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THE VEGETATION OF WESTERN AUSTRALIA

by

T. E. H. APLIN

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Chapter II—continued

Part 3—The Vegetation of Western Australia[1]

With an Account on the Conservation of the Flora

Contributed by T. E. H. Aplin
(Western Australian Herbarium, Department of Agriculture)

The flora of Western Australia consists of about 6,500 flowering plants (angiosperms), 15 cycads and conifers (gymnosperms) and 50 ferns. The families of flowering plants which characterise the flora are also widespread throughout Australia, *e.g.* Myrtaceae, Proteaceae and Leguminosae. The Stylidiaceae, Goodeniaceae and Epacridaceae, which are poorly represented outside Australia, are well developed in Western Australia. The five families which are endemic to Western Australia are entirely restricted to the South-West Province. These are the Cephalotaceae, Eremosynaceae, Emblingiaceae, Ecdeiocoleaceae and Anarthriaceae. Other large groups of plants (below the level of family) which are almost wholly endemic to this State are the *Chloanthoideae* (Verbenaceae), *Prostantheroideae* (Lamiaceae), *Persoonieae* and *Banksieae* (Proteaceae) and *Epacrideae* (Epacridaceae). The *Chamelaucoideae* (Myrtaceae), although not strictly endemic, has a high percentage of species restricted to Western Australia.

The State of Western Australia occupies about one-third of the continental land-mass of Australia and lies south of the equator between latitudes 13° and 35°. One-third of the State lies within the tropics, while the remainder extends into the temperate zone. Climatically, Western Australia shows a marked variation from a predominantly summer rainfall pattern in the north to a characteristically Mediterranean-type winter rainfall pattern in the south. Between these two rainfall systems is a large region whose climate is characterised by the extreme variability of the rainfall both annually and seasonally.[2] The vegetation of Western Australia, in general terms, is determined by these varying climatic patterns, although local changes in geology, soils, topography and drainage may affect the structure and/or the floristic composition of plant communities. The delineation of the present day vegetation also reflects the past tectonic and climatic history of the Australian continent.

The development of the so-called pan-Australian mesophytic flora, which include the tropical broad-leaved genera *Cinnamomum* and *Tristania*, the more temperate genera *Dacrydium*, *Podocarpus*, *Araucaria*, *Nothofagus* and *Phyllocladus* and the typically Australian genera *Eucalyptus*, *Casuarina*, *Callitris* and *Banksia*, began in the early Tertiary era. It is generally accepted that in the Palaeozoic era the Australian continent was united with the continents of Africa, Antarctica, India and South America in a once common land-mass known as Gondwanaland. During this period these continents had a common flora as exemplified by the *Glossopteris* elements. In the late Neocomian period (Early Cretaceous), rifting between India (with Africa and South America) and Australia (with Antarctica) was initiated. In Eocene times (Early to Mid-Tertiary), sea-floor spreading between Australia and Antarctica commenced and for the first time the southern coasts were warmed by the entering Indian Ocean. The Australian continental block was thus isolated at about the time the pan-Australian flora began to develop. The northward drift of the continent brought the Australian block into contact with the Asian block in the middle Miocene period (Late Tertiary), and allowed the entry of a different flora, the ' Indo-Malayan ' flora.

(1) See *Appendix* for reference to additional information in earlier issues of the Year Book.
(2) See Part 2 of Chapter II—*Climate and Meteorology*.

The degree of endemism and diversification in the south-western flora, which had its origin in pre-Miocene times, was brought about largely by the isolation caused by the late Eocene and Miocene seas which inundated the Nullarbor Shelf. Another factor that contributed to the diversification of the flora was the laterisation that occurred in the Tertiary period, with the subsequent dissection of the lateritic landscape causing fragmentation of a once continuous flora. The significance of the flora of Western Australia, with regard to relict floral and morphological characters, is dealt with in the section *Conservation of the Flora* on pages 78-80.

Formations and Alliances

The classification of vegetation involves the grouping of similar structural units and the grouping or classification of the floristic components present in all strata of plant communities that form part of the vegetation.

In a survey of major plant communities of Australia and Papua New Guinea for the Conservation of Terrestrial Communities Section of the International Biological Programme (I.B.P./C.T.) a structural classification scheme was devised. This scheme, produced by Australian plant ecologists and freed from previous conceptions of the Australian Vegetation, was considered to be easy to understand and to use in the field in Australia. The classification of plant communities involved a simple two-dimensional table using the variables height/life form of the tallest stratum, and the projective foliage cover of the tallest stratum. Major structural formations recorded in Australia are summarised in the following table and further divisions based on height classes and projective foliage cover can be instituted. The nature of the understorey provides logical subdivisions to the formations.

PLANT COMMUNITIES—MAJOR STRUCTURAL FORMATIONS

Life-form and height of tallest stratum	Projective foliage cover of tallest stratum, as per cent	Description
Trees over 30 m	70–100	High closed forest
	30–70	High open forest
	10–30	High woodland
	under 10	High open woodland
Trees 10–30 m	70–100	Closed forest
	30–70	Open forest
	10–30	Woodland
	under 10	Open woodland
Trees under 10 m	70–100	Low closed forest
	30–70	Low open forest
	10–30	Low woodland
	under 10	Low open woodland
Shrubs over 2 m	70–100	Closed scrub
	30–70	Open scrub
	10–30	High shrubland
	under 10	High open shrubland
Shrubs under 2 m	70-100	Closed heath
	30-70	Open heath
	10-30	Low shrubland
	under 10	Low open shrubland
Herbs	70–100	Closed herbland, tussock grassland, sedgeland, etc.
	30–70	Herbland, tussock grassland, sedgeland, etc.
	10–30	Open herbland, tussock grassland, sedgeland, etc.
Hummock grasses	10–30	Hummock grassland
	under 10	Open hummock grassland

To include floristic detail, the following three categories are often used to define subdivisions within a structural formation.

1. *Alliance*—A series of climax plant communities which have (i) the same structural characteristics, (ii) related species as dominants in the uppermost stratum, and (iii) possibly the same or related species in the understorey.
2. *Association*—A series of climax plant communities which have (i) the same structural characteristics, (ii) the same species as dominants in the uppermost stratum, and (iii) possibly different floristic composition in the understorey.
3. *Society*—A series of climax plant communities which have (i) the same structural characteristics, (ii) the same species as dominants in the uppermost stratum, and (iii) the same species prominent in the lower strata.

High open forest and high woodland are represented by *Eucalyptus diversicolor* (Karri), *E. marginata-E. calophylla* (Jarrah-Marri) and *E. gomphocephala* (Tuart) alliances, all in the South-West Province.

The forest formations are represented by *E. marginata-E. calophylla* and *Agonis flexuosa* (West Australian Peppermint) alliances in the South-West; and by *E. tetradonta-E. miniata* (Darwin Stringybark-Woolly Butt), *E. tectifica-E. grandifolia* (Grey Box-Cabbage Gum) alliances in the Northern Province. Woodland and open woodland formations are represented by *E. loxophleba* (York Gum), *E. wandoo* (Wandoo), *E. salmonophloia* (Salmon Gum), *E. occidentalis* (Swamp Yate), *E. astringens* (Brown Mallet), *E. cornuta* (Yate), *E. rudis-Melaleuca* spp. (Flooded Gum-Paper Bark) and *Casuarina obesa* (Swamp Sheoak) alliances in the South-West; by *E. torquata-E. lesouefii* (Coral Gum-Goldfields Blackbutt), *E. dundasii* (Dundas Blackbutt) and *E. transcontinentalis-E. flocktoniae* (Morrell-Merrit) alliances in the Eremean; and by *E. camaldulensis* (River Red Gum), *E. tectifica-E. grandifolia, E. tetradonta-E. miniata, E. latifolia* (Round-leaf Bloodwood), *E. papuana* (Ghost Gum), *E. polycarpa-E. apodophylla* (Long-fruited Bloodwood-White Bark), *E. microtheca* (Coolabah) and by *Terminalia* spp., *Melaleuca* spp. and *Adansonia gregorii* (Baobab) alliances in the Northern Province.

