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THE VEGETATION OF
BOYAGIN NATURE RESERVE

A Report Prepared for
Department of Conservation and Land Management

Dames & Moore
INTERNATIONAL



Dames & Moore Job No. 14209-001-71

May 1985

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PREFACE

The following statements describing the project to map the vegetation of Boyagin Nature Reserve and the aims of the project are taken from the Dames & Moore Proposal and the Department of Fisheries and Wildlife Terms of the Consultancy.

The principal aim of the study was to provide broad-scale vegetation mapping designed to facilitate reserve management, especially for fire control consistent with the conservation status of the reserve. Mapping aimed to identify major vegetation units at a scale suited to the planning of firebreak layout by Departmental staff. Notes on the potential for soil erosion within each broad unit were also to be compiled, although a detailed soil survey is not within this brief.

The scope of the study was to include:

1. Compilation of existing sketch maps prepared by Mr N. McKenzie and others, by splicing together the sketch maps and appropriate reproduction,
2. Interpretation of aerial photographs supplied by Mr K. Atkins to plot broad-scale vegetation units at a scale of 1:16000,
3. A broad-scale field survey of vegetation to check boundaries drawn on aerial photographs and to describe gross vegetation structure and floristics of each unit. It was understood that about 6 to 7 units, or possibly more, would be recognisable and that each should be described in terms of overstorey species where present, and the half-dozen or so major understorey species, emphasising composition in terms of likely flammability. Minor vegetation types observed during field work were to be described and located even if too small to map. Particular reference was to be made to:
 - o The fire hazard in each unit,
 - o Occurrence of sensitive units requiring special fire management,
 - o Evidence of particular sensitivity to soil erosion.

4. Production of a vegetation map showing vegetation units as described above, with coded annotation of units,
5. Plant species observed during the course of field work were to be checked off against existing records and any particularly sensitive species was to be noted. It was understood that although a detailed vegetation survey was not required from this study, specimens of species not previously noted for Boyagin Nature Reserve were to be collected for the Pingelly Reserve Management Office and, if in flower, for the W.A. Herbarium,
6. A report was to be produced detailing interpretation of the vegetation unit codes used on the plan produced under 4 above, with notes on the fire and erosion control management appropriate to each unit. Photographs of each vegetation type and points of specific interest were also to be included in the final report. Any recommendations for further study were to be made as appropriate.

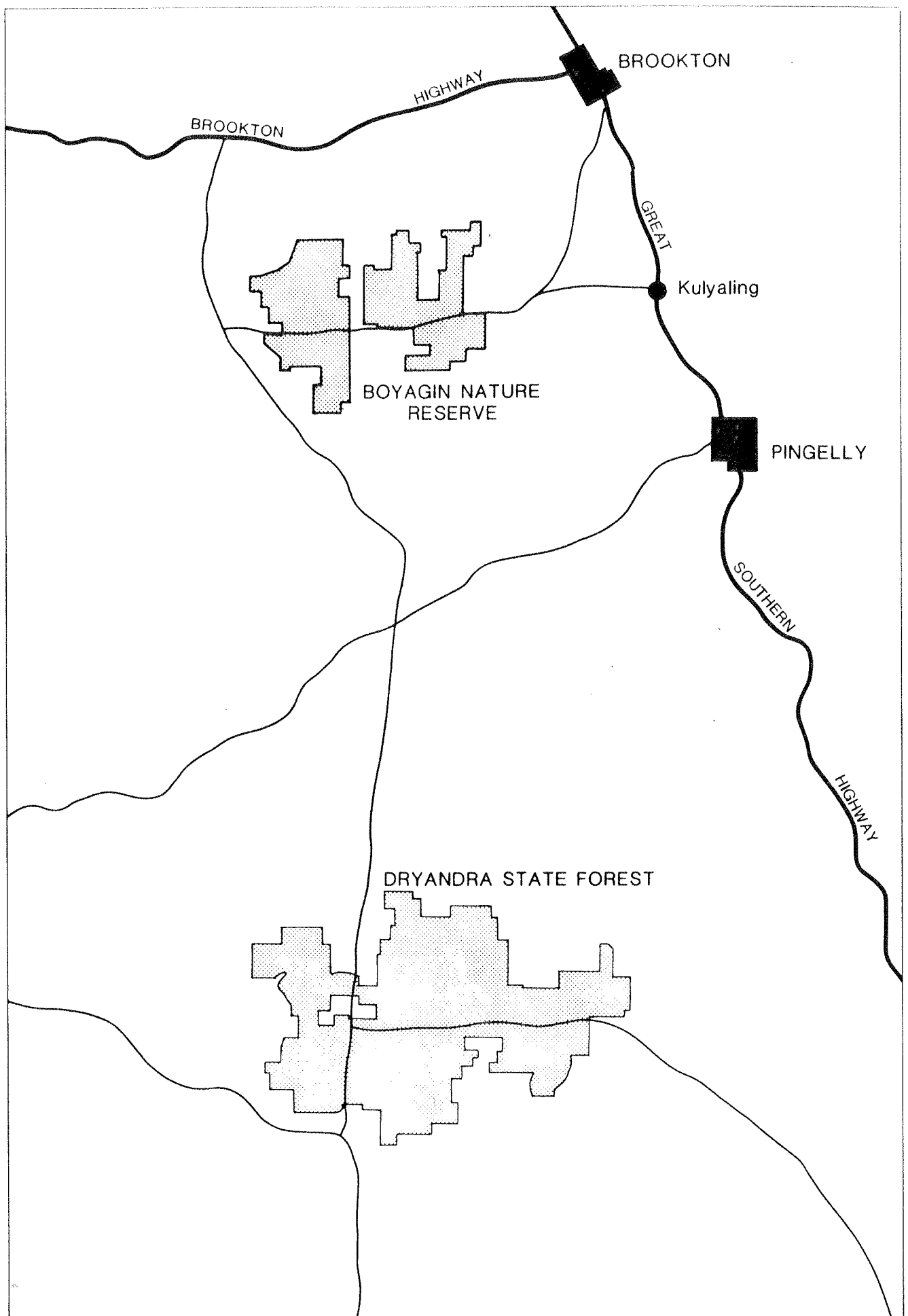
The information presented in the report is based largely upon interpretation and organisation of aerial photographs, reports, species lists, maps and notes provided by Department of Fisheries and Wildlife staff, supplemented by two field trips to the reserve, on 27 February and 25-26 March 1985.

1.0 INTRODUCTION

Boyagin Nature Reserve comprises three reserves situated about 10km southwest of Brookton and 15 km north-northwest of Pingelly (32° 28'S x 116° 54'E; Figure 1). Apart from a few, mostly very small areas of privately owned bushland the set of reserves is entirely surrounded by cleared farmland. A strip of farmland divides the reserve into an eastern section and a western section and the east-west running Boyagin Road further divides these sections into northern sections and southern sections. The reserve lies in mixed farming country near the western edge of the wheatbelt. It consists, for the most part, of rougher country left over after better quality agricultural land had been selected and cleared. This was noted at various times, including 1959, when A.G. Harris, then Conservator of Forests, wrote in a letter to the Chief Warden of Fauna that "...the areas (of the reserve) are unattractive for forestry or agriculture (but) may be of value for the protection of fauna".

Rough terrain characterises the Boyagin Nature Reserve, with laterite ridges and breakaways being the predominant features. Granite outcrops occur in a number of places on the reserve, with the twin monadnock, Boyagin Rock, being the largest.

The reserve lies between 280 and 410 metres above sea level, with over 90% of its area lying above 300 metres. The highest known point in the reserve is 402 metres high Jelcobine Hill (Figure 2).



LOCATION - BOYAGIN NATURE RESERVE

Figure 1
Dames & Moore

2.0 LANDFORMS AND SOILS

2.1 INTRODUCTION

Two soil surveys of the reserve have been undertaken in recent years, the first being a soil classification by the Lands and Surveys Department in 1982 and the second being by W.M. McArthur of Dames & Moore in 1985.

In a September 28, 1982 report to the Surveyor General, a Lands & Surveys Department staff surveyor describes the first survey method and report preparation as follows:

"Soil samples were taken at regular intervals and in areas of particular interest or change. A one metre hand auger was used for sampling. The data obtained from soil samples together with interpretation of 1:50,000 aerial photography and familiarity with the land system, was the basis for the determination of soil boundaries."

"Final determination of soil boundaries has been marked on aerial photography and will be forwarded to the photogrammetric section for preparation and drafting of soil plans. A scale of 1:20,000 has been selected as suitable."

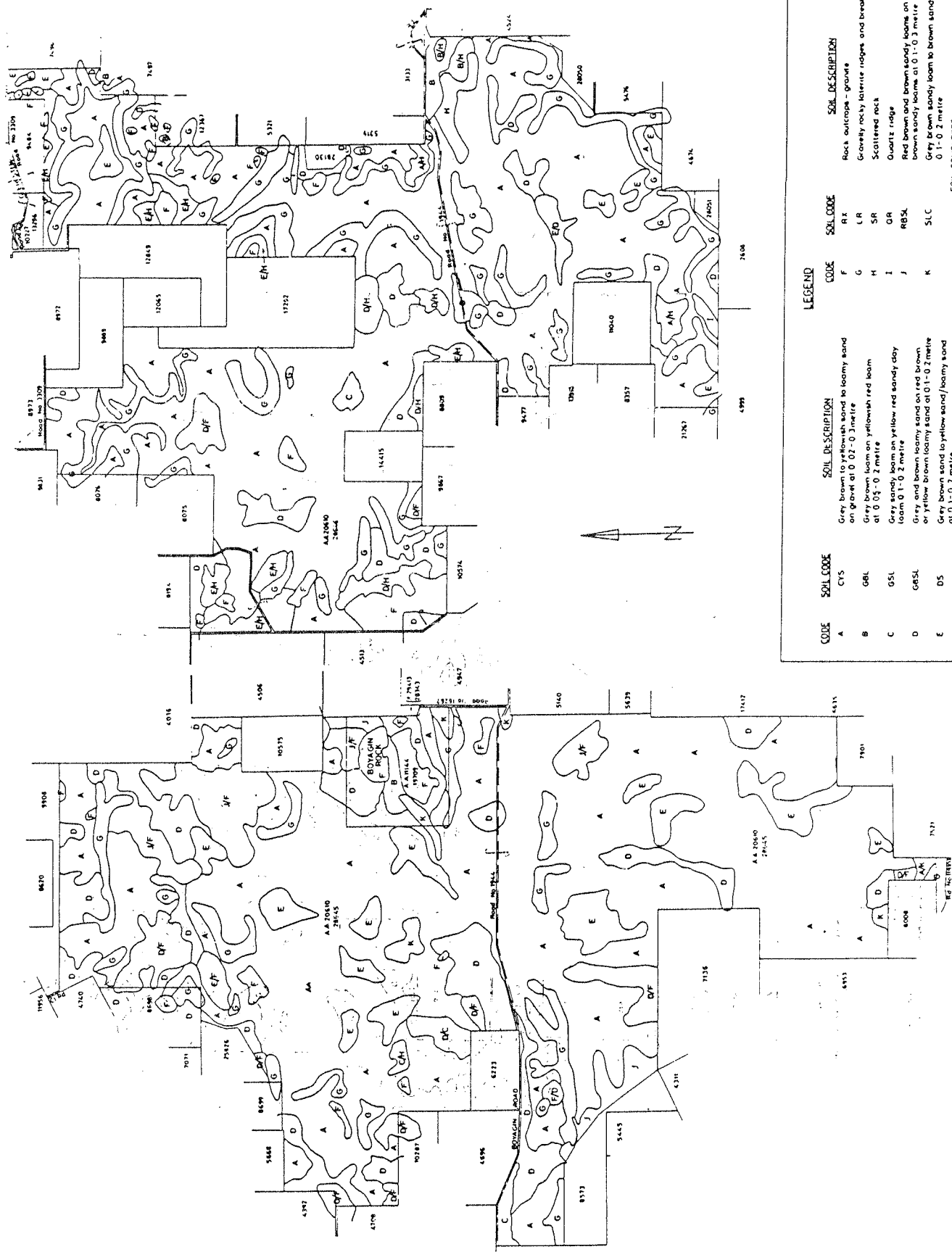
"The soil plan will be prepared on a clear transparent base to enable vegetation plan overlays."

