar structure but the shrub layer and ground cover are more sparse. The undulating to hilly country is of Permian clays and shales with a rainfall of 800 - 1000 mm and supports open-forests of *Angophora*, gum, ironbark and stringybark. *Angophora costata*, *A. floribunda*, *E. acmenioides*, *E. maculata*, *E. pilularis*, broad leaved ironbarks and stringybarks and *Corymbia gummifera* are the main tree species, with smaller trees of *Allocasuarina*, *Exocarpus cupressiformis*, *Persoonia*, *Acacia* and occasional *Doryanthes excelsa*. In the more exposed areas this alliance is replaced by the woodlands, while in the sheltered areas dry rainforest may occur. Extensive clearing of these tall open-forest has taken place.



Eucalyptus open-forest of on a protected site, near Lake Macquarie



Eucalyptus piperita open-forest on a dry site south of Newcastle



Eucalyptus - Angophora costata open-forest on low nutrient soil near Gateshead

3C. On the deeply dissected Triassic sandstone southern mountains of the headwaters of the Doyles and Baerami Creeks and Widden Brook and to the west of Mt. Nullo, Mid, High- to Tall Mixed Eucalypt Open-forests are also found. Basically of *Angophora floribunda*, *E. punctata*, ironbarks and/or stringybarks they have a more open canopy and a sparse to dense shrub layer or with a ferny ground cover. This area ranges in altitude from 100 m in the east to 1000 m in the west, and has a rainfall ranging from 900 to 600 mm.

Within this alliance five sub-alliances may be recognised:

Mixed Eucalypt Open-forest is comprised of a variety of eucalypt canopy species with decreasing diversity westwards but at the same time the shrub layer becomes more complex. To the east occurs *Angophora floribunda*, *A. euryphylla*, *E. agglomerata*, *E. deanei*, *E. eugenioides*, *E. sparsifolia*, *E. pilularis*, *E. punctata*, *E. saligna*, *E. sieberi* and *Syncarpia glomulifera*. The *E. agglomerata*, *E. eugenioides*, *E. oblonga*, *E. piperita* and *E. punctata* continue westwards and are joined by *Corymbia gummifera* and *C. eximia* towards the central area but do not extend fully westwards. In the western parts *E. multicaulis* occurs.



An eucalypt open-forest of *E. punctata* and *E. eugenioides* in the headwaters of Apple Tree Ck.

A sub-alliance of *E. deanei*, *E. piperita* and *E. saligna* is found on the basalt caps and some of the better soils, occasional with *Angophora floribunda* and *Allocasuarina torulosa*. The shrub layer is usually poor, but a herbaceous, ferny or grassy ground cover is often present. The few grasses are mostly species of *Poa*. At higher altitudes on better soils, such as in this gully *E. viminalis* may occur.



E. viminalis

On the light sandy soils in the extreme west of this sub-formation, mid-high open-forests of *E. multicaulis* with a rich heath layer occur.

A sub-alliance of stringybarks occurs throughout the range, the dominants include *E. agglomerata*, *E. eugenioides* and *E. sparsifolia*. Towards the east, *E. scias* may be present. Associated species include *Angophora floribunda*, *Allocasuarina*, and *E. punctata*, with shrubs of *Acacia*, *Cassinia*, *Persoonia*, *Hibbertia* and *Oxylobium* and *Themeda australis* and *Imperata cylindrica*.

Ironbark sub-alliances also occur towards the west. Dominated by *E. crebra* or *E. fibrosa* with *Angophora floribunda* and *E. punctata* and with minor occurrences of other ironbarks (*E. nubila*, *E. sideroxylon* and *E. caleyi*). Tall shrubs, such as *Acacia* species form a sub-canopy over a poor shrub layer and ground cover.

4. Evergreen Woodlands

Woodlands and Open-woodlands have their canopies clearly separated, with a crown cover < 40% and are variable in height. In the Hunter Valley they form a major part of the vegetation cover. They are highly variable in their structure, and may have sub-canopies and/or shrub layers, or lack these and possess only a grassy ground cover. In the river and creek valleys the original woodland has been substantially cleared.

Distribution: Woodlands occur across most of the Hunter Valley, westwards from the east of Maitland and Cessnock, and as small areas of Sub-alpine Woodland on the Barrington Tops plateau. They merge with the open-forests and rainforests on the higher areas on the southern watershed and the mountainous areas and escarpments of the Barrington Tops, Mt. Royal and Liverpool Ranges and the Wattagan mountains.