The low forest formations are represented by *Melaleuca lanceolata-Callitris preissii* (Rottnest Teatree-Rottnest Cypress Pine), *E. platypus E. spathulata-E. annulata* (Moort-Swamp Mallet-Open-fruited Mallee), *Agonis juniperina* (Warren River Cedar), *Banksia menziesii-B. attenuata-Casuarina fraserana-E. todtiana* (Menzies Banksia-Slender Banksia-Fraser's Sheoak-Coastal Blackbutt), *E. falcata,* and *B. prionotes* (Acorn Banksia) alliances in the South-West. Low woodland and low open woodlands are represented by *E. erythrocorys* (Illyarrie), *Casuarina huegeliana* (Rock Sheoak) and *Banksia* spp. alliances in the South-West; by *E. brevifolia* (Snappy Gum), *E. pruinosa* (Silver-leaf Box), *E. dichromophloia* (Red-barked Bloodwood), *E. argillacea* (Kimberley Grey Box), *E. microtheca, Grevillea striata* (Beefwood), *Lysiphyllum cunninghamii* (Bauhinia) and *Melaleuca* spp. (Paper Bark) alliances in the Northern Province; and by *E. gongylocarpa* (Desert Gum), *E. kingsmillii* (Kingsmill's Mallee), *Casuarina decaisneana* (Desert Sheoak) and *Acacia sowdenii* (Myall) alliances in the Eremean Province.

The scrub formations are represented in the South-West Province by *Acacia rostellifera-A. cyclops-A.cochlearis, Agonis* spp., *Pultenaea reticulata, Melaleuca huegelii, M. globifera, E. foecunda* (White Mallee), *Acacia* spp.- *Casuarina* spp.-*Melaleuca* spp. (Woodjil-Tamar-Broombush) and mixed Proteaceae-Myrtaceae alliances; and by *Melaleuca thyoides, Melaleuca uncinata* and *Acacia aneura* (Mulga) alliances in the Eremean Province. High shrubland formation include *Actinostrobus arenarius* (Sandplain Cypress Pine), *Banksia ashbyi-B. sceptrum, B. baxteri, B. speciosa* (Showy Banksia), *E. reduncaE. uncinata* (Black Marlock-Hook-leaf Mallee), *E. tetragona* (Tallerack), *Grevillea eriostachya-G. didymobotrya-G. leucopteris* and *B. hookerana-Xylomelum angustifolium* (Banksia -Sandplain Woody Pear) alliances; and by *Acacia* spp.-*Cassia* spp.-*Eremophila* spp., *E. kingsmillii, E. youngiana* (Large-fruited Mallee), *A. victoriae, A. pyrifolia, A. pachycarpa-Grevillea wickhamii, Acacia lysiphloia-Acacia* spp., and *A. aneura* alliances in the Eremean Province.

Heath formations are restricted to the South-West Province and are made of mixed communities in which the families Proteaceae, Myrtaceae, Epacridaceae, Xanthorrhoeaceae

and Leguminosae are well represented. The genera *Dryandra, Banksia, Hakea, Casuarina, Xanthorrhoeae* (Blackboy or grass tree), *Leptospermum, Kunzea* and *Melaleuca* usually dominate the heath communities. Low shrubland formations are dominated by chenopodiaceous shrubs. The most important alliances are *Kochia sedifolia* (Blue Bush), *Atriplex* spp. (Saltbush) and *Arthrocnemum* spp. (Samphire), which are well represented in the Eremean Province.

The hummock grasslands are dominated by species of *Triodia* and *Plectrachne*. These genera, commonly called Spinifex, grow outwards leaving the centre senescent or dead. This formation is found in the Eremean Province. Tussock grasslands are dominated by species of *Astrebla* (Mitchell Grass), *Bothriochloa-Chrysopogon* (Blue Grass-Ribbon Grass), *Iseilema* (Flinders Grass) and by *Themeda* (Kangaroo Grass) alliances with *Sehima* (White Grass), *Heteropogon* (Spear Grass), *Cymbopogon* (Scent Grass), *Sorghum* (Wild Sorghum) and *Aristida* (Three-awn Grass) usually seen only under woodland formations. Fringing grasslands include *Coelorhachis, Arundinella* (Reed Grass) and *Imperata* (Blady Grass). These formations are restricted to the Northern Province. Sedgelands are represented in the South-West Province by communities in which the families Juncaceae, Cyperaceae, Restionaceae and Anarthriaceae are prominent.

Other plant communities, recorded in edaphic complexes, include coastal dune vegetation, halophytic communities, swamp communities, lithic complexes and aquatic complexes. Each of these complexes may be unimportant in terms of area, but are of significance in providing the habitat for particularly interesting plants, *e.g. Cephalotus, Byblis, Drosera,* etc.

Botanical Provinces and Districts

The vegetation of Western Australia has been sub-divided into three Botanical Provinces. The areas that these provinces occupy, is determined largely by climatic pattern. Within each province are smaller regions, known as Botanical Districts, in which the structure and floristics of the vegetation are determined partly by climate and partly by geology and soils. The boundaries of these provinces and districts are shown on the map on page 74.

The *Northern Province*, or Tropical Zone, is characterised by a dry monsoonal climate. The rainfall received in the summer months ranges from less than 500 mm to over 1,250 mm per annum. The annual mean maximum temperature is over 30°C. The evaporation rate ranges from 2,000-2,500 mm per annum.

The vegetation formations consist of grassy *Eucalyptus* open forests and woodlands. The major components are 'Australian' elements, with 'Indo-Malayan' elements as minor components. The latter are usually found in special habitats such as streamlines or scarps. Some important 'Indo-Malayan' genera are *Ficus* (Moraceae), *Barringtonia* (Lecythidaceae) and *Terminalia* (Combretaceae).

The *Hann* botanical district, commonly referred to as the Kimberley Plateau, consists of a series of sandstone, shale, quartzite and volcanic rocks of Lower Proterozoic age. The topography varies from a rolling to hill landscape to a very rugged dissected plateau. Saline mud flats are present along estuaries.

On the volcanic rocks and shales, on gently undulating to hilly topography, the woodland and open woodland formations consist mainly of *E. tectifica-E. grandifolia* alliance. The *E. tectifica* sub-alliance is restricted to the volcanic soils while the *E. grandifolia* sub-alliance is developed on the shales and sandstones. *E. latifolia* and *E. papuana* alliances characterise the flats and levee soils. These alliances and sub-alliances include a number of plant associations. Each association is characterised by one or more *Eucalyptus* species. The understorey layers consist of a sparse low tree or high shrubland layer and a dense to moderately dense grassland layer. Small tree genera include *Cochlospermum, Terminalia, Atalaya* and *Erythrophleum*. Grass genera include *Bothriochloa, Sehima, Chrysopogon, Sorghum, Heteropogon* and *Themeda*.

