The Vegetation of Western Australia. 1 : 3,000,000 Map with Explanatory Memoir.

Second Edition.

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Abstract

This memoir accompanies the new 1:3,000,000 scale map of the Vegetation of Western Australia. It 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: 52 major vegetation types that occur alone, 5 categories of bare and poorly-vegetated ground and 18 vegetation mosaics. Types range from tall forests of *Eucalyptus diversicolor* of 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 or kwongan of the south west, the saltbush, bluebush and samphire shrublands which occur on saline soils throughout the State, and the various grasslands of *Triodia* (spinifex) and/or *Sorghum, Astrebla, Chrysopogon*. The grasslands in the central and northern parts of the State often have emergent trees with low cover and are described as savanna or steppe.

The map has been generated from a comprehensive, computerised database (Integraph Geographic Information System and associated ORACLE tables) of the vegetation of the State, developed over the past decade, based mainly on the work of J S Beard from 1964 to 1981 (see Hopkins *et al.* in press). More than 1,000 vegetation associations mapped at the scale of 1:250,000 are included in the database. The categories of natural plant cover shown on the map are equivalent to the Supergroups in the new taxonomy of the vegetation developed for that database — each Supergroup is made up of many associates that are floristically and physiognomically related. The structure, composition, and general distribution of each of the Supergroup level vegetation types is described in the Memoir.

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. Users interested in more detailed information on the vegetation of a specific area should query the database. The database is now being used for a wide range of research and planning purposes, including the on-going development of the terrestrial nature conservation reserve system and in the development of natural resource management strategies for regional NRM organisations.

Introduction

Vegetation is something that provides a cover of photosynthetic tissue across the land surface, composed of plants, 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 eg trees or shrubs, trees up to 20 m in height or trees more than 20 m tall and so on, or floristic composition eg *Eucalyptus diversicolor*, *Agonis flexuosa*, *Allocasuarina decussata*, *Trymalium spathulatum*, *Chorilaena quercifolia*, *Acacia pentadenia*, *Hovea* spp., *Bossiaea* spp., *Leucopogon verticillatus* and so on, or some combination of those eg *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 an art and 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 Western-style 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. Hobbs and Hopkins (1990) have categorised these vegetation states as conservation, replacement and utilisation respectively.

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 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 and forestry. It can also be a useful guide on access to remote areas, by cross-country vehicles or helicopter, since a vegetation map shows 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 rural development: Maps showing original and remnant native vegetation contain 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 coming to be recognised: its capacity to reduce salinisation and waterlogging, to minimise erosion, to provide shelter for stock, and to provide a source of predators of insect pests.

The vegetation database which underpins this 1:3,000,000 scale map is currently being used extensively for all these applications.

Early mapping

Information about the spatial distribution of features on the earth's surface has been collected since organised societies began: the oldest surviving map dates from 3500 BC. The initial purposes for collecting geographical data were to aid navigation, for military reasons and later, for census and taxation purposes. These early maps were topographic and cadastral, containing general information about the configuration of the landscape and about land ownership. Later, developments in the assessment and understanding of natural resources, including geology, soils and vegetation, provided new data to be mapped. A new generation of map products emerged, with qualitative or quantitative information about a specific theme expressed as areas of equal value separated by lines, or chloropleths.

Even as methods of surveying and measuring land for the purposes of compiling cadastral maps improved, maps of large areas showing geology, soils and vegetation continued to be rather imprecise: they remained mere sketch maps. Before the introduction of aerial photography in the 1930s it was virtually impossible to map large areas accurately in detail, and any precise vegetation mapping, for example, was confined to local studies.

It is interesting that in the early period for vegetation mapping, Western Australia was well to the fore. L. Diels' book *Die Pflanzenwelt von West-Australien* (The Plant World of Western Australia) published in German in 1906, included a sketch-map at the scale of 1:27,000,000 of the whole continent as the end-papers 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 1902, the Annual Report of the Woods and Forests Department 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 this map showed in colour the jarrah, karri, tuart, white gum, red gum (marri) and york gum and jam forest (and woodland) types. Western Australia also produced the first State map of vegetation, when J.T. Jutson in 1914 produced a sketch at 1:5,000,000 to accompany his classic work on physiography (Jutson 1914). The map was

published in colour and distinguished nine basic vegetation types, alluding to two more (fringing forests and mangrove woodlands) in the legend.

In 1928 the Forests Department reprinted the map with the addition of data contributed by C.A. Gardner on the distribution of the more important species of *Eucalyptus*. This map was again reprinted in 1952 and 1967 without revision. In the meantime Gardner (1942) had published a general account of the vegetation of the State which included a small black and white map at a scale of 1:25,000,000: this was still based on Jutson.

In about 1929, sixty-four 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: 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 1960ab).

The State-wide vegetation mapping project

In 1964 the first author of this memoir, then Director of Kings Park and Botanic Garden, and Professor M J 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 and produced seven 1:1,000,000 scale maps of the vegetation of the State (Beard 1974a, 1975a, 1975b, 1976a, 1979a, 1981a, Beard and Webb 1974), 24 1:250,000 maps for the south west corner of the State between Shark Bay and Esperance (Beard 1960, 1972a, 1972b, 1972c, 1972d, 1972e, 1973a, 1973b, 1976b, 1976c, 1976d, 1976e, 1976f, 1979b, 1979c, 1979d, 1979e, 1980a, 1980b, 1980c, 1980d) (all with explanatory text), together with a number of additional publications (eg. Beard 1980e, 1981b, 1990, Beard and Sprenger 1984). The Director, National Parks Board of Western Australia, Dr F G 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, depopulation by Aboriginal people and so on.

Beard went on to produce two State-wide vegetation maps: one at the scale of 1:3,000,000 which included 39 vegetation units plus a further 11 mosaic units (Beard 1981b) and the second at the scale of 1:10,000,000 with 27 vegetation types

and two mosaics. The latter map was first published with brief explanatory notes in a school atlas (WAY79 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 for at least ten years.

Apart from the three 1:250,000 map sheets contributed by Smith (1972, 1973, 1974), all the mapping was effected on mosaics of aerial photography 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 1986, work has been underway to capture to a Geographic Information System (GIS) and associated Relational Database Management System (ORACLE) all of Beard's vegetation mapping as Phase 1 of a vegetation database for the State. This Phase 1 project is now complete: there is a 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 there are almost 1000 vegetation types. These vegetation associations have been agglomerated in a systematic way to give more general units suitable for mapping at smaller scales. This database and the vegetation taxonomy are described in Hopkins *et al.* (in press). This database has been used to produce this new edition of the *Vegetation of Western Australia.*

Classification and terminology

A critical decision to be made at the commencement of the Vegetation Survey of Western Australia was the approach to be adopted to describing vegetation. Because it was to be a survey of a very large, little-known area, it was considered the 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, however desirable they might be. It was expected that those quantitative or phytosociological methods would be applied in later, more detailed studies, and this is indeed happening.

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 formation 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 worked out and included in the first publication of the Survey (Beard and Webb 1974): this has come to be known as the Beard-Webb System. A similar system was independently proposed by Specht (1970). A description of the Beard-Webb System follows.

Vegetation can usually be observed to consist of defined layers or strata. There will usually be a ground layer of 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 which determines the functioning of the vegetation and enables it to be characterised as forest, shrubland or grassland and so on. In the Specht System, the diagnostic layer is the tallest layer. In contrast, the Beard-Webb System focuses on the ecologically dominant layer - the layer which, because of height or density or both, is considered to have a controlling effect on other layers. It can be observed that dense canopies of trees or shrubs suppress the layers beneath them, but open canopies may not, and so that the understoreys become fully developed. In this 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 System and the Beard-Webb Scheme becomes apparent when considering such vegetation types as shrublands and grasslands with very sparse emergent trees: by the Specht scheme these would be classed as open-woodlands whereas, by the Beard-Webb Scheme they are classed as shrublands or grasslands (tree savanna/steppe).

The second most important characteristic of vegetation is the density of each of the layers, usually measured as canopy cover or projective foliage cover or crown cover. The third important characteristic is the floristic composition of each layer particularly any species which outweigh others in number 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 referred to in 1 above.

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

2. *Density (lower case letters)* -

d	Dense canopy, projective foliage cover > 70 per cent
c	Mid-dense canopy, projective foliage cover 30 - 70 per cent
i	Incomplete canopy, open not touching. projective foliage cover 10 - 30 per cent
r	Rare but conspicuous, projective foliage cover < 10 per cent
b	Barren, vegetation largely absent, projective foliage cover negligible
p	Scattered groups. No definable projective foliage cover

3. *Floristic (lower case letters)* -

a	*Acacia, Adansonia, Aristida & Astrebla* (Kimberley)
ag	*Agonis*
b	*Banksia, Bauhinia* (Kimberley)
c	*Casuarina* (now mostly *Allocasuarina*) or *Callitris*
d	*Dryandra, Dodonaea*
e	*Eucalyptus* (now includes *Corymbia), Enneapogon* (Kimberley)
g	*Grevillea*
h	*Hakea*
j	*Jacksonia*
k	Chenopodiaceae
l	*Lamarchia, Livistona* (Kimberley)
m	*Melaleuca, Myoporum*
n	*Nuytsia*
o	*Owenia*
p	pine (*Callitris*)
s	*Sehima, Sporobolus, Sorghum* (all Kimberley)
t,(p)	*Terminalia* (Kimberley), *Triodia* (includes *Plectrachne*)
x	Heterogeneous (mixed or other)

The classification resulting from the application of the first two diagnostic features or characteristics of vegetation can be represented in tabular form. The following Table shows the final form of the Beard-Webb Scheme, highlighting the binomial codes for each vegetation type and showing the formal name that has been adopted for that type.

Table 1. Classification of vegetation used by Beard for the Vegetation of Western Australia project, from Beard (1981a) with additional names collated from other map sheets and explanatory notes including Beard and Sprenger (1984), and updated during this project.

Table 1a. Communities classified by the upper stratum (ie the upper stratum is ecologically dominant)

Life Form/ Height Class	Canopy Cover				
	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**: Sparse canopy Projective foliage cover ≤10%	**b**: Very sparse canopy Projective foliage cover ≅0%
T: Tall trees >30m tall	**Td**: Dense tall forest	**Tc**: Tall forest	**Ti**: Tall woodland	**Tr**: Open tall woodland	
M: Mediun trees 10-30m tall	**Md**: Dense forest	**Mc**: Forest	**Mi**: Woodland	**Mr**: Open woodland	**Mb**: Very sparse woodland
L: Low trees <10m tall	**Ld**: Dense low forest	**Lc**: Low forest	**Li**: Low woodland	**Lr**: Open low woodland	**Lb**: Very sparse low woodland
S: Shrubs > 1m tall	**Sd**: Dense thicket	**Sc**: Thicket	**Si**: Scrub	**Sr**: Open scrub	**Sb**: Very sparse scrub
Z: Dwarf shrubs < 1m tall	**Zd**: Dense heath	**Zc**: Heath	**Zi**: Dwarf scrub	**Zr**: Open dwarf scrub	**Zb**: Very sparse dwarf scrub
G: Bunch grasses, sedges	**Gd**: Dense grassland	**Gc**: Mid-dense grassland	**Gi**: Grassland	**Gr**: Open grassland	**Gb**: Very sparse grassland
H: Hummock grasses			**Hi**: Hummock grassland	**Hr**: Open hummock grassland	**Hb**: Very sparse hummock grassland
F: Forbs	**Fd**: Dense herbfield	**Fc**: Mid-dense herbfield	**Fi**: Herbfield	**Fr**: Open herbfield	**Fb**: Very sparse herbfield
X: Lichens and mosses			**Xi**: Mat plants	**Xr**: Open mat plants	**Xb**: Very sparse mat plants
C: Succulents			**Ci**: Succulent steppe	**Cr**: Open succulent steppe	**Cb**: Very sparse succulent steppe

Table 1b. Communities classified according to the second stratum (ie the upper stratum is not the most important ecologically)

Description	Canopy Cover of Tree or Shrub Stratum			
	i: Incomplete canopy Projective foliage cover 10-30%	**r**: Sparse canopy Projective foliage cover ≤10%	**b**: Very 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 strata (where the upper stratum is not the most important ecologically)

	Canopy Cover of Tree or Shrub Stratum		
Description	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		

(Note, not all of the named vegetation types occur in Western Australia – they are included here for completeness).

The code letters derived from the vegetation classification appear as a triplet notation in each polygon on the 1:250,000 and 1:1,000,000 scale maps, with additional codes identifying diagnostic floristic elements. As an example, there are polygons on the Perth and Swan sheets (Beard 1979c, 1981a) of e_2Mc which are of Medium forest, jarrah. The notation represents e = *Eucalyptus*, e_2 = *Eucalyptus marginata* or jarrah, M = medium height trees, c = mid-dense canopy. A more detailed explanation of the triplet notation and its development is given in Beard and Webb (1974). Triplet notations do not appear on the 1:3,000,000 scale map because the classification used to produce that map is too generalised to permit their use.

The basic unit identified during the Vegetation Survey is the plant association. This is defined as the largest identifiable unit with consistent dominant species or group of species. Some 715 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 floristically into alliances. Associations may also be grouped together according to their physiognomy (structure and growth-form), into formations: the formation is thus a physiognomic unit. It is alliance-level categories of vegetation that are shown on the 1:1,000,000 scale maps.

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 general international practice, and is as follows:

T	Blue
M	Green
L	Orange
S	Yellow
Z	Grey
G	Olive
H	Red/Pink
F	Rare, not provided
X	Hachured
C	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. A major variation is that vegetation dominated by lichens and mosses (**X** above) was not extensive enough to appear at the scale of 1:3,000,000. In this version of the map, mosaics appear as diagonal hatching, with the colours of the stripes reflecting the components of the mosaic. The three strata vegetation types, pindan and spinifex complex, are mapped in mauve.

The vegetation types shown on the accompanying 1:3,000,000 scale map are described in Appendix 1.

The Interim Biogeographic Regionalisation for Australia

The idea that it is possible to recognise biogeographic regions 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 1867, 1883). A similar observation was later made by Ludwig Diels who divided the southern part of the State into two Botanical Provinces, the Southwest Province and the Eremaean Province, with this latter name derived from the Greek word for desert (Diels 1906). 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. C 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 Western Province further to the east (Gardner 1942, Gardner and Bennetts 1956). The Districts within the South Western Province were refined by N H 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 N T 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. In 1970, H Doing reexamined Burbidge's continental treatment using an analysis of plant species patterns combined with vegetation patterns (Doing 1970). Doing recognised 25 regions for Australia, of which 7 fall within Western Australia.

Zoogeographic regionalisations began with R Tate (1890) who distinquished the

south-west corner of the State, the Autochthonian, from the Eremian or desert region. Soon after, W Baldwin Spencer (1896) erected 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 empahsis 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 (eg 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 J T Jutson (Jutson 1914, 1934), E de C Clarke (1926, 1935, see also Clarke *et al.*1948), L J H Teakle (Teakle 1938), J Macdonald Holmes (Holmes 1938, 1944), Gentilli and Fairbridge (1952) and Gentilli (1978), Jennings and Marbutt (1986), McArthur and Bettenay (1979), Laut *et al.* (1975) 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 (eg. 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 on factors such as geology and climate as well as vegetation. Beard recognised three major Provinces and an Interzone, and, within these, 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 Southwestern Interzone or Coolgardie District; and the Southwestern Botanical Province comprising Irwin, Darling, Avon, Roe and Eyre Districts. These Districts were considered to be *natural ecological regions* with each possessing a characteristic unity of environmental features distinct from that of other Districts. Beard also recognises Subdistricts: these 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 and Sprenger 1984, Beard 1990) which showed the same phytogeographic regions but with a more generalised nomenclature. Figure 1 shows Beard's Natural Regions with the names given to each one by that author.

Most recently, the national nature conservation agency (the Australian National

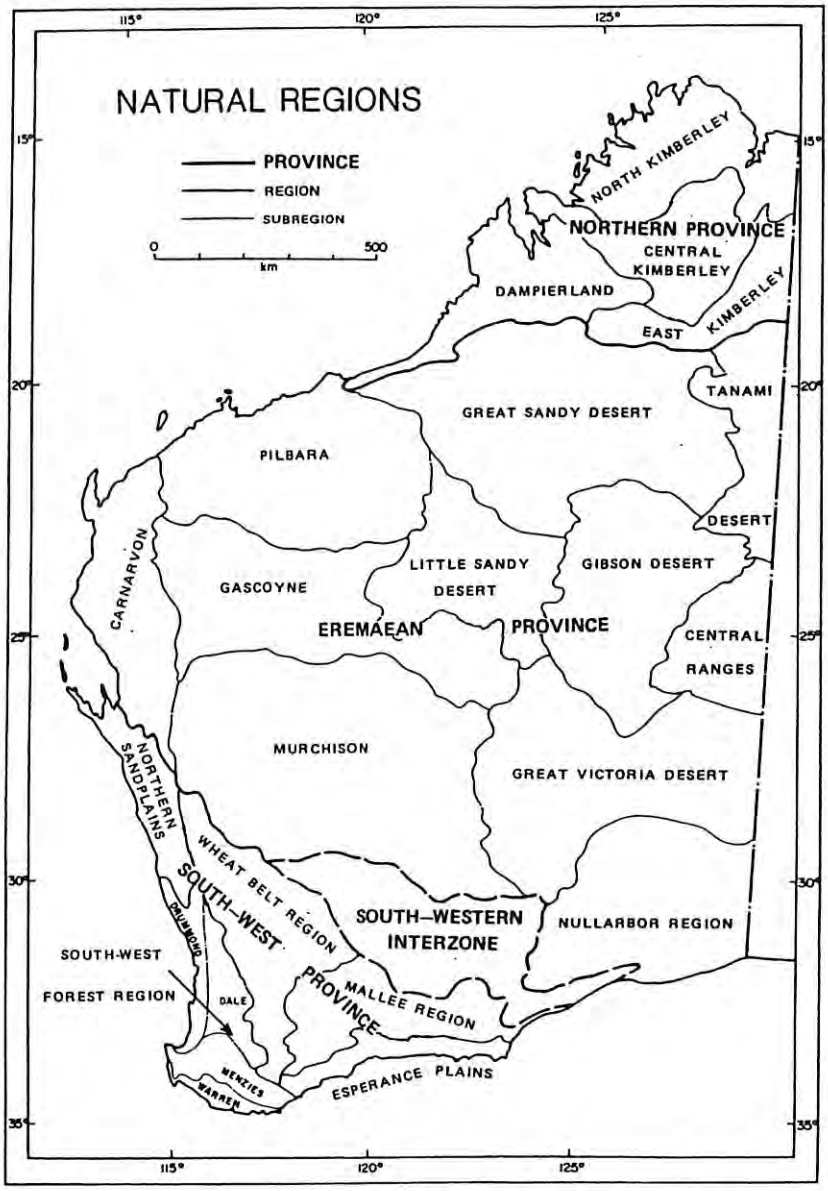

Figure 1. Map showing the Natural Regions of Western Australia described by Beard (from Beard and Sprenger 1984).

Parks and Wildlife Service, subsequently named the Australian Nature Conservation Agency, now 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 sound basis for designing a national network of nature conservation reserves. The scheme finally adopted is based on the biogeographic regionalisations developed separately by each of the States and Territories matched across borders (Thackway and Cresswell 1994). The Western Australian input to the national scheme is Beard's Phytogeographic or Natural Regions (Beard 1980e, Beard and Sprenger 1984), with minor changes derived from new knowledge and contributed by N L McKenzie, G J Keighery, K F Kenneally, G Wardell-Johnson and J S Beard. The scheme resulting from this second approach, named the Interim

Biogeographic Regionalisation for Australia (IBRA), has recently been used as the basis for a conservation assessment at the national scale (Thackway and Cresswell 1995) and at the State scale for Western Australia (Hopkins *et al.* 1996). 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), with background geographical data, is included here (Map 2). The relationship between IBRA Regions and Beard's Natural and Phytogeographic Regions is shown in Table 2.

It is important to realise that the regional boundary lines generally represent a zone of change in biophysical charasteristics 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 Region 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 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.

Table 2. Relationship between Beard's Natural Regions (Beard and Sprenger 1984, Beard 1990) and the recently derived Regions forming the Western Australian part of the Interim Biogeographic Regionalisation for Australia (Thackway and Cresswell 1995). Names ascribed to the Phytogeographic Provinces, Districts and Sub-districts by Beard (1980e) are included in brackets.

Beard's Natural Region (Phytogeographical Region)	**IBRA Region**	**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 Western Province		
Northern Sandplains (Irwin)	Geraldton Sandplains	GS
Avon Wheatbelt (Avon)	Avon Wheatbelt	AW
South West Forest Region - Drumond (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

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Appendix 1. Descriptions of the vegetation types

In this section, the vegetation types shown on the accompanying map are described. 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. 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 eighteen most extensive ones are described after the bare ground categories. Insert maps show the location of occurrence of each type.

In many cases the vegetation types appear to be 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. These geographic groupings are largely a reflection of current and past climates.

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. Between approximately 18° and 23° South latitude, 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 and herbaceous shrubby perennial plants germinate after good rains and cover 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 samphires that we call halophyll types and those composed mainly of saltbush and bluebush that we call sarcophyll types. Samphire is the term applied to halophytes (salt loving plants) such as *Halosarcia* species that form succulent, leafless shrubs generally less than 0.5 m tall. Halophyll types are characterised by samphire and 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 Nullarbor Bioregion, *A. hymenotheca* in Coolgardie and Nullarbor Bioregions and *A. cinerea* (grey saltbush) in Carnarvon Bioregion. Bluebush is usually *Maireana sedifolia* (pearl bluebush) once known as *Kochia sedifolia*. Saltbush and bluebush shrub layers typically have a cover of between 30-70%. 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 samphires and satbush/bluebush occur together, we have mapped them as the relevant halophyll vegetation type.

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 up-date the species names used in this memoir, drawing on information available from the Western Australian Herbarium. In most cases, the change has been straight forward, while in other cases some uncertainty remains. Where there is uncertainty, we have attempted to indicate this. For example, in the original mapping documentation, the senior author, J S 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*.

Major vegetation types

1. Tall forest, mainly karri, and Tall woodland, tuart

Tall forest consists of trees exceeding 30m in height with closed canopy. *Eucalyptus diversicolor* (karri) is the principal species in this vegetation type. It may occur in pure stands or in mixtures with *Corymbia calophylla* (marri) and/or *E. marginata* (jarrah), and less commonly with *Eucalyptus jacksonii* (red tingle), *E. guilfoylei* (yellow tingle) and *E. brevistylis* (Rates tingle). This is the major vegetation type in the Warren Bioregion, covering nearly 650,000 ha.

The 104,00 ha of pure karri stands occur on the deep loams throughout the Warren Bioregion. Here it may grow to 70m in height and have an understorey at about 10m of *Agonis flexuosa* (peppermint), *Allocasuarina decussata* (karri oak) and *Banksia* spp. Below the understorey tree stratum, there is a continuous stratum to about 3m 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. An extensive area (351,000 hectares) between Denmark and Manjimup is mapped as tall jarrah-marri forest with patches of taller karri.

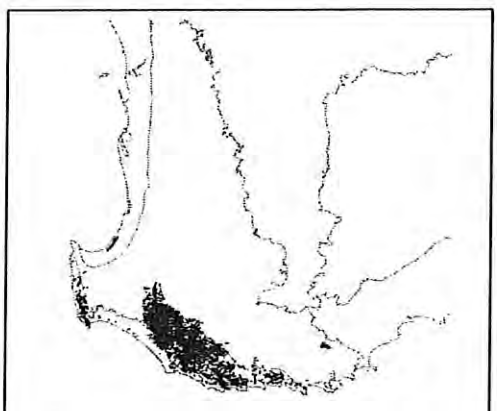

Figure 2. Vegetation type 1: Tall forest and tall woodland.

Two eastern outliers of karri occur: one around the granite massif of the Porongurup Range (Jarrah Forest Bioregion) where it appears 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 40m 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 (>30m) with a more open canopy (projective foliage cover 10-30%). The only association in the State in this structural formation is the tuart woodland in Swan Coastal Plain Bioregion.

A small pocket (8,500 hectares) of tall *Eucalyptus gomphocephala* (tuart) woodland is found on calcareous soils between Busselton and Bunbury (Swan Coastal Plain Bioregion). These stands reach a height of 40 m. It is probable that the understorey consisted of *Agonis flexuosa* (peppermint) trees up to 15m in height, with shrubs to 2m in height such as *Templetonia retusa*, *Spyridium globosum*, *Olearia axillaris* (coastal daisybush), *Hakea prostrata* (harsh hakea), *Diplolaena dampieri* (southern diplolaena) and *Acacia* spp. However, introduced grasses as a consequence of the regular burning and grazing over the past 170 years or so have largely replaced the shrub stratum.

2. Medium forest, mainly jarrah and marri

Trees reaching a height at maturity of between 10 and 30m with a mid-dense canopy make up a vegetation type called medium forest or merely forest. 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. Covering most of the Jarrah Forest Bioregion and extending into Warren and Swan Coastal Plain Bioregions, it totals over 4.3 million hectares.

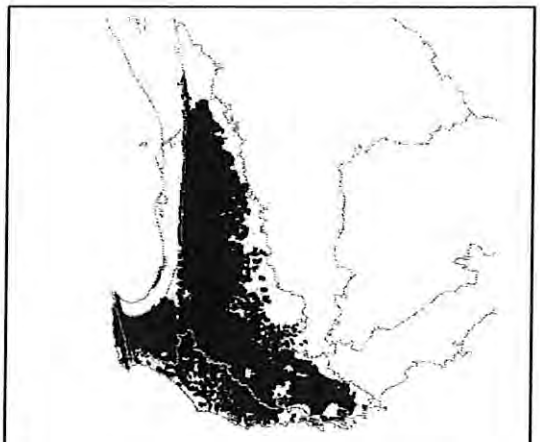

Figure 3. Vegetation type 2: Medium forest, mainly jarrah and marri.

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 up to about 30 – 40m tall in the higher rainfall parts of the Bioregion (>1,000 mm) and up to about 25m in the east. A lower layer of small trees (about 7m 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 2m tall) with species in the families

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

Vegetation composed of trees 10 – 30m in height with an open canopy (10-30% projective foliage cover) is classified as woodland. Trees are predominantly eucalypts and occur in a wide variety of associations. Woodlands are extensive in south western Australia, covering over 16 million hectares. Because of this great extent, and the variety of associations present, this vegetation type has been divided into two groups; jarrah, marri and wandoo woodlands which occur in the western and central part of the south west (Vegetation Type 3), and the other woodlands which occur to the east and out into the goldfields (Vegetation Type 4).

The eastern Jarrah Forest Bioregion is dominated by mixed woodlands comprising *Eucalyptus marginata* (jarrah), *Corymbia calophylla* (marri) and *Eucalyptus wandoo* (wandoo), with the jarrah present on the lateritic residuals and largely absent from the valleys. Here the trees reach 20 – 25m in height and are more widely spaced than trees in the jarrah forest proper. There are few smaller trees, 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

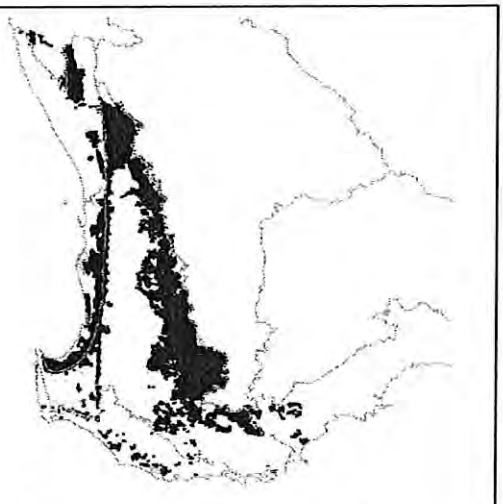

Figure 4. Vegetation Type 3: Woodland, jarrah, marri, wandoo.

