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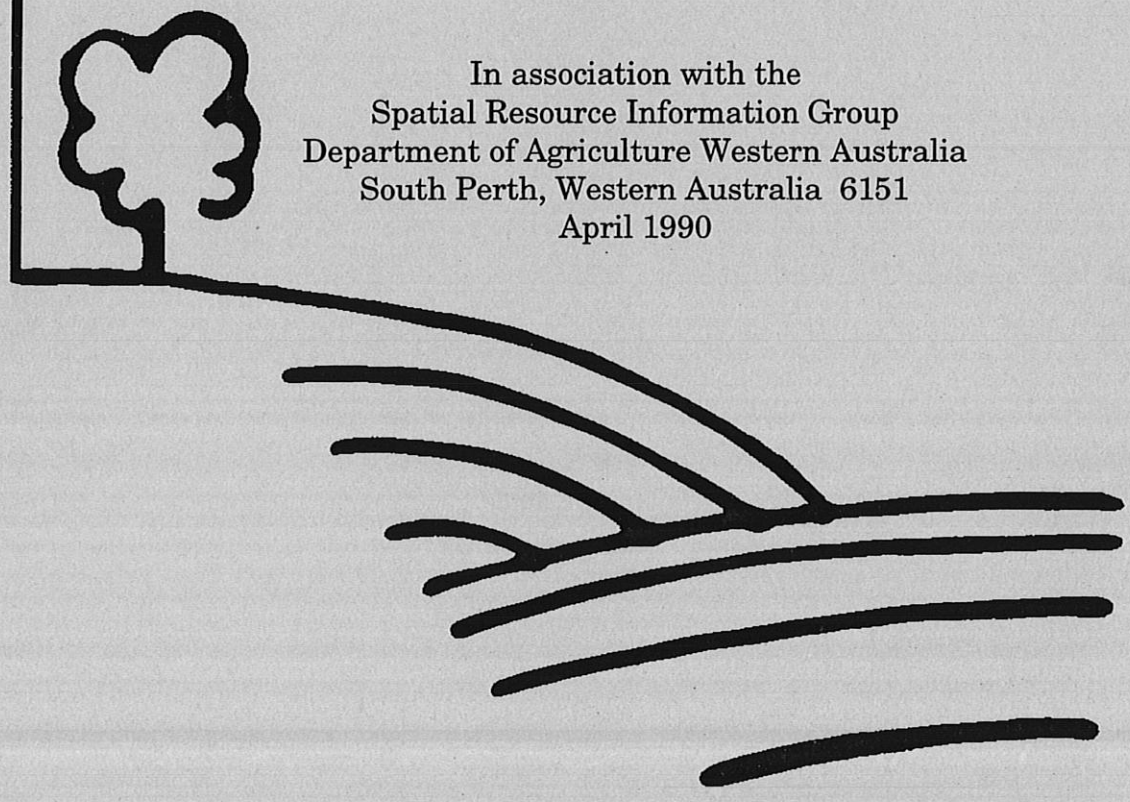
FLORISTIC SURVEY OF REMNANT VEGETATION IN THE DANDARAGAN AREA, WESTERN AUSTRALIA

Compiled by: E.A. Griffin



In association with the
Spatial Resource Information Group
Department of Agriculture Western Australia
South Perth, Western Australia 6151
April 1990

RESOURCE MANAGEMENT
TECHNICAL REPORT **143**

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Department of Agriculture

Western Australia

Resource Management

Technical Report No. 143

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A. ABSTRACT

A study involving the documentation of the extent and floristic composition of patches of native vegetation left uncleared by agricultural development is described. The study focused on Dandaragan, an area which was developed early in the history of European settlement of Western Australia. It is at the southern end of the floristically rich Northern Kwongan and had a wide range of vegetation and soil types.

Floristic Regions were defined in the study area by detailed analysis of the floristic data. These regions were shown to be a better fit to maps of soil and geology types than were existing Vegetation System maps of the area.

The concentration of the major conservation reserves in only a few of these regions left the floristic variation of most of these regions poorly represented conservation reserves. Recommendations to improve this situation are made but opportunities are very limited since other Crown land is in short supply. Therefore, remnant vegetation patches on private property are essential for adequate conservation of flora in this area. The remnants considered most important were identified but remain confidential until permission of land owners is obtained.

About 13% of the private property remains uncleared. This could decline to less than 10% if clearing proceeds as indicated by respondents of a questionnaire. Mapping of these remnants showed a wide range of patch sizes from a few hectares to several thousand. Patches were distributed unevenly throughout the study area with the older settled areas having least.

The regional patterns in agricultural development were very similar to the floristic regions identified. Thus some Floristic Regions had only a small area of remnants and others quite large areas. In apparent contrast, the remnants in regions with small areas remaining were under less threat of being cleared than those with large areas.

Farmers' attitudes to remnants appeared similar to those recently reported for an area of the Wheatbelt. Generally they recognise both that these remnants have both agronomic and nature conservation values. Many are prepared to protect and maintain these areas using their own resources. Some have protected areas which have very high conservation values. A significant proportion would protect more of their remnants if the cost is spread across the community (ie Government assistance).

B. RECOMMENDATIONS

1. - dedicate for conservation several of the Crown reserves which currently have other purposes,

2. - disseminate value of specific important remnants to individual farmers and encourage them to protect them,

3. - prepare maps of the Agricultural areas of Western Australia reflecting the chronology of agricultural development,

4. - identify priority for assistance to protect areas throughout the Agricultural areas of Western Australia using a combination of history of agricultural development and vegetation maps,

5. - extend this type of study to other areas of the Agricultural areas of Western Australia, and

6. - review the boundaries of vegetation systems and botanical districts developed by Beard in the southern part of his Irwin Botanical District.

C. INTRODUCTION

The Northern Kwongan (Beard 1976a) (or Sandplains) has been recorded as an important area botanically (eg. George *et al.* 1979). There are a number of major conservation areas in the Northern Kwongan (eg. Kalbarri and Watheroo National Parks). Most of these are listed on the register of the National Estate. However, few have received any biological study, exceptions being the proposed Mt Lesueur Reserves (Griffin and Hopkins 1985; Martinick and Associates 1988, and the South Eneabba Reserve Hnatiuk and Hopkins). There has also been little regional study conducted to document the variation between these areas. Griffin *et al.* (1983) studied the variation on the floristic composition in kwongan growing on laterite uplands in a small area between Jurien and Three Springs, Griffin and Keighery (1989) studied an area of Bassendean Dunes between Moore RIver and Jurien, and Froend (1988) compared the vegetation of several reserves west of Eneabba. Management plans have been prepared for only a few of the Conservation Reserves (eg. Crook *et al.* 1984).

There are several proposals for new conservation reserves in the Northern Kwongan which are yet to be implemented. These include the Mt Lesueur Reserves, Arrowsmith Lake Area, and Coomallo Reserves all of which were formally proposed by the Environmental Protection Authority (EPA 1976). More recent proposals for Conservation Reserves have been made by several Western Australian Government Departments. These include three in an area of vacant Crown land west of Cataby (B. Hodge, Minister for Conservation and Land Management pers comm. 1987).

Implementation of these proposals has been delayed because of the claims of competing land users. Attempts to resolve these were being made by Government inter-departmental Committees. Unfortunately little biological information is available to support the importance of the reserve proposals. The likelihood of regional studies being undertaken in the near future appears remote.

There have always been some people in the rural community to whom native vegetation has a value of its own. Awareness has developed in a wider section of the community of the value of native vegetation for the productivity of rural lands. Without doubt the latter has meant that more people have come to realise the intrinsic values of the native flora and fauna. The Dandaragan area includes groups and individuals who are working to maintain a balance between the natural biota and the farming areas so that both can have a viable future. Several Land Care District Committees have been established in the area.

The Dandaragan area has a wide range of vegetation and soil types. Because of that it has had a long history of rural development. It was amongst the earliest areas settled in Western Australia at about 1841 (Cameron 1979). Even so there are still significant areas being cleared.

In common with most of the Western Australian Wheatbelt, few areas were set aside for the conservation of flora and fauna

proir to land being alienated. Therefore, the persistance of the native biota is dependant on remnant vegetation patches on private property. The future of these remnants is dependant on a number of factors. These vary from the possibility that they will be cleared, to the probability that without some kind of management, at least the smaller patches will degrade and also be lost forever.

Coates (1987) documented the remnant vegetation in a portion of the wheatbelt. A survey of the attitude of farmers to these remnants was also described. The present project was designed to document the areas which are still not cleared, identify the regional patterns in the floristic composition of the vegetation, promote the values of the natural flora and determine the attitude of farmers to the issues involved in retaining native vegetation.

The project was divided into two aspects:

- floristic survey, and

- mapping of remnant patches and farmers' attitudes.

Study Area

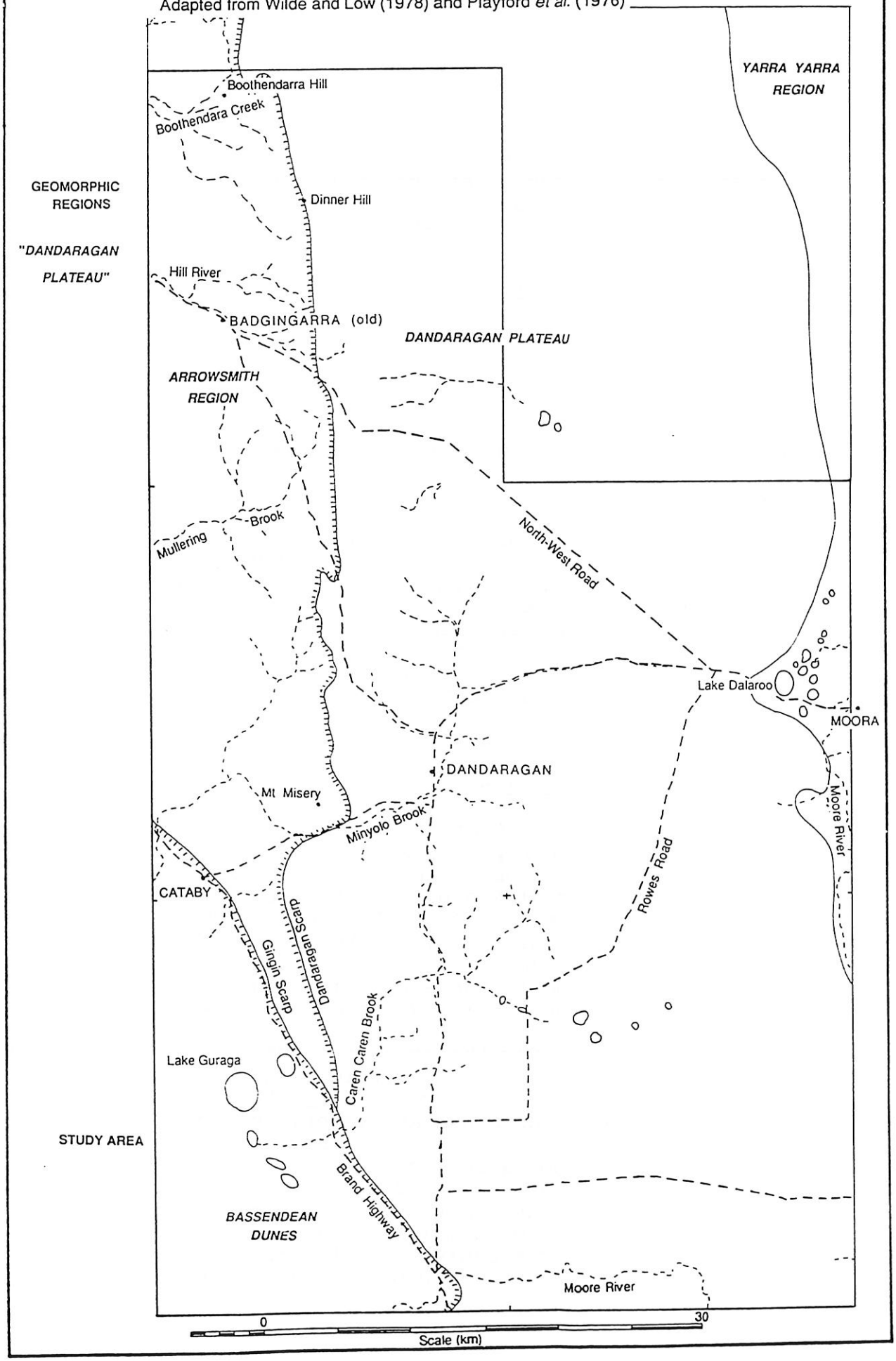
The older settled areas of Dandaragan were made the focus of this study because these would presumably have had the greatest impact of clearing and because the band of Red Gum woodlands which characterises this area is unusual in the Northern Kwongan. For completeness of mapping, it was decided to extend the survey to cover five 1:50 000 map sheets (Figure 1). This meant approximate boundaries of Moora, Moore River, Brand Highway and the North-West Road. The study area was mostly in the shires of Dandaragan but partly also in the shire of Moora and Victoria Plains on the east.

Physiography, Geology and Soils

The study area covers part of the Dandaragan Plateau and Yarra Yarra Region, with minor portions of the Gingin Scarp, the Arrowsmith Region and Bassendean Dunes, the last stated being part of the Swan Coastal Plain (Playford *et al.* 1976, Wilde and low 1978), (Figure 1). Overall, there is about 200m of difference in elevation. The Yarra Yarra Region and the Bassendean Dunes have very low relief, each 20 - 30m. On the Dandaragan Plateau and in the Arrowsmith Region the major trunk valleys are about 100m lower than the interfluvials.

A surface geology map for the area were published at the scale of 1:250,000 (Wilde and Low 1978) (Figure 2). This shows the majority of the study area is covered by shallow unconsolidated colluvial sands and lateritic gravels. The uplands of the Dandaragan Plateau and Arrowsmith Region have residual laterite capping reflecting the significant erosional modification. Aeolian sands predominate in the Yarra Yarra Region. The Gingin Scarp, a Pleistocene marine shoreline scarp is much deflated with mainly colluvial sands and gravels with minor lateritic residuals. The Bassendean Dunes are dunes and coastal deposits probably of Pleistocene and Recent

Figure 1 Location Map and Physiography.
Adapted from Wilde and Low (1978) and Playford *et al.* (1976)



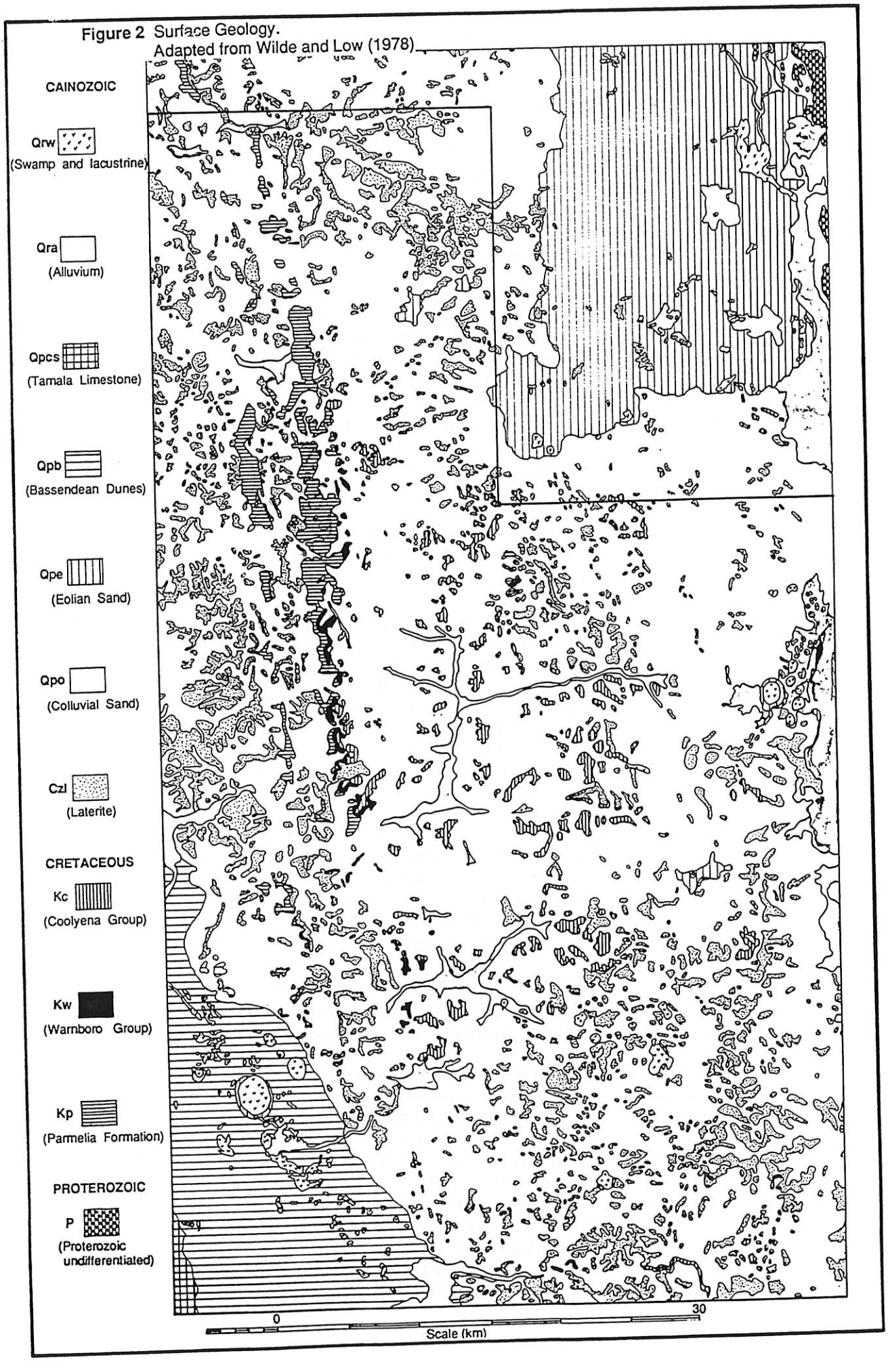


Figure 2 Surface Geology.
Adapted from Wilde and Low (1978)

age. The drainage systems and the deflation of the Gingin scarp have contributed to these deposits.

Churchward (1970), in studying a portion of this area (essentially the catchments of the Minyolo and Caren Caren Brooks), concluded that the erosional processes contributed greatly to the soil development of the area. He described a transition from yellow sands on the uplands to brown sands and clays on the main trunk valleys. Churchward's study contributed to the coarser scale mapping of the South West of Western Australia by Northcote *et al.* (1967) published at the scale of 1:250 000 and reproduced in part in Figure 3.

Additional soil units defined by Northcote *et al.* (1967) include siliceous sands and patches of lateritic gravels and sandy acid yellow mottled soils which are dominant in the north-west and south-east of the Dandaragan Plateau. The Yarra Yarra Region has yellow earthy sands but in a more subdued topography and therefore with less lateritic gravel. The small portion of the Moore River floodplain includes hard alkaline yellow mottled soils. The Arrowsmith Region has principally sandy acidic yellow mottled soil and lateritic sandy gravels. The Gingin Scarp was not defined as a separate unit having been combined with the adjacent upland areas mentioned above. The Bassendean Dunes are principally leached sands but also include patches of alluvium which is mainly a leached sand over a sandy clay.

Several sources have been used to prepare an interpretation of underlying rocks ie. solid geology (Figure 4). Except for a narrow strip on the eastern side of the study area, the underlying rocks are all part of the Perth Sedimentary Basin. Underlying that eastern strip are Proterozoic sediments but they are not exposed in the study area. Block faulting of the Perth Sedimentary Basin and subsequent erosion has revealed a variety of sedimentary formations varying in ages from the Jurassic to the Cretaceous. The oldest sedimentary rocks exposed are of the Jurassic Yarragadee Formation, which is principally sandstone. These are conformably overlayen by the Cretaceous Parmelia Formation (a recently named formation formerly included in the Yarragadee Formation, Backhouse 1984). This has interbedded siltstones and sandstones. Two distinct, predominantly siltstone and mudstone sequences, Otorowiri and Carnac Members, are important aquacludes.

The younger Cretaceous Formations have been placed into two groups; the Warnboro Group and the Coolyena Group. The formations within these groups are neither continuous in extent nor uniform in thickness. In fact some are little more than a few tens of metres thick maximum. They also have rather shallow dip angles. Because of these factors, the extent of their surface expression is influenced by the major drainage lines, which, as mentioned above, provides up to 100m local relief. A wide variety of rock types occur in these formations from, for example, the coarse grained ferruginous, felspathic Dandaragan Sandstone to the Gingin Chalk. The rocks were also deposited in a range of sedimentary environments from aeolian to lacustrine and even marine. Glauconite, a potassium bearing clay mineral and phosphate nodules, both typical of marine deposits, are present in some

Figure 3 Soil Map.
(Adapted from Northcote *et al.* 1967)

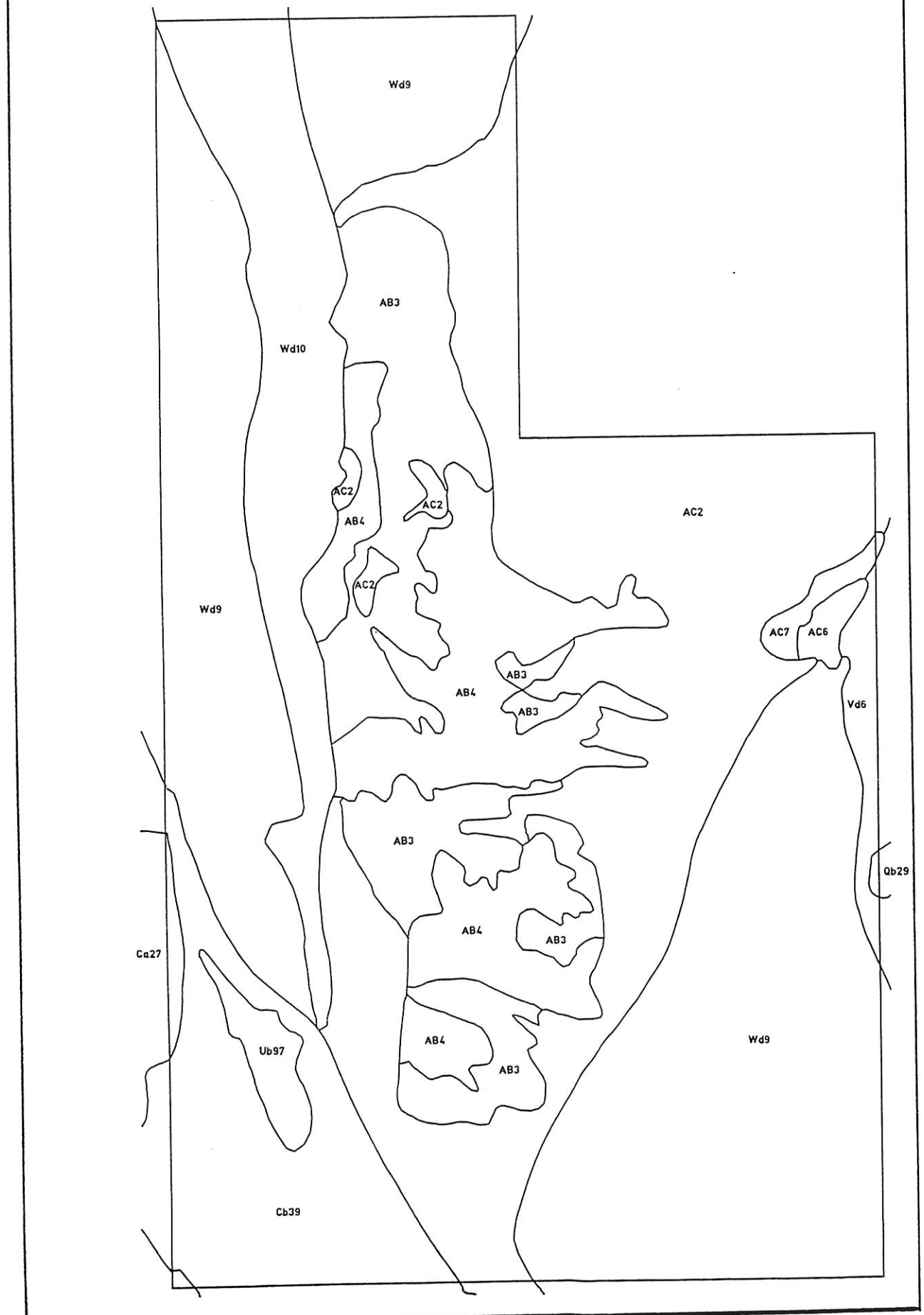
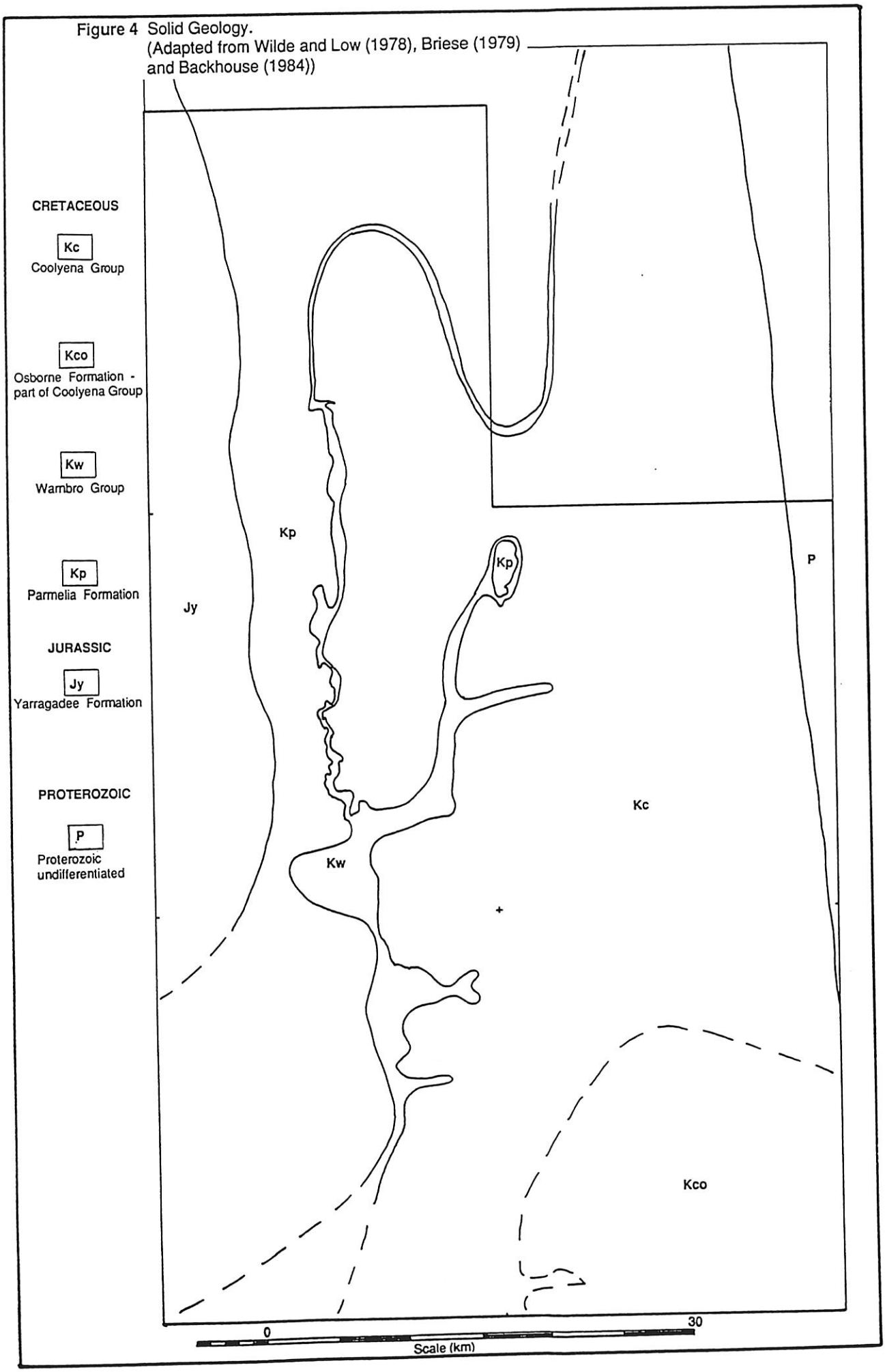


Figure 4 Solid Geology.
(Adapted from Wilde and Low (1978), Briese (1979) and Backhouse (1984))



rocks, especially in the Coolyena Group, and have great significance for soil fertility. Because of the formations' thin and discontinuous nature, Figure 4 shows the extent of the surface expression of the Warnboro and Coolyena Groups rather than the individual formations. An exception to this is an area of the predominantly sandstone Osborne Formation in the south-east where it is relatively thick.

A comparison between the soils and solid geology maps (Figures 3 and 4 respectively) shows some significant correlations. Table 1 also shows the relationship between solid geology, landscape and soils defined by Northcote *et al.* (1967) and Churchward (1970). The Wd9 unit corresponds to the Yarragadee Formation, Osborne Formation and the upper member of the Parmelia Formation. All are predominantly continental sandstones on which sandy acidic yellow mottled soil and with lateritic sandy gravels have developed. The Wd10 has been derived from the lower members of the Parmelia formation, principally the siltstone Otorowiri and Carnac Members. The remainder of the soils are derived from the Coolyena Group, probably with a minor contribution from the Warnboro Group. The soils in this area show a close relationship to landscape but their origin is undoubtedly a combination of erosional modification of a deeply weathered profile as suggested by Churchward (1970) and differential exposure of the relatively thin formations.

Drainage

With the moderate rainfall, low relief and porous soils there are few significant drainage lines. The principal ones are the Moore River, the Hill River and Minyolo Brook. The Moore River drains little of the study area but rather extensive areas of the wheatbelt to the east. The Hill River and several other minor drainage lines, eg. Boothendarra Creek and Mullering Brook, have their headwaters at the base of the Dandaragan Scarp. Harley (1975) reported the presence of soaks and wells along, and adjacent to, the Dandaragan Scarp. Their presence is attributed to the impeding layers of the Parmelia Formation. These soaks undoubtedly contribute to the flow of the drainage lines and quite probably the existence of the Dandaragan Scarp.

The Minyolo Brook and several minor streams drain the area where the Coolyena Group of formations are close to the surface. Water here is mainly from surface run off and shallow, unconfined aquifers perched on the impervious Osborne Formation. Like all of the smaller drainage lines, water from the Minyolo Brook does not reach the sea directly but discharges into seasonally wet or inundated depressions and lakes on the Bassendean Dunes. Water from some of these subsequent finds its way to the sea via subterranean drainage lines and aquifers.

Groundwater salinity levels are mainly less than 1,000 ppm in the study area. However, there are several exceptions to this. Levels of above 2,000 ppm have been reported from a narrow aquifer above the Otorowiri Member (Harley, 1975). The surface water in several of the soaks and springs which have given rise to swampy ground may be up to 7,000 ppm because of

Table 1 Description of soils related to geology and landforms. (Adapted from Northcote *et al.* (1967) and geological maps presented in this paper. Soil units named by Churchward (1970) are indicated *)

Landscape Units.....	Northcote Code	Soil Description.....
A. Yarragadee Formation		
Upland	Wd9	- lateritic sandy gravels
Broad valleys	Wd9	- sandy acidic yellow mottled
B. Lower Parmelia Formation		
Upland	Wd10	- lateritic sandy gravels
Pediments	Wd10	- duplex, generally yellow mottled
Broad valleys	Wd10	- sandy acidic yellow mottled
C. Upper Parmelia Formation		
(as for **A.**)		
D. Warnboro & Lower Coolyena Groups		
Undulating Upland	AC2, AC3	- (Karamal*) Yellow sands with some gravelly sands
Upper Tributary Valleys	AB3	- (Koondiwoodie*) Yellow brown to reddish brown sands
Lower Tributary Valleys	AB4	- (Dandaragan*) Brown to red-brown sands
Main trunk valleys	AB4	- (Yere*) Brown sands on reddish brown clay (duplex)
E. Osborne Formation		
(as for **A.**)		
F. Bassendean Dunes		
Dunes and swales	Cb39	- leached coarse sands
Undulating plain	Ub97	- duplex yellow mottled
G. Eolian Sands (Yarra Yarra Region)		
undulating plateau, some dunes	Ac4, Ac5	- yellow earthy sands with some duplex yellow gravelly

concentration of salts by evapotranspiration (Briese, 1979). Some of the groundwater in the east of the study area along the Darling fault zone may reach similar levels apparently because of infiltration by saline surface water from the Yarra Yarra Region.

Vegetation and Flora

Beard (1979) produced a map of the area at the scale of 1:250,000. On this he defined the major vegetation types which he could recognise. He appears to have drawn extensively on the surface geology map mentioned above for guidance thus recognising a close relationship between geology, soils and vegetation. The vegetation types have been combined into vegetation systems which been reproduced here (Figure 5). The study area principally covers his Dandaragan and Warro Systems with some Koojan, Gingin and Bassendean and a narrow strip of the Lesueur System. Beard describes the Dandaragan System as being dominated by Marri (*Eucalyptus calophylla*) with Banksia woodlands on leached sands, heath and mallee on gravels and Flooded Gum (*Eucalyptus rudis*) in the drainage lines.