On the sandstone and quartzite rocks, ranges and hogbacks, the woodland, open woodland and low open woodland formations are mainly made up of *E. tetradonta-E.*

miniata alliance. In this alliance, which is characterised by *Eucalyptus* species, the *E. tetradonta* sub-alliance is found mainly in the northern high-rainfall region while the *E. phoenicea-E. ferruginea* (Gnainggar-Rusty Bloodwood) sub-alliance is its southern lower-rainfall counterpart. *Callitris intratropica* (Northern Cypress Pine) forms pure stands on deep red sands. The *E. dichromophloia* sub-alliance is found on skeletal sands in rugged sandstone areas. The small tree/shrub layer in the *E. tetradonta-E. miniata* alliance includes the genera *Petalostigma, Grevillea, Gardenia, Persoonia, Buchanania, Ventilago, Planchonia, Eugenia, Brachychiton, Terminalia, Acacia, Jacksonia* and *Melaleuca*. The grass storey is dominated by *Plectrachne pungens*, together with *Sorghum* and *Aristida*. Flats and levees usually carry a *E. polycarpa-E. apodophylla* alliance, while the very steep scarps carry a *Brachychiton* spp.-*Terminalia* spp.-*E. confertiflora* variable woodland.

Other alliances and associations found in the Hann botanical district are *Terminalia* spp.-*Bothriochloa* spp. woodland and grassland communities, on soils of heavy texture; *E. brevifolia, E. argillacea* and *Melaleuca viridiflora* associations on podsolics, over shales and sandstones; fringing communities of *E. camaldulensis* and *Terminalia* spp.-*Ficus* spp.-*Melaleuca* spp.; and mangrove communities on the estuarine mud flats.

The *Ord* botanical district, known as the Ord-Victoria region, extends into the Northern Territory. There are three distinct sub-regions in the Western Australian portion, the Cambridge Gulf lowlands, the Ord River basin and the Halls Creek ridges. The geology ranges from Quaternary alluvia, through Permian, Devonian-Carboniferous and Cambrian-Ordovician sediments to Proterozoic and Archaean metamorphic rocks.

The alluvial flood plains of the Ord River system carry a tall grass formation including the genera *Bothroichloa, Astrebla, Chrysopogon, Sorghum* and *Ophiurus*. Frontage woodlands carry a *E. papuana* alliance. *E. tetradonta-E. miniata* alliance occurs mainly on lateritic areas or on acid rocks. *E. tectifica-E. grandifolia* alliance occurs more commonly on soils formed on basic rocks, or shales and limestones. Low open woodlands of *E. pruinosa* association are the low-rainfall counterparts of the *E. tectifica* woodlands and occur on soils derived from basic rocks. *E. brevifolia* association is generally seen on skeletal soils on acid rocks, and also on many other soils. Low open woodlands of *Terminalia* spp. alliance occur on cracking clay soils formed on volcanics and limestone. Tussock grasslands with *Astrebla, Bothriochloa, Chrysopogon* and *Panicum* occur on high-level plains of Tertiary alluvia. The rugged hilly country of the Halls Creek ridges carries *E. brevifolia* and *E. pruinosa* low open woodland associations over *Triodia intermedia*. The gently undulating plains with calcareous soils carry arid short grass communities of *Enneapogon* (Bottle Washers), *Aristida* and *Sporobolus*. These areas have suffered severe wind and gully erosion and have in recent years been resown to the alien *Cenchrus ciliaris* (Buffel Grass). Low open woodlands of *E. argillacea* are present on red soils on basic rocks (limestone dolomites and volcanics).

The *Fitzroy* botanical district, sometimes known as Fitzroyland, is a region in which a great thickness of gently folded sedimentary rock, of Palaeozoic and Mesozoic age overlies a Precambrian basement of crystalline rock. The basement outcrops along the north and east of the basin.

The up-land regions consist of low hills and stoney plains with granite domes, gneiss hills, schist ridges and gently sloping sandy plateaux. The vegetation formations consist of low open woodland formations of *Eucalyptus* species with a hummock grassland ground layer. The main alliance of *E. brevifolia* is represented by a number of associations. One noteworthy association is *Grevillea pyramidalis*. The hummock grassland layer consists of the genera *Triodia* and *Plectrachne* in almost pure stands of species. A short grass ground storey with *Enneapogon* and *Aristida* may be seen on the interfluves and hill-foot slopes to the south-east. The drainage floors usually carry low open woodland formations of *E. dichromophloia* and *E. tectifica* alliances. The grass layer includes the genera *Chrysopogon, Sehima, Sorghum* and *Bothriochloa*.

Rocky limestone areas and shallow calcareous soils are characterised by *Triodia wiseana* hummock grassland. The *Adansonia gregorii* open woodland association is largely restricted to rugged limestone country, although *A. gregorii* may be found associated with other species, *e.g.* with *E. dichromophloia* and *E. perfoliata* (Twinleaf Bloodwater) on granite,

tors or domes to the north. *E. dichromophloia, Grevillea striata* and *Lysiphyllum cunninghamii* low open woodland alliances occur on the outcrop plains over the gently folded sandstone, shale and limestone. These may be linearly oriented along strike lines and associated with *Acacia, Atalaya, Ventilago* and *Dolichandrone*. Cracking clay plains on the sedimentary rocks carry tussock grasslands of *Astrebla, Bothriochloa* and *Chrysopogon*. The tributary alluvial plains of the Fitzroy River consist mainly of *Grevillea striata* and *Lysiphyllum cunninghamii* low woodland with *Triodia* and *Chrysopogon*. The stable and active flood-plains carry *Astrebla* and *Chrysopogon-Bothriochloa* tussock grasslands, with *Acacia suberosa* as an important associate, and *E. papuana* and *E. microtheca* woodland alliances. Lining the main channels are *E. camaldulensis-Terminalia platyphylla* fringing communities. Coastal flats have fringing mangrove forests. Open grasslands of *Xerochloa* spp. occur on the margins of saline influence.

The *Dampier* botanical district consists of extensive sand plains. Surface drainage is lacking in most areas. The dominant layer in the vegetation is composed of *Acacia*, the more important species being *A. tumida, A. eriopoda, A. pachycarpa, A. holosericea* and *A. monticola*. *E. dichromophloia* and *E. zygophylla* make up the tallest stratum of the low woodland formation containing these *Acacia* species. Other tree genera include *Gyrocarpus, Atalaya, Hakea, Grevillea, Lysiphyllum, Persoonia* and *Erythrophleum*, with the occasional *Adansonia*. In the high rainfall area, a woodland formation of *E. miniata* alliance is present. This alliance also has a strong layer of *Acacia* shrubs. In this district *E. tetradonta* is not associated with *E. miniata* as it is in the Hann and Ord botanical districts. The grass ground storey is predominantly *Plectrachne pungens-Chrysopogon* spp. Shallow valleys, pans and depressions, which may be up to five kilometres wide, carry woodlands of *E. polycarpa, E. tectifica, E. microtheca* and *Melaleuca* spp. alliances, with various tall grasses. The saline coastal flats carry *Sporobolus virginicus* and *Arthrocnemum* spp. communities.

The *Eremean Province*, which lies between the predominantly summer and predominantly winter rainfall patterns of the north and the south-west, respectively, is intermediate in character. The rainfall, which over most of the province is less than 400 mm per annum, is received either from extensions of summer rainfall southward or from northern extensions of the southern winter systems. The vegetation of the province varies from woodland, high shrubland, low shrubland to hummock grassland. Eleven botanical districts have been broadly recognised, seven of them in the desert area.