Apparently no map showing soil sample sites is available. Nor was a clear transparent base soil plan seen by Dames & Moore. There are, however, copies of the soil plan available at scales of 1:28,300 and 1:40,000.

A second soil survey was undertaken by Dames & Moore consultant W.M. McArthur in February and March 1985. The survey was specifically designed to locate and describe erosion hazard soils and slopes and was based on aerial photo interpretation, familiarity with the types of soils in the reserve (e.g. McArthur, Churchward and Hick 1977), and one brief field trip.

2.2 DESCRIPTION

The soils of the reserve as classified and mapped by the staff surveyor are shown in Figure 3 and described below.



LEGEND		SOIL COMPLEXES	
CODE	SOIL CODE	CODE	SOIL CODE
A	CYS	F	RL
B	GBL	G	LR
C	GSL	H	SR
D	GRSL	I	GR
E	DS	J	RBSL
		K	SLC
		Example:	
		A/F	CYS/RL
			Complex of granite rock outcrop and CYS soils
SOIL DESCRIPTION		SOIL DESCRIPTION	
Grey brown to yellowish sand to loamy sand on gravel at 0.02-0.2 metre		Rock outcrop - granite	
Grey brown loam on yellowish red loam at 0.05-0.2 metre		Coarsely rocky laterite ridges and breakaways	
Grey sandy loam on yellow red sandy clay loam 0.1-0.2 metre		Scattered rock	
Grey and brown loamy sand on red brown or yellow brown loamy sand at 0.1-0.2 metre		Quartz ridge	
Grey brown sand to yellow sand/loamy sand at 0.1-0.2 metre		Red brown and brown sandy loam on grey brown sandy loam at 0.1-0.3 metre	
		Grey brown sandy loam to brown sandy clay 0.1-0.2 metre	

BOYAGIN NATURE RESERVE

SOILS AND LANDFORMS

"The soils....are complex because of the rough and dissected nature of the area."

"The eastern section of Reserve 20610 (Loc. 28646) comprises a lateritic plateau with numerous rocky lateritic ridges and breakaways. Coarse gravels under sand to sandy loams top soils occur on the higher slopes leading off the plateau. Further down the profile the gravels tend to change in size from coarse to medium and often fine with increasing depth of top soil. The gravel soils (CYS) are designated as "A" on the soil plan. Associated with the lower profiles in the land system are the D & E series of soil. These areas are irregular and difficult to accurately plot. Areas of exposed granite bed rock occur throughout the lower areas with an association of sheoak and gritty sands. Smaller areas of loams and sandy loams over sandy clay loams are found in the low lying washed and dissected areas."

"The western portion of the reserve (Loc. 28645) similarly consists of a central lateritic undulating plateau with rough rocky laterite ridges and breakaways with gravelly slopes. Larger areas of granite bedrock have been exposed through deposition (sic.; should read 'erosion') of overlying soils. It is expected that subsoils overlying the bedrock will be medium to heavy clays at depth. This pattern would be similar through the entire reserve. Within the laterite plateau pockets of E series sands have accumulated in depressions. These are deep sand to loamy sands which have a higher reflectance and appear white on the photography. They are associated with stands of Eucalyptus marginata (Jarrah) and Eucalyptus calophylla (Marri). These areas should not be confused with other darker tones in the E series which are darker gritty deep sands adjacent to granite and Casuarina areas."

"Provision has been made for the existence of soil complexes,...designated as e.g. D/F or a complex of GBSL and RX types."

The following description, and map (Figure 4), is based upon the 1985 field work and photo interpretation undertaken by W.M. McArthur.

The pattern of land forms in the reserve and soils is determined by the degree of erosion of the old lateritic upland. The non-granite outcrop parts of the reserve are readily divided into the lateritic remnants, often marked by small scarp at the edges, and the various materials exposed by erosion or by erosional products.

2.2.1 The Lateritic Uplands

The lateritic uplands have a very gently undulating topography, including some local divides and sometimes showing small erosion gullies. The rims of these upland remnants usually have narrow zones of lateritic duricrust while the interior parts, often concave or gully-sloping, have deep, fine, gravelly sands or sandy loams. There may be areas of yellow or grey sands which occur only sporadically.

Rock outcrops in the lateritic uplands are uncommon.

Included with the uplands are the heads of ancient valleys which are remnants of the old drainage system that existed before the old surface was dissected. These valleys may have lateritic materials extending downslope almost to the valley floor, which usually has sandy detritus.

2.2.2 The Dissected Landscapes

The dissected landscapes have formed after removal of the upper parts of the lateritic profile and the consequent exposing of various weathered and unweathered sub-strata. The actual surface is very variable and changes may occur rapidly and dramatically in short distances. This is because the erosional detritus is subject to sorting during transport and also because the nature of the eroded material ranges from clay to gravel.

At the foot of the erosion scarp (the pediment) mottled zone material (often pink clay), which sheds water very efficiently and is likely to erode, is usually exposed; rarely this is covered by a gravel mantle. This is a narrow zone, downslope from which there is usually a broad zone of gravelly detritus overlying a clay sub-strate. Further down slope, with the slope decreasing, the soil is often sand or sandy loam on the surface overlying clay. This extends down to the functional drainage lines.

Rocks outcrop at various points along this downslope transect.

2.3 EROSION HAZARD

The main factor influencing erosion in the reserve is the slope, and the steep slopes of the pediments are the most likely sites to erode if disturbed. Even under natural conditions there are sometimes erosion gullies on the pediment slopes.

Also, where there are large expanses of granite and where runoff is high, erosion hazard is increased when land is cleared downslope. Even on gentle slopes, when there is a long distance of cleared land for water to collect on, erosion will take place. Therefore, the length of flow needs to be reduced by side drains to avoid gullies.

Any sandy surface is unlikely to erode because of easy water penetration into it. Most of the lateritic uplands are not prone to erosion, although there are some incipient gullies formed on the steeper slopes. Examples of these incipient gullies can be seen where laterite extends downslope into the old valleys.

Erosion hazard is increased when there is a change in penetrability in the profile. Thus, sand over clay and sand over granite provide conditions for erosion to develop.

3.0 VEGETATION

3.1 INTRODUCTION

The vegetation of Boyagin Nature Reserve has been mapped at the small scales of 1:3,000,000, 1:1,000,000 and 1:250,000 by Beard (1981b, 1981a, 1979). The vegetation is shown at a scale of 1:250,000 as wandoo (Eucalyptus wandoo) and powderbark wandoo (E. accedens) woodlands with small enclaves of York gum (E. loxophleba) and marri (E. calophylla) woodlands. The reserve is in the Dryandra Vegetation System, where typically there is a catena of these woodlands with brown mallet (E. astringens) and Allocasuarina huegeliana woodlands, occasional jarrah (E. marginata) trees, granite outcrop communities, E. drummondii mallee-heaths and flooded gum (E. rudis) riverine woodlands.

There is no large scale vegetation map of the entire Boyagin Nature Reserve, but three sets of working maps together cover the majority of it. The first set was produced by the Forests Department. The second two sets are partial drafts drawn by Fisheries and Wildlife Department staff members.

The eleven Kulyaling Mallet Classification maps produced by the Forests Department, probably in 1930, are the most comprehensive, largest scale and, by several decades, the earliest set of vegetation maps of the reserve. Map Sheets 1 through 10, but not 11, were made available for the current mapping project. The maps were produced at a scale of 10 chains to an inch.

The two partial vegetation map drafts are tracings of vegetation boundaries interpreted on 1:16,000 scale colour and infra-red aerial photographs. The earlier, more detailed set covers various parts of the reserve. The tracings were done by Mr N. McKenzie, who also checked boundaries in the field. The second, more recent set is much less detailed and covers fewer parts of the reserve, in some cases the same parts mapped by McKenzie. Both sets of tracings are joined and reproduced in Figure 5, a separate sheet that has not been reduced and incorporated with this text.

3.2 MAJOR PLANT COMMUNITIES

The principal plant communities in the reserve occur as tree communities (forests, low forests, woodlands and low woodlands), short and tall kwongan (or heaths and shrublands) and herbaceous plant communities. Some of the tree-dominated communities also occur as tall shrublands and grade into kwongan.

The principal woody plant communities can be grouped into associations on the bases of prominence or dominance of 14 species occurring singly, in pairs or in larger groups. The total number of associations and mosaics of communities in the reserve is much greater. These 14 species and the symbols used for them on the vegetation map, Figure 6, are listed in Table 1.

There is considerable variation in height, density and species proportions in tree overstoreys as well as in their shrub understoreys. The vegetation is, in much of the reserve, a continuum that can be broken down into units only arbitrarily. Consequently, plant community species associations previously diagrammed for the reserve show a high degree of overlap and vegetation units on sketch maps which have been drawn by different people for the same area have different boundaries and designations.