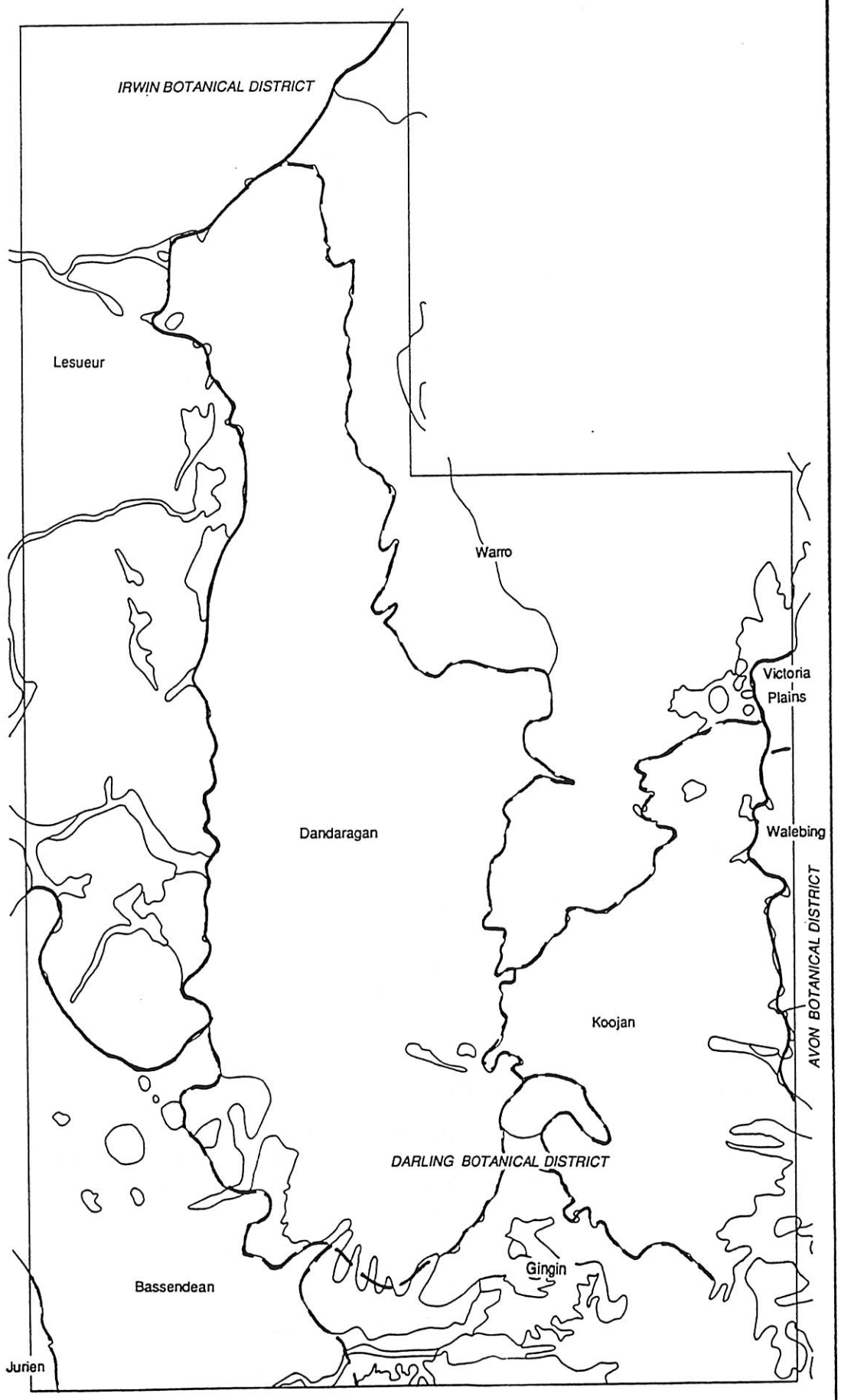
The Banksia Low Woodland is dominated by *Banksia attenuata, B. menziesii* and occasionally *B. ilicifolia* along with *Eucalyptus todtiana*. The understory species were reported to vary considerably but included for example *Adenanthos cygnorum, Allocasuarina humilis, Stirlingia latifolia*, and *Anigozanthos humilis*. The heaths in swamps varied considerably leading Beard to remark that the "... whole is a mosaic requiring further study." The deep swamps included trees of *Melaleuca raphiophylla* and *Banksia littoralis*.

The Warro System is dominated by Banksia low woodland which includes *Banksia attenuata, B. menziesii, B.prionotes, Eucalyptus todtiana* and *Xylomelum angustifolium*. This is accompanied by heath and scrub heath on laterite and sand respectively. Small patches of woodlands including *Casuarina obesa* and *Eucalyptus loxophleba* occur in wet sites. The Lesueur, Koojan and Gingin Systems are dominated by heath and scrub heath. Species typical of the Northern Kwongan are dominant. There are also occasional patches of Wandoo (*Eucalyptus wandoo*) woodlands. The Bassendean System is dominated by Banksia woodlands with isolated patches of winter wet depressions which include paperbarks.

Beard recognised that his vegetation systems could be amalgamated into Botanical Districts. The boundaries of several run through the study area (Figure 5). The majority of the study area is in the Darling Botanical District with only the Lesueur System in the Irwin Botanical District. A small portion of the Avon Botanical District occurs on the eastern boundary of the study area.

No detailed botanical survey has been conducted in the area. Griffin and Keighery (1989) conducted a survey of the Bassendean System between Moore River and Jurien. Bell and Loneragan (1985) reported some studies which included parts of the Badgingarra National Park. Elkington (1987) covered part of the vacant Crown land west of Cataby.

Figure 5 Vegetation Systems Map.
(Adapted from Beard, 1976)
(other lines vegetation units mapped by Beard)



Climate

The climate of the study area can be defined as Warm Mediterranean (Bagnouls and Gaussen 1957). This classification indicates a winter rainfall with approximately 5 - 6 dry months per year. There are significant gradients in climatic variables in the area. Bullsbrook has an average annual rainfall of about 700 mm, while Jurien receives about 570 mm and Moora about 460 mm (Figure 6). This also shows Jurien has lower summer temperatures and higher winter temperatures than either Bullsbrook and Moora. Figure 7 shows that prominent east - west gradients are also noticeable with, for example, rainfall declining from west to east. The Gingin Scarp produces a distortion of this gradient, apparently an oreographic influence by which rainfall along the scarp is slightly higher than on the coast. Evapotranspiration increases from west to east.

Land Use

The study area is primarily private property, with only minor amounts of Crown reserves and vacant Crown land (Figure 8). The low nutrient status and poor water retention qualities of the soil of the vacant Crown land has prevented significant agricultural development on the Bassendean dunes.

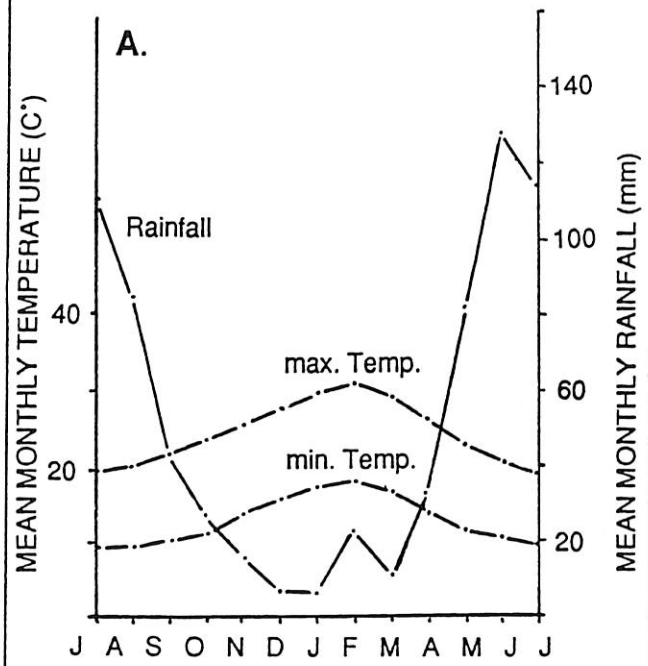
Major Crown reserves in the region surrounding the study area are National Parks (eg. Watheroo and Badgingarra) or Nature Reserves (Namming, Eneminga, Boothendarra) all vested in the National Parks and Nature Conservation Authority. There are several small reserves for various purposes, either vested in the Dandaragan Shire or unvested. However, no conservation reserves exist in the focus of the study (the Dandaragan Vegetation System).

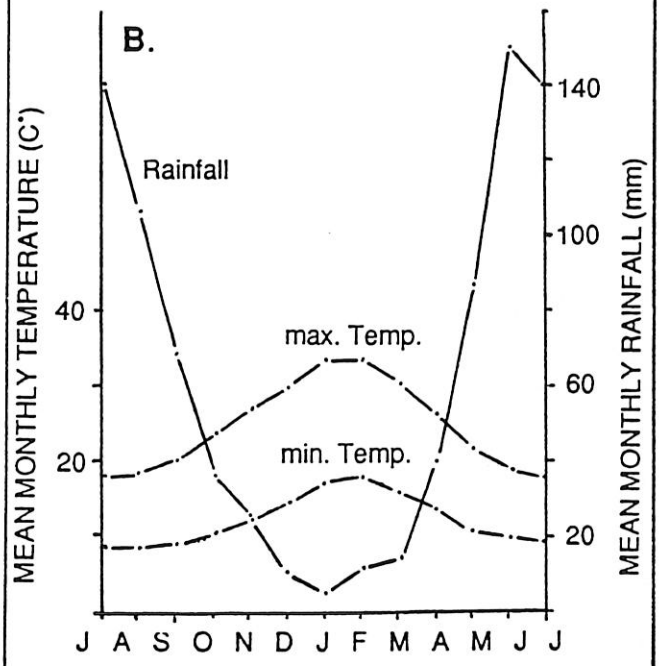
The largest conservation reserve is Namming Nature Reserve in the south-west on the Bassendean Dunes, followed in area by Boothendarra Nature Reserve north of Badgingarra. Most other reserves are small and have been set aside generally for purposes other than for the conservation of flora and fauna.

No place in the study area is on the Register of the National Estate. However, the larger conservation reserves in the region have been listed on the Register (Figure 8). Listing indicates Federal Government recognition that the places have values which warrant special consideration. Registration is principally a method by which listed areas are brought to the attention of Federal Government Departments and Agencies who, if they propose actions which would disturb a place, must seek advice on their values. Private property as well as Crown land (eg. conservation reserves) may be included on the Register. Entry in the Register is on the basis of objective evaluation against formal criteria. These criteria may include things other than nature conservation significance; for example cultural factors may be included.

Few of the areas listed in the region have had their values documented thoroughly. This study will provide regional information valuable for the areas already listed. The information will also in the preparation of new nominations.

Figure 6 Ombrothermic Diagrams. (**A.** - Jurien, **B.** - Bullsbrook and **C.** - Moora.)





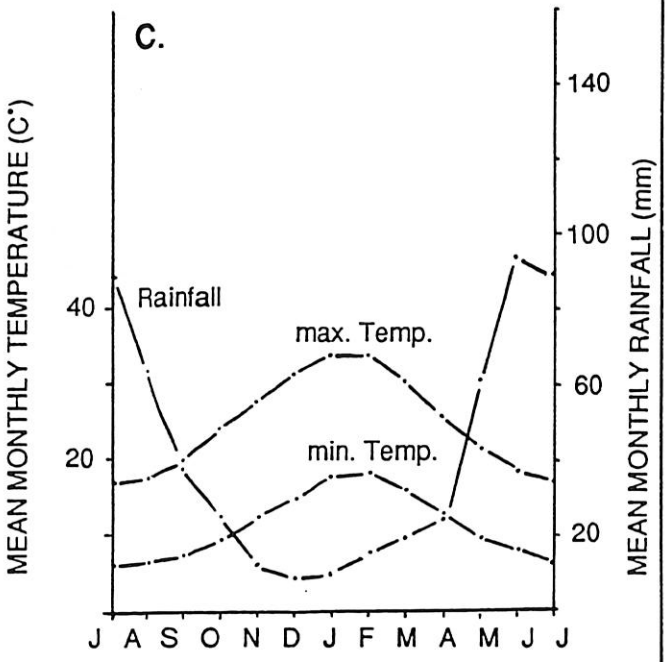


Figure 7 Rainfall Isopleths.

(Extracted from Bureau of Meterology, 1968. Isopleths convertd from inches to mm, interval 2")

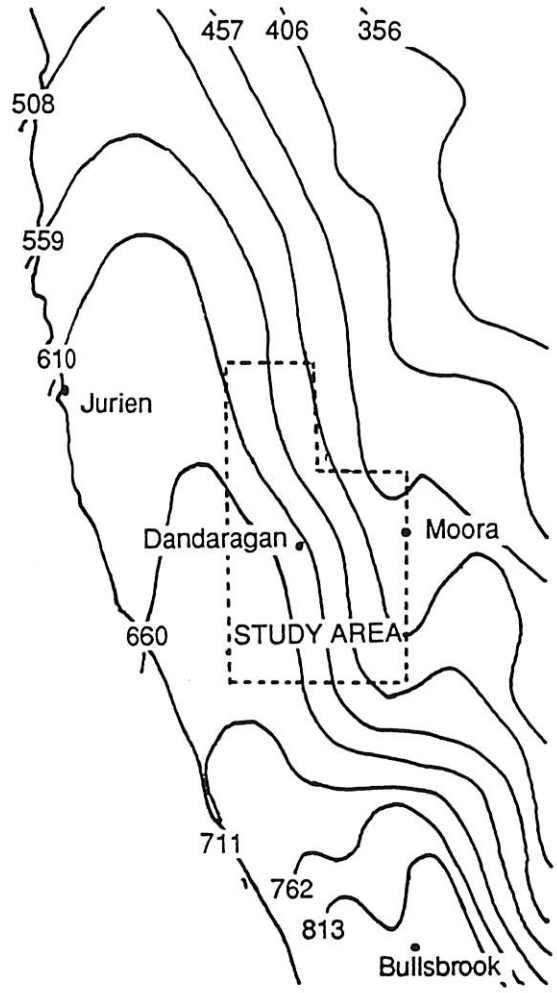
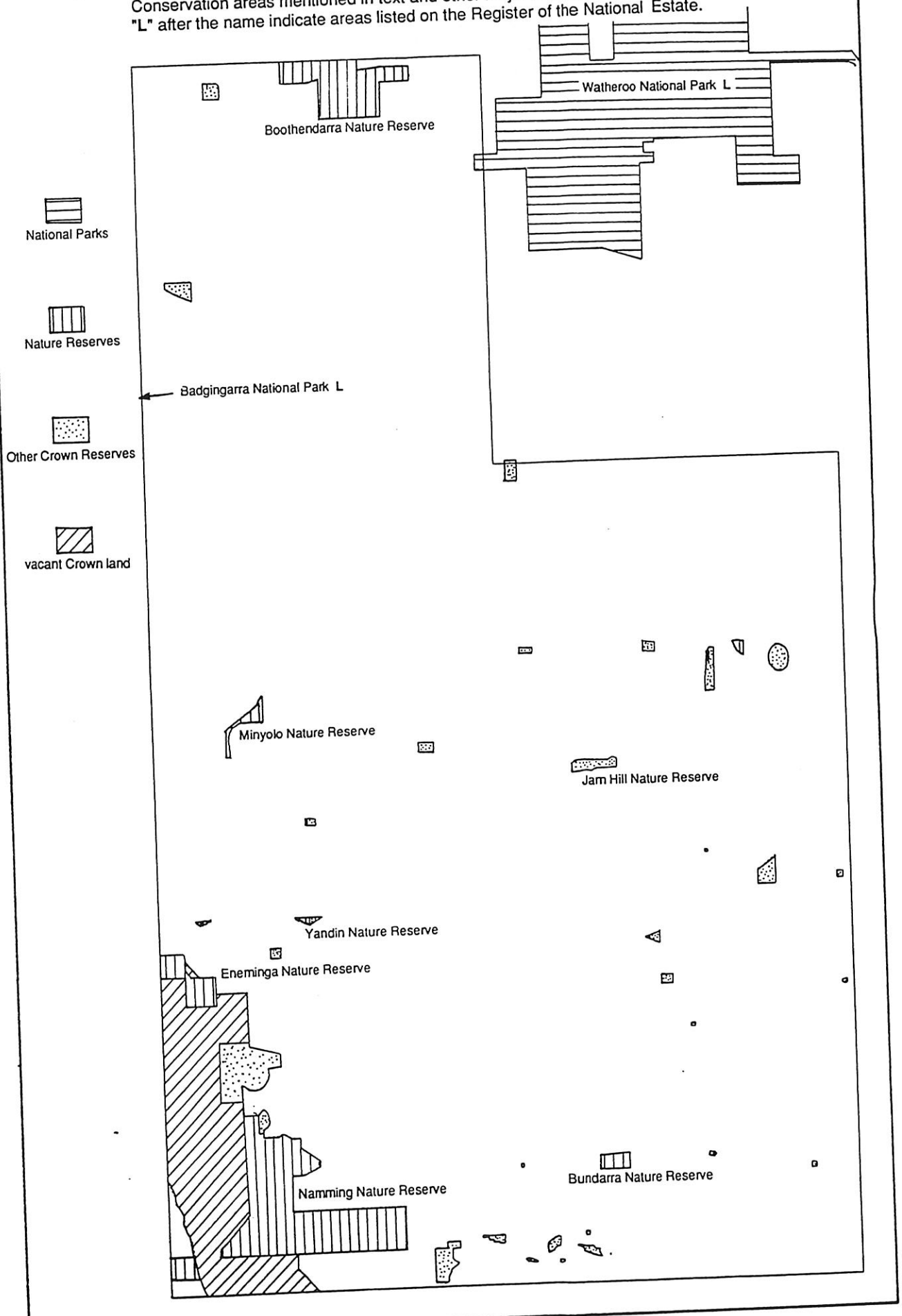


Figure 8 Crown Land and Reserves.
Conservation areas mentioned in text and other major ones are named.
"L" after the name indicate areas listed on the Register of the National Estate.



Crown lands are used to a minor extent by beekeepers and wildflower pickers. Their activities together with those of the mineral explorers may have an adverse impact on the flora and fauna in the area especially (but not only) through the spread of plant pathogens (eg. *Phytophthora* spp.).

D. FLORISTIC SURVEY

INTRODUCTION

The main purpose of this part of the study was to document the composition of wide range of vegetation types which occur in the study area. These are growing on a wide range of soils and geological formations. Studies by Griffin *et al.* (1983) and observations by Beard (1979a) and Dodd and Griffin (1989) indicated that there could be considerable variation in the floristic composition of at least some of these vegetation types. The study was also designed to detect the existance of such variation in this area and to determine the factors responsible for its existance. In the context of this study it was important to determine the adequacy of conservation of any floristic variation and make recommendations which would assist in the improvement of conservation.

METHODS

Selection of Locations for Sampling

The location of sampling sites were selected to give as wide a range as possible of vegetation types from throughout the study area. Preference was given to areas which were in existing (or proposed) Conservation Reserves rather than private property or road reserves. Recently burnt areas were not considered suitable and in general the areas selected had not been burnt for more than 10 years. Vegetation in good condition was preferred but some areas with significant weed invasion were included as there was no suitable alternative.

Sampling Methods

This study was based on intensive sampling of the different vegetation types in small representative patches. Detailed studies over the last decade have recognised that the appropriate sample size for this type of ecological study in the Northern Kwongan is about 100m² (Griffin and Hopkins 1985). This has been used as a standard for several studies in the area (Griffin *et al.* 1983, Martinick and Associates 1988). Insufficient time prevented the establishment and thorough examination of permanent quadrats. An alternative releve (plant list) method was adopted with a sample size of about 100m² which ensured a reasonable compatibility of data collected with previous data sets. The releves were sampled once between July and November 1988.

The data collected included information on species and the quadrat being sampled. A sample of the recording sheet is included in Appendix 1. For most releves all species which were found in the quadrat were recorded and an estimate of the Canopy Cover using the Domin-Kranjina Cover-Abundance scale (Mueller-Dombois and Ellenberg 1974) was made for each species. Voucher specimens for many species encountered during the study were taken and are lodged in the Western Australian Herbarium.

Principal information on the quadrat included:

- classification of position in the landscape on a predefined schematic diagram,
- description of surface soil,
- classification of how well the area drained on a three level scale,
- estimation of the slope of the ground and the aspect of that slope,
- estimation of the percentage of the ground surface covered by litter, and
- description of the vegetation structure in terms of the classification scheme of Muir (1977) (Appendix 2).

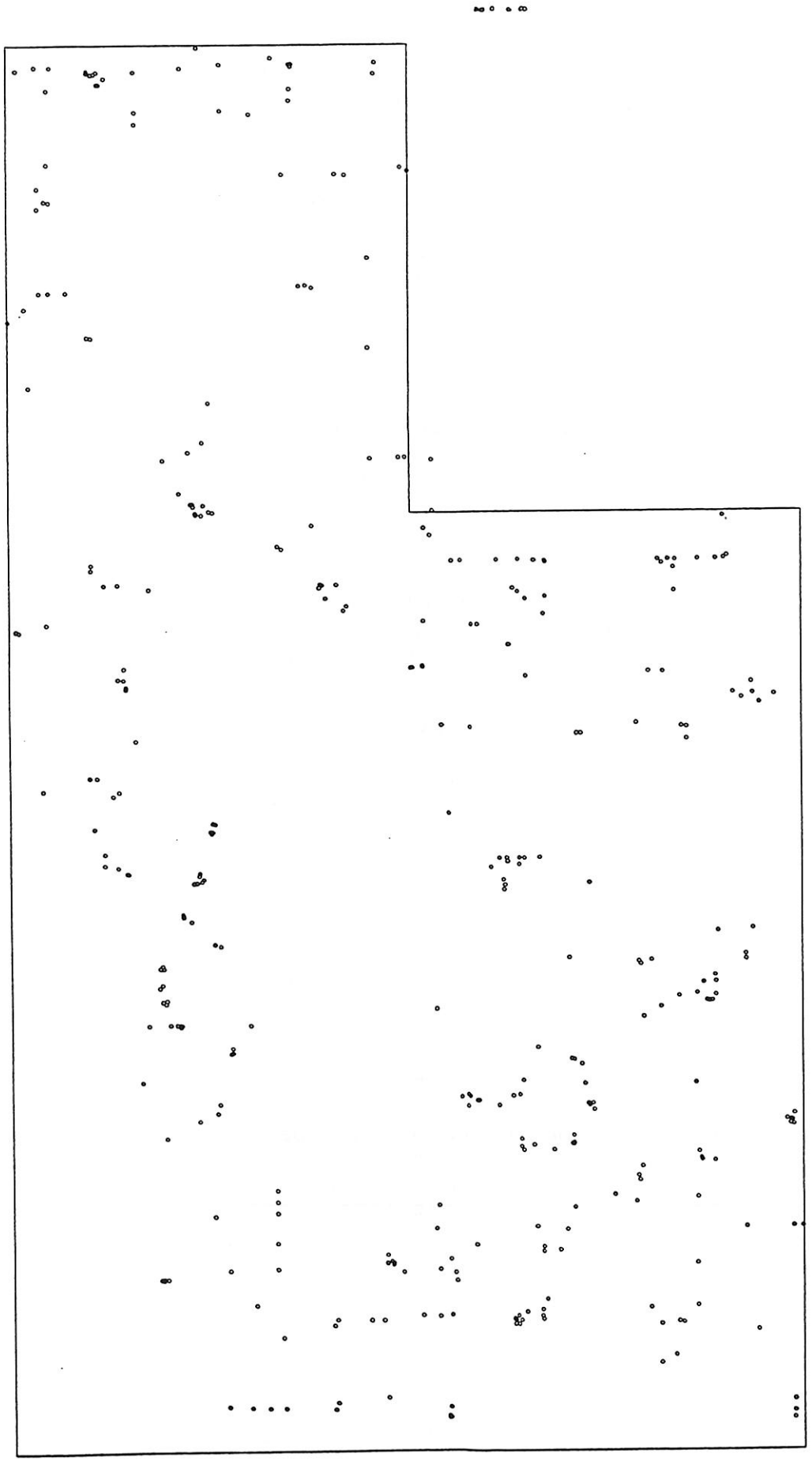
The field work resulted in data from 348 releves being collected. This was supplemented by 9 quadrats from a study of flora and vegetation between Moore River and Jurien (Griffin and Keighery 1989). The location of these releves and quadrats is shown in Figure 9.

Analysis and Summary of Data from Releves

All data collected were incorporated into a computer database (Dbase). This facilitated data correction, preparation for analysis and summary of results. The principal analyses were performed with the aid of a package of computer programs called PATN (Belbin 1987). Included in this are a variety of programs which analyse and summarise the data.

For the analysis, a matrix of species by releves was prepared. The purpose of the computer analysis was to provide a simplified means of representing what is a very complex species data set. In general, the programs used were attempting to perform three basic functions. Firstly, they provided a means of producing groups of releves according to their species composition. This enabled definition of Floristic Types. Secondly, the programs enabled the differences between vegetation types to be identified and possible reasons for these differences to be hypothesized and tested. Finally, it provided a means of simply displaying the results.

Figure 9 Location of study sites.



The principal programs used were:

ASO - This is a program which produces a similarity measure between each row (eg. releves) of the data matrix and each other row. A variety of formulas are available. In this case the Bray and Curtis coefficient was used. The similarity measures were presented as an Association Matrix of the original row (eg. releves) by row (eg. releves).

FUSE - This is an ordination program which combines the rows into groups. Again there are a number of different ways the fusion can occur. In this case the group average method was used. This ultimately produces one group made up of all rows.

DEND - This displays the history of fusion from FUSE and other similar programs.

MST - This is an alternate way of displaying the similarity between the rows. By definition it combines all rows into a tree (or network diagram) so that each row is joined to the row to which it is most similar.

KYST - This is a type of ordination program which attempts to represent the total variation in the data matrix in a small number of dimensions. Rather than forming groups out of the rows, it presents the rows in multi-dimensional space so that the most similar rows are close and least similar rows are far apart.

TWAY - This is a way in which the raw data can be presented in a table form (eg. with the species as the rows and the releves as the columns). The order in which the rows and columns appear can, for example, show how well the species relate to the groups of releves.

Although there was only one data set, two different forms were analysed. The first form had the releves as the rows and the species as the columns. In the other data set the species were the rows and the releves the columns. In both data sets the cover of the species was ignored. This is termed presence/absence form. Of the programs mentioned above only ASO, FUSE and TWAY were used with the second data set.

Summary of Floristic Data

Certain information about the species (or more correctly taxa) which were recorded in the study was obtained principally from the Department of Conservation and Land Management (Griffin, Hopper and Hopkins unpublished data). This indicated species which are:

- Declared Rare under the Wildlife Conservation Act,
- regionally endemic with small geographic ranges, and
- poorly known and are therefore considered in need of further study.

Summaries were done on the basis of these categories and also on major taxonomic groupings eg. plant families.

RESULTS

Flora

The total number of flowering plant taxa (species, subspecies and varieties) in the study area was 876 (Appendix 3). There was no attempt to collect all species growing in the study area but species which have been recorded from the area (Griffin, Hopper and Hopkins unpublished) were included. The total flora of the study area would be somewhat larger than the 876.

The total represents 263 genera and 68 families. The 63 taxa which are obviously undescribed represent a very important proportion of the total (7%). (There were additional species which were difficult to identify and some may prove to be also undescribed.) One of the undescribed species appeared to have been collected for the first time (*Chamelauceum* sp EAG 4861) during this study. Alien species were represented by 17 species but the number is a gross under estimate as no attempt was made to collect these species.

Typical of Kwongan areas, the families Proteaceae (135 taxa), Myrtaceae (130) and Papilionaceae (66) are the best represented (Table 2). These families account for over one third of the total taxa found in this study. Other rich families include Liliaceae (55), Asteraceae (41), Epacridaceae (33), Mimosaceae (32) and Cyperaceae (31). A large number of the families are represented by only one taxon (9 families eg. Zamiaceae, Boraginaceae, and Polygonaceae) or one genus (33 families eg. Juncaginaceae, Droseraceae and Dilleniaceae). Similarly over half of the genera (134) are represented by only one taxon (eg. *Caustis, Sowerbaea, Strangea* and *Myriocephalus*). The most important genera are *Acacia* (32 species), *Hakea* (30), *Stylidium* (28), *Melaleuca* (25), *Dryandra* (22), and *Grevillea* (21).

A large number of the 876 taxa are restricted to the Northern Kwongan. Twenty-four are considered Very Geographically Restricted (geographic range of less the 50km) (eg. *Calytrix platycheiridia, Dryandra sclerophylla, Myriocephalus suffruticosus* and *Stylidium aeonioides*), and 87 species are Geographically Restricted (between 100 and 160 km) (eg. *Banksia grossa, Conostylis aculeata* ssp. *breviflora, Haemodorum loratum, Hensmania stoniella, Strangea cynanchocarpa* and *Thysanotus spiniger*). A total of 124 species found in this study were considered as endemic to the Northern Kwongan between the Moore and Irwin Rivers (Griffin, Hopper and Hopkins unpublished data). Of these 124 only about 20% were restricted to one of the physiographic regions. The Arrowsmith Region has the most with 19 (eg. *Beaufortia bicolor, Dryandra nana* and *Thysanotus* aff. *sparteus* EAG 2511). Only 3 of those they recognised as restricted to the Dandaragan Plateau (eg. *Beaufortia eriocephala* and *Calytrix platycheiridia* MYREUC*AN), 4 to the Yarra Yarra Region (eg. *Acacia flabellifolia* and *Jacksonia eremodendron*) and one which was thought to be restricted to the Eneabba Plain (*Schoenus* aff. *obtusifolius* EAG 3841) were found. Additional to these endemics are two which extend south of the Moore River but are

restricted to the Bassendean Dunes (*Banksia laricina* and *Verticordia nitens*).

Ten of the species found were Declared Rare under the Wildlife Conservation Act (eg. *Asterolasia drummondii* and *Chamelauceum* sp EAG 4861) (Appendix 3). Several others are probably also rare but require further study to confirm this. Generally speaking, these taxa are considered poorly known. At least 60 taxa in this study are already recognised as poorly known (Table 3). Undoubtedly others including some of the many which were difficult to identify would also be poorly known.

There were a number of finds of significance. The knowledge of the distribution of several species was considerably enhanced by this study. For example, until now there was no precise locality known for several species (*Grevillea thyrsoides, Myriocephalus suffruticosus* and *Lasiopetalum* aff. *membranaceum*). Others had their known range considerably extended by this study (*Astroloma* aff. *serratifolium* NG Marchant sn, *Schoenus* aff. *indutus* EAG 3842 and *Thysanotus vernalis*). One variety found is so poorly known that it is not represented in the collections at the Western Australian Herbarium but it appears to be *Gastrolobium ilicifolium* var. *lobatum*.

Table 2 Numbers of Taxa in Important Families and Genera.

POACEAE	15	PAPILIONACEAE	66
CYPERACEAE	31	*Daviesia*	16
Schoenus	15	*Gastrolobium*	9
RESTIONACEAE	26	*Jacksonia*	14
Loxocarya	8	DILLENIACEAE	12
LILIACEAE *	55	*Hibbertia*	12
Lomandra	9	MYRTACEAE	130
Thysanotus	12	*Calytrix*	14
HAEMODORACEAE	30	*Melaleuca*	22
Conostylis	17	*Eucalyptus*	18
ORCHIDACEAE	26	*Verticordia*	19
PROTEACEAE	135	APIACEAE	16
Banksia	16	EPACRIDACEAE	33
Dryandra	22	*Astroloma*	8
Grevillea	21	*Leucopogon*	18
Hakea	30	GOODENIACEAE	29
Petrophile	16	*Dampiera*	9
DROSERACEAE	13	STYLIDIACEAE	30
Drosera	13	*Stylidium*	28
MIMOSACEAE	32	ASTERACEAE	41
Acacia	32		
TOTAL TAXA	876	No releves	357

* For purposes of comparison with other studies, LILIACEAE includes families 54C (DASYPOGONACEAE) to 54J (COLCHICACEAE).

Table 3 Plant Taxa considered Poorly Known.
(Extract from Hopper and van Leeuwen in press).

Priority one: High priority species which are known from only one or a few localities on lands under threat.

Acacia flabellifolia
Arnocrinum gracillimum
Beaufortia eriocephala
Dryandra aff. *polycephala* EAG 4945
Eremaea beaufortioides
Eucalyptus aff. *drummondii* MIH Brooker sn
Grevillea thyrsoides
Hakea auriculata var. *spathulata*
Hakea erinacea var. *longiflora*
Hemigenia curvifolia
Kunzea sp DJE Whibley 4887
Lasiopetalum aff. *membranaceum* Stoate sn
Lechenaultia juncea
Loxocarya sp EAG 5268
Myriocephalus suffruticosus
Olax scalariformis
Persoonia rudis
Thysanotus anceps

Priority two: High priority species known from one or a few localities on land not under immediate threat.

Acacia aff. *myrtifolia* RJ Cranfield 33 (P33)
Acacia plicata
Astroloma aff. *pallidum* EAG 1022
Astroloma aff. *serratifolium* NG Marchant sn
Calytrix platycheiridia
Daviesia aff. *striata* MD Crisp 6213
Eremaea aff. *brevifolia* D Coates M1 175.5
Eucalyptus sp MIH Brooker 9740
Grevillea aff. *bipinnatifida* SD Hopper 6350
Guichenotia sp EAG 858
Hensmania stoniella
Hypocalymma aff. *tetraptrum* CA Gardner 9014 (yellow flower)
Hypocalymma tetrapterum
Jacksonia eremodendron
Loxocarya aff. *fasciculata* B Briggs 6319
Oxylobium reticulatum var. *gracile*
Physopsis spicata
Schoenus aff. *indutus* EAG 3842
Schoenus aff. *obtusifolius* EAG 3841
Stylidium aeonioides
Thysanotus aff. *sparteus* EAG 2511
Thysanotus spiniger
Thysanotus vernalis

Table 3 continued

Priority three: Known from several localities, some of which are on lands not under immediate threat.

Acacia volubilis
Allocasuarina grevillioides
Beaufortia bicolor
Comesperma acerosum
Darwinia pinifolia
Dryandra subulata
Dryandra tortifolia
Eremaea aff. *violacea* EAG 1557
Isopogon adenanthoides
Jacksonia carduacea
Lasiopetalum lineare
Lepidobolus sp EAG 2093
Leucopogon phyllostachys
Phlebocarya filifolia
Phlebocarya pilosissima ssp. *pilosissima*
Restio sp B Briggs 6308
Restio sp B Briggs 850
Scholtzia teretifolia
Sphaerolobium macranthum var. *pulchellum*
Stylidium aff. *bulbiferum* AH Burbidge 2100

Priority five: taxa for high priority monitoring (ie. which are considered to have been adequately surveyed and not endangered or in need of special protection, but could be if present circumstances change.

Darwinia sanguinea
Eucalyptus carnabyi
Eucalyptus macrocarpa ssp. SD Hopper 3121
Macropidia fuliginosa
Thelymitra variegata var. *apiculata*

Floristic Analysis

The objects of the study were to describe the vegetation of the area, to describe the relationships between vegetation types and various edaphic parameters, and to examine for and if possible describe geographic patterns in the distribution of vegetation types. The results outlined below fill all these objectives. It is not possible to present all the information generated in this study except merely summarise important results. The numerical analyses, classification and ordination, enabled the vegetation types and the relationships between them to be described. The geographic patterns were illucidated more intuitively. The regions described include a unique combinations of vegetation, soil, landforms with a high intra-regional consistency between each.

Classification

For convenience it was decided to use 35 groups of releves for general presentation of the information sampled. It was quite clear that for many of these 35 Floristic Types sub-types were distinguishable on floristic and/or geographic grounds. Many of the sub-types had few members and therefore the information was too sparse to produce reliable descriptions of floristic composition or their edaphic characteristics. Appendix 4 provides a description of the 35 Floristic Types in terms of the floristic composition, vegetation structure and soil and landform characteristics.

