VEGETATION SURVEY OF WESTERN AUSTRALIA

VEGETATION MAP

COLLIE SI 50 - 6

1974

WESTERN AUSTRALIAN DEPARTMENT OF AGRICULTURE

VEGETATION MAP OF COLLIE

Latitude 33°00′ to 34°00′S
Longitude 115°30′ to 117°00′E

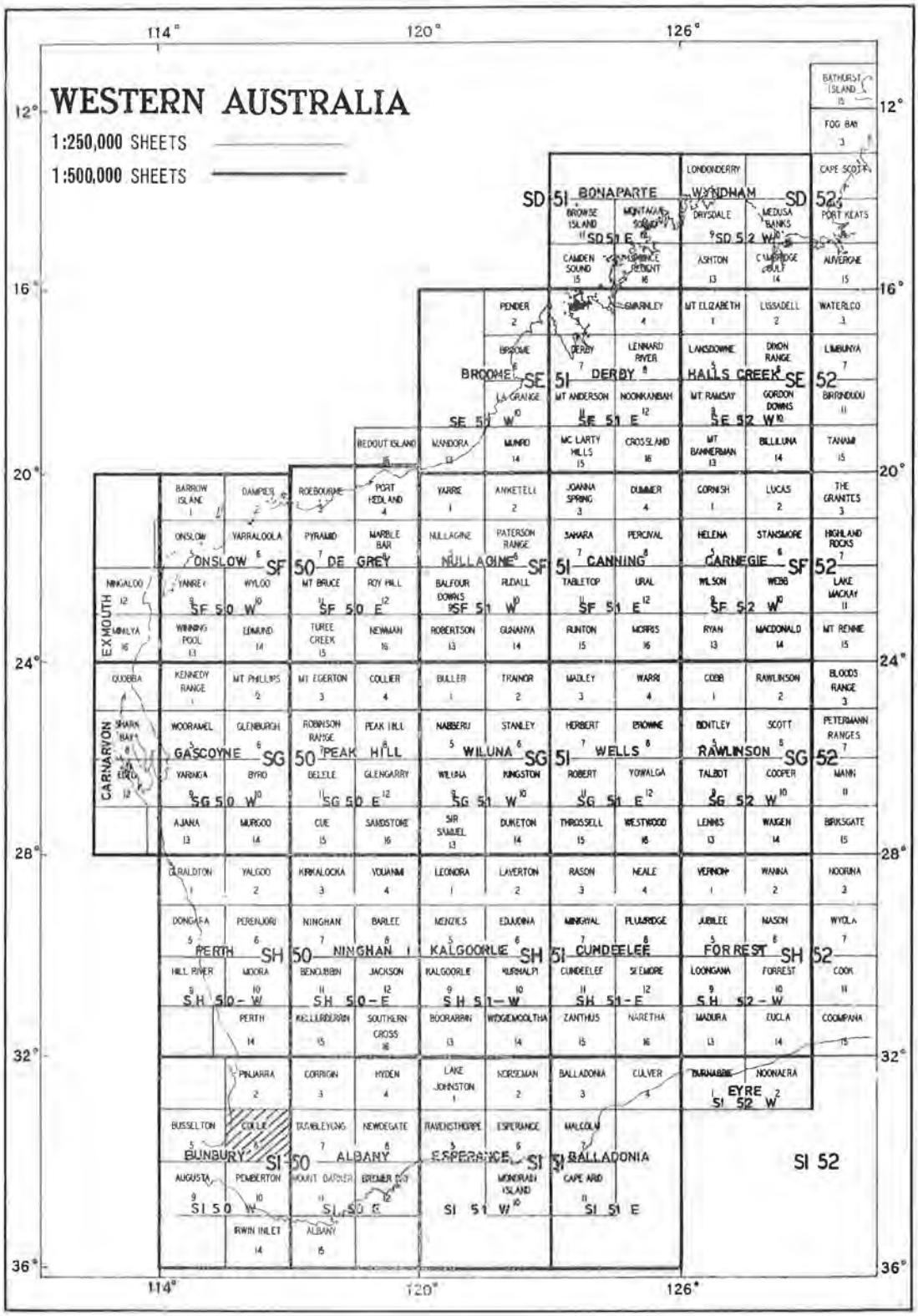
Scale 1 : 250 000

by

Francis G. Smith, D.Sc., B.Sc.(Forestry)

1974

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°
BATHURST ISLAND
FOG BAY
CAPE SCOTT
PORT KEATS
ALVERONE
SD 51 BONAPARTE
WYNDHAM SD 52
BROWSE ISLAND
MONTAGU SOUND
LONDONDERRY
DRYSDALE
MEDUSA BANKS
SD 51 E
SD 52 W
CAMDEN SOUND
PRINCE REGENT
ASHTON
CAMBRIDGE GULF
PENDER
SWANLEY
WT ELIZABETH
LISSADELL
WATERLOO
BROOME
DERBY
LENNARD RIVER
LAWSDOWNE
DIXON RANGE
HALLS CREEK
LIMBUNYA
SE 51 W
SE 51 E
SE 52 W
LA GRANGE
WT ANDERSON
NOONKANBAH
WT RAMSAY
GORDON DOWNS
BIRDUDUU
REDOUT ISLAND
MANDORA
MUNRO
MC LARTY HILLS
CROSSLAND
WT BANNERMAN
BILLILUNA
TANAMI
BARROW ISLAND
DAMPIER
ROEBOURNE
PORT HEDLAND
YARRIE
ANKETELL
JOANNA SPRING
DUMMER
CORNISH
LUCAS
THE GRANITES
ONSLOW
PYRAMID
MARBLE BAR
NULLAGINE
PATERSON RANGE
SAHARA
PERCIVAL
HELENA
STANSMORE
HIGHLAND ROCKS
SF 50 DE GREY SF 51 CANNING SF 52
CARNEGIE
EXMOUTH
NINGALOO
YANREY
WYLOO
MT BRUCE
ROY HILL
BALFOUR DOWNS
RUDALL
TABLETOP
URAL
WILSON
WEBB
LAKE MACKAY
SF 50 W
SF 50 E
SF 51 W
SF 51 E
SF 52 W
MINILYA
WINNING POOL
EDMUND
TUREE CREEK
NEWMAN
ROBERTSON
GUANAYA
RUNTON
MORRIS
RYAN
MACDONALD
MT RENNIE
QUOBBA
KENNEDY RANGE
MT PHILLIPS
MT EGERTON
COLLIER
BULLER
TRAINOR
MADLEY
WARRI
COBB
RAWLINSON
BLOODS RANGE
CARNARVON
SHARK BAY
WOORAMEL
GLENBURGH
ROBINSON RANGE
PEAK HILL
NABBERU
STANLEY
HERBERT
BROWNE
BENTLEY
SCOTT
PETERMANN RANGES
GASCOYNE SG 50 PEAK HILL WILUNA SG 51 WELLS SG 52 RAWLINSON
EDEL
YARINGA
BYRO
BELELE
GLENGARRY
WILUNA
KINGSTON
ROBERT
YOWALGA
TALBOT
COOPER
MANN
SG 50 W
SG 50 E
SG 51 W
SG 51 E
SG 52 W
AJANA
MURGOO
CUE
SANDSTONE
SIR SAMUEL
DUKETON
THROSSELL
WESTWOOD
LENNIS
WAIGEN
BRIKSGATE
GERALDTON
YALGOO
KIRKALOCKA
YOUANMI
LEONORA
LAVERTON
RASON
NEALE
VERNON
WANNA
NOORNA
DONGARA
PERENJORI
NINGHAN
BARLEE
MENZIES
EDJUDINA
MINGAYAL
PLUMRIDGE
JUBILEE
MASON
WYOLA
PERTH SH 50 NINGHAN I KALGOORLIE SH 51 CUNDEELEE FORREST SH 52
HILL RIVER
MOORA
BENCUBBIN
JACKSON
KALGOORLIE
KURNALPI
CUNDEELEE
SIEMORE
LOONGANA
FORREST
COOK
SH 50-W
SH 50-E
SH 51-W
SH 51-E
SH 52-W
PERTH
KELLERBERRIN
SOUTHERN CROSS
BOORABBIN
WIDGEMOOLTHA
ZANTHUS
NARETHA
MADURA
EUCLA
COOMPANA
PINJARRA
CORRIGIN
HYDEN
LAKE JOHNSTON
NORSEMAN
BALLADONIA
CULVER
BURNABBIE
NOONAERA
I EYRE
SI 52 W
BUSSELTON
COLLIE
TAMBELLUP
NEWDEGATE
RAVENSTHORPE
ESPERANCE
MALCOLM
BUNBURY SI 50 ALBANY ESPERANCE SI 51 BALLADONIA
SI 52
AUGUSTA
PEMBERTON
MOUNT BARKER
BREMER BAY
MONDRAIN ISLAND
CAPE ARID
SI 50 W
SI 50 E
SI 51 W
SI 51 E
IRWIN INLET
ALBANY

CONTENTS

COMPILATION AND CLASSIFICATION

The Vegetation Map of the Collie 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 the 1966 aerial photographs at a scale of 1 : 40 000 and the Forests Department A.P.I. Plans which provided some additional information on vegetation structure and principal trees occurring in forested areas.

Traverses by motor vehicle, on foot and by boat were made during the period May 1973 to February 1974, covering the routes illustrated on the border of the map, to check the interpretation of vegetation structure and plant associations which had been made by stereoscopic viewing of the aerial photographs.

