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The vegetation of Western Australia at the 1:3,000,000 scale. Explanatory memoir. Second edition.

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ABSTRACT

A new colour vegetation map for Western Australia has been developed at a level of detail appropriate for publishing at the 1:3,000,000 scale. This memoir accompanies the map, which is based on the statewide mapping carried out by John Beard. The published maps and reports have been valuable resources for biologists and planners for decades, and this information is now available as a spatial dataset, making it more accessible for a broader range of uses. This memoir explains how the data were derived and describes the units of vegetation shown on the map.

The 1:3,000,000-scale vegetation map shows the distribution of 75 major categories of natural plant cover in Western Australia as they would have been at the time of European settlement, with 50 major vegetation types, five categories of bare and poorly-vegetated ground and 20 vegetation mosaics (combinations of vegetation types). This classification was carried out in 1996–97 and is influenced by the original framework developed by Beard for the earlier 1:3,000,000 map. Vegetation types range from tall forests of karri (*Eucalyptus diversicolor*) in the high rainfall zone of the South West; through to the forests and woodlands dominated by eucalyptus, melaleuca, allocasuarina or acacia in the medium to low rainfall areas; the sclerophyllous shrublands of the South West; the saltbush, bluebush and samphire shrublands that occur on saline soils throughout the state; and the various grasslands of *Triodia* (spinifex) in central parts and *Sorghum*, *Astrebla* and *Chrysopogon* in northern parts of the state. These grasslands often have emergent tree cover of over 10% with density and are described as steppe or savanna.

The map has been generated from a comprehensive, spatial database of the vegetation of the state, based mainly on the work of JS Beard carried out from 1964 to 1981. Almost 900 vegetation associations, derived from the 1:250,000-scale maps are included in the database. These were grouped into vegetation types based on physiognomy, floristics and, in some cases, ecological and regional attributes, and largely followed the framework developed by Beard. This work was carried out prior to the development of the National Vegetation Information System (NVIS; ESCAVI 2003). A subsequent reclassification of system associations (an intersection of Beard's vegetation associations with his vegetation systems) was described in six levels according to the NVIS, but is not described in this publication. The structure, composition, and general distribution of each of the vegetation types are described in this memoir. The memoir also includes details about the development and current delineation of the bioregions known as the IBRA (Interim Biogeographic Regionalisation of Australia). The description of vegetation types are referenced to these regions.

The six most extensive vegetation types are:

- low woodland, open low and sparse woodland dominated by *Acacia aneura* (mulga), which covers over 36 million ha and extends over eight IBRA regions;
- a mosaic of open tree steppe and open shrub-steppe that covers over 25.5 million ha and dominates three desert IBRA regions;

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- shrub-steppe of hummock grassland dominated by *Triodia* spp. with scattered shrubs of *Acacia* spp. and *Grevillea* spp., mapped over nearly 25 million ha;
- scrub, open scrub and sparse shrub of *Acacia* spp., *Melaleuca* spp. and other species, mapped widely over the state and that covers over 15 million ha;
- the woodlands of the Avon Wheatbelt Bioregion, Coolgardie Bioregion, riverine areas and the Northern Kimberley Bioregion that cover nearly 13.5 million ha.

These six vegetation types account for 55% of the state.

The six most restricted vegetation types identified by the classification process are:

- freshwater lakes, which total nearly 22,700 ha;
- samphire with scattered trees or low trees, mapped over nearly 39,000 ha;
- pockets of low forest of acacia, Rottnest cypress, coastal moort or mixed tropical forest (rain forest), which cover 55,600 ha;
- sedgelands of the South West (59,000 ha);
- thickets with medium open woodland or scattered trees (62,600 ha);
- low woodland or open low woodlands over bluebush and/or saltbush (87,700 ha).

Some of these could be incorporated into other units in future classifications.

The 1:3,000,000-scale map gives a general impression of the vegetation of the state, as well as aspects of the geology, geomorphology and climate patterns. The vegetation database that underpins this map is currently being used for a wide range of research and planning purposes, including the on-going development of the terrestrial nature conservation reserve system. It is not ideal for this latter purpose as the scale of the mapping at 1:250,000 is relatively broad. More detailed vegetation datasets will be required to undertake more effective land use planning as conserving Western Australia's unique and fragile native vegetation communities becomes more challenging into the future.

Keywords: GIS, John Beard, mapping, vegetation, Western Australia.

INTRODUCTION

Vegetation provides a cover of photosynthetic tissue across the land surface, which may exhibit patterns both in space and in time. Importantly, this cover is not uniform, and so the challenge for those studying vegetation is to make some sense of the patterns in that non-uniformity. Depending on the particular perspective of the person studying the vegetation, those patterns may be described in terms of structural and life-form characteristics (e.g. trees or shrubs, trees up to 30 m in height or trees more than 30 m tall) or floristic composition (e.g. *Eucalyptus diversicolor*, *Agonis flexuosa*, *Allocasuarina decussata*, *Trymalium spatulatum*, *Chorilaena quercifolia*, *Acacia pentadenia*, *Hovea* spp., *Bossiaea* spp., *Leucopogon verticillatus*), or some combination of those (e.g. *Eucalyptus diversicolor* tall forest). Studies of vegetation are normally accompanied by mapping of vegetation units so that location and extent, as well as physical characteristics, may be documented. As techniques for analysing vegetation data, managing data, and cartography have improved, so vegetation mapping has grown as a science.

A vegetation map, then, is one that shows the pattern of plant cover across the earth's surface. In some places this cover is a natural one, largely unaffected by intensive human development, such as can be seen in the inland areas of the state, while in other areas it has clearly been substantially modified, as in the intensive agricultural areas of the South West. An intermediate case is where there is a natural plant cover, but it has been, or is in the process of being modified through use. An example of this is those areas of Western Australia that are under pastoral lease, where the native vegetation is grazed by sheep, goats or cattle and where weed invasion is common. Hopkins and Hobbs (1990) have categorised these vegetation states as conservation, replacement and utilisation respectively. More recently Thackway and Lesslie (2005) assessed the vegetation condition in terms of assets, states and transitions as residual, modified or transformed.

Generally, vegetation mapping is concerned with natural plant cover as it exists or as it used to exist, while agricultural crops are described through land-use mapping. This means that to map vegetation as it used to exist and where the vegetation is removed or replaced, it is necessary to reconstruct a picture of the original or natural plant cover. This is what has been done for this map in developing a coverage of the urban and farming areas of Western Australia.

The data presented in vegetation maps may be interpreted in many ways and for many different purposes, including the following:

Conservation: Vegetation mapping provides an inventory of plant associations and plant habitats, which is one layer of the basic information required for planning a comprehensive, adequate and representative system of reserves for the conservation of biodiversity. At a later stage, a vegetation map of each national park or nature reserve is one of the basic necessities for planning and on-going management.

Environmental impact assessment: Facts about vegetation are a part of necessary basic knowledge when assessments of impact upon the environment made by proposed mining and other land development are being made. It is important to know what kinds of native vegetation might be affected, and to place that knowledge in a regional context.

Potential land use: A vegetation map is a useful basis for more detailed surveys of land potential for agriculture, pastoral use or timber production. It can also be a useful guide on access to remote areas, by cross-country vehicles or helicopter, since a vegetation map shows height and density of vegetation. Patterns in vegetation are often picked up in soil and geological surveys and used with on-ground sampling data to map those resources.

Sustainable agricultural development: Maps showing original and remnant native vegetation can provide a wealth of information about the capacity of the land to sustain various kinds of agricultural and pastoral pursuits. For example, the value of remnant native vegetation in the agricultural region is now broadly recognised: its capacity to reduce salinization and waterlogging, to minimise erosion, to provide shelter for stock, and to provide a source of predators of insect pests.

Revegetation/restoration of cleared lands: Maps showing the original vegetation can be used to guide revegetation projects, in terms of identifying the native species suitable for the site, and the floristics and structure required to restore biodiversity to the site.

The purpose of this second edition of the 1:3,000,000-scale map and memoir was to document the digital capture of Beard's original vegetation maps and demonstrate the major vegetation patterns in Western Australia as of the year 2000, so that future reinterpreatations and refinements have a published base. Subsequent descriptions of the vegetation units have been undertaken but are not dealt with in detail here.

EARLY VEGETATION MAPPING

As early as the beginning of the 20th century, the unique vegetation communities of Western Australia were already of interest to botanists. Ludwig Diels' book Die Pflanzenwelt von West-Australien (The Plant World of Western Australia) published in German in 1906 and translated and republished (Diels et al. 2007), included a sketch map at the scale of 1:27,000,000 of the whole continent as the endpapers to the book. This was the only comprehensive and authoritative account of any Australian vegetation to be published prior to the First World War. Western Australia made an early start in mapping when, in 1901, the Annual Report of the Woods and Forests Department (Richardson 1902) included a sketch map of part of the South West "showing the approximate position of timber forests". On a scale of 1 inch to 15 miles the map showed in colour the jarrah, karri, tuart, white gum, red gum (marri), York gum and jam forest (and woodland) types.

In 1928 the Forests Department produced the earliest vegetation map, compiled by CA Gardner (Kessell 1928). The map was published in colour and distinguished nine basic vegetation types, alluding to two more (fringing forests and mangrove woodlands) in the legend. Gardner (1942) published a general account of the vegetation of the State that included a small black and white map at a scale of 1:25,000,000, based on this early map. Jutson (1934) included the coloured vegetation map in the revision of his classic work on physiography (Jutson 1914). The map was again reprinted in 1952 and 1967 by the Forest Department with revision by Gardner to include the distribution of the more important species of *Eucalyptus*.

In about 1929, 64 areas throughout the South West Agricultural Region were set aside for mallet bark production, under the protection of the Forests Department. In the ensuing years, the mallet reserves were mapped in detail at the scale of 10 chains to the inch.

The introduction of aerial photography transformed vegetation mapping, as it became possible to map vegetation accurately and rapidly. In Western Australia, the Department of Lands and Surveys began programming this photography in 1947. Following this, the Forests Department commenced detailed stock-mapping of the state forests in the South West at the scale of 1 mile:1 inch (1:63,360), and the pastoral section of the Department of Lands and Surveys began to produce pastoral-classifications plans at a scale of 1:250,000, with plant cover mapped according to its estimated carrying capacity. The land systems mapping carried out by CSIRO provided a sound basis for identifying and describing vegetation units in the same area, but these units were not mapped (for example, see Speck 1960a, 1960b).

THE STATE-WIDE VEGETATION MAPPING PROJECT

In 1964, John Beard, then Director of Kings Park and Botanic Garden, and Professor MJ Webb of the Geography Department of the University of Western Australia, initiated a project called the Vegetation Survey of Western Australia. The objective of this project was to develop an inventory of plant communities throughout the state as a necessary part of the basic scientific information required to develop native plants in horticulture. The project took 17 years to complete a set of 160 1:250,000 maps, 24 of which were published with explanatory text. These cover the south-west corner of the state between Shark Bay and Esperance (Beard 1960, 1972a–e, 1973a–b, 1976b–f, 1979b–e, 1980a–d) The Director, National Parks Board of Western Australia, Dr FG Smith, produced the 1:250,000 map sheets for the South West (Smith 1972, 1973, 1974) but mapped only existing vegetation, whereas Beard attempted to produce maps showing the vegetation as it might have been at the time of settlement, prior to the extensive clearing for urban development and agriculture and the changes induced by pastoralism, logging, mining, depopulation of Aboriginal people and

altered fire regimes. Beard went on to compile seven 1:1,000,000-scale maps of the vegetation of the state (Beard 1974a, 1974b, 1975a, 1975b, 1976a, 1979a, 1981a; Beard & Webb 1974), together with a number of additional publications (e.g. Beard 1980e, 1981b, 1990; Beard & Sprenger 1984).

The first state-wide vegetation map at the scale of 1:3,000,000, which included 39 vegetation units plus a further 11 mosaic units, was compiled from reduced photographs of the seven 1:1,000,000 maps to form the first edition of this memoir (Beard 1981b). A second state map at the scale of 1:10,000,000, with 27 vegetation types and two mosaics, was first published in 1979 with brief explanatory notes in a school atlas (Jarvis 1979), then as a frontispiece in Ford (1985), and then included in Beard's own volume on the state's flora and vegetation (Beard 1990). A version of Beard's vegetation mapping was incorporated into the map of the vegetation of Australia (1:5,000,000 scale) by Carnahan (1990).

The first edition of the 1:3,000,000 map of the vegetation of Western Australia (Beard 1981b) has been used extensively for teaching and general reference purposes, both within educational and research institutions (including schools) as well as within the wider community. This map has been out of print since about 1990.

Apart from the three 1:250,000 map sheets contributed by Smith (1972, 1973, 1974), all of Beard's mapping was based on mosaics of aerial photographs at the scale of 1 inch to 1 mile (1:63,360) or 1:50,000, and was reduced and drawn at 1:250,000 using the standard grid of the Australian topographic series maps (Australian Map Grid; AMG). Linework from these 1:250,000 compilation sheets was then drawn onto a standard topographic base and published with explanatory notes (black and white maps covering the south-west of Western Australia, see references above), or compiled at 1:1,000,000 scale and published with detailed explanatory notes (colour maps covering the whole of Western Australia, see references above).

Since the commencement of the Vegetation Survey of Western Australia, and the publication of most of the vegetation maps, there have been major advances in computing technology, especially in the application of computers to management of data, including analyses. A major advance has been the development of geographic information systems (GIS). The advantage of GIS for large map data sets is that it is easily used for a whole range of analyses that facilitate conservation and land planning. In 1986, a project began to capture the map data in a digital format for GIS with a view to being able to use this important data set for a wide range of planning, management and reporting functions.

Between 1986 and 2000, all of Beard's 1:250,000 vegetation maps were captured in a geographic information system (GIS) and associated relational database. This included new line work compiled for the areas covered by Smith's maps (Smith 1972, 1973, 1974) using System 6 vegetation mapping (Heddle et al. 1980) for the Collie sheet and soil and landform data from the then Department of Agriculture. This, combined with Beard's maps, produced seamless map coverage of the whole state at the scale of 1:250,000 with a consistent nomenclature. At this scale, the linework consists of over 30,000 polygons and almost 900 vegetation types. These vegetation associations have been agglomerated in a systematic way based on structural, floristic and geographic characteristics to give more general units, the vegetation types, suitable for mapping at smaller scales such as the current 1:3,000,000 map. This agglomeration included structural and floristic characteristics and was largely based on the the groupings derived by Beard in the production of the earlier 1:3,000,000 map and was carried out in 1996–97 prior to the development of the National Vegetation Information System (NVIS; ESCAVI 2003). Figure 1 illustrates the hierarchical classification system used in compiling the earlier 1:3,000,000 map and the new digital version.

CLASSIFICATION OF VEGETATION AND TERMINOLOGY

A critical decision made at the commencement of the Vegetation Survey of Western Australia was the approach adopted to describing vegetation. Because it was to be a survey of a very large, little-known area, it was considered most appropriate to approach the characterisation of vegetation on a physiognomic basis, that is, to classify on structure and growth-form rather than on species composition. Floristic information on the dominant species would be included, but time would not permit the use of quantitative or phytosociological methods that listed all species, however desirable they might be. It was expected that those phytosociological methods would be applied in later, more detailed studies, and this indeed has happened (e.g. Muir 1977; Bridgewater & Zammit 1979; Gibson et al. 2004). In the vegetation survey the basic unit is a physiognomic-floristic unit, the plant association. The association is the largest possible group with consistent plant dominants, either of the same or closely allied species present as similar growth form and structure. Associations may be divided into minor floristic groups and may be grouped according to their physiognomy (structure and growth form) into formations.

It was necessary then to develop a classification and nomenclature suitable for distinguishing and describing the wide range of vegetation types that could be expected to be encountered in the course of the project. At the time, aspects of the physiognomy, classification and nomenclature of Australian plant formations had been discussed by Beadle and Costin (1952) and by Williams (1955), but there was no generally agreed system. An approach appropriate to Western Australian needs was developed and included in the first publication of the survey (Beard 1969; see also Beard & Webb 1974); this has come to be known as the Beard–Webb Scheme. A similar scheme was independently proposed by Specht (1970). A description of the Beard–Webb Scheme follows.

Vegetation can usually be observed to consist of defined layers or strata. There will usually be a ground layer of

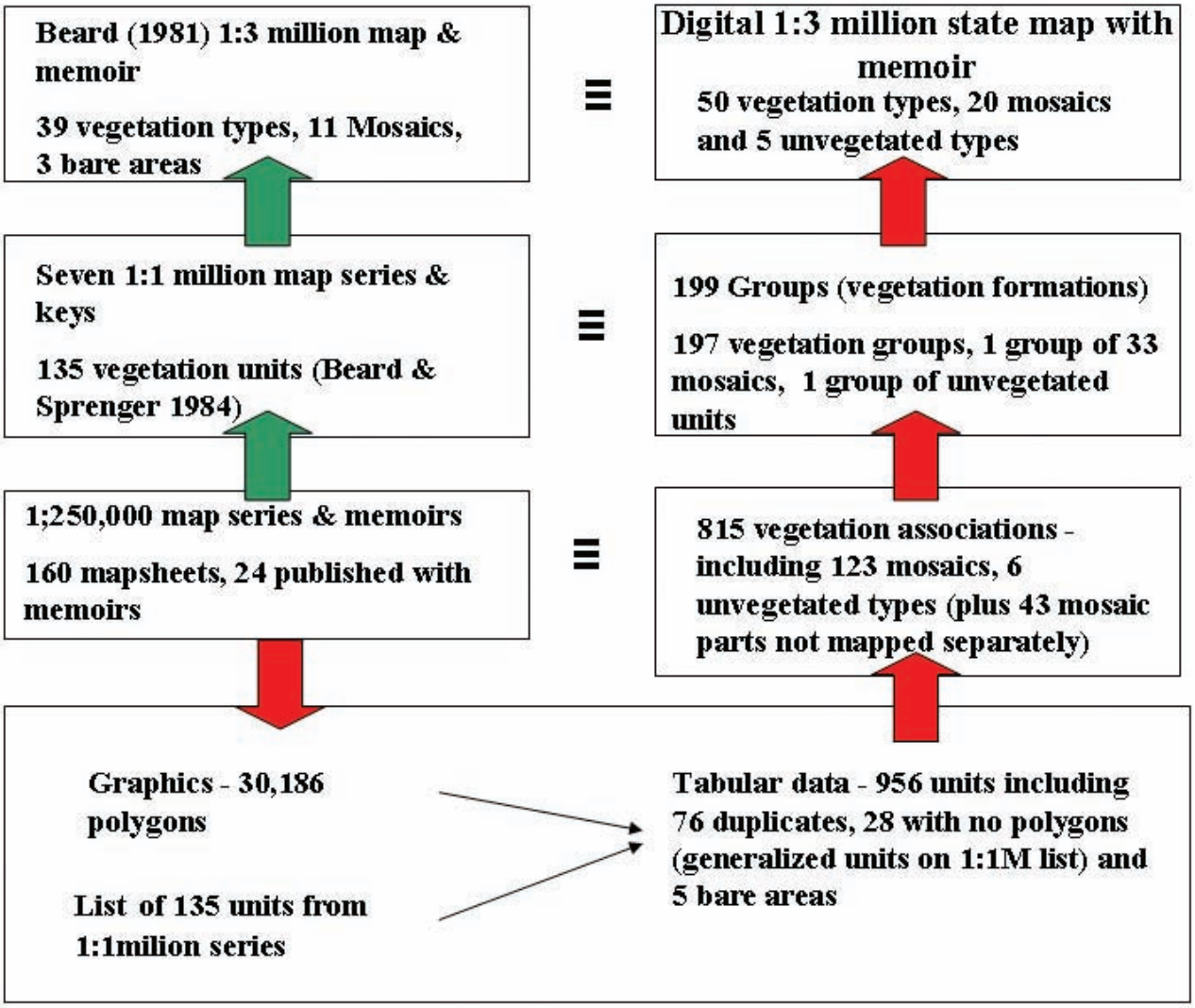


Figure 1. The hierarchical classification scheme derived from the original vegetation mapping (green arrows) and developed in the production of the new digital map and database (red arrows).

small herbaceous plants, a layer of shrubs or several layers of different-sized shrubs, a layer of small trees and a layer of taller trees. Greatest value is attached to the dominant layer or layers, as it is the dominant layer that determines the physiognomy (form and morphological structure) of the vegetation and enables it to be characterised as forest, shrubland or grassland and so on. In the Specht Scheme, the diagnostic layer is the tallest layer. In contrast, the Beard–Webb Scheme focuses on the ecologically dominant layer—the layer which, because of height or density or both, is considered to have an influence on other layers. It can be observed that dense canopies of trees or shrubs suppress the layers beneath them, but open canopies may not, so that the understoreys become fully developed. In the latter case, the understoreys can be considered dominant and thus they are used to classify the vegetation. The significance of the difference between the Specht Scheme and the Beard–Webb Scheme becomes apparent when considering such vegetation types as shrublands and grasslands with sparse emergent trees: by the Specht Scheme these would be classed as open woodlands, whereas by the Beard–Webb Scheme they would be classed as shrublands or grasslands (tree savanna/steppe).

The second most important characteristic of vegetation is the density of each of the layers. Beard used projective foliage cover (pfc), which is defined as the percentage of area covered by foliage (Specht 1970). The third important characteristic is the floristic composition of each layer, particularly if there are any species that outweigh others in number or biomass or characterise the community in other important ways.

The classification developed through the Beard–Webb Scheme is based on these three characteristics or diagnostic features:

1. nature and height of the dominant stratum or of other strata if of diagnostic importance;
2. density of strata (cover measured in terms of pfc) referred to in 1 above; and
3. dominant or diagnostic plant species.

For the first two of these diagnostic features, specific categories have been developed. Each category is given a code letter, as follows:

1. Physiognomy of dominant stratum (capital letters)

- **T** Tall trees >30 m tall
- **M** Medium trees 10–30 m tall
- **L** Low trees <10 m tall
- **S** Shrubs >1 m tall
- **Z** Dwarf shrubs <1 m tall
- **G** Bunch grasses
- **H** Hummock grass (spinifex)
- **F** Forbs
- **X** Lichens and mosses
- **C** Succulents—can be shrubs, dwarf shrubs or forbs, usually members of the Chenopodiaceae family

2. Density (lower case letters)

- **d** Dense canopy, projective foliage cover >70%
- **c** Mid-dense canopy, pfc 30–70%
- **i** Incomplete canopy, open but not touching, pfc 10–30%
- **r** Rare but conspicuous, pfc <10%
- **b** Barren, vegetation largely absent
- **p** Scattered groups, no definable pfc

3. Floristic (lower case letters; see Appendix 1 for the numerical expansion of these codes)

- **a** *Acacia, Adansonia, Aristida* and *Astrebla* (Kimberley)
- **ag** *Agonis*
- **b** *Banksia, Bauhinia* (Kimberley)
- **c** *Casuarina* (now mostly *Allocasuarina*) or *Callitris*
- **d** *Dryandra* (now *Banksia*), *Dodonaea*
- **e** *Eucalyptus* (now includes *Corymbia), Enneapogon* (Kimberley)
- **g** *Grevillea*
- **h** *Hakea*
- **j** *Jacksonia*
- **k** Chenopodiaceae
- **l** *Lamarchea, Livistona* (Kimberley)
- **m** *Melaleuca, Myoporum*
- **n** *Nuytsia*
- **o** *Owenia*
- **p** *Callitris* (pine)
- **s** *Sehima, Sporobolus, Sorghum* (all Kimberley)
- **t,(p)** *Terminalia* (Kimberley), *Triodia* (includes *Plectrachne*)
- **x** Heterogeneous (mixed or other species not mentioned above)

Appendix 1, Table 1.1 lists the species used in the mapping and memoir; Table 1.2 is the list in order of codes used in the mapping; and Table 1.3 lists the common names in order. Table 2 lists the recent taxonomic name changes obtained from FloraBase (Western Australian Herbarium 2010).

The classification resulting from the application of the first two diagnostic features or characteristics of vegetation can be represented in tabular form. Table 1 shows the final form of the Beard–Webb Scheme (with minor modifications), highlighting the binomial codes for each vegetation type and showing the formal name that has been adopted for that type. This has been adapted from Beard (1981a) and explanatory notes including Beard and Sprenger (1984), with additional codes and names collated from map sheets.

Table 1c was created during the classification of vegetation associations to produce the accompanying digital map, and highlights the complexity of these vegetation types. Pindan and pindan woodlands were previously grouped under shrublands, but have a complex structure of trees, shrubs and grasses. Spinifex complexes have varying mixtures of shrubs, dwarf shrubs or hummock grassland. Therefore, it is difficult to identify a dominant component in these complexes.

The code letters derived from the vegetation classification appear as a triplet notation (or multiples of triplet notation) in each polygon on the 1:250,000- and 1:1,000,000-scale maps, with the codes identifying diagnostic floristic elements (often genus and species), the structural element and the cover element. As an example, there are polygons on the Perth and Swan sheets (Beard 1979c, 1981a) of e_2Mc that are of medium forest, jarrah. The notation represents genus e = *Eucalyptus*, species e_2 = *Eucalyptus marginata* or jarrah, M = medium height trees, c = mid-dense canopy. A list of the floristic codes used in the mapping is presented in Appendix 1, Table 1.2. A more detailed explanation of the triplet notation and its development is given in Beard and Webb (1974).

The basic unit identified during the vegetation survey is the plant association. This is defined as the largest identifiable unit with a consistent dominant species or group of species. Some 815 associations and 127 mosaics, consisting of closely intermixed patches of two or three associations, are mapped at the 1:250,000 scale. Associations may be grouped together according to their physiognomy (structure and growth-form) into formations: the formation is thus a physiognomic unit.

The Beard–Webb Scheme attempted to carry treatment in the notation and terminology through into the map colour scheme. The colour scheme is best seen on the 1:1,000,000-scale maps where the vegetation units are at the formation level. The colour spectrum ranges from blue for moist forest through to red for desert, in accord with

Table 1

Classification of vegetation used by Beard for the Vegetation of Western Australia project.

Table 1a. Communities with a single significant (dominant by cover) layer

Life Form/ Height Class	Cover Class					
	d: Dense canopy; projective foliage cover >70%	**c**: Mid-dense canopy; projective foliage cover 30–70%	**i**: Incomplete canopy; projective foliage cover 10–30%	**r**: Open canopy; projective foliage cover ≤10%	**b**: Sparse canopy; projective foliage cover ≅0%	**p**: Scattered groups; no definable projective foliage cover
T: Tall trees >30 m tall	**Td**: Dense tall forest	**Tc**: Tall forest	**Ti**: Tall woodland	**Tr**: Open tall woodland		
M: Medium trees 10–30 m tall	**Md**: Dense forest	**Mc**: Forest	**Mi**: Woodland	**Mr**: Open woodland	**Mb**: Sparse woodland	**Mp:** Scattered groups of trees
L: Low trees <10 m tall	**Ld**: Dense low forest	**Lc**: Low forest	**Li**: Low woodland	**Lr**: Open low woodland	**Lb**: Sparse low woodland	**Lp:** Scattered groups of low trees
S: Shrubs >1 m tall	**Sd**: Dense thicket	**Sc**: Thicket	**Si**: Scrub	**Sr**: Open scrub	**Sb**: Sparse scrub	**Sp**: Scattered groups of shrubs
Z: Dwarf shrubs <1 m tall	**Zd**: Dense heath	**Zc**: Heath	**Zi**: Dwarf scrub	**Zr**: Open dwarf scrub	**Zb**: Sparse dwarf scrub	**Zp**: Scattered groups of dwarf shrubs
G: Bunch grasses, sedges	**Gd**: Dense grassland	**Gc**: Mid-dense grassland	**Gi**: Grassland grassland	**Gr**: Open grassland	**Gb**: Sparse	**Gp**: Scattered groups of bunch grasses
H: Hummock grasses			**Hi**: Hummock grassland	**Hr**: Open hummock grassland	**Hb**: Sparse hummock grassland	**Hp**: Scattered groups of hummock grass
F: Forbs	**Fd**: Dense herbfield	**Fc**: Mid-dense herbfield	**Fi**: Herbfield	**Fr**: Open herbfield	**Fb**: Sparse herbfield	**Fp**: Scattered groups of forbs
X: Lichens and mosses			**Xi**: Mat plants	**Xr**: Open mat plants	**Xb**: Sparse mat plants	
C: Succulents			**Ci**: Succulent steppe	**Cr**: Open succulent	**Cb**: Sparse succulent	**Cp**: Scattered groups of succulent steppe

Table 1b. Communities with two significant layers.

Description	Cover Class of Tree or Shrub Stratum			
	i: Incomplete canopy; projective foliage cover 10–30%	**r**: Sparse canopy; projective foliage cover ≤10%	**b**: Sparse canopy; projective foliage cover ≅0%	Absent
Wooded bunch grassland	**Mi/LiGc**: Savanna woodland	**Mr/LrGc**: Tree savanna **SrGc**: Shrub savanna	**Mb/LbGc**: Sparse tree savanna **SiGc**: Sparse shrub savanna	**Gc** Grass savanna
Wooded hummock **grassland**	**Mi/LiHc**: Steppe woodland	**Mr/LrHc**: Tree-steppe **SrHc**: Shrub-steppe	**Mb/LbHc**: Sparse tree savanna **SbHc**: Sparse shrub savanna	
Wooded succulent steppe	**Mi/LiCi**: Thickly wooded succulent steppe	**Mr/LrCi**: Lightly wooded succulent steppe	**LbCi**: Sparsely wooded succulent steppe	**Ci**: Succulent steppe
Heath with trees		**LSi**: Tree-heath		
Heath with shrubs		**SZc**: Scrub-heath		
Heath with mallee		**eSZc**: Mallee-heath		

Table 1c. Communities with three significant layers.

Description	Cover Class of Tree or Shrub Stratum		
	c: Mid-dense canopy; projective foliage cover 30–70%	**i**: Incomplete canopy; projective foliage cover 10–30%	**r**: Sparse canopy; projective foliage cover ≤10%
Wooded thicket with grass	**Mi/LrScGi** Pindan		
Hummock grasslands with low trees, scrub or dwarf scrub	**Li/Si/Sr/SZc/Zp/Hi** Spinifex complexes		
Wooded thicket with succulents	**Mi/LrScCi** Salt flat		

general international practice, and is as follows:

- **T Tall trees** blue
- **M Medium trees** green
- **L Low trees** orange
- **S Shrubs** yellow
- **Z Dwarf shrubs** grey
- **G Bunch grasslands** olive
- **H Hummock grasslands** pink
- **C Chenopods** brown

Density of the vegetation is conveyed by shade of colour, dark for dense, pale for open. The general transition from the desert southwards is expressed in the sequence of colours red-orange-yellow-green-blue, and northwards in red-yellow-olive-green. 'Z' and 'C' are mainly edaphically controlled and are therefore extraneous to the climatic sequence.

The basic principles of this colour scheme were followed in the production of the present map. Mosaics appear as diagonal hatching, with the colours of the stripes reflecting the components of the mosaic, and tree symbols have been used to differentiate savanna grasslands in the Kimberley. The three-strata vegetation types, pindan and spinifex complex, are mapped in mauve. Vegetation dominated by lichens and mosses (X above) and forbs (F) were not extensive enough to appear at the scale of 1:3,000,000.

PHYTOGEOGRAPHIC REGIONS AND THE INTERIM BIOGEOGRAPHIC REGIONALISATION FOR AUSTRALIA

The idea that it is possible to recognise biogeographic or natural ecological regions within Western Australia, or groups of organisms with particular geographical affinities, has existed since the time of the earliest biological explorations of the state. A range of schemes has been proposed over the years. These fall loosely into three streams in a manner that generally reflects the component of the environment of interest to the particular author. The three streams centre on botanical, zoological and physical/biophysical aspects of the environment.

Botanical interpretations began when Ferdinand von Mueller drew attention to the special character of the south-western flora and suggested a boundary running from Shark Bay to Israelite Bay (von Mueller 1883). A similar observation was later made by Ludwig Diels, who divided the southern part of the state into two botanical provinces, the South West Province and the Eremaean Province, with this latter name derived from the Greek word for desert (Diels et al. 2007). Diels went on to subdivide the South West Province into six botanical districts and the Southern Eremaean Province into two, with each district being characterised by a range of climatic, floristic and vegetation factors. Charles A Gardner extended these concepts throughout the state, recognising a Northern Botanical Province with five districts, adding a further three districts to the Eremaean Province and adjusting the boundary of the South West Province further to the east (Gardner 1942; Gardner & Bennetts 1956). The districts within the South West Province were refined by NH Speck, and the concept of vegetation systems as sub-sets of districts was introduced (Speck 1958). The botanical provinces were continued throughout the Australian continent by NT Burbidge (1960), and three intermediate areas or interzones were recognised. The interzone in Western Australia coincides closely with Gardner and Bennett's (1956) Coolgardie District. Beard described the natural regions of the deserts in Western Australia (Beard 1960). Doing (1970) re-examined Burbidge's continental treatment using an analysis of plant species patterns combined with vegetation patterns, which resulted in the recognition of 25 regions for Australia, of which 7 fall within Western Australia.

Zoogeographic regionalisations began with R Tate (1890), who distinguished the south-west corner of the state, the Autochthonian, from the Eremaean or desert region. Soon after, W Baldwin Spencer (1896) differentiated a Torresian sub-region taking in the tropical/monsoonal part of northern Australia including the Kimberley, and a Bassian sub-region running along the remainder of the south-east coast east to the Great Divide and including Tasmania. He dispensed with the Autochthonian region, incorporating this last area within his Eyrean (desert) sub-region. Serventy and Whittell (1948) argued for a change in emphasis from regions to elements of the fauna, based on their studies of birds, and to a large extent this has been taken up by zoologists (e.g. see treatment for birds by Cracraft 1986). A number of regionalisations based on elements of the fauna are given in Keast (1981).

Some of the concepts embodied in the Western Australian regionalisations developed by geologists, geomorphologists, pedologists, climatologists and geographers have also informed biogeographers. Noteable are the schemes of Clarke (1926, 1935), Clarke et al. (1948), Gentilli and Fairbridge (1952), Gentilli (1978), Holmes (1938, 1944), Jennings and Marbutt (1986), Jutson (1914, 1950), Laut et al. (1975), McArthur and Bettenay (1979), Teakle (1938) and Wyrwoll and Glover (1989).

In the course of the Vegetation Survey of Western Australia project, Beard developed a deep insight into the ecological basis for the phytogeographic regionalisation that had been proposed previously and was able to refine the concepts and the boundaries. Beard began to incorporate redefined boundaries on his published 1:1,000,000 vegetation maps (e.g. see Beard 1974a) and in 1978 compiled the first detailed, state-wide map of his regionalisation at the scale of 1:2,500,000, subsequently published with detailed explanatory notes (Beard 1980e). The phytogeographic regions represented a very considerable refinement of the scheme of Gardner and Bennetts (1956), with boundaries that are largely coincident with boundaries of vegetation units mapped by Beard at the scale of 1:250,000 selected on the basis of

factors such as geology and climate as well as vegetation. Beard recognised three major provinces and an interzone, and within these, 21 districts.

There is a long-standing tradition in Western Australia that recognises three botanical provinces, the Northern, Eremaean and South West, and the 'Interzone' between the Eremeaen and the South West (Fig. 2). The climate, vegetation and flora of the three provinces are distinct from each othe, with the Interzone, in terms of vegetation, being more similar to the South West. Further descriptions of the botanical provinces and districts along with a general statewide discussion on climate, topography, geology, soils, fire and human influences are included in the first edition of this memoir (Beard 1981b).

Within the provinces, Beard identified 21 districts: the Northern Botanical Province comprising Gardner, Fitzgerald, Dampier and Hall Districts; the Eremaean Botanical Province comprising Canning, Mueller, Carnarvon, Fortescue, Keartland, Carnegie, Giles, Ashburton, Austin, Helms, and Eucla Districts; the South West Interzone or Coolgardie District; and the South West Botanical Province comprising Irwin, Darling, Avon, Roe and Eyre Districts. These districts were considered to be natural ecological regions with each possessing a

Figure 2. Map of the natural regions of Western Australia (Beard & Sprenger 1984).

characteristic unity of environmental features distinct from that of other districts. Beard also recognised subdistricts, which are shown on the individual 1:250,000 map sheets.

The 1:2,500,000 map of the phytogeographic regions includes considerable geographical detail so it is possible to locate other work quite precisely in relation to regional boundaries. Beard subsequently published a small-scale map of the natural regions of Western Australia (Beard & Sprenger 1984; Beard 1990), which showed the same phytogeographic regions but with a more generalised nomenclature (Fig. 2).

The then national nature conservation agency (the Australian National Parks and Wildlife Service, subsequently named the Australian Nature Conservation Agency, then the Biodiversity Unit of Australian Government Department of the Environment and Heritage) took up the idea of using environmental regionalisations as the basis for conservation planning and setting priorities for funding for land acquisition and research. In particular, it was thought that defining regions based on environmental factors rather than using existing political and administrative boundaries would provide a

Figure 3. Spatially corrected version of the Interim Biogeographic Regionalization for Western Australia showing the fine level of detail in the regional boundaries.

sound basis for designing a national network of nature conservation reserves. The scheme finally adopted was based on the biogeographic regionalisations developed separately by each of the states and territories, matched across borders. The Western Australian input to the national scheme was Beard's phytogeographic or natural regions (Beard 1980e; Beard & Sprenger 1984), with minor changes derived from new knowledge contributed by NL McKenzie, GJ Keighery, KF Kenneally, G Wardell-Johnson and JS Beard. This scheme was used as the basis for a conservation assessment at the national scale (Thackway & Cresswell 1995) and at the state scale for assessing the conservation status of vegetation types in Western Australia (Hopkins et al. 1996; Shepherd et al. 2001). Because of the importance attached to the Interim Biogeographic Regionalisation for Australia in current planning and administrative procedures, a spatially corrected version (see Hopkins et al. 1996) is included here (Fig. 3) and presented on the 1:3,000,000 map as thick black lines. At the time of publication, this information was available from the Australian Department of Sustainability, Environment, Water, Population and Communities website http://www.environment.gov.au/parks/nrs/science/bioregion-framework/ibra/index.html

It is important to realise that the regional boundary lines generally represent a zone of change in biophysical characteristics rather than a sharp transition. In some cases, the zone of change may be rather broad while in others it may be narrow, so that the transition may seem relatively sharp. For example, the southern boundary of Beard's Northern Province against the Great Sandy Desert Bioregion indicates a gradual decline in annual rainfall, and so the zone of change may be considered to be about 100 km wide. In contrast, the boundary between Beard's Drummond Region and his Dale Region is along the Darling Fault, and at the foot of the Darling Scarp. This line follows the geological fault and indicates a rapid change from the coastal sands of the Swan Coastal Plain with its characteristic biota to the lateritic uplands of the Darling Range typically supporting jarrah forest. In this case, the zone of transition is between 5 and 10 km wide.

The relationship between Beard's natural regions (Beard & Sprenger 1984; Beard 1990) and the recently derived bioregions forming the Western Australian part of the Interim Biogeographic Regionalisation for Australia is shown in Table 2. Names ascribed to the phytogeographic provinces, districts and sub-districts by Beard (1980e) are included in brackets.

Table 2

Relationship between Beard's natural regions and the recently derived bioregions forming the Western Australian part of IBRA.

Beard's Natural Region (Phytogeographical Region)	IBRA Bioregion	IBRA Code
Northern Province		
North Kimberley (Gardner Region)	North Kimberley (includes Yampi Peninsula)	NK
(not previously defined—portion of North Kimberley east of Cambridge Gulf)	Victoria Bonaparte	VB
East Kimberley (Hall)	Ord-Victoria Plains	OVP
Central Kimberley (Fitzgerald)	Central Kimberley (excludes Yampi Peninsula)	CK
Dampierland (Dampier)	Dampierland	DL
Eremaean Province		
Tanami Desert (Mueller)	Tanami	TAN
Great Sandy Desert (Canning)	Great Sandy Desert	GSD
Pilbara (Fortescue)	Pilbara	PIL
Little Sandy Desert (Keartland)	Little Sandy Desert	LSD
Gibson Desert (Carnegie)	Gibson Desert	GD
Central Ranges (Giles)	Central Ranges	CR
Gascoyne (Ashburton)	Gascoyne	GAS
Carnarvon (Carnarvon)	Carnarvon	CAR
Murchison (Austin)	Murchison	MUR
(not previously defined—southern portion of Murchison)	Yalgoo	YAL
Great Victoria Desert (Helms)	Great Victoria Desert	GVD
Nullarbor (Eucla)	Nullarbor	NUL
(not previously defined—Roe Plain portion of Eucla)	Hampton	HAM
South-Western Interzone		
South-Western Interzone (Coolgardie)	Coolgardie	COO
South West Province		
Northern Sandplains (Irwin)	Geraldton Sandplains	GS
Avon Wheatbelt (Avon)	Avon Wheatbelt	AW
South West Forest Region – Drummond (Darling–Drummond)	Swan Coastal Plain	SWA
South West Forest Region – Dale (Darling–Dale)	Jarrah Forest	JF
South West Forest Region – Menzies (Darling–Menzies)	Jarrah Forest	JF
South West Forest Region – Warren (Darling–Warren)	Warren	WAR
Mallee Region (Roe)	Mallee	MAL
Esperance Plains (Eyre)	Esperance Plains	ESP

DATABASE IMPROVEMENTS AND APPLICATIONS

The new 1:3,000,000-scale map (at A0 size) and digital photographs accompanying this explanatory memoir make this valuable resource more accessible and available for further development and extrapolation. Underpinning the map is a database and spatial layers of vegetation associations mapped at the 1:250,000 scale, available on application to the GIS Sections of the Department of Agriculture and Food Western Australia (DAFWA) or Department of Parks and Wildlife (DPaW). This database has been used for a wide range of research and planning purposes, including the ongoing development of the terrestrial nature conservation reserve system based in the Comprehensive, Adequate and Representative analysis (Hopkins et al. 1996; Government of Western Australia 2010), in the development of natural resource management strategies for regional natural resource management organisations, and assessment of the native vegetation extent type and status (Shepherd et al. 2001). The database has been ideal for integration at a national scale and was used for an assessment of land use and vegetation in Western Australia for the National Land and Water Resources Audit (Beeston et al. 2002). During the audit, data sets on the extent of pre-European vegetation associations and the present vegetation extent were both substantially upgraded to agreed national standards, and these two data sets were intersected to produce a coverage of present vegetation type and extent (Beeston et al. 2002). The availability of comparable data sets for pre-European vegetation type and extent and present vegetation type and extent provides the opportunity to quantify the impacts of land clearing on individual vegetation types.

In 2006, the vegetation associations used to compile the classification for the 1:3,000,000 map were intersected with the vegetation systems that Beard had developed. This resulted in the creation of over 2,175 system associations. Roger Walker (then DEC) collated information from the explanatory notes and maps and scanned original material to compile vegetation attributes for most of the system associations. This database has been made consistent with the National Vegetation Information System (NVIS) using the standards set out in the Australian Vegetation Attributes Version 6.0 (ESCAVI 2003). NVIS provides a nationally consistent framework for describing and compiling data and information for all vegetation types in Australia. During compilation of data for NVIS, the base mapped unit was the System Associations, which was equivalent to Level 5 (Association) or Level 6 (Sub-Association). Using the NVIS framework vegetation, descriptions at Levels 5 and 6 can be grouped into broader units (Level 1 through 4) to generate consistent continental-scale vegetation maps. The taxonomy was also updated for many of the units. These data are available from DAFWA and DPaW.

The map presents regional patterns in vegetation, but an inherent problem is the precision of the linework in relation to what is actually on the ground. There is now a need to correct the line work of the original vegetation maps to match current digital topographic and aerial photographic images. Many of the applications mentioned above would benefit from a more precise, accurate vegetation information system at a much larger scale (1:10,000).

DESCRIPTIONS OF THE VEGETATION TYPES

In this section, the vegetation types shown on the 1:3,000,000 map are described. This classification was compiled prior to NVIS and is largely based on the 1981 version of the 1:3,000,000 map. The vegetation types are discussed in the order in which they appear in the legend of the map, which is more-or-less from the tallest to the shortest. This differs from the first edition, which grouped the main vegetation types by botanical province and included a general description of the provinces. Five categories of bare ground and very sparsely vegetated areas are also included. Mosaic units comprising two, and occasionally three, vegetation types also occur. The twenty most extensive mosaics are described after the bare ground categories. The descriptions and distribution figures include which of the IBRA Bioregions (see Table 2 for definition of codes) the vegetation type occurs in and the full extent in hectares. The area of each vegetation type was calculated using Albers Equal Area projection, which is the best method for measuring areas over a large region like Western Australia, and they match well with the total area of the state of about 235,000,000 ha (2,530,000 km^2). Accompanying photographic plates give a visual indication of each vegetation type.

In some cases the vegetation types are grouped geographically. For example, the major forest types all occur in the South West, while all the savanna types (dominated by tropical grasses, sometimes with emergent trees) occur in the Kimberley. Vegetation types with a substantial or dominant component of hummock grasses, popularly known as spinifex country, are the most widespread vegetation type in the state, dominating the Eremaean Botanical Province. Between latitudes of approximately 18 ° and 23 ° south, hummock grasslands occur on almost all substrate types so that the vegetation consists of little else, while south of 23 ° hummock grasslands are confined to arid sandplains and dunefields. The hummock grasslands are so named because the grass plants are organised into scattered, rounded, dense clumps better described as 'hummocks' than 'tussocks', generally with canopy cover of 10–30%. It is a growth form peculiar to Australia and gives a unique appearance to Australian arid grassland or steppe, distinguishing it from others of the world's steppes. All species of hummock grass belong to the genus *Triodia* (including those formerly *Plectrachne*). Scattered trees and shrubs are almost always present and distinguish the four mapped types of spinifex grasslands. Annual herbaceous and shrubby perennial plants germinate after good rains and grow in the bare ground between the hummocks.

The suite of vegetation types previously described as succulent steppe, and dominated by species of the family Chenopodiaceae, has been subdivided into two distinct types: those composed mainly of samphire that we call halophyll types, and those composed mainly of saltbush and bluebush that we call sarcophyll (or flesh-loving) types. Samphire is the term applied to halophytes (salt-loving plants) such as *Tecticornia* species that form succulent, leafless shrubs generally less than 0.5 m tall. These are found scattered around salt lakes, estuaries and along saline drainage systems. Saltbush is the common term applied to *Atriplex* species, specifically *A. vesicaria* (bladder saltbush) in the Nullarbor Bioregion, *A. hymenotheca* in the Coolgardie and Nullarbor Bioregions and *A. cinerea* (grey saltbush) in the Carnarvon Bioregion. Bluebush is usually *Maireana sedifolia* (pearl bluebush), once known

Table 3

Vegetation types of Western Australia and area in hectares.

VT	Description	Area (ha)
Tall Forest and Woodland		
1	Tall forest: mainly karri (*Eucalyptus diversicolor*) Tall woodland: tuart (*E. gomphocephala*)	276,235
Medium Forest and Woodland		
2	Forest: mainly jarrah (*Eucalyptus marginata*) and marri (*Corymbia calophylla*)	2,893,645
3	Woodland: jarrah (*Eucalyptus marginata*), marri (*Corymbia calophylla*) and wandoo (*E. wandoo*)	1,923,349
4	Woodland: Wheatbelt—York gum (*Eucalyptus loxophleba*), salmon gum (*E. salmonophloia*), etc. Goldfields—gimlet (*E. salubris*), redwood (*E. transcontinentalis*), etc. Riverine—rivergum (*E. camaldulensis*). Tropical—Darwin stringybark (*E. tetrodonta*) and woolybutt (*E. miniata*)	13,448,499
5	Medium–low woodland: York gum (*Eucalyptus loxophleba*) and cypress (*Callitris columellaris*)	172,649
Low Forest and Woodland		
6	Low forest: wattle (*Acacia rostellifera*), Rottnest pine (*Callitris preissii*), moort (*Eucalyptus platypus*) or mixed tropical forest	77,885
7	Low forest, woodland or low woodland with scattered trees: jarrah (*Eucalyptus marginata*), banksia (*Banksia* spp.) or casuarina (*Allocasuarina* spp.)	325,513
8	Low woodland, open low woodland or sparse woodland: mulga (*Acacia aneura*) and associated species	36,244,131
9	Low woodland or open low woodland: Other wattle (*Acacia* spp.), banksia (*Banksia* spp.), peppermint (*Agonis flexuosa*), cypress pine (*Callitris* spp.), casuarina (*Allocasuarina* spp.), York gum (*Eucalyptus loxophleba*)	2,563,342
10	Mangroves: low forest (Kimberley) or thicket (Pilbara) mangroves (*Avicennia marina, Rhizophora stylosa, Bruguiera exaristata*)	190,088
Tall Shrubland		
11	Tree-heath: mixed heath with low trees (*Banksia ashbyi*)	369,125
12	Thicket with medium open woodland, low woodland or scattered low trees: teatree (*Melaleuca* spp.) with York gum (*Eucalyptus loxophleba*), wandoo (*E. wandoo*) or casuarina (*Allocasuarina* spp.)	53,711
13	Scrub with open woodland or scattered trees: wattle (*Acacia* spp.) with York gum (*Eucalyptus loxophleba*), casuarina (*Allocasuarina* spp.), mulga (*Acacia aneura*)	2,957,962
14	Thicket: wattle, casuarina and teatree (*Acacia–Allocasuarina–Melaleuca* alliance).	5,696,197
15	Scrub, open scrub or sparse scrub: Wattle, teatree & other species *Acacia* spp. *Melaleuca* spp.	16,745,041
16	Mallee: eucalypt shrubland (*Eucalyptus eremophila, E. redunca, E.* spp.)	6,333,871
Low Shrubland		
17	Mallee-heath: mixed heath with scattered mallee e.g. tallerack (*Eucalyptus pleurocarpa*)	1,513,398
18	Scrub-heath: mixed heath with scattered tall shrubs *Acacia* spp., Proteaceae and Myrtaceae.	3,523,447
19	Heath: low shrubs of mixed composition.	207,724
20	Dwarf scrub or open low shrub: *Acacia* spp., *Eremophila* spp., *Senna* spp.	685,531
Bunch Grassland		
21	Pindan woodland: wattle thicket (*Acacia tumida*) with eucalypt woodland (*Eucalyptus tectifica, Corymbia grandifolia*) over spinifex, (*Triodia pungens, T. bitextura*)	1,463,269
22	Pindan with low trees: wattle thicket (*Acacia eriopoda*) with scattered low trees (*Corymbia dichromophloia*) over spinifex (*Triodia pungens, T. bitextura*)	4,075,252
23	Grasslands, high grass savanna woodland on basalt: grey box (*Eucalyptus tectifica*), cabbage gum (*Corymbia grandifolia*) over white grass (*Sehima nervosum*) and ribbon grass (*Chrysopogon* spp.)	2,775,141
24	Grasslands, high grass savanna woodland on sandstone: Bloodwood (*Corymbia dichromophloia*), stringybark (*Eucalyptus tetrodonta*) over curly spinifex (*Triodia bitextura*) and sorghum (*Sorghum* spp.)	6,115,312
25	Grasslands, tall bunch-grass savanna woodland: grey box (*Eucalyptus tectifica*) over ribbon grass (*Chrysopogon* spp.)	233,481
26	Grasslands, tall bunch-grass low-tree savanna: Mainly ribbon grass (*Chrysopogon* spp.), blue grass *Dichanthium* spp. with low woodland or scattered trees (e.g. *Eucalyptus terminalis*)	1,108,741
27	Grasslands, tall bunch-grass savanna: mainly Mitchell grass (*Astrebla* spp.)	1,697,656
28	Grasslands, short bunch-grass low-tree savanna: short grasses (*Enneapogon* spp., *Aristida* spp.) with scattered trees e.g. Bauhinia (*Bauhinia cunninghamii*) and snappy gum (*Eucalyptus brevifolia*)	491,021
29	Grasslands, short bunch-grass savanna: annual grasses (*Enneapogon* spp. *Aristida* spp. etc) on dry plains and salt-water grasses (*Sporobolus virginicus*) on the coast	1,147,223
30	Grasslands, curly spinifex savanna woodland or low trees: *Triodia bitextura* with *Eucalyptus phoenicea*, *E. brevifolia, Corymbia ferruginea, C. dichromophloia.*	4,980,485

Table 3 (cont.)

VT	Description	Area (ha)
31	Grasslands, tall bunch-grass open savanna woodland (riverine): coolibah (*Eucalyptus microtheca*) over ribbon grass (*Chrysopogon* spp.), blue grass (*Dichanthium* spp.)	343,278
32	Riverine sedgeland/grassland with trees: river gum (*Eucalyptus camaldulensis*), coolibah (*E. microtheca* in the Kimberley and *E. victrix* in the Pilbara) over mixed sedges	519,452
33	Sedgeland: (mainly in the South West) Cyperaceae, Restionaceae, Juncaceae	59,213
Spinifex Grassland		
34	Tree-steppe: desert oak (*Allocasuarina decaisneana*) with soft spinifex (*Triodia pungens*)	1,826,433
35	Low tree-steppe: hummock grassland (*Triodia* spp.) with scattered bloodwood (*Corymbia dichromophloia*) and snappy gum (*Eucalyptus brevifolia*)	16,053,836
36	Sparse low tree-steppe: hummock grassland (*Triodia* spp.) with sparse eucalypts e.g. bloodwood (*Corymbia dichromophloia*) and snappy gum (*Eucalyptus brevifolia*)	1,751,714
37	Tree-and-shrub steppe: hummock grassland (*Triodia* spp.) with scattered eucalypts (*Eucalyptus gongylocarpa*) over wattle scrub (*Acacia* spp.) or mallee	12,536,719
38	Shrub-steppe: hummock grassland (*Triodia* spp.) with scattered shrubs (*Acacia* spp., *Grevillea* spp.) or mallee (*Eucalyptus* spp.)	25,315,525
39	Sparse shrub-steppe: hummock grassland (*Triodia* spp.) with sparse shrubs (*Acacia* spp.)	7,906,238
40	Grass-steppe: hummock grassland (*Triodia* spp.)	2,527,282
41	Spinifex complexes: hummock grassland (*Triodia* spp.) with scattered low trees over dwarf shrubs or mixed short grass and spinifex mixed species	1,597,775
Halophyll and Sarcophyll Communites		
42	Samphire with thicket and scattered trees: *Tecticornia* spp. with tea tree (*Melaleuca* spp.), York gum (*Eucalyptus loxophleba*), casuarina (*Casuarina obesa*),	210,110
43	Saltbush and/or bluebush with woodland or scattered trees: *Atriplex* spp., *Maireana* spp. with salmon gum (*Eucalyptus salmonophloia*) and gimlet (*E. salubris*)	488,501
44	Samphire with scattered medium or low trees: *Tecticornia* spp. with York gum (*Eucalyptus loxophleba*), mulga (*Acacia aneura*), melaleuca (*Melaleuca* spp.), casuarina (*Allocasuarina* spp.)	48,407
45	Saltbush and/or bluebush with low trees: *Atriplex* spp., *Maireana* spp. with mulga (*Acacia aneura*), other wattle (*A. papyrocarpa*), casuarina (*Allocasuarina cristata*)	2,961,385
46	Saltbush and/or bluebush with scattered low trees: *Atriplex* spp., *Maireana* spp. with mulga (*Acacia aneura*), other wattle (*A. papyrocarpa*), casuarina (*Allocasuarina cristata*)	4,558,992
47	Samphire with thicket/scrub: *Tecticornia* spp. with *Melaleuca* spp., *Acacia* spp.	735,504
48	Saltbush and bluebush with scrub or open scrub: *Atriplex* spp, *Maireana* spp. with mulga (*Acacia aneura*), other wattle (*Acacia* spp.)	1,422,307
49	Saltbush and bluebush: *Atriplex* spp., *Maireana* spp. communities on alkaline soils	7,311,044
50	Samphire: *Tecticornia* spp. communities in saline areas	2,141,162
Bare and Sparsely Vegetated Areas		
51	Salt lake, lagoon, claypan	3,586,343
52	Freshwater lake	23,562
53	Tidal mud flat	739,821
54	Rock	329,966
55	Dune sand	95,544
	MOSAICS	
101	Woodland/Low woodland/Low forest or Woodland	149,717
102	Woodland/Mallee	1,955,344
103	Woodland/Scrub	332,482
104	Woodland/Shrub (mallee) steppe	1,092,784
105	Woodland/Succulent steppe with open low woodland	490,400
106	Low woodland/Scrub	542,293
107	Scrub-heath/Thicket	372,886
108	Scrub-heath/Heath	291,568
109	Mallee/Mallee-heath	261,687
110	Scrub or very open scrub/Grass steppe	712,124
111	Pindan/Tall bunch-grass savanna with low trees	261,130
112	Curly spinifex low tree savanna/Sparse low tree-steppe	602,455
113	High-grass savanna woodland/Curly spinifex savanna	970,179
114	Curly spinifex or short-grass low tree savanna/Grass-steppe	393,229
115	Short bunch-grass low tree savanna/Tree-steppe	519,761
116	Short bunch-grass savanna/Grass-steppe	958,198
117	Sparse low tree-steppe/Sparse shrub-steppe	27,688,259
118	Low tree-steppe/Scrub	52,794
119	Low woodland or open low woodland/Saltbush and bluebush	172,534
120	Succulent steppe saltbush and bluebush/Samphire	87,828
	TOTAL	**253,286,688**

as *Kochia sedifolia*. Saltbush and bluebush shrub layers typically have a pfc of between 10–30%. The sarcophyll vegetation types are particularly prominent on the limestone plains of the Nullarbor Plain and on the calcrete plains in the central Carnarvon Bioregion. Where samphire and saltbush/bluebush occur together, it has been mapped as a mosaic due to the fine gradation of vegetation associations fringing the intricate patterns in the salt lakes.

Finally, it is necessary to comment on the currency of the plant names used in this memoir. The original fieldwork and the compilation of those data for the vegetation mapping project began in 1964 and was completed some 17 years later in 1981. Since that time, there have been substantial changes in the taxonomy and nomenclature of Western Australian plants, and in the application of common names. We have attempted to update the species names used in this memoir, drawing on information available from the Western Australian Herbarium (Appendix 1, Table 2). In many cases, the change has been straightforward, while in other cases some uncertainty remains. Where there is uncertainty, we have attempted to indicate this. For example, in the original mapping documentation, Beard used the symbol a_9 and the common name bowgada to refer to both *Acacia ramulosa* and *A. linophylla*. Nowadays, only *Acacia linophylla* has the common name of bowgada, while A. *ramulosa* is known as horse wattle. Where we have been unable to distinguish which species was being referred to, we use *A. linophylla*/*ramulosa*. In other cases, such as that of *Melaleuca uncinata* and *Acacia aneura*, the species has been subdivided and it is not possible to update it, so the original name has been retained (annotated with s.l. which stands for sensu lat or 'leave as is'). Some of the eucalypt species have had name changes, and for up-to-date taxonomy of eucalypts in the Avon Wheatbelt and Mallee Bioregions see French (2012). Scientific and common names are both used to make the text understood by non-scientists. A list of the vegetation types and mosaics is presented in Table 3. This equates to the legend on the map poster. Scientific and common names are both used to make the text understood by non-scientists. A list of the vegetation types and mosaics is presented in Table 3. This equates to the legend on the map poster.

MAJOR VEGETATION TYPES

Tall Forest and Woodland

1. Tall forest: mainly karri. Tall woodland: tuart

Tall forest consists of trees exceeding 30 m in height with a closed canopy (>70% projected foliage cover). *Eucalyptus diversicolor* (karri) is the principal species in this vegetation type, occurring in pure stands or in mixtures with *Corymbia calophylla* (marri) and/or *E. marginata* (jarrah), and less commonly with *E. jacksonii* (red tingle), *E. guilfoylei* (yellow tingle) and *E. brevistylis* (Rates tingle). Units containing karri form the major vegetation type in the Warren Bioregion, covering over 275,000 ha (Fig. 4).

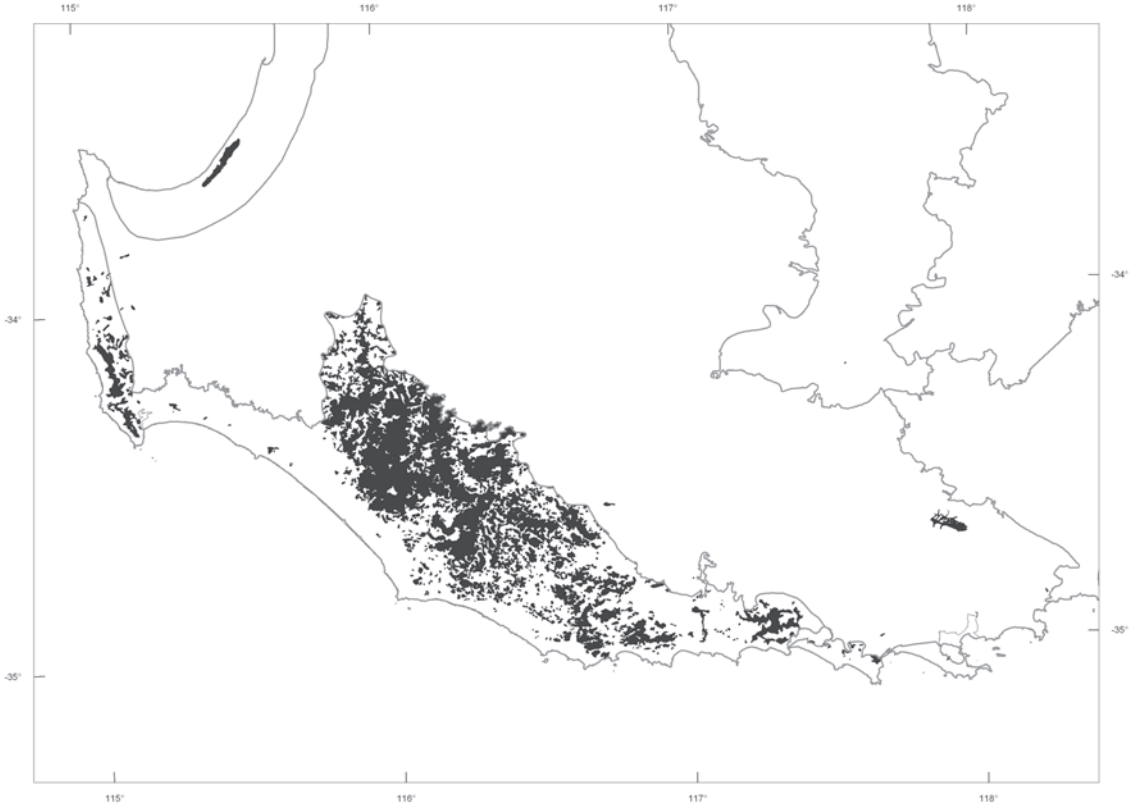


Figure 4. Vegetation Type 1: Tall forest and tall woodland.

Plate 1. Tall forest: karri north of Augusta (photo by Ladislav Mucina).

Plate 2. Tuart between Bunbury and Busselton (photo by Cliff Winfield).

The 72,000 ha of pure karri stands occur on the deep loams extending from north of Augusta (Plate 1) to Denmark in the Warren Bioregion. It may grow to 70 m in height and have an understorey at about 10 m of *Agonis flexuosa* (peppermint), *Allocasuarina decussata* (karri oak) and *Banksia* spp. Below the understorey tree stratum, there is a continuous stratum to about 3 m of predominantly soft-leaved shrubs such as *Trymalium spatulatum* (karri hazel), *Chorilaena quercifolia, Hovea elliptica* (tree hovea) and *Acacia pentadenia* (karri wattle). The mainly podzolic soils in the mid- to lower-landscape positions throughout the main range of karri tend to support mixed karri–marri forest. Towards the lower rainfall margins of the range, these karri–marri forests may be interspersed with jarrah–marri forest to form a mosaic. Patches of tall karri–marri forest total over 160,000 ha between Denmark and Nannup.

Two eastern outliers of karri occur: one around the granite massif of the Porongurup Range (Jarrah Forest Bioregion) where it appeared to have a similar understorey to the forests in the Pemberton area, and the other to the south-east, below Mt Many Peaks. At the western end of its distribution, in the Augusta – Margaret River area, patches of karri occur on old, highly weathered coastal dunes, areas of alluvium or on young soils along streams. Towards the south coast near Walpole–Nornalup, karri is associated with tall *Eucalyptus jacksonii* (red tingle), *E. guilfoylei* (yellow tingle) and *E. brevistylis* (Rates tingle).

There are small areas of jarrah tall forest and jarrah–marri tall forest, normally not exceeding 40 m in height, on the poorer soils. They have an understorey of sclerophyll (tough leaved) shrubs and are essentially a taller version of the medium-height jarrah forests described below.

Tall woodland consists of tall trees (>30 m) with a more open canopy (projected foliage cover 10–30%). The only association in the state of this structural formation is the tuart woodland in the Swan Coastal Plain Bioregion. A small pocket (3150 ha) of tall *Eucalyptus gomphocephala* (tuart) woodland is found on calcareous soils between Busselton and Bunbury (Swan Coastal Plain Bioregion; Plate 2). These stands reach a height of 40 m. It is probable that the understorey consisted of *Agonis flexuosa* (peppermint) trees up to 15 m in height, with shrubs to 2 m in height such as *Templetonia retusa*, *Spyridium globulosum*, *Olearia axillaris* (coastal daisybush), *Hakea prostrata* (harsh hakea), *Diplolaena dampieri* (southern diplolaena) and *Acacia* spp. As a consequence of burning and grazing over the past 170 years, introduced grasses have largely replaced the shrub stratum.

Medium Forest and Woodland

2. Medium forest: mainly jarrah and marri

Medium forest consists of trees reaching a height at maturity of between 10 and 30 m with a mid-dense canopy (30–70% pfc). Nearly all of this type consists of *Eucalyptus marginata* (jarrah) or a mixture of jarrah and *Corymbia calophylla* (marri). This is described as a dry sclerophyll forest because of the relatively low rainfall area in which it occurs and because of the thick, hard nature of the leaves of the understorey species. Covering most of the Jarrah Forest Bioregion and extending into the Warren (Plate 3) and Swan Coastal Plain Bioregions, it totals nearly 2.9 million ha (Fig. 5).

Eucalyptus marginata (jarrah) forest is best developed on the lateritic soils of the Darling Range in the high rainfall areas of the Jarrah Forest Bioregion. *Corymbia calophylla* (marri) is associated with it on the poorer quality sites, including those with leached sands. Trees grow to about 30–40 m tall in the higher rainfall (>1000 mm) parts of the bioregion and to about 25 m in the east. A lower layer of small trees (about 7 m high) includes species such as *Banksia grandis* (bull banksia), *Allocasuarina fraseriana* (sheoak) and *Persoonia longifolia* (snottygobble), and there is a rich shrub stratum (shrubs to 2 m tall) with species in the families Myrtaceae, Proteaceae, Fabaceae and Ericaceae, as well as prominent *Kingia australis* (grass tree), *Xanthorrhoea* spp. (balga) and *Macrozamia riedlei* (zamia).

As mapped at the 1:3,000,000 scale, the jarrah–marri forest may include the following:

- *E. patens* (yarri) on the valley loams, and *E. megacarpa* (bullich) and *Taxandria linearifolia* (swamp peppermint) in the swampy bottomlands.

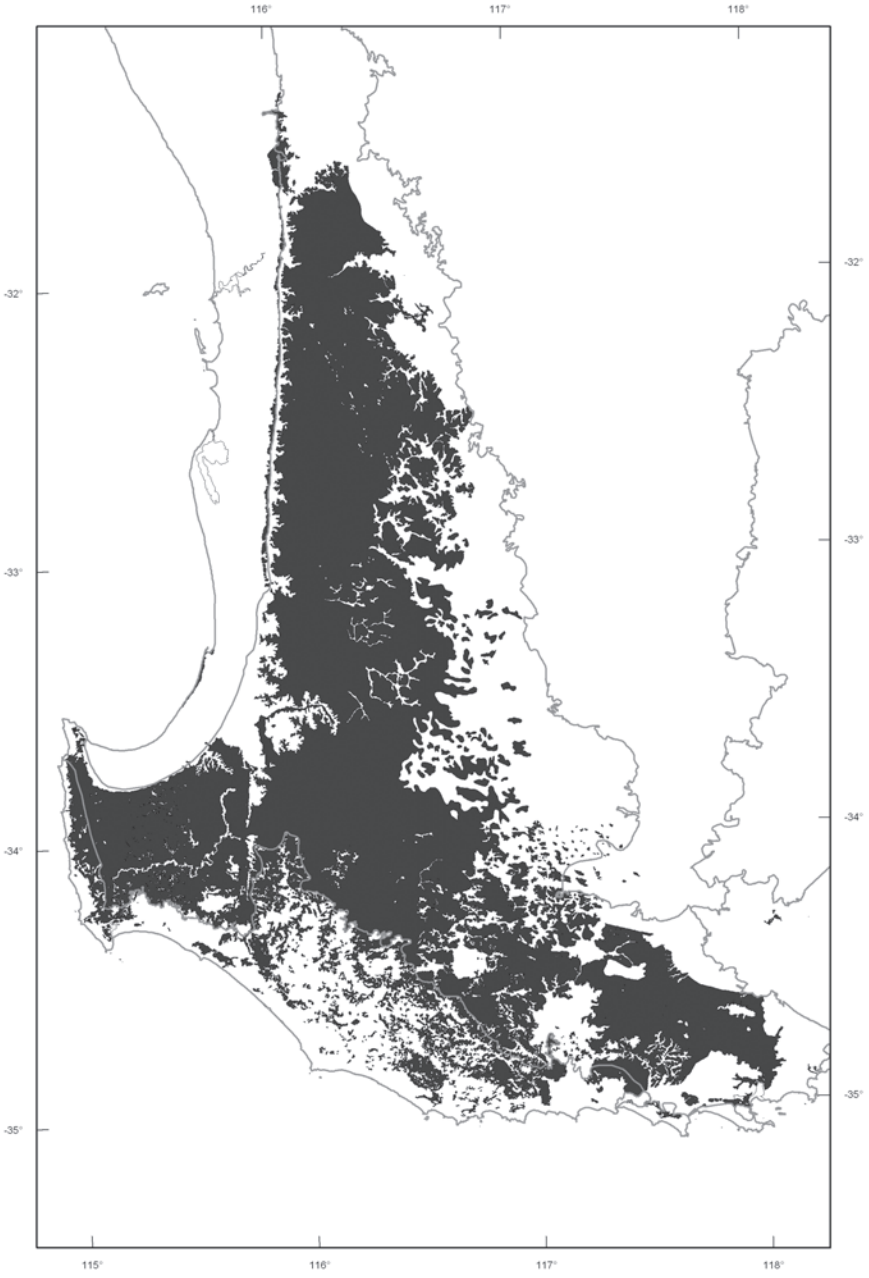


Figure 5. Vegetation Type 2: Medium forest, mainly jarrah and marri.

Plate 3. Forest: jarrah near Walpole (photo by Neil Burrows).

- *Eucalyptus wandoo* (wandoo) on loamy soils and *E. accedens* (powderbark wandoo) on the drier eastern margins. Here the open shrub understorey includes poison plants from the family Fabaceae.
- Small areas of forest of jarrah with *Eucalyptus jacksonii* (red tingle), jarrah with *E. guilfoylei* (yellow tingle) and jarrah with *E. brevistylis* (Rates tingle) occur on poorer soils near the tall tingle forests towards the south coast. There is also an area supporting a mosaic of *Eucalyptus marginata* (jarrah) and *E. guilfoylei* (yellow tingle) with medium forest with *Eucalyptus marginata* (jarrah) and *E. brevistylis* (Rates tingle) medium forest.

This vegetation type also includes the patches of *Eucalyptus cornuta* (yate) medium forest, which occur along the south coast between Black Point and Walpole, and on islands off the Albany and Esperance coasts.

3. Woodland: jarrah, marri, wandoo, tuart and flooded gum

Vegetation composed of trees 10–30 m in height with an open canopy (10–30% pfc) is classified as woodland. Trees are predominantly eucalypts and occur in a wide variety of associations. Woodlands are extensive in the south of Western Australia, covering nearly 2 million ha (Fig. 6 and 7). Because of this great extent and the variety of associations present, the woodland types have been divided into two: jarrah, marri and wandoo woodlands that occur in the western and central part of the south west (Vegetation Type 3); and the other woodlands that occur elsewhere in the state (Vegetation Type 4). Patches and small areas of open woodland (2–10% pfc) have been included here rather than creating a separate vegetation type based on structure but with a variety of tree species. Open woodland occurs over a relatively small area of only 23,750 ha, most of which is in the Swan Coastal Plain Bioregion, with small areas in the Jarrah Forest and Avon Wheatbelt Bioregions.

The eastern Jarrah Forest Bioregion is dominated by mixed woodlands containing *Eucalyptus marginata* (jarrah), *Corymbia calophylla* (marri) and/or *Eucalyptus wandoo* (wandoo; Plate 4), with the jarrah present on the lateritic residuals and largely absent from the valleys. In this part of the bioregion the trees reach 20–25 m in height and are more widely spaced than trees in the jarrah forest proper, and the understorey is composed of a wide variety of sclerophyllous shrub species. Small pockets of pure jarrah occur in the northern and central parts of this bioregion, with more extensive areas in the south. Jarrah, marri and wandoo occur to the west and on the northern slopes of the Stirling Range and in the western edge of the Esperance Plains Bioregion.

Eucalyptus accedens (powderbark wandoo) occurs with marri and wandoo, and *E. astringens* (brown mallet) forms woodlands on the lateritic residuals on the eastern fringes of the Darling Plateau and into the Avon Wheatbelt Bioregion, where the rainfall is lower. The understorey of the *E. astringens* woodlands (occasionally forests) is usually quite sparse. Open woodlands of *Eucalyptus wandoo* (wandoo) occur on its own or with *E. accedens*

(powderbark wandoo) towards the top of the landscape where there are lateritic remnants.

Marri is typical of the deep sands that occur throughout the Swan Coastal Plain Bioregion. It is often associated with jarrah and usually has an understorey of banksia and casuarina low trees over *Xanthorrhoea* and mixed shrubs. *Eucalyptus gomphocephala* (tuart) occurs on the calcareous Cottesloe and Karrakatta sands from Busselton through to the Moore River. The stout mature trees grade in height from 40 m, described above, to 25 m around Perth, and may have subdominant jarrah and marri and an understorey of *Agonis flexuosa* (peppermint) and banksia low trees and mixed coastal shrubs. Other species, which occur in association with the jarrah and marri in these woodlands, include *Corymbia haematoxylon* (mountain marri), *Eucalyptus occidentalis* (flat-topped yate), *E. patens* (yarri), *E. rudis* (flooded gum), *E. decipiens* (redheart) and *Allocasuarina fraseriana* (sheoak).

The tongue of lateritic plateau between Gingin and Bindoon has a mosaic of medium open (10–30% pfc) jarrah and marri woodland with a low banksia understorey interspersed with very scattered (<10% pfc) jarrah and marri trees of medium height.

Extending northwards along the Swan Coastal Plain from the tall *Eucalyptus gomphocephala* (tuart) woodland between Busselton and Bunbury, and continuing through to beyond Guilderton/Moore River, is an open woodland of tuart. There may be marri and jarrah with the tuart. Where the understorey is more substantial, these associations have been mapped as low woodland or scrub with scattered trees.

