VEGETATION SURVEY OF WESTERN AUSTRALIA

VEGETATION MAP

BUSSELTON SI 50 - 5

AUGUSTA SI 50 - 9

1973

WESTERN AUSTRALIAN DEPARTMENT OF AGRICULTURE

VEGETATION MAP OF BUSSELTON and AUGUSTA

Latitude 33°30′ to 34°30′

Longitude 114°00′ to 115°30′

Scale 1:250,000

by

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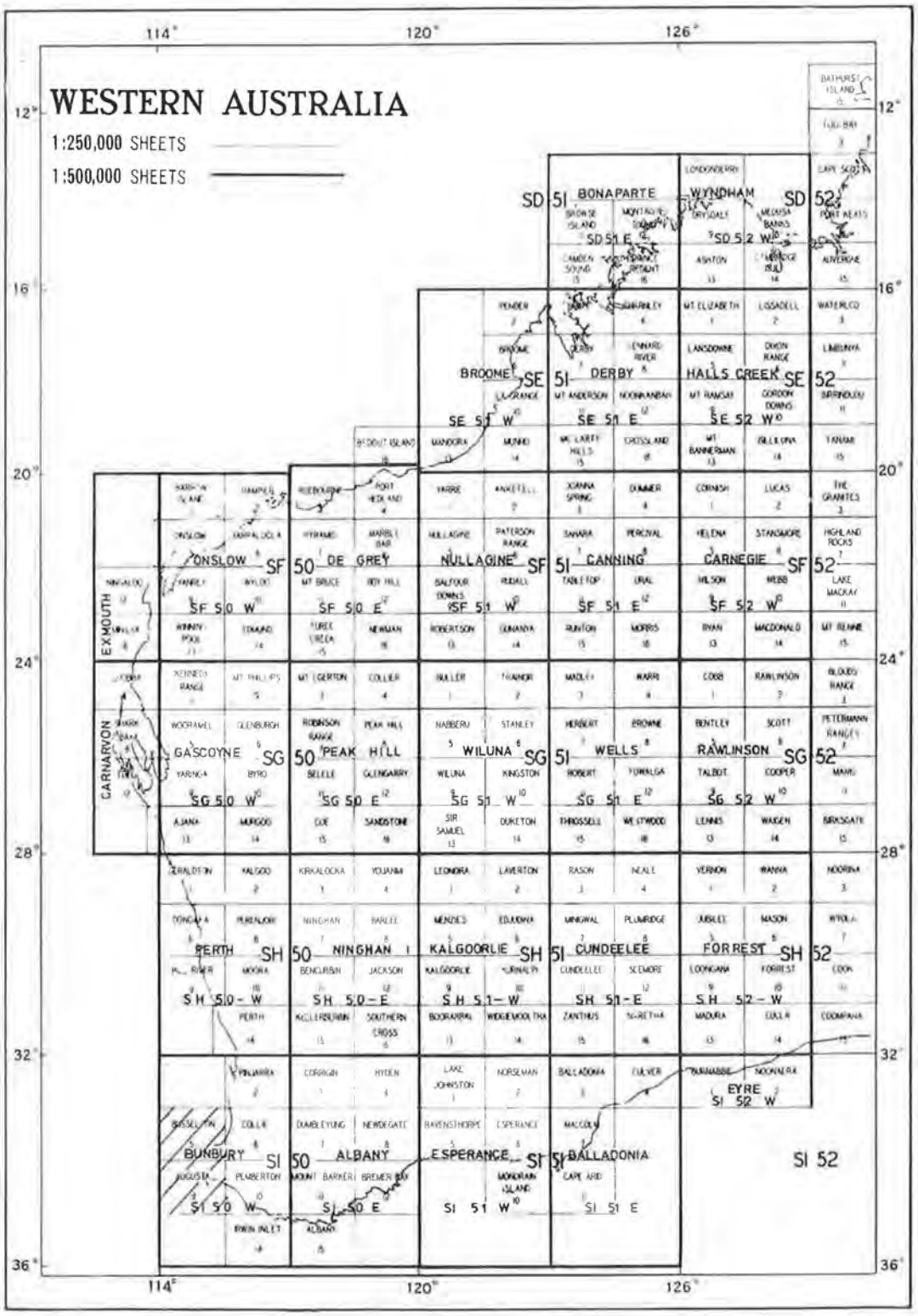
1973

WESTERN AUSTRALIAN DEPARTMENT OF AGRICULTURE


WESTERN AUSTRALIA
1:250,000 SHEETS
1:500,000 SHEETS
114°
120°
126°
12°
16°
20°
24°
28°
32°
36°
SD 51 BONAPARTE
SD 52
SD 51 E
SD 52 W
WYNDHAM
BROOME SE
DERBY
HALLS CREEK SE
SE 51 W
SE 51 E
SE 52 W
ONSLOW SF 50 DE GREY NULLAGINE SF 51 CANNING CARNEGIE SF 52
SF 50 W
SF 50 E
SF 51 W
SF 51 E
SF 52 W
EXMOUTH
CARNARVON
GASCOYNE SG 50 PEAK HILL WILUNA SG 51 WELLS RAWLINSON SG 52
SG 50 W
SG 50 E
SG 51 W
SG 51 E
SG 52 W
PERTH SH 50 NINGHAN I KALGOORLIE SH 51 CUNDEELEE FORREST SH 52
SH 50 - W
SH 50 - E
SH 51 - W
SH 51 - E
SH 52 - W
EYRE SI 52 W
BUNBURY SI 50 ALBANY ESPERANCE SI 51 BALLADONIA SI 52
SI 50 W
SI 50 E
SI 51 W
SI 51 E

CONTENTS

COMPILATION AND CLASSIFICATION

The Vegetation Map of the Busselton-Augusta area has been compiled and drawn by the author in accordance with the requirements of the Western Australian Vegetation Survey Committee. Sources of information were 1967 aerial photographs at a scale of 1:40,000 and the Forests Department's A.P.I. Plans which provided some additional information on vegetation structure and principal trees occurring in forested areas.

Traverses by motor vehicle and on foot were made during the period June 1971 to August 1972 covering the routes illustrated on the border of the vegetation map.

Plant material was identified in the field by the author or, in the case of unfamiliar material, was named at the Western Australian Herbarium.

Photographs illustrating this text were taken and processed by the author.

Vegetation has been mapped on the basis of structural criteria of the tallest stratum. Structural formations are indicated by colours. Subdivisions of these formations are on the basis of plant associations which are indicated by means of symbols.