Jarrah, marri and wandoo occur in the western edge of the Esperance Plains Bioregion on the northern slopes of the Stirling Range.

Eucalyptus accedens (powderbark) and *E. astringens* (brown mallet) form 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.

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. Tuart occurs on the calcareous Cottesloe and Karrakatta sands from Busselton through to the Moore River. The stout mature tree grade in height from 40m, described above, to 25m around Perth. Tuart woodland may have sub-dominant 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 jarrah and marri woodland with a low banksia understorey interspersed with very scattered jarrah and marri trees of medium height.

On a narrow strip south of Gingin on the Swan Coastal 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, other

This extensive vegetation type includes the York gum-salmon gum woodlands in the Avon Wheatbelt Bioregion, the mixed woodlands of the Coolgardie Bioregion, the small areas of tropical woodlands in the Kimberley and the riverine woodlands in the eastern Jarrah Forest Bioregion. It covers nearly 14 million hectares.

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 18m in height in the west and prefers sand, sandy loam or loamy soils often with clayey subsoil. Salmon gum, *E. salubris* (gimlet) and *E. longicornis* (red morrell) extend throughout the Avon Wheatbelt and Mallee Bioregions. Salmon gum forms majestic stands to over 25m 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 drier Coolgardie Bioregion are made up of a variety of eucalypt species all of which grow tall and straight to about 20m. *Eucalyptus transcontinentalis* (redwood), *E. flocktoniae* (merrit) occur on sandy loams. These woodlands tend to have shrubby understoreys with *Atriplex* and *Melaleuca*.

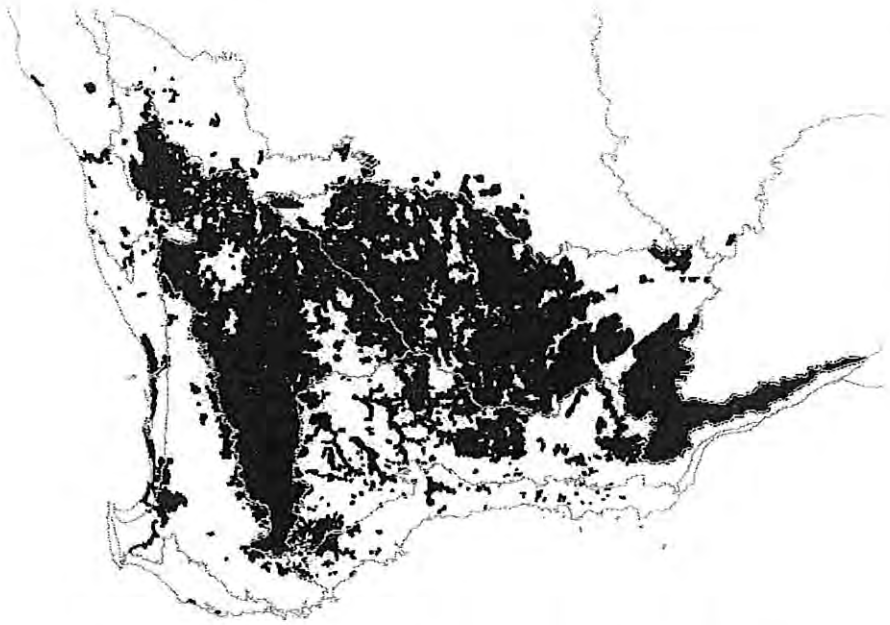

Figure 5. Vegetation Type 4, southern extent: Woodland, wheatbelt and goldfields.

Eucalyptus torquata (coral gum) and *E. le souefii* (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. The eucalypts, *E. kondininensis* (Kondinin blackbutt), *E. gracilis* (yorrell) and *E. melanoxylon* (black morrel), occur on more saline soils with an understorey that includes saltbush and *Mairaena* (bluebush). The two types of understory characterised as broombush and saltbush 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 amongst the karri and jarrah forests. Yate also occurs in small pockets in swamplands and steep river valleys along the south coast towards Esperance.

Several of these woodlands described above form mosaics with mallee communities (Mosaic 2), mallee steppe (Mosaic 3), open mallee steppe (Mosaic 4) and succulent steppe with open low woodland (Mosaic5).

Eucalyptus camaldulensis (river gum) grows along drainage lines throughout the State from about Eneabba north - mainly the area experiencing summer rainfall. In the Kimberley it occurs with *Terminalia platyphylla* and *E. papuana* (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 trees of *Melaleuca* spp., *Bauhinia cunninghami*, *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. On the river floodplains in the Gascoyne Bioregion, the banks and islands carry dense marginal vegetation with river gum to 18m. *Acacia aneura (mulga)*, *A. citridoviridis* 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 a medium woodland which may include *E. patens* (yarri) and *E. megacarpa* (bullich), and there may be an understorey of *Agonis flexuosa* (peppermint). On the margins of the upper Blackwood River there may also be *E. marginata* (jarrah) and *Corymbia calophylla* (marri).

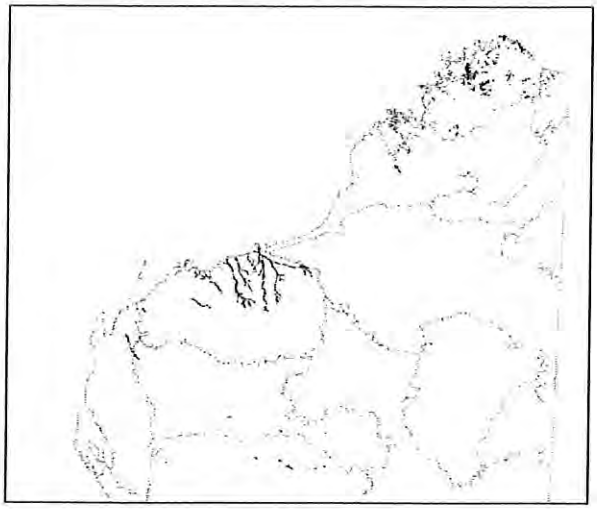

Figure 6. Vegetation Type 4, northern extent: Woodland, riverine and tropical.

In the Northern Kimberley Bioregion, *Eucalyptus tetrodonta* (Darwin stringybark) and *E. miniata* (woolybutt) form a tropical woodland with understorey of palms (*Livistona eastonii* (fan palm)) (150,000 hectares). These occur on the Mitchell Plateau on red clay-loams of the lateritic profile. The tall straight eucalypts reach to nearly 20m with the palm layer below. Associated species include small trees of *Terminalia* spp. and *Erythrophleum chlorostachys* (ironwood), and shrubs of *Grevillea* spp.and *Cochlospermum fraseri*.

5. Open woodland, marri, wandoo, river gum

This vegetation type is composed of trees 10 - 30m in height with a open canopy (< 10% projective foliage cover). It occurs over a relatively small area of only 23,750 hectares, most of which is in the Swan Coastal Plain Bioregion, with small areas in Jarrah Forest and Avon Wheatbelt Bioregions. *Corymbia calophylla* (marri) and *Eucalyptus rudis* (flooded gum) occur along drainage lines and around swamps. *Eucalyptus wandoo* (wandoo) occurs on its own or with *E. accedens* (powderbark) towards the top of the landscape where there are lateritic remnants. There are small patches of open woodland of pure *Corymbia calophylla* (marri) in the vicinity of the Moore River, northern Swan Coastal Plain Bioregion. In the Avon Wheatbelt Bioregion, *E. loxophleba* (York gum) and *E. salmonophloia* (salmon gum) form open woodlands with an open understorey on heavy clay soils.

Extending northwards along the Swan Coastal Plain from the tall *Eucalyptus gomphocephala* (tuart) woodland between Busselton and Bunbury, which is described above, 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

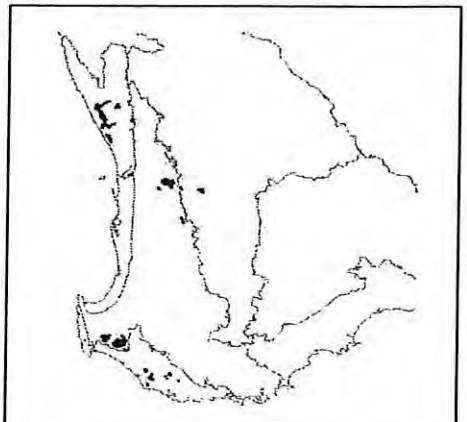

Figure 7. Vegetation Type 5: Open woodland, marri, wandoo, river gum.

mapped as low woodland or scrub with scattered trees.

A number of areas of very sparse (≅2% cover) woodland occur, usually as secondary components of mosaics. In the production of this map, they have generally been assigned to the vegetation type of the more extensive mosaic component. For example, the mosaic of jarrah - marri medium open woodland and a low banksia woodland understorey, with very scattered patches of jarrah - marri has been assigned to the low woodland with scattered trees (Vegetation Type 8). Similarly, the mosaics of very scattered salmon gum and yorrell or morrell over saltbush and samphire or just samphire have both been assigned to the saltbush and/or bluebush with scattered trees (Vegetation Type 49).

6. Medium - Low woodland, York gum, cypress pine

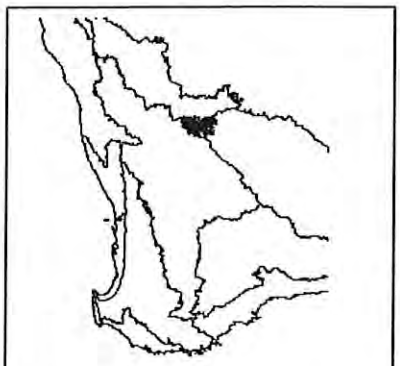

Figure 8. Vegetation Type 6: Medium low woodland, York gum, cypress pine.

This vegetation type is a mixture of medium (10-30m) and low (<10m) woodlands and is transitional between the shrublands of the South West and the mulga woodlands to the north. There is an incomplete canopy with a projective foliage cover of 10-30%. This vegetation type is confined to the north west corner of the Coolgardie Bioregion where it covers almost 128,000 hectares.

A *Eucalyptus loxophleba* (York gum), *Callitris glaucophylla* (white cypress pine) medium to low (8 - 15m) woodland is developed on red earthy sands or sandy plains in the extremity of the Coolgardie Bioregion. The York gums are taller in the south, becoming lower as conditions become drier. The scattered sclerophyll understorey is mainly *Acacia*, and the mallee *E. oleosa* (giant mallee) may be present.

7. Low forest, acacia, Rottnest pine, coastal moort, mixed tropical forest

Low forest is a closed formation consisting of trees less than 10m tall, with a cover of 70 - 100%. This is an uncommon formation in Western Australia, covering just slightly more than 100,000 hectares. 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.

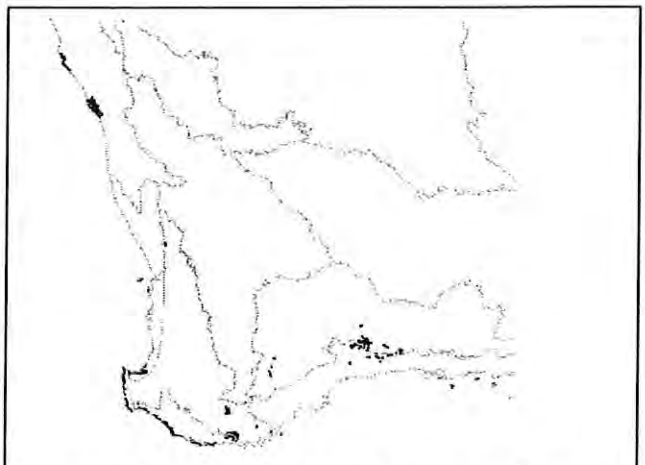

Figure 9. Vegetation Type 7, southern extent: Low forest, acacia, Rottnest pine, coastal moort.

The largest association in this vegetation type, covering over 35,000 hectares in the Geraldton Sandplain Bioregion, is *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 10m) of the *A. rostellifera* (summer-scented wattle) thickets that occur on coastal dunes around the coast, from Geraldton to east of Esperance.

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

Eucalyptus platypus (moort) occurs on heavy clay soils scattered through the Mallee Bioregion with *E. annulata* (open-fruited mallee), *E. spathulata* (swamp mallet) and *E. diptera* (two-winged gimlet). Trees are 3-5m tall with little or no understorey. On Bald Island, an isolated granite boss 2 kilometres 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.

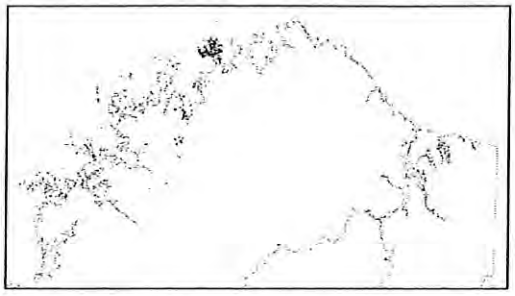

Figure 10. Vegetation type 7, northern extent: Low forest, mixed tropical forest.

In the Kimberley, pockets of mixed tropical deciduous and semi-deciduous forest and vine thicket occur on sheltered scree slopes and on mudflats. The pockets are small: for example the 84 patches in the database range in size from 5 hectares through to 381 hectares 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 exciting botanically as they contain Western Australia's only examples of rainforest biota, and they provide a marked contrast to the surrounding savannas.

Callitris preissii (Rottnest Island pine) and *Acacia rostellifera* (summer-scented wattle) occur on Garden Island. *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 Warren and southern Jarrah Forest Bioregions. There is an understorey of rushes.

It is possible that some of the associations that comprise this vegetation type were more common and widespread at the time of European settlement, but they have been reduced by changed fire regimes over the past 170 years or so.

8. Low forest, Low woodland, Low woodland with scattered trees, jarrah, banksia, casuarina

This vegetation type includes the variety of low forest and woodland formations, dominated mainly by jarrah but including other species of eucalypts, banksias and casuarinas. Low forest and low woodland are both dominated by trees less than 10m

in height but they are separated by cover: forest has a projective foliage cover of 30 - 70% and woodland has a cover of 10 - 30%. Scattered emergent medium trees (>10m) may be present. These forests and woodlands are found in the Swan Coastal Plain Bioregion and in the south coastal areas of Jarrah Forest Bioregion. They cover a total area of 463,000 hectares.

Eucalyptus marginata (jarrah) low forest is the major component of this vegetation type covering 115,000 hectares. It occurs on extremely poor siliceous soils in the south eastern Jarrah Forest Bioregion north of Albany. Scattered stunted, crooked trees may emerge to 15m from a lower stand with thinner more crowded stems over a mixed sclerophyll understorey. *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.

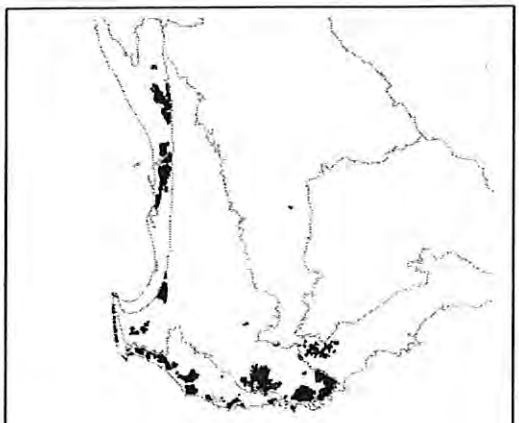

Figure 11. Vegetation type 8: jarrah, banksia Low forest, Low woodland, Low woodland with scattered trees.

Low woodland of jarrah and banksia occurs on patches of deep sand which 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 77,000 hectares of the Swan Coastal Plain Bioregion. In parts of the Bioregion where the rainfall is higher, the jarrah may be reasonably pure. 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 heathy understorey of shrubs and sedges.

9. Low woodland, open low woodland and sparse woodland; mulga

The most extensive vegetation type in Western Australia is the *Acacia aneura* (mulga) low woodland, open low woodland and sparse woodland type. Covering over 38 million hectares, low woodlands of mulga and associated species (mainly acacias) are distributed throughout the Murchison, Gascoyne, Great Victoria Desert and Central Range Bioregions and they extend into the Pilbara, Gibson Desert and Little Sandy Desert Bioregions. Mulga (3 - 6m high) is mapped as low woodland (27 million hectares), open low woodland (300,000 hectares) or very scattered trees (7 million hectares). Associated species include *Allocasuarina cristata* in the Murchison Bioregion, and *Acacia eremaea* (snakewood) and *A. victoriae* (bardi bush) in the Gascoyne Bioregion. The composition of the ground layer of

ephemeral herbs and grasses varies with the season and amount of rainfall. Mulga occurs at its northern limits in the southern Pilbara Bioregion where it covers the valley plains. It has the unusual understorey of shrubs of *Eremophila* and *Senna* and annuals such as *Ptilotus exaltatus* (tall mulla mulla). In the northern Great Victoria Desert Bioregion, mulga occurs on hills and breakaways and between the sandhills where the soil is too fine to support the usual open tree and mallee steppe (hummock grassland with scattered eucalypts over mallee (Vegetation Type 42). 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.* Optimum conditions for mulga are the plains of the Murchison Bioregion with deep red loams overlying a siliceous hard pan - here mulga forms tall dense stands. There are thought to be several distinct forms or even new species within mulga: one distinct form with a horizontal branching habit is thought to be restricted to the calcrete platforms on Byro Station, which is near the junction of the Murchison, Carnarvon and Gascoyne Bioregions.

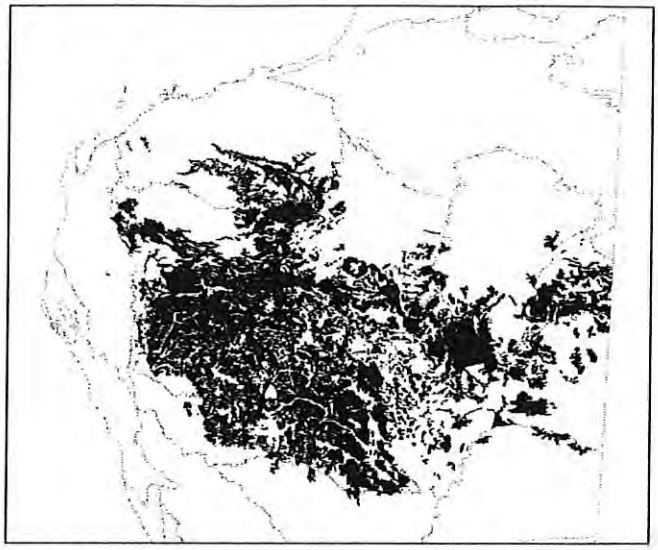

Figure 12. Vegetation Type 9: Low woodland, open low and sparse woodland, mulga.

The *Acacia aneura* (mulga) and *A. xiphophylla* (snakewood) low woodland in the Gascoyne Bioregion (700,000 hectares) generally occurs lower in the landscape than the more common association of *Acacia aneura* (mulga) and *A. xiphophylla* (snakewood) scrub (1.8 million hectares), (see Vegetation Type 16). A scrub association of *Acacia aneura* (mulga) and *A. ramulosa/ A. linopylla* (bowgada) also occurs, as well as low or open low *Acacia aneura* (mulga) woodland over *Acacia ramulosa/ A. linopylla* (bowgada) scrub (see Vegetation Type 14).

10. Low woodland, open low woodland, other species

This vegetation type includes the low tree (< 10m) woodlands (10 - 30% cover) and open low woodlands (< 10% cover) dominated by species other than *Acacia aneura* (mulga). This type occurs throughout the southern parts of the State particularly in the Carnarvon, Yalgoo and Swan Coastal Plain Bioregions and cover over 2.6 million hectares. The dominants include other *Acacia* species, banksia, peppermint, pine, casuarina and York gum.

Several species of *Acacia*, occuring in a variety of combinations, form extensive low woodlands in the Carnarvon Bioregion. These include *Acacia victoriae* (bardi bush), *A. xiphophylla* (snakewood), *Acacia subtessarogona, A. ramulosa* and *A. linnopylla* (bowgada). Beards 'a9' code referred to the two acacias, *Acacia ramulosa* and *A. linnopylla*. 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.

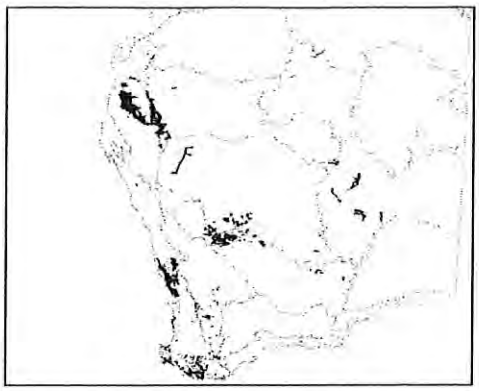

Figure 13. VegetationType 10: Low woodland, open low woodland, other than mulga

Callitris glaucophylla (white cypress pine) and *Eucalyptus loxophleba* (York gum) mixed with some mulga (*Acacia aneura*) form low woodland in the Yalgoo Bioregion. Other species found in this vegetation type include *Acacia ramulosa* and *A. linopylla,* scattered *Brachychiton gregorii*, *Bursaria occidentalis* and *Eucalyptus kingsmillii* (Kingsmill's mallee), *E. oldfieldii* (Oldfield's mallee) and *E. oleosa* (giant mallee) with under-shrubs of *Senna artemisioides subsp. x coriacea* (desert cassia), *Eremophila clarkei* (turpentine bush), *E. leucophylla* (wilcox bush), *E. platycalyx* (grainte poverty bush) *and Olearia pimeleoides*. In the Nullarbor Bioregion, the low woodlands have white cypress pine (*Callitris glaucophylla*) and mulga (*Acacia aneura*) only.

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

Trees to 6 - 8m in height of *Banksia attenuata* (slender banksia), *B. menziesii* (firewood banksia) and *B. prionotes* (acorn banksia) make up the low woodlands which are well developed on the deep siliceous sands in the Swan Coastal Plain Bioregion. These woodlands have a rich shrub understorey. This vegetation type continues on the limestone around Lancelin, but here the understorey is quite different.

Melaleuca rhaphiophylla (swamp paperbark) and *M. cuticularis* (saltwater paperbark) form low woodland communities along streamlines and around swamps in the Warren and Jarrah Forest Bioegions. 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 on 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.

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 19); and
- *E. wandoo* (wandoo) and *E. accedens* (powderbark) in the Avon Wheatbelt Bioregion. This is also a components of a mosaic with scrub heath (see Vegetation Type 19).

11. Mangroves

Mangroves are a vegetation type found on protected coasts and in estuaries and tidal creeks between 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 and in the Leschenault Estuary. Mangrove communities consist of trees and shrubs (and one species of fern elsewhere) and they are best developed in the tropics. In the Kimberley Bioregions, they occur as a low to medium forest covering about 155,000 hectares whereas in the Pilbara Bioregion (40,000 hectares) and Carnarvon Bioregion (34,500 hectares) they tend to form thickets.

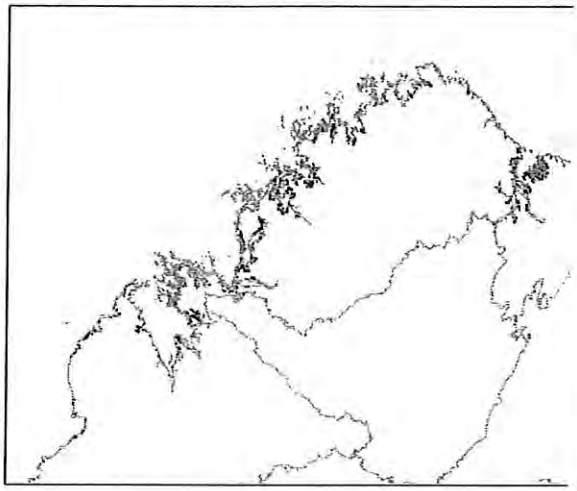

Figure 14. Vegetation type 11: Mangroves, Kimberley.

Along the Kimberley coast, on either sandstone or basaltic substrates, mangroves can form extensive belts. Generally, mangroves are tallest (8 – 12m, rarely up to 20m) 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* (ribber-fruited orange mangrove), *Sonneratia alba* (pornupan), Campostemon schultzii (kapok mangrove) and *Ceriops tagal* (spurred mangrove), and shrubs of *Aegilatus annulata* (club mangrove) and *Aegiceras corniculatum* (river mangrove). Near Broome, the tall

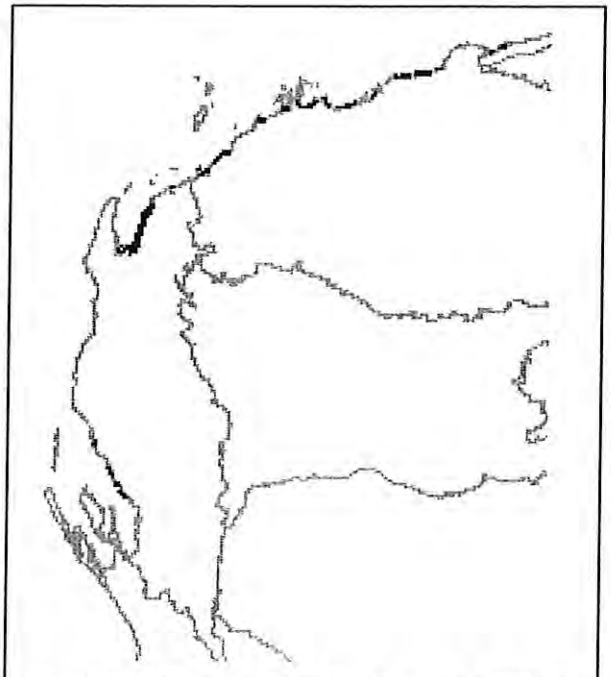

Figure 15. Vegetation Type 11: Mangroves, Pilbara to Shark Bay.

fringe is predominantly *Ceriops tagal* with *Brugieria exaristata* in the inner zone.

In the Pilbara, 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 *Aegilatus annulata* (club mangrove) is found, and *Aegiceral corniculatum (river mangrove)* lines the seaward ends of creeks.

In the shelter of Shark Bay in the Carnarvon Bioregion, the coast is lined with the mangrove species *Avicennia marina* (white mangrove), *Rhizophora stylosa* (spotted-leaved red mangrove), *Ceriops tagal* (spurred mangrove) and *Aegilatis annulata* (club mangrove).

12. 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 2m tall, with some emergent taller shrubs >2m tall. There are emergent trees to 6m. 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.

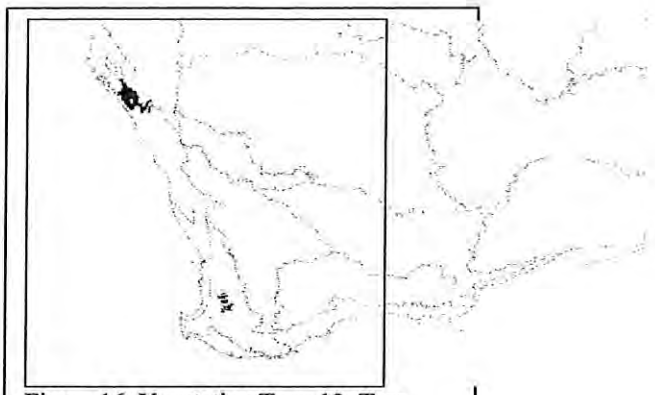

Figure 16. Vegetation Type 12: Tree heath.