On a narrow strip south of Gingin on the Swan Coastal

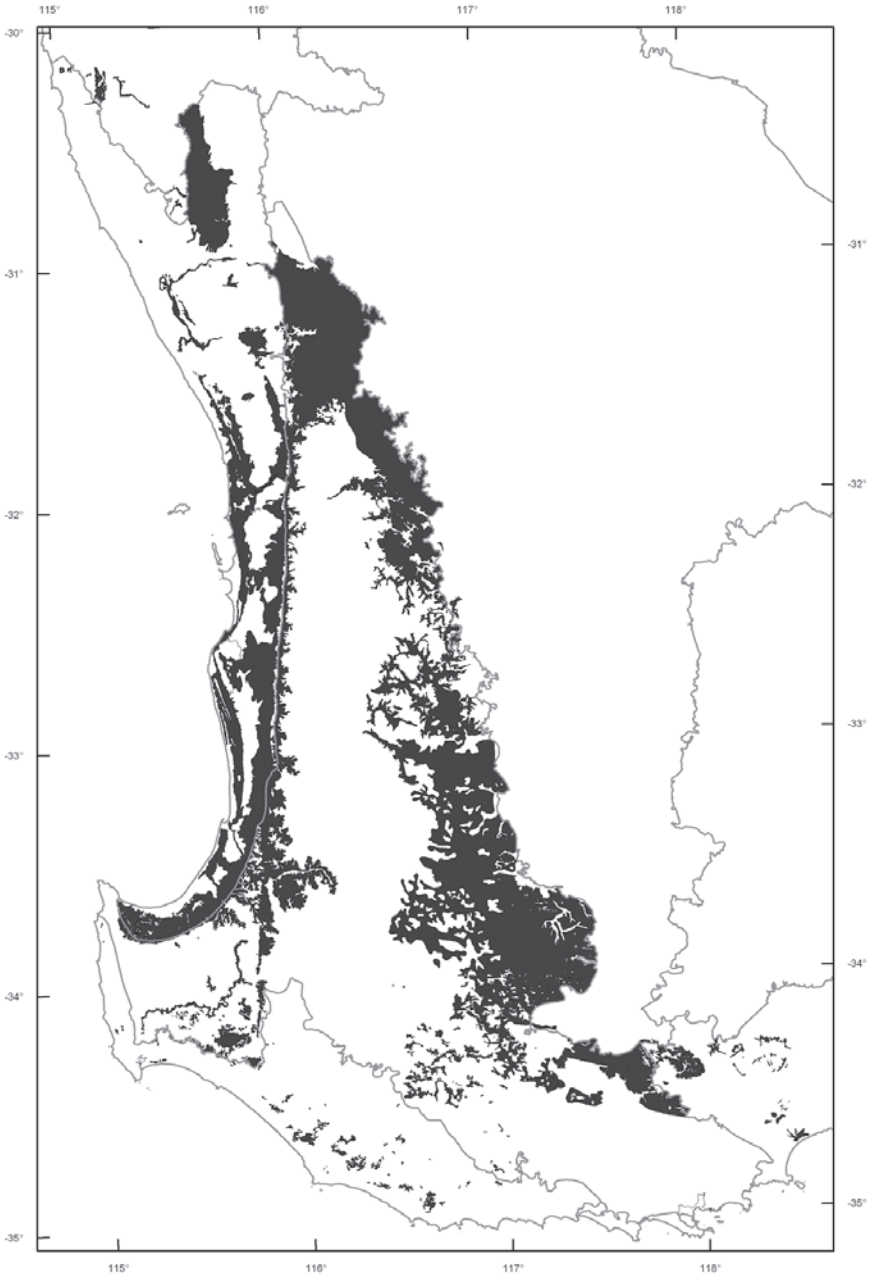


Figure 6. Vegetation Type 3: Woodland: jarrah, marri, wandoo, tuart and flooded gum.

Plate 4. Woodland: wandoo near Moora (photo by Ladislav Mucina).

Plain, and spreading across the coastal plain between Perth and Busselton, there are areas supporting a mosaic of jarrah–marri medium woodland, low banksia woodland, low melaleuca woodlands and forests in swampy areas and along drainage lines. Some *Casuarina obesa* (swamp sheoak) low woodland may also be present.

4. Woodland: Wheatbelt—York gum, salmon gum, etc; Goldfields—gimlet, redwood; Riverine—river gum; and Tropical—messmate, woolybutt.

This extensive vegetation type of other woodlands also with a cover of 10–30% pfc, features the York gum – salmon gum woodlands in the Avon Wheatbelt Bioregion, the mixed woodlands of the Coolgardie Bioregion, as well as the small areas of tropical woodlands in the Kimberley and the riverine woodlands in the Pilbara Bioregion. It occurs in 14 of the 26 bioregions and covers over 13.5 million ha (Fig. 7).

Large areas of *Eucalyptus loxophleba* (York gum), sometimes with *E. salmonophloia* (salmon gum), with an understorey of *Acacia acuminata* (jam) and *Allocasuarina huegeliana* 5–8 m tall, form an important component of the Avon Wheatbelt Bioregion. York gum reaches about 18 m in height in the west and prefers sand, sandy loam or loamy soils often with clayey subsoil. *Eucalyptus salmonophloia* (salmon gum), *E. salubris* (gimlet) and *E. longicornis* (red morel; Plate 5) extend throughout the Avon Wheatbelt and Mallee Bioregions. Salmon gum forms attractive stands to over 25 m in height, with stands on red, sandy loams generally having an understorey of *Melaleuca* shrubs, while stands on winter-wet soils and around salt lakes may have a ground layer of *Atriplex* (saltbush).

The woodlands in the Coolgardie Bioregion, where the rainfall is less than further west, are made up of a variety of eucalypt tree species all of which grow tall and straight to about 20 m. *Eucalyptus salmonophloia* (salmon gum; Plate 6) is widespread on red loamy soil, *E. transcontinentalis* (redwood) and *E. flocktoniae* (merrit) occur on sandy loams and tend to have shrubby understoreys with *Atriplex* and *Melaleuca*. *Eucalyptus torquata* (coral gum) and *E. lesouefii* (goldfields blackbutt) are characteristic of greenstone ridges and often have an understorey of small trees such as *E. campaspe* (silver-topped gimlet), *E. clelandii* (Cleland's blackbutt), *Allocasuarina cristata* and *Grevillea nematophylla* and an open shrub layer of mainly *Eremophila* spp. Woodlands of *E. kondininensis* (Kondinin blackbutt) in the Avon Wheatbelt and Mallee Bioregion, *E. gracilis* (yorrell) and *E. melanoxylon* (black morrel) occur on more saline soils, with an understorey that includes saltbush and *Maireana* (bluebush). The two types of understorey, saltbush and bluebush, change independently of the overstorey and presumably are controlled by soil pH.

Eucalyptus occidentalis (flat-topped yate) and *Melaleuca* spp. (paperbark) form medium woodlands in swampy areas in the Warren Bioregion. Yate also occurs in small pockets in swamplands and steep river valleys along the south coast in the Esperance Plains Bioregion.

Several of the woodlands described above form mosaics with mallee communities (Mosaic 102; Fig. 69), open mallee steppe (Mosaic 104; Fig. 71) and succulent steppe with open low woodland (Mosaic 105; Fig. 72).

Eucalyptus camaldulensis (river gum) grows along drainage lines throughout the state from about Eneabba north, mainly in the area experiencing summer rainfall (Fig. 7). In three small areas on watercourses in the western Kimberley, *Eucalyptus camaldulensis* (river gum) occurs with *Terminalia platyphylla* and *Corymbia papuana* s.l. (ghost gum) and may be associated with *Ficus coronulata* (river fig), *F. racemosa* (stem-fruit fig), *Adansonia gregorii* (boab) and *Nauclea orientalis* (Leichhardt pine). Smaller (<10 m) trees of *Melaleuca* spp., *Bauhinia cunninghamii*, *Acacia* spp. and *Brachychiton* spp. may form dense fringes along river channels. A grass layer of *Chrysopogon* spp. (ribbon grass) and/or *Dichanthium* ssp. (blue grass) is usually present. The rivers of the Pilbara Bioregion are lined with either *Eucalyptus camaldulensis* (river gum) and/or *E. victrix* (coolibah; Plate 7). On the river floodplains in the Gascoyne Bioregion, the banks and islands carry dense marginal vegetation with *E. camaldulensis* to 18 m. *Acacia aneura* s.l. (mulga), *A. citrinoviridis* and *A. grasbyi* (miniritchie) occur as subordinate trees, with a shrub layer below. In the south-west of the state, the equivalent habitats are occupied by *Eucalyptus rudis* (flooded gum): here it forms medium woodland that may include *E. patens* (yarri) and *E. megacarpa* (bullich), and there may be an understorey of

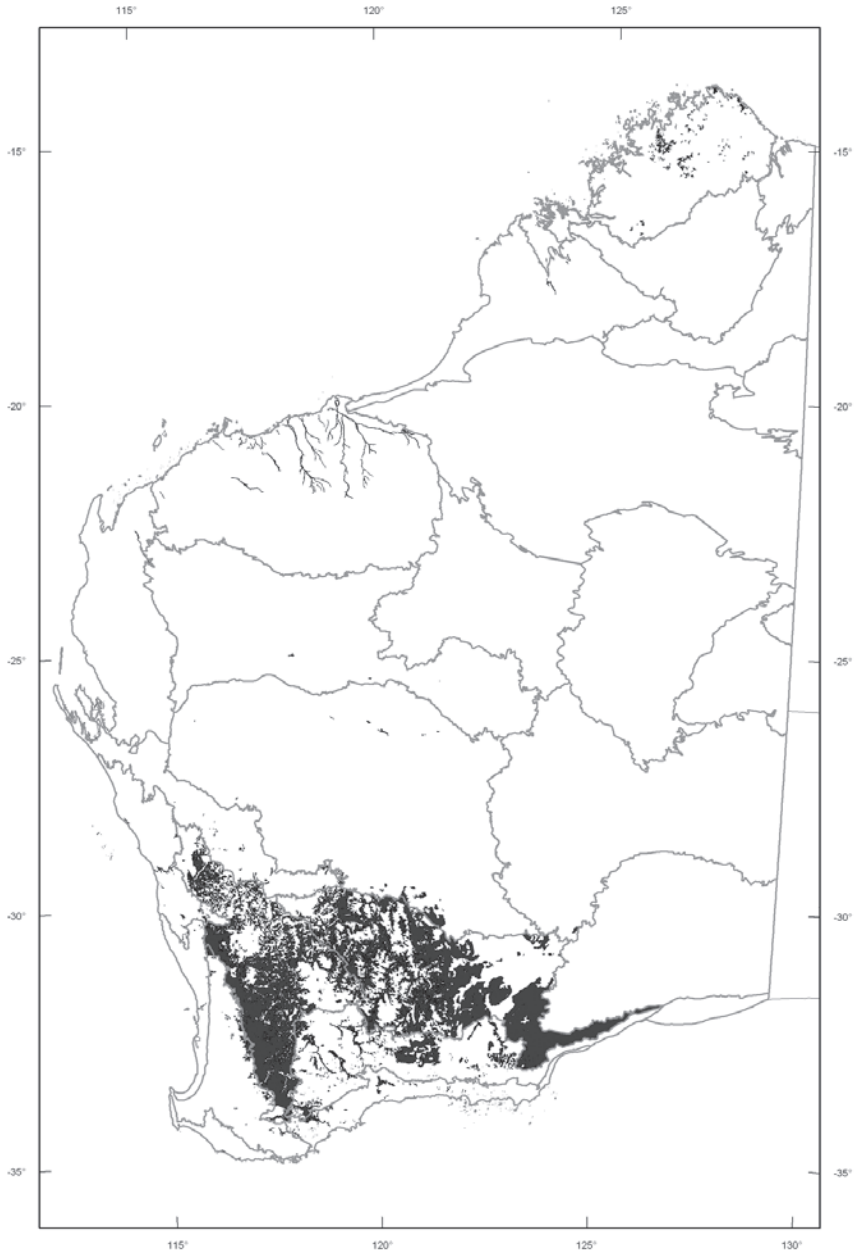


Figure 7. Vegetation Type 4: Woodlands.

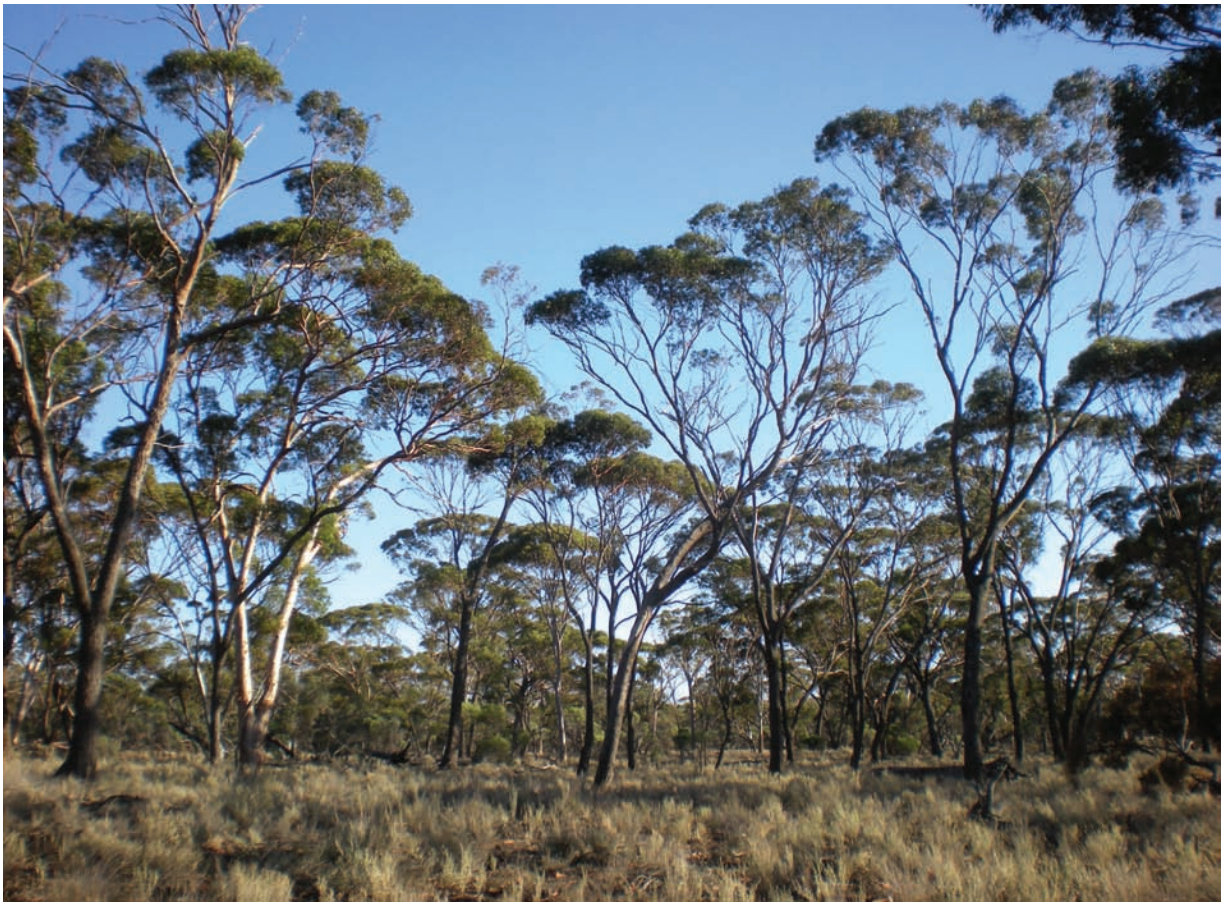


Plate 5. Wheatbelt woodland: red morrel near Goomalling (photo by Judith Harvey).

Plate 6. Goldfields woodland: salmon gum near Lake Johnson (photo by Judith Harvey).

Plate 7. Riverine woodlands: coolibah at Millstream–Chichester National Park (photo by Ladislav Mucina).

Plate 8. Tropical woodland of stringybark and woolybutt on the Mitchell Plateau (photo by John Beard).

Agonis flexuosa (peppermint). On the margins of the upper Blackwood River there may also be *E. marginata* (jarrah) and *Corymbia calophylla* (marri).

In the Northern Kimberley Bioregion, *Eucalyptus tetrodonta* (Darwin stringybark) and *E. miniata* (woolybutt; Plate 8) form a tropical woodland (154,000 ha), often with an understorey of palms (*Livistona eastonii*, fan palm). These occur on the Mitchell Plateau on red clay-loams of the lateritic profile (Fig. 7; northern woodlands). The tall, straight eucalypts reach to nearly 20 m. Associated species include small trees of *Terminalia* spp. and *Erythrophleum chlorostachys* (ironwood), and shrubs of *Grevillea* spp. and *Cochlospermum fraseri.*

5. Medium–low woodland: York gum and cypress

This vegetation type is a mixture of medium (10–30 m) and low (<10 m) woodlands and is transitional between the shrublands of the South West and the mulga woodlands to the north (Plate 9). There is an incomplete canopy with 10–30% pfc. This vegetation type is largely confined to the north-west corner of the Coolgardie Bioregion, where it covers over 172,000 ha (Fig. 8).

Eucalyptus loxophleba (York gum) to 10–15 m and *Callitris columellaris* (white cypress pine) to 8 m form medium to low woodland on red earth soil rising from drainage lines. The York gums are taller in the south,

Plate 9. Medium–low woodland: Cypress near Toolonga (photo by Greg Keighery).

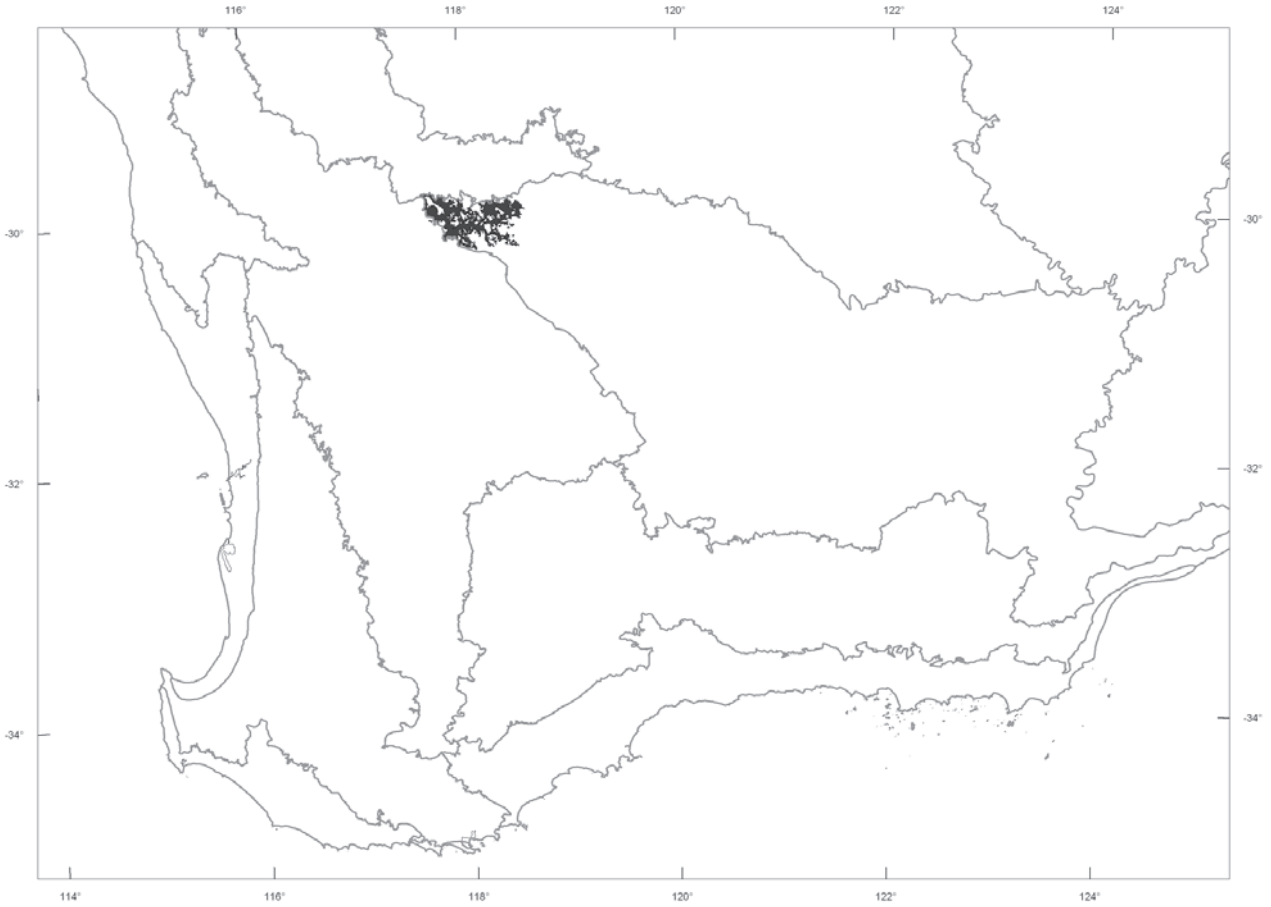


Figure 8. Vegetation Type 5: Medium–low woodland: York gum and cypress.

becoming lower as conditions become drier. The understorey is of variable density and includes *Acacia acuminata* and *A. resinimarginea*. *Callitris* occasionally becomes dominant as a low woodland of 5–8 m over dense thickets of *Acacia* spp. On low-lying red loams *E. salubris* occurs with sparse *Callitris columellaris* (white cypress pine).

6. Low forest: acacia, peppermint, coastal moort, Rottnest pine or mixed tropical forest

Low forest is a closed formation consisting of trees <10 m tall, with 70–100% pfc. This is an uncommon formation in Western Australia, covering nearly 78,000 ha (Figs. 9–12). It is, however, widespread and varied, ranging from the tropical deciduous rain forests in the Kimberley to the low moort forests on islands off the south coast.

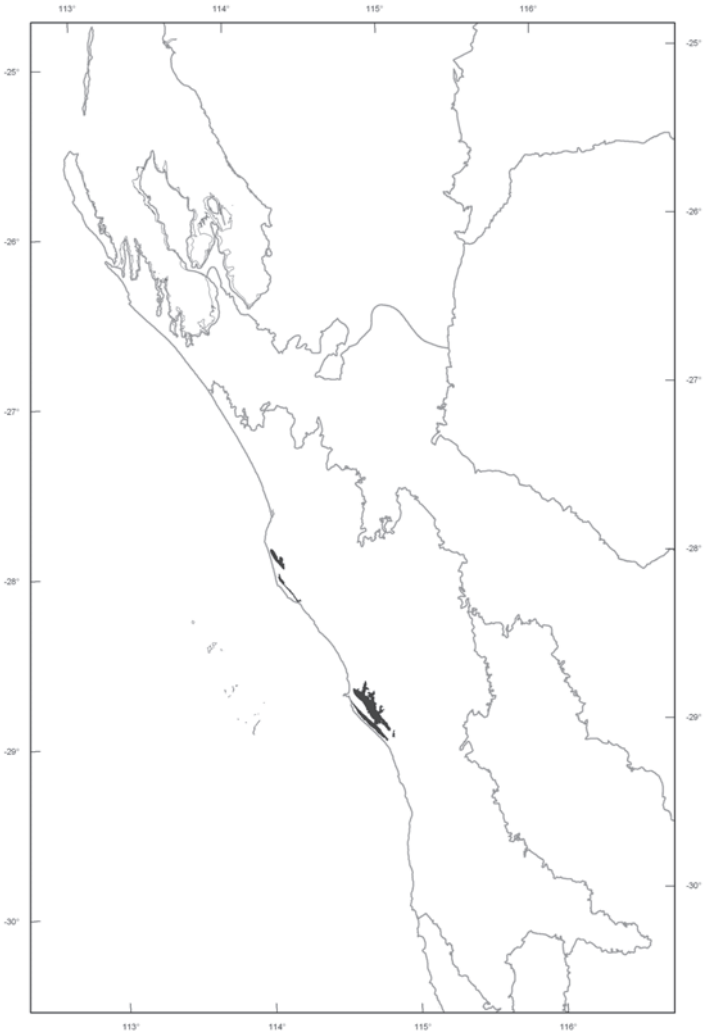
The largest association in this vegetation type, covering nearly 33,000 ha in the Geraldton Sandplain Bioregion (Fig. 9), is the *Acacia rostellifera* (summer-scented wattle) low forest that occurs south-east of Geraldton and 50 km north near Hutt Lagoon. These stands occur on alluvial flats and are a taller version (to 10 m) of the *A. rostellifera* (summer-scented wattle) thickets that occur on coastal dunes from Geraldton to east of Esperance.

Eucalyptus platypus (moort) occurs on heavy clay soils scattered through the Mallee Bioregion (Fig. 10) with *E. annulata* (open-fruited mallee), *E. spathulata* (swamp mallet) and *E. diptera* (two-winged gimlet). Trees are 3–5 m tall with little or no understorey. On Bald Island, an isolated granite boss 2 km off the Albany coast, *Callitris* occurs with *Eucalyptus lehmannii* (Bald Island marlock) and *Melaleuca lanceolata* as a low forest. Further east, *E. lehmannii* and *E. cornuta* (yate) low forest occurs on the islands of the Recherche Archipelago.

Callitris preissii (Rottnest Island pine; Fig. 10, Plate 10) and *Acacia rostellifera* (summer-scented wattle) occur on Garden Island (Fig. 11). *Callitris preissii* and *Melaleuca lanceolata* low forest is thought to have been the original vegetation on the coastal dunes on Rottnest Island and the adjacent mainland, prior to the clearing and burning associated with early European settlement.

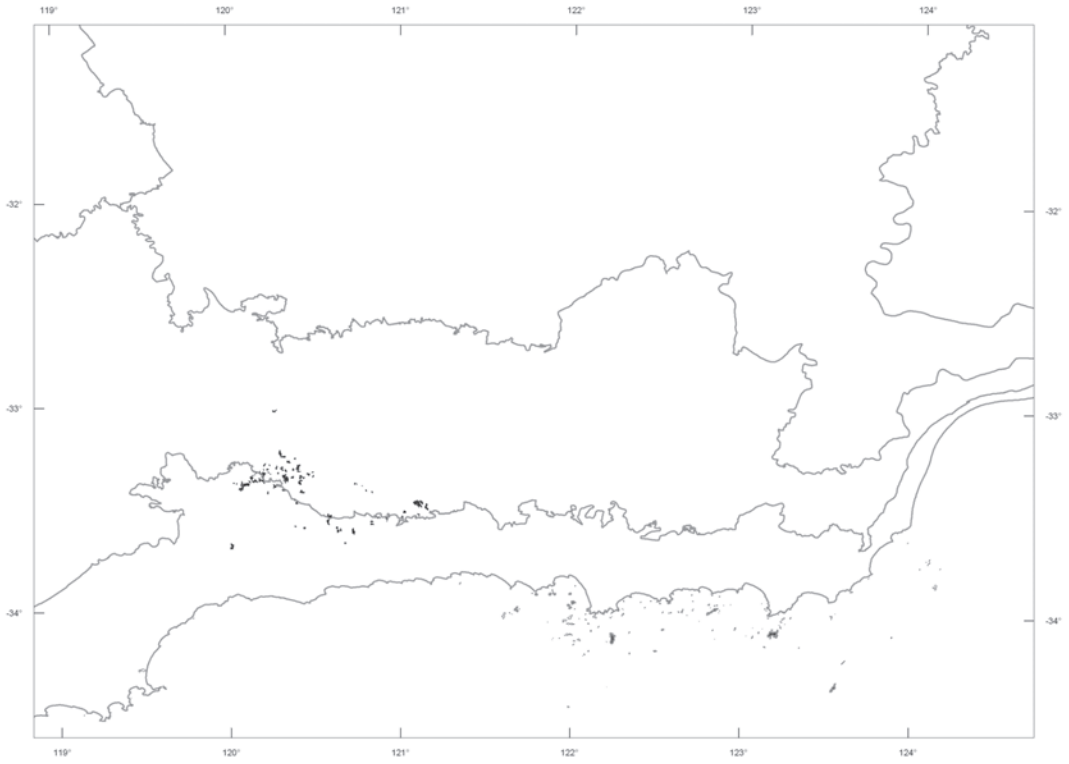
The paperbark tree *Melaleuca rhaphiophylla* (swamp paperbark) forms a low forest in deep swamps in the Warren and southern Jarrah Forest Bioregions (Fig. 11) and in patches too small to show at the 1:3,000,000 scale in Esperance Bioregion (Plate 11). There is usually an understorey of rushes.

In the Kimberley, pockets of mixed tropical deciduous and semi-deciduous forest and vine thicket occur on sheltered scree slopes and on mudflats (Fig. 12, Plates 12 and 13). The pockets are small: for example, the 84 patches



LEFT: Figure 9. Vegetation Type 6: Low forest, central west; acacia.

BELOW: Figure 10. Vegetation Type 6: Low forest, south; moort.



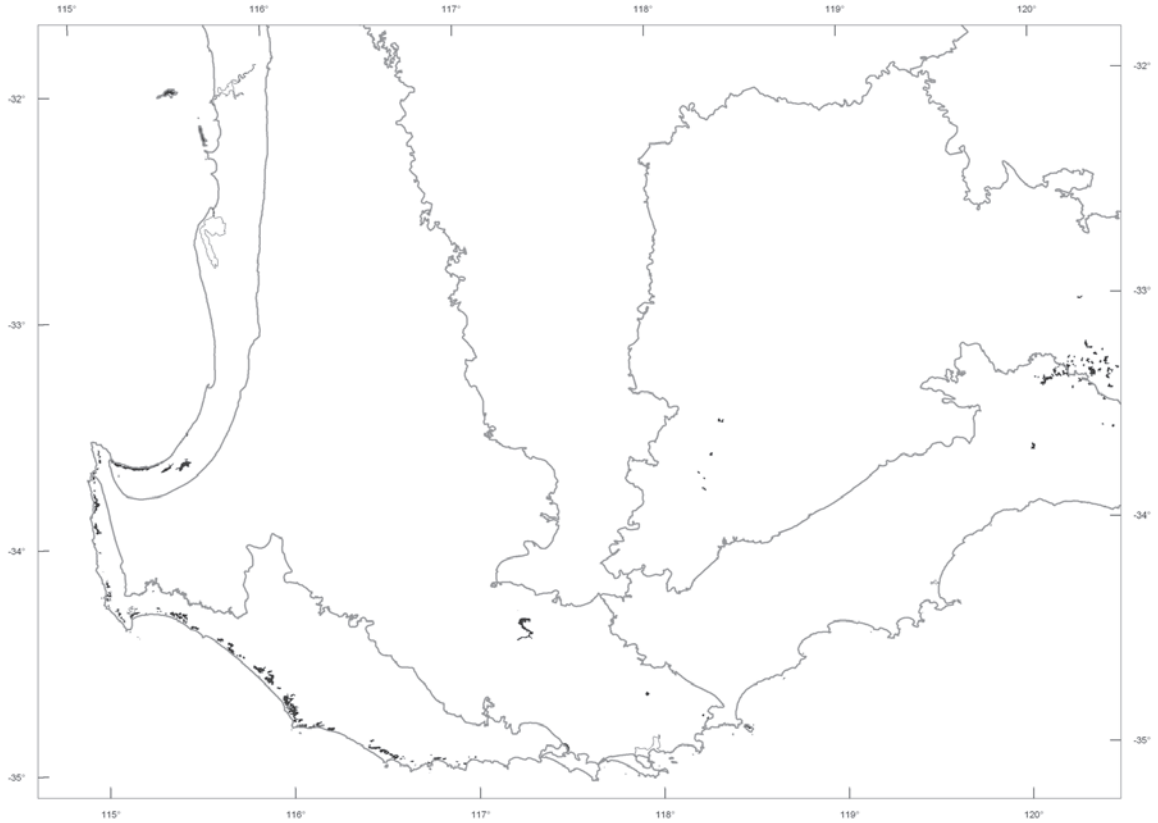


Figure 11. Vegetation Type 6: Low forest, south-west; Rottnest pine, acacia or melaleuca.

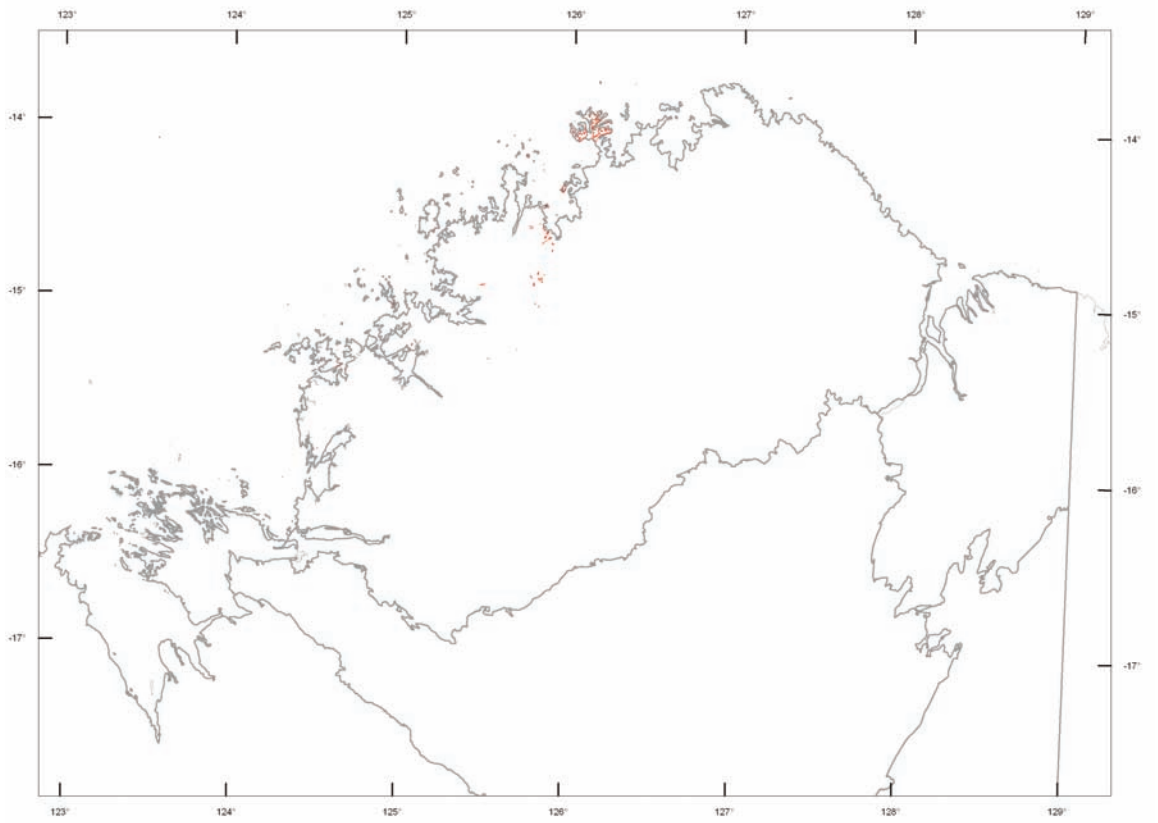


Figure 12. Vegetation Type 6: Low forest, mixed tropical forest.

Plate 10. Low forest: callitris over pellitory on Garden Island (photo by Greg Keighery).

in the database range in size from 5 ha through to 381 ha in size, and there are many more that are too small to map even at the scale of 1:250,000. These dry monsoonal rainforests are of interest botanically as they contain Western Australia's only examples of rainforest biota, and they provide a marked contrast to the surrounding savannas.

It is possible that some of the associations that comprise Vegetation Type 6 were more common and widespread at the time of European settlement, but were reduced by changed fire regimes prior to mapping.

Plate 11. Low forest: melaleuca near Hopetoun (photo by Ladislav Mucina).

Plate 12. Low forest: mixed tropical forest near Beagle Bay on the Dampier Peninsula (photo by Greg Keighery).

Plate 13. Low forest: mixed tropical forest in Prince Regent National Park (photo by Norm McKenzie).

7. Low forest, low woodland, low woodland with scattered trees: jarrah, banksia and casuarina

Vegetation Type 7 includes a variety of low forest and woodland formations, dominated mainly by jarrah (Plate 14) but including banksias, casuarinas and other species of eucalypts. Low forest and low woodland are both dominated by trees <10 m in height but they are separated by cover: forest has a cover of 30–70% pfc and woodland a cover of 10–30% pfc. Scattered emergent medium trees (>10 m) may be present. These forests and woodlands

Plate 14. Low forest: jarrah near Young Siding (photo by Libby Sandiford).

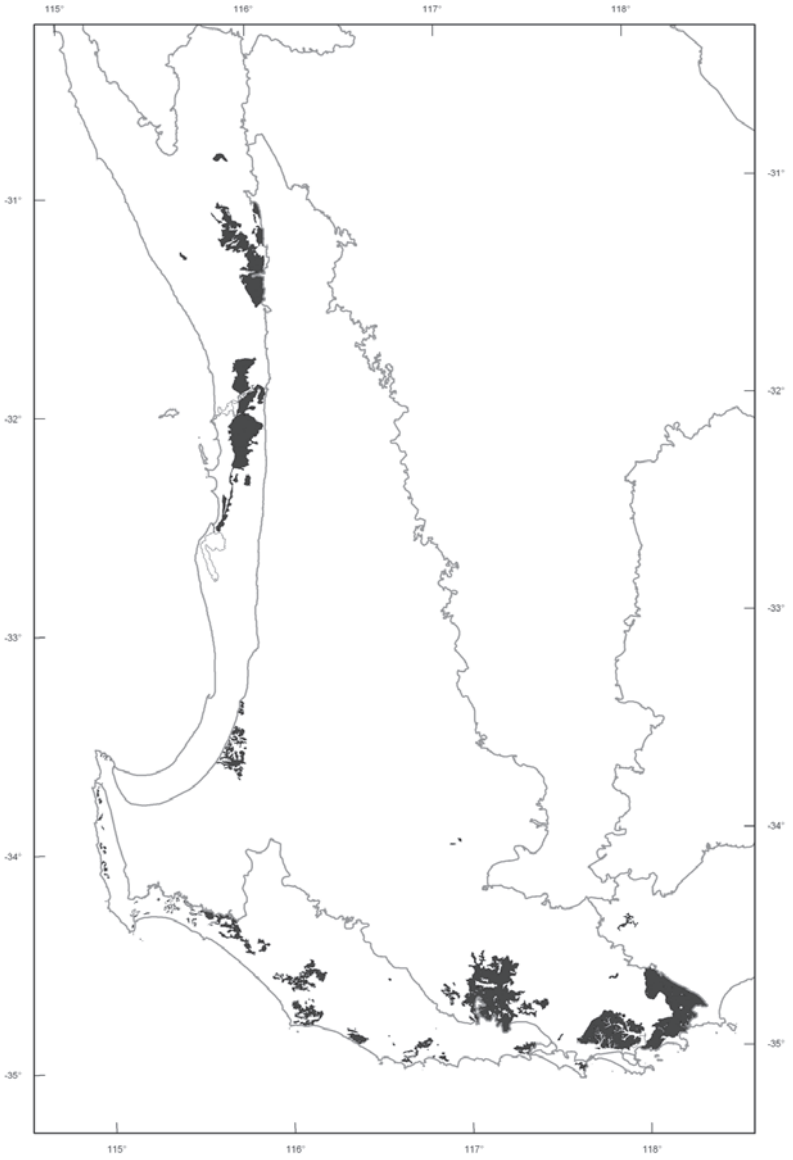


Figure 13. Vegetation Type 7: Low forest, low woodland, low woodland with scattered trees.

are found in the south coastal areas of the Jarrah Forest and Swan Coastal Plain Bioregions. They cover a total area of over 325,000 ha (Fig. 13).

Eucalyptus marginata (jarrah) low forest is the major component of this vegetation type, covering over 94,000 ha. It occurs on extremely poor siliceous soils in the south eastern Jarrah Forest Bioregion north of Albany. Scattered stunted, crooked trees may emerge to 15 m from a lower stand with thinner, more crowded stems over a mixed sclerophyll understorey (Plate 14). *Allocasuarina fraseriana* (sheoak) occurs nearby on deeper soils, generally with a sparse shrub understorey and a herb layer. *Eucalyptus decipiens* (redheart) and jarrah occur in small patches (sometimes as low woodland rather than low forest) in valleys in the Stirling Range. *E. staeri* (Albany blackbutt) also forms a low forest with jarrah, and sometimes replaces jarrah on the poorly-drained bleached sands over laterite on high rainfall sites near the south coast.

Low woodland of jarrah and banksia occurs on patches of deep sand that extend south from the Jarrah Forest Bioregion into the Warren Bioregion. This association is common between the tall forest and the coastal heaths and swamps.

Open or sparse jarrah–marri woodland (12–15m) emerges from a low woodland mid-storey of *Banksia menziesii* (firewood banksia), *B. attenuata* (slender banksia) and *Allocasuarina fraseriana* (sheoak). This association originally covered some 76,000 ha of the Swan Coastal Plain Bioregion. In parts of the bioregion where the rainfall is higher, the jarrah may approach a monoculture. Banksias develop well on the deeply leached siliceous sands of the coastal plain, while the sheoak is more common inland from Perth. There is a complex heath understorey of shrubs and sedges.

Low *Agonis flexuosa* (peppermint) forest has been placed in this vegetation type. It occurs in patches in sheltered sites in coastal regions from east of Albany to Perth (Peppermint Grove).

8. Low woodland, open low woodland and sparse woodland: mulga

The most extensive vegetation type in Western Australia is the *Acacia aneura* s.l. (mulga) low woodland (10–30% pfc), open low woodland (<10% pfc) and sparse woodland (negligible pfc) type (Plate 15). Covering over 36 million ha, low woodlands of *Acacia aneura* s.l. (mulga) and associated species (mainly acacias) are distributed throughout the Murchison, Gascoyne, Great Victoria Desert, Central Ranges and Pilbara Bioregions and they extend into the Gibson Desert, Little Sandy Desert, Nullarbor and Yalgoo Bioregions (Fig. 14). Mulga (3–6 m high) is mapped as low woodland (26 million ha), open low woodland (396,000 ha) or very scattered trees (8 million ha).

Associated species include *Allocasuarina cristata* in the Murchison Bioregion, and *Acacia eremaea* (snakewood) and *A. victoriae* (bardi) in the Gascoyne Bioregion. The composition of the ground layer of ephemeral herbs and grasses varies with the season and amount of rainfall. *Acacia aneura* s.l. occurs at its northern limits in the southern Pilbara Bioregion where it covers the valley plains (Plate 15). It has the unusual understorey of shrubs of *Eremophila* spp. and *Senna* spp. and annuals such as *Ptilotus nobilis* (tall mulla mulla). In the northern Great Victoria Desert Bioregion, mulga occurs on hills and breakaways and between the sandhills where the soil texture is too fine to support the usual open tree and mallee steppe (hummock grassland with scattered eucalypts over mallee (Vegetation Type 37). Associated species include *A. quadrimarginea* and *A. tetragonophylla* on and near the breakaways, and *A. pruinocarpa* (gidgee) and *A. linophylla* (bowgada) between the dunes. The understorey may contain *Eremophila latrobei* (warty fuchsia bush), *Senna* spp. and *A. aciphylla.* The best development of *Acacia aneura* s.l. occurs on the plains of the Murchison Bioregion with deep red loams overlying a siliceous hard

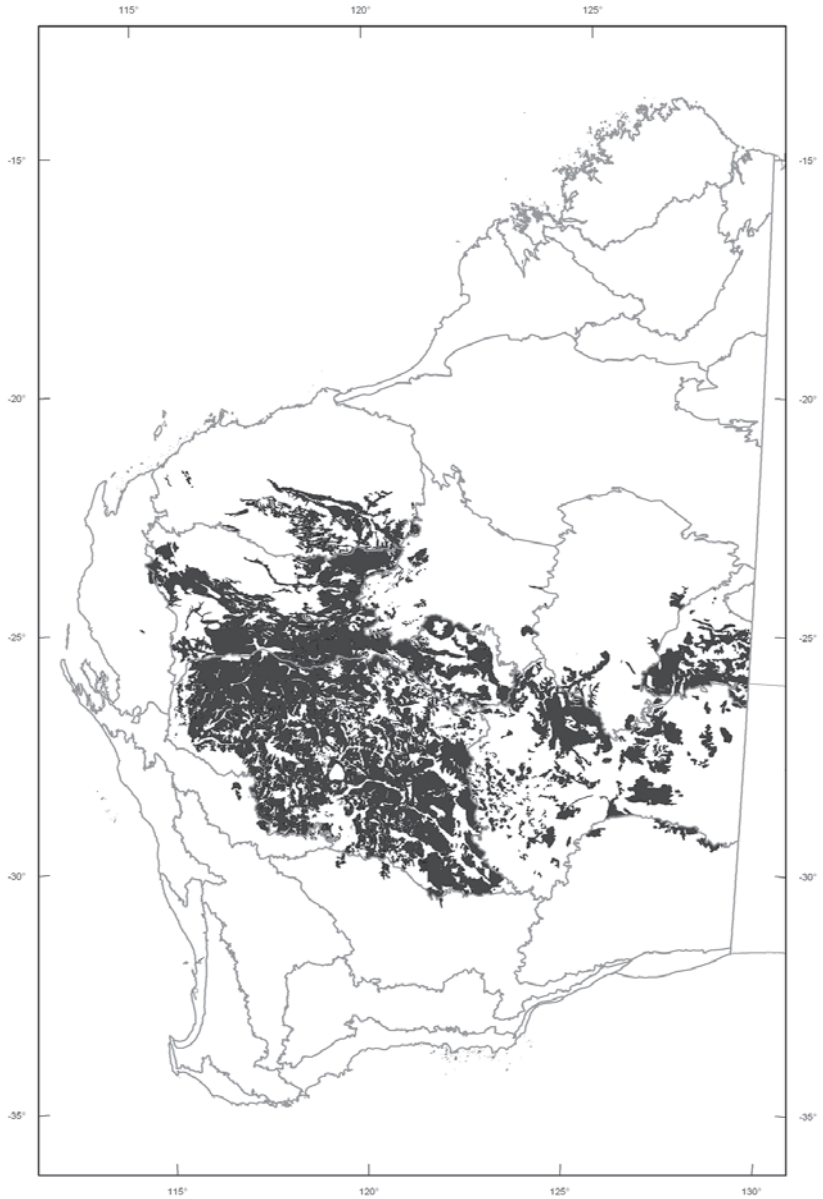


Figure 14. Vegetation Type 8: Low woodland, open low and sparse woodland; mulga.

Plate 15. Low woodland: mulga in the Pilbara (photo by Stephen van Leeuwen).

pan. Here it forms tall dense stands. There are now 12 species within *Acacia aneura* (Maslin & Reid 2012), but it is not possible to differentiate them here. One distinct form with a horizontal branching habit can be found on the calcrete platforms on Byro Station, which is near the junction of the Murchison, Carnarvon and Gascoyne Bioregions.

The *Acacia aneura* s.l. (mulga) and *A. xiphophylla* (snakewood) low woodland in the Gascoyne Bioregion (700,000 ha) generally occurs lower in the landscape than the more common association of *Acacia aneura* s.l. (mulga) and *A. xiphophylla* (snakewood) scrub (1.6 million ha). The latter is classified in Vegetation Type 15 (Scrub), along with a scrub association of *Acacia aneura* s.l. (mulga) and *A. ramulosa/A. linophylla* (bowgada). Low or open low *Acacia aneura* s.l. (mulga) woodland over *Acacia ramulosa/ A. linophylla* (bowgada) scrub falls into Vegetation Type 13 (Scrub with woodland or scattered trees).

9. Low woodland, open low woodland: other species

This vegetation type (Plate 16) includes the low tree (<10 m) woodlands (10–30% pfc) and open low woodlands (<10% pfc) dominated by species other than *Acacia aneura* s.l. (mulga). This type occurs throughout the southern parts of the state, particularly in the Carnarvon, Swan Coastal Plain, Yalgoo, Great Victoria Desert, Murchison and Gascoyne Bioregions and covers over 2.5 million ha (Fig. 15). The dominants include acacia, banksia, peppermint, cypress pine, casuarina and York gum.

Several species of *Acacia*, occurring in a variety of combinations, form extensive low woodlands in the Carnarvon Bioregion. These include *Acacia victoriae* (bardi), *A. xiphophylla* (snakewood), *Acacia subtessarogona, A. ramulosa* and *A. linophylla* (bowgada). Beard's 'a_9' code referred to the two acacias, *Acacia ramulosa* and *A. linophylla.* Only *Acacia linophylla* is now known commonly as 'bowgada' and *A. ramulosa* is called horse-wattle. Low woodland of *Acacia coriacea* (wirewood) is found in the Murchison and Gascoyne Bioregions.

Callitris columellaris (white cypress pine) and mulga (*Acacia aneura* s.l.), occasionally mixed with some *Eucalyptus loxophleba* (York gum), form low woodlands in the Yalgoo Bioregion. Understorey species include *Acacia hemiteles*, *Senna artemisioides* subsp. *petiolaris, Eremophila scoparia, E. decipiens, Maireana sedifolia* (bluebush) and *Ptilotus obovatus* (cotton bush).

Allocasuarina cristata low woodland is found mainly in the Great Victoria Desert Bioregion, on the calcareous hardpans around Lake Throssell and Lake Rason. This woodland extends into the Murchison and Coolgardie Bioregions.

LEFT: Figure 15. Vegetation Type 9: Low woodland, open low woodland; other than mulga.

BELOW: Plate 16. Low woodland: banksia near Perth (photo by Mark Bundrett).

Plate 17. Low woodland: melaleuca fringing Lake Angove near Albany (photo by Libby Sandiford).

Plate 18. Low woodland: sheoak near Gingin (photo by Ladislav Mucina).

Trees to 6–8 m in height of *Banksia attenuata* (slender banksia), *B. menziesii* (firewood banksia) and *B. prionotes* (acorn banksia) make up the low woodlands that are well developed on the deep siliceous sands in the Swan Coastal Plain Bioregion (Plate 16). These woodlands have a rich shrub understorey. This vegetation type continues on the limestone around Lancelin, but here the understorey is quite different. The low woodlands in this bioregion are anomalous in comparison with the surrounding vegetation types. Their low stature is due to environmental factors different from those of the low woodlands further inland.

Melaleuca rhaphiophylla (swamp paperbark) and *M. cuticularis* (saltwater paperbark) form low woodland communities along streamlines and around swamps in the Warren and Jarrah Forest Bioregions (Plate 17). Associated species include *Banksia verticillata* (Albany banksia) and various reeds and sedges.

Agonis flexuosa (peppermint) occurs as low woodlands on coastal and near-coastal calcareous dunes along the south and south-west coasts from near Albany in the Jarrah Forest Bioregion through the Warren Bioregion to Perth in the Swan Coastal Plain Bioregion. *Casuarina obesa* occurs around salt lakes in the Murchison, Avon Wheatbelt and Swan Coastal Plain Bioregions (Plate 18).

Allocasuarina huegeliana and *Eucalyptus loxophleba* (York gum) may form low woodland around granite rocks in the Avon Wheatbelt Bioregion. The understorey varies according to soil depth.

Also included in this vegetation type are the very sparse low woodlands of:

- *Acacia victoriae* and *A. xiphophylla* (snakewood) in the Pilbara and Carnarvon Bioregions;
- *Eucalyptus erythrocorys* (illyarrie) between Jurien Bay and Irwin River in the Geraldton Sandplain Bioregion, as a component of a mosaic with scrub-heath (see Vegetation Type 18); and
- *E. wandoo* (wandoo) and *E. accedens* (powderbark wandoo) in the Avon Wheatbelt Bioregion. This is also a component of a mosaic with scrub-heath (see Vegetation Type 19).

10. Mangroves

Mangroves are a vegetation type found on protected coasts and in estuaries and tidal creeks between the spring high tide level and mean sea level, from the Northern Territory – Western Australian border to Shark Bay, with small stands occurring on islands of the Abrolhos (too small to show on the map) and in the Leschenault Estuary (Figs. 17–20). Mangrove communities consist of trees and shrubs and they are best developed in the tropics. In the Kimberley Bioregions, they occur as a low to medium forest covering about 144,000 ha, whereas in the Pilbara Bioregion

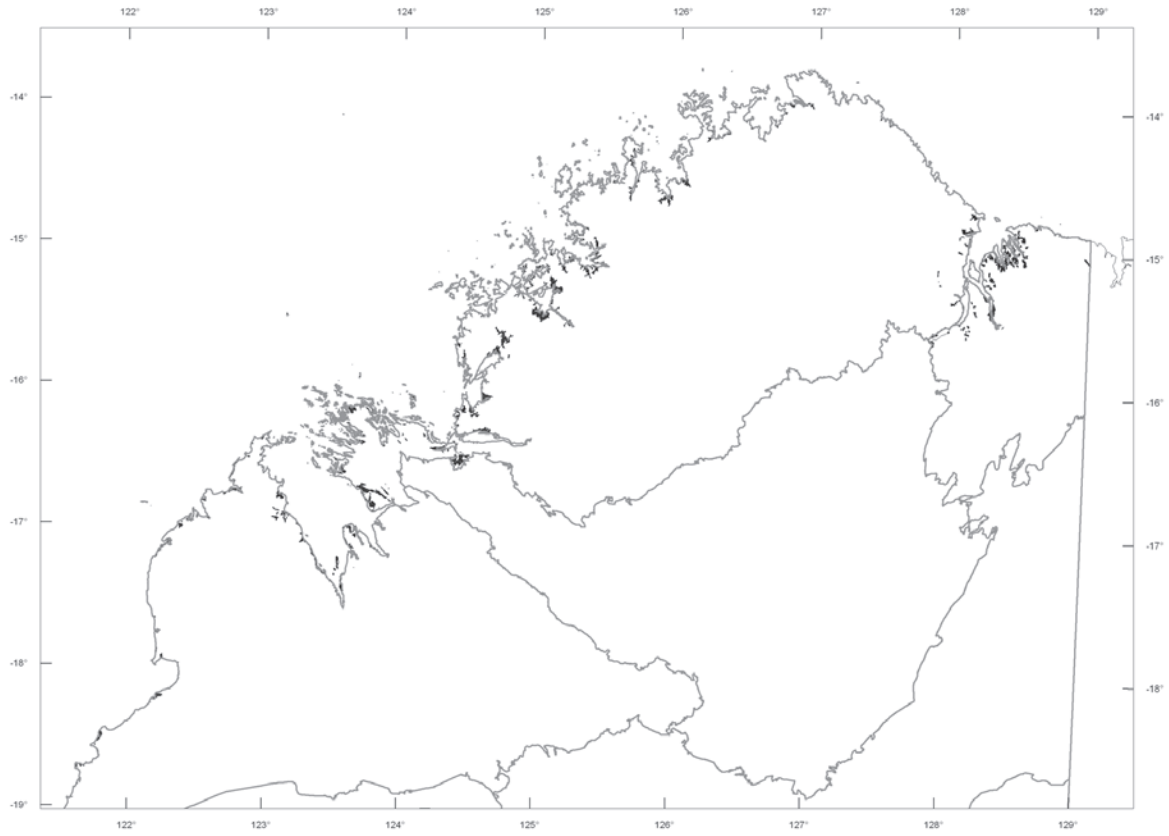


Figure 16. Vegetation Type 10: Mangroves, Kimberley.

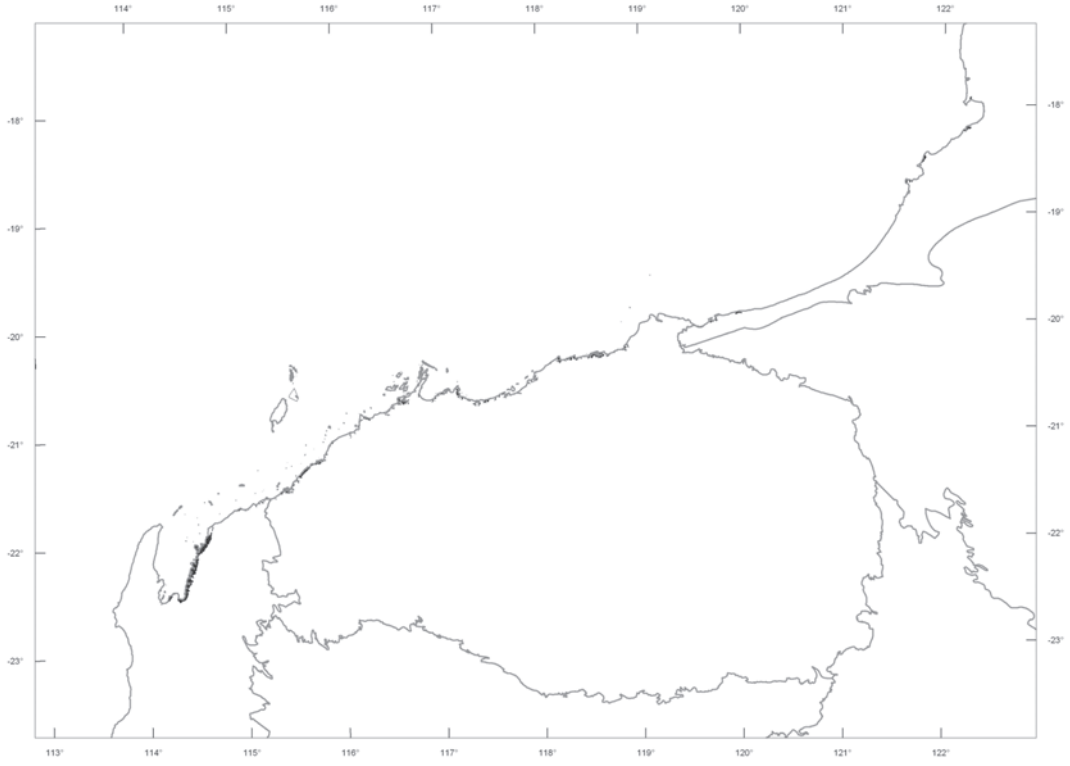


Figure 17. Vegetation Type 10: Mangroves, Pilbara.

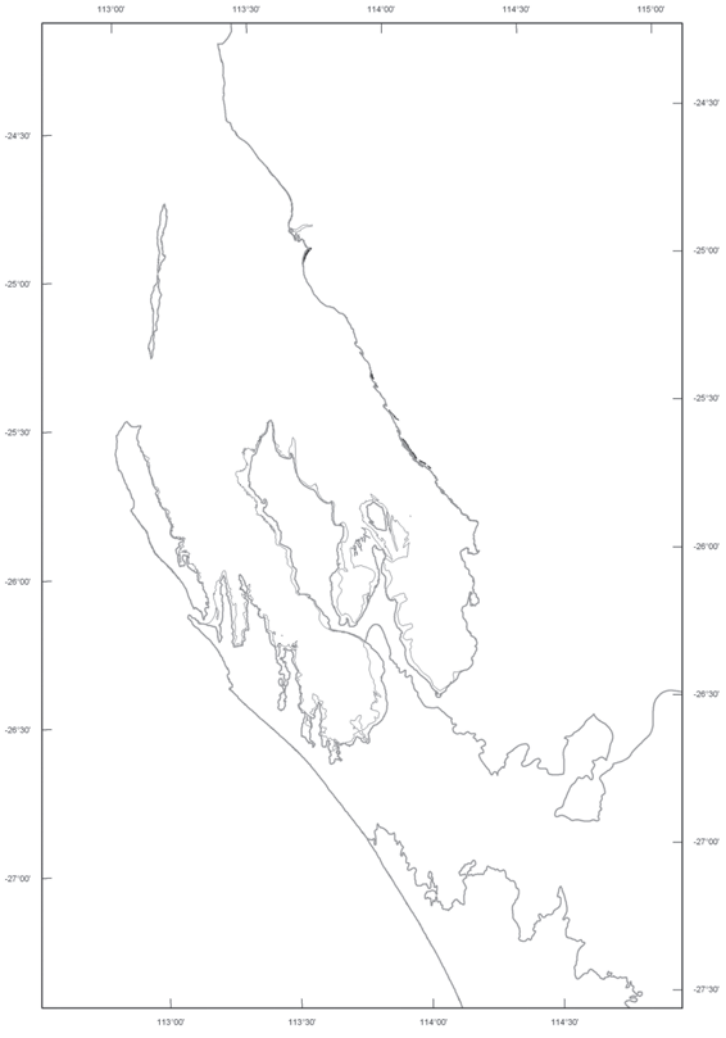


Figure 18. Vegetation Type 10: Mangroves, Carnarvon.

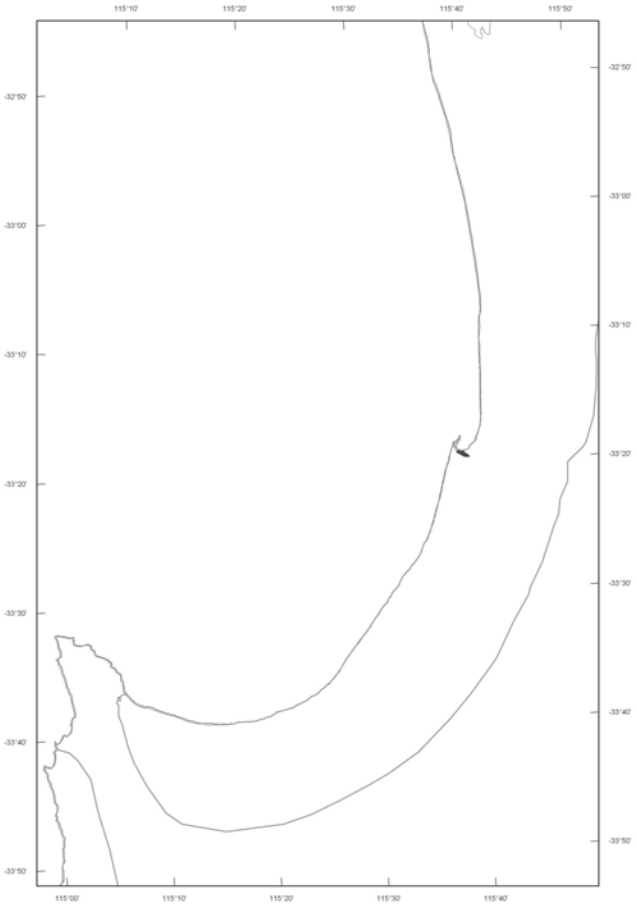


Figure 19. Vegetation Type 10: Mangroves, Swan Coastal Plain.

(15,000 ha) and the Carnarvon Bioregion (31,200 ha) they tend to form thickets.

Along the Kimberley coast (Fig. 16), on mud deposits adjacent to sandstone or basaltic substrates, mangroves can form extensive belts. Generally, mangroves are tallest (8–12 m, rarely up to 15 m) towards the seaward margins, declining in height inland. Mangroves typically consist of a single tree stratum growing in bare mud. Fifteen species have been recorded in the north: these include trees of *Avicennia marina* (white mangrove), *Rhizophora stylosa* (spotted-leaved red mangrove), *Bruguiera exaristata* (ribbed-fruited orange mangrove), *Sonneratia alba* (pornupan), *Camptostemon schultzii* (kapok mangrove) and *Ceriops tagal* (spurred mangrove), and shrubs of *Aegialitis annulata* (club mangrove) and *Aegiceras corniculatum* (river mangrove). Near Broome, the tall fringe is predominantly *Ceriops tagal* with *Bruguiera exaristata* in the inner zone.

In the Pilbara (Fig. 17), the deep-water fringe is dominated by *Avicennia marina* (white mangrove) with *Rhizophora stylosa* (spotted-leaved red mangrove) behind, and *Ceriops tagal* (spurred mangrove) on the landward edge. On gently sloping rises *Aegialitis annulata* (club mangrove) is found and *Aegiceras corniculatum* (river mangrove) lines the seaward ends of creeks.

In the shelter of Shark Bay in the Carnarvon Bioregion (Fig. 18), the coast is lined with the mangrove species *Avicennia marina* (white mangrove; Plate 19). The southern most occurrence of mangrove, *Avicennia marina* (white mangrove), is in the city of Bunbury (Fig. 19).

Plate 19. Mangroves in Shark Bay (photo by John Huisman).

Tall Shrubland

11. Tree heath

This is a formation that is classified according to the characteristics of the second stratum, which is composed of shrubs. The mixed sclerophyll shrub stratum is made up of shrubs to 2 m tall, with some emergent taller shrubs >2 m tall. There are emergent trees to 6 m. Tree heath is a feature of the northern part of the Geraldton Sandplains Bioregion, although there are very small areas of melaleuca tree-heath associated with swampy areas within the jarrah forests of the South West.

The unusual tree heath of the Yalgoo Bioregion consists of low trees, tall and low shrubs, herbs and grasses and is found over 347,000 ha of sandhill country south of Shark Bay (Fig. 21). The structureless red-brown sandy soil is swept into confused sand ridges. Low trees (to 6 m) and tall shrubs include *Banksia ashbyi* (Ashby's banksia) (Plate 20), *Grevillea gordoniana*, *Acacia ligulata* (umbrella bush), *A. longispinea*, *Melaleuca huegelii* ssp. (chenille honeymyrtle) and *M. pristicensis* (mindiyed) with mallees of *Eucalyptus obtusifolia*, *E. eudesmioides* and *E. mannensis* (Mann Range mallee). Smaller shrubs include *Adenanthos acanthophyllus*, *Alyogyne cuneiformis* (coastal hibiscus), *Anthocercis littorea* (yellow tailflower), *Anthotroche walcottii*, *Calytrix brevifolia* and many more. *Triodia danthonioides*, *Ptilotus nobilis* (tall mulla mulla), and *Trichodesma zeylanicum* (camel bush) may be found as the ground layer. This association contains many endemic species (restricted in distribution to a particular locality) such as *Eucalyptus beardiana* (Beard's mallee),

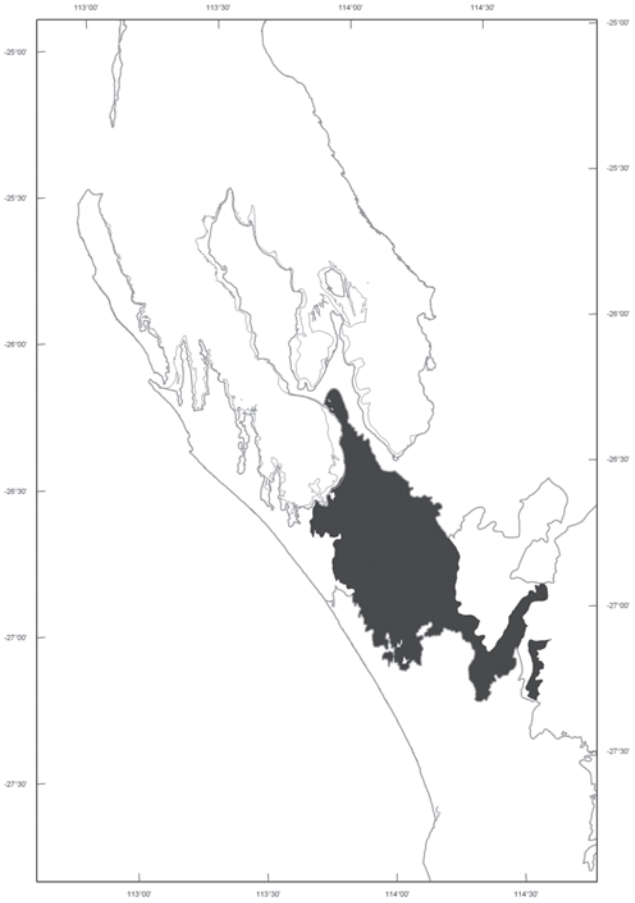


Figure 20. Vegetation Type 11: Tree heath, north.

Plate 20. Tree heath near Tamala Station (photo by Ladislav Mucina).

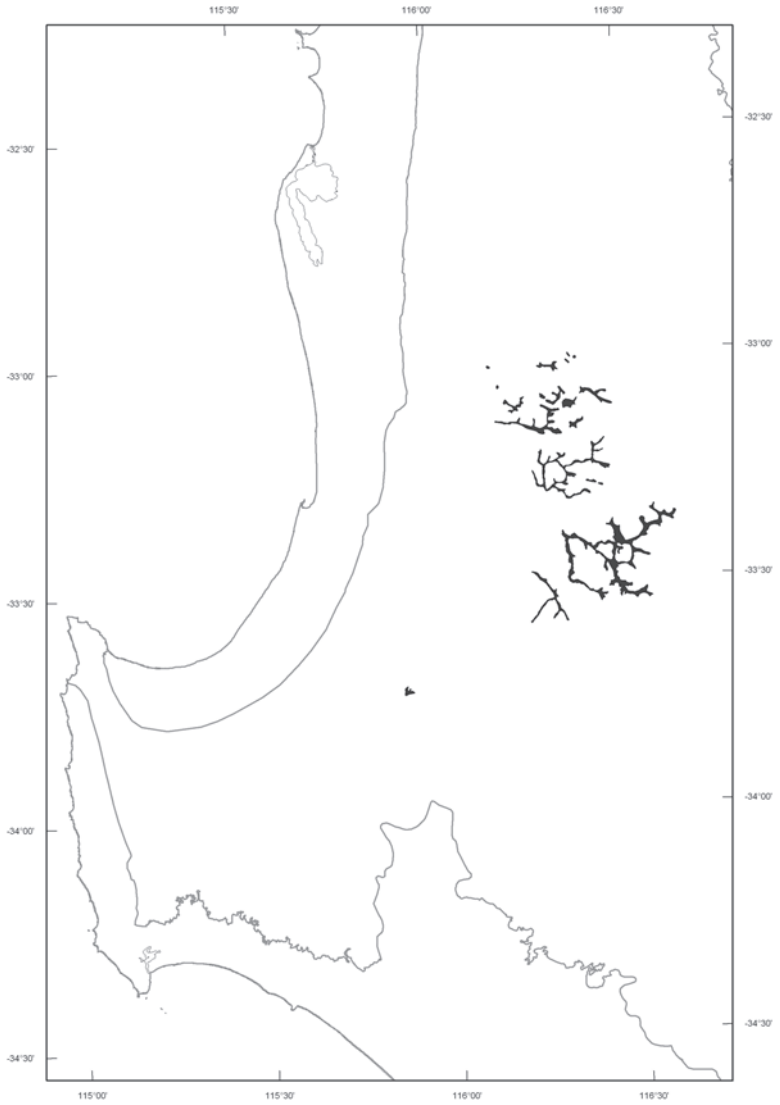


Figure 21. Vegetation type 11: Tree heath, south.

E. roycei (Shark Bay mallee), *Adenanthos acanthophyllus* and *Grevillea rogersoniana* (Rogersons' grevillea). It is suggested that the open, irregular nature of this vegetation type may protect it from fire.

In swampy areas within the Jarrah Forest Bioregion, *Melaleuca preissiana* (moonah) and *Banksia littoralis* occur over and adjacent to tea tree (*Melaleuca* spp.) thickets and sedgelands in patches totalling nearly 20,000 ha (Fig. 22).

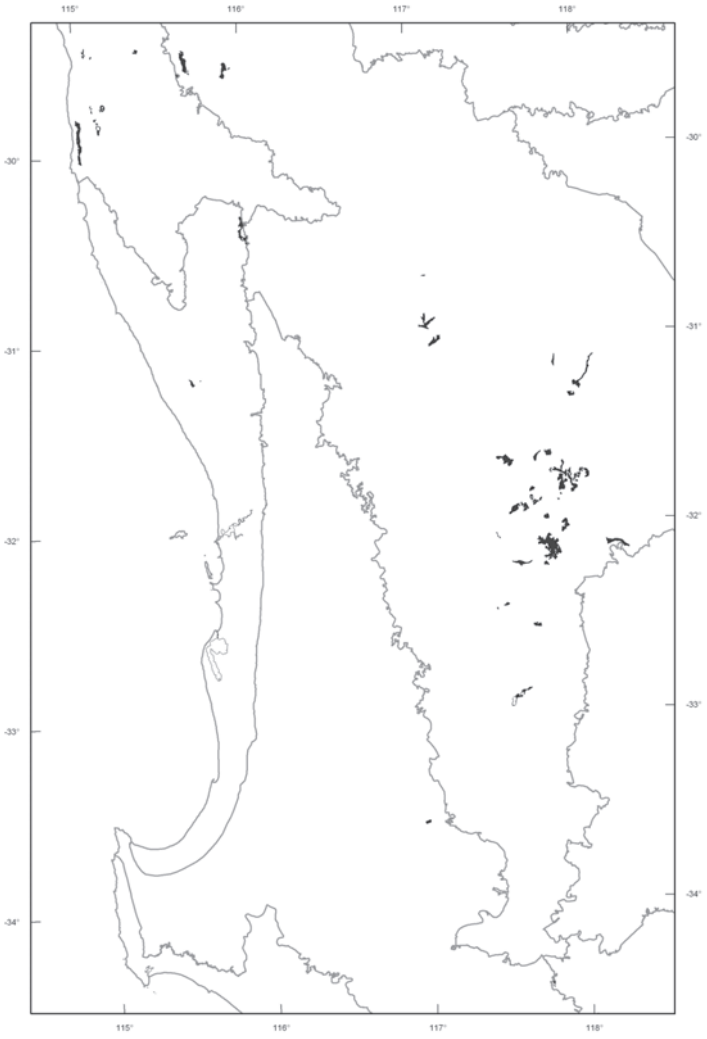
12. Thicket with scattered medium trees or scattered low trees

(Shown on the map in the colour of the thicket overlaid with or symbols.)

Thickets are composed of mid-dense shrubs >1 m in height. The formations included in this unit are thickets that have scattered, emergent trees of either medium height (between 10–30 m) or low (<10 m) woodland or scattered trees (Plate 21). Trees include *Eucalyptus loxophleba* (York gum), *E. occidentalis* (flat-topped yate), *E. wandoo* (wandoo), *E. rudis* (flooded gum) and *Allocasuarina* spp. (sheoak). Thickets with scattered medium or low trees occur on nearly 54,000 ha, half of which is in the Avon Wheatbelt Bioregion (Fig. 22).

Melaleuca thickets, commonly *M. uncinata* s.l. (broom bush) or *M. thyoides*, have scattered emergent trees of *Eucalyptus loxophleba* (York gum) of 8–15 m in height. These occur on drainage systems in the central Avon Wheatbelt Bioregion. Here and in the eastern part of this bioregion there is often a similar unit of scattered trees, thicket and samphire. South of the Irwin River in the Geraldton Sandplain Bioregion are three small patches of scattered *E. camaldulensis* (river gum) over *M. thyoides* thicket to 2.5 m, confined to wet depressions in the edge of the coastal limestone deposits.

Allocasuarina campestris thickets with scattered *Eucalyptus wandoo* (wandoo) are found on coarse sandy soils adjacent to the granite rock outcrops in the central Avon Wheatbelt Bioregion. Other shrub species present here include *Acacia* sp. aff. *linophylla*, *A. stereophylla* and *A. neurophylla* over a lower layer of the sedge *Ecdeiocolea monostachya*. *Allocasuarina campestris* thickets also have



LEFT: Figure 22. Vegetation Type 12: Thicket with scattered medium trees or scattered low trees.

BELOW: Plate 21. Thicket with trees, near Lake Bryde (not mapped; photograph by Ecoscapes).

emergent *Acacia acuminata* (jam) and *Allocasuarina huegeliana* low trees further north in the Avon Wheatbelt Bioregion. To the south, in low-lying areas north of Kojonup, scattered *Eucalyptus wandoo* (wandoo) and *E. occidentalis* (flat-topped yate) occur over a tea tree thicket that is dominated by *Beaufortia micrantha* (little bottlebrush) and *Kunzea ericifolia* (spearwood).

Scattered low trees of *Casuarina obesa* (swamp sheoak) occur over thicket of *Melaleuca thyoides* on the eastern fringe of the playa (dry salt) lakes just in from the coast in the southern Geraldton Sandplains Bioregion.

Low *Eucalyptus wandoo* (wandoo) and *E. accedens* (powderbark wandoo) emerge from *Allocasuarina campestris, Grevillea petrophiloides* and dryandra thickets on a lateritic ridge just west of Three Springs, and form a *Melaleuca uncinata* s.l. (broom bush) thicket in a small patch south-west of Three Springs.

13. Scrub with open woodland, scattered trees

(Shown on the map in the colour of the scrub overlaid with symbol.)

This vegetation type, covering nearly 3 million ha, has a more open shrub layer than the previous unit and is composed mainly of acacia with emergent eucalypts and sheoaks (Plate 22). Medium trees over scrub occur mainly in the central Geraldton Sandplains Bioregion extending through the northern Avon Wheatbelt, Yalgoo and Coolgardie Bioregions, with two small patches in the Murchison Bioregion. In drier areas the tree layer is lower. Low trees over scrub associations extend over 2.9 million ha, predominantly in the Yalgoo Bioregion and extending into the Murchison, Gascoyne and Carnarvon Bioregions (Fig. 23).

Acacia acuminata (jam) and *Hakea pycnoneura* scrub, often with scattered *Eucalyptus loxophleba* (York gum) taller than 10 m, is found covering the dissected country on Proterozoic rocks from north of Geraldton to around Northampton. *Acacia rostellifera* (summer-scented wattle) is also present with the jam under York gum in the upper reaches of the Irwin River, west of the Darling fault.

Medium height *Allocasuarina huegeliana* is an emergent from the *Acacia acuminata* (jam) scrub in the northern Avon Wheatbelt Bioregion. Elsewhere in this bioregion, *Acacia acuminata* (jam) scrub with scattered York gum occurs in the valleys, while the hill slopes support *Allocasuarina campestris* thicket. To the north-west, in the Yalgoo Bioregion, a similar valley vegetation is associated with *Acacia ramulosa* and *A. linophylla* (bowgada) scrub on rises.