The dendrogram (Appendix 5) shows how this particular classification has fused the releves. Included also for each releve is the codes for the landscape, soil and vegetation types recognised.

The classification of the floristic data produced Floristic Types of releves which can be related to landscape, soil and vegetation (Tables 4 to 6). Some Types are from a specific landscape, soil or vegetation type, most are from several similar types but some no apparent relationship to any. There is a clear correlation between some of the landscape, soil and vegetation types for example Floristic Types 1 to 5 and 35 were mainly in drainage lines with humic sand with a conspicuous wet Heath *or Casuarina obesa* woodland. On the other hand each specific landscape or soil type has a number of Floristic Types. A significant number of the Vegetation types recognised were more or less related to a specific Floristic Type.

Ordination

Ordination of the floristic data assisted in understanding the relationship between the vegetation types recognised in the field and the Floristic Types generated by the classification. Figure 10 shows most of the releves displayed on a plot of the second and third most important ordination vector. Plotted on this figure is the Floristic Type code to which each releves was assigned by the classification. This shows a reasonable level of consistency between the different methods of analysis. The Floristic Types are grouped into super-types for display convenience. The data set is probably more complex than those on which this technique is often used. However, generalizations are possible from the results of this analysis.

The first vector discriminated principally between releves of drainage lines etc and the rest. It did not show as clearly the relationships within the rest hence its not being presented here. Vector 2 discriminated between drainage line vegetation at one extreme and that of lateritic uplands on the other. Vector 3 discriminated between woodlands of clayey soils and low woodlands and heaths of sandy soils. Vector 4 discriminated between heaths of gravelly or clayey soils and certain low woodlands of sandy soils. Releves intermediate on these vectors had intermediate soil, landform or vegetation.

Table 4 Landscape code versus Floristic Type

TYPE	Landscape Code*														
	SP	U	uSS	uSSb	uSSr	mSS	mSSb	mSSr	lSS	lSSr	AF	DR	DUr	DUs
	1	2	3	4	5	6	7	8	9	10	1	2	4	5
1												4		
2												2		
3												4		
4											1	2		
5					1			1				3		
6		4	2	1		1	1				2	1		
7			5			2			1					
8									2		3			
9		1							1		2			
10		1	1					1						
11		2			1	4	1	1	3		1			
12	1	2	1						2	2	3	3		
13	2	2	3			2			4					
14						1					1			
15		3	1						3		2			
16		6	2			3		1	3					
17		2	1			3			5					
18		2							3		1			
19		2	1	2			1		1					
20		2	1	2		2	2		1					
21		14	2	2		1			2					
22		2	1			1								
23		3	1											
24		4						1						
25		18	2											
26		20	4			1			1					
27		1				2			4					
28	3	11	5			7			8					
29		7	13			9			8					
30		3				1			1					
31		2	1			1			2					
32	5								2					
33	1					3		1	17		1			
34									1				1	4
35												2		
	SP	U	uSS	uSSb	uSSr	mSS	mSSb	mSSr	lSS	lSSr	AF	DR	DUr	DUs
	1	2	3	4	5	6	7	8	9	10	1	2	4	5

* Landscape Code

1	sandplain, upland
2	lateritic upland
3	upper slope
4	upper slope, breakaway
5	upper slope, small rise
6	mid slope
7	mid slope, breakaway
8	mid slope, small rise
9	lower slope
10	lower slope, small rise
11	alluvial flat
12	drainage line
14	dune rise
15	dune slope

Table 5 Soil code versus Floristic Type

Type	Soil Code	1 2 3 4 5 6 7 8 9 10 1 2	3 4 5 6 7 8 9 20 1	2 3 4 5 6 7 8 9 30	1 2 3 4 5
1	2				
2	1		1 1		
3	3		1		
4	1		1		
5	1		1	1	1
6	3		1		1
7			2 1		2 2
8	1		1		
9	1			2	
10	1				
11	3	1 2		1 1	
12	1	2	2	1	
13					
14	1				
15	5	1			
16	6				
17	1		2		
18	1 1		1		
19	3			1 3	
20	2		1 1	3	
21			1	5	
22				2 1	
23					
24	1		4	1 1	
25	2		1	1	
26					
27	1				
28	110	15	1		
29	7	217	7 4		
30		1 4	1		
31	5				
32	1 5				
33	513		4 1		
34					
35	2				

Soil Code	
1	humic sand, grey or brown
2	grey sand over lateritic gravel
3	grey sand
4	grey sand over pale yellow, yellow or orange sand
5	pale, or very pale, yellow sand over yellow sand
6	yellow sand
7	brown sand over loam, gravel or clay
8	orange, or pale orange sand
9	red sand
10	gravelly grey sand over lateritic gravel or duricrust
11	gravelly pale yellow sand over lateritic gravel
12	gravelly orange fine sand over lateritic gravel
13	grey loamy sand over gravel or clay
14	pale yellow loamy sand over yellow sand
15	orange or brown loamy sand over clay or gravel
16	red loamy sand
17	lateritic gravel & duricrust, grey sandy matrix
18	lateritic gravel & duricrust, yellow sandy matrix
19	lateritic gravel & duricrust, brown sandy matrix
20	lateritic gravel & duricrust, orange sandy matrix
21	lateritic gravel & duricrust, red sandy matrix
22	lateritic gravel & duricrust, grey or red loamy matrix
23	lateritic gravel & duricrust, yellow sandy loamy matrix
24	lateritic gravel & duricrust, orange sandy loamy matrix
25	lateritic gravel & duricrust, brown loamy matrix
26	lateritic gravel & duricrust, red loamy matrix
27	lateritic duricrust, brown loamy gravelly matrix
28	lateritic duricrust, gravelly grey loam matrix
29	grey sandy loam over loamy clay or clayey loam
30	gravelly grey loam ?over clay
31	brown or pale brown loam
32	brown clay loam
33	gravelly brown clayey loam
34	brown loamy clay
35	brown clay

Table 6 Vegetation code versus Floristic Type

TYPE	J.pall 1	C.obes 2	WET1 3	WET2 4	M.unci 5	CLAY1 7	CLAY2 8	A.camp 9	GRAVEL 10	E.acce 1	E.loxo 2	E.wand 3	E.calo 4	B.prio 6	B.prio 7	B.atte 8	E.todt 9	B.burd 20	SAND1 1	H.obli 2	A.aren 3	HEATH1 4	LATERI 5	C.long 6	D.carl 7	D.pate 8
1			2	1	1																					
2		1			1																					
3		*4*																								
4				1				1			1															
5	1			1						1	2															
6											*3*	2	*7*													
7												*8*														
8				1		1	1					1							1							
9			1										1						2							
10										*3*																
11							1	4	*8*																	
12			1	2	1		1	1	2		1			1					3		1					
13														*7*	3				2		1					
14																2										
15															5	3	1									
16													*5*		1	4	3		2							
17													*8*		1		1		1							
18				1				1											*4*							
19						*6*	1																			
20						*4*	1		3																2	
21						1							1						4			1	3		2	*12*
22						1													1				2			
23						1																		1	2	
24																						1	3	1		
25																						1	*6*	*8*	4	1
26																						2	*16*	1	*7*	1
27															1		2	2	2							
28															*9*		4		*14*	3	4					
29															1	6	7		*15*	*6*		2				
30													1			4										
31															1	3			1	1						
32															1		2	1	3							
33				1											4	*9*	*8*			1						
34																6										
35			2																							
	1 J.pall	2 C.obes	3 WET1	4 WET2	5 M.unci	7 CLAY1	8 CLAY2	9 A.camp	10 GRAVEL	1 E.acce	2 E.loxo	3 E.wand	4 E.calo	6 B.prio	7 B.prio	8 B.atte	9 E.todt	20 B.burd	1 SAND1	2 H.obli	3 A.aren	4 HEATH1	5 LATERI	6 C.long	7 D.carl	8 D.pate

* Vegetation Code (based on dominant species and structure)

1 *Juncus pallidus* Sedgeland
2 *Casuarina obesa* Woodland
3 WET HEATH 1 mixed including *Eucalyptus rudis*
4 WET HEATH 2 mixed including *Verticordia densiflora*, *Calothamnus hirsutus* and *Thryptomene prolifera*
5 *Melaleuca uncinata* and *M. hamulosa* Heath
7 CLAY HEATH 1 mixed including *Calothamnus quadrifidus* *Melaleuca radula*, *M.* aff *tricophylla*, *Hypocalymma angustifolium*
8 CLAY HEATH 2 mixed including *Petrophile seminuda*, *P. chrysantha* Heath
9 *Allocasuarina campestris* Heath some with *Eucalyptus gittinsii*
10 GRAVEL HEATH mixed including *Allocasuarina microstachya*, *A. ramosissima*, *Eucalyptus gittinsii*
11 *Eucalyptus accedens* Woodlands
12 *Eucalyptus loxophleba* Woodlands
13 *Eucalyptus wandoo* Woodlands
14 *Eucalyptus calophylla* Woodlands
16 *Banksia prionotes* Woodlands usually with *Ecdeiocolea monostachya*
17 *Banksia prionotes* Woodlands often with *B. attenuata*, *Eucalyptus todtiana* or *Xylomelum angustifolium*
18 *Banksia attenuata* Woodlands often with *B. menziesii*, *Eremaea pauciflora*, *Eucalyptus todtiana*
19 *Eucalyptus todtiana* Open Woodlands often with *Banksia attenuata*, *Eremaea pauciflora*, *Adenanthos cygnorum*
20 *Banksia burdettii* Open Woodlands often with *B. attenuata*
21 SAND HEATH mixed including *Adenanthos cygnorum*, *Banksia leptophylla*, *Calothamnus quadrifidus*, *Eremaea pauciflora*, *Petrophile ericifolia*
22 *Hakea obliqua* Heath
23 *Actinostrobus arenarius* Heath
24 HEATH 1 mixed often with *Gastrolobium oxylobioides*
25 LATERITE HEATH mixed dominance
26 *Calothamnus longissimus* Heath
28 *Dryandra patens* Heath

Figure 10 Ordination of relevés.
(Presence / Absence Data: Vector 2 by Vector 3.)

a. Floristic Types
(lines define super-Types).

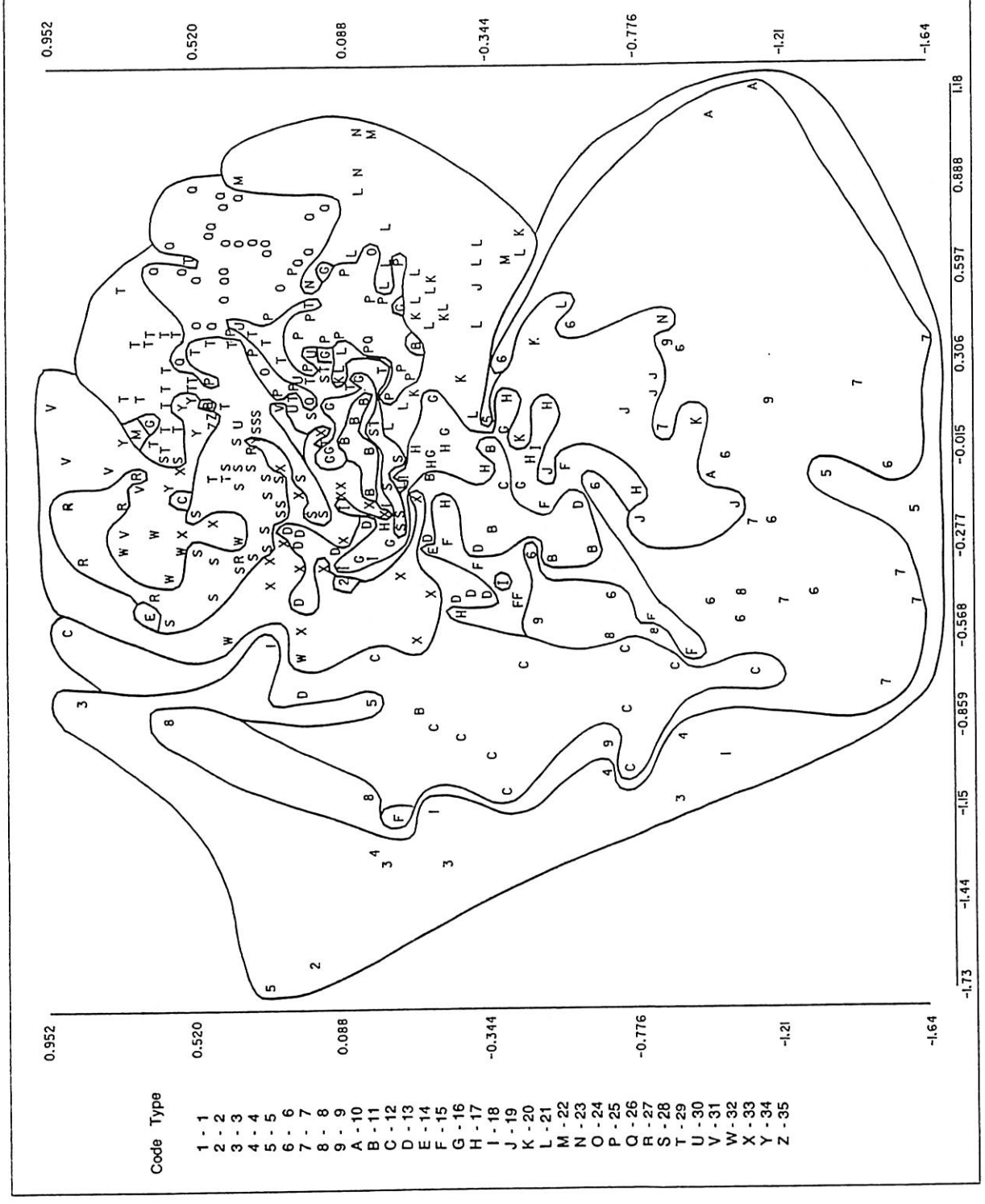


Figure 10 Ordination of relevés.
b. Floristic Regions

An interesting feature of Figure 10 is the differential spread of releves. Those of drainage lines are widely spread indicating these are very variable in floristic composition. To a lesser degree so are those of woodlands on clayey soils. On the other hand, those of laterite heath sites are close together suggesting much less variation.

Some Floristic Types were clearly distinct from other Types, but others could best be termed transitional. This is difficult to appreciate on the ordination diagram (Figure 10) or even the dendrogram (Appendix 5). A clearer way to display this is shown in Figure 11. This minimum spanning diagram by definition joins all releves together so that each is connected to the one to which is most similar. Also displayed on this figure are the Floristic Types (and super-types).

This shows that the members of most Floristic Type are aggregated together. The major divergence to this generalization is the super-Type of wet areas (1 to 5) and Floristic Type 12 and several small Types. Releves are mostly connected to members of their own Floristic Type. Types 24, 25, 30 and 35 (and some with just a few members) with members all connected to each other are probably discrete types. Types such as 6, 18, 21 and 28 are probably transitional because they have many members connected to other Types rather than fellow members of their Type.

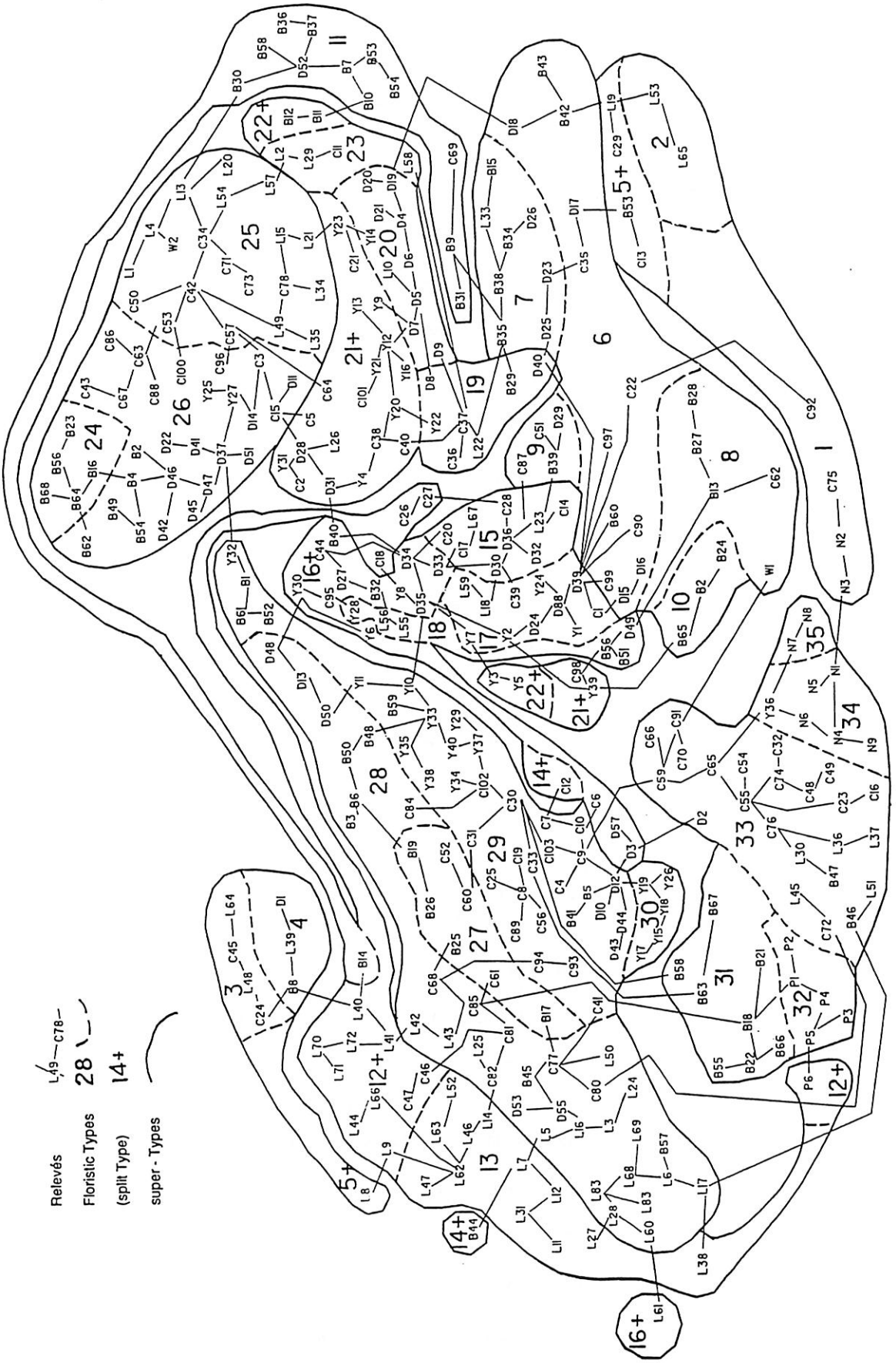
Geographic Patterns

A geographic plot of the Floristic Types showed that some of the 35 Types were confined to short geographic ranges (eg. Type 32 to the north-east and Type 34 to the south-west), but many were much more widely distributed. A closer examination, however, revealed that many of the sub-types were also confined over short geographic ranges. A careful examination of the distribution of the Types and sub-types showed considerable similarity in patterns across the Floristic Types. For example, certain sub-types of 25, 26, 28, 29 and 33 had similar geographic ranges.

In this way the study area was divided into seven Geographic Regions. Table 7 shows the distribution of the Floristic sub-types between the Geographic Regions. Generally each Region contained most, if not all, members of specific Floristic Types or sub-types (see also Figure 11b). The proposed boundaries appear to also hold for widely different vegetation types. These data provide strong evidence for a fundamental geographic component controlling Floristic composition of the vegetation in the Dandaragan area.

The Geographic Regions cold be readily recognised on aerial photographs. It was possible, therefore, to enhance the boundaries by extrapolating from these photographs and the results are presented in Figure 12. Wetlands and drainage lines provided the greatest difficulties in interpreting the appropriate position for these boundaries. This was because the soils for these areas have been transported downstream and the vegetation has affinities with that of the upstream Region. Insufficient sampling, because of lack of remnant vegetation, made it difficult in some areas. Landscape and

Figure 11 Minimum Spanning Diagram.
a. showing relationships between relevés
(Relevé joined to most similar other relevés - from presence/absence data).



b. showing Floristic Regions of relevés

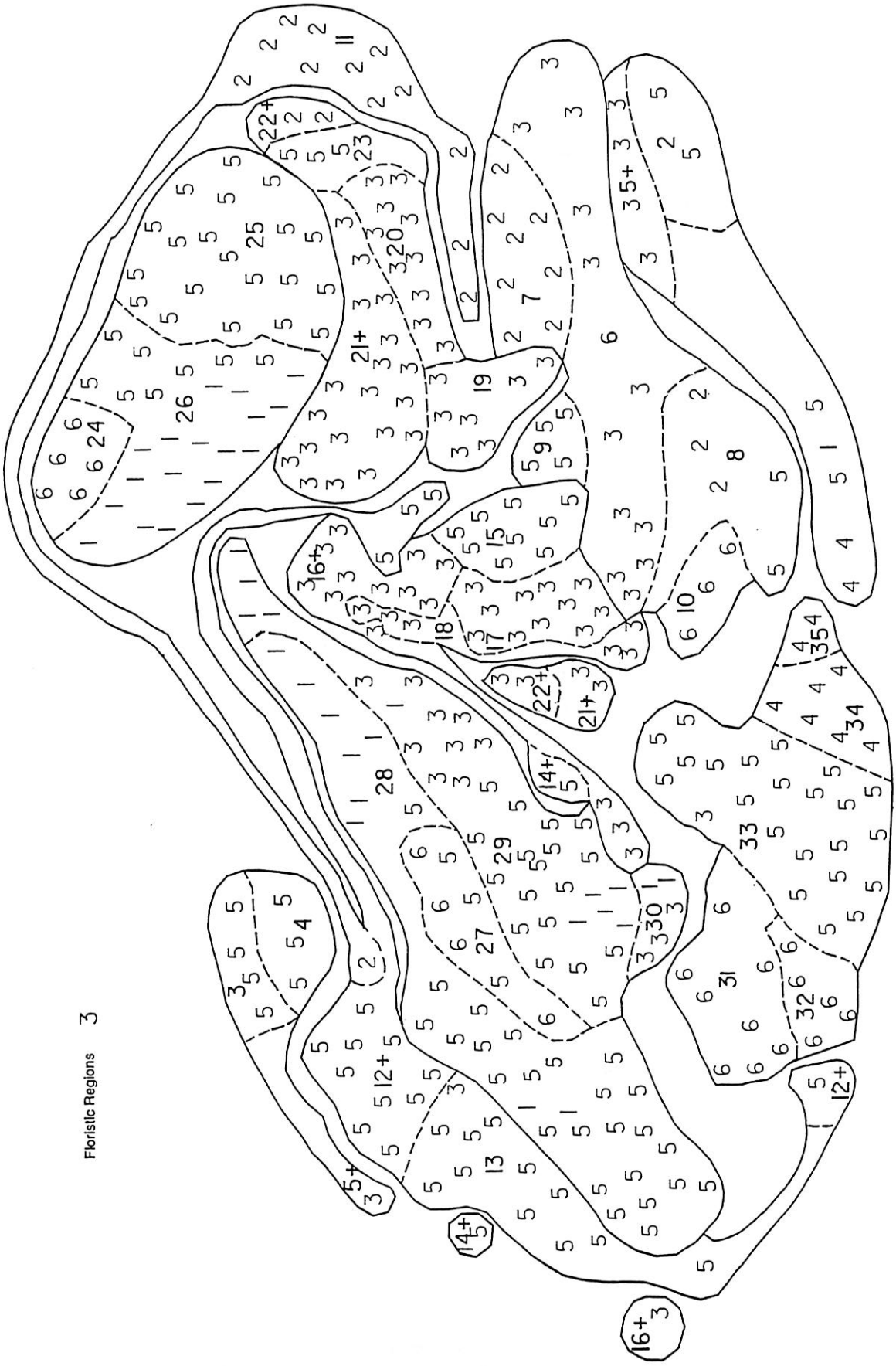


Figure 12 Floristic Regions.

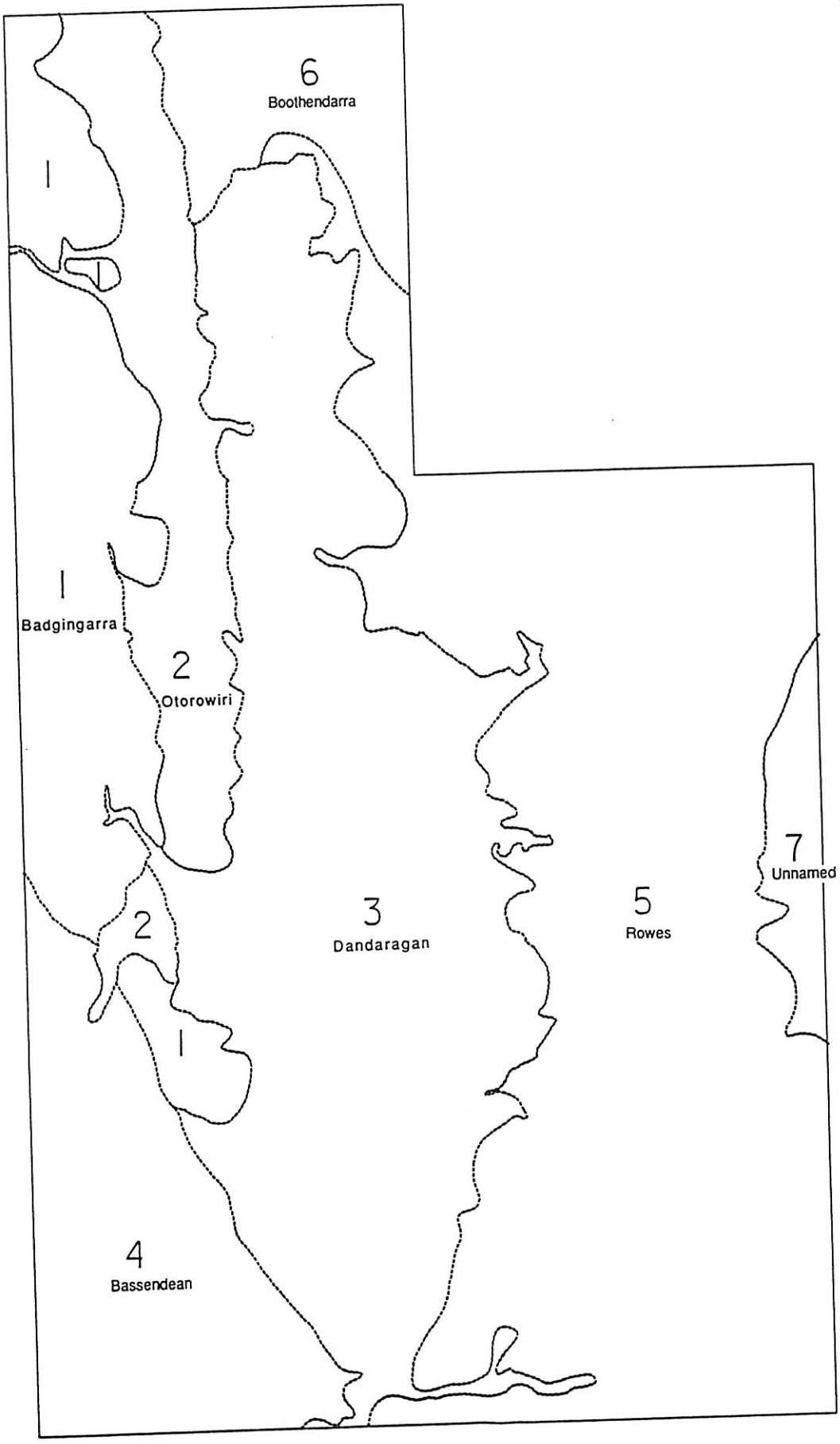


Table 7 Distribution of Floristic Types by Floristic Region. Sub-Types (refer Appendix 5) occurring in each are indicated.

FLORISTIC TYPE	FLORISTIC REGION 4	1	6	5	3	2	other	
1	2			1,3				
2				1,2				
3				1,2				
4				1,2				
5					1-3			
6					1,5			
7						1,3,4	2	
8				3,4		1,2		
9				1,2				
10			1,2					A
11						1-6		B
12				1-5				C
13				1-7				D
14				1-2				E
15				1-4				F
16					1-6			G
17					1-4			H
18					1-3			I
19					1-4			J
20					1-4			K
21					1-8			L
22					2	1		M
23				1-3				N
24			1-3					O
25				1-8				P
26		1-4, 8*-11		5-8*				Q
27			1,2,5	3,4				R
28		9-12		1-8				S
29		1,2, 9,10		3-8, 11	12-15			T
30		2			1			U
31			1-3					V
32			1-3					W
33				1-7,9	8			X
34	1-3							Y
35	1-2							Z
	4	1	6	5	3	2	other	

FLORISTIC REGION

* sub-type 8 split

1 Badgingarra
2 Otorowiri
3 Dandaragan
4 Bassendean
5 Rowes
6 Boothendarra

soil would need to be investigated more thoroughly to clarify the boundaries.

The distribution of some Floristic Types suggest that the proposed Geographic Regions may be further divided. For example, it was almost possible to produce two Regions out of Rowes Region, one north and one south, but the boundary between the two would have been very convoluted and did not appear to by supported by aerial photographic interpretation. Also a Floristic Type confined to the Watheroo National Park was included in the Boothendarra Region but further sampling would probably confirm it to be quite separate.

Appendix 6 provides a description of the vegetation in each of the regions.

Control of Geographic Patterns

The floristic regions defined in this study show considerable similarity to the existing Vegetation map produced by Beard (1979) (Figure 5) and more particularly the underlying geological sediments and soil units (Figures 3 and 4). Table 8 shows a summary of the interrelationships between these units.

With only a few minor discrepancies, The Bassendean Floristic Region corresponds to both the Bassendean Dunes and the Bassendean Vegetation System; the Badgingarra Region to the Yarragadee Geological Formation; Otorowiri Region to lower members of the Parmelia Formation including the essentially siltstone Otorowiri and Carnac Members and an unnamed sandstone member which occurs between them; the Boothendarra Region to the upper unnamed sandstone member of the Parmelia Formation; Dandaragan Region to the Dandaragan Vegetation System on the more dissected soils occurring on the Coolyena Group; the northern part of the Rowes Region to the Warro System on the less dissected soils of the Coolyena Group; and southern part of the Rowes Region to the Osborne Formation.

Beard (1979) combines the Badgingarra, Otorowiri and Boothendarra Regions into his Lesueur Vegetation System. The outlying portion of Beard's Gairdner System which is part of the Boothendarra Region was obviously Beard's attempt to recognise a vegetation unit near Alexander Morrison National Park. The portion of the Marchagee System in the Boothendarra Region conforms with the suggestion made earlier that the Floristic Group around Watheroo National Park might be separated from the Boothendarra Region.

Table 8 Floristic Regions related to Geology, Soil and Vegetation Units

Floristic Region	Geology Unit*1	Soil*2	Vegetation*3
4 Bassendean	**Bassendean D**	Cb39, Ub97	Bassendean S
1 Badgingarra	**Yarragadee F**	Wd9 (NW)	Lesueur S (part)
2 Otorowiri	**Parmelia F** (lower) -Otorowiri M -Unnamed Sandstone -Carnac M	Wd10	Lesueur S (part), Gairdner S (part)
6 Boothendarra	**Parmelia F** (upper) -Unnamed Sandstone	Wd9 (N)	Lesueur S (part), Marchagee S (part)
3 Dandaragan	**Coolyena G** (part)	AB2,3,4, Ac2	Dandaragan S
5 Rowes (N)*4	**Coolyena G** (part)	Ac2	Warro S
(S)*4	**Coolyena G** (lower) -Osborne F	Wd9 (SE), Ac2	Koojan S, Gingin S (part)

*1 Geological Units (refer Figures 2 and 4) G = Group, F = Formation, M = Member

*2 Soil Unit (refer Figure 3) NW = North-western part, N = Northern part, SE = South-eastern part

*3 Vegetation Systems (refer Figure 5) S = Vegetation System

*4 Rowes Floristic Region has, for convenience of this comparison been divided into northern (N) and southern parts (S).

DISCUSSION

Flora

The study area has proved to have a very rich in vascular flora. The total of 876 taxa is greater than has been reported for any other study in the Northern Kwongan including the 820 which have so far been found in the proposed Mt Lesueur reserve (Griffin, Hopper and Hopkins unpublished data). This is not really a fair comparison since the present study is over 10 times the size of the proposed Mt Lesueur reserve (300,000 ha versus 27,000ha). A recent study based on the Bassendean Dunes but with a lower sampling intensity (93 quadrats compared to 357 releves) reported 624 species (Griffin and Keighery, 1989).

The present study clearly has a high *alpha* diversity (species richness in a community) and probably also a very high *gamma* diversity which is inferred because of the wide variety of vegetation types identified (cf Table 6). The study area also appears to have a high *beta* diversity ("the degree of change in species composition of communities along a gradient" Whittaker 1970) inferred from the clear geographic patterns which were demonstrated within the major Floristic Types.

Typical of the Northern Kwongan, the study area is dominated by taxa of the plant families Proteaceae, Myrtaceae and Papilionaceae (Hnatiuk and Hopkins 1981; Griffin, Hopper and Hopkins unpublished data, Griffin and Keighery 1989). The richest genera are similar but not the same for each of these studies. Like the proposed Mt Lesueur reserve *Acacia, Hakea, Stylidium, Melaleuca* and *Eucalyptus* are very important. *Acacia* and *Melaleuca* are less important on the Bassendean dunes and at Eneabba than for the study area or Mt Lesueur. These data confirm the high *beta* diversity of the study area. Orchidaceae were low in the study area compared to the Mt Lesueur reserves which probably reflects less thorough sampling. Several genera are richer in the study area than at Mt Lesueur (eg. *Calytrix, Verticordia, Grevillea, Dryandra, Hakea, Jacksonia, Conostylis,* and *Leucopogon*. This probably reflects the much larger study area as many of the species of these genera appear to have limited geographic ranges.

The study area is rich in endemic species. It includes half of the known endemic species which occur in the northern kwongan between the Moore and Irwin Rivers (Griffin, Hopper and Hopkins unpublished data). These represent about 15% of the total taxa found in the study area. This proportion of endemic taxa is slightly higher than has been recorded in the Mt Lesueur reserves, an area reputed for its concentration of endemic plants (Griffin, Hopper and Hopkins unpublished data). A significant difference, however, is that the study area has fewer Very Geographically Restricted taxa (less than 50km range) but more Geographically Restricted taxa (50 to 100km range). This high proportion of endemic species contributes to the high *beta* diversity of this part of the northern kwongan.