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. Each was taken

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 schrubland	E3
	under 10	Low open schrubland	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
Hummock grasses	70–100	Hummock grassland	G1
	30–70	Open hummock grassland	G2

Standard descriptions used for each structural class

at a place within the boundaries of the map and the location is given by map grid reference.

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.

The structural classification follows the system proposed by Prof. R. L. Specht (1970). The criteria 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 to 2 m. Herbs, including grasses and sedges form one life-form class and hummock grasses another 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 for comparison of plant formations.

TOPOGRAPHY

Most of the Collie region consists of a hilly and steeply hilly dissected laterite-covered plateau 220 m to 340 m above sea level with occasional hills rising another 30 to 100 m. The Darling Escarpment forms the western edge of the plateau and drops steeply from 220 m to 40 m on the coastal plain north of the Collie River. South of the Collie River a low plateau, 100 m to 160 m above sea level, lies at the foot of the Darling Escarpment and extends westwards to the Dunsborough-Augusta Escarpment of the Naturaliste-Leeuwin ridge. The northern escarpment of this low plateau forms an arc sweeping round from Dunsborough to the point where the Collie River emerges from the line of the Darling Escarpment.

The Darling Escarpment is cut by deep, steeply-sided valleys with massive outcrops of granite or gneiss. Further east, the plateau valleys are more shallow and in the centre, the basin forming the catchment area of the Collie River ranges from flat to strongly undulating, with sandy flats and swamps.

Further east again, the valleys become narrow, steep-sided and with breakaways, lateritic mesas and occasional granite tors. In the eastern part of the map the country becomes gently rolling to hilly, with tors and laterite mesas and buttes and some wide valleys.

At the foot of the Darling and Dunsborough-Collie River Escarpments lies the Swan Coastal Plain, mostly less than 40 m above sea level. Northwards from Wokalup, the narrow Ridge Hill Shelf follows the foot of the Darling Escarpment at between 40 and 80 m above sea level. The shelf is composed of residual laterite and yellow sand forms the western fringe.

Along the foot of the Dunsborough-Collie River Escarpment, southwards from near Burekup, the ground slopes more gently to the coastal plain and the actual foot of the escarpment is less well defined. Below the lateritic cap of the low plateau, the escarpment is mainly sandy, the sand lying deeply at its foot.

Much of the coastal plain consists of riverine material and is flat to gently undulating, swampy in parts. The major swamp is Benger Swamp, 3 km wide by 4 km long. This part of the coastal plain is bounded in the west by low hills of coastal dune origin which impede drainage, giving rise to numerous small swamps among low sand hills and ridges. Further west are more defined ridges running parallel with the coast, rising in parts to over 40 m, and having a core of aeolionite or limestone. Between these ridges lies a chain of shallow lakes and swamps, of which the principal are Lake Preston, Myalup Swamp, Leschenault Inlet, Cokelup Swamp and Stirling Swale.

Two large river systems drain from the eastern areas of the map and pass westerly through the plateau in deep gorges. The Williams River rises near Williams to join the Murray which runs north off the map to flow eventually into Peel Inlet. The Blackwood River drains most of the eastern part of the map through its tributaries the Arthur, Hillman, Beaufort and Balgarup Rivers before flowing into deepening valleys near Boyup Brook, passing through Bridgetown and Balingup to Nannup and then westerly to the Hardy Inlet and Flinders Bay.

The Williams-Murray river system also drains the northern part of the plateau on this map, and the Blackwood drains the southern part. The central area, the Collie Basin, is drained by the Collie River and its tributaries the East Collie, Bingham and Harris Rivers. These waters are collected in the Wellington Dam west of Collie, before passing through a deep

gorge in the escarpment to flow across the coastal plain into Leschenault Inlet.

South of the Murray River system, the Harvey River drains the western side of the plateau to flow through the flats of the Pinjarra Plain on its way to the Harvey Estuary. A system of drains now carries the waters clear of the swamps, the main branch going north and a diversion drain running west through the sand ridges to the sea at Myalup. Other branch drains join up with the Wellesley River which runs south through the swamps on the west side of the plain to join the Brunswick River.

North of the Collie River, the western edge of the plateau is drained by the Brunswick River and its tributary the Lunenburgh River. After collecting the waters of the Wellesley, the Brunswick River also turns south to join the Collie before it passes through the main sand ridge to Leschenault Inlet.

The Preston River with its tributary, the Ferguson River, drains the western edge of the plateau between the Collie and Blackwood river systems and flows into the Leschenault Inlet.

The low plateau west of the Darling Escarpment is drained to the north west by the Capel, Ludlow and Abba Rivers, and to the south by the Blackwood River tributaries, St John Brook and St Paul Brook.

VEGETATION SYSTEMS

A vegetation system is a sequence or a recurring pattern of plant associations linked in their occurrence to topographic or edaphic factors. Some vegetation systems that occur in this map have been described by N. H. Speck (1958); where applicable, his names have been adopted. Where, during the present survey, it has been found that a soil system or combination described by McArthur and Bettenay (1960) fits more accurately the boundaries of a vegetation system, then the name of the soil system has been applied to the vegetation system. Similarly, names of soil combinations described by R. Smith (1951) have also been applied to vegetation systems where appropriate.

The concept of vegetation systems helps to make sense of the complexity of variation in vegetation types and leads to a better understanding of the ecology of the area.

The older division into Botanical Provinces (Gardner 1942) and Botanical Districts (Diels 1906) gives convenient geographical boundaries based on climatic factors. Districts have a broad relation to combinations of vegetation systems but systems may be common to more than one District.

The area of this map falls within the South Western Province with winter rainfall and summer drought; the four wettest consecutive months being May to August with more than 175 mm rainfall for the period (Gardner 1942). The Districts included in the map are parts of Darling 500 to 1 000 mm, Warren 1 300 to 1 800 mm, Avon 250 to 600 mm and Stirling 300 to 800 mm mean annual rainfall.

Darling system (N. H. Speck 1958)

The Darling vegetation system consists of prime Jarrah *Eucalyptus marginata* Sm. forest between the Avon River in the north and the Karri forest in the south and bounded by the Darling Escarpment in the west and the Bannister vegetation system in the east. The eastern boundary passes southwards from Clackline through Boddington, Bowelling and Dinninup approximately. The mean annual rainfall is 990 mm to 1 020 mm of which 635 mm to 760 mm fall in winter.

The area consists of a laterite-capped plateau dissected moderately to deeply by more or less youthful streams with steep sided valleys and narrow alluvial plains. The Precambrian basement of granite and epidiorite dykes or intrusions is exposed in river valleys.

The undulating laterite-capped surface of the plateau is covered with open forest (B2) predominantly Jarrah *Eucalyptus marginata* Sm. on skeletal laterite and a mixture of Jarrah and Marri *E. calophylla* R.Br. on deeper sandy soils. On narrow flats in some valleys Forest Blackbutt *E. patens* Benth. occurs mixed with Jarrah and Marri or in small stands on its own. Along river banks Flooded Gum *E. rudis* Endl. forms fringing forest and *Melaleuca rhaphiophylla* Schau. forms a dense understorey at the water's edge of the more permanent rivers. The best growth of forest occurs in the western parts, and it clearly exceeds 30 m to become high open forest (A2) in small areas such as at the confluence of the Hamilton and Collie Rivers west of Collie and near the Blackwood River west of Bridgetown and Balingup. Towards the east the height of the trees decreases and the forest becomes more open.

In shallow valleys high on the plateau towards and at the headwaters of streams, woodland (B3) of Bullich *E. megacarpa* F. Muell. occurs. In the valleys to the east of the system, and on the slopes of the Darling Escarpment, where the presence of dolerite or epidiorite

dykes or intrusions in the parent granite or gneiss gives rise to clayey soils, there are local occurrences of woodland (B3) composed of Wandoo *E. redunca* Schau. var. *elata* Benth.

In broad valley bottoms and swamps, particularly in the Collie Basin, low woodland (C3) of Flooded Gum and Paperbark *Melaleuca preissiana* Schau. or low open woodland (C4) of Paperbark and Banksia species occur with understoreys of heath and sedges. In the broadest impeded drainage areas, closed scrub (D1) or open heath (E2) is present.

Chapman system (Smith, R. 1951; Smith, R. 1952)

The Chapman vegetation system consists of Jarrah *E. marginata* Sm. and Jarrah-Marri *E. calophylla* R. Br. open forest (B2) between the Darling Escarpment in the east, the Dunsborough-Augusta Escarpment in the west, the Swan Coastal Plain in the north and the Scott River Plains in the south. The average annual rainfall is between 990 mm and 1 400 mm. The area is a low undulating plateau at one time capped extensively with laterite and has an altitude of between 100 m and 160 m, rising to 180 m in the northeast. Tributaries of the Blackwood River cutting deeply into the unconsolidated alluvial and colluvial material reveal clay strata which form convex hill slopes below the lateritic caps. On the clay is found high open shrubland (D4) characterised by the presence of *Kingia australis* R. Br. with shrubby Jarrah. The higher valleys may contain Bullich *E. megacarpa* F. Muell. woodland (B3). Forest Blackbutt *E. patens* Benth. occurs, particularly in the deeper and lower valleys. Paperbark *Melaleuca preissiana* Schau. and *Banksia* low woodlands (C3) and open woodlands (C4) occur in damp sites.