3.2.1 Tree Communities

The most widespread association in the reserve is woodland or low woodland dominated by Eucalyptus accedens, often with E. wandoo or E. astringens and often as an overstorey or emergent in E. drummondii kwongan. Lateritic soils on the plateaus and pockets of sand overlying lateritic soils support woodlands and low woodlands of E. accedens, intergrading, on the poorer sites, with kwongan vegetation characterised by two small trees or mallees, E. drummondii and E. exilis. On the more favourable sites E. wandoo and E. calophylla are more common. Eucalyptus marginata also occurs on some plateaux, as scattered individuals or small populations. Pediment slopes below the laterite breakaways generally support E. accedens woodlands but on some laterite or, particularly, clayey soils E. astringens woodlands or patches of forest replace them.

Typically, E. astringens woodlands approach the density of open forest and have a very sparse understorey. In most cases E. astringens woodlands are pole stands that are regenerating following heavy, recurrent cutting from the 1930s or earlier until, probably, 1960.

Eucalyptus calophylla and E. wandoo occur with E. accedens or in place of it on mid-slopes with loamy soils. On sandier upper slopes and on sandy loamy soils on lower slopes E. accedens often shares dominance with E. wandoo or is replaced by it. Allocasuarina huegeliana trees are common in this woodland and sometimes occur as the dominant species on coarse sandy soils.

In many of the broad valleys and shallow slopes bordering them, generally on sandy loamy soils, Eucalyptus wandoo is the dominant tree. Allocasuarina huegeliana is commonly an understorey tree in E. wandoo woodland. Acacia acuminata is less common, sometimes occurring with the Allocasuarina in the understorey and sometimes without it. The two poisons, Gastrolobium spinosum and Oxylobium parviflorum, form dense shrub understoreys to over 2m tall under wandoo canopies. In some areas the two poisons, particularly Gastrolobium spinosum, form thickets without an overstorey.

Eucalyptus loxophleba woodland, together with E. wandoo woodland, originally covered most of the lowland area surrounding the reserve. Most of it has since been cleared and now occurs in the reserve only as small, mixed populations on the reserve's periphery. The largest remaining stand of E. loxophleba in the reserve is along Boyagin Road at the eastern end of the southeastern block. Acacia acuminata is a small tree that is sub-dominant in parts of the stand.

Allocasuarina huegeliana forms monospecific stands of open low forest on lower slopes and drainage floors and on granite rocks and soils around them. Stands of the Allocasuarina often have canopy densities in excess of 30% and form catenas with thickets of Gastrolobium spinosum, Oxylobium parviflorum, Dryandra sessilis and Acacia lasiocalyx in some places. Where the Allocasuarina trees are mature and openly spaced the two poisons often occur as an understorey.

Two wattles, Acacia acuminata and Acacia lasiocalyx, form low forests and open low forests that on some sites might be better described as shrub communities. Communities dominated by Acacia acuminata are uncommon in the reserve, but dense Acacia lasiocalyx communities form mosaics with Allocasuarina huegeliana low forests around many of the granite outcrops. In some areas, Allocasuarina campestris forms dense thickets that closely resemble Allocasuarina huegeliana stands on the aerial photographs.

3.2.2 Kwongan Communities (Sclerophyllous Shrublands)

The Kwongan communities of Boyagin Nature Reserve can, similarly to those of Tutanning Nature Reserve, be grouped into four types on the basis of structure and floristic composition (Brown and Hopkins 1983):

1. Dense Dryandra - Petrophile shrublands that are 2-3m tall when mature and generally confined to duricrust,

2. Diverse, mixed shrublands less than 2m tall, with a high proportion of species belonging to the families Proteaceae, Myrtaceae and Leguminosae and occurring commonly on lateritic duricrust and on sandy soils in depressions in the lateritic plateaus and on spillway deposits that blend into the lower parts of the landscape,
3. Sclerophyllous shrubland with Eucalyptus drummondii or E. exilis occurring as an overstorey or emergent, often with Type 1 or Type 2 kwongan as an understorey and usually on sandy and gravelly soils on the laterite plateaus, or on Boyagin Rock with E. caesia as the dominant,
4. Sclerophyllous shrubland with Xanthorrhoea preissii and emergents of Banksia attenuata, B. prionotes, B. grandis and Hakea baxteri on highly reflective, white, sandy soils.

3.2.3 Herbaceous Plant Communities

Where there is shallow soil development on granite outcrops, there is often a low meadow of resurrection plants and small, ephemeral annuals. These communities on Boyagin Rock, as well as other granite outcrops outside the reserve, are being described by R. Ornduff and are the principal source of 1985 additions to the Boyagin Nature Reserve species list.

3.3 VEGETATION MAP

The vegetation map, presented in reduced form in Figure 6, was traced from boundaries drawn with wax pencil onto stereo pairs of 1:16,000 scale coloured aerial photographs. This vegetation map is considered to be the most comprehensive and accurate yet produced of the reserve. Frequent reference was made to the maps discussed in Section 3.1 during the mapping. Although different boundaries were selected in many cases, many may be no more accurate than some of the ones drawn by earlier mappers. The map's accuracy can be improved by further field checking.

The greatest amount of uncertainty in the mapping undoubtedly lies with the choice of boundaries between Eucalyptus wandoo and E. accedens associations and between E. accedens and kwongan. In the former instance, the boundaries between E. accedens and E. wandoo are very difficult or impossible to pick up on aerial photographs and still

TABLE 1

PLANT ASSOCIATIONS OF BOYAGIN NATURE RESERVE

FORESTS, WOODLANDS, LOW FORESTS, LOW WOODLANDS

E	<u>Eucalyptus</u> species
Ea	mainly <u>Eucalyptus accedens</u>
Ec	<u>Eucalyptus calophylla</u> prominent
El	<u>Eucalyptus loxophleba</u> dominant
Em	<u>Eucalyptus marginata</u> prominent
Ew	mainly <u>Eucalyptus wandoo</u>
M	<u>Eucalyptus astringens</u> (Mallet) prominent
C	<u>Allocasuarina</u> species, generally Ch but sometimes Cc
Cc	<u>Allocasuarina campestris</u>
Ch	<u>Allocasuarina huegeliana</u>
A	<u>Acacia</u> species
Aa	<u>Acacia acuminata</u> (Jam)
Al	<u>Acacia lasiocalyx</u>

KWONGAN (SHRUB/HEATH COMMUNITIES)

K	Kwongan
tK	tall Kwongan (taller than 2m)
sK	short Kwongan (shorter than 1.5m)
Kd	<u>Dryandra</u> sp. (mainly <u>D. nobilis</u>) prominent
Ke	<u>Eucalyptus exilis</u> or <u>Eucalyptus drummondii</u> prominent
Kb	Kwongan with emergent <u>Banksia attenuata</u> or <u>Banksia grandis</u>
Kg	<u>Eucalyptus caesia</u> (Gunguru) stands

HERBACEOUS PLANT COMMUNITIES

G	Granite rock surface, meadows
cl	cleared land

difficult to determine in the field. Earlier mappers tended to include too much E. accedens in their E. wandoo associations, and the current mapping may show too much E. wandoo in E. accedens associations, especially on slopes.

Boundaries drawn between kwongan communities and E. accedens communities with kwongan understorey must also be drawn arbitrarily, not so much because the communities are difficult to distinguish on aerial photographs as because the decrease in E. accedens crown density from E. accedens woodland to E. accedens occurring as emergents in kwongan is frequently gradual and continuous.

The style of mapping and the symbols used on the map are based on the Tutanning Nature Reserve vegetation map. In general, the same symbols are used on the two maps except where a dominant occurs in one reserve and not the other. Furthermore, more kwongan dominants are recognised on the Boyagin map than on the Tutanning map.

4.0 FLORA

4.1 INTRODUCTION

Boyagin Nature Reserve is in the South-west Botanical Province on the boundary between the Darling Botanical District (Dale Subdistrict) and the Avon Botanical District (Beard 1980). Beard defines the botanical districts primarily on the basis at vegetation, but they can also be viewed as floristic areas. As drawn by Beard, the boundary between the Darling and Avon Districts is a more or less north-south line that runs west of Boyagin Rock.

Beard (1980) defines the eastern boundary of the Darling's Dale Subdistrict as "where E. accedens and E. astringens replace E. marginata on lateritic residuals, E. calophylla retires from woodlands of mid slope, and E. loxophylla and/or E. occidentalis appear on lower slopes." That the reserve is on the boundary between the two botanical districts is indicated by the phenomena that both E. accedens and E. marginata occur on lateritic residuals and that E. calophylla occurs on some mid-slopes (especially next to granite monadnocks) and E. loxophleba on a few lower slopes (and mid slopes).

It can be expected that the reserve's position on the boundary between the two botanical districts would be reflected in a flora which is richer than it would be if the reserve were not on the boundary and had floristic elements of only one district instead of two.

4.2 VASCULAR PLANT SPECIES

Approximately 420 species of vascular plants are currently recorded from the reserve. At least twelve percent of the species were added to the list in 1985, and there are undoubtedly many species in the reserve that are not listed. The species list is presented, with an introduction, in Appendix B.

4.3 RARE, GEOGRAPHICALLY RESTRICTED AND POORLY COLLECTED SPECIES

Two of the species recorded from the reserve are on the most recent list of gazetted Rare Flora Species: Eucalyptus caesia and E. exilis. In Boyagin Nature Reserve Eucalyptus caesia ssp. caesia is found in several small populations on Boyagin Rock, but it also occurs in approximately seven other populations on other granite outcrops in the

wheatbelt (Hopper and Burgman 1983; Moran and Hopper 1983). Eucalyptus exilis, an associate of E. drummondii, has been recorded only from Boyagin Nature Reserve and two other localities, Wickpin Reserve and in the Mundaring Weir catchment (Brooker 1974). It is, however, common and widespread in Boyagin Reserve, as a dominant in kwongan communities on lateritic residuals.

Nine other non-gazetted rare and geographically restricted species listed by Millar (1982) are also recorded for the reserve. These nine species are listed in Table 2 with their known geographic ranges and number of specimens in the Western Australian Herbarium at the time Millar did her survey.

Figure 7 shows locations in the reserve where Calothamnus planifolius, C. rupestris, Eucalyptus caesia, E. exilis, Gastrolobium stipulare and Hakea loranthifolia have been recorded. Eucalyptus exilis certainly occurs more widely in the reserve than the map indicates; others of the listed species probably do also.