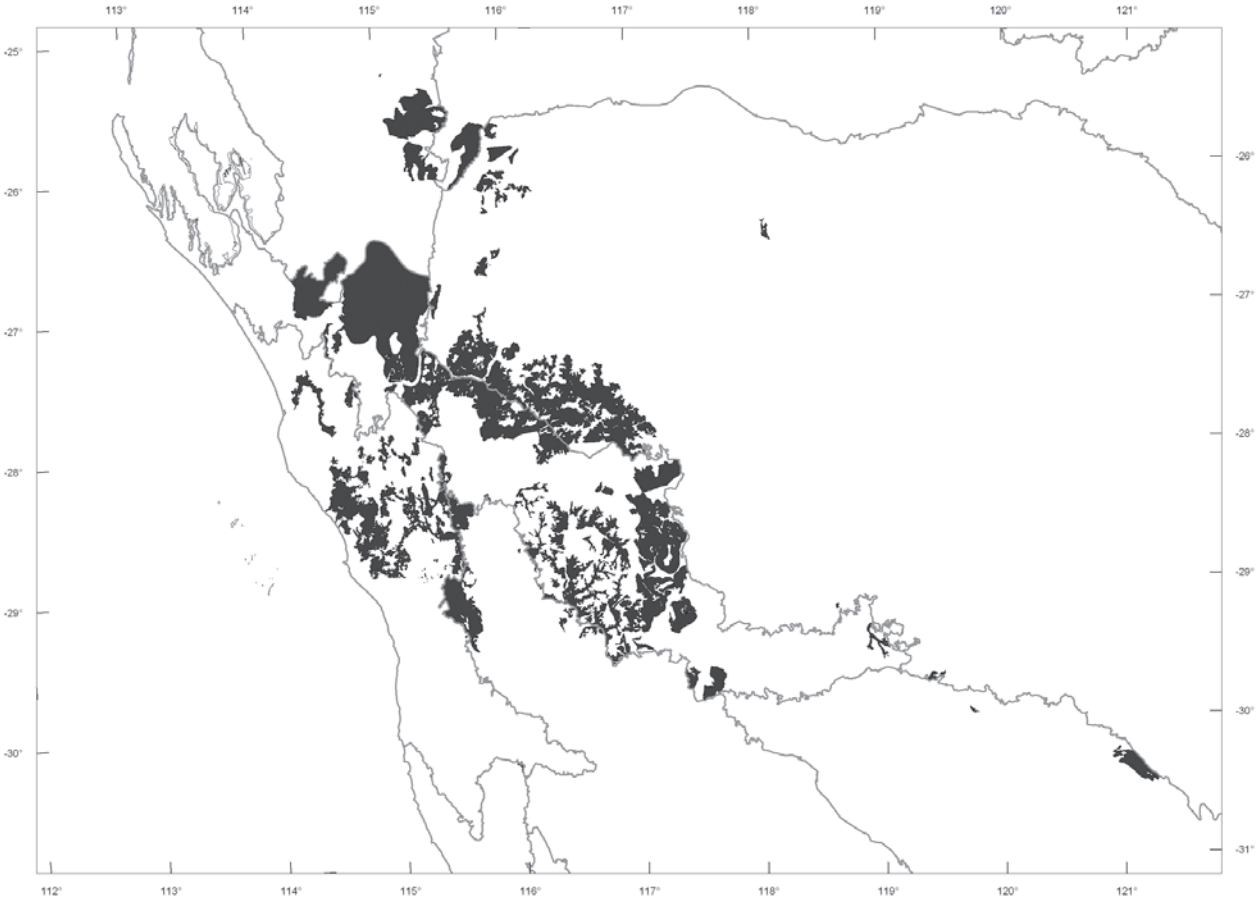


Figure 23. Vegetation Type 13: Scrub with medium woodland, with scattered medium trees, low woodland or with scattered low trees.

Plate 22. Scrub with open woodland, near Hamelin Pool (photo by Ladislav Mucina).

In this vegetation type, the most common emergent low tree is *Acacia aneura* s.l. (mulga), which occurs as low woodland to open low woodland. The scrub layer is predominantly *Acacia ramulosa /A. linophylla* (bowgada), often with *Acacia grasbyi* (miniritchi). On nearly one million ha in the Murchison and Yalgoo Bioregions, the mulga forms low woodland over the scrub dominated by these acacias. The *Acacia aneura* s.l. (mulga) is more open but still emergent over *Acacia ramulosa /A. linophylla* and *Acacia grasbyi* on a further 250,000 ha in these bioregions. On another 182,000 ha in the central Yalgoo and the Carnarvon Bioregions, *Acacia grasbyi* (miniritchi) drops out as a co-dominant under low mulga woodland.

Other emergent trees through the *Acacia ramulosa/A. linophylla* (bowgada) scrub include low *Allocasuarina huegeliana* and/or *Eucalyptus loxophleba* (York gum) in the Geraldton Sandplains Bioregion, *Allocasuarina cristata* in the Coolgardie Bioregion, *Callitris columellaris* (white cypress pine*)* in the Yalgoo Bioregion and *E. microtheca* (coolibah) woodland on isolated drainage systems in the north-west Murchison Bioregion. On the red sandplains of the southern Carnarvon Bioregion, bowgada scrub has scattered *Callitris columellaris* (white cypress pine) and eucalypts such as *E. eudesmioides* and *E. oldfieldii* (Oldfield's mallee). Slightly further north, there is a dune-field with mulga open low woodland over bowgada scrub on the inter-dunal flats and with bowgada and grevillea scrub on sand hills.

A unit of acacia scrub and mallee (various species) with scattered *Eucalyptus loxophleba* (York gum) occurs on red bottomland soils on the Victoria Plateau, north east of Geraldton. Mallee species include *Eucalyptus obtusifolia* (Dongara mallee), *E. oleosa* s.l. (giant mallee), *E. moderata* (redwood mallee), and occur with *Acacia acuminata* (jam), *A. ligulata* (umbrella bush), *A. ramulosa/ A. linophylla* (bowgada) and *A. tetragonophylla*. A tree form of *E. oleosa* (giant mallee) joins the *E. loxophleba* (York gum) at the northern limit of this unit. At the north-eastern tip of the Swan Coastal Plain Bioregion, there is a very small unit consisting of mallee (possibly *E. foecunda*; narrow-leaved red mallee) with scattered York gum.

On a rocky ironstone ridge on the northern boundary of the Coolgardie Bioregion, there is a mosaic of *Acacia quadrimarginea* thicket with *Allocasuarina cristata* and *Eucalyptus lesouefii* (goldfields blackbutt) medium woodland.

14. Thicket

Vegetation consisting of shrubs >1 m tall with a 30–70% pfc are classified as thickets. Just under 5.7 million ha is covered with thickets of acacia, casuarina and/or tea tree, of which nearly 4.7 million ha occur in the Avon Wheatbelt and Coolgardie Bioregions (Fig. 24). Other bioregions where thickets are important are the Geraldton Sandplains, Carnarvon, Yalgoo and Mallee Bioregions. They also occur in small coastal pockets in the Dampierland Bioregion (Fig. 25).

The most common thicket unit is the acacia–allocasuarina–melaleuca alliance on sandplains, covering

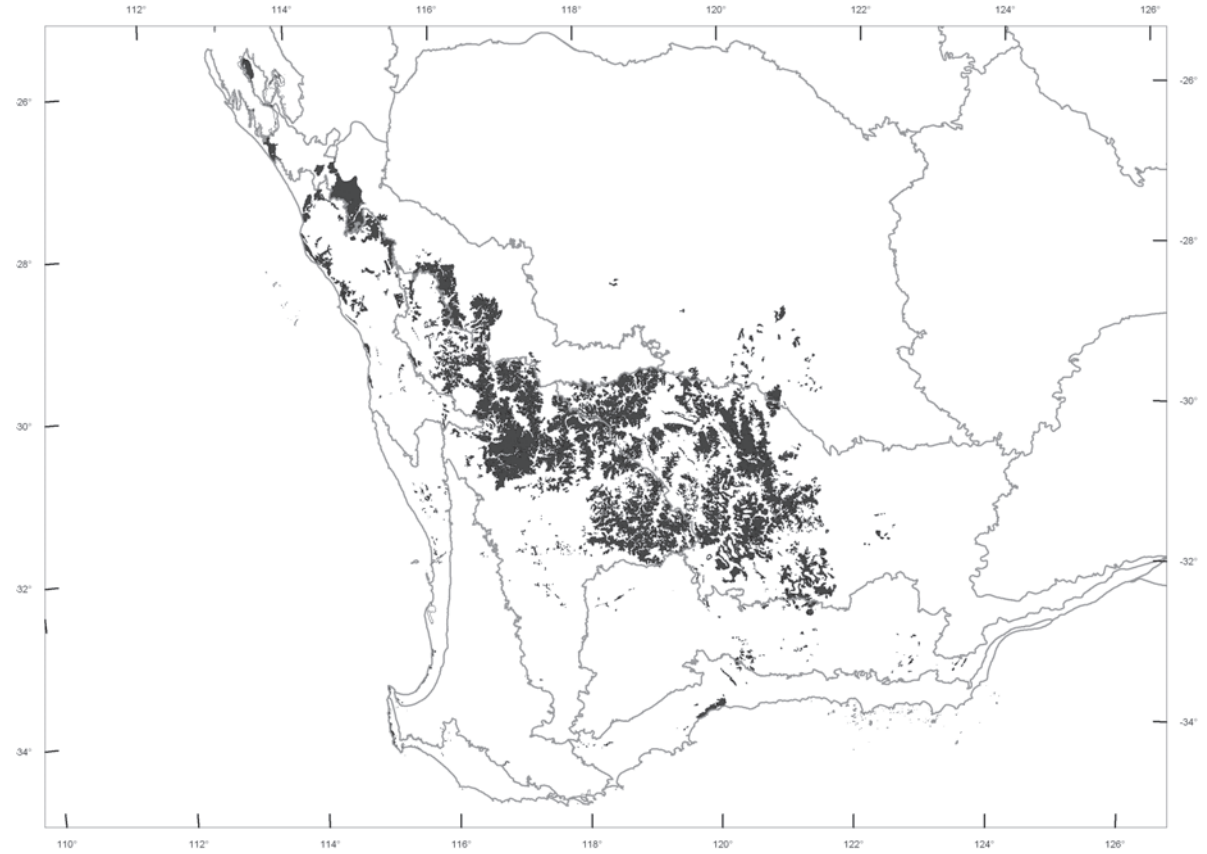


Figure 24. Vegetation Type 14: Thicket, South West.

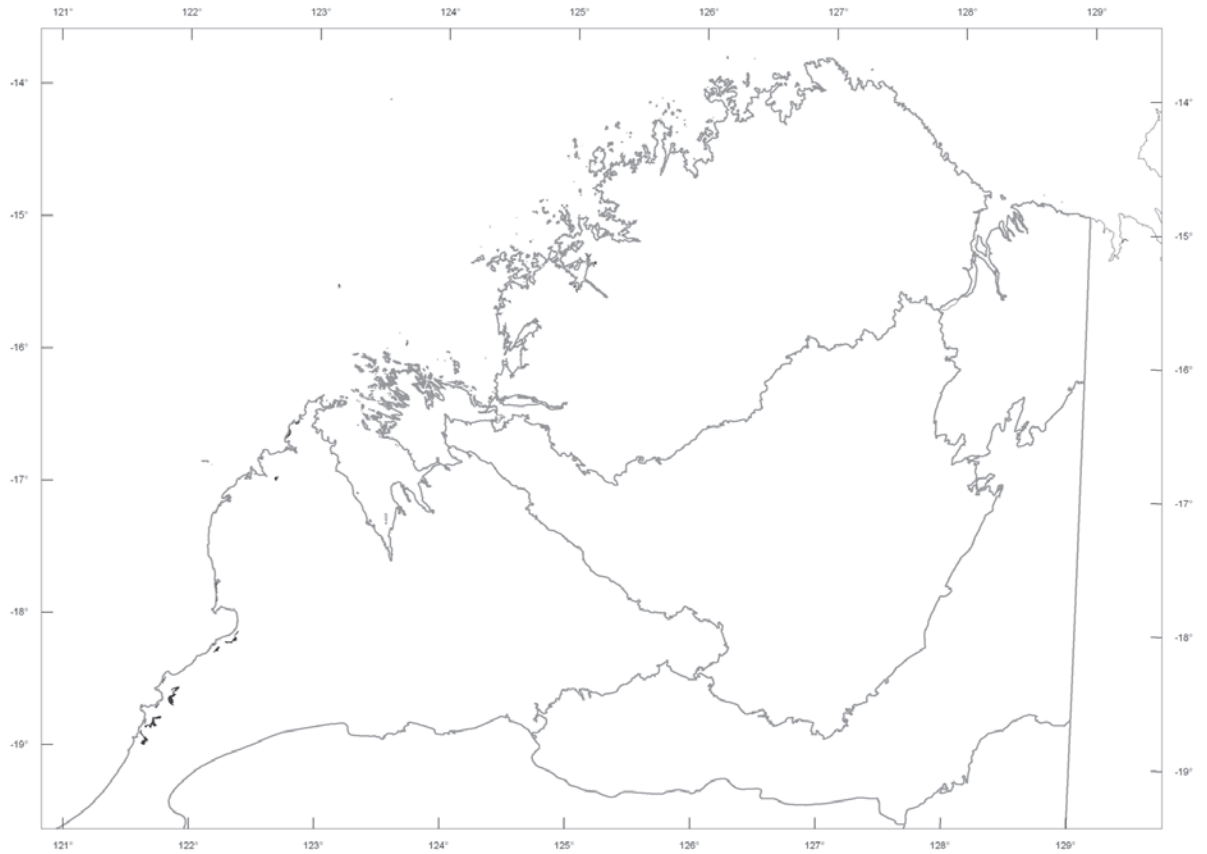


Figure 25. Vegetation Type 14: Thicket, Kimberley.

nearly 1.8 million ha. Generally, allocasuarina is dominant in areas receiving greater than 325 mm of rainfall per annum, acacia tolerates drier conditions and melaleuca is dominant on clayey, winter-wet or swampy soils.

Mixed acacia thickets are also common, with *Acacia neurophylla*, *A. beauverdiana* (pukkati) and *A. resinimarginea* thickets occurring over extensive areas (more than 1 million ha) in the Avon Wheatbelt and Coolgardie Bioregions on shallow, nutrient-deficient sands over laterite. The very rocky ironstone ridges in the Coolgardie Bioregion are covered with dense thickets of *Acacia quadrimarginea* with *Allocasuarina acutivalvis* and *A. campestris*. A variety of other wattle thickets is found near the coast from Cape Leeuwin (*A. truncata*) through Perth and Geraldton (*A. rostellifera*; summer-scented wattle), to thickets of *A. eriopoda* (Broome wattle) near Broome.

The *Allocasuarina campestris* thickets of the Coolgardie, Avon Wheatbelt and Mallee Bioregions form the third largest group of thicket associations. *Allocasuarina campestris* forms thickets 1–2.5 m tall, mainly on shallow lateritic soils. Associated smaller shrubs include species of *Acacia*, *Melaleuca* and *Hakea*.

Melaleuca and *Acacia* species often occur together. For example, *Acacia ramulosa/A. linophylla* (bowgada), *A. acuminata* (jam) and *Melaleuca uncinata* s.l. (broom bush) thickets occur along the south-western boundary of the Yalgoo Bioregion (330,000 ha) and extend south into the Avon Wheatbelt Bioregion (10,000 ha; Plate 23). This is a transitional unit, as bowgada has a more northern distribution whereas jam and *Melaleuca uncinata* s.l. are common to the south. Other acacia–melaleuca associations include the *A. ligulata* (umbrella bush) and *M. uncinata* s.l. (broom bush) dominated thicket that occurs on patches of dark brown loamy soil between the Murchison and Hutt Rivers, and the *A. acuminata* (jam), *A. rostellifera* (summer-scented wattle) and *M. megacephala* thicket found flanking the Hutt River.

The mallee–casuarina thickets of the northern central Avon Wheatbelt Bioregion cover 743,000 ha. Here, *Allocasuarina campestris* occurs with *Eucalyptus foecunda* (narrow-leaved mallee) or *E. moderata* (redwood mallee) on the shallow sand over ironstone, while the mallee eucalypts plus *E. erythronema* occur on the pink earth, a duplex soil with sand over clay.

A large area of acacia–casuarina thicket (totalling over 530,000 ha) has been mapped using the general acSc code rather than codes stating the dominant species present. It occurs mainly on sandplains in the Avon Wheatbelt Bioregion, and would include *Acacia acuminata* (jam), *Allocasuarina campestris*, *Allocasuarina huegeliana* and *Allocasuarina acutivalvis*. On the red sands of the Geraldton Sandplains Bioregion, there are thickets of *Acacia acuminata*, *A. longispinea*, *A. stereophylla, Allocasuarina campestris, Allocasuarina acutivalvis, Eremaea pauciflora* and *Melaleuca uncinata* s.l. (broom bush).

Many of the tea tree thickets characteristically associated with the swamps of the South West have just been labelled generally as mSc (39,000 ha). In the Geraldton Sandplains Bioregion, *Melaleuca uncinata* s.l. (broom bush) occurs on swampy country at the foot of breakaways, *M. thyoides* occurs in wet depressions on the flat coastal plain and *M. cardiophylla* (tangling melaleuca)

Plate 23. Thicket near Dallwalinu (photo by Ladislav Mucina).

thickets are restricted the steep rocky ridges, parallel to the coast south of Geraldton.

On the coastal plains of the Dampierland Bioregion, tea tree thickets occur at the change of slope inland of the coastal grasslands, and a wattle thicket of acacia is mapped near Broome (Fig. 25).

Other thicket associations include:

- an extensive (152,000 ha) mixed thicket on the red soils of the northern Geraldton Sandplains where *Acacia* spp., *Allocasuarina* spp, *Eucalyptus eudesmioides*, *Banksia ashbyi* and other species occur together;
- an unusual *Melaleuca megacephala – Hakea pycnoneura* thicket on the Moresby Range north of Geraldton;
- mixed thickets of the Stirling Range;
- the dryandra–eucalypt thickets on the steep slopes of the Barren Range in the Fitzgerald National Park, south of Ravensthorpe;
- the mixed dryandra thicket in Mt Ragged east of Esperance; and
- the dryandra thickets that occur on hills and ranges, for example, dryandra–casuarina thickets on the lateritic hills of the Wongan Hills, north-east of Perth.

There are mosaics or mixtures of thickets with woodland (see Vegetation Type 13), scrub-heath (see Mosaic 107; Fig 74) and samphire (see Vegetation Types 42 and 47).

15. Scrub, open and sparse scrub

This vegetation type is composed of shrubs greater >1 m in height with pfc ranging from 30% down to scattered clumps with no definable cover. Those associations with 10–30% pfc are termed scrub (Plate 24), those with <10% pfc are called open scrub, while sparse scrub is where the shrubby vegetation is extremely sparse or in scattered clumps with negligible cover. This vegetation type is very widespread, occurring in 21 of the 26 bioregions and covering over 16.7 million ha or 6.6% of the state. The predominant scrub occurring in Western Australia is acacia-dominated. Scrub is an important component of the western central part of the state: it occurs in the Gascoyne Bioregion (5.7 million ha), the Carnarvon Bioregion (2.9 million ha), the Murchison Bioregion (2.5 million ha), the Yalgoo Bioregion (1.3 million ha), the Great Victoria Desert Bioregion (1.2 million ha), the Gibson Desert Bioregion (1 million ha), the Central Ranges Bioregion (527,000 ha) and the Pilbara Bioregion (235,000 ha; Fig. 26).

There are over 9 million ha of scrub mapped as pure *Acacia aneura* s.l. (mulga) or dominated by mulga with usually only one other *Acacia* species. Pure mulga scrub occurs on over 2 million ha in the Gascoyne Bioregion, over 1 million ha in the Murchison, Gibson Desert and Great Victoria Desert Bioregions, and nearly 500,000 ha in the Central Range Bioregion. The species most commonly associated with mulga is *Acacia xiphophylla* (snakewood): *A. aneura* s.l. and *A. xiphophylla* scrub covers

Plate 24. Scrub near Paynes Find (photo by Ladislav Mucina).

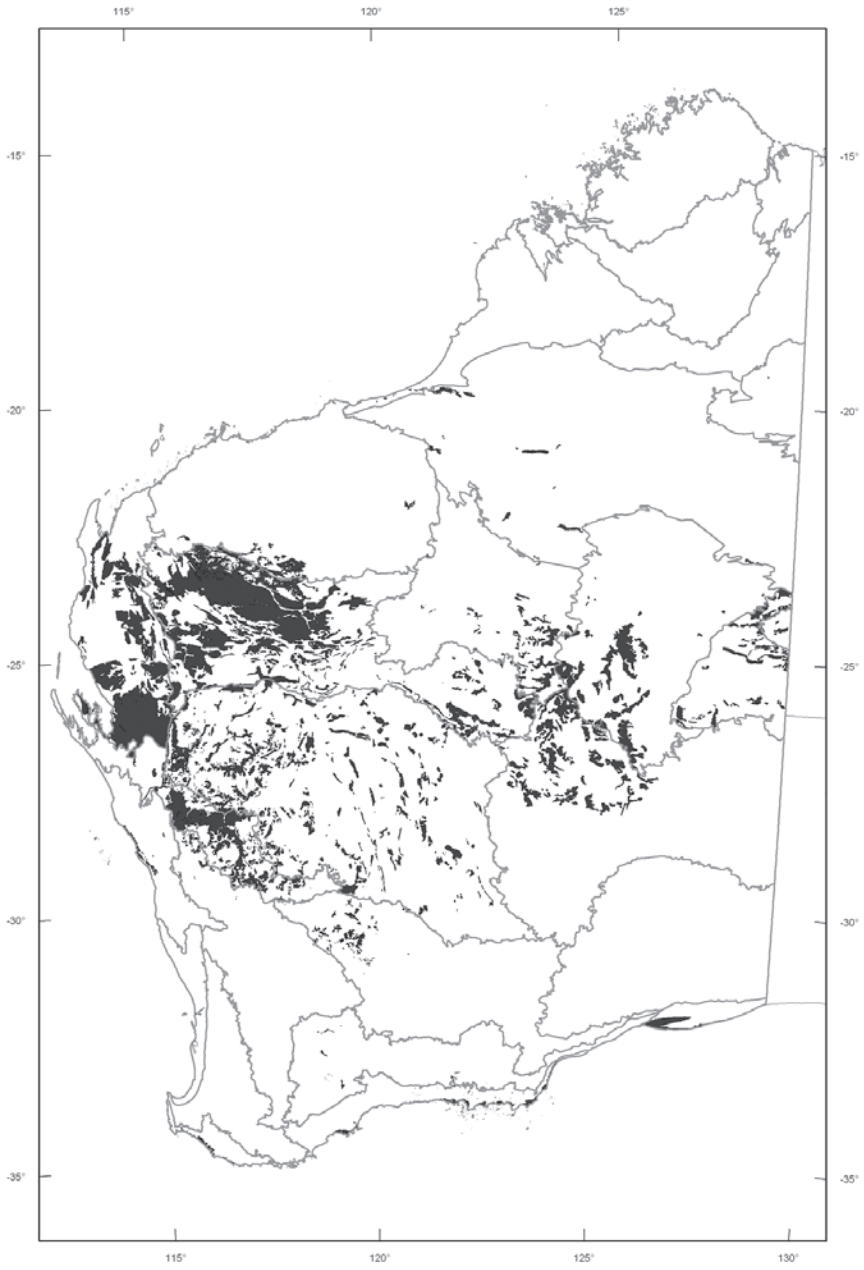


Figure 26. Vegetation Type 15: Scrub.

about 1.7 million ha in the Gascoyne Bioregion and occurs mainly on hills and ranges. Other species associated with mulga include *A. quadrimarginea, A. victoriae* (bardi) and *A. ramulosa/A. linophylla* (bowgada). Understorey species include *Eremophila* spp. and *Senna* spp. (cassia) with a ground layer of annuals, e.g. *Swainsona formosa* (Sturt pea), *Goodenia maideniana* and *Ptilotus* spp.

Scrub dominated by other *Acacia* species covers over 6 million ha and occurs throughout the state except for the Kimberley and forested areas of the South West. By far the most extensive non-mulga acacia scrub is that of *A. ramulosa* and *A. linophylla*, referred to by Beard as bowgada (a_9). It covers over 1.3 million ha throughout the Murchison, Gascoyne, Yalgoo, Carnarvon, Avon Wheatbelt, Gibson Desert, Great Victoria Desert and Little Sandy Desert Bioregions. *Acacia ramulosa* and *A. linophylla* (bowgada) are associated with *A. sclerosperma* (limestone wattle) on over nearly 300,000 ha in the Carnarvon Bioregion. This region also contains large areas of *Acacia ramulosa* and *A. linophylla* (bowgada) with *A. victoriae* (bardi) and/or *A. xiphophylla* (snakewood). In the Yalgoo Bioregion, *Acacia ramulosa* and *A. linophylla* (bowgada) occurs mainly with *A. acuminata* (jam), but also with *A. murrayana* (sandplain wattle), *A. victoriae* and *A. grasbyi* (miniritchi). The snakewood scrub on shingle plains in the Gascoyne Bioregion has an understorey of *Ptilotus* spp. and saltbush (e.g. *Atriplex* spp.). The major scrub components of the Coolgardie Bioregion are *Acacia brachystachya* (turpentine mulga) or *Acacia ramulosa* and *A. linophylla* (bowgada) occurring on young soils over granite with species such as *Allocasuarina cristata*.

Mallee with patches of acacia scrub is a major component of the Hampton and Esperance Plains

Bioregions on over 300,000 ha of coastal dunes. Species include *Eucalyptus angulosa* (ridge-fruited mallee), *Acacia cyclops* (coastal wattle), *A. saligna*, *Calothamnus quadrifidus* and *Melaleuca elliptica* (granite bottlebrush).

Other scrub associations include:

- tea tree scrub mainly in valleys and depressions associated with saltpans in the Great Sandy Desert and Little Sandy Desert Bioregions (160,000 ha) where *Melaleuca lasiandra* and *M. glomerata* may grow up to 2 m high;
- tea tree scrub in swampy areas of the Esperance Plains and Mallee Bioregions where *Melaleuca* spp. form an irregular open habit with little or no understorey;
- *Melaleuca laxiflora* scrub in small patches in the mallee and *M. thyoides* scrub around some of the salt lakes in the Newdegate area;
- *Acacia rostellifera* (summer-scented wattle) and *Banksia prionotes* (acorn banksia) scrub on shallow red sand over limestone in the Geraldton Sandplains Bioregion;
- *Acacia ramulosa/A. linophylla* (bowgada) and *Grevillea stenobotrya* on the north–south orientated sand dunes in patches between the Murchison and Wooramel Rivers; and
- *Agonis flexuosa* (peppermint) scrub that commonly occurs behind dunes in coastal areas between Busselton and Albany.

Most of the open scrub and sparse scrub vegetation is dominated by *Acacia aneura* s.l. (mulga). Nearly 28,000 ha of open mulga scrub occurs in the Gascoyne Bioregion, predominantly on the rocky rises and ranges. *Senna artemisioides* subsp. *artemisioides* (bloodbush) and numerous *Eremophila* species may also be present. *Acacia victoriae* (bardi) with *A. xiphophylla* (snakewood) or *Acacia sclerosperma* (limestone wattle) open scrub or sparse scrub occurs in the Gascoyne Bioregion on gravel plains and shingle plains as well as in the Carnarvon Bioregion. *Eremophila cuneifolia* (pinyuru) is a typical undershrub. A small patch of mulga and *A. grasbyi* (miniritchie) sparse scrub occurs in the southern central Pilbara Bioregion. *Acacia ligulata* (umbrella bush) open scrub or *Acacia rostellifera* (summer-scented wattle) open scrub occurs on the coastal dunes in the Geraldton Sandplains Bioregion, totalling over 10,000 ha.

Open scrub with hummock grasslands occurs over large expanses (nearly 8 million ha) in the dry interior and is mapped as sparse scrub steppe (Vegetation Type 39).

16. Mallee

Mallee is a eucalypt tall-shrub formation unique to Australia. Each plant has an underground rootstock or lignotuber, from which grow numerous spindly stems with foliage clumped at the ends (Plate 25). Height varies according to time since last fire, but may be over 10 m.

Plate 25. Mallee near Lake King (photo by Ladislav Mucina).

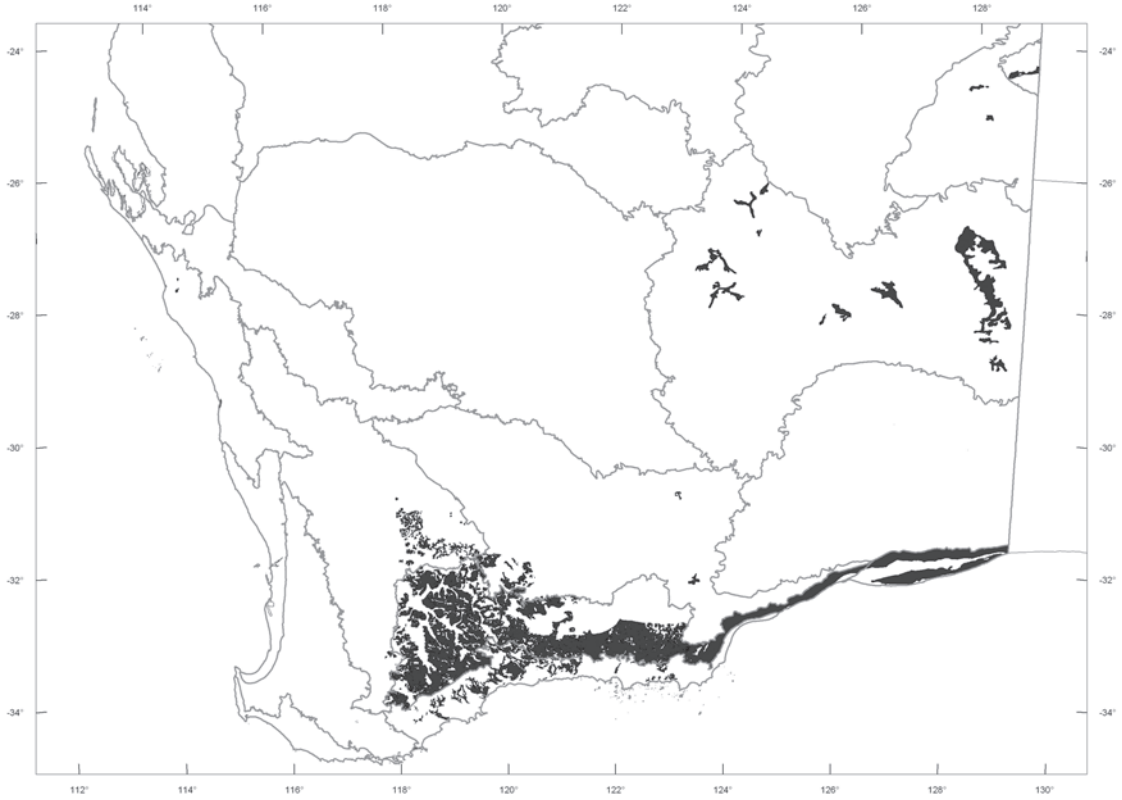


Figure 27. Vegetation Type 16: Mallee.

Over 6.3 million ha of the state is mapped as mallee. This is mainly in the Mallee Bioregion, extending into the Avon Wheatbelt, Coolgardie, Esperance Plains and Hampton Bioregions, with further outlying occurrences in the Great Victoria Desert and Central Ranges Bioregions (Fig. 27).

Seventy-five percent (over 4 million ha) of the state's mallee vegetation occurs in the Mallee Bioregion, where it originally covered more than half of the bioregion. Mallee/woodland mosaics (see Mosaic 102; Fig. 69) account for a further 25% of the bioregion's area. Within that bioregion, mallee tends to occur mid-slope and is associated with a soil described as a sandy alkaline yellow-mottled duplex soil known technically as *soloth.* Overall, *Eucalyptus eremophila* (horned mallee) is the most consistent mallee species with *E. moderata* (redwood mallee), *E. oleosa* (giant mallee), *E. incrassata,* (lerp mallee), *E. foecunda* (narrow-leaved red mallee), *E. redunca* (black marlock) and *E. uncinata* (hook-leaved mallee) also mapped. Shrubs of one or more species of *Melaleuca* commonly dominate the understorey, e.g. *M. pungens* and *M. spicigera. Acacia* species and occasional small clumps of grasses may also be present.

The mallee of the Esperance Plains Bioregion includes species such as *E. eremophila* (horned mallee), *E. oleosa* (giant mallee), *E. socialis* (red mallee), and *E. cooperiana* (many-flowered mallee). *Eucalyptus forrestiana* (Forrest's mallee) and *E. gracilis* (yorrell) occur on the south coast limestone and lime sands of the Hampton Bioregion.

The mallee of the Great Victoria Desert Bioregion covers nearly 800,000 ha and includes *E. comitae-vallis* (Comet Vale mallee) on the calcareous soils of the ancient drainage lines near Lake Throssell and Lake Wells. Further east near Neale Junction, the mallee is *E. oleosa* (giant mallee) with an understorey of scattered *Triodia* spp. (spinifex). Further east again, the mallee occurs between the sandhills but the identity of the eucalypt species was not documented.

A small area (3000 ha) of *Eucalyptus obtusiflora* subsp. *dongarraensis* (Dongara mallee) occurs on the coast near Dongara in the south-west of the Geraldton Sandplains Bioregion.

Mosaics consisting of mallee with patches of woodland occur throughout the south-western part of the state. They are generally found towards the top of the landscape and appear to be transitional between the mallee associations to the south and the woodlands to the west and north (see Mosaic 102).

Low Shrubland

17. Mallee-heath

Mixed heath (mixed shrubs <1 m, with 30–70% pfc) with scattered emergent mallee is classified as mallee-heath. This vegetation type predominates on the lateritic sandplain along the south coast from north of Albany to Twilight Cove at the south-western end of the Nullarbor Plain, and covers about 1.5 million ha (Fig. 28).

Eucalyptus pleurocarpa (blue mallee, tallerack) is common on soils where there is an ironstone horizon. The species is very characteristic because of its straggly habit and blue leaves (Plate 26). Nearly 35% (over

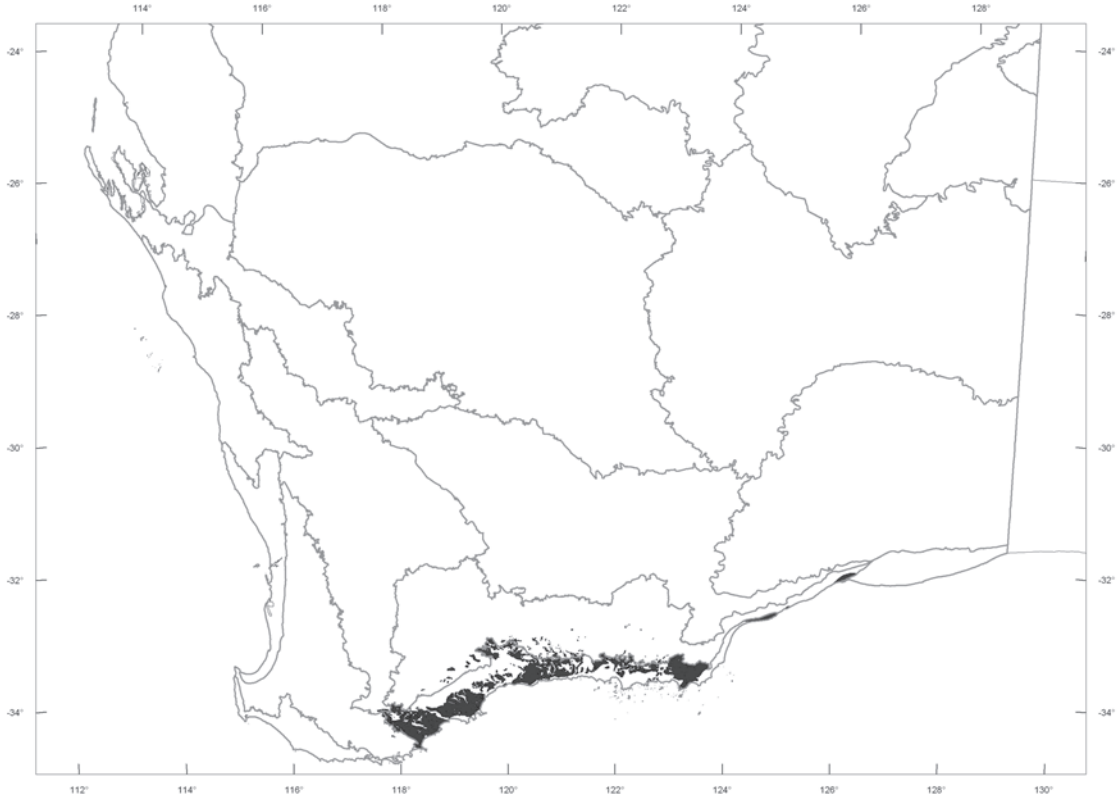


Figure 28. Vegetation Type 17: Mallee-heath.

Plate 26. Mallee-heath in Fitzgerald River National Park (photo by Ladislav Mucina).

960,000 ha) of the Esperance Plains Bioregion is tallerack mallee-heath, and a mosaic of *E. redunca* (black marlock) mallee with tallerack mallee-heath covers a further 262,000 ha (see Mosaic 109; Fig. 76). The heath stratum comprises a very rich assemblage of tall and medium to low shrubs, including *Grevillea hookeriana* (red toothbrushes), *Hakea cinerea* (ashy hakea), *H. corymbosa* (cauliflower hakea), *H. prostrata* (harsh hakea), *Isopogon buxifolius, Lambertia inermis* (chittick), *E. pleurocarpa* (blue mallee, tallerack), *Petrophile* spp. and the smaller *Taxandria linearifolia* (swamp peppermint), *Gastrolobium latifolium, Allocasuarina* spp., *Daviesia teretifolia, Banksia prolata, B. nivea* (couch honeypot), *Grevillea pectinata* (comb-leaved grevillea), *Coopernookia strophiolata* and *Lechenaultia formosa* (red leschenaultia).

Eucalyptus incrassata (lerp mallee) mallee-heath occurs over an area of 220,000 ha to the east of the tallerack, where the ironstone is absent. Other large shrubs include *Hakea cinerea* (ashy hakea) and *Grevillea hookeriana* (red tooth brushes) with patches of *Nuytsia floribunda* (Christmas tree) in depressions.

A mallee form of jarrah (*E. marginata)* emerges from the heath in the Stirling Ranges and across the south-west corner of the Esperance Plains Bioregion. Here, taller shrubs include *Banksia grandis* (bull banksia), *Hakea baxteri* (fan hakea), *H. cucullata* (hood-leaved hakea), *H. pandanicarpa, Lambertia ericifolia* (heath-leaved honeysuckle) and *L. uniflora.* A rich suite of smaller shrubs include *Banksia petiolaris, B. sphaerocarpa* (round-fruit banksia), *Beaufortia cyrtodonta, Boronia crenulata* (aniseed boronia), *Gompholobium villosum, Allocasuarina humilis* (dwarf sheoak), *Conospermum coerulescens* subsp. *dorrienii* (Stirling Range smokebush), *Darwinia diosmoides, Banksia nivea* (couch honeypot), *B. proteoides* (king dryandra), *Isopogon cuneatus* (coneflower), *I. dubius* (pincushion coneflower), *Lysinema ciliatum* (curry flower), *Melaleuca incana* subsp. *incana, Petrophile divaricata, Platytheca galioides, Sphaerolobium macranthum, Sphenotoma dracophylloides, Synaphea favosa* and *Xanthosia rotundifolia* (southern cross).

18. Scrub-heath

This vegetation type of mixed heath with scattered tall shrubs of *Acacia* spp. and/or members of the Proteaceae family occurs over more than 3.5 million ha. The upper layer may reach 4.5 m and the lower layer has a strong component of species from the family Myrtaceae. The vegetation associations in this vegetation type are named according to their locality and to some extent the soils on which they occur rather than the species present.

Scrub-heath is a major component of the Geraldton Sandplains Bioregion (1.8 million ha), occurring on soils ranging from laterite to grey sand over laterite to deep yellow sands. It extends thoughout the Avon Wheatbelt, Mallee and Coolgardie Bioregions to extensive areas in the Esperance Plains Bioregion (Fig. 29). Other areas occur along the south coast of the Warren and Jarrah Forest Bioregions.

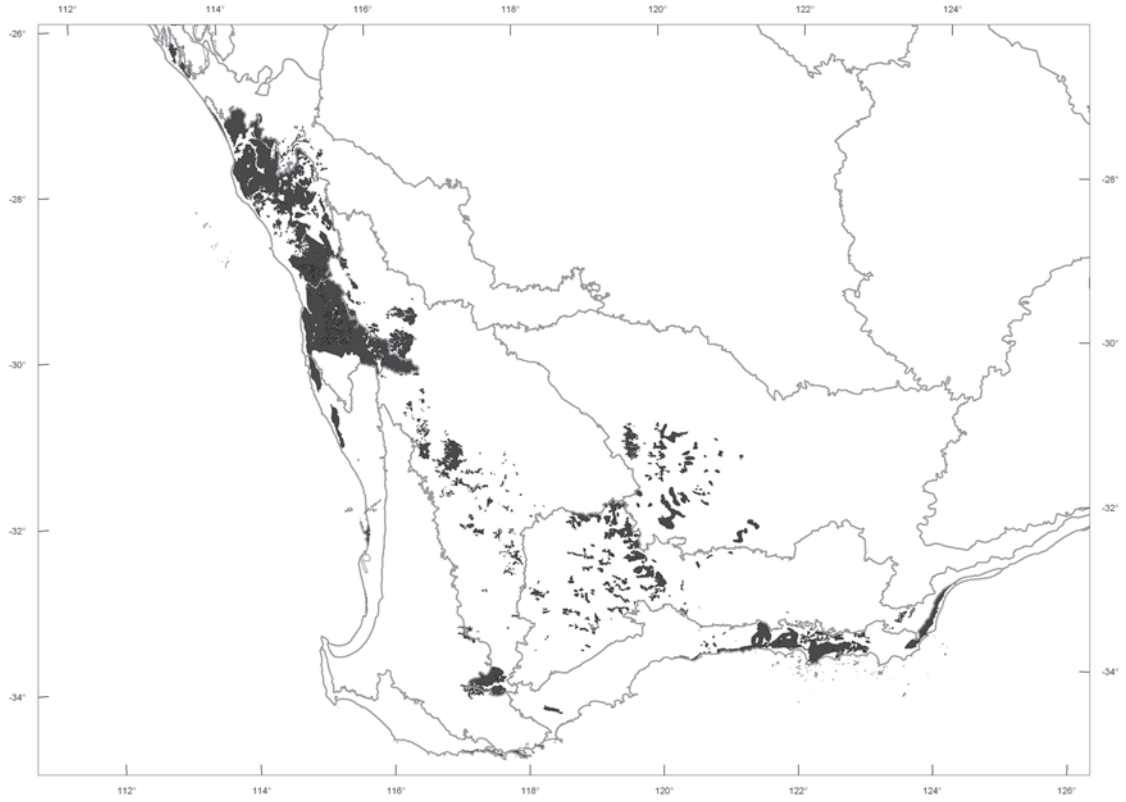


Figure 29. Vegetation Type 18: Scrub-heath.

Plate 27. Scrub-heath in South Eneabba Nature Reserve (photo by Ladislav Mucina).

Plate 28. Scrub-heath in the Fitzgerald River National Park (photo by Gil Craig).

The scrub-heath in the Geraldton Sandplains Bioregion has a very rich and diverse species composition drawn from such genera as *Acacia*, *Eucalyptus*, *Grevillea*, *Hakea*, *Calothamnus*, *Allocasuarina*, *Conospermum*, *Eremaea*, *Hibbertia*, *Melaleuca*, *Petrophile* and *Thryptomene* (Plate 27). The actual species composition varies according to the soils and position in the landscape. Those species typical of the lateritic sandplain include *Hakea obliqua* (needles and corks), *Gastrolobium oxylobioides* (Champion Bay poison), *Allocasuarina campestris, Banksia fraseri* var. *ashbyi, B. carlinoides,* (pink dryandra) and *Melaleuca radula* (graceful honeymyrtle). *Verticordia chrysantha, Banksia* spp. (varying locally), *Xylomelum angustifolium* (sandplain woody pear) and *Actinostrobus arenarius* (sandplain cypress) characterise the scrub-heath on deep yellow sands. The sandplains cover nearly 500,000 ha from north of the Murchison River into the northern Avon Wheatbelt Bioregion, with a further 300,000 ha of scrub-heath on a coastal association of yellow sandplain. This features the taller *Banksia attenuata* (slender banksia), *B. menziesii* (firewood banksia), *B. prionotes* (acorn banksia), *Acacia rostellifera* (summer-scented wattle) and *Banksia sessilis* (parrot bush) over *Calothamnus quadrifidus, Eremaea beaufortioides* and *Gastrolobium spinosum* (prickly poison). The deep sandy flats inland of the coastal limestone supports scrub-heath with scattered *Eucalyptus todtiana* (coastal blackbutt), *Banksia* spp. and *Xylomelum angustifolium* (sandplain woody pear).

A mosaic of limestone scrub-heath with sparse patches of low *Eucalyptus erythrocorys* (illyarrie) trees occurs between Jurien Bay and Irwin River in the Geraldton Sandplain Bioregion. This is mapped as scrub-heath and included here because of the very open nature of the emergent low trees.

On the Toolonga Plateau flanking the Murchison River, there is a scrub-heath with *Actinostrobus arenarius* (sandplain cypress), *Banksia sceptrum* and *Xylomelum angustifolium* (sandplain woody pear) on the sand ridges, with various species of *Acacia, Eucalyptus, Grevillea, Hakea* and *Calothamnus* present on the sandplain.

Scrub-heath described as a dryandra–calothamnus association with *Banksia prionotes* (acorn banksia) is found on the coastal limestone in the northern Swan Coastal Plain Bioregion and adjacent Geraldton Sandplains Bioregion. Additional conspicuous species include *B. attenuata* (slender banksia), *B. menziesii* (firewood banksia), *Nuytsia floribunda* (Christmas tree), *Xanthorrhoea preissii*, *Banksia sessilis* (parrot bush) and *Calothamnus quadrifidus*. A coastal scrub-heath with *Olearia axillaris*, *Scaevola crassifolia* and *Exocarpos sparteus* with pockets of *Agonis flexuosa, Acacia cochlearis* and *A. rostellifera* thickets occurs along the coast north and south of Bunbury.

The mosaic of the dryandra–calothamnus scrub-heath with scattered low trees of *Eucalyptus wandoo* (wandoo) and *E. accedens* (powderbark wandoo) is shown as scrub-heath. This occurs on sandplain south-west of Three Springs in the Avon Wheatbelt Bioregion.

Scrub-heath in the Mallee Bioregion (over 365,000 ha) is also of a heterogeneous composition, but *Grevillea hookeriana* (red tooth brushes) is a reliable character species. Also present is the peculiar *Allocasuarina pinaster*

(compass bush) and scattered mallees such as *Eucalyptus albida* (white-leaved mallee) and *E. incrassata* (lerp mallee).

Scrub-heath exists in the Coolgardie Bioregion as small patches, which total nearly 260,000 ha. A common emergent is *Grevillea excelsior* (flame grevillea) to 4.5 m over a lower layer of 0.6–0.9 m high shrubs, e.g. *Acacia* spp. *Melaleuca acuminata*, *M. cordata* and *Thryptomene* spp., and prostrate woody plants such as *Balaustion pulcherrimum* (native pomegranate) and *Borya nitida* (pincushions).

Extensive areas (over 280,000 ha) of banksia scrub-heath exist on the sandplains and the coastal plain (mapped separately) in the Esperance Plains Bioregion. The species-rich scrub-heath features emergent large bushy shrubs of *Banksia speciosa* (Plate 28), with *Lambertia inermis* (chittick) in the west and *Nuytsia floribunda* (Christmas tree) common east of Esperance. The scrub-heath north of Israelite Bay appears to be similar to that around Esperance.

Included in this vegetation type is an unusual mosaic of thicket and heath. On extensive areas of coastal limestone in the central Geraldton Sandplains Bioregion, thickets of *Acacia rostellifera* (summer-scented wattle), with *A. cyclops* (coastal wattle) in the south, and *Melaleuca cardiophylla* (tangling melaleuca) in the north, are interspersed with patches of *Acacia lasiocarpa* (panjang) and *Melaleuca systena* (coastal honeymyrtle) heath.

Mosaics of scrub-heath include the hakea scrub-heath with dryandra heath on the laterite sandplains around Badgingarra, in the Geraldton Sandplains Bioregion (see Mosaic 108; Fig.75).

19. Heath

A mid-dense (30–70% pfc) layer of low shrubs <1 m in height constitutes heath. It often occupies relatively small areas compared with the scrub-heaths, and many of these patches are not discernible at the 1:3,000,000 scale. Heaths occur on either limestone and lime sands near the coast, exposed laterite in upland situations or sand on laterite. A total of just over 207,000 ha of heath has been mapped in the Geraldton Sandplains, Swan Coastal Plain, Avon Wheatbelt, Warren, Jarrah Forest, and Yalgoo Bioregions (Fig. 30) with a further 170,000 ha mapped as mosaics of heath with woodlands (see below), scrub-heath (Mosaic 108; Fig. 75) or with thickets (Mosaic 107; Fig. 74).

The most common heath mapped is the dryandra-dominated heath, which covers nearly 60,000 ha in the Avon Wheatbelt, Swan Coastal Plain and Mallee Bioregions. For example, the 39,000 ha of dryandra heath on the Dandaragan Plateau (north-eastern Swan Coastal Plain Bioregion) is dominated by *B. carlinoides* (pink dryandra) and *B. sessilis*. South-east of Narrogin in the Avon Wheatbelt Bioregion, the heath includes *Banksia armata* (prickly dryandra), *B. cirsioides, B. squarrosa* (pingle) and *B. vestita* (summer dryandra).

The southern tip of the Geraldton Sandplains Bioregion is mapped as a mosaic of *Dryandra* heath (Plate 28) and *Hakea*-dominated scrub-heath (mentioned above in Vegetation Type 18). In the area immediately to the north of this, mixed heath on laterite is mapped as distinct patches amongst the scrub–heath of the lateritic sandplain. This mixed heath is also dominated by dryandras. Mixed heaths are also mapped along the south coast. There, species composition is influenced by the soils, with

Plate 29. Heath in Lesueur National Park (photo by Ladislav Mucina).

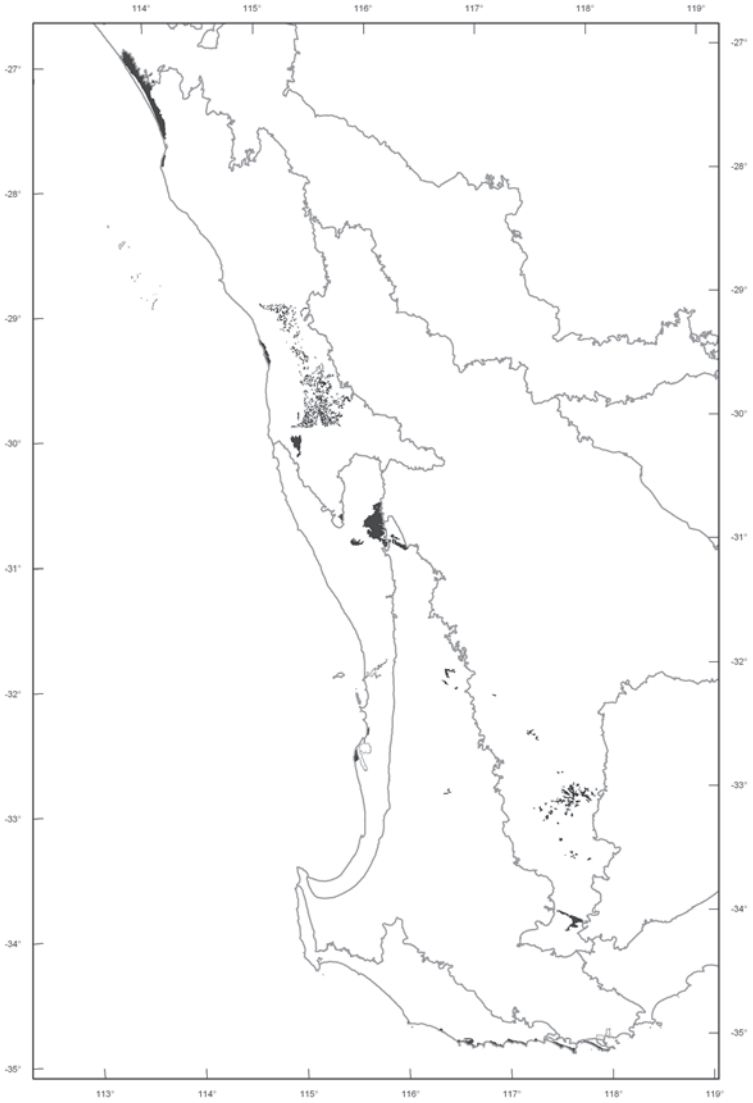


Figure 30. Vegetation Type 19: Heath.

limestone sites supporting *Pimelea rosea* (rose banjine), *Leucopogon revolutus, Bossiaea rufa* and *Olearia axillaris* (coastal daisybush), while the sites near granite support *Andersonia simplex* (spiked andersonia), *Lysinema ciliatum* s.l. (curry flower), *Leucopogon reflexus* and *Dasypogon bromeliifolius* (pineapple bush). Species common to both soil types include *Scaevola crassifolia* (thick-leaved fan-flower), *Adenanthos cuneata, Agonis flexuosa* (peppermint) and *Hakea costata* (ribbed hakea). Over 51,000 ha of mixed heath on limestone stretches along the coast north of Kalbarri above the Zuytdorp Cliffs. Here the vegetation is constantly wind-pruned, and includes such species as *Melaleuca leiopyxis, Grevillea stenomera* (lace-net grevillea), *Conospermum stoechadis* (common smokebush), *Allocasuarina humilis* (dwarf sheoak), *Calothamnus chrysantherus* (claw flower), *Hakea trifurcata* (two-leaf hakea) and *Pimelea spectabilis* (bunjong). Another coastal wind-pruned heath is the *Jacksonia horrida – Acacia truncata* heath found along the central south-coastal area in the Warren Bioregion, for example in the Nuyts Wilderness.

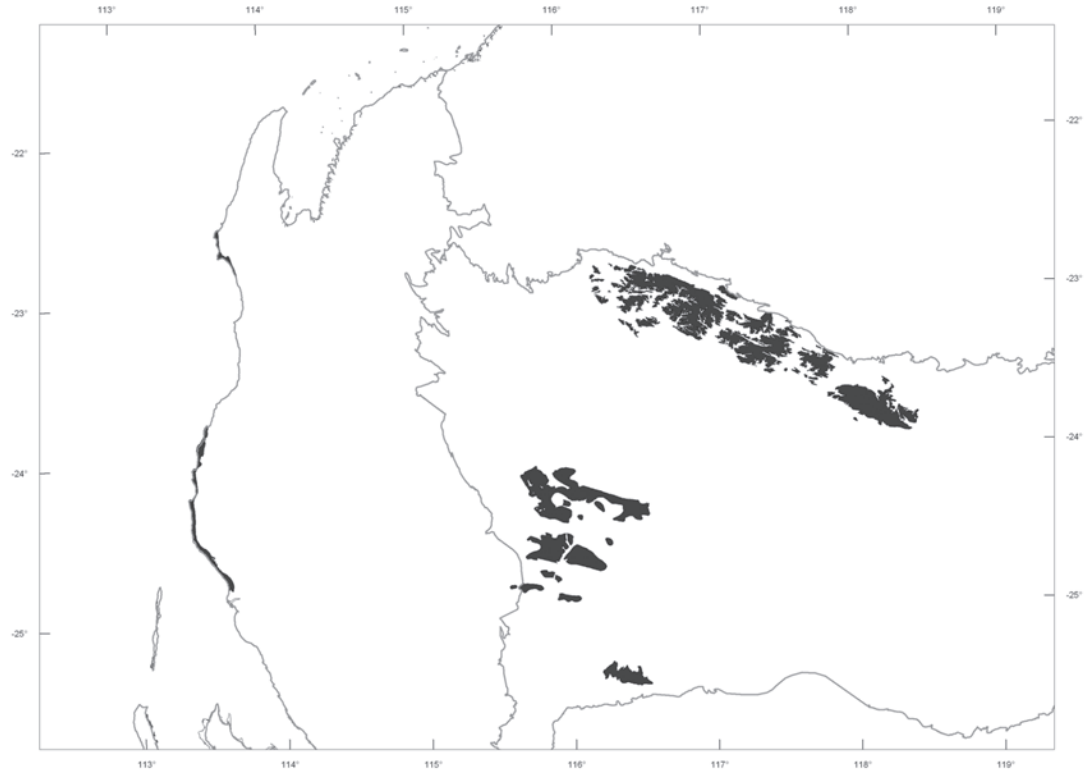
Along the coast of the southern Geraldton Sandplains Bioregion, *Acacia lasiocarpa* (panjang) and *Melaleuca systena* (coastal honeymyrtle) form a pure heath covering nearly 5000 ha on the sandy flats. More common, covering nearly 100,000 ha, are the mosaics of this association with patches with *Acacia rostellifera* (summer-scented wattle) and *Melaleuca cardiophylla* (tangling melaleuca) or *Acacia cyclops* (coastal wattle) thicket on dunes, which extend along the coast from south of Dongara all the way to Perth (included in Mosaic 107; Fig. 74).

Included in this vegetation type are unusual areas of heath interspersed with patches of woodland. For example, there are areas of *Dryandra* heath interspersed with patches of woodland or open woodland occurring in the northern Swan Coastal Plain and southern Geraldton Sandplains Bioregions. They include scattered patches of *Eucalyptus wandoo* (wandoo), *Corymbia calophylla* (marri) and/or *E. accedens* (powderbark wandoo) woodland in the dryandra heath in the northern part of the Gardiner Range near Mt Lesueur. These eucalypts also occur on their own as open woodlands over dryandra heath near the heath on the Dandaragan Plateau. An area of *Eucalyptus wandoo* (wandoo) occurs over mixed heath near Tambellup, southern tip of the Avon Wheatbelt Bioregion.

20. Dwarf scrub, open low scrub

Shrublands with height <1 m where the cover is 10–30% pfc are classified as dwarf scrub, and as open low scrub where the cover is <10%. This vegetation type extends over nearly 690,000 ha, mainly in the Gascoyne Bioregion, with minor occurrences in the Carnarvon Bioregion (Fig. 31) and Esperance Plains Bioregions (Fig. 32).

An unusual *Eremophila* and *Senna* (cassia) dwarf scrub association is found on the shale in the Ashburton Valley and Yinnietarra Hills in the Gascoyne Bioregion. It covers a total of over 640,000 ha. Either *Senna artemisioides* subsp. *artemisioides* (bloodbush) or *S. artemisioides* subsp. × *coriacea* (desert cassia) appear to be locally dominant, associated with *S. glutinosa* subsp. × *luerssenii*



ABOVE: Figure 31. Vegetation Type 20: Dwarf scrub, north. BELOW: Figure 32. Vegetation Type 20: Dwarf scrub, south.

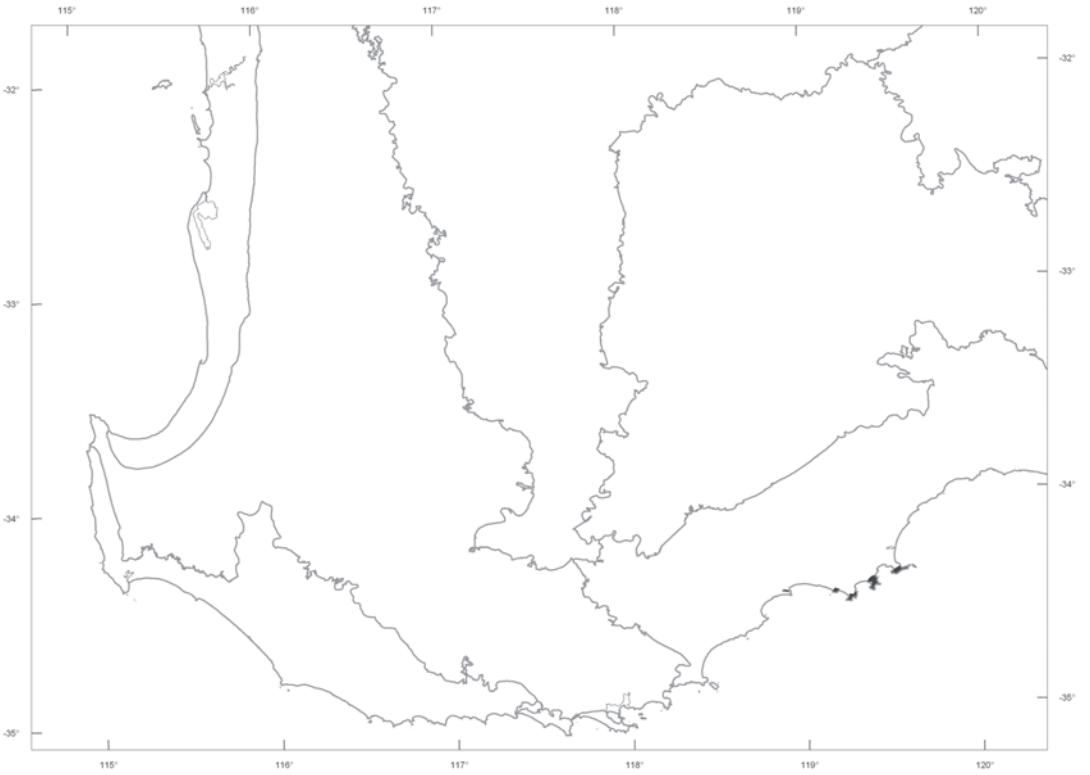


Plate 30. Dwarf scrub north of Carnarvon (photo by Andrew Perkins).

(white cassia), *Eremophila cuneifolia* (pinyuru), *E. abietina* (spotted poverty bush), *Acacia tetragonophylla*, *Ptilotus drummondii* (narrowleaf mulla mulla) and *P. obovatus* (cotton bush).

The coastline west of Lake Macleod (Carnarvon Bioregion) has a linear patch of *Acacia coriacea* (wirewood) dwarf scrub on recent sands (Plate 30). The dwarf scrub on the recent dunes on the eastern shore of Dirk Hartog Island is likely to be similar.

Dwarf scrub occurs on the granite headlands near Bremer Bay in the Esperance Plains Bioregion, covering a total of over 5500 ha. The shallow soil and the constant wind keep the shrubs of *Banksia pteridifolia* (tangled honeypot), *Banksia dryandroides* (dryandra-leaved banksia), *Pimelea ferruginea* and *Isopogon formosus* (rose coneflower) low.

Bunch-Grassland

21. Pindan woodland

(Shown on the map in the colour of the pindan overlaid with 🌴 symbols.)

Pindan woodland, or pindan, is the term used to describe a particular three-stratum vegetation type where the tallest stratum is not the most important ecologically. At maturity, pindan is a thicket of unarmed (not prickly) phyllodal *Acacia* spp. over a lower stratum of grasses, herbs and low woody shrubs, with an emergent layer of taller trees. However, while regenerating after a fire, pindan can appear more like savanna woodland until the shrub layer matures. Pindan woodland covers nearly 1.5 million ha on the Dampier Peninsula and the Fitzroy sandplains north-east of Derby (Fig. 33), occurring primarily on the red sandy plains. It consists of a medium height (10–30 m) woodland (10–30% pfc), typically *Eucalyptus tectifica* (grey box) and *E. grandifolia* (cabbage gum), over *Acacia tumida* thicket (30–70% pfc) with a grassy ground layer (10–30% pfc) of *Triodia bitextura* (formally *Plectrachne pungens*; curly spinifex), *Triodia pungens* (soft spinifex) and some *Chrysopogon fallax* (golden beard grass; Plate 31). Additional species such as *Acacia platycarpa* and *Eucalyptus miniata* (woolybutt) are present north-east of Derby. The shrub layer may also contain *Acacia eriopoda* (Broome wattle), *A. holosericea* (candelbra wattle), *Dolichandrone heterophylla* (lemonwood), *Gardenia pyriformis*, *Grevillea refracta* (silver-leaf grevillea) and *Hakea arborescens* (common hakea). Other scattered tree species include *Corymbia polycarpa* (long-fruited bloodwood), *Corymbia papuana* s.l. (ghostgum), *Erythrophleum chlorostachys* (ironwood), *Gyrocarpus americanus* (helicopter tree) and *Bauhinia cunninghamii* (bauhinia).

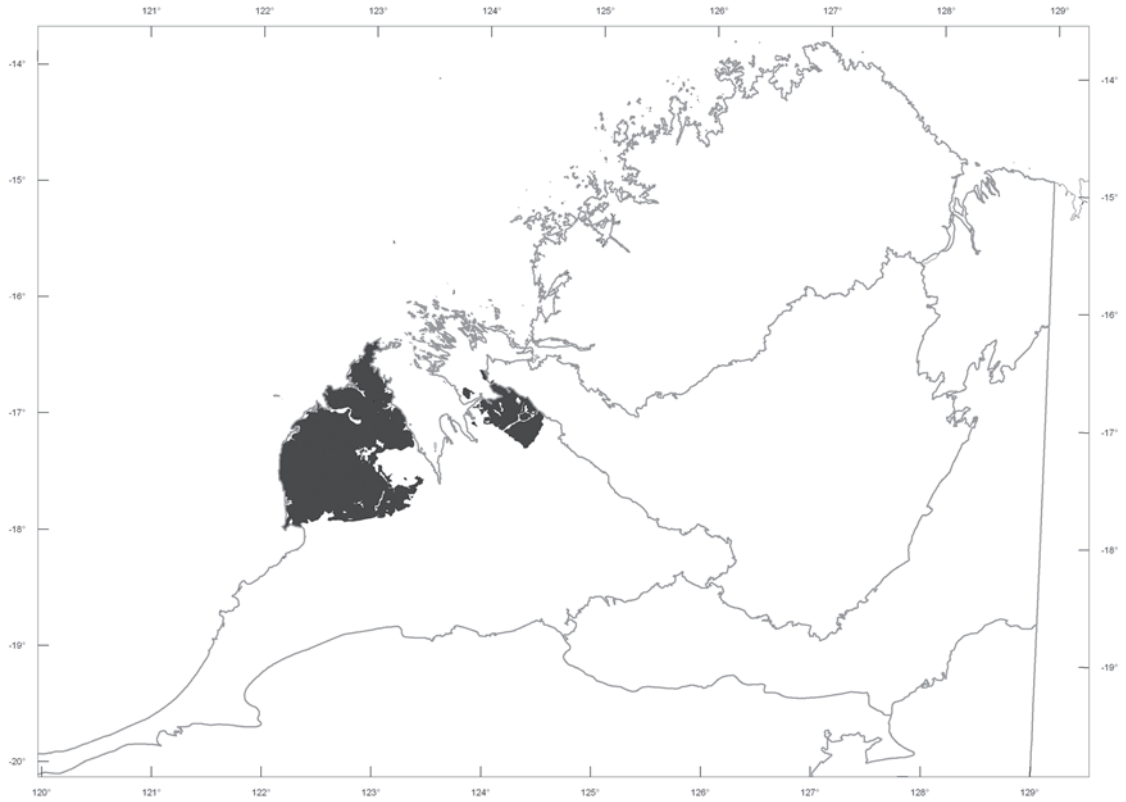


Figure 33. Vegetation Type 21: Pindan woodland.

Plate 31. Pindan woodland near Kilto Station near Broome (photo by Ladislav Mucina).

22. Pindan with low trees

Much of the remainder of the Dampierland Bioregion to the south and east of the Dampier Peninsula is covered with pindan, similar in structure to the pindan woodland described above but with a lower tree layer, which is presumed to reflect the lower rainfall where it occurs (Fig. 34). Emergent species here include *Corymbia confertiflora*, *C. cadophora* and *C. dichromophloia* (variable barked bloodwood; Plate 32). Pindan with low trees covers over 4 million ha and occurs mainly on sandplain, and on and between sand dunes. The dense acacia layer is almost entirely *A. eriopoda* (Broome pindan wattle), which can reach 6 m. Other shrubs include *A. monticola*, *A. holosericea* (candlebra wattle), *A. stipuligera*, *Calytrix exstipulata* (Kimberley heather),

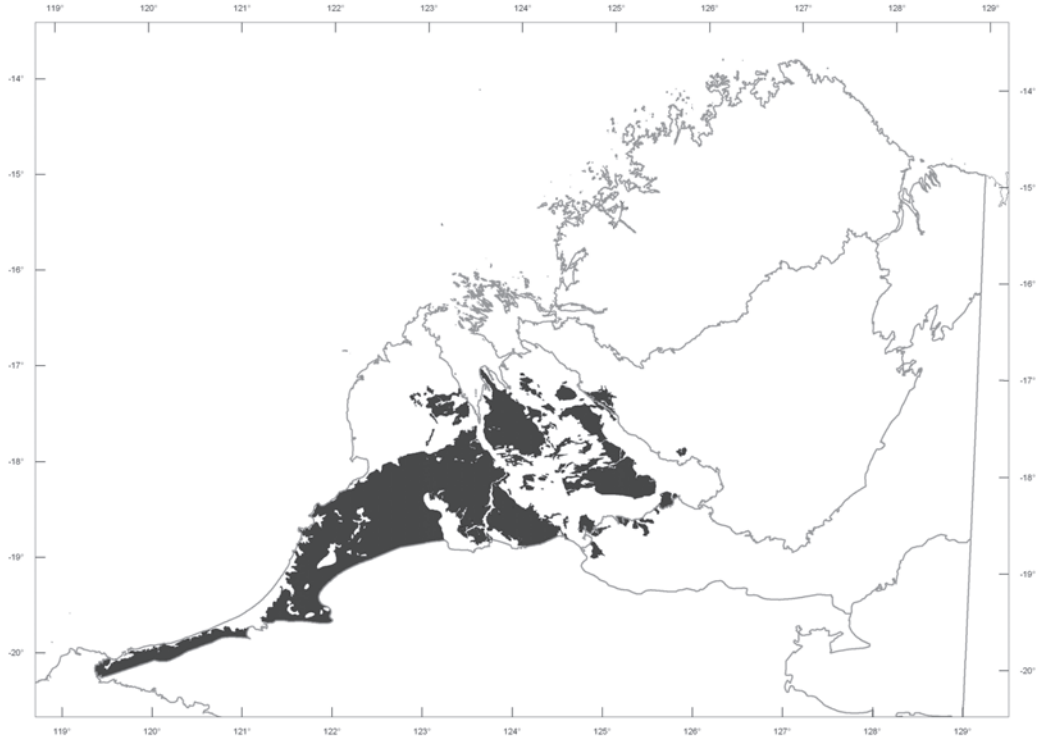


Figure 34. Vegetation Type 22: Pindan with low trees.

Plate 32. Pindan with low trees south of Broome (photo by Ladislav Mucina).

Grevillea pyramidalis (caustic bush), *G. refracta* (silver-leaved grevillea), *G. wickhamii* (Wickham's grevillea) and *Hakea macrocarpa* (jaradinty). The ground layer consists of scattered hummock grasses of the 'soft spinifex' type, i.e. *Triodia pungens* and *T. schinzii*, with some mixture of *Chrysopogon* and short grasses (*Aristida* spp., *Eriachne* spp.; wanderrie grasses). South of the Fitzroy River there is a mosaic of pindan and tall bunch savanna (Mosaic 112; Fig 79).

23. High grass savanna woodland on basalt

(Shown on the map in the colour of high grass savanna overlaid with 🌾 symbols.)

High grass savanna woodland comprises tall (>1 m) tussock grasses (both annual and perennial) with occasional shrubs and an overstorey of trees. The main species of grass is *Sehima nervosum* (white grass). Also present may be *Chrysopogon fallax* (golden beard grass) up to 1.5 m, *Sorghum plumosum* (plume canegrass) and *Themeda triandra* (kangaroo grass). There is a poor shrub layer. The tree layer is predominantly *Eucalyptus tectifica* (grey box), *E. grandifolia* (cabbage gum) and *Corymbia papuana* s.l. (ghost gum) and may be dense enough to form woodlands. Areas of basalt supporting this vegetation type are the Gibb Hills, and the Gibb River plain of the North Kimberley Bioregion extending into the Central Kimberley Bioregion. There are small occurrences in the Victoria Bonaparte Bioregion, bringing the total extent to nearly 2.8 million ha (Fig. 35).

The woodlands of *Eucalyptus tectifica* (grey box; Plate 33), often with *E. grandifolia* (cabbage gum), occur over the dense perennial *Sehima nervosum* (white grass). Associated small deciduous trees include *Hakea arborescens* (common hakea), *Cochlospermum fraseri* (kapok bush), *Terminalia circumalata* and *Erythrophleum chlorostachys* (ironwood). *Corymbia foelscheana* joins the *E. tectifica* (grey box), *E. grandifolia* assemblage over the white grass on gentle slopes. In the more dissected landscape of the Victoria Bonaparte Bioregion, the same species of tree emerge over a grassy layer of *Sorghum stipoideum* (annual sorghum) and *Triodia bitextura* (curly spinifex).

Eucalyptus argillacea (Mt House box) and *Corymbia opaca* (inland bloodwood) occur over *Sehima nervosum* (white grass) on rolling basalt country between the sandstone ridges of the Durack Ranges.

Units similar to those described above occur as part of mosaics on the basaltic hills, in the Victoria Bonaparte Bioregion, and on the dissected, basaltic Antrim plateau

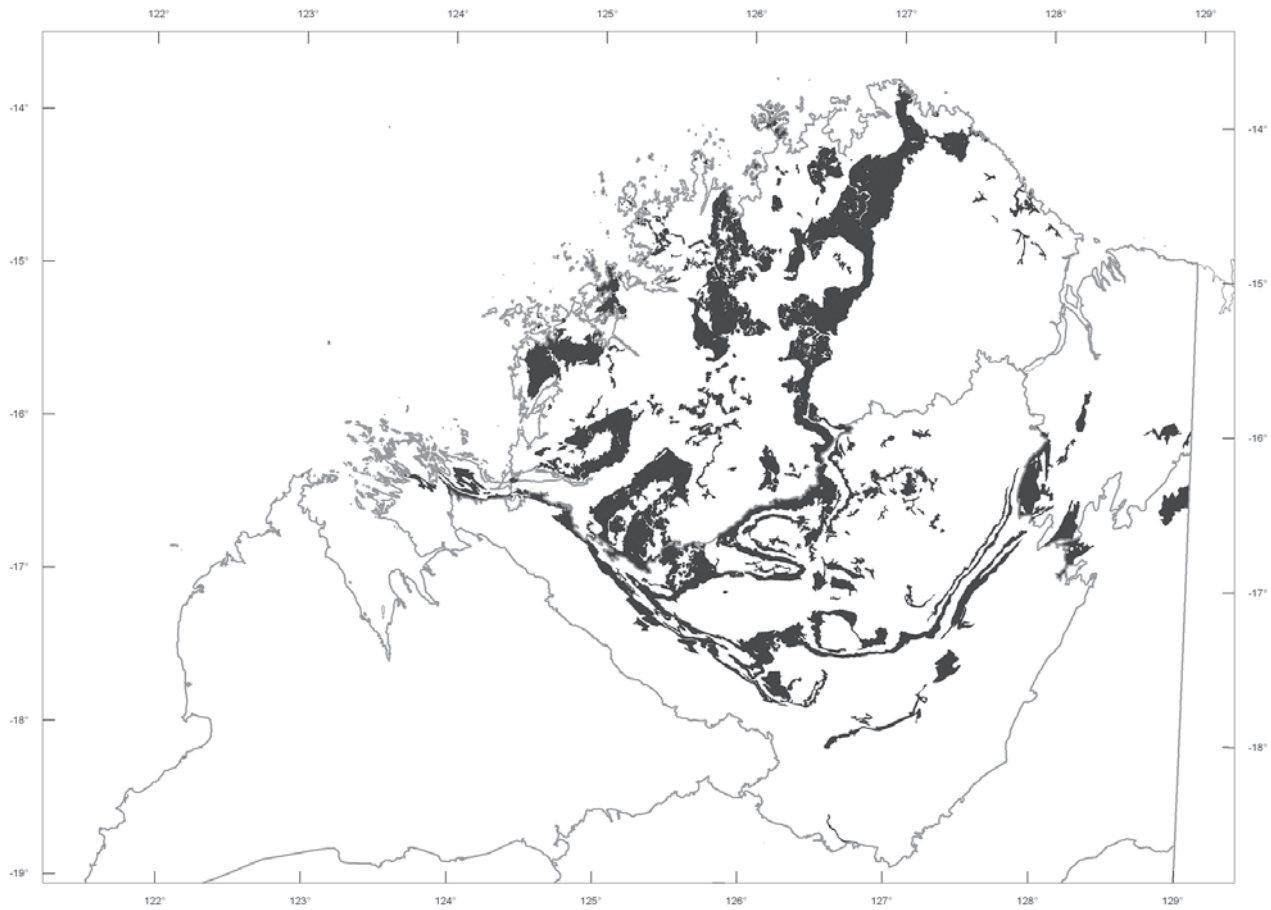


Figure 35. Vegetation Type 23: High grass savanna woodland on basalt.