As has been shown in previous studies, the currently defined physiographic regions do not provide a good indication of the distribution of the endemic taxa. It seems unlikely that this could be improved much even if the boundaries are more carefully defined since many of the endemic taxa appear to occur in two or more of the physiographic regions.

Floristic Analysis

The results of the detailed analysis of the suite of plant taxa growing in various vegetation types throughout the study area revealed the area was very diverse. There was general accord between the Floristic Groupings generated and the soil, landform and vegetation types recognised in the field.

Strong geographic patterns were detected in the distribution of the Floristic Groupings. This accords with other studies in the northern kwongan (eg. Griffin *et al.* 1983). The most significant aspect was the recognition of relatively simple geographic boundaries which reflected the variation in floristic composition of most vegetation types. The underlying geological formations, even though generally much weathered, appeared the factor most responsible for the Floristic Regions so defined. A similar relationship was suggested for a nearby area (Griffin and Keighery, 1989). There was no evidence that gradients in climatic variables proposed by various authors (eg. Beard 1981, page 126) had any influence on the distribution of floristic types in this study area.

Beard's physiognomically (structurally) based vegetation mapping (Beard 1979) shows a certain similarity to the distribution of geological substrates and, to a certain degree, also the Floristic Regions of this study. However, the major differences (cf. Figures 5 and 4) are probably the reflection of difficulties encountered by Beard in recognising changes in floristic composition which are not accompanied by physiognomic changes.

The current study makes a case for a review of some of Beard's vegetation system boundaries. Of greatest significance is the recognition of the Otorowiri and Boothendarra floristic regions. The northward extension of these regions can almost certainly be made at least as far as the Arrowsmith River. The main reason for such an extrapolation is that the underlying geological formations have been recognised that far north (Commander, 1978). This is also supported by the studies of floristic variation on lateritic uplands in the Eneabba - Three Springs area (Griffin *et al.* 1983). So does the distribution of vegetation in Alexander Morrison National Park support this proposal (Griffin unpublished data).

A recent floristic study of vegetation on the Bassendean Dunes (Griffin and Keighery, 1989) suggested there was need to review the boundaries of the Botanical Districts in this area. The present study provides more weight to this suggestion. Beard (1979) defined a major floristic boundary in the study area dividing it between the Darling and Irwin Botanical Districts (Figure 5). Obviously the marri woodlands of the Dandaragan vegetation system have affinities with forest areas

of the Darling District. However, Beard included the Warro and Koojan vegetation systems (roughly equivalent to Rowes Floristic Region) in his Darling District. This study showed that the vegetation of these systems have significant affinities with his Lesueur system (Badgingarra and Boothendarra Region). It would be more logical to place these all in the Irwin District (Table 8). Forther studies are needed to document the floristic composition of the vegetation on the Dandaragan Plateau south of Moore River before more definative can be made about boundaries of the Botanical Districts in this area.

Conservation

Several of the Floristic Regions (Bassendean and Boothendarra) are reasonably well catered for by conservation reserves (Table 9). Unfortunately, much of the study area has neither Crown reserves nor vacant Crown land which could be added to the conservation estate. Therefore, for the specific combination of native plants of these regions to be conserved, either certain land would need to be acquired by the Crown or the existing land owners voluntarily protect them. Ideally, most of the remaining uncleared land deserves to be retained in that condition.

Several Crown Reserves which exist for purposes other than conservation were identified as being important (Appendix 7). Several should be dedicated to the purpose of conservation of flora and fauna and appropriately managed as a matter of urgency. The most important of these are Boothendarra Hill, Jam Hill, The Damper (a Water Reserve on Capitella Rd) and a gravel reserve at the corner of Boundary and Barberton West Roads.

A number of farmers are already protecting some of the most important remnants. Recommendations for specific privately owned remnants with very high conservation value have been made but are not included in this report (Attachment 1). This is to preserve the confidentiality of the land owner. This information will be released to the local Land Care District Committees, but only with the approval of the land owner. This information will be valuable in assessing funding priorities for the Voluntary Vegetation Retention Scheme should the owner apply for assistance under it.

Similarly, areas which are considered would be valuable additions to the Register of the National Estate have been identified in the confidential attachment. Individual landowners will be approached at a later date and assisted with completion of a nomination should they wish to proceed.

Table 9 Conservation Status of Floristic Regions.

1. Badgingarra Region

Reasonably well represented by Badgingarra National Park (outside the present Study area) and several minor reserves (Twarta, Mullering and Minyolo Nature Reserves.)

2. Otorowiri Region

The conservation of vegetation in this Region is poor. There are only two small Crown reserves in the Region (Boothendarra Hill and Winjardie Reserve), both vested in Dandaragan Shire, but not currently for purposes of conservation. Outside the study area, a small part of the vegetation of Alexander Morrison National Park is representative of some of the Region. Despite this, the prospect of saving a representative portion of what remains is good as a number of land owners are currently protecting valuable remnants.

3. Dandaragan Region

Again the conservation of this Region is very poor. There is only one small Nature Reserve in the Region (Yandin) but this is very atypical. The only other Crown reserves are small (a water reserve on Dandaragan Road and a small reserve of unknown purpose south-east of Dinner Hill. The remnants are mainly on uplands. Of these some are very valuable and at least one is being protected by the land owner.

4. Bassendean Region

The part of the Bassendean Region within the study area is well represented in Crown reserves (Namming and Enaminga Nature Reserves and Lake Guraga Recreation Reserve).

5. Rowes Region

In the study area this Region has a number of Crown reserves which are possibly representative of the Region. However, their small size means that careful management is essential to ensure their aviability. Only three are conservation reserves, Bundarra, Jam Hill and an unnamed one on Dandaragan road, and only Bundarra is vested in the National Parks and Nature Conservation Authority. The reserves are mainly for water or gravel. Outside the study area Watheroo National Park would conserve some of the vegetation types of this Region. Several significant sized remnants exist. None of the owners have made decisions to protect them but fortunately they do not have plans to clear much of it. It is important to encourage some of these to be protected.

6. Boothendarra Region

There is only a small portion of this Region within the study area. Even so it is well represented in the conservation estate by the Boothendarra Nature Reserve. Outside the study area it is also well represented through Alexander Morrison and Watheroo National Parks and a large area of vacant Crown land (Big Soak Plain).

E. REMNANT VEGETATION

INTRODUCTION

Remnant vegetation, particularly in the essentially cleared agricultural areas are increasingly becoming recognised as valuable resources. In areas with few conservation reserves, these remnants have significant conservation value. Other values, however, have not gone unnoticed and there is, for a variety of agronomic and even global reasons, concern that these remnants should be preserved.

A recent study on remnant vegetation in a small portion of the Western Australian wheatbelt covered aspects of extent remaining and its management (Coates 1987). There was a significant difference between the shires surveyed in the amount of land which remained uncleared. In general the more recently settled areas had more areas left uncleared.

In that study only 2% of farmers believed that the dissadvantages of remnant vegetation outweighed the benefits from having it. Agronomic reasons were the primary benefit which most farmers believed was obtained from these remnants. However, its value for native plants and animals was clearly recognised by a very high proportion of these farmers.

This part of the present study is attempting to determine if the attitudes of farmers of the Dandaragan area is consistant with those of wheatbelt farmers. It was also hoped that farmer involvement in this study will contribute to increasing their awareness of the values of the remnant vegetation. It was also hoped to identify any differences between farmers attitudes which might be related the part of the study area in which they lived.

METHODS

The project was commenced in May 1988. The majority of the field work and farmer contacts were completed in the Spring of 1988.

Mapping

The study area was mapped at the scale of 1:50 000 with reference to several sources. Principally, aerial photo mosaics (Department of Land Administration, 1980) were used but supplemented by satellite image (29.01.1988) and 1:20,000 colour photographs covering the Gingin mound ground water area (14.03.1989). Field reconnaissance was used to update the most recent clearing. Several categories were used to describe the remnant vegetation:

- totally uncleared
- modified, eg chained,
- cleared with scattered trees, and
- cleared with few or no trees.

In general Crown land was excluded from this mapping. However, several Crown reserves, in particular 25143 - Agricultural research station, and 16833 - Use and Benefit of Aborigines were included as well as smoe small reserves for Water or Gravel as they were partially cleared for Agricultural purposes.

In an attempt to overcome photographic distortions, the products of this mapping were plotted onto existing maps of vegetation produced by the Department of Land Administration. These were then incorporated into a computer data base by the Geographic Systems Information Branch, Resource Management Division of the Department of Agriculture.

Questionnaire

Attempts were made to contact as many of the landowners as possible in the study area. The most recent ownership information available from the Dandaragan Shire and the Department of Agriculture was used for direct mail contact. In this way it was hoped to:

- inform them personally of the project,
- seek permission to inspect their properties, and
- inquire about the status of any uncleared vegetation on their properties and their attitudes to its retention.

This was conducted by means of a questionnaire (Appendix 7).

RESULTS

Mapping

Figure 13 shows the different types of remnant vegetation in the study area. Also shown are the areas of Crown land. These of course are uncleared and equivalent to Remnant Vegetation. Shown too are the boundaries of the Foristic Regions. It was hoped to be able to provide statistics on the areas of each type of remnant but it has not possible at this stage.

The figure shows that the Remnant vegetation is generally medium to large compact areas. The areas mapped as Modified Remnants and Scattered Trees are more numerous but smaller.

The distribution of these different types of remnant vegetation relates closely to the Floristic Regions. These appear to reflect differences in the pre-existing native vegetation and the european clearing history. Areas of Scattered Trees are concentrated in the Dandaragan Region (3), the only part of the Study area with sizable trees. Areas most thoroughly cleared are in the Otorowiri Region and parts of the Rowes Region (2 & 5), regions which have few trees.

The majority of the Remnant Vegetation occurs in the Badgingarra, Rowes and Boothendarra Regions (numbers 1,5 & 6) reflecting the most recent phase of agricultural clearing.

Questionnaire

Although every effort was made to send questionnaires to every landowner in the study area, 24 of the 168 sent out did not reach the addressees indicating only 86% of the farmers were canvassed. Of these, 74 (44% of total or 51% of those receiving questionnaires) completed the questionnaires. The majority of the respondents (86%) were prepared to have their property inspected, usually by appointment. Some requested confidentiality, presumably being concerned with the possibility of rare plants being found or clearing plans being divulged. The respondents represented 121,000 ha, or 14% of the total study area.

Of the 70 who did not complete the questionnaire, only 3 replied indicating they wished to have nothing to do with the survey. Although it is probable that many of the remaining 67 were also not interested in the survey, personal contacts revealed that some were definitely interested. It was believed that the respondents were probably slightly biased towards the more interested part of the community.

Family owner/operators predominate amongst the respondents. Only 10 of the 74 were either employees or lessees. Farm size is very variable from 60 hectares to 5060 ha. Table 10 gives an indication of the frequency of farm sizes. Smallest farms

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Table 10 Range of farm sizes and recent and future clearing intentions

Area Range (ha)	All	Number of Farmers - who have, or may clear - Recent[a]	Future	Either
0 - 500	11	1	2	2
501 - 1000	12	2	2	3
1001 - 1500	19	4	6	8
1501 - 2000	12	6	6	7
2001 - 2500	5	2	1	2
2501 - 3000	4	4	2	4
3001 - 3500	6	2	3	4
over 3500	5	3	3	3
total	74	24	25	33
Chi Square Test[b]		8.1	1.7	4.7
probability		*	NS	NS

[a] - last 5 years
[b] - difference from distribution of All responding farms
NS - Not Significantly different from distribution of All farms
* - Significantly different at level of probability $P < 0.05$

were mainly in the Dandaragan Floristic Region, while the biggest were both the Dandaragan Region and the Rowes Region.

Planned Clearing

Although the Dandaragan area has a long history of European settlement, there is a significant proportion of farms which are still being cleared. Almost half (45%) had done some clearing in the last five years or were planning to do so in the future (Table 10). Owners of larger farms predominated in these groups, especially amongst those who have cleared in the last 5 years.

Figure 14a gives an indication of the relationship between the areas uncleared on farms and the size of the farms. It is clear that even some of the bigger farms have quite small areas uncleared. A comparison with Figure 14b shows how clearing of the area planned would affect the areas remaining uncleared.

Despite the long history of settlement and the high proportion of clearing continuing to occur, most farmers reported having some uncleared bush (62 out of 74 or 84%). Even after the proposed clearing, this proportion will remain very similar (83%). For the respondents to the questionnaire this was 16,000 ha or 13% of the area or on average 216 ha per farm.

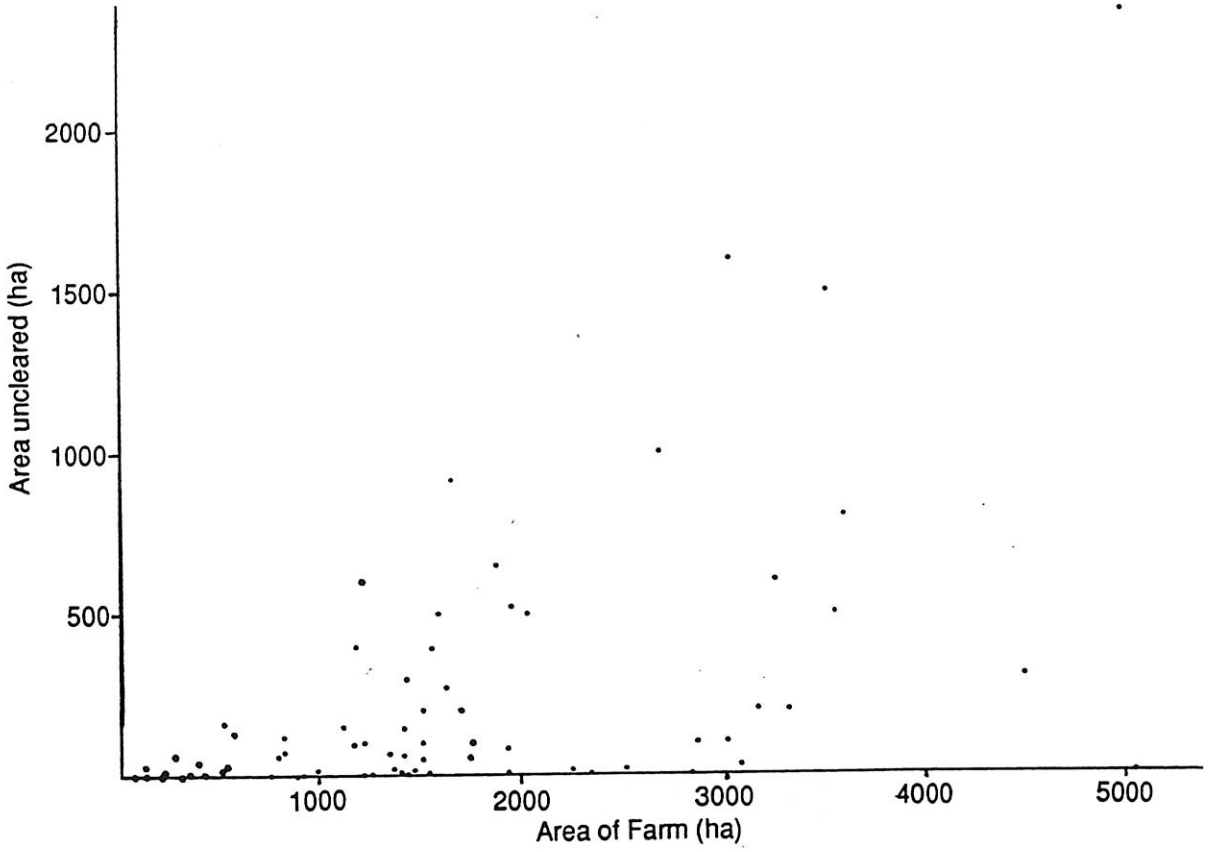
The averages per farm varied considerably between Floristic regions. The 24 farms surveyed in Rowes Region had almost two-thirds of the total uncleared area reported by respondants. By contrast the 25 farms in the Dandaragan Region had only 800 hectares. Farm averages vary from 50 ha in the Dandaragan Region, 90 in the Otorowiri Region 230 in the Badgingarra Region and over 400 in the Rowes and Boothendarra Regions.

The planned clearing would reduce the total for all respondants to less than 10,000 ha total or 7.6% (92 ha per farm). Planned clearing, which was essentially proportional to the areas left uncleared, would result in average areas of about 40 hectares in both Dandaragan and Otorowiri, 150 in Badgingarra and 200 and 400 in Rowes and Boothendarra respectively.

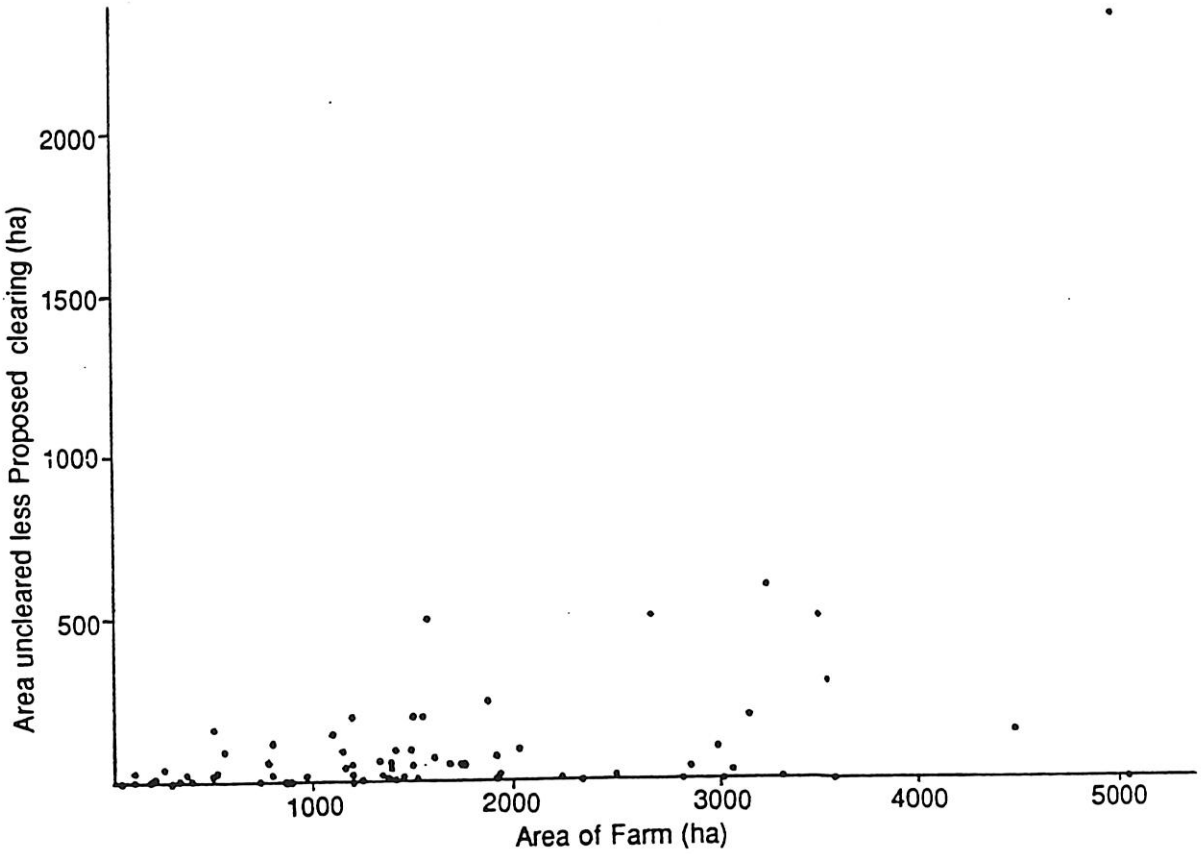
The average area of uncleared land per farm, however, is misleading since 6 of the farms have almost half of the total uncleared land. On the other hand half the farms have less than 70 ha and many of these have several discrete patches. With the proposed clearing, half the farmers would have less than 50 ha, only a slight reduction over present areas. This suggests that a majority of farmers are happy with about 50 ha of uncleared bush on their properties. The planned clearing would greatly affect the number of large sized blocks of bush in the area. Only 7% of farms would have more than 200 hectares and there is little certainty that even these would remain intact.

Figure 14 Farm size versus Areas uncleared.

a. Currently uncleared



b. Currently uncleared less Proposed clearing



Reasons for Retention

All of the reasons for leaving areas uncleared which were suggested in the questionnaire received some affirmation from respondents (Table 11). Farm management reasons were, however, the most important. Leaving shelter for stock was the main reason for doing so and helping control salinity or erosion, and having not yet cleared were also important. Nature conservation was a significant factor also, even if not the major reason. However, a majority of people were aware of the value these areas were in providing for native plants, birds and other animals.

The only detectable difference between farmers in the different Floristic Regions was that more of the Badgingarra, Rowes and Boothendarra farmers indicated that they had not completed their planned clearing. More of them also considered that they had areas which were not suitable for clearing.

Table 11 Reasons for leaving areas uncleared on Farms

	Major		**Minor**		**Either**	
	#	%	#	%	#	%
Stock Shelter	20	(31%)	25	(40%)	45	(71%)
Salinity & Erosion Control	16	(25%)	12	(19%)	28	(44%)
Not Suitable for Farming	14	(22%)	19	(30%)	34	(52%)
Home for Birds and Animals	11	(17%)	21	(33%)	32	(51%)
Conserve Native Plants	10	(16%)	21	(33%)	31	(49%)
Not yet Cleared	9	(14%)	12	(19%)	28	(44%)
Own Pleasure	6	(10%)	25	(40%)	31	(49%)
Increases Property Value	4	(6%)	18	(29%)	22	(35%)
Poison Plants	7	(11%)	8	(13%)	15	(24%)

% is of total of 63 respondents who had some bush areas uncleared.

Fencing

Over 40% of the farmers indicated that their uncleared areas were unfenced (Table 12). (Unfortunately this is an over estimate as some did not answer the question and were included as having no fencing). Only one sixth indicated that their uncleared areas were mostly fenced. Although the answers to this question suggest a poor level of fencing, it does not necessarily reflect the areas which are totally fenced. Many of the farmers have totally excluded stock from some patches but obviously few have fenced all.

More farmers in the Otorowiri Region indicated their uncleared areas were completely fenced than those from any other region. Dandaragan and Rowes farms were apparently the poorest fenced.

Government assistance would attract a high proportion of farmers to fence more bush (Table 12). Clearly those who have fenced off some ('little' to 'a lot') but not all are more attracted by Government assistance. No differences were detected in the response to Government assistance from farmers from different parts of the study area.

The amount of fencing which farmers thought they required seemed very variable compared to the area left uncleared (Figure 15). However, some did not answer this question either. By excluding those who indicated they had fenced off all their areas and those of the remainder who did not indicated that they needed any, an average of 6km per farm with uncleared bush was arrived at.

Table 12 Farmers and fencing bush areas. Number of farmers with bush areas and the relative amount of bush areas fenced off, and the number who would fence more with Government assistance.

Currently Fenced	**Number of farmers** Total	Fence More	
none	26	12	(46%)
little	13	7	(54%)
half	3	2	(67%)
a lot	10	7	(70%)
all	11	3	(27%)
Total	63	31	(49%)

% is proportion of total in respective "fenced" category

Fencing and Rare Plants

Half of the respondents indicated that they were prepared to fence off stock from rare plants if the plants were found on their property. There was a clear difference between the two groups of farmers who would and would not fence off voluntarily. Simply stated, those who had completed their proposed farm development would and the others would not. Table 13 shows that those who intended to clear large areas would not fence voluntarily. The differences in intentions were statistically significant. Similarly Table 14 shows those with large uncleared areas would not fence voluntarily. These differences were also statistically significant.

Proportionally more farmers from the Dandaragan and the Otorowiri Regions were prepared to voluntarily fence off rare plants than those from Rowes Region. This difference was mainly related to the high proportion of farmers in the Rowes Region with large areas remaining uncleared, many of whom wished to clear more.

Table 13 Voluntary fencing off rare plants. Farmers' preparedness to fence rare plants voluntarily and the areas which they intended to clear in the future.

Future Clearing Area Range (ha)	Number of Farmers fence	not fence
0	28	21
1 - 100	4	7
101 - 200	4	1
201 - 300		1
301 - 400	1	2
401 - 500		3
over 500		2
Total	37	37

Difference between 'fence' and 'not fence' related to area statistically significant Chi Square = 6.4 , $p < 0.05$

Table 14 Voluntary fencing off rare plants. Farmers' preparedness to fence rare plants voluntarily and the areas uncleared at present.

Uncleared Area Range (ha)	Number of Farmers fence	not fence
0	5	6
1 - 100	23	13
101 - 200	5	5
201 - 400	3	2
401 - 800	1	7
over 800		4
Total	37	37

Difference between 'fence' and 'not fence' related to area statistically significant Chi Square = 11.3 , $p < 0.05$

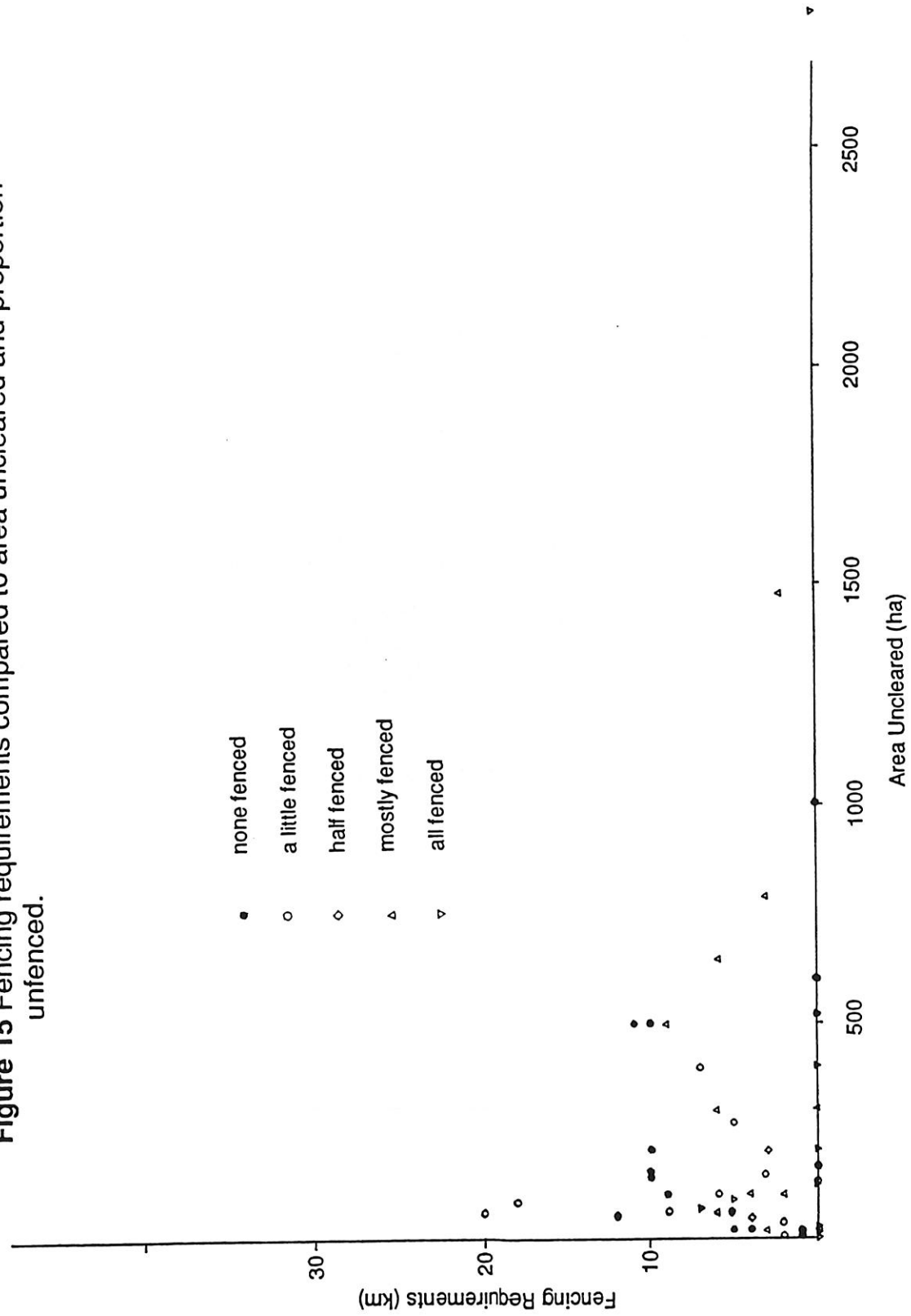


Figure 15 Fencing requirements compared to area uncleared and proportion unfenced.

Table 15 Responses to Government encouragement to fence. Farmers' not prepared to fence rare plants voluntarily, Government measures which would encourage them to do so, and the area of uncleared bush on their farms

.....number of farmers.....

Uncleared Area range (ha)			Government assist*. any	mater.	assist.	compen.
	0	6				
1 -	100	13	7	6	3	2
100 -	200	5	2	2		
200 -	400	2	2	2	1	1
400 -	800	7	6	3	4	3
over	800	4	3	2	2	2
	Total	37	20	15	10	8

* would do so with Government assistance
any - any of measures indicated
mater. - supply of materials
assist.- financial assistance
compen.- compensation for area lost

Most of those with large uncleared areas would fence them off if there was Government assistance. The major forms of Government assistance which would receive a positive response would be provision of fencing materials, assistance with fencing and management and compensation for productive land which can not be cleared (Table 15). More compulsive measures were only selected by 2 farmers, probably indicating that most farmers are supportive to the need to fence off rare plants. Some undoubtedly wish to maintain complete control of their farms. There was no obvious difference in attitudes to fencing which could be related to region.

Government Advice

Generally farmers do not wish advice from Government for fencing uncleared areas (only 36% did).

DISCUSSION

The responses provided by the farmers showed that as a group they are reasonably well informed about the values of remnant vegetation. In general their attitudes are similar to those reported by Coates (1987) for several shires of the wheatbelt. Not only did a majority report having left remnant vegetation for farm management reasons but they also recognise that its values for native birds and animals and asthetics influenced them.

The rate of clearing in the past 5 years appears to be similar to the wheatbelt areas, especially the shire of Pingelly for example.

Farmers attitudes are clearly related to the proportion of farm they have so far developed. Those who have cleared most are generally happier to retain what is left. This may seem contrary, but it is probably related to two significant factors. First of these is financial. Those with greatest areas uncleared tend to be in the more recently established areas and are probably having difficulties in meeting normal farm costs. They are likely to view uncleared land as an opportunity to extricate themselves from this situation. The possibility of rare plants restricting these plans together with expenditure on fencing off these areas would probably seem to them as an imposition.

The second is awareness of diminishing resource. The older settled areas with less uncleared land and probably greater financial security recognise the values of the little that is left. Some do so because of impending problems such as for example salinity. Others, however, have recognised the paucity of bush and wish to save some of what is left.

From a nature conservation point of view, one of the more significant findings from this study has been the recognition of the Floristic Regions mentioned in the earlier section and their apparent relationship to different phases of agricultural development. The Dandaragan Floristic Region was the oldest region settled in the study area. It has also been mostly cleared except for significant areas of scattered trees. The Otorowiri Region was next settled followed by selected parts of the Bassendean. Farm settlement in the other regions is generally more recent. This sequence of development reflected differences in a combination of factors including soil fertility.

Beard's vegetation map shows a slightly poorer relationship to agricultural development than the Floristic Regions defined here. He was unable to detect the differences between the Otorowiri, Badgingarra and Boothendarra Regions each of which has a different history as mentioned above.

The significance of these findings are twofold. Firstly the Floristic Regions define areas which have a similar range of vegetation and soil and therefore provide ideal regions for which management guidelines could be expected to be reasonably consistant. However, such detailed Floristic Regions have not been defined for much of the State and Beard's vegetation maps are probably an acceptable alternative. The major deficiency in the Beard's mapping is the difficulty which he obviously had in descriminating between vegetation types with few clear dominant species.

The second aspect relates to being able to recognise important remnant patches of native vegetation. This is often necessary to set priorities for allocating the limited financial assistance which is available. Such decisions are potentially difficult in the absence of both detailed descriptions of the specific patches, and the documentation of the regional variation of vegetation. In the absence of such detailed knowledge, the history of agricultural development is probably as useful a criteria as is available. Therefore, maps showing the phases of land alienation (ie settlement) could be used together with Beard's vegetation maps to provide a geographic context in which to assess the value of remnant patches.

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H. APPENDICES

Appendix 1 Floristic Survey Field sheets

DANDARAGAN REMNANTS VEGETATION ASSESSMENT

Property:.................., Reserve No: _ _ _ _ _, AMG: 50J _ _ _ _ _ _ _ _ _, Map:...................

Code: _ _ _ _ _ _ _ _, Type: _, Fenced: _, Condition:..............., Patch Size: _ _ _ _ ha, Fire Age: _ _ yr

Landscape:....................................., Veg Type:..............................., Slope: _ _°, Aspect: _ _°

Bare: _ _%, Litter: _ _%, Weeds: _ _%, Drainage: _, Wet: _, Salt: _, Geol:................, Date: _ _/_ _/_ _

Surface Soil:.. Sub Soil:.......................................