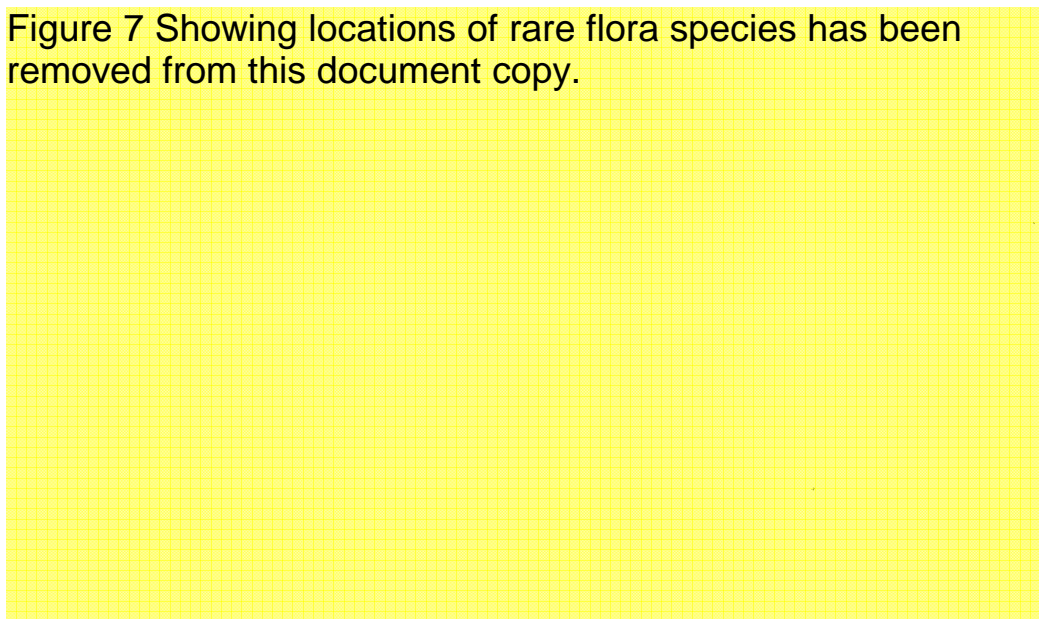
TABLE 2

NON-GAZETTED RARE AND GEOGRAPHICALLY RESTRICTED SPECIES OF
VASCULAR PLANTS
BOYAGIN NATURE RESERVE

<u>SPECIES</u>	<u>SPECIMENS QUANTITY</u>	<u>APPROXIMATE GEOGRAPHIC RANGE</u>
<u>Acacia deflexa</u>	9	Brookton-Bendering
<u>Boronia capita</u> ssp. <u>clavata</u> ¹	16	Coorigin-Nyabing
<u>Calothamnus planifolius</u>	11	Pingelly-Nyabing
<u>Calothamnus rupestris</u>	15	Red Hill-Boyagin Rock
<u>Dryandra cynaroides</u>	8	Brookton-Woodanilling
<u>Gastrolobium stipulare</u>	1	East of Wagin
<u>Hakea loranthifolia</u>	2	Beverley-Pingelly
<u>Hemigenia saligna</u>	4	Geraldton area
<u>Thomasia montana</u>	7	York-Brookton

1. The list of species for the reserve does not indicate whether B. c. ssp. clavata or B. c. ssp. capita is the subspecies recorded from the reserve.

Figure 7 Showing locations of rare flora species has been removed from this document copy.



5.0 FIRE MANAGEMENT

Fire management of Boyagin Nature Reserve can be based on a number of premises, among which the following may be the most relevant here:

1. Fires may start in the reserve, from lightning, arson, campfires and other causes, and spread into adjacent farmland,
2. Fires may spread into the reserve from adjacent farmland,
3. Native vegetation needs to be regenerated and rejuvenated by periodic burning.

The great majority of fires may be prevented from spreading into the reserve or out of it by an adequate system of firebreaks around the reserve's periphery. Firebreaks would not, however, prevent burning bark, leaves or branchlets becoming detached and being blown into farmland by strong winds during a fire in the reserve. Nor would litter fuel levels significantly reduce this risk.

There is certainly no ecological need for frequent burning of any of the natural vegetation in the reserve. In fact, some of it appears to have been burnt excessively frequently, particularly some of the wandoo woodland. Regrowth of mature trees in some of these areas will probably take many decades.

The current debate about frequency, timing and intensity of burning of native vegetation is fueled by conjecture and lack of data and long-term appropriate research. This gap is beginning to be filled by a few projects such as the analyses being carried out in Tutanning Nature Reserve by the Wildlife Research Centre (Kessell, Good and Hopkins 1984; Hopkins pers. comm.). Techniques employed and data collected at Tutanning should be useful in planning a fire management system for Boyagin Nature Reserve.

Different types of vegetation support and react to fire in different ways. For instance, the Tutanning studies found that E. wandoo woodlands have a very high rate of litter/fuel decomposition, much higher than other woodlands studied (Kessell et al. 1984).

Communities of Allocasuarina species are very fire sensitive. The trees are killed by even mild fires but are not fully consumed and remain standing, becoming the source of ground fuels when they fall down several years later.

Sclerophyllous Kwongan is very susceptible to fire and will carry a hot fire even if there is no litter fuel.

Few sites with substantial litter buildup were observed in the reserve. Most stand with litter buildup that were observed were around the feet of granite outcrops and not likely to be a significant hazard.

From the point of view of both litter fuel hazard reduction and native vegetation regeneration any intentional burning of the reserve should be restricted to the boundaries and the picnic area until much more is known about the fire ecology of both plant and animal components of the reserve's ecosystems. With these possible exceptions, fire management in the short term should be restricted to the maintenance of firebreaks.

Creation of new firebreaks should be limited and some existing firebreaks could be closed off where they run in pairs. Even where existing firebreaks mount steep slopes and are likely to lead to erosion, the erosion hazard could be reduced by putting in cross drains. However, placing of firebreaks should be avoided in Banksia Kwongan (Kb), a rare type of vegetation in the reserve, on soils that are soft when wet, especially at the feet of granite outcrops, and in areas where rare species are known to occur (see Figure 7).

Firebreaks are normally made and maintained by ploughing or grading. Of these two methods, surface grading does less damage and is less likely to lead to erosion. But a third method of maintaining firebreaks should be given consideration: raking. Wide rakes towed by four-wheel drive vehicles are being used successfully in the metropolitan area to keep firebreaks clear of debris and plant growth, with a minimum amount of soil damage.

Consideration should also be given to restricting of the width of firebreaks. In general, firebreaks need not be wide to function as firebreaks. Animal trails are often sufficient to stop a ground fire, even in dense vegetation. The second, and perhaps primary, function of a firebreak, access, can also be met with a narrow firebreak.

6.0 RECOMMENDATIONS FOR FURTHER WORK

As the vegetation map of the reserve presented in this report must be considered provisional, as the vegetation descriptions are incomplete and as systematic flora surveys have not been done, there is still much field work that needs doing in the reserve. Consequently, it is recommended that:

1. A comprehensive vegetation survey based on the information in this report be undertaken. The survey would concentrate on refining and expanding vegetation descriptions and checking accuracy of designations and boundaries drawn on the aerial photographs.
2. A series of systematic flora surveys be undertaken through the flowering season, from midwinter or earlier until early summer. The surveys should include representative stands of all vegetation units and all stands of Banksia kwongan and granite-related vegetation.
3. Consideration be given to application of a PREPLAN-Tutanning Nature Reserve type management plan to Boyagin Nature Reserve and to collection of the prerequisite data.

7.0 ACKNOWLEDGMENTS

Drafts, notes, aerial photos, plant species lists, reprints, sketch maps and departmental files upon which this report is based were provided by K. Atkins, A.J.M. Hopkins, J.M. Brown and S.D. Hopper. Assistance in the field was provided by R. Saffrey.

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APPENDIX A

DESCRIPTIONS OF VEGETATION UNITS
BOYAGIN NATURE RESERVE

APPENDIX A

DESCRIPTIONS OF VEGETATION UNITS

The descriptions of basic vegetation units are synthesised from notes by N. McKenzie and field observations by W.M. McArthur, R. Saffrey and A.S. Weston.

Definition of the units is, to a large degree, subjective and influenced by the distinctiveness of vegetation patterns on aerial photographs.

The diagnosis of each unit and the formation unit terms used in the descriptions are based upon the scheme of Muir (1977).

The symbol, or code, for each basic unit is given in the top left hand corner of each page. The symbols are defined in Table 1.

Only one vegetation unit is described per page, and each page has space for addition of information, amendments and notes.

Ew Eucalyptus wandoo (Wandoo, White gum) Woodlands

Diagnosis: Woodland (from Forest to Low Woodland A)

Plate 1

Description:

- | | | |
|---------|----|--|
| Stratum | 1. | Generally <u>Eucalyptus wandoo</u> but often merging with <u>E. accedens</u> woodlands and with <u>E. calophylla</u> in some places. |
| Stratum | 2. | <u>Allocasuarina huegeliana</u> and, less commonly, <u>Acacia acuminata</u> low woodlands. |
| Stratum | 3. | Variable in density and species composition but often with a very open shrub stratum or none, particularly on flats on valley floors. Common Stratum 3 species include <u>Gastrolobium spinosum</u> , <u>Oxylobium parviflorum</u> , <u>Calothamnus</u> sp., and <u>Acacia pulchella</u> . |
| Stratum | 4. | Open Dwarf Scrub and Open Sedges of various species including <u>Bossiaea eriocarpa</u> , <u>Allocasuarina humilis</u> , <u>Lepidosperm</u> sp., <u>Dryandra</u> sp., <u>Platysace</u> sp. |

Comments: Eucalyptus wandoo woodlands most commonly occur on sandy loams of lower slopes and on drainage floor soils, but they can also be found on heavier soils and gravel, on gentle mid slopes, where understoreys vary from pure Oxylobium parviflorum to a mixed species heath. Some E. wandoo woodlands have been severely burnt, as in Plate 1, where dead, decaying but still upright trunks can be seen surrounded by regenerations mallee wandoo regrowth that is 4-6m tall.

Ea Eucalyptus accedens (Powderbark wandoo) Woodlands

Diagnosis: Low Woodland A (from Low Forest A to Open Low Woodland B) over variable understorey

Plate 2

Description:

Stratum 1. Generally Eucalyptus accedens but with E. marginata on some plateau surfaces, E. astringens on some slopes, E. wandoo on some lower slopes and gravelly upper slopes and E. calophylla on a few lower slopes. Beard (1979) contends that where these species occur together on plateau surfaces each species tends to occur in pure patches that form mosaics with other species patches.

Stratum 2. Allocasuarina huegeliana as Low Woodland B, on many sites.

Stratum 3. Highly variable in density and species composition but generally Heath A to Open Low Scrub A: Calothamnus planifolius, Dryandra sessilis, D. nobilis, Gastrolobium spinosum, Hakea trifurcata, Leptospermum erubescens, Melaleuca sp., Oxylobium parviflorum, Petrophile divaricata.

Stratum 4. Dwarf Scrub that is also variable in density and species composition: Adenanthos? cygnorum, Allocasuarina humilis, Beaufortia incana, Bossiaea eriocarpa, Dryandra nivea.

Comments: Eucalyptus accedens woodlands occur over a wide range of slopes, exposures and substrates and, consequently, exhibit a wide range of form and species composition.