Plate 33. High grass savanna on basalt on the Kimberley Plateau (photo by John Beard).

south of the upper reaches of the Ord River. Other components of these mosaics are open, low tree-steppe of *Eucalyptus brevifolia* (Kimberley snappy gum) over *Triodia wiseana* (limestone spinifex), sometimes with *T. intermedia* or *Sehima nervosum* (white grass).

24. High grass savanna woodland on sandstone

(Shown on the map in the colour of high grass savanna overlaid with 🌾 symbols.)

This unit of high grass savanna woodland is similar in structure to the previous vegetation type, but distinguished on the basis of substrate, as this unit occurs mainly in areas dominated by sandstone and sandstone-derived soils**.** The grass layer is more open than that on the basalt, and consists mainly of annual species of *Sorghum*, e.g. *S. australiense* and *S. stipoideum*, with sparse *Triodia bitextura* (curly spinifex). Common tree species include *Corymbia dichromophloia* (variable barked bloodwood), *Eucalyptus tetrodonta* (Darwin stringybark) and *E. miniata* (woolybutt; Plate 34).

High grass savanna woodland on sandstone occurs on extensive areas in the North Kimberley Bioregion, including the Prince Regent Plateau in the west and the Karunjie Plateau in the east. This vegetation type extends on similar but more dissected sandstone in the east throughout the Victoria Bonaparte Bioregion. There are small occurrences in the Central Kimberley Bioregion. High grass savanna woodland on sandstone covers over 6 million ha (Fig. 36). Dominant tree species of high grass savanna woodland on low sandy plains are *Eucalyptus tetrodonta* (Darwin stringybark), *E. miniata* (woolybutt) to 25 m on deeper soils in low-lying country, and *Corymbia dichromophloia* (variable barked bloodwood) on shallow soils in the Victoria Bonaparte Bioregion. Small trees include *Buchanania obovata, Brachychiton diversifolius, Syzygium suborbiculare, Grevillea cunninghamii, Grevillea* spp. and, where there are red sands, *Callitris columellaris*. Scattered shrubs are also common and include several *Acacia* species, notably *A. monticola, A. sericata* and *A. tumida*. *Bossiaea bossiaeoides, Calytrix exstipulata* (Kimberley heather), *Sorghum stipoideum* (annual sorghum) and *S. timorense* dominate the grass layer, which grows to 2 m during the wet season, while *Triodia bitextura* (curly spinifex) is present on rocky outcrops.

On deeper soils in the central North Kimberley Bioregion, there is a distinctive high bunch-grass savanna woodland association with *Sorghum stipoideum* (annual sorghum) and *S. timorense*, with the additional component of *Triodia bitextura* (curly spinifex) and with an overstorey of *Eucalyptus tetrodonta* (Darwin stringybark). This is mapped as a mosaic (see Mosaic 113; Fig. 80).

In the northern Victoria Bonaparte Region south-east of Cambridge Gulf, *Corymbia confertifolia* (rough leaved cabbage gum), *Corymbia foelscheana* and sometimes *Eucalyptus tectifica* (grey box) occur over *Sehima*

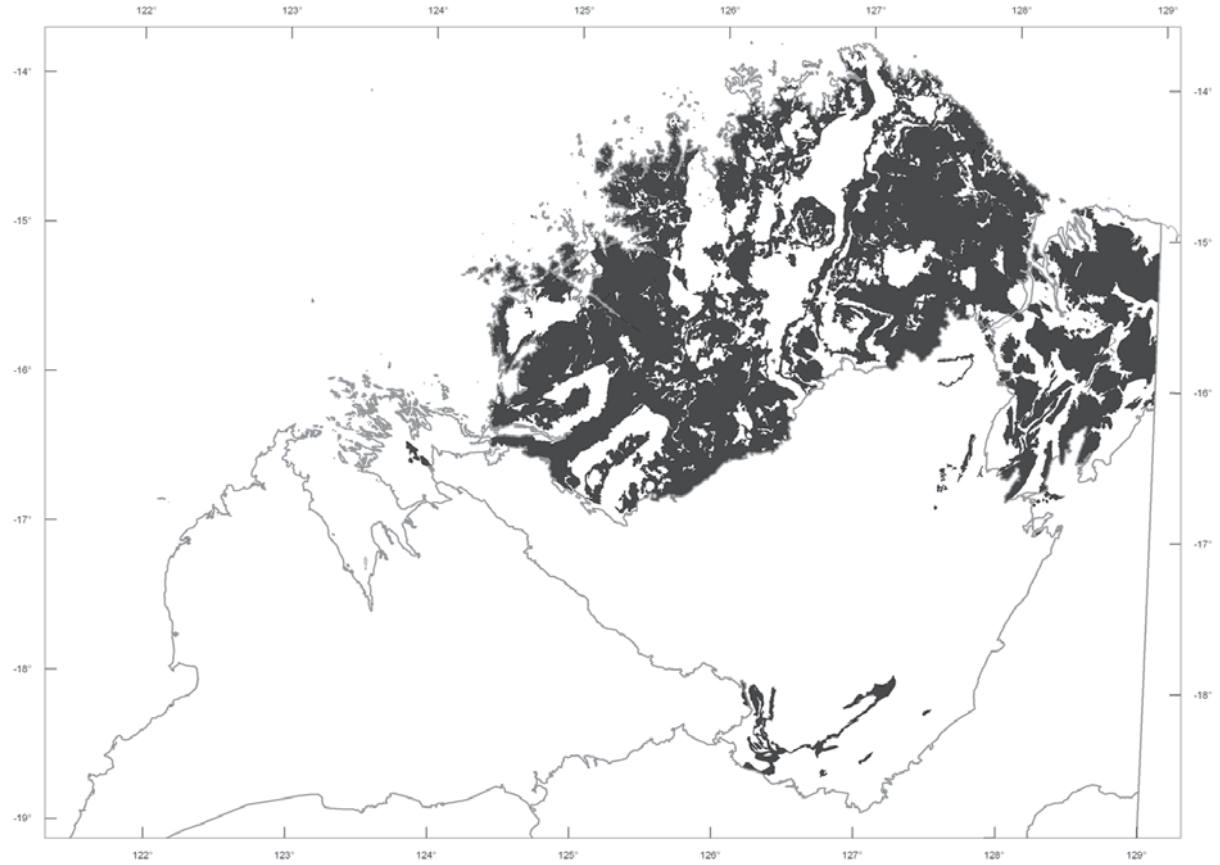


Figure 36. Vegetation Type 24: High grass savanna woodland on sandstone.

Plate 34. High grass savanna near Beverley Springs (photo by John Beard).

nervosum (white grass), with *Sorghum* spp. (sorghum), *Themeda triandra* (kangaroo grass) or *Triodia* spp. on low limestone mesas. On ridges in the low-lying sandplains very scattered *Terminalia* spp. and *Bauhinia* cunninghamii occur over *Sorghum* spp. (tall upland grass) on the eastern flanks of the Ningbing ranges north of Kununurra.

Also included in Vegetation Type 24 is a patch of scattered *Eucalyptus brevifolia* (Kimberley snappy gum) over *Sorghum* spp. (upland tall grass) and *Triodia bitextura* (curly spinifex) on granitic soils protruding from the sandstone in the O'Donnell Range in the Victoria Bonaparte Bioregion.

25. Tall bunch-grass savanna woodland

(Shown on the map in the colour of tall bunch-grass savanna overlaid with symbols.)

Tall bunch-grass savanna is composed mainly of perennial tussock grasses 0.5–1 m tall with an incomplete canopy of medium height (10–30 m) trees. This vegetation type differs from Vegetation Type 26 in that the tree layer is taller. It covers only 233,000 ha, occurring on the western arm and southern part of the Central Kimberley Bioregion, with small areas in the Dampierland Bioregion on broad valley floors (Fig. 37).

The grasses *Chrysopogon latifolius* (broadleaf ribbongrass) and *C. fallax* (golden beard grass) may be joined by *Dichanthium* spp. (blue grasses) under *E. tectifica* (grey box) and *Corymbia grandifolia* (cabbage gum; Plate 35).

Grasslands of *Sehima nervosum* (white grass) with low woodlands of *E. tectifica* (grey box) and *E. grandifolia* (cabbage gum) occur in ribbon-like patches on dolerite in the southern part of the Central Kimberley Bioregion. The tall bunch-grass open savanna woodland communities characteristic of the rivers and drainage lines in the Kimberley have been mapped separately (Vegetation Type 39).

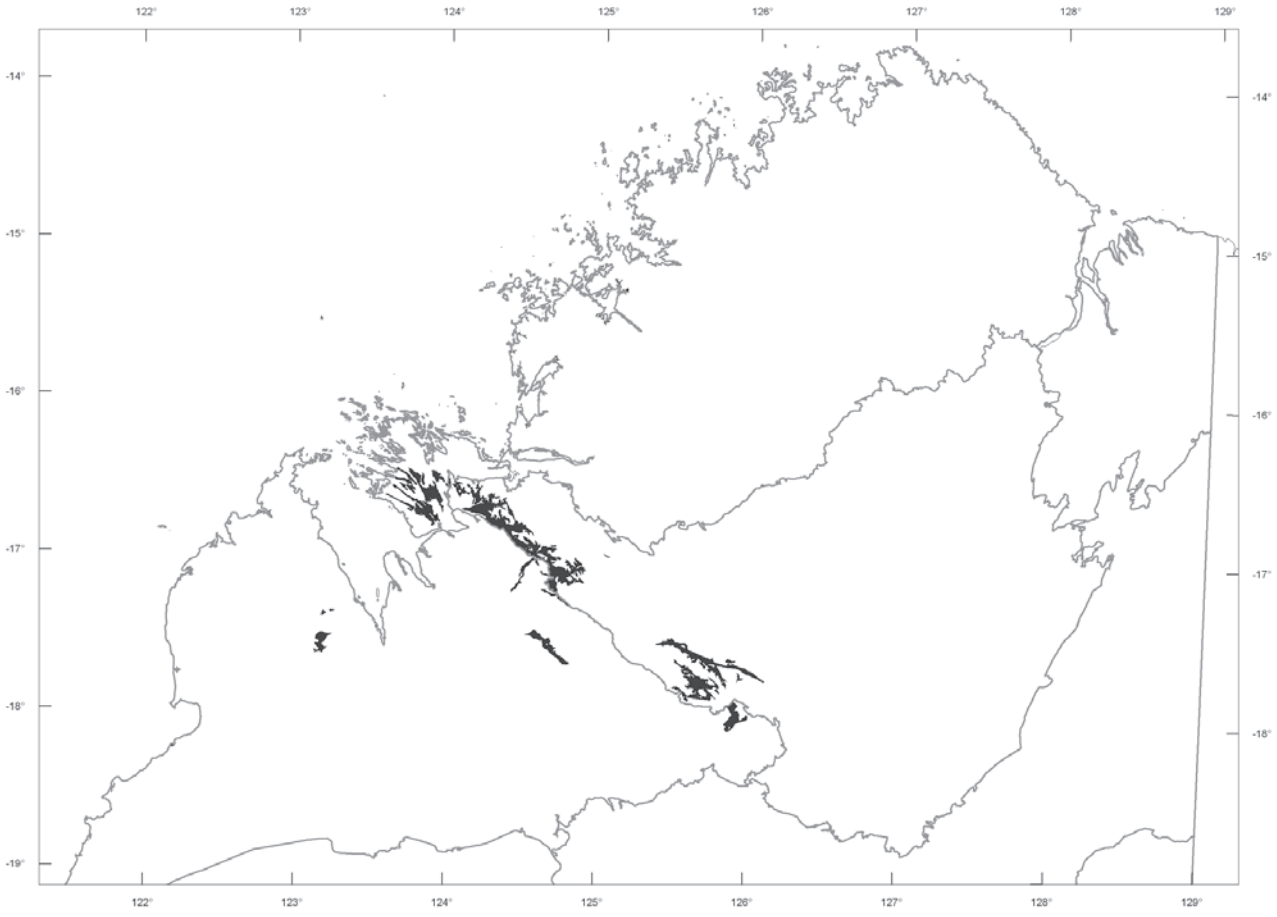


Figure 37. Vegetation Type 25: Tall bunch-grass savanna woodland.

Plate 35. Tall grass savanna on Mount House Station (photo by John Beard).

26. Tall bunch-grass low tree savanna

(Shown on the map in the colour of tall bunch-grass savanna overlaid with symbols.)

Most of this tall bunch-grass savanna unit has perennial tussock grasses 0.5–1 m tall with a conspicuous low tree layer with 10–30% pfc. There is one association, *Eucalyptus tectifica* (grey box) and *Corymbia grandifolia* (cabbage gum) low woodland over ribbon grass, that has a denser low woodland component. This is similar to Vegetation Type 25 but has a lower (<10 m) tree canopy. Grasses are mainly *Chrysopogon* spp. (ribbon or beard grass) with emergent trees such as *E. tectifica* (grey box), *Corymbia grandifolia* (cabbage gum) and *C. opaca* (bloodwood). It occurs in localized areas totalling over 1 million ha in the central Dampierland, Central Kimberley and eastern Ord – Victoria Plains Bioregions (Fig. 38).

On 170,000 ha of yellow loamy soils between the Fitzroy and Leonard Rivers in the Dampierland Bioregion, the tall bunch-grass low tree savanna consists of *Adansonia gregorii* (boab), *Bauhinia cunninghamii* (bauhinia) and *Grevillea striata* (beefwood) over *Chrysopogon* spp. (ribbon or beard grass; Plate 36). A unit similar to this, but with additional *Dichanthium* spp. (blue grass), extends over 57,000 ha into the Central Kimberley Bioregion.

Tall bunch-grass low tree savanna characterised by *Aristida pruinosa* (gulf feathertop wiregrass) and *Chrysopogon fallax* (golden beard grass) has two different overstoreys. Those with *Eucalyptus tectifica* (grey box) and *Corymbia opaca* (inland bloodwood) cover 113,000 ha on the low-lying sandstone plains around the Osmond Range in the Ord – Victoria Plains Bioregion. Those with *Corymbia grandifolia* (cabbage gum) and *Eucalyptus pruinosa* (silver box) occur to the south of the Carr Boyd Ranges on 59,000 ha of sandy plain that surrounds outcrops of sandstone.

Low woodlands of *Eucalyptus tectifica* (grey box) and *Corymbia grandifolia* (cabbage gum) over *Chrysopogon* spp. (ribbon or beard grass) occur over 160,000 ha in the Central Kimberley Bioregion on dolerite in the broad, low valley floors. The tree layer may also include scattered *Corymbia dichromophloia* (variable barked bloodwood), *C. polycarpa* (bloodwood), *Adansonia gregorii* (boab) and *Bauhinia cunninghamii* (bauhinia). The shrub layer is moderately dense, and includes such species as *Sterculia viscidula*, *Calytrix* sp., *Gardenia resinosa*, *Grevillea refracta* (silver-leaf grevillea), *G. heliosperma* (rock grevillea), *G. pyramidalis* (caustic bush), *G. wickhamii*, *Eucalyptus mooreana* (mountain whitegum) and *Terminalia* spp. Other grasses include *Aristida* spp., *Sehima nervosum* (white grass), *Sorghum* spp. and *Triodia bitextura* (curly spinifex).

An area (43,000 ha) of tall bunch-grass low tree savanna with *Corymbia grandifolia* (cabbage gum) and *Corymbia polycarpa* (bloodwood) occurs on sandy plains in the Central Kimberley Bioregion. A low tree layer 3–6 m in height, containing *Terminalia canescens*, *Melaleuca minutifolia* (tea tree) and *Dolichandrone lanceolata*, is

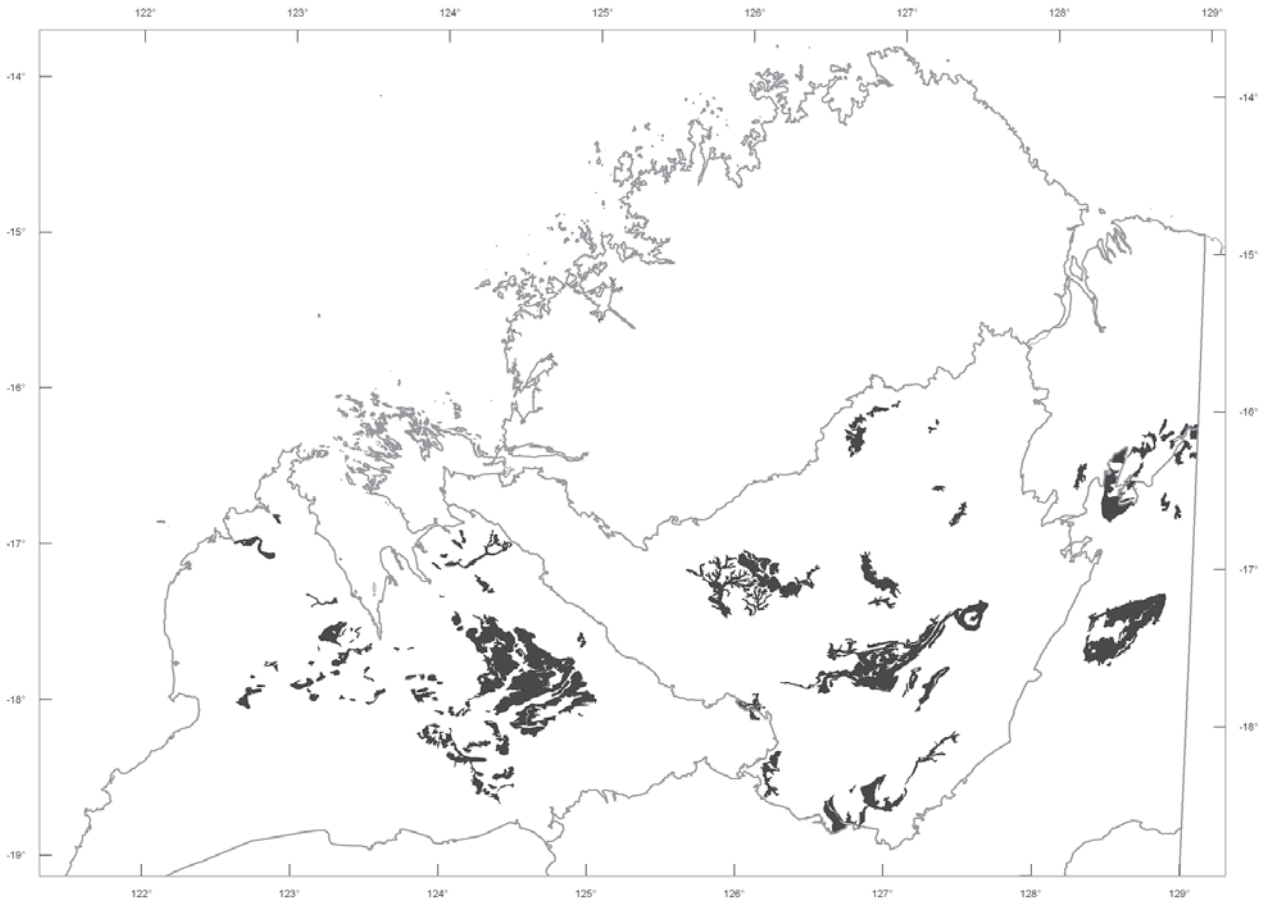


Figure 38. Vegetation Type 26: Tall bunch-grass low tree savanna.

Plate 36. Bunch-grass low tree savanna east of Derby (photo by John Beard).

commonly present. Other grasses include *Dichanthium* spp., *Sorghum* spp. and *Themeda triandra* (kangaroo grass). Similar low tree units with *Eucalyptus brevifolia* (Kimberley snappy gum), *Corymbia dichromophloia* (variable barked bloodwood) and/or *C. grandifolia* (cabbage gum) low trees over the *Chrysopogon* spp. (ribbon or beard grass) occur throughout the Central Kimberley Bioregion over an area of nearly 150,000 ha.

An open low tree savanna of paperbarks (*Melaleuca nervosa* and *M. acacioides*; coastal paperbark) and *Chrysopogon* spp. (ribbon or beard grass), *Dichanthium* spp. and *Sehima* spp. grasses occurs in seasonally swampy bottomlands inland from the major bays on the Dampier peninsula e.g. Beagle Bay.

27. Tall bunch-grass savanna, sometimes with sparse low trees

This tall bunch-grass savanna vegetation type has perennial tussock grasses 0.5–1 m tall, sometimes with sparse low trees, and mainly occurs on black soil plains. The main component of this vegetation type is Mitchell grass (*Astrebla* spp.) often with *Dichanthium* spp. (blue grass) and *Chrysopogon latifolius* (broadleaf ribbongrass). Emergents include inconspicuous or scattered groups of *Terminalia* spp., *Acacia suberosa* (corkybark wattle), *Bauhinia cunninghamii* (bauhinia) and *Eucalyptus microtheca* (coolibah). It is characteristic of the Kimberley black soil plains found in the north-eastern and south-eastern Dampierland Bioregion, the south-eastern and northern Ord – Victoria Plains Bioregion and the central Victoria Bonaparte Bioregion. Tall bunch-grass savanna and tall bunch-grass savanna with sparse low trees together cover nearly 1.7 million ha (Fig. 39).

The bunch-grasses, which cover 314,000 ha of the Denison Plains in the south-eastern Ord – Victoria Plains Bioregion, consist mainly of Mitchell grasses. *Astrebla pectinata* (barley Mitchell grass), *A. squarrosa* (bull Mitchell grass) and *A. elymoides* (weeping Mitchell grass) are interspersed with *Dichanthium fecundum* (curly blue grass), *Aristida latifolia* (feathertop wire grass) and *Chrysopogon fallax* (golden beard grass). Native legumes, such as *Neptunia* sp. (sensitive plants), are also present. Annuals, which occupy the spaces between the perennial bunch grasses in good rainfall years, include *Iseilema* spp. (Flinders grasses), *[1] *Echinochloa colona* (awnless barnyard grass), *Eragrostis japonica* (delicate lovegrass), *Brachyachne convergens* (spider grass), **Malvastrum americanum* (spiked malvastrum), *Crotalaria medicaginea*, *Sida fibulifera*, *S. spinosa* (spiny sida), *Alysicarpus rugosus* (rough chainpea), *Rhynchosia minima* and many others.

[1] * introduced species (not native to the area)

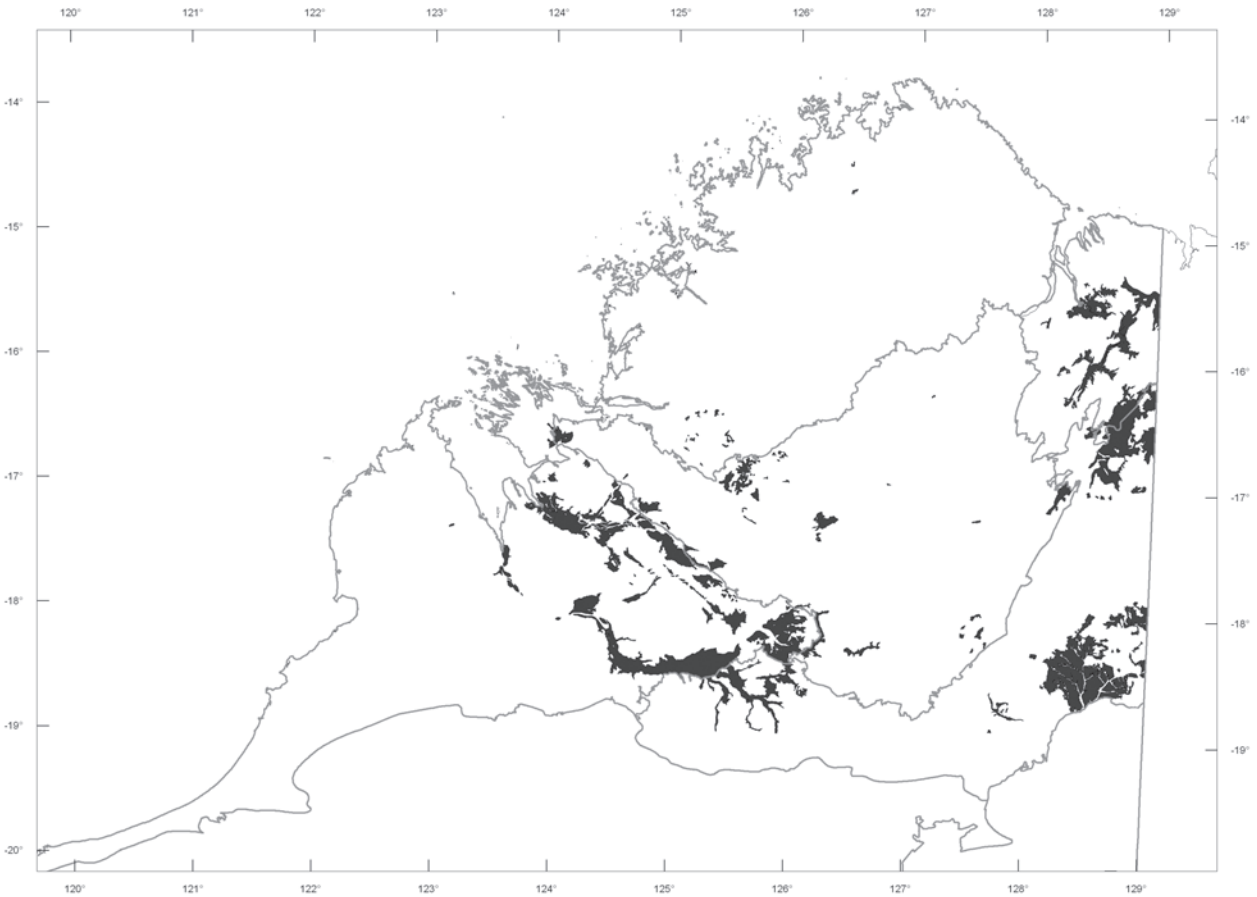


Figure 39. Vegetation Type 27: Tall bunch-grass savanna, or tall bunch-grass savanna with sparse low trees.

Throughout the central Victoria Bonaparte Bioregion, the bunch-grass savanna woodland that occurs on black soil plains is joined by tussock grasses (>1 m) with scattered emergent deciduous trees. Scattered low trees of *Bauhinia cunninghamii* (bauhinia) or *Eucalyptus microtheca* (coolibah) and *Terminalia* spp. occur over perennial tussock-grasses (up to 2 m) of *Sorghum plumosum* (plume canegrass) and *S. timorense*, with bunch-grasses such as *Dichanthium sericeum* (Queensland blue grass), *D. fecundum* (curly blue grass) and/or *Astrebla squarrosa* (bull mitchell grass).

Astrebla pectinata (barley Mitchell grass) bunch-grass savanna on black soil plains is mapped in five areas that total nearly 65,000 ha in the Ord – Victoria Plains and Victoria Bonaparte Bioregions. It has sparse emergents including *Terminalia arostrata* (crocodile tree) and *T. oblongata* (rosewood). *Dichanthium* spp. (blue grass) join this association on adjacent basaltic soils that cover a further 36,000 ha on the Denison Plains in the Ord – Victoria Plains Bioregion (Plate 37). Black soil plains with *Astrebla* spp. (Mitchell grass) and/or *Chrysopogon* spp. (ribbon grass) and *Dichanthium* spp. (bluegrass) associations cover 325,000 ha in the Fitzroy and Leonard river basins. Here tussocky perennial grasses 0.6–1.2 m tall form a moderately dense layer distinguished by *Astrebla squarrosa* (bull mitchell grass), *A. pectinata* (barley Mitchell grass) and *A. elymoides* (weeping mitchell grass), with *Chrysopogon latifolius* (broadleaf ribbongrass), *Dichanthium* spp. (blue grass), *Sehima nervosum* (white grass) and *Aristida latifolia* (feathertop wire grass) commonly present. Annuals, herbs and leguminous species further enrich the community. Very open trees include *Bauhinia cunninghamii* (bauhinia), *E. microtheca* (coolibah) and *Acacia suberosa* (corkybark wattle).

The tall bunch-grass savanna with very scattered low trees of *Acacia suberosa* (corkybark wattle) over *Astrebla* spp. (Mitchell grass) occur over 43,500 ha in the North and Central Kimberley Bioregions, and over a smaller area (11,200 ha) of *Chrysopogon latifolius* (broadleaf ribbon grass) and *Dichanthium* spp. (blue grass) in the Central Kimberley Bioregion. A total of 37,500 ha of *Chrysopogon latifolius* (broadleaf ribbon grass) and *Dichanthium* spp. (blue grass) without emergents occurs mainly in the Dampierland Bioregion.

The *Astrebla* spp. (Mitchell grass), *Chrysopogon latifolius* (broadleaf ribbon grass) and *Dichanthium* spp. (blue grass) that occurs on 76,000 ha of black soil plains in the Dampierland, Central Kimberley and Ord – Victoria Plains Bioregions has very rare or scattered groups of *Adansonia gregorii* (boab), *Bauhinia cunninghamii* (bauhinia) and *Grevillea striata* (beefwood).

On riverine areas in the south-west of the Central Kimberley Bioregion and on adjacent small patches in the southern North Kimberley Bioregion, the black soil supports sparse low trees of *Bauhinia cunninghamii* (bauhinia) and *E. microtheca* (coolibah) over the *Chrysopogon latifolius* (broadleaf ribbon grass).

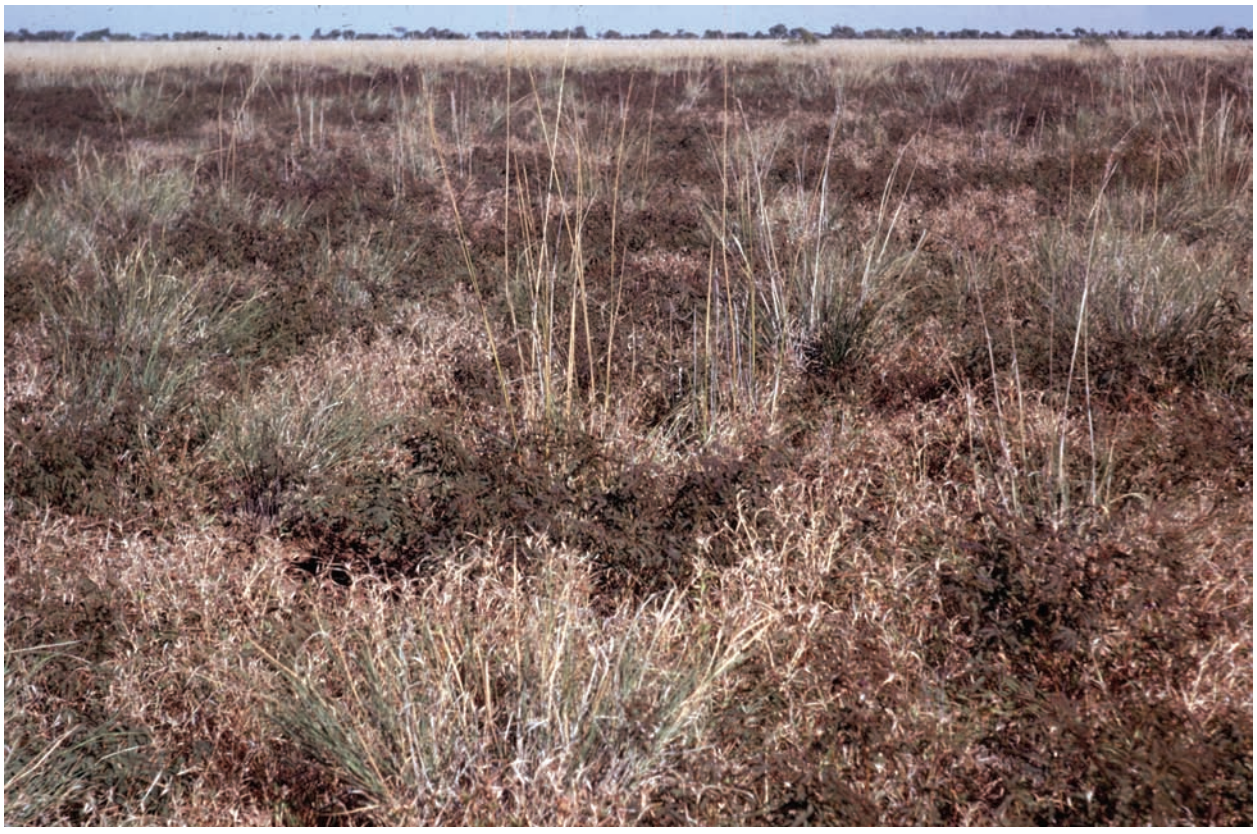


Plate 37. Tall bunch-grass savanna on the Denison Plains (photo by John Beard).

28. Short bunch-grass low tree savanna

(Shown on the map in the colour of short bunch-grass savanna overlaid with symbols.)

Annual or short-lived perennial grasses <0.5 m in height dominate short bunch-grass savanna. It occurs on its own or with an open (<10% cover) low tree layer. Short bunch-grass low tree savanna occurs in the drier Kimberley, in a discontinuous band from south of Kununurra to near Broome. It is found on lowland plains and covers over 490,000 ha (Fig. 40). The short grasses are mainly *Enneapogon* spp. (arid short grass) and *Aristida* spp. and the emergent trees are *Bauhinia cunninghamii* (bauhinia) and *Eucalyptus brevifolia* (Kimberley snappy gum; Plate 38).

In the eastern Central Kimberley Bioregion, the short bunch-grasses occur on the duplex soils of the plains and gentle slopes in the Bow River Hills area. The principal species are *Enneapogon* spp. (arid short grass), *Aristida contorta* (bunch kerosene grass), *Sporobolus australasicus* (fairy grass), *Tragus australianus* (small burrgrass), *Oxychloris scariosa* (winged chloris), *Sida fibulifera* (silver sida), *Portulaca oleracea* (purslane) and *Cleome viscosa* (tickweed). The main emergent is *Eucalyptus brevifolia* (Kimberley snappy gum), which becomes more open in the drier Ord – Victoria Plains Bioregion. *Corymbia opaca* (inland bloodwood) may also be present. These associations account for nearly half of the vegetation type, covering a total of 217,000 ha.

Along drainage lines and on river flats in the southern central Dampierland Bioregion and running through the Poole Range in the western Ord – Victoria Plains Bioregion, open *Bauhinia cunninghamii* (bauhinia) emerges from *Aristida pruinosa* (gulf feathertop wiregrass) or *A. brownii* short grass plains. This vegetation type covers a total of 127,000 ha. Low trees of *Bauhinia cunninghamii* (bauhinia) and *Grevillea striata* (beefwood) and other grasses such as *Chrysopogon* spp. (ribbon or beard grass) and *Triodia pungens* (soft spinifex) may also be present. Being adjacent to areas of pindan vegetation, these associations may also have sparse *Acacia eriopoda* (Broome pindan wattle) and *A. monticola* (gawar) shrubs, with an unidentified acacia replacing *A. eriopoda* and forming thickets on the alluvial river flats.

Vegetation in which low trees of *Eucalyptus argillacea* (Mt House box) and *Corymbia opaca* (inland bloodwood) emerge from *Enneapogon* spp. (arid short grass) occurs in two areas totalling over 134,000 ha. One is on the upper reaches of the Ord River in the Ord – Victoria Plains Bioregion, and the other is along the Durham River in the Victoria Bonaparte Bioregion. Associated species include *Terminalia arostrata* (crocodile tree), *Gyrocarpus*

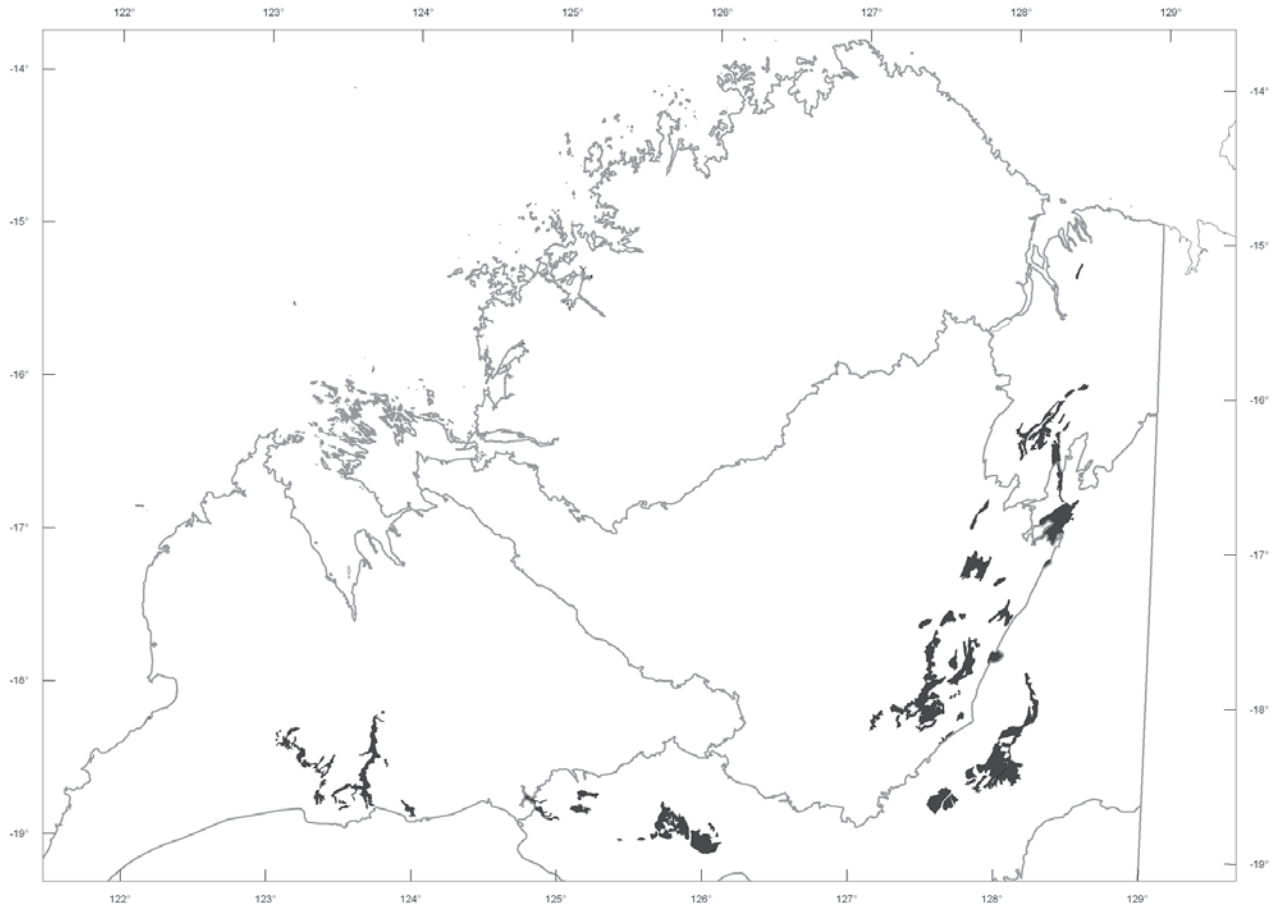


Figure 40. Vegetation Type 28: Short bunch-grass low tree savanna.

Plate 38. Short bunch-grass low tree savanna near Halls Creek (photo by Ladislav Mucina).

americanus (helicopter tree), *Bauhinia cunninghamii* (bauhinia), *Acacia victoriae* (bardi) and **Vachellia farnesiana* (introduced mimosa bush), with *Dichanthium sericeum* subsp. *sericeum* (slender bluegrass) and *Triodia intermedia* obvious in the ground layer.

29. Short bunch-grass savanna

This vegetation type is similar to the previous vegetation type but it does not have an emergent tree layer. *Sporobolus virginicus* (salt-water couch) is a common species on the coast and *Enneapogon* spp. and *Aristida* spp. typify the annual grasses of the dry inland plains. This vegetation type occurs mainly along the coastal plain of the Dampierland Bioregion and on dry shale and limestone plains in the Ord River valley. It also includes the extensive area of savanna grass plain in the Pilbara, which brings the total extent to over 1.14 million ha (Fig. 41).

In the Dampierland Bioregion, the short bunch-grassland with *Sporobolus virginicus* (salt-water couch) 0.15–0.3 m tall is found on swampy clay plains on the coast behind 80 Mile Beach and inland from Roebuck Bay, between the pindan and the sea. Another area of similar vegetation occurs on the north coast of the Victoria Bonaparte Bioregion. Other species are occasional samphire (*Tecticornia* spp.), *Sclerolaena* sp. and *Eragrostis falcata* (sickle lovegrass). Together these two vegetation types cover nearly 260,000 ha.

Arid short grasses (*Enneapogon* spp.) occur over 263,000 ha on the softer limestone and shale plains through which the Ord River flows. Other associated grasses are *Aristida contorta* (bunch kerosene grass), *Sporobolus australasicus* (fairy grass), *Tragus australianus* (small burrgrass) and *Oxychloris scariosa* (winged chloris) and forbs such as *Sida fibulifera* (silver sida), *Portulaca oleracea* (purslane) and *Cleome viscosa* (tickweed).

In the Pilbara Bioregion on the coast near Onslow and Roebourne, and inland flanking the Robe and Fortescue rivers on the lower slopes of the Hamersley Range, short bunch-grasslands occur on the dark cracking clays that are derived from basalt. These total over 525,000 ha and are dominated by *Astrebla pectinata* (barley Mitchell grass) and *Eragrostis setifolia* (Plate 39). An adjacent area of nearly 850,000 ha (Mosaic 116; Fig. 83) is mapped as a mosaic of savanna grass plain and *Triodia pungens* (soft spinifex) or *T. wiseana* (limestone spinifex).

Short bunch-grass savanna composed of *Eragrostis eriopoda* and *Triodia pungens* (soft spinifex) occurs over 96,000 ha on clay plains mainly in the Tanami Desert, but also in pockets in the Great Sandy Desert and Central Ranges Bioregions. Other species found here include *Tephrosia arenicola* and *Dampiera candicans*, with *Frankenia* spp. and *Tecticornia* spp. in saline areas. Clumps of tea tree scrub, *Melaleuca lasiandra* and *M. glomerata* may also be present.

Figure 41. Vegetation Type 29: Short bunch-grass savanna.

Plate 39. Short bunch-grassland, Pilbara (photo by Stephen van Leeuwen).

30. Curly spinifex savanna woodland or low tree savanna

(Shown on the map in the colour of curly spinifex savanna overlaid with symbols.)

Triodia bitextura is commonly known as curly spinifex and grows to between 0.5 and 1 m tall. Curly spinifex savanna woodland is distinguished by the presence of *Triodia bitextura* with 30–70% pfc, with a medium height (10–30 m) tree layer with 10–30% pfc. It covers just over 100,000 ha in the Central Kimberley Bioregion. More commonly, the curly spinifex savanna has a low tree component, either incomplete (10–30% cover) or more open and scattered (<10% pfc). This consists of trees such as *Eucalyptus brevifolia* (Kimberley snappy gum), *Eucalyptus phoenicea* (gnaingar) and *Corymbia ferruginea* (rusty bloodwood). It occurs on skeletal soils associated with sandstone. This is the characteristic vegetation of the Central Kimberley Bioregion, covering 70% of the bioregion, a total of nearly 5 million ha (Fig. 42).

Curly spinifex savanna woodland of *Eucalyptus brevifolia* (snappy gum), often with *Corymbia dichromophloia* (variable barked bloodwood), occurs over *Triodia bitextura* (curly spinifex) on the ridges in the King Leopold Ranges, Central Kimberley Bioregion.

Eucalyptus phoenicea (gnaingar) and *Corymbia ferruginea* over *Triodia bitextura* (curly spinifex) curly spinifex low tree savanna occurs extensively (1.9 million ha) in the Central Kimberley Bioregion, adjacent to the high grass savanna woodlands to the north in the Northern Kimberley Bioregion. The upper tree layer is typically 8–10 m tall with trees with gnarled and twisted trunks seldom more than 0.3–0.5 m in diameter. The cypress, *Callitris columellaris*, is occasionally found. There may be a shrub layer, generally sparse, but in some areas the acacia may develop into thickets reminiscent of pindan. Principal components of this layer are *Acacia sericata* and other *Acacia* spp., *Gardenia* spp., *Grevillea agrifolia* (blue grevillea), *G. cunninghamii, G. pteridifolia* (silky grevillea), *Jacksonia forrestii, Petalostigma pubescens, Planchonia careya* (mangaloo) and *Ventilago viminalis* (supplejack).

Savanna woodland associations with the low (<10 m) tree component of *Eucalyptus brevifolia* (Kimberley snappy gum) occur extensively (1.2 million ha) over the sandstone ridges of King Leopold Durack Ranges and Evelyn Ranges. Here, where the rainfall is lower than the sandstone plateau to the north, the low tree savanna of *E. brevifolia* (Kimberley snappy gum), usually with *Corymbia dichromophloia* (variable barked bloodwood), occurs over *Triodia bitextura* (curly spinifex; Plate 40).

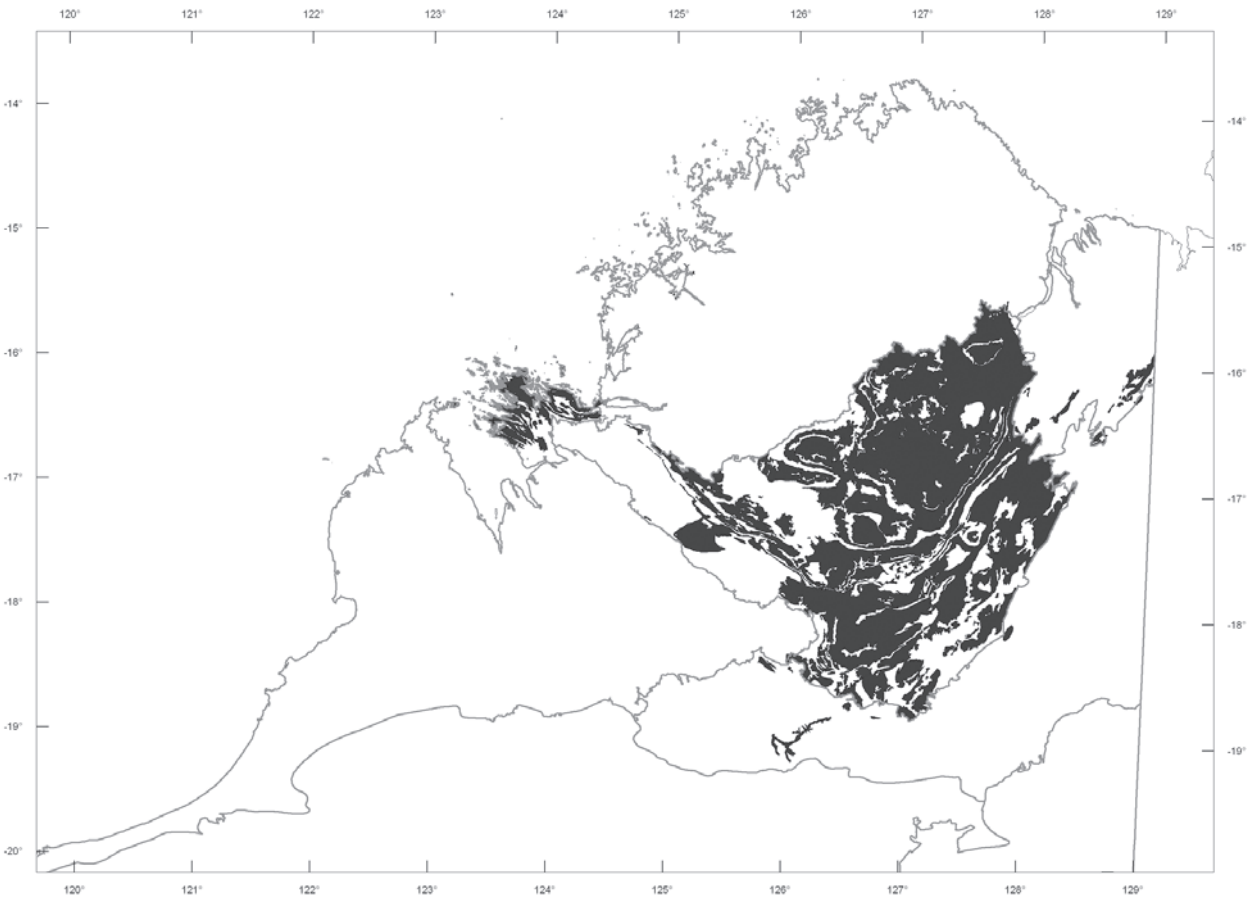


Figure 42. Vegetation Type 30: Curly spinifex savanna woodland.

Plate 40. Curly spinifex savanna woodland near Argyle (photo by Libby Mattiske).

On lower hill slopes and valley floors, *Enneapogon* spp. (arid shortgrass) occur with the curly spinifex. This is similar to other curly spinifex associations in Vegetation Type 35, Hummock grasslands low tree-steppe.

The vegetation of the islands off the coast of the Central Kimberley Bioregion, e.g. Buccaneer Archipelago, has been mapped as similar to the above association, but the *E. brevifolia* (Kimberley snappy gum) is replaced by *E. miniata* (woolybutt).

A large curly spinifex mosaic (Mosaic 112; Fig. 79) is the low tree savanna/sparse low tree savanna over *Triodia bynoei* in the western arm of the Central Kimberley Bioregion.

31. Tall bunch-grass open savanna woodland (riverine)

This small vegetation type, which covers just 343,000 ha, has a similar understorey to the other tall bunch-grass vegetation types (Vegetation Types 26 and 27) but it is characteristic of riverine environments. It consists of the *Eucalyptus microtheca* (coolibah) over *Chrysopogon* spp. (ribbon or beard grass) grasses. It is characteristic of river flats mainly in Dampierland, and it also occurs along some drainage lines in the Central and Northern Kimberley and the Ord – Victoria Plains Bioregions (Fig. 43).

The ribbons of *E. camaldulensis* (rivergum) woodland (which are often too narrow to be mapped) are fringed by tall bunch-grass savanna woodland. This vegetation type occurs along the levee banks and back slopes of the Fitzroy River and its tributaries, the Leonard River and at the base of the north-eastern arm of King Sound. Species include *Eucalyptus microtheca* (coolibah) over *Chrysopogon* spp. (ribbon or beard grass; Plate 41), sometimes with *Dichanthium* spp. (blue grass). *Corymbia papuana* s.l. (ghost gum) joins the coolibah on flats around Fitzroy Crossing. A riverine short bunch-grass association has also been placed in this unit: *Corymbia polycarpa* (long-fruited bloodwood) savanna woodland over *Aristida holathera* (erect kerosene grass) occurs in the Central Kimberley Bioregion on river flats along the Hann River, a tributary of the Fitzroy River.

High grass savanna woodland of *E. grandifolia* (cabbage gum) and *Corymbia papuana* s.l. (ghost gum) alliance over mixed grass (e.g. *Sorghum plumosum, Themeda triandra, Sehima nervosum, Dichanthium* sp. and *Bothriochloa* sp.) is associated with streamlines and levees in the Northern Kimberley Bioregion. These are

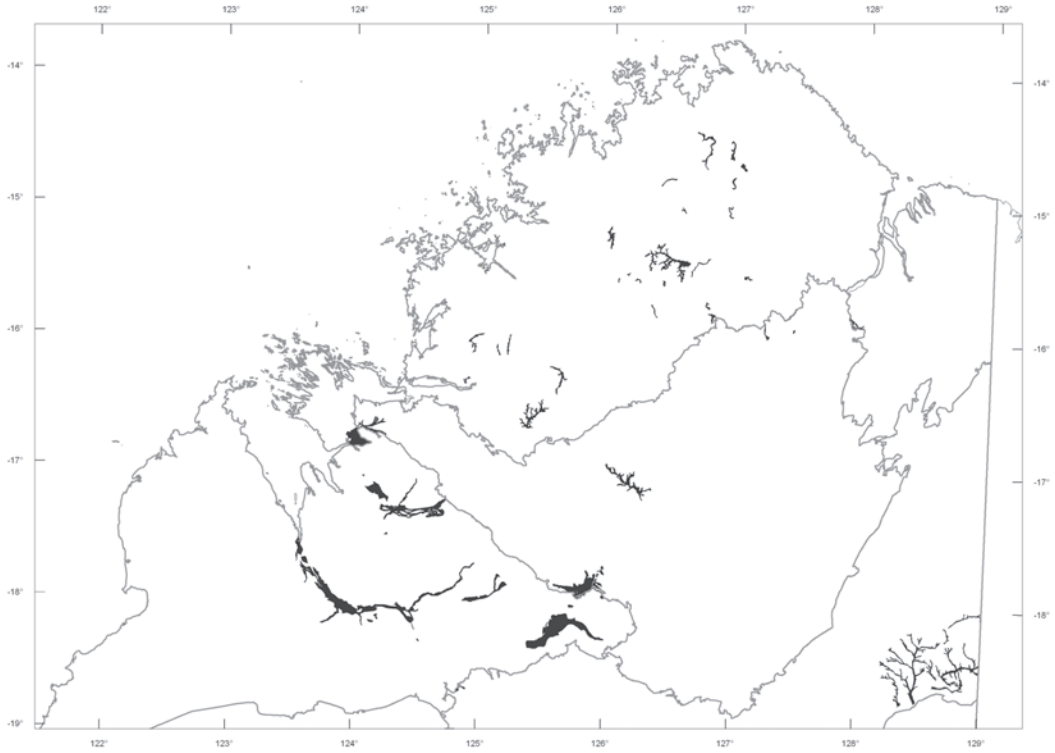


Figure 43. Vegetation Type 31: Tall bunch-grass open savanna woodland associated with drainage features.

Plate 41. Tall bunch-grass with scattered coolibah in drainage channels on the Denison Plains (photo by John Beard).

usually linear and more extensive than shown on the 1:250,000 maps.

An association of *E. microtheca* (coolibah) and *E. tectifica* (grey box) low tree savanna woodland over *Triodia* sp. and *Themeda triandra* (kangaroo grass) is mapped over nearly 518,000 ha along the channels through the Denison Plains in the Ord – Victoria Plains Bioregion (Fig. 45). Other trees include *Bauhinia cunninghamii* (bauhinia) and *Terminalia arostrata* (crocodile tree).

32. Riverine sedgeland/grassland with trees

This unit has a ribbon-like distribution associated with drainage lines. It is scattered over the northern half of the state and covers an area of over half a million hectares (Fig. 44). The trees are mainly *Eucalyptus microtheca* (coolibah) or *E. victrix* (coolibah) and *E. camaldulensis* (river gum) over mixed sedges from the families Cyperaceae and Restionaceae, and grasses (*Aristida* spp. and *Eragrostis* spp.).

North of Lake Gregory in the western Tanami Bioregion are extensive areas of low open *E. microtheca* (coolibah) over various sedges. *Terminalia platyphylla* (wild plum), *Bauhinia cunninghamii* and *Grevillea striata* (beefwood) may be present and grasses include *Iseilema vaginiflorum* (Flinders grass) and *Dactyloctenium radulans* (button grass). In the valleys and near claypans in the Gibson Desert Bioregion, *E. victix* (coolibah) with 10–30% pfc over various sedges is mapped over a total of 212,000 ha.

In the Pilbara Bioregion, and to a much lesser extent in the Gascoyne and Little Sandy Desert Bioregions, the riverine woodland tends to be more open (<10% pfc) than the previous associations. The species here is *Eucalyptus victix* (coolibah; Plate 42), and *E. camaldulensis* (river gum) may also be found over a variety of sedges and grasses. Also in the Pilbara is an area of 67,000 ha of sedges with open *Corymbia candida* on the Onslow Coastal Plain.

North-west of Albany along the Hay and Mitchell river valleys in the Jarrah Forest Bioregion is a unit mapped as low woodland of *Melaleuca* spp. (paperbark) over various sedges.

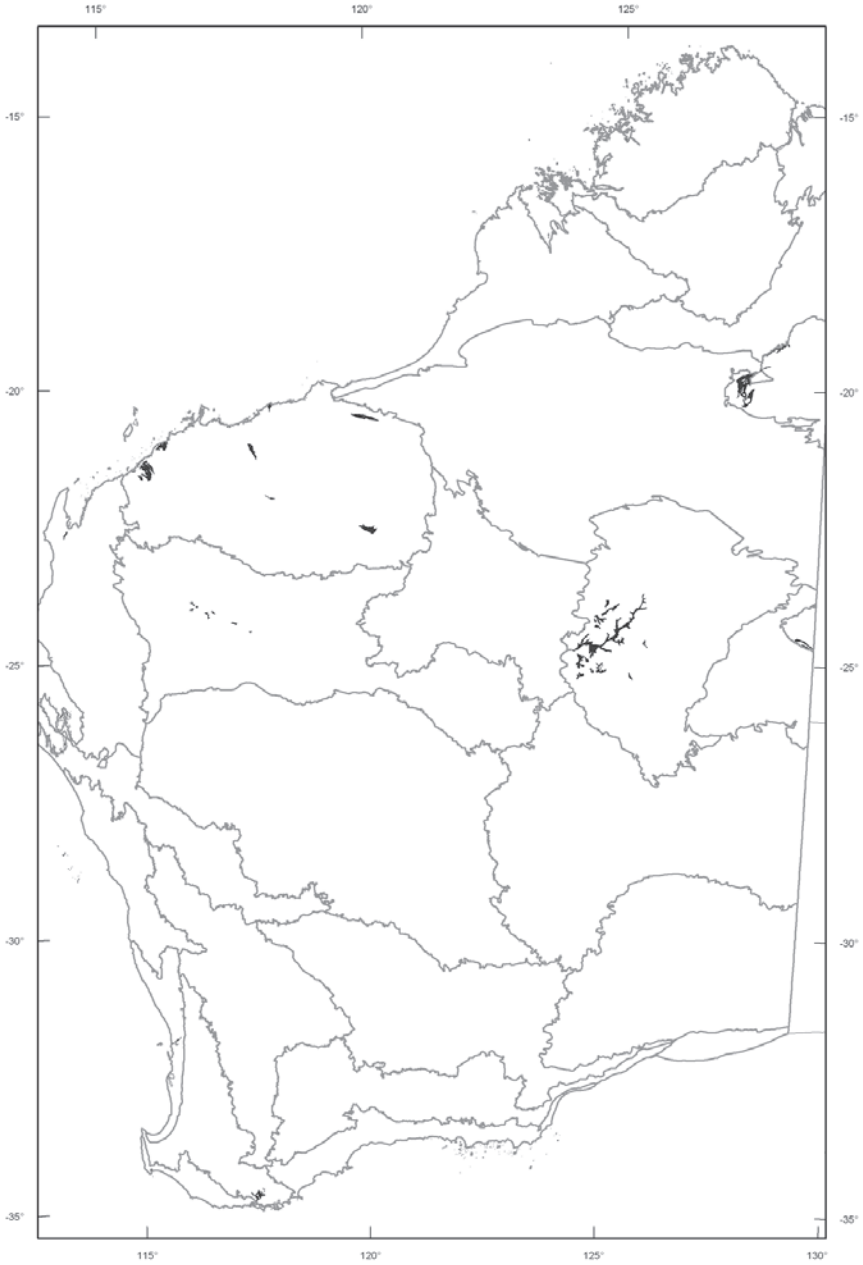


Figure 44. Vegetation Type 32: Riverine sedgeland/grassland with trees.

Plate 42. Riverine sedgeland/grassland in the Pilbara (photo by Mick Davis).

33. Sedgeland

Sedgelands are dense, single-layered vegetation associations with a height of up to 1 m. Species are from the Cyperaceae, Restionaceae and Juncaceae families. This vegetation type is confined to the near-coastal areas in the South West, mainly in the Warren Bioregion, with smaller areas in Jarrah Forest, Swan Mallee and Esperance Plains Bioregions, and totals nearly 60,000 ha (Fig. 46). Communities of reeds such as *Gahnia trifida* or *Lepidosperma gladiatum* (sword sedge) occur on very

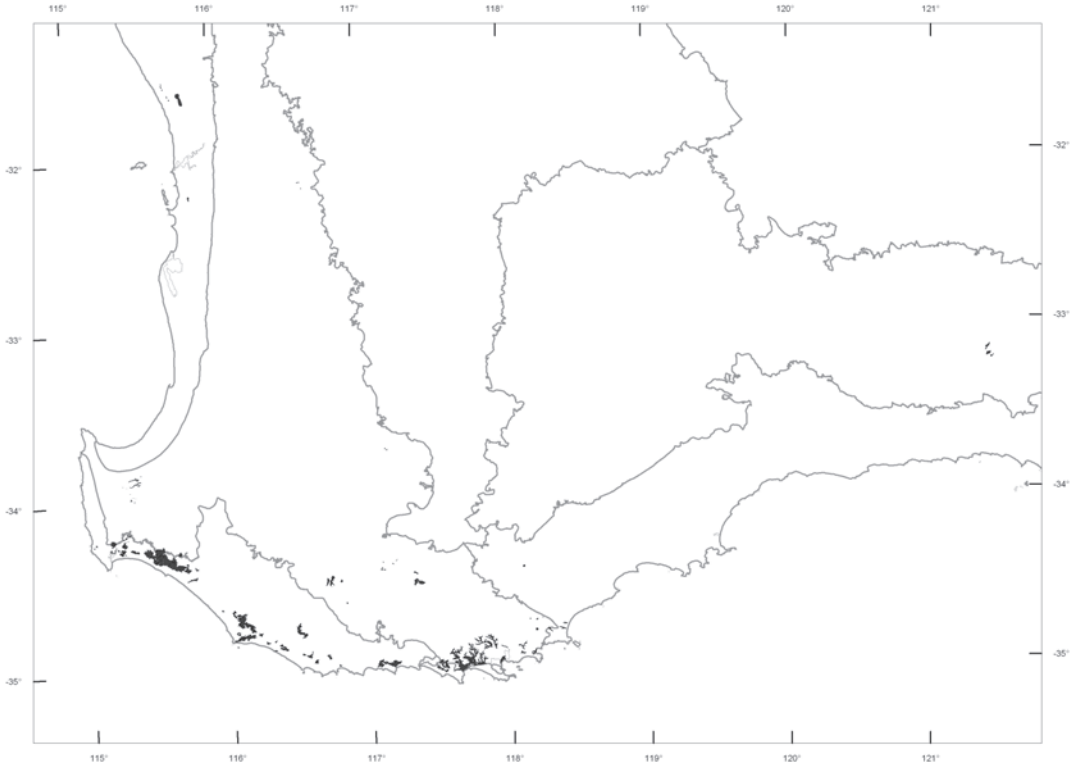


Figure 45. Vegetation Type 33: Sedgeland.

Plate 43. Sedgeland in Walpole–Nornalup National Park (photo by Ladislav Mucina).

poorly drained, sandy plains and in deep swamps fringing lakes and estuaries (Plate 43). Scattered woody shrubs to 2 m may be present, e.g. *Beaufortia sparsa* (swamp bottlebrush), *Callistemon glaucus* (Albany bottlebrush) and *Melaleuca* spp.

Spinifex Grassland

34. Tree-steppe: desert oak

Hummock or spinifex grasslands with medium woodland or irregularly scattered trees 10–25 m tall are classified as tree-steppe. An incomplete groundcover, 10–30% pfc, mainly of *Triodia pungens* (soft spinifex) occurs under

Plate 44. Tree-steppe in Gibson Desert Nature Reserve (photo by Ian Kealley).

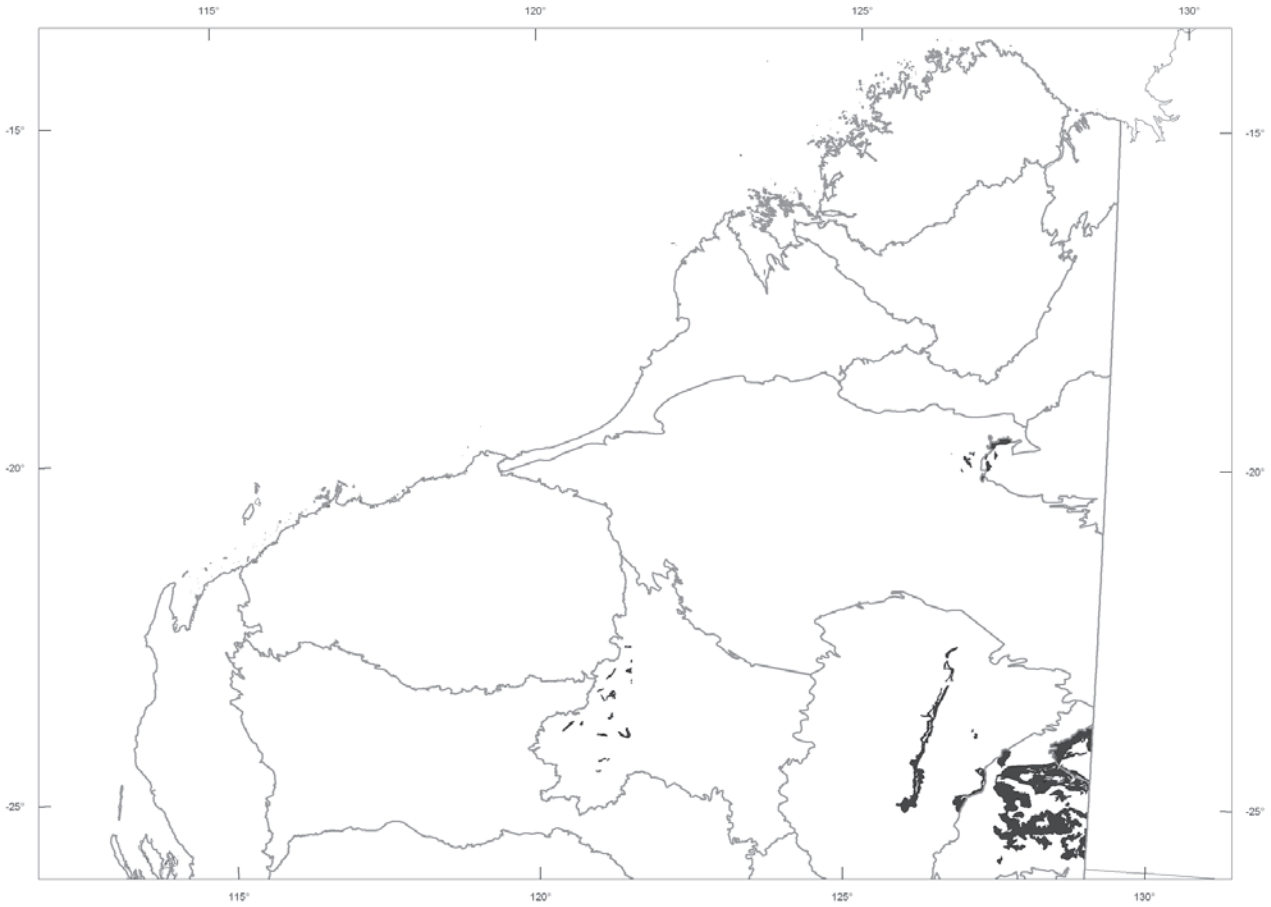


Figure 46. Vegetation Type 34: Tree-steppe.

the distinctive *Allocasuarina decaisneana* (desert oak) woodland (10–30% pfc) or open woodland (<10% pfc). This vegetation type covers an area of over 1.8 million ha and is present in five bioregions. Most of the unit occurs in the Central Ranges Bioregion (nearly 1.2 million ha), where it makes up 60% of the Western Australian part of this bioregion. Smaller areas occur in the Gibson Desert, Great Sandy Desert, Little Sandy Desert and Tanami Bioregions (Fig. 46).

The sandhill country of the Central Ranges Bioregion and adjacent southern Great Sandy Desert Bioregion is described as a mosaic of *Allocasuarina decaisneana* (desert oak) woodland between the sand dunes with grass-steppe of *Triodia basedowii* (hard spinifex) on the dunes. It has been mapped here as tree-steppe. To the west, this unit occurs along the Lake Newell – Lake Cobb drainage system in the Gibson Desert Bioregion (Plate 44).

In the Tanami Bioregion and adjacent northern Great Sandy Desert Bioregion, steppe woodland with desert oak (*Allocasuarina decaisneana*) reaching 9–12 m over *Triodia pungens* (soft spinifex) covers sandplains adjacent to the lower reaches of Sturt Creek, which flows into Lake Gregory.

In the Little Sandy Desert Bioregion, a steppe with very scattered desert oak (*Allocasuarina decaisneana*) also occurs in the swales between the sand dunes, with the hummock grass, *Triodia basedowii* (hard spinifex), on the dunes.

35. Low tree-steppe

In this vegetation type, the hummock grassland has an overstorey of scattered low trees (<10 m tall with <10% pfc). It is mainly scattered *Corymbia dichromophloia* (variable barked bloodwood) and/or *E. brevifolia* (Kimberley snappy gum) over *Triodia* species (spinifex). This vegetation type covers over 16 million ha and is the third most extensive vegetation type in the state. A further 28 million ha are mapped as mosaics of low tree-steppe usually with shrub-steppe (see Mosaic 117; Fig. 84). This vegetation type is spread over nine bioregions, dominating the Great Sandy Desert, Pilbara and Ord – Victoria Plains Bioregions (Fig. 47).

The *Triodia pungens* (soft spinifex) on lateritic sandplain of the Sturt Plateau in the Ord – Victoria Plains Bioregion has an open overstorey (6–8 m tall) of *Eucalyptus brevifolia* (Kimberley snappy gum) and/or *Corymbia dichromophloia* (variable barked bloodwood). The numerous shrubs that may be present include *Acacia monticola, A. tenuissima, A. pachycarpa, A. tumida, Senna* spp., *Dolichandrone heterophylla* (lemonwood), *Grevillea pyramidalis* (caustic bush), *G. wickhamii* (Wickham's

grevillea) and *Gossypium australe*. These associations cover a total area of nearly 760,000 ha.

In the Pilbara Bioregion, over 3.4 million ha of rugged range country are covered in low tree-steppe. The spinifex layer is *Triodia wiseana* (limestone spinifex) and the dominant eucalypt is *E. leucophloia* (Pilbara snappy gum; Plate 45), with *E. gamophylla* (twin-leaf mallee) and *E. kingsmillii* (Kingsmill's mallee) also present. There are few large shrubs but a rich flora of small shrubs and forbs. Tall shrubs (> 1 m) include *Senna artemisioides* subsp. × *sturtii* (grey senna), *S. pleurocarpa* var. *pleurocarpa* (native senna), *Dodonaea viscosa* (sticky hopbush), *Grevillea wickhamii* (Wickham's grevillea) and *Hakea lorea* (witinti). Small shrubs (<1 m) include *Acacia adoxa, A. maitlandii* (Maitland's wattle), *A. steedmanii* subsp. *borealis, A. orthocarpa* (needleleaf wattle), *Atriplex* sp., *Gompholobium polyzygum*, *Gastrolobium grandiflorum* (wallflower poison), *Keraudrenia integrifolia* (common firebush), *Mirbelia viminalis, Petalostylis labicheoides* (slender petalostylis), *Ptilotus rotundifolius* (royal mulla mulla), *Sida echinocarpa, S.* sp. aff. *petrophila* and *Triumfetta chaetocarpa* (urchins).

Over 10 million ha in the northern Great Sandy Desert Bioregion is mapped as low tree-steppe of *Triodia pungens* (soft spinifex) and *Triodia schinzii* (feathertop spinifex) with eucalypts on and between sandhills. The eucalypt species was undescribed when the original mapping was done. It is probably the recently described *Corymbia chippendalei* (desert bloodwood), which is present in the adjacent mosaic to the south, although *E. brevifolia* (Kimberley snappy gum) may be present as this is present in the Great Sandy Desert Bioregion.

The adjacent mosaic, covering over 28.6 million ha, has a very open, low tree-steppe of *Triodia schinzii*

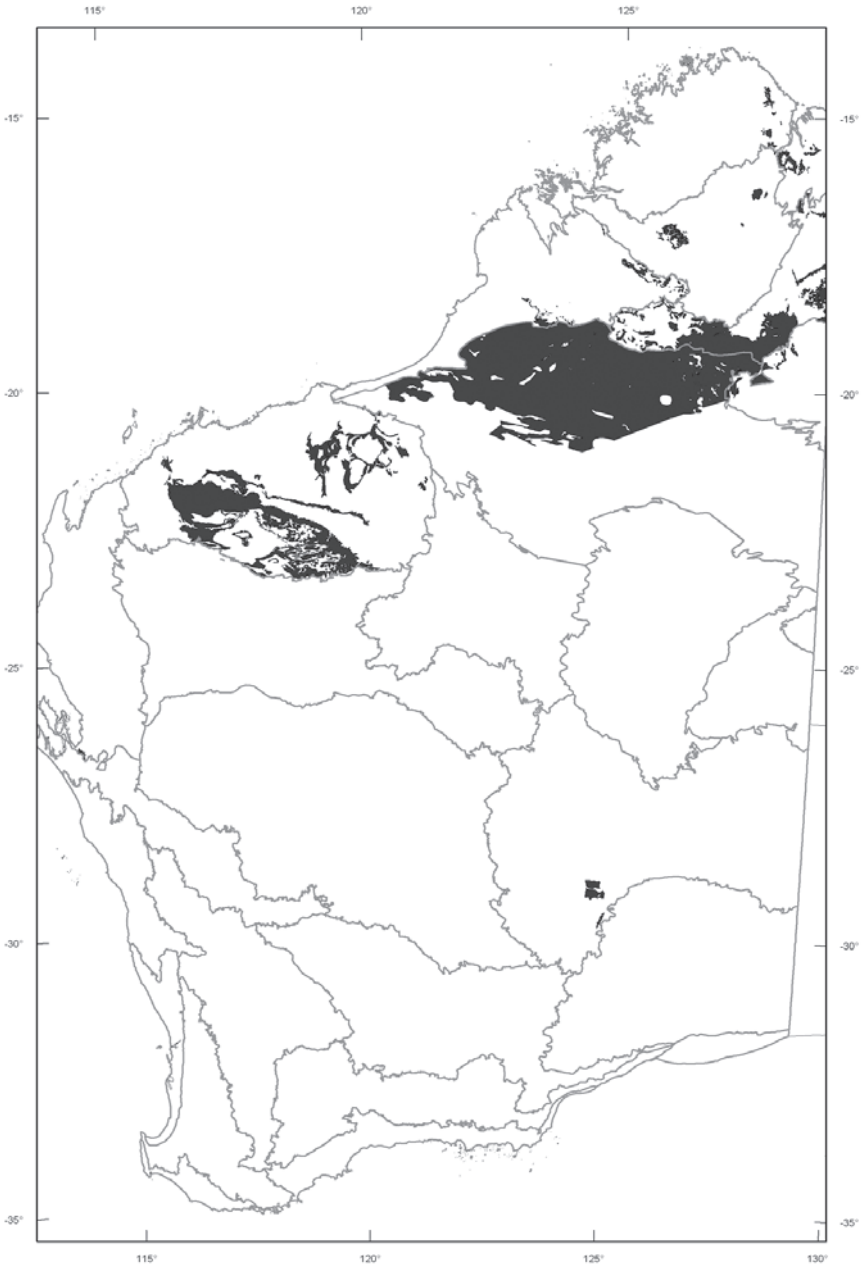


Figure 47. Vegetation Type 35: Low tree-steppe.

(feathertop spinifex) and *C. chippendalei* (desert bloodwood) on sandhills, with spinifex and mixed open shrub-steppe between sandhills (Mosaic 117; Fig. 84). It is difficult to discern the boundary so a straight line has been used. Future refinements of this mapping could clarify this boundary.

The dissected plains, through which Christmas Creek flows, (southern central Ord – Victoria Plains Bioregion) is covered with over 275,000 ha of open, low tree-steppe with patches of hummock grassland. *Eucalyptus brevifolia* (Kimberley snappy gum) over *Triodia pungens* (soft spinifex) open low tree-steppe occurs on the sandplain, with *Triodia intermedia* (hard spinifex) grass steppe on the stripped laterite or stony surfaces. Other species present in the tree-steppe include *Acacia monticola* (gawar), *A. holosericea* (candelbra wattle), *A. lysiphloia* (turpentine wattle), *A. pachycarpa, A. tumida* (pindan wattle), *Grevillea pyramidalis* (caustic bush), *G. refracta* (silver-leaved grevillea) and *G. wickhamii* (Wickham's grevillea). *Acacia orthocarpa* (needleleaf wattle) occurs on stony ground with the hard spinifex.