Criteria used in the structural classification are life-form, height and density. There are three height classes for trees—over 30 m, 10 to 30 m, and under 10 m. There are two height classes for shrubs—over 2 m, and up

Standard descriptions used for each structural class

Life-form and height of tallest stratum	Projective foliage cover of tallest stratum, per cent	Description	Reference code
Trees over 30 m	70–100	High closed forest	A1
	30–70	High open forest	A2
	10–30	High woodland	A3
	under 10	High open woodland	A4
Trees 10–30 m	70–100	Closed forest	B1
	30–70	Open forest	B2
	10–30	Woodland	B3
	under 10	Open woodland	B4
Trees under 10 m	70–100	Low closed forest	C1
	30–70	Low open forest	C2
	10–30	Low woodland	C3
	under 10	Low open woodland	C4
Shrubs over 2 m	70–100	Closed scrub	D1
	30—70	Open scrub	D2
	10–30	High shrubland	D3
	under 10	High open shrubland	D4
Shrubs up to 2 m	70–100	Closed heath	E1
	30–70	Open heath	E2
	10–30	Low shrubland	E3
	under 10	Low open shrubland	E4
Herbs	70–100	Closed herbland, grassland, sedgeland, etc.	F1
	30–70	Herbland, grassland, sedgeland, etc.	F2
	10–30	Open herbland, grassland, sedgeland, etc.	F3

to 2 m. Herbs, which include grasses, sedges and hummock grasses, form the other life-form class.

There are four density classes based on projective foliage cover. Crown area cover is not used because it does not allow for the difference in the amount of light passing through the canopy of forests of similar crown cover but vastly different foliage cover. Because the amount of light passing through the main or top canopy has a big influence on the structure of the understorey, the use of projective foliage cover should give a better basis of comparison of plant formations.

Life-form—height classes are indicated by different colours: tall trees—purple; medium trees—brown; small trees—red; tall shrubs—orange; small shrubs—yellow; and herbs—green. Density of cover is indicated by different shades of colour; the darkest for the most dense and the lightest for the most open.

TOPOGRAPHY

A substantial part of the Busselton-Augusta area consists of a low, undulating plateau at one time extensively capped by laterite. This plateau extends westwards from the foot of the Darling-Nannup escarpment and is dissected by the westward flowing rivers Blackwood and Margaret. The altitude of most of the plateau is between 100 m and 140 m rising to 180 m in the northwest. It slopes downward from east to west and from north to south. On the plateau, the two branches of Margaret River form flood plains, and some large swamps occur above the headwaters of one of its tributaries, Mowen River. A feature of this plateau is that adjacent to some of the deeper river valleys, the convex hills slopes are covered with clayey loam. Lateritic outcrops and gravels may occur on the higher slopes above the clay areas.

The western part of this plateau is deeply dissected by Margaret River as it continues its westward course, by Carbunup River flowing northwards, and by Chapman and Upper Chapman Brooks flowing southwards to join the Blackwood, which itself turns south to flow into the Hardy Inlet, and thence to Flinders Bay.

Along the west coast, between Cape Naturaliste in the north and Cape Leeuwin in the south, stands a high steep-sided ridge of granitic gneiss, secondary limestone (aeolionite) and sand dunes, rising to over 200 m in parts. Margaret River penetrates through the centre of this ridge to the sea. A series of brooks cuts through the ridge draining the western end of the plateau. The southern third of the ridge, which includes the massive Boranup Hill, 193 m high, is penetrated only by Turner Brook which flows through a spectacular limestone gorge at Deepdene.

To the north of the pateau, and eastwards from Dunsborough, a broad coastal plain slopes down gently from 60 m at the foot of the plateau to a narrow belt of estuaries and marshes behind the low coastal sand dunes bordering Geographe Bay. This plain is drained by a series of north-flowing rivers which have their headwaters in the northern edge of the plateau. The principal rivers are the Ludlow, Abba, Sabina and Vasse which flow into lakes forming the Wonnerup and Vasse Estuary, and the Buayanup, Carbunup and Mary Brook which flow into Broadwater Lake to the west of Busselton. A few small brooks drain eastwards into Geographe Bay from Naturaliste Downs, which forms the northern end of the west coast ridge and rises to a height of 220 m. The coastal plain contains large areas of land once subject to periodic flooding but a series of drains have been cut to supplement the rivers in draining those areas and Broadwater Lake.

To the south, the plateau falls gently to another coastal plain which has a substantial range of sand dunes between it and the Southern Ocean. The plain consists of peaty sand and is characterised by the presence of low sand ridges and hillocks of lateritic gravel. In the plain there are areas of ironstone covered only by a thin layer of sandy soil. The coastal dunes prevent free drainage into the ocean and give rise to large areas of swamp, the waters of which are collected by the Scott River which flows westwards to empty into the estuary of the Blackwood River.

Mean annual rainfall ranges from about 800 mm in the north-eastern corner of the sheet to 1400 mm on the higher part of the plateau south of the Margaret River and on the southern part of the west coast at Deepdene. Most of this rainfall occurs in winter, but in the south as much as 300 mm occurs in summer.

VEGETATION SYSTEMS

In the region covered by the Busselton-Augusta sheet, five separate series or systems of plant associations can be recognised. The plant associations within a series or system form a sequence or pattern linked to topographic or edaphic factors. I have given to the vegetation systems the names which have been applied to the corresponding soil combinations or systems. The Chapman, Boranup and Scott River vegetation systems have the same boundaries as the soil combinations of the same name described by R. Smith (1951). The Pinjarra Plain and Spearwood vegetation systems cover the areas of soil systems of the same names described by McArthur and Bettenay (1960).

I have not designated their Quindalup Dune Soil System as a separate vegetation system because, in the area covered by this map, the vegetation is not characteristic of that system as described by those authors, but being dominated by Peppermint *Agonis flexuosa* (Spreng.) Schau., has an affinity with the Spearwood system and may be regarded as a part of the Boranup system.

Chapman system

Most of the region, in particular the lateritic plateau, is covered with Jarrah open forest (B2). The best development of purely Jarrah *Eucalyptus marginata* Sm. open forest occurs on the lateritic gravels of the hills, but in the valleys and richer sandy soils, Marri *E. calophylla* R. Br. becomes an important component giving rise to closed forest (B1) on the most favourable sites, particularly along the Blackwood river. In the valleys of the lower Blackwood, lower Margaret, and near the west coast, Peppermint *Agonis flexuosa* (Spreng.) Schau. becomes a component of the top canopy. In the deep valleys near Margaret River, there are limited areas of high open forest (A) of Jarrah and Marri and occasionally of Karri *E. diversicolor* F. Muell.

The broad valleys of the upper reaches of the Margaret River and the swamps of the higher parts of the plateau support sedgeland (F1). Also on the plateau are large areas of clayey loam in which the Jarrah forest degenerates into open woodland (B4) or even high open shrubland (D4) characterised by the presence of *Kingia australis* R. Br. On the grey earths in the broader western valleys of the plateau, Marri becomes the more frequent component of the open forest.

On high ground near the northern edge of the plateau on sandy lateritic gravels, the Jarrah becomes sparse, forming woodland (B3) with an understorey of small trees, Mountain Marri *E. haematoxylon* Maiden. In some localities, Jarrah is more or less absent, and the Mountain Marri with *Banksia* spp. form low woodland (C3).