The unusual tree heath of the Geraldton Sandplains Bioregion consisting of low trees, tall and low shrubs, herbs and grasses is found over 36,000 hectares of sandhill country south of Shark Bay. The structureless red-brown sandy soil is swept in to confused sand ridges. Low trees (to 6m) and tall shrubs include *Banksia ashbyi* (Ashby's banksia), *Grevillea gordoniana*, *Acacia ligulata (umbrella bush)*, *A. longispinea*, *Melaleuca* sp. aff. *huegelii* (chenille honeymyrtle) and *M.* sp. aff *nesophila* (mindiyed)with mallees of *Eucalyptus obtusifolia, E. eudesmioides, E. foecunda* (narrow-leaved red mallee) 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 exaltatus* (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* (Beards mallee), *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, *Melaleuca preissiana* (moonah) and *Banksia littoralis* occur over and adjacent to tea tree (*Melaleuca* spp.) thickets and sedgelands.

13. Thicket with scattered medium trees or scattered low trees (shown on the map in the colour the thicket overlaid with  or  symbols).

Figure 17. Vegetation Type 13: Thicket with scattered medium trees or scattered low trees.

Thickets are composed of dense to mid-dense shrubs >1m in height. The two formations included in this unit are thickets that have scattered, emergent trees of either medium height (between 10 - 30m) or occasional low trees (<10m). 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 more than 250,000 hectares, most of which is in the Avon Wheatbelt Bioregion.

Melaleuca thickets, commonly *M. uncinata* (broom bush) or *M. thyoides*, have scattered emergent trees of *Euaclyptus loxophleba* (York gum) of 8 - 15m 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, Geraldton Sandplain Bioregion, are three small patches of scattered *E. camaldulensis* (river gum) over *M. thyoides* thicket to 2.5m 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 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* spp. thickets on a lateritic ridge just west of Three Springs, and from a *Melaleuca uncinata* (broom bush) thicket in a small patch southwest of Three Springs.

Occurring in small areas throughout the Avon Wheatbelt Bioregion are several small mosaics of woodland and thicket which have been included in this vegetation type:

- On Kooolanooka hills in 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 thicket of *Allocasuarina campestris, Acacia acuminata* (jam), *Grevillea stenosygia*, *Melaueca cordata*, *M.nematophylla*, *M. radula* covers the hills,

- On the footslopes of the Kookanooka Hills there is a mosiac of open *Eucalyptus loxophleba* (York gum) medium woodland interpersed with the *Allocasuarina campestris* thicket which occurs on the adjacent hills.
- In the lower-central part of the Bioregion, just north east of Corrigin there is an area of patchy acacia-casuarina-melaleuca thicket with *Eucalyptus loxophleba* (York gum) and *E. salmonophloia* (salmon gum) medium woodland.
- In a valley traversing the boundary between the Avon Wheatbelt and Geralton Sandplaind Bioregions there is a mosaic of *Melaleuca thyoides* thicket with *Eucalyptus loxophleba* (York gum) and *E. salmonophloia* (salmon gum) medium woodland.

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. Scrub with medium woodland, scattered medium trees, low woodland or scattered low trees (shown on the map in the colour of the scrub overlaid with  symbols).

This vegetation type, covering over three million hectares, has a more open shrub layer than the previous unit and is comprised mainly of acacia with emergent eucalypts and sheoaks. 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 Murchison Bioregion. In drier areas the tree layer is lower. Low trees over scrub extends over about 2.6 million hectares in Yalgoo Bioregion, southern Carnarvon and western Murchison Bioregions.

Acacia acuminata (jam) and *Hakea pycnoneura* scrub, often with scattered *Eucalyptus loxophleba* (York gum) taller than 10m, 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.

Figure 18. Vegetation Type 14: Scrub with medium woodland, with scattered medium trees, low woodland or with scattered low trees.

Medium height *Allocasuarina huegeliana* is an obvious emergent from the *Acacia acuminata* (jam) scrub in northern Avon Wheatbelt Bioregion. Elsewhere in that 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. linopylla* (bowgada) scrub on rises.

In this vegetation unit, the most common low tree emergent is *Acacia aneura* (mulga) which occurs as a low woodland to an open low woodland. The scrub layer

is predominantly *Acacia ramulosa /A. linnopylla* (bowgada), often with *Acacia grasbyi* (miniritchie). On nearly one million hectares in Murchison and Yalgoo Bioregions, the mulga forms low woodland over the scrub dominated by these acacias. The mulga is more open but still emergent over bowgada and miniritchie on a further 250,000ha in these Bioregions. On another 182,000 hectares in the central Yalgoo and Carnarvon Bioregions, *Acacia grasbyi* (miniritchie) drops out as a co-dominant under low mulga woodland.

Other emergent trees through the *Acacia ramulosa /A. linnopylla* (bowgada) scrub include low *Allocasuarina huegeliana* and/or *Eucalyptus loxophleba* (York gum) in Geraldton Sandplains Bioregion, *A. cristata* in Coolgardie Bioregion, and *Callitris glaucophylla* (white cypress pine) in Yalgoo Bioregion. On the red sandplains of southern Carnarvon Bioregion, bowgada scrub has scattered *Callitris glaucophylla* (white cypress pine) and eucalypts such as *Eucalyptus oleosa* (giant mallee), *E. eudesmioides* and *E. oldfieldii* (Oldfield's mallee). Slightly further north, there is an dunefield with mulga open low woodland over bowgada scrub on the inter-dunal flats and with bowgada and grevillea scrub on sandhills.

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* (giant mallee), *E. transcontinentalis* (redwood), 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 York gum at the northern limit of this unit. At the north-eastern tip of Swan Coastal Plain Bioregion, there is a unique unit consisting of mallee (possibly *E. foecunda* (narrow-leaved red mallee)) with scattered York gum.

15. Thicket

Vegetation types consisting of shrubs >1m tall with a 30 - 70% canopy cover are classified as thickets. Nearly 6 million hectares is covered with thickets of acacia, casuarina and/or tea tree or which 4 million hectares occur in the Avon Wheatbelt Bioregion extending into the Coolgardie Bioregion. Other Bioregions where thickets are important are Geraldton Sandplains, Carnarvon, Yalgoo and Mallee Bioregions.

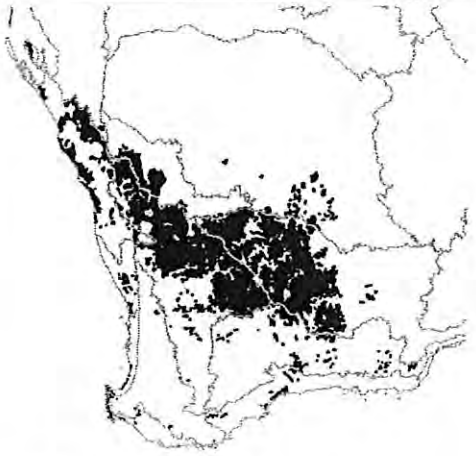

Figure 19. Vegetation Type 15: Thicket.

The most common thicket unit is the acacia-casuarina-melaleuca alliance on sandplains, covering nearly 1.8 million hectares. Generally, *Allocasuarina* is dominant in areas receiving greater than 325 mm of rainfall per annum, *Acacia* tolerates drier conditions and Mela*l*euca is dominant on clayey, winter-wet or swampy soils.

Mixed *Acacia* thickets are the next largest alliance, with *Acacia neurophylla*, *A. beauverdiana* (pukkati) and *A. resinomarginea*

thickets common over extensive areas (more than 1 million hectares) 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 *Allocasuarina 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 - 2.5m 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* (broom bush) thickets occur along the south western boundary of Yalgoo Bioregion (330,000 hectares) and extend south into Avon Wheatbelt Bioregion (10,000 hectares). This is a transitional unit, as bowgada has a more northern distribution whereas jam and *Melaleuca uncinata* are common to the south. Other acacia-melaleuca associations include:

- *A. rostellifera* (summer-scented wattle) and *M. cardiophylla* (tangling melaleuca) thickets, often interspersed with scattered reefs of *Eucalyptus erythrocorys* (illyarrie) occurring on limestone near Dongara; and
- *A. ligulata* (umbrella bush) and *M. uncinata* (broom bush) dominated thicket occurs on patches of dark brown loamy soil between the Murchison and Hutt Rivers, and *A. acuminata (jam)*, *A. rostellifera* (summer-scented wattle) and *M. megacephala* thicket is found flanking the Hutt River.

The mallee-casuarina thickets of the northern central Avon Wheatbelt Bioregion covers 735,000 hectares. Here *Allocasuarina campestris* occurs with *Eucalyptus foecunda* (narrow-leaved red mallee), *E. redunca* (black marlock) and *E. transcontinentalis* (redwood) 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 350,000 hectares) has been mapped using the general acSc code rather than codes stating the dominant species present. It occurs mainly on sandplains in Avon Wheatbelt, 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* (broom bush).

Many of the tea tree thickets characteristically associated with the swamps of the South West have just been labelled generally as mSc (34,000 hectares). In the Geraldton Sandplains Bioregion, *Melaleuca uncinata* (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) thickets are restricted the steep rocky ridges, parallel to the coast south of Geraldton.

Other thicket associations include:

- An extensive (152,000 hectares) mixed thicket on the red soils of the northern Geraldton Sandplains where *Acacia*, *Allocasuarina*, *Eucalyptus eudesmoides*, *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 occurring on hills and ranges, for example, dryandra-casuarina thickets on the lateritic hills of the Wongan Hills, NE of Perth.

There are mosaics of thickets with woodland (see Vegetation Type 13), scrub heath (see Mosaic 7) and heath (see Vegetation Type 18)

16. Scrub, open and sparse scrub.

These vegetation types are composed of shrubs greater than 1m in height. Those associations with a canopy cover of less than 30% are termed scrub, those with less than 10% are called open scrub, while sparse scrub is where the shrubby vegetation is extremely sparse or in scattered clumps with no discernible canopy cover. This vegetation type is very widespread, occurring in 18 of the 26 Biogeographic Regions and covering over 14.5 million hectares or 5.66% 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 Gascoyne Bioregion (5.7 million hectares), Carnarvon Bioregion (3.1 million hectares), Murchison Bioregion (2.5 million hectares), Yalgoo Bioregion (1.15 million hectares), Central Ranges (1 million hectares), Geraldton Sandplains Bioregion (500,000hectares) and Pilbara Bioregion (300,000hectares).

There is nearly 7 million hectares of scrub of pure *Acacia aneura* (mulga) or dominated by mulga with usually only one other *Acacia* species. Pure mulga scrub occurs on over 1 million hectares in Murchison Bioregion and Gascoyne Bioregion, nearly 1 million in Central Range Bioregion and nearly 500,000 hectares in Gibson Desert Bioregion. The species most commonly associated with mulga is *Acacia xiphophylla* (snakewood): *A. aneura* and *A. xiphophylla* scrub covers about 120,000 hectares in the Gascoyne Bioregion and occurs mainly on hills and ranges. Other species associated with mulga include *A. quadrimarginea, A. victoriae* (bardi bush), *A. ramulosa/A. linopylla* (bowgada). Understorey species include *Eremophila* and *Senna* (Cassia) with a ground layer of annuals eg *Swainsona formosa* (Sturt pea), *Goodenia*

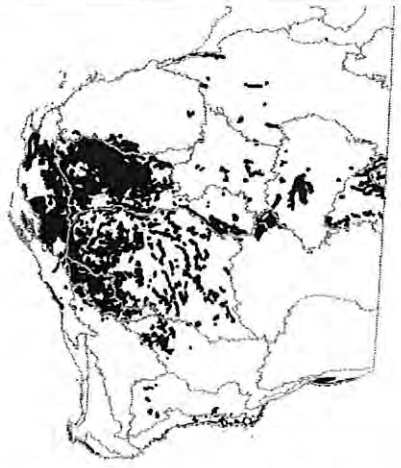

Figure 20. Vegetation Type 16: Scrub.

maideniana and *Ptilotus* spp. in season.

Scrub dominated by other *Acacia* species covers over 6 million hectares 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). Only *Acacia linophylla* is now known commonly as bowgada while *A. ramulosa* is now called horse wattle. This association covers over 1.3 million hectares 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 hectares in Carnarvon Bioregion. This region also contains large areas of *Acacia ramulosa* and *A. linophylla* (bowgada) with *A. victoriae* (bardi bush) 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* (miniritchie). The snakewood scrub on shingle plains in Gascoyne Bioregion has an understorey of *Ptilotus* spp. and saltbush eg *Atriplex* spp. *Acacia brachystachya* (turpentine mulga) or *Acacia ramulosa* and *A. linophylla* (bowgada) scrub are the major scrub components of the Coolgardie Bioregion, occurring on fresh soils over granite with species such as *Allocasuarina cristata*.

Mallee and acacia scrub is a major component of Hampton and Esperance Plains Bioregions on over 300,00 hectares of coastal dunes. Species include *E. angulosa* (ridge-fruited mallee), *A. cyclops* (coastal wattle), *A. saligna, Calothamnus quadrifidus* and *Melaleuca elliptica* (granite bottlebrush).

Other scrub associations include:

- Tea tree scrub mainly on saltpans in Geraldton Sandplains Bioregion (110,000 hectares) where *Melaleuca lasiandra* and *M. glomerata* may grow up to 2m high,
- Tea tree scrub in swampy areas of 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 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,
- *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 *Acacia aneura* (mulga) dominated. Nearly 28,000 hectares of open mulga scrub occur in 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 bush) with *A. xiphophylla* (snakewood) or *Acacia* sclerosperma (limestone wattle) open scrub or sparse scrub occurs in Gascoyne Bioregion on gravel plains and shingle plains as well as in 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 and *Acacia rostellifera* (summer-scented wattle) open scrub occur on the coastal dunes in Geraldton Sandplains Bioregion, totalling over 10,000 hectares.

Open scrub with hummock grasslands occurs over large expanses (nearly 8 million hectares) in the dry interior and is mapped as very sparse scrub steppe (Vegetation Type 41).

17. Mallee

Mallee is a shrub-eucalypt formation unique to Australia. Each plant has an underground rootstock or lignotuber, from which grow numerous spindly stems with foliage clumped at the ends. Height varies according to time since last fire but may be over 10m. Over 5.6 million hectares of the State is mapped as mallee: this is mainly in the Mallee Bioregion extending into the Esperance Sandplains and Hampton Bioregions, with minor occurrences in the Geraldton Sandplains and Great Victoria Desert Bioregions.

Seventy-five percent (over 4 million hectares) of the State's mallee vegetation occurs in the Mallee Bioregion where it originally covered more than half of the Region. Mallee/woodland mosaics (see Mosaic 2) account for a further area 25% of the Bioregion. Within that Bioregion, mallee tends to occur mid-slope and 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. transcontinentalis* (redwood), *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 understorey eg. *M. pungens* and *M. spicigera*. *Acacia* spp. and occasional small clumps of grasses may also be present.

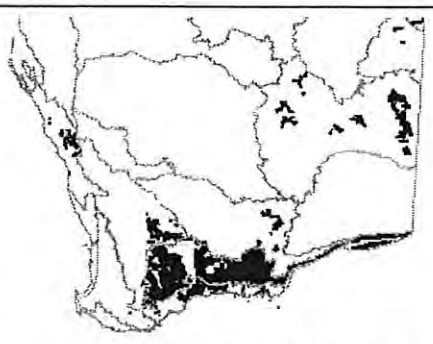

Figure 21. Vegetation Type 17: Mallee.

The Esperance Plains Bioregion mallee 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 over 44,000 hectares and includes *E. comitae-vallis* (Commet Vale mallee) on the calcareous soils of the

ancient drainage lines near Lake Throssell and Lake Wells. Further east near Nearle 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 (3,200 hectares) of *Eucalyptus obtusifolia* (Dongara mallee) occurs on the coastnear 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 2).

18. Mallee heath

Mixed heath (mixed shrubs < 1m, with a cover of 30 - 70%) 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 once covered about 1.6 million hectares

Eucalyptus tetragona (tallerack) is common on soils where there is an ironstone horizon. The species is very characteristic because of its straggly habit and blue leaves. Nearly 50% (over 1.1 million hectares) of 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 hectares. The heath stratum comprises a very rich assemblage of tall and medium to low shrubs; eg *Grevillea hookeriana* (red tooth brushes), *Hakea cinerea* (ashy hakea), *H. corymbosa* (cauliflower hakea), *H. prostrata* (harsh hakea), *Isopogon buxifolius, Lambertia inermis* (chittick), *E. tetragona* (tallerack), *Petrophile* spp. and the smaller *Agonis linearifolia* (swamp peppermint) *Brachysema latifolium, Allocasuarina* spp., *Daviesia teretifolia, Dryandra longifolia, D. nivea* (couch honeypot), *Grevillea pectinata* (comb-leaved grevillea), *Coopernookia strophiolata, Lechenaultia formosa* (red leschenaultia).

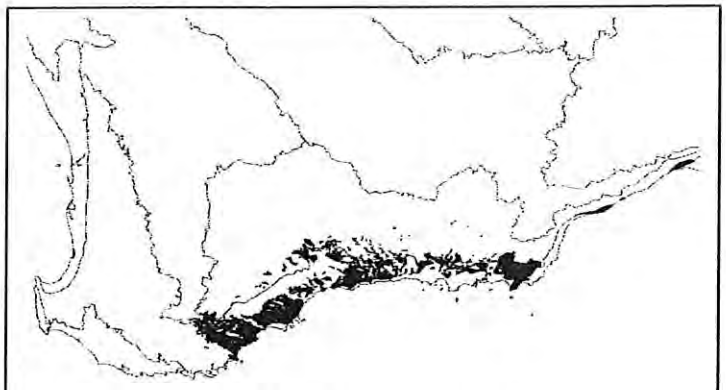

Figure 22. Vegetation Type 18: Mallee heath.

Eucalyptus incrassata (lerp mallee) mallee heath occurs over an area of 220,000 hectares 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* (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, Dryandra nivea* (couch honeypot), *D. proteoides* (king dryandra), *Isopogon cuneatus* (coneflower), *L 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).

19. Scrub heath

This vegetation type of mixed heath with scattered tall shrubs of *Acacia* and members of the Proteaceae family occurs over nearly 3.4 million hectares. The upper layer may reach 4.5m 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, occuring on soils ranging from laterite to grey sand over laterite to deep yellow sands. It extends thought he Avon Wheatbelt, Mallee and Coolgardie Bioregion to extensive areas in the Esperance Plains Bioregion. Other areas occur along the south coast of the Warren and Jarrah Forest Bioregions

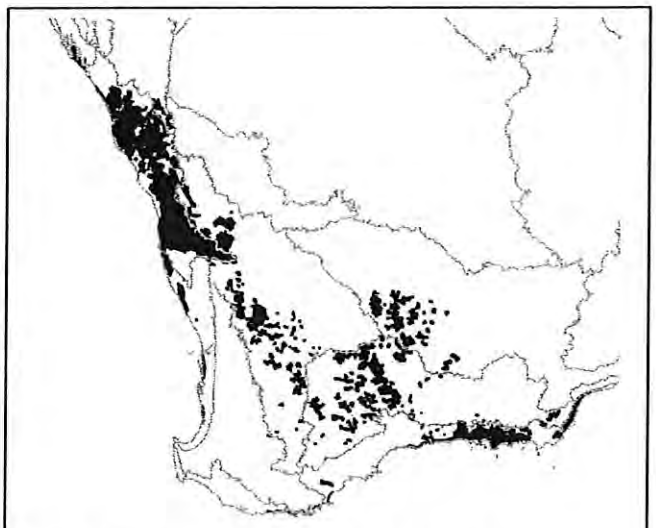

Figure 23. Vegetation Type 19: Scrub-heath.

Over 500,000 hectares of scrub heath occurs in the central Geraldton Sandplains Bioregion. Species composition is extremely mixed and is drawn from such genera as *Acacia*, *Eucalyptus*, *Grevillea*, *Hakea*, *Calothamnus*, *Allocasuarina*, *Conospermum*, *Eremaea*, *Hibbertia*, *Melaleuca*, *Petrophile* and *Thryptomene*. 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, Dryandra fraseri* var. *ashbyi, D. carlinoides,* 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 yellow sandplains extend over 300,00 hectares from north of the Murchison River into the northern Avon Wheatbelt Bioregion with a further 300,000 hectares 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 *Dryandra 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 limestone scrub-heath with sparse low *Eucalyptus erythrocorys* (illyarrie) trees occurs between Jurien Bay and Irwin River in the Geraldton Sandplain Bioregion. This is mapped as scrub heath 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 dryandra-calothamnus association with *Banksia prionotes* (acorn banksia) is found on the coastal limestone in the northern Swan Coastal Plain and adjacent Geraldton Sandplains; additional conspicuous species include *B. attenuata* (slender banksia), *B. menziesii* (firewood banksia), *Nuytsia floribunda* (christmas tree), *Xanthorrhoea preissii*, *Dryandra sessilis* (parrot bush) and *Calothamnus quadrifidus*.

The mosaic of the Dryandra-Calothamnus scrub heath with scattered low trees of *Eucalyptus wandoo* (wandoo) and *E. accedens* (powderbark) 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 (300,000 hectares) is also of a heterogeneous composition, but *Grevillea hookerana* (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 totalling nearly 300,00 hectares. A common emergent is *Grevillea excelsior* (flame grevillea) to 4.5m over a lower layer of 60-90 cm high shrubs eg *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 of Banksia scrub heath exist on the deep sands in the Esperance Plains Bioregion. The species rich heath features the large bushy shrubs of *Banksia speciosa* and with *Lambertia inermis* (chittick) as emergent 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 Bagingarra, Geraldton Sandplain Bioregion (see Mosaic 8).

20. Heath

A closed layer of low shrubs under 1m 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 nearly 200,000 hectares of heath has been mapped in Avon Wheatbelt, Geraldton Sandplain, Jarrah Forest, Mallee, Swan Coastal Plain and Warren Bioregions with a further 170,000 hectares mapped as mosaics of heath with woodlands (see below), scrub heath (Mosaic 8) or thickets (see Vegetation Type 19).

The most common heath mapped is the *Dryandra*-dominated heath, which covers over 60,000 hectares in Avon Wheatbelt, Swan Coastal Plain and Mallee Bioregions. For example, the 38,000 hectares of *Dryandra* heath on the Dandaragan Plateau (north eastern Swan Coastal Plain Bioregion) is dominated by *D.carlinioides* and *D. sessilis*. South east of Narrogin in Avon Wheatbelt Bioregion, the heath includes *Dryandra armata* (prickly dryandra), *D. cirsioides D. carduacea* (pingle) and *D.vestita*. A further 18,000 hectares in Geraldton Sandplains, Jarrah Forest and Swan Coastal Plain Bioregions are mapped as *Eucalyptus wandoo* (wandoo), *Corymbia calophylla* (marri) and/or *E. astringins* (powderbark wandoo) woodland with patches of *Dryandra* heath.

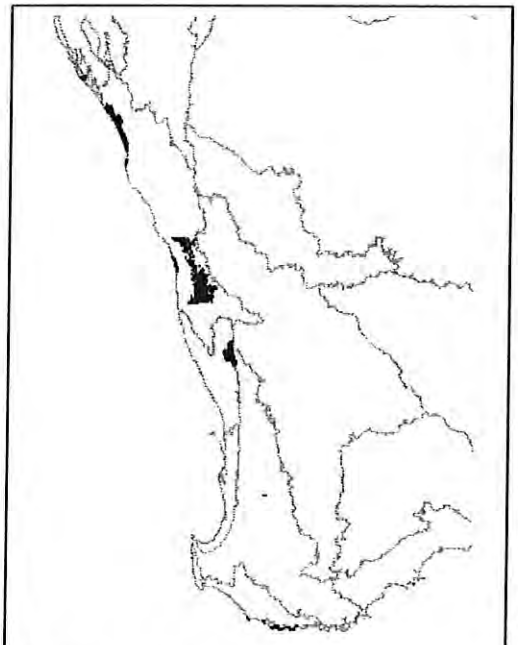

Figure 24. Vegetation Type 20: Heath.

The southern tip of the Geraldton Sandplain Bioregion is mapped as a mosaic of *Dryandra* heath and *Hakea*-dominated scrub heath (mentioned above in Vegetation Type 22). 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 *Dryandra* species. Mixed heaths are also mapped along the south coast. There, species composition is influenced by the soils, with 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* (curry flower), *Leucopogon reflexus and Dasypogon bromeliifolius* (pineapple bush). Common species to both soil types include *Scaevola crassifolia* (thick-leaved fan-flower), *Adenanthos cuneata, Agonis flexuosa* (peppermint) and *Hakea costata* (ribbed hakea). Over 42,000 hectares 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 is found along the central south-coastal area in Warren Bioregion, for example in the Nuyts Wilderness.

Along the southern Geraldton Sandplains Bioregion coast, *Acacia lasiocarpa* (panjang) and *Melaleuca systena* (coastal honeymyrtle) form a pure heath covering over 10,000 hectares on the sandy flats. More common (over 90,000 hectares) 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 (see Vegetation Type 19).

Mosaics of *Dryandra* heath interspersed with patches woodland or open woodland occur in the northern Swan Coastal plain and southern Geraldton Sandplains Bioregions. Many of these mosaics are adjacent to areas of heath or a mosaic of scrub heath with heath (Mosaic 8). For example scattered patches of *Eucalyptus wandoo* (wandoo), *E. accedens* (powderbark wandoo) and *Corymbia calophylla* (marri) woodland occur 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.

21. Dwarf scrub, open low scrub

Heath with more open cover is classified as dwarf scrub where the cover is between 10 and 30% and as open low scrub where the cover is less that 10%. It extends over nearly 700,000 hectares, mainly in the Gascoyne Bioregion, with minor occurrences in the Carnarvon and Esperance Plains Bioregions.

An unusual *Eremophila* and *Senna* (cassia) dwarf scrub association is found on the shale in Ashburton Valley and Yinnietarra Hills in Gascoyne Bioregion. It covers a total of nearly 650,000 hectares. Either *Senna artemisioides subsp. artemisioides* (bloodbush) or *S. artemisioides subsp. x coriacea* (desert cassia) appears to be locally dominant, associated with *S. glutinosa subsp. xluerssenii* (white cassia), *Eremophila cuneifolia* (pinyuru), *E. abietina* (spotted poverty bush), *Acacia tetragonophylla*, *Ptilotus drummondii* (narrowleaf mulla mulla) and *P. obovatus* (cotton bush).

Figure 25. Vegetation Type 21 Dwarf scrub – northern extent

The coastline west of Lake Macleod Carnarvon Bioregion) has a linear patch of

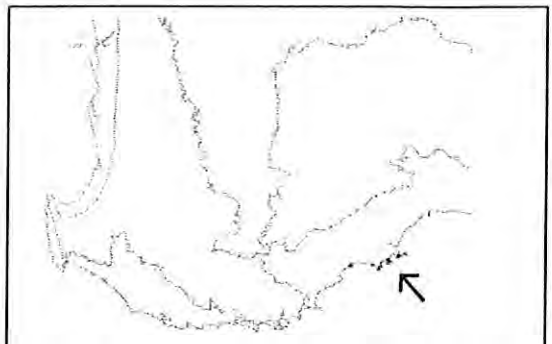

Figure 26. Vegetation Type 21: Dwarf Scrub – southern extent

Acacia coriacea (wirewood) dwarf scrub on recent sands. 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 Esperance Plains Bioregion covering a total of over 10,000 hectares. The shallow soil and the constant wind keeps the shrubs of *Dryandra pteridifolia*(tangled honeypot), *Banksia dryandroides* (dryandra-leaved banksia), *Pimelea ferruginea, and Isopogon formosus* (rose coneflower) low.