Structure: the Woodland communities vary in height from 7 - 30 m, and vary in crown cover from mid-dense at the boundary of the open-forests to very sparse where a thin scattering of trees occurs in grassland with isolated trees. In the Woodland - Shrubland sub-formation a shrub understory occurs, however, in the other sub-formations this is mostly lacking and is replaced by a grassy ground cover.

Climatic and edaphic factors: Woodlands occur in response to one or more of the environmental factors of poor soils, lower rainfall, exposure and/or extremes of temperature.

The following sub-formations occur:

4A. *Eucalyptus* Tall Woodland

Extending from the north of the Lower Hunter River and into the southern end of the Mt. Royal Ranges, in gullies to the west of the Barrington Tops plateau, and in sheltered patches on the Liverpool Range, this sub-formation occurs on undulating to mountainous Carboniferous shales and clays; with an altitude varying from 30 - 300 m, and a rainfall of 750 - 1000 mm. The trees range in height from 20 - 30 m tall, shrubs are few, but a grassy ground cover is present. Canopy species include *E. propinqua*, *E. sp.aff. punctata*, *E. piperita*, *E. eugenioides*, *E. teretecornis*, *E. amplifolia*, *E. molyneuxiana*, broad leafed ironbarks and *Corymbia maculata*. Scattered *Angophora floribunda* and *Allocasuarina torulosa* may be present and *Waterhousea floribunda* may occur along the streams. Ground covers includes *Imperata cylindrica* and species of *Poa* and *Paspalum* with sedges and bracken fern in the moister areas, grading into *Themeda australis* and *Sporobolus* and *Dichanthium* grasses where drier. Nearer the coast a heath understory tends to be formed. Closed forest of rainforest species may be found in sheltered areas and intrude into the Tall Woodlands as a mesic understory.



Eucalyptus tall woodland north of Raymond Terrace

4B. Eucalyptus Woodland - Shrubland.

This sub-formation occurs on the Triassic sandstone country surrounding the Goulburn River. It merges with the Open Woodland - Grassland on the Merriwa Plateau in the north, and with the Woodland in the east where the sandstones give way to the Permian strata of the valley floor. It is confined to skeletal sandy soils on flat ridge tops and steep gully sides, at an elevation of 200 to 1000 m. The rainfall varies from about 550 to 750 mm. With a canopy of ironbarks and gums about 10 m tall, *Callitris endlicheri* may occur as scattered individuals or as dense stands within this sub-formation. A sparse to dense sclerophyllous shrub layer 1 - 2 m tall and a patchy ground cover of grasses and herbs is present. In areas of thin soils or of water logging in wet periods the woodland gives way to patches of heath. The ironbarks *E. crebra* and *E. fibrosa*, together with the stringybark *E. sparsifolia* and the gums *E. dawsoni* and *E. punctata* are dominant. Other canopy species include *E. prominula*, *E. saligna*, *E. tereticornis* and less commonly *E. nubila*, *E. sideroxylon*, *E. caleyi*, *E. rossi* and the mallee *E. dwyeri*. *Corymbia eximia* occurs in the south-east and is replaced by *C. trachyphloia* westwards. *Angophora floribunda* occurs at lower levels in the valleys. Shrubs are numerous and varied, while the ground cover is sparse.

Woodland-shrubland with ironbark dominated woodland-shrubland in the Pokolbin - Broke area. On more protected sites a dense understory often occurs. Further west in the Goulburn valley, with decreasing rainfall the tree height decreases and acacias may be common, as here in Dingo Ck.



Pokolbin - Broke



Dingo Ck

This sub-formation also includes a number of different communities, e.g. *Acacia doratoxylon* on a dry ridge top, with little or no understory, and stands of mallee (*E. castrensis*) in woodland-shrubland near Broke.



Acacia doratoxylon



Mallee

4C. *Eucalyptus* Woodland

This Woodland occurs in the central valley, north-west from near Maitland and along the floodplains and terraces of the major rivers and streams. On flat to mostly undulating and low hilly country, the substrate includes Permian clays and shales, granites, Tertiary basalts and Quaternary sands and alluvium. The altitude varies from about 30 m to 900 m, and the rainfall from about 1000 mm near the coast to about 550 in the west. The trees range in height up to about 10 m tall, and there may be occasional scattered shrubs or low heath (mostly in the far western part) and a grassy ground cover is usually present. In the eastern parts the dominant trees are: *E. moluccana*, *E. tereticornis*, *E. paniculata*, *E. fibrosa* and *C. maculata*. Near the centre of