The *Fortescue* botanical district, usually placed in the Northern Province, consists of the Pilbara block. This district is intermediate in character between the Northern and the Eremean Provinces. It consists of granite plains to the north and west, rising gently inland to a capping of basalt in the Chichester Range and beyond this to the dolomite and jaspilite of the Hamersley Range. The vegetation of the narrow coastal strip carries grasslands of *Eragrostis* and *Eriachne* and low open shrublands of *Acacia translucens-A. inaequilatera* alliance. *Acacia pyrifolia* high open shrubland alliance is present on granite and basalt soils. The *Acacia* alliances have a strongly developed *Triodia pungens* hummock grassland ground layer. The high shrubland *A. aneura* alliance is found along the major valleys and southern flanks of the Hamersley Range. A sparse shrub layer and a short grass ground flora composed of *Eragrostis* (Love grass), *Eriachne* (Wanderrie grass) and *Aristida* characterise these communities. On the Proterozoic rocks of the Hamersley Range the characteristic vegetation is a low open woodland formation, with *E. brevifolia* alliance. The hummock grassland ground layer is composed of *Triodia wiseana*.

The *Ashburton* and the *Austin* botanical districts are separated by the prevailing rainfall patterns. The former, with its rainfall more likely to occur in summer, and the latter, with its rainfall more likely to occur in winter, both carry extensive high shrubland formations of *A. aneura* alliance but, whereas the northern alliance is associated more with grass genera such as *Aristida, Eragrostis, Eriachne, Panicum, Brachiaria, Triodia* and *Setaria*, the southern alliance is associated more with genera such as *Danthonia, Eremophila, Kochia, Bassia, Helipterum, Cephalipterum, Velleia, Swainsona* and other herbaceous annuals. The *A. aneura* alliance consists of a number of sub-alliances and associations. These include the *A. aneura-Eremophila leucophylla, A. aneura-E. fraseri, A. aneura-A. tetragono-*

phylla, A. aneura-A. craspedocarpa, A. aneura-A. sclerosperma, A. aneura-A. linophylla, A. aneura-Callitris huegelii, A. xiphophylla-A. grasbyi and *A. sclerosperma-A. ramulosa* sub-alliances. The latter two are prominent in the Carnarvon Basin. *E. kingsmillii* is also associated with *A. aneura*, and with a hummock grassland ground layer. *Kochia pyramidata* is associated with *A. aneura* on saline alluvial plains. Other woody genera that are prominent in the *A. aneura* alliance are *Hakea, Grevillea, Atriplex, Frankenia, Plagianthus, Heterodendron* and *Brachychiton.* The upper margins and floors of pans and salt lakes in the Austin district carry an *Arthrocnemum* spp. alliance. Fringing these flats are *Melaleuca uncinata* communities. The drainage channels are fringed by *E. camaldulensis* and *E. microtheca* alliances.

The Canning, Mueller, Keartland, Carnegie, Giles and Helms botanical districts comprise what was once called the Carnegie botanical district. These make up the desert region of Western Australia.

The *Canning* and *Mueller* districts contain extensive areas of high shrubland with several species of *Acacia* dominating. Scattered trees of *Eucalyptus* sp. (Desert Bloodwood) are present on the dunes. *E. pachyphylla* and *E. odontocarpa* are prominent in the north-eastern sector, while woodlands of *Casuarina decaisneana* are also of local importance there, in the interdunes. The ground layer of hummock grassland include *Triodia* and *Plectrachne. Grevillea wickhamii* and *Acacia monticola* are dominant on stoney rises. Low trees of *E. pruinosa, E. brevifolia, E. setosa* and *E. microtheca* occur at a very low density.

The *Keartland* district has a noticeable abundance of *Thrytomene maissoneuvii* and other Myrtaceae in the high shrubland formation. The Desert Bloodwood is present on the dunes, together with *Plectrachne schinzii. A. aneura* is of local importance, on small hills and mesas, with *Triodia pungens.*

The *Carnegie* district carries extensive areas of *A. aneura*, with *Danthonia* and seasonal ephemerals. On the rises of the lateritic plains hummock grasslands of *Triodia basedowii* and high shrublands with *E. kingsmillii* merge in with the *A. aneura* which tend to thin out. Desert Bloodwood, *Casuarina decaisneana*, and *E. microtheca* become more local in distribution, while *Plectrachne schinzii* is increasingly replaced by *Thryptomene maissoneuvii* southwards.

The *Giles* district consists of ranges with sandhill country between them, somewhat similar to the Carnegie district. On the ranges the high shrubland is made up predominantly of *Acacia* spp. including *A. aneura*, with *Eromophila, Hakea, Grevillea* and *Eucalyptus* as co-dominants in some areas. *Callitris columellaris* is locally dominant. *Triodia basedowii* and *Plectrachne melvillei* form the hummock grassland ground layer. The *A. aneura* alliance, prominent on basalt soils, has a ground flora of seasonal ephemerals and scattered *Eremophila* and *Cassia.*

The *Helms* district contains extensive areas of *A. aneura* alliance. A high shrubland formation characterised by *E. youngiana* alliance is also well developed. Associated with the shrubland community are other tall shrubs such as *Hakea, Acacia, Melaleuca, Grevillea* and other *Eucalyptus* species. Patches of open woodland of *E. gongylocarpa* are restricted apparently to areas where the sand is deeper. The hummock grass associated with *E. youngiana* and *E. gongylocarpa* is *Triodia basedowii.*

The *Eucla* botanical district, commonly referred to as the Nullarbor Plain, is dominated by a low shrubland formation of *Kochia sedifolia. Atriplex, Stipa* and seasonal ephemerals are well represented. Towards the margin a low open woodland of *Acacia sowdenii* alliance, with a low shrubland understorey of *Kochia* and *Atriplex*, becomes more and more evident. Along the coastal strip low woodlands of *Eucalyptus* spp. and *A. sowdenii* alliances are to be seen on the ridges and flats, respectively.

The *Coolgardie* botanical district marks the transition from the South-West Province to the Eremean Province, from the Eucalyptus zone to the Acacia zone. In this district a high degree of variability occurs within Eucalyptus and Acacia. It is thought that this variability may have been due to climatic oscillations known to have occurred since the Pleistocene period, thus making many of the ' species ' of recent origin. The vegetation is a mosaic of woodland and shrubland formations. The woodland formations

include *E. salmonophloia, E. transcontinentalis-E. flocktoniae, E. torquata-E. lesouefii, E. dundasii-E.longicornis* and *E. brockwayi* alliances. Shrubland formations include *Grevillea eriostachya-G. didymobotrya-G. excelsior, Eucalyptus foecunda, E. eremophila* and other mallee or shrub eucalypts, *Acacia* spp.- *Casuarina* spp.-*Melaleuca* spp. and *Acacia aneura* alliances. Salt lakes and salt pans are associated with halophytic communities of *Arthrocnemum* and *Atriplex* alliances.