The slopes of the Dunsborough-Collie River Escarpment form the northern edge of the plateau where it meets the Swan Coastal Plain. On these slopes, up to 100 m in altitude, there are large areas of very sandy lateritic gravel on which Jarrah forms woodland (B3) with Mountain Marri *E. haematoxylon* Maiden as a characteristic small tree in the understorey. Other understorey trees include *Banksia* spp. In some localities, Jarrah is more or less absent or appears as a shrub and Mountain Marri forms low woodland (C3) with *Banksia* spp.

The lowest slopes of the escarpment, up to the 60 m contour, are very sandy in parts with low open forest (C2) of *Banksia attenuata* R. Br., *B. ilicifolia* R. Br., *Nuytsia floribunda* (Labill.) R. Br. ex Fenzl. and *Eriostemon spicatus* A. Rich. Occasional Jarrah may be present. This plant association appears to belong to the Bassendean System, and the sands on which it occurs to be remnants of ancient coastal dunes.

Pinjarra Plain system (McArthur & Bettenay 1960)

The Pinjarra Plain vegetation system occurs on that part of the Swan Coastal Plain which is generally unconsolidated riverine material between the foot of the Darling and Dunsborough-Collie River Escarpments and the sand dune systems. The surface is flat to slightly undulating, sloping gently from 40 m at the foot of the escarpments and Ridge Hill Shelf to little above sea level and is cut by river channels. The vegetation is now mostly cleared but it appears to have been mainly Marri *E. calophylla* R. Br. open forest (B2) with Flooded Gum *E. rudis* Endl. in the wetter parts. Wandoo *E. redunca* Schau. var. *elata* Benth. also occurred and is now represented only by relic trees. Areas subject to frequent flooding, such as Benger Swamp, support Paperbark *Melaleuca rhaphiophylla* Schau. low closed or open forest (C1 and C2), *Melaleuca* closed scrub (D1) or sedgeland (F1).

Jarrah *E. marginata* Sm. open forest (B2) occurs on higher areas where there are deposits of laterite gravel; Jarrah-Marri open forest occurs on river levees. Flooded Gum forms fringing forests along rivers with *Meleleuca rhaphiophylla* and in some places with Peppermint *Agonis flexuosa* (Spreng.) Schau.

Bassendean system (McArthur and Bettenay 1960)

The Bassendean vegetation system consists of *Banksia* low woodland (C3), *Banksia* low open forest (C2) and Jarrah *E. marginata* Sm. woodland (B3) or open woodland, in which the *Banksia* community forms the understorey, on an intricate pattern of low sand dunes interspersed with swamps containing Paperbark *Melaleuca preissiana* Schau. low open woodland (C4) or low woodland (C3), or *M. rhaphiophylla* Schau. low open forest (C2).

This system is located between the Pinjarra Plain system and the Spearwood system which forms its western boundary. The dunes are apparently of coastal origin but have been strongly leached and eroded. The Bassendean system has a series of swamps and small lakes along its boundary with the Spearwood system, though in some places there appears to be some overlap between the two systems.

Spearwood system (McArthur and Bettenay 1960)

The Spearwood vegetation system consists of Tuart *E. gomphocephala* DC. high woodland (A3), woodland (B3) and Jarrah *E. marginata* Sm.—Marri *E. calophylla* R. Br. woodland (B3) on sand ridges running parallel with the coast from the area of Sabina River in the South to Yanchep in the north. Between the sand ridges lies a series of swamps, lakes and estuaries in and around which Paperbarks occur. In the drier depressions *M. preissiana* Schau. forms low open woodland (C4). In the more permanent swamps *M. rhaphiophylla* Schau. forms low open forest (C2) and low closed forest (C1). Around the edges of the more salty lakes, such as Lake Preston and the Leschenault Inlet, *M. cuticularis* Labill forms a low fringing forest.

Tuart occurs on ridges having aeolionite or limestone overlaid by yellow or brown sand. Where the sand is deeper, Jarrah and Marri also occur, particularly on the sides of the ridges. If the sand is very deep, and possibly leached white on the surface, Jarrah-Marri woodland without Tuart occurs. Some of the ridges are very low, rising only slightly above the swamps, while others are fairly high, up to 40 m above sea level. On the seaward side of the system, and generally in the southern parts, Peppermint *Agonis flexuosa* (Spreng.) Schau. is an important understorey tree. It also forms stands of low open forest (C2) and, more rarely, low closed forest (C1). The system occurs on the western shores of Lake Preston and Leschenault Inlet where the Tuart and Peppermint is in places being overlaid by sand of the present coastal dunes.

On ridges from which the sand is mostly eroded away, leaving a hard capping of secondary calcite on the surface, open heath (E2) occurs with scattered *E. decipiens* Endl. in shrub form.

Rockingham system (Speck 1958)

The Rockingham vegetation system is a narrow strip of open heath (E2) and open scrub (D2) on the most recent coastal dunes between the sea and the Spearwood system.

On white sand dunes or blowouts there is a sparse cover of *Olearia axillaris* (DC.) Benth., *Jacksonia furcellata* (Bonpl.) DC., *Cakile maritima* Scap., *Acacia cyclops* A. Cunnex G. Don, *Ammophila arenaria* (L.) Link and *Scirpus nodosus* Rottl.

On the more stable fore-dunes *Olearia axillaris, Scaevola crassifolia* Labill. and *Exocarpus sparteus* R. Br. are most common; while further inland *Acacia cochlearis* (Labill.) A. Wendl. and *Jacksonia furcellata* are most common. In hollows in the dunes, *Acacia rostellifera* Benth, forms open scrub.

Bannister system (Speck 1958)

The Bannister vegetation system is the easterly marginal area of Jarrah *E. marginata* Sm. open forest (B2). Jarrah and Jarrah-Marri *E. calophylla* R. Br. open forest is confined to the extensive laterite capping of the undulating hill tops and to gravelly slopes.

In the valleys, Marri occurs on sandy loams over granite or gneiss and Wandoo *E. redunca* Schau. var. *elata* Benth. forms woodland (B3) on loams over dolerite or epidiorite.

On flats associated with streams *E. rudis* Endl. forms fringing forest and woodland (B3) and Wandoo or Wandoo and Marri form woodland on better drained areas.

In the area of this system, the Jarrah and Jarrah-Marri open forest is lower and more open than in the Darling System.

Williams system

The Williams vegetation system occurs on undulating plateau country from which most of the laterite sheet has been eroded and the hills are of the basement rock.

Some Jarrah *E. marginata* Sm. occurs where there is laterite but this is in the form of woodland (B3) which merges into Wandoo *E. redunca* Schau. var. *elata* Benth. woodland on the lateritic material. On laterite hill tops and breakaways Brown Mallet *E. astringens* Maiden forms open forest (B2) but many of these laterite caps and their Mallet stands are too small to map. On granitic hills and slopes, Marri *E. calophylla* R. Br. and Flooded Gum *E. rudis* Endl. form woodland and *Casuarina huegeliana* Miq. forms low open forest, open scrub or closed scrub.

On the lower slopes of hills and valleys and low granite ridges York Gum *E. loxophleba* Benth. forms woodland (B3). *Acacia acuminata* Benth. may form a small tree understorey under Wandoo or York Gum and may also occur in the form of low open forest (C2).

Beaufort System

The Beaufort vegetation system occurs in country similar to that of the Williams system but lacking the granite hills. Laterite is more plentiful and there are broad clayey valleys.

On the more extensive laterite hills, some Jarrah *E. marginata* Sm. open forest (B2) occurs. This is low in height and open, becoming woodland (B3) and merging with Wandoo *E. redunca* Schau. var. *elata* Benth. on lateritic slopes. Wandoo woodland is widespread. Mallet *E. astringens* Maiden open forest (B2) occurs on small laterite caps and breakaways and on laterite sheets south of the Beaufort River. On the clay soils of the Beaufort River flats and southwards Swamp Yate *E. occidentalis* Endl. forms woodland with an understorey of *Melaleuca* shrubs or samphire. Other than in proximity to the Beaufort River, York Gum *E. loxophleba* Benth. is absent. *Acacia acuminata* Benth. and *Casuarina* sp. may form stands of closed scrub (D1).

FORMATIONS AND PLANT ASSOCIATIONS

A2 HIGH OPEN FOREST

Karri Forest (K)

High open forest of Karri *Eucalyptus diversicolor* F. Muell. occurs on this map in one small area, up the valley of Gregory Brook south of the Blackwood River. Another small stand occurs just off the map 25 km from Bridgetown on the road to Nannup. These are outliers of the main block of Karri forest which lies to the south. The understorey had been burnt at the time of this survey. A description of Karri forest is given in Vegetation Map Pemberton-Irwin Inlet (Smith, F. G. 1972).

Jarrah-Marri High Open Forest (JM) and Jarrah-Marri-Blackbutt High Open Forest (JMBb)

Limited areas of high open forest of Jarrah and Marri, *E. marginata* Sm. and *E. calophylla* R.Br. occur on the lateritic plateau near the Blackwood River west of Bridgetown and Balingup. In the valleys in this area Forest Blackbutt *E. patens* Benth. becomes co-dominant. Jarrah-Marri-Blackbutt high open forest also occurs near the confluence of the Hamilton and Collie Rivers west of Collie. These areas of high open forest show the best development of the Jarrah-Marri Association which is described in detail in its most usual form, open forest (B2).