A low tree-steppe of *Owenia reticulata* (native walnut) over *Triodia pungens* (soft spinifex) occurs between the widely-spaced sandy ridges, and forms a transition between desert tree-steppe (*Eucalyptus* spp.) and the pindan. This covers nearly 3.6 million ha in the northern Great Sandy Desert Bioregion. In the deeper sandy areas, *Triodia schinzii* (feathertop spinifex) joins or replaces the soft spinifex. Associated species include *Gardenia pyriformis, Erythrophleum chlorostachys* (ironwood), *Acacia pachycarpa, A. monticola, Hakea lorea* (witinti), *Grevillea refracta* (silver-leaf grevillea) and *G. wickhamii* (Wickham's grevillea).

Included in this vegetation type are some Kimberley units sometimes described as semi-desert spinifex-steppe. One is a low steppe woodland of *Eucalyptus pruinosa* (silverbox) and *Melaleuca* spp. (3–4.5 m) over *Triodia bitextura* (curly spinifex), which covers nearly 111,000 ha in the Cockburn Range (Victoria Bonaparte Bioregion) and 60,000 ha in the North Kimberley Bioregion. This unit has a dense tree layer and occurs on shale slopes. The *Melaleuca* species include one or two of the following occurring in each stand: *M. minutifolia* (tea tree), *M. alsophila, M. acacioides* and *M. viridiflora*. On the shale plains in the Central Kimberley Bioregion, *Triodia pungens* (soft spinifex) and *Triodia bitextura* (curly spinifex) grasslands have a low, more open tree layer of *E. argillacea* (Mt House box) and *E. brevifolia* (Kimberley snappy gum). *Melaleuca minutifolia* (tea tree), a shrub to 2 m, is common and *Acacia monticola, A. stellaticeps, Senna desolata, Grevillea pyramidalis* (caustic bush), *Gossypium sturtianum* (Sturt's desert rose) and *Hibiscus panduriformis* (yellow hibiscus) may also be present.

On the steep rocky limestone hills in the Ord – Victoria Plains Bioregion, *Triodia wiseana* (limestone spinifex) has a sparse tree layer, mainly of *Terminalia* spp. Other trees and shrubs such as *Atalaya hemiglauca* (whitewood), *Cochlospermum fraseri* (kapok bush), *Dodonaea physocarpa, Ficus orbicularis* and *Bauhinia cunninghamii* may also occur. Other spinifexes such as *Triodia intermedia* and/or *T. inutilis* occur with *E. brevifolia* (Kimberley snappy gum) over the extensive dissected lateritic plains

Plate 45. Low tree-steppe in Karijini National Park (photo by Ladislav Mucina).

of the upper Denison Plains in the Ord – Victoria Plains Bioregion.

On the sandplains of the Great Victoria Desert Bioregion, the spinifex layer of *Triodia basedowii* (hard spinifex) or *T. scariosa* has an open overstorey of *Acacia aneura* s.l. (mulga) and often *Casuarina pauper* (black oak) low trees. These associations represent a transition from the pure mulga to the mallee and spinifex on the sandplain.

In Carnarvon, south of Hamelin Pool, there is a 14,500 ha patch of low tree-steppe on sandplain, with *Eucalyptus obtusifolia* (Dongara mallee) and *E. foecunda* (narrow-leaved red mallee) over *Triodia plurinervata.* This patch lies between the tree-heath to the south and the acacia scrub to the north.

36. Sparse low tree-steppe

Where the tree layer has a height <10 m and <2% pfc over the spinifex, the vegetation is classified as sparse low tree-steppe. Although it is varied floristically, a large proportion of the area is *Eucalyptus brevifolia* (Kimberley snappy gum) over *Triodia* spp. Seventy percent of this vegetation type occurs in Ord – Victoria Plains Bioregion. It occurs elsewhere in the Kimberley in the Dampierland Bioregion and in the Tanami Bioregion. There are outliers in the Central Ranges, Great Victoria Desert and Carnarvon Bioregions, contributing to the total extent for this vegetation type of over 1.7 million ha (Fig. 48).

The sandstone ridges and plateaux of the Ord –Victoria Plains Bioregion support a sparse low tree-steppe composed of *Eucalyptus brevifolia* (Kimberley snappy gum) over *Triodia pungens* (soft spinifex). The snappy gum is joined by *Corymbia dichromophloia* (variable barked bloodwood) on basalt and dolerite, and the spinifexes are *T. intermedia* and *T. wiseana* (limestone spinifex). On the quartzite ridges the vegetation is *T. intermedia* and *T. inutilis* with emergent scattered *Eucalyptus brevifolia* (Kimberley snappy gum) and *Corymbia dichromophloia* (variable barked bloodwood). In the western end of this region, on the St George Ranges, *Eucalyptus setosa* (referred to on earlier maps but not an extant name) replaces the snappy gum to occur with *Corymbia dichromophloia* (variable barked bloodwood) over *T. pungens* (soft spinifex) and *T. intermedia.*

A sparse, medium tree-steppe features very scattered *Adansonia gregorii* (boab; to 12 m) over open *Triodia wiseana* on the limestone outcrops that form the Napier Hills and Oscar Plateau, along the north-eastern boundary

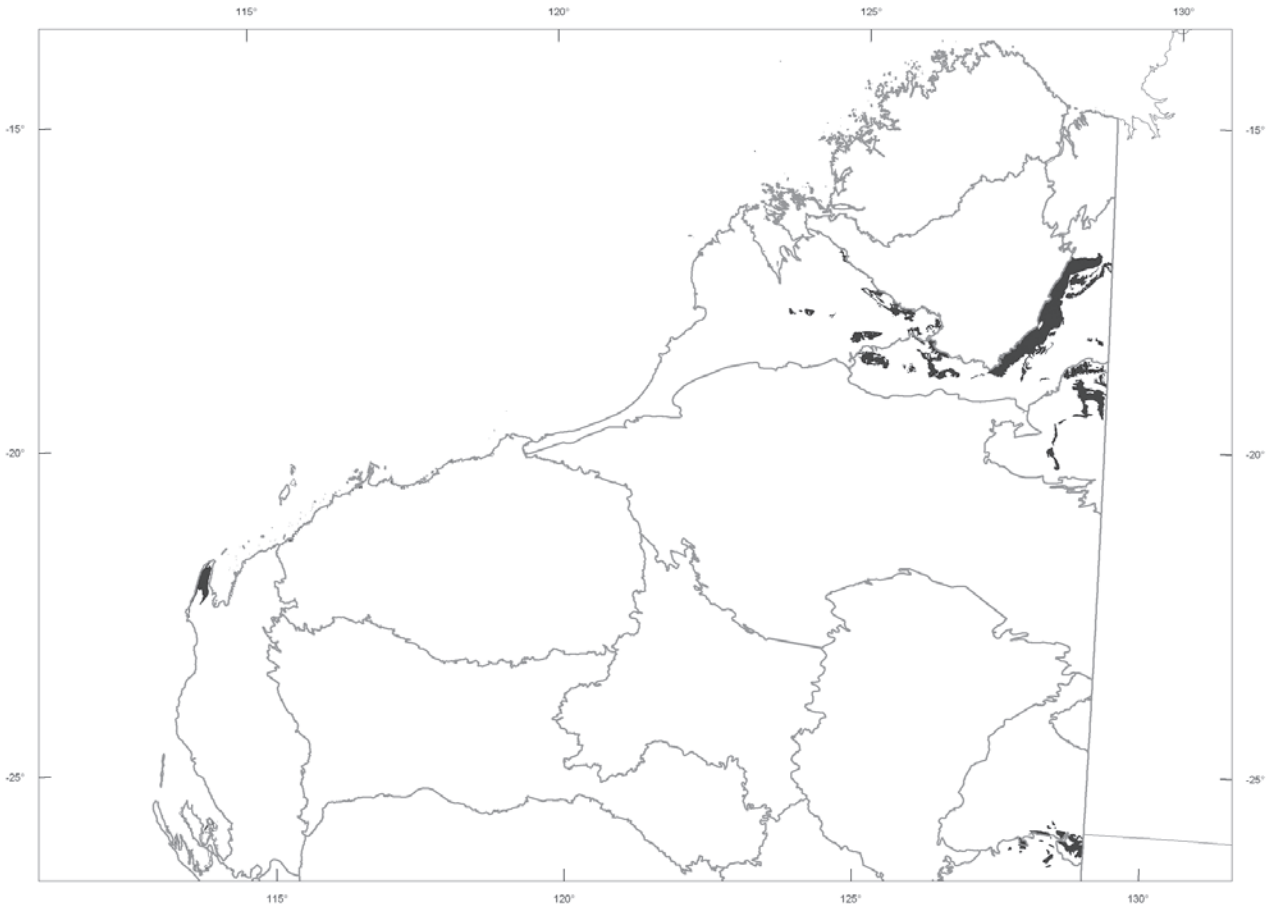


Figure 48. Vegetation Type 36: Sparse low tree-steppe.

Plate 46. Sparse tree-steppe and Devonian limestone reef near Fitzroy Crossing (photo by Ladislav Mucina).

of the Dampierland Bioregion. To the north-east, this unit forms part of Mosaic 112 (Fig. 79). Also on the Oscar Plateau is a unit of very scattered, mixed low trees (including *Corymbia dichromophloia,* variable barked bloodwood) and *Eucalyptus brevifolia* (Kimberley snappy gum) over *Triodia wiseana* (Plate 46).

Eucalyptus leucophloia (Pilbara snappy gum) over *T. pungens* (soft spinifex) is the common sparse tree-steppe on the rocky ranges in the Tanami Bioregion (e.g. Gardiner and Kearney ranges). *Corymbia aspera* may be found on cliffs and *Grevillea wickhamii* (Wickham's grevillea), *Eremophila* spp. and *Senna* spp. occur as occasional shrubs.

In the south-east Central Ranges Bioregion, scattered low *Corymbia eremaea* cling to the slopes of the boulder-strewn ranges. These ranges are gneissic in structure with intrusive dykes, which form the outcrops of bare boulders. *Triodia basedowii* (hard spinifex) provides a general cover, with occasional *Ficus brachypoda* and *Callitris columellaris* (white cypress pine) growing in gullies and crevices between the boulders. Mulga (*Acacia aneura* s.l.) is also present on mid and lower slopes.

On Cape Range in the Carnarvon Bioregion, there is a relatively small area (about 84,000 ha) of sparse tree-steppe with scattered *E. prominens* (previously mapped as *Corymbia dichromophloia)* over *T. pungens* (soft spinifex) and *T.* sp. indet. aff. *angusta* on limestone plateaux and in canyons.

37. Tree-and-shrub steppe

(Shown on the map in the colour of shrub-steppe overlaid with low tree symbols.)

This hummock grassland of *Triodia* spp. has a low tree layer of scattered eucalypts such as *Eucalyptus gongylocarpa* (marble gum), and a shrub layer of *Acacia* spp. or mallee eucalypts such as *E. youngiana* (large-fruited mallee). It dominates the Great Victoria Desert Bioregion, with over 11.4 million ha of the bioregion's 22.7 million ha covered. A further 900,000 ha occur in the Carnarvon, Pilbara, Murchison, Ord – Victoria Plains and Gascoyne Bioregions (Fig. 49).

Open *E. gongylocarpa* (marble gum) and *E. youngiana* (large-fruited mallee) over *Triodia basedowii* (hard spinifex) occurs on sandplain and between sandhills throughout the Great Victoria Desert Bioregion (Plate 47). Structure varies slightly, with the height of the marble gum ranging from 9 to 12 m. On the sandplain, other species present include tall shrubs of *Acacia ligulata* (umbrella bush), *A. helmsiana, A. murrayana* (sandplain wattle), *Alyogyne pinoniana* (sand hibiscus), *Grevillea juncifolia* (honey-suckle grevillea), *G. pterosperma, Hakea multilineata* (grass-leaf hakea), *H. suberea* and *Melaleuca leiocarpa,* and smaller ericoid shrubs such as *Baeckea cryptandroides* and *Homalocalyx thryptomenoides. Xanthorrhoea thorntonii* (desert balga) occur in groups at widely spaced intervals. In the dune country, the marble

gum is mainly restricted to the interdunes. In general, the lower flanks of the dunes are covered with *Aluta maisonneuvei*, with occasional *Calytrix longiflora* and *Micromyrtus flaviflora.* The summits are sparsely covered with *Grevillea stenobotrya, Gyrostemon ramulosa* and *Crotalaria cunninghamii.* To the west in the Murchison Bioregion the mallee is *Eucalyptus kingsmillii.*

In the uplands of the eastern Pilbara Bioregion, there is an occurrence of tree-and-shrub steppe on chert. The mixture of *Triodia pungens* (soft spinifex) and *T. brizoides* has a very sparse (<1%) layer of *Eucalyptus leucophloia* (Pilbara snappy gum) low trees and an open lower layer of *Acacia eriopoda* and *A. victoriae* shrubs.

In higher rainfall areas to the north, on the western arm of the Ord – Victoria Plains Bioregion, the tree layer is more dense (<10%). *Corymbia dichromophloia* (variable barked bloodwood) forms a low open tree layer, with a shrub layer of *A. pyrifolia* (ranji bush) over *T. pungens* (soft spinifex).

In the Gascoyne Bioregion, a small area of low open tree-and-shrub steppe is found on quartzite-derived sandplain. Here, scattered *Corymbia deserticola* and *Hakea lorea* (witinti) occur over *Acacia eriopoda* and *A. coriacea* (wirewood), with *Triodia basedowii* (hard spinifex) providing the main cover.

Further west in the Carnarvon Bioregion, the low tree-and-shrub steppe is variable but mapped as open eucalypts and *A. pyrifolia* (ranji bush) shrubs over *Triodia pungens* (soft spinifex) and *T. basedowii* (hard spinifex). The eucalypts are *Eucalyptus victrix* (coolibah) and *C.*

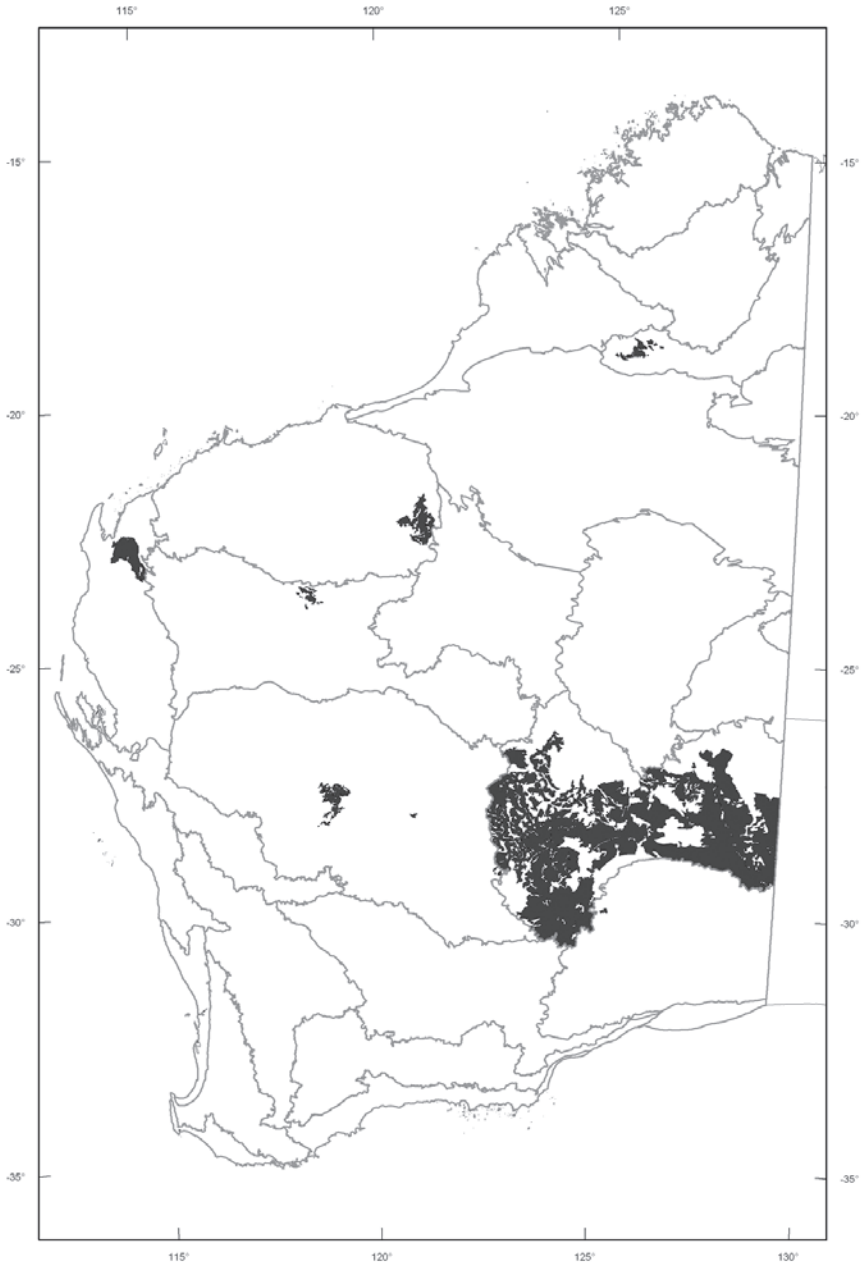


Figure 49. Vegetation Type 37: Tree-and-shrub steppe.

Plate 47. Tree-and-shrub steppe in the Great Victoria Desert (photo by Ian Kealley).

deserticola, with occasional *Owenia reticulata* (native walnut) and *Hakea lorea* (witinti). Similar vegetation is found in the north-west Great Sandy Desert and south-western Ord – Victoria Plains Bioregions. In these areas, other shrubs include *A. bivenosa* and *A. xiphophylla*, while *Triodia schinzii* (feathertop spinifex) may be found in the ground layer.

38. Shrub-steppe

This hummock grassland vegetation type has *Triodia* spp. with a 10–30% pfc, with an open overstorey (<10% pfc) of shrubs such acacia, grevillea and mallee eucalypts. It is the characteristic vegetation of the interdunal swales and desert sandplains that receive less than 250 mm rainfall per annum. Under higher rainfall conditions, shrub-steppe appears on stony ground. It is the second most extensive vegetation type in the state, covering a total area of over 25.3 million ha, with 8 million ha in the Pilbara Bioregion, 3.2 million ha in the Murchison Bioregion, 2.6 million in the Great Sandy Desert and Great Victoria Bioregions, 2.2 million ha in the Tanami Bioregion, 1.8 million ha in the Gibson Desert Bioregion and 1.5 million ha in the Little Sandy Desert Bioregion. It also occurs in another nine bioregions (Fig. 50).

The most common association is mixed *Acacia* spp. and other species over *Triodia basedowii* (hard spinifex). This covers over 8.3 million ha, with over 1 million ha in each of the Gibson Desert and Little Sandy Desert Bioregions. It is the vegetation most characteristic of the swales between the sand dunes. There are several *Acacia* and *Grevillea* spp., including *A. grasbyi* (miniritchie), *A. helmsiana, A. linophylla* (bowgada), *A. pachycarpa, Grevillea eriostachya* (flame grevillea) and/or *G. juncifolia* (honey-suckle grevillea). *Triodia schinzii* (feathertop spinifex) is often found with the hard spinifex. Where very scattered trees occur on top of the dunes, the vegetation has been mapped as a mosaic of open low tree-steppe of *Corymia chippendalei* (desert bloodwood) and *Triodia schinzii* (feathertop spinifex) on sandhills with shrub-steppe of mixed shrubs over spinifex between the sandhills (Mosaic 117; Fig. 84).

The two most common *Acacia* species associated with *Triodia pungens* (soft spinifex) are *Acacia pyrifolia* (ranji bush) and *Acacia eriopoda* (Plate 48). Shrub-steppe of *Acacia pyrifolia* (ranji bush) over soft spinifex occurs on the deeper soils on granite in the Abydos Plain, Oakover Valley and extends south into the Chichester Plateau. This accounts for over 3.3 million ha of the northern half of the Pilbara Bioregion. Other shrub species include

Grevillea pyramidalis (caustic bush), *G. wickhamii* (Wickham's grevillea), *Hakea lorea* (witinti) and *Acacia pachycarpa*. Further south on the basaltic soils flanking the Fortescue River, the association is joined by *A. xiphophylla* (snakewood). On sand-free lateritic uplands, *Acacia pachycarpa* shrub-steppe over *Triodia pungens* (soft spinifex) occurs in the Great Sandy Desert, Ord – Victoria Plains and Tanami Bioregions. Other species include *Eremophila* spp. and *Senna* spp. south of latitude 22° S, *Triodia pungens* (soft spinifex) is replaced by *T. basedowii* (hard spinifex) and this association covers nearly 1 million ha of the Gibson Desert Bioregion.

A shrub-steppe of *Acacia aneura* s.l. (mulga) and mallee *Eucalyptus kingsmillii* (Kingsmill's mallee) over *Triodia basedowii* (hard spinifex) occurs on the red sands in the north-eastern Murchison Bioregion. It has a similar flora to that of the tree-and-shrub steppe in that bioregion (Vegetation Type 37). Other mallee eucalypts include *E. lucasii, E. ebbanoensis* and *E. leptophylla. E. gongylocarpa* (marble gum) may be present on pockets of deep sands. Small trees and large shrubs include *A. pruinocarpa* (gidgee), *A. ramulosa/A. linophylla* (bowgada), *Brachychiton gregorii, Grevillea juncifolia* (honey-suckle grevillea), *Hakea lorea* (witinti), *Pittosporum angustifolium* (weeping pittosporum) and *Santalum acuminatum* (quandong). To the east, nearly 1.6 million ha of sandhill country bordering the Great Victoria Desert and Central Ranges Bioregions supports mulga and another mallee, probably *E. gamophylla* (twin-leaf mallee), over spinifex. *Triodia basedowii* (hard spinifex) is most common in the swales between the sandhills while *T. pungens* (soft spinifex) is more common on the sandplain.

Mallee shrub-steppe with *Eucalyptus oleosa* (giant mallee) over *Triodia scariosa* occurs in the south-eastern

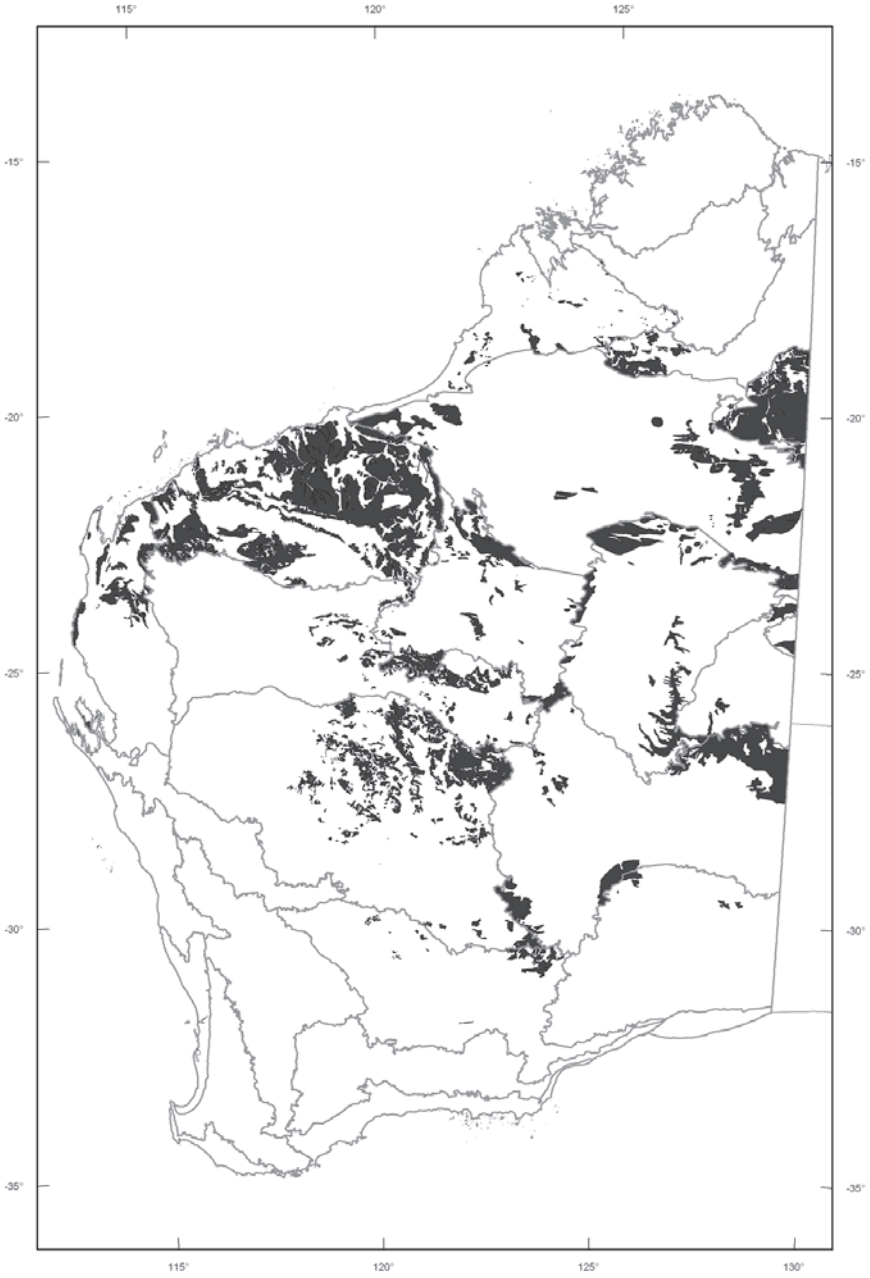


Figure 50. Vegetation Type 38: Shrub-steppe.

Plate 48. Shrub-steppe near Nanutarra south of Onslow (photo by Ladislav Mucina).

Great Victoria Desert Bioregion, extending into the Nullarbor, north-eastern Coolgardie and western Murchison Bioregions. An outlier occurs east of Norseman on Dundas Hill in the south central Coolgardie Bioregion and south-west of Forrest Lakes in the Northern Nullarbor Bioregion.

Several species of *Eucalyptus*, *E. youngiana* (large-fruited mallee), *E. oleosa* (giant mallee), *E. gamophylla* (twin-leaf mallee) and *E. pruinosa* (silver-leaved box) occur as open mallee over *T. basedowii* (hard spinifex), *T. scariosa* or *T. pungens* (soft spinifex). These associations total over 2.2 million ha, with the largest being *E. youngiana* (large-fruited mallee) over *T. basedowii* (hard spinifex), which covers nearly 90,000 ha of sandplains in the north-west the Great Victoria Desert Bioregion. Other occurrences of this open mallee steppe are in the Ord – Victoria Plains (*E. pruinosa*), Pilbara (*E. gamophylla*), Gascoyne, Murchison, Coolgardie and Great Victoria Desert (*E. youngiana* and *E. oleosa*) Bioregions. A mosaic of open mallee steppe with woodland is described as Mosaic 104 (Fig. 71).

Shrub-steppe that contains a mixture of shrub species covers over 3 million ha. In the northern desert bioregions the *Acacia* shrub layer is supplemented by species of *Grevillea* and *Hakea*. The hummock grass layer is either *Triodia pungens* (soft spinifex) or *T. basedowii* (hard spinifex). Over 1 million ha of the Great Sandy Desert Bioregion is mapped as a shrub-steppe of mixed shrubs over *Triodia pungens* (soft spinifex). Here other species include *Grevillea stenobotrya*, *G. eriostachya* (flame grevillea), *G. juncifolia* (honey-suckle grevillea), *Acacia victoriae, A. ligulata* (umbrella bush) and *Crotalaria cunninghamii.* Further south, extending into the dune country of the Little Sandy Desert, Central Ranges, Gibson Desert and Pilbara Bioregions, *Triodia schinzii* may join the soft or hard spinifex under the mixed shrub layer in between the dunes. In addition, in the northern Little Sandy Desert Bioregion, *Acacia coriacea* (wirewood) and *Hakea lorea* (witinti) over *Triodia basedowii* (hard spinifex) covers nearly 530,000 ha. Other conspicuous species are *Hakea rhombales* and *Xanthorrhoea thorntonii* (desert balga). In the Tanami Bioregion, on 718,000 ha of shallow soil on sandplains flanking the lower Sturt Creek, *Hakea lorea* (witinti) to 3 m is emergent over the soft spinifex. *Grevillea refracta* (silver-leaf grevillea) is common over soft spinifex in the west in the Dampierland Bioregion. South of latitude 22 °S, *Aluta maisonneuvei* may be present as the low shrub amongst the spinifex.

An unusual dwarf shrub-steppe of low (0.5 m) *Acacia stellaticeps* over *Triodia pungens* (soft spinifex) covers the sandy alluvial deposits between rivers in the coastal areas of the Pilbara Bioregion. This fringes the *Acacia eriopoda* shrub-steppe, and totals an area of over 2.2 million ha.

The shrub-steppe unit of *Acacia aneura* s.l. (mulga) and *A. pyrifolia* (ranji bush) over *Triodia pungens* (soft spinifex) and *T. basedowii* (hard spinifex) is mapped on the basaltic hills on the Hamersley Plateau in the Pilbara Bioregion. It forms a transition from the low mulga woodlands in the valley, through the *T. pungens* (soft spinifex) on the lower slopes to the acacia shrub-steppe with *A. pyrifolia* (ranji bush), *Grevillea pyramidalis* (caustic bush) and *T. basedowii* (hard spinifex) on the stony ground upslope.

39. Sparse shrub-steppe

This vegetation type is dominated by the hummock grassland component and does not have a conspicuous overstorey. The shrubs occur in scattered groups with no substantial foliage cover. The shrubs are usually *Acacia* spp. and the ground cover *Triodia* spp. This vegetation type dominates the Gibson Desert Bioregion, is an important component of the Pilbara Bioregion and also occurs in the Carnarvon and Gascoyne Bioregions (Fig. 51). It covers a total of over 7.9 million ha.

Most of the Gibson Desert Bioregion is described as mulga parkland on lateritic plains: *Triodia basedowii* (hard spinifex) with very patchy mulga scrub. In detail, it is described as a mosaic of mulga scrub on the plains with very scattered mulga on the hillsides, but it is coded and

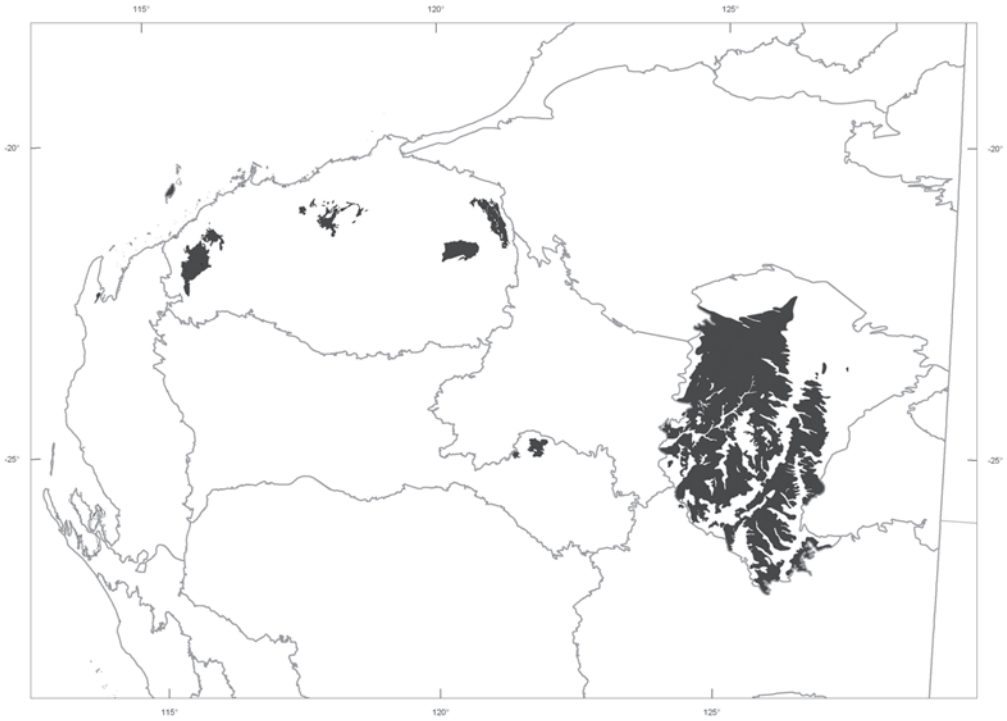


Figure 51. Vegetation Type 39: Sparse shrub-steppe.

Plate 49. Sparse shrub-steppe on the Cane River south-east of Onslow (photo by Stephen van Leeuwen).

mapped as sparse shrub-steppe. *Hakea lorea* (witinti) often occurs on the hill crests. Other species include *Acacia pruinocarpa* (gidgee), *A. dictyophleba*, *A. grasbyi* (miniritchie), *A. helmsiana* and *Eucalyptus kingsmillii* (Kingsmill's mallee). An outlier of this occurs to the west in the Gascoyne Bioregion.

In the Pilbara Bioregion, there are several different units of sparse shrub-steppe. Common is *Acacia bivenosa* over a variety of *Triodia* species, including the hard spinifexes *T. basedowii* (hard spinifex) and *T. wiseana* (limestone spinifex) and *Triodia brizoides* in the north-east. *Acacia bivenosa* and *A. trachycarpa* (minni ritchi) over *Triodia wiseana* (limestone spinifex) sparse shrub-steppe occurs on very poor rocky country on gneiss in the central east of the Pilbara. In the far west, near the Cane River, *Acacia pyrifolia* (ranji bush) joins *Acacia bivenosa* over *Triodia basedowii* (hard spinifex) and *T. wiseana* (limestone spinifex; Plate 49). Barrow Island is mapped as predominately scattered mixed shrubs over *Triodia wiseana* (limestone spinifex) and *Triodia* sp. indet. aff. *angusta*.

40. Grass-steppe

Hummock grassland without emergent trees or shrubs is classified according to the species of spinifex (*Triodia* spp.). A variety of herbs may be present between the hummocks, as the species composition of this component is dependent upon the amount and season of rainfall. Grass-steppe is not a common vegetation type in Western Australia, but it is an important component of vegetation mosaics

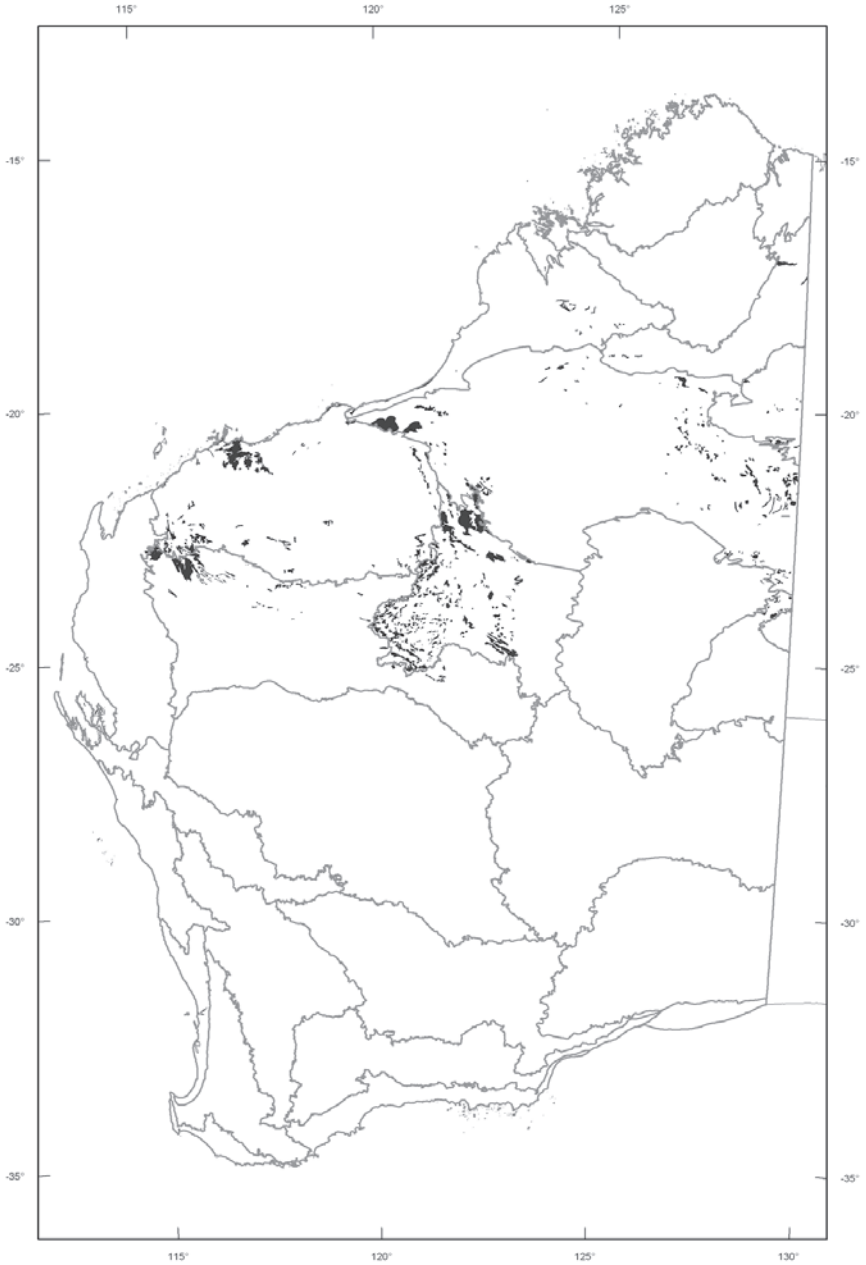


Figure 52. Vegetation Type 40: Grass-steppe.

Plate 50. Grass-steppe south-east of Exmouth Gulf (photo by Vanessa Clarke).

occurring in sand dune country. It occurs as patches on rocky outcrops rather than in wide expanses and has a total extent of over 2.5 million ha, mainly in the Little Sandy Desert, Great Sandy Desert, Pilbara and Gascoyne Bioregions (Fig. 52).

Generally *Triodia pungens* (soft spinifex) occurs north of latitude 22° S and *T. basedowii* (hard spinifex) occurs south of this latitude. The most common grass-steppe, dominated by *T. pungens* (soft spinifex), occurs on hills and ranges in the Great Sandy Desert, Gibson Desert Bioregion and adjacent northern Little Sandy Desert Bioregion. Further south in the Little Sandy Desert Bioregion the dominant spinifex in the grass-steppe is *T. basedowii* (hard spinifex).

In the Barlee Range (Gascoyne Bioregion) and adjacent south-west Pilbara Bioregion, *Triodia wiseana* (limestone spinifex) is common. *T. wiseana* (limestone spinifex) mixed with *T. basedowii* (hard spinifex) grass-steppe occurs near the north-west tip of the Gascoyne Bioregion (Plate 50). Along the northern coast of the Carnarvon and Pilbara Bioregions, the grass-steppe is mapped as *T. pungens* (soft spinifex).

The hummock grasslands to the south and south-east of Point Samson in the Pilbara Bioregion are a mixture of *Triodia pungens* (soft spinifex) and *T. wiseana* (limestone spinifex). Here they occur on hilly ground adjacent to the alluvial plains that support a mosaic of mixed short bunch-grasses and spinifex (see Mosaic 116).

There are small patches of grass-steppe in the Dampierland Bioregion amongst the sparse tree-steppe on rugged country north of the Fitzroy River. *Triodia intermedia* (buck spinifex) is the characteristic species, with *T. pungens* (soft spinifex) coming in on higher ground.

41. Spinifex complexes

This vegetation type is distinguished by having three layers, of which the hummock grassland is most important, i.e. has the most cover. Other components that may co-occur are sparse low trees, scrub, open scrub, sparse dwarf scrub and short grass. For example, in the mixed sandplain of the southern Murchison Bioregion, scattered low trees over dwarf shrubs and/or mixed short grass may be present with the spinifex. Beard (1976a, 1981b) originally mapped this as a mixed sandplain mosaic. Spinifex complexes cover a total of nearly 1.6 million ha mainly in the Murchison, Carnarvon and Yalgoo Bioregions (Fig. 53).

The spinifex complexes of the south-western Murchison Bioregion cover over 800,000 ha. They show an interesting intermingling of the eucalypts and

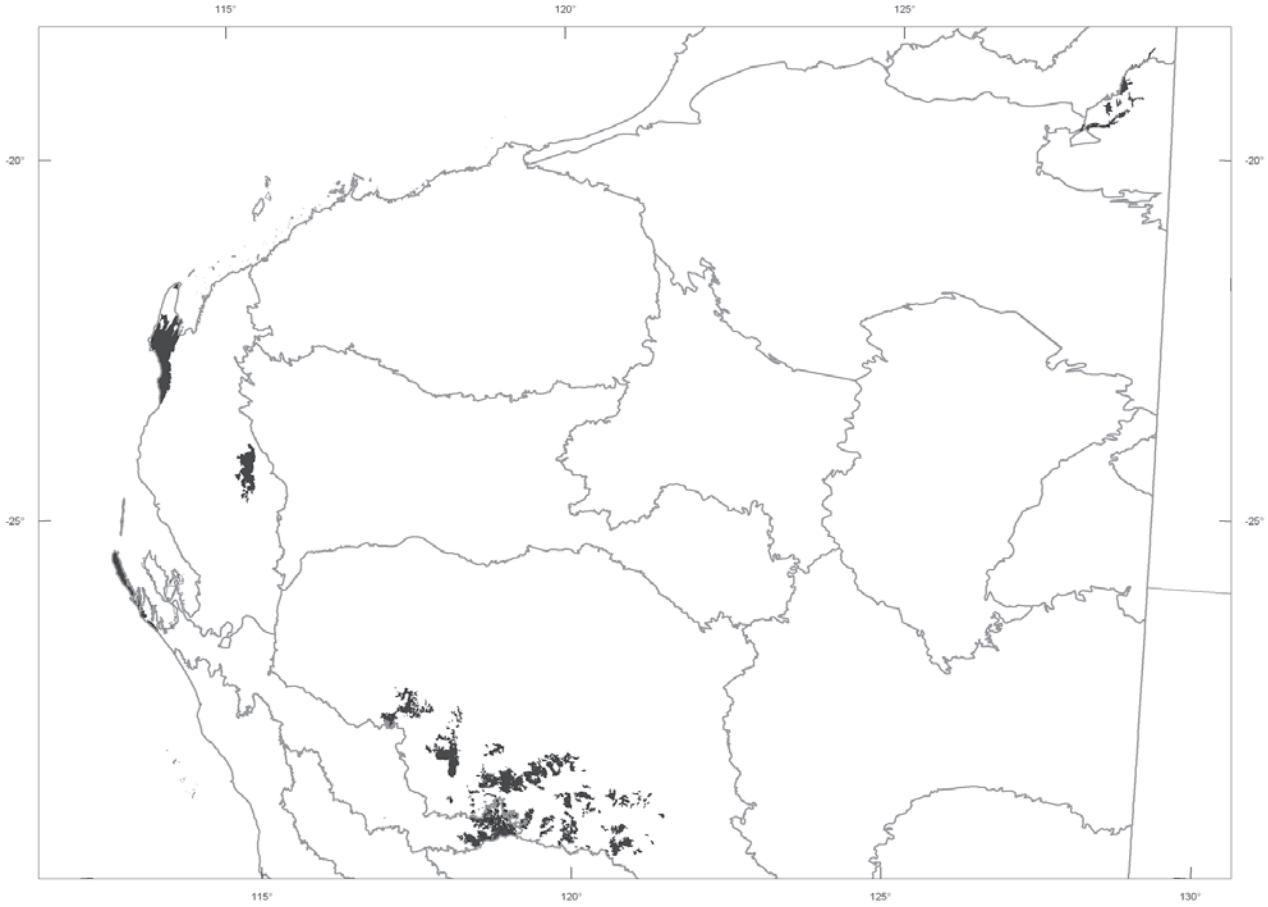


Figure 53. Vegetation Type 41: Spinifex complexes.

Plate 51. Spinifex complex in Cape Range National Park (photo by Ladislav Mucina).

hummock grass of the tropical tree-steppe with the sclerophyll shrubs of the south-western scrub and heath. The soils appear to grade from the orange-red sand favouring the tree-steppe to the yellow-brown sand beneath the heath elements. They are mapped as *T. basedowii* (hard spinifex), *T. scariosa* and *T.* sp. indet. (probably *T. rigidissima)* and sparse dwarf shrubs with either scattered low trees of *Eucalyptus oleosa* (giant mallee), open mallee of *Eucalyptus oleosa* or scrub of *Acacia ramulosa* and *A. linophylla* (bowgada). Other low tree species include *Eucalyptus kingsmillii* (Kingsmill's mallee), *Acacia aneura* s.l. (mulga), and *Callitris columellaris* (white cypress pine). Tall shrubs include *Allocasuarina acutivalvis*, *Grevillea juncifolia* (honey-suckle grevillea), *G. obliquistigma, Hakea multilineata* (grass-leaf hakea) and *Santalum acuminatum* (quandong). Medium shrubs include *Allocasuarina campestris*, *Eremophila drummondii*, *E. forrestii*, *Melaleuca uncinata* s.l. (broom bush) and *Phebalium canaliculatum*. Small shrubs include *Baeckea floribunda*, *Daviesia grahamii, Philotheca tomentella, Halgania viscosa, Olearia pimeleoides* and *Thryptomene urceolaris*. Ephemeral herbs include *Lawrencella davenportii* (sticky everlasting), *Leucochrysum stipitatum* (woolly sunray), *Podolepis canescens* (grey podolepis) and *Waitzia nitida* (golden waitzia).

In the Carnarvon Bioregion, there are three areas with vegetation classified as spinifex complex. Hummock grasses *Triodia pungens* (soft spinifex) and *T. basedowii* (hard spinifex) occur with mixed scrub and dwarf scrub on over 200,000 ha on the sandhill country at the southern end of Cape Range. *Triodia schinzii* (feathertop spinifex) may also occur in the grass layer and shrub species include *Acacia spathulifolia, Grevillea eriostachya* (flame grevillea), *Hakea stenophylla, Hibbertia spicata, Mirbelia ramulosa, Thryptomene baeckeacea* and *Verticordia etheliana* (Plate 51). The sandplain with dunes on top of the Kennedy Range (110,000 ha) supports a mid-dense cover (30–70% pfc) of *Triodia basedowii* (hard spinifex), with scattered shrubs such as *Grevillea eriostachya* (flame grevillea) and a mixture of small ericoid or heathy shrubs such as *Baeckea* spp., *Calytrix brevifolia* and *Phyllanthus* species. Wattle (*Acacia* spp.) scrub with heath shrubs and spinifex covers most of Dirk Hartog Island (53,000 ha), on the grey and pink soils over limestone. *Acacia ligulata* (umbrella bush) is usually present and *Melaleuca cardiophylla* (tangling melaleuca) and *Thryptomene baeckeacea* may also be found. On the rockiest, driest and most exposed sites along the south-west coast of the island and further south on the Edel Land Peninsula, the unit is mixed heath and spinifex (51,000 ha). Shrubs, pruned by the wind, include some species from the south-west, such as *Olearia axillaris* (coastal daisybush), *Scaevola crassifolia* (thick-leaved fan-flower), *Melaleuca huegelii* (chenille honeymyrtle) and *M. cardiophylla* (tangling melaleuca), and the spinifex here is the local endemic *T. plurinervata.*

Several units of spinifex, short bunch-grasses and scattered trees occur in the Tanami Bioregion and adjacent Ord – Victoria Plains Bioregion. Here, the *Astrebla pectinata* (barley Mitchell grass) occurs with *Themeda triandra* (kangaroo grass) in the depressions of grey silt along old drainage lines near Sturt Creek. Along Sturt Creek, scattered *Eucalyptus microtheca* (coolibah) emerge from the bunch-grass and *Triodia pungens* (soft spinifex).

Halophyll and Sarcophyll Communities

42. Samphire with thicket and woodland or scattered trees

Samphire communities termed by Beard as halophyll types have been differentiated from the sarcophyll (saltbush/bluebush) shrub communities in this classification due to their ecological distinctiveness, i.e. they are found on saline soils. They are associated with a variety of structural and floristic components.

This vegetation type consists of two strata with the samphire ground cover: medium (10–30 m) trees and a tall (>2 m) shrub layer. It commonly occurs as bands of fringing vegetation, with the samphire near lakes and water courses grading into thickets and then woodland. The samphire averages a cover of 10–30% pfc, the thicket has a cover of 30–70% pfc and the density of the medium tree layer ranges from a cover of 10–30% pfc (woodland), to <10% pfc (open woodland) to ≈0% pfc (very scattered

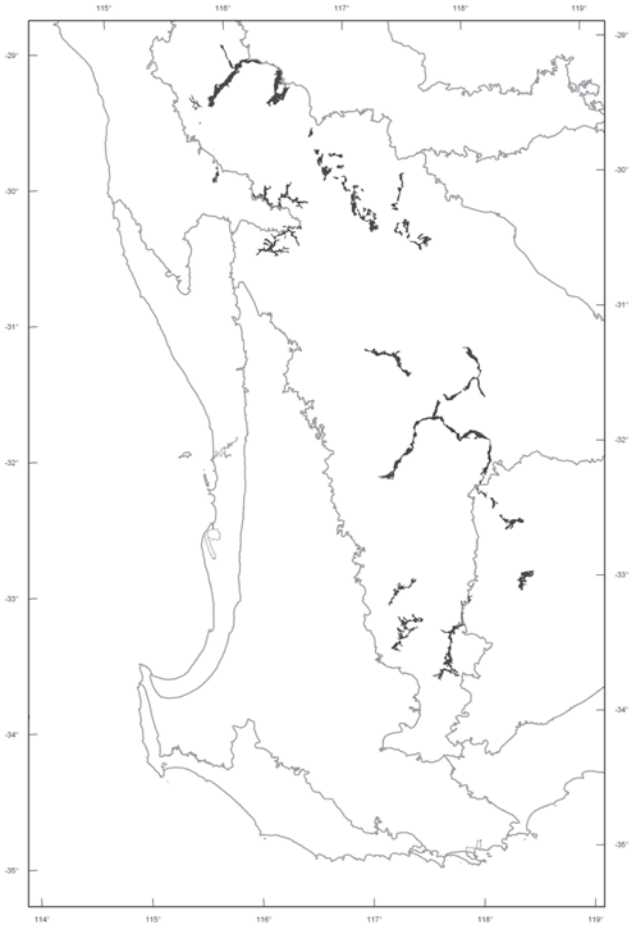


Figure 54. Vegetation Type 42: Samphire with thicket and woodland or scattered trees.

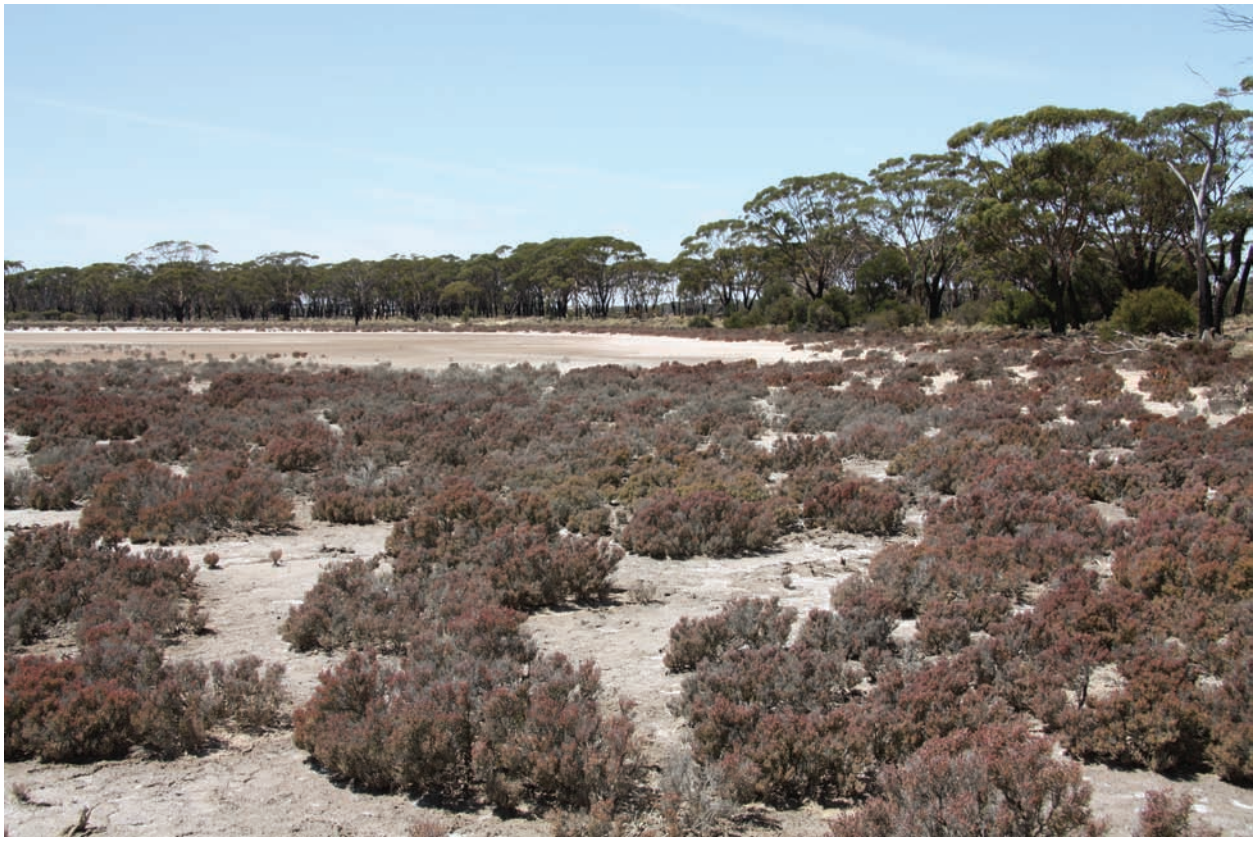


Plate 52. Samphire with thicket and trees near Lake King (photo by Ladislav Mucina).

trees). This unit is associated with heavy soils near saline drainage lines and covers an area of over 210,000 ha. Samphire includes species from the genera *Tecticornia* and *Sarcocornia*. It occurs mainly in the Avon Wheatbelt Bioregion, extending into the Geraldton Sandplains, Yalgoo and Mallee Bioregions (Fig. 54).

Saline areas totalling nearly 180,000 ha in the northern and central Avon Wheatbelt Bioregion support an association with *Eucalyptus loxophleba* (York gum) woodland or open woodland with *Melaleuca* spp. (tea tree) thickets (often *M. thyoides*) and samphire (Plate 52). Other tree species include *Casuarina obesa* (swamp sheoak) and *E. rudis* (flooded gum) in the west, with *E. salmonophloia* (salmon gum) and *E. occidentalis* (flat-topped yate) in the east. The height and density of the tree layer appears to reflect rainfall, and a tree layer is often absent in the drier regions (see Vegetation Type 43). The samphire is mainly *Tecticornia* spp., with occasional low succulents such as *Carpobrotus* spp. and *Disphyma* spp.

In the Mallee Bioregion there are associations of scattered *Eucalyptus kondininensis* (Kondinin blackbutt) with *E. gracilis* (yorrell) or *E. loxophleba* (York gum), and a small area of scattered *E. salmonophloia* (salmon gum) and *E. longicornis* (red morrel) with the thickets and samphire. *Eucalyptus longicornis* (red morrel) is found on highly calcareous soils and *E. kondininensis* (Kondinin blackbutt) appears to prefer gypsum soils.

43. Saltbush and/or bluebush with woodland or scattered trees

Saltbush and bluebush communities termed by Beard as sarcophyll types with fleshy leaves have been differentiated from halophytic samphire communities as they tend to occur on alkaline soils, such as those that occur on the Nullarbor. There are a few linear areas associated with salt lakes that are mapped as a mixture of samphire and saltbush and bluebush. These combination units have been assigned to a classification based on proximity to similar units.

This vegetation type has saltbush and/or bluebush dominant in the ground layer (10–30% pfc). Bluebush is commonly applied to *Maireana* species, usually *M. sedifolia* (pearl bluebush). This species was once known as *Kochia sedifolia*, hence the 'k' symbol used in the mapping. Saltbush is the common term applied to *Atriplex* species, specifically *A. vesicaria* (bladder saltbush) in the Nullarbor Bioregion, *A. hymenotheca* in the Coolgardie and Nullarbor Bioregions and *A. cinerea* (grey saltbush) in the Carnarvon Bioregion (see Vegetation type 48). The medium tree layer ranges from 30–70% pfc (woodland), to 10–30% pfc (open woodland) and occasionally to <10% pfc (scattered trees). Common species include *Eucalyptus salmonophloia* (salmon gum) and *E. salubris* (gimlet) over the *Atriplex* spp. and *Maireana* spp. This

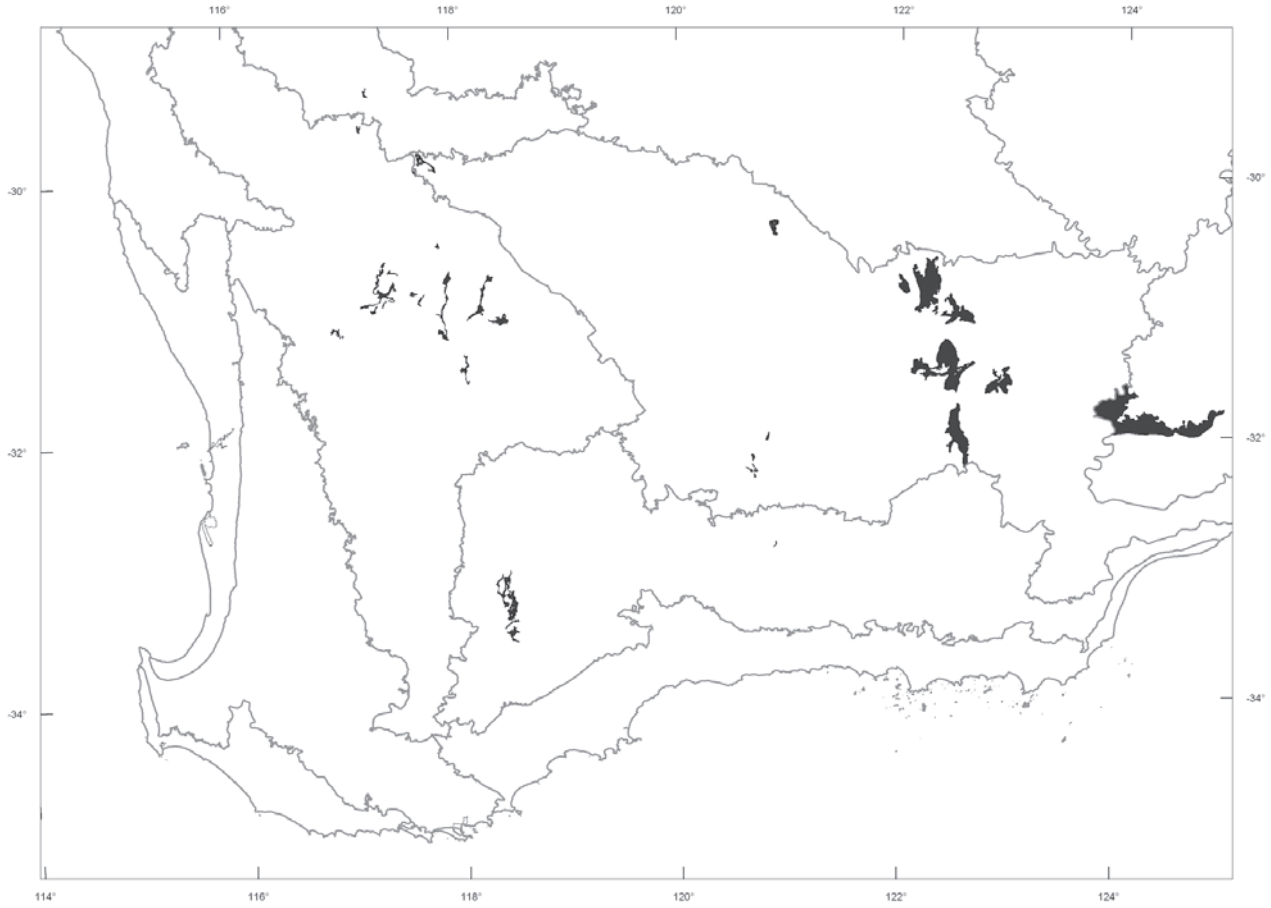


Figure 55. Vegetation Type 43: Saltbush and/or bluebush with woodland or scattered trees.

particular vegetation type is found mainly in the Coolgardie, Nullarbor and Avon Wheatbelt Bioregions and covers a total of nearly 490,000 ha (Fig. 55).

In the Coolgardie Bioregion, there are substantial areas (253,000 ha) of woodland, mainly *Eucalyptus salmonophloia* (salmon gum) or *E. salubris* (gimlet), over *Maireana sedifolia* (pearl bluebush) and *M. pyramidata* (sago bush) or *Atriplex vesicaria* (bladder saltbush) occurring on the alkaline soils (Plate 53). Other eucalypts may also be present, including *E. lesouefii* (goldfields blackbutt), *E. transcontinentalis* (redwood), *E. oleosa* (giant mallee) and *E. campaspe* (silver-topped gimlet). *Cratystylis conocephala* (grey bush), another sub-shrub with glaucus semi-succulent leaves, may also mingle with the *Atriplex* and *Maireana.* Annuals may be found here in season, especially *Brachyscome, Cephalipterum drummondii* (pompom head), *Rhodanthe floribunda* (white everlasting) and *Ptilotus nobilis* (tall mulla mulla).

Eucalyptus salmonophloia (salmon gum) and *E. salubris* (gimlet) occur over *Maireana sedifolia* (pearl bluebush), extending into the Nullarbor Bioregion, and covering over 150,000 ha. This is flat country on limestone where, due to the higher rainfall than the rest of the Nullarbor, the tree layer is >10 m over bluebush. In the south-west corner of the Nullarbor Bioregion there is a mosaic (see Mosaic 105) of woodland on the sandy rises, with open *Myoporum* low woodland over saltbush on the clay flats.

In the north-west Coolgardie Bioregion and adjacent Avon Wheatbelt and Yalgoo Bioregions, *Eucalyptus loxophleba* (York gum) over *Atriplex* spp. (saltbush) has been mapped over nearly 7000 ha.

There are two small mosaics of saltbush and samphire (totalling over 44,000 ha) that do not fit well into Vegetation Types 42 or 43 and so are included in this vegetation type, due to their linear nature on the map. Around the salt lakes north and north-west of Kellerberrin in the Avon Wheatbelt Bioregion, these mosaics have patches of either scattered *E. salmonophloia* (salmon gum) and *E. gracilis* (yorrell) medium trees or sparsely scattered *Eucalyptus loxophleba* (York gum), *Eucalyptus salmonophloia* (salmon gum) and *E. longicornis* (red morrel) with the saltbush and samphire. Belts of *Tecticornia leptoclada* and *Gunniopsis calcarea* (samphire)

Plate 53. Woodland over saltbush and bluebush in Majestic Timber Reserve east of Kalgoorlie (photo by Ian Kealley).

near salty areas grade into *Maireana brevifolia* (bluebush) under the scattered trees or woodland. Communities with a *Melaleuca* spp. (tea tree) shrub layer may occur nearby. Other mosaics of *Eucalyptus salmonophloia* (salmon gum) and *E. longicornis* (red morrel) occur with samphire (14,000 ha) or saltbush (10,000 ha) fringing Lake Grace.

44. Samphire with woodland or low woodland

In this vegetation type, the samphire layer with 10–30% pfc has a medium (>10 m) or low (<10 m) tree layer with 10–30% pfc. The vegetation is typically samphire with either *Acacia aneura* s.l. (mulga) low woodland,

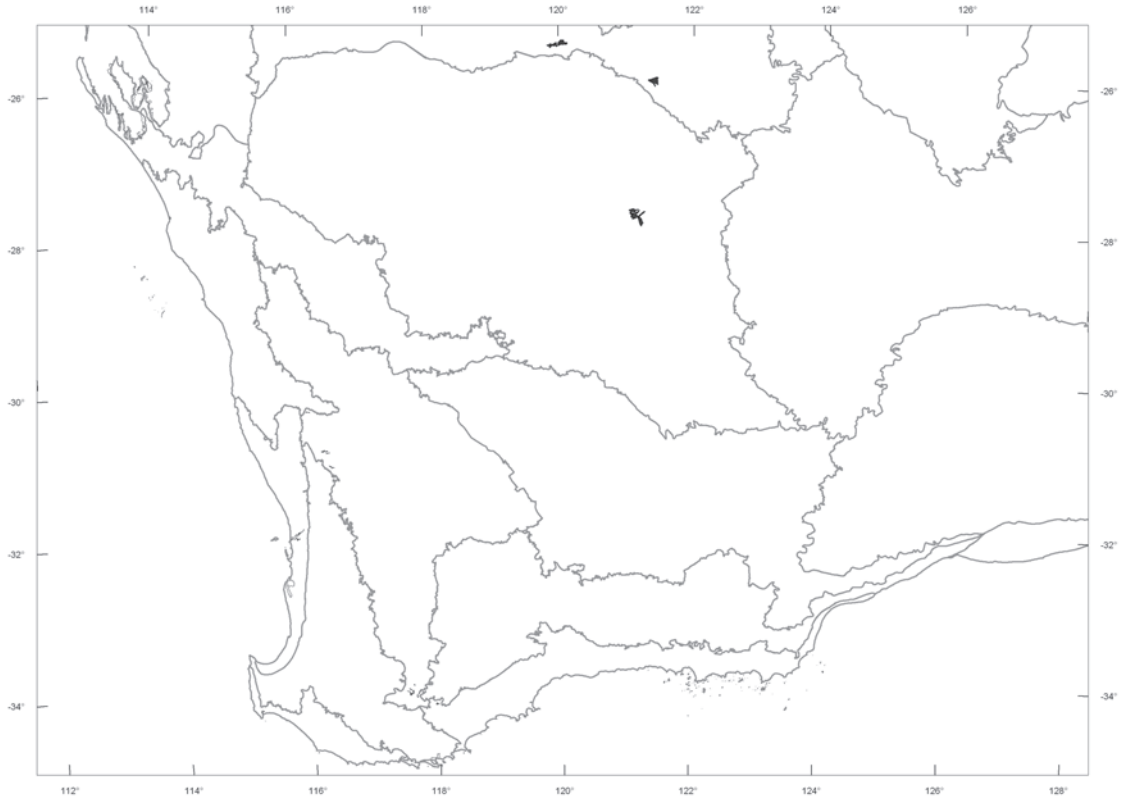


Figure 56. Vegetation Type 44: Samphire with woodland or low woodland.

Plate 54. Samphire and trees near Hyden (photo by Ladislav Mucina).

which occurs in the Gascoyne Bioregion and Murchison Bioregion, or *Eucalyptus loxophleba* (York gum) or *Casuarina obesa* (swamp sheoak) woodland in the Avon Wheatbelt Bioregion (Fig. 56). This vegetation type covers just over 48,000 ha of the state.

Acacia aneura s.l. (mulga) low woodland, sometimes with *A. ramulosa*/*A. linophylla* (bowgada), occurs with samphire on saline soils adjacent to Lake Darlot in the Murchison Bioregion, and north of Lake Gregory in the Gascoyne Bioregion.

On saline flats in the central west Avon Wheatbelt Bioregion, *Eucalyptus loxophleba* (York gum) occurs on its own or is joined by *E. salmonophloia* (salmon gum) and *E. longicornis* (red morrel) in association with the samphire. York gum drops out of this association and *E. salubris* (gimlet) may be present (Plate 54) in the salt lake systems of the western and central Mallee Bioregion. A small area of *Casuarina obesa* (swamp sheoak) woodland over samphire is also mapped in the central west Avon Wheatbelt Bioregion. In the south of the Avon Wheatbelt Bioregion, *Melaleuca* sp. (tea tree) is mapped as low woodland over samphire along drainage lines and around salt lakes. This association is likely to occur elsewhere, but in patches too small for mapping at this scale.

45. Saltbush and/or bluebush with low woodland

In this vegetation type the low saltbush and/or bluebush shrub layer with 10–30% pfc has an overstorey of low (<10 m) woodland with an average cover of 10–30% pfc. It is the common 'thickly wooded succulent steppe' (after Beard 1981a) or sarcophyllic association of the northern Nullarbor Bioregion and covers over 2.9 million ha. Other associations include the mulga–sheoak associations, or *A. papyrocarpa* (western myall) over bluebush in the Murchison, Coolgardie and Yalgoo Bioregions (Fig. 57).

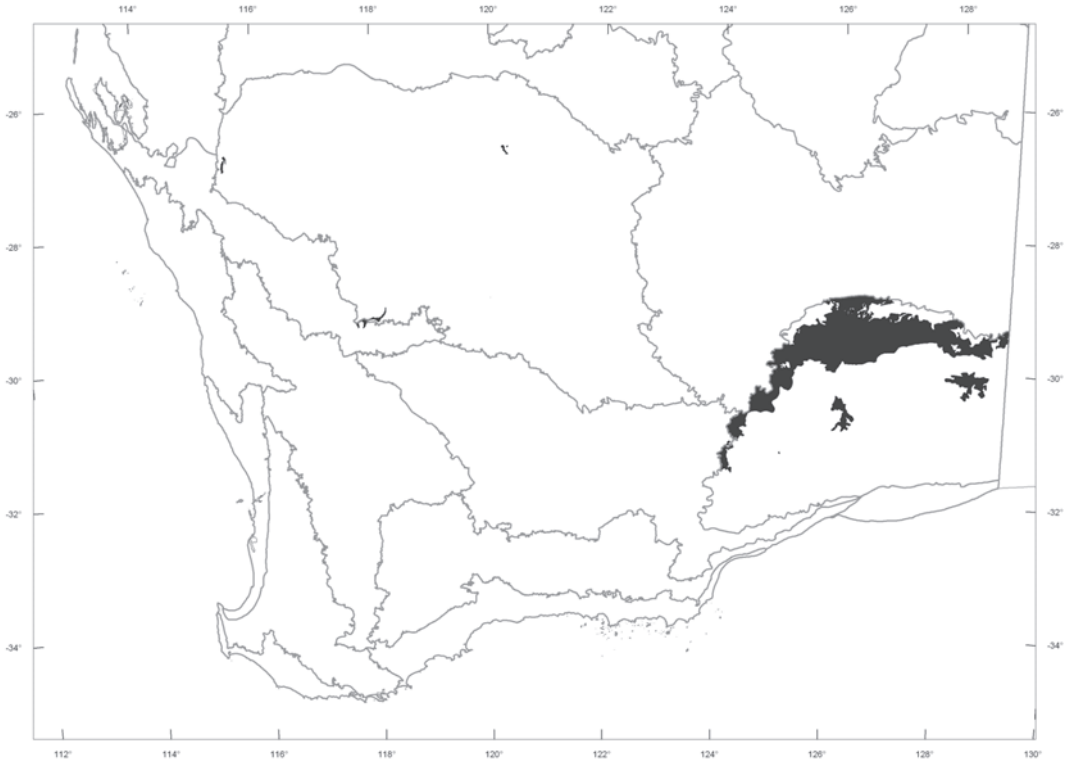


Figure 57. Vegetation Type 45: Saltbush and/or bluebush with low woodland.

Plate 55. Bluebush with low trees in Plumridge Nature Reserve (photo by Greg Keighery).

The limestone plateau of the Nullarbor Plain is more elevated in the north, where a 2.4 million ha band of thickly wooded sarcophyllic steppe is found on the deep, pink, calcareous sandy loam. *Maireana sedifolia* (pearl bluebush) and seasonal herbs and grasses form the ground layer, with *Acacia aneura* s.l. (mulga) to 4.5 m being common as the tree layer (Plate 55). Other associated low trees include *Casuarina pauper* (black oak) to 9 m, *Myoporum platycarpum* (sugarwood) to 6 m and occasional *Eucalyptus oleosa* (giant mallee).

On the northern edge of the treeless part of the Nullarbor Plain, south of the lightly wooded myall low open woodland (see Vegetation Type 46), there are two areas (totalling 230,000 ha) of bluebush with *Acacia papyrocarpa* (western myall) low woodland. These appear to occur in large depressions. Small areas of saltbush, with or without bluebush, with mulga or *Acacia xiphophylla* (snakewood) occur in depressions mainly in the Murchison Bioregion.

Mosaic 119 (Fig. 86) mulga, with patches of saltbush and bluebush on greenstones in the Murchison Bioregion, is similar in structure to this vegetation type.

46. Saltbush and/or bluebush with scattered low trees

In this vegetation type a saltbush and/or bluebush layer (still 10–30% pfc) has an overstorey of open low woodland (<10% pfc). It is similar to the previous vegetation type but differs by having a more open overstorey over the bluebush and/or saltbush. It is referred to by Beard (1981a) as 'thinly wooded succulent'. Important associations include the *Acacia papyrocarpa* (western myall) open low woodland over bluebush, which covers over 4.5 million ha in the Nullarbor and Hampton Bioregions (Fig. 58). *Acacia aneura* s.l. (mulga), sometimes with *Casuarina pauper* (black oak), over the bluebush and/or saltbush covers 800,000 ha in the eastern Murchison, northern Coolgardie and western Great Victoria Desert Bioregions.

A lightly wooded band of vegetation on the Nullarbor dominated by bluebush (*Maireana sedifolia*) with scattered *Acacia papyrocarpa* (western myall; Plate 56) occurs between the treeless plain and the mulga/sheoak low woodland described in Vegetation Type 45. The tree density appears to be governed by the depth of the calcareous loamy soils over limestone. In the north-east Nullarbor Bioregion, the bluebush is replaced by saltbush (*Atriplex vesicaria, A. acutibractea* and *A. cryptocarpa*),

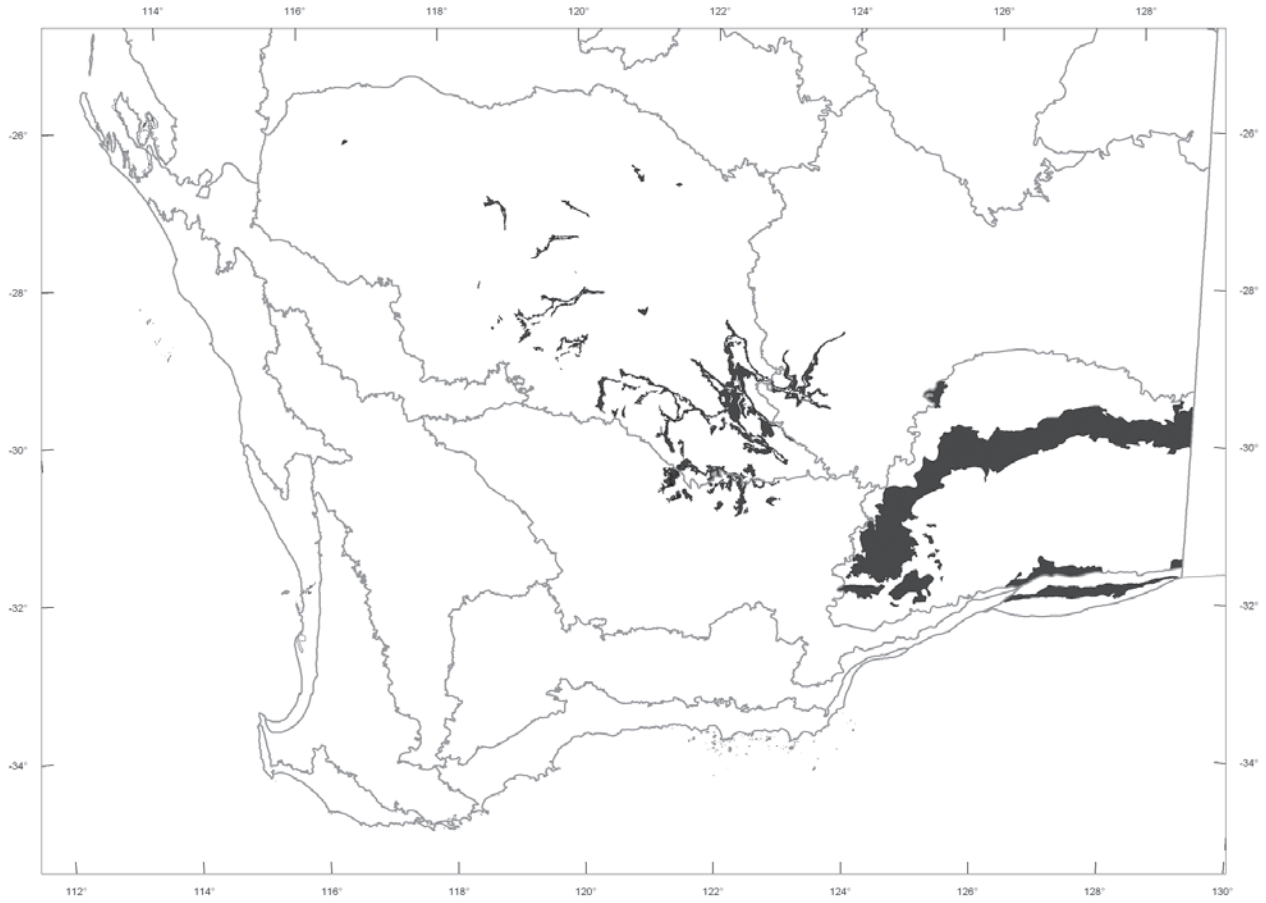


Figure 58. Vegetation Type 46: Saltbush and/or bluebush with scattered low trees.