22. 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-strata vegetation type where the tallest stratum is not the most important ecologically. At maturity, pindan is a thicket of un-armed phyllodal *Acacias* over a lower stratum of grasses, herbs and low woody shrubs, with emergent layer of taller trees. However, while regenerating after a fire, pindan can appear more like savanna woodland. Pindan and low tree pindan are characteristic of the Dampierland Bioregion where they covers a total of about 5.5 million hectares. Pindan occurs primarily on the red sandy plains. Here, the dominant stratum of *Acacia* spp., usually *A. tumida* and *A. eriopoda* (Broome wattle), has an open upper stratum of trees such as *Eucalyptus tectifica* (grey box) and *E. grandifolia* (cabbage gum) and an open ground layer of spinifex, usually *Triodia pungens* (soft spinifex) and *T. bitextura* (curly spinifex).

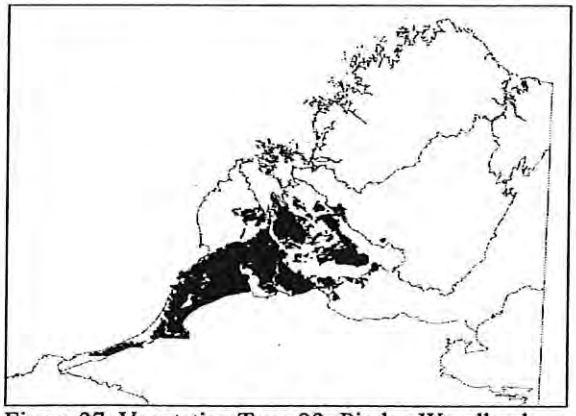

Figure 27. Vegetation Type 22: Pindan Woodland

Pindan woodland covers nearly 1.5 million hectares on the Dampier Peninsular and the Fitzroy sandplains, north east of Derby. It consists of an open, medium height (10-30m) tree layer, typically *Eucalyptus tectifica* (grey box) and *E. grandifolia* (cabbage gum), over *Acacia tumida* thicket, with a relatively sparse grassy ground layer of *Triodia bitextura* (formally *Plectrachne pungens)* (curly spinifex) and some *Chrysopogon fallax* (golden beard grass). Additional species *Acacia platycarpa* and *Eucalyptus miniata* (woolybutt) are present north east of Derby. The shrub layer also may 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), *E. papuana* (ghostgum), *Erythrophleum chlorostachys* (ironwood), *Gyrocarpus americanus* (helicopter tree) and *Bauhinia cunninghamii* (bauhinia).

23. Pindan with low trees

Much of the remainder of Dampierland Bioregion to the south and east of the Dampier Penninsular is covered with a 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. Emergent species here include *Eucalyptus cladophora*, *E. confertifolia* and *Corymbia dichromophloia* (variable barked bloodwood). Pindan with low trees covers over 4 million hectares and occurs mainly on sandplain, and on and between sand dunes. The dense *Acacia* layer is almost entirely *A. eriopoda* (Boome pindan wattle) which can reach 6m. Other shrubs include *A. monitcola*, *A. holosericia* (candlebra wattle), *A. stipuligera*, *Calytrix exstipulata*, *Grevillea pyramidalis* (caustic bush), *G. refracra* (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. shinzii* 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 (Mosaic12).

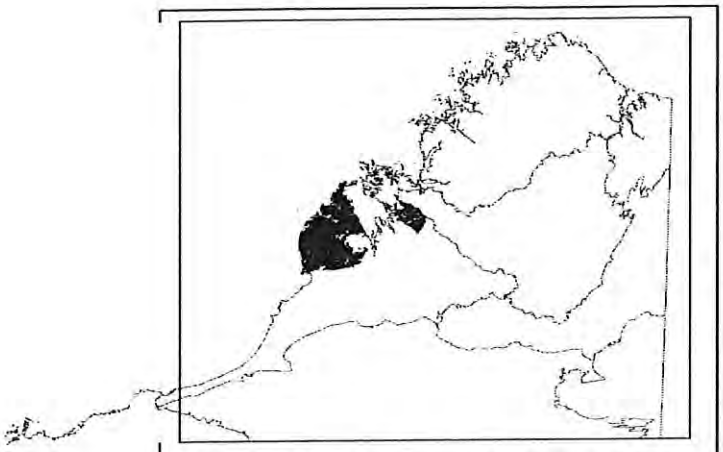

Figure 28. Vegetation Type 23: Pindan with low trees

24. High grass savanna woodland on basalt (shown on the map in the colour of high grass savanna overlaid with Y symbols).

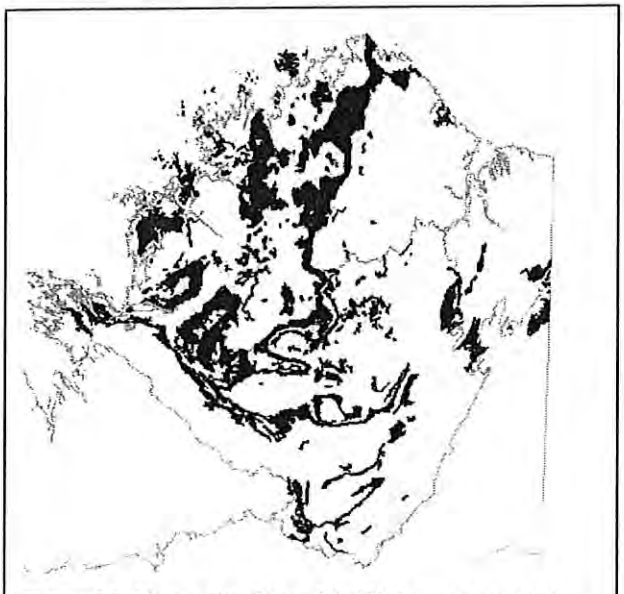

Figure 29. Vegetation Type 24: High grass savanna woodland on basalt.

High grass savanna woodland comprises tall (>100 cm) tussock grasses (both annual and perenial) with occasional shrubs and an overstorey of trees. The main species of grass is *Sehima nervosum* (white grass). *Chrysopogon fallax* (golden beard grass) up to 1.5m, *Sorghum plumosum* (plume canegrass) and *Themeda triandra* (kangaroo grass) may also be present. There is a poor shrub layer. The tree layer is predominantly *Eucalyptus tectifica* (grey box), *E. grandifolia* (cabbage gum) and *E. papuana* (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 Central Kimberley. There are small occurrences in the Victoria Bonaparte Bioregion, bringing the total extent to nearly 2.9 million hectares.

The woodlands of *Eucalyptus tectifica* (grey box), 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). Vine thickets can be found on the edge of basaltic plateaux, and *E. papuana* (ghost gum) is present along streamlines. *Eucalyptus foelscheana* joins the *E. tectifica* (grey box), *E. grandifolia* assemblage over the whitegrass on gentle slopes. In the more dissected landscape of Victoria Bonaparte Bioregion, the same species of tree emerge over a grassy layer of annual sorghum and *Triodia bitextura* (curley spinifex). Grasslands of *Sehima nervosum* (white grass) with low woodlands of *E. tectifica*, (grey box) *E. grandifolia* (cabbage gum) occur in ribbon-like patches on dolerite in Central Kimberley Bioregion.

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, south of Lake Argyle, and on the dissected, basaltic Antrim plateau 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).

25. High grass savanna woodland on sandstone (shown on the map in the colour of high grass savanna overlaid with ᚠ symbols).

This unit of high grass savanna woodland is similar in structure to the previous vegetation type but distinguished on the basis of substrate: 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* eg *S. australiense* and, *S.* stipoideum, with sparse *Triodia bitetxura* (curly spinifex). Common tree species include *Corymbia dichromophloia* (variable barked bloodwood), *Eucalyptus tetrodonta* (Darwin stringybark) and *E. miniata* (woolybutt).

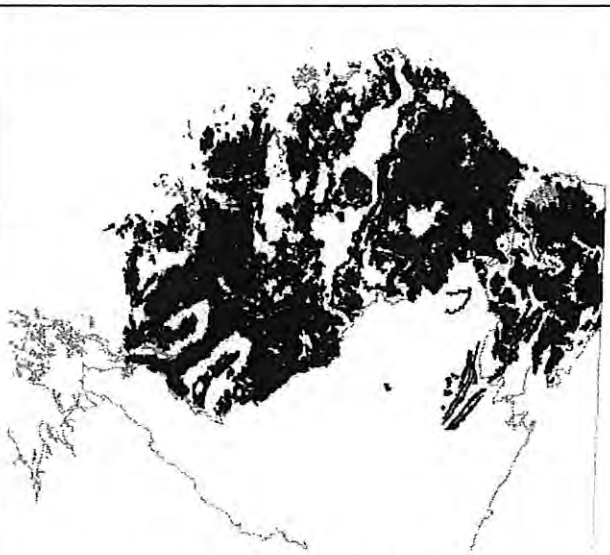

Figure 30. Vegetation Type 25: High grass savanna woodland on sandstone

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. These vegetation types extend on similar but more dissected sandstone in the east throughout Victoria Bonaparte Bioregion. There are small occurrences in the Central Kimberley Bioregion. High grass savanna woodland on sandstone covers nearly 6 million hectares. Dominant tree species of high grass savanna woodland on sandstone are *Eucalyptus tetrodonta* (Darwin stringybark), *E. miniata* (woolybutt) to 25m on deeper soils in low-lying country, and *Corymbia dichromophloia* (variable barked bloodwood) on shallow soils in Victoria Bonaparte Bioregion. Small trees include *Buchanania obovata, Brachychiton diversifolius, Syzygium suborbiculare, Grevillea cunninghamii, Grevillea* spp., and *Callitris intratropica* on red sands. Scattered shrubs are also common and include several *Acacia* species, notably *A. monticola, A. sericata var dunnii* and *A. tumida, Bossiaea bossiaeoides, Calytrix leschenaultii. Sorghum stipoideum* (annual sorghum) and *S. timorense* dominate the grass layer, which grows to 2m during the wet season, while *Triodia bitetxura* (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 mosaic (see Mosaic 13).

26. High grass savanna and high grass savanna with scattered trees

This high grass savanna woodland has tussock grasses (>100 cm) with scattered emergent deciduous trees. This vegetation type is relatively small in extent (almost 230,000 hectares) and occurs mainly in the Victoria Bonaparte Bioregion where it is the major vegetation type of the Ord Plains.

Scattered low trees of *Bauhinia cunninghamii* (bauhinia) or *Eucalyptus microtheca* (coolabah) and *Terminalia* spp. occur over perennial grasses (up to 2m) of *Sorghum plumosum* (plume canegrass), *S. timorense* with *Dichanthium tenuiculum, D. fecundum* (curly blue grass), and/or *Astrebla squarrosa* (bull mitchell grass).

Also included in this vegetation type is a patch of scattered *Eucalyptus brevifolia* (Kimberley snappy gum) over *Sorghum* spp. (upland tall grass) and *Triodia bitextura* (curly spinifex) on granitic soils in Victoria Bonaparte Bioregion.

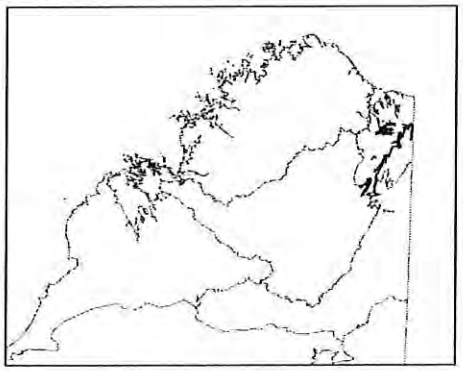

Figure 31. Vegetation Type 26: High grass savanna and high grass savanna with scattered trees.

27. Tall bunch grass savanna woodland (shown on the map in the colour of tall bunch grass savanna overlaid with ᵀ symbols).

Tall bunch-grass savanna is composed mainly of perennial tussock grasses 50-100 cm tall. An incomplete canopy of medium height trees is present. This is a small vegetation type (<250,000 hectares) occurring mainly on the western arm of Central

Kimberley Bioregion with small areas in Dampierland Bioregion on broad valley floors.

The grasses, *Dichanthium* spp. (blue grasses) or *Aristida* spp. (kerosene grasses) may occur with or instead of *Chrysopogon latifolius* (broadleaf ribbongrass) and *C. fallax.* (golden beard grass). *Corymbia dichromophloia* (variable barked bloodwood), *C. polycarpa* (long-fruited bloodwood), *Adansonia gregorii* (boab) and *Bauhinia cunninghamii* (Bauhinia) may join the main tree species of *E. tectifica* (grey box) and *Corymbia grandiflora* (cabbage gum).

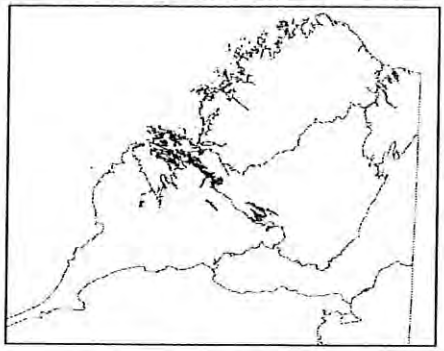

Figure 32. Vegetation Type 27: Tall bunch grass savanna woodland.

The tall bunch grass open savanna woodland communities characteristic of the rivers and drainage lines in the Kimberley has been mapped separately (Vegetation Type 39).

28. Tall bunch-grass low tree savanna (shown on the map in the colour of tall bunch grass savanna overlaid with symbols).

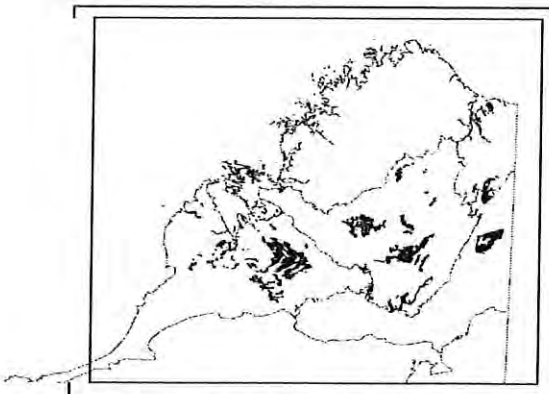

Figure 33. Vegetation Type 28: Tall bunch grass low-tree savanna.

Most of this tall bunch-grass savanna unit has perennial tussock grasses 50-100 cm tall with a conspicuous low tree layer with 10-30% cover. There is one association, *Euccalyptus tectifica* (grey box) and *E. grandiflora* (cabbage gum) low woodland over ribbon grass that has a denser low woodland component. Grasses are mainly *Chrysopogon* spp (ribbon or beard grass) with emergent trees such as *E. tectifica* (grey box), *Corymbia grandiflora* (cabbage gum) and *C. opaca* (bloodwood). It covers just over 1 million hectares in the central Dampierland, Central Kimberley and eastern Ord-Victoria Plains Bioregions.

On 170,000 hectares 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). A unit similar to this, but with additional *Dichanthium* spp.(blue grass), extends over 57,000ha into the Central Kimberley Bioregion.

Tall bunch grasslands of *Aristida pruinosa* (gulf feathertop wiregrass) and *Chrysopogon fallax* (golden beard grass) have two different overstoreys. Those with *Eucalyptus tectifica* (grey box) and *Corymbia opaca* (inland bloodwood) cover 113,000 hectares 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 west of Lake Argyle on 59,000 hectares

of sandy plain which surround outcrops of sandstone.

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

An area (43,000hectares) of tall bunch grass savanna low trees with *Corymbia grandiflora* (cabbage gum) and *Corymbia polycarpa* (bloodwood) occurs on sandy plains in Central Kimberley Bioregion. A low tree layer 3 - 6m in height containing *Terminalia canescens*, *Melaleuca minutifolia* (tea tree) and *Dolichandrone lanceolata* is 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. grandiflora* (cabbage gum) low trees over the *Chrysopogon* spp. (ribbon or beard grass) occur throughout the Central Kimberley Bioregion over an area of nearly 150,000ha.

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 occur in seasonally swampy bottomlands, inland from the major bays on the Dampier peninsula eg. Beagle Bay.

29. Tall bunch grass savanna, tall bunch grass savanna with very sparse low trees

This tall bunch-grass savanna vegetation type has perennial tussock grasses 50 - 100 cm tall, sometimes with very scattered low trees. The main component of this vegetation type is mitchell grass (*Astrebla* spp.) often with *Dichanthium* spp. (blue grass) and *Crysopogon latifolius* (broadleaf ribbongrass). Emergents include inconspicuous or scattered groups of *Terminalia* spp, *Acacia suberosa* (corkybark wattle), *Bauhinia cunninghamii* (bauhinia) and *Eucalyptus microtheca* (coolabah). It is characteristic of the Kimberley black soil plains found in the northeastern and southeastern Dampierland Bioregion, and southeastern and northern Ord-Victoria Plains Bioregion. Tall bunch grass savanna and tall bunch grass savanna with very sparse low trees together cover nearly 1.4 million hectares.

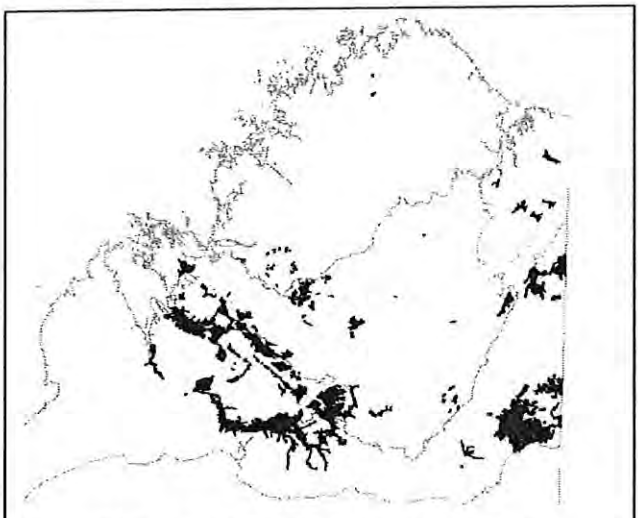

Figure 34. Vegetation Type 29: Tall bunch grass savanna with very sparse low trees and tall bunch grass

The treeless grasslands, which cover the 700,000 hectares of the Denison Plains in southeastern 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 *Crysopogon 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), **Echinochloa colona* (awnless barnyard grass), *Eragrostis japonica* (delicate lovegrass), *Brachyachne convergens* (spider grass), **Malvastrum americanum* (spiked malvastrum), *Crotularia medicaginea*, *Sida fibuliera*, *S. spinosa* (spiny sida), *Alysicarpus rugosus* (rough chainpea), *Rhynchosia minima* and many others.

Astrebla pectinata (barley mitchell grass) bunch grass savanna on black soil plains is mapped in five areas totalling 70,500ha near the shores of Lake Argyle (Ord-Victoria Plains and Victoria Bonaparte Bioregions). It has very sparse emergents including *Terminalia arostrata* (crocodile tree) and *T. oblongata* (rosewood). *Dichanthium* spp (blue grass) joins this association on adjacent basaltic soils covering a further 47,000ha in Ord-Victoria Plains Bioregion. Black soil plains with mitchell grass and/or ribbon/bluegrass (*Crysopogon*, *Dicanthium*) associations cover 42,000 hectares in the Fitzroy and Leonard River basins. Here tussocky perenial grasses 60-120 cm tall form a moderately dense layer distinguished by *Astrebla squarrosa* (bull mitchell grass), *S. pectinata* and *A. elymoides* (weeping mitchell grass) with *Crysopogon 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* (coolabah) and *Acacia suberosa* (corkybark wattle).

Very scattered low trees of *Acacia suberosa* (corkybark wattle) occur with *Astrebla* spp. (mitchell grass) over 35,000 hectares in Central Kimberley Bioregion and over a similar area (30,500 hectares) of *Crysopogon latifolius* (broadleaf ribbon grass) and *Dichanthium* spp (blue grass) in Central Kimberley Bioregion and Dampierland Bioregion. A total of 37,000 hectares of *Crysopogon latifolius* (broadleaf ribbon grass) and *Dichanthium* spp (blue grass) occur without emergents in Dampierland Bioregion, with a small area extending into Central Kimberley Bioregion.

The *Astrebla spp.* (mitchell grass) and *Crysopogon latifolius* (broadleaf ribbon grass) and *Dichanthium* spp. (blue grass) occurring on 72,000 hectares of black soil plains in 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 large areas in Central Kimberley Bioregion and on adjacent small patches in southern North Kimberley Bioregion the black soil supports very sparse low trees of *Bauhinia cunninghamii* (bauhinia) and *E. microtheca* (coolabah) over the *Crysopogon latifolius* (broadleaf ribbon grass).

30. 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 dominate short bunch-grass savanna less than 50 cm in height. 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 Lake Argyle to near Broome. It is found on lowland plains and covers a total of over 750,000 hectares. 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).

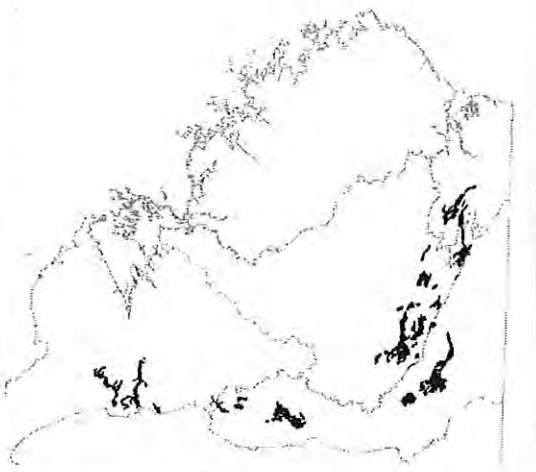

Figure 35. Vegetation Type 30: Short bunch grass low tree savanna.

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. This association accounts for more than half of the vegetation unit covering a total of 480,000 hectares.

Along drainage lines and on river flats in the southern central Dampierland Bioregion and running through the Poole Range in western Ord-Victoria Plains Bioregion, open Bauhinia emerges from *Aristida pruinosa* (gulf feathertop wiregrass) or *A. brownii* short grass plains. This vegetation type covers a total of 137,000 hectares. Low trees of *Bauhinia cunninghamii* 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 wattle) and *A. monticola* (gawar) shrubs with an unidentified acacia replacing *A. eriopoda* and forming thickets on the alluvial river flats.

A vegetation type 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 hectares. One is on upper reaches of the Ord River in Ord-Victoria Plains Bioregion, and the other is along the Durham River just west of Lake Argyle in Victoria Bonaparte Bioregion. Associated species include *Terminalia arostrata* (crocodile tree), *Gyrocarpus americanus* (helicopter tree), *Bauhinia cunninghamii, Acacia victoriae (bardi bush)* and *A. farnesiana* (mimosa bush) with *Dichanthium sericeum* subsp. *sericeum* (slender bluegrass) and *Triodia intermedia* obvious in the ground layer.

31. 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 bringing the total extent to over 1,125,000 hectares.

In the Dampierland Bioregion, the short bunch grassland with *Sporobolus virginicus* (salt-water couch) 15 - 30cm tall is found on swampy clay plains on the coast in 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 Victoria Bonaparte Bioregion. Other species are occasional samphires (*Halosarcia* spp.), *Sclerolaena* sp. and *Eragrostis falcata* (sickle lovegrass). Together these two vegetation types cover 247,000 hectares.

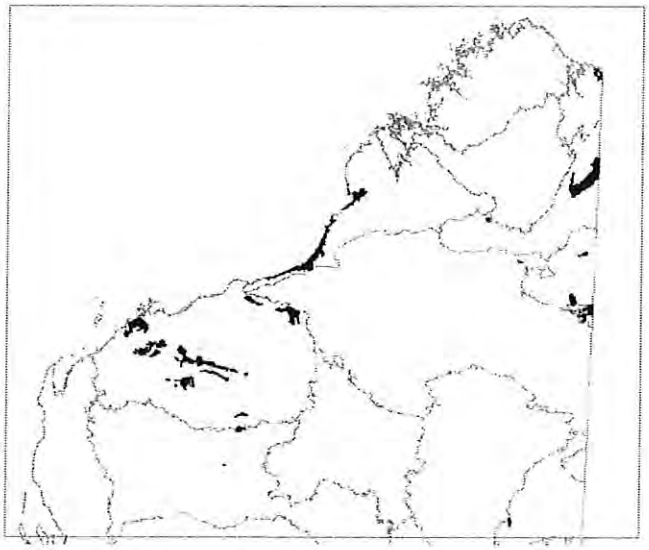

Figure 36. Vegetation Type 31: Short bunch grass savanna.

Arid short grasses *Enneapogon* spp. occur on the softer limestone and shale plains through which the Ord River flows north to Lake Argyle (263,000 hectares). 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 near Onslow and Roebourne, nearly 500,000 hectares of short bunch grasslands occur on the dark cracking clays that are derived from basalt. These may have been originally mainly *Astrebla pectinata* (barley mitchell grass) as this species now remains in pockets amongst the *Eragrostis setifolia*. An adjacent area of nearly 850,00 hectares is mapped as a mosaic of savanna grass plain and *Triodia pungens* (soft spinifex) or *T. wiseana* (limestone spinifex)(Mosaic 16).

Short bunch grass savanna composed of *Eragrostis eriopoda* and *Triodia pungens* (soft spinifex) occur over 82,00000 hectares on clay plains in the Great Sandy Desert and Central Ranges Bioregions. Other species found here include *Tephrosia arenicola*, *Dampiera candicans*, with *Frankenia* and *Halosarcia* in saline areas. Clumps of tea tree scrub, *Melaleuca lasiandra* and *M. glomerata* may also occur.

32. Curly spinifex savanna woodland (shown on the map in the colour of curly spinifex savanna overlaid with $\bar{T}$ symbols), low tree savanna

Figure 37. Vegetation Type 32a: curly spinifex savanna woodland.

Triodia bitextura (formerly *Plectracne pungens*) is commonly known as curly spinifex and grows to between 50 and 100cm tall. Curly spinifex savanna woodland is distinguished by the presence of *Triodia bitextura* with a cover of 30 – 70%, with a medium (10-30m) height tree layer with a cover of 10 - 30%. It is found covering just over 100,000 hectares in Central Kimberley Bioregion. More commonly the curly spinifex grass layer, has a low tree component, either incomplete (10 - 30% cover) or a more open scattered (<10% cover). 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 5.5 million hectares.

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) low tree savanna woodland, occurs extensively (1.6 million hectares) in Central Kimberley Bioregion adjacent to the high grass savanna woodlands to the north in the Northern Kimberley Bioregion. The upper tree layer is typically 8-10m tall with trees of poor form, gnarled and twisted with trunks seldom more than 30-50 cm in diameter. The cypress, *Callitris intratropica* is occasionally found. There may be a shrub layer, generally sparse, but in some areas *Acacia* spp. 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).

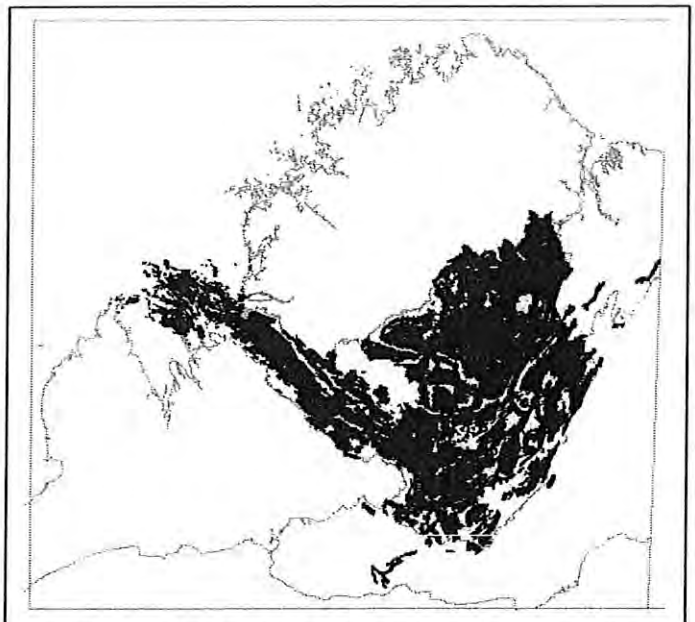

Figure 38. Vegetation Type 32b: curly spinifex savanna low tree savanna.