T1: _, T2: _, MT: _, MS: _, S: _, SA: _, SB: _, SC: _, SD: _, MP: _, B: _, H: _, SA: _, SB: _,

(+ solitary, insig, 1 seldom, insig, 2 <1%, 3 1-5%, 4 5-10%, 5 10-25%, 6 25-33.3%, 7 33.3-50%, 8 50-75%, 9 >75%)

Appendix 2 Muir Vegetation Classification Scheme

VEGETATION CLASSIFICATION TO BE USED IN WHEATBELT SURVEY

LIFE FORM/HEIGHT CLASS		CANOPY COVER			
		DENSE 70-100% d	MID-DENSE 30-70% c	SPARSE 10-30% i	VERY SPARSE 2-10% r
T	Trees >30m	Dense Tall Forest	Tall Forest	Tall Woodland	Open Tall Woodland
M	Trees 15-30m	Dense Forest	Forest	Woodland	Open Woodland
LA	Trees 5-15m	Dense Low Forest A	Low Forest A	Low Woodland A	Open Low Woodland A
LB	Trees <5m	Dense Low Forest B	Low Forest B	Low Woodland B	Open Low Woodland B
KT	Mallee tree form	Dense Tree Mallee	Tree Mallee	Open Tree Mallee	Very Open Tree Mallee
KS	Mallee shrub form	Dense Shrub Mallee	Shrub Mallee	Open Shrub Mallee	Very Open Shrub Mallee
S	Shrubs >2m	Dense Thicket	Thicket	Scrub	Open Scrub
SA	Shrubs 1.5-2.0m	Dense Heath A	Heath A	Low Scrub A	Open Low Scrub A
SB	Shrubs 1 0-1.5m	Dense Heath B	Heath B	Low Scrub B	Open Low Scrub B
SC	Shrubs 0.5-1.0m	Dense Low Heath C	Low Heath C	Dwarf Scrub C	Open Dwarf Scrub C
SD	Shrubs 0.0-0.5m	Dense Low Heath D	Low Heath D	Dwarf Scrub D	Open Dwarf Scrub D
P	Mat plants	Dense Mat Plants	Mat Plants	Open Mat Plants	Very Open Mat Plants
H	Hummock Grass	Dense Hummock Grass	Mid-Dense Hummock Grass	Hummock Grass	Open Hummock Grass
GT	Bunch grass >0.5m	Dense Tall Grass	Tall Grass	Open Tall Grass	Very Open Tall Grass
GL	Bunch grass <0.5m	Dense Low Grass	Low Grass	Open Low Grass	Very Open Low Grass
J	Herbaceous spp.	Dense Herbs	Herbs	Open Herbs	Very Open Herbs
VT	Sedges >0.5m	Dense Tall Sedges	Tall Sedges	Open Tall Sedges	Very Open Tall Sedges
VL	Sedges <0.5m	Dense Low Sedges	Low Sedges	Open Low Sedges	Very Open Low Sedges
X	Ferns	Dense Ferns	Ferns	Open Ferns	Very Open Ferns
	Mosses, liverwort	Dense Mosses	Mosses	Open Mosses	Very Open Mosses

Appendix 3 Vascular Plant Species List

This list is not attempting to be comprehensive of the Study Area, it mainly includes species found in or around quadrats. It is supplemented by information collected by Griffin, Hopper and Hopkins (unpublished data) for endemic species.

Species are organised in plant families following the order of Green (1985). Nomenclature follows Green, but takes into account recent revisions provided in supplements. Name changes from two recent revisions (Crisp and Weston 1989 involving *Gastrolobium, Oxylobium* and *Nemcia,* and Wilson 1989 involving *Helipterum*) have not been included.

For each undescribed and uncertain taxon a voucher is cited. In some cases initials are used: EAG - E.A. Griffin

These specimens are mostly in the lodged in the collection of the Western Australian Herbarium except for some marked "n.v."

Certain distribution information is also provided. (Sources Griffin, Hopper and Hopkins unpublished data, Rye 1982)
First column - Declared Rare Flora
Second column - Geographic range: (1) less than 50 km, (2) 50 to 160 km, (3) greater than 160 km but endemic to Northern Kwongan between Moore and Irwin Rivers, (.) greater than 160 km but not an endemic.
Third column - Conservation coding: (1 to 5) research priorities outlined in Table 3.

Alien species are indicated by "*" in front of the name.

MONOCOTYLEDONS

** 2 LYCOPODIACEAE
. . . *Phylloglossum drummondii* Kunze

** 3 SELAGINELLACEAE
. . . *Selaginella gracillima* (Kunze)Alston

** 7 ADIANTACEAE
. . . *Cheilanthes austrotenuifolia* H.Quirk & T.C.Chambers

** 16A ZAMIACEAE
. . . *Macrozamia riedlei* (Fisch.ex Gaudich.)C.Gardner

** 18 CUPRESSACEAE
. . . *Actinostrobus acuminatus* Parl.
. . . *Actinostrobus arenarius* C.Gardner
. . . *Actinostrobus pyramidalis* Miq.

** 26 JUNCAGINACEAE
. . . *Triglochin centrocarpa* Hook.
. . . *Triglochin minutissima* F.Muell.
. . . *Triglochin striata* Ruiz Lopez & Pavon

** 31 POACEAE
. . . *Amphipogon debilis* R.Br.
. . . *Amphipogon turbinatus* R.Br.
. . . **Avena fatua* L.
. . . **Briza maxima* L.
. . . **Briza minor* L.
. . . *Bromus rubens* L.
. . . *Danthonia caespitosa* Gaudich.
. . . **Ehrharta longiflora* Smith
. . . *Neurachne alopecuroides* R.Br.
. . . **Pentaschistis airoides* (Nees)Stapf
. . . *Plectrachne danthonioides* (F.Muell.)C.E.Hubb.
. . . *Poa drummondiana* Nees
. . . *Stipa elegantissima* Labill.
. . . *Stipa macalpinei* Reader
. . . **Vulpia myuros* (L.)C.Gmelin var. *hirsuta* Hack.

** 32 CYPERACEAE
. . . *Baumea juncea* (R.Br.)Palla
. . . *Baumea preissii* Nees
. . . *Caustis dioica* R.Br.
. . . *Cyperus tenuifloris* Rottb.
. . . *Isolepis marginata* (Thunb.)A.Dietr.
. . . *Isolepis* sp indet (EAG 5022)
. . . *Lepidosperma angustatum* R.Br.
. . . *Lepidosperma pubsquameum* Steudel
. . . *Lepidosperma scabrum* Nees
. . . *Lepidosperma tenue* Benth.
. . . *Lepidosperma* sp indet (EAG 4583)
. . . *Mesomelaena graciliceps* (C.B.Clarke)K.L.Wilson
. . . *Mesomelaena stygia* (R.Br.)Nees
. . . *Mesomelaena tetragona* (R.Br.)Benth.
. . . *Schoenus brevisetis* (R.Br.)Benth.
. . . *Schoenus caespititius* W.Fitzg.
. . . *Schoenus curvifolius* (R.Br.)Benth.
. . . *Schoenus globifer* Nees
. . . *Schoenus grandiflorus* (Nees)F.Muell.
. . . *Schoenus pedicellatus* (R.Br.)Benth.
. . . *Schoenus pleistemoneus* F.Muell.
. . . *Schoenus rigens* S.T.Blake
. . . *Schoenus rodwayanus* W.Fitzg.
. . . *Schoenus subflavus* Kuek.
. . . *Schoenus unispiculatus* F.Muell.ex Benth.
. . . *Schoenus* aff. *brevisetis* (R.Br.)Benth. (EAG 1911)
. 1 2 *Schoenus* aff. *indutus* (EAG 3842)
. 3 2 *Schoenus* aff. *obtusifolius* Kuek. (EAG 3841)
. . . *Schoenus* aff. *rodwayanus* W.Fitzg. (BJ Keighery 731)
. . . *Tetraria octandra* (Nees)Kuek.
. . . *Tricostularia neesi* Lehm.

** 39 RESTIONACEAE
. . . *Alexgeorgia nitens* (Nees)L.Johnson & B.Brigg
. 3 7 *Alexgeorgia subterranea* Carlq.
. . . *Anarthria gracilis* R.Br.
. . . *Anarthria laevis* R.Br.
. . . *Anarthria polyphylla* Nees
. . . *Anarthria prolifera* R.Br.
. . . *Ecdeiocolea monostachya* F.Muell.
. . . *Hypolaena exsulcata* R.Br.
. . . *Lepidobolus chaetocephalus* F.Muell.

RESTIONACEAE (continued)

. . . *Lepidobolus preissianus* Nees
. 2 3 *Lepidobolus* sp (EAG 2093)
. . . *Lepidibolus* sp indet
. . . *Leptocarpus coangustatus* Nees
. . . *Loxocarya fasciculata* (R.Br.)Benth.
. . . *Loxocarya flexuosa* (R.Br.)Benth.
. . . *Loxocarya* aff. *cinerea* R.Br. (EAG 1986)
. 2 2 *Loxocarya* aff. *fasciculata* (R.Br.)Benth. (B Briggs 6319)
. . . *Loxocarya* sp (EAG 4588)
. . . *Loxocarya* sp (EAG 5230)
. 2 1 *Loxocarya* sp (EAG 5268)
. . . *Loxocarya* sp indet
. . . *Lyginea barbata* R.Br.
. . . *Restio* aff. *sphacelatus* R.Br. (EAG 653)
. 2 3 *Restio* sp (B Briggs 850)
. 3 3 *Restio* sp (B Briggs 6308)
. . . *Restio* sp indet

** 40 CENTROLEPIDACEAE
. . . *Aphelia brizula* F.Muell.
. . . *Aphelia cyperoides* R.Br.
. . . *Aphelia nutans* J.D.Hook.ex Benth.
. . . *Centrolepis aristata* (R.Br.)Roemer & Schultes
. . . *Centrolepis drummondiana* (Nees)Walp.
. . . *Centrolepis pilosa* Heiron.
. . . *Centrolepis polygyna* (R.Br.)Hieron
. . . *Centrolepis* aff. *drummondiana* (Nees)Walp. (EAG 4956)

** 50 PHILYDREACEAE
. . . *Philydrella pygmaea* (R.Br.)Caruel ssp. pygmaea

** 52 JUNCACEAE
. . . *Juncus pallidus* R.Br.

** 54C DASYPOGONACEAE
. . . *Acanthocarpus caniculatus* George
. . . *Acanthocarpus preissii* Lehm.
. . . *Calectasia cyanea* R.Br.
. . . *Chamaexeros serra* (Endl.)Benth.
. 2 7 *Dasypogon obliquifolius* Lehm.ex Nees
. . . *Lomandra brittanii* T.S.Choo
. . . *Lomandra caespitosa* (Benth.)Ewart
. . . *Lomandra collina* (R.Br.)Ewart
. . . *Lomandra hastilis* (R.Br.)Ewart
. . . *Lomandra hermaphrodita* (C.P.R.Andrews)C.Gardner
. . . *Lomandra preissii* (Endl.)Ewart
. . . *Lomandra sericea* (Endl.)Ewart
. . . *Lomandra suaveolens* (Endl.)Ewart
. . . *Lomandra* sp indet (hemispherical leaf)

** 54D XANTHORRHOEACEAE
. . . *Xanthorrhoea drummondii* Harvey
. . . *Xanthorrhoea preissii* Endl.

** 54E PHORMIACEAE
. . . *Dianella revoluta* R.Br. var. *divaricata* (R.Br.)R.Henderson
. . . *Stypandra glauca* R.Br.

** 54F ANTHERICACEAE
. 1 1 *Arnocrinum gracillimum* Keighery
. . . *Arnocrinum preissii* Lehm.ex Endl.
. . . *Arthropodium curvipes* S.Moore
. . . *Borya sphareocephala* R.Br.
. . . *Caesia micrantha* Lindley
. . . *Caesia* aff. *micrantha* Lindley (EAG 5158)
. . . *Chamaescilla corymbosa* (R.Br.)F.Muell.ex Benth.
. . . *Chamaescilla spiralis* (Lindley)Oestenf.
. . . *Corynotheca micrantha* (Lindley)J.F.Macbr.
. . . *Dichopogon capillipes* (Endl.)Brittan
. . . *Dichopogon preissii* (Endl.)brittan
. 2 2 *Hensmania stoniella* Keighery
. . . *Hensmania turbinata* (Endl.)W.Fitzg.
. . . *Johnsonia pubescens* Lindley
. . . *Laxmannia omnifertilis* Keighery
. . . *Laxmannia ramosa* Lindley
. . . *Laxmannia sessiliflora* Decne. ssp. *drummondii* Keighery
. . . *Sowerbaea laxiflora* Lindley
. 3 1 *Thysanotus anceps* Lindley
. . . *Thysanotus dichotomus* (Labill.)R.Br.
. . . *Thysanotus manglesianus* Kunth
. . . *Thysanotus patersonii* R.Br.
. . . *Thysanotus sparteus* R.Br.
. 2 2 *Thysanotus spiniger* Brittan
. . . *Thysanotus tenellus* Endl.
. . . *Thysanotus thyrsoideus* Baker
. . . *Thysanotus triandrus* (Labill.)R.Br.
. 1 2 *Thysanotus vernalis* Brittan
. . . *Thysanotus* aff. *multiflorus* R.Br. (BJ Keighery 205)
. 1 2 *Thysanotus* aff. *sparteus* R.Br. (EAG 2511)
. . . *Tricoryne elatior* R.Br.

** 54J COLCHICACEAE
. . . *Burchardia bairdiae* Keighery
. . . *Burchardia multiflora* Lindley
. . . *Burchardia umbellata* R.Br.
. . . *Wurmbea dioica* (R.Br.)F.Muell. ssp. *alba* T.Macfarlane

** 55 HAEMORODACEAE
. . . *Anigozanthos humilis* Lindley ssp. humilis
. . . *Anigozanthos pulcherrimus* Hook.
. . . *Blancoa canescens* Lindley
. . . *Conostylis aculeata* R.Br. ssp. *aculeata*
. 2 7 *Conostylis aculeata* R.Br. ssp. *breviflora* Hopper
. . . *Conostylis androstemma* F.Muell.
. 2 7 *Conostylis angustifolia* Hopper
. . . *Conostylis aurea* Lindley
. . . *Conostylis candicans* Endl. ssp. *candicans*
. 3 7 *Conostylis crassinerva* J.W.Green ssp. *absens* Hopper
. 2 7 *Conostylis crassinerva* J.W.Green ssp. *crassinerva*
. . . *Conostylis festucacea* Endl. ssp. *festucacea*
. 1 7 *Conostylis festucacea* Endl. ssp. *filifolia* (F.Muell.)Hopper
. 3 7 *Conostylis hiemalis* Hopper
. . . *Conostylis juncea* Endl.
. . . *Conostylis latens* Hopper
. . . *Conostylis prolifera* Benth.
. . . *Conostylis teretifolia* J.W.Green ssp. *teretifolia*
. . . *Conostylis teretiuscula* F.Muell.
. . . *Conostylis* sp indet (EAG 5348)

HAEMODORACEAE (continued)

. . . *Haemodorum laxum* R.Br.
. 2 7 *Haemodorum loratum* T.Macfarlane
. . . *Haemodorum simplex* Lindley
. . . *Haemodorum spicatum* R.Br.
. 2 7 *Haemodorum venosum* T.Macfarlane
. 3 5 *Macropidia fuliginosa* (Hook.)Druce
. . . *Phlebocarya ciliata* R.Br.
. 2 3 *Phlebocarya filifolia* (F.Muell.)Benth.
. 2 3 *Phlebocarya pilosissima* (F.Muell.)Benth. ssp. *pilosissima*
. . . *Tribonanthes australis* Endl.

** 60 IRIDACEAE

. . . *Orthrosanthus laxus* (Endl.)Benth. var. *laxus*
. . . *Patersonia juncea* Lindley
. . . *Patersonia occidentalis* R.Br.
. . . *Patersonia* aff. *umbrosa* R.Br. (EAG 5448)

** 66 ORCHIDACEAE

. . . *Caladenia flava* R.Br. ssp. flava
. . . *Caladenia gemmata* Lindley
. . . *Caladenia hirta* Lindley ssp. hirta
. . . *Caladenia longicauda* Lindley ssp. (SD Hopper sn)
. . . *Caladenia roei* Benth.
. . . *Caladenia* sp (AP Brown 198 & Sv Leeuwen)
. . . *Diuris laxiflora* Lindley
. . . *Diuris longifolia* R.Br.
. . . *Diuris* sp indet
. . . *Drakea elastica* Lindley
. . . *Elythranthera brunonis* (Endl.)George
. . . *Eriochilus dilatatus* Lindley
. . . *Leporella fimbriata* (Lindley)George
. . . *Leporella menziesii*
. . . *Microtus unifolia* (G.Forster)H.G.Reichb.
. . . *Orchid sp indet* (brown spotted leaf)
. . . *Prasophyllum cyphochilum* Benth.
. . . *Prasophyllum ovale* Lindley var. *triglochin* H.G.Reichb.
. . . *Prasophyllum sargentii* (Nichols)George
. . . *Prasophyllum* sp (EAG sn)
. . . *Pterostylis nana* R.Br.
. . . *Pterostylis vittata* Lindley
. . . *Thelymitra antennifera* (Lindley)J.D.Hook.
. . . *Thelymitra campanulata* Lindley
. . . *Thelymitra pauciflora* R.Br.
. 2 5 *Thelymitra variegata* (Lindley)F.Muell. var. *apiculata* A.S.George

DICOTYLEDONS

** 70 CASUARINEACEAE
. . . *Allocasuarina campestris* (Diels)L.Johnson
. 2 3 *Allocasuarina grevillioides* (Diels)L.Johnson
. . . *Allocasuarina humilis* (Otto & Dietr.)L.Johnson
. . . *Allocasuarina microstachya* (Miq.)L.Johnson
. 2 7 *Allocasuarina ramosissima* (C.Gardner)L.Johnson
. . . *Allocasuarina thuyoides* (Miq.)L.Johnson
. . . *Casuarina obesa* Miq.

** 90 PROTEACEAE
. . . *Adenanthos cygnorum* Diels
. . . *Adenanthos drummondii* Meissner
. . . *Banksia attenuata* R.Br.
. 3 7 *Banksia burdettii* E.G.Baker
. . . *Banksia candolleana* Meissner
. 2 7 *Banksia chamaephyton* George
. . . *Banksia grandis* Willd.
. 2 7 *Banksia grossa* George
. . . *Banksia ilicifolia* R.Br.
. . . *Banksia incana* George
. 2 7 *Banksia lanata* George
. ? . *Banksia laricina* C.Gardner
. . . *Banksia leptophylla* George
. . . *Banksia littoralis* R.Br.
. . . *Banksia menziesii* R.Br.
. 2 7 *Banksia micrantha* George
. . . *Banksia prionotes* Lindley
. . . *Banksia sphaerocarpa* R.Br. var. *sphaerocarpa*
. . . *Conospermum acerosum* Lindley
. . . *Conospermum densiflorum* Lindley
. . . *Conospermum glumaceum* Lindley
. . . *Conospermum incurvum* Lindley
. 2 7 *Conospermum nervosum* Meissner
. . . *Conospermum stoechadis* Endl.
. . . *Conospermum* aff. *triplinervium* R.Br. (EAG 5262)
. . . *Dryandra armata* R.Br.
. . . *Dryandra bipinnatifida* R.Br.
. 3 7 *Dryandra carlinoides* Meissner
. . . *Dryandra cuneata* R.Br.
. . . *Dryandra fraseri* R.Br.
. 3 7 *Dryandra kippistiana* Meissner
. 2 7 *Dryandra nana* Meissner
. . . *Dryandra nivea* (Labill.)R.Br.
. . . *Dryandra patens* Benth.
. 1 7 *Dryandra sclerophylla* Meissner
1 2 6 *Dryandra serratuloides* Meissner
. . . *Dryandra sessilis* (Knight)Domin
. 3 7 *Dryandra shuttleworthiana* Meissner
. . . *Dryandra speciosa* Meissner
. 2 3 *Dryandra subulata* C.Gardner
. 2 3 *Dryandra tortifolia* Kipp.ex Meissner
. 2 7 *Dryandra tridentata* Meissner
. 2 7 *Dryandra* aff. *conferta* Benth. (EAG 3162)
. 2 7 *Dryandra* aff. *falcata* R.Br. (EAG 3489)
. 2 7 *Dryandra* aff. *patens* Benth. (EAG 1507)
. 2 1 *Dryandra* aff. *polycephala* (EAG 4945)
. 2 7 *Dryandra* aff. *pteridifolia* R.Br. (EAG 3457)

PROTEACEAE (continued)

. . . *Grevillea acerosa* F.Muell.
. . . *Grevillea amplexans* F.Muell.ex Benth.
. . . *Grevillea brachystachya* Meissner
. . . *Grevillea drummondii* Meissner
. . . *Grevillea eriostachya* Lindley
. . . *Grevillea hookeriana* Meissner
. . . *Grevillea integrifolia* (Endl.)Meissner ssp. *integrifolia*
. . . *Grevillea integrifolia* (Endl.)Meissner ssp. *shuttleworthiana* (Meissner)McGillvray
. . . *Grevillea leucopteris* Meissner
. . . *Grevillea paniculata* Meissner
. . . *Grevillea pilulifera* (Lindley)Druce
. . . *Grevillea pinifolia* Meissner
. . . *Grevillea polybotrya* Meissner
. 2 7 *Grevillea rudis* Meissner
1 2 6 *Grevillea saccata* Benth.
. . . *Grevillea synapheae* R.Br.
. 2 1 *Grevillea thyrsoides* Meissner
. . . *Grevillea vestita* (Endl.)Meissner
. 1 2 *Grevillea* aff. *bipinnatifida* R.Br. (SD Hopper 6350)
. . . *Grevillea* aff. *flexuosa* (Lindley)Meissner (EAG 5040)
1 1 6 *Grevillea* aff. *hookeriana* Meissner (SD Hopper 6333)
. . . *Hakea auriculata* Meissner var. *auriculata*
. 2 1 *Hakea auriculata* Meissner var. *spathulata* Meissner
. . . *Hakea baxteri* R.Br.
. . . *Hakea brachyptera* Meissner
. . . *Hakea candolleana* Meissner
. . . *Hakea circumalata* Meissner
. 2 7 *Hakea conchifolia* Hook.
. . . *Hakea corymbosa* R.Br.
. . . *Hakea costata* Meissner
. . . *Hakea erinacea* Meissner var. erinacea
. 1 1 *Hakea erinacea* Meissner var. longiflora Benth.
. 2 7 *Hakea flabellifolia* Meissner
. . . *Hakea gilbertii* Kipp.ex Meissner
. . . *Hakea incrassata* R.Br.
. . . *Hakea invaginata* B.L.Burtt
. . . *Hakea lissocarpha* R.Br.
. . . *Hakea marginata* R.Br.
1 2 6 *Hakea megalosperma* Meissner
. . . *Hakea myrtoides* Meissner
. . . *Hakea obliqua* R.Br.
. . . *Hakea platysperma* Hook.
. . . *Hakea prostrata* R.Br.
. . . *Hakea ruscifolia* Labill.
. . . *Hakea smilacifolia* Meissner
. . . *Hakea stenocarpa* R.Br.
. . . *Hakea trifurcata* (Smith)R.Br.
. . . *Hakea undulata* R.Br.
. . . *Hakea varia* R.Br.
. . . *Hakea* aff. *falcata* R.Br. (EAG 4745)
. . . *Hakea* aff. *obliqua* R.Br. (EAG sn)
. 3 3 *Isopogon adenanthoides* Meissner
. . . *Isopogon asper* R.Br.
. . . *Isopogon divergens* R.Br.
. . . *Isopogon drummondii* Benth.
. . . *Isopogon dubius* (R.Br.)Druce
. . . *Isopogon linearis* Meissner
. . . *Isopogon teretifolius* R.Br.

PROTEACEAE (continued)

. . . *Isopogon* aff. *axillaris* R.Br. (EAG 5368)
. . . *Lambertia multiflora* Lindley
. . . *Persoonia comata* Meissner
. . . *Persoonia quinquenervis* Hook.
. 1 1 *Persoonia rudis* Meissner
. . . *Persoonia striata* R.Br.
. . . *Persoonia* aff. *sulcata* Meissner (EAG 795)
. . . *Petrophile brevifolia* Lindley
. . . *Petrophile brevifolia x linearis*
. 2 7 *Petrophile chrysantha* Meissner
. . . *Petrophile chrysantha* Meissner (EAG) (inland form)
. . . *Petrophile drummondii* Meissner
. . . *Petrophile ericifolia* R.Br.
. 2 7 *Petrophile inconspicua* Meissner
. . . *Petrophile linearis* R.Br.
. . . *Petrophile macrostachya* R.Br.
. . . *Petrophile megalostegia* F.Muell.
. . . *Petrophile seminuda* Lindley
. . . *Petrophile serruriae* R.Br.
. . . *Petrophile shuttleworthiana* Meissner
. . . *Petrophile striata* R.Br.
. . . *Petrophile* aff. *brevifolia* Lindley (EAG 2203)
. . . *Petrophile* aff. *divaricata* R.Br. (EAG 2547)
. . . *Stirlingia arbrontanoides*
. . . *Stirlingia latifolia* (R.Br.)Steudel
. . . *Stirlingia simplex* Lindley
. 2 7 *Strangea cynanchocarpa* (Meissner)F.Muell.
. . . *Synaphea petiolaris* R.Br.
. . . *Synaphea spinulosa* (Burm.f.)Merr.
. . . *Xylomelum angustifolium* Kipp. & Meissner

** 92 SANTALACEAE
. . . *Exocarpos aphyllus* R.Br.
. . . *Exocarpus aphyllus* R.Br.
. . . *Leptomeria empetriformis* Miq.
. . . *Santalum spicatum* (R.Br.)A.DC.

** 95 OLACACEAE
. . . *Olax benthamiana* Miq.
. 3 1 *Olax scalariformis* A.S.George

** 97 LORANTHACEAE
. . . *Lysiana casuarinae* (Miq.)Tieghem
. . . *Nuytsia floribunda* (Labill.)R.Br.ex Fenzel

** 103 POLYGONACEAE
. . . *Muehlenbeckia adpressa* (Labill.)Meissner

** 105 CHENOPODIACEAE
. . . *Rhagodia baccata* (Labill.)Moq.

** 106 AMARANTHACEAE
. . . *Ptilotus gaudichaudii* (Steudel)J.Black
. . . *Ptilotus manglesii* (Lindley)F.Muell.
. . . *Ptilotus stirlingii* (Lindley)F.Muell. var. *stirlingii*

** 108 GYROSTEMONACEAE
. . . *Gyrostemon ramulosus* Desf.
. . . *Tersoonia cyathiflora* (Fenzl)George

** 110A MOLLUGINACEAE
. . . *Macarthuria apetala* Harvey
. . . *Macarthuria australis* Huegel ex Endl.

** 111 PORTULACACEAE
. . . *Calandrinia calyptrata* J.D.Hook.
. . . *Calandrinia corrigioloides* F.Muell.ex Benth.
. . . *Calandrinia decumbens*
. . . *Calandrinia granulifera* Benth.

** 131 LAURACEAE
. . . *Cassytha flava* Nees
. . . *Cassytha glabella* R.Br.
. . . *Cassytha pomiformis* Nees
. . . *Cassytha racemosa* Nees

** 143 DROSERACEAE
. . . *Drosera barbigera* Planchon
. . . *Drosera bulbosa* Hook.
. . . *Drosera erythrorrhiza* Lindley
. . . *Drosera gigantea* Lindley
. . . *Drosera glanduligera* Lehm.
. . . *Drosera heterophylla* Lindley
. . . *Drosera leucoblasta* Benth.
. . . *Drosera macrantha* Endl.
. . . *Drosera menziesii* R.Br. ssp. *menziesii*
. . . *Drosera radicans* N.Marchant
. . . *Drosera rehingeri* A.Strid
. . . *Drosera stolonifera* Endl. ssp. *humilis* (Planchon)N.Marchant
. . . *Drosera stolonifera* Endl. ssp. *stolonifera*

** 149 CRASSULACEAE
. . . *Crassula colorata* (Nees)Ostenf.
. . . *Crassula natans* Thunb.
. . . *Crassula peduncularis* (Smith)Meigen

** 152 PITTOSPORACEAE
. . . *Billardiera bicolor* (Putterl.)E.M.Bennett
. . . *Billardiera coeruleo-punctata* (Klotzsch)E.M.Bennett
. . . *Billardiera ringens* (J.Drumm.ex Harvey)E.M.Bennett
. . . *Sollya heterophylla* Lindley

** 160 SURIANACEAE
. . . *Stylobasium australe* (Hook.)Prance

** 163 MIMOSACEAE
. . . *Acacia acuminata* Benth.
. . . *Acacia alata* R.Br. var. *alata*
. . . *Acacia auronitens* Lindley
. . . *Acacia barbinervis* Benth.
. . . *Acacia blakelyi* Maiden
. . . *Acacia costata* Benth.
. 2 7 *Acacia epacantha* (Maslin)Maslin
. . . *Acacia ericifolia* Benth.
. 2 1 *Acacia flabellifolia* W.Fitzg.
1 2 6 *Acacia forrestiana* E.Pritzel
. . . *Acacia incrassata* Hook.
. . . *Acacia lasiocarpa* Benth. var. *bracteolata* Maslin
. . . *Acacia lasiocarpa* Benth. var. *lasiocarpa*
. . . *Acacia lasiocarpa* Benth. var. *sedifolia* (Meissner)Maslin

MIMOSACEAE (continued)

. . . *Acacia latipes* Benth.
. . . *Acacia leptospermoides* Benth. ssp. *leptospermoides*
. . . *Acacia microbotrya* Benth.
. . . *Acacia moirii* E.Pritzel ssp. *recurvistipula* Maslin
. . . *Acacia multispicata* Benth.
. 2 2 *Acacia plicata* Maslin
. . . *Acacia pulchella* R.Br. var. *glaberrima* Meissner
. . . *Acacia pulchella* R.Br. var. *goadbyi* (Domin)Maslin
. . . *Acacia pulchella* R.Br. var. *pulchella*
. . . *Acacia saligna* (Labill.)H.L.Wendl.
. . . *Acacia scirpifolia* Meissner
. . . *Acacia sessilis* Benth.
. . . *Acacia sp indet* (EAG 4906)
. . . *Acacia sphacelata* Benth.
. . . *Acacia stenoptera* Benth.
. 2 3 *Acacia volubilis* F.Muell.
. . . *Acacia* aff. *microbotrya* Benth. (BR Maslin 5302)
. 2 2 *Acacia* aff. *myrtifolia* (Smith)Willd. (RJ Cranfield 33)

** 164 CAESALPINIACEAE
. . . *Labichea punctata* Benth.

** 165 PAPILIONACEAE
. . . *Aotus procumbens* Meissner
. . . *Bossiaea eriocarpa* Benth.
. . . *Chorizema aciculare* (DC.)C.Gardner
. . . *Daviesia benthamii* Meissner
. . . *Daviesia cardiophylla* F.Muell.
. . . *Daviesia daphnoides* Meissner
. . . *Daviesia decurrens* Meissner
. . . *Daviesia dielsii* E.Pritzel
. . . *Daviesia divaricata* Benth.
. . . *Daviesia hakeoides* Meissner
. . . *Daviesia incrassata* Smith
. . . *Daviesia nudiflora* Meissner
. . . *Daviesia pedunculata* Benth.
. . . *Daviesia polyphylla* Benth.
. . . *Daviesia preissii* Meissner
. . . *Daviesia quadrilatera* Benth.
. . . *Daviesia triflora* M.D.Crisp
. . . *Daviesia* aff. *quadrilatera* Benth. (EAG 5349)
. 1 2 *Daviesia* aff. *striata* Turcz. (MD Crisp 6213)
. . . *Euchilopsis linearis* (Benth.)F.Muell.
. 2 7 *Gastrolobium bidens* Meissner
. . . *Gastrolobium callistachys* Meissner
. . . *Gastrolobium ilicifolium* Meissner
. . . *Gastrolobium ilicifolium* Meissner var. lobatum Benth.
. . . *Gastrolobium oxylobioides* Benth.
. . . *Gastrolobium pauciflorum* C.Gardner
. . . *Gastrolobium plicatum* Turcz.
. . . *Gastrolobium spinosum* Benth.
. . . *Gastrolobium villosum* Benth.
. . . *Gompholobium aristatum* Benth.
. . . *Gompholobium burtonioides* Meissner
. . . *Gompholobium knightianum* Lindley
. . . *Gompholobium marginatum* R.Br.
. . . *Gompholobium preissii* Meissner
. . . *Gompholobium shuttleworthii* Meissner
. . . *Gompholobium tomentosum* Labill.

PAPILIONACEAE (continued)

. . . *Hovea pungens* Benth.
. . . *Hovea stricta* Meissner
. . . *Hovea trisperma* Benth.
. . . *Isotropis cuneifolia* (Smith)Benth.ex B.D.Jackson
. . . *Jacksonia capitata* Benth.
. 2 3 *Jacksonia carduacea* Meissner
. 2 2 *Jacksonia eremodendron* E.Pritzel
. . . *Jacksonia floribunda* Endl.
. . . *Jacksonia foliosa* Turcz.
. . . *Jacksonia furcellata* (Bonpl.)DC.
. . . *Jacksonia lehmannii* Meissner
. . . *Jacksonia macrocalyx* Meissner
. . . *Jacksonia restioides* Meissner
. . . *Jacksonia spinosa* (Labill.)R.Br.
. . . *Jacksonia sternbergiana* Huegel
. . . *Jacksonia stricta* Meissner
. . . *Jacksonia ulicina* Meissner
. . . *Jacksonia* aff. *sericea* Benth. (EAG 5534)
. . . *Kennedia prostrata* R.Br.
. . . *Mirbelia floribunda* Benth.
. . . *Mirbelia spinosa* Benth.
. . . *Oxylobium capitatum* Benth.
. 2 2 *Oxylobium reticulatum* Meissner var. gracile Benth.
. . . *Pultenaea ericifolia* Benth.
. . . *Sphaerolobium macranthum* Meissner
. 2 3 *Sphaerolobium macranthum* Meissner var. pulchellum
. . . *Templetonia biloba* (Benth.)Polh.
. . . *Templetonia sulcata* (Meissner)Benth.
. . . **Trifolium campestre* Schreber
. . . *Viminaria juncea* (Schrader & Wendl.)Hoffsgg.

** 167 GERANIACEAE
. . . **Erodium aureum* Carolin
. . . *Erodium cygnorum* Nees
. . . *Erodium* sp indet

** 168 OXALIDACEAE
. . . **Oxalis* sp indet

** 175 RUTACEAE
1 2 6 *Asterolasia drummondii* Paul G.Wilson
. . . *Boronia coerulescens* F.Muell.
. . . *Boronia cymosa* Endl.
. . . *Boronia ovata* Lindley
. . . *Boronia ramosa* (Lindley)Benth. ssp. *anaethifolia* (Bartl.) Paul G.Wilson
. . . *Diplolaena microcephala* Bartling var. *drummondii* Benth.
. . . *Diplolaena microcephala* Bartling var. *velutina*
. 2 7 *Eriostemon pinoides* Paul G.Wilson
. . . *Eriostemon spicatus* A.Rich.
. . . *Geleznowia verrucosa* Turcz.