Boranup system

The Naturaliste-Leeuwin ridge, presenting great variation in exposure to the prevailing winds, rising from sea level to over 200 m and then dropping steeply on the eastern side to less than 100 m, and being composed of granitic rocks, limestone and sand, has a rapidly changing and complex vegetation system. On the exposed western slopes, the vegetation is open heath (E2) which in areas of better development, or less frequent fires, and also where the limestone is near the surface, becomes open scrub (D2) or even closed scrub (D1) as between Yallingup and Cape Clairault, north of Cowaramup Bay and north of Cape Mentelle. With decrease in exposure, Jarrah, Peppermint and Banksia low open forest (C2) or Banksia or Peppermint low woodland (C3) or low open woodland (C4) occur. With further decreases in exposure the Jarrah becomes taller developing into open forest (B2). In the lee of the high ground, particularly in the south and more rarely in the northern part of the ridge, Karri high open forest (A2) occurs. Where the escarpment is particularly steep, as to the east of Boranup Hill, the change from open heath (E2) to Karri high open forest (A2) is abrupt, without intervening zones of low woodland or open forest. Stands of Karri high open forest are also associated with limestone caves and deep hollows at the foot of the escarpment. At the northern end of the escarpment, in the lee of the Naturaliste Downs, Yate *E. cornuta* Labill. open forest (B2) occurs on the richer brown soils and in valleys is accompanied by Marri, Flooded Gum *E. rudis* Endl. and Peppermint.

Extending along the shores of Flinders Bay the Boranup System covers extensive sand dunes up to 4 km wide. On the seaward side the dunes are covered with open heath (E2) and open scrub (D2). Further inland there is Peppermint low open forest (C2), Peppermint low woodland (C3) and Jarrah open forest (B2). In the lee of a sand blowout near White Point there is a small area of Peppermint low closed forest (C1). On some undulating sand dune country, tall shrubland (D3) occurs, composed of Banksias, Parrot Bush *Dryandra sessilis* (Knight) Domin, and Peppermint.

Pinjarra Plain system

The northern coastal plain was formerly covered with Marri open forest (B2), now mostly cleared, with some Jarrah in higher areas where lateritic gravel is present. With

the Marri near rivers, Forest Blackbutt *E. patens* Benth, occurs, while along the rivers Flooded Gum is also found with Paperbark *Melaleuca rhaphiophylla* Schau. and Peppermint; the latter occurring particularly closer to the coast.

There are very extensive areas of land with impeded drainage, formerly covered with Paperbark low woodland (C3) and in some places, low open woodland (C4) with a few Christmas Trees *Nuytsia floribunda* (Labill.) R. Br. ex Fenzl. and *Kingia*. On more sandy sites, low open forest (C2) of *Banksia* spp. with Christmas Trees and some *Melaleuca* occur as extensions of the Bassendean system.

Spearwood system

Between the north coastal plain and the sea, coastal sand dunes and low limestone ridges give rise to another vegetation system. Extending north-westwards from the region of the Sabina River Tuart *E. gomphocephala* DC. high woodland (A3), with a small patch of high open forest, occurs on sandy soil overlying a low limestone ridge. In the region of the Sabina River, the Tuart tails off westerly into what are now merely remnants of Yate open forest (B2). Peppermint forms the main understorey of the Tuart high woodland, occurring also on the coastal dunes as low open forest (C2) and extending westwards from Busselton along the coast to Dunsborough as open forest (B2). Between the Tuart high woodland and the Peppermint low open forest of the sand dunes there are expanses of flats bordering the Vasse and Wonnerup Estuaries, covered with low succulent salt tolerant Samphire shrubs *Arthrocnemum* spp. forming open heath (E2).

In the swamps between and behind the dunes, myrtaceous closed scrub (D1), open scrub (D2) or Paperbark low open forest (C2) occur. Along the inland edge of the Tuart high open woodland, are narrow belts of Jarrah open forest (B2), Banksia low open forest (C2), and Paperbark low open woodland (C4) in the wet areas, with occasional stands of Paperbark low closed forest (C1).

Scott River system

South of the Chapman system occur extensive areas of low open woodland (C4) on acid peaty sand. The small trees are Paperbarks, Jarrah and Banksias, the understorey being composed of small shrubs and sedges. The wetter areas are mainly sedgeland (F1). Arising above the low open woodland and sedgeland flats, small lateritic hillocks have Jarrah low open forest (C2) and sandy ridges have Banksia low woodland (C3). At and to the north of the Scott River, there are areas of low shrubland (E3) over ironstone.

Along the Scott River there are some occurrences of Karri high open forest (A2) and Jarrah-Marri open forest (B2).

FORMATIONS AND PLANT ASSOCIATIONS

A2 HIGH OPEN FOREST

Karri Forest (K)

High open forest dominated by Karri *Eucalyptus diversicolor* F. Muell. occurs mainly on the eastern escarpment of the Naturaliste-Leeuwin ridge, particularly between Calgardup Brook and Flinders Bay. There is an outlying stand north of the Margaret River at Ellen Brook and another, the most northerly, above Quininup Brook. Elsewhere, Karri forest occurs in valleys near Karridale, up Boojidup Brook, in the vicinity of the town of Margaret River and up Scott River. Karri grows on light soils, deep brown sands, derived from granite and gneiss, mostly on hillsides and along valleys. It may be associated with aeolianite outcrops, caves and sink holes. Mean annual rainfall is over 1,000 mm and summer rainfall usually exceeds 300 mm, and the sites are sheltered from prevailing westerly winds.

Karri grows to 80 m tall with 45 m of clean trunk and a wide, spreading and somewhat open crown. In Arumvale forest there are extensive areas of evenly aged Karri with close grown tall straight stems and closely packed crowns. More isolated stands of Karri, in small valleys at the foot of the escarpment and on the slopes above Quininup Brook, are shorter stemmed with heavy branches and wide crowns. Where Karri occurs, it is in pure stands, intermingling with Jarrah *E. marginata* Sm. and Marri *E. calophylla* R. Br. only at the edges of stands. Both these species, either separately or together, form high open forest in small areas along rivers, particularly near Margaret River.

In more open parts of virgin Karri forest understorey trees occur, particularly *Banksia grandis* Willd., *Casuarina decussata* Benth., *Agonis flexuosa* (Spreng.) Schau., *Agonis juniperina* Schau., and *Banksia littoralis* R. Br. The two *Agonis* species and *B. littoralis* occur mainly in the bottoms of valleys. Shrubs may form a closed understorey up to 5 m high. Common species are *Acacia pentadenia* Lindl., *Bossiaea laidlawiana* Tovey & Morris, *Chorilaena quercifolia* Endl., *Hibbertia tetrandra* (Lindl.) Gilg., *Hovea elliptica* (Sm.) DS., and *Trymalium spathulatum* (Labill.) Ostf. Where the scrub has been reduced by periodic burning, Bracken *Pteridium esculentum* (Forst. f.) Nakai thrives in its place. *Albizia lophantha* (Willd.) Benth. and *Templetonia retusa* R. Br. occur at Dianella.

A3 HIGH WOODLAND

Tuart Forest (T)

High woodland (A3) dominated by Tuart *Eucalyptus gomphocephala* DC., starts in the area of Sabina River east of Busselton and extends in an almost continuous narrow belt on limestone formations of the coastal plain, northwest and then northwards. In the Sabina and Ludlow River areas Tuarts grow to 40 m in almost pure stands. Formerly, massive Tuarts, up to 8 m girth, formed high open forest in their most favourable areas, with crowns intermingled and only a low shrub understorey. Today, there is only a small area, just east of Sabina River and south of the rifle range, that resembles high open forest (A2). The remainder of the Tuarts are more openly spaced, forming at the best a high woodland (A3) with a fairly dense understorey of *Agonis flexuosa* (Spreng.) Schau. Around Ludlow, some remnants of Tuart forest have been underplanted with pine plantations (Pi). Natural regeneration of Tuart is not very apparent, but the Forests Department has established an experimental plantation.