A mosaic of the above association with *Eucalyptus brevifolia* (Kimberley snappy gum) low tree savanna over curly spinifex occurs to the south over an area of just

over 300,000 hectares. As both components of the mosaic are the same vegetation type, this mosaic in not hatched on the map.

Savanna woodland associations with the lower tree component of the *Eucalyptus brevifolia* (Kimberley snappy gum), occur extensively (2.5 million hectares) over the sandstone ridges of King Leopold and the Durack 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). On lower hill slopes and valley floors *Enneapogon* spp, (arid shortgrass) occurs with the curly spinifex.

The vegetation of the islands off the Central Kimberley Bioregion coast, eg 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 12) is the low tree savanna very sparse low tree savanna over *Triodia bynoei* in the western arm of the Central Kimberley Bioregion

33. Tall bunch grass open savanna woodland associated with drainage features.

This small vegetation unit, covering just over 230,000 hectares has a similar understory to the other tall bunch grass vegetation types (Vegetation Types 30 and 31) but it is characteristic of riverine environments. It consists of the *Eucalyptus microtheca* (coolabah) 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 Central Kimberley, Victoria Bonaparte and Ord-Victoria Plains Bioregions.

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* (coolabah) over *Chrysopogon spp.* (ribbon or beard grass) sometimes with *Dichanthium* spp. (blue grass). *E. papuana* (ghost gum) joins the coolabah 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.

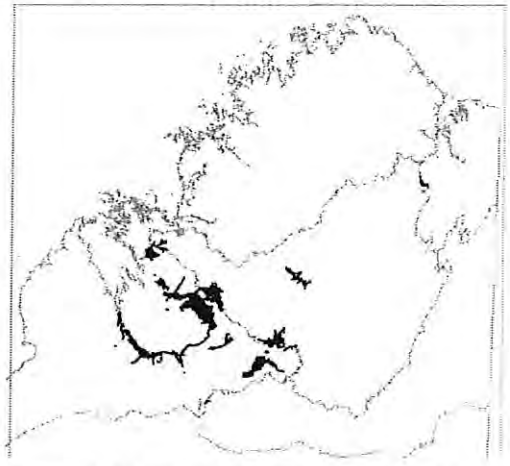

Figure 39. Vegetation Type 33: Tall bunch grass open savanna woodland associated with drainage features.

34. 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 totals area of over half a million hectares. The trees are mainly *Eucalyptus microtheca* (coolabah) and *E. camaldulensis* (river gum) over mixed sedges from the families Cyperaceae and Restionaceae, and grassss (*Aristida* spp. and *Eragrostis* spp.).

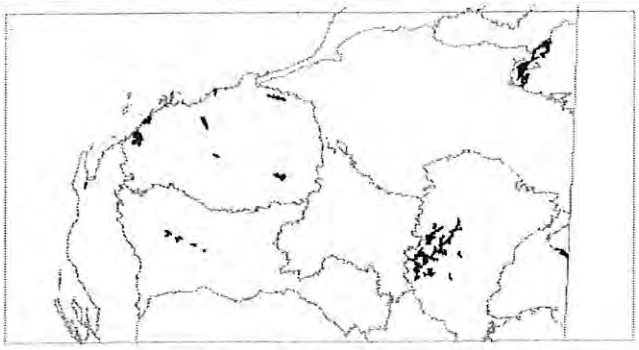

Figure 40. Vegetation Type 34: Riverine sedgeland/ grassland with trees.

An association of *E. microtheca* (coolabah) and *E. tectifica*, (grey box) low tree savanna woodland over sedges is mapped over 42,500 hectares along the channels through the Dennison Plains. Other trees include *Bauhinia cunninghamii*, (bauhinia) and *Terminalia arostrata* (crocodile tree).

In the valleys and near claypans in Gibson Desert Bioregion, *E. microtheca* (coolabah) with a cover of 10-30% over various sedges is mapped over a total of 212,000 hectares.

In the Pilbara Bioregion, and to a much lesser extent in Gascoyne and Little Sandy Desert Bioregions, the riverine woodland tends to be more open (<10%), than the previous associations. The species here are *Eucalyptus microtheca* (coolabah) and *E. camaldulensis* (river gum) may also be found.

In Tanami Bioregion the coolabah layer is more open and the sedge layer may also include many forbs and some bunch grasses.

35. Sedgeland

Sedgelands are dense, single-layered vegetation associations with a height of up to 1m. 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 Warren Bioregion, with smaller areas in Jarrah Forest, Swan and Esperance Plains Bioregions. Communities of reeds occur on very poorly drained, sandy plains and in deep swamps fringing lakes and estuaries. Scattered woody shrubs to 2m may be present eg. *Beaufortia sparsa* (swamp bottlebrush), *Callistemon glaucus*

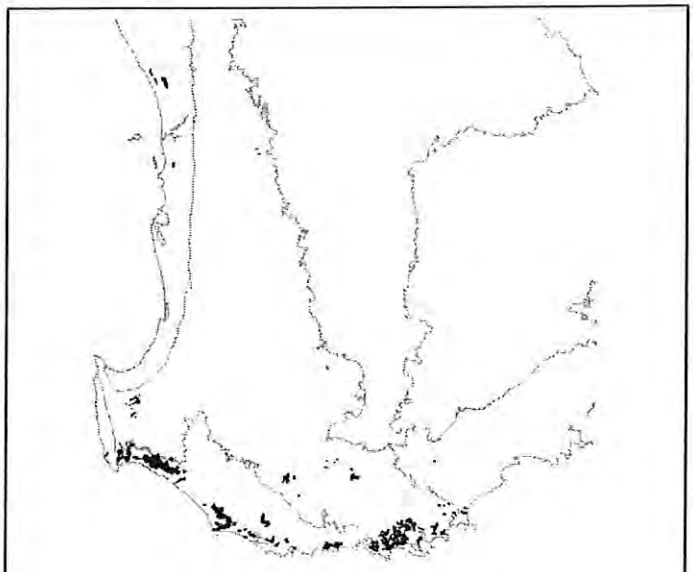

Figure 41. Vegetation Type 35: Sedgeland.

(Albany bottlebrush) and *Melaleuca* spp.

36. Hummock grasslands, tree steppe with desert oak

Hummock grasslands with medium woodland or irregularly scattered trees 10-25 m tall is classified as tree steppe. An open groundcover, cover 10-30%, mainly of *Triodia pungens* (soft spinifex) occurs under the distinctive *Allocasuarina decaisneana* (desert oak) woodland (30-70% cover) or open woodland (10-30% cover). This vegetation type covers an area of over 1.8 million hectares and is present in five Bioregions. Most of the unit occurs in Central Ranges Bioregion (1.5 million hectares) where it makes up 60% of the Western Australian part of this Bioregion. Smaller areas occur in the Gibson Desert, Little Sandy Desert, Great Sandy Desert and Tanami Bioregions.

The sandhill country of the Central Ranges 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.

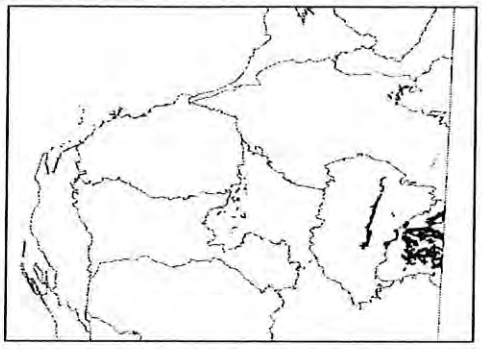

Figure 42. Vegetation Type 36: Tree steppe.

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

On the western edge of 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.

37. Hummock grasslands, low tree steppe

In this vegetation type, the hummock grassland has an overstorey of scattered low trees (<10m tall with <10% cover). It is mainly scattered *Corymbia dichromophloia* (variable barked bloodwood) and/or *E. brevifolia* (Kimberley snappy gum) over *Triodia* species (spinifex). This vegetation type covers almost 15.7 million hectares and is the third most extensive vegetation type in the State. A further 26 million hectares are mapped as mosaics of low tree steppe usually with shrub steppe (see Mosaic 18). This vegetation type is spread over nine Bioregions, of which the most important are Great Sandy Desert, Pilbara and Ord-Victoria Plains Bioregions.

The *Triodia pungens* (soft spinifex) on lateritic sandplain of the Sturt Plateau in the Ord-Victoria Plains Bioregion has an open overstory of *Eucalyptus brevifolia* (Kimberley snappy gum) and/or *Corymbia dichromophloia* (variable barked bloodwood) (6 - 8m tall). 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 1.15 million hectares.

In the Pilbara Bioregion, over 2.5 million hectares of rugged range country are covered in low tree steppe. The spinifex layer is *Triodia wiseana* (limestone spinifex) and *E. leucophloia* (Pilbara snappy gum) is the dominant eucalypts 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 (> 1m) include *Senna artemisioides* subsp. *x 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 lycopodiifolia, A. maitlandii* (Maitland's wattle), *A. validinervia, A. orthocarpa, Atriplex sp., Gompholobium polyzygum, Gastrolobium grandiflorum* (wallflower poison), *Keraudrenia integrifolia* (common firebush), *Mirbelia viminalis, Petalostyles labicheoides* (slender petalostylis), *Ptilotus rotundifolius* (royal mulla mulla), *Sida echinocarpa, S.* sp. aff. *petrophila* and *Triumfetta chaetocarpa* (urchins).

Over 5 million hectares in northern Great Sandy Desert Bioregion, extending into the Tanami Bioregion, is mapped as low tree steppe of *Triodia pungens* (soft spinifex) and *Triodia schinzii* (previously *Plectrachne*) (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 *Eucalyptus 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.

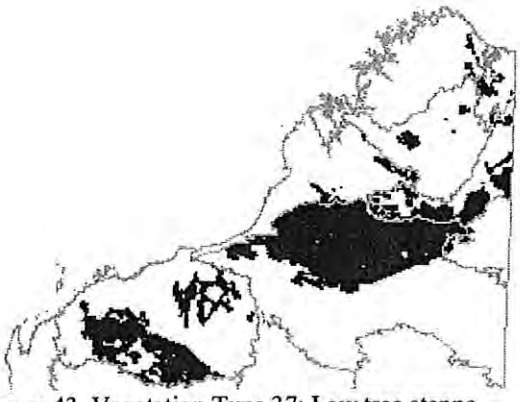

Figure 43. Vegetation Type 37: Low tree steppe – northern extent

The adjacent mosaic has a very open low tree steppe of *Triodia schinzii* (feathertop spinifex) and *E. chippendalei* (desert bloodwood) on sandhills with spinifex and mixed open shrubs steppe between sandhills. (Mosaic18)

Forming a transition between desert tree steppe (*Eucalyptus* spp.) and the pindan is a low tree steppe of *Owenia reticulata* (native walnut) over *Triodia pungens* (soft spinifex) occuring between the widely spaced sandy ridges. This covers over 3.5 million hectares 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. (3-4.5m) over *Triodia bitextura* (curly spinifex), which covers nearly 120,000 hectares in the Cockburn Range (Victoria Bonaparte Bioregion) and 60,000 hectares 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. acaciodes and *M. viridiflora*. On the shale plains in Central Kimberley Bioregion, *Triodia pungens* (soft spinifex) and *Triodia bitextura* (curly spinifex) has a low, more open, tree layer with *E. argillacea* (Mt House box) and *E. brevifolia* (Kimberley snappy gum). *Melaleuca minutifolia* (tea tree), a shrub to 2m, is common and *Acacia monticola, A. translucens, 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 Ord-Victoria Plains Bioregion *Triodia wiseana* (limestone spinifex) has a sparse layer mainly of *Terminalia* spp. Other trees and shrubs such *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 of the upper Denison Plains in Ord-Victoria Plains Bioregion.

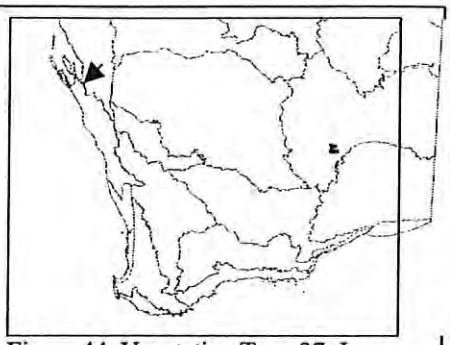

Figure 44. Vegetation Type 37: Low tree steppe – southern extent

On the sandplains of the Great Victoria Desert Bioregion, the spinifex layer of *Triodia basedowii* (hard spinifex) has an open overstorey of *Acacia aneura* (mulga) and *Casuarina pauper* (black oak) low trees. This association represents a transition from the pure mulga to the mallee and spinifex on sandplain.

In Carnarvon Bioregion, south of Hamelin Pool, there is a 14,500 hectare 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.

38. Hummock grasslands, very sparse low tree steppe

Where the tree layer has a height of less than 10m and a cover of less than 10% 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 Central Ranges and Carnarvon Bioregions, contributing to the total extent for this vegetation type of over 1.7 million hectares.

Figure 45. Vegetation Type 38: Very sparse low tree steppe.

The sandstone ridges and plateaux of Ord-Victoria Plains Bioregion support a very sparse low tree steppe comprised 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* replaces the snappy gum to occur with the bloodwood over *T. pungens* (soft spinifex) and *T. intermedia*

A sparse medium tree steppe, features very scattered *Adansonia gregorii* (boab) (to12m) over open *Triodia. wiseana* on the limestoneoutcrops which form the Napier Hills and Oscar Plateau, along the north eastern boundary of the Dampierland Bioregion. To the north east, this unit forms part of the Mosaic 12.

Pilbara snappy gum over soft spinifex is the common sparse tree steppe on the rocky ranges in the Tanami Bioregion (eg Gardiner and Kearney Ranges). *Eucalyptus aspera* may be found on cliffs and *Grevillea wickhamii* (Wickham's grevillea), *Eremophila* spp. and *Senna* spp. occur as occasional shrubs.

In south east Central Ranges Bioregion, scattered low *Corymbia dichromophloia* (variable barked bloodwood) 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 platypoda* and *Callitris glaucophylla* (white cypress pine) growing in gullies and crevices between the boulders. Mulga (*Acacia aneura*) is also present on mid- and lower slopes.

On Cape Range in the Carnarvon Bioregion, there is a relatively small area (about 8,400 hectares) of sparse tree-steppe with scattered *E. prominens* (previously thought to be *Corymbia dichromophloia)* over *T. pungens* (soft spinifex) and *T.* sp. indet. aff. *angusta* on limestone plateaux and canyons.

39. Hummock grasslands, tree and shrub steppe (shown on the map in the colour of shrub steppe overlaid with ⚲ symbols)

This hummock grassland of *Triodia* spp. has a low tree layer of scattered eucalypts such as *E. 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 nearly 11.5 million hectares of the Region's 22.7 million hectares covered. A further 900,000 hectares occur in Pilbara, Gascoyne, Carnarvon, Murchison and Ord-Victoria Plains Bioregions.

Open *Eucalyptus 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. Structure varies slightly with the height of the marble gum ranging from 9 to 12m. 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) occurs 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 *Thryptomene maisonneuvei* with occasional *Calytrix*

longiflora and *Micromyrtus flaviflora.* The summits are sparsely covered with *Grevillea stenobotrya, Gyrostemon ramulosa* and *Crotalaria cunninghamii.*

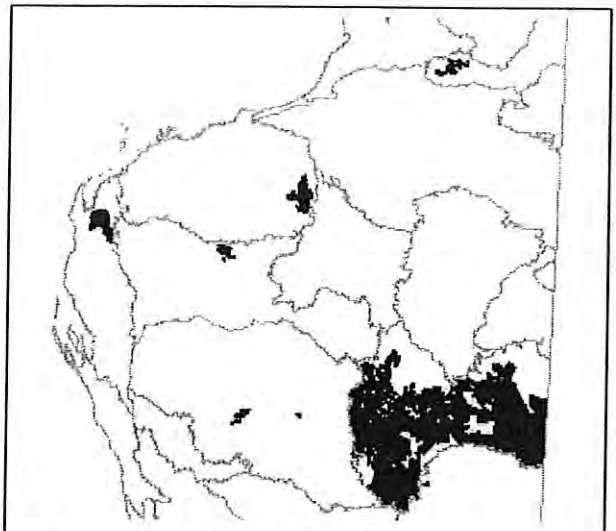

Figure 46. Vegetation Type 39: Hummock grasslands, tree and shrub steppe.

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

In higher rainfall areas to the north, on the western arm of Ord-Victoria Plains Bioregion, the tree layer is denser. *Corymbia dichromophloia* (variable barked bloodwood) forms a low open tree layer with 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 *Eucalyptus setosa* and *Hakea* lorea (witinti) occur over *Acacia pachycarpa* 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 microtheca* (coolabah) and *E. setosa* 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.

40. Hummock grasslands, shrub steppe

This hummock grassland vegetation type has *Triodia* spp. with a cover of 10-30%, with scattered (cover <10%) of shrubs such as species of *Acacia*, *Grevillea* and mallee eucalypts. It is the characteristic vegetation of the interdunal swales and desert sandplains which 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 million hectares: 8 million hectares in the Pilbara Bioregion, 6.4 million hectares in the Little Sandy Desert Bioregion; 4.5million in the Great Sandy Desert Bioregion, 3.4 million ha (11%) in the Murchison Bioregion, 2.6million hectares in the Gibson Desert Bioregion and 2.3 million hectares in the Tanami Bioregion. It also occurs in another eleven Bioregions.

The most common association is mixed *Acacia* spp. and other species over *Triodia basedowii* (hard spinifex). This covers over 8.3 million hectares with over 1 million hectares 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.: *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 *E.*

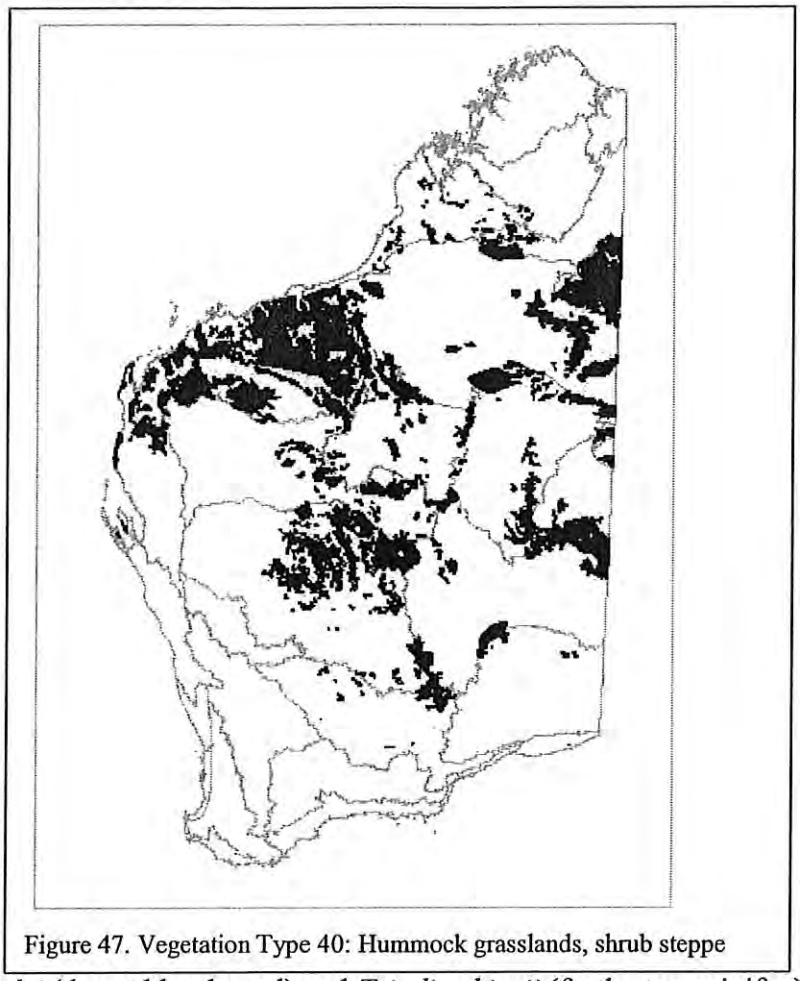

Figure 47. Vegetation Type 40: Hummock grasslands, shrub steppe

chippendalei (desert bloodwood) and *Triodia shinzii* (feathertop spinifex) on sandhills with shrub steppe of mixed shrubs over spinifex between the sandhills (Mosaic 18).

The two most common *Acacia* species associated with *Triodia pungens* (soft spinifex) are *Acacia pyrifolia* (ranji bush) and *Acacia pachycarpa.* Shrub steppe of ranji over soft spinifex occurs on the deeper soils on granite in the Abydos plain, Oakover valley and extends south into the Chitchester plateau. This accounts for over 3.3 million hectares 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). *Acacia pachycarpa* shrub steppe over *Triodia pungens* (soft spinifex) occurs on sand-free lateritic uplands in 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 1m hectares of Gibson Desert Bioregion

A shrub steppe of *Acacia aneura* (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 Great Victoria Desert Bioregion (Vegetation Type 39). 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 phylliraeoides* (weeping pittosporum) and *Santalum acuminatum* (quandong). To the east, nearly 1.6 million hectares of sandhill country bordering 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 *Triodia 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 Great Victoria Desert Bioregion extending into the Nullarbor, north eastern Coolgardie and western Murchison Bioregions

Several species of *Eucalyptus*, *E. youngiana* (large-fruited mallee), *E. oleosa* (giant mallee), *E. gamophylla* and *E.prunosa* (silverleaved box) occur as open mallee over *T basedowii* (hard spinifex), *T scariosa* or *T. pungens* (soft spinifex). These associations total over 2.2 million hectares with the largest being *E. youngiana* (large-fruited mallee) over *T basedowii* (hard spinifex) covering nearly 90,000 hectares of sandplains in the north-west Great Victoria Desert Bioregion. Other occurrences of this open mallee steppe are in the Ord Victoria Plains (*E. prunosa*), 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 4.

Shrub steppe that contains a mixture of shrub species covers over 3 million hectares. 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 hectares of the Great Sandy Desert Bioregion is mapped as a shrub steppe of mixed shrubs over *Triodia pungens* (soft spinifex). Here 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 Little Sandy Desert, Central Ranges, Gibson Desert and Pilbara Bioregions *Triodia shinzii* may join the soft or hard under the mixed shrub layer in between the dunes. In addition, in northern Little Sandy Desert Bioregion, *Acacia coriacea* (wirewood) and *Hakea lorea* (witinti) over *Triodia basedowii* (hard spinifex) covers nearly 700,000 hectares. Other conspicuous species are *Hakea rhombales* and *Xanthorrhoea thorntonii* (grass tree). In the Tanami Bioregion, on 1.7 million hectares of shallow soil on sandplains flanking the lower Sturt Creek, *Hakea lorea* (witinti) to 3m, is emergent over the soft spinifex. *Grevillea refracta* (silver-leaf grevillea) is common over soft spinifex in the west in Dampierland Bioregion. South of latitude 22° S, *Thryptomene maisonneuvei* may be present as the low shrub amongst the spinifex

A unusual dwarf shrub steppe of low (50 cm) *Acacia translucens* over *Triodia*

pungens (soft spinifex) covers the sandy alluvial deposits between rivers in the coastal areas of Pilbara Bioregion. This fringes the *Acacia pachycarpa* shrub steppe, and totals an area of over 2.2 million hectares.

The shrub steppe unit of *Acacia aneura* (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 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, Grevillea pyramidalis* (caustic bush) and *T. basedowii* on the stony ground upslope.

41. Hummock grasslands, very 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 Pilbara Bioregion and also occurs in Great Sandy Desert, Carnarvon and Gascoyne Bioregions. It covers a total of nearly 8 million hectares.

Most of the Gibson Desert Bioregion is descrided 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 mapped as very sparse shrub steppe. *Hakea lorea* (witinti) often occurs on the hillcrests. Other species include *Acacia pruinocarpa* (gidgee), *A. dictyophleba, A. grasbyi* (miniritchie), *A. helmsiana* and *Eucalyptus kingsmillii* (Kingsmill's mallee).

Figure 48. Vegetation Type 41: Very sparse shrub steppe.

In the Pilbara, 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* over *Triodia wiseana* (limestone spinifex) sparse shrub steppe occurs on very poor rocky country on gneiss just to the south west. In the west, near the Cane River, *Acacia pyrifolia* (ranji bush) joins *Acacia bivenosa* over *Triodia basedowii* (hard spinifex) and *T. wiseana* (limestone spinifex). Barrow Island is mapped as predoninately scattered mixed shrubs over *Triodia wiseana* (limestone spinifex) and *Triodia* sp. indet. aff. *angusta*.

42. Hummock grasslands, 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 - the species composition of this component depends on the amount and season os rainfall. Grass steppe is not a common vegetation type in Western Australia,

but it is an important component of vegetation mosaics occurring in sand dune country. It occurs as patches on rocky outcrops rather than in wide expanses, and has a total extent of 2.5 million hectares in the Great Sandy Desert, Little Sandy Desert, Pilbara and Gascoyne Bioregions.

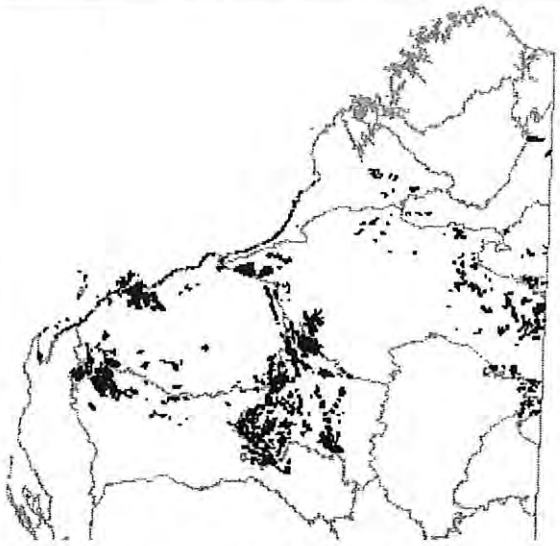

Figure 49. Vegetation type 42: Grass steppe.

Generally *T. pungens* (soft spinifex) occurs north of latitude 22° S and *Triodia basedowii* (hard spinifex) occurs south of this latitude. The most common grass steppe, dominated by *Triodia pungens* (soft spinifex), occurs on hills and ranges in 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 *Triodia basedowii* (hard spinifex).

In the Barlee Range (Gascoyne Bioregion) and adjacent south west Pilbara Bioregion, *Triodia wiseana* (limestone spinifex) is common. *Triodia wiseana* (limestone spinifex) mixed with *T. basedowii* (hard spinifex) grass steppe occurs near north west tip of the Gascoyne Bioregion. 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 supporting a mosaic of mixed short bunch grasses and spinifex (see Mosaic 16).

There are small patches of grass steppe in 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.

43. Hummock grasslands, Spinifex Complexes

This vegetation type is distinguished by having three layers, of which the hummock grassland is most important. 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 originally mapped this as a mixed sandplain mosaic. Spinifex complexes cover a total of 1.3 million hectares in the Carnarvon, Murchison, and Tanami Bioregions.