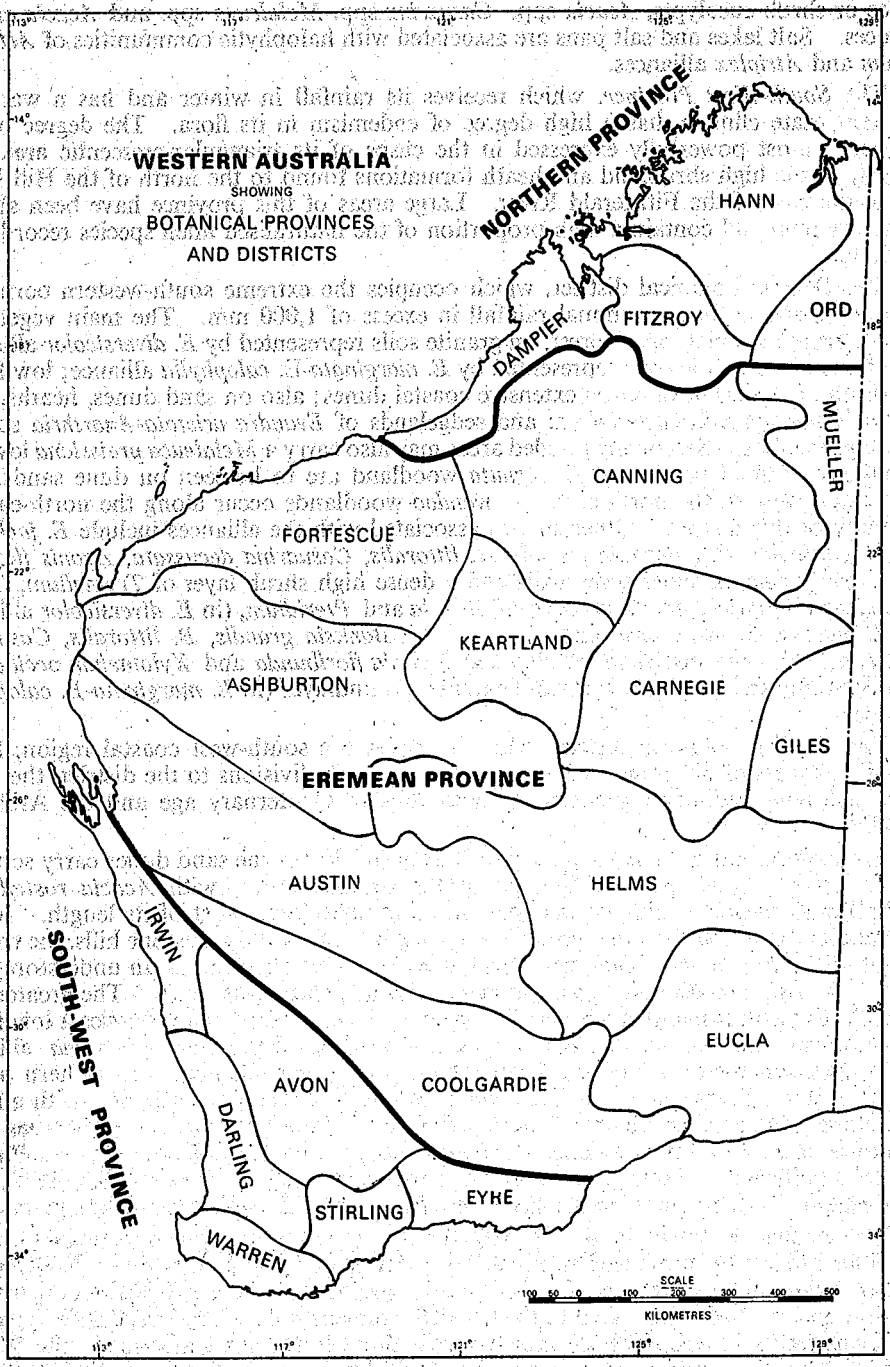
The *South-West Province*, which receives its rainfall in winter and has a warm to cool temperate climate, has a high degree of endemism in its flora. The degree of endemism is most powerfully expressed in the cusps of its triangular-crescentic area particularly in the high shrubland and heath formations found to the north of the Hill River and to the east of the Fitzgerald River. Large areas of this province have been altered greatly by man and contain a high proportion of the naturalised alien species recorded in the State.

The *Warren* botanical district, which occupies the extreme south-western corner of Western Australia, has an annual rainfall in excess of 1,000 mm. The main vegetation formations are the high open forest, on granite soils represented by *E. diversicolor* alliance; open forest, on lateritic soils represented by *E. marginata*-E. *calophylla* alliance; low forest and scrub of *Agonis flexuosa* on extensive coastal dunes; also on sand dunes, heaths, with *Jacksonia horrida-Acacia decipiens*; and sedgelands of *Evandra aristata-Anarthria* spp. in waterlogged areas. Seasonally flooded areas may also carry a *Melaleuca preissiana* low forest alliance. Small patches of *E. cornuta* woodland are to be seen on dune sands, and more extensively to the north-east. *E. wandoo* woodlands occur along the north-eastern boundary of this district. Other species associated with the alliances include *E. jacksonii* and *E. guilfoylei* with *Banksia grandis, B. littoralis, Casuarina decussata, Agonis flexuosa* and *A. juniperina* as understorey trees and a dense high shrub layer of *Trymalium, Chorilaena, Hovea elliptica, Acacia pentadenia, Albizia* and *Pteridium*, (in *E. diversicolor* alliance) and *E. patens, E. megacarpa* and *E. rudis* with *Banksia grandis, B. littoralis, Casuarina fraserana, Persoonia longifolia, P. elliptica, Nuytsia floribunda* and *Xylomelum occidentale* as understorey trees and a low shrub heathlike groundlayer (in *E. marginata-E. calophylla* alliance).

The *Darling* botanical district, which occupies the south-west coastal region, has a rainfall in excess of 625 mm. There are two major sub-divisions to the district, the Perth basin, overlying sedimentary rocks of Cretaceous to Quaternary age and the Archaean Shield.

In the Perth basin the narrow strip of Recent or Pleistocene sand dunes carry scrub or low forests of *Agonis flexuosa* alliance at the southern edge, with *Acacia rostellifera-A. cyclops-A. cochlearis* alliance and sand dune complex over most of its length. Inland and parallel to the coastal dune system is a narrow belt of coastal limestone hills, the natural habitat of the *E. gomphocephala* woodland alliance. This alliance has an understorey tree layer of *Banksia grandis* and *Agonis flexuosa*, with a sparse shrub layer. The greater part of the Perth basin is mantled with aeolian sands. The northern sector carries a low forest formation of *Banksia menziesii-B. attenuata-Casuarina fraserana-E. todtiana* alliance, with a heath understorey, and smaller areas of *B. prionotes* alliance; the southern part is dominated by a *E. marginata-E. calophylla* open forest or woodland alliance, with a heath understorey, and smaller areas of *Banksia* low forest. Poorly drained swampy areas carry *Casuarina obesa* low forest alliance; *Actinostrobus pyramidalis* (Swamp Cypress Pine) is of local significance. Swamp and fen formations are made up of complex communities of sedgeland. Watercourses in the district are fringed by a *E. rudis-Melaleuca* spp. alliance.

The Archaean Shield in the Darling district is a laterite capped plateau dissected by young streams to form steep sided valleys. An open forest formation of *E. marginata -E. calophylla* alliance characterises the lateritic erosional and deep depositional surfaces, with *E. wandoo* alliance restricted to the heavier pediment soils. The understorey layers of the *E. marginata-E. calophylla* alliance resemble those in the same alliance in the Warren district. The *E. wandoo* understorey layer has a more open character. This alliance which in its most highly developed state fringes the eastern boundary of this district is more widely distributed in the Avon botanical district.