E1 Eucalyptus loxophleba (York gum) Woodlands

Diagnosis: Low Woodland A

Plate 2

Description:

Stratum 1. Eucalyptus loxophleba Low Woodland A.

Stratum 2. Commonly Acacia acuminata; also Allocasuarina huegeliana.

Comments: The few stands of Eucalyptus loxophleba woodland that occur in the reserve have E. wandoo as scattered emergents. Also see comments under Acacia acuminata woodland.

Ec Eucalyptus calophylla (Marri, Red gum) Woodlands

Diagnosis: Forest to Low Woodland A, as small stands

Plate 3

Description:

Stratum 1. Eucalyptus calophylla generally as an emergent or small stand in woodlands dominated by other species, especially E. wandoo, E. accedens, E. loxophleba, Acacia acuminata and Allocasuarina huegeliana.

Lower Strata: Dryandra sessilis, Gastrolobium spinosum, Hakea trifurcata, Macrozamia riedlei, Melaleuca sp., Oxylobium parviflorum and Xanthorrhoea preissii.

Comments: Eucalyptus calophylla woodlands in the reserve are few and limited in size. The largest, though still small, stands are below granite outcrops.

Em Eucalyptus marginata (Jarrah) Woodlands

Diagnosis: Woodland to Open Woodland

Plate 3

Description: Commonly an emergent in Kwongan on lateritic residuals.

M Eucalyptus astringens (Brown mallet) Woodlands

Diagnosis: Low Woodland, but Low Forest of regenerating pole stands are common and mature woodland is rare.

Plate 4

Description:

- Stratum 1. Eucalyptus astringens, often as small stands in E. accedens woodlands.
- Stratum 2. Understorey is commonly absent or very sparse; Allocasuarina huegeliana in some stands.
- Stratum 3. Gastrolobium spinosum or Oxylobium parviflorum and Dodonaea bursariifolia in some stands, often patchy.

Comments: Eucalyptus astringens stands in the reserve were managed by the Forests Department until 1963 and were cut for tannin until 1960. Stumps are still common, and stands are now in various stages of regeneration.

The scale insects established on the trunks of Eucalyptus astringens attract European bees.

Cc Allocasuarina campestris communities

Diagnosis: Understorey in some woodlands. Also Thickets and Dense Heath A (but listed under tree communities) - has been diagnosed as Kwongan in some wheatbelt nature reserves.

Plate 5

Description: Frequently very dense monospecific stands with almost no understorey.

Comments: Often bordering stands of Acacia lasiocalyx.

Ch Allocasuarina huegeliana (She-oak) Low Forest

Diagnosis: Low Forest A (Dense Low Forest A to Low Woodland A)

Plate 5

Description:

Stratum 1. Allocasuarina huegeliana and, in some places, Acacia acuminata or A. lasiocalyx,

Lower Strata: Absent or sparse in most pure stands, especially unburnt stands. Understorey elsewhere includes Dodonaea sp., Dryandra sessilis, Gastrolobium spinosum, Leptospermum erubescens, Macrozamia riedlei, Oxylobium parviflorum, Xanthorrhoea sp, and Baeckea sp.

Aa Acacia acuminata (Jam) Woodland

Diagnosis: Low Woodland A and Low Woodland B

Plate 2, 6

Description:

Stratum 1. Acacia acuminata alone but more commonly with Allocasuarina huegeliana and with Eucalyptus loxophleba, E. wandoo and E. calophylla as emergents. More common as Stratum 2 understorey.

Lower Strata: Acacia saligna, Allocasuarina campestris, Calothomnus sp., Dryandra sessilis, Gastrolobium spinosum, Hakea sp., Oxylobium parviflorum and Xanthorrhoea preissii.

Comments: Acacia acuminata woodland and Eucalyptus loxophleba woodland are two extremes of what is more commonly a woodland with the eucalypt as the dominant and the Acacia as dominant of Stratum 2. These communities, being indicators of better agricultural soils, are poorly represented in the reserve and where they do occur often have conspicuous populations of alien grasses and other herbaceous weeds. Eucalyptus calophylla and, more often, E. wandoo occur as emergents in some Acacia acuminata woodlands.

A1 Acacia lasiocalyx Forest

Diagnosis: Dense Low Forest A and B to Low Woodland A and B or Dense Thicket and Thicket often with only sparse understorey.

Plate 6

Description:

Stratum 1. Acacia lasiocalyx, often with or adjoining Allocasuarina campestris and Allocasuarina huegeliana

Lower Strata: Dodonaea attenuata

Comments: Generally on the margins of granite outcrops or bordering them.

tKd

Dryandra Tall Kwongan

Diagnosis:

Thicket (Dense Thicket to Heath A) comprising shrubs ranging in height from a few centimetres to more than 2m.

Plate 7

Description:

No distinct understorey strata.

Dryandra nobilis, Petrophile heterophylla, Dryandra stuposa,
Dryandra spp., Hakea gilbertii, Hakea trifurcata, Acacia ?
celastrifolia, Stirlingia tenuifolia, Leptospermum spinescens.

Comments:

Generally on shallow soil on lateritic residuals, especially on their margins and breakways, merging with other communities on yellow sand.

tKe Eucalyptus drummondii - E. exilis Tall Kwongan

Diagnosis: Tree and Shrub Mallee with Dense Thicket to Heath A.

Plate 7

Description:

- Stratum 1. Eucalyptus drummondii, E. exilis and more rarely, E. falcata,
E. foecunda and E. marginata.
- Stratum 2. Melaleuca ? seriata, Hakea trifurcata, Acacia ? celastrifolia
- Stratum 3. Beaufortia incana, Banksia sphaerocarpa, Dryandra armata,
Dryandra ssp., Adenanthos ? cygnorum, Leucopogon sp.,
Daviesia rhombifolia, Jacksonia sp., Hakea ssp, Petrophile
Isopogon teretifolia

Comments: Eucalyptus drummondii is the most common dominant eucalypt in this associations, although E. exilis is also common and widespread in Tall Kwongan in the reserve. The second stratum grades into Dryandra Tall Kwongan Eucalyptus marginata sometimes occurs as an emergent or overstorey. The stands frequently grade into E. accedens woodlands and Allocasuarina campestris thickets.

tKg Eucalyptus caesia Tall Kwongan

Diagnosis: Tree Mallee with Thicket

Plate 8

Description:

Stratum 1. Eucalyptus caesia, Hakea petolaris, Allocasuarina huegeliana.

Stratum 2. Calothamnus rupestris, Gastrolobium spinosum, Billardiera erubescens, Kunzea pulchella

Stratum 3. Spartochloa scirpoidea.

Comments: Stands seen on south Boyagin Rock, a rare community in the reserve.

Kb Kwongan with emergent Banksia or: Banksia attenuata Open Low Woodland B

Diagnosis: Open Low Woodland B or Open Sparse Low Woodland B with Heath and Low Scrub.

Plate 9

Description:

- Stratum 1. Banksia attenuata, B. prionotes, B. grandis Open Low Woodland (emergents): B or emergents.
- Stratum 2. Dryandra sessilis, Hakea baxteri, Eucalyptus drummondii, Xanthorrhoea preissii,
- Stratum 3. Leptospermum erubescens, Banksia sphaerocarpa, Allocasuarina humilis, Lambertia ? echinata, Stirlingia ? latifolia, Daviesia spp., Conospermum stoechadis, ? Eremaea sp.
- Stratum 4. Caustis dioica, Synaphaea ? petiolaris, Lepidosperma spp., Restionaceae spp., various low shrubs and herbaceous plants.

Comments: Occurs at only four or five locations, a rare community in the reserve.

sK

Short Kwongan

Diagnosis:

Dense Heath (Dense Heath A to Low Heath B)

Plate 10

Description:

1. Gastrolobium spinosum in almost pure stands to mixed stands as Dense Heath A and Heath A.

2. Allocasuarina thuyoides in mixed Low Heath C and Dense Low Heath C.

3. Allocasuarina humilis.

Comments:

Short kwongan occurs in many forms, with a wide variation in species diversity and is most common on heavier soils below the lateritic residuals and on granite outcrops.

G

Granite Meadow and Crack communities

Plate 11

Comments:

These communities are species-rich associations of small, mostly annual species that are short-lived and flower between mid-winter and late spring. These herbaceous granite rock communities of Boyagin Rock and other south-western granite outcrops have been studied by R. Ornduff, who is currently completing a paper on them. Their counterparts in Chiddercooping Nature Reserve are also being studied, by A.S. Weston.

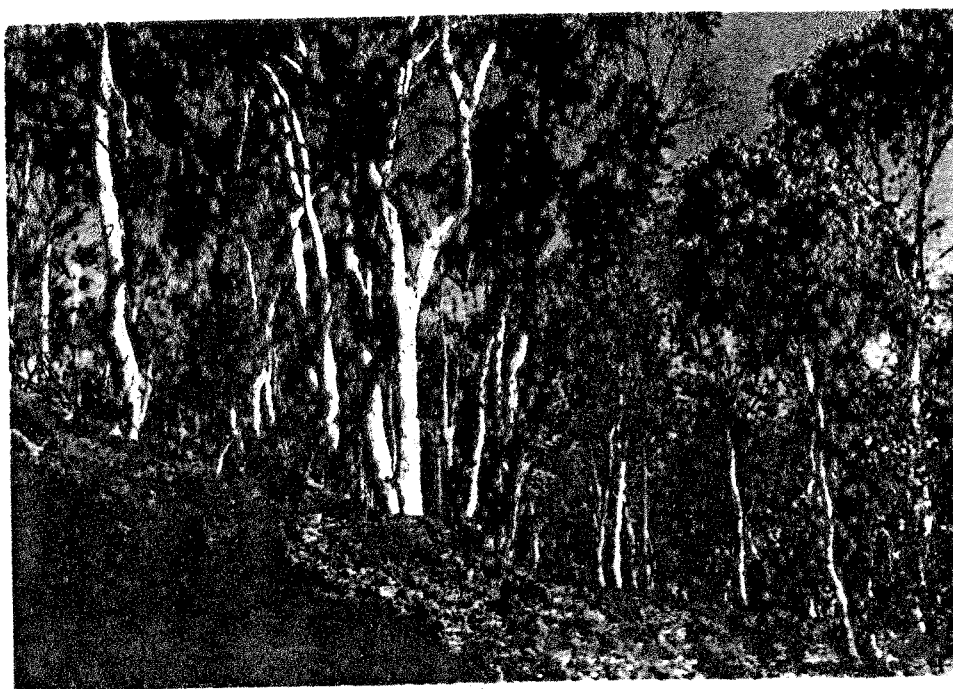


Ew Mature Eucalyptus wandoo Woodland on valley floor with Stratum 2 understory of Acacia acuminata