A3 HIGH WOODLAND

Tuart Forest (T)

High woodland dominated by Tuart *Eucalyptus gomphocephala* DC. extends from the area of the Sabina River east of Busselton in a continuous belt on the limestone formation of the coastal plain as far as the Capel River. Northwards from Capel the tallest trees are confined to the centre of the belt while on either side the formation becomes woodland, with only occasional trees reaching 30 m or more.

In the south Tuart grows to 40 m in almost pure stands with a fairly dense understorey of *Agonis flexuosa* (Spreng.) Schau. There is also some *Banksia grandis* Willd. but this is more abundant in Tuart woodland. Along the eastern edge of the Tuart, Jarrah *E. marginata* Sm. and Marri *E. calophylla* R.Br. occur. Marri may also occur at the edges of depressions in the ridge.

B1 CLOSED FOREST

This formation is of very limited occurrence, usually too small to be mapped. It can occur in pure stands of Marri *Eucalyptus calophylla* R.Br., mixtures of Marri and Jarrah *E. marginata* Sm., in pure stands of Forest Blackbutt *E. patens* Benth. and mixtures of all three. The understorey consists of very low shrubs of Bracken *Pteridium esculentum* (Forst. f.) Nakai. Closed forest also occurs on levees on the banks of the Blackwood River where *E. rudis* Endl. forms the canopy and may be accompanied by *Melaleuca rhaphiophylla* Schau. or *Agonis flexuosa* (Spreng.) Schau.

Pine Plantations (Pi)

Established plantations of *Pinus* species form closed forest and have been mapped as such at Myalup, Harvey, Wellington Dam, Collie River, Capel, Tutunup, Grimwade, Nannup and Quongup.

B2 OPEN FOREST

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

Open forest is the most widespread formation in the Darling, Chapman and Bannister vegetation systems and probably in the Pinjarra Plain system before clearing.

Open forest of pure Jarrah *Eucalptus marginata* Sm. occurs on the laterite plateau, particularly on the skeletal laterite of the hill tops. On the deeper, more sandy soils, Marri *E. calophylla* R.Br. becomes co-dominant. While lateritic soil appears to be the prime requirement of Jarrah, it grows well on the sandy soil of the coastal plain and even on the older coastal sand dunes of the Bassendean and

Spearwood systems but in more open formations.

In the deeper valleys of the Darling vegetation system, Forest Blackbutt *E. patens* Benth. also occurs as a co-dominant. In the upper reaches of streams on the Darling Plateau, Bullich *E. megacarpa* F. Muell. also may occupy damp sites. On lower ground along water courses and river banks subject to occasional flooding, Flooded Gum *E. rudis* Endl. occurs.

On the face of the Darling Escarpment and in shallow valleys in the eastern parts of the Darling vegetation system, where the presence of epidiorite dykes gives rise to clayey soil, Wandoo *E. redunca* Schau. var. *elata* Benth. occurs.

In its densest blocks, the pure Jarrah forest is dark with an almost total absence of understorey trees. The darkness is accentuated by the dark brown fissured bark, frequently blackened by fire. The individual crowns have widespreading branches and on the whole Jarrah forms an open forest rarely exceeding about 30 m in height.

The principal understorey trees are *Banksia grandis* Willd. and *Casuarina fraserana* Miq., the latter forming almost pure stands on poor sites over massive laterite sheet. Other understorey trees are *Persoonia longifolia* R. Br., *P. elliptica* R. Br., *Nuytsia floribunda* (Labill.) R. Br. ex Fenzl. *Xylomelum occidentale* R. Br. and, on wetter sites, *Banksia littoralis* R. Br. Mountain Marri *E. haematoxylon* Maiden occurs towards the northern edge of the Chapman Vegetation system.

Blackboys *Xanthorrhoea preissii* Endl. and Zamia palm *Macrozamia riedlei* (Gaud.) C.A. Gardn. are common in parts and there is a continuous layer of a variety of low shrubs of *Adenanthos, Grevillea, Hakea, Leptomeria, Acacia, Daviesia, Bossiaea, Hovea, Astroloma, Leucopogon* and *Agonis parviceps* Schau.

Jarrah-Wandoo Open Forest (JW)

To the east of the main mass of Jarrah forest in the Bannister vegetation system, Jarrah *Eucalyptus marginata* Sm. and Wandoo *E. redunca* Schau. var. *elata* Benth. occur together in varying proportions on lateritic soils, particularly on hill slopes.

This is generally an interzone between Jarrah open forest on the laterite cap on the hill top and Wandoo woodland in the valley. Marri *E. calophylla* R. Br. may also be present and Wandoo and Marri may together form open forest or woodland.

Mallet Open Forest (Ma)

On hill tops in the eastern areas of the Collie map, in the Williams and Beaufort vegetation systems, the laterite caps and small breakaways have small stands of Mallet *Eucalyptus astringens* Maiden open forest. The largest areas occur near the Beaufort and Arthur Rivers.

The crowns of the Mallet are dense and there is no understorey.

B3 WOODLAND

Tuart Woodland (T)

Tuart *E. gomphocephala* DC. forms woodland, with only occasional trees reaching 30 m, northwards from the Capel River. Pure Tuart woodland occurs on the low and sometimes broad ridges up the western side of the limestone belt. Where the ridges are high, as in the eastern part of the belt, Tuart stands are confined more to the crests where the limestone is near the surface. On the slopes, Tuart forms mixtures with Jarrah *E. marginata* Sm. and Marri *E. calophylla* R. Br. Jarrah tends to be more prominent on the eastern slopes. On some limestone hills, *E. decipiens* Endl. forms small pure stands.

Agonis flexuosa (Spreng.) Schau. continues to be an important understorey tree, particularly on the seaward side of the limestone ridges, but *Banksia grandis* Willd. and *B. attenuata* R. Br. are common particularly on the higher ridges and on the eastern side.

Jacksonia furcellata (Bonpl.) DC. is a locally common shrub in the understorey. *Templetonia retusa* (Vent.) R. Br. and *Acacia decipiens* (Koen.) R. Br. were observed as low shrubs under Tuart near Myalup at the south end of Lake Preston.

Jarrah-Marri Woodland (JM)

On the deeper sands of the Spearwood system, Tuart is absent and Jarrah and Marri form woodland on their own. There may be some *Agonis flexuosa* in the understorey, but *Banksia grandis* and *B. attenuata* are most frequent. *Persoonia longifolia* R. Br. also occurs. Jarrah-Marri woodland is also associated with river levees on the coastal plain.

On sandy lateritic gravels in the eastern areas of the map Jarrah and Marri occur in woodlands with a low shrub understorey of such

plants as *Hakea undulata* R. Br. and *Dryandra sessilis* (Knight) Domin. The *Dryandra* can be quite dense on the more lateritic soils.

Jarrah-Mountain Marri Woodland (JH)

On the slopes of the Dunsborough-Collie River Escarpment at the northern edge of the low plateau of the Chapman vegetation system, on sandy lateritic soil, Jarrahs form a woodland characterised by the presence of a small tree, Mountain Marri *Eucalyptus haematoxylon* Maiden. Other small trees present are *Banksia grandis* and *B. attenuata*. On similar sites Jarrah may be absent or occur only as a small tree and Mountain Marri with the Banksias form low woodland (C3).

Bullich Woodland (Bu)

In the upper reaches of valleys on the Darling Plateau and the low plateau of the Chapman system Bullich *Eucalptus megacarpa* F. Muell. forms woodland, usually along the valley bottom in strips too small to be mapped. Its pale bark and straight stem gives it the appearance of young Karri *E. diversicolor*. It is, however, readily distinguishable by its large characteristic fruits.

Jarrah-Banksia (JB) and Jarrah-Marri-Banksia (JMB) Woodland

In the northern part of the Bassendean Vegetation system on this map, and east of the Myalup pine plantations which lie on the deeper sands of the Spearwood system, the low sand dunes are narrow and separated by quite extensive belts of swamp. Here Jarrah *E. marginata* Sm. forms woodland with an understorey of *Banksia attenuata* R. Br., *B. ilicifolia* R. Br. and occasional *Nuytsia floribunda* (Labill.) R. Br. ex Fenzl.

Marri *E. calophylla* R. Br. occurs with the Jarrah further south, particularly on the broader areas of sand which are enriched possibly by material carried down by the Wellesley, Brunswick, Collie, Ferguson, Preston and Capel River systems, or blown inland from the Spearwood system. West of Boyanup low dunes of leached sand are more frequent with *Banksia* low open forest more typical of the Bassendean system.

Wandoo Woodland (W)

Wandoo *E. redunca* Schau. var. *elata* Benth. forms woodland over most of the Williams and Beaufort vegetation systems on the east of the map, and on the hill slopes and valley bottoms in the Bannister vegetation system. In the Darling system, Wandoo woodland is confined to small areas in valleys in the eastern parts and some places on the Darling Escarpment and is associated with the occurrence of epidiorite dykes or intrusions. In the Pinjarra Plain there are scattered remnants.

Wandoo woodland at its best occurs on clayey soils in valley bottoms such as between Cordering and Bowelling, but most of this has been cleared for agriculture. On the lateritic soils, Wandoo does not grow so tall, and often the stems are so frequent that it looks like open forest. However, the leaf structure is so open that the amount of light passing through makes it woodland.