WESTERN AUSTRALIA
SHOWING
BOTANICAL PROVINCES
AND DISTRICTS
NORTHERN PROVINCE
HANN
FITZROY
ORD
DAMPIER
MUELLER
CANNING
FORTESCUE
KEARTLAND
ASHBURTON
CARNEGIE
GILES
EREMEAN PROVINCE
AUSTIN
HELMS
IRWIN
SOUTH-WEST PROVINCE
EUCLA
AVON
COOLGARDIE
DARLING
STIRLING
EYRE
WARREN
SCALE
100 50 0 100 200 300 400 500
KILOMETRES

The *Irwin* botanical district, for the most part, overlies sedimentary rocks from Silurian to Quaternary age, with smaller areas of Precambrian metamorphics. This district contains one of the two floristically important cusps of the South-West Province. At the northern extremity, the Irwin district consists of red and yellow sands underlain by Mesozoic sediments. The high shrubland formation is made up of *Acacia linophylla-A. brachystachya, Grevillea eriostachya-G. didymobotrya-G. leucopteris, Eucalyptus eudesmoides* (Mallalie) and *E. oldfieldii* (Oldfield's Mallee) alliances. Low woodlands of *Banksia ashbyi-B. sceptrum* and *B. prionotes* occur on deep sands. Open heath formations of Proteaceae, Myrtaceae, and Leguminosae occur in areas where the sand is shallow or where a lateritic crust is present. These formations vary considerably in floristic composition.

On the metamorphic rocks, the vegetation on residual flat tops and plateau surfaces carry low forests of *B. prionotes* alliance with heath on the lateritic surfaces. A woodland formation of *E. loxophleba* alliance dominates the loamy valley soils, now extensively used for farming. This alliance is associated with a high shrub layer of *Acacia acuminata* (Raspberry Jam) and a herbaceous ground layer composed of *Stipa, Neurachne* and seasonal ephemerals. *E. salmonophloia* alliance is locally significant only in the eastern part of the district.

The vegetation of the coastal dune system is an extension of the Darling district. The limestone hills in the Irwin district carry low woodlands of *E. erythrocorys*. Poorly drained areas and small lakes carry or are fringed by *Casuarina obesa* and *E. rudis-Melaleuca* spp. alliances.

The central to southern portions of the Irwin district are characterised by the so-called 'sand plains'. These carry low woodlands of *Banksia menziesii-B. attenuata-E. todtiana* and *B. prionotes* alliances particularly on the deeper sands. *E. lanepoolei* (Salmon White Gum) and *E. accedens* (Powder Bark Wandoo) are of local significance, on heavy clay soils. In areas of deep dissection, the valleys carry woodlands of *E. wandoo* and *E. calophylla* alliances. Heath formations cover most of the elevated regions. The heath communities vary in composition, depending upon the depth of sand and the presence of laterite, and some may eventually develop into high shrubland communities with long-term fire protection. Proteaceae, Myrtaceae and Leguminosae are dominant components, while on laterite hills *Xanthorrhoea reflexa* and *Dryandra* spp. become very conspicuous. *Banksia hookerana* alliance is locally significant north of the Arrowsmith River. High shrubland communities with *Grevillea eriostachya-G. didymobotrya-G. eriostachya, Lambertia multiflorus* (Native Honeysuckle) and *Actinostrobus arenarius* alliances are also significant in the sandplain region.

The *Avon* botanical district, which covers most of the so-called wheat belt, is now for the most part cleared, of native vegetation, for farming.

On the eastern edge of the Darling district, on the low hilly to hilly terrain, with hard acidic yellow mottled soils, the pediments of early erosional cycles, the woodland formation consists of *E. wandoo* alliance. *E. marginata-E. calophylla* alliance occur on soils which tend more to ironstone gravels with a sandy matrix. The *E. wandoo* alliance is associated with *E. accedens*, and with *E. astringens* which commonly occur on lateritic breakaways. In the southern portion *E. gardneri* (Blue Mallet) and *E. falcata* (White Mallet) are more commonly seen on the breakaways, while *E. cornuta* woodland alliance replaces the *E. wandoo* woodland alliance. The *E. wandoo* woodland has a very open low shrub layer. Poisonous plants of the genera *Gastrolobium* and *Oxylobium* are commonly seen in this woodland formation. On granite outcrops, a vegetation complex reflects the succession of colonisation by algae and lichen to shrublands with *Leptospermum* and eventually to climax communities of woodland of *Casuarina huegeliana* alliance, which occur on sandy or gritty soils over one metre in depth.

On the hard neutral red soils, of the river valley systems, which represent further erosional cycles, the woodland formation is represented by the *E. loxophleba* alliance, with *Acacia acuminata* as its main associate. *A. acuminata* tends to merge with the *E. wandoo* alliance, particularly as the soils become sandy or gritty. In the southern portion *E.*

occidentalis alliance replaces the *E. loxophleba* alliance. *E. occidentalis* woodlands occur also on the clay soils of swamps or seasonal shallow lakes.

Extensive areas of *E. salmonophloia* woodland alliance are found in the hard alkaline yellow soils further to the east, on valley plains and terraces. *E. salmonophloia* woodland has an open mixed low shrub understorey with *Kochia* and *Atriplex* dominating in more saline soils. Other trees associated with this alliance are *E. salubris* (Gimlet), *E. longicornis* (Red Morrell) and *E. melanoxylon* (Black Morrell).

Forming a mosaic with the woodland formations are the low woodland and shrubland formations developed on the plateau areas, on sandy yellow earths containing ironstone gravel and over mottled or pallid-zoned clays. The *B. prionotes* woodland alliance and *Acacia* spp.-*Casuarina* spp.-*Melaleuca* spp. and *Grevillea eriostachya-G. didymobotrya-G. leucopteris* shrubland alliances occur on yellow sand. *Dryandra* spp. and mixed Myrtaceae, Proteaceae, Leguminosae and Epacridaceae heath alliances occur on laterite or shallow sand over laterite. Other shrubland formations include *E. eremophila* (Horned Mallee), *E. oldfieldii* (Oldfield's Mallee), *E. drummondii* (Drummond's Gum), *E. pyriformis* (Pear-fruit Mallee) and other mallee or shrub eucalypt alliances. *E. macrocarpa* (Mottlecah) shrubland occurs on deep sand.

The salt lakes, remnants of once extensive river systems, carry *Casuarina obesa* and *Melaleuca* spp. low woodland alliances on the fringes with low shrubland formations of *Arthrocnemum* spp. alliance in the old watercourses. *E. sargentii* (Salt River Mallet) and *E. kondininensis* (Stocking Tree) grow on saline soils.

The *Stirling* botanical district, which includes the Stirling and Mount Barren Ranges, together with the Eyre district form the second of the two floristically important cusps of the South-West Province.

The Stirling district, which lies at the edge of the Archaean Shield where it abuts into the Proterozoic metamorphics of the Albany-Esperance block, consists largely of sediments of middle and late Eocene age, at one time mantled by a lateritic crust, which is represented in the present landscape by narrow ironstone gravel ridges and erosional scarps along the northern edge.

The Stirling and Mount Barren Ranges which rise abruptly out of an otherwise predominantly undulating landscape are composed of hard Proterozoic metasedimentary rocks. The ranges carry closed heath and scrub formations of mixed Myrtaceae, Proteaceae, Leguminosae and Epacridaceae alliance. They are noted for their diversity in the flora and their conspicuous endemic or near endemic species. Woodlands of *E. marginata-E. calophylla, E. wandoo* and *E. cornuta* occur on the lower slopes and valleys of the Stirling Range.

Over a large area of the Stirling district, the vegetation is made up of high shrubland formations with shrub or mallee eucalypts dominating. *E. tetragona, E. redunca-E. uncinata, E. gardneri-E. nutans* and *E. eremophila-E. oleosa* alliances form a mosaic over the area, the former on the undulating upper slopes and rises nearer the coast. Patches of mixed heath of Proteaceae, Myrtaceae and Leguminosae are present. The heath vegetation merges into and forms the understorey of the high shrubland communities. Low forests of *E. platypus-E. gardneri-E. falcata* alliance occur locally on scarp slopes.