Ewa Regenerating, mallee-type stand of Eucalyptus wandoo and E. accedens on gentle slope, with old, dead, burnt stump

Darnes & Moore



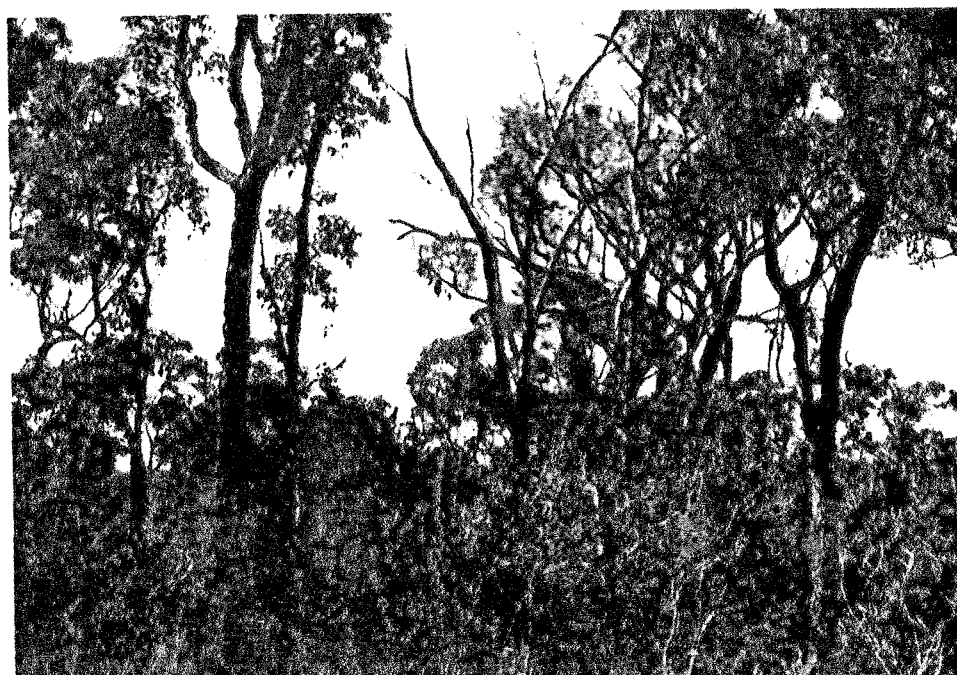
Ea Eucalyptus accedens Woodland below escarpment



EIAa Eucalyptus loxophleba Low Woodland A and Acacia acuminata Low Woodland B



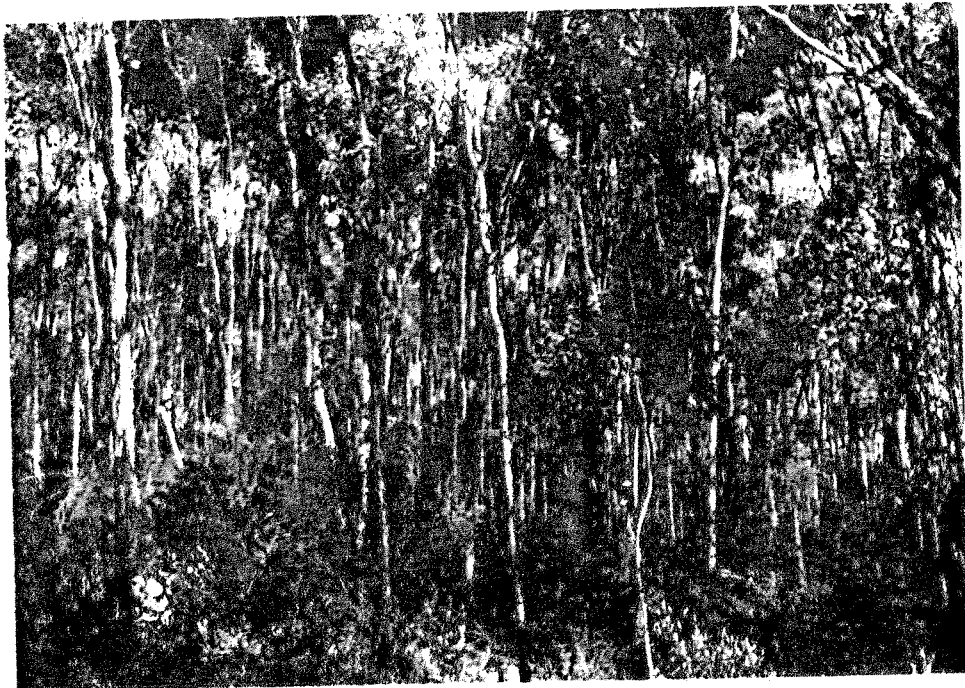
EcCh Eucalyptus calophylla Woodland in Allocasuarina huegeliana Low Forest A



EmK Eucalyptus marginata Woodland with Dryandra Kwongan understorey



M Immature Eucalyptus astringens Low Woodland merging
with E. accedens Woodland



MEa Low Forest regenerating pole stand of Eucalyptus
astringens and E. accedens



Cc Allocasuarina campestris Dense Thicket



Ch Allocasuarina huegeliana Dense Low Forest A



Aa Acacia acuminata Low Woodland



Al Acacia lasiocalyx Dense Thicket with Eucalyptus calophylla and Allocasuarina huegeliana



tKd Dryandra tall Kwongan



tKe Eucalyptus drummondii - E exilis tall Kwongan, with
Melaleuca ? seriata Stratum 2



tKg Eucalyptus caesia tall Kwongan with Calothamnus rupestris in Stratum 2



tKg Eucalyptis caesia tall Kwongan in soil pocket on granite outcrop



Kb Kwongan with Hakea baxteri and emergent Banksia attenuata



Kb Kwongan with Xanthorrhoea preissii and Hakea baxteri

A-27



sK Short Kwongan: 1. Gastrolobium spinosum



sK Short Kwongan: 2. Allocasuarina thuyoides

APPENDIX B

VASCULAR PLANT SPECIES LIST
BOYAGIN NATURE RESERVE

APPENDIX B

VASCULAR PLANT SPECIES LIST

The approximately 420 species of vascular plants recorded from Boyagin Nature Reserve are listed in Table B-1. The species are listed strictly alphabetically in the first column and the collectors and their collection numbers are listed in the second column. There should be at least one collector and one collection number given for each species, and there should be at least one voucher specimen in the Western Australian Herbarium for each species listed. Without voucher specimens there is no proof that the species name listed reflects a correct identification. Several incorrect determinations, invalid names and synonyms have been removed from the list.

The list is based on an undated species list for the reserve provided by Ken Atkins, with additions from a December 1982 list in Western Australian Wildlife Research Centre files of Species Recorded at Boyagin Nature Reserve Which have not been Recorded at Tutanning Nature Reserve, from notes by Norm McKenzie (Jacksonia sternbergiana) and Ken Atkins (Conostylis petrophiloides), from personal communications with Robert Ornduff and from collections made by Arthur Weston in February and March 1985.

These sources have added more than fifty species to the list provided by Ken Atkins, and the list still falls far short of being complete. The list's deficiencies are probably greatest among herbaceous plants, particularly aliens, grasses, sedges and members of the family Restionaceae. It is likely that, ultimately, the number of species recorded from Boyagin Nature Reserve will approach, if not exceed, the number recorded from Tutanning Nature Reserve (620: Brown and Hopkins 1983). It is also likely that most of the species occurring at Tutanning also occur at Boyagin, and vice versa.

Comparisons between the floras of the two reserves, and some other reserves in the wheatbelt, would be facilitated if the species were listed by family, as has been done for the Tutanning list. Listing by family would also facilitate comparisons of family importances in the reserve.

KEY TO ABBREVIATIONS USED FOR COLLECTORS

* Introduced species
dd Doubtful determination
K.A. Ken Atkins

N. McK. Norm McKenzie
R.O. Robert Ornduff
A.S.W. Arthur Weston

VASCULAR PLANT SPECIES LIST

BOYAGIN NATURE RESERVE 20610

<u>SPECIES</u>	<u>COLLECTOR AND COLLECTION NUMBER</u>
<i>Acacia acuminata</i> Benth.	
<i>Acacia alata</i> R.Br.	
<i>Acacia browniana</i> H.L. Wendl. var. <i>intermedia</i> (E. Pritzel) Maslin	
<i>Acacia celastrifolia</i> Benth.	
<i>Acacia chrysocephala</i> Maslin	
<i>Acacia congesta</i> Benth.	
<i>Acacia deflexa</i> Maiden & Blakely	
<i>Acacia insolita</i> E. Pritzel	
<i>Acacia lasiocalyx</i> C. Andrews	
<i>Acacia lasiocarpa</i> Benth. var. <i>sedifolia</i> (Meisn.) Maslin	
<i>Acacia microbotrya</i> Benth.	
<i>Acacia myrtifolia</i> (Sm.) Willd.	
<i>Acacia pulchella</i> R.Br. var. <i>pulchella</i>	
<i>Acacia pulchella</i> R.Br. var. <i>subsessilis</i> Maslin	
<i>Acacia saligna</i> (Labill.) H.L. Wendl.	
<i>Acacia sphacelata</i> Benth.	
<i>Acacia squamata</i> Lindl.	
<i>Acacia stenoptera</i> Benth.	
<i>Adenanthos cygnorum</i> Diels	
<i>Adenanthos drummondii</i> Meisn.	
<i>Agrostocrinum scabrum</i> (R.Br.) Baill.	
* <i>Aira caryophyllea</i> L.	R.O.
<i>Allocasuarina campestris</i> (Diels) L. Johnson	
<i>Allocasuarina huegeliana</i> (Miq.) L. Johnson	
<i>Allocasuarina humilis</i> (Otto & Dietr.) L. Johnson	
<i>Allocasuarina microstachya</i> (Miq.) L. Johnson	
<i>Allocasuarina thuyoides</i> (Miq.) L. Johnson	
<i>Amyema miquellii</i> (Lehm. ex Miq.) Tiegh.	A.S.W. 14707
* <i>Anagallis arvensis</i> L.	R.O.
<i>Andersonia brevifolia</i> Sonder	
<i>Andersonia caerulea</i> R.Br.	