The understorey of the Wandoo woodland has been described as similar to that of Jarrah forest, but with no *Casuarina fraserana* or *Persoonia* (Gardner 1962). A common understorey small tree or shrub is *Acacia acuminata* Benth. *Dryandra sessilis* creates a dense understorey on some lateritic hill tops. *Casuarina huegeliana* Miq. and *Banksia grandis* may also occur.

The low understorey shrubs at Stockyard Road at the western edge of the Bannister system are *Dryandra nivea* R. Br., *Gastrolobium calcinum* Benth., *Trymalium ledifolium* Fenzl., *Acacia nervosa* DC., *Hakea lissocarpha* R. Br. and *Hypolaena exsulca* R. Br. Understorey shrubs occurring in Wandoo woodland near Williams are *Gastrolobium bilobum* R. Br., *Oxylobium parviflorum* Benth. and *Oxylobium capitatum* Benth. Further south, in the Beaufort system north of Kojonup Brook the understorey is richer in species; *Eucalyptus incrassata* Labill. a small tree or mallee, *E. foecunda* Schau., *Isopogon teretifolius* R. Br., *Hypocalymma angustifolium* Endl., *Calothamnus planifolius* Schau., *Hakea lissocarpha* R. Br., *H. lehmanniana* Meisn., *Dryandra armata* R. Br., *Leptospermum erubescens* Schau., *Beaufortia bracteosa* Diels, *Petrophile squamata* R. Br. and the very common *Gastrolobium spinosum* Benth.

York Gum Woodland (L)

Near low granite outcrops and on valley soils in the Williams vegetation system, York Gum *Eucalyptus loxophleba* Benth. occurs as woodland, sometimes little more than 10 m high. Understorey tall shrubs or small trees are *Acacia acuminata* and *Casuarina huegeliana*. The ground flora is grass. No stands of York Gum were found in the area of the survey which had not been subject to frequent and recent disturbance.

Flooded Gum Woodland (R)

Flooded Gum *Eucalyptus rudis* Endl. forms woodland along the banks of streams and rivers, and even along creeks and drainage lines which rarely flow with water. Along the more or less permanent rivers there may be dense belts of fringing forest. Flooded Gum may have a dense understorey of *Melaleuca rhaphiophylla* Schau. lower down the river bank or actually in the river bed. Closed scrub (D1) of Myrtaceous species occurs in damp areas. On the coastal plain, *Agonis flexuosa* may also occur, and Marri, *E. calophylla* is frequently associated.

In the Williams vegetation system, remnants of Flooded Gum woodland extend up the hillsides and even occur on top of Mt. Hillman, 80 m above the nearby Williams River.

Swamp Yate Woodland (Ys)

In low lying areas from the Beaufort River southwards (the Beaufort vegetation system) Swamp Yate *Eucalyptus occidentalis* Endl. forms woodland. The understorey may consist of Samphire *Arthrocnemum* spp., as near Bokal. This would appear to indicate that Swamp Yate may have some degree of salt tolerance; certainly at Mullidup on the Tone River (Pemberton map) the salt tolerant Paperbark *Meleleuca cuticularis* Labill. grows with Swamp Yate. In the quite extensive areas of Swamp Yate south of the Beaufort River near Bokal, the understorey consists of *Melaleuca viminea* Lindl. and *M. cymbifolia* Benth.

C1 LOW CLOSED FOREST

Paperbark Low Closed Forest (P)

Melaleuca rhaphiophylla Schau. forms small areas of low closed forest in swamps. Both *M. rhaphiophylla* and *M. cuticularis* Labill. form narrow belts of dense fringing forest, the former along river banks and the latter at the edges of salty lakes and inlets.

Peppermint Low Closed Forest (Ag)

Two small areas of Peppermint *Agonis flexuosa* (Spreng.) Schau. have been mapped at the seaward edge of the Spearwood vegetation system. They lie on the western side of Leschenalt Inlet, in the lee of recent sand dunes.

C2 LOW OPEN FOREST

Paperbark Low Open Forest (P)

Melaleuca rhaphiophylla Schau. forms small areas of low open forest in swamps and along river banks.

Peppermint Low Open Forest (Ag)

Along the western edge of the Tuart woodland, (Spearwood vegetation system) there are frequent occurrences of small areas of low open forest of *Agonis flexuosa* (Spreng.) Schau.

Banksia Low Open Forest (B)

A low open forest of *Banksia attenuata* R. Br., *B. ilicifolia* R. Br., occasional *Nuytsia floribunda* (Labill.) R. Br. ex Fenzl. and *Eriostemon spicatus* A. Rich. occurs on the low, eroded and leached sand dunes between the Spearwood system and the almost flat Pinjarra Plain. It also occurs on the low sandy slopes at the foot of the Dunsborough-Collie River Escarpment. In some areas the vegetation is more open, possibly because of fire or human activity.

Occasional Jarrah *E. marginata* Sm. may be present, particularly on the slightly higher dunes.

Casuarina Low Open Forest (C)

Casuarina obesa Miq. low open forest, up to 10 m high, occurs in the Pinjarra Plain vegetation system on recently formed soils near swamps and estuaries. It may adjoin Samphire flats on slightly higher land.

On soils overlying granite, particularly in the Williams vegetation system and occasionally in the Beaufort system, *Casuarina huegeliana* Miq. forms stands of low open forest or closed scrub.

In the Jarrah forest, Darling and Chapman systems, massive laterite sheet can give rise to the occurrence of low open forest or open forest of *Casuarina fraserana* Miq.

Casuarina spp. also form low open forest or closed scrub on river flood plains in the eastern areas of the map such as those by the Arthur and Beaufort Rivers.

Acacia Low Open Forest (A)

Low open forest or open scrub of *Acacia acuminata* Benth. occurs in the Williams and Beaufort vegetation systems. The stands of pure *Acacia* merge into Wandoo, York Gum or Flooded Gum woodland.

C3 LOW WOODLAND

Paperbark Low Woodland (P)

Melaleuca rhaphiophylla Schau. may form low woodland in swamps but on ground less frequently inundated *M. preissiana* Schau. is found. Co-dominant with *M. preissiana* are Swamp Banksia *Banksia littoralis* R. Br. and occasional *Nuytsia floribunda* (Labill.) R. Br. ex Fenzl.

Banksia ilicifolia R. Br. is locally common. Along stream lines, Flooded Gum *Eucalyptus rudis* Endl. may occur in this association as a small tree. The understorey is composed of a fairly dense heath or scrub of mainly Myrtaceous shrubs. (See C4 Paperbark Low Open Woodland).

Banksia Low Woodland (B)

In the Bassendean vegetation system, *Banksia* low woodland is a more open phase of the more common Banksia low open forest (C2). This may have been induced by fire or human activity.

Mountain Marri Low Woodland (H)

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

Peppermint Low Woodland (Ag)

To the west of Lake Preston on the coastal sand dunes a small belt of Peppermint *Agonis flexuosa* (Spreng.) Schau. low woodland occurs. This is a more open phase of the more common Peppermint low open forest (C2).

C4 LOW OPEN WOODLAND

Paperbark Low Open Woodland (P)

An open woodland in which Paperbark *Melaleuca preissiana* Schau. occurs as a small tree, covers open flats of leached sand subject to seasonal flooding. In its wetter parts it includes small swamps with *M. rhaphiophylla* Schau. either as a small tree forming stands of low forest or in the form of closed scrub. The understorey is closed heath with closed sedgeland in the wetter parts. A frequent co-dominant is Swamp Banksia *B. littoralis* R. Br.

Nuytsia floribunda (Labill.) R. Br. ex Fenzl. also occurs. Flooded Gum *E. rudis* Endl. may be present in river valleys. Common shrubs are *Astartea fascicularis* (Labill.) DC., *Agonis linearifolia* (DC.) Schau., *Melaleuca polygaloides* Schau. *M. leptoclada* Benth., *M. preissiana* Schau., *M. rhaphiophylla* Schau., *M. spathulata* Schau., *M. viminea* Lindl. and *Hakea prostrata* R. Br. may be locally common on slightly higher ground at the edges. Other species which may occur are *Acacia divergens* Benth., *A. extensa* Lindl., *Oxylobium linearifolium* (Don.) Druce, and *Hakea marginata* R. Br.

D1 CLOSED SCRUB

Melaleuca Closed Scrub (Me)

In areas subject to inundation for periods longer than are the Paperbark low open woodlands, but not for as long as are the swamps which support Paperbark low open forest, there is closed scrub, composed mainly of *Melaleuca* spp.

On the coastal plain, this closed scrub consists of *M. rhaphiophylla* Schau. (Cokelup Swamp) or *M. rhaphiophylla* with some *M. viminea* Lindl.

On the Darling plateau, in the Collie Basin and the river valleys and headwaters, *M. viminea* is most common. Other species on the Bingham River flats are *Kunzea ericifolia* Reichb., *Acacia saligna* (Labill.) H. Wendl., *Hakea varia* R. Br., *Viminaria juncea* Sm. and *Jacksonia furcellata* (Bonpl.) DC.

Mangrove Closed Scrub (Mg)

At Bunbury small areas of Mangrove *Avicennia marina* (Forsk.) Vierh. form closed scrub round the edges of Anglesea Island and on the south side of the sand spit between Leschenault Inlet and Koombana Bay. Another small patch occurs towards the north end of the Inlet where a sand blowout reaches the water north of Waterloo Head.

This is the most southerly occurrence of Mangrove on the Western Australian coast.