B1 CLOSED FOREST

Marri Forest (M) and Jarrah-Marri Forest (JM)

Limited areas of prime Marri *Eucalyptus calophylla* R. Br. and of mixed Jarrah *E. marginata* Sm. and Marri closed forest (B1) occur along the Blackwood River. The understorey consists of very low shrubs or bracken. Near river banks *Agonis flexuosa* (Spreng.) Schau. further increases the density of the tree canopy, and only sedges form the understorey.

Pine Plantations (Pi)

Plantations of *Pinus* species established by the Forest Department have been mapped at Margaret River, Ludlow and on the Busselton-Nannup road due south of Ludlow.

B2 OPEN FOREST

Jarrah Forest (J)

An open forest (B2) dominated by Jarrah *Eucalyptus marginata* Sm. extends over most of the Busselton and Augusta areas on a low lateritic plateau. This forest extends westwards from the Darling escarpment to the eastern escarpment of the Naturaliste-Leeuwin ridge, where it is limited by exposure to westerly winds and the presence of Karri high open forest (A2).

On the plateau, the presence of clayey loam on some hill slopes reduces the forest to open woodland (B4) or, north of the Blackwood River, to high open shrubland (D4). Along rivers Jarrah is co-dominant with Marri *E. calophylla* R. Br. and a more dense forest occurs Along lower reaches of rivers and in the deeper gullys *Agonis flexuosa* (Spreng.) Schau. adds a dense understorey which may extend upwards into the top canopy.

Common understorey trees are *Banksia grandis* Willd. and *Casuarina fraserana* Miq., the latter forming almost pure stands of open forest or low open forest on poor sites over massive laterite sheet. Other understorey trees are *Banksia littoralis* R. Br., *Persoonia longifolia* R. Br., *P. elliptica* R. Br., *Nuytsia floribunda* (Labill.) R. Br. ex Fenzl. and *Xylomelum occidentale* R. Br. In areas of open woodland (B4) or low open woodland (C4) and open high shrubland (D4) *Casuarina humilis* Otto et Dietr. and *Kingia australis* R. Br. are common. *Nuytsia floribunda* occurs particularly on flat wet sandy soils overlying clay on watersheds and outwash areas. *Xanthorrhoea preissii* Endl. and *Macrozamia riedlei* (Gaud.) C. A. Gardn. are common in parts and there is a continuous layer of a variety of low shrubs of *Podocarpus, Adenanthos, Grevillea, Hakea, Leptomeria, Acacia, Daviesia, Bossiaea, Hovea, Astroloma, Leucopogon* and *Agonis parviceps* Schau.

Jarrah open forest also occurs on sand hills between the swamps of Scott River and the south coast. In damper sites Bullich *Eucalyptus megacarpa* F. Muell. may occur. On the escarpment in the west between Dunsborough and Augusta, as altitude and exposure increase, Jarrah open forest becomes low open forest (C2) and then degenerates into open scrub (D2). In these situations *Banksia* and *Agonis flexuosa* may be co-dominant or dominant.

Jarrah-Marri Open Forest (JM)

On deeper more sandy soils, Marri becomes co-dominant with Jarrah. Jarrah-Marri open forest occurs mainly along river valleys; *Agonis flexuosa* may become an important constituent in the deeper valleys. Flooded Gum *E. rudis* Endl. ocurs on lower ground and along river

banks, and Forest Blackbutt *E. patens* Benth. may be present in damp areas.

Marri Forest (M)

On the leached grey earths of the broad coastal plain north of the low lateritic plateau and between the plateau and the escarpment of the Naturaliste-Leeuwin ridge, the open forest (B2) is dominated by Marri. Jarrah occurs but infrequently. In wetter sites, Forest Blackbutt is common and Flooded Gum occurs locally in a form with large leaves, buds and fruits. Yate *E. cornuta* Labill. occurs particularly around the Sabina River and at the foot of the Naturaliste Downs on moist brown sands. *Agonis flexuosa* and *Banksia* species are frequently important constituents and *Acacia cochlearis* Wendl. and *A. cyanophylla* Lindl. are prominent in the understorey.

Peppermint Forest (Ag)

Along the low coastal sand dunes bordering Geographe Bay between Dunsborough and Busselton and in small sheltered pockets on the west and south coasts such as at Deepdene and south of Milyeaanup Swamp, Peppermint *Agonis flexuosa* (Spreng.) Schau. grows to more than 10 m tall, forming open forest (B2). Where it is most dense the understorey consists only of the sedge *Lepidosperma gladiatum* Labill. Along the Geographe Bay coast the understorey consists of *Acacia decipiens* (Koen.) R. Br., *A. cochlearis* Wendl., *Acanthocarpus preissii* Lehm., *Anthericum divaricatum* Jacq., *Anthocercis littorea* Labill., *Leucopogon australis* R. Br., *Lepidosperma gladiatum* and *Pimelea argentea* R. Br.

Melaleuca Forest (Me)

North-west of Bunker Bay there is a small unique stand of *Melaleuca lanceolata* Otto up to 12 m tall forming open forest (B2). This species forms a patch of low closed forest (C1) just east of Cape Clairault and a very small stand of low open forest immediately north of Cape Leeuwin.

B3 WOODLAND

Jarrah Woodland (J)

Jarrah *Eucalyptus marginata* Sm. forms woodland (B3) along the southern edge of the main block of Jarrah open forest (B2) where it adjoins the peaty acid sands of the south coast flats. Typically Jarrah woodland has an understorey of smaller trees, *Banksia ilicifolia* R. Br., *B. grandis* Willd., *B. littoralis* R. Br., *Nuytsia floribunda* (Labill.) R. Br. ex Fenzl. and Paperbark *Melaleuca preissiana* Schau. Often Blackboys *Xanthorrhoea* species are common. The shrub layer is fairly open, except in the wetter parts where sedges become more numerous.

Jarrah-Mountain Marri Woodland (JH)

On high ground at the northern edge of the lateritic plateau on more sandy soil, Jarrah forms another type of woodland characterised by the presence of a small tree, Mountain Marri *Eucalyptus haematoxylon* Maiden. Other small trees present are *Banksia grandis* Willd. and *B. attenuata* R. Br. On similar sites Jarrah may be absent or occur only as a small tree, and Mountain Marri with the Banksias forms low woodland (C3).

B4 OPEN WOODLAND

Jarrah Open Woodland (J)

On clayey sites south of Blackwood River, a few scattered Jarrah *E. marginata* Sm. occur with shallow root systems impeded by the clay. The understorey consists of somewhat thinly distributed *Hakea, Banksia grandis* Willd., *Kingia australis* R. Br., *Casuarina humilis* Otto et Dietr. *Xanthorrhoea species* and *Dasypogon hookeri* Drumm. On some sites the Jarrah is short and spindly. Hard clay-covered ant nests housing large black ants are a common feature of the clayey areas.