Andersonia lehmanniana Sonder	
Anigozanthos humilis Lindl.	
Aphelia brizula F. Muell.	R.O.
Aphelia cyperoides R.Br.	R.O.
*Arctotheca calendula (L.) Levyns	
Arthropodium capillipes Endl.	
Astroloma epacridis (DC.) Druce	
Astroloma pallidum R.Br.	
Astroloma serratifolium (DC.) Bruce	
*Avena fatua L.	
Baeckea camphorosmae Endl.	
Baeckea crispiflora F. Muell.	
Baeckea floribunda Benth.	
Baeckea grandiflora Benth.	
Banksia attenuata R.Br.	
Banksia grandis Willd.	
Banksia prionotes Lindl.	
Banksia sphaerocarpa R.Br.	
Beaufortia bracteosa Diels	
Beaufortia eriocephala W.V. Fitzg.	
Beaufortia aff. eriocephala W.V. Fitzg.	
Beaufortia incana (Benth.) George	
Beaufortia interstans F. Muell.	
Billardiera coerulea-punctata (Klotzsch) E.M. Benn.	
Billardiera erubescens (Putterl.) E.M. Benn.	K.A.
Billardiera variifolia DC.	
Blennosperma drummondii A. Gray	R.O.
Boronia busselliana F. Muell.	
Boronia capitata Benth.	
Boronia scabra Lindl.	
Boronia spathulata Lindl.	
Borya sphaerocephala R.Br.	
Bossiaea eriocarpa Benth.	
Brachycome glandulosa (Steetz) Benth.	R.O.
*Briza maxima L.	
*Briza minor L.	R.O.
Burtonia conferta DC.	

<i>Caladenia deformis</i> R.Br.	
<i>Caladenia dilatata</i> R.Br.	
<i>Caladenia discoidea</i> Lindl.	
<i>Caladenia flava</i> R.Br.	
<i>Caladenia filamentosa</i> R.Br.	
<i>Caladenia hirta</i> Lindl.	
<i>Caladenia longiclavata</i> E. Coleman	
<i>Caladenia reptans</i> Lindl.	
<i>Caladenia saccharata</i> H. Reichnb.	
<i>Caladenia sericea</i> Lindl.	
<i>Calandrinia calcytrapa</i> J.D. Hook.	R.O.
<i>Calocephalus drummondii</i> (A. Gray) Benth.	
<i>Calothamnus planifolius</i> Lehm.	
<i>Calothamnus preissii</i> Schauer	
<i>Calothamnus quadrifidus</i> R.Br.	
<i>Calothamnus rupestris</i> Schauer	
<i>Calothamnus sanguineus</i> Labill.	
<i>Calytrix angulata</i> Lindl.	
<i>Calytrix?</i> <i>fraseri</i> A. Cunn.	
<i>Calytrix</i> aff. <i>empetroides</i> (Schauer) Benth.	
<i>Calytrix leschenaultii</i> (Schauer) Benth.	
<i>Calytrix oldfieldii</i> Benth.	
<i>Cassytha glabella</i> R.Br.	
<i>Cassytha pomiformis</i> Nees	
<i>Cassytha racemosa</i> Nees	
<i>Caustis dioica</i> R.Br.	
* <i>Centaurium erythraea</i> Rafn.	
<i>Centrolepis aristata</i> (R.Br.) R. & S.	R.O.
<i>Centrolepis drummondiana</i> (Nees) Walp.	R.O.
<i>Chamaexeros serra</i> (Endl.) Benth.	
<i>Chamaescilla corymbosa</i> (R.Br.) F. Muell. ex Benth.	
<i>Chamelaucium drummondii</i> Meisn. ssp. <i>hallii</i> (Ewart) Marchant & Keighery	
<i>Cheilanthes austrotenuifolia</i> Quirk & Chambers	
<i>Cheilanthes sieberi</i> Kunze	R.O.
<i>Choretrum lateriflorum</i> R. Br., dd (probably <i>Ch. glomeratum</i>)	
<i>Comesperma calymega</i> Labill.	K.A.

<i>Comesperma</i> aff. <i>confertum</i> Labill.	
<i>Comesperma</i> aff. <i>virgatum</i> Labill.	
<i>Comesperma</i> <i>volubile</i> Labill.	
<i>Conospermum</i> <i>amoenum</i> Meisn.	
<i>Conospermum</i> <i>distichum</i> R.Br.	
<i>Conospermum</i> <i>stoechadis</i> Endl.	
<i>Conostylis</i> <i>petrophiloides</i> F. Muell. ex Benth.	K.A.
<i>Conostylis</i> <i>setigera</i> R. Br.	
<i>Crassula</i> <i>colorata</i> (Nees) Ostenf. var. <i>acuminata</i> (Reader) Toelken	R.O.
<i>Crassula</i> <i>exserta</i> (Reader) Ostenf.	R.O.
<i>Crassula</i> <i>natans</i> Thumb. var. <i>minus</i> (Eckl. & Zeyher) Rowley	R.O.
<i>Cryptandra</i> <i>glabriflora</i> Benth.	
<i>Cryptandra</i> <i>nutans</i> Steud.	K.A.
<i>Cryptandra</i> <i>pungens</i> Steud.	
<i>Dampiera</i> ? <i>glabrescens</i> Benth.	
<i>Dampiera</i> <i>lavandulacea</i> Lindl.	
<i>Dampiera</i> aff. <i>leptoclada</i> Benth.	
<i>Dampiera</i> <i>lindleyi</i> De Vriese	
<i>Dampiera</i> <i>linearis</i> R.Br.	
<i>Dampiera</i> <i>obliqua</i> Rajput & Caroll	
<i>Dampiera</i> <i>preissii</i> De Vriese	
<i>Daviesia</i> <i>cardiophylla</i> F. Muell.	
<i>Daviesia</i> <i>cordata</i> Sm.	
<i>Daviesia</i> <i>costata</i> Cheel	
<i>Daviesia</i> aff. <i>grahamii</i> Ewart & J. White	
<i>Daviesia</i> <i>hakeoides</i> Meisn.	
<i>Daviesia</i> <i>incrassata</i> Sm. ssp. <i>incrassata</i>	
<i>Daviesia</i> <i>preissii</i> Meisn.	K.A.
<i>Daviesia</i> <i>rhombifolia</i> Meisn.	
<i>Dillwynia</i> <i>cinerascens</i> R.Br. ex Sims	
<i>Diplolaena</i> <i>microcephala</i> Bartl.	
<i>Diuris</i> <i>longifolia</i> R.Br.	
<i>Dodonaea</i> <i>attenuata</i> A. Cunn.	
<i>Dodonaea</i> <i>bursariifolia</i> Behr. & F. Muell.	
<i>Dodonaea</i> <i>pinifolia</i> Miq.	
<i>Drosera</i> <i>glanduligera</i> Lehm.	K.A., R.O.
<i>Drosera</i> <i>bulbosa</i> Hooker	

<i>Drosera? leucoblata</i> Benth.	
<i>Drosera macrantha</i> Endl.	
<i>Drosera menziesii</i> R.Br.	
<i>Drosera? paleacea</i> DC.	
<i>Drosera platystigma</i> Lehm.	
<i>Drosera? sewelliae</i> Diels	
<i>Drosera subhirtella</i> Planch.	
<i>Dryandra armata</i> R.Br.	
<i>Dryandra carduacea</i> Lindl.	
<i>Dryandra aff. conferta</i> Benth.	
<i>Dryandra cynaroides</i> C.A Gardner	
<i>Dryandra fraseri</i> R.Br.	
<i>Dryandra nivea</i> (Labill.) R.Br.	
<i>Dryandra nobilis</i> Lindl.	
<i>Dryandra sessilis</i> (Knight) Domin.	
<i>Dryandra stuposa</i> Lindl.	
<i>Dryandra</i> sp.	522
* <i>Ehrharta longiflora</i> Smith	R.O.
<i>Elythranthera brunonis</i> (Endl.) George	
<i>Eriochilus dilatatus</i> Lindl.	
<i>Erodium botrys</i> (Cav.) Bertol.	R.O.
<i>Erodium cygnorum</i> Nees	R.O.
<i>Eucalyptus accedens</i> W.V. Fitzg.	
<i>Eucalyptus anceps</i> (R.Br. ex Maiden) Blakely	
<i>Eucalyptus astringens</i> (Maiden) Maiden	
<i>Eucalyptus caesia</i> Benth. ssp. <i>caesia</i>	
<i>Eucalyptus calophylla</i> Lindl.	
<i>Eucalyptus drummondii</i> Benth.	
<i>Eucalyptus exilis</i> Brooker	
<i>Eucalyptus falcata</i> Turcz.	
<i>Eucalyptus foecunda</i> Schauer	
<i>Eucalyptus incrassata</i> Labill.	
<i>Eucalyptus loxophleba</i> Benth.	
<i>Eucalyptus marginata</i> Donn ex Sm.	
<i>Eucalyptus redunca</i> Schauer	
<i>Eucalyptus rudis</i> Endl.	K.A.
<i>Eucalyptus wandoo</i> Blakely	

Gastrolobium hookeri Meisn.
Gastrolobium reticulatum (Meisn.) Benth.
Gastrolobium spinosum Benth.
Gastrolobium stipulare Meisn.
Gastrolobium tricuspidatum Meisn.
Gastrolobium trilobum Benth.
Glossostigma drummondii Benth.
Gompholobium aristatum Benth.
Gompholobium knightianum Lindl.
Gompholobium tomentosum Labill.
Gonocarpus nodulosus Nees
Goodenia affinis De Vriese
Goodenia incana R.Br.
Goodenia pinifolia De Vriese
Goodenia scapigera R.Br.
Goodenia? watsonii F. Muell. & Tate
Grevillea bipinnatifida R.Br.
Grevillea hookeriana Meisn.
Grevillea leptobotrys Meisn.
Grevillea monticola Meisn.
Grevillea pilulifera (Lindl.) Druce
Grevillea pritzelii Diels
Grevillea tenuiflora (Lindl.) Meisn.
Grevillea triloba Meisn.
Haemodorum simplex Lindl.
Hakea baxteri R.Br.
Hakea erinacea Meisn.
Hakea gilbertii Kipp. ex Meisn.
Hakea incrassata R.Br.
Hakea lissocarpha R.Br.
Hakea loranthifolia Meisn.
Hakea multilineata Meisn.
Hakea petiolaris Meisn.
Hakea prostrata R.Br.
Hakea trifurcata (Sm.) R.Br.
Hakea ruscifolia Labill.
Hakea undulata R.Br.
Helichrysum lindleyi Hj. Eich.

K.A.

R.O.

K.A.