Avicennia marina is the first coloniser of new mud in the intertidal zone. As the mud builds up higher, Samphire open heath takes over. Close to the water are *Salsola kali* L., *Salicornia quinqueflora* Ung. Sternb. and *Suaeda australis* (R. Br.) Moq.

The construction of the new harbour at Bunbury, on the old delta of the Preston River, cuts off the Leschenault Inlet at Anglesea Island. The waters of the Collie and Preston Rivers now enter the sea by means of the Cut through the coastal dunes due west of the mouth of the Collie River. As the part of the inlet where most of the Mangrove occurs is

now reduced to a small tidal basin in which no new mud is likely to be deposited, their future appears insecure. It is possible that Mangrove could be established on new mud banks between the Cut and the mouths of the Collie and Preston Rivers.

D2 OPEN SCRUB

Banksia Open Scrub (B)

On sand outwash areas in the eastern parts of the map, such as at the south side of the Arthur River near Kokarrup Pool, open scrub is formed by *Banksia prionotes* Lindl., *B. attenuata* R. Br., *Hakea prostrata* R. Br., *Kunzea ericifolia* Reichb., *Nuytsia floribunda* (Labill.) R. Br. ex Fenzl. and *Casuarina* sp.

Coastal Dunes Open Scrub (Ag or A)

On stable sand dunes Peppermint *Agonis flexuosa* (Spreng.) Schau. forms open scrub with *Acacia rostellifere* Benth. also forming open scrub in the hollows, sometimes with *A. saligna* (Labill.) H. Wendl.

D4 HIGH OPEN SHRUBLAND

Jarrah-Kingia High Open Shrubland (Ki)

On the low plateau where the tributaries of the Blackwood River cut deep into unconsolidated material, a yellowish clay loam is exposed on convex hill sides and valley slopes below the level of the lateritic material of the hill tops. The vegetation of these clayey areas is a high open shrubland characterised by the presence of numerous *Kingia australis* R. Br. together with *Dasypogon hookeri* Drumm., *Banksia grandis* Willd., *Casuarina humilis* Otto et Dietr., *Xanthorrhoea* sp., scrubby Jarrah *Eucalyptus marginata* Sm. and scrubby *Xylomelum occidentale* R. Br.

E2 OPEN HEATH

Myrtaceous Open Heath (My)

On the leached sands of broad valley bottoms and hollows subject to occasional inundation, in situations intermediate between those supporting Paperbark low open woodland and those supporting closed scrub, Myrtaceous open heath occurs with patches of closed heath.

This may be a phase of closed scrub following a fire, in which case the low shrubs are mainly either *Melaleuca rhaphiophylla* Schau. or *M. viminea* Lindl.

Close to Bondi Formation north of Nalyerin Lake, open heath consists of *M. viminea, M. polygaloides* Schau., *Kunzea recurva* Schau., *Leptospermum ellipticum* Engl., *Astartea fascicularis* (Labill.) DC., *Hakea recurva* Meisn., *H. varia* R. Br., *Leucopogon reflexus* R. Br., *Adenanthos obovatus* Labill., *Pultenaea ochreata* Meisn., *Daviesia pectinata* Lindl. and *Hypocalymma angustifolium* Endl.

On the Harris River flats at Treesville open heath is composed of *M. viminea, M. leptoclada* Benth., *M. spathulata* Schau. and *Hakea marginata* R. Br.

Coastal Heath

On the stabilised coastal sand dunes heath is of variable density and is composed of many species. Some plants or associations of plants form closed heath in patches too small to be mapped. Elsewhere the same or other species form low open shrubland, and there may even be occasional tall shrubs.

Acacia species are most common on the dunes away from the sea, but as the coast is approached, *Olearia axillaris* (DC.) Benth. becomes a common and characteristic shrub.

South of Bunbury, *Acacia cochlearis* (Labill.) H. Wendl. is most common; north of Bunbury it is joined by or replaced on stabilised dunes by *Acacia rostellifera* Benth.

At Peppermint Grove Beach and Doungup, near the mouth of the Capel River, the sand dunes are very narrow and the following species occur—*Acacia cochlearis, Olearia axillaris, Scaevola crassifolia* Labill., *Spyridium globulosum* (Labill.) Benth., *Alyxia buxifolia* R. Br., *Acanthocarpus preissii* Lehm., *Spinifex longifolius* R. Br., *Hardenbergia comptoniana* Benth., *Tetragonia decumbens* Mill., *Rhagodia radiata* Nees., *Threlkeldia diffusa* R. Br., *Pelargonium capitatum* (L.) Ait. and *Anthericum divaricatum* Jacq.

Further north, at Koombana Trig (The Paps) the coastal dunes are wider and adjoin Tuart woodland. Here, the differences between the *Acacia* and *Olearia* phases are clearer. In the heath on the Tuart side of the dunes *Acacia cochlearis* is common, *Jacksonia furcellata* (Bonpl.) DC. frequent and there are patches of *Schoenus grandiflorus* (Nees) F. Muell.

Other plants present are *Eremophila glabra* (R. Br.) Ostf., *Leucopogon parviflorus* (Andr.) Lindl., *Rhagodia radiata, Phyllanthus calycinus* Labill., *Scaevola holosericea* DeVr., *Opercularia vaginata* Labill., *Conostylis aculeata* R. Br. ssp. *preissii* (Endl.) J. W. Green, *Exocarpos sparteus* R. Br., *Acanthocarpus preissii, Hardenbergia comptoniana, Clematis pubescens* Hueg., *Anthocercis littorea* Labill. and *Acacia saligna* (Labill.) H. Wendl.

On the seaward side *Olearia axillaris, Scaevola crassifolia* and *Exocarpos sparteus* are most common. Other plants are *Spyridium globulosum, Diplolaena dampieri* Desf., *Acanthocarpus preissii, Santalum* sp., *Tetragonia decumbens* Mill., *Hardenbergia comptoniana, Alyxia buxifolia, Spinifex longifolius, Hibbertia cuneiformis* (Labill.) Gilg., *Leucopogon parviflorus, Cassytha racemosa* Nees., *Jacksonia furcellata, Anthericum divaricatum, Carpobrotus virescens* (Haw.) Schwantes and *Phyllanthus calycinus.*

North of Bunbury, on stabilised sand dunes between Leschenault Inlet and the sea, the open heath consists mainly of *Acacia rostellifera, Jacksonia furcellata, Templetonia retusa* (Vent.) R. Br. *Rhagodia radiata* and *Exocarpos sparteus.*

Samphire Open Heath (Sa)

On flats adjoining estuaries subject to flooding with salty water, a highly specialised form of low open heath exists. Adjoining the Wonnerup estuary the principal plants are *Arthrocnemum bidens* Nees., *A. halocnemoides* Nees. and other *Arthrocnemum* species. At the north end of Leschenault Inlet, *A. halocnemoides* is most common.

On the mud flats behind the Mangroves fringing Anglesea Island, Bunbury, the samphire plants are *Salsola kali* L., *Salicornia quinqueflora* Ung. Sternb. and *Suaeda australis* (R. Br.) Moq.

Poot Open Heath (De)

On limestone hills east of Lake Preston, where Tuarts are sparse or absent, and a hard capping of secondary calcite occurs on the surface, a different form of open heath exists. *Eucalyptus decipiens* Endl. occurs as an occasional small tree or as a shrub and is accompanied by *Hakea prostrata* R. Br., *H. trifurcata* (Sm.) R. Br., *Melaleuca huegelii* Endl., *Jacksonia furcellata* (Bonpl.) DC. and *Casuarina humilis* Otto et Dietr.

F1 CLOSED HERBLAND

Where swamps composed of sedges or reeds are large enough to be mapped they are shown as closed herbland.

SWAMP VEGETATION

Many of the small lakes are in fact swamps covered with *Juncus* or *Gahnia* species. Benger Swamp contains *Typha orientalis* Presl. The bed of Malyerin Lake contains *Baumea articulata* (R. Br.) S. T. Blake. At the edges of Leschenault Inlet *Juncus maritimus* Lam. is common.

BARE SAND DUNES (Sd)

Bare sand dunes or blowouts on the coast may support a sparse vegetation. Shrubs observed on bare dunes between Leschenault Inlet and the sea are *Olearia axillaris* (DC.) Benth., *Jacksonia furcellata* (Bonpl.) DC., *Acacia cyclops* A. Cunn ex G. Don., *Ammophila arenaria* (L.) Link, *Scirpus nodosus* Rottl., *Cakile maritima* Scop. and *Arctotheca populifolia* (Berg.) Norl.

PRIMARY INDUSTRIES

One of the main industries of the area is forestry, based particularly on the utilisation of Jarrah and to a lesser extent of Forest Blackbutt and Wandoo. Some of the best Jarrah-Marri and Jarrah-Blackbutt sites in the Darling vegetation system have been clear-felled and planted with high yielding *Pinus radiata.* On Jarrah-Marri belts of the Spearwood system and Jarrah-Banksia intermediate between Spearwood and Bassendean systems, plantations of *Pinus pinaster* have been established. Plantations of Pines are also being planted on Jarrah-Mountain Marri sites on the northern escarpment of the Chapman system.

The region is valuable for honey production, particularly from Jarrah and Marri and to a lesser extent from Blackbutt in the Darling system. In the eastern areas, the better stands of Wandoo are utilised and, in the Spearwood system, honey is obtained from Peppermint and occasionally from Tuart.