C1. LOW CLOSED FOREST

Peppermint Low Closed Forest (Ag)

Only two small areas of Peppermint *Agonis flexuosa* (Spreng.) Schau., low closed forest (C1) have been mapped. One is in the lee of a sand blowout on the south coast near White Point and the other is on the northern edge of Tuart forest north of Ludlow.

Melaleuca Low Closed Forest (Me)

One small area of *Melaleuca lanceolata* Otto low closed forest (C1) has been mapped west of Cape Clairault. A small patch of the same species occurs at Cape Leeuwin, but is more open. A larger area, also more open and consisting of larger trees occurs at Bunker Bay.

Paperbark Low Closed Forest (P)

In and around swamps and lakes on the inland side of the Tuart limesone ridge there are small very dense stands of Paperbark *Melaleuca rhaphiophylla* Schau.

C2 LOW OPEN FOREST

Jarrah-Marri Low Open Forest (JM)

On the higher ground of the Naturaliste-Leeuwin ridge as exposure to westerly winds

increases, Jarrah open forest grades down into a low open forest (C2). The main constituents are Jarrah *Eucalyptus marginata* Sm., Marri *E. calophylla* R. Br., *Banksia* species, including *B. grandis* Willd., *Casuarina, Agonis flexuosa* (Spreng.) Schau. and occasional *Xylomelum occidentale* R. Br. In parts *Jacksonia furcellata* DC. is a common shrub.

Peppermint Low Open Forest (Ag)

Above the Jarrah and Karri forests on the Naturaliste-Leeuwin ridge, in valleys and sheltered hollows on the seaward side of the ridge, along the coastal sand ridges eastwards from Busselton, in parts west of Busselton, and in sheltered parts of the south coast sand dunes covering large areas, Peppermint *Agonis flexuosa* (Spreng.) Schau. forms low open forest (C2). The understorey is subdued and consists mainly of *Lepidosperma gladiatum* Labill. Inland from Hamelin Bay, *Melaleuca huegelii* Endl. is co-dominant with Peppermint.

Jarrah-Banksia Low Open Forest (JB)

At the western end of Long Swamp, east of Augusta, and to the east of Long Swamp on sand ridges, Jarrah and *Banksia ilicifolia* R. Br. form low open forest (C2).

Banksia Low Open Forest (B)

On slightly elevated sandy areas inland from the Tuart limestone belt and other sandy areas in the coastal plain north of the main Jarrah open forest, low open forest (C2) occurs composed of *Banksia attenuata* R. Br. and *B. ilicifolia* with some *Nuytsia floribunda* (Labill.) R. Br. ex Fenzl.

Paperbark Low Open Forest (P)

Paperbark *Melaleuca rhaphiophylla* Schau. forms low open forest (C2) in and around swamps, particularly inland from the coastal sand dunes along the shore of Geographe Bay, on the flats between the Jarrah open forest and the south coast sand dune system and, more rarely, along the eastern escarpment of the Naturaliste-Leeuwin ridge. Paperbark also occurs along banks of streams and rivers and may be accompanied by *M. acuminata* F. Muell. south of Busselton. In very narrow belts between the Tuart forest and Wonnerup and Vasse estuaries, Paperbark is accompanied by Flooded Gum *Eucalyptus rudis* Endl. and, less frequently, by Peppermint.

C3 LOW WOODLAND

Jarrah Low Woodland (J)

On higher ground on the Naturaliste-Leeuwin ridge, particularly where granitic rock is close to the surface, as well as on some of the lower slopes of the eastern escarpment, Jarrah *Eucalyptus marginata* Sm. forms low woodland (C3), usually with a high proportion of *Banksia* species. Marri *E. calophylla* R. Br. may also be present, or *Casuarina* may be co-dominant.

Banksia Low Woodland (B)

On high ground with sandy soils, particularly between Naturaliste Downs and Dunsborough and on other sandy sites at the foot of the eastern escarpment of the Naturaliste-Leeuwin ridge, south of Calgardup Brook, *Banksia* species form low woodland (C3). Other areas occur both east and west of Augusta.

Jarrah-Banksia Low Woodland (JB)

Jarrah and *Banksia ilicifolia* R. Br. form low woodland on sand ridges in the flats of the south coast plain. In situations closer to the south coast sand dunes Bullich *E. megacarpa* F. Muell. may occur.

Peppermint Low Woodland (Ag)

Southwards from Deepdene on high ground west of the Karri forest, and again on the south coast sand dunes, Peppermint *Agonis flexuosa* (Spreng.) Schau. forms areas of low woodland in situations which are less sheltered from winds than those in which Peppermint low open forest thrives. There are, however, indications that burning or pasture improvement may be responsible for thinning out the open forest.

Eucalyptus haematoxylon Low Woodland (H)

On high ground near the northern edge of the lateritic plateau on fairly sandy soil, Mountain Marri *E. haematoxylon* Maiden together with *Banksia grandis* Willd. and *B. attenuata* R. Br. form low woodland (C3). Understorey shrubs include *Casuarina humilis* Otto et Dietr. and *Banksia sphaerocarpa* R. Br.

C4 LOW OPEN WOODLAND

Paperbark Low Open Woodland (P)

An open woodland in which Paperbark *Melaleuca preissiana* Schau. appears as a small tree, scattered or in small groups, covers large areas of open flats of leached sand subject to seasonal flooding. The largest areas occur south of the main block of Jarrah open forest and north of the sand dunes of the south coast and either side of the lower reaches of the

Blackwood River. Small areas occur on hollows and at the side of drainage lines in the Jarrah forest. Similar areas occur on the northern coastal plain, but here *Melaleuca rhaphiophylla* Schau. is the more common Paperbark. A frequent co-dominant is Swamp Banksia *B. littoralis* R. Br. Stunted Jarrah may also be present and Blackboys may be frequent. *Nuytsia floribunda* (Labill.) R. Br. ex Fenzl. also occurs.

The understorey is a closed heath with closed sedgeland in wetter parts. The shrubs *Astartea fascicularis* (Labill.) Dc., *Agonis parviceps* Schau. and *Melaleuca preissiana* are particularly abundant with *Leptospermum firmum* (Schau.) Benth., *Agonis marginata* (Labill.) Schau., *A. juniperina* Schau., *Kunzea recurva* Schau. and *Beaufortia sparsa* R. Br. Common small sedges are *Lepidosperma longitudinal* Labill. and *Mesomelaena tetragona* (R. Br.) F. Muell. *Boronia* species also occur.

Included in the low open woodland (C4) are swamps with Paperbark low closed forest (C1) or low open forest (C2), closed scrub (D1), closed heath and sedgeland (F1) too small to be mapped. Narrow ridges and small hillocks of Jarrah and Banksia low open forest and low woodland (C3) are also included in the low open woodland areas of the south coast flats.