the sub-formation *E. tereticornis* and *C. maculata* are replaced by *E. blakelyi*, *E. dawsonii* and *E. punctata*, particularly where it joins the Woodland - Shrubland. *E. moluccana* and *E. crebra* often form an exclusive alliance. Further inland, *E. moluccana* grades into *E. albans* and *E. microcarpa*, and *E. crebra* is joined by *E. fibrosa*, *E. nubila* and *E. caleyi* (near Murrumbo). *E. melliodora* becomes increasingly frequent from about the centre of the range. In the east the ground cover is composed of *Sporobolus indicus* var. *capensis*, *Paspalum dilatatum*, *Themeda australis*, *Aristida* species and *Cynodon dactylon*. *Dichanthium sericeum* occurs throughout the sub-formation except on sandy soils and dry areas where it is rare, whereas *Aristida* species are common across the whole range. *Notodanthonia linkii* is most common in the western half of the range where *Austrostipa setacea* also occurs. The greater part of this woodland has been thinned or cleared, with remnants of the former woodland existing only in scattered pockets.



Gum-Ironbark-Box Woodland with a grassy ground cover in the central valley

On the sands by the Wollombi Brook near Warkworth an unusual community, characterised by *Banksia integrifolia* and *Melaleuca* species exists. Communities of mixed non-*Eucalyptus* species (related to the rainforests species near the coast) frequently occur on scree slopes and non-eucalypt vine thicket shrubs may form small communities.



Wollombi Brook



Scree Slope

4D. *Eucalyptus* Open-Woodland

Extending from the slopes and ridges of the Liverpool and Mt Royal Ranges towards the southern edge of the Merriwa Plateau and into the Upper Hunter Valley, this Open-woodland occurs on undulating to mountainous landforms of Devonian limestones and shales and Carboniferous shales and clays, Tertiary basalts and Quaternary alluvium. The altitude ranges from 100 m. to 1200 m. and the rainfall from 550 to 1000 mm. It is an open-woodland of *Eucalyptus* and *Angophora* trees about 10 m tall, mostly with a ground cover of grasses with patches of shrub understory. In the sheltered areas on the Liverpool and Mt. Royal Ranges patches of non-sclerophyll closed-forest occur. *Angophora floribunda*, *E. melliodora*, *E. laevopinea* (confined mostly to the higher and cooler aspects), *E. moluccana* and *E. blakelyi* (at lower altitudes and lower rainfall) are the main tree species. In the upper reaches of the valley, *E. moluccana* grades into *E. albens*. Shrubs of genera *Rubus*, *Acacia*, *Bursaria*, *Cassinia*, *Rapanea* and *Exocarpus* amongst others occur mostly at the higher altitudes. Species of *Poa*, *Pteridium* and *Trifolium* and *Themeda australis* form a ground cover and are most common in the cooler parts of the sub-formation, while species of *Dichanthium*, *Aristida*, *Eragrostis* and *Chloris* and some *Austrostipa setacea* are common in the drier parts.



In the protected parts on the Liverpool Ra. the woodland merges with close-forest "brush"



In more exposed parts on the Liverpool Ra. the woodland is more open



E. albens open-woodland in the far west of the Valley on the Dividing Ra.

In the Upper Hunter near Timor stands of *Xanthorrhoea glauca* occur on the limey soils associated with the Timor Devonian limestones. On remnant basalt caps in the Goulburn valley open-woodland is also found, such as on Mt Dangar and above the Goulburn R.



Mt Dangar



Goulburn R.

4E. *Eucalyptus* Open-woodland and Grassland.

This Open-woodland - Grassland occurs on the undulating lowlands of the rivers and creeks of the Merriwa plateau, and in patches on the undulating country bordering the flood plain along the Upper Hunter River, and on the Wybong and Sandy Creeks and Dartbrook floodplains. The substrates are of Carboniferous and Permian clays and shales, Tertiary basalts and Quaternary alluvium. The altitude varies from 200 - 500 m and the rainfall is about 550 mm. This sub-formation is more sparse than the above Open-woodland and has scattered trees up to 10 m tall with a grassy ground cover. Shrubs are generally absent. On undulating country *E. albens* tends to occur, while *E. blakelyi* and *E. melliodora* along with *Angophora floribunda* tend to occupy the low

lying areas and *Brachychiton populneus* is scattered throughout the formation. Ironbarks are absent. Grass cover is predominantly species of *Austrostipa*, *Dichanthium*, *Chloris* and *Notodanthonia linkii* and *Aristida ramosa*.



Open-woodland - grassland in the river valleys on the Merriwa plateau

4F. Sub-alpine Woodland.