The fertile Pinjarra Plain has been cleared and is used for grazing cattle, with milk production centered on the Harvey and Brunswick areas. Deficiencies of trace elements delayed agricultural development in the Spearwood system, but recent years have seen the clearing of the understorey of the lower Tuart ridges and the establishment of pastures for beef production. More recently even the infertile Bassendean sands have been partly cleared.

In the valleys and on the slopes of the Bannister and Beaufort systems, and almost totally in the Williams system, the woodlands have been cleared for some arable crops and the grazing of sheep.

Outside of forest reserves, the natural vegetation in these areas remains only on laterite

hilltops and in areas containing an abundance of poisonous *Gastrolobium* shrubs.

Sands of the Bassendean system, particularly on the seaward side where they adjoin or are partly overlain by the eastern edge of the Spearwood system, and at the foot of the Dunsborough-Collie River Escarpment, are being mined for their valuable mineral content.

Coal is mined in the valleys of the Collie Basin and tin in the hills around Greenbushes.

The waters of Lake Preston and Leschenault Inlet are attractive recreational areas. The former is now a National Park in which the restful pleasures of nature can be enjoyed, while Leschenault Inlet is remarkable for its population of edible crabs. Koombana Bay, protected by the basalt reef on which the seaward arm of the Bunbury harbour facility is built, provides a base for yachting and other water sports. In the forest reserves on the Darling Plateau, facilities for recreation are provided in the form of picnic spots, scenic drives, and more recently, bush walking trails. The Logue Brook, Harvey, Stirling and Wellington Dams, and the Blackwood River valley between Bridgetown, Balingup and Nannup provide foci of attraction for those who find pleasure in the scenery provided by forest and water. The Darling Escarpment provides magnificent views of the Swan Coastal Plain and the ocean.

REFERENCES

DIELS, L. (1906) The vegetation of the World VII. The plant world of Western Australia, south of the Tropics.

GARDNER, C. A. (1942) The vegetation of Western Australia with special reference to the climate and soils. Presidential Address 1942 *J. of the Roy. Soc. W. Aust.* 28.

GARDNER, C. A. (1962) The vegetation of Western Australia; *Official Year Book of W. Aust.* No. 3.

MACARTHUR, W. M. T. & 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.

SMITH, R. (1952) The soils of the South West Australian Agricultural Region. Thesis D.Sc. (Agric.) Univ. W. Aust.

SPECHT, R. L. (1970) Vegetation Chap. 5 in *The Australian Environment.* C.S.I.R.O. Melbourne Univ. Press.

SPECK, N. H. (1958) The vegetation of the Darling-Irwin Botanical District, Part IV, Vegetation Systems. Thesis Ph.D. Univ. W. Aust.

SMITH, F. G. (1972) Vegetation Map: Pemberton-Irwin Inlet. W. Aust. Department of Agriculture.

A2 K Karri High Open Forest *Eucalyptus diversicolor;* Gregory Brook 394 803

A2 JM Jarrah-Marri High Open Forest *E. marginata* and *E. calophylla;* between Nannup and Kirup 388 824

A3 T Tuart High Woodland *E. gomphocephala;* Stirling Road, Capel 350 855

B1 Bb Blackbutt Closed Forest *E. patens;* Brunswick River, Mornington 399 897

B2 JM Jarrah-Marri Open Forest *E. marginata* and *E. calophylla;* 8 km from Bridgetown on Boyup Brook Road 418 811

B2 MBb Marri-Blackbutt Open Forest *E. calophylla* and *E. patens;* Brunswick River, Mornington 398 895

B2-B3 JM Jarrah-Marri Open Forest—Woodland *E. marginata* and *E. calophylla;* north of Wild Horse Hill 468 904.

B2 JMW Jarrah-Marri-Wandoo Open Forest *E. marginata, E. calophylla* and *E. redunca* var. *elata*; Cordering 468 863

B2 WM Wandoo-Marri Open Forest *E. redunca* var. *elata* and *E. calophylla;* Coolakin 457 896

B2-B3 W Wandoo Open Forest—Woodland *E. redunca* var. *elata;* 484 836

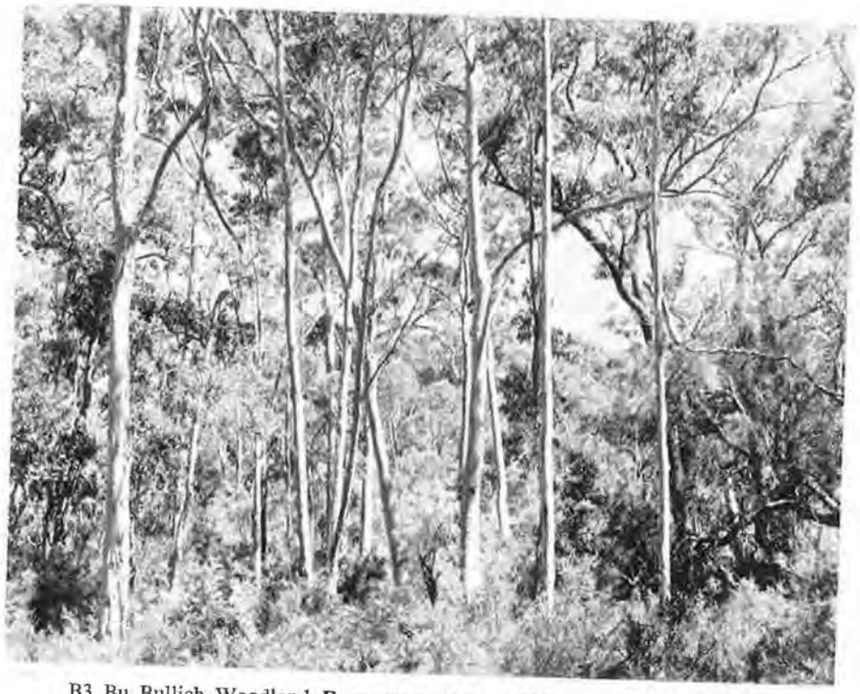
B2 Ma Mallet Open Forest *E. astringens;* north of Muradup 500 822

B2 R Flooded Gum Open Forest *E. rudis*; Blackwood River, Peninsula, Bridgetown 406 807

B3 T Tuart Woodland *E. gomphocephala;* west of Lake Preston 368 915

B3 JMB Jarrah-Marri-Banksia Woodland *E. marginata, E. calophylla, Banksia grandis* and *B. attenuata* on Karrakatta Sand, Spearwood System 360 863

B3 JH Jarrah-Mountain Marri Woodland *E. marginata, E. haematoxylon, B. attenuata, Xylomelum occidentalis* and *Casuarina fraserana;* east of Capel 60-100 m above sea level on escarpment 371 854



B3 Bu Bullich Woodland ***E. megacarpa***; near Millstream Dam 391 810

B3 JMB Jarrah-Marri-Banksia Woodland *E. marginata, E. calophylla, Banksia attenuata* and *B. ilicifolia* on Bassendean Sand 378 909

B3 J Jarrah Woodland *E. marginata* with *Dryandra sessilis* understorey; north of Muradup 497 825

B3 W Wandoo Woodland *E. redunca* var. *elata* with low shrub understorey, *Gastrolobium spinosum* very common; north of Muradup 498 825

B3 L York Gum Woodland *E. loxophleba;* 4 km S.E. from Williams 493 912

B3 RP Flooded Gum and Paperbark Woodland *E. rudis and Melaleuca rhaphiophylla;* Blackwood River, Cordinup 451 828

B3 Ys Swamp Yate Woodland *E. occidentalis;* south of Beaufort River 493 860

C2 P Paperbark Low Open Forest *Melaleuca cuticularis;* Lake Preston, western shore 367 921

C2 Ag Peppermint Low Open Forest *Agonis flexuosa;* west of Leschenault Inlet 368 895

C2 B Banksia Low Open Forest *Banksia attenuata, B. ilicifolia, Nuytsia floribunda* and *Eriostemon spicatus*; Ludlow 352 851

C2 C Casuarina Low Open Forest *Casuarina huegeliana;* 502 853

C2 A Acacia Low Open Forest *Acacia acuminata* with occasional *E. redunca* var. *elata*; south of Beaufort River 495 857

C3 P Paperbark Low Woodland *Melaleuca preissiana*; Yourdamung 427 897

C3 B Banksia Low Woodland *Banksia attenuata, B. ilicifolia, Eriostemon spicatus* with occasional *E. marginata;* ridge of Bassendean Sand 377 908

C3 H Mountain Marri Low Woodland *E. haematoxylon;* Hithergreen 354 832

C4 P Paperbark Low Open Woodland *Melaleuca preissiana, Banksia littoralis* and *Xanthorrhoea preissii* with occasional *E. rudis;* Haddleton Spring 458 847

D1 Me Melaleuca Closed Scrub *Melaleuca rhaphiophylla* and *M. viminea;* Benger Swamp 384 902

D1 Mg Mangrove Closed Scrub *Avicennia marina;* Anglesea Island, Bunbury at low tide 364 882

D1 Mg Mangrove Closed Scrub, *Avicennia marina;* western side of Leschenault Inlet at end of advancing sand dune 368 894

D2 A Acacia Open Scrub *Acacia rostellifera* with *Agonis flexuosa* low woodland in background; west of Leschenault Inlet 367 897