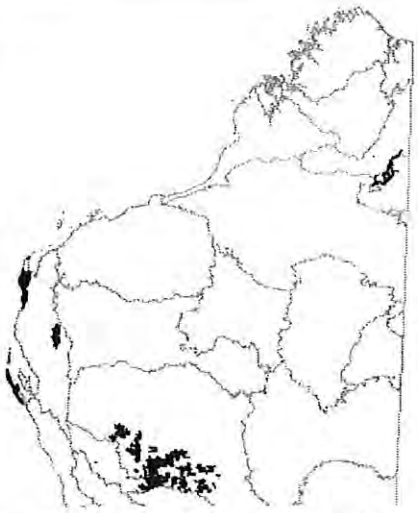

Figure 50. Vegetation Type 43: Spinifex complexes.

The spinifex complexes of the southwestern Murchison Bioregion total over 750,000 hectares. These show an interesting intermingling of the eucalypts and 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 favoring the tree steppe to the yellow-brown sand beneath the heath elements. They are mapped as spinifex *Triodia irritans* (mapped as *T. basedowii* (hard spinifex), *Triodia scariosa* and T. sp. indet. (probably *Triodia 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. linopylla* (bowgada). Other low tree species include *Eucalyptus kingsmillii* (Kingsmill's mallee), *Acacia aneura* (mulga), and *Callitris glaucophylla* (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. leucophylla*, *Melaleuca uncinata* (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. The mixed scrub and dwarf scrub with *Triodia pungens* (soft spinifex) and *T. basedowii* (hard spinifex) occurs on over 200,000 hectares on the sandhill country at the southern end of Cape Range. Shrub species include *Acacia spathulifolia, Grevillea eriostachya* (flame grevillea), *Hakea stenophylla, Hibbertia spicata, Mirbelia ramulosa Thryptomene baeckeacea* and *Verticordia etheliana* with *Triodia schinzii* (feathertop spinifex) also in the grass layer. The sand plain with dunes on top of the Kennedy Range (110,000 hectares) supports a cover 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* sp. Covering most of Dirk Hartog Island (53,000 hectares), *Acacia* scrub with heath shrubs and spinifex covers 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 hectares). Shrubs, pruned by the wind, include some species from the South West: *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 *Triodia 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* (coolabah) emerge from the bunch grass and *Triodia pungens* (soft spinifex).

44. Samphire with thicket and woodland or scattered trees

This vegetation type consists of three strata: medium trees over a tall (>2m) shrub layer over samphire. The thicket has a cover of 30 - 70% while the characteristic samphire has a cover of between 10 and 30%. The density of the medium tree layer ranges from a cover of 10 - 30% (woodland), to <10% (open woodland) to ≈0% (very scattered trees). This unit is associated with heavy soils near saline drainage systems and covers an area of nearly 250,000 hectares. Samphire includes species from the genera *Halosarcia* and *Sarcocornia.* It occurs mainly in Avon Wheatbelt Bioregion extending into the Geraldton Sandplains, Yalgoo and Mallee Bioregions.

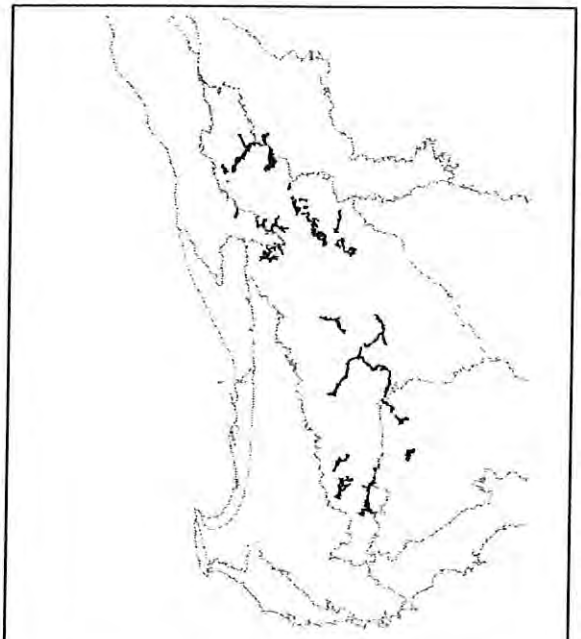

Figure 51. Vegetation Type 44: Samphire with thicket and woodland or scattered trees.

Saline areas totalling nearly 180,000 hectares in northern and central Avon Wheatbelt Bioregion support a three-strata association with *Eucalyptus loxophleba* (York gum) woodland or open woodland over tea tree (*Melaleuca* sp.) thickets (often *M. thyoides*) and samphire. Other tree species include *Casuarina obesa* (swamp sheoak), and *E. rudis* (flooded gum) in the west, *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 - it is often absent in the drier regions (see Vegetation Type 53). The samphire is mainly Halosarcia spp., with occasional low succulents such as *Carpobrotus* spp. and *Disphyma* spp.

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

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

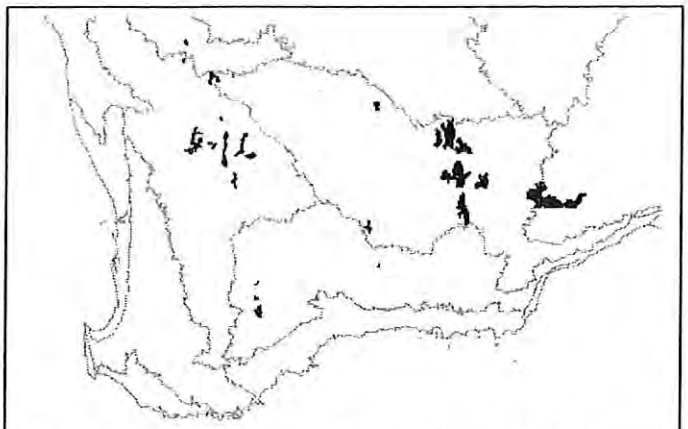

Figure 52. Vegetation Type 45: Saltbush and/or bluebush with woodland or scattered trees.

This vegetation type has saltbush and/or bluebush dominant in the ground layer (10 – 30% cover) with the medium tree layer ranging from a cover of 30 - 70% (woodland), to 10 - 30% (open woodland) and occasionally to <10% (scattered trees). Common species include *E. salmonophloia* (salmon gum) and *E. salubris* (gimlet) over *Atriplex* spp. and *Maireana* spp. 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 as *Kochia sedifolia* These associations characteristically have a cover of between 30-70%. This particular vegetation type is found mainly in the Coolgardie, Nullarbor and Avon Wheatbelt Bioregions and covers a total of nearly 500,000 hectares.

In Coolgardie Bioregion, there are substantial areas (250,000 hectares) 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. Other eucalypts may also be present: *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 *Brachycome, Cephalipterum drummondii* (pompom head), *Rhodanthe floribunda* (white everlasting) and *Ptilotus exaltatus* (tall mulla mulla).

Eucalyptus salmonophloia (salmon gum) and *E. salubris* (gimlet) occur over *Maireana sedifolia* (pearl bluebush), *Acacia papyrocarpa* (western myall) and *Myoporum platycarpum* (sugarwood) in the south west corner of the Nullarbor Bioregion, covering over 150,000 hectares. This is flat country on limestone where, due to the higher rainfall, the *tree layer is >10m over* bluebush. Low trees over bluebush occurs to the east adjacent to the Nullarbor Plain. The vegetation is transitional to the adjacent eucalypt woodlands to the west In the south west corner of the Nullabor Bioregion there are mosaics (see Mosaic 5) of woodlands 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 12,000 hectares

Two small mosaics of saltbush and samphire (totalling 34,000 hectares) are included in this vegetation type, as their linear nature would not show any hatching. Around the salt lakes north and north west of Kellerberrin in the Avon Wheatbelt Bioregion,

these mosaics have patches of either scattered *Eucalyptus salmonophloia* (salmon gum) and *E. gracilis* (yorrell) medium trees or scattered *Eucalyptus loxophleba* (York gum), *Eucalyptus salmonophloia* (salmon gum) and *E. longicornis* (red morrel) medium woodland over the saltbush and samphire. Belts of *Halosarcia leptoclada* and *Gunniopsis calcarea* (samphire) near the salty areas grade into and *Maireana brevifolia* (bluebush) under the scattered trees or woodland. Communities with a tea tree shrub layer may occur nearby.

46. Samphire with woodland or low woodland

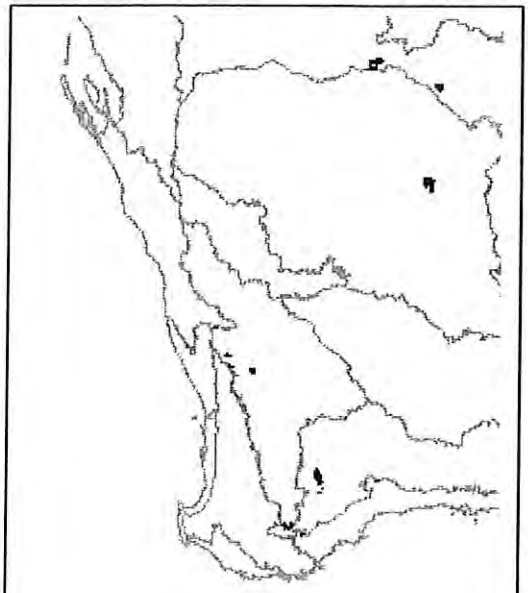

Figure 53. Vegetation Type 46: Samphire with woodland or low woodland.

In this vegetation type, the samphire layer with a cover of 30 - 70% has medium (>10m) or low (<10m) tree layer with a cover of 30 - 70%. The vegetation is typically either *Acacia aneura* (mulga) low woodland with patches of samphire, which occurs in the Gascoyne Bioregion and Murchison Bioregion, or *Eucalyptus loxophleba* (York gum) or *Casuarina obesa* (swamp sheoak) woodland over samphire which is present in the Avon Wheatbelt Bioregion. This is a small vegetation type covering just over 56,000 hectares of the State.

Acacia aneura (mulga) low woodland, sometimes with *A. ramulosa* / *A. linopylla* (bowgada), occurs over samphire on saline soils adjacent to Lake Darlot in the Murchison Bioregion, and 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) over samphire. York gum drops out of this association in the salt lake systems of the western Mallee Bioregion. A small area of *Casuarina obesa* (swamp sheoak) woodland over samphire is also mapped in central west Avon Wheatbelt Bioregion. This association is likely to occur elsewhere, but in patches too small for mapping at this scale.

47. Saltbush and/or bluebush with low woodland

This vegetation type has a low woodland component over a saltbush and/or bluebush shrub layer. It is the common 'thickly wooded succulent' (after Beard 1981a) or sarcophyllic association of the northern Nullarbor Bioregion and covers over 300,000 hectares. Other associations include a mulga, saltbush and bluebush association on greenstones in Murchison Bioregion, and mulga-sheoak associations over bluebush in Murchison, Coolgardie and Yalgoo Bioregions.

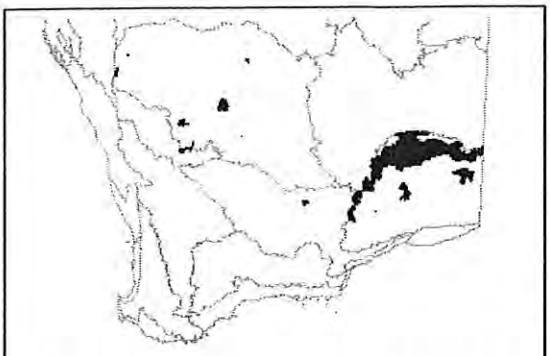

Figure 54: Vegetation type 47: Saltbush and/or bluebush with low woodland.

The limestone plateau of the Nullarbor Plain is more elevated in the north where a band of thickly wooded sarcophyllic steppe is found on the deep, pink, calcareous sandy loam. *Acacia aneura* (mulga) to 4.5m is common, with scattered *Casuarina pauper* (black oak) to 9m, *Myoporum platycarpum* (sugarwood) to 6 m and occasional *Eucalyptus oleosa* (giant mallee) also present. *Mariana sedifolia* (pearl bluebush) and seasonal herbs and grasses form the open ground layer.

On the northern edge of the treeless part of the Nullarbor Plain, south of the lightly wooded myall low open woodland (see Vegetation Type 48), there are two areas of *Acacia papyrocarpa* (western myall) low woodland over bluebush. These appear to occur in large depressions.

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 saltbush and bluebush. A futher patch of this woodland over saltbush and bluebush occurs 150 km to the west-south-west. Still in Murchison Bioregion, a band of mulga and *Casuarina pauper* (black oak) low woodland over saltbush and bluebush extends out from the northern end of Lake Moore.

48. Saltbush and/or bluebush with scattered low trees

This vegetation type is an open low woodland over a saltbush and/or bluebush layer. It is the referred to by Beard (1981a) as 'thinly wooded succulent'. It is similar to the previous vegetation type but differs by having a more open (<10%) canopy over the bluebush and/or saltbush. Important associations include the *Acacia papyrocarpa* (western myall) open low woodland over bluebush covering 3.5 million hectares in Nullarbor and Hampton Bioregions. *Acacia. aneura* (mulga), sometimes with *Casuarina pauper* (black oak), over the bluebush and/or saltbush covers 800,000 hectares in the eastern Murchison, northern Coolgardie and western Great Victoria Desert Bioregions.

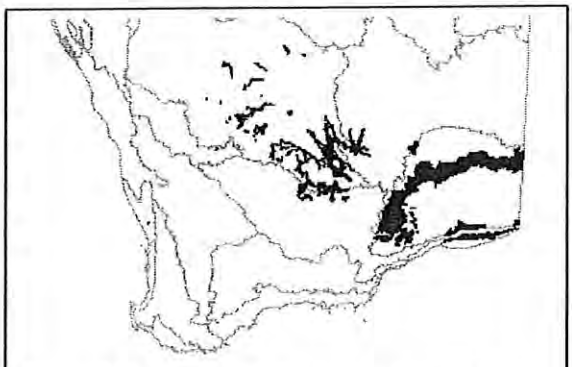

Figure 55.Vegetation Type 48: Saltbush and/or bluebush with scattered low trees.

A lightly wooded band of vegetation on the Nullarbor dominated by *Acacia papyrocarpa* (western myall) over the bluebush (*Maireana sedifolia*) occurs between the treeless plain and the mulga/sheoak low woodland described in Vegetation Type 47. The tree density appears to be governed by the depth of the calcareous loamy soils over limestone. In the north east Nullabor Bioregion, the bluebush is replaced by saltbush (*Atriplex vesicatia, A. acutibractea and A. crypocarpa*) 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 5m and may be joined by scattered *Myoporum platycarpum* (sugarwood), mallee *Eucalyptus oleosa* (giant mallee), *Pittosporum phylliraeoides* (weeping pittosporum), *Acacia aneura* (mulga) and *Casuarina pauper* (black oak). The ground layer is similar to the bluebush communities in the Nullarbor Plain (see Vegetation Type 50).

Calcareous soils are also associated with saline depressions in the Murchison Bioregion. These are generally vegetated with *Acacia aneura* (mulga) and saltbush (egAtriplex vesicaria, *A. lindleyi*), or mulga and bluebush (*Maireana sedifolia*, *M. carnosa* (cottony bluebush), *M. enchylaenoides* and *M. georgii* (satiny bluebush) with *Casuarina pauper* (black oak) joining the mulga (*Acacia aneura*) tree layer in the south east. Associated and sometime fringing species include *Acacia sclerosperma* (limestone wattle), *A. victoria* (bardi bush), *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 paplatycarpum* woodland (see Mosaic 5).

49. Samphire with thicket or scrub

This vegetation type consists of a samphire layer with taller shrubs forming thickets or scrub. Thickets consist of tea tree (*Melaeuca* spp.) and scrub species are either *Melaleuca* spp. or *Acacia* spp. *Halosarcia* 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 scrub in the interior of the State and thickets and scrub in the south west. This vegetation type covers a total of about 750,000 hectares, nearly half of which is found in the Great Sandy Desert Bioregion mainly around Lake Mackay, with the most of remainder being in the Little Sandy Desert, Gibson Desert, Murchison, Yalgoo and Avon Wheatbelt Bioregions.

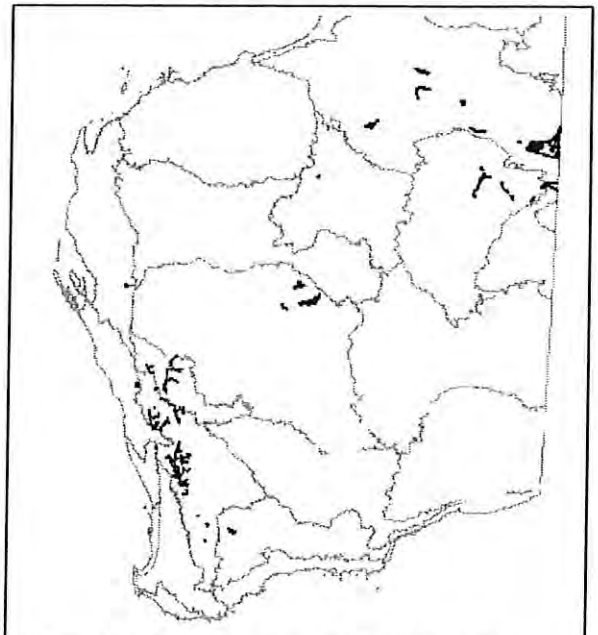

Figure 56. Vegetation Type 49: Samphire with thicket or scrub.

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

The areas around salt lakes in the northern Murchison Bioregion have a mosaic of *Acacia ramulosa* / *A. linopylla* (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 Yalgoo Bioregion. As the patches of these mosaics tend to be small and linear, they are included within this unit.

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

50 Saltbush and bluebush with scrub, open scrub or very sparse scrub

In this vegetation type, the saltbush and/or bluebush stratum is dominant (10 - 30% cover). There may be a shrub layer, >1m tall, with a cover of 10 - 30% (scrub) or <10% (open scrub) or very sparse scrub where the shrubs are largely absent or in scattered groups with no discernible foliage cover. This vegetation type is varied, with different combinations and cover densities of *Acacia* species. *Acacia aneura* (mulga) is common, with *Acacia ramulosa/A. linopylla* (bowgada), *A. victoria* (bardi bush) and/or *A. sclerosperma* (limestone wattle) also present. The saltbush and/or bluebush layer is composed of species of *Atriplex* and *Maireana*. Samphire may occur on the margins of this unit adjacent to salt lakes. This vegetation type covering over 2 million hectares occurs mainly in Carnarvon, and Murchison Bioregions extending into Yalgoo, Gascoyne, and Coolgardie Bioregions.

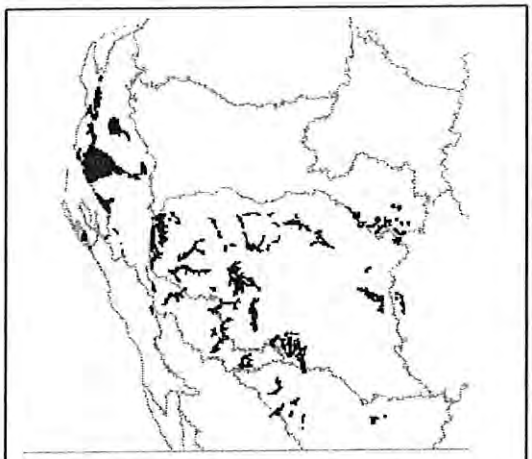

Figure 57. Vegetation Type 50: Saltbush and bluebush with scrub, open scrub or very sparse scrub.

The Murchison Bioregion is the main region where mulga and other *Acacia* species are present as the major shrubs over saltbush and/or bluebush. Areas totalling 260,000 hectares are mapped as mulga scrub over mixed succulent steppe. This is mainly saltbush/bluebush with samphire on the salty margins. In the Coolgardie and Murchison Bioregions, *Acacia aneura* (mulga) is present over saltbush only. *A. sclerosperma* (limestone wattle) joins the mulga in saltbush/bluebush habitats that extend into Yalgoo and Gascoyne Bioregions. *Acacia sclerosperma* (limestone wattle) also occurs with *A. xiphophylla* (snakewood), and *A. victoria* (bardi bush) and *Acacia ramulosa/A. linopylla* (bowgada) over the succulent steppe mainly in the Murchison Bioregion. In the southern Murchison and adjacent Yalgoo Biorgeions *Acacia acuminata* (jam) and *Acacia ramulosa/ A. linopylla* (bowgada) over saltbush, cover an area of nearly 50,000 hectares. *Acacia xiphophylla* (snakewood) open scrub over saltbush occurs in the Carnarvon Bioregion, and there is a large area (104,000 hectares) of poor stony country where *A. xiphophylla* (snakebush) is largely absent or in scattered groups over open saltbush. Towards the coast, there is *Acacia coriacea* (wirewood) and *A. sclerosperma* (limestone wattle) over saltbush and samphire

On and around Lake Annean, Murchison Bioregion, there is an association covering nearly 19,000 hectares of *A. sclerosperma* (limestone wattle), *Acacia ramulosa/A.*

linopylla (bowgada) open scrub over saltbush and bluebush on the sand dunes, with samphire on the clay pans 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 dampiera, Exocarpos sparteus* (broom ballart), *Atriplex bunburyana* (silver saltbush) and *Frankenia pauciflora* (seaheath) as a ground layer.

Units and mosaics of sparse scrub with saltbush and bluebush cover nearly 800,000 hectares in Carnarvon Bioregion. *Acacia sclerosperma* (limestone wattle) is most common with *A. xiphophylla* (snakewood) occurring with it or replacing it. *Acacia victoriae* is also mapped with *Acacia sclerosperma* (limestone wattle) and *A. xiphophylla* (snakewood). The often-linear mosaics on drainage systems are shown as a single colour on the 1:3,000,000 map for reasons of clarity.

51. 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 6.7 million hectares and describes the predominant vegetation of the Nullarbor Plain.

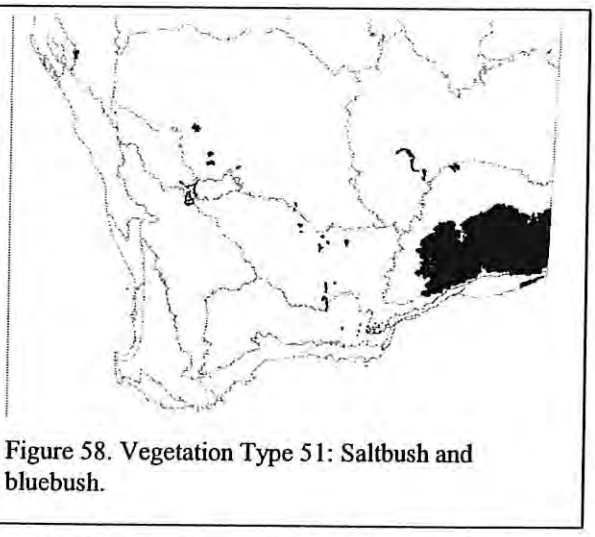

Figure 58. Vegetation Type 51: Saltbush and bluebush.

The *Maireana sedifolia* (pearl bluebush) steppe, with annual grasses and forbs, covers an area of over 6.6 million hectares on the Nullarbor Plain. The shallow, pinkish-brown, silty soils are derived from the underlying limestone and there are numerous depressions known as dongas. Here the moisture collects in good years and grasses such as *Stipa nitida, S. eremophila* and *Danthonia 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 *Danthonia setosa* and *Stipa elegantisima,* and many of annuals after rain.

There are few areas of saltbush and bluebush where there are rare *Acacia aneura* (mulga) and *Acacia sclerosperma* (limestone wattle) low trees in scattered groups

over the saltbush and bluebush layer. These areas are close to Mt Magnet, and adjacent to patches of open *Acacia* scrub over saltbush/bluebush.

52. Samphire

This is a single-layer vegetation type with up to 30% cover of samphires, mainly *Halosarcia halocnemoides* (shrubby samphire) and other *Halosarcia* 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, Marieana and Frankenia usually fringes the areas of samphires. Samphire associations cover nearly 2 million hectares, occurring mainly in Murchison and Gascoyne Bioregions, to a lesser extent in Great Sandy Desert and Carnarvon Bioregions, as well as 4 other regions. Other associated species include *Disphyma crassifolium* (round-leaved pigface), *Sclerolaena deserticola* and *Zygophyllum aurantiacum* (shrubby twinleaf)

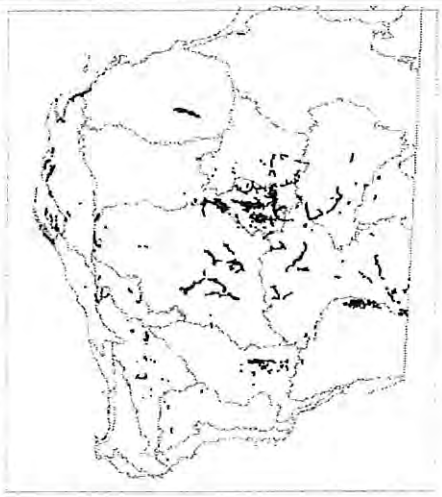

Figure 59. Vegetation Type 52: Samphire.

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 *Marieana pyramidata* (sago bush), *Atriplex rhagodioides A. vesicaria* and a variety of annuals such as Ptilotus spp. Lake Austin, a gypsifenous lake south of Cue, is mapped as mosaic of saltbush and bluebush/samphire. Here there is an occurrence of the unusual *Lawrencia helmsii*, a semi -succulent, cactus-like plant from the Hibiscus family (Malvaceae).

The large area of saltbush and samphire occurring around Lake Macleod in Carnarvon Bioregion has been included in this vegetation type.

Bare and sparsely vegetated areas

53. Salt lakes, lagoons, claypans

Salt lakes and clay pans occur through out the State except the Kimberley (there is only one example of this unit in the Kimberley - a clay pan on the Dampier peninsular). The unit includes lagoons, inlets, claypans. gypsum lakes and semi-seasonal wetlands that may be vegetated eg Lake Austin which supports samphires. They may be seasonally inundated or filled only after an extreme rainfall event.