** 182 TREMANDRACEAE
. . . *Tetratheca confertifolia* Steetz
. . . *Tetratheca paucifolia* J.Thompson
. . . *Tetratheca* sp (EAG 5175)

** 183 POLYGALACEAE
. 2 3 *Comesperma acerosum* Steetz
. . . *Comesperma calymega* Labill.
. . . *Comesperma ciliatum* Steetz
. . . *Comesperma scoparium* Steetz

** 185 EUPHORBIACEAE
. . . *Beyeria brevifolia* (Muell.arg.)Benth.
. . . **Euphorbia terracina* L.
. . . *Monotaxis grandiflora* Endl.
. . . *Phyllanthus calycinus* Labill.
. . . *Poranthera microphylla* Brong.
. . . *Pseudanthus virgatus* (Klotzsch)Muell.Arg.
. . . *Ricinocarpus glaucus* Endl.
. . . *Stachystemon axillaris* George
. . . *Stachystemon vermicularis* Planchon

** 202 STACKHOUSIACEAE
. . . *Stackhousia monogyna* Labill.
. . . *Tripterococcus brunonis* Endl.

** 207 SAPINDACEAE
. . . *Diplopeltis huegelii* Endl.
. . . *Dodonaea divaricata* Benth.
. . . *Dodonaea ericoides* Miq.

** 215 RHAMNACEAE
. . . *Cryptandra arbutiflora* Fenzl
. . . *Cryptandra glabriflora* Benth.
. 2 7 *Cryptandra humilis* (Benth.)F.Muell.
. . . *Cryptandra leucophracta* Schldl.
. . . *Cryptandra pungens* Steudel
. . . *Cryptandra* aff. *leucophracta* Schldl. (EAG 5263)
. . . *Spyridium tridentatum* (Steudel)Benth.
. . . *Trymalium ledifolium* Fenzl
. . . *Trymalium wichurae* Nees ex Reissek
. 1 7 *Trymalium* aff. *wichurae* S.Moore (EAG 2234)

** 223 STERCULIACEAE
. . . *Guichenotia sarotes* Benth.
. 2 2 *Guichenotia* sp (EAG 858)
. . . *Keraudrenia hermanniifolia* Gay
. 2 7 *Lasiopetalum drummondii* Benth.
. 2 3 *Lasiopetalum lineare* S.Paust
. 1 1 *Lasiopetalum* aff. *membranaceum* (Steudel)Benth. (Stoate sn)
. . . *Rulingia densiflora* (Turcz.)Benth.
. . . *Rulingia* sp *indet* (EAG 5413)
. . . *Thomasia grandiflora* Lindley

** 226 DILLENIACEAE
. . . *Hibbertia acerosa* (R.Br.ex DC.)Benth.
. . . *Hibbertia aurea* Steudel
. . . *Hibbertia crassifolia* (Turcz.)Benth.
. . . *Hibbertia desmophylla* (Benth.)F.Muell.
. . . *Hibbertia huegelii* (Endl.)F.Muell.
. . . *Hibbertia hypericoides* (DC.)Benth.
. . . *Hibbertia polystachya* Benth.
. . . *Hibbertia racemosa* (Endl.)Gilg
. . . *Hibbertia rupicola* (S.Moore)C.Gardner
. . . *Hibbertia spicata* F.Muell.

DILLENIACEAE (Continued)

. . . *Hibbertia subvaginata* (Steudel)F.Muell.
. . . *Hibbertia* aff. *montana* Steudel (EAG 1831)

** 243 VIOLACEAE
. . . *Hybanthus calycinus* (DC.ex Ging.)F.Muell.
. 2 7 *Hybanthus* aff. *floribundus* (Lindley)F.Muell. (EAG sn)

** 263 THYMELAEACEAE
. . . *Pimelea angustifolia* R.Br.
. . . *Pimelea floribunda* Meissner
. . . *Pimelea imbricata* R.Br. var. piligera (Benth.)Diels & E.Pritzel
. . . *Pimelea leucantha* Diels
. . . *Pimelea sulphurea* Meissner
. . . *Pimelea* sp indet (EAG 4884)

** 273 MYRTACEAE
. . . *Astartea fascicularis* (Labill.)DC.
. . . *Baeckea camphorosmae* Endl.
. . . *Baeckea crispiflora* F.Muell.
. . . *Baeckea floribunda* Benth.
. . . *Baeckea grandiflora* Benth.
. . . *Baeckea tenuifolia* (Turcz.)Domin
. . . *Baeckea* sp (EAG 5206)
. 2 3 *Beaufortia bicolor* Strid
. . . *Beaufortia elegans* Schauer
. 2 1 *Beaufortia eriocephala* W.Fitzg.
. . . *Beaufortia squarrosa* Schauer
. 2 7 *Beaufortia* aff. *bracteosa* Diels (EAG 1176)
. . . *Callistemon phoeniceus* Lindley
. . . *Calothamnus hirsutus* T.J.Hawkeswood
. 3 7 *Calothamnus longissimus* F.Muell.
. . . *Calothamnus quadrifidus* R.Br.
. . . *Calothamnus sanguineus* Labill.
. . . *Calothamnus torulosus* Schauer
. . . *Calytrix acutifolia* L.A.Craven
. . . *Calytrix angulata* Lindley
. . . *Calytrix aurea* Lindley
. . . *Calytrix depressa* (Turcz.)Benth.
. . . *Calytrix flavescens* Cunn.
. . . *Calytrix fraseri* Cunn.
. . . *Calytrix glutinosa* Lindley
. . . *Calytrix leschenaultii* (Schauer)Benth.
. 1 2 *Calytrix platycheiridia* L.A.Craven
. . . *Calytrix sapphirina* Lindley
. . . *Calytrix strigosa* Cunn.
. . . *Calytrix tenuifolia* (Meissner)Benth.
. . . *Calytrix* sp indet (EAG 5265) (Boothendarra)
. . . *Calytrix* sp indet (EAG 5407)
. . . *Chamelauceum uncinatum* Schauer
1 1 6 *Chamelauceum* sp (EAG 4861)
. . . *Conothamnus trinervis* Lindley
. 2 7 *Corynanthera flava* J.W.Green
. 3 7 *Darwinia neildiana* F.Muell.
. . . *Darwinia pauciflora* Benth.
. 1 3 *Darwinia pinifolia* (Lindley)Benth.
. 2 5 *Darwinia sanguinea* (Meissner)Benth.
. 2 7 *Darwinia speciosa* (Meissner)Benth.
. 2 1 *Eremaea beaufortioides* Benth.

MYRTACEAE (continued)

. . . *Eremaea fimbriata* Lindley
. . . *Eremaea pauciflora* (Endl.)Druce ssp. (EAG 5433) (narrow leaf)
. . . *Eremaea pauciflora* (Endl.)Druce ssp. *pauciflora*
. . . *Eremaea violacea* F.Muell.
. 2 2 *Eremaea* aff. *brevifolia* (Benth.)Domin (D Coates M1 175.5)
. 2 3 *Eremaea* aff. *violacea* (EAG 1557)
. . . *Eucalyptus accedens* W.Fitzg.
. . . *Eucalyptus calophylla* Lindley
. . . *Eucalyptus camaldulensis* Dehnh.
. 2 5 *Eucalyptus carnabyi* Blakely & H.Steedman
. . . *Eucalyptus falcata* Turcz.
. . . *Eucalyptus gittinsii* Brooker & Blaxell
. . . *Eucalyptus lane-poolei* Maiden
. . . *Eucalyptus loxophleba* Benth.
. 2 5 *Eucalyptus macrocarpa* Hook. ssp. (SD Hopper 3121)
. . . *Eucalyptus rudis* Endl.
. . . *Eucalyptus tetragona* (R.Br.)F.Muell.
. . . *Eucalyptus todtiana* F.Muell.
. 2 7 *Eucalyptus wandoo* Blakely ssp. (MIH Brooker 9885 & C Souness)
. 1 1 *Eucalyptus* aff. *drummondii* Benth. (MIH Brooker sn)
1 1 6 *Eucalyptus* aff. *petraea* D.J.Carr & S.G.M.Carr (MIH Brooker 9026)
. 2 2 *Eucalyptus* sp (MIH Brooker 9740)
1 1 6 *Eucalyptus* sp (MIH Brooker 9744)
. . . *Eucalyptus* sp (CA Gardner 9088)
. . . *Hypocalymma angustifolium* Endl.
. . . *Hypocalymma linifolium* Turcz.
. . . *Hypocalymma xanthopetalum* F.Muell.
. 1 2 *Hypocalymma* aff. *tetraptrum* Turcz. (CA Gardner 9014) (yellow flower)
. . . *Kunzea ericifolia x recurva*
. . . *Kunzea recurva* Schauer
. . . *Kunzea* aff. *micrantha* Schauer (EAG 5382)
. 1 1 *Kunzea* sp (DJE Whibley 4887)
. . . *Leptospermum oligandrum* Turcz.
. . . *Leptospermum spinescens* Endl.
. . . *Melaleuca acerosa* Schauer
. . . *Melaleuca ciliosa* Turcz.
. . . *Melaleuca cuticularis* Labill.
. . . *Melaleuca hamulosa* Turcz.
. . . *Melaleuca pentagona* Labill.
. . . *Melaleuca platycalyx* Diels
. . . *Melaleuca preissiana* Schauer
. . . *Melaleuca radula* Lindley
. . . *Melaleuca raphiophylla* Schauer
. . . *Melaleuca scabra* R.Br.
. . . *Melaleuca seriata* Lindley
. . . *Melaleuca teretifolia* Endl.
. . . *Melaleuca trichophylla* Lindley
. . . *Melaleuca tuberculata*
. . . *Melaleuca uncinata* R.Br.
. . . *Melaleuca undulata* Benth.
. . . *Melaleuca urceolaris* F.Muell.ex Benth.
. . . *Melaleuca viminea* Lindley
. . . *Melaleuca* aff. *acerosa* Schauer (EAG 2436)
. . . *Melaleuca* aff. *ciliosa* Turcz. (EAG 5468)
. . . *Melaleuca* aff. *tricophylla* Lindley (EAG 5432)
. . . *Melaleuca* sp indet (EAG 5358) (thick leaf)
. . . *Pericalymma ellipticum* (Endl.)Schauer

MYRTACEAE (continued)

. . . *Pileanthus filifolius* Meissner
. . . *Regelia inops* (Schauer)Schauer
. . . *Scholtzia capitata* F.Muell.ex Benth.
. . . *Scholtzia involucrata* (Endl.)Druce
. . . *Scholtzia laxiflora* Benth.
. . . *Scholtzia parviflora* F.Muell.
. 2 3 *Scholtzia teretifolia* Benth.
. . . *Scholtzia* aff. *involucrata* (Endl.)Druce (EAG 5500)
. . . *Scholtzia* aff. *laxiflora* Benth. (EAG 5405)
. . . *Scholtzia* sp indet (EAG 4882)
. . . *Thryptomene prolifera* Turcz.
. . . *Thryptomene racemulosa* Turcz.
. . . *Verticordia acerosa* Lindley
. . . *Verticordia chrysantha* Endl.
. . . *Verticordia densiflora* Lindley
. . . *Verticordia drummondii* Schauer
. 3 7 *Verticordia grandis* J.Drumm.ex Meissner
. . . *Verticordia huegelii* Endl.
. 2 7 *Verticordia insignis* Endl. ssp. (AS George 16871 & EA George)
. 2 7 *Verticordia muelleriana* C.Gardner ssp. *muelleriana*
. . . *Verticordia nitens* (Lindley)Endl.
. . . *Verticordia nobilis* Meissner
. . . *Verticordia ovalifolia* Meissner
. 2 7 *Verticordia patens* George
. . . *Verticordia pennigera* Endl.
. . . *Verticordia picta* Endl.
. . . *Verticordia plumosa* (Desf.)Druce var. (E.Pritzel Oct 1901)
. . . *Verticordia preissii* Schauer
. 3 7 *Verticordia* aff. *chrysantha* Endl. (AS George 7856)
. . . *Verticordia* aff.*brownii* (Desf.)DC. (AS George 16562 & EA George)
. 1 7 *Verticordia* sp (AS George 16361 & EA Berndt)

** 276 HALORAGACEAE
. . . *Glischrocaryon aureum* (Lindley)Orch.
. . . *Gonocarpus nodulosus* Nees
. . . *Gonocarpus pithyoides* (R.Br.ex Benth.)Orch.

** 281 APIACEAE
. . . *Actinotus leucocephalus* Benth.
. . . *Centella asiatica* L.
. . . *Daucus glochidiatus* (Labill.)Fischer et al.
. . . *Eryngium pinnatifidum* Bunge
. . . *Homalosciadium homalocarpum* (F.Muell.)H.Eichler
. . . *Hydrocotyle callicarpa* Bunge
. . . *Platysace juncea* (Bunge)Norman
. . . *Platysace teres* (Bunge)Norman
. . . *Platysace xerophila* (E.Pritzel)L.Johnson
. . . *Trachymene cyanopetala* (F.Muell.)Benth.
. . . *Trachymene ornata* (Endl.)Druce
. . . *Trachymene pilosa* Smith
. . . *Xanthosia candida* (Benth.)Steudel
. . . *Xanthosia ciliata* Hook.
. . . *Xanthosia fruticulosa* Benth.
. . . *Xanthosia huegelii* (Benth.)Steudel

** 288 EPACRIDACEAE
. . . *Andersonia heterophylla* Sonder
. . . *Andersonia lehmanniana* Sonder
. . . *Astroloma glaucescens* Sonder
. . . *Astroloma pallidum* R.Br.
. . . *Astroloma serratifolium* (DC.)Druce var. *horridulum* (Pritzel)Druce
. . . *Astroloma serratifolium* (DC.)Druce var. *serratifolium*
. . . *Astroloma stomarrhena* Sonder
. . . *Astroloma xerophyllum* (DC.)Sonder
. 2 2 *Astroloma* aff. *pallidum* R.Br. (EAG 1022)
. 2 2 *Astroloma* aff. *serratifolium* (DC.)Druce (NG Marchant sn)
. . . *Brachyloma preissii* Sonder
. . . *Conostephium minus* Lindley
. . . *Conostephium pendulum* Benth.
. . . *Conostephium preissii* Sonder
. . . *Leucopogon australis* R.Br.
. . . *Leucopogon capitellatus* DC.
. . . *Leucopogon conostephioides* DC.
. . . *Leucopogon elegans* Sonder
. . . *Leucopogon hispidus* E.Pritzel
. . . *Leucopogon leptanthus* Benth.
. . . *Leucopogon nutans* E.Pritzel
. . . *Leucopogon oxycedrus* Sonder
. 2 3 *Leucopogon phyllostachys* Benth.
. . . *Leucopogon polymorphus* Sonder
. . . *Leucopogon sprengelioides* Sonder
. . . *Leucopogon striatus* R.Br.
. . . *Leucopogon strongylophyllus* F.Muell.
. . . *Leucopogon* aff. *carinatus* R.Br. (EAG 5388)
. . . *Leucopogon* aff. *elegans* Sonder (EAG 5518)
. . . *Leucopogon* aff. *planifolius* Sonder (EAG 2512)
. . . *Leucopogon* aff. *rubicundus* F.Muell.ex Benth. (EAG 2206)
. . . *Leucopogon* sp (EAG 1031) (recurved leaf)
. . . *Lysinema ciliatum* R.Br.

** 293 PRIMULACEAE
. . . **Anagallis arvensis* L. var. *caerulea* Gouan

** 302 LOGANIACEAE
. . . *Logania campanulata* R.Br.
. . . *Logania spermacocea* F.Muell.
. . . *Mitrasacme paradoxa* R.Br.

** 303A MENYANTHACEAE
. . . *Villarsia capitata* Nees

** 310 BORAGINACEAE
. . . *Halgania littoralis* Gaudich.

** 311A CHLOANTHACEAE
. . . *Lachnostachys eryiobotrya* (F.Muell.)Druce
. 2 2 *Physopsis spicata* Turcz.
. . . *Pityrodia bartlingii* (Lehm.)Benth.
. . . *Pityrodia verbascina* (F.Muell.)Benth.

** 313 LAMIACEAE
. . . *Hemiandra linearis* Benth.
. . . *Hemiandra pungens* R.Br.
1 2 6 *Hemiandra rutilans* O.Sarg.
. 2 1 *Hemigenia curvifolia* F.Muell.
. . . *Hemigenia diplanthera* F.Muell.
. . . *Hemigenia scabra* Benth.
. . . *Microcorys* sp (RJ Hnatiuk 771501)

** 323 LENTIBULARIACEAE
. . . *Polypompholyx multifida* (R.Br.)F.Muell.
. . . *Polypompholyx tenella* (R.Br.)Lehm.

** 326 MYOPORACEAE
. . . *Eremophila glabra* (R.Br.)Ostenf.

** 331 RUBIACEAE
. . . **Galium murale* (L.)All.
. . . *Opercularia spermacocea* Labill.
. . . *Opercularia vaginata* Labill.

** 339 CAMPANULACEAE
. . . **Wahlenbergia capensis* (L.)A.DC.
. . . *Wahlenbergia preissii* Vreise

** 340 LOBELIACEAE
. . . *Isotoma hypocrateriformis* (R.Br.)Druce
. . . *Lobelia heterophylla* Labill.

** 341 GOODENIACEAE
. . . *Dampiera alata* Lindley
. . . *Dampiera carinata* Benth.
. . . *Dampiera cuneata* R.Br.
. . . *Dampiera lavandulacea* Lindley
. . . *Dampiera lindleyi* Vreise
. . . *Dampiera linearis* R.Br.
. . . *Dampiera oligophylla* Benth. var. *juncea* (Benth.)Rajput & Carolin
. . . *Dampiera spicigera* Benth.
. . . *Dampiera teres* Lindley
. . . *Goodenia affinis* Vreise
. . . *Goodenia caerulea* R.Br.
. . . *Goodenia fasciculata* (Benth.)Carolin
. . . *Goodenia filiformis* R.Br. var. *minutiflora* F.Muell.
. . . *Goodenia hassallii* F.Muell.
. . . *Goodenia pulchella* Benth.
. . . *Lechenaultia biloba* Lindley
. . . *Lechenaultia floribunda* Benth.
. . . *Lechenaultia hirsuta* F.Muell.
. 2 1 *Lechenaultia juncea* E.Pritzel
. . . *Lechenaultia linarioides* DC.
. . . *Lechenaultia stenosepala* E.Pritzel
. . . *Scaevola canescens* Benth.
. . . *Scaevola glandulifera* DC.
. . . *Scaevola lanceolata* Benth.
. . . *Scaevola paludosa* R.Br.
. . . *Scaevola phlebopetala* F.Muell.
. . . *Scaevola* sp indet (EAG 4604)
. . . *Velleia trinervis* Labill.
. . . *Verreauxia reinwardtii* (Vreise)Benth.

** 343 STYLIDIACEAE
. . . *Levenhookia dubia* Sonder
. . . *Levenhookia leptantha* Benth.
. . . *Stylidium adpressum* Benth.
. 1 2 *Stylidium aeonioides* Carlq.
. . . *Stylidium breviscapum* R.Br.
. . . *Stylidium brunonianum* Benth. ssp. *brunonianum*
. . . *Stylidium bulbiferum* Benth.
. . . *Stylidium calcaratum* R.Br.
. . . *Stylidium caricifolium* Lindley
. . . *Stylidium carnosum* Benth.
. . . *Stylidium crossocephalum* F.Muell.
. . . *Stylidium dichotomum* DC.
. . . *Stylidium diuroides* Lindley
. . . *Stylidium divaricatum* Sonder
. . . *Stylidium emarginatum* Sonder ssp. *emarginatum*
. . . *Stylidium junceum* R.Br.
. . . *Stylidium leptocalyx* Sonder
. . . *Stylidium leptophyllum* DC.
. . . *Stylidium macrocarpum* (Benth.)R.Erickson & J.H.Willis
. . . *Stylidium miniatum* Mildbr.
. . . *Stylidium obtusatum* Sonder
. . . *Stylidium periscelianthum* R.Erickson & J.H.Willis
. . . *Stylidium petiolare* Sonder
. . . *Stylidium piliferum* R.Br.
. . . *Stylidium pubigerum* Sonder
. . . *Stylidium pycnostachyum* Lindley
. . . *Stylidium repens* R.Br.
. . . *Stylidium schoenoides* DC.
. 2 3 *Stylidium* aff. *bulbiferum* Benth. (AH Burbidge 2100)
. 3 7 *Stylidium* aff. *repens* R.Br. (AS George 2341)

** 345 ASTERACEAE
. . . **Arctotheca calendula* (L.)Levyns
. . . *Asteridea pulverulenta* Lindley
. . . *Brachycome pusilla* Steetz
. . . *Cephalosorus carpesioides* (Turcz.)P.S.Short
. . . *Chrysocoryne pusilla* (Benth.)Endl.
. . . *Cotula coronopifolia* L.
. . . *Craspedia* sp (EAG 5161)
. . . *Gnapalium sphaericum* Willd.
. . . *Helichrysum bracteatum* (Vent.)Andrews
. . . *Helichrysum lindleyi* H.Eichler
. . . *Helipterum corymbosum* (A.Gray)Benth.
. . . *Helipterum cotula* (Benth.)DC.
. . . *Helipterum hyalospermum* F.Muell.ex Benth.
. . . *Helipterum manglesii* (Lindley)F.Muell.ex Benth
. . . *Helipterum spicatum* (Steetz)F.Muell.ex Benth.
. . . *Helipterum strictum* (Lindley)Benth.
. . . *Helipterum tenellum* Turcz.
. . . **Hypochoeris glabra* L.
. . . *Lageinfera huegelii* Benth.
. . . *Millotia tenuifolia* Cass.
. 1 1 *Myriocephalus suffruticosus* Benth.
. . . *Olearia axillaris* (DC.)F.Muell.ex Benth.
. . . *Olearia paucidentata* (Steetz)F.Muell.ex Benth.
. . . *Olearia rudis* (Benth.)F.Muell.ex Benth.
. . . *Olearia strigosa* (Steetz)Benth.
. . . *Pithocarpa pulchella* Lindley
. . . *Podolepis canescens* Cunn.ex DC.

ASTERACEAE (continued)

. . . *Podolepis capillaris* (Steetz)Diels
. . . *Podolepis gracilis* (Lehm.)R.A.Graham
. . . *Podolepis lessonii* (Cass.)Benth.
. . . *Podotheca angustifolia* (Labill.)Less.
. . . *Podotheca gnaphalioides* R.A.Graham
. . . *Quinetia urvillei* Cass.
. . . *Rutidosis multiflora* (Nees)Robinson
. . . *Senecio lautus* G.Forster ex Willd. ssp. *dissectifolius* Ali
. . . *Siloxeros humifusus* Labill.
. . . **Sonchus oleraceus* L.
. . . **Ursinia anthemoides* (L.)Poiret
. . . *Waitzia aurea* (Benth.)Steetz
. . . *Waitzia paniculata* (Steetz)F.Muell.ex Benth.
. . . Asteraceae Genus indet (EAG 5524)

Appendix 4 Definition of Floristic Types. Summary of Principal Species, Vegetation Structure, Topographic and Soil Attributes of Major Floristic Types

Floristic Types are described as a synthesis of the releves sampled. The ordering relates to the classification presented in the dendrogram in Appendix 5.

Structure: is a simplification of that used by Muir (1977) (Appendix 2). Structural types included in square brackets [ ] are present in some releves only.

Species listed occur in more than about 25% of releves in the Type. Several categories of species are defined. Within each category they are listed in decreasing order of importance.

Dominant Species: - are ones with Cover Abundance greater than about 5%

Constant Species: - are ones which are usually present at most releves in Type. They may be present in other Types. (For Types with only one releve these are not defined.)

Faithful Species: - are ones which are usually only present in releves of the Type, but not necessarily all. A Faithful species may also be a Constant species or a Dominant species.

Rare or Poorly Known Species: - are essentially Faithful Species which are Declared Rare or are Poorly Known.

Values before each species indicate relative importance in respective category (1 greatest, 3 lesser)

Type 1

Structure: Heath or Thicket over Low Scrub over [Herbs]
Dominant Species: *1 Actinostrobus pyramidalis, 1 Calothamnus hirsutus, 2 Eucalyptus rudis, 2 Hypocalymma angustifolium, 2 Melaleuca pentagona, 2 Melaleuca uncinata*
Constant Species: *1 Hypochoeris glabra, 1 Drosera glanduligera, 1 Stylidium petiolare, 2 Homalosciadium homalocarpum, 2 Rutidosis multiflora, 2 Actinostrobus pyramidalis, 2 Drosera heterophylla, 2 Elythranthera brunonis*
Faithful Species: *1 Aphelia brizula, 1 Melaleuca viminea, 3 Actinostrobus pyramidalis*
Topography: drainage line
Soil: humic sand, grey or brown, and grey or brown sand over clay or gravel

Type 2

Structure: [Low Forest] over Heath over Open Herbs
Dominant Species: *1 Melaleuca hamulosa, 2 Casuarina obesa, 2 Crassula natans, 2 Calothamnus hirsutus*
Constant Species: *1 Cotula coronopifolia, 1 Melaleuca hamulosa*
Faithful Species: *1 Melaleuca cuticularis,*
Topography: drainage line
Soil: humic sand, grey or brown, and grey sand over gravel or clay

Type 3

Structure: Low Woodland over [Heath] over Dense Herbs
Dominant Species: *1 Casuarina obesa, 2 Eucalyptus loxophleba, 2 Melaleuca teretifolia*
Constant Species: *1 Casuarina obesa, 2 Sowerbaea laxiflora, 2 Drosera heterophylla*
Faithful Species: *2 Casuarina obesa, 2 Melaleuca raphiophylla, 2 Lysiana casuarinae*
Topography: drainage line
Soil: humic sand, grey or brown

Type 4

Structure: Open Low Woodlands over [Heath] over Low Heath over Dense Herbs
Dominant Species: *1 Borya sphareocephala, 1 Centrolepis aristata, 1 Thryptomene prolifera, 2 Scholtzia parviflora, 2 Allocasuarina campestris*
Constant Species: *1 Centrolepis aristata, 1 Drosera heterophylla, 2 Borya sphareocephala, 2 Brachycome pusilla, 2 Quinetia urvillei, 2 Isolepis marginata, 2 Tribonanthes australis, 2 Calothamnus hirsutus, 2 Eucalyptus loxophleba, 2 Thryptomene prolifera, 2 Philydrella pygmaea* ssp. *pygmaea, 2 Stylidium obtusatum, 2 Stylidium petiolare*
Faithful Species: *2 Centrolepis aristata*
Topography: drainage line and alluvial flat
Soil: humic sand, grey or brown, and brown sand over clay or gravel

Type 5

Structure: Low Forest over [Low Heath] over Dense Herbs over [Tall Sedges]
Dominant Species: *1 Eucalyptus loxophleba, 2 Juncus pallidus, 2 Calothamnus hirsutus*
Constant Species: weeds
Faithful Species:
Topography: mainly drainage line
Soil: loamy sand, clayey loam or clay, mainly brown or grey

Type 6

Structure: Low Forest over [Low Scrub] over Dwarf Scrub over Open Herbs
Dominant Species: *1 Eucalyptus calophylla, 1 Eucalyptus loxophleba, 2 Hypochoeris glabra, 2 Ursinia anthemoides*
Constant Species: *1 Ursinia anthemoides, 1 Hibbertia racemosa, 2 Eucalyptus calophylla, 2 Hypochoeris glabra*
Faithful Species: *1 Caladenia gemmata, 2 Sonchus oleraceus, 2 Erodium* sp indet EAG sn, *2 Euphorbia terracina*
Topography: variable, mainly lateritic upland and upper slope but also drainage line and alluvial flats
Soil: lateritic gravel and duricrust, orange, brown or red loamy matrix, some with red or brown sand covering

Type 7

Structure: Open Forest over Dwarf Scrub over Open Herbs
Dominant Species: *1 Eucalyptus wandoo* ssp. MIHB 9885 & C Souness, *2 Hypocalymma linifolium, 2 Stylidium bulbiferum, 2 Hypochoeris glabra*
Constant Species: 1 *Eucalyptus wandoo* ssp. MIHB 9885 & C Souness, *2 Dichopogon capillipes, 2 Hypochoeris glabra, 2 Ursinia anthemoides, 2 Orthrosanthus laxus* var. *laxus, 2 Briza maxima*
Faithful Species: *1 Caesia* aff. *micrantha* EAG 5158, *2 Myriocephalus suffruticosus, 2 Gastrolobium plicatum, 2 Helipterum tenellum, 2 Dodonaea divaricata, 3 Eucalyptus wandoo* ssp. MIHB 9885 & C Souness
Rare or Poorly Known Species: *Myriocephalus suffruticosus, Acacia plicata*
Topography: mainly upper slope
Soil: gravelly grey or brown loam, some clayey

Type 8

Structure: [Open Woodland over] Scrub over Low Heath over Herbs
Dominant Species: *1 Calothamnus quadrifidus, 1 Petrophile seminuda, 2 Calytrix acutifolia*
Constant Species: *1 Loxocarya* sp indet, *1 Calothamnus quadrifidus, 1 Baeckea crispiflora, 1 Petrophile seminuda, 1 Burchardia multiflora,*
Faithful Species:
Topography: lower slope and alluvial flat
Soil: orange or brown loam, some over gravel

Type 9

Structure: Woodland over Scrub over Low Heath over Dense Herbs
Dominant Species: *1 Scholtzia parviflora, 2 Acacia saligna*
Constant Species: 1 *Acacia saligna, 2 Scholtzia parviflora*
Faithful Species:
Rare or Poorly Known Species: *Darwinia pinoides*
Topography: mainly alluvial flat
Soil: mixed, grey or brown sand, some over lateritic gravel

Type 10

Structure: Low Forest over Dwarf Scrub
Dominant Species: *1 Eucalyptus accedens*
Constant Species: *1 Eucalyptus accedens, 1 Baeckea camphorosmae, 1 Hakea lissocarpha, 1 Trymalium wichurae, 1 Tetratheca confertifolia, 1 Trachymene pilosa*
Faithful Species:
Topography: variable, upland and slope
Soil: lateritic gravel & duricrust, grey sandy matrix, some covered by grey sand

Type 11

Structure: [Mallee Shrubs] over [Low Scrub] over Low Heath over Open Low Sedges
Dominant Species: *1 Allocasuarina campestris, 1 Allocasuarina ramosissima, 1 Eucalyptus gittinsii, 1 Hakea gilbertii, 1 Ecdeiocolea monostachya*
Constant Species: *1 Schoenus subflavus, 2 Allocasuarina ramosissima, 2 Burchardia umbellata, 2 Baeckea crispiflora, 2 Hakea gilbertii, 2 Hakea incrassata, 2 Ecdeiocolea monostachya, 2 Opercularia vaginata*
Faithful Species: *1 Allocasuarina grevillioides, 1 Acacia multispicata, 1 Daviesia polyphylla, 2 Leucopogon leptanthus, 2 Astroloma* aff. *serratifolium* NG Marchant sn, *2 Persoonia striata, 3 Hakea gilbertii*
Rare or Poorly Known Species: *Dryandra serratuloides, Thysanotus vernalis, Astroloma* aff. *serratifolium* NG Marchant sn, *Grevillea thrysiodes*
Topography: mainly mid slope, also upland and lower slope
Soil: lateritic gravel & duricrust, grey, yellow, orange or brown sandy loamy matrix, some covered by sand of similar colours

Type 12

Structure: [Open Low woodland] over Low Heath over [Open Low Sedges]
Dominant Species: *1 Melaleuca scabra, 1 Ecdeiocolea monostachya, 2 Borya sphareocephala, 2 Caustis dioica, 2 Melaleuca uncinata*
Constant Species: *2 Ursinia anthemoides, 2 Melaleuca scabra*
Faithful Species: *1 Hakea candolleana, 1 Scaevola* sp indet EAG 4604, *2 Grevillea hookeriana, 2 Scholtzia* aff. *involucrata* EAG 5500
Topography: variable, mainly lower slope and alluvial flat
Soil: mainly orange sand, also some grey, yellow or brown sand

Type 13

Structure: Low Woodland over [Low Scrub] over Low Heath over low Sedges
Dominant Species: *1 Banksia prionotes, 1 Ecdeiocolea monostachya, 1 Schoenus subflavus, 2 Xylomelum angustifolium, 2 Actinostrobus arenarius, 2 Mesomelaena stygia*
Constant Species: *1 Banksia prionotes, 1 Mesomelaena stygia, 1 Schoenus subflavus, 1 Grevillea integrifolia* ssp. *integrifolia, 2 Ecdeiocolea monostachya, 2 Grevillea eriostachya, 2 Lepidobolus preissianus*
Faithful Species: *2 Hakea* aff. *obliqua* EAG sn, *2 Boronia coerulescens*
Topography: variable, mainly lower to upper slope
Soil: pale, or very pale, yellow sand over yellow sand

Type 14

Structure: Open Low Woodland over Dwarf Scrub over [Herbs]
Dominant Species: *1 Banksia attenuata, 2 Banksia menziesii, 2 Calytrix fraseri, 2 Eremaea pauciflora* ssp. *pauciflora, 2 Leptospermum oligandrum*
Constant Species: *1 Banksia attenuata, 1 Eucalyptus todtiana, 1 Hibbertia huegelii, 1 Caustis dioica*
Faithful Species:

Topography: variable, mid slope and alluvial flats
Soil: variable, orange ,grey or pale yellow

Type 15

Structure: Low Forest over Low Scrub over Dwarf Scrub over [Herbs]
Dominant Species: *1 Banksia attenuata, 1 Banksia prionotes, 2 Eucalyptus todtiana, 2 Scholtzia parviflora, 2 Loxocarya* sp indet
Constant Species: *1 Banksia attenuata, 2 Banksia prionotes, 2 Eucalyptus todtiana, 2 Scholtzia parviflora, 2 Caladenia flava* ssp. *flava, 2 Hypochoeris glabra, 2 Ursinia anthemoides, 2 Loxocarya* sp indet
Faithful Species:
Topography: variable, upland to alluvial flats
Soil: mainly grey sand over yellow sand

Type 16

Structure: Low Woodland over Low Heath over [Open Low Sedges]
Dominant Species: *1 Banksia attenuata, 1 Hibbertia hypericoides, 1 Leptospermum oligandrum, 2 Eucalyptus todtiana, 2 Allocasuarina humilis*
Constant Species: *1 Hibbertia hypericoides, 1 Anigozanthos humilis* ssp. *humilis, 1 Melaleuca ciliosa, 2 Dryandra nivea, 2 Hakea trifurcata, 2 Ursinia anthemoides, 2 Mesomelaena stygia, 2 Drosera erythrorrhiza*
Faithful Species:
Topography: lateritic upland and lower to upper slope
Soil: mainly grey or pale yellow sand both over yellow sand