The Sub-alpine Woodland occurs above the Cool Temperate Closed-forest and Eucalyptus Tall Woodland on the higher and exposed hills of the Barrington Tops - Tubbrabucca plateau, at an altitude of 1350 to above 1500 m. Here the substrate is Tertiary basalt and the rainfall is from 750 - 1500 mm. The dominant tree is *E. pauciflora*, about 15 m tall, with *E. dalrympleana* and *E. stellulata* as associates. The canopy cover is mostly sparse but in places the canopies may touch. A shrub understory is sometimes present, and where this occurs, *Acacia dealbata* subsp. *subalpina* is the common shrub species along with species of *Tasmania* and *Dicksonia antarctica*. Mostly a tussock grassy ground cover of *Poa labillardierii* is present. In sheltered areas, stunted *Nothofagus moorei* and *Elaeocarpus holopetalus* closed-forest may occur.



Sub-alpine woodland of Snow Gums with a grassy ground cover and mixed understory on the Barrington plateau

5. Heathland

Heaths are composed of low to medium high shrubs with small, hard (ericoid) leaves and generally occur on low nutrient soils, such as coastal sands and the shallow sandy soils of sandstone areas. The canopies may be closed (dense) to open, with or without emergent shrubs and with or without a sparse herb or graminoid ground cover.

Near the coast, heaths occur on exposed coastal sands, dune systems and headlands.



Heath on the coastal aeolian sands near Redhead



Wet heath on periodically inundated coastal sands
near Belmont

Further inland, heaths occur in other formations, particularly in the Open-forest and Woodland - shrubland subformation, on exposed or seasonally wet and poorly drained areas and on thin skeletal soils of the Triassic sandstone and granite areas. Here dry heath occurs as an understory in ironbark woodland-shrubland.



Near Bulga in the central part of the Hunter Valley

Species are predominantly of the Proteaceae, Fabaceae, Mimosaceae, Myrtaceae and Epacridaceae families. Emergents in coastal heaths are often *Banksia* and mallee-like eucalypts, while inland these are replaced by species of *Leptospermum* and *Acacia*.

6. Grassland, Sedgeland and Wetland

Natural grasslands are often associated with one or more of the woodland and sedge formations. They were probably of only small extent in the Hunter prior to white settlement, but have now been markedly increased by clearing and many exotic grasses have either been introduced or have invaded the areas. Tussock grasslands occur in the cold frost hollows on the Barrington Tops plateau, usually in association with mossy swamps. Sedgelands and wetlands are confined to the lower reaches of rivers, estuarine areas and behind coastal dune systems.

The small natural grasslands which are thought to have existed prior to white settlement in the eastern part of the Upper Hunter are mostly a *Notodanthonia linkii* - *Austrostipa setacea* community, while *Notodanthonia linkii* together with *Dichanthium* and *Aristida* species occur westward from the central valley. The latter are also components of the grasslands on the Merriwa plateau.



Grasslands on the Merriwa plateau

In the lower Hunter *Paspalum* and *Sporobolus* species predominate.

Tussock grasslands, of mostly *Poa* species, occur in the cold frost hollows on the Barrington Tops plateau, usually in association with mossy swamps, as at Polblue Swamp. A bog in a grassy frost hollow occurs on the basalts of Coolah Tops.



Barrington Tops



Polblue Swamp



Coolah Tops

Most swamps and sedgelands occurs on the water logged areas of the lower Hunter River and creeks draining into Lake Macquarie. Other small areas are scattered throughout the Valley on brackish and gravelly soils associated with watercourses and low lying depressions. Sedges are often associated with permanently waterlogged to periodically wet and damp areas mostly on sands or saline or acid soils. Swamp vegetation varies from 12 m tall *Melaleuca* Open-forests to woodlands with a shrub understory and dense sedge ground cover to shrublands with emergent taller shrubs and to sedgefields. *Melaleuca quinquenervia* is the dominant tree species in coastal wetlands, and *M. nodosa*, *M. styphelioides* and *Casuarina glauca* are common associates. Other trees include *E. robusta* and *Livistona australis* both of which may be locally dominant. Shrubs of *Leptospermum*, *Callistemon*, *Banksia* and *Acacia* also occur. Ferns, Cyperaceae and Restionaceae sedges and grasses are common.



Saltmarsh in the Hunter River estuary



A dense stand of *Melaleuca quinquenervia* with a fern and sedge ground cover in a coastal wetland south of Newcastle



A *Phragmites* wetland in the swales of the dunes supporting open-forest north of Newcastle