Peppermint Low Open Woodland (Ag)

An area of low open woodland (C4) occurs on the Naturaliste-Leeuwin ridge south of Deepdene. This is quite different from the Paperbark low open woodland as Peppermint *Agonis flexuosa* (Spreng.) Schau. is the dominant tree. As in the case of open woodlands (C3) in nearby areas, fires are suspected as being the main cause of the open character of this vegetation.

D1 CLOSED SCRUB

Myrtaceous Closed Scrub (My)

Along drainage lines and flat banks of streams and rivers in higher rainfall areas where the soil is damp most of the time, and at head waters of streams closed scrub grows up to 4 m high.

The species vary from area to area; along river banks at Tetron *Agonis linearifolia* Schau. is most abundant; in Chapman Valley *A. linearifolia* is accompanied by *Melaleuca polygaloides* Schau. whereas in seepage areas in the foothills of the lateritic plateau near Quindalup *Agonis juniperina* Schau. and *Kunzea ericifolia* Reichb. occur.

Melaleuca huegelii Closed Scrub (Me)

On the Naturaliste-Leeuwin ridge facing the ocean on sites where limestone appears near the surface closed scrub is formed by *Melaleuca huegelii* Endl. This is most noticeable near Yallingup, Canal Rocks and Cape Mentelle. At Injidup Springs *M. huegelii* is accompanied by *Dryandra sessilis* (Knight) Domin.

Peppermint Closed Scrub (Ag)

In similar situations on coastal sand, possibly where there is a little more shelter, Peppermint *Agonis flexuosa* (Spreng.) Schau. forms closed scrub, accompanied by *Dryandra sessilis* north of Cape Leeuwin where limestone occurs, and with *Boronia elata* Sm. near Deepdene.

Acacia decipiens Closed Scrub (A)

In the lee of the Boranup Sand Patch at the upper edge of the Karri forest closed scrub occurs, consisting mainly of *Acacia decipiens* R. Br.

D2 OPEN SCRUB

Peppermint Open Scrub (Ag)

While closed scrub (D1) usually consists of only one dominant species, and at the most two species, open scrub (D2), which occurs widely on coastal sands and limestones, may contain more species.

On the sand hills of the south coast, open scrub typically consists of Peppermint *Agonis flexuosa* (Spreng.) Schau., *Jacksonia horrida* DC., and *Acacia decipiens* R. Br. On the Naturaliste-Leeuwin ridge, the presence of limestone allows the inclusion of Parrot Bush *Dryandra sessilis* (Knight) Domin.—at Cape Mentelle, Injidup Springs, Canal Rocks, Boranup, Cosy Corner and north of Cape Leeuwin —and of *Melaleuca huegelii* Endl—at Cape Mentelle and Injidup Springs. While Peppermint seems always to be present, *Acacia decipiens* can become the most common species and the flora may be enriched by the presence of *Eucalyptus megacarpa* F. Muell. Blackboys, *Xanthorrhoea* spp., *Melaleuca acerosa* Schau., *Hakea nitida* R. Br., *Spyridium globulosum* (Labill.) Benth. and *Leucopogon* species may also be present in the understorey.

Near Cape Naturaliste Peppermint open scrub includes Marri *Eucalyptus calophylla* R. Br. and Jarrah *E. marginata* Sm. as tall shrubs, and in parts Peppermint may be accompanied by *Banksia* species.

Paperbark and Peppermint Open Scrub (PAg)

South of Busselton, in low lying areas, Paperbark *Melaleuca rhaphiophylla* forms open scrub with Peppermint.

D3 HIGH SHRUBLAND

Peppermint-Parrot Bush High Shrubland (AgD)

South of Scott River near the south coast, there occur areas of moist flats and hollows with sandy ridges. Peppermint *Agonis flexuosa* (Spreng.) Schau. occurs on the moister sites while Parrot Bush *Dryandra sessilis* (Knight) Domin. occurs on the ridges, forming high shrubland (D3).

D4 HIGH OPEN SHRUBLAND

Jarrah-Kingia High Open Shrubland (JKi)

On the low lateritic plateau north of Blackwood River a form of high open shrubland (D4) occurs on convex hill sides and valley slopes which are covered with a yellowish clay loam. The vegetation consists of scrubby Jarrah *E. marginata* Sm., *Kingia australis* R. Br., *Dasypogon hookeri* Drumm., *Banksia grandis* Willd., *Hakea* sp., *Casuarina humilis* Otto et Dietr. and *Xanthorrhoea* species. The vegetation is similar to Jarrah open woodland south of the Blackwood but lacks trees.

E2 OPEN HEATH

In exposed situations on the west and south coasts open heath occurs in which the principal species are *Acacia decipiens* R. Br. and *Jacksonia horrida* DC. On the west coast *Scaevola crassifolia* Labill. and *S. nitida* R. Br. are locally abundant. Other important species are *Spyridium globulosum* (Labill.) Benth. and *Leucopogon parviflorus* (Andr.) Lindl. Near the sea the grey leaved *Olearia axillaris* (DC.) F. Muell. ex Benth. becomes common. *Melaleuca huegelii* Endl. may occur in limestone areas. Where limestone occurs near the surface *Dryandra sessilis* (Knight) Domin. is common. Other species are *Melaleuca acerosa* Schau., *Hibbertia, Hardenbergia* and *Pimelea.*

Towards the northern end of the Naturaliste-Leeuwin ridge, *Acacia pulchella* R. Br., *Calothamnus* species and *Casuarina humilis* Otto et Dietr. are of local occurrence with *Calothamnus, Hakea* and *Xanthorrhoea* being predominant near Dunsborough.

Samphire Open Heath (Sa)

On the flats adjoining Vasse and Wonnerup estuaries subject to flooding with salty water a highly specialised form of low open heath occurs. The principal plants are *Arthrocnemum bidens* Nees., *A. halocnemoides* Nees. var. *halocnemoides* and other *Arthrocnemum* species.

E3 LOW SHRUBLAND

Coastal Shrubland (O)

Close to the sea and on mobile sand dunes and blowouts the open heath and scrub of stable dunes give way to a low shrubland characterised by the grey leaved shrub *Olearia axillaris* (DC.) F. Muell. ex Benth. which grows to between 1 and 3 m tall. Other constituents in the south and west are *Spyridium globulosum* (Labill.) Benth., *Acacia cyclops* Cunn. ex Don., *A. decipiens* R. Br., *Hibbertia cuneiformis* (Labill.) Gilg., *Exocarpos sparteus* R. Br., *Pimelea clavata* Labill., *Helichrysum cordatum* DC., *Calocephalus brownii* (Cass.) F. Muell., *Scaevola crassifolia* Labill., *S. nitida* R. Br. and *Scirpus nodosus* Rottb.

On the north coast, Geographe Bay, changes are apparent in the constituents. *Olearia axillaris, Spyridium globulosum* and *Scaevola crassifolia* continue to be important, while *Acacia cochlearis* Wendl. becomes of equal importance in frequency with *O. axillaris.* Other species are *Acanthocarpus preissii* Lehm. and *Alyxia buxifolia* R. Br.