A.S.W. 14706

<i>Helipterum demissum</i> (A. Gray) Druce	R.O.
<i>Helipterum manglesii</i> Lindl. (Benth.)	
<i>Hemiandra linearis</i> Benth.	
<i>Hemigenia pritzelii</i> S. Moore	
<i>Hemigenia saligna</i> Diels	
<i>Hibbertia commutata</i> Steud.	
<i>Hibbertia enerva</i> (DC.) Hoogl.	
<i>Hibbertia inclusa</i> Benth.	
<i>Hibbertia microphylla</i> Steud.	
<i>Hibbertia polystachya</i> Benth.	
<i>Hibbertia pungens</i> Benth.	
<i>Hibbertia rupicola</i> (S. Moore) C.A. Gardner	
<i>Homalosciadium homalocarpum</i> (F. Muell.) Hj. Eich.	R.O.
<i>Hovea chorizemifolia</i> (Sweet) DC.	
<i>Hovea elliptica</i> (Sm.) DC., dd	
<i>Hovea trisperma</i> Benth.	
<i>Hydrocotyle diantha</i> DC.	R.O.
* <i>Hypochoeris glabra</i> L.	
* <i>Hypochoeris radicata</i> L.	R.O.
<i>Hypoxis hookeri</i> Geerinck	R.O.
<i>Hypoxis</i> sp.	? 979
<i>Isoetes australis</i> S. Williams	R.O.
<i>Isoetes drummondii</i> A. Braun	R.O.
<i>Isolepis marginata</i> (Thunb.) A. Dietr.	R.O.
<i>Isolepis stellata</i> (C.B. Clarke) K.L. Wilson	R.O.
<i>Isopogon dubius</i> (R.Br.) Druce	
<i>Isopogon teretifolius</i> R.Br.	
<i>Isotoma hypocrateriformis</i> (R.Br.) Druce	
<i>Isotropis cuneifolia</i> (Sm.) Benth. ex B.D. Jackson	
<i>Jacksonia densiflora</i> Benth.	
<i>Jacksonia restioides</i> Meisn.	
<i>Jacksonia racemosa</i> Meisn.	
<i>Jacksonia sternbergiana</i> Hueg.	N. McK. 703
<i>Kennedia carinata</i> (Benth.) Domin	
<i>Kennedia coccinea</i> Vent.	
<i>Kennedia eximia</i> Lindl.	
<i>Kennedia prostrata</i> R.Br.	

Kunzea pulchella (Lindl.) George
Kunzea recurva Schauer
Lambertia echinata R.Br.
Lambertia ilicifolia Hooker
Lasiopetalum molle Benth.
Laxmannia grandiflora Lindl.
Laxmannia squarrosa Lindl.
Lechenaultia biloba Lindl.
Lepidobolus preissianus Nees
Lepidosperma gracile R.Br.
Lepidosperma tuberculatum Nees
Leptocarpus scariosus R. Br.
Leptomeria pauciflora R.Br.
Leptospermum erubescens Schauer
Leptospermum spinescens Endl.
Leucopogon conostephioides DC.
Leucopogon aff. *cordatus* Sonder
Leucopogon dielsianus E. Pritzel
Leucopogon minutifolius W.V. Fitzg.
Leucopogon ovalifolius Sonder
Leucopogon parviflorus (Andr.) Lindl.
Leucopogon tenuis DC.
Leucopogon sp.
Leucopogon sp.
Levenhookia dubia Sonder
Levenhookia pusilla R.Br.
Lobelia rarifolia E. Wimmer
Logania micrantha Benth.
Lomandra effusa (Lindl.) Ewart
Lysinema ciliatum R.Br.
Macrozamia riedlei (Fisch. ex Gaud.) C.A. Gardner
Melaleuca platycalyx Diels
Melaleuca aff. *pungens* Schauer
Melaleuca radula Lindl.
Melaleuca seriata Lindl.
Melaleuca subtrigona Schauer
Melaleuca uncinata R.Br.

? 572

? 811

R.O.

R.O.

Mesomelaena pseudostygia (Keuk.) K.L. Wilson	
Microcorys capitata (Bartl.) Benth.	
Microcorys aff. ericifolia Benth.	
Millotia tenuifolia Cass.	R.O.
Mirbelia dilatata R.Br.	
Mitrasacme paradoxa R.Br.	R.O.
Monotaxis grandiflora Endl.	
Muehlenbeckia adpressa (Labill.) Meisn.	
Neurachne alopecuroidea R.Br.	
Nuytsia floribunda (Labill.) R.Br. ex Fenzl	
Olex benthamiana Miq.	
Olearia rudis (Benth.) F. Muell. ex Benth.	
Oxylobium parviflorum Benth.	
Oxalis corniculata L.	
Paracaleana nigrita (Lindl.) Blaxell	
*Parentucellia latifolia (L.) Caruel	R.O.
Parietaria debilis G. Forst.	R.O.
Patersonia juncea Lindl.	
*Pentaschistis airoides (Nees) Stapf	R.O.
Persoonia quinquenervis Hooker	
Persoonia hakeiformis Meisn.	
Persoonia striata R.Br.	
Persoonia trinervis Meisn.	
Petrophile brevifolia Lindl.	
Petrophile divaricata R.Br.	
Petrophile ericifolia R.Br.	
Petrophile heterophylla Lindl.	
Petrophile longifolia R.Br.	
Petrophile media R.Br.	
Petrophile rigida R.Br.	
Petrophile serruriae R.Br.	
Petrophile squamata R.Br.	
Petrophile striata R.Br.	
*Petrorhagia velutina (Guss.) P.W. Ball & V.M. Heywood	R.O.
Philydrella pygmaea (R.Br.) Caruel	
Phyllanthus calycinus Labill.	
Pimela argentea R.Br.	

<i>Pimela rosea</i> R.Br.	
<i>Pimela spectabilis</i> (Fisch & C.A. Meyer) Lind.	
<i>Platysace</i> sp.	A.S.W. 14688
<i>Pleurosorus rutifolius</i> (R.Br.) Fe'e	R.O.
<i>Podolepis canescens</i> A. Cunn. ex DC	
<i>Podolepis lessonii</i> (Cass.) Benth.	R.O.
<i>Polypompholyx multifida</i> (R.Br.) F. Muell.	
<i>Polypompholyx tenella</i> (R.Br.) Lehm.	R.O.
<i>Poranthera ericoides</i> Klotzsch	
<i>Prasophyllum macrostachyum</i> R.Br. var <i>macrostachyum</i>	
<i>Pterostylis nana</i> R.Br.	
<i>Pterostylis recurva</i> Benth.	
<i>Pterostylis sargentii</i> C. Andrews	
<i>Pterostylis vittata</i> Lindl.	
<i>Ptilotus declinatus</i> Nees	
<i>Ptilotus humilis</i> (Nees) F. Muell.	R.O.
<i>Ptilotus manglesii</i> (Lindl.) F. Muell.	
<i>Ptilotus polystachyus</i> (Gaud.) F. Muell.	
<i>Ptilotus spathulatus</i> (R. Br.) Poirer	
<i>Pultenaea spinulosa</i> (Turcz.) Benth	
<i>Quinetia urvillei</i> Cass.	R.O.
<i>Restio megalotheca</i> F. Muell.	
<i>Restio sphacelatus</i> R.Br.	
* <i>Romulea rosea</i> (L.) Eckl.	
<i>Rutidosis multiflora</i> (Nees) B.L. Robins.	R.O.
<i>Santalum murrayanum</i> (Mitch.) C.A. Gardner	
<i>Scaevola helmsii</i> E. Pritzel	
<i>Schoenus curvifolius</i> (R.Br.) Benth.	
<i>Schoenus</i> aff. <i>nanus</i> (Nees) Benth.	R.O.
<i>Schoenus</i> sp.	? 1060
<i>Siloxerus humifusus</i> Labill.	
<i>Sollya heterophylla</i> Lindl.	
<i>Sowerbaea laxiflora</i> Lindl.	
<i>Spartochloa scirpoidea</i> (Steud.) C.E. Hubb.	R.O.
<i>Spiculaea ciliata</i> Lindl.	
<i>Stackhousia brunonis</i> Benth.	K.A.
<i>Stackhousia monogyna</i> Labill.	R.O.
<i>Stackhousia pubescens</i> A. Rich.	

<i>Stackhousia scoparia</i> Benth.	
<i>Stirlingia latifolia</i> (R.Br.) Steud.	
<i>Stirlingia tenuifolia</i> (R.Br.) Steud.	
<i>Stylidium amoenum</i> R.Br.	
<i>Stylidium breviscapum</i> R.Br.	
<i>Stylidium bulbiferum</i> Benth.	
<i>Stylidium calcaratum</i> R.Br.	
<i>Stylidium caricifolium</i> Lindl.	
<i>Stylidium ciliatum</i> Lindl.	
<i>Stylidium obtusatum</i> Sonder	
<i>Stylidium petiolare</i> Sonder	K.A.
<i>Stylidium piliferum</i> R.Br.	
<i>Stylidium rhynchocarpum</i> Sonder	
<i>Stylidium repens</i> R.Br.	
<i>Stylidium schoenoides</i> DC.	
<i>Stylidium squamellosum</i> DC.	
<i>Stylidium uniflorum</i> Sonder	
<i>Stypandra imbricata</i> R.Br.	R.O.
<i>Synaphea petiolaris</i> R.Br.	
<i>Synaphea</i> sp.	
<i>Tetratheca confertifolia</i> Steetz	
<i>Tetratheca virgata</i> Steetz	
<i>Thelymitra antennifera</i> (Lindl.) J.D. Hooker	
<i>Thelymitra canaliculata</i> R.Br.	
<i>Thelymitra nuda</i> R.Br.	
<i>Thomasia foliosa</i> Gay	
<i>Thomasia montana</i> Steud.	
<i>Thryptomene australis</i> Endl.	
<i>Thysanotus dichotomus</i> (Labill.) R.Br.	
<i>Thysanotus patersonii</i> R.Br.	
<i>Thysanotus sparteus</i> R.Br.	
<i>Trachymene cyanopetala</i> (F. Muell.) Benth.	
<i>Trachymene ornata</i> (Endl.) Druce	
<i>Trachymene pilosa</i> Sm.	
<i>Tribonanthus australis</i> Endl.	R.O.
<i>Tricoryne elatior</i> R.Br.	
<i>Tricoryne humilis</i> Endl.	
<i>Triglochin calcitrapa</i> Hook.	R.O.

Triglochin centrocarpa Hook.
 Trymalium ledifolium Fenzl
 Trymallum myrtillus S. Moore
 Urocarpus squamuligerus (Hook.) P.G. Wilson
 *Ursinia anthemoides (L.) Poir.
 Verticordia brownii (Desf.) DC.
 Verticordia densiflora Lindl.
 Verticordia grandiflora Endl.
 Verticordia huegelii Endl.
 Verticordia pennigera Endl.
 Verticordia pholidophylla F. Muell.
 Verticordia serrata (Lindl.) Schauer
 *Vulpia myuros (L.) C. Gmel.
 Waitzia aurea (Benth.) Steetz
 Waitzia citrina (Benth.) Steetz
 Waitzia paniculata F. Muell. ex Benth.
 Xanthorrhoea reflexa D.A. Herbert
 Xanthorrhoea preissii Endl.
 Xanthosia atkinsoniana F. Muell.

R.O.

K.A.

R.O.