Plate 56. Bluebush with scattered low trees on the Nullarbor (photo by John Beard).

and to the west and south in the Hampton Bioregion both saltbush and bluebush are mapped. The flat-topped *Acacia papyrocarpa* (western myall) grows to between 3 and 5 m and may be joined by scattered *Myoporum platycarpum* (sugarwood), mallee *Eucalyptus oleosa* (giant mallee), *Pittosporum angustifolium* (weeping pittosporum), *Acacia aneura* s.l. (mulga) and *Casuarina pauper* (black oak). The ground layer is similar to the bluebush communities on the Nullarbor Plain (see Vegetation Type 49).

Calcareous soils are also associated with saline depressions in the Murchison Bioregion. These are generally vegetated with *Acacia aneura* s.l. (mulga) and saltbush (e.g. *Atriplex vesicaria*, *A. lindleyi*), or mulga and bluebush (*Maireana sedifolia*, *M. carnosa* [cottony bluebush], *M. enchylaenoides* and *M. georgei* [satiny bluebush]), with *Casuarina pauper* (black oak) joining the mulga (*Acacia aneura* s.l.) tree layer in the south-east. Associated and sometime fringing species include *Acacia sclerosperma* (limestone wattle), *A. victoriae* (bardi), *Hakea preissii* (needle tree), *Maireana pyramidata* (sago bush), *M. triptera* (three-winged bluebush) and *Eremophila pterocarpa* (silver poverty bush).

In the south-west Nullarbor Bioregion, there are mosaics of scattered medium woodland with the succulent steppe saltbush under open low *Myoporum platycarpum* woodland (Mosaic 105; Fig. 72).

47. Samphire with thicket or scrub

This vegetation type consists of a samphire layer with taller shrubs forming thickets of melaleuca, or scrub of melaleuca or acacia, or narrow bands of samphire fringed by thickets or scrub. *Tecticornia* is the main genus of samphire. Samphire with thicket or scrub is typical of salt lake margins where the soil is deep enough to support shrubs. This vegetation type covers over 735,000 ha, nearly half of which is found in the Great Sandy Desert Bioregion, mainly around Lake Mackay, with most of the remainder being in the Little Sandy Desert, Gibson Desert, Murchison, Yalgoo and Avon Wheatbelt Bioregions (Fig. 59).

The vegetation associated with depressions in the Great Sandy Desert and Gibson Desert Bioregions is described on the original maps as 'lake depressions – tea tree'. Species include *Melaleuca lasiandra*, *M. glomerata* and *Acacia ligulata* (umbrella bush) to 2 m.

The areas around salt lakes in the northern Murchison Bioregion have a mosaic of *Acacia ramulosa* and *A. linophylla* (bowgada) scrub on sand hills, with samphire on the flats. In a small area in the Carnarvon Bioregion the scrub component of the mosaic is joined by *Acacia sclerosperma* (limestone wattle). There is a mosaic of *A. sclerosperma* (limestone wattle) and *A. xiphophylla* (snakewood) scrub over samphire in the Yalgoo Bioregion.

Figure 59. Vegetation Type 47: Samphire with thicket or scrub.

As the patches of these mosaics tend to be small and linear, they are included within this unit rather than as a cross hatched mosaic on the map.

In the Geraldton Sandplains, Avon Wheatbelt and Yalgoo Bioregions, *Melaleuca thyoides* or *M. uncinata* s.l. (broom bush) scrub occurs on the sandy rises adjacent to saline mud flats that support samphire (Plate 57). Samphire species include *Tecticornia halocnemoides* (shrubby samphire) and *T. indica* (samphire). Few other species are present.

48. Saltbush and bluebush with scrub, open scrub or sparse scrub

In this vegetation type, the saltbush and/or bluebush ground stratum is dominant (10–30% pfc). There may be a shrub layer >1 m tall, with 10–30% pfc (scrub) or <10% pfc (open scrub) or sparse scrub (where the shrubs are largely absent or in scattered groups with no discernible foliage cover). Generally, when the shrub layer has the same cover as the ground layer the vegetation would be classified according to the taller layer; however, it is included here because of the ecological affiliation with the succulent ground layer and because there is no such association in the Scrub Vegetation Type 15. Vegetation Type 48 is varied, with different combinations and cover densities of *Acacia* species. *Acacia aneura* s.l. (mulga) is common, with *Acacia ramulosa/A. linophylla* (bowgada), *A. victoriae* (bardi) and/or *A. sclerosperma* (limestone wattle) also present. The saltbush and/or bluebush layer is composed of species of *Atriplex* and *Maireana*. Samphire

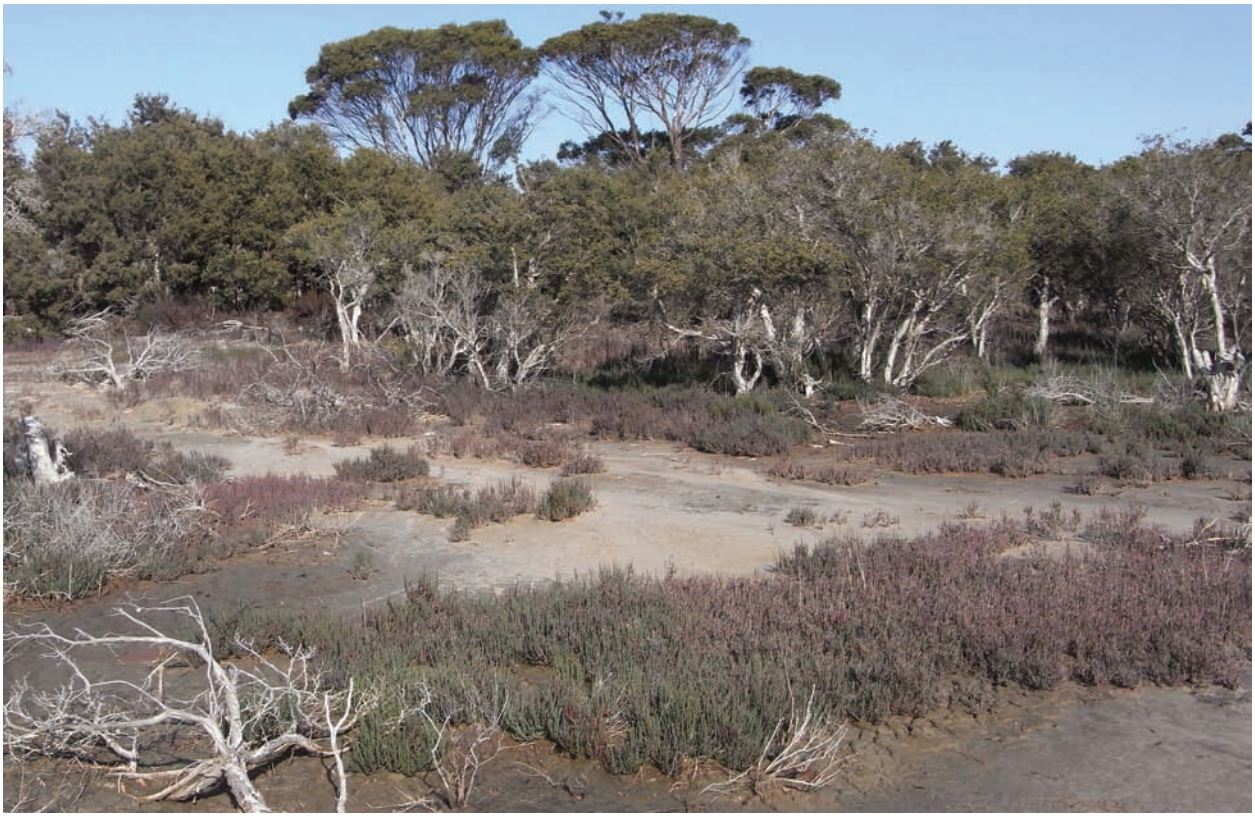


Plate 57. Samphire and thicket on Chillinup Lake near the Stirling Range (photo by Ladislav Mucina).

may occur on the margins of this unit adjacent to salt lakes. This vegetation type covers over 1.4 million ha, mainly in the Carnarvon and Murchison Bioregions, extending into the Yalgoo, Gascoyne, and Coolgardie Bioregions (Fig. 60).

The Murchison Bioregion is the main region where mulga and other *Acacia* species are present as the common shrubs over saltbush and/or bluebush. Areas totalling 260,000 ha are mapped as mulga open scrub over mixed succulent steppe. This is mainly saltbush/bluebush with samphire on the salty margins that is representative of the combination units mentioned in Vegetation Type 43. In the Coolgardie and Murchison Bioregions, *Acacia aneura* s.l. (mulga) is present over only saltbush. *A. sclerosperma* (limestone wattle) joins the mulga in saltbush/bluebush habitats that extend into the Yalgoo and Gascoyne Bioregions. *Acacia sclerosperma* (limestone wattle) also occurs with *A. xiphophylla* (snakewood), *A. victoriae* (bardi) and *Acacia ramulosa*/*A. linophylla* (bowgada) over the succulent steppe, mainly in the Murchison Bioregion. In the southern Murchison and adjacent Yalgoo Bioregions, *Acacia acuminata* (jam) and *Acacia ramulosa*/*A. linophylla* (bowgada) over saltbush, with or without bluebush, cover an area of nearly 75,000 ha. *Acacia xiphophylla* (snakewood) open scrub over saltbush occurs in the Carnarvon Bioregion, and there is a large area (nearly 105,000 ha) of poor stony country where *A. xiphophylla* (snakebush) is largely absent or in scattered groups over open saltbush (Plate 58). Towards the coast, there is *Acacia coriacea* (wirewood) and *A. sclerosperma* (limestone wattle) over saltbush and samphire.

On and around Lake Annean in the central Murchison Bioregion, there is an association of *A. sclerosperma* (limestone wattle), *A. ramulosa*/*A. linophylla* (bowgada)

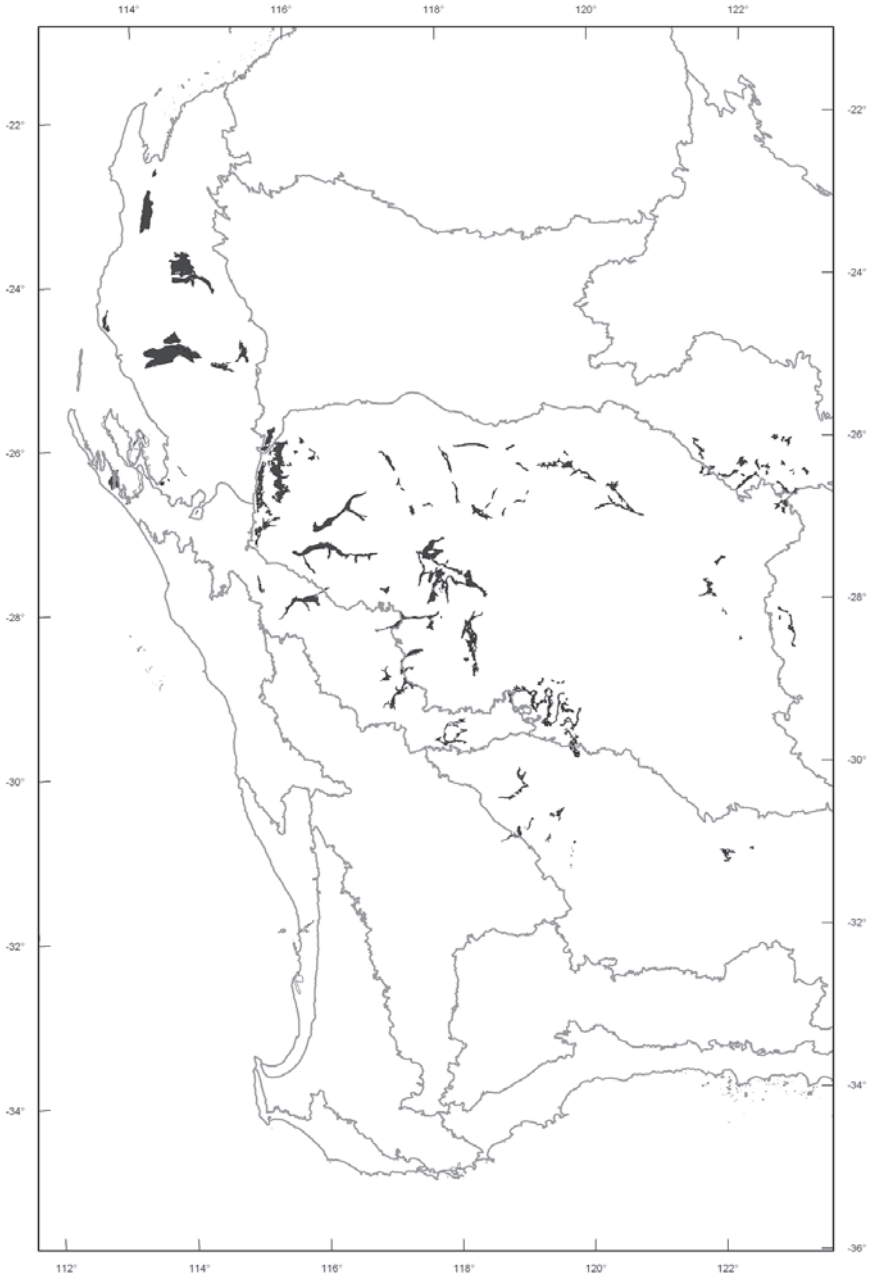


Figure 60. Vegetation Type 48: Saltbush and bluebush with scrub, open scrub or sparse scrub.

Plate 58. Saltbush and open scrub near Shark Bay (photo by Andrew Perkins).

open scrub over saltbush and bluebush on the sand dunes that covers nearly 19,000 ha, with samphire on the claypans between the dunes.

On Edel Land in Shark Bay, there is an association of acacia and melaleuca scrub over saltbush. Species include *Melaleuca huegelii* (chenille honeymyrtle), *Acacia ligulata* (umbrella bush), *A. tetragonophylla, A. xanthina, Alyogyne cuneiformis* (coastal hibiscus), *Diplolaena dampieri, Exocarpos sparteus* (broom ballart), with *Atriplex bunburyana* (silver saltbush) and *Frankenia pauciflora* (sea heath) as a ground layer. The often-linear mosaics on drainage systems are included here as they are best shown as a single colour on the 1:3,000,000 map for reasons of clarity.

49. Saltbush and bluebush

This vegetation type is made up of *Atriplex* spp. (saltbush) and/or *Maireana* spp. (bluebush) dwarf shrubs with no emergent tree or tall shrub strata. Often there is a fine-scale gradation from samphire to saltbush to bluebush, especially at sites near salt lakes. Bluebush associations have been further classified based on soils and topography. This vegetation type covers a total area of over 7.3 million ha and is the predominant vegetation of the Nullarbor Plain (Fig. 61). In the Carnarvon Bioregion is an area of saltbush and bluebush with scattered islands of *Acacia* spp.

The *Maireana sedifolia* (pearl bluebush) succulent steppe, with annual grasses and forbs (Plate 59), covers an area of over 6.6 million ha on the Nullarbor Plain. The shallow, pinkish-brown silty soils are derived from the underlying limestone and there are numerous depressions, known as dongas, where saltbush (*Atriplex* spp.) is found. Here the moisture collects in good years and grasses such as *Austrostipa nitida*, *A. eremophila* and *Austrodanthonia caespitosa* grow. Other annuals include *Zygophyllum ovatum* (dwarf twinleaf), *Lepidium oxytrichum*, *L. rotundum* (veined peppercress) and *Rhodanthe floribunda* (white everlasting). Towards the South Australian border in the central Nullarbor Plain, saltbushes such as *Atriplex vesicaria* (bladder saltbush), *A. acutibractea* (toothed saltbush) and *A. cryptocarpa* join the bluebush.

Saltbush associations with no bluebush or samphire are scattered throughout the drier parts of the south-west of the state on calcareous soils. The saltbush species *Atriplex vesicaria* (bladder saltbush), *A. acutibractea* (toothed saltbush) and *A. cryptocarpa* may be joined by *Cratystylis conocephala* (greybush), *Ptilotus obovatus* (cotton bush), *Frankenia interioris* and grasses such as *Austrodanthonia setacea* and *Austrostipa elegantissima,* as well as many annuals after rain.

Units and mosaics of saltbush and bluebush with islands of wattle scrub cover nearly 600,000 ha in the Carnarvon Bioregion. The most common of the wattles are *Acacia sclerosperma* (limestone wattle), with *A. xiphophylla* (snakewood) occurring with it or replacing it. *Acacia victoriae* is also mapped with *Acacia sclerosperma* (limestone wattle) and *A. xiphophylla* (snakewood).

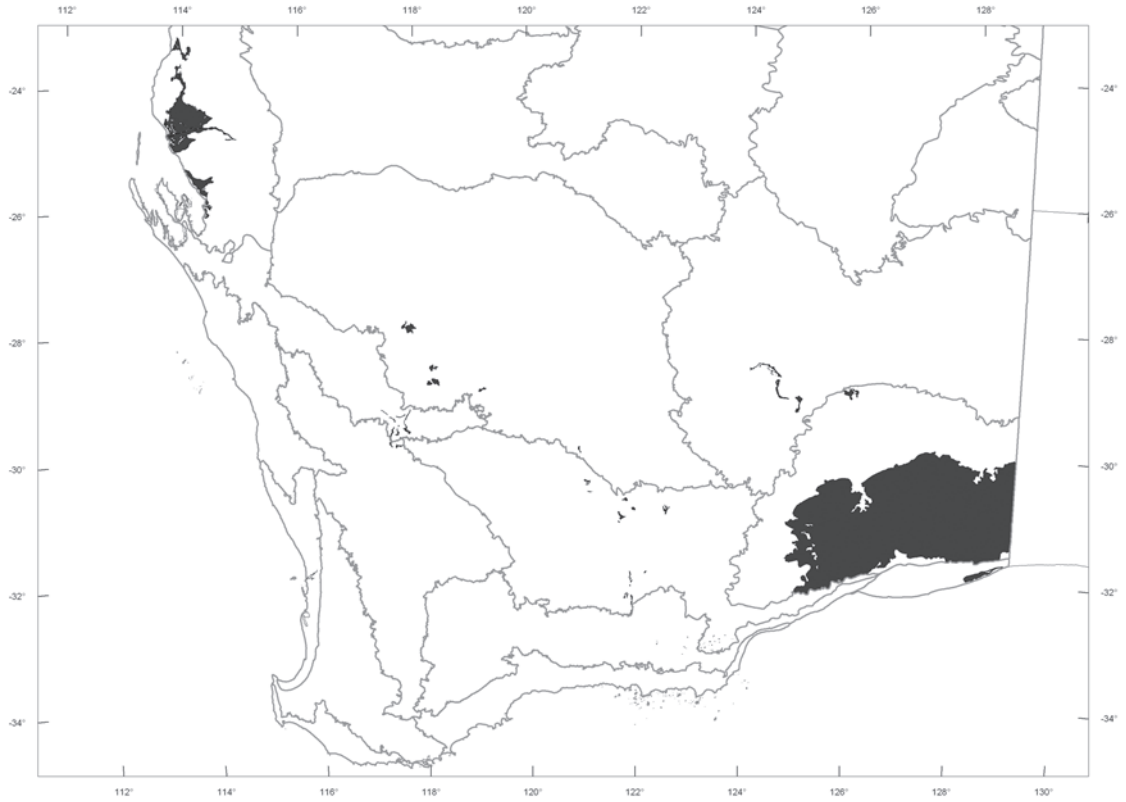


Figure 61. Vegetation Type 49: Saltbush and bluebush.

Plate 59. Bluebush on the Nullarbor Plain (photo by Peter Canty).

Included within the areas mapped as saltbush and bluebush are a few small areas of *Acacia aneura* s.l. (mulga) and *A. sclerosperma* (limestone wattle) low trees in scattered groups on sandy rises between the saltbush and bluebush layer. These areas are close to Mount Magnet, and adjacent to patches of open acacia scrub over saltbush/bluebush.

50. Samphire

This is a single-layer vegetation type with up to 30% pfc of samphire, mainly *Tecticornia halocnemoides* (shrubby samphire) and other *Tecticornia* spp. It is typically found on the margins of salt lakes in a zone where only highly salt-tolerant plants survive. A saltbush zone of *Atriplex, Maireana* and *Frankenia* usually fringes the areas of samphire. Samphire associations cover over 2 million ha, occurring mainly in the Murchison and Gascoyne Bioregions, to a lesser extent in the Pilbara, Great Sandy Desert and Carnarvon Bioregions, as well as three other regions (Fig. 62). Other associated species include *Disphyma crassifolium* (round-leaved pigface), *Sclerolaena deserticola* and *Zygophyllum aurantiacum* (shrubby twinleaf).

The Murchison and Gascoyne Bioregions have large areas of this vegetation type where there is disorganised drainage with water flowing into salt lakes. Around Lake Carnegie, for example, the halophyte community includes *Maireana pyramidata* (sago bush), *Atriplex rhagodioides A. vesicaria* and a variety of annuals such as *Ptilotus* spp. Lake Austin, a gypsiferous lake south of Cue, is mapped as a mosaic of saltbush and bluebush/samphire. Here there

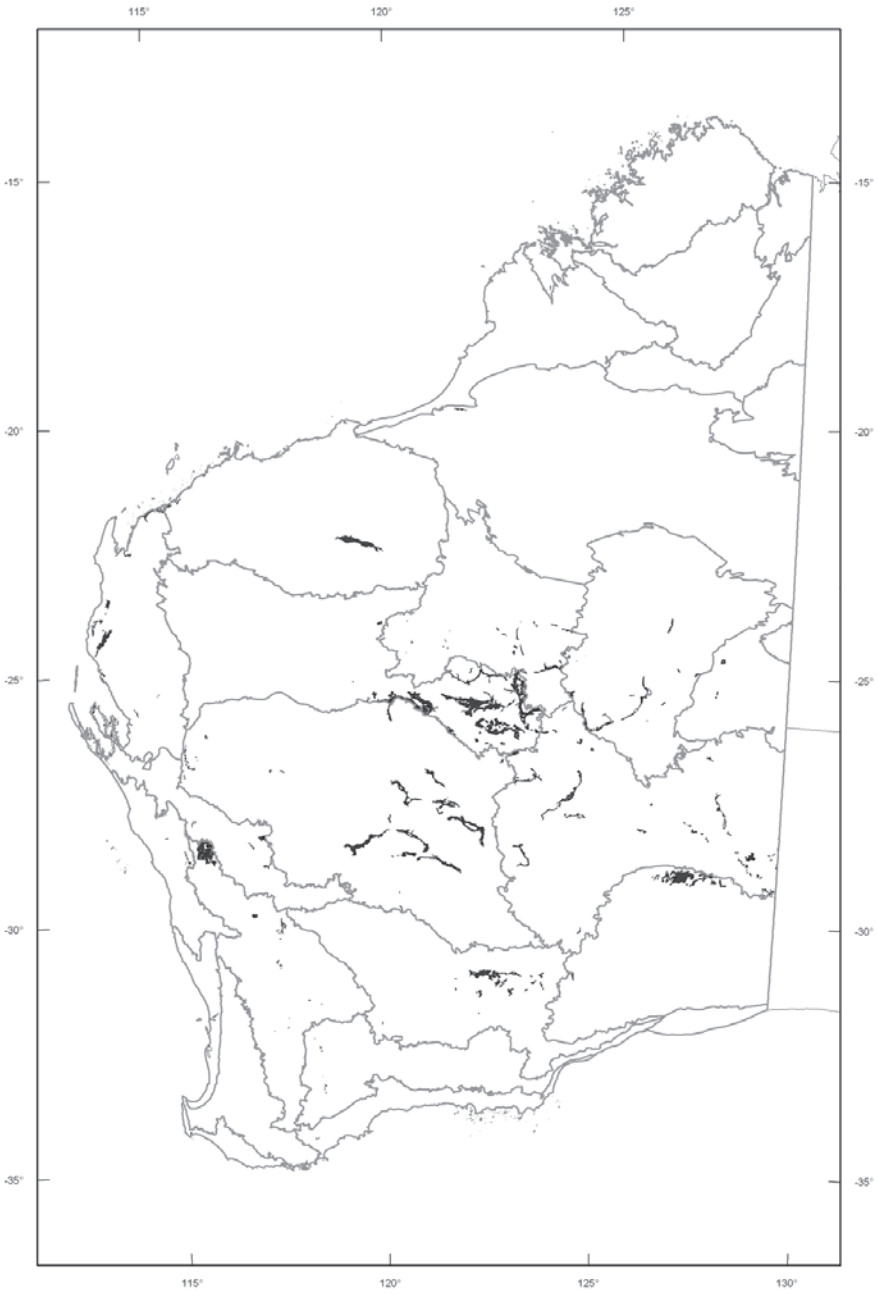


Figure 62. Vegetation Type 50: Samphire.

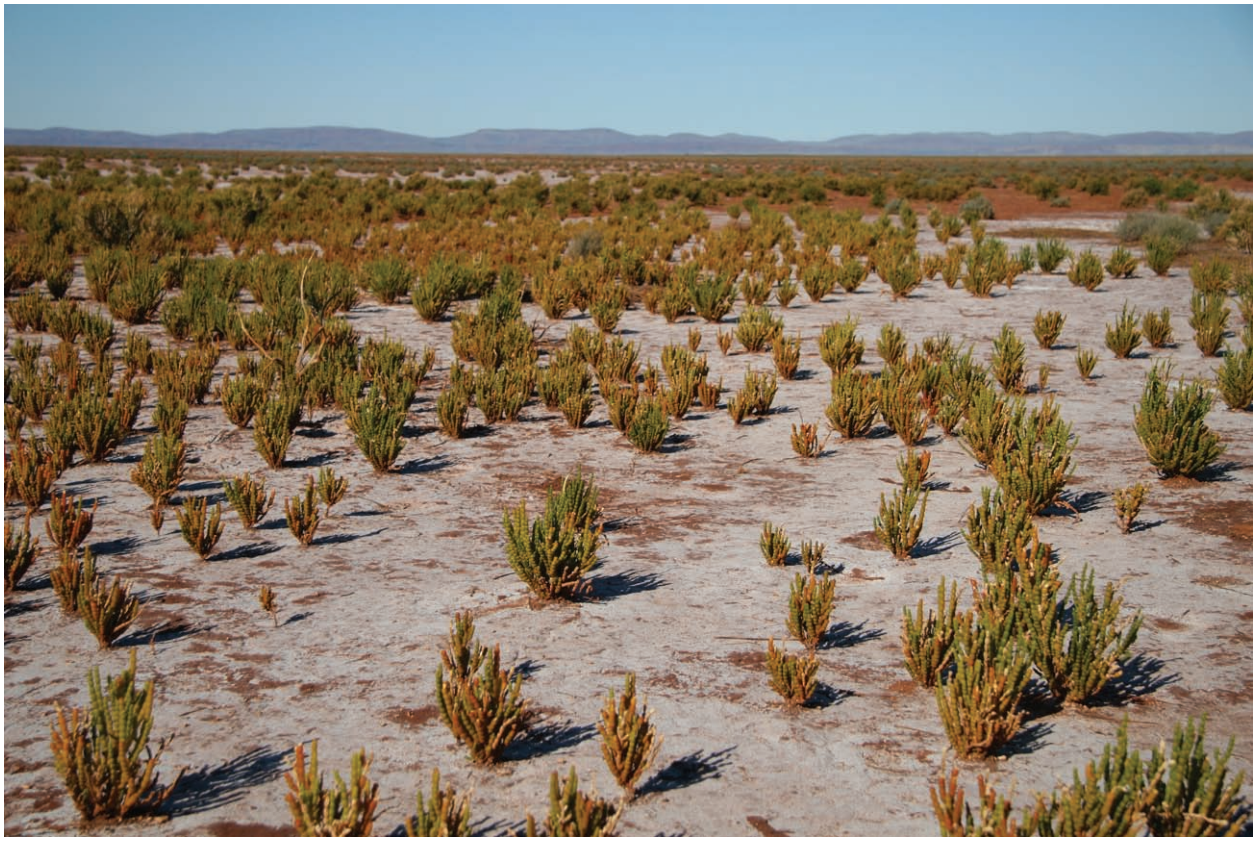


Plate 60. Samphire in the Fortescue Marsh in the Pilbara (photo by Mick Davis).

is an occurrence of the unusual *Lawrencia helmsii*, a semi-succulent, cactus-like plant from the hibiscus family (Malvaceae). The Fortescue Marshes just south of the Goodaidarrie Hills in the Pilbara Bioregion contain a broad expanse of *Tecticornia* spp. (Plate 60). The large area of saltbush and samphire occurring around Lake Macleod in the Carnarvon Bioregion has been included in this vegetation type.

Bare and Sparsely Vegetated Areas

51. Salt lakes, lagoons, clay pans

Salt lakes and clay pans occur throughout the state, except the Northern Kimberley, Central Kimberley and Ord – Victoria Plain Bioregions, and there are only minor occurrences in the other two Kimberley Bioregions (Dampierland and Victoria Bonaparte). The unit includes lagoons, claypans, gypsum lakes and semi-seasonal wetlands that may be sparsely vegetated. Salt lakes occur in 23 of the 26 bioregions and may range in size from 0.2 to 261,922 ha. Salt lakes may be seasonally inundated or filled only after an extreme rainfall event. Claypans occur in desert areas such as the Great Sandy, Little Sandy and Gibson Desert Bioregions. Lagoons include Hutt River Lagoon and mud-locked tidal lagoons in the Victoria Bonaparte, Northern Kimberley and north coastal Pilbara Bioregions. Nearly 3.5 million ha are mapped as salt lakes and a further 87,000 ha as claypans.

The largest area of salt lakes and clay pans occurs in the Great Sandy Desert (734,000 ha) with the extensive Lake Mackay and Lake Hopkins (Plate 61) near the Northern Territory border and the Percival Lake chain containing Lake Auld. Lake Gregory becomes a large inland freshwater lake after heavy rain but gradually dries out and, in the process of drying, becomes saline. This is mapped as a salt lake. The Murchison Bioregion also has a large area with nearly 714,000 ha. This includes Lake Barlee, Lake Moore, Lake Ballard and Lake Austin, which are sparsely vegetated with samphire. The Coolgardie Bioregion has nearly 550,000 ha of salt lakes, lagoons and claypans, while the Gascoyne, Carnarvon, Little Sandy Desert and Great Victoria Desert Bioregions each have over 200,000 ha.

Plate 61. Salt lake Lake Hopkins, south-eastern tip of the Great Sandy Desert Bioregion (photo by Vanessa Clarke).

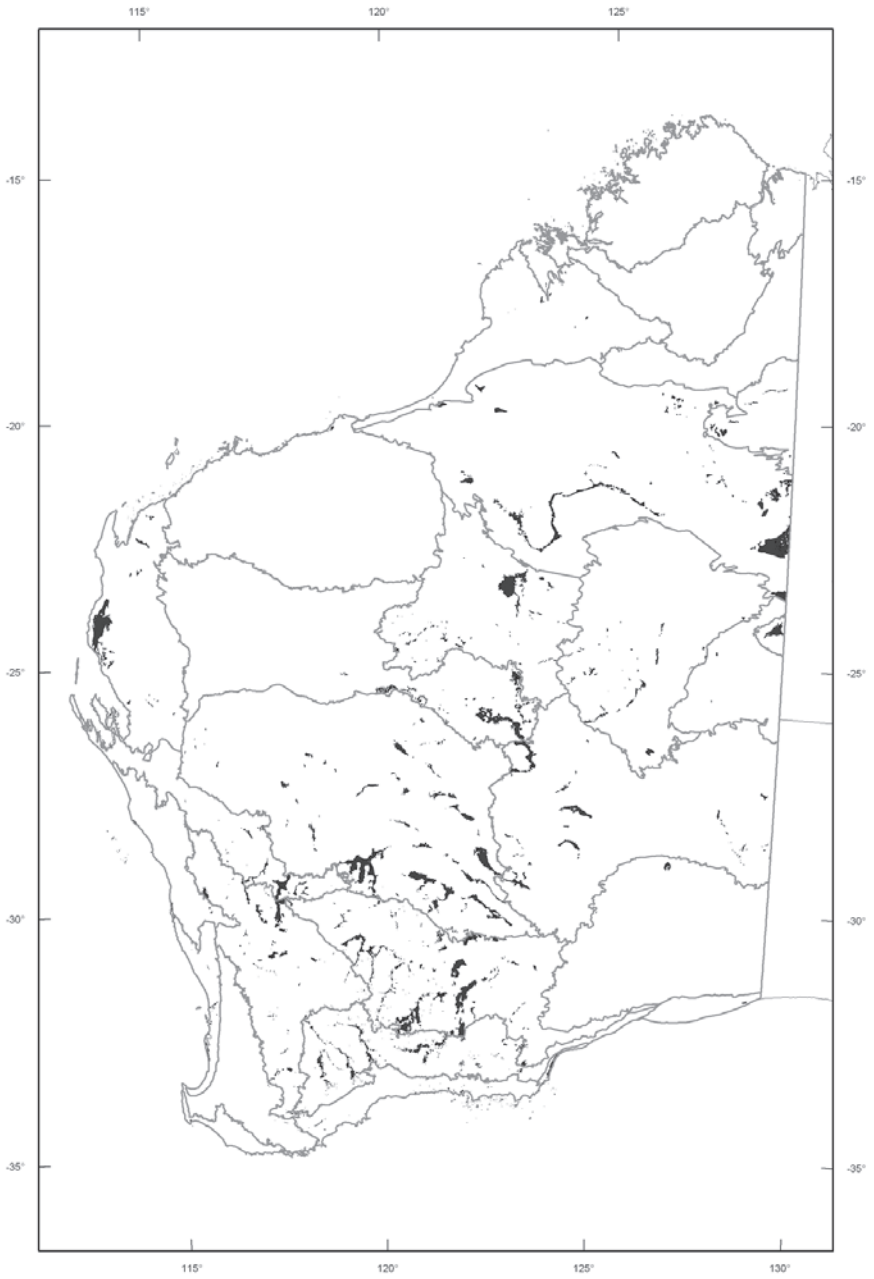


Figure 63. Vegetation Type 51: Salt lakes, lagoons, claypans.

Plate 62. Freshwater Lake Jasper (photo from Enjoy Western Australia website).

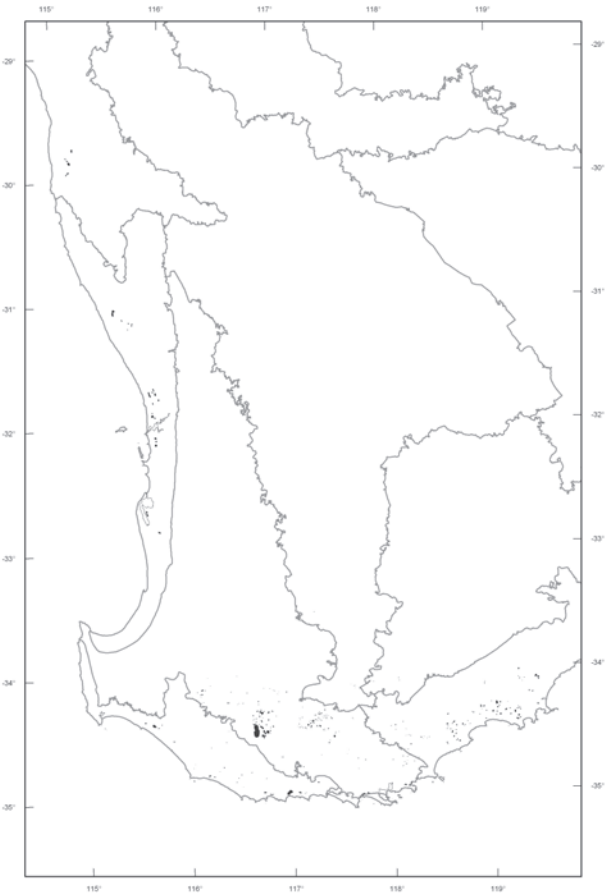


Figure 64. Vegetation Type 52: Freshwater lakes, south.

52. Freshwater lakes

Permanent natural freshwater lakes occur in the south-west in the Jarrah Forest and Warren Bioregions (Plate 62). Seasonal lakes occur in the Avon Wheatbelt, Esperance Plains, Geraldton Sandplains, Jarrah Forest, Mallee, Swan Coastal Plain and Yalgoo Bioregions (Fig. 64). The total area of natural freshwater lakes present at the time mapping was undertaken (1965–1981) was estimated to be about 23,500 ha. Lake Toolibin is a rare example of a freshwater lake in the Avon Wheatbelt Bioregion.

53. Tidal mud flats

Tidal mud flats occur especially along sheltered coastlines and they may experience significant tidal fluctuations. This unit covers nearly 740,000 ha (Fig. 65). Mud flats are extensive in the Pilbara Bioregion and Carnarvon Bioregion (178,000 ha), and in the Dampierland, Northern Kimberley and Victoria Bonaparte Bioregions cover 435,000 ha (Plate 63). They may have a fringing vegetation of mangroves, samphire or grasslands.

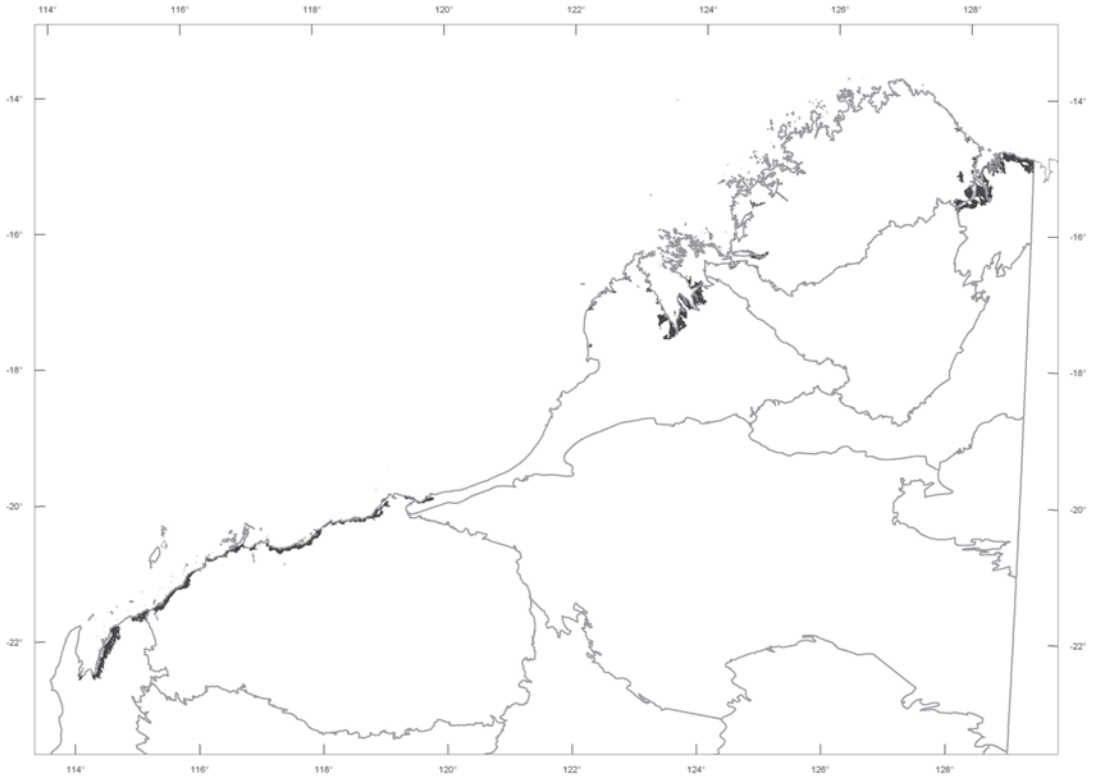


Figure 65. Vegetation Type 53: Tidal mud flats.

Plate 63. Mud flats in Cambridge Gulf near Wyndham (photo by Ladislav Mucina).

54. Bare rock and associated sparse vegetation

Exposed rocks are scattered throughout the Coolgardie, Avon Wheatbelt, Mallee, Murchison, Esperance Plains, Gascoyne, Geraldton Sandplains, Jarrah Forest, Warren and Yalgoo Bioregions (Fig. 66). They include land-locked monoliths and coastal granite. There are over 4450 exposures of bare rock in the vegetation database, totalling nearly 330,000 ha. Most are small and isolated, and do not show on the 1:3,000,000 map.

Prominent granite outcrops include the Porongurup Range and Mt Lindesay in the Jarrah Forest Bioregion, Boyagin and Wave Rock in the Avon Wheatbelt Bioregion, and King Rock, Peak Charles and Peak Eleanora in the Mallee Bioregion. Headlands and islands along the south coast (Jarrah Forest and Esperance Plains Bioregions) may have exposures of granite.

The Porongurup Range, one of the largest granite massifs in the state, is encircled by an inner ring of *Eucalyptus cornuta* then *Eucalyptus diversicolor* (karri) to 60 m. Mt Lindesay has *E. marginata* (jarrah), *Corymbia calophylla* (marri) and *E. megacarpa* (bullich) low woodland in its gullies and *E. marginata* scrub-heath on the upper slopes. Other species include *Hakea varia* (variable leaved hakea), *Beaufortia decussata* (gravel bottlebrush) and two species of *Andersonia* that are endemic to the mountain. In the Jarrah Forest and Avon Wheatbelt Bioregions, the rocks may be covered with mats of lichen, moss and the resurrection plant *Borya nitida* (Plate 64). Shrubs such as *Thryptomene australis* (hook-leaf thryptomene), *Kunzea pulchella* (granite kunzea), *Grevillea bipinnatifida* (fuchsia grevillea), *Hakea elliptica* (oval-leaf hakea), *H. undulata* (wavy-leaved hakea) and the weeping mallee *Eucalyptus caesia* (caesia) are species associated with granite rocks in the Avon Wheatbelt Bioregion. Thickets of *Allocasuarina huegeliana* and *Acacia acuminata* (jam) often surround these outcrops. Species of lichen appear to differ markedly between rocks in high rainfall areas and those rocks further east that receive low rainfall.

In the Murchison Bioregion there are weathered granite rocks such as Walga Rock west of Cue.

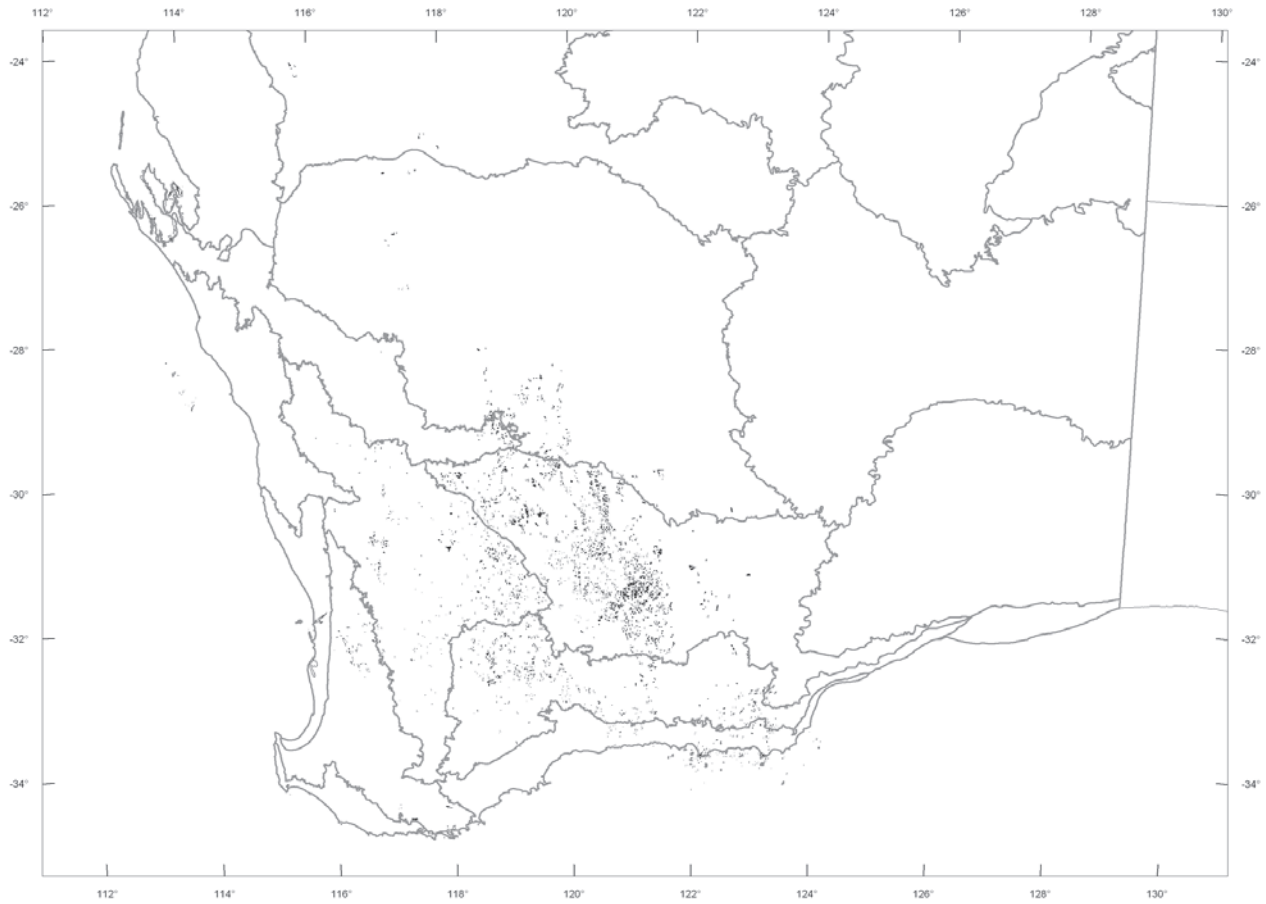


Figure 66. Vegetation Type 54: Bare rock and associated sparse vegetation.

Plate 64. Sandford Rocks near Westonia (photo by Ladislav Mucina).

55. Sand

Considerable drifts of coastal sand occur on the west coast between Moore River and Geraldton (northern Swan Coastal Plain and Geraldton Sandplains Bioregions), along the south coast between Augusta and Walpole (Warren Bioregion) and on to Two Peoples Bay (Jarrah Forest Bioregion), and along the Esperance Plains and Hampton Bioregion coastlines (Plate 65, Fig. 67). The Gascoyne River bed (Carnarvon Bioregion) and the Lacepede Islands off Dampierland Bioregion have also been mapped as sand. Vegetation is usually non-existent, but may include scattered grasses, herbs and shrubs. The total area of this unit is over 95,000 ha. Most of this unit occurs as a narrow belt around the coast and is too narrow to show at this scale of mapping.

Figure 67. Vegetation Type 55: Sand.

Plate 65. Sand dunes near Eyre (photo by Norm McKenzie).

VEGETATION MOSAICS

Mosaics of two or more vegetation types are shown on the map as stripes of the colours of the two major components. In total, mosaics cover nearly 26.5 million ha throughout the state. They are listed here in a similar order to the individual vegetation types above and numbered from 100 to avoid confusion with the vegetation types.

Mosaic 101. Medium forest or woodland/ Low woodland/Low forest or woodland

This mosaic covers nearly 108,250 ha in the Swan Coastal Plain Bioregion and 41,000 ha in the southern Jarrah Forest and eastern Warren Bioregions (Fig. 68). The swamps and sand ridges of the Bassendean Dune system south of Perth characteristically support a mosaic of *Eucalyptus marginata* (jarrah) – *Corymbia calophylla* (marri) woodland with low banksia woodland, with a low forest of paperbark (*Melaleuca* spp.) around the wetlands. The banksia low woodland is dominated by *Banksia attenuata* (candle banksia), *B. menziesii* (firewood banksia), *B. ilicifolia* (holly-leaved banksia) and *Nuytsia floribunda* (Christmas tree). North of Perth on the Pinjarra Plain at the base of the Darling Scarp, there is a similar mosaic with additional low woodland of *Allocasuarina fraseriana*.

East of the Kalgan River a medium forest of *E. marginata* (jarrah) occurs with a low forest of *E. marginata* (jarrah) and *Allocasuarina fraseriana* (sheoak) on poorly drained plains dotted with small freshwater lakes and swamps.

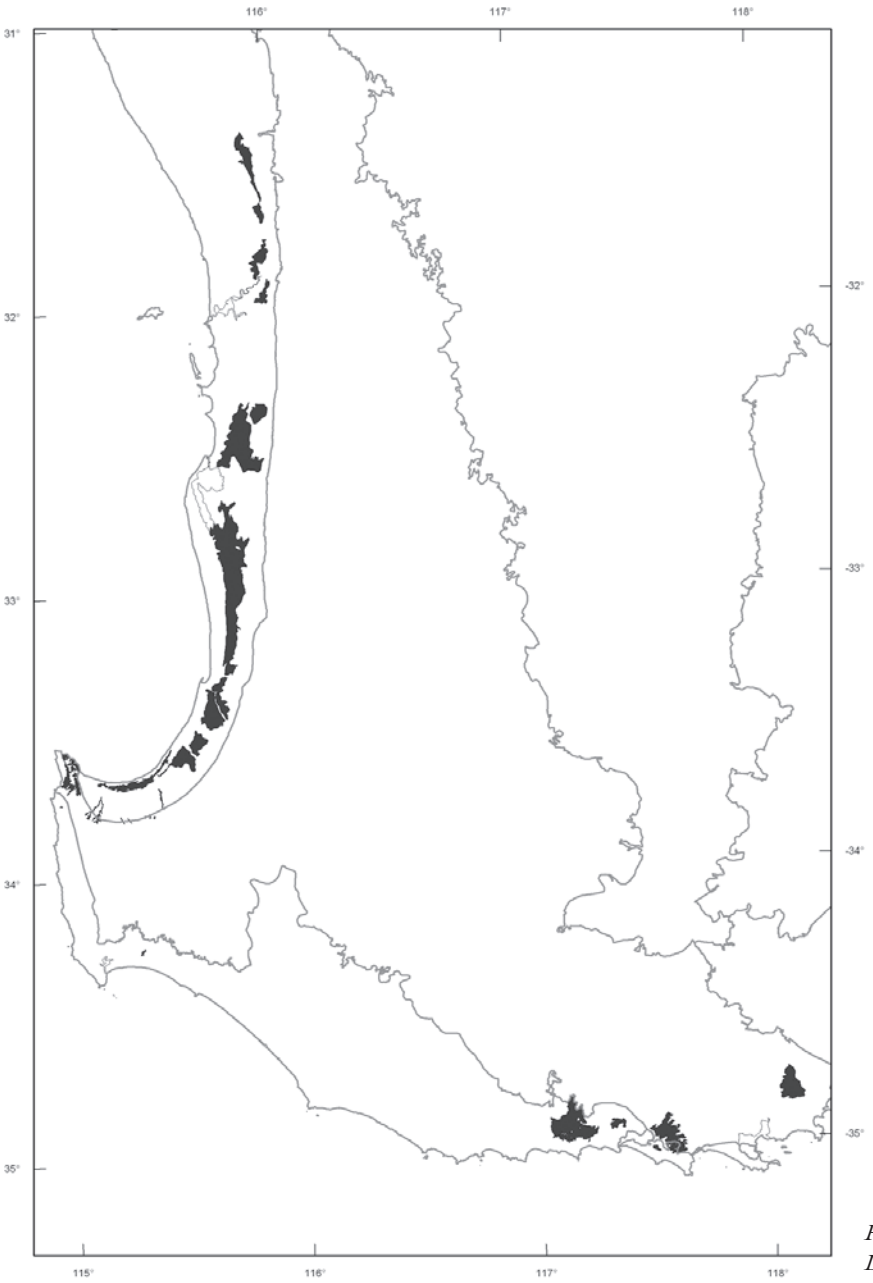


Figure 68. Mosaic 101: Medium woodland/ Low forest/Low woodland.

Mosaic 102. Woodland/Mallee tall shrubland

This mosaic, which covers nearly 2 million ha mainly in the Mallee Bioregion with smaller areas in the Avon Wheatbelt, Coolgardie and Esperance Bioregions (Fig. 69), is transitional between the mallee to the south and the woodlands to the north. The mosaic may take the form of mallee shrublands with patches of woodland or woodland with patches of mallee. As the extent of each component is not often known and both strata have the same densities (10–30%), the taller stratum is mentioned first.

The major associations are:

- On the gently undulating plains in the north-eastern Mallee Bioregion, *Eucalyptus flocktoniae* (merrit) and *E. torquata* (coral gum) occur as patches of medium woodland in mallee shrublands dominated by *E. eremophila* (horned mallee). To the west and in the eastern Coolgardie Bioregion, *E. salmonophloia* (salmon gum) and *E. oleosa* (giant mallee) occur over *E. eremophila* (horned mallee). These two associations cover nearly 1.2 million ha.
- In the south-eastern Avon Wheatbelt Bioregion extending into the Mallee Bioregion, the valley soils

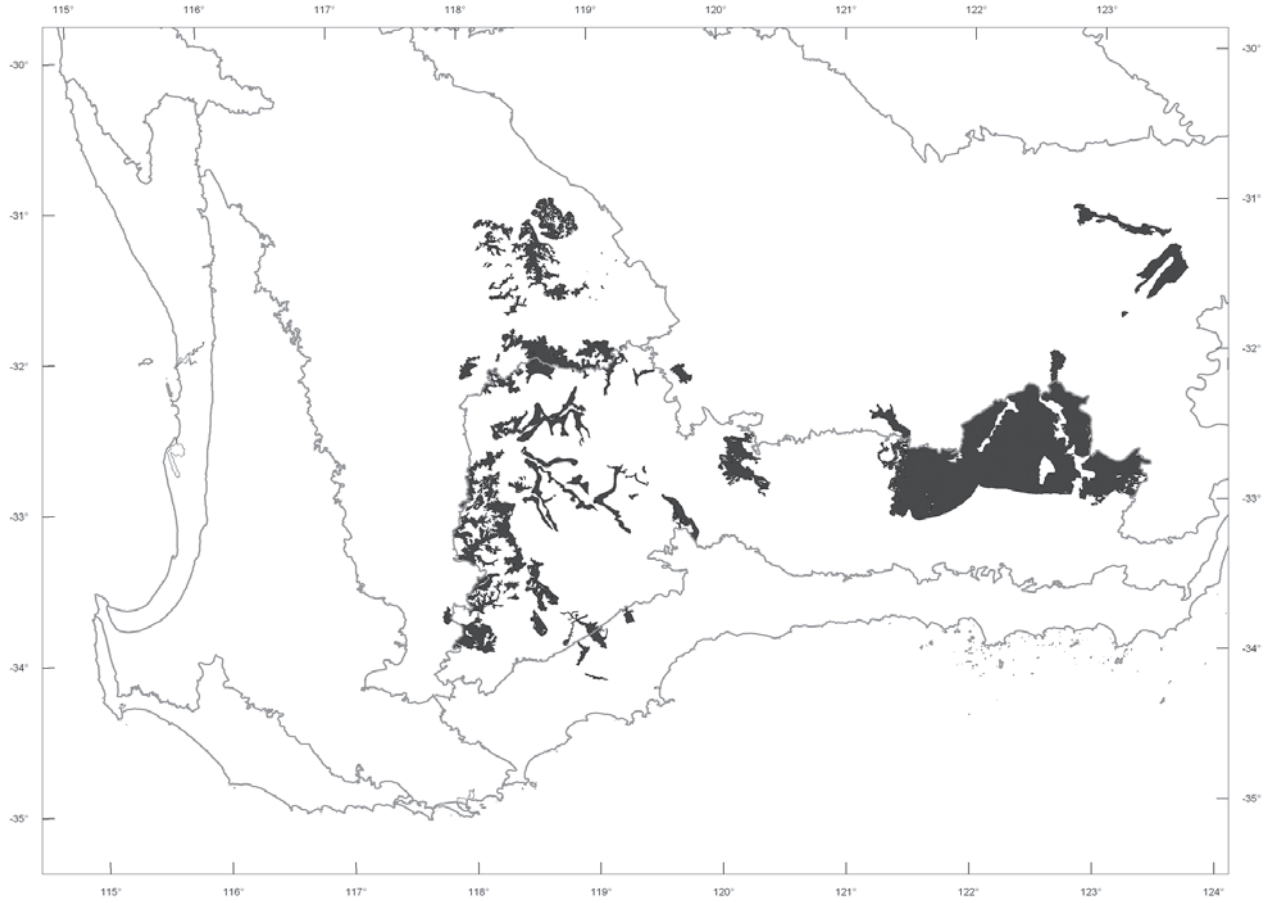


Figure 69. Mosaic 102: Woodland/Mallee tall shrubland.

higher in the landscape support *Eucalyptus salmonophloia* (salmon gum), with or without *E. salubris* (gimlet), as patches of medium woodland in mallee shrublands dominated by *E. moderata* (redwood mallee) and *E. redunca* s.l. (black marlock) mallee. These cover an area of 357,000 ha. When the mapping was carried out *Eucalyptus redunca* s.l. (black marlock) was understood to be widespread. It has since been recognised as belonging to a range of other taxa, many of which have been described decades ago.

- In the same region but lower in the landscape, patches of *Eucalyptus salmonophloia* (salmon gum) and *E. loxophleba* (York gum) woodland occur with mallee shrublands of *E. eremophila* (horned mallee) and *E. redunca* (black marlock). In the vicinity of salt lakes, *E. longicornis* (red morrel) replaces the *E. loxophleba* (York gum) over *E. eremophila* (horned mallee) and *E. redunca* s.l. (black marlock). These associations cover more than 233,000 ha.
- In the central Avon Wheatbelt Bioregion around Merredin, the upper parts of the major valleys have patches of *Eucalyptus salubris* (gimlet) and *E. salmonophloia* (salmon gum) medium woodland that occur over *E. loxophleba* (York gum mallee-form) and *E. sheathiana* (ribbon-barked gum) mallee. This mosaic unit covers over 145,000 ha.

Mosaic 103. Medium woodland/Thicket or scrub

A mosaic of medium woodland on red loam on the flats between the hills with *Dodonaea* scrub on the hills is typical of the Fraser Range in the Coolgardie Bioregion. Near the outcrops of granulite gneiss of the range, there are *Eucalyptus lesouefii* (goldfield's blackbutt) and *E. dundasii* (Dundas blackbutt). On the southern end, the main eucalypts are *E. flocktoniae* (merrit), *E. oleosa* (red mallee) and *E. transcontinentalis* (redwood) on the pink calcareous soils. *Dodonaea microzyga* is the unusual dominant of the scrub component, and there are occasional scattered emergent *Allocasuarina huegeliana* and *Pittosporum angustofolium* to 6 m. Other species present include *Beyeria lechenaultii* shrubs and *Aristida contorta* (bunched kerosene grass). This mosaic covers nearly 177,500 ha.

Small areas of *E. salmonophloia* (salmon gum) and *E. loxophleba* (York gum) over thickets of *Allocasuarina campestris*, *Melaleuca thyoides* or the acacia–casuarina–melaleuca alliance are mapped in the northern Avon Wheatbelt Bioregion and included in this mosaic.

Several small mosaics of woodland and thicket occur in small areas throughout the Avon Wheatbelt Bioregion:

- On the foot-slopes of the Kookanooka Hills, east of Geraldton, there is a mosaic of open *Eucalyptus*

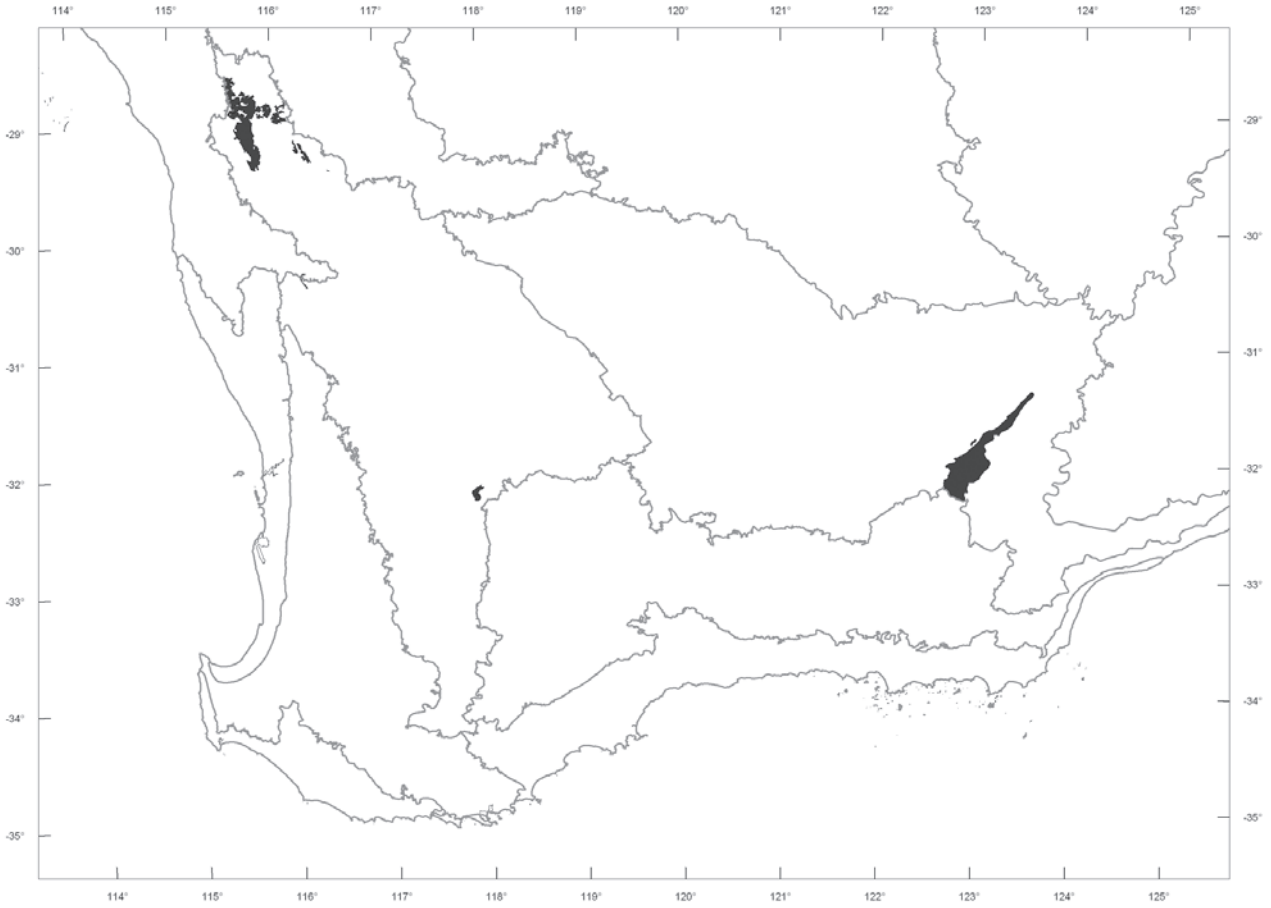


Figure 70. Mosaic 103: Woodland/Thicket or scrub.

loxophleba (York gum) medium woodland interspersed with the *Allocasuarina campestris* thicket that occurs on the adjacent hills.

- *Acacia acuminata* (jam) scrub with scattered York gum in the valleys, interspersed with patches of *Allocasuarina campestris* thickets, also occurs in an area inland from Geraldton.
- In the lower-central part of the bioregion, just north-east of Corrigin, an area of patchy acacia–casuarina–melaleuca thicket with *Eucalyptus loxophleba* (York gum) and *E. salmonophloia* (salmon gum) medium woodland has been mapped.
- In a valley traversing the boundary between the Avon Wheatbelt and Geraldton Sandplain Bioregions there is a mosaic of *Melaleuca thyoides* thicket with *Eucalyptus loxophleba* (York gum) and *E. salmonophloia* (salmon gum) medium woodland.

The total area covered by this mosaic is over 332,000 ha (Fig. 70).

Mosaic 104. Woodland/Open mallee steppe

This mosaic consists of *E. salmonophloia* (salmon gum) and *E. oleosa* (giant mallee growing as a tree) or *E. salubris* (gimlet) medium woodland, interspersed with patches of open mallee steppe of *E. oleosa* (giant mallee) over *Triodia scariosa* spinifex. This mosaic vegetation type covers nearly 1.1 million ha in the Coolgardie Bioregion (Fig. 71). Typically, the woodland occurs on calcareous soils while the mallee steppe occurs on patches of sand overlying the calcareous hardpan. This mosaic appears to be a transition between the woodlands to the south and the shrub-steppe to the north.

Mosaic 105. Medium woodland/Succulent steppe with open low woodland

Near Balladonia, in the south-east Nullarbor Bioregion, there is a mosaic of scattered medium woodland of *Eucalyptus salmonophloia* (salmon gum) and *E. salubris* (gimlet) on rises, with open low *Myoporum platycarpum* (sugarwood) woodland over succulent steppe of *Atriplex* spp. (saltbush) on the intervening clay flats (Fig. 72). This occurs on flat limestone country and appears to be transitional between the adjacent woodlands and the sarcophyllic vegetation types to the north and east. *Acacia papyrocarpa* (western myall) and *Maireana sedifolia* (pearl bluebush) may also be present. Towards the eastern and western ends of this mosaic, *E. oleosa* (giant mallee) and *E. flocktoniae* woodland become the main trees occurring on silty rises interspersed with the *Myoporum*, saltbush and *Cratystylis conocephala* (greybush) on clay flats. *Eremophila dempsteri* and *Olearia muelleri* (goldfields daisy) are often present here. This mosaic covers over 490,000 ha.

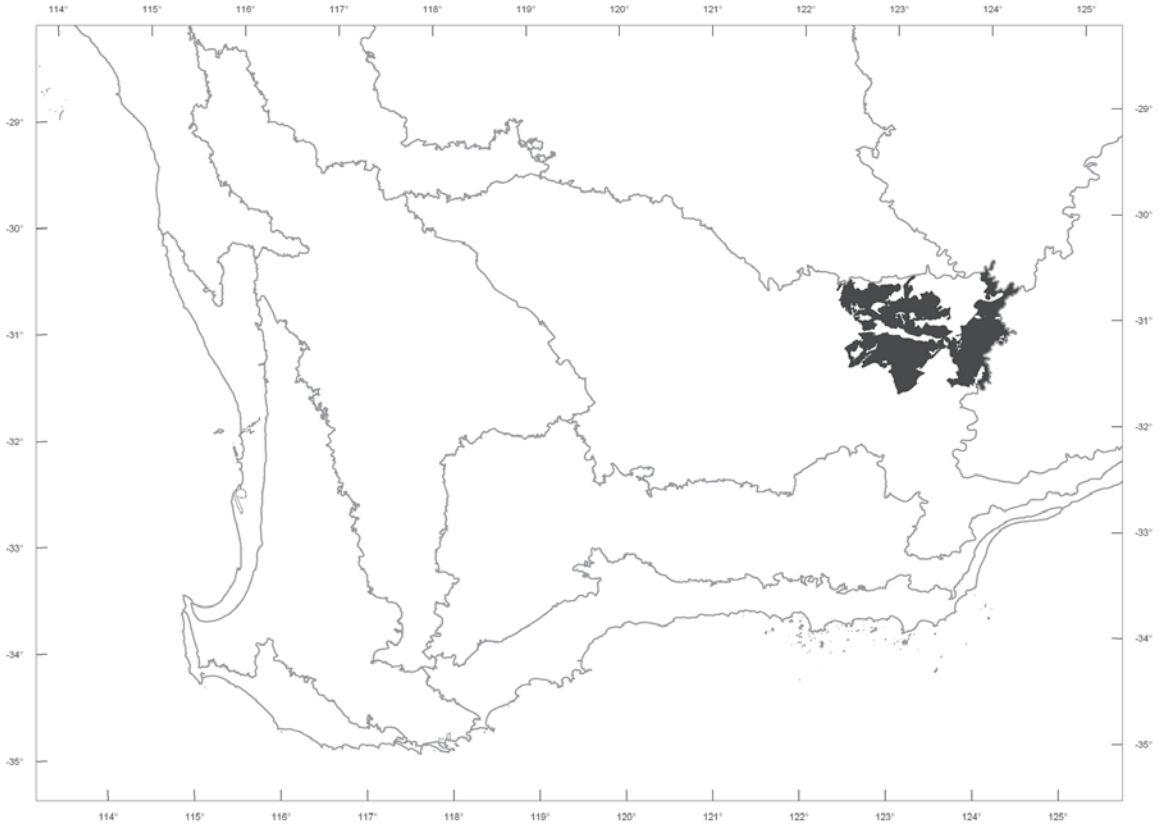


Figure 71. Mosaic 104: Woodland/Open mallee steppe.

Figure 72. Mosaic 105: Woodland/Succulent steppe with open low woodland.

Mosaic 106. Low woodland/Scrub or thicket

Two low woodland/scrub mosaics occur next to each other on nearly 460,000 ha of the Yalbalgo Plain in the central Carnarvon Bioregion (Fig. 73). The northern mosaic has low *Acacia coriacea* (waterwood) woodland on the sandhills, with scrub of *Acacia sclerosperma* (limestone wattle), *A. ramulosa*/*A. linophylla* (bowgada) and *A. subtessarogona* between the dunes. To the south, the low *A. coriacea* (waterwood) woodland occurs on sandhills, with *A. sclerosperma* (limestone wattle) and *A. ramulosa*/*A. linophylla* (bowgada) on the flats. The *A. coriacea* (waterwood) trees may reach 6 m in height. *A. ramulosa*/*A. linophylla* (bowgada) are dominant on the well-drained sand and *A. sclerosperma* (limestone wattle) occurs on the heavier soils. Other species present here include *Senna charlesiana* (green cassia), *S.* aff. *desolata, Eremophila forrestii, E. maitlandii* (Shark Bay poverty bush), *Grevillea eriostachya, G. stenobotrya, Ptilotus obovatus, Scaevola spinescens* and *Stylobasium spatulatum* (pebble bush).

Acacia rostellifera (summer-scented wattle) and *M. cardiophylla* (tangling melaleuca) thickets, often interspersed with scattered belts of *Eucalyptus erythrocorys* (illyarrie), occur over 32,000 ha on limestone near Dongara. Low banksia woodland with *B. attenuata, B. menziesii* and *B. ilicifolia* are found with numerous tea tree thickets and paperbark swamps and cover 41,000 ha in the north and central Swan Coastal Plain Bioregion.

On Koolanooka hills in the northern Avon Wheatbelt Bioregion, there is the unusual mosaic of the mallee *Eucalyptus ebbanoensis* and *Acacia acuminata* (jam) scrub under scattered *Allocasuarina huegeliana* interspersed with patches of thickets of *Allocasuarina campestris, Acacia acuminata, Melaleuca cordata*, *M. nematophylla* and *M. radula* on the hills.

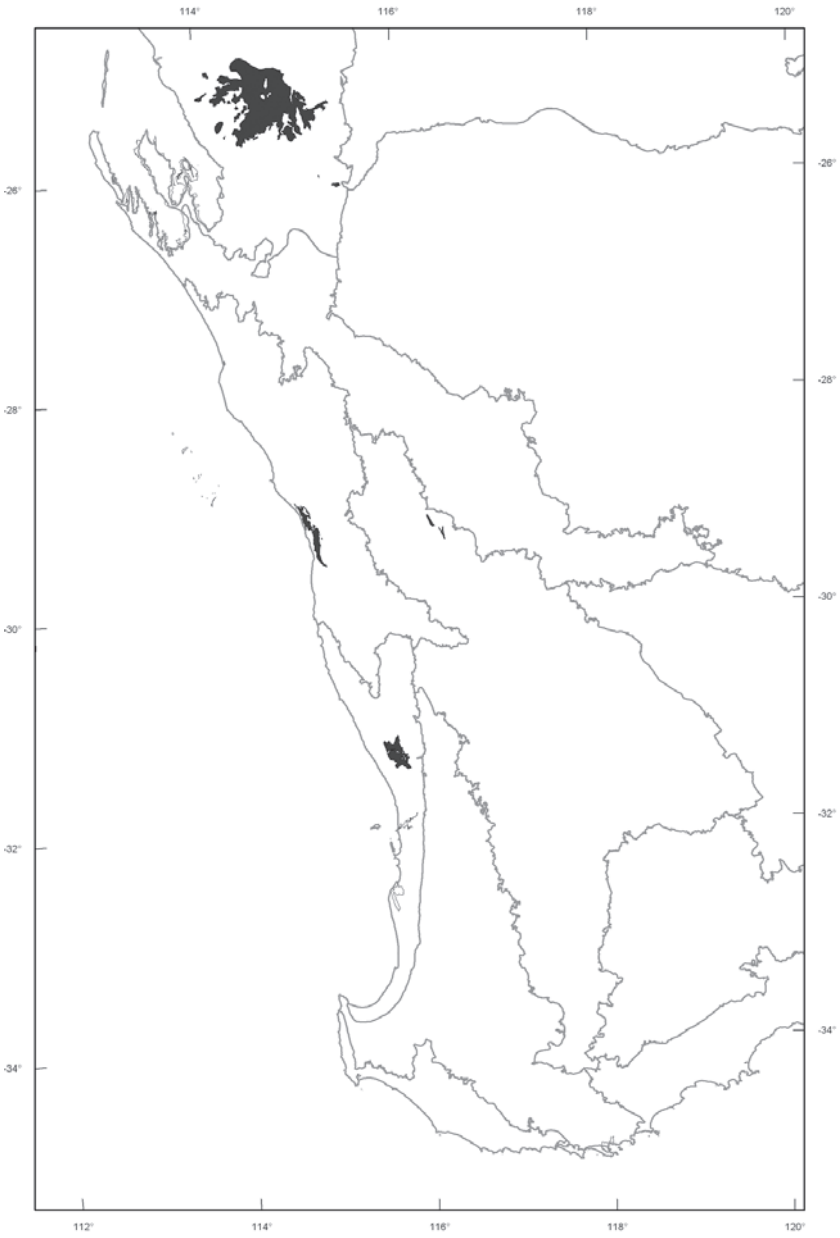


Figure 73. Mosaic 106: Low woodland/ Scrub or thicket

Mosaic 107. Scrub-heath/Thicket

Scrub-heath with patches of thicket occurs throughout the Geraldton Sandplain, Swan Coastal Plain, Avon Wheatbelt and into the Yalgoo and Mallee Bioregions, totalling nearly 373,000 ha (Fig. 74).

At the southern end of Edel Land in the Shark Bay area, Yalgoo Bioregion, there are 19,000 ha of mixed coastal scrub-heath, characterised by *Acacia ligulata* and *Diplolaena dampieri,* with thickets of *Acacia rostellifera* (summer-scented wattle), *Thryptomene baeckeacea* and *Melaleuca cardiophylla* (tangling melaleuca). *Acanthocarpus preissii*, *Atriplex bunburyana, Frankenia laxiflora* and *Olearia axillaris* are also present.

A substantial area (93,000 ha) in the eastern central Geraldton Sandplain Bioregion is a mosaic of acacia–casuarina thickets on red sandplain with patches of an inland association of scrub-heath on yellow sandplain or on sandhills. Scrub-heath species include *Actinostrobus arenarius* (sandplain cypress), *Banksia sceptrum* (sceptre banksia), *B. ashbyi* (Ashby's banksia), *Xylomelum angustifolium* (sandplain wood pear) and *Grevillea leucopteris* (white plume grevillea).

A small patch (2000 ha) of a mosaic of *Banksia–Xylomelum* scrub-heath on sandplain with *Allocasuarina campestris* thicket occurs in the northern Avon Wheatbelt Bioregion. The scrub-heath includes *Actinostrobus arenarius* (sandplain cypress), *Banksia burdettii* (Burdett's banksia), *B. prionotes* (acorn banksia), *Eucalyptus pyriformis* (pear-fruited mallee) and *Xylomelum angustifolium* (sandplain woody pear).

Small, scattered upland areas with a mosaic of scrub-heath on shallow sands over laterite, and *Allocasuarina campestris* or occasionally *A. acutivalvis* thicket on laterite, occur throughout the southern Avon Wheatbelt Bioregion and into the Mallee Bioregion, and make up a total of 167,000 ha. Dryandras often join the *Allocasuarina campestris* in the thickets. The scrub-heath is very rich in species with no obvious dominants.

Thickets of *Acacia rostellifera* (summer-scented acacia) and *Melaleuca cardiophylla* (tangling melaleuca) are interspersed with *A. lasiocarpa* (panjang) and *Melaleuca systena* (coastal melaleuca) heath. These extend over nearly 70,000 ha along the coast in the northern Swan Coastal Plain Bioregion and into the southern Geraldton Sandplain Bioregion.