Ironstone Shrubland (V)

In the southern coastal plain adoining and north of Scott River there are quite extensive areas of ironstone or ferruginous sandstone plain covered with only a very thin layer of soil. The vegetation consists of a low shrubland in which the principal shrubs, 1 m to 1.5 m tall, are *Viminaria juncea* (Willd.) Hoffm., *Grevillea synapheae* R. Br., *Acacia myrtifolia* (Sm.) Willd. and *Loxocarya flexuosa* (R. Br.) Benth.

F1 CLOSED HERBLAND

Sedgeland (S)

Towards the south coast, inland from the coastal dune system and on the black peaty sands of flats subject to prolonged flooding and waterlogging, there are extensive areas of sedgeland (F1). In some areas it merges with closed heath forming pockets of sedgeland in the wettest parts of low open woodland (C4). In other areas shrubby plants and herbaceous plants are so intermixed it is difficult to determine whether the formation should be called heath or sedgeland. Sedgelands also occur

along broad river valleys such as the upper reaches of the Margaret River and in poorly drained hollows in the Jarrah forest. Plants characteristic of sedgelands on the south coast flats are *Evandra aristata* R. Br. (up to 1 m tall), *Anarthria prolifera* R. Br., *A. scabra* R. Br., *Restio applanatus* Spreng., *Leptocarpus scariosus* R. Br., *Leptosperma persecans* S. T. Blake and *Lysinema conspicuum* R. Br.

Shrubs most frequently associated with sedgelands are *Leptospermum firmum* (Schau.) Benth., *L. oligandrum* Turez., *L. ellipticum* Endl., *Astartea fascicularis* (Labill.) D.C., *Agonis linearifolia* Schau., *Leucopogon gilberti* Stschegl., *L. pendulus* R. Br., *Andersonia caerulea* R. Br., and *Beaufortia sparsa* R. Br.

On low narrow sand ridges *Banksia ilicifolia* R. Br., *Banksia attenuata* R. Br. and occasionally small Jarrah *Eucalyptus marginata* Sm. form low open woodland, low woodland or even low forest, included in sedgeland. Swamp vegetation, in parts very extensive, is included in sedgeland as mapped. On the flats of the Margaret River typical plants are *Leptocarpus tenax* (Labill.) R. Br., *Stylidium imbricatum* Benth., *Restio ustulatus* F. Muell. ex Ewart & Sparman, *Beaufortia sparsa, Hakea ceratophylla* (Sm.) R. Br., *Leptospermum ellipticum* Endl. and *Dasypogon hookeri* Drumm.

SWAMP VEGETATION

The permanent swamps are filled with rushes *Juncus* species standing in water. There may also be scattered Paperbarks *Melaleuca rhaphiophylla* Schau., but most frequently there is a narrow belt of low open forest around the edge of the swamp. On areas frequently flooded, the small trees are *M. rhaphiophylla* or *Agonis juniperina* Schau. On slightly higher ground *Melaleuca preissiana* Schau. and *Banksia littoralis* R. Br. may occur and near the north coast *Agonis flexuosa* (Spreng.) Schau. and *Eucalyptus rudis* Endl. are common associates. On damp and frequently flooded ground the understorey consists of *Gahnia trifida* Labill. or *Lepidosperma gladiatum* Labill.

PRIMARY INDUSTRIES

Earlier this century there was a flourishing timber industry centred on the Karri forests growing in the lee of the Naturaliste-Leeuwin ridge. The mill was at old Karridale, now abandoned, and the timber was exported from Hamelin Bay on the west coast in summer and from Flinders Bay in winter. Systematic logging continues in the Jarrah forest of the low plateau and pine plantations have been established at Margaret River and near Ludlow. The Ludlow plantations have a current production if about 3,000 m³ a year. The narrow belt of Tuart forest just inland from the Wonnerup and Vasse estuaries provide valuable hardwood for building railway waggons.

The north coastal plain and the richer valleys and slopes between the plateau and the Naturaliste-Leeuwin ridge have been cleared of their natural vegetation and converted to pasture. The flats on both sides of the lowest reaches of the Blackwood River and much of the Scott River, as well as some of the high ground on the Naturaliste-Leeuwin ridge, have been cleared recently.

Of a total of 240 000 ha in the Augusta-Margaret River District, 55 000 ha have been cleared, 49 500 for pasture and 1 230 ha for crops, mainly green feed and silage. Some 20,000 cattle are kept for milk production and 26,000 for beef. There are also some 86,000 sheep and 6,300 pigs.

A greater proportion of Busselton District has been cleared. Of the total area of 133 000 ha, 70 400 ha have been cleared, 65 000 ha being under pasture and 2 200 ha under crops, mainly green feed and silage but also with some 230 ha under lettuce and 300 ha under potatoes. Over 46,000 cattle are kept for beef production and 15,000 for milk. There are at least 82,000 sheep and 3,400 pigs.

The beaches in the north, surf in the west and the fascinating limestone caves and delightful countryside attract numerous holiday-makers seeking relaxation and tourism provides the major industry for the towns of Busselton, Augusta and Margaret River.

Busselton and Cowaramup provide convenient bases for commercial honey producers who specialise in the production of honey and beeswax from Karri, Marri and Jarrah and, to a lesser degree, from Tuart, Yate and Peppermint.

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McArthur, W. M. T. and Bettenay, E. (1960): The development and distribution of the soils of the Swan Coastal Plain, Western Australia. Soil Pub. 16, C.S.I.R.O.

Smith, R. (1951): Soils of the Margaret River —Lower Blackwood River Districts, Western Australia. Bull. 262, C.S.I.R.O.

A3 T Tuart High Woodland *E. gomphocephala* with *Agonis flexuosa* understorey ; near Ludlow 343845

A2 K Karri High Open Forest *Eucalyptus diversicolor* ; Douglas Road, Arumvale 305779

A2 K Karri High Open Forest *E. diversicolor*, more open and heavily branched ; Quininup Brook 300833

B1 JM Jarrah—Marri Closed Forest *E. marginata* and *E. calophylla ;* north bank of Blackwood River, Denny Road 337791

B1 M Marri Closed Forest *E. calophylla ;* near junction of Rosa Brook with Blackwood River, Denny Road 342792

B2 JM Jarrah—Marri Open Forest *E. marginata* and *E. calophylla* with *Agonis flexuosa ;* near Margaret River, Lorry Road 312804

B2 M Marri Open Forest *E. calophylla ;* Lorry Road 312802

B2 JC Jarrah—Casuarina Open Forest *E. marginata* and *Casuarina fraserana ;* Oasis Road 332803

B2 MY Marri—Yate Open Forest *E. calophylla* and *E. cornuta* with *E. rudis* and *Agonis flexuosa ;* Naturaliste Downs 303850

B2 Me Melaleuca Open Forest *Melaleuca lanceolata ;* north-west of Bunker Bay 302856

C1 Ag Peppermint Low Closed Forest *Agonis flexuosa ;* near Ludlow 348854

C2 Ag Peppermint Low Open Forest *Agonis flexuosa* , near Augusta golf course 309762

C2 JM Jarrah—Marri Low Open Forest *E. marginata* and *E. calophylla* with *Casuarina fraserana, Jacksonia furcellata* scrub in foreground ; Cullen Road 299822