Type 17

Structure: Low Forest over Low Scrub over Low Heath over [Herbs] over [Open Low sedges]
Dominant Species: *1 Eucalyptus calophylla, 2 Hibbertia hypericoides, 2 Calothamnus quadrifidus, 2 Hypochoeris glabra, 2 Loxocarya* sp indet
Constant Species: *1 Hibbertia hypericoides, 1 Melaleuca ciliosa, 1 Anigozanthos humilis* ssp. *humilis, 2 Mesomelaena stygia, 2 Drosera erythrorrhiza, 2 Dryandra nivea, 2 Hakea trifurcata, 2 Ursinia anthemoides*
Faithful Species: *3 Goodenia affinis*
Topography: mainly lower slope, but also other slopes
Soil: mainly orange sand, also red or brown sand

Type 18

Structure: Low Scrub over Low Heath
Dominant Species: *1 Calothamnus quadrifidus, 2 Mesomelaena stygia, 2 Hibbertia hypericoides, 2 Hakea trifurcata*
Constant Species: *1 Calothamnus quadrifidus, 2 Allocasuarina humilis, 2 Hypocalymma angustifolium, 2 Neurachne alopecuroides, 2 Petrophile brevifolia, 2 Lepidobolus preissianus, 2 Opercularia vaginata*
Faithful Species:
Rare or Poorly Known Species: *Scholtzia terretifolia, Dryandra subulata*
Topography: variable, lower slope and laterite upland
Soil: variable, yellow, orange or grey sand

Type 19

Structure: Low Scrub over Low Heath over [Herbs]
Dominant Species: *1 Melaleuca radula, 2 Hibbertia hypericoides, 2 Melaleuca* aff. *tricophylla* EAG 5432, *2 Hakea lissocarpha, 2 Briza maxima, 2 Hypochoeris glabra*
Constant Species: *1 Hakea lissocarpha, 2 Melaleuca radula, 2 Baeckea crispiflora, 2 Neurachne alopecuroides, 2 Hypochoeris glabra, 2 Ursinia anthemoides*
Faithful Species:
Topography: mainly upper slope, also laterite upland and other slopes
Soil: gravelly grey loam ?over clay; or lateritic gravel & duricrust, orange or brown loamy matrix

Type 20

Structure: Low Scrub over Low Heath over [Herbs]
Dominant Species: *2 Leucopogon polymorphus, 2 Calothamnus quadrifidus, 2 Eucalyptus gittinsii, 2 Melaleuca radula, 2 Daviesia preissii, 2 Gastrolobium spinosum, 2 Oxylobium reticulatum* var. *gracile, 2 Dryandra carlinoides, 2 Hakea undulata*
Constant Species: *1 Calothamnus quadrifidus, 2 Hibbertia hypericoides, 2 Leucopogon polymorphus, 2 Baeckea camphorosmae, 2 Melaleuca ciliosa, 2 Dryandra fraseri, 2 Dryandra nivea, 2 Hakea incrassata, 2 Hakea lissocarpha, 2 Petrophile brevifolia, 2 Xanthorrhoea drummondii, 2 Burchardia umbellata*
Faithful Species: *Grevillea* aff. *flexuosa* EAG 5040
Rare or Poorly Known Species: *Acacia forrestiana, Asterolasia drummondii*
Topography: mid and upper slope
Soil: gravelly grey loam ?over clay; or lateritic gravel & duricrust, grey or brown loamy matrix

Type 21

Structure: [Open Low Woodland] over [Low Scrub] over Low Heath
Dominant Species: *1 Dryandra patens, 2 Dryandra carlinoides, 2 Xanthorrhoea drummondii,*
Constant Species: *1 Hibbertia hypericoides, 1 Calothamnus sanguineus, 2 Melaleuca ciliosa, 2 Hakea lissocarpha, 2 Hakea stenocarpa, 2 Opercularia vaginata, 2 Xanthorrhoea drummondii, 2 Ursinia anthemoides*
Faithful Species: *Gompholobium knightianum, 2 Hovea pungens, 2 Acacia* aff. *myrtifolia* RJ Cranfield 33, *2 Eucalyptus lane-poolei*
Rare or Poorly Known Species: *Chamelauceum* sp EAG 4861, *Acacia* aff. *myrtifolia* RJ Cranfield 33
Topography: mainly lateritic upland, some upper slope
Soil: lateritic gravel & duricrust, grey sandy or brown loamy matrix; or grey sand or loam over lateritic gravel

Type 22

Structure: Low Scrub over Low Heath
Dominant Species: *1 Calothamnus sanguineus, 2 Hibbertia hypericoides, 2 Melaleuca* aff. *acerosa* EAG 2436, *2 Schoenus subflavus*
Constant Species: *1 Hibbertia hypericoides, 1 Calothamnus sanguineus, 2 Allocasuarina humilis, 2 Bossiaea eriocarpa, 2 Hakea trifurcata, 2 Xanthorrhoea drummondii*
Faithful Species:
Topography: laterite upland and upper slope
Soil: lateritic gravel & duricrust, orange sandy loamy matrix; or orange, or pale orange sand

Type 23

Structure: Low Heath
Dominant Species: *2 Gastrolobium spinosum*
Constant Species: *1 Hibbertia hypericoides, 2 Gastrolobium spinosum, 2 Dryandra carlinoides, 2 Dryandra patens, 2 Hakea lissocarpha, 2 Xanthorrhoea drummondii*
Faithful Species:
Topography: laterite upland and upper slope
Soil: lateritic gravel & duricrust, grey or red sandy or brown loamy matrix

Type 24

Structure: Low Heath
Dominant Species: *1 Dryandra armata, 1 Hakea gilbertii, 2 Hibbertia hypericoides, 2 Calothamnus longissimus, 2 Melaleuca* aff. *tricophylla* EAG 5432
Constant Species: *1 Calothamnus longissimus, 1 Dryandra carlinoides, 1 Hakea incrassata, 1 Caustis dioica, 1 Cassytha pomiformis, 2 Mesomelaena stygia, 2 Mesomelaena tetragona, 2 Schoenus subflavus, 2 Tetraria octandra, 2 Hibbertia hypericoides, 2 Leucopogon conostephioides, 2 Dampiera spicigera, 2 Beaufortia* aff. *bracteosa* EAG 1176, *2 Calothamnus sanguineus, 2 Jacksonia restioides, 2 Neurachne alopecuroides, 2 Dryandra armata, 2 Dryandra kippistiana, 2 Hakea gilbertii*
Faithful Species: *1 Dryandra armata*
Topography: laterite upland and mid slope
Soil: lateritic gravel & duricrust, grey sandy matrix

Type 25

Structure: Low Heath over [Open Low Sedges]
Dominant Species: *1 Calothamnus longissimus, 1 Dryandra carlinoides, 1 Hibbertia hypericoides, 2 Dryandra kippistiana, 2 Allocasuarina humilis, 2 Mesomelaena stygia*
Constant Species: *1 Allocasuarina humilis, 1 Baeckea grandiflora, 1 Hakea incrassata, 1 Hibbertia hypericoides, 1 Neurachne alopecuroides, 2 Caustis dioica, 2 Schoenus subflavus, 2 Jacksonia restioides, 2 Dryandra carlinoides, 2 Hakea lissocarpha, 2 Hakea stenocarpa, 2 Opercularia vaginata*
Faithful Species: *1 Jacksonia foliosa, 2 Beaufortia eriocephala, 2 Chamaexeros serra, 2 Chorizema aciculare, 2 Kunzea* sp DJE Whibley 4887, *2 Halgania littoralis, 2 Stylidium caricifolium, 3 Calothamnus longissimus, 3 Laxmannia omnifertilis*
Rare or Poorly Known Species: *Beaufortia eriocephala, Kunzea* sp DJE Whibley 4887, *Sphaerolobium macranthum* var. *pulchellum*
Topography: laterite upland and minor upper slope
Soil: lateritic gravel & duricrust, grey sandy matrix; some yellow, orange or brown sandy or loamy matrix; some covered by gravelly grey sand

Type 26

Structure: Low Heath
Dominant Species: *1 Hibbertia hypericoides, 1 Calothamnus sanguineus, 2 Allocasuarina humilis, 2 Lambertia multiflora, 2 Calothamnus torulosus, 2 Melaleuca trichophylla, 2 Dryandra* aff. *falcata* EAG 3489, *2 Dryandra carlinoides*
Constant Species: *1 Hibbertia hypericoides, 1 Calothamnus sanguineus, 1 Lambertia multiflora, 2 Allocasuarina humilis, 2 Mesomelaena stygia, 2 Schoenus subflavus, 2 Tetraria octandra, 2 Haemodorum venosum, 2 Baeckea grandiflora, 2 Neurachne alopecuroides, 2 Hakea conchifolia, 2 Hakea incrassata, 2 Xanthorrhoea drummondii*
Faithful Species: *1 Macropidia fuliginosa, 1 Grevillea synapheae, 1 Anarthria gracilis, 2 Dryandra bipinnatifida, 2 Hibbertia* aff. *montana* EAG 1831, *2 Acacia moirii* ssp. *recurvistipula, 2 Gastrolobium bidens, 2 Lepidobolus* sp EAG 2093, *2 Labichea punctata, 2 Astroloma* aff. *pallidum* EAG 1022, *2 Pseudanthus virgatus, 2 Microcorys* sp RJH 771501, *3 Conothamnus trinervis, 3 Tripterococcus brunonis, 3 Schoenus brevisetis, 3 Comesperma acerosum, 3 Thysanotus* aff. *sparteus* EAG 2511, *3 Dryandra* aff. *falcata* EAG 3489, *3 Hakea conchifolia, 3 Sphaerolobium macranthum, 3 Isopogon adenanthoides, 3 Calothamnus torulosus*
Rare or Poorly Known Species: *Hakea erinacea* var. *longiflora, Lepidobolus* sp EAG 2093, *Loxocarya* aff. *fasciculata* B Briggs 6319
Topography: laterite upland and some upper slope
Soil: lateritic gravel & duricrust, grey sandy matrix; some grey or red loamy matrix; some covered by gravelly grey sand

Type 27

Structure: Open Low Woodland over Low Scrub over Low Heath
Dominant Species: *1 Eremaea pauciflora* ssp. *pauciflora, 1 Petrophile ericifolia, 2 Eucalyptus todtiana, 2 Melaleuca seriata, 2 Adenanthos cygnorum, 2 Banksia burdettii, 2 Beaufortia elegans, 2 Xylomelum angustifolium*
Constant Species: *1 Banksia leptophylla, 1 Schoenus subflavus, 2 Beaufortia elegans, 2 Leptospermum oligandrum, 2 Daviesia nudiflora, 2 Adenanthos cygnorum, 2 Banksia attenuata, 2 Hakea costata, 2 Caustis dioica, 2 Mesomelaena stygia, 2 Drosera erythrorrhiza, 2 Anigozanthos humilis* ssp. *humilis, 2 Patersonia occidentalis*
Faithful Species:
Rare or Poorly Known Species: *Eremaea* aff. *violacea* EAG 1557, *Loxocarya* sp EAG 5268
Topography: lower and mid slope
Soil: grey or yellow sand

Type 28

Structure: Open Low Woodland over Low Scrub over Low Heath over Open Low Sedges
Dominant Species: *1 Mesomelaena stygia, 2 Allocasuarina humilis, 2 Actinostrobus arenarius, 2 Schoenus subflavus, 2 Hibbertia hypericoides, 2 Beaufortia elegans, 2 Eremaea pauciflora* ssp. *pauciflora, 2 Leptospermum oligandrum, 2 Banksia attenuata, 2 Banksia leptophylla, 2 Banksia prionotes, 2 Petrophile ericifolia*
Constant Species: *1 Mesomelaena stygia, 1 Leptospermum oligandrum, 1 Schoenus subflavus, 1 Hakea costata, 2 Allocasuarina humilis, 2 Caustis dioica, 2 Hibbertia hypericoides, 2 Beaufortia elegans, 2 Conospermum stoechadis, 2 Petrophile macrostachya*
Faithful Species: *1 Schoenus* aff. *obtusifolius* EAG 5841, *3 Beaufortia elegans, 3 Geleznowia verrucosa, 3 Cassytha racemosa, 3 Verticordia drummondii,*
Rare or Poorly Known Species: *Corynanthera flava, Schoenus* aff. *obtusifolius* EAG 3841
Topography: variable, upland and lower to upper slope
Soil: mainly yellow sand, some grey sand

Type 29

Structure: [Open Low Woodland] over Low Scrub over Low Heath over Open Low Sedges
Dominant Species: *1 Eremaea pauciflora* ssp. *pauciflora, 1 Hibbertia hypericoides, 2 Adenanthos cygnorum, 2 Hakea obliqua, 2 Allocasuarina humilis, 2 Mesomelaena stygia*
Constant Species: *1 Conostylis aurea, 2 Allocasuarina humilis, 2 Mesomelaena stygia, 2 Hibbertia hypericoides, 2 Anigozanthos humilis* ssp. *humilis, 2 Dryandra nivea, 2 Petrophile macrostachya, 2 Xanthorrhoea drummondii*
Faithful Species: *2 Eremaea pauciflora* ssp. EAG 5433, *2 Lomandra brittanii, 2 Tersoonia cyathiflora, 2 Cryptandra humilis*
Rare or Poorly Known Species: *Schoenus* aff. *indutus* EAG 3842
Topography: variable, lower to upper slope and lateritic upland
Soil: mainly grey sand, some over gravel; some yellow or pale yellow sand

Type 30

Structure: Low Forest over Low Heath
Dominant Species: *1 Banksia attenuata, 1 Stirlingia latifolia, 1 Hibbertia hypericoides, 2 Eucalyptus calophylla, 2 Adenanthos cygnorum, 2 Banksia menziesii, 2 Schoenus subflavus*
Constant Species: *1 Hibbertia hypericoides, 1 Conostephium pendulum, 1 Anigozanthos humilis* ssp. *humilis, 1 Hypocalymma xanthopetalum, 1 Bossiaea eriocarpa, 1 Stirlingia latifolia, 2 Banksia attenuata, 2 Banksia menziesii, 2 Johnsonia pubescens, 2 Allocasuarina humilis, 2 Hibbertia subvaginata, 2 Drosera erythrorrhiza, 2 Drosera menziesii* ssp. *menziesii ,2 Blancoa canescens, 2 Conostylis aurea, 2 Conostylis juncea, 2 Melaleuca ciliosa, 2 Isotropis cuneifolia, 2 Eriostemon spicatus, 2 Ursinia anthemoides*
Faithful Species: *3 Blancoa canescens*
Topography: variable, mainly lateritic upland
Soil: grey sand

Type 31

Structure: Open Low Woodland over Open Scrub over Low Heath
Dominant Species: *1 Adenanthos cygnorum, 2 Banksia attenuata, 2 Banksia leptophylla, 2 Eremaea pauciflora* ssp. *pauciflora, 2 Melaleuca scabra, 2 Calytrix* sp indet EAG 5265, *2 Hakea obliqua*
Constant Species: *1 Banksia attenuata, 1 Hibbertia desmophylla, 1 Astroloma xerophyllum, 1 Eremaea pauciflora* ssp. *pauciflora, 1 Eucalyptus todtiana, 1 Melaleuca scabra, 1 Dryandra* aff. *conferta* EAG 3162, *1 Petrophile linearis, 1 Stirlingia latifolia, 2 Lysinema ciliatum, 2 Conostylis aurea, 2 Leptospermum oligandrum, 2 Adenanthos cygnorum, 2 Petrophile chrysantha* EAG (inland form), *2 Synaphea spinulosa*
Faithful Species: *1 Verticordia ovalifolia, 1 Jacksonia carduacea, 3 Petrophile chrysantha* EAG (inland form)
Rare or Poorly Known Species: *Jacksonia carduacea*
Topography: variable, upland and lower to upper slope
Soil: grey or pale yellow sand over yellow sand

Type 32

Structure: Open Low Woodland over Open Scrub over Low Heath
Dominant Species: *1 Eremaea pauciflora* ssp. *pauciflora, 2 Calytrix depressa, 2 Leptospermum oligandrum, 2 Banksia attenuata, 2 Banksia leptophylla, 2 Petrophile ericifolia*
Constant Species: *1 Eremaea pauciflora* ssp. *pauciflora, 1 Leptospermum oligandrum, 1 Verticordia densiflora, 1 Dampiera spicigera, 1 Amphipogon turbinatus, 1 Neurachne alopecuroides, 1 Schoenus subflavus, 2 Banksia attenuata, 2 Banksia burdettii, 2 Banksia prionotes, 2 Mesomelaena stygia, 2 Hibbertia desmophylla, 2 Patersonia occidentalis, 2 Calytrix sapphirina, 2 Leptospermum spinescens, 2 Daviesia triflora, 2 Alexgeorgia nitens*
Faithful Species: *1 Orchid* sp indet, *2 Lepidosperma* sp indet EAG 4583, *2 Schoenus* aff. *brevisetis* EAG 1911, *2 Lomandra* sp indet, *2 Verticordia muelleriana* ssp. *muelleriana, 3 Daviesia triflora, 3 Eremaea violacea, 3 Lepidibolus* sp indet,

Rare or Poorly Known Species: *Lechenaultia juncea, Hensmania stoniella, Jacksonia eremodendron*
Topography: upland sandplain and lower slope
Soil: mainly grey sand, possibly over yellow

Type 33

Structure: Open Low Woodland over Low Scrub over Low Heath over Open Low Sedges
Dominant Species: *1 Eremaea pauciflora* ssp. *pauciflora, 1 Melaleuca seriata, 1 Banksia attenuata, 1 Alexgeorgia nitens, 2 Banksia burdettii, 2 Banksia menziesii, 2 Mesomelaena stygia*
Constant Species: *1 Melaleuca seriata, 1 Banksia attenuata, 2 Bossiaea eriocarpa, 2 Amphipogon turbinatus, 2 Stirlingia latifolia, 2 Anigozanthos humilis* ssp. *humilis, 2 Alexgeorgia nitens*
Faithful Species: *3 Conostylis aculeata* ssp. *aculeata , 3 Hensmania turbinata*
Topography: mainly lower slope, some mid slope
Soil: predominantly grey sand; some pale yellow sand over yellow

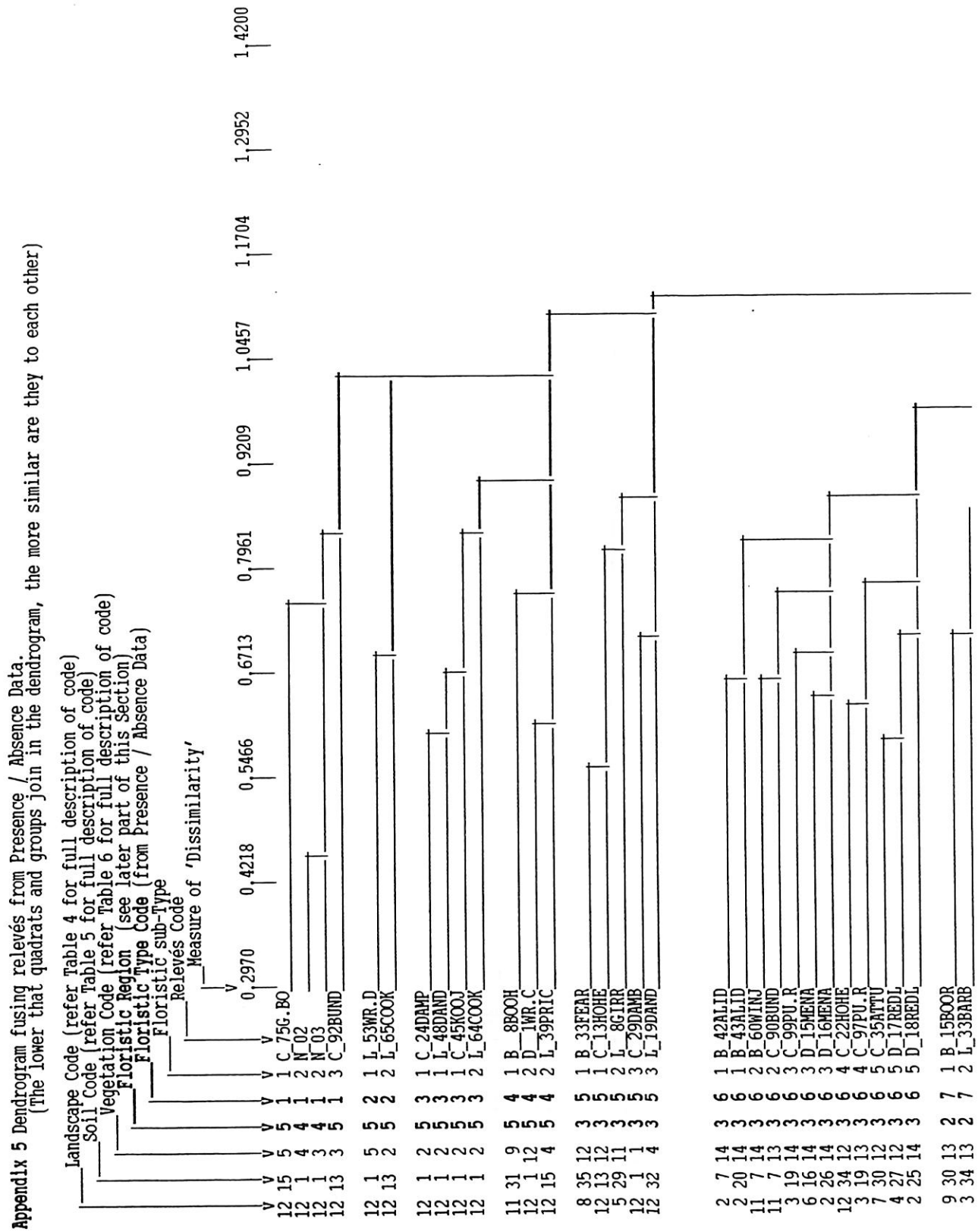
Type 34

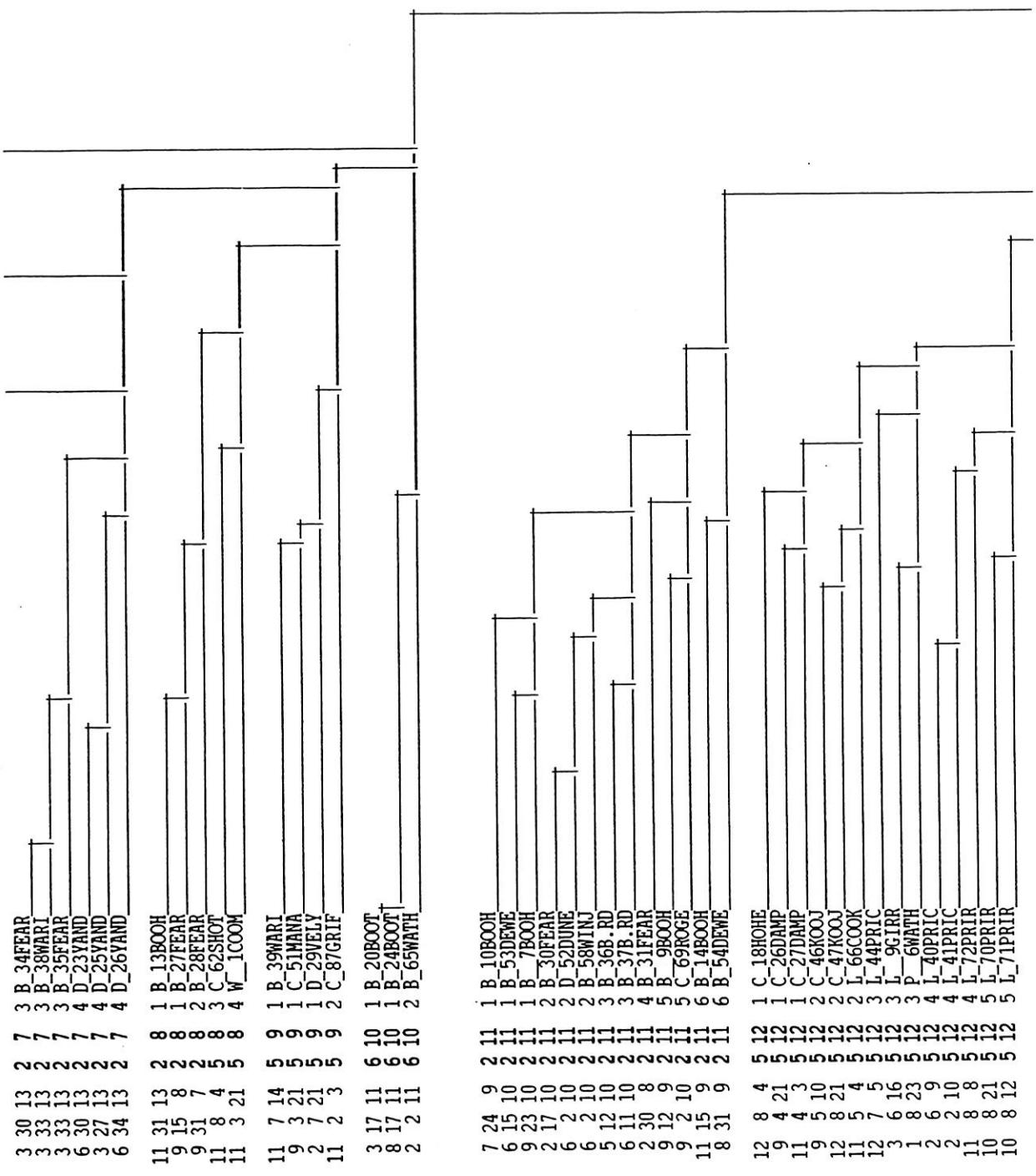
Structure: Low Woodland over Scrub over Low Scrub over Dwarf Scrub over [Herbs] over Open Low Sedges
Dominant Species: *1 Eremaea pauciflora* ssp. *pauciflora, 1 Banksia attenuata, 2 Banksia menziesii, 2 Astroloma xerophyllum, 2 Leucopogon conostephioides*
Constant Species: *1 Banksia attenuata, 1 Eremaea pauciflora* ssp. *pauciflora, 1 Burchardia umbellata, 1 Hibbertia subvaginata, 1 Drosera erythrorrhiza, 1 Astroloma xerophyllum, 1 Leucopogon conostephioides, 1 Patersonia occidentalis, 1 Bossiaea eriocarpa, 1 Petrophile linearis, 1 Alexgeorgia nitens, 1 Lyginea barbata, 2 Jacksonia floribunda, 2 Jacksonia* aff. *sericea* EAG 5534, *2 Amphipogon turbinatus, 2 Banksia menziesii*
Faithful Species: *2 Thysanotus* aff. *multiflorus* BJK 205, *2 Schoenus caespititius, 2 Pterostylis nana, 3 Drosera radicans*
Rare or Poorly Known Species: *Stylidium* aff. *repens* ASG 2341
Topography: dunes and lower slope
Soil: grey sand

Type 35

Structure: Open Low Woodland over [Low Scrub] over Dwarf Scrub over Dense Sedges (Tall or Low)
Dominant Species: *1 Hibbertia subvaginata, 2 Anarthria laevis, 2 Anarthria prolifera*
Constant Species: *1 Schoenus rodwayanus, 1 Hibbertia subvaginata, 1 Leucopogon sprengelioides, 1 Dampiera linearis, 1 Cassytha glabella, 1 Hypocalymma angustifolium, 1 Kunzea recurva, 1 Melaleuca preissiana, 1 Melaleuca scabra, 1 Euchilopsis linearis, 1 Jacksonia* aff. *sericea* EAG 5534, *1 Hypolaena exsulcata*
Faithful Species: *2 Schoenus rodwayanus, 2 Euchilopsis linearis*
Topography: drainage line
Soil: humic sand, grey or brown

Appendix 5 Dendrogram fusing releves from Presence / Absence Data.