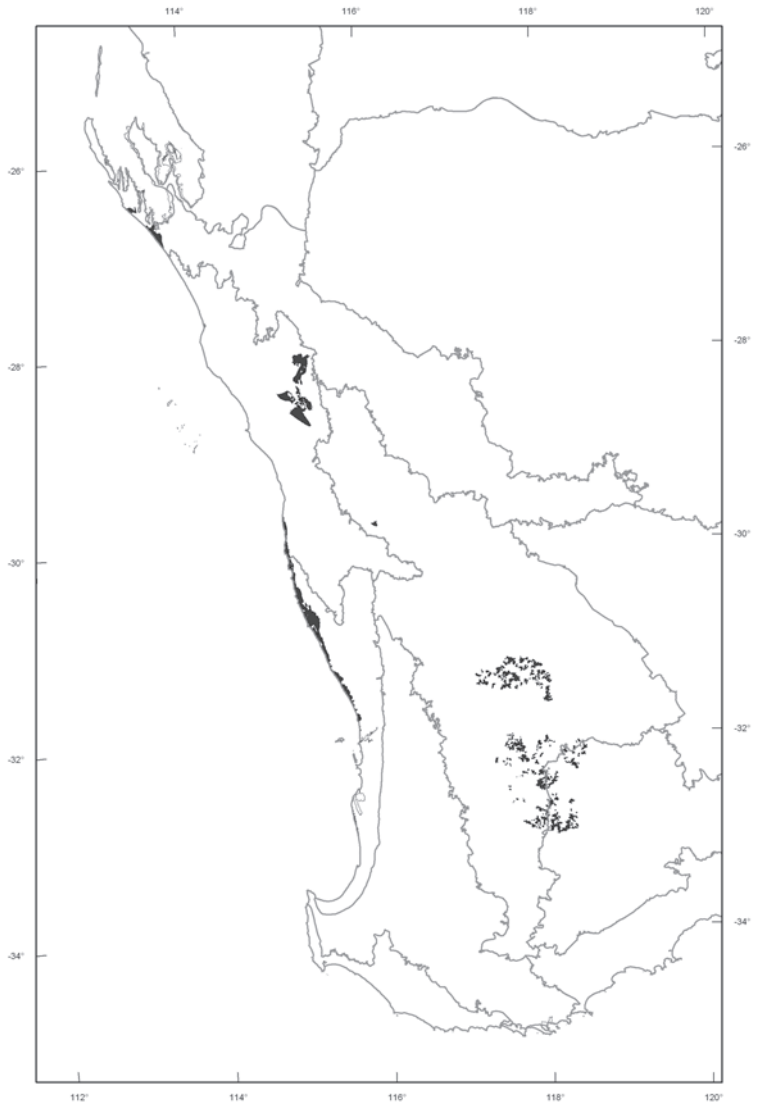


Figure 74. Mosaic 107: Scrub-heath/Thicket.

Mosaic 108. Scrub-heath/Heath

The mosaics of scrub-heath with patches of heath mainly occur in the southern Geraldton Sandplain and northern Swan Bioregions and total nearly 300,000 ha (Fig. 75).

On the laterite sandplains around Badgingarra in the northern part of the Swan Coastal Plain Bioregion and adjacent Geraldton Sandplain Bioregion there is a mosaic of hakea scrub-heath on sand and dryandra heath on laterite. Many species of *Banksia* (ex *Dryandra)* are present and *Xanthorrhoea drummondii* is conspicuous on the mesas capped with laterite. On the sandy mid-slope soils containing ironstone gravel there are emergent shrubs, including *Hakea obliqua* (needles and corks) to a height of about 2 m, over a dense, rich assemblage of low shrubs (<1 m), mostly highly sclerophyllous and pungent, and a ground layer of scattered small herbaceous plants and sedges from the families Cyperaceae and Restionaceae.

Further south, flanking the Moore River east of Regan's Ford, there is a small patch of mixed scrub-heath with dryandra heath and to the south-west of this a 1500 ha area of dryandra heath with patches of low *Banksia* woodland. This is the only low woodland/heath mosaic, so is included here due to its geographic association with the scrub-heath/heath units.

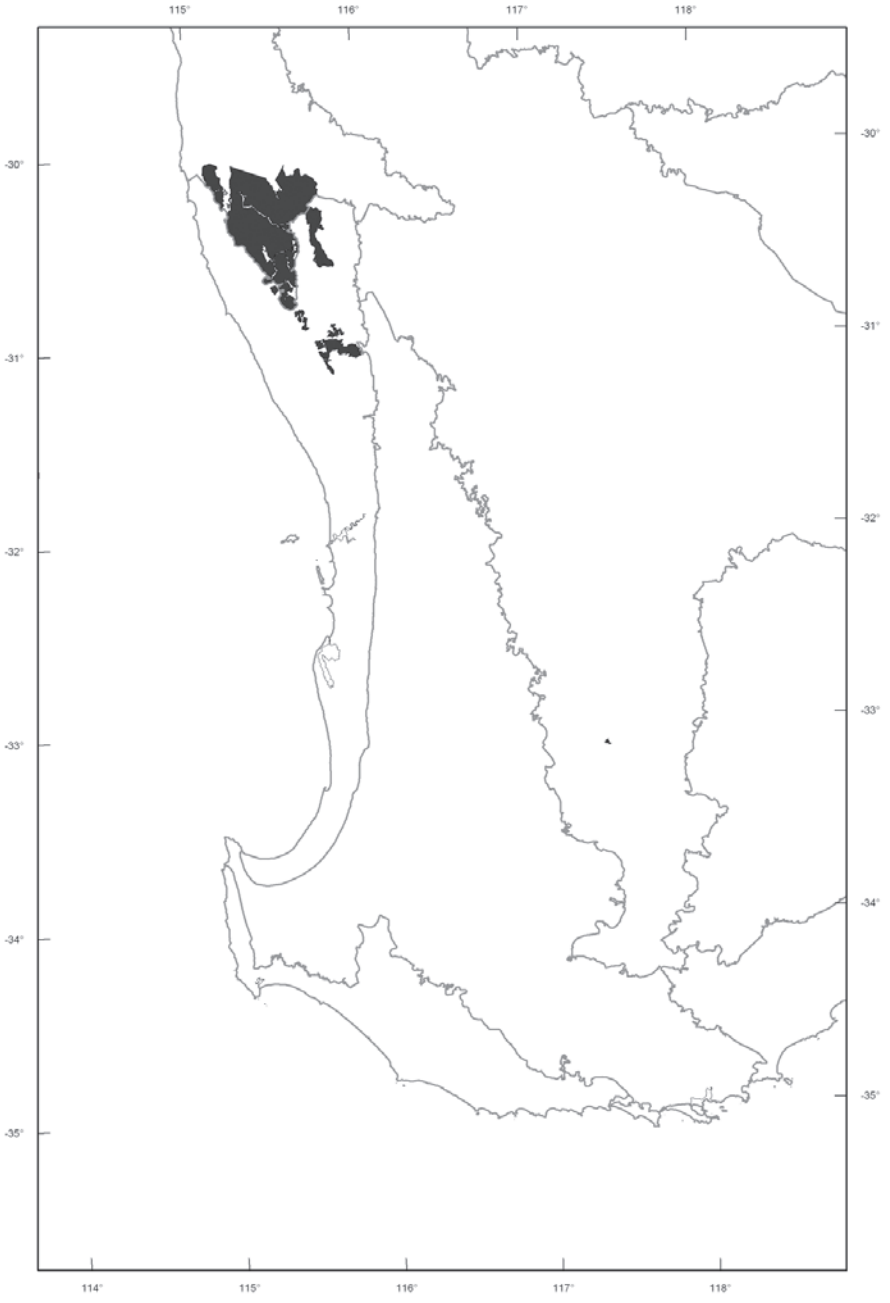


Figure 75. Mosaic 108: Scrub-heath/ Heath.

Mosaic 109. Mallee/Mallee-heath

This mosaic, which covers over 261,600 ha in the northern Esperance Sandplain Bioregion (Fig. 76), has mallee-dominated tall shrubland merging into mallee with heath. The mosaic unit appears to be transitional between the mallee to the north and the mallee-heath to the south. The distribution of the mallee and the mallee-heath components appears to be governed by variations in soil depth and texture. The mallee eucalypts tend to segregate into two associations, one of *E. eremophila* (horned mallee) – *E. oleosa* (giant mallee; up to 2 m) and the other of *E. redunca* s.l. (black marlock) – *E. uncinata* (hooked leaved mallee; up to 2.5 m), but they merge into one another and it is not uncommon to see all four species together. The former, where segregated, is found on lateritic soils (sand over ironstone gravel) mainly on mid to upper slopes. It includes other species such as *E. cylindriflora*, *E. pileata* (capped mallee), *Hakea multilineata* (grass leaf hakea), *Banksia media* (southern plains banksia) and *Melaleuca scabra* (rough honeymyrtle). The *E. redunca* s.l. (black marlock) – *E. uncinata* (hooked leaved mallee) association is found on the sand-over-clay differentiated soil that lacks ironstone nodules and occurs mainly in the valleys. Typical components of this mallee include *E. incrassata* (lerp mallee), *E. astringens* brown mallet), *Hakea laurina* (pincushion hakea), *Banksia caleyi* (Cayley's banksia) and *Melaleuca subtrigona*. The *E. pleurocarpa* (blue mallee, tallerack) mallee-heath occurs on the old lateritic sandplain where there is a surface horizon of bleached white sand over a layer of ironstone nodules and this over dense mottled subsoil. It consists of very scattered mallee clumps (1.5–3 m), over a rich ground layer of heath plants. Some of these are listed in the description of mallee-heath (Vegetation Type 18).

Mosaic 110. Scrub or very open scrub/ Grass-steppe

In the northern Carnarvon, north-western Gascoyne and western Pilbara Bioregions are mosaics of patches or groves of scrub (10–30% pfc, >2 m) and hummock grasslands. These total over 466,000 ha (Fig. 77). Also included in this mosaic is an area of scattered groves of acacia on grass plain and an area of dwarf scrub and hard spinifex, bringing the total of this unit to over 712,000 ha.

There are two similar mosaics of acacia scrub with patches of spinifex associated with the ranges in the north-western end of the Gascoyne Bioregion. In the east, *Acacia eremaea* (snakewood) scrub has broad patches of *Triodia*

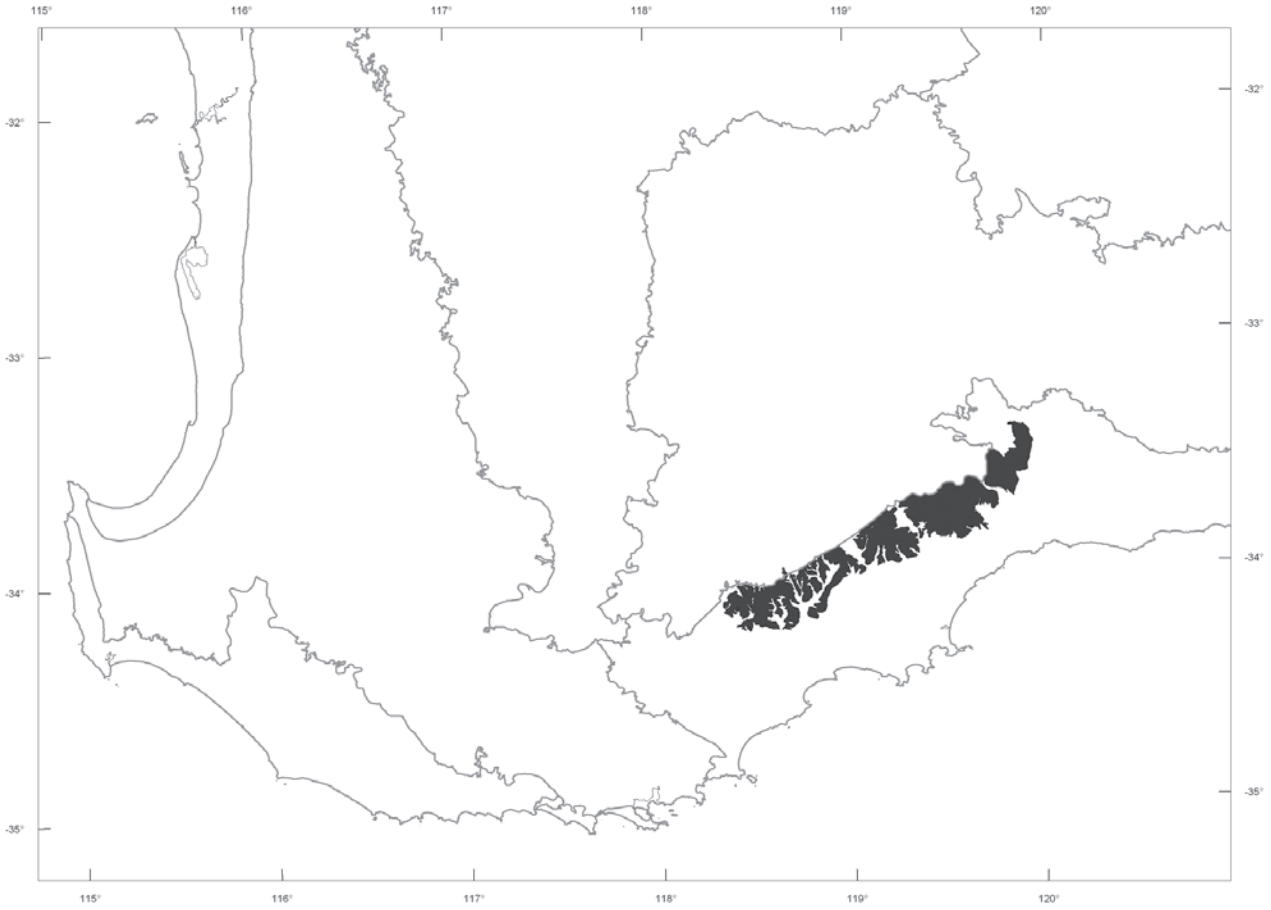


Figure 76. Mosaic 109: Mallee/Mallee-heath.

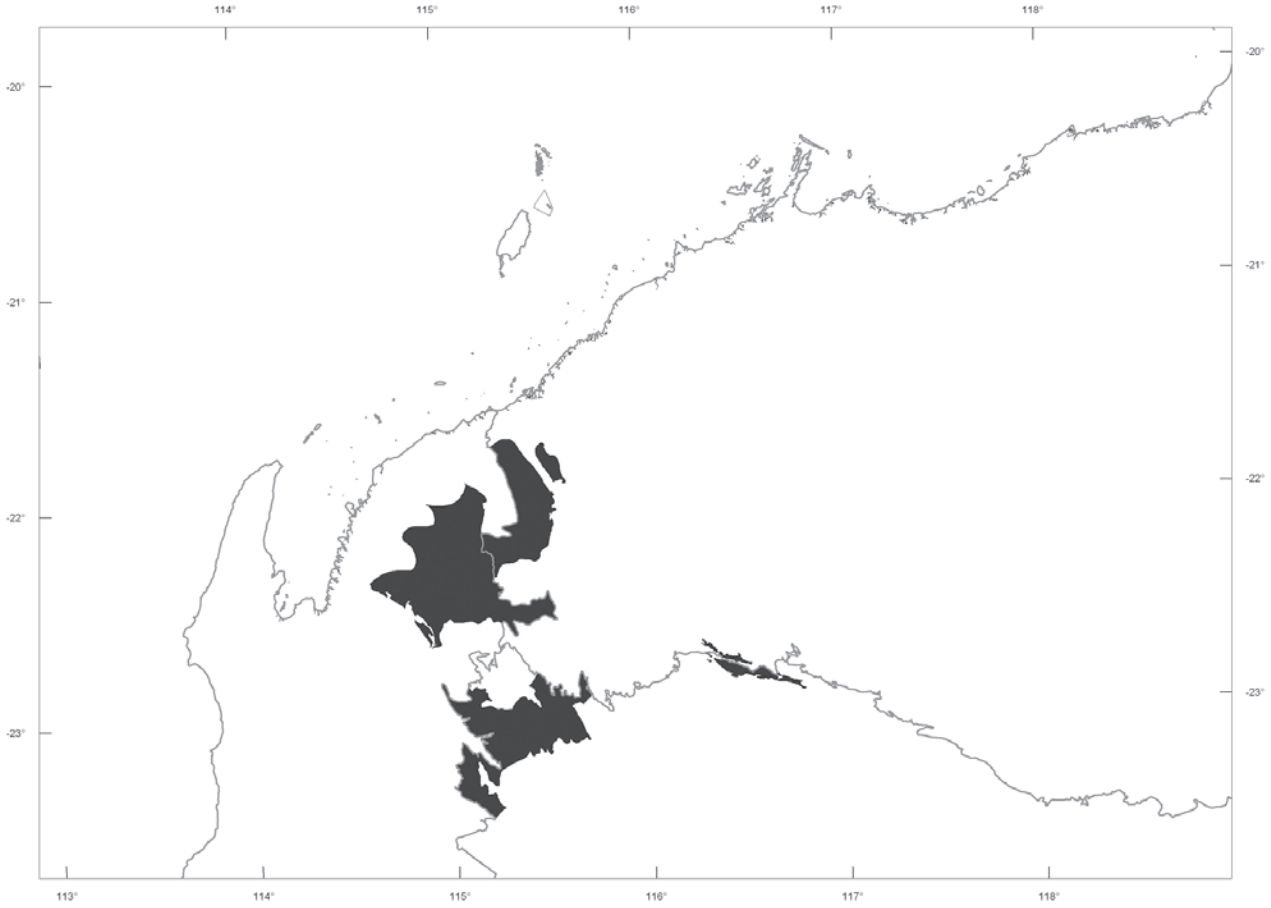


Figure 77. Mosaic 110: Scrub or very open scrub/Grass-steppe.

basedowii (hard spinifex) and *T. wiseana* (limestone spinifex). To the west, the *A. eremaea* (snakewood) scrub is joined by *A. victoriae* (bardi) scrub. Here the spinifex patches are smaller and contain *Triodia basedowii* (hard spinifex) only. Their total area is about 240,000 ha.

The mosaic of scattered groves of *Acacia victoriae* (bardi) and *A. eremaea* (snakewood) scrub with short bunch-grass plain on neutral red earth soils with a gravelly surface covers over 313,000 ha. It occurs on the south-eastern portion of the Yannarie Coastal Plain (Carnarvon Bioregion). The stunted (1.5–2.5 m) snakewood occurs in groves mixed with *A. victoriae* (bardi), *A. tetragonophylla* (kurara), *A. bivenosa* and *Eremophila cuneifolia*. South-east of Shark Bay, *Acacia victoriae* (bardi) and *A. eremaea* (snakewood) occur over 130,000 ha on sandy patches where *Triodia basedowii* (hard spinifex) is the main hummock grass. Claypans and bare patches of gravel and shingle also occur here. Claypans develop a cover of the annual trailing herb *Swainsona pterostylis* in favourable seasons.

On the Onslow Plain is a unit of *Acacia eremaea* (snakewood) and *A. victoriae* (bardi) scrub, with patches of shrub-steppe of *A. pyriformis* (ranji bush) scrub over *Triodia pungens* (soft spinifex) and, locally, *T. basedowii* (hard spinifex) on hard alkaline red soils. Included here is the unusual *Eremophila–Senna* (*Cassia*) dwarf scrub patches interspersed with *Triodia wiseana* (limestone spinifex) on the shale hills in the Hardy River valley on the boundary between the Pilbara and Gascoyne Bioregions. This appears to be an intergrade between the *Triodia wiseana* hummock grasslands to the north and the *Eremophila–Senna* dwarf scrub on the shale hills to the south-east. Species include *Eremophila cuneifolia* (pinyuru), *E. abietina* (spotted poverty bush) and *Senna artemisioides* subsp. *oligophylla*.

Mosaic 111. Pindan/Tall bunch-grass low tree savanna

On the South Fitzroy Plains, Dampierland Bioregion, there is an area of over 260,000 ha of alternating sandy rises with pindan and loam flats and low tree savanna (Fig. 78). The pindan consists of *Acacia eriopoda* (Broome pindan wattle) thickets with scattered low *Corymbia dichromophloia* (bloodwood) over *Triodia pungens* (soft spinifex) and *T. bitextura* (curly spinifex). The intervening heavier soils support tall bunch-grass savanna, with low trees of *Adansonia gregorii* (boab), *Bauhinia cunninghamii* (bauhinia) and *Grevillea striata* (beefwood) over *Chrysopogon* spp. (ribbon or beard grass). Patches of *Triodia intermedia* may also be present.

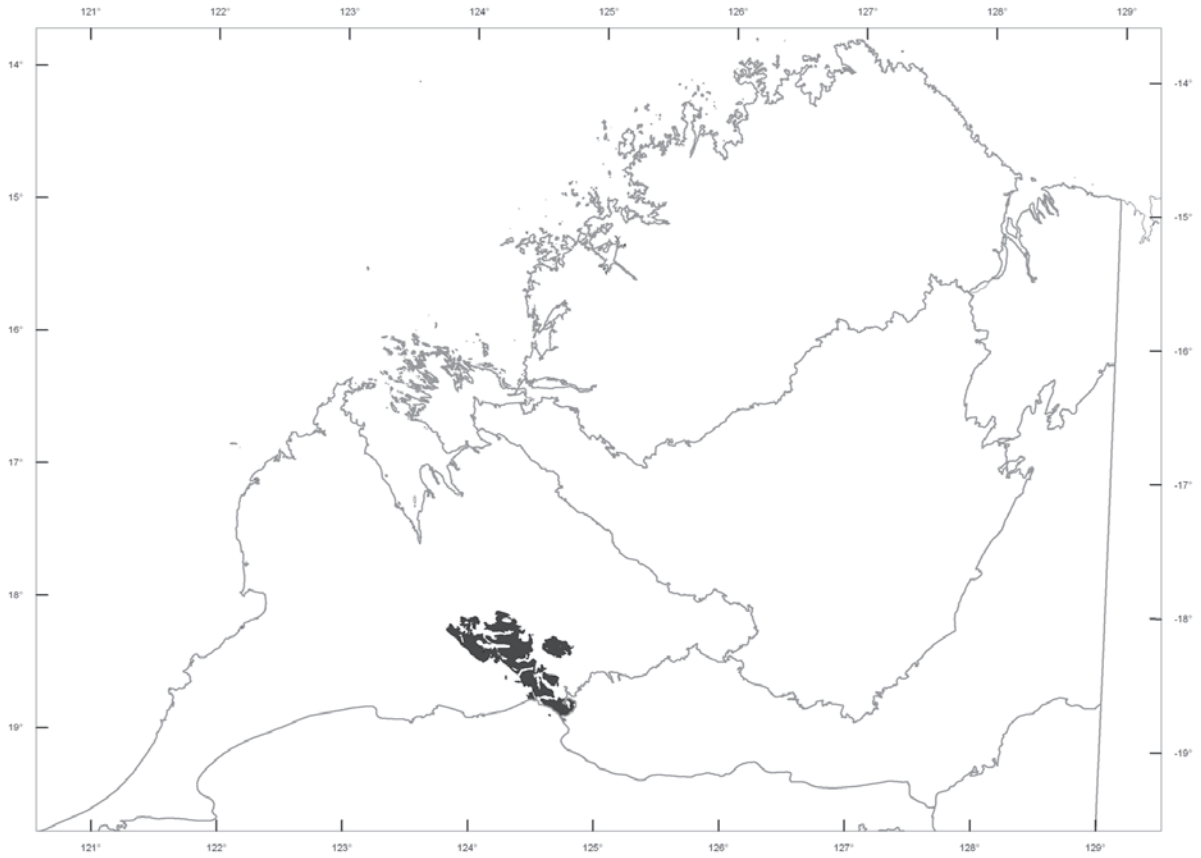


Figure 78. Mosaic 111: Pindan/Tall bunch-grass low tree savanna.

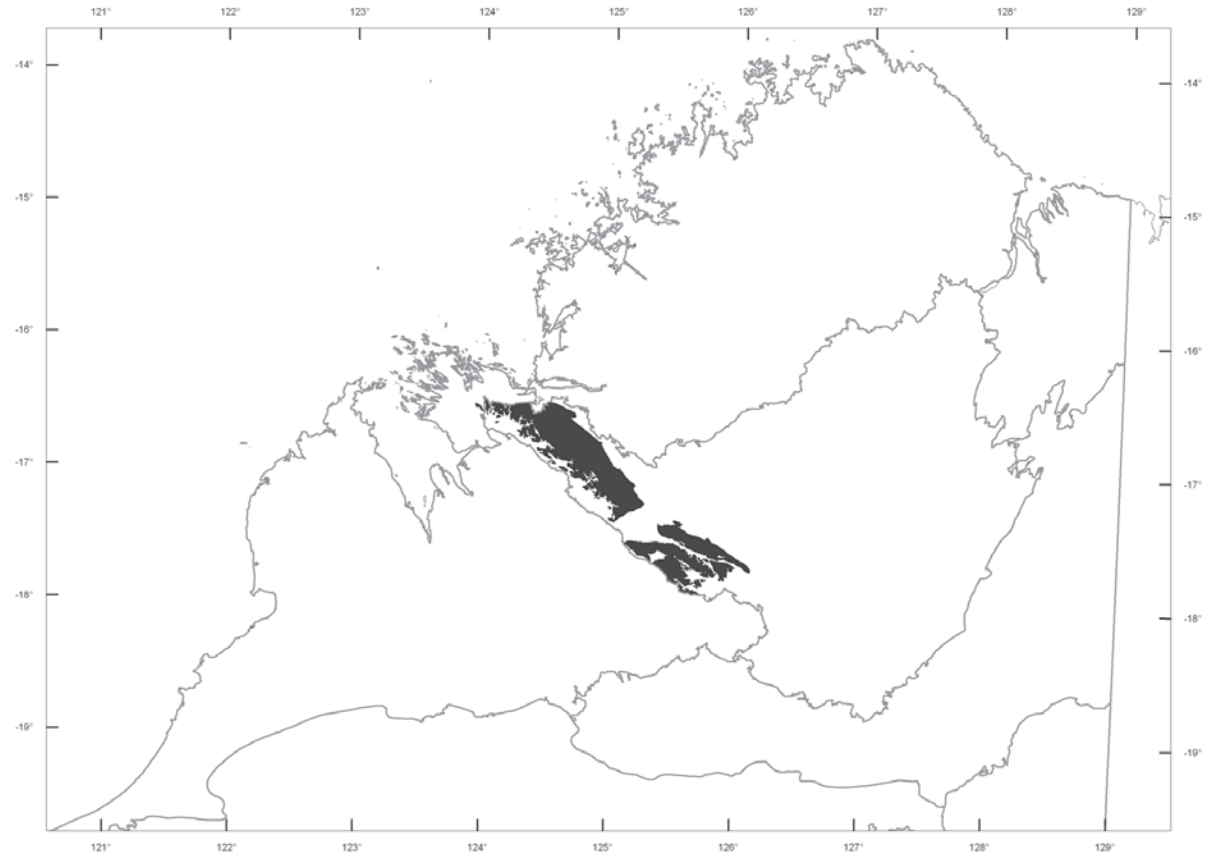


Figure 79. Mosaic 112: Curly spinifex low tree savanna/Sparse low tree-steppe.

Mosaic 112. Curly spinifex low tree savanna/Sparse low tree-steppe

This mosaic is found over 600,000 ha in the western arm of the Central Kimberley Bioregion (Fig. 79). It consists of a low tree savanna with *Eucalyptus brevifolia* (Kimberley snappy gum) and *Corymbia cadophora* (twin-leaf bloodwood) over *Triodia bitextura* (curly spinifex) on the rocky slopes of granite, gneiss and schist, with sparse low tree-steppe of *Adansonia gregorii* (boab) over *Triodia bynoei* (a hummock grass to 1.5 m) between the rock outcrops. Characteristic low tree and shrub species include *Brachychiton viscidulus* (sticky kurrajong), *Buchanania obovata, Cochlospermum fraseri* (kapok bush), *Gardenia resinosa, Ficus* spp. and *Terminalia latipes* subsp. *psilocarpa* (mador).

Mosaic 113. High bunch-grass savanna woodland/Curly spinifex savanna

This mosaic is a high bunch-grass association of *Eucalyptus tetrodonta* woodland on sandstone, interspersed with areas dominated by *Triodia bitextura* (curly spinifex). This unit is typical of the deeper soils over sandstone that cover an area of over 970,000 ha in the North Kimberley Bioregion (Fig. 80). The mixed low tree and shrub layer is similar to Vegetation Type 24, but with *Banksia dentata* (tropical banksia) and other species occurring on the deeper sand. *Sorghum timorense* and *S. stipoideum* (annual sorghum) to 2 m are also present, as are other species of eucalypts e.g. *Eucalyptus miniata* (woolybutt), *Corymbia polycarpa* (long fruited bloodwood) and *C. dichromophloia* (variable barked bloodwood).

Mosaic 114. Curly spinifex or short-grass low tree savanna/Grass-steppe

On the dissected laterite plains adjoining the Louisa Range, on the southern edge of the Central Kimberley Bioregion, there is a mosaic of low tree savanna with *Triodia bitextura* (curly spinifex) and scattered *Eucalyptus brevifolia* (Kimberley snappy gum) interspersed with patches of *T. intermedia* (hard spinifex). This and the following units cover nearly 400,000 ha (Fig. 81).

A similar mosaic but over the short bunch-grassland occurs to the south-east in the McLintock Ranges in the Ord – Victoria Plains Bioregion. Here, over 123,000 ha of open low *Eucalyptus brevifolia* (Kimberley snappy gum) over *Enneapogon* spp. (arid short grass) occurs with *Triodia pungens* (soft spinifex), occasionally with *T. intermedia* (hard spinifex) grass steppe. *Carissa lanceolata* (conkerberry) shrubs may also be present.

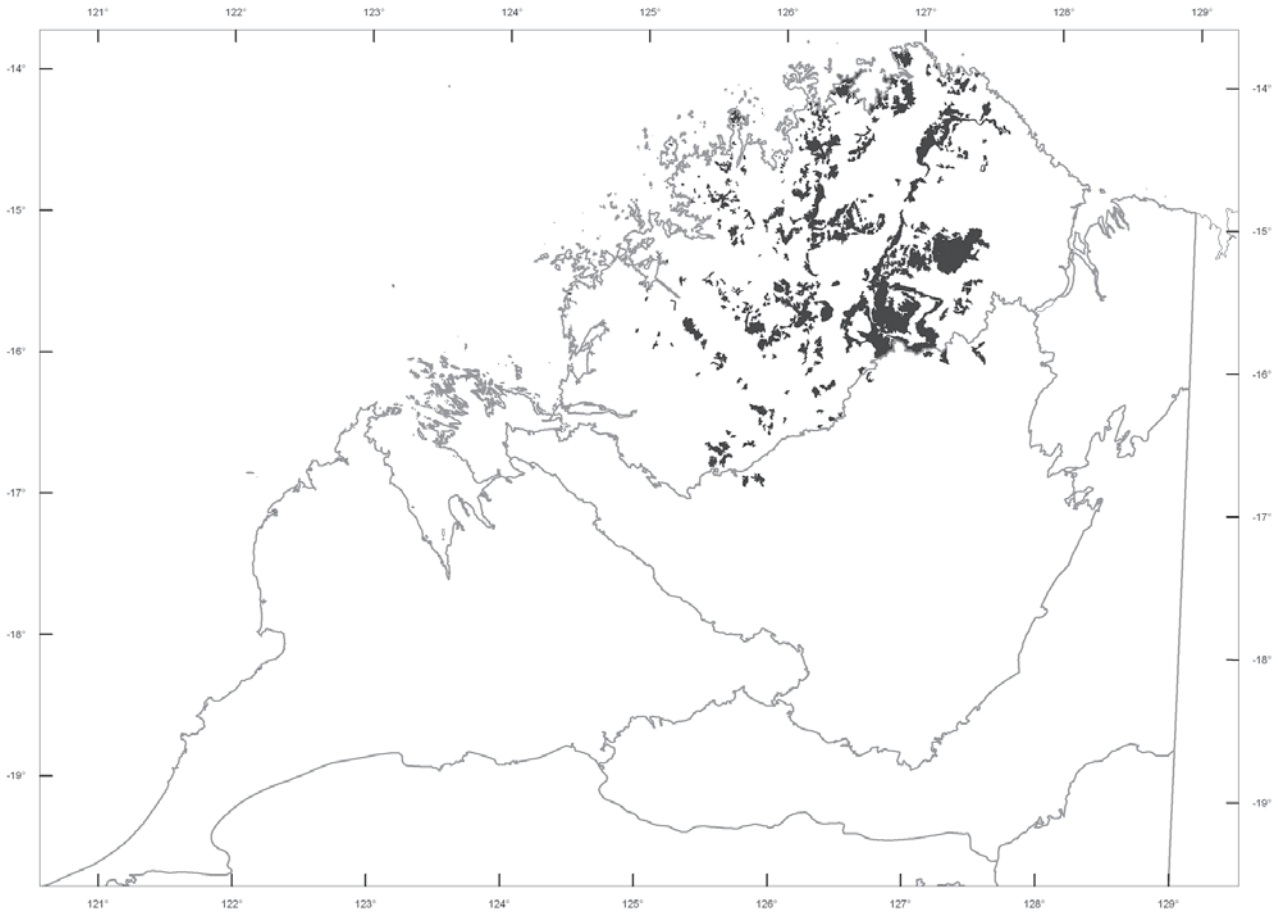


Figure 80. Mosaic 113: High bunch-grass savanna woodland/Curly spinifex.

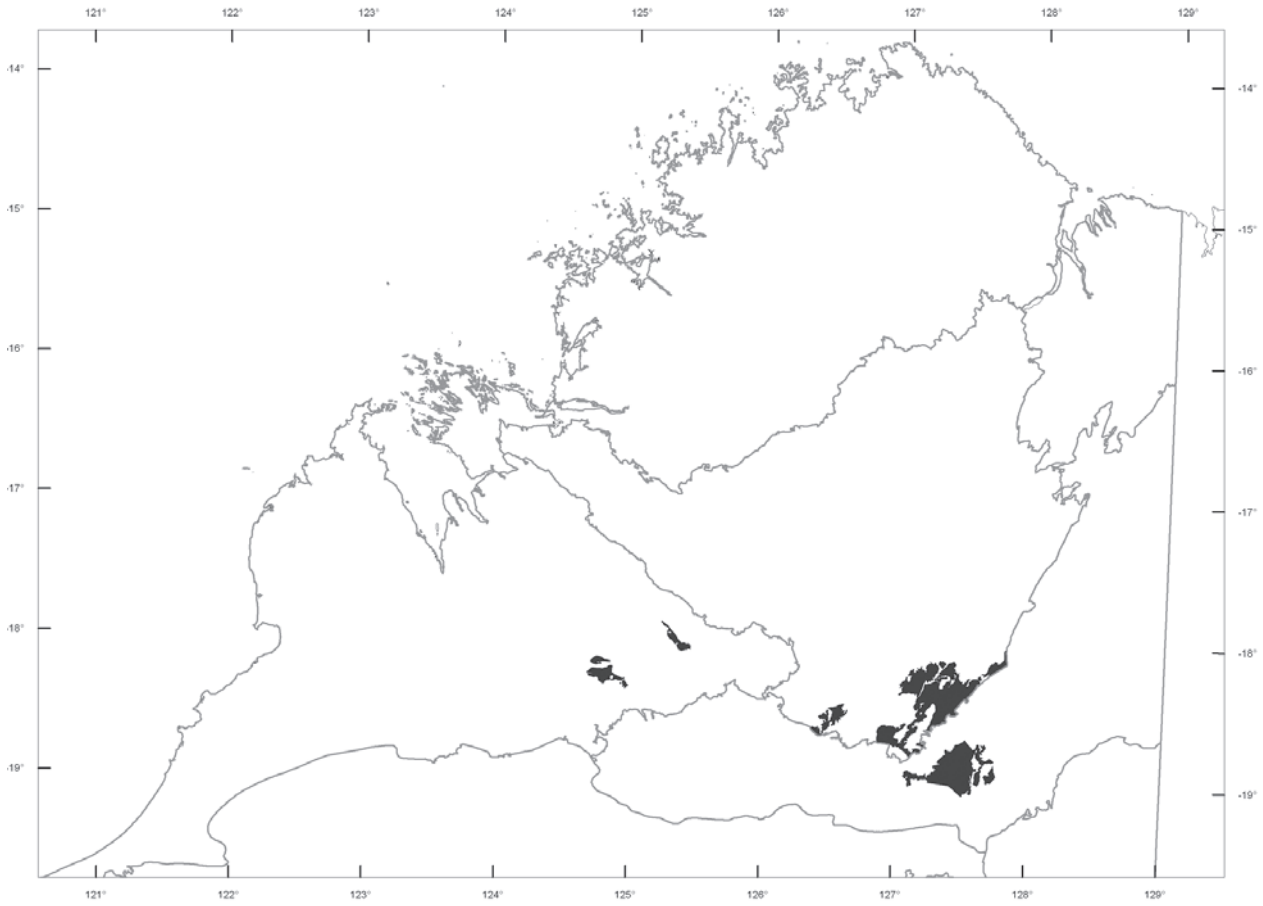


Figure 81. Mosaic 114: Curly spinifex low tree savanna/Grass-steppe.

To the west in the Dampierland Bioregion are two areas of tall bunch-grass low tree savanna interspersed with hummock grasslands covering over 39,000 ha. Low trees include *Adansonia gregorii* (boab), *Bauhinia cunninghamii* (bauhinia) and *Grevillea striata* (beefwood) over ribbon grass. The hummock grasslands are characterised by open low tree-steppe of *Eucalyptus brevifolia* (Kimberley snappy gum) over *Triodia pungens* (soft spinifex), or just grass-steppe of *Triodia pungens* (soft spinifex) and *Triodia bitextura* (curly spinifex).

Mosaic 115. Short bunch-grass low tree savanna/Low tree-steppe

This mosaic of short bunch-grass, low tree savanna with tree-steppe on stony rises occurs on the igneous rocks of the Bow River Hills, in the south-east Central Kimberley Bioregion, and more extensively on the volcanic soils of the Atrium Plateau in the Ord – Victoria Plains Bioregion, and covers a total of nearly 520,000 ha (Fig. 82). *Eucalyptus brevifolia* (Kimberley snappy gum) is commonly confined to the rough hilly ground where it forms a tree-steppe over a ground layer of *Triodia wiseana* (limestone spinifex) and *T. intermedia*. The moderate to gentle slopes support short bunch-grass savanna with a tree layer of *Eucalyptus argillacea* (Mt House box) and *Corymbia opaca* (bloodwood) over *Enneapogon* spp. In the north of the Ord – Victoria Plains Bioregion, there is a very mixed assemblage generally dominated by *Themeda triandra* (kangaroo grass) and *Sehima nervosum* (white grass) with *Sorghum plumosum* (plume canegrass), *Chrysopogon fallax* (golden beard grass), *Aristida pruinosa,* (gulf feathertop wiregrass), *Heteropogon contortus* (bunch speargrass) and other species.

Mosaic 116. Short bunch-grass savanna/ Grass-steppe

A short bunch-grass savanna/grass-steppe mosaic occurs along the alluvial flats on the lower reaches of rivers in the Pilbara and Carnarvon Bioregions, covering over 958,000 ha (Fig. 83). The grass-steppe component is the hummock grasses *Triodia pungens* (soft spinifex) or *T. wiseana* (limestone spinifex). The grasses attain 0.3–0.45 m in height and form a closed vegetation type that is quite different from the nearby open hummock grassland.

Included in this mosaic is an area in the north of the Carnarvon Bioregion where various sedges and sparsely scattered *Acacia eremaea* (snakewood) occur with *Triodia pungens* (soft spinifex) and scattered *A. pyrifolia* (ranji) This unit covers nearly 110,000 ha.

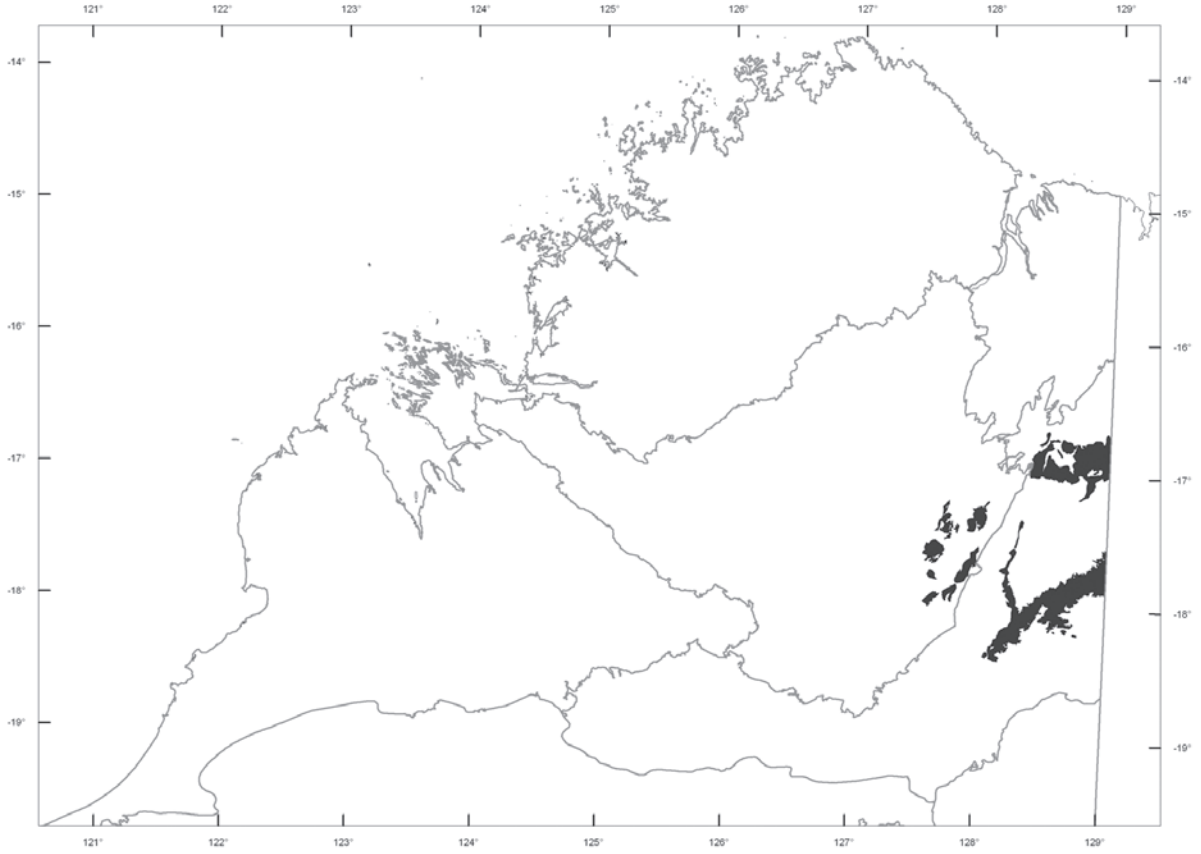


Figure 82. Mosaic 115: Short bunch-grass low tree savanna/Low tree-steppe

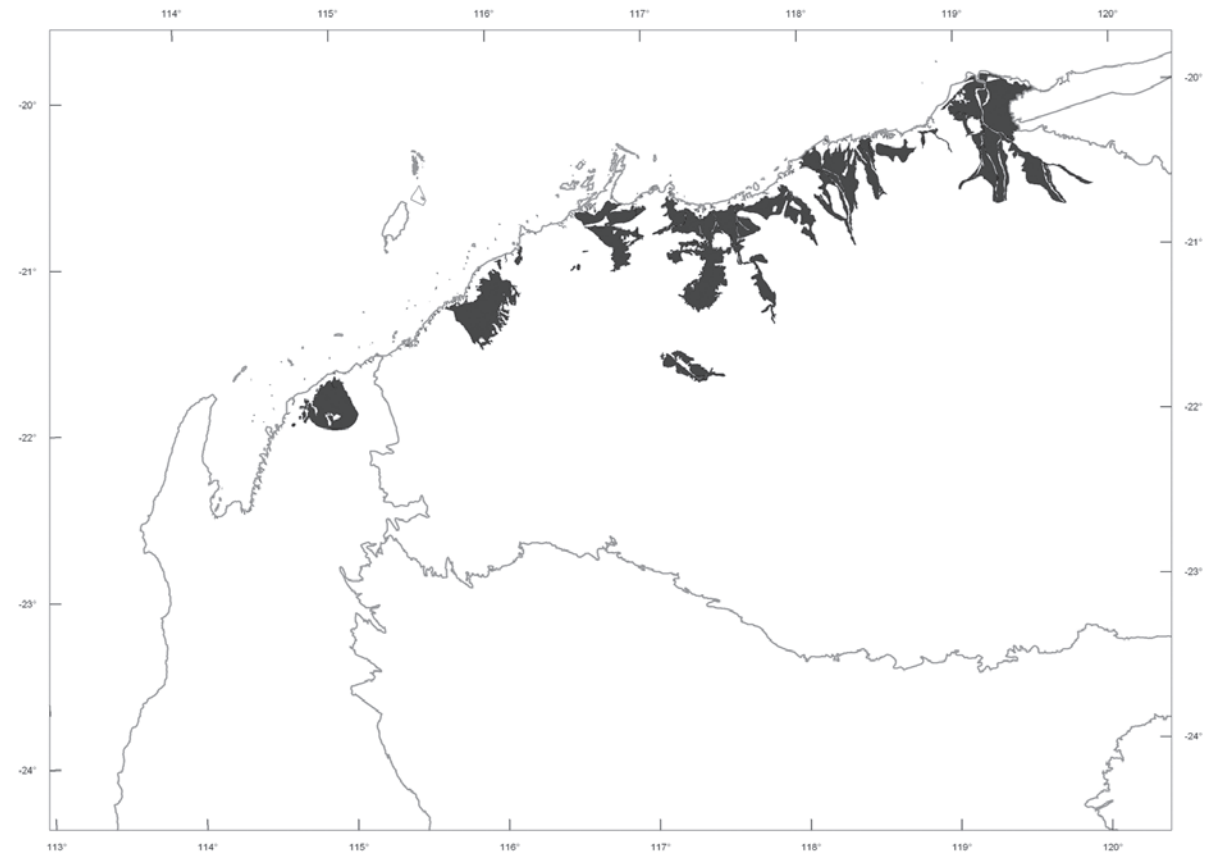


Figure 83. Mosaic 116: Short bunch-grass savanna/Grass-steppe.

Mosaic 117. Sparse low tree-steppe/Sparse shrub-steppe

The desert sand dune country of the Great Sandy Desert and Little Sandy Desert Bioregions is mapped as a mosaic of open low tree-steppe and open shrub-steppe (Fig. 84). This is the largest mosaic and the largest single vegetation type in the state, with an area of over 27.7 million ha. *Triodia schinzii* (feathertop spinifex) and very open low *Eucalyptus chippendalei* (desert bloodwood) occur on the sandhills, with an open shrub-steppe of spinifex (*Triodia* spp.) and mixed open shrubs between the sandhills. Typical dune plants are *Grevillea stenobotrya, Acacia ligulata* (umbrella bush), *A. victoriae* and the soft shrub *Crotalaria cunninghamii* (green birdflower). The distribution of the desert bloodwood is extremely irregular. The feathertop spinifex also occurs in the swales but is replaced by *Triodia pungens* (*T. basedowii* south of about 22 °S) where the lateritic gravel is exposed. Shrubs present on the sandhills include *Hakea lorea* (witinti), *A. pachycarpa, A. monticola* (gawar), *A. tumida* (pindan wattle), *Grevillea wickhamii* (Wickham's grevillea) and *G. eriostachya* (flame grevillea). Trees of *Corymbia dichromophloia* and *C. aspera* may be present in the swales on sandy soils.

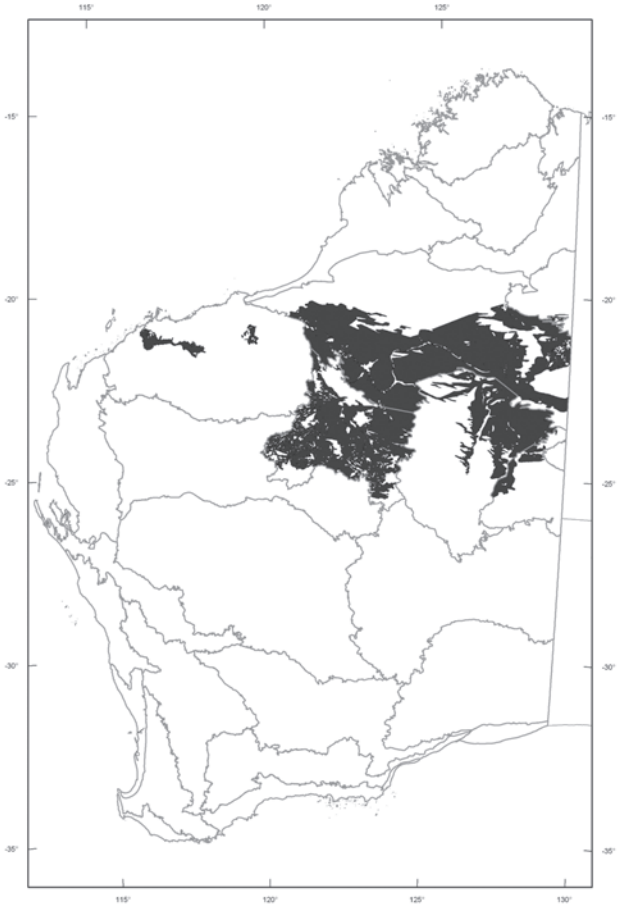


Figure 84. Mosaic 117: Sparse low tree-steppe/Sparse shrub-steppe.

A similar mosaic, but with a more open shrub layer, is mapped over 200,000 ha in the central Great Sandy Desert Bioregion between the tree-steppe and the tree-steppe/shrub-steppe mosaic described above. *Triodia pungens* (soft spinifex) and *Triodia schinzii* (feathertop spinifex) with scattered *Eucalyptus* sp. (probably *Corymbia chippendalei*, desert bloodwood) low tree-steppe occurs in sandy valleys, with *T. pungens* (soft spinifex) and sparse *Acacia pachycarpa* shrub-steppe on lateritic rises.

On the western part of the Chichester Range and in the valleys of the Gorge Range, Pilbara Bioregion, there is a mosaic with *Triodia wiseana* (limestone spinifex) and scattered *Eucalyptus leucophloia* (Pilbara snappy gum) open low tree-steppe that occurs along the drainage lines and a shrub-steppe of *T. pungens* (soft spinifex) and *Acacia pyrifolia* (ranji bush) on the mesas. The total area of this mosaic is over 585,000 ha.

Mosaic 118. Low tree-steppe/Scrub

Isolated depressions in the northern part of the Great Sandy Desert Bioregion are mapped as a mosaic of hummock grasslands and scrub (Fig. 85). The open low tree-steppe with *Corymbia chippendalei* (desert bloodwood) and *Triodia schinzii* (feathertop spinifex) on the sandhills with shrublands of tea tree scrub in the swales occurs in three areas totalling nearly 53,000 ha. Scattered *Corymbia chippendalei* (desert bloodwood) occur on the flanks of the parallel sand dunes with a ground cover of *Triodia schinzii* (feathertop spinifex). Where the swales become deeper depressions a tea tree scrub of *Melaleuca lasiandra* and *M. glomerata* is common.

Mosaic 119. Low woodland or open low woodland/Saltbush and bluebush

On the greenstone formation near Sandstone in the central Murchison Bioregion, there is an area of mulga low woodland with numerous small salty depressions vegetated with *Atriplex* spp. (saltbush) and *Maireana* spp. (bluebush; Fig. 86). Another patch of this woodland over saltbush and bluebush occurs 150 km to the west-south-west. Still in the Murchison Bioregion, a band of mulga and *Casuarina pauper* (black oak) low woodland over *Atriplex* spp. (saltbush) and *Maireana* spp. (bluebush) extends out from the northern end of Lake Moore. A mosaic of *A. ramulosa/A. linophylla* (bowgada) and *A. grasbyi* (miniritchie) scrub with scattered mulga, interspersed with scattered groups of saltbush/bluebush, occurs on a patch on the northern bank of the Murchison River on the western edge of the Murchison Bioregion. Also in the Murchison is a unit of sparse mulga with scattered patches of unknown chenopods east of Lake Breberle. These units total over 172,000 ha.

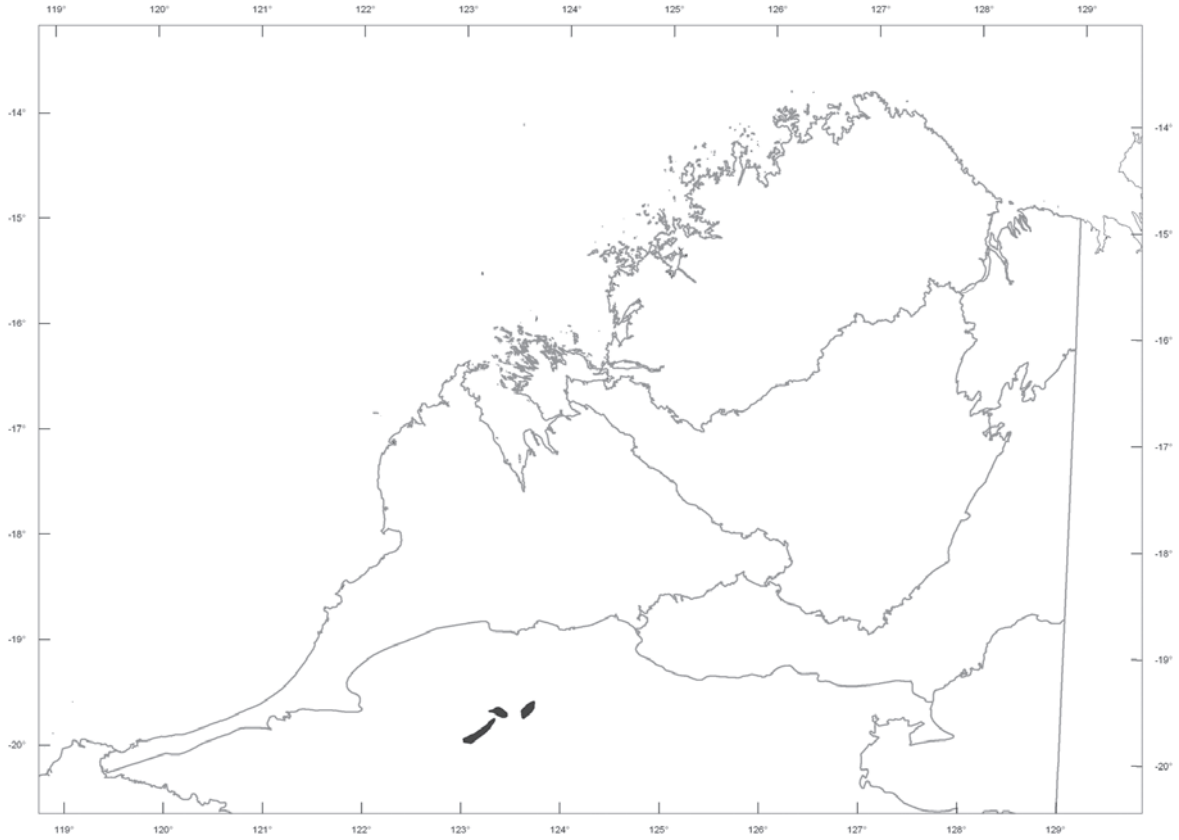


Figure 85. Mosaic 118: Low tree-steppe/Scrub.

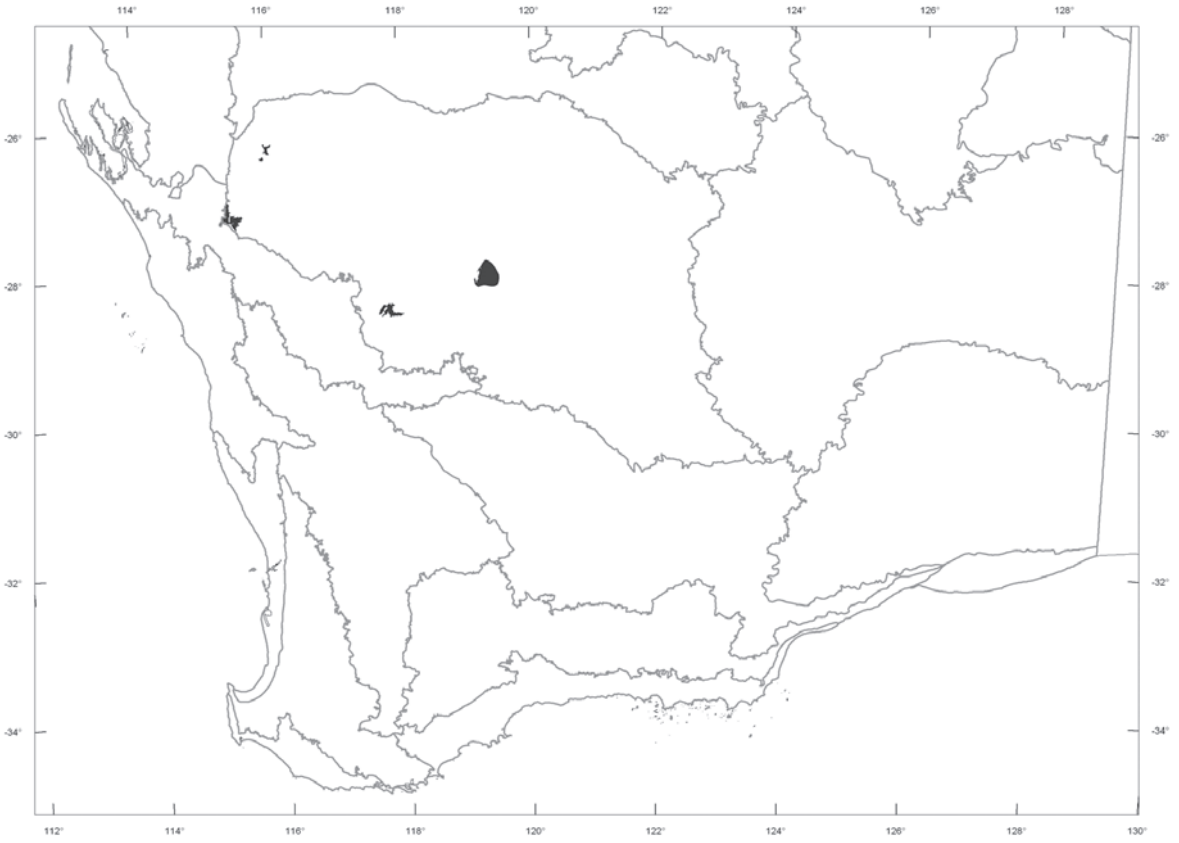


Figure 86. Mosaic 119: Low woodland/Saltbush and bluebush.

Mosaic 120. Succulent steppe saltbush and bluebush /Samphire

The two mosaic units included here cover the complex vegetation patterns that fringe salt lakes, where samphire occurring near the lake bed is fringed by *Atriplex* spp. (saltbush) and *Maireana* spp. (bluebush). This vegetation type covers nearly 88,000 ha. There may be scattered shrubs and the occasional eucalypt or casuarina. The complex pattern of islands and sand (gypsum) ridges in Lake Austin (nearly 70,000 ha) in the Murchison Bioregion was mapped in this way (Fig. 87). Samphire (*Tecticornia* spp.) communities with the tall, spindly and unusual *Lawrencia helmsii* (dunna dunna) are obvious. On higher ground, saltbush such as *Atriplex vesicaria* and *A. lindleyi* subsp. *inflata* and bluebush such as *Maireana pyramidata* and *M. pentatropis* occur with *Frankenia pauciflora* (seaheath). Shrubs include *Grevillea sarissa, Acacia sclerosperma* (limestone wattle), *A. tetragonophylla* (kurara) and *Eremophila maculata* (native fuchsia).

Lake Annean to the north is similar and is mapped as a mosaic of succulent steppe with scattered *Acacia sclerosperma* (limestone wattle), *Acacia ramulosa* and *A. linophylla* (bowgada) over *Atriplex* spp. (saltbush) and *Maireana* spp. (bluebush), fringed by samphire succulent steppe.

Figure 87. Mosaic 120: Saltbush and bluebush/Samphire.

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APPENDIX 1

Species names, common names and codes used in the vegetation maps and most of the species mentioned in the memoir. Name changes are all current to 2010, with recent name changes presented in Table 2.

Table 1.1. Species used in mapping and descriptive text

MAP CODE	CURRENT GENUS	CURRENT SPECIES	COMMON NAME
	Acacia	*aciphylla*	
a19	*Acacia*	*acuminata*	(jam)
	Acacia	*adoxa*	
a1	*Acacia*	*aneura* s.l.	(mulga)
a34	*Acacia*	*beauverdiana*	(pukkati)
a6	*Acacia*	*bivenosa*	
	Acacia	*blakelyi*	
a15	*Acacia*	*brachystachya*	(turpentine mulga)
a3	*Acacia*	*coriacea*	(waterwood or wirewood)
a32	*Acacia*	*cyclops*	(coastal wattle)
a12	*Acacia*	*cyperophylla*	(miniritchie)
a4	*Acacia*	*delibrata*	
	Acacia	*dictyophleba*	(sandhill wattle)
a11	*Acacia*	*eremaea*	(snakewood)
a5	*Acacia*	*eriopoda*	In Pilbara and Gascoyne Regions
a28	*Acacia*	*eriopoda*	(Broome pindan wattle)
a17	*Acacia*	*grasbyi*	(miniritchie)
	Acacia	*holosericea*	(candelbra wattle)
a26	*Acacia*	*lasiocarpa*	(panjang)
a21	*Acacia*	*ligulata*	(umbrella bush)
a9	*Acacia*	*linophylla*	(bowgada bush)
	Acacia	*longispinea*	
	Acacia	*lysiphloia*	(turpentine wattle)
	Acacia	*maitlandii*	(Maitland's wattle)
a30	*Acacia*	*monticola*	(gawar)
a20	*Acacia*	*murrayana*	(sandplain wattle)
a33	*Acacia*	*neurophylla*	
	Acacia	*orthocarpa*	(needleleaf wattle)
a5	*Acacia*	*pachycarpa*	
a13	*Acacia*	*papyrocarpa*	(western myall)
	Acacia	*pentadenia*	(karri wattle)
	Acacia	*pruinocarpa*	(gidgee)
a2	*Acacia*	*pyrifolia*	(ranji bush)
a14	*Acacia*	*quadrimarginea*	
a9	*Acacia*	*ramulosa*	(horse mulga, bowgada)
a35	*Acacia*	*resinimarginea*	
a23	*Acacia*	*rostellifera*	(summer-scented wattle)
a8	*Acacia*	*sclerosperma*	(limestone wattle)
	Acacia	*sericata*	
	Acacia	*stereophylla*	
	Acacia	*stellaticeps*	
	Acacia	*stipuligera*	
a27	*Acacia*	*suberosa*	(corkybark wattle)
a16	*Acacia*	*subtessarogona*	
	Acacia	*tenuissima*	
	Acacia	*tetragonophylla*	(kurara)
a7	*Acacia*	*trachycarpa*	(minni ritchi)
a31	*Acacia*	*truncata*	
a29	*Acacia*	*tumida*	(pindan wattle)
	Acacia	*steedmanii subsp. borealis*	
a10	*Acacia*	*synchronicia*	(bardi)
	Acacia	*xanthina*	(white-stemmed wattle)
a11	*Acacia*	*xiphophylla*	(snakewood)

Table 1.1 (cont.)

MAP CODE	CURRENT GENUS	CURRENT SPECIES	COMMON NAME
	Acanthocarpus	*preissii*	
	Actinostrobus	*arenarius*	(sandplain cypress)
α	*Adansonia*	*gregorii*	(boab)
	Adenanthos	*acanthophyllus*	
	Adenanthos	*cuneatus*	(coastal jugflower)
	Aegialitis	*annulata*	(club mangrove)
	Aegiceras	*corniculatum*	(river mangrove)
ag	*Agonis*	*flexuosa*	(peppermint)
c4	*Allocasuarina*	*acutivalvis*	
c3	*Allocasuarina*	*campestris*	
c1	*Allocasuarina*	*decaisneana*	(desert oak)
	Allocasuarina	*decussata*	(karri sheoak)
	Allocasuarina	*dielsiana*	(northern sheoak)
c7	*Allocasuarina*	*fraseriana*	(sheoak)
c5	*Allocasuarina*	*huegeliana*	(rock sheoak)
	Allocasuarina	*humilis*	(dwarf sheoak)
	Allocasuarina	*pinaster*	(compass bush)
	Aluta	*maisonneuvei*	
	Alyogyne	*cuneiformis*	(coastal hibiscus)
	Alyogyne	*pinoniana*	(sand hibiscus)
	Alysicarpus	*rugosus*	(rough chainpea)
	Andersonia	*simplex*	(spiked andersonia)
	Anthocercis	*littorea*	(yellow tailflower)
	Anthotroche	*walcottii*	
	Aristida	*contorta*	(bunched kerosene grass)
a3*	*Aristida*	*holathera*	(Beard's tufted annual grass)
	Aristida	*latifolia*	(feathertop wiregrass)
a2*	*Aristida*	*pruinosa*	(gulf feathertop wiregrass)
	Astrebla	*elymoides*	(weeping Mitchell grass)
a1*	*Astrebla*	*pectinata*	(barley Mitchell grass)
	Astrebla	*squarrosa*	(bull Mitchell grass)
	Atalaya	*hemiglauca*	(whitewood)
	Atriplex	*acutibractea*	(toothed saltbush)
	Atriplex	*bunburyana*	(silver saltbush)
k1	*Atriplex*	*cinerea*	(greysaltbush)
	Atriplex	*cryptocarpa*	
	Atriplex	*lindleyi*	
k1	*Atriplex*	*hymenotheca*	
	Atriplex	*rhagodioides*	
k1	*Atriplex*	*vesicaria*	(bladder saltbush)
	Avicennia	*marina*	(white mangrove)
	Baeckea	*floribunda*	
	Balaustion	*pulcherrimum*	(native pomegranate)
	Banksia	*armata*	(prickly dryandra)
b4	*Banksia*	*ashbyi*	(Ashby's banksia)
b1	*Banksia*	*attenuata*	(slender banksia)
	Banksia	*burdettii*	(Burdett's banksia)
	Banksia	*caleyi*	(Cayley's banksia)
	Banksia	*carlinoides*	(pink dryandra)
	Banksia	*cirsioides*	
	Banksia	*dentata*	(tropical banksia)
	Banksia	*dryandroides*	(dryandra-leaved banksia)
	Banksia	*fraseri var. ashbyi*	
	Banksia	*grandis*	(bull banksia)
d1	*Banksia*	*heliantha*	(oak-leaved dryandra)
	Banksia	*ilicifolia*	(holly-leaved banksia)
	Banksia	*media*	(southern plains banksia)
b2	*Banksia*	*menziesii*	(firewood banksia)

MAP CODE	CURRENT GENUS	CURRENT SPECIES	COMMON NAME
	Banksia	*nivea*	(honeypot dryandra)
	Banksia	*petiolaris*	
b3	*Banksia*	*prionotes*	(acorn banksia)
	Banksia	*prolata*	
	Banksia	*proteoides*	(king dryandra)
	Banksia	*pteridifolia*	(tangled honeypot)
	Banksia	*sceptrum*	(sceptre Banksia)
	Banksia	*sessilis*	(parrot bush)
	Banksia	*sphaerocarpa*	(round-fruit banksia)
	Banksia	*squarrosa subsp. squarrosa*	(pingle)
	Banksia	*verticillata*	(Albany banksia)
	Banksia	*vestita*	summer dryandra
b1#	*Bauhinia*	*cunninghamii*	(bauhinia)
	Beaufortia	*cyrtodonta*	
	Beaufortia	*decussata*	(gravel bottlebrush)
	Beaufortia	*micrantha*	(little bottlebrush)
	Beaufortia	*sparsa*	(swamp bottlebrush)
	Beyeria	*lechenaultii*	
	Boronia	*crenulata*	(aniseed boronia)
	Borya	*nitida*	(pincushions)
	Bothriochloa	spp.	
	Bossiaea	*bossiaeoides*	(bossiaea)
	Bossiaea	*rufa*	
	Brachyachne	*convergens*	(spider grass)
	Brachychiton	*diversifolius*	
	Brachychiton	*gregorii*	(desert kurrajong)
	Brachychiton	*viscidulus*	(sticky kurrajong)
	Bruguiera	*exaristata*	(ribbed-fruited orange mangrove)
	Buchanania	*obovata*	(wild mango)
	Bursaria	*occidentalis*	
	Callistemon	*glaucus*	
p	*Callitris*	*columellaris*	(white cypress pine)
p	*Callitris*	*preissii*	(Rottnest island pine)
	Calothamnus	*chrysantherus*	(claw flower)
	Calytrix	*brevifolia*	
	Calytrix	*exstipulata*	(Kimberley heather)
	Calytrix	*leschenaultii*	
	Camptostemon	*schultzii*	kapok mangrove
	Carissa	*lanceolata*	(conkerberry)
c6	*Casuarina*	*obesa*	(swamp sheoak)
c2	*Casuarina*	*pauper*	(black oak)
	Cephalipterum	*drummondii*	(pompom head)
	Ceriops	*tagal*	(spurred mangrove)
	Chorilaena	*quercifolia*	(chorilaena)
c*	*Chrysopogon*	*fallax*	(golden beard grass)
c*	*Chrysopogon*	*latifolius*	(broadleaf ribbongrass)
	Cleome	*viscosa*	(tickweed)
	Cochlospermum	*fraseri*	(kapok bush)
	Conospermum	*coerulescens subsp. dorrienii*	(Stirling Range smokebush)
	Conospermum	*stoechadis*	(common smokebush)
	Coopernookia	*strophiolata*	
	Corymbia	*aspera*	
e58	*Corymbia*	*cadophora*	(twin-leaf bloodwood)
e3	*Corymbia*	*calophylla*	(marri)
	Corymbia	*candida*	
e23	*Corymbia*	*chippendalei*	(desert bloodwood)
e59	*Corymbia*	*confertiflora*	(roughleaf cabbage gum)
e24	*Corymbia*	*dichromophloia*	(variable barked bloodwood)
	Corymbia	*eremaea*	

Table 1.1 (cont.)

MAP CODE	CURRENT GENUS	CURRENT SPECIES	COMMON NAME
e56	*Corymbia*	*ferruginea*	(rusty bloodwood)
e62	*Corymbia*	*foelscheana*	
e51	*Corymbia*	*grandifolia*	(cabbage gum)
e63	*Corymbia*	*haematoxylon*	(mountain marri)
e61	*Corymbia*	*opaca*	(inland bloodwood)
e52	*Corymbia*	sens. lat. *papuana*	(ghostgum) Excluded name
e57	*Corymbia*	*polycarpa*	(long-fruited bloodwood)
	Cratystylis	*conocephala*	(greybush)
	Crotalaria	*cunninghamii*	(green birdflower)
	Crotalaria	*medicaginea*	
	Dactyloctenium	*radulans*	(button grass)
	Dampiera	*candicans*	
	Darwinia	*diosmoides*	
	Dasypogon	*bromeliifolius*	(pineapple bush)
	Daviesia	*grahamii*	
	Daviesia	*teretifolia*	
d*	*Dichanthium*	*fecundum*	(curly bluegrass)
d*	*Dichanthium*	*sericeum*	(Queensland blue grass)
	Diplolaena	*dampieri*	(southern diplolaena)
	Disphyma	*crassifolium*	(round-leaved pigface)
d	*Dodonaea*	*inaequifolia*	
d2	*Dodonaea*	*microzyga*	
	Dodonaea	*physocarpa*	
	Dodonaea	*viscosa*	(sticky hopbush)
	Dolichandrone	*heterophylla*	(lemonwood)
	Dolichandrone	*lanceolata*	
e*	*Enneapogon*	spp.	(arid short grass)
	*Echinochloa**	*colona*	(awnless barnyard grass)
	Enekbatus	*cryptandroides*	
	Eragrostis	*falcata*	(sickle lovegrass)
	Eragrostis	*setifolia*	(neverfail grass)
	Eragrostis	*tenellula*	(delicate lovegrass)
	Eriachne	spp.	(wanderrie grasses)
	Eremaea	*beaufortioides*	
	Eremaea	*pauciflora*	
	Eremophila	*abietina*	(spotted poverty bush)
	Eremophila	*clarkei*	(turpentine bush)
	Eremophila	*cuneifolia*	(pinyuru)
	Eremophila	*dempsteri*	
	Eremophila	*drummondii*	
	Eremophila	*forrestii*	(Wilcox bush)
	Eremophila	*latrobei*	(warty fuchsia bush)
	Eremophila	*maculata*	(native fuchsia)
	Eremophila	*maitlandii*	(Shark Bay poverty bush)
	Eremophila	*platycalyx*	(granite poverty bush)
	Eremophila	*pterocarpa*	(silver poverty bush)
	Erythrophleum	*chlorostachys*	(ironwood)
e45	*Eucalyptus*	*accedens*	(powderbark wandoo)
	Eucalyptus	*albida*	(white-leaved mallee)
e76	*Eucalyptus*	*angulosa*	(ridge-fruited mallee)
	Eucalyptus	*annulata*	(open-fruited mallee)
e54	*Eucalyptus*	*argillacea*	(Mt House box)
e64	*Eucalyptus*	*astringens*	(brown mallet)
	Eucalyptus	*beardiana*	(Beard's mallee)
e16	*Eucalyptus*	*brevifolia*	(Kimberley snappy gum)
e75	*Eucalyptus*	*brevistylis*	(Rates tingle)
	Eucalyptus	*caesia*	(caesia)
e18	*Eucalyptus*	*camaldulensis*	(river gum)

MAP CODE	CURRENT GENUS	CURRENT SPECIES	COMMON NAME
	Eucalyptus	*campaspe*	(silver-topped gimlet)
	Eucalyptus	*clelandii*	(Cleland's blackbutt)
	Eucalyptus	*comitae-vallis*	(Comet Vale mallee)
e40	*Eucalyptus*	*concinna*	(Victoria Desert mallee)
e31	*Eucalyptus*	*cooperiana*	(many-flowered mallee)
e37	*Eucalyptus*	*cornuta*	(yate)
e35	*Eucalyptus*	*corrugata*	(rough fuited mallee)
	Eucalyptus	*cylindriflora*	(white mallee)
e67	*Eucalyptus*	*decipiens*	(redheart)
	Eucalyptus	*diptera*	(two-winged gimlet)
e1	*Eucalyptus*	*diversicolor*	(karri)
e14	*Eucalyptus*	*dundasii*	(Dundas blackbutt)
e15	*Eucalyptus*	*eremophila*	(horned mallee)
e44	*Eucalyptus*	*erythrocorys*	(illyarrie)
e70	*Eucalyptus*	*eudesmioides*	(malallie)
e11	*Eucalyptus*	*flocktoniae*	(merrit)
e47	*Eucalyptus*	*foecunda*	(narrow-leaved red mallee)
e32	*Eucalyptus*	*forrestiana*	(Forrest's marlock)
e25	*Eucalyptus*	*gamophylla*	(twin-leaf mallee)
e69	*Eucalyptus*	*gardneri*	(blue mallet)
e4	*Eucalyptus*	*gomphocephala*	(tuart)
e19	*Eucalyptus*	*gongylocarpa*	(marble gum)
e36	*Eucalyptus*	*gracilis*	(yorrell)
e74	*Eucalyptus*	*guilfoylei*	(yellow tingle)
e29	*Eucalyptus*	*incrassata*	(lerp mallee)
e68	*Eucalyptus*	*jacksonii*	(red tingle)
e21	*Eucalyptus*	*kingsmillii*	(Kingsmill's mallee)
e66	*Eucalyptus*	*kondininensis*	(Kondinin blackbutt)
e38	*Eucalyptus*	*lehmannii*	(Bald Is. marlock, bushy yate)
e13	*Eucalyptus*	*lesouefii*	(goldfields blackbutt)
e16	*Eucalyptus*	*leucophloia* subsp. *leucophloia*	(Pilbara snappy gum)
e9	*Eucalyptus*	*longicornis*	(red morrel)
e6	*Eucalyptus*	*loxophleba*	(York gum)
	Eucalyptus	*mannensis*	(Mann Range mallee)
e2	*Eucalyptus*	*marginata*	(jarrah)
e71	*Eucalyptus*	*megacarpa*	(bullich)
e17	*Eucalyptus*	*microtheca*	(coolibah)
e17	*Eucalyptus*	*victrix*	(coolibah)
e49	*Eucalyptus*	*miniata*	(woollybutt)
	Eucalyptus	*mooreana*	(mountain white gum)
e28	*Eucalyptus*	*proxima*	
e43	*Eucalyptus*	*obtusifolia*	(Dongara mallee)
e7	*Eucalyptus*	*occidentalis*	(flat-topped yate)
	Eucalyptus	*oldfieldii*	(Oldfield's mallee)
e22	*Eucalyptus*	*oleosa*	(giant mallee)
e46	*Eucalyptus*	*oraria*	
e72	*Eucalyptus*	*patens*	(yarri)
e55	*Eucalyptus*	*phoenicea*	(gnainga, scarlet gum)
	Eucalyptus	*pileata*	(capped mallee)
e33	*Eucalyptus*	*platypus*	(moort)
e26	*Eucalyptus*	*pleurocarpa*	(blue mallee, tallerack)
e60	*Eucalyptus*	*pruinosa*	(silver box)
	Eucalyptus	*pyriformis*	(pear-fruited mallee)
e27	*Eucalyptus*	*redunca* s.l.	(black marlock)
	Eucalyptus	*roycei*	(Shark Bay mallee)
e18	*Eucalyptus*	*rudis*	(flooded gum
e8	*Eucalyptus*	*salmonophloia*	(salmon gum)
e34	*Eucalyptus*	*salubris*	(gimlet)
e39	*Eucalyptus*	*sheathiana*	(ribbon-barked gum)

Table 1.1 (cont.)