Woodland formations of *E. occidentalis, E. loxophleba* and *E. salmonophloia* alliances occur along drainage lines and loamy slopes and flats. The former alliance is favoured by higher rainfall and winter wet sites and is often seen on or around clay pans. Salt lakes are covered by or fringed by low shrubland formations of *Arthrocnemum* spp. and *Atriplex* spp. alliances. A scrub formation of *Melaleuca* spp. alliance may also be present.

The littoral fringe of the coastal plain is made up of a chain of granite bosses with drift sand between them. *Acacia rostellifera-A. cyclops-A. cochlearis* and *Agonis flexuosa* scrub alliances are present with the sand dune and granite lithic complexes. *Banksia baxteri* and *B. attenuata*, as well as *Lambertia inermis* (Chittick), are dominant on the drift sand, inland, with *E. marginata* and *E. cornuta*, the latter restricted to interdunal flats.

The *Eyre* botanical district, which is virtually a continuation of the Stirling district is covered for the most part with shrubland formations. *E. tetragona* alliance gives way to

Banksia speciosa-Lambertia inermis and *Nuytsia floribunda* as the soils become sandier, while inland *E. eremophila-E. oleosa* and *E. redunca-E. uncinata-E. forrestiana* alliances occur over extensive areas. *E. redunca-E. uncinata* occur also on broad valley slopes. To the east *E. tetragona* is replaced by *E. incrassata*, while a *E. cooperana* (Many-flowered Mallee) alliance is found on limestone soils at the extreme southern end of the Nullarbor Plain, near the Russell Ranges.

Open heath of mixed Proteaceae, Myrtaceae and Leguminosae alliance forms mosaics with high shrubland communities and provide the understorey layer for the latter. The Russell Ranges, which are similar to the Stirling and Mount Barren Ranges, carry a heath and scrub formation.

The coastal granite bosses and intervening drift sand carry the usual sand dune and granite lithic complexes. Scrub is made up of *E. platypus* var. *heterophylla-E. angulosa* and *A. cyclops*. Coastal swamps carry a *Melaleuca* spp. alliance. Inland granite rocks carry a lithic complex.

The principal woodland alliance is *E. occidentalis*, along water courses and associated with clay pans. *Arthrocnemum* spp. alliance is found in and around salt lakes.

The naturalised flora of Western Australia which now make up so much of the landscape of the South-West Province is composed of elements from many parts of the world. These plants have in some instances been deliberately introduced, others have been introduced by accident. Some species have been introduced on more than one occasion and several variants may be present. The more successful species originate from areas of similar climate, and in the absence of disease and insect attack, which in their native habitat would keep them in check, are able to disseminate at an alarming rate. South Africa and the Mediterranean Region provide most of the successful alien species found in the South-West Province.

Grasses of importance are represented by the genera *Bromus* (Brome Grass), *Lolium* (Rye Grass), *Hordeum* (Barley Grass), *Avena* (Oats), *Aira* (Silver Grass), *Briza* (Blowfly Grass), *Poa* (Winter Grass) and *Vulpia* (Silver Grass) from Southern Europe, and *Eragrotis* (Love Grass), *Ehrharta* (Veldt Grass) and *Rhynchelytrum* (Red Top) from South Africa. Pasture legumes from southern Europe include *Trifolium* (Clover), *Medicago* (Medic, Lucerne), *Lupinus* (Lupin), *Ornithopus* (Serradella), *Vicia* (Vetch) and *Lotus* (Birdsfoot Trefoil). *Psoralea pinnata* (African Scurf Pea) from South Africa is a shrubby weed.

The weed flora of Western Australia is composed largely of alien species. Very few native species have become weeds in this State. The ubiquitous composite *Cryptostemma calendula* (Cape Weed) originates from South Africa, as do *Arctotheca, Berkheya, Osteospermum, Gorteria, Cotula* and *Ursinia*. Naturalised European composites include *Carthamus* (Saffron Thistle), *Hypochoeris* (Flat Weed), *Carduus* (Slender Thistle), *Inula* (Stinkwort), *Lactuca* (Lettuce), *Erigeron* (Fleabane), *Centaurea* (Cockspur Thistle) and *Cirsium* (Spear Thistle). The Brassicaceae, significant as crop weeds, comprise *Raphanus* (Radish), *Brassica* (Turnip), *Rapistrum* (Turnip Weed) and *Sinapis* (Charlock). *Carrichtera annua* (Ward's Weed) is widely naturalised in the Eucla district. All these are of European origin. The South African Iridaceae are represented by genera such as *Homeria* (Cape Tulip), *Watsonia, Gladiolus, Moraea, Ixia* and *Sparaxis* and were introduced in the first instance as garden subjects. *Echium* (Paterson's Curse) (Boraginaceae) was another garden introduction, while *Rubus* (Blackberry) (Rosaceae), a woody species, was introduced for its fruit. *Oxalis* (Soursob) (Oxalidaceae), from South Africa, is common in vineyards and orchards, while the family Polygonaceae is represented by *Rumex* (Dock) and *Emex* (Double Gee), weeds of wide habitat. The latter, introduced as a spinach from South Africa, is now extremely widely distributed in the South-West and Eremean Provinces. Also widely distributed but more localised in occurrence is *Argemone* (Mexican Poppy) (Papaveraceae), with origins in North America. *Prosopis* (Mesquite) (Mimosaceae) and *Parkinsonia* (Ceasalpiniaceae) from the Americas, and *Calotropis* (Asclepiadaceae) from Africa, are weedy shrubs or small trees naturalised in the tropics.

In addition to the naturalised alien species which now exceed 600 in number, there are hundreds of species of plants under cultivation in Western Australia. These include field crops (cereal, legumes and oil seeds), horticultural plants (fruit, vegetables and garden

subjects) and forest trees. Other species are being deliberately introduced for particular purposes, *e.g.* the reclamation of waste land and saline areas.

As man's activities further impinge upon the natural ecosystems and as more and more alien plants become naturalised in this State, so will the effect of these plants species be more widely felt in the natural environment. It is essential to have information on the biology of alien species so that proper management measures can be applied to maintain harmony within our natural ecosystems.

Conservation of the Flora

The establishment, revocation and purpose of reserves fall into two main categories. There are those Acts which allow the Government to set aside reserves for public purposes, which give them varying degrees of permanence, and which make provision for their control and management. These include the Land Act, the Parks and Reserves Act, the Native Flora Protection Act and the Fauna Conservation Act. Acts which give power to authorities to permit land or water to be taken from reserves and to be used for certain other specified purposes include the Public Works Act, the Forests Act, the Mining Act, the Petroleum Act, and the Town Planning and Development Act.

Under the Land Act the Governor may by proclamation reserve Crown lands for a number of public purposes and also classify these as either 'A' 'B' or 'C'. Purposes of reservation include 'fauna', 'flora' and 'public recreation', and any particular reserve can have several purposes. A Class 'A' reserve can be revoked only by an Act of Parliament but the Governor, by notice in the *Government Gazette of Western Australia*, may cancel or amend the boundaries of any reserve not classified 'A'.

The Parks and Reserves Act provides for the appointment of Boards for the control and management of parks and reserves vested in the Crown. The National Parks Board of Western Australia administers sixty-three National Parks and other reserves, totalling 1,770,784 hectares in area (30 June 1974). Currently there is no legislation relating specifically to the management of National Parks.