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6 34 13 2 7 4 D_26YAND
11 31 13 2 8 1 B_13BOOH
9 15 8 2 8 1 B_27FEAR
9 31 7 2 8 2 B_28FEAR
11 8 4 5 8 3 C_62SHOT
11 3 21 5 8 4 W__1COOM
11 7 14 5 9 1 B_39WARI
9 3 21 5 9 1 C_51MANA
2 7 21 5 9 1 D_29VELY
11 2 3 5 9 2 C_87GRIF
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8 17 11 6 10 1 B_24BOOT
2 2 11 6 10 2 B_65WATH
7 24 9 2 11 1 B_10BOOH
6 15 10 2 11 1 B_53DEWE
9 23 10 2 11 1 B_7BOOH
2 17 10 2 11 2 B_30FEAR
6 2 10 2 11 2 D_52DUNE
6 2 10 2 11 2 B_58WINJ
5 12 10 2 11 3 B_36B.RD
6 11 10 2 11 3 B_37B.RD
2 30 8 2 11 4 B_31FEAR
9 12 9 2 11 5 B_9BOOH
9 2 10 2 11 5 C_69ROGE
11 15 9 2 11 6 B_14BOOH
8 31 9 2 11 6 B_54DEWE
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1 8 23 5 12 3 P__6WATH
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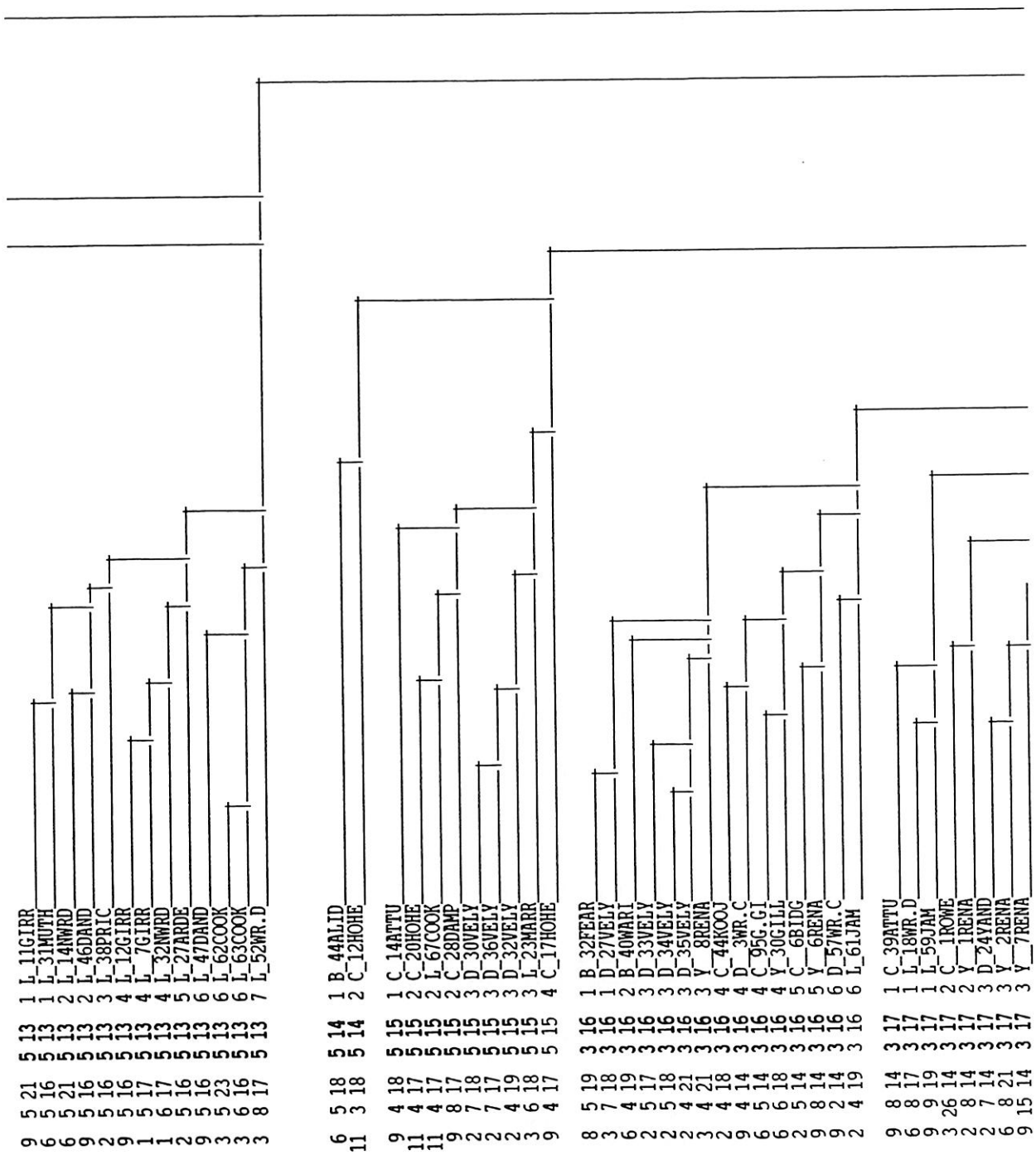
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9 8 17 5 15 2 C_28DAMP
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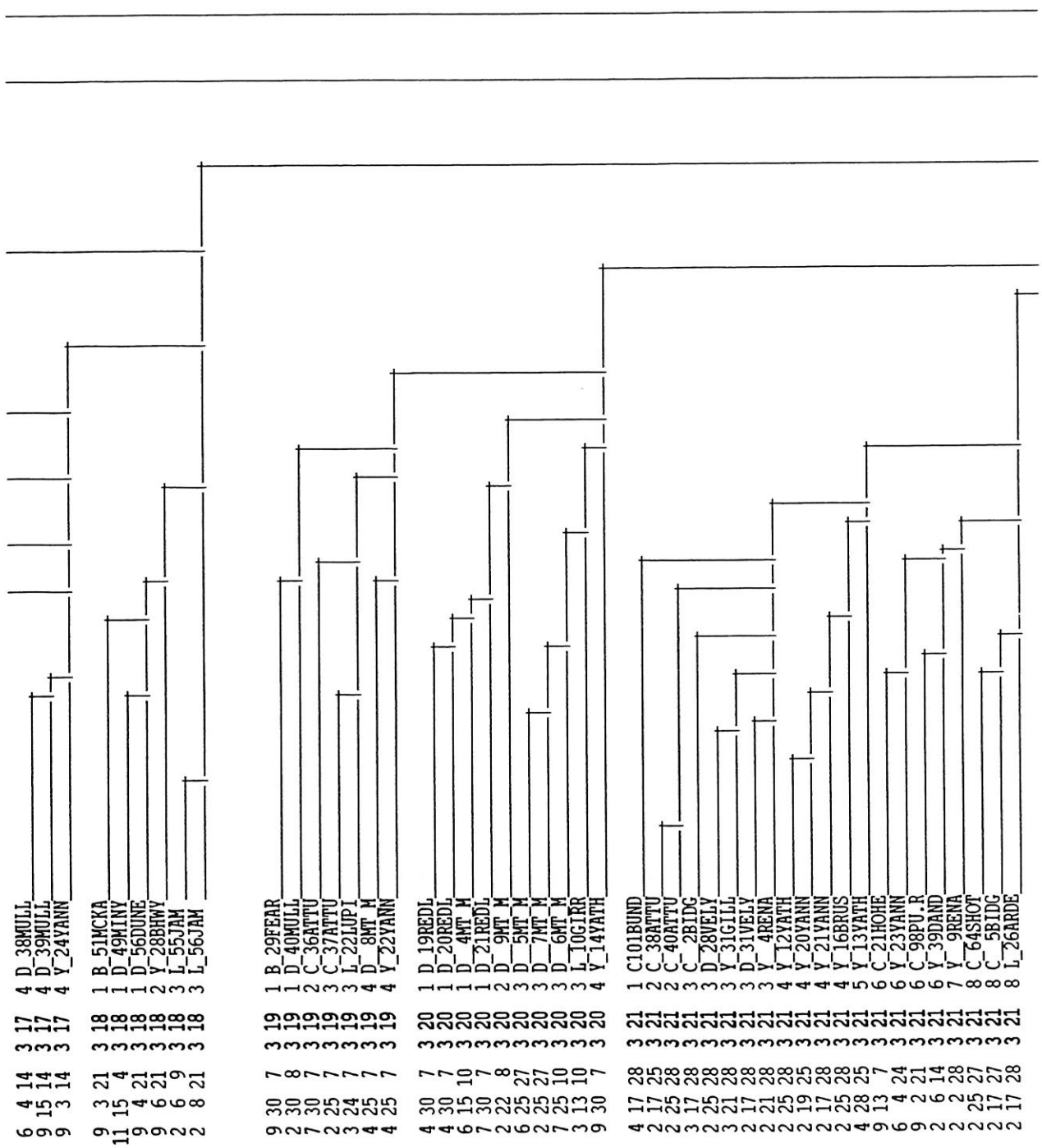
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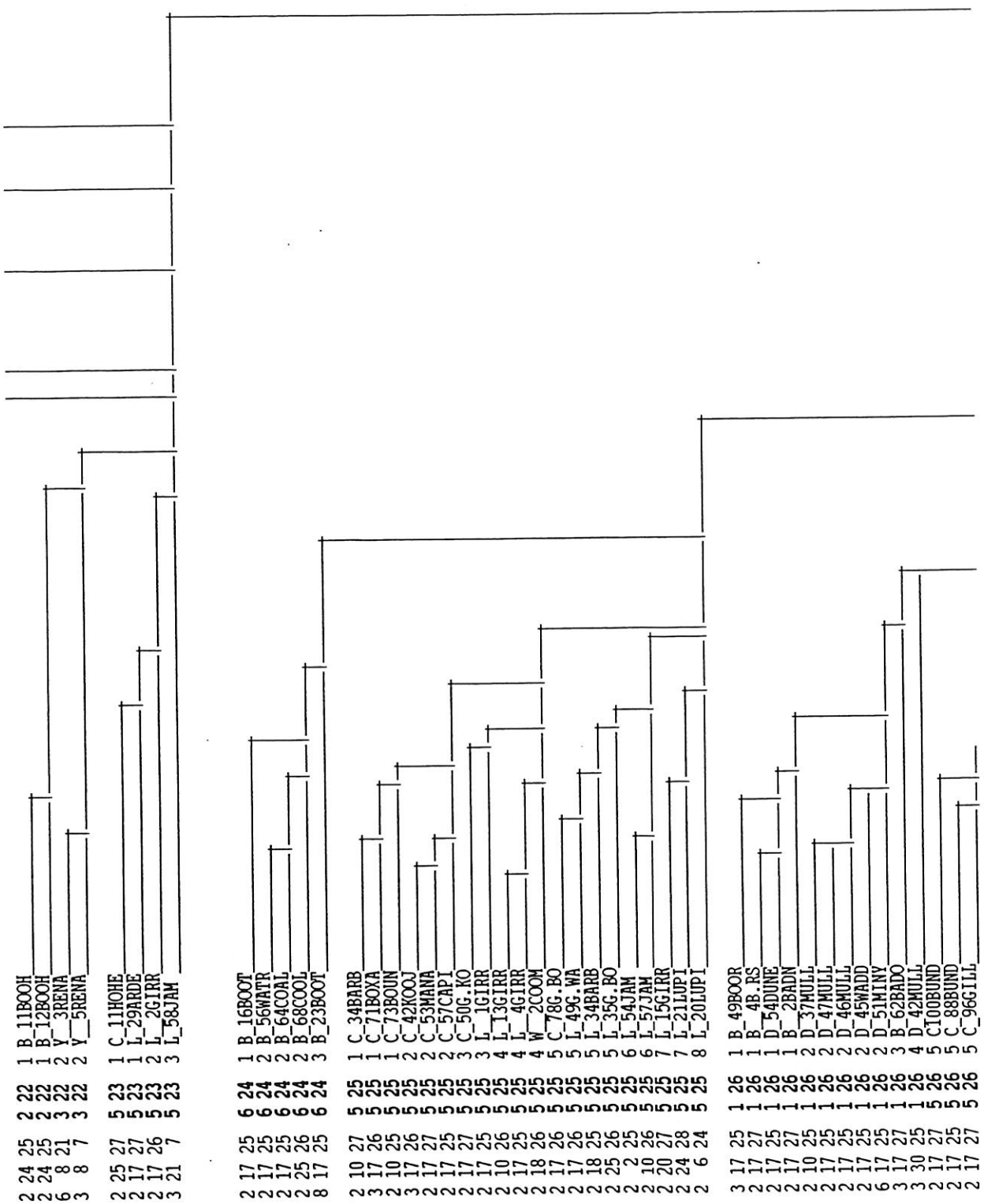
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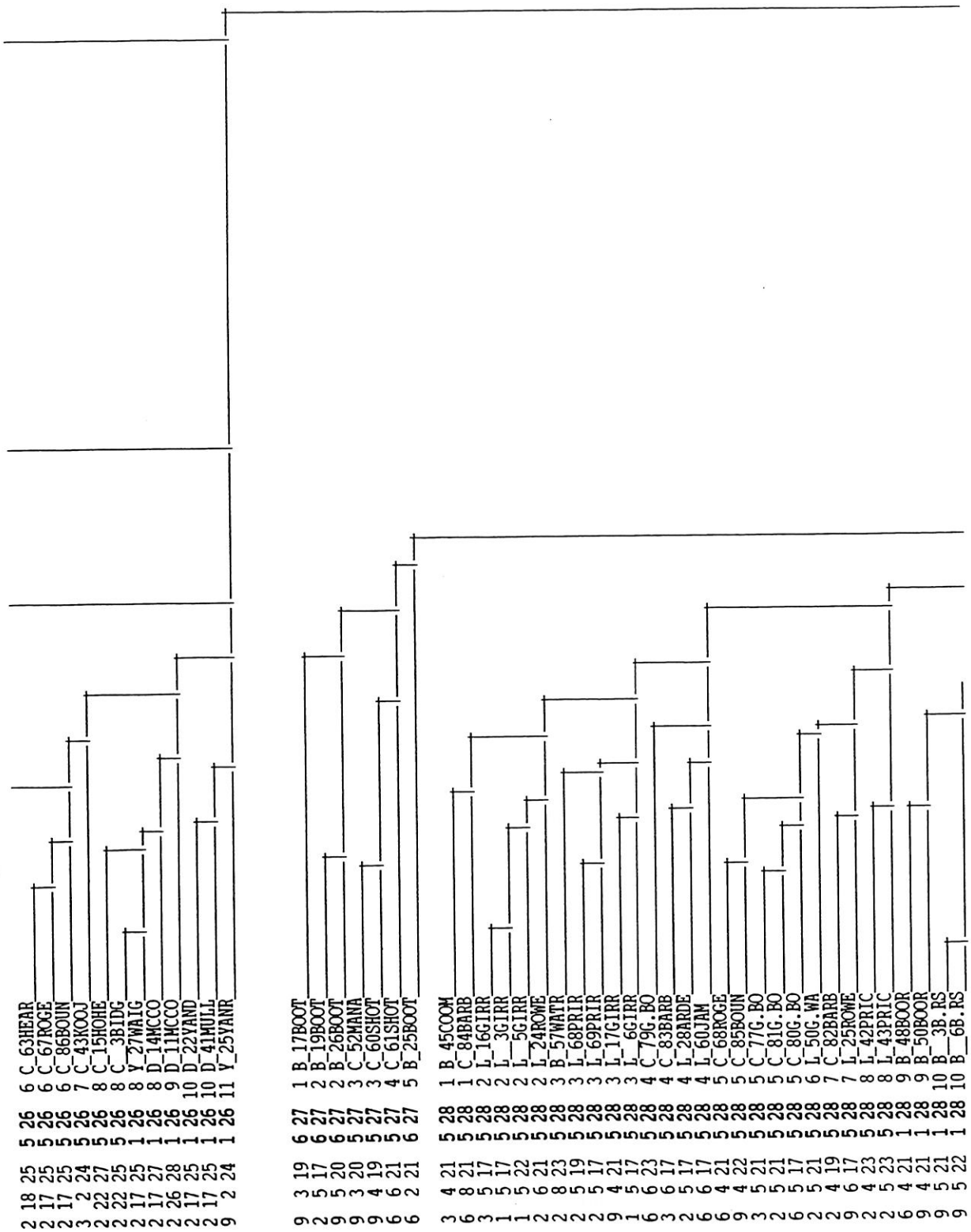
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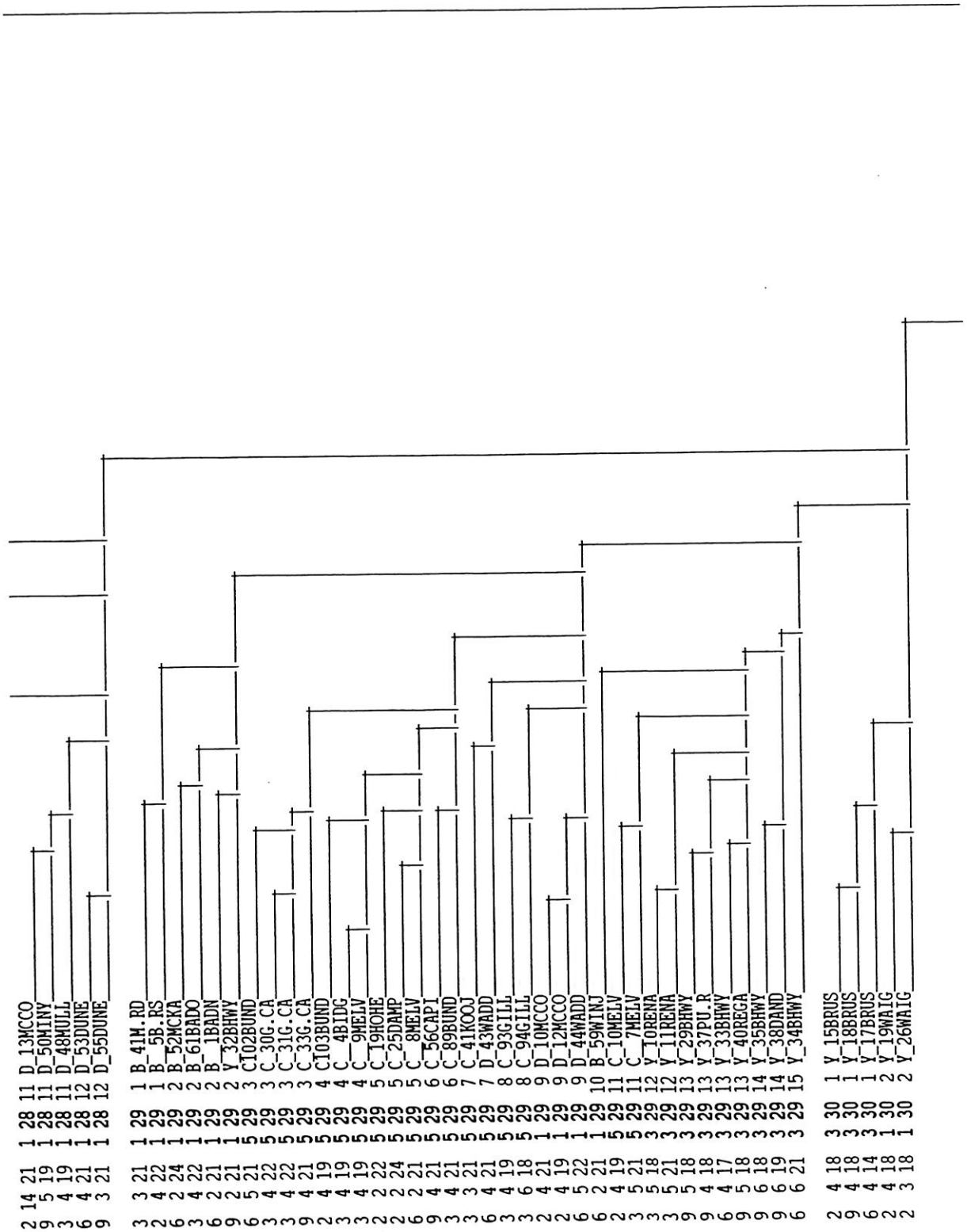
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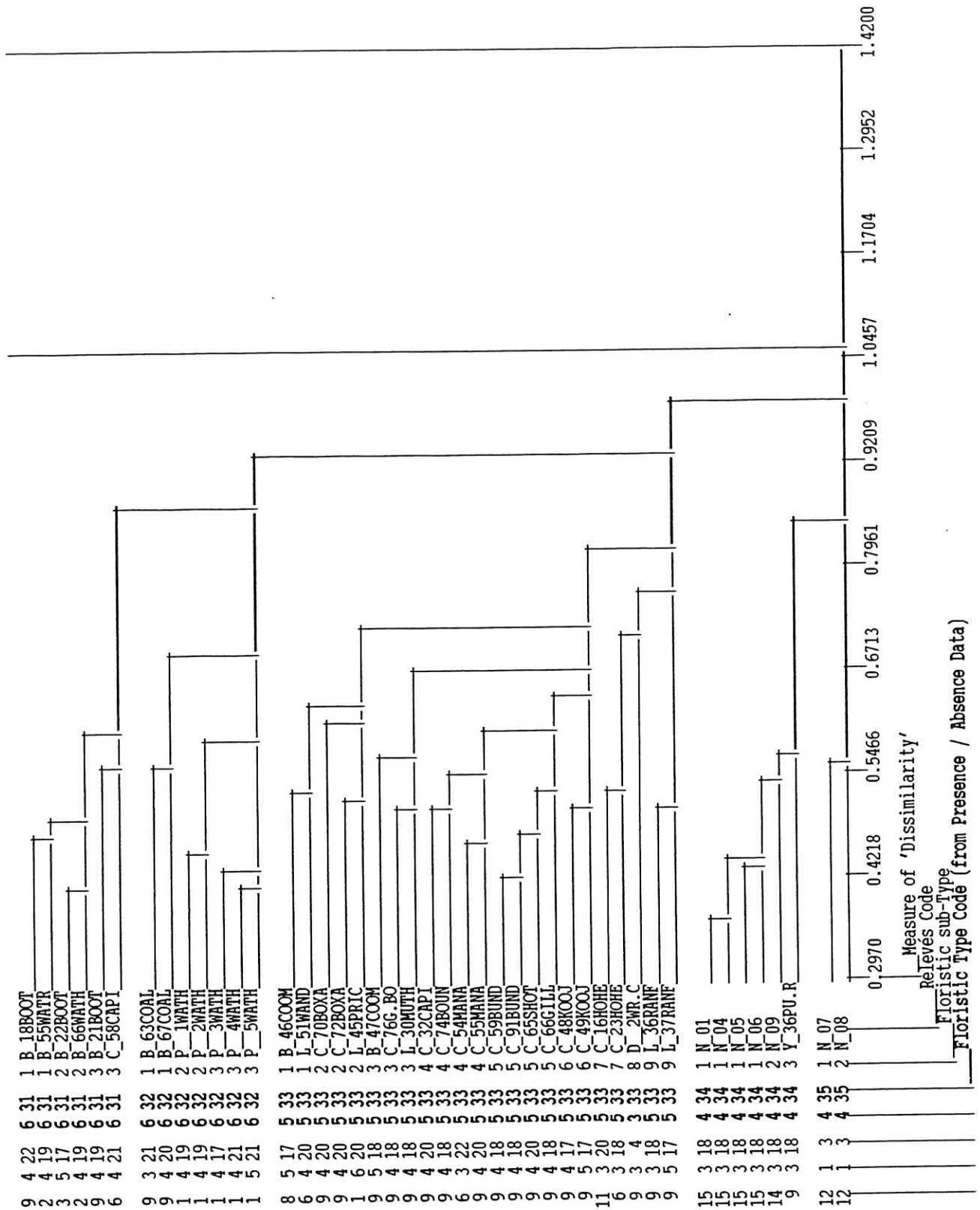
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9 L_37RANF
1 N_01
1 N_04
1 N_05
1 N_06
2 N_09
3 Y_36PU.R
1 N_07
2 N_08
0.2970
0.4218
0.5466
0.6713
0.7961
0.9209
1.0457
1.1704
1.2952
1.4200
Measure of 'Dissimilarity'
ReleVes Code
Floristic sub-Type
Floristic Type Code (from Presence / Absence Data)

Appendix 6 Description of vegetation of Floristic Regions

The seven geographic regions as defined in Figure 12 are described in terms of landscape units. Relationships between floristic regions, geology, soils and vegetation systems are shown in Table 8. Detailed descriptions of each Floristic Type referred to here are provided in Appendix 4. Although floristic differences between sub- Types have not been elucidated yet, an indication of some of the differences is provided here.

1. Badgingarra Region

Boundaries:

This region, named after the town of Badgingarra, extends beyond the study area in the west, probably as far as the Gingin scarp. Its eastern boundary is generally the western limit of the outcrop of the Otorowiri Member of the Parmelia Formation which is expressed by a change in soil types and a reduced elevation. South of Cataby, these boundaries are difficult to define with confidence. This region probably extents significantly to the north to about Eneabba.

Description:

This region consists predominantly of uplands and colluvial slopes with soils dominated by laterite or sand respectively. The drainage lines are generally steeply incised where the soil is derived from relatively fresh rocks. The few broad sections of drainage lines are infilled with alluvium derived from the Otorowiri Region.

The vegetation is dominated by heath of three main floristic types. Type 26 occurs on the laterite uplands and the distinctive species are often *Dryandra* aff. *falcata* and *Calothamnus torulosus*. Types 28 and 29 both occur on colluvial and residual sands and occur both in this region and Rowes Region. The main differences appear to be the general absence of *Banksia prionotes, B. leptophylla* and *Eremaea pauciflora* in this Region. There is very little Banksia woodland in this region.

Drainage line communities were not sampled in detail. The incised drainage lines are generally lined by *Eucalyptus wandoo* often with *Scholtzia parviflora* scrub growing in the narrow strip of well sorted sand. *Melaleuca raphiophylla* is often to be found lining the the drainage channels. The broader lines, being filled with alluvium, have Marri, York gum and Wandoo woodlands. The dominant shrub species in this case is generally *Calothamnus quadrifidus*. The shallow grey sand often present on the fringe in in this case is usually dominated by *Verticordia densiflora*.

2. Otorowiri Region

Boundaries:

This region is named after the Otorowiri Member of the Parmelia Formation which out crops here. It reflects an outcrop of siltstones and mudstones which occur at the base of the Parmelia Formation. The western boundary is, as described for the eastern boundary of the Badgingarra Region, expressed by an increase in slope. The eastern boundary is the Dandaragan Scarp, a discontinuous feature which includes features such as Dinner Hill. The rim of the breakaways have been included in this region. Its southern limit appears to extend beyond the Gingin scarp terminating with the Bassendean Dunes.

Description:

Only small remnant upland patches are present, these having been efficiently removed by erosion because of the fine nature of the soil and rocks. Thus the area has lower elevation than much of the study area. The foot of the scarp is characterised by many steeply incised (in places) drainage lines. These combine after only a few kilometres and form less incised lines which pass through a region of gently undulating low hills.

The vegetation reflects this difference in dissection. Typically Wandoo woodlands (Type 7) occur in the steeply incised slopes forming a narrow discontinuous band at the foot of the Dandaragan Scarp. York Gum occasionally occurs with the wandoo but it often occurs as separate woodlands along some drainage lines. Understory species are very variable and include *Myriocephalus suffruticosus*, *Hypocalymma ? linifolium* and *Acacia plicata*. Associated with these woodlands and on some breakaway slopes are low heaths on heavy soils. Typically *Melaleuca radula* is conspicuous but also *Calothamnus quadrifidus* and *Petrophile seminuda* are dominant in places.

Much of this Region has been cleared, especially the heath areas east of Mullering road. It is not known what was present here and sampling was obviously deficient.

On low gravelly slopes and divides is a distinctive heath or mallee heath, mainly in the northern parts of this region. Conspicuous is the mallee *Eucalyptus gittinsii*. Its presence and that of other species is dependant on the relative amount of gravel present. Several species of *Allocasuarina* (*A. campestris, A. ramosissima* and *A. microstachya*) are often dominant. The tussock sedge (*Ecdeiocolea monostachya*) is usually present where there is shallow sand over the gravel or clay.

The drainage lines are mainly wandoo or york gum in the eastern portion while Marri dominates some in the west.

3. Dandaragan Region

Boundaries:

The Dandaragan Region is very similar to Beard's (1979) Dandaragan Vegetation System and the name is therefore retained. The western boundary is the Dandaragan and Gingin scarp. As mentioned for Badgingarra, these was some difficulties in definition in the vicinity of Cataby. The eastern boundary is essentially an erosion feature marking the upper limit of the Minyolo and Caren Caren Brooks. The northern boundary appears to be the limit of the Warnboro and Coolyena geological Groups.

Description:

This is essentially the area in which Churchward (1970) studied the soils of the Dandaragan Region in detail. A brief description of the soils are provided in Table 1. Beard (1979) also recognised essentially the same area having apparently circumscribed the occurrences of Marri woodlands.

The Region has two well developed, seasonally flowing drainage systems. The predominant landform is the colluvial valley slopes. Interfluvial divides are only a minor component with only a small proportion of these being the original Tertiary upland surface. Distinct alluvial valley floors are present but only a small proportion of the area.

Detailed sampling of the vegetation concentrated on the upland areas because the clearing has removed native vegetation from most other parts of this Region. Enough remnants remain to provide an indication of the pre-European vegetation.

Marri Woodlands predominated in almost all areas. The sandy uplands were marri, occasionally with Banksia trees but more commonly with heath dominated by *Calothamnus quadrifidus, Hibbertia hypericoides, H. racemosa* and *Hypocalymma angustifolia* and occasionally *Dryandra sessilis* (Floristic Types 6, 16, 17). These shrub areas occasionally exist with no tree overstorey. A similar absence of trees is more common for upland laterite areas. Here, *Dryandra patens* commonly dominates these generally red duricrust laterites (Floristic Type 21). It is usually accompanied by *Calothamnus sanguineus, Dryandra carlinoides* and *Hakea lissocarpha.*

Steep breakaway slopes are generally *Melaleuca radula* dominated Heath (Floristic types 19 and 20). Occasionally present at the base these slopes are york gum woodlands with an understorey of *Gastrolobium callistachys.*

The colluvial slopes are generally marri woodlands with a mixture of understorey species depending on the relative proportion of sands and gravels. In places Marri is of minor importance, particularly at the southern limit on the Gingin Scarp. Here there is low heath with the occasional low tree *Eucalyptus todtiana.* Deeper pockets of sand appear to allow the development of low tree understorey of *Banksia* species, *B. attenuata* on grey sands and *B. prionotes* on yellow or orange sands (Floristic Types 16 and 17). Probably the best development of these banksia dominated areas are lower slopes where considerable sand (usually grey) has accumulated adjacent to drainage lines. These sands are well sorted, low in clay and

consequently unfavourable situations for marris to grow. Minor drainage lines are generally sandy. Few of these remain and are now dominated by sedges which have invaded since clearing. These appear similar to the drainage lines of the Rowes Region from which the soil may have been derived. *Banksia prionotes* woodlands appear to surround scrub of *Scholtzia parviflora* (Vegetation Type 16 and 9) which can dominate ephemeral depressions. Some such depressions are diatomaceous in origin with york gum growing on them. *Melaleuca raphiophylla* dominates depressions which appear to have a permanent supply of water at least close to the ground surface.

Almost all of the main drainage lines have been grossly changed. The drainage channels are principally *Eucalyptus rudis* (flooded gum) and *Melaleuca raphiophylla* (paper bark). They are, however, narrow and are usually surrounded by Marri woodlands. The upper reaches of the Minyolo Brook have *Casuarina obesa* woodlands possibly indicating a saline subsoil.

4. Bassendean Region

Boundaries:

The Bassendean Region corresponds with the Bassendean Dunes and Beard's (1979) Bassendean Vegetation System. Its eastern boundary is the Gingin scarp, and the western boundary is the more calcareous Spearwood Dunes.

This Region could probably be subdivided further since Griffin and Keighery (1979) demonstrated a floristic discontinuity within the Bassendean dunes at about Cataby.

Description:

It is principally an area of unconsolidated siliceous sand dunes with a number of lakes and wet depressions developed in the swales. The dunes have little soil structure while the depressions have either clay or organic impeding layers.

The majority of the land in this area is uncleared and belongs to the Crown. Because of this no floristic sampling was undertaken. Data from Griffin and Keighery (1989) were incorporated to allow some comparisons to be made between the areas.

The dunes are almost entirely low woodlands dominated by *Banksia attenuata* and *B. menziesii* (Floristic Type 34). Associated species include *Eucalyptus todtiana* and *B. ilicifolia*. The shrub species *Eremaea pauciflora* is usually very important in these woodlands.

The wet depressions are very variable in floristic composition (Floristic Types 1 and 35), probably reflecting differences in substrate and moisture status. Conspicuous species often found in some include *Melaleuca preissiana, M. raphiophylla* and *Actinostrobus pyramidalis*. Some areas are dominated by low shrubs eg *Calothamnus hirsutus* or sedges eg *Baumea preissii* and *Anarthria laevis*.

5. Rowes Region

Boundaries:

This region corresponds to part of several of Beard's (1979) Vegetation Systems. Hence the new name which is taken from a major road in the area. Its western boundary coincides with the eastern boundary of the Dandaragan Region. Its eastern boundary is essentially the floodplain of the Moore River. Both its northern and southern limits go beyond the present study area. It is probable that in the north it includes part of the Watheroo National Park and in the south it extends beyond the Moore River. There are some differences within this region which may warrant its subdivision into northern and southern parts. There are obvious differences in the composition of the laterite uplands but in contrast, little in the winter wet depressions.

Description:

In general terms the landscape and soils are similar to the Badgingarra Region with grey sands and gravels on the uplands and upper colluvial slopes. The local relief is not as great and the drainage lines are different. In the Rowes region they are broad U-shaped and infilled by sand and in places diatomite. This suggests great antiquity rather than the relatively recent rejuvenation which has occurred in the Badgingarra Region.

The vegetation reflects these similarities and differences in landforms and soils. The low heaths of the lateritic uplands, however, show distinct floristic differences, particularly Floristic Type 25 which generally has a significant contribution from *Calothamnus longissimus* and does not have the species named in the description of the Badgingarra Region. There are differences in the composition of vegetation on laterite within the Region with southern portion being more similar to those of the Badgingarra Region. This may be related to the southern area being more dissected and therefore having a lateritic soil type more similar to Badgingarra.

The upper slopes, mainly with pale yellow sand, usually have low heath, generally with occasional low trees of *Eucalyptus todtiana* (Floristic Types 28 and 29). Several shrub species (eg *Banksia leptophylla, Eremaea pauciflora and Petrophile ericifolia*) are more likely to be present here than in the Badgingarra Region.

Banksia trees may occur in upper parts of the landscape as an open low woodland presumably in areas of deep sand. Often *Banksia prionotes* is important here and occasionally *Xylomelum angustifolium* (Woody pear) and *Actinostrobus arenarius* (Floristic Types 13 and 28).

On the lower slopes, or even the valley bottoms, where the sand is deeper banksia woodlands of *B. attenuata* and *B. menziesii* have developed. Particularly in pale sand in the valley bottoms these trees are accompanied or even replaced by *B. burdettii*, a large shrub species (Floristic Type 33). This species is typical of the leached soils of this region.

Although the drainage lines have great antiquity, many have been infilled but sand. A system of integrated drainage channels are

absent. Rainfall in excess of evapotranspiration probably either recharges the groundwater or joins more co-ordinated drainage lines by flow within the surface sand deposits. There are, however, many winter wet depressions which support a wide variety of vegetation types. They are similar to those described for the minor drainage lines of the Dandaragan Region. There are low heaths dominated by species such as *Thryptomene prolifera* (Floristic Type 4), and *Grevillea paniculata* or *Melaleuca seriata* (Type 8). Open woodlands of *Eucalyptus rudis, Eucalyptus camaldulensis* (Types 1 and 9) and woodlands of *Casuarina obesa* are also present. There is a wide range of as yet poorly defined vegetation types surrounding these wetlands (Type 12). Typically, however, these are surrounded by *Banksia prionotes* woodlands (Type 13) and usually some *Scholtzia parviflora*.

6. Boothendarra Region

Boundaries:

This is an area which Beard (1979) included with what is here called the Badgingarra and Otorowiri Regions. The name is derived from the Boothendarra Nature Reserve which it is typical of this Region. On its western boundary is the Otorowiri Region thus it is effectively a replacement for the Dandaragan Region in this the northern part of the study area. Its eastern boundary has not been defined but it probably extends to include the western part of the Watheroo National Park. For the purpose of this study sample sites from Watheroo have been included in this region (Floristic Type 32). Its northern limit extends well beyond the study area and includes part of the Alexander Morrisson National Park and perhaps even Tathra National Park.

Description:

The area is similar to the Badgingarra Region but it is less dissected. There are few breakaway features and the typically U-shaped valleys rarely support recognisable depressions or channels being infilled by sand. These differences probably reflect differences in the rock types from which these Regions were developed. It seems probable that the unnamed upper sandstone of the Parmelia Formation has a lower proportion of fine fractions than the Yarragadee Formation. The later development of this area for farming supports this hypothesis.

There are only small exposures of laterite in this area. They tend to be floristically distinct from other Regions but the reasons are not clear. Also present in areas with lateritic duricrust is *Eucalyptus accedens* (Powder bark wandoo) woodlands which generally occur no where else in the study area.

The colluvial sands have open low woodlands and heaths (Types 27, 31 and 32) which are floristically distinct from other Regions but have most in common with the Rowes Region. Banksia woodlands are less common here than in Rowes. Typically the area is low heath with the occasional stunted tree of *Eucalyptus todtiana* or *Xylomelum angustifolium*. The centre of valleys may have patches of heath dominated by *Banksia burdettii* and/or *B. leptophylla*. Occasionally also are patches of *B. prionotes*, usually in yellow or orange sand.

The only drainage depression in this Region (but outside the study area) is the Big Soak where *Eucalyptus camaldulensis* occurs on an area probably diatomaceous in origin.

7. Unnamed Region

This is an area of alluvium through which the Moore River now passes. Insufficient information is available to describe it. Unfortunately there is very limited amounts of uncleared vegetation remaining to study.

Conspicuous, however, are the woodlands of wandoo, salmon gum and york gum and it is clearly quite different from any of the other regions in the study area.

Appendix 7 Crown land important for conservation.

This attachment describes the key areas of Crown land which have significance for the conservation of flora. It excludes existing conservation reserves vested in the National Parks and Nature Conservation Authority (NP&NCA) and managed by the Department of Conservation and Land Management (CALM).

A priority rating is assigned. Areas with Priority '1' are very important. The areas are listed geographically within Floristic Regions.

Priority '1' areas should be listed on the Register of the National Estate.

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1. Badgingarra Region

Badgingarra Research Station (Reserve C25143) (Priority 3):

This is typical of the sandy upland areas around Badgingarra. It is probably similar to parts of Badgingarra National Park. However, as it appears to have proportionally more yellow sand than the National Park, it compliments it. One Declared Rare plant species (*Grevillea saccata*) was found. This is not known from any CALM conservation reserves, but is secure, for the moment, in several areas of Crown land.

Old Badgingarra Townsite ([? reserve number]) (Priority 3):

The area inspected is dominated by sand and laterite heath. It appears to be transitional in floristic composition between the Badgingarra and Rowes Regions. It is a valuable educational resource.

Mullering Road (Road number 14612) (Priority 2):

The road reserve just south of where it joins Waddi Road is almost 0.5km wide. In this area it contains a wide variety of vegetation formations and types from Marri woodlands, Mallee heaths and low heath vegetation. It appears to be representative of the boundary between the Badgingarra and Otorowiri Regions. It also contains perhaps the only known population of a rare *Acacia* [] although it may occur on an adjacent property.

Mullering Road (Road number 14612) (Priority 2):

Another portion of this road has a threatened population of the Declared Rare plant *Hakea megalosperma*. This is its most southern and isolated population. Apparently it also occurs on the adjacent property (Location 3900).

2. Otorowiri Region

Boothendarra Hill (C29719) (Priority 1):

This is a very valuable area. Although small, it contains a complex suite of vegetation types, some of which are not known from other reserves or even other uncleared patches of bush. Some of it is similar to the south-west corner of Alexander Morrison National Park (off Toobardi Rd). One Declared Rare plant species (*Dryandra serratuloides*) has been found here. This is only the second population of this species to be found on any Crown reserves. The remainder are on road reserves and are vulnerable. It is likely that other rare species will also be found here. It should be vested in the NP&NCA.

Winjardie ([reserve number]) (Priority 2):

This small reserve contains examples of the Hill River, now very modified elsewhere, and adjacent lower gravelly slopes. The adjacent Nature Reserve (Twarta) also includes examples of the Hill River but there are few other examples of the lower gravelly slopes, particularly areas dominated by *Melaleuca ciliata*. It should be jointly vested in the Dandaragan Shire and the NP&NCA.

3. Dandaragan Region

Marri Reserve (Plan 13785 lot 15) (Priority 3):

This small area (40ha) was apparently transferred to the shire of Dandaragan on the division of the Mungedar properties. It contains areas of Marri woodland rarely found on conservation reserves. Its small size and condition (weed invasion at least in the southern part) reduce its viability.

Water, Camping and Gravel Reserve (Reserve C12276) (Priority 2):

This reserve at the junction of the Dandaragan and Muthawandery Roads includes a representative area of *Banksia prionotes* woodland growing near a drainage line. It is one of a few of its type in this Region.

Dandaragan Road (Road