C2 J Jarrah Low Open Forest *E. marginata* with *Banksia grandis* and *Xylomelum occidentale;* Wyadup Road 298837

C2 B Banksia Low Open Forest *Banksia attenuata* and *B. ilicifolia* with *Nuytsia floribunda ;* near Ludlow 345844

C2 P Paperback Low Open Forest *Maleleuca rhaphiophylla ;* Quindalup 310845

C3 J Jarrah Low Woodland *E. marginata ;* near Cape Naturaliste 302855

C3 H Mountain Marri Low Woodland *E. haematoxylon* with *Banksia* spp. ; Sabina Road 343827

C3 B Banksia Low Woodland *Banksia* spp. ; Meelup Spring 305849

C4 P Paperback Low Open Woodland *Melaleuca rhaphiophylla;* near Augusta 313766

D1 My Myrtaceous Closed Scrub *Agonis juniperina* and *Kunzea ericifolia* with *Melaleuca rhaphiophylla* in background ; south-west from Quindalup 308842

D1 Me Melaleuca Closed Scrub *Melaleuca huegelii ;* near Canal Rocks 297839

D1 D Parrot Bush Closed Scrub *Dryandra sessilis ;* near Cape Mentelle 298804

D1 Ag Peppermint Closed Scrub *Agonis flexuosa ;* Deepdene 303757

D2 Ag Peppermint Open Scrub *Agonis flexuosa* with *Dryandra sessilis ;* near Cape Leeuwin 313756

D4 JKi Jarrah—Kingia High Open Shrubland *E. marginata*, shrub form, and *Kingia australis* with Jarrah Open Forest in background : McCorkhill 349806

E2 A Acacia Open Heath *Acacia decipiens* with *Melaleuca huegelii* and *Leucopogon parviflorus ;* near mouth of Margaret River 297802

E2 O Olearia Open Heath *Olearia axillaris* with *Acacia decipiens, Spyridium globulosum, Scaevola nitida* and *Hibbertia* sp. ; near Cape Leeuwin 313755

E2 Ca Calothamnus Open Heath *Calothamnus quadrifidus* and *Hakea trifurcata ;* north of Dunsborough 308848

E2 Sa Samphire Open Heath *Arthrocnemum bidens* and *A. holocnemoides ;* Wonnerup Estuary 346852

E3 V Viminaria Low Shrubland *Viminariaj uncea* with *Grevillea synapheae*, *Acacia myrtifolia* and *Loxocarya flexuosa ;* ironstone plain north of Scott River 328768

F1 S Closed Herbland—Sedgeland ; upper Margaret River 337817

17533/5/73—2M

WILLIAM C. BROWN, Government Printer, Western Australia

AUSTRALIA 1:250,000

BUSSELTON AND AUGUSTA

REFER TO THIS MAP AS:
SI 50-9 & SI 50-5 VEGETATION

VEGETATION SURVEY TRAVERSES

LEGEND

VEGETATION STRUCTURE

LIFE FORM AND HEIGHT OF TALLEST STRATUM	FORMATION	PROJECTIVE FOLIAGE COVER OF TALLEST STRATUM, PER CENT
TREES (Above 30 metres)	High closed forest	70-100
	High open forest	30-70
	High woodland	10-30
	High open woodland	BELOW 10
TREES (10 to 30 metres)	Closed forest	70-100
	Open forest	30-70
	Woodland	10-30
	Open woodland	BELOW 10
TREES (Below 10 metres)	Low closed forest	70-100
	Low open forest	30-70
	Low woodland	10-30
	Low open woodland	BELOW 10
SHRUBS (Above 2 metres)	Closed scrub	70-100
	Open scrub	30-70
	High Shrubland	10-30
	High open shrubland	BELOW 10
SHRUBS (Below 2 metres)	Closed heath	70-100
	Open heath	30-70
	Low shrubland	10-30
	Low open shrubland	BELOW 10
HERBS	Closed herbland	70-100
	Herbland	30-70
	Open herbland	10-30
HUMMOCK GRASSES	Hummock Grassland	70-100
	Open Hummock Grassland	30-70
BARREN	Sand Dunes	Sd
CLEARED LAND		

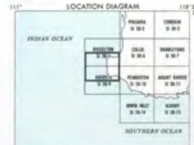
PLANT ASSOCIATIONS

	Acacia decipiens	A
Peppermint	*Agonis flexuosa*	Ag
	Banksia species	B
	Casuarina fraserana	C
	Dryandra sessilis	D
	Eucalyptus haematoxylon	H
Jarrah	*E. marginata*	J
Karri	*E. diversicolor*	K
	Kingia australis	Ki
Marri	*E. calophylla*	M
	Melaleuca species	Me
Myrtaceae		My
	Olearia axillaris	O
Paperbark	*Melaleuca species*	P
Pine Plantations		Pi
Flooded Gum	*E. rudis*	R
Sedgeland		S
Samphire	*Arthrocnemum species*	Sa
Tuart	*E. gomphocephala*	T
	Viminaria juncea	V
Yate	*E. cornuta*	Y

Remnants of plant associations on cleared land are shown in italics.

Waterhole; water tank; dam; dry lake
Lake; river or stream perennial
Lake; river or stream intermittent
Dam or weir; falls; rapids
Drain or ditch perennial, intermittent
Spring perennial, intermittent, ricefields
Marsh or swamp; mangroves

LOCATION DIAGRAM



Compiled by Dr. Francis G. Smith, in accordance with the requirements of the Western Australian Vegetation Survey Committee from aerial photography flown 1967, Forests Department Aerial Photo Interpretation plans, and field surveys carried out by the Author from June 1971 to August 1972.
Drawings prepared under the direction of the Surveyor General, Department of Lands and Surveys, Western Australia, on base maps made available by courtesy of the Director of Military Surveys, Department of the Army, Canberra, and printed by the Government Printer of Western Australia.

Scale 1:250,000

Statute Miles: 5, 0, 5, 10, 15, 20, 25
Nautical Miles: 5, 0, 5, 10, 15, 20
Yards: 10,000, 0, 10,000, 20,000, 30,000
Kilometres: 5, 0, 5, 10, 15, 20, 25

ELEVATIONS SHOWN IN FEET
VERTICAL DATUM IS BASED ON MEAN SEA LEVEL, FREMANTLE

TRANSVERSE MERCATOR PROJECTION
HORIZONTAL DATUM IS BASED ON PERTH OBSERVATORY, LATITUDE 31°57'09.63"S LONGITUDE 115°50'26.10"E

GRID NUMBERS INDICATE THE 10,000 YARD TRANSVERSE MERCATOR GRID, ZONE I (AUSTRALIA SERIES), CLARKE 1858 SPHEROID
THE LAST FOUR DIGITS OF THE GRID NUMBERS ARE OMITTED

1968 MAGNETIC DECLINATION FOR THIS SHEET VARIES FROM 3°30' WESTERLY FOR THE CENTRE OF THE WEST EDGE TO 4°30' WESTERLY FOR THE CENTRE OF THE EAST EDGE. MEAN ANNUAL CHANGE IS NEGLIGIBLE.

VEGETATION
BUSSELTON AND AUGUSTA
WESTERN AUSTRALIA