The Murchison Bioregion has the largest area of salt lakes in the State with over 3.5 million hectares. These include Lake Barlee, Lake Moore and Lake Ballard. The Coolgardie Bioregion has over 500,000 hectares while the Mallee, Great Victoria Desert, Little Sandy Desert and Avon Wheatbelt Bioregions each have over 100,000 hectares. Salt lakes occur in 23 of the 26 regions and may range in size from 0.2 to 261922 hectares. Claypans occur in desert areas such as the Great Sandy, Little Sandy

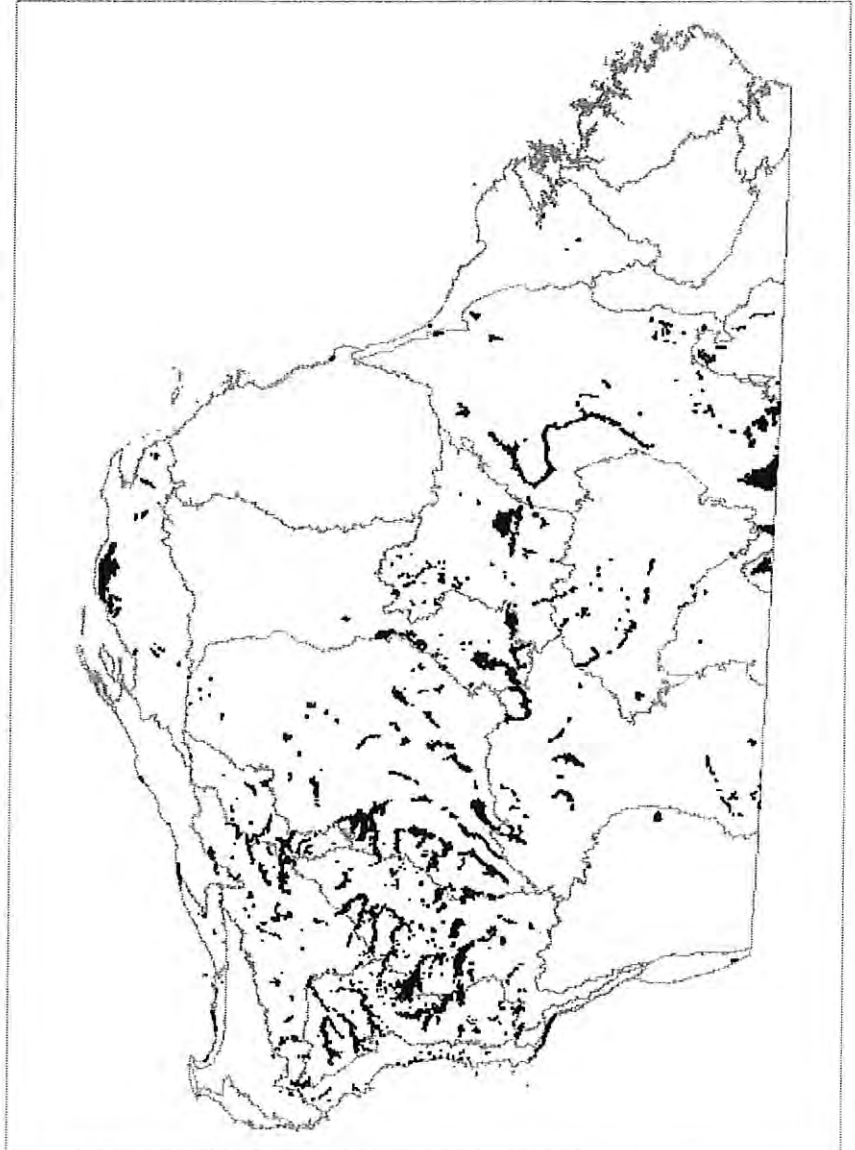

Figure 60. Vegetation Type 53: Salt lakes, lagoons, claypans.

and Gibson Desert Bioregions. Lagoons include Hutt River Lagoon and mud-locked tidal lagoons in the western Kimberley and north coastal Pilbara Bioregion.

54. Freshwater lakes

Permanent natural freshwater lakes occur in the south west in Jarrah Forest and Warren Bioregions. Seasonal lakes occur in the Avon Wheatbelt Dampierland. Esperance Plains,.Geraldton Sandplains, Jarrah Forest, Mallee, Ord-Victoria Plains, Swan Coastal Plain, Victoria Bonaparte and Yalgoo Bioregions. Lakes such as Lake Gregory in the Great Sandy Desert become large inland freshwater lakes after heavy rain but gradually dry out and, in the process of drying become saline. Thgis is mapped as a salt lake. This unit also includes Lake Argyle in the Kimberley, which is mapped as having an area of 1,899,056 hectares – although this is not a pre-European feature, it is included because of its size and significance. The total area of natural freshwater lakes present at the time of European settlement was about 21,985 hectares. Many of these are now saline.

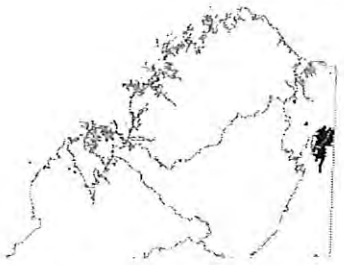

Figure 61. Vegetation Type 54: Freshwater lakes – northern extent.

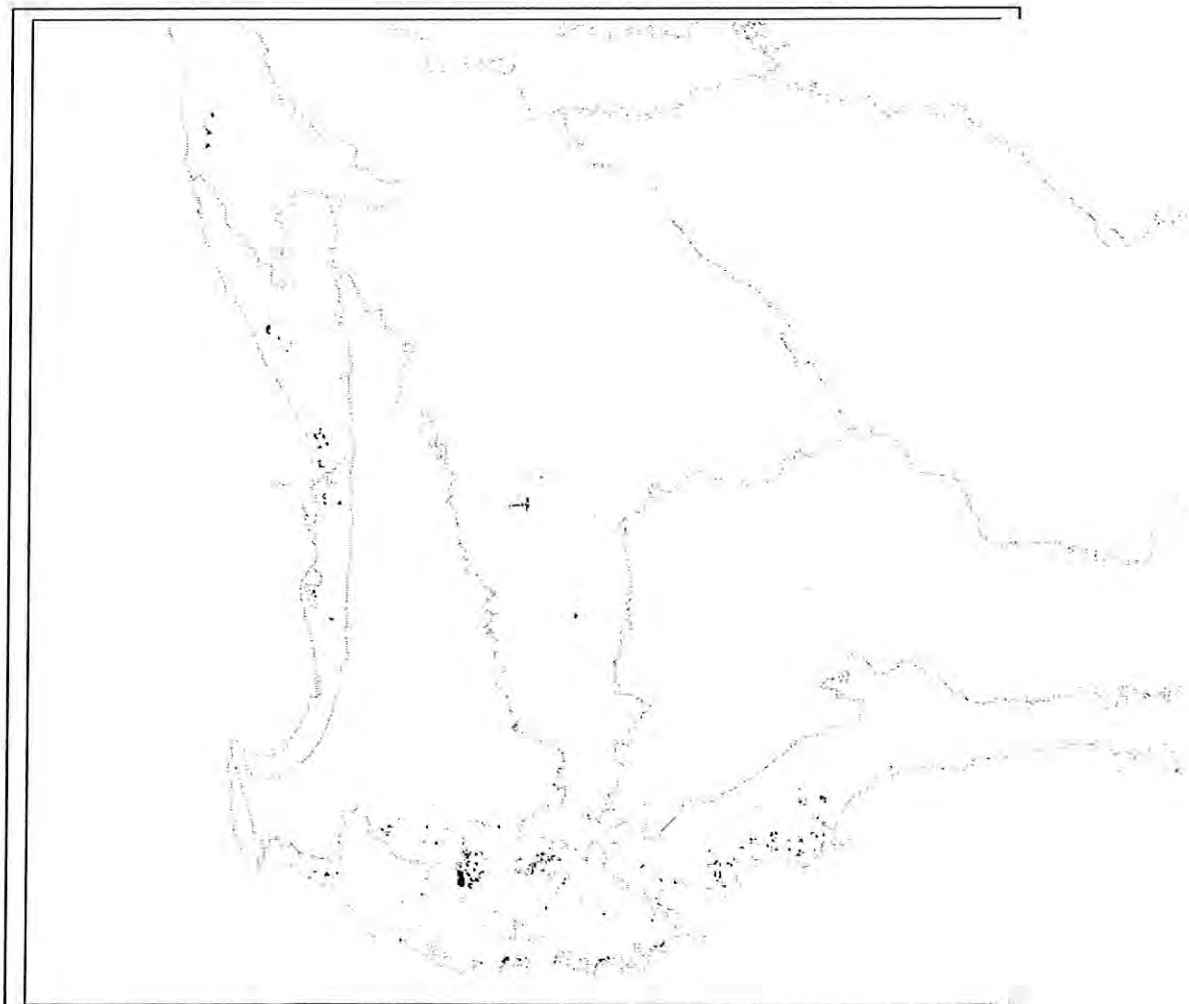

Figure 62. Vegetation Type 54: Freshwater lakes – southern extent

55. Tidal mud flats

Tidal mud flats occur especially along low energy coastlines. This unit has a total area of over 760,000 hectares. Mud flats are more extensive in the Pilbara Bioregion and Carnarvon Bioregion than in the Kimberley. They may have a fringing vegetation of mangroves or samphire, or a combination of these.

Figure 63. Vegetation Type 55: Tidal mud flats.

56. 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. They include land-locked monoliths and coastal granite. There are over 4,450 exposures of bare rock in the vegetation database, totaling over 316,000 hectares in area. Most are small and isolated, and do not show at the 1:3,000,000 scale.

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

The Porongurups, one of the largest granite massifs in the State is encircled by an

inner ring of *Eucalyptus cornuta* then *Eucalyptus diversicolor* (karri) to 60m. Mt Lindesay in the Warren Bioregion has *E. marginata*, (jarrah) *Corymbia calophylla* (marri) and *E. megecarpa* (bullich) low woodland in its gullies and *E. marginata* scrubheath on the upper slopes. Other species include *Hakea varia*, (variable leaved hakea), *Beaufortia decussata* (gravel bottlebrush) and 2 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*. 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 on 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 these further east.

In the Murchison Bioregion there are weathered granite rocks such as Walga Rock west of Cue. Mt Augustus, the largest rock in Western Australia, is a sandstone outcrop. This has a good cover of *Acacia ramulosa/A. linopylla* (bowgada) low open woodland (see Vegetation Type 9)

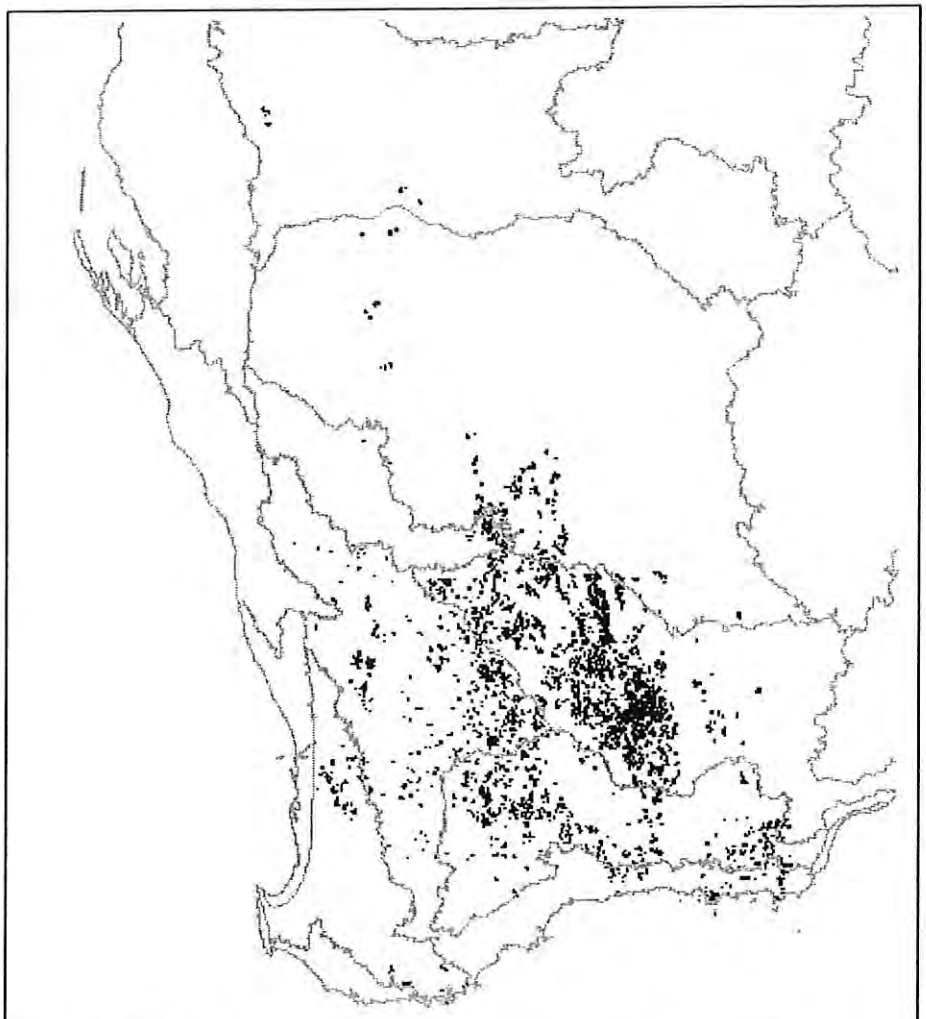

Figure 64. Vegetation Type 56: Bare rock and associated sparse vegetation.

57 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), along the Esperance Plains and Hampton Bioregion coastlines. The Gascoyne River bed (Carnarvon Bioregion) and the Lacepede Islands off Dampierland Bioregion have also been mapped as sand. The total area of this unit is over 315,036 hectares.

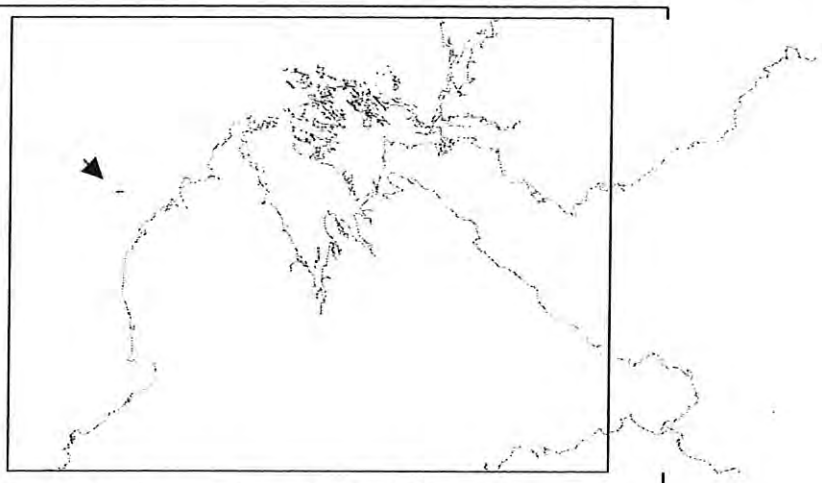

Figure 65. Vegetation Type 57: Sand, Kimberley

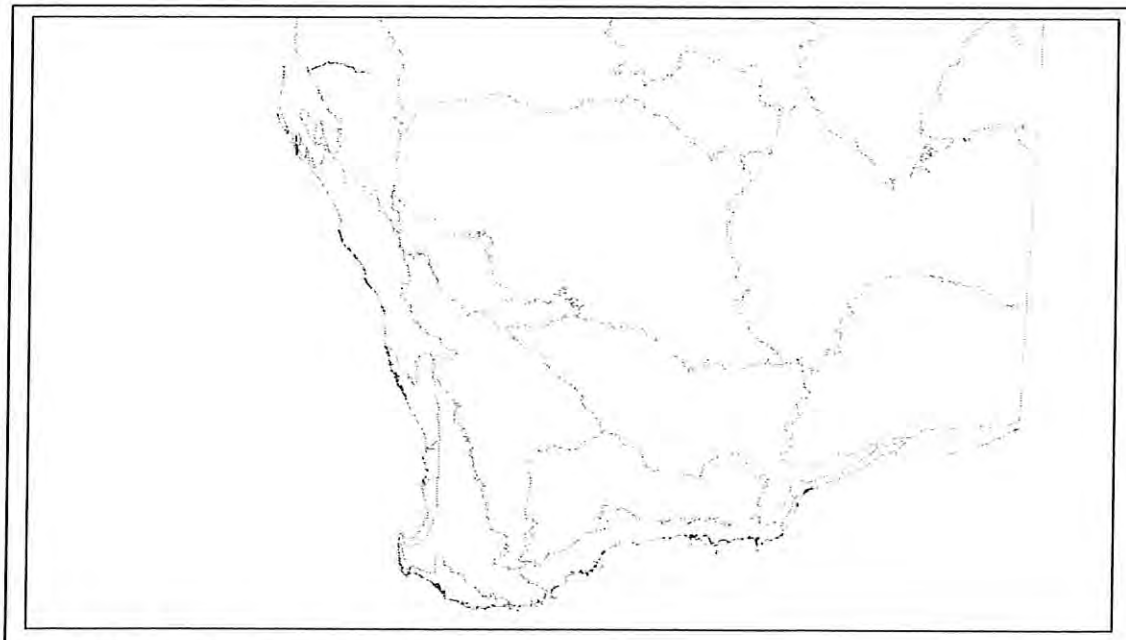

Figure 66. Vegetation Type 57: Sand, south west.

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 hectares throughout the State. They are listed here in a similar order to the individual vegetation types above.

Mosaic 1. Medium woodland / Low woodland / Low forest or woodland

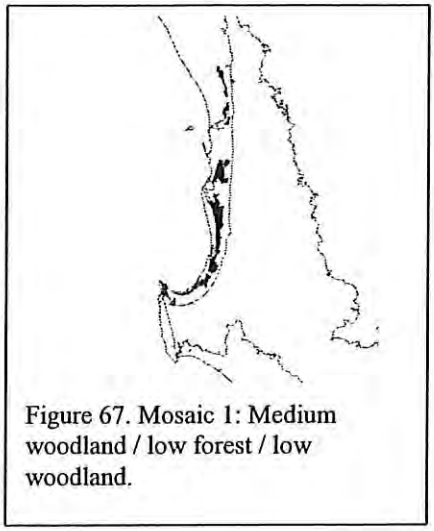

Figure 67. Mosaic 1: Medium woodland / low forest / low woodland.

This mosaic, covering 66,500 hectares in the Swan Coastal Plain Bioregion is made up of three components. 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* ssp.) 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* (Christmans 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*.

Mosaic 2. Woodland / Mallee tall shrubland

This mosaic, covering over 2 million hectares in Mallee and Coolgardie Bioregions, 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 (30 - 70%), the taller stratum is mentioned first.

The major associations are:

Figure 68. Mosaic 2: Woodland / Mallee tall shrubland

- 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 *Eucalyptus eremophila* (horned mallee). To the west and in the eastern Coolgardie Bioregion, *E. salmonophloia* (salmon gum) and *E. oleosa* (giant mallee) occur over *Eucalyptus eremophila* (horned mallee). These two associations cover over a total 1,307,000 hectares.
- In the south eastern Avon Wheatbelt Bioregion extending into the Mallee Bioregion, the valley soils higher in the landscape support *Eucalyptus*

salmonophloia (salmon gum), with *E. salubris* (gimlet) in the west, as patches of medium woodland in mallee shrublands dominated by *Eucalyptus transcontinentalis* (redwood) and *E. redunca* (black marlock) mallee. These cover an area of 382,000 hectares

- In the same region but lower in the landscape, patches of *Eucalyptus salmonophloia* (salmon gum) and/or *E. loxophleba* (York gum) woodland occur mallee shrublands of over *Eucalyptus eremophila* (horned mallee) and *E. redunca* (black marlock). In the vicinity of saltlakes, *E. longicornis* (red morrell) replaces the York gum over the same mallee species. These associations cover more than 192,000 hectares.
- 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), with occasional *E. wandoo* (wandoo), medium woodland occur over *E. loxophleba* (York gum mallee-form) and *Eucalyptus sheathiana* (ribbon-barked gum) mallee. This mosaic unit covers over 170,000 hectares.

Mosaic 3. Medium woodland / *Dodonaea* scrub

Figure 69. Mosaic 3: Woodland / Scrub.

Typifying the Fraser Range in the Coolgardie Bioregion is a mosaic of medium woodland on red loam on the flats between the hills with *Dodonaea* scrub on the hills. Near the outcrops of granulite gneiss of the Range, there are *Eucalyptus lesoufii* (goldfield's blackbutt) and *E. dundasii* (Dundas blackbutt). On the southern end, the main eucalypts are *E. floctoniae* (merrit), E. oleosa (red mallee) and *E. transcontinentalis* on the pink calcareous soils. *Dodonaea microzyga* is the unusual dominant of the scrub component, and there are occasional scattered emergent *Allocasuarina heugeliana* and *Pittosporum phillyraeoides* to 6m. Other species present include *Beyeria lechenaulta* shrubs and *Aristda contorta* (bunched kerosene grass). This mosaic covers 175,500 hectares.

Mosaic 4. Woodland / Open mallee steppe

Figure 70. Mosaic 4: 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 in its mallee form) over *Triodia scariosa* spinifex. This mosaic vegetation type covers over 1 million hectares in Coolgardie Bioregion. 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 5. Medium woodland / Succulent steppe with open low woodland

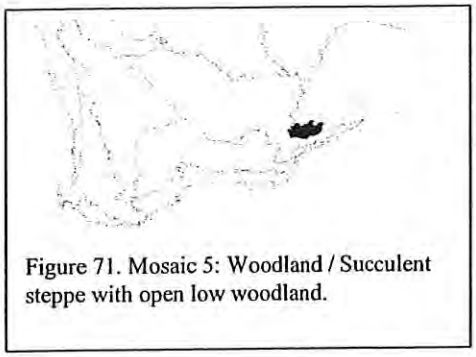

Figure 71. Mosaic 5: Woodland / Succulent steppe with open low woodland.

Near Balladonia, south east Nullarbor Bioregion, there is a mosaic of scattered medium woodland of *Eucalyptus salmonophloia* (salmon gum) and *E. salubris* (gimlet) on rises, with succulent steppe of saltbush (*Halosarcia* spp. under open low *Myoporum platycarpum* (sugarwood) woodland on the intervening clay flats. 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.

Mosaic 6. Low woodland / Scrub

Two low woodland/scrub mosaics occu each other on over 500,000 hectares Yalbalgo Plain in the central C Bioregion. The northern mosaic h *Acacia coriacaea* (waterwood) woodlan sandhills with scrub of *Acacia scler* (limestone wattle), *A. ramulosa/A. li* (bowgada) and *A. subtessarogona* between the dunes. To the south, the low *A. coriacaea* (waterwood) woodland occurs on dense sandhills with *A. sclerosperma* (limestone wattle) and *A. ramulosa/A. linophylla* (bowgada) on the flats. The *A. coriacaea* (waterwood) trees may reach 6m 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), *C. aff desolata, Eremophila leucophylla, E. maitlandii* (Shark Bay poverty bush), *Grevillea eriostachya, G. stenobotrya, Ptilotus obovatus, Scaevola spinescens* and *Stylolasium spathulatum* (pebble bush).

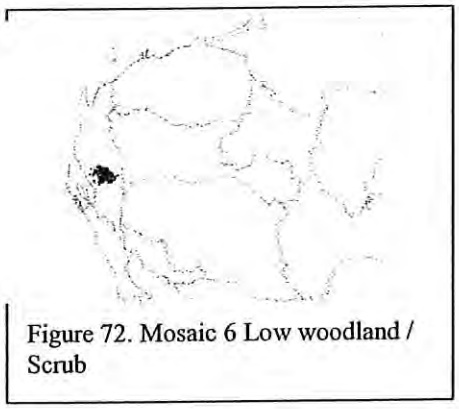

Figure 72. Mosaic 6 Low woodland / Scrub

Mosaic 7. Scrub-heath / Thicket

Scrub-heath with patches of thickets occurs throughout the Geraldton Sandplain, Avon Wheatblet and into the Mallee Bioregions totalling nearly 262,000 hectares.

At the southern end of Edel Land in the Shark Bay area, Carnarvon Bioregion, there are 13,000 hectares of mixed coastal scrub heath, charaterised by *Acacia ligulata* and *Diplolaena dampieri,* with thickets of *Acacia rostellifera* (summer-scented wattle), *Thryptomene ?baeckiacea* and *Melaleuca cardiophylla* (tangling melaleuca). *Acanthocarpus preissii, Atriplex bunburyana, Frankenia laxiflora and Olearia*

axillaris are also present.

A substantial area (83,000 hectares) 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).

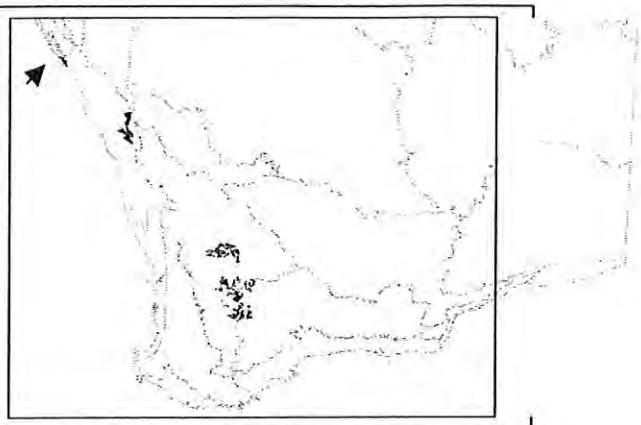

Figure 73. Mosaic 7: Scrub-heath / Thicket.

A small patch (2,000 hectares) 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) and the thickets also contain *Allocasuarina acutivalvis* as a co-dominant.

Making up a total of 163,000 heactares are small, scattered upland areas with a mosaic of scrub-heath on shallow sands over laterites and *Allocasuarina campestris* thicket on laterite occur throughout the southern Avon Wheatbelt Bioregion and into the Mallee Bioregion. *Dryandra* species often join the *Allocasuarina campestris* in the thickets. The scrub heath is very rich in species with no obvious dominants.

Mosaic 8. Scrub heath/ heath

Ther are two mosaics of scrub heath with patches of heath. These occur in the southern Geradldton Sandplain and northern Avon Wheatbelt Bioregions, totalling nearly 300,000 hectares.

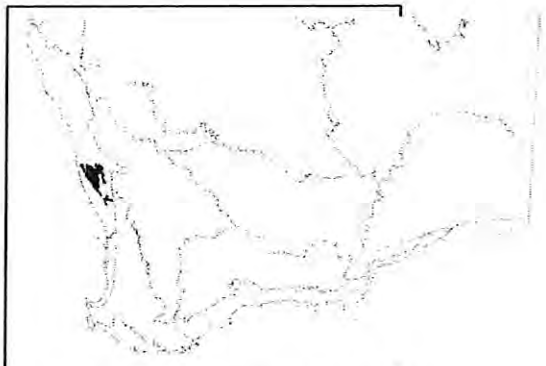

Figure 74. Mosaic 8: Scrub heath/ heath.

On the laterite sandplains around Badgingarra in the northern part of the Swan Coastal Plain Bioregion and adjacent Geradldton Sandplain Bioregion there is a mosaic of *Hakea* scrub heath on sand and *Dryandra* heath on laterite. Many species of *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 2m over a dense, rich assemblage of low shrubs (<1m), 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 Regans Ford, there is a small patch of mixed scrub-heath with *Dryandra* heath.

Mosaic 9. Mallee shrubland/ mallee heath

This mosaic, covering 267,000 hectares within the Esperance Sandplain Bioregion, 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 associations tend to segragate into two associations, one of *E. eremophila* (spreading mallee)- *E. oleosa* (giant mallee) (up to 2 m) and the other of *E. redunca* (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 up slopes (interflues?). 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* (black marlock,)- *E. uncinata* (hooked leaved mallee) association is found on the sand-over-clay differentiated soil which 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 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).

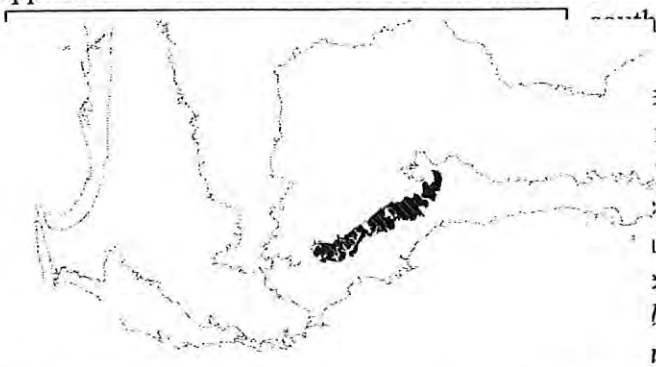

Figure 75. Mosaic 9: Mallee shrubland/ mallee heath.

Mosaic 10. Scrub or very open scrub / Grass steppe

In the northern Carnarvon and north eastern Gascoyne Bioregions there are mosaics of scrub (>2m) and hummock grasslands. These total over 450,000 hectares.