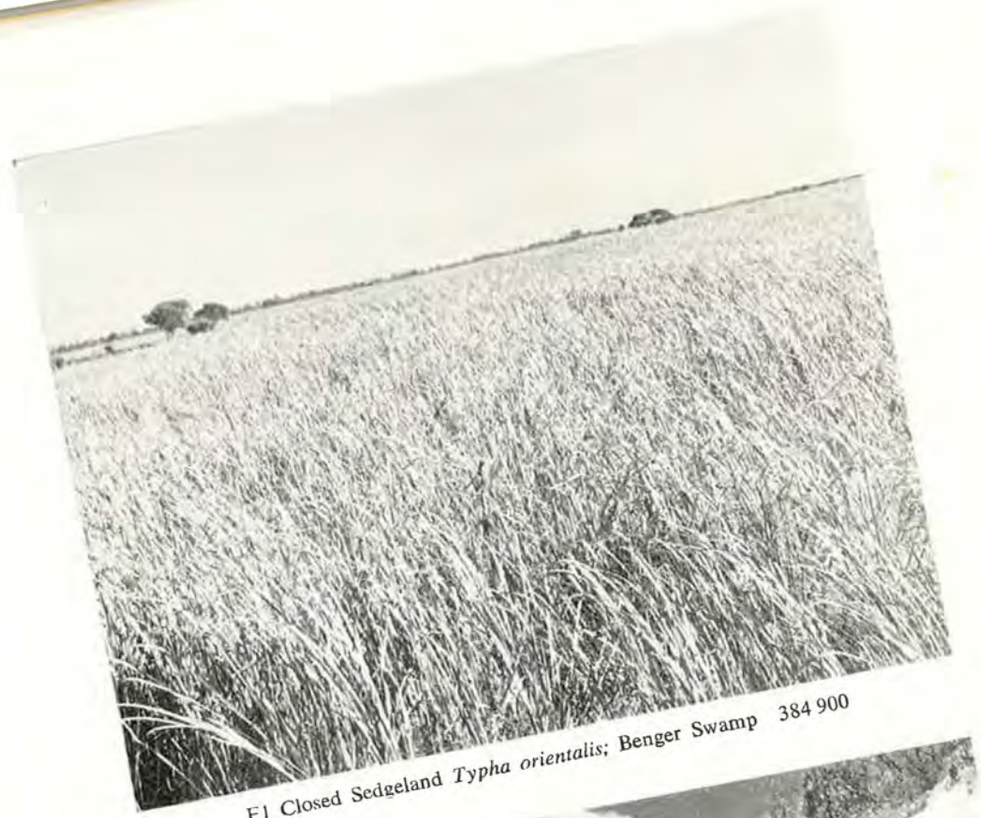
D4 Ki Jarrah-Kingia High Open Shrubland *Kingia australis, Casuarina humilis* and scrubby Jarrah *E. marginata;* 357 820

E2 My Myrtaceous Open Heath; Harris River 427 901

E2 A Acacia Coastal Heath *Acacia cochlearis* (most common), *Olearis axillaris, Scaevola crassifolia, Spyridium globulosum* and others; Peppermint Grove Beach 349 857

E2 Coastal Heath *Olearia axillaris, Scaevola crassifolia* and *Exocarpos sparteus* most common; seaward from Koombana Trig 361 877

Sa Samphire Open Heath *Arthrocnemum halocnemoides;* north end of Leschenault Inlet 368 897



F1 Closed Sedgeland *Typha orientalis*; Benger Swamp 384 900

Sd Sand Dune *Cakile maritima*, *Arctotheca populifolia*, *Scirpus nodosus* and *Olearia axillaris*; Leschenault Inlet 367 889

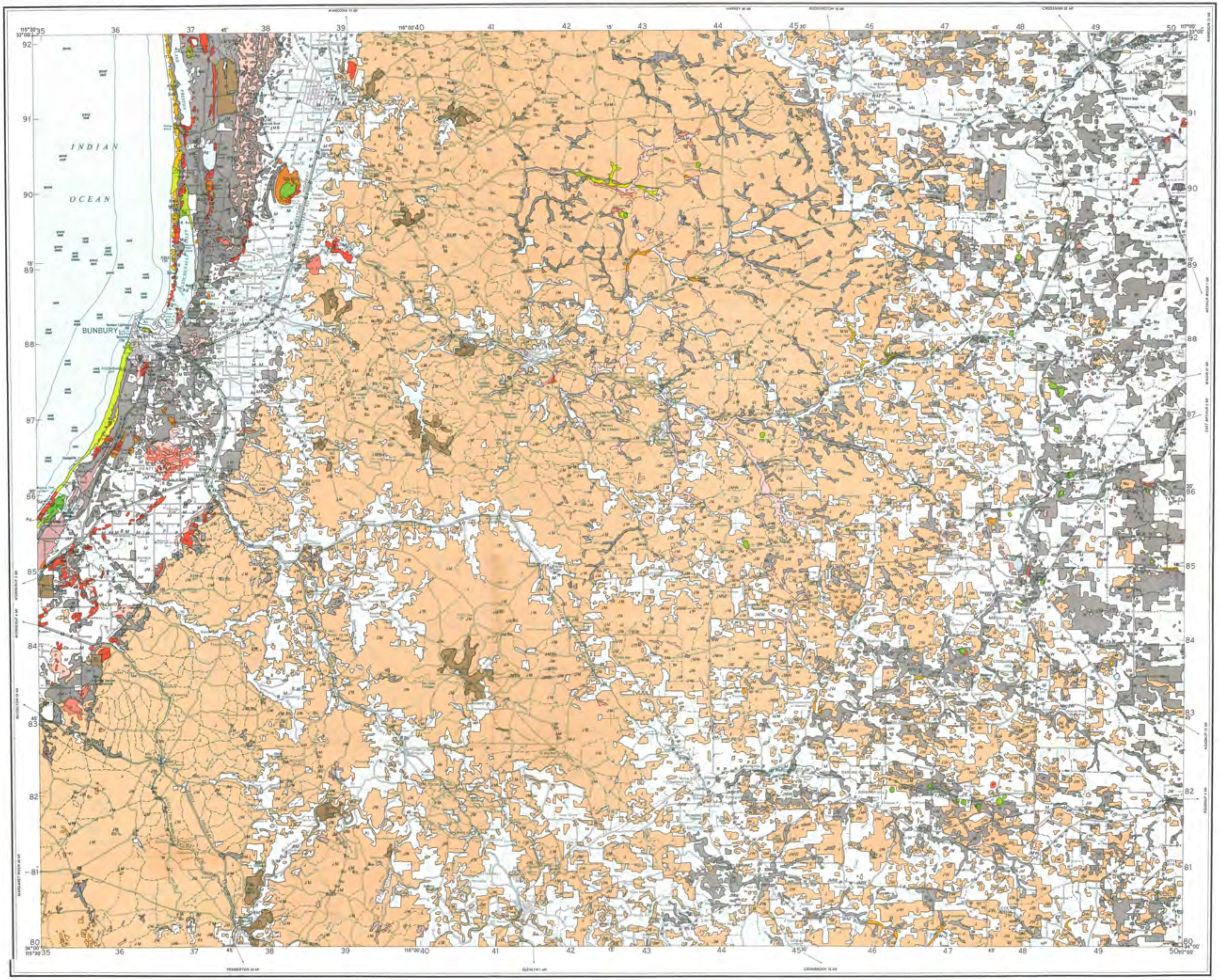
WILLIAM C. BROWN, Government Printer, Western Australia

36407/4/74—2M

AUSTRALIA 1:250 000

COLLIE

REFER TO THIS MAP AS:
SI 50-6 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 species	A
Peppermint	*Agonis flexuosa*	Ag
	Banksia species	B
Blackbutt	*Eucalyptus patens*	Bb
Bullich	*E. megacarpa*	Bu
	Casuarina species	C
Dieback	*E. decipiens*	Db
Mountain Marri	*E. haematoxylon*	H
Jarrah	*E. marginata*	J
Karri	*E. diversicolor*	K
	Kingia australis	Ki
York Gum	*E. loxophleba*	L
Marri	*E. calophylla*	M
Mallet	*E. astringens*	Ma
	Melaleuca species	Me
Mangrove	*Avicennia marina*	Mg
Myrtaceae		My
Paper Bark	*Melaleuca species*	P
Pine Plantations		Pi
Flooded Gum	*E. rudis*	R
Samphire	*Arthrocnemum species*	Sa
Tuart	*E. gomphocephala*	T
Wandoo	*E. redunca var. elata*	W
Swamp Yate	*E. occidentalis*	Ys

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 1966, Forests Department Aerial Photo Interpretation plans, and field surveys carried out by the Author from May, 1973 to February, 1974.

Scale 1:250,000

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°57'07.83"S, LONGITUDE [illegible]

GRID NUMBERS INDICATE THE 10,000 YARD TRANSVERSE MERCATOR GRID, ZONE 1 (AUSTRALIA SERIES). CLARKE 1858 SPHEROID
THE LAST FOUR DIGITS OF THE GRID NUMBERS ARE OMITTED

[illegible] MAGNETIC DECLINATION FOR THIS SHEET VARIES FROM [illegible] WESTERLY FOR THE CENTRE OF THE WEST EDGE TO [illegible] WESTERLY FOR THE CENTRE OF THE EAST EDGE. MEAN ANNUAL CHANGE IS NEGLIGIBLE

VEGETATION
COLLIE
WESTERN AUSTRALIA