MAP CODE	CURRENT GENUS	CURRENT SPECIES	COMMON NAME
e30	*Eucalyptus*	*socialis*	(red mallee)
	Eucalyptus	*spathulata*	(swamp mallet)
e65	*Eucalyptus*	*staeri*	(Albany blackbutt)
e50	*Eucalyptus*	*tectifica*	(grey box, Darwin box)
e48	*Eucalyptus*	*tetrodonta*	(Darwin stringybark)
e73	*Eucalyptus*	*todtiana*	(coastal blackbutt)
e12	*Eucalyptus*	*torquata*	(coral gum)
e10	*Eucalyptus*	*transcontinentalis*	(redwood)
e10	*Eucalyptus*	*moderata*	(redwood mallee)
	Eucalyptus	*uncinata*	(hook-leaved mallee)
e5	*Eucalyptus*	*wandoo*	(wandoo)
e20	*Eucalyptus*	*youngiana*	(large-fruited mallee)
e53	*Eucalyptus*	sp.	[incorrectly named setosa]
	Exocarpos	*sparteus*	(broom ballart)
	Ficus	*brachypoda*	
	Ficus	*coronulata*	(river fig)
	Ficus	*orbicularis*	
	Ficus	*racemosa*	(stem-fruit fig)
	Frankenia	*pauciflora*	(seaheath)
	Frankenia	*interioris*	
	Frankenia	*laxiflora*	
	Gahnia	*trifida*	
	Gardenia	*pyriformis*	
	Gardenia	*resinosa*	
	Gastrolobium	*grandiflorum*	(wallflower poison)
	Gastrolobium	*latifolium*	
	Gastrolobium	*oxylobioides*	(Champion Bay poison)
	Gastrolobium	*spinosum*	(prickly poison)
	Gompholobium	*polyzygum*	
	Gompholobium	*villosum*	
	Goodenia	*maideniana*	
	Gossypium	*sturtianum*	(Sturt's desert rose)
	Grevillea	*agrifolia*	(blue grevillea)
	Grevillea	*bipinnatifida*	(fuchsia grevillea)
	Grevillea	*cunninghamii*	
	Grevillea	*eriostachya*	(flame grevillea)
	Grevillea	*excelsior*	(flame grevillea)
	Grevillea	*gordoniana*	
	Grevillea	*heliosperma*	(rock grevillea)
	Grevillea	*hookeriana*	(red tooth brushes)
	Grevillea	*juncifolia*	(honey-suckle grevillea)
	Grevillea	*leucopteris*	(white plume grevillea)
	Grevillea	*nematophylla*	
	Grevillea	*obliquistigma*	
	Grevillea	*pectinata*	(comb-leaved grevillea)
	Grevillea	*pteridifolia*	(silky grevillea)
	Grevillea	*pterosperma*	
	Grevillea	*pyramidalis*	(caustic bush)
g1	*Grevillea*	*refracta*	(silver-leaf grevillea)
	Grevillea	*rogersoniana*	(Rogersons' grevillea)
	Grevillea	*stenobotrya*	
	Grevillea	*stenomera*	(lace-net grevillea)
g2	*Grevillea*	*striata*	(beefwood)
	Grevillea	*wickhamii*	(Wickham's grevillea)
	Gyrocarpus	*americanus*	(helicopter tree)
	Hakea	*arborescens*	(common hakea)
	Hakea	*baxteri*	fan hakea
	Hakea	*cinerea*	(ashy hakea)
	Hakea	*corymbosa*	(cauliflower hakea)

MAP CODE	CURRENT GENUS	CURRENT SPECIES	COMMON NAME
	Hakea	*costata*	(ribbed hakea)
	Hakea	*cucullata*	(hood-leaved hakea)
	Hakea	*elliptica*	(oval-leaf hakea)
	Hakea	*laurina*	(pincushion hakea),
h	*Hakea*	*lorea* subsp *suberea*	(corkwood, witinti)
	Hakea	*macrocarpa*	(jaradinty)
	Hakea	*multilineata*	(grass-leaf hakea)
h	*Hakea*	*obliqua*	(needles and corks)
	Hakea	*pandanicarpa*	
	Hakea	*preissii*	(needle tree)
	Hakea	*prostrata*	(harsh hakea)
	Hakea	*pycnoneura*	
	Hakea	*rhombales*	
h	*Hakea*	*stenophylla*	
	Hakea	*trifurcata*	(two-leaf hakea)
	Hakea	*undulata*	(wavy-leaved hakea)
	Hakea	*varia*	(variable leaved hakea)
	Halgania	*viscosa*	
	Heteropogon	*contortus*	(bunch speargrass)
	Hibbertia	*spicata*	
	Hibiscus	*panduriformis*	(yellow hibiscus)
	Homalocalyx	*thryptomenoides*	
	Hovea	*elliptica*	(tree hovea)
	Iseilema	spp.	(Flinders grass)
	Isopogon	*buxifolius*	
	Isopogon	*cuneatus*	(coneflower)
	Isopogon	*dubius*	(pincushion coneflower)
	Isopogon	*formosus*	(rose coneflower)
	Jacksonia	*forrestii*	
j	*Jacksonia*	*horrida*	
	Keraudrenia	*integrifolia*	(common firebush)
	Kunzea	*ericifolia*	(spearwood)
	Kunzea	*pulchella*	(granite kunzea)
l	*Lamarchea*	*hakeifolia*	
	Lambertia	*ericifolia*	(heath-leaved honeysuckle)
	Lambertia	*inermis*	(chittick)
	Lambertia	*uniflora*	
	Lawrencella	*davenportii*	(sticky everlasting)
	Lawrencia	*helmsii*	(dunna dunna)
	Lechenaultia	*formosa*	(red leschenaultia)
	Lepidium	*oxytrichum*	
	Lepidium	*rotundum*	(veined peppercress)
	Lepidopsperma	*gladiatum*	(sword sedge)
	Leucochrysum	*stipitatum*	(woolly sunray)
	Leucopogon	*reflexus*	
	Leucopogon	*revolutus*	
l#	*Livistona*	*eastonii*	(fan palm)
	Lysinema	*ciliatum*	(curry flower)
	Macrozamia	*riedlei*	(zamia)
	Maireana	*pentatropis*	
	Maireana	*pyramidata*	(sago bush)
k	*Maireana*	*sedifolia*	(pearl bluebush)
	Maireana	*triptera*	(three winged bluebush)
	Malvastrum	*americanum*	(spiked Malvastrum)
	Melaleuca	*acacioides*	(coastal paperbark)
	Melaleuca	*acuminata*	
	Melaleuca	*alsophila*	
m	*Melaleuca*	*cardiophylla*	(tangling melaleuca)
	Melaleuca	*cordata*	
	Melaleuca	*cuticularis*	(saltwater paperbark)

Table 1.1 (cont.)

MAP CODE	CURRENT GENUS	CURRENT SPECIES	COMMON NAME
	Melaleuca	*elliptica*	(granite bottlebrush)
	Melaleuca	*glomerata*	
	Melaleuca	*huegelii*	(chenille honeymyrtle)
	Melaleuca	*incana* subsp. *incana*	
	Melaleuca	*lasiandra*	
m	*Melaleuca*	*laxiflora*	
	Melaleuca	*leiocarpa*	
	Melaleuca	*leiopyxis*	
	Melaleuca	*megacephala*	
	Melaleuca	*minutifolia*	(tea tree)
	Melaleuca	*nesophila*	(mindiyed)
m2	*Melaleuca*	*preissiana*	(moonah)
	Melaleuca	*pungens*	
	Melaleuca	*radula*	(graceful honeymyrtle)
m	*Melaleuca*	*rhaphiophylla*	(swamp paperbark)
	Melaleuca	*scabra*	(rough honeymyrtle)
	Melaleuca	*spicigera*	
	Melaleuca	*subtrigona*	
m4	*Melaleuca*	*systena*	(coastal honeymyrtle)
m	*Melaleuca*	*thyoides*	
m6	*Melaleuca*	*uncinata* s.l.	(broom bush)
	Melaleuca	*viridiflora*	(broadleaf paperbark)
	Mirbelia	*ramulosa*	
	Mirbelia	*viminalis*	
m	*Myoporum*	*platycarpum*	(sugarwood)
	Nauclea	*orientalis*	(Leichardt pine)
	Neptunia	spp.	(sensitive plant)
n	*Nuytsia*	*floribunda*	(christmas tree)
	Olearia	*axillaris*	(coastal daisybush)
	Olearia	*muelleri*	(goldfields daisy)
	Olearia	*pimeleoides*	(pimelea daisybush)
o#	*Owenia*	*reticulata*	(desert walnut, native walnut)
	Oxychloris	*scariosa*	(winged chloris)
	Persoonia	*longifolia*	(snottygobble)
	Petalostigma	*pubescens*	
	Petalostylis	*labicheoides*	(slender petalostylis)
	Petrophile	*divaricata*	
	Phebalium	*canaliculatum*	
	Philotheca	*tomentella*	
	Pimelea	*ferruginea*	
	Pimelea	*rosea*	(rose banjine)
	Pimelea	*spectabilis*	(bunjong)
	Pittosporum	*angustofolium*	(weeping pittosporum)
	Planchonia	*careya*	(mangaloo)
	Platytheca	*galioides*	
	Podolepis	*canescens*	(grey podolepis)
	**Portulaca*	*oleracea*	(purslane)
	Ptilotus	*drummondii*	(narrowleaf mulla mulla)
	Ptilotus	*nobilis*	(tall mulla mulla)
	Ptilotus	*obovatus*	(cotton bush)
	Ptilotus	*rotundifolius*	(royal mulla mulla)
	Rhizophora	*stylosa*	(spotted-leaved red mangrove)
	Rhodanthe	*floribunda*	(white everlasting)
	Rhynchosia	*minima*	(rhynchosia)
	Santalum	*acuminatum*	(quandong)
	Scaevola	*crassifolia*	(thick-leaved fan-flower)
	Scaevola	*sericophylla*	
	Scaevola	*spinescens*	(currant bush)

MAP CODE	CURRENT GENUS	CURRENT SPECIES	COMMON NAME
	Sclerolaena	*deserticola*	
s1*	*Sehima*	*nervosum*	(white grass)
	Senna	*artemisioides* subsp. *artemisioides*	
	Senna	*artemisioides* subsp. x *coriacea*	
	Senna	*artemisioides* subsp. *oligophylla*	
	Senna	*artemisioides* subsp. x *sturtii*	
	Senna	*charlesiana*	
	Senna	*glutinosa* subsp. x *luerssenii*	
	Senna	*pleurocarpa* var. *pleurocarpa*	
	Sida	*echinocarpa*	
	Sida	*fibulifera*	(silver sida)
	Sida	*petrophila*	
	Sida	*spinosa*	(spiny sida)
	Sonneratia	*alba*	(pornupan)
	Sorghum	*plumosum*	(plume canegrass)
s2*	*Sorghum*	*stipoideum*	(annual sorghum)
s2*	*Sorghum*	*timorense*	
	Sphaerolobium	*macranthum*	
	Sphenotoma	*dracophylloides*	
	Sporobolus	*australasicus*	(fairy grass)
s3*	*Sporobolus*	*virginicus*	(salt water couch, marine couch)
	Stylobasium	*spatulatum*	(pebble bush)
	Swainsona	*formosa*	Sturts desert pea
	Swainsona	*pterostylis*	
	Synaphea	*favosa*	
	Syzygium	*suborbiculare*	
	Taxandria	*linearifolia*	(swamp peppermint)
k3	*Tecticornia*	*halocnemoides*	(shrubby samphire)
k3	*Tecticornia*	*indica*	(samphire)
	Tecticornia	*leptoclada*	
	Tephrosia	*arenicola*	
	Terminalia	*arostrata*	(crocodile tree)
	Terminalia	*latipes* subsp. *psilocarpa*	
	Terminalia	*oblongata*	
	Terminalia	*platyphylla*	(wild plum)
k*	*Themeda*	*triandra*	(kangaroo grass)
	Thryptomene	*australis*	(hook-leaf thryptomene)
	Thryptomene	*baeckeacea*	
	Thryptomene	*urceolaris*	
	Tragus	*australianus*	(small burrgrass)
	Trichodesma	*zeylanicum*	(camel bush)
t2*	*Triodia*	*basedowii*	(hard spinifex, lobed spinifex)
p3*	*Triodia*	*bitextura*	(curly spinifex)
t6*	*Triodia*	*brizoides*	
p4*	*Triodia*	*bynoei*	
t10*	*Triodia*	*cunninghamii*	
	Triodia	*danthonioides*	
t4*	*Triodia*	*intermedia*	
t5*	*Triodia*	*inutilis*	
p2*	*Triodia*	*melvillei*	
t9*	*Triodia*	*plurinervata*	
t1*	*Triodia*	*pungens*	(soft spinifex)
t8*	*Triodia*	*scariosa*	
p1*	*Triodia*	*schinzii*	(feathertop, soft spinifex)
t3*	*Triodia*	*wiseana*	(limestone spinifex)
	Triumfetta	*chaetocarpa*	(urchins)
	Trymalium	*spatulatum*	(karri hazel)
	**Vachellia*	*farnesiana*	(mimosa bush)
	Ventilago	*viminalis*	(supplejack)
	Verticordia	*chrysantha*	

Table 1.1 (cont.)

MAP CODE	CURRENT GENUS	CURRENT SPECIES	COMMON NAME
	Verticordia	*etheliana*	
	Waitzia	*nitida*	
	Xanthorrhoea	*drummondii*	
	Xanthorrhoea	*thorntonii*	(desert balga)
	Xanthosia	*rotundifolia*	(southern cross)
	Xylomelum	*angustifolium*	(sandplain woody pear)
	Zygophyllum	*aurantiacum*	(shrubby twinleaf)
	Zygophyllum	*ovatum*	(dwarf twinleaf)
*	grasses		
#	Kimberley		

Table 1.2. Codes used in the mapping.

MAP CODE	CURRENT GENUS	CURRENT SPECIES	COMMON NAME
α	*Adansonia*	*gregorii*	(boab)
a1	*Acacia*	*aneura* s.l.	(mulga)
a1*	*Astrebla*	*pectinata*	(barley Mitchell grass)
a2	*Acacia*	*pyrifolia*	(ranji bush)
a2*	*Aristida*	*pruinosa*	(gulf feathertop wiregrass)
a3	*Acacia*	*coriacea*	(waterwood or wirewood)
a3*	*Aristida*	*holathera*	(Beard's tufted annual grass)
a4	*Acacia*	*delibrata*	
a5	*Acacia*	*pachycarpa*	
a5 (& a28)	*Acacia*	*eriopoda*	In Pilbara and Gascoyne Regions
a6	*Acacia*	*bivenosa*	
a7	*Acacia*	*trachycarpa*	(minni ritchi)
a8	*Acacia*	*sclerosperma*	(limestone wattle)
a9	*Acacia*	*linophylla*	(bowgada bush)
a9	*Acacia*	*ramulosa*	(horse mulga, bowgada)
a10	*Acacia*	*synchronicia*	(bardi,)
a11	*Acacia*	*eremaea*	(snakewood)
a11	*Acacia*	*xiphophylla*	(snakewood)
a12	*Acacia*	*cyperophylla*	(miniritchie)
a13	*Acacia*	*papyrocarpa*	(western myall)
a14	*Acacia*	*quadrimarginea*	
a15	*Acacia*	*brachystachya*	(turpentine mulga)
a16	*Acacia*	*subtessarogona*	
a17	*Acacia*	*grasbyi*	(miniritchie)
a19	*Acacia*	*acuminata*	(jam)
a20	*Acacia*	*murrayana*	(sandplain wattle)
a21	*Acacia*	*ligulata*	(umbrella bush)
a23	*Acacia*	*rostellifera*	(summer-scented wattle)
a26	*Acacia*	*lasiocarpa*	(panjang)
a27	*Acacia*	*suberosa*	(corkybark wattle)
a28	*Acacia*	*eriopoda*	(Broome pindan wattle)
a29	*Acacia*	*tumida*	(pindan wattle)
a30	*Acacia*	*monticola*	(gawar)
a31	*Acacia*	*truncata*	
a32	*Acacia*	*cyclops*	(coastal wattle)

Table 1.2 (cont.)

MAP CODE	CURRENT GENUS	CURRENT SPECIES	COMMON NAME
a33	*Acacia*	*neurophylla*	
a34	*Acacia*	*beauverdiana*	(pukkati)
a35	*Acacia*	*resinimarginea*	
ag	*Agonis*	*flexuosa*	(peppermint)
b1	*Banksia*	*attenuata*	(slender banksia)
b1#	*Bauhinia*	*cunninghamii*	(bauhinia)
b2	*Banksia*	*menziesii*	(firewood banksia)
b3	*Banksia*	*prionotes*	(acorn banksia)
b4	*Banksia*	*ashbyi*	(Ashby's banksia)
c*	*Chrysopogon*	*fallax*	(golden beard grass)
c*	*Chrysopogon*	*latifolius*	(broadleaf ribbongrass)
c1	*Allocasuarina*	*decaisneana*	(desert oak)
c2	*Casuarina*	*pauper*	(black oak)
c3	*Allocasuarina*	*campestris*	
c4	*Allocasuarina*	*acutivalvis*	
c5	*Allocasuarina*	*huegeliana*	(rock sheoak)
c6	*Casuarina*	*obesa*	(swamp sheoak)
c7	*Allocasuarina*	*fraseriana*	(sheoak)
d	*Dodonaea*	*inaequifolia*	
d*	*Dichanthium*	*fecundum*	(curly bluegrass)
d*	*Dichanthium*	*sericeum*	(Queensland blue grass)
d1	*Banksia*	*heliantha*	(oak-leaved dryandra)
d2	*Dodonaea*	*microzyga*	
e*	*Enneapogon*	spp.	(arid short grass)
e1	*Eucalyptus*	*diversicolor*	(karri)
e2	*Eucalyptus*	*marginata*	(jarrah)
e3	*Corymbia*	*calophylla*	(marri)
e4	*Eucalyptus*	*gomphocephala*	(tuart)
e5	*Eucalyptus*	*wandoo*	(wandoo)
e6	*Eucalyptus*	*loxophleba*	(York gum)
e7	*Eucalyptus*	*occidentalis*	(flat-topped yate)
e8	*Eucalyptus*	*salmonophloia*	(salmon gum)
e9	*Eucalyptus*	*longicornis*	(red morrel)
e10	*Eucalyptus*	*transcontinentalis*	(redwood)
e10	*Eucalyptus*	*moderata*	(redwood mallee)
e11	*Eucalyptus*	*flocktoniae*	(merrit)
e12	*Eucalyptus*	*torquata*	(coral gum)
e13	*Eucalyptus*	*lesouefii*	(goldfields blackbutt)
e14	*Eucalyptus*	*dundasii*	(Dundas blackbutt)
e15	*Eucalyptus*	*eremophila*	(horned mallee)
e16	*Eucalyptus*	*brevifolia*	(Kimberley snappy gum)
e16	*Eucalyptus*	*leucophloia*	(Pilbara snappy gum)
e17	*Eucalyptus*	*microtheca*	(coolibah)
e17	*Eucalyptus*	*victrix*	(coolibah)
e18	*Eucalyptus*	*rudis*	(flooded gum)
e18	*Eucalyptus*	*camaldulensis*	(river gum)
e19	*Eucalyptus*	*gongylocarpa*	(marble gum)
e20	*Eucalyptus*	*youngiana*	(large-fruited mallee)
e21	*Eucalyptus*	*kingsmillii*	(Kingsmill's mallee)
e22	*Eucalyptus*	*oleosa*	(giant mallee)
e23	*Corymbia*	*chippendalei*	(desert bloodwood)
e24	*Corymbia*	*dichromophloia*	(variable barked bloodwood)
e25	*Eucalyptus*	*gamophylla*	(twin-leaf mallee)
e26	*Eucalyptus*	*pleurocarpa*	(blue mallee, tallerack)
e27	*Eucalyptus*	*redunca*	(black marlock)
e28	*Eucalyptus*	*platypus*	(moort)
e29	*Eucalyptus*	*incrassata*	(lerp mallee)
e30	*Eucalyptus*	*socialis*	(red mallee)

Table 1.2 (cont.)

MAP CODE	CURRENT GENUS	CURRENT SPECIES	COMMON NAME
e31	*Eucalyptus*	*cooperiana*	(many-flowered mallee)
e32	*Eucalyptus*	*forrestiana*	(Forrest's marlock)
e33	*Eucalyptus*	*proxima*	(red flowered moort)
e34	*Eucalyptus*	*salubris*	(gimlet)
e35	*Eucalyptus*	*corrugata*	(rough fuited mallee)
e36	*Eucalyptus*	*gracilis*	(yorrell)
e37	*Eucalyptus*	*cornuta*	(yate)
e38	*Eucalyptus*	*lehmannii*	(Bald Is. marlock, bushy yate)
e39	*Eucalyptus*	*sheathiana*	(ribbon-barked gum)
e40	*Eucalyptus*	*concinna*	(Victoria Desert mallee
e43	*Eucalyptus*	*obtusifolia*	(Dongara mallee)
e44	*Eucalyptus*	*erythrocorys*	(illyarrie)
e45	*Eucalyptus*	*accedens*	(powderbark wandoo)
e46	*Eucalyptus*	*oraria*	
e47	*Eucalyptus*	*foecunda*	(narrow-leaved red mallee)
e48	*Eucalyptus*	*tetrodonta*	(Darwin stringybark)
e49	*Eucalyptus*	*miniata*	(woollybutt)
e50	*Eucalyptus*	*tectifica*	(grey box, Darwin box)
e51	*Corymbia*	*grandifolia*	(cabbage gum)
e52	*Corymbia*	*sens lat papuana*	(ghostgum) excluded name
e53	*Eucalyptus*	sp.	[incorectly named *setosa*]
e54	*Eucalyptus*	*argillacea*	(Mt House box)
e55	*Eucalyptus*	*phoenicea*	(gnainga, scarlet gum)
e56	*Corymbia*	*ferruginea*	(rusty bloodwood)
e57	*Corymbia*	*polycarpa*	(long-fruited bloodwood)
e58	*Corymbia*	*cadophora*	(twin-leaf bloodwood)
e59	*Corymbia*	*confertiflora*	(roughleaf cabbage gum)
e60	*Eucalyptus*	*pruinosa*	(silver box)
e61	*Corymbia*	*opaca*	(inland bloodwood)
e62	*Corymbia*	*foelscheana*	
e63	*Corymbia*	*haematoxylon*	(mountain marri)
e64	*Eucalyptus*	*astringens*	(brown mallet)
e65	*Eucalyptus*	*staeri*	(Albany blackbutt)
e66	*Eucalyptus*	*kondininensis*	(Kondinin blackbutt)
e67	*Eucalyptus*	*decipiens*	(redheart)
e68	*Eucalyptus*	*jacksonii*	(red tingle)
e69	*Eucalyptus*	*gardneri*	(blue mallet)
e70	*Eucalyptus*	*eudesmioides*	(malallie)
e71	*Eucalyptus*	*megacarpa*	(bullich)
e72	*Eucalyptus*	*patens*	(yarri)
e73	*Eucalyptus*	*todtiana*	(coastal blackbutt)
e74	*Eucalyptus*	*guilfoylei*	(yellow tingle)
e75	*Eucalyptus*	*brevistylis*	(Rates tingle)
e76	*Eucalyptus*	*angulosa*	(ridge-fruited mallee)
g1	*Grevillea*	*refracta*	(silver-leaf grevillea)
g2	*Grevillea*	*striata*	(beefwood)
h	*Hakea*	*stenophylla*	
h	*Hakea*	*lorea subsp suberea*	(corkwood, witinti)
h	*Hakea*	*obliqua*	(needles and corks)
j	*Jacksonia*	*horrida*	
k	*Maireana*	*sedifolia*	(pearl bluebush)
k*	*Themeda*	*triandra*	(kangaroo grass)
k1	*Atriplex*	*cinerea*	(greysaltbush)
k1	*Atriplex*	*hymenotheca*	
k1	*Atriplex*	*vesicaria*	(bladder saltbush)
k3	*Tecticornia*	*halocnemoides*	(shrubby samphire)
k3	*Tecticornia*	*indica*	(samphire)
l	*Lamarchea*	*hakeifolia*	

MAP CODE	CURRENT GENUS	CURRENT SPECIES	COMMON NAME
l#	*Livistona*	*eastonii*	(fan palm)
m	*Melaleuca*	*cardiophylla*	(tangling melaleuca)
m	*Melaleuca*	*laxiflora*	
m	*Melaleuca*	*rhaphiophylla*	(swamp paperbark)
m	*Melaleuca*	*thyoides*	
m	*Myoporum*	*platycarpum*	(sugarwood)
m2	*Melaleuca*	*preissiana*	(moonah)
m4	*Melaleuca*	*systena*	(coastal honeymyrtle)
m6	*Melaleuca*	*uncinata*	(broom bush)
n	*Nuytsia*	*floribunda*	(christmas tree)
o#	*Owenia*	*reticulata*	(desert walnut, native walnut)
p	*Callitris*	*columellaris*	(white cypress pine)
p	*Callitris*	*preissii*	(Rottnest island pine)
p1*	*Triodia*	*schinzii*	(feathertop, soft spinifex)
p2*	*Triodia*	*melvillei*	
p3*	*Triodia*	*bitextura*	(curly spinifex)
p4*	*Triodia*	*bynoei*	
s1*	*Sehima*	*nervosum*	(white grass)
s2*	*Sorghum*	*stipoideum*	(annual sorghum)
s2*	*Sorghum*	*timorense*	
s3*	*Sporobolus*	*virginicus*	(salt water couch, marine couch)
t1*	*Triodia*	*pungens*	(soft spinifex)
t10*	*Triodia*	*cunninghamii*	
t2*	*Triodia*	*basedowii*	(hard spinifex, lobed spinifex)
t3*	*Triodia*	*wiseana*	(limestone spinifex)
t4*	*Triodia*	*intermedia*	
t5*	*Triodia*	*inutilis*	
t6*	*Triodia*	*brizoides*	
t8*	*Triodia*	*scariosa*	
t9*	*Triodia*	*plurinervata*	
#	Kimberley		
*	grasses		

Table 1.3. Common names used in the descriptive text.

COMMON NAME	CURRENT GENUS	CURRENT SPECIES	MAP CODE
acorn banksia	*Banksia*	*prionotes*	b3
Albany banksia	*Banksia*	*verticillata*	
Albany blackbutt	*Eucalyptus*	*staeri*	e65
aniseed boronia	*Boronia*	*crenulata*	
annual sorghum	*Sorghum*	*stipoideum*	
arid short grass	*Enneapogon*	spp.	e*
Ashby's banksia	*Banksia*	*ashbyi*	b4
ashy hakea	*Hakea*	*cinerea*	
awnless barnyard grass	*Echinochloa**	*colona*	
Bald Is. marlock, bushy yate	*Eucalyptus*	*lehmannii*	e38
bardi,	*Acacia*	*synchronicia*	a10
barley Mitchell grass	*Astrebla*	*pectinata*	a1*
bauhinia	*Bauhinia*	*cunninghamii*	b1#
Beard's mallee	*Eucalyptus*	*beardiana*	
Beard's tufted annual grass	*Aristida*	*holathera*	a3*
beefwood	*Grevillea*	*striata*	g2
black marlock	*Eucalyptus*	*redunca*	e27
black oak	*Casuarina*	*pauper*	c2
bladder saltbush	*Atriplex*	*vesicaria*	k1
blue grevillea	*Grevillea*	*agrifolia*	
blue mallee, tallerack	*Eucalyptus*	*pleurocarpa*	e26
blue mallet	*Eucalyptus*	*gardneri*	e69
boab	*Adansonia*	*gregorii*	α
bossiaea	*Bossiaea*	*bossiaeoides*	
bowgada bush	*Acacia*	*linophylla*	a9
broadleaf paperbark	*Melaleuca*	*viridiflora*	
broadleaf ribbongrass	*Chrysopogon*	*latifolius*	c*
broom ballart	*Exocarpos*	*sparteus*	
broom bush	*Melaleuca*	*uncinata* s.l.	m6
Broome pindan wattle	*Acacia*	*eriopoda*	a28
brown mallet	*Eucalyptus*	*astringens*	e64
bull banksia	*Banksia*	*grandis*	
bull Mitchell grass	*Astrebla*	*squarrosa*	
bullich	*Eucalyptus*	*megacarpa*	e71
bunch speargrass	*Heteropogon*	*contortus*	
bunched kerosene grass	*Aristida*	*contorta*	
bunjong	*Pimelea*	*spectabilis*	
Burdett's banksia	*Banksia*	*burdettii*	
button grass	*Dactyloctenium*	*radulans*	
cabbage gum	*Corymbia*	*grandifolia*	e51
caesia	*Eucalyptus*	*caesia*	
camel bush	*Trichodesma*	*zeylanicum*	
candelbra wattle	*Acacia*	*holosericea*	
capped mallee	*Eucalyptus*	*pileata*	
cauliflower hakea	*Hakea*	*corymbosa*	
caustic bush	*Grevillea*	*pyramidalis*	
Cayley's banksia	*Banksia*	*caleyi*	
Champion Bay poison	*Gastrolobium*	*oxylobioides*	
chenille honeymyrtle	*Melaleuca*	*huegelii*	
chittick	*Lambertia*	*inermis*	
chorilaena	*Chorilaena*	*quercifolia*	
christmas tree	*Nuytsia*	*floribunda*	n
claw flower	*Calothamnus*	*chrysantherus*	
Cleland's blackbutt	*Eucalyptus*	*clelandii*	
club mangrove	*Aegialitis*	*annulata*	
coastal blackbutt	*Eucalyptus*	*todtiana*	e73
coastal daisybush	*Olearia*	*axillaris*	
coastal hibiscus	*Alyogyne*	*cuneiformis*	
coastal honeymyrtle	*Melaleuca*	*systena*	m4

COMMON NAME	CURRENT GENUS	CURRENT SPECIES	MAP CODE
coastal jugflower	*Adenanthos*	*cuneatus*	
coastal paperbark	*Melaleuca*	*acacioides*	
coastal wattle	*Acacia*	*cyclops*	a32
comb-leaved grevillea	*Grevillea*	*pectinata*	
Comet Vale mallee	*Eucalyptus*	*comitae-vallis*	
common firebush	*Keraudrenia*	*integrifolia*	
common hakea	*Hakea*	*arborescens*	
common smokebush	*Conospermum*	*stoechadis*	
compass bush	*Allocasuarina*	*pinaster*	
coneflower	*Isopogon*	*cuneatus*	
conkerberry	*Carissa*	*lanceolata*	
coolibah	*Eucalyptus*	*microtheca*	e17
coolibah	*Eucalyptus*	*victrix*	e17
coral gum	*Eucalyptus*	*torquata*	e12
corkwood, witinti	*Hakea*	*lorea* subsp. *suberea*	h
corkybark wattle	*Acacia*	*suberosa*	a27
cotton bush	*Ptilotus*	*obovatus*	
crocodile tree	*Terminalia*	*arostrata*	
curly bluegrass	*Dichanthium*	*fecundum*	d*
curly spinifex	*Triodia*	*bitextura*	p3*
currant bush	*Scaevola*	*spinescens*	
curry flower	*Lysinema*	*ciliatum*	
Darwin stringybark	*Eucalyptus*	*tetrodonta*	e48
delicate lovegrass	*Eragrostis*	*tenellula*	
desert balga	*Xanthorrhoea*	*thorntonii*	
desert bloodwood	*Corymbia*	*chippendalei*	e23
desert kurrajong	*Brachychiton*	*gregorii*	
desert oak	*Allocasuarina*	*decaisneana*	c1
desert walnut, native walnut	*Owenia*	*reticulata*	o#
Dongara mallee	*Eucalyptus*	*obtusifolia*	e43
dryandra-leaved banksia	*Banksia*	*dryandroides*	
dunna dunna	*Lawrencia*	*helmsii*	
Dundas blackbutt	*Eucalyptus*	*dundasii*	e14
dwarf sheoak	*Allocasuarina*	*humilis*	
dwarf twinleaf	*Zygophyllum*	*ovatum*	
fairy grass	*Sporobolus*	*australasicus*	
fan hakea	*Hakea*	*baxteri*	
fan palm	*Livistona*	*eastonii*	l#
feathertop wiregrass	*Aristida*	*latifolia*	
feathertop, soft spinifex	*Triodia*	*schinzii*	p1*
firewood banksia	*Banksia*	*menziesii*	b2
flame grevillea	*Grevillea*	*eriostachya*	
flame grevillea	*Grevillea*	*excelsior*	
flat-topped yate	*Eucalyptus*	*occidentalis*	e7
Flinders grass	*Iseilema*	spp.	
flooded gum	*Eucalyptus*	*rudis*	e18
Forrest's marlock	*Eucalyptus*	*forrestiana*	e32
fuchsia grevillea	*Grevillea*	*bipinnatifida*	
gawar	*Acacia*	*monticola*	a30
ghostgum	*Corymbia*	*sens lat papuana*	e52
giant mallee	*Eucalyptus*	*oleosa*	e22
gidgee	*Acacia*	*pruinocarpa*	
gimlet	*Eucalyptus*	*salubris*	e34
gnainga, scarlet gum	*Eucalyptus*	*phoenicea*	e55
golden beard grass	*Chrysopogon*	*fallax*	c*
goldfields blackbutt	*Eucalyptus*	*lesouefii*	e13
goldfields daisy	*Olearia*	*muelleri*	
graceful honeymyrtle	*Melaleuca*	*radula*	
granite bottlebrush	*Melaleuca*	*elliptica*	
granite kunzea	*Kunzea*	*pulchella*	

Table 1.3. (cont.)

COMMON NAME	CURRENT GENUS	CURRENT SPECIES	MAP CODE
granite poverty bush	*Eremophila*	*platycalyx*	
grass-leaf hakea	*Hakea*	*multilineata*	
gravel bottlebrush	*Beaufortia*	*decussata*	
green birdflower	*Crotalaria*	*cunninghamii*	
grey box, Darwin box	*Eucalyptus*	*tectifica*	e50
grey podolepis	*Podolepis*	*canescens*	
greybush	*Cratystylis*	*conocephala*	
greysaltbush	*Atriplex*	*cinerea*	k1
gulf feathertop wiregrass	*Aristida*	*pruinosa*	a2*
hard spinifex, lobed spinifex	*Triodia*	*basedowii*	t2*
harsh hakea	*Hakea*	*prostrata*	
heath-leaved honeysuckle	*Lambertia*	*ericifolia*	
helicopter tree	*Gyrocarpus*	*americanus*	
holly-leaved banksia	*Banksia*	*ilicifolia*	
honeypot dryandra	*Banksia*	*nivea*	
honey-suckle grevillea	*Grevillea*	*juncifolia*	
hood-leaved hakea	*Hakea*	*cucullata*	
hook-leaf thryptomene	*Thryptomene*	*australis*	
hook-leaved mallee	*Eucalyptus*	*uncinata*	
horned mallee	*Eucalyptus*	*eremophila*	e15
horse mulga, bowgada	*Acacia*	*ramulosa*	a9
illyarrie	*Eucalyptus*	*erythrocorys*	e44
inland bloodwood	*Corymbia*	*opaca*	e61
ironwood	*Erythrophleum*	*chlorostachys*	
jam	*Acacia*	*acuminata*	a19
jaradinty	*Hakea*	*macrocarpa*	
jarrah	*Eucalyptus*	*marginata*	e2
kangaroo grass	*Themeda*	*triandra*	k*
kapok bush	*Cochlospermum*	*fraseri*	
kapok mangrove	*Camptostemon*	*schultzii*	
karri	*Eucalyptus*	*diversicolor*	e1
karri hazel	*Trymalium*	*spatulatum*	
karri sheoak	*Allocasuarina*	*decussata*	
karri wattle	*Acacia*	*pentadenia*	
Kimberley heather	*Calytrix*	*exstipulata*	
Kimberley snappy gum	*Eucalyptus*	*brevifolia*	e16
king dryandra	*Banksia*	*proteoides*	
Kingsmill's mallee	*Eucalyptus*	*kingsmillii*	e21
Kondinin blackbutt	*Eucalyptus*	*kondininensis*	e66
kurara	*Acacia*	*tetragonophylla*	
lace-net grevillea	*Grevillea*	*stenomera*	
large-fruited mallee	*Eucalyptus*	*youngiana*	e20
Leichardt pine	*Nauclea*	*orientalis*	
lemonwood	*Dolichandrone*	*heterophylla*	
lerp mallee	*Eucalyptus*	*incrassata*	e29
limestone spinifex	*Triodia*	*wiseana*	t3*
limestone wattle	*Acacia*	*sclerosperma*	a8
little bottlebrush	*Beaufortia*	*micrantha*	
long-fruited bloodwood	*Corymbia*	*polycarpa*	e57
Maitland's wattle	*Acacia*	*maitlandii*	
malallie	*Eucalyptus*	*eudesmioides*	e70
mangaloo	*Planchonia*	*careya*	
Mann Range mallee	*Eucalyptus*	*mannensis*	
many-flowered mallee	*Eucalyptus*	*cooperiana*	e31
marble gum	*Eucalyptus*	*gongylocarpa*	e19
marri	*Corymbia*	*calophylla*	e3
merrit	*Eucalyptus*	*flocktoniae*	e11
mimosa bush	**Vachellia*	*farnesiana*	

COMMON NAME	CURRENT GENUS	CURRENT SPECIES	MAP CODE
mindiyed	*Melaleuca*	*nesophila*	
miniritchie	*Acacia*	*cyperophylla*	a12
miniritchie	*Acacia*	*grasbyi*	a17
minni ritchi	*Acacia*	*trachycarpa*	a7
moonah	*Melaleuca*	*preissiana*	m2
moort	*Eucalyptus*	*platypus*	e28
mountain marri	*Corymbia*	*haematoxylon*	e63
mountain white gum	*Eucalyptus*	*mooreana*	
Mt House box	*Eucalyptus*	*argillacea*	e54
mulga	*Acacia*	*aneura*	a1
narrowleaf mulla mulla	*Ptilotus*	*drummondii*	
narrow-leaved red mallee	*Eucalyptus*	*foecunda*	e47
native fuchsia	*Eremophila*	*maculata*	
native pomegranate	*Balaustion*	*pulcherrimum*	
needle tree	*Hakea*	*preissii*	
needleleaf wattle	*Acacia*	*orthocarpa*	
needles and corks	*Hakea*	*obliqua*	h
neverfail grass	*Eragrostis*	*setifolia*	
northern sheoak	*Allocasuarina*	*dielsiana*	
oak-leaved dryandra	*Banksia*	*heliantha*	d1
Oldfield's mallee	*Eucalyptus*	*oldfieldii*	
open-fruited mallee	*Eucalyptus*	*annulata*	
oval-leaf hakea	*Hakea*	*elliptica*	
panjang	*Acacia*	*lasiocarpa*	a26
parrot bush	*Banksia*	*sessilis*	
pear-fruited mallee	*Eucalyptus*	*pyriformis*	
pearl bluebush	*Maireana*	*sedifolia*	k
pebble bush	*Stylobasium*	*spatulatum*	
peppermint	*Agonis*	*flexuosa*	ag
Pilbara snappy gum	*Eucalyptus*	*leucophloia* subsp. *leucophloia*	e16
pimelea daisybush	*Olearia*	*pimeleoides*	
pincushion coneflower	*Isopogon*	*dubius*	
pincushion hakea	*Hakea*	*laurina*	
pincushions	*Borya*	*nitida*	
pindan wattle	*Acacia*	*tumida*	a29
pineapple bush	*Dasypogon*	*bromeliifolius*	
pingle	*Banksia*	*squarrosa* subsp. *squarrosa*	
pink dryandra	*Banksia*	*carlinoides*	
pinyuru	*Eremophila*	*cuneifolia*	
plume canegrass	*Sorghum*	*plumosum*	
pompom head	*Cephalipterum*	*drummondii*	
pornupan	*Sonneratia*	*alba*	
povertybush	*Acacia*	*translucens*	
powderbark wandoo	*Eucalyptus*	*accedens*	e45
prickly dryandra	*Banksia*	*armata*	
prickly poison	*Gastrolobium*	*spinosum*	
pukkati	*Acacia*	*beauverdiana*	a34
purslane	*Portulaca*	*oleracea*	
quandong	*Santalum*	*acuminatum*	
Queensland blue grass	*Dichanthium*	*sericeum*	d*
ranji bush	*Acacia*	*pyrifolia*	a2
Rates tingle	*Eucalyptus*	*brevistylis*	e75
red flowered moort	*Eucalyptus*	*proxima*	e33
red leschenaultia	*Lechenaultia*	*formosa*	
red mallee	*Eucalyptus*	*socialis*	e30
red morrel	*Eucalyptus*	*longicornis*	e9
red tingle	*Eucalyptus*	*jacksonii*	e68
red tooth brushes	*Grevillea*	*hookeriana*	
redwood	*Eucalyptus*	*transcontinentalis*	e10
redwood mallee	*Eucalyptus*	*moderata*	e10

Table 1.3. (cont.)

COMMON NAME	CURRENT GENUS	CURRENT SPECIES	MAP CODE
redheart	*Eucalyptus*	*decipiens*	e67
rhynchosia	*Rhynchosia*	*minima*	
ribbed hakea	*Hakea*	*costata*	
ribbed-fruited orange mangrove	*Bruguiera*	*exaristata*	
ribbon-barked gum	*Eucalyptus*	*sheathiana*	e39
ridge-fruited mallee	*Eucalyptus*	*angulosa*	e76
river fig	*Ficus*	*coronulata*	
river gum	*Eucalyptus*	*camaldulensis*	e18
river mangrove	*Aegiceras*	*corniculatum*	
rock grevillea	*Grevillea*	*heliosperma*	
rock sheoak	*Allocasuarina*	*huegeliana*	c5
Rogersons' grevillea	*Grevillea*	*rogersoniana*	
rose banjine	*Pimelea*	*rosea*	
rose coneflower	*Isopogon*	*formosus*	
Rottnest island pine	*Callitris*	*preissii*	p
rough chainpea	*Alysicarpus*	*rugosus*	
rough fuited mallee	*Eucalyptus*	*corrugata*	e35
rough honeymyrtle	*Melaleuca*	*scabra*	
roughleaf cabbage gum	*Corymbia*	*confertiflora*	e59
round-fruit banksia	*Banksia*	*sphaerocarpa*	
round-leaved pigface	*Disphyma*	*crassifolium*	
royal mulla mulla	*Ptilotus*	*rotundifolius*	
rusty bloodwood	*Corymbia*	*ferruginea*	e56
sago bush	*Maireana*	*pyramidata*	
salmon gum	*Eucalyptus*	*salmonophloia*	e8
salt water couch, marine couch	*Sporobolus*	*virginicus*	s3*
saltwater paperbark	*Melaleuca*	*cuticularis*	
samphire	*Tecticornia*	*indica*	k3
sand hibiscus	*Alyogyne*	*pinoniana*	
sandhill wattle	*Acacia*	*dictyophleba*	
sandplain cypress	*Actinostrobus*	*arenarius*	
sandplain wattle	*Acacia*	*murrayana*	a20
sandplain woody pear	*Xylomelum*	*angustifolium*	
sceptre Banksia	*Banksia*	*sceptrum*	
seaheath	*Frankenia*	*pauciflora*	
sensitive plant	*Neptunia*	spp.	
Shark Bay mallee	*Eucalyptus*	*roycei*	
Shark Bay poverty bush	*Eremophila*	*maitlandii*	
sheoak	*Allocasuarina*	*fraseriana*	c7
shrubby samphire	*Tecticornia*	*halocnemoides*	k3
shrubby twinleaf	*Zygophyllum*	*aurantiacum*	
sickle lovegrass	*Eragrostis*	*falcata*	
silky grevillea	*Grevillea*	*pteridifolia*	
silver box	*Eucalyptus*	*pruinosa*	e60
silver poverty bush	*Eremophila*	*pterocarpa*	
silver saltbush	*Atriplex*	*bunburyana*	
silver sida	*Sida*	*fibulifera*	
silver-leaf grevillea	*Grevillea*	*refracta*	g1
silver-topped gimlet	*Eucalyptus*	*campaspe*	
slender banksia	*Banksia*	*attenuata*	b1
slender petalostylis	*Petalostylis*	*labicheoides*	
small burrgrass	*Tragus*	*australianus*	
snakewood	*Acacia*	*eremaea*	a11
snakewood	*Acacia*	*xiphophylla*	a11
snottygobble	*Persoonia*	*longifolia*	
soft spinifex	*Triodia*	*pungens*	t1*
southern cross	*Xanthosia*	*rotundifolia*	
southern diplolaena	*Diplolaena*	*dampieri*	

COMMON NAME	CURRENT GENUS	CURRENT SPECIES	MAP CODE
southern plains banksia	*Banksia*	*media*	
spearwood	*Kunzea*	*ericifolia*	
spider grass	*Brachyachne*	*convergens*	
spiked andersonia	*Andersonia*	*simplex*	
spiked malvastrum	*Malvastrum*	*americanum*	
spiny sida	*Sida*	*spinosa*	
spotted poverty bush	*Eremophila*	*abietina*	
spotted-leaved red mangrove	*Rhizophora*	*stylosa*	
spurred mangrove	*Ceriops*	*tagal*	
stem-fruit fig	*Ficus*	*racemosa*	
sticky everlasting	*Lawrencella*	*davenportii*	
sticky hopbush	*Dodonaea*	*viscosa*	
sticky kurrajong	*Brachychiton*	*viscidulus*	
Stirling Range smokebush	*Conospermum*	*coerulescens* subsp. *dorrienii*	
Sturt's desert pea	*Swainsona*	*formosa*	
Sturt's desert rose	*Gossypium*	*sturtianum*	
sugarwood	*Myoporum*	*platycarpum*	m
summer dryandra	*Banksia*	*vestita*	
summer-scented wattle	*Acacia*	*rostellifera*	a23
supplejack	*Ventilago*	*viminalis*	
swamp bottlebrush	*Beaufortia*	*sparsa*	
swamp mallet	*Eucalyptus*	*spathulata*	
swamp paperbark	*Melaleuca*	*rhaphiophylla*	m
swamp peppermint	*Taxandria*	*linearifolia*	
swamp sheoak	*Casuarina*	*obesa*	c6
sword sedge	*Lepidosperma*	*gladiatum*	
tall mulla mulla	*Ptilotus*	*nobilis*	
tangled honeypot	*Banksia*	*pteridifolia*	
tangling melaleuca	*Melaleuca*	*cardiophylla*	m
tea tree	*Melaleuca*	*minutifolia*	
thick-leaved fan-flower	*Scaevola*	*crassifolia*	
three winged bluebush	*Maireana*	*triptera*	
tickweed	*Cleome*	*viscosa*	
toothed saltbush	*Atriplex*	*acutibractea*	
tree hovea	*Hovea*	*elliptica*	
tropical banksia	*Banksia*	*dentata*	
tuart	*Eucalyptus*	*gomphocephala*	e4
turpentine bush	*Eremophila*	*clarkei*	
turpentine mulga	*Acacia*	*brachystachya*	a15
turpentine wattle	*Acacia*	*lysiphloia*	
twin-leaf bloodwood	*Corymbia*	*cadophora*	e58
twin-leaf mallee	*Eucalyptus*	*gamophylla*	e25
two-leaf hakea	*Hakea*	*trifurcata*	
two-winged gimlet	*Eucalyptus*	*diptera*	
umbrella bush	*Acacia*	*ligulata*	a21
urchins	*Triumfetta*	*chaetocarpa*	
vaiable barked bloodwood	*Corymbia*	*dichromophloia*	e24
variable leaved hakea	*Hakea*	*varia*	
veined peppercress	*Lepidium*	*rotundum*	
Victoria Desert mallee	*Eucalyptus*	*concinna*	e40
wallflower poison	*Gastrolobium*	*grandiflorum*	
wanderrie grasses	*Eriachne*	spp.	
wandoo	*Eucalyptus*	*wandoo*	e5
warty fuchsia bush	*Eremophila*	*latrobei*	
waterwood or wirewood	*Acacia*	*coriacea*	a3
wavy-leaved hakea	*Hakea*	*undulata*	
weeping Mitchell grass	*Astrebla*	*elymoides*	
weeping pittosporum	*Pittosporum*	*angustofolium*	
western myall	*Acacia*	*papyrocarpa*	a13
white cypress pine	*Callitris*	*columellaris*	p

Table 1.3. (cont.)

COMMON NAME	CURRENT GENUS	CURRENT SPECIES	MAP CODE
white everlasting	*Rhodanthe*	*floribunda*	
white grass	*Sehima*	*nervosum*	s1*
white mallee	*Eucalyptus*	*cylindriflora*	
white mangrove	*Avicennia*	*marina*	
white plume grevillea	*Grevillea*	*leucopteris*	
white-leaved mallee	*Eucalyptus*	*albida*	
white-stemmed wattle	*Acacia*	*xanthina*	
whitewood	*Atalaya*	*hemiglauca*	
Wickham's grevillea	*Grevillea*	*wickhamii*	
Wilcox bush	*Eremophila*	*forrestii*	
wild mango	*Buchanania*	*obovata*	
wild plum	*Terminalia*	*platyphylla*	
winged chloris	*Oxychloris*	*scariosa*	
woolly sunray	*Leucochrysum*	*stipitatum*	
woollybutt	*Eucalyptus*	*miniata*	e49
yarri	*Eucalyptus*	*patens*	e72
yate	*Eucalyptus*	*cornuta*	e37
yellow hibiscus	*Hibiscus*	*panduriformis*	
yellow tailflower	*Anthocercis*	*littorea*	
yellow tingle	*Eucalyptus*	*guilfoylei*	e74
York gum	*Eucalyptus*	*loxophleba*	e6
yorrell	*Eucalyptus*	*gracilis*	e36
zamia	*Macrozamia*	*riedlei*	

Table 2. Name changes incorporated into the memoir.

ORIGINAL GENUS	ORIGINAL SPECIES	CURRENT GENUS	CURRENT SPECIES	CURRENT SUBSPECIES
Acacia	*decipiens*	*Acacia*	*truncata*	
Acacia	*impressa*	*Acacia*	*monticola*	
Acacia	*farnesiana*	*Vachellia*	*farnesiana*	
Acacia	*lycopodiifolia*	*Acacia*	*adoxa*	
Acacia	*pachycarpa*	*Acacia*	*eriopoda*	In Pilbara and Gascoyne Regions
Acacia	*translucens*	*Acacia*	*stellaticeps*	
Acacia	*validinervia*	*Acacia*	*steedmanii* subsp. *borealis*	
Acacia	*victoriae*	*Acacia*	*syncrhoconia*	
Acacia	*xylocarpa*	*Acacia*	*orthocarpa*	
Aristida	*browniana*	*Aristida*	*holathera*	
Agonis	*linearifolia*	*Taxandria*	*linearifolia*	
Arthrocnemum	spp.	*Tecticornia*	spp.	
Baeckea	*cryptandroides*	*Enekbatus*	*cryptandroides*	
Bursaria	*spinosa*	*Bursaria*	*occidentalis*	
Burtonia	*polyzyga*	*Gompholobium*	*polyzygum*	
Burtonia	*villosa*	*Gompholobium*	*villosum*	
Brachysema	*latifolium*	*Gastrolobium*	*latifolium*	
Callistemon	*speciosus*	*Callistemon*	*glaucus*	
Callistris	*intratropica*	*Callitris*	*columellaris*	
Calytrix	*interstans*	*Calytrix*	*exstipulata*	
Calytrix	*microphylla*	*Calytrix*	*exstipulata*	
Calytrix	*brachyphylla*	*Calytrix*	*leschenaultii*	
Cassia	*oligophylla*	*Senna*	*artemisioides*	subsp. *artemisioides*
Cassia	*nemophila*	*Senna*	*artemisioides*	subsp. x *coriacea*
Cassia	*desolata*	*Senna*	*artemisioides*	subsp. x *sturtii*
Cassia	*luerssenii*	*Senna*	*glutinosa*	subsp. x *luerssenii*
Cassia	*pleurocarpa*	*Senna*	*pleurocarpa*	var. *pleurocarpa*
Cassia	*chatelainiana*	*Senna*	*charlesiana*	
Casuarina	*acutivalvis*	*Allocasuarina*	*acutivalvis*	
Casuarina	*campestris*	*Allocasuarina*	*campestris*	
Casuarina	*decaisneana*	*Allocasuarina*	*decaisneana*	
Casuarina	*decussata*	*Allocasuarina*	*decussata*	
Casuarina	*dielsiana*	*Allocasuarina*	*dielsiana*	
Casuarina	*fraseriana*	*Allocasuarina*	*fraseriana*	
Casuarina	*huegeliana*	*Allocasuarina*	*huegeliana*	
Casuarina	*humilis*	*Allocasuarina*	*humilis*	
Casuarina	*pinaster*	*Allocasuarina*	*pinaster*	
Casuarina	*cristata*	*Casuarina*	*pauper*	
Chloris	*scariosa*	*Oxychloris*	*scariosa*	
Clianthus	*formosus*	*Swainsona*	*formosa*	
Conospermum	*dorrienii*	*Conospermum*	*coerulescens*	subsp. *dorrienii*
Danthonia	*caespitosa*	*Austrodanthonia*	*caespitosa*	
Dichanthium	*affine*	*Dichanthium*	*sericeum*	subsp. *sericeum*
Dryandra	*ashbyi*	*Banksia*	*fraseri*	var. *ashbyi*
Dryandra	*carduacea*	*Banksia*	*squarrosa*	subsp. *squarrosa*
Dryandra	*armata*	*Banksia*	*armata*	
Dryandra	*cirsioides*	*Banksia*	*cirsioides*	
Dryandra	*longifolia*	*Banksia*	*prolata*	
Dryandra	*nivea*	*Banksia*	*nivea*	
Dryandra	*proteoides*	*Banksia*	*proteoides*	
Dryandra	*pteridifolia*	*Banksia*	*pteridifolia*	
Dryandra	*quercifolia*	*Banksia*	*heliantha*	
Dryandra	*sessilis*	*Banksia*	*sessilis*	
Eragrostis	*japonica*	*Eragrostis*	*tenellula*	
Eremophila	*leucophylla*	*Eremophila*	*forrestii*	
Eriostemon	*tomentellus*	*Philotheca*	*tomentella*	
Eucalyptus	*aspera*	*Corymbia*	*aspera*	

Table 2 (cont.)

ORIGINAL GENUS	ORIGINAL SPECIES	CURRENT GENUS	CURRENT SPECIES	CURRENT SUBSPECIES
Eucalyptus	sp. aff. *aspera*	*Corymbia*	*candida*	
Eucalyptus	*brevifolia*	*Eucalyptus*	*leucophloia*	In the Pilbara
Eucalyptus	*calophylla*	*Corymbia*	*calophylla*	
Eucalyptus	*chippendalei*	*Corymbia*	*chippendalei*	
Eucalyptus	*confertiflora*	*Corymbia*	*confertiflora*	
Eucalyptus	*dichromophloia*	*Corymbia*	*dichromophloia*	
Eucalyptus	*dongarraensis*	*Eucalyptus*	*obtusifolia*	var. *dongarensis*
Eucalyptus	*ferruginea*	*Corymbia*	*ferruginea*	
Eucalyptus	*foelscheana*	*Corymbia*	*foelscheana*	
Eucalyptus	*grandifolia*	*Corymbia*	*grandifolia*	
Eucalyptus	*haematoxylon*	*Corymbia*	*haematoxylon*	
Eucalyptus	*microtheca*	*Eucalyptus victrix* in Pilbara/Gascoyne/Western Deserts		
Eucalyptus	*papuana*	*Corymbia* sens. lat. *papuana* Excluded name not found in Australia		
Eucalyptus	*perfoliata*	*Corymbia*	*cadophora*	
Eucalyptus	*polycarpa*	*Corymbia*	*polycarpa*	
Eucalyptus	*nutans*	*Eucalyptus*	*proxima*	
Eucalyptus	*setosa* (e53)	excluded taxon (Not in WA. See Brooker & Kleinig, Field Guide 3:106 [1994])		
Eucalyptus	*Setosa*	*Eucalyptus*	*deserticola*	In Gascoyne and Carnarvon Regions
Eucalyptus	*terminalis*	*Corymbia*	*opaca*	
Eucalyptus	*tetragona*	*Eucalyptus*	*pleurocarpa*	
Eucalyptus	*transcontinentalis*	*Eucalyptus*	*moderata*	
Gardenia	*keartlandii*	*Gardenia*	*pyriformis*	
Hakea	*suberea*	*Hakea*	*lorea*	subsp. *suberea*
Halosarcia	*halocnemoides*	*Tecticornia*	*halocnemoides*	
Halosarcia	*leptoclada*	*Tecticornia*	*leptoclada*	
Helichrysum	*davenportii*	*Lawrencella*	*davenportii*	
Helipterum	*stipitatum*	*Leucochrysum*	*stipitatum*	
Helipterum	*floribundum*	*Rhodanthe*	*floribunda*	
Jacksonia	*thesioides*	*Jacksonia*	*forrestii*	
Kochia	*sedifolia*	*Maireana*	*sedifolia*	
Kunzea	*vestita*	*Kunzea*	*ericifolia*	
Lysiphyllum	*cunninghamii*	*Bauhinia*	*cunninghamii*	
Malvastrum	*spicatum*	*Malvastrum*	*americanum*	*
Melaleuca	*polygaloides*	*Melaleuca*	*incana*	subsp. *incana*
Melaleuca	*parviflora*	*Melaleuca*	*laxiflora*	
Melaleuca	*acerosa*	*Melaleuca*	*systena*	
Olearia	*propinqua*	*Olearia*	*pimeleoides*	
Pittosporum	*phylliraeoides*	*Pittosporum*	*angustifolium*	
Plectrachne	*pungens*	*Triodia*	*bitextura*	
Plectrachne	*bynoei*	*Triodia*	*bynoei*	
Plectrachne	*melvillei*	*Triodia*	*melvillei*	
Plectrachne	*schinzii*	*Triodia*	*schinzii*	
Ptilotus	*exaltatus*	*Ptilotis*	*nobilis*	
Sorghum	*australiense*	*Sorghum*	*timorense*	
Sterculia	*viscidula*	*Brachychiton*	*viscidulus*	
Stipa	*nitida*	*Austrostipa*	*nitida*	
Stipa	*elegantissima*	*Austrostipa*	*elegantissima*	
Stipa	*eremophila*	*Austrostipa*	*eremophila*	
Swainsona	*occidentalis*	*Swainsona*	*pterostylis*	
Terminalia	*rogersii*	*Terminalia*	*arostrata*	
Terminalia	*ferdinandiana*	*Terminalia*	*latipes*	subsp. *psilocarpa*
Terminalia	*volucris*	*Terminalia*	*oblongata*	
Themeda	*australis*	*Themeda*	*triandra*	
Thryptomene	*maisonneuvei*	*Aluta*	*maisonneuvei*	
Waitzia	*aurea*	*Waitzia*	*nitida*	
Wehlia	*thryptomenoides*	*Homalocalyx*	*thryptomenoides*	
Xanthorrhoea	*reflexa*	*Xanthorrhoea*	*drummondii*	*sw*

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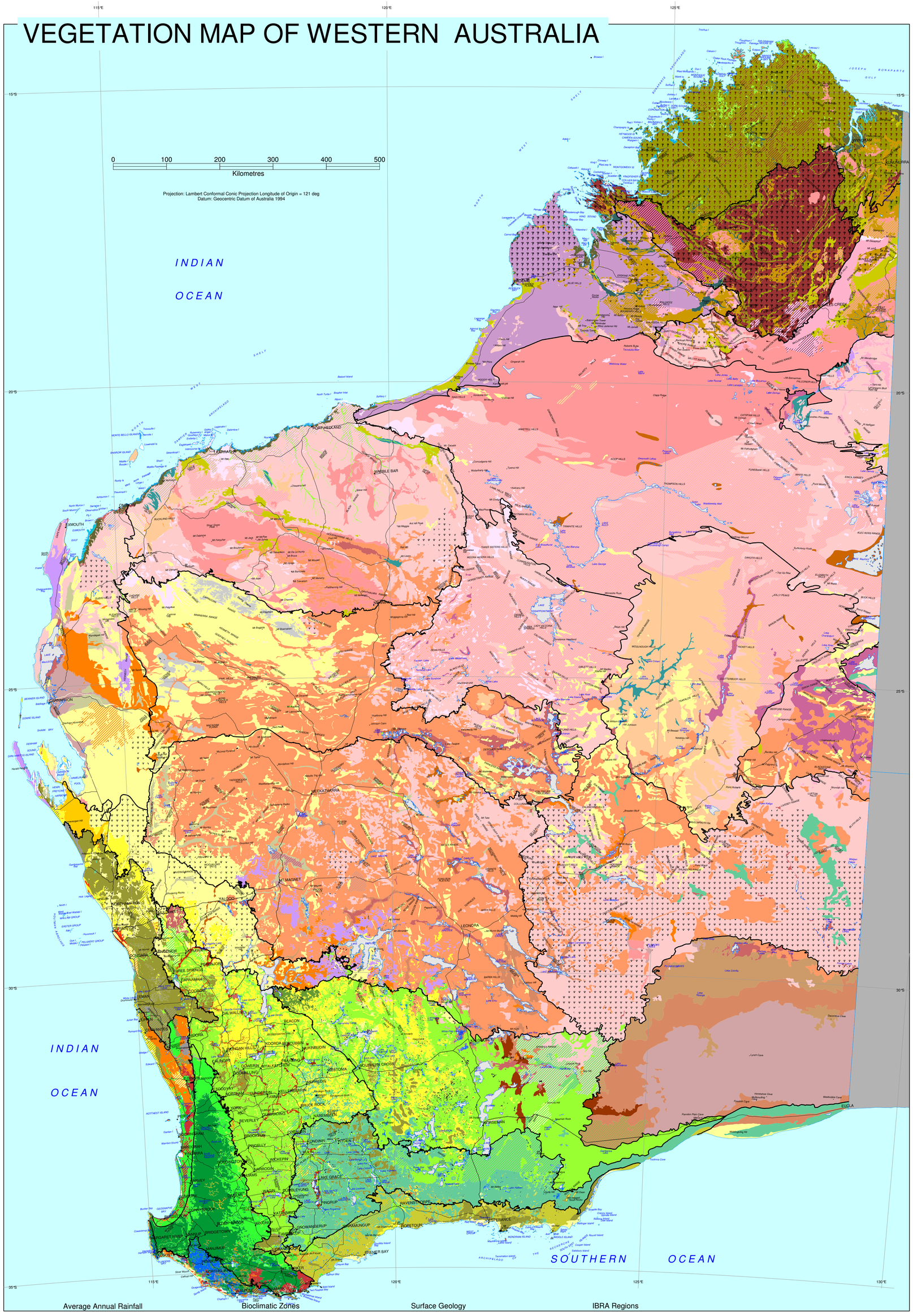
VEGETATION MAP OF WESTERN AUSTRALIA



PHYSIOGNOMIC VEGETATION TYPES

Legend

TALL FOREST AND WOODLAND — **> 30m tall**

1	Tall forest Tall woodland	Mainly karri *(Eucalyptus diversicolor)* Tuart *(E. gomphocephala)*

MEDIUM FOREST AND WOODLAND — **10 - 30m tall**

2	Forest	Mainly jarrah *(E. marginata)* and marri *(Corymbia calophylla)*
3	Woodland	Jarrah *(E. marginata)*, marri *(C.calophylla)* and wandoo *(E. wandoo)*
4	Woodland	Wheatbelt - york gum *(E. loxophleba)*, salmon gum *(E. salmonophloia)* etc. Goldfields - gimlet *(E. salubris)*, redwood *(E.transcontinentalis)* etc. Riverine - rivergum *(E. camaldulensis)* Tropical - Darwin stringybark *(E. tetrodonta)*, woolybutt *(E. miniata)*
5	Medium-low woodland	York gum *(E. loxophleba)* and cypress *(Callitris columellaris)*

LOW FOREST AND WOODLAND — **< 10m tall**

6	Low forest	Wattle *(Acacia rostellifera)*, Rottnest pine *(Callitris preissii)*, moort *(Eucalyptus platypus)* or mixed tropical forest
7	Low forest, woodland or low woodland with scattered trees	Jarrah (*E. marginata*), banksia (*Banksia* spp.) or casuarina *(Allocasuarina* spp.)
8	Low woodland, open low woodland or sparse woodland	Mulga *(Acacia aneura)* and associated species
9	Low woodland or open low woodland	Other wattle (*Acacia* spp.), banksia (*Banksia* spp.), peppermint (*Agonis flexuosa*), cypress pine (*Callitris* spp.), casuarina (*Allocasuarina* spp.), York gum (*E. loxophleba)*
10	Mangroves	Low forest (Kimberley) or thicket (Pilbara) mangroves *(Avicennia marina, Rhizophora stylosa, Bruguiera exaristata)*

TALL (SCLEROPHYLL) SHRUBLAND — **> 1m tall**

11	Tree-heath	Mixed heath with low trees (*Banksia ashbyi*)
12	Thicket with medium open woodland, low woodland or scattered low trees	Teatree (*Melaleuca* spp.) with York gum (*E. loxophleba*), wandoo (*E. wandoo*) or casuarina . (*Allocasuarina* spp.*)*
13	Scrub with open woodland or scattered trees	Wattle (*Acacia* spp.) with York gum (*E. loxophleba*), casuarina (*Allocasuarina* spp.), mulga (*Acacia aneura*)
14	Thicket	Wattle, casuarina and teatree (*Acacia-Allocasuarina-Melaeuca* alliance)
15	Scrub, open scrub or sparse scrub	Wattle (*Acacia* spp.), teatree (*Melaleuca* spp.) and other species
16	Mallee	Eucalypt shrubland (*E.eremophila, E. redunca, E.* spp.)

LOW (SCLEROPHYLL) SHRUBLAND — **< 1m tall**

17	Mallee-heath	Mixed heath with scattered mallee eg tallerack, (*E. pleurocarpa)*
18	Scrub-heath	Mixed heath with scattered tall shrubs *Acacia* spp., Proteaceae and Myrtaceae
19	Heath	Low shrubs of mixed composition
20	Dwarf scrub or open low shrubs	*Acacia* spp., *Eremophila* spp. and *Senna* spp.

PINDAN

21	Pindan Woodland	Wattle thicket (*A. tumida*) with eucalypt woodland (*E. tectifica, Corymbia grandifolia*) over spinifex (*Triodia pungens, T. bitextura*)
22	Pindan with low trees	Wattle thicket (*A. eripodia*) with scattered low trees (*C.dichromophloia*) over spinifex (*T. pungens, T. bitextura*)

BUNCH GRASSLAND

23	Grassland, high grass savanna woodland on basalt	Grey box (*E. tectifica*), cabbage gum (*C. grandifolia*) over white grass (*Sehima nervosum*) and ribbon grass (*Chrysopogon* spp.)
24	Grasslands, high grass savanna woodland on sandstone	Bloodwood (*Corymbia dichromophloia*), stringybark (*E. tetrodonta*) over curly spinifex (*Triodia bitextura*) and sorghum (*Sorghum* spp.)
25	Grasslands, tall bunch-grass savanna woodland	Grey box (*E. tectifica*) over ribbon grass (*Chrysopogon spp.*)
26	Grasslands, tall bunch-grass low-tree savanna	Mainly ribbon grass (*Chrysopogon spp., Dichantuium* spp.), blue grass (*Dichanthium* spp.) with low woodland or scattered trees (eg. *E. terminalis*)
27	Grasslands, tall bunch-grass savanna	Mainly Mitchell grass (*Astrebla* spp.)
28	Grasslands, short bunch-grass low-tree savanna	Short grasses (*Enneapogon* spp., *Aristida* spp.) with scattered trees e.g. Bauhinia (*Bauhinia cunninghamii*) and snappy gum (*E. brevifolia*)
29	Grasslands, short bunch-grass savanna	Annual grasses (*Enneapogon* spp., *Aristida* spp. etc.) on dry plains and salt-water grasses (*Sporobolus virginicus*) on the coast
30	Grasslands, curly spinifex savanna woodland or low trees	*Triodia bitextura* with *E. phoenicea, Corymbia ferruginea, E. brevifolia, C. dichromophloia*
31	Grasslands, tall bunch-grass open savanna woodland (riverine)	Coolibah (*E. microtheca*) over ribbon grass (*Chrysopogon* spp.), blue grass (*Dichanthium* spp.)
32	Riverine sedgeland/grassland with trees	Rivergum (*E. camaldulensis*), coolibah (*E. microtheca* in the Kimberley and *E. victrix* in the Pilbara) over mixed sedges
33	Sedgeland	(Mainly in the south-west) *Cyperaceae, Restionaceae, Juncaceae*

SPINIFEX GRASSLAND

34	Tree-steppe	Desert oak (*Allocasuarina decaisneana*) with soft spinifex (*Triodia pungens*)
35	Low tree-steppe	Hummock grassland (*Triodia* spp.) with scattered bloodwood (*C. dichromophloia*) and snappy gum (*E. brevifolia*)
36	Sparse low tree-steppe	Hummock grassland (*Triodia* spp.) with sparse eucalypts e.g. bloodwood (*C. dichromophloia*) and snappy gum (*E.brevifolia*)
37	Tree- and shrub-steppe	Hummock grassland (*Triodia* spp.) with scattered eucalypts (*E. gongylocarpa*) over wattle scrub (*Acacia* spp.) or mallee (*Eucalyptus* spp.)
38	Shrub-steppe	Hummock grassland (*Triodia* spp.) with scattered shrubs (*Acacia* spp., *Grevillea* spp.) or mallee (*Eucalyptus* spp.)
39	Sparse shrub-steppe	Hummock grassland (*Triodia spp.*) with sparse shrubs (*Acacia* spp.)
40	Grass-steppe	Hummock grassland (*Triodia* spp.)
41	Spinifex complexes	Hummock grassland (*Triodia* spp.) with scattered low trees over dwarf shrubs or mixed short grass and spinifex mixed species

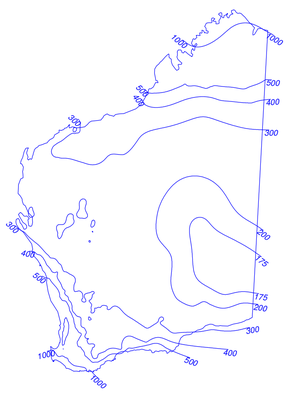
HALOPHYLL AND SARCOPHYLL COMMUNITIES

42	Samphire with thicket and scattered trees	*Tecticornia* spp. with tea tree (*Melaleuca* spp.) with York gum (*E. loxophleba*), casuarina (*Casuarina obesa*)
43	Saltbush and/or bluebush with woodland or scattered trees	*Atriplex* spp., *Maireana* spp. with Salmon gum (*E. salmonophloia*) and gimlet (*E. salubris*)
44	Samphire with scattered medium or low trees	*Tecticornia* spp. with York gum (*E. loxophleba*), mulga (*Acacia aneura*), melaleuca (*Melaleuca* spp.), casuarina (*Allocasuarina* spp.)
45	Saltbush and/or bluebush with low trees	*Atriplex* spp., *Maireana* spp. with mulga (*Acacia aneura*), other wattle (*A. papyocarpa*), casuarina (*Allocasuarina cristata*)
46	Saltbush and/or bluebush with scattered low trees	*Atriplex* spp. *Maireana* spp. with mulga (*Acacia aneura*), other wattle (*A. papyocarpa*), casuarina (*Allocasuarina cristata)*
47	Samphire with thicket/scrub	*Tecticornia* spp. with *Melaleuca* spp., *Acacia* spp.
48	Saltbush and bluebush with scrub or open scrub	*Atriplex* spp., *Maireana* spp. with mulga (*Acacia aneura*), other wattle (*Acacia* spp.)
49	Saltbush and bluebush	*Atriplex* spp., *Maireana* spp. on alkaline soils
50	Samphire	*Tecticornia* communities in saline areas

BARE AREAS

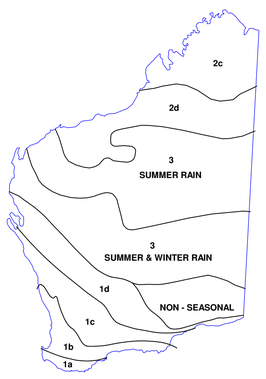
51	Salt lake, lagoon, clay pan	54	Rock
52	Freshwater lake	55	Dune sand
53	Tidal mud flat		

See Beard et al. (2013) memoir for maps showing the distribution of individual vegetation types.



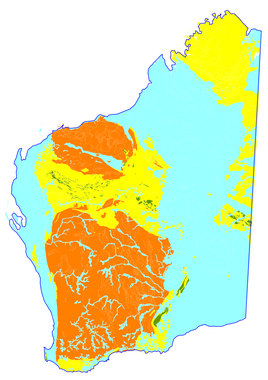
Average Rainfall in millimetres from 1889 -2005

Source: Based on data supplied by the Queensland Department of Environment and Resource Management (2005)



1 - Mediterranean = winter rain
2 - Tropical = summer rain
3 - Desert = no reliable growing season
a = 3 - dry months
b = 5 - 6 dry months
c = 7 - 8 dry months
d = semi-desert 9 - 11 dry months

Source: Beard (1981)



Archaean- mainly granite with included metmorphic rocks

Proterozoic- sedimentary, metamorphic and igneous rocks

Proterozoic - Phanerozoic

Phanerozoic - mainly sandstone, siltstones and limestones

Source: Geological Survey of Western Australia (2001)

Source: Commonwealth Department of Sustainability, Environment, Water, Population and Communities (2004)

Vegetation mosaics are shown as stripes of their respective colours

Major Vegetation Mosaics

101	Woodland/Low woodland/Low forest or Woodland	111	Pindan/Tall bunch-grass low tree savanna
102	Woodland/Mallee	112	Curly spinifex low tree savanna/Sparse low tree-steppe
103	Woodland/Scrub	113	High-grass savanna woodland/Curly spinifex savanna
104	Woodland/Shrub-steppe (mallee)	114	Curly spinifex or short bunch-grass low tree savanna/Grass-steppe
105	Woodland/Saltbush with scattered low trees	115	Short bunch-grass low tree savanna/Tree-steppe
106	Low woodland/Scrub	116	Short bunch-grass savanna/Grass-steppe
107	Scrub-heath/Thicket	117	Sparse low tree-steppe/Sparse shrub-steppe
108	Scrub-heath/Heath	118	Low tree-steppe/Scrub
109	Mallee/Mallee-heath	119	Low woodland or open low woodland/Bluebush and saltbush
110	Scrub or very open scrub/Grass-steppe	120	Saltbush and bluebush/Samphire

IBRA region boundary

Major road

Acknowledgement:
Vegetation shown is original natural vegetation presumed to have existed prior to European settlement.
Descriptions of each of the vegetation types can be found in the accompanying memoir.

Beard, J. S., Beeston, G. R., Harvey, J. M. Hopkins, A. J. M. and Shepherd D.P. (2013)
The vegetation of Western Australia at the 1:3 000 000 scale Explanatory Memoir Second Edition
In: *Conservation Science Western Australia-Vol 9.*

Map produced by Geographic Information Services, Department of Agriculture and Food Western Australia (Job No. 2008192)

Source data:
The major sources of data in the database was the published and unpublished mapping of J.S.Beard at 1:250,000 scale.
Mapping of the south west corner was complied by A.J.M. Hopkins from various sources.

Department of Parks and Wildlife

Department of Agriculture and Food

GOVERNMENT OF WESTERN AUSTRALIA

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