Associated with the ranges in the north western end of the Gascoyne Bioregion there are two similar mosaics of *Acacia* scrub with patches of spinifex. Their total area is about 230,000 hectares

In the east, *A. eremaea* (snakewood) scrub has broad patches of *Triodia basedowii* (hard spinifex) and *T. wiseana* (limestone spinifex). To the west, the *A. eremaea* (snakewood) scrub is joined by *A. victoriae* (bardi bush) scrub. Here the spinifex patches are smaller and support *Triodia basedowii* (hard spinifex) only.

Figure 76. Mosaic 10: Scrub or very open scrub/ hummock grassland.

The mosaic of scattered groves of *Acacia victoriae* (bardi bush) and *A. eremaea* (snakewood) scrub with grass steppecovers over 313,000 heactares on the south eastern portion of the Yannarie Coastal Plain (Carnarvon Bioregion). The plains are higher than the surrounding country with clayey soils underlying a surface of stones. The stunted (1.5 - 2.5m) snakewood occurs in groves mixed with *A. victoriae* (bardi bush), *A. tetragonaphylla* (kurara), *A. bivenosa* and *Eremophila cuneifolia. Triodia basedowii* is the main hummock grass occurring on sandy patches. Claypans and bare patches of gravel and shingle also occur here. Claypans develop a cover of the annual trailing herb *Swainsonia pterostylis* in favourable seasons.

Mosaic 11. Pindan / Tall bunch grass savanna with low trees

On the South Fitzroy Plains, Dampierland Bioregion, there is an area, of nearly 200,00 hectares, of alternating sandy rises with pindan and loam flats with low tree savanna. The pindan consists of *Acacia eriopoda* (Broome wattle) thickets with scattered low *Eucalyptus 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.

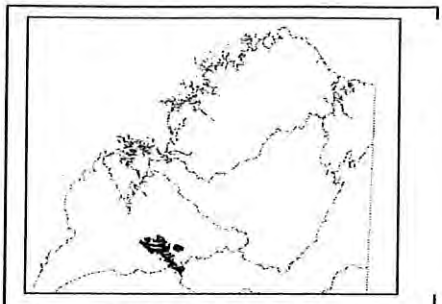

Figure 77. Mosaic 11: Pindan / Tall bunch-grass savanna with low trees.

Mosaic 12 Curly spinifex low tree savanna / Sparse low tree steppe

This mosaic is found over 500,000 hectares in the western arm of the Central Kimberley Bioregion. It consists of a low tree savanna *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 very sparse low tree savanna 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). In the south eastern third of the area covered by this mosaic, the *Adansonia gregorii* (boab) becomes lower (< 10 m) and the *Triodia bynoei* is replaced by Triodia wiseana (limestone spinifex).

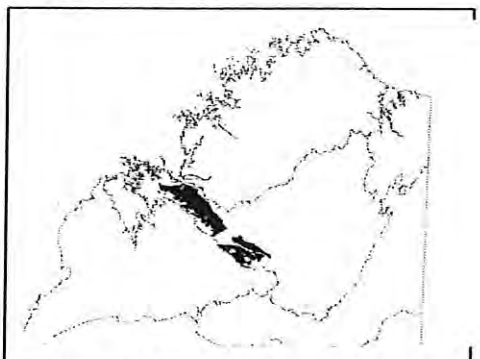

Figure 78. Mosaic 12 Curly spinifex low tree savanna /sparse low tree steppe.

Mosaic 13. High bunch grass savanna woodland / Curly spinifex savanna

This unit is a fine-scale mosaic, similar to the individual vegetation types described at the beginning of this section. It is included here and striped on the map to distinguish it from the adjacent High grass savanna woodland on sandstone (Vegetation Type 25). This mosaic is a high bunch-grass association of *Eucalyptus tetradonta* woodland on sandstone with a dominance of *Triodia bitextura* (curly spinifex) in the ground layer. This mosaic unit occurs on the deeper soils over sandstone covering an area of over 980,000 hectares in the North Kimberley Bioregion. The mixed low tree and shrub layer is similar to Vegetation Type 25 but with *Banksia dentata* (tropical banksia) and other species occuring on the deeper sand. The annual sorghum (*S. australiense* and *S. stipoideum*) to 2m are also present as are other species of eucalypts e.g. *Eucalyptus miniata* (woolybutt), *Corymbia polycarpa* (long friuted bloodwood and *C. dichromophloia* (variable barked bloodwood).

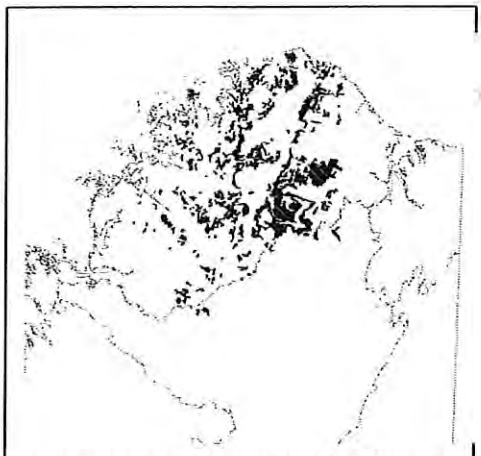

Figure 79. Mosaic 13: High bunch-grass savanna woodland/curly spinifex.

Mosaic 14. Curly spinifex 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 *Triodia bitextura* (curly spinifex) and scattered *Eucalyptus brevifolia* (Kimberley snappy gum) interspersed with patches of *T. intermedia* (hard spinifex). This mosaic covers 233,000 hectares.

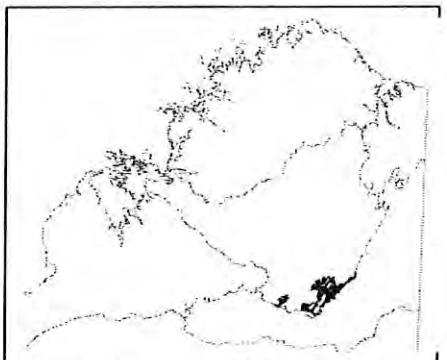

Figure 80: Mosaic 14 Curly spinifex low tree savanna / Grass steppe.

Mosaic 15. Short bunch-grass low tree savanna / Tree steppe

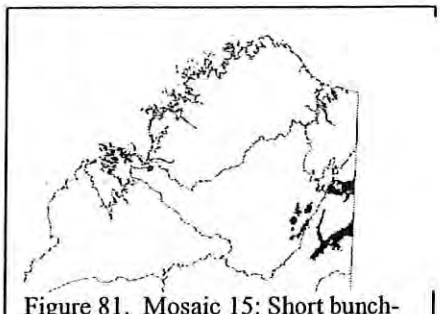

Figure 81. Mosaic 15: Short bunch-grass low tree savanna / Tree steppe.

This mosaic of short bunch-grass, low tree ınna with tree steppe on stony rises occurs on igneous rocks of the Bow River Hills, south Central Kimberley Bioregion, and more ınsively on the Atrium Plateau volcanics in Ord-Victoria Plains Bioregion. *Eucalyptus ıifolia* (Kimberley snappy gum) is commonly fined to the rough hilly ground where it torms a tree steppe over a ground layer of *Triodia wiseana* (limestone spinifex), *T.*

intermedia and T. inutilis. The moderate to gentle slopes support short bunch-grass savanna with a tree layer of *Eucalyptus argilliaceae* (Mt House box), *Corymbia opaca* (bloodwood) over *Enneapogon* spp. In the north of the Ord-Victoria Plains Bioregion adjacent to Lake Argyle, there is a similar mosaic with an additional ground layer of 'tippera tall grass' assemblage. This 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 contrortus* (bunch speargrass) and other species. The total area of these two mosaics is nearly 520,000 hectares.

Mosaic 16. Short bunch-grass savanna / Grass steppe

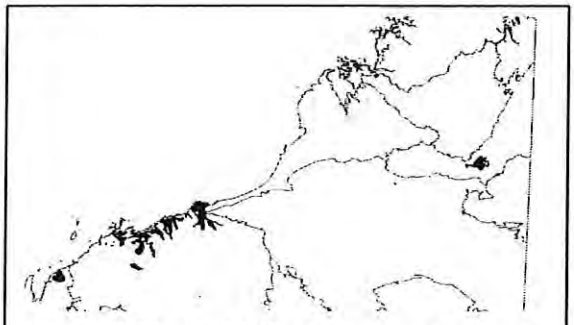

Figure 82. Mosaic 16: Short bunch-grass savanna / Grass steppe

A short bunch-grass savanna/ grass steppe mosaic occurs along the alluvial flats on the lower reaches of rivers in the Pilbara Bioregion. The short bunch grassland component is mainly *Eragrostis* aff. *setifolia*, and the grass steppe component is the hummock grasses *Triodia pungens* (soft spinifex) or *T. wiseana* (limestone spinifex). The grasses attain 30-45cm in height and form a closed vegetation type that is quite different from the nearby open hummock grassland. This mosaic covers 845,000 hectares.

A similar mosaic but with a low tree layer over the short bunch grassland occurs to the south east of the McLintock Ranges the Ord-Victoria Plains Bioregion. Here, nearly 150,000 hectares of open low tree *Eucalytpus brevifolia* (Kimberley snappy gum) over *Enneapogon* spp. (arid short grass) occurs with *Triodia pungens* (soft spinifex) and *T. intermedia* (hard spinifex) grass steppe *Carissa lanceolata* (conkerberry) shrubs may also be present.

Mosaic 17. Open low tree steppe / Grass steppe

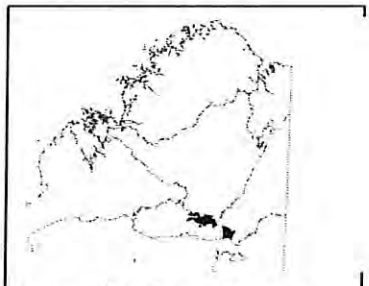

Figure 83. Mosaic 17: Open low tree steppe / Grass steppe.

ssected plains, through which Christmas Creek (southern central Ord-Victoria Plains Bioregion) red with a mosaic, covering 68,000 hectares, of ow tree steppe with patches of hummock nd. (*Eucalytpus brevifolia* (Kimberley snappy ver *Triodia pungens* (soft spinifex) open low tree steppe occurs on the sandplain with *Triodia intermedia* (hard spinifex) grass steppe coming in on the stripped laterite or stony surfaces. Other species present in the tree steppe include *Acacia monticola (gawar), A. holoseriea,* (candelarbra 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 orthopocarpa* (needleleaf wattle) occurs on stony ground with the hard spinifex.

Mosaic 18. Open low tree steppe / Open shrub steppe

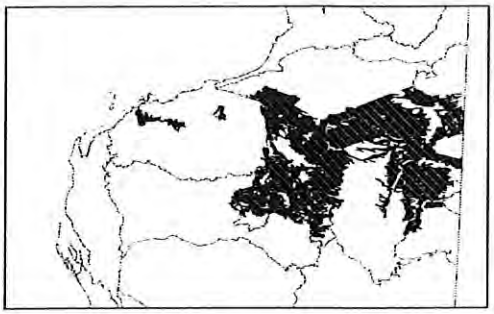

Figure 84. Mosaic 18: Open low tree steppe / Shrub steppe.

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. This is the largest mosaic and the largest single vegetation association in the State, with an area of 26 million hectares. *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. victoria* 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 *E. aspera* may be present in the swales on sandy soils.

A similar mosaic, but with a more open shrub layer, is mapped 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 *Eucalyptus chippendalei* (desert bloodwood)) low tree steppe occurs in sandy valleys with *T. pungens* (soft spinifex) and very 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 a denser tree layer than the mosaics described above. Here *Triodia wiseana* (limestone spinifex) and scattered *Eucalyptus leucophloia* (Pilbara snappy gum) open low tree-steppe occur along the drainage lines and a shrub-steppe of *T. pungens* (soft spinifex) and *Acacia pyrifolia* (ranji bush) occurs on the mesas. The total area of this mosaic is over 50,000 hectares.

Appendix 2. Species names used in the vegetation map database and referred to in this Memoir.

Table 1. Species used in mapping and descriptive text

MAP CODE	CURRENT GENUS	CURRENT SPECIES	COMMON NAME
	Acacia	aciphylla	
a_{19}	Acacia	acuminata	(jam)
a_1	Acacia	aneura	(mulga)
a_{34}	Acacia	beauverdiana	(pukkati)
a_6	Acacia	bivenosa	
	Acacia	blakelyi	
a15	Acacia	brachystachya	(turpentine mulga)
a3	Acacia	coriacea	(wirewood)
a32	Acacia	cyclops	(coastal wattle)
a12	Acacia	cyperophylla	(miniritchie)
a4	Acacia	delibrata	
	Acacia	dictyophleba	(sandhill wattle)
a11	Acacia	eremaea	(snakewood)
a28	Acacia	eriopoda	(Broome pindan wattle)
	Acacia	farnesiana	(mimosa bush)
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	lycopodiifolia	
	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	stipuligera	
a27	Acacia	suberosa	(corkybark wattle)
a16	Acacia	subtessarogona	
	Acacia	tenuissima	
	Acacia	tetragonophylla	(kurara)
a7	Acacia	trachycarpa	(minni ritchi)

MAP CODE	CURRENT GENUS	CURRENT SPECIES	COMMON NAME
	Acacia	translucens	(povertybush)
a31	Acacia	truncata	
a29	Acacia	tumida	(pindan wattle)
	Acacia	validinervia	
a10	Acacia	victoriae	(bardi)
	Acacia	xanthina	(white-stemmed wattle)
a11	Acacia	xiphophylla	
	Acanthocarpus	preissii	
	Actinostrobus	arenarius	(sandplain cypress)
a/a	Adansonia	gregorii	(boab)
	Adenanthos	acanthophyllus	
	Adenanthos	cuneatus	(coastal jugflower)
	Aegialitis	annulata	(club mangrove)
	Aegiceras	corniculatum	(river mangrove)
ag	Agonis	flexuosa	(peppermint)
	Agonis	linearifolia	(swamp 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	huegelliana	(rock sheoak)
	Allocasuarina	humilis	(dwarf sheoak)
	Allocasuarina	pinaster	(compass bush)
	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	
k1	Atriplex	hymenotheca	
	Atriplex	rhagodioides	
k1	Atriplex	vesicaria	(bladder saltbush)
	Avicennia	marina	(white mangrove)
	Baeckea	cryptandroides	
	Baeckea	floribunda	
	Balaustion	pulcherrimum	(native pomegranate)
b4	Banksia	ashbyi	(Ashby's banksia)
b1	Banksia	attenuata	(slender banksia)
	Banksia	burdettii	(Burdett's banksia)

MAP CODE	CURRENT GENUS	CURRENT SPECIES	COMMON NAME
	Banksia	caleyi	(Cayley's banksia)
	Banksia	dentata	(tropical banksia)
	Banksia	dryandroides	(dryandra-leaved banksia)
	Banksia	grandis	(bull banksia)
	Banksia	ilicifolia	(holly-leaved banksia)
	Banksia	media	(southern plains banksia)
b2	Banksia	menziesii	(firewood banksia)
	Banksia	petiolaris	
b3	Banksia	prionotes	(acorn banksia)
	Banksia	sceptrum	(sceptre Banksia)
	Banksia	sphaerocarpa	(round-fruit banksia)
	Banksia	verticillata	(Albany banksia)
b1#	Bauhinia	cunninghamii	(bauhinia)
	Beaufortia	cyrtodonta	
	Beaufortia	decussata	(gravel bottlebrush)
	Beaufortia	micrantha	(little bottlebrush)
	Beaufortia	sparsa	(swamp bottlebrush)
	Beyeria	lechenaulta	
	Boronia	crenulata	(aniseed boronia)
	Borya	nitida	(pincushions)
	Bossiaea	bossiaeoides	(bossiaea)
	Bossiaea	rufa	
	Brachyachne	convergens	(spider grass)
	Brachychiton	diversifolius	
	Brachychiton	gregorii	(desert kurrajong)
	Brachychiton	viscidulus	(sticky kurrajong)
	Brachysema	latifolium	(broad-leaved brachysema)
	Bruguiera	exaristata	(ribbed-fruited orange mangrove)
	Buchanania	obovata	(wild mango)
	Bursaria	occidentalis	
	Callistemon	glaucus	
p	Callitris	glaucophylla	(white cypress pine)
	Callitris	intratropica	
p	Callitris	preissii	(Rottnest island pine)
	Calothamnus	chrysantherus	(claw flower)
	Calytrix	brevifolia	
	Calytrix	exstipulata	(Kimberley heather)
	Calytrix	leschenaultii	
	Camphostemon	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	

MAP CODE	CURRENT GENUS	CURRENT SPECIES	COMMON NAME
e58	Corymbia	cadophora	(twin-leaf bloodwood)
e3	Corymbia	calophylla	(marri)
e59	Corymbia	confertiflora	(roughleaf cabbage gum)
e24	Corymbia	dichromophloia	(vaiable barked bloodwood)
e56	Corymbia	ferruginea	(rusty bloodwood)
e51	Corymbia	grandifolia	(cabbage gum)
e63	Corymbia	haematoxylon	(mountain marri)
e61	Corymbia	opaca	(inland bloodwood)
e57	Corymbia	polycarpa	(long-fruited bloodwood)
	Cratystylis	conocephala	(greybush)
	Crotalaria	cunninghamii	(green birdflower)
	Crotalaria	medicaginea	
	Dampiera	candicans	
	Darwinia	diosmoides	
	Dasypogon	bromeliifolius	(pineapple bush)
	Daviesia	grahamii	
	Daviesia	teretifolia	
d*	Dichanthium	fecundum	(curly bluegrass)
d*	Dichanthium	sericeum subsp. 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	
	Dryandra	armata	(prickly dryandra)
	Dryandra	cirsioides	
	Dryandra	fraseri var. ashbyi	
	Dryandra	longifolia	
	Dryandra	nivea	(couch honeypot)
	Dryandra	proteoides	(king dryandra)
	Dryandra	pteridifolia	(tangled honeypot)
d1	Dryandra	quercifolia	(oak-leaved dryandra)
	Dryandra	sessilis	(parrot bush)
	Dryandra	squarrosa subsp. Squarrosa	(pingle)
e*	Enneapogon	spp	(arid short grass)
	Echinochloa*	colona	(awnless barnyard grass)
	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)

MAP CODE	CURRENT GENUS	CURRENT SPECIES	COMMON NAME
	Eremophila	latrobei	(warty fuchsia bush)
	Eremophila	maitlandi	(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)
	Eucalyptus	campaspe	(silver-topped gimlet
e23	Eucalyptus	chippendalii	(desert bloodwood)
	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	cylidriflora	(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	(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)

MAP CODE	CURRENT GENUS	CURRENT SPECIES	COMMON NAME
e17	Eucalyptus	microtheca	(coolibah)
e49	Eucalyptus	miniata	(woollybutt)
	Eucalyptus	mooreana	(mountain white gum)
e43	Eucalyptus	obtusifolia	(Dongara mallee)
e7	Eucalyptus	occidentalis	(flat-topped yate)
	Eucalyptus	oldfieldii	(Oldfield's mallee)
e22	Eucalyptus	oleosa	(giant mallee)
e52	Eucalyptus	papuana	(ghostgum)
e72	Eucalyptus	patens	(yarri)
e55	Eucalyptus	phoenicea	(gnainga, scarlet gum)
	Eucalyptus	pileata	(capped mallee)
e28	Eucalyptus	platypus	(moort)
e60	Eucalyptus	pruinosa	(silver box)
	Eucalyptus	pyriformis	(pear-fruited mallee)
e27	Eucalyptus	redunca	(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)
e30	Eucalyptus	socialis	(red mallee)
	Eucalyptus	spathulata	(swamp mallet)
e65	Eucalyptus	staeri	(Albany blackbutt)
e50	Eucalyptus	tectifica	(grey box, Darwin box)
e26	Eucalyptus	tetragona	(blue mallee, tallerack)
e48	Eucalyptus	tetrodonta	(Darwin stringybark)
e73	Eucalyptus	todtiana	(coastal blackbutt)
e12	Eucalyptus	torquata	(coral gum)
e10	Eucalyptus	transcontinentalis	(redwood)
	Eucalyptus	uncinata	(hook-leaved mallee)
e5	Eucalyptus	wandoo	(wandoo)
e20	Eucalyptus	youngiana	(large-fruited mallee)
	Exocarpos	sparteus	(broom ballart)
	Ficus	coronulata	(river fig)
	Ficus	orbicularis	
	Ficus	racemosa	(stem-fruit fig)
	Frankenia	pauciflora	(seaheath)
	Gardenia	pyriformis	
	Gardenia	resinosa	
	Gastrolobium	grandiflorum	(wallflower poison)
	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)

MAP CODE	CURRENT GENUS	CURRENT SPECIES	COMMON NAME
	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)
	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	
k3	Halosarcia	halocnemoides	(shrubby samphire)
k3	Halosarcia	indica	(samphire)
	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)

MAP CODE	CURRENT GENUS	CURRENT SPECIES	COMMON NAME
	Kunzea	ericifolia	(spearwood)
	Kunzea	pulchella	(granite kunzea)
l	Lamarchea	hakeifolia	
	Lambertia	ericifolia	(heath-leaved honeysuckle)
	Lambertia	inermis	(chittick)
	Lambertia	uniflora	
	Lawrencella	davenportii	(sticky everlasting)
	Lechenaultia	formosa	(red leschenaultia)
	Lepidium	oxytrichum	
	Lepidium	rotundum	(veined peppercress)
	Leucochrysum	stipitatum	(woolly sunray)
	Leucopogon	reflexus	
	Leucopogon	revolutus	
l#	Livistona	eastonii	(fan palm)
	Lysinema	ciliatum	(curry flower)
	Macrozamia	riedlei	(zamia)
	Maireana	pyramidata	(sago bush)
k	Maireana	sedifolia	(pearl bluebush)
	Maireana	triptera	(three winged bluebush)
	Malvastrum	americanum	
	Melaleuca	acacioides	(coastal paperbark)
	Melaleuca	acuminata	
	Melaleuca	alsophila	
m	Melaleuca	cardiophylla	(tangling melaleuca)
	Melaleuca	cordata	
	Melaleuca	cuticularis	(saltwater paperbark)
	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	(broom bush)
	Melaleuca	viridiflora	(broadleaf paperbark)
	Mirbelia	ramulosa	
	Mirbelia	viminalis	
m	Myoporum	platycarpum	(sugarwood)
	Nauclea	orientalis	(Leichardt pine)

MAP CODE	CURRENT GENUS	CURRENT SPECIES	COMMON NAME
	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	phylliraeoides	(weeping pittosporum)
	Planchonia	careya	(mangaloo)
	Platytheca	galioides	
	Podolepis	canescens	(grey podolepis)
	Portulaca	oleracea	(purslane)
	Ptilotus	drummondii	(narrowleaf mulla mulla)
	Ptilotus	exaltatus	(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)
	Sclerolaena	deserticola	
s1*	Sehima	nervosum	(white grass)
	Senna	artemisioides subsp. Artemisioides	
	Senna	artemisioides subsp. x coriacea	
	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)
	Soneratia	alba	pornupan
	Sorghum	plumosum	(plume canegrass)
s2*	Sorghum	stipoideum	
s2*	Sorghum	timorense	
	Sphaerolobium	macranthum	
	Sphenotoma	dracophylloides	

MAP CODE	CURRENT GENUS	CURRENT SPECIES	COMMON NAME
	Sporobolus	australasicus	(fairy grass)
s3*	Sporobolus	virginicus	(salt water couch, marine couch)
	Stylobasium	spathulatum	(pebble bush)
	Swainsona	formosa	
	Swainsona	pterostylis	
	Synaphea	favosa	
	Syzygium	suborbiculare	
	Tephrosia	arenicola	
	Terminalia	arostrata	(crocodile tree)
	Terminalia	latipes subsp. psilocarpa	
	Terminalia	oblongata	
k*	Themeda	triandra	(kangaroo grass)
	Thryptomene	australis	(hook-leaf thryptomene)
	Thryptomene	baeckeacea	
	Thryptomene	maisonneuvei	
	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)
	Ventilago	viminalis	(supplejack)
	Verticordia	chrysantha	
	Verticordia	etheliana	
	Waitzia	nitida	
	Xanthorrhoea	drummondii	
	Xanthorrhoea	thorntonii	(grass tree)
	Xanthosia	rotundifolia	(southern cross)
	Xylomelum	angustifolium	(sandplain woody pear)
	Zygophyllum	aurantiacum	(shrubby twinleaf)
	Zygophyllum	ovatum	(dwarf twinleaf)

* grasses
\# Kimberley

Table 2. Recent 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	xylocarpa	Acacia	orthocarpa	
Aristida	browniana	Aristida	holathera	
Arthrocnemum	spp.	Halosarcia	spp.	
Bursaria	spinosa	Bursaria	occidentalis	
Burtonia	polyzyga	Gompholobium	polyzygum	
Burtonia	villosa	Gompholobium	villosum	
Callistemon	speciosus	Callistemon	glaucus	
Callitris	columellaris	Callitris	glaucophylla	
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	huegelliana	Allocasuarina	huegelliana	
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
Dichanthium	affine	Dichanthium	sericeum	subsp. sericeum
Dryandra	ashbyi	Dryandra	fraseri	var. ashbyi
Dryandra	carduacea	Dryandra	squarrosa	subsp. squarrosa
Eragrostis	japonica	Eragrostis	tenellula	
Eremophila	leucophylla	Eremophila	forrestii	
Eriostemon	tomentellus	Philotheca	tomentella	
Eucalyptus	perfoliata	Corymbia	cadophora	
Eucalyptus	brevifolia	Eucalyptus	leucophloia	in the Pilbara
Eucalyptus	calophylla	Corymbia	calophylla	
Eucalyptus	confertiflora	Corymbia	confertiflora	
Eucalyptus	dichromophloia	Corymbia	dichromophloia	
Eucalyptus	dongarrensis	Eucalyptus	obtusifolia	
Eucalyptus	ferruginea	Corymbia	ferruginea	
Eucalyptus	foelscheana	name not current and should not be used, I. Brooker pers. comm.)		
Eucalyptus	grandifolia	Corymbia	grandifolia	
Eucalyptus	haematoxylon	Corymbia	haematoxylon	
Eucalyptus	terminalis	Corymbia	opaca	
Eucalyptus	polycarpa	Corymbia	polycarpa	

ORIGINAL GENUS	ORIGINAL SPECIES	CURRENT GENUS	CURRENT SPECIES	CURRENT SUBSPECIES
Eucalyptus	nutans	Eucalyptus	platypus	
Eucalyptus	setosa (e53)	excluded taxon (Not in W.A. See Brooker & Kleinig, Field Guide 3:106(1994))		
Gardenia	keartlandii	Gardenia	pyriformis	
Hakea	suberea	Hakea	lorea	subsp suberea
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	
Plectrachne	pungens	Triodia	bitextura	
Plectrachne	bynoei	Triodia	bynoei	
Plectrachne	melvillei	Triodia	melvillei	
Plectrachne	schinzii	Triodia	schinzii	
Sorghum	australiense	Sorghum	timorense	
Sterculia	viscidula	Brachychiton	viscidulus	
Swainsona	occidentalis	Swainsona	pterostylis	
Terminalia	rogersii	Terminalia	arostrata	
Terminalia	ferdinandiana	Terminalia	latipes,	subsp. psilocarpa
Terminalia	volucris	Terminalia	oblongata	
Themeda	australis	Themeda	triandra	
Waitzia	aurea	Waitzia	nitida	
Wehlia	thryptomenoides	Homalocalyx	thryptomenoides	
Xanthorrhoea	reflexa	Xanthorrhoea	drummondii	sw