The Fauna Conservation Act is primarily designed to give protection to certain species of vertebrate fauna. All reserves under the Land Act, for which one of the purposes is fauna conservation, are deemed by the Fauna Conservation Act to be 'Fauna Sanctuaries'. These reserves are vested and controlled by The Western Australian Wild Life Authority, the statutory chairman of which is the Director of Fisheries and Wildlife. It is obvious that the conservation of flora is of vital importance in these fauna reserves.

The Native Flora Protection Act, administered by the Conservator of Forests, protects all native flora on all Crown lands, State Forests and lands reserved for public purposes under the provisions of the Land Act within the South-West and Eucla Divisions, and flora in all parts of the State that are reserved under the provisions of the Land Act for the protection of indigenous flora and fauna. A number of genera in the Northern Province are totally protected, *e.g. Cycas*, *Adansonia* and *Pandanus*. Under the Forests Act licences may be issued for commercial exploitation of flora in the State Forests.

The rationale for an adequate network of reserves to conserve the flora and fauna has been presented in many ways. Given that it is desirable that other organisms be given the opportunity to survive, how best can their conservation be achieved? The ecosystem, in any one place, is in a dynamic state. Their species composition is continually undergoing change. This change, and the distribution of species within the ecosystem, is not random but is highly complex with intergrading variations, and with limits that are difficult to define. Any assessment of the adequacy of a reserve to conserve the plant or animal communities it contains must take into account the dynamics of the ecosystem and, until detailed studies have been made, must remain largely subjective. Reserves of over 4,000 hectares in area appear to have a relatively good chance of achieving their conservation objectives. Smaller reserves and roadside verges are of great value for the conservation of particular plant species and small animals, and also provide the means by which the public and tourists gain an acquaintance with the native flora and fauna. With increased pressure on land use in other directions, urban, rural or forestry, each reserve, large or small, will be

essentially an 'island' of the original landscape. Ecological pressures from adjacent man-made ecosystems need to be buffered against. External treatments which could alter the composition of reserves include alien plant and animal species, fertilisers, pathogens, pesticides and indiscriminate burning.

In the I.B.P./C.T. survey on the conservation status of plant communities it was shown that, of 218 alliances listed for Western Australia, only 2 per cent were well conserved, 49 per cent were moderately to reasonably conserved, while 49 per cent were poorly conserved or not conserved at all in National Parks, Reserves and Crown land deemed suitable for the conservation of major plant communities. The survey also showed that there were twenty-eight reserves over 4,000 hectares in area in the South-West Province and eleven and four, respectively in the Eremean and the Northern Provinces. The figures also include Crown land not yet reserved, but considered to be suitable for conservation areas. The reserves mentioned in the following text are some of the more important for the conservation of flora.

Walpole-Nornalup National Park contains representatives of the *E. diversicolor* high forest alliance.

Stirling Range, Fitzgerald River and *Cape Arid National Parks* contain a great diversity of species, many of which are endemic to the south coastal region or to the ecosystems within each park.

The *Cape Le Grand National Park*, also noted for its range of endemic species, conserves areas of the granite ecosystem of the south coast.

Kalbarri National Park, in the northern cusp of the south-western crescentic-triangle, is another important conservation area for the highly diverse species composition of the vegetation and the high degree of endemism in the flora.

Badgingarra, Moore River, Nambung and *Watheroo National Parks* and the *Green Head* and *Capamauro Swamp* flora reserves, which occur in the Perth Sedimentary Basin, collectively provide suitable conservation areas for floristically rich woodland, shrubland and heath communities of the region.

The *Dryandra* and *Julimar State Forests* are important areas for *E. wandoo* and northern *E. marginata-E. calophylla* alliances. The small (less than 4,000 hectares) *Tutanning* reserve is an area of considerable value as it contains several elements of now rare plant communities, once widely distributed in the wheat belt.

The Eremean Province contains the *Chichester Range* and *Hamersley Range National Parks*, the *Barlee Range, Nullarbor Cliffs* and *Bernier* and *Dorre Island* reserves, the *Bremer Range, North Nullarbor, Mount Manning, Dampier Archipelago, Queen Victoria Spring* and *Lake Disappointment* areas of vacant Crown land, recommended as being suitable for setting aside as conservation areas. These areas collectively include a number of the representative plant communities of the Province and, in the face of biological and other pressures, are becoming increasingly important conservation areas.

The Northern Province contains the *Prince Regent River* and *Point Coulomb* reserves and the *Drysdale River* and *Napier-Oscar Range* Crown land areas. These areas contain many representative plant communities of the Province.

The reliability of information for most of the areas set aside or considered suitable for conservation in Western Australia is generally poor to fair. Very few areas have been biologically surveyed in detail.

The I.B.P./C.T. survey highlighted the number of rare and endangered plant species in Western Australia. These were categorised into (i)—probably extinct (number in this category=7); (ii)—endangered, only small stands remain, under adverse conditions (46); (iii)—rare, population requires constant monitoring (45); (iv)—depleted, population originally widespread but now reduced in area, requires constant monitoring (15); (v)—species known only from original collection, more information required on their distribution and status (321); (vi)—species of geographical importance, with a disjunct or isolated distribution (18).

Plant taxonomists and morphologists cannot entirely agree, among themselves, on the evolutionary relationships of seed plants. However, certain floral and morphological

characters are considered to be primitive or to have developed at a very early stage in the evolution of the seed plant. Primitive floral characters are seen in 27 relict genera in Western Australia (17 in the South-West Province, 12 in the Eremean Province and 16 in the Northern Province). They include *Cycas, Macrozamia, Callitris, Casuarina, Hibbertia, Emblingia, Codonocarpus, Persoonia, Clematis* and *Pandanus.* Relict species which have retained primitive morphological characters number 234 for the State. A large proportion of these are found in the South-West Province. One hundred and nine species are present in the Stirling botanical district. Many endemic genera are represented, *e.g. Isopogon, Adenanthos, Stirlingia, Synaphea* and *Franklandia* (Proteaceae) and *Andersonia, Sphenotoma, Cosmelia, Lysinema, Coleanthera* and *Conostephium* (Epacridaceae). *Thysanotus* (Liliaceae) and *Stylidium* (Stylidiaceae) which, although not strictly endemic to, are most richly represented in the State.

The I.B.P./C.T. survey set guidelines for future action on conservation. These include a detailed biological survey of plants, animals and ecosystems, the incorporation of at least one reasonably large sample of each major ecosystem into a network of conservation areas, a temporary stay both in further land development of semi-natural areas and further alienation of Crown land until assessments can be made as to what additional conservation areas are required, the consultation of experts from State and Federal bodies to ensure that all rare and unique plants and animals are included in and adequately catered for biologically in the conservation network, and the careful preparation of management plans based upon existing and continuing research on ecological conservation.

The Report by the Western Australian sub-committee of the Australian Academy of Science Committee on National Parks recommended that a number of large areas that were considered to include representative communities of natural wildlife and of scenic types be set aside as National Parks or equivalent reserves. The report also referred to the increasing public interest in conservation issues and, resultant upon this, the many new reserves created over recent years in the State. The Environmental Protection Authority, through its Conservation through Reserves Committee, is reviewing and updating the Report of the Academy of Science.

Once it is accepted that all living communities, ecosystems and landscapes be allowed to survive, the concept of a network of conservation areas, managed scientifically, should be unstintingly supported and encouraged. Covering a wide range of interests, aesthetic, educational, recreational and functional, these conservation areas represent rare and precious examples of our original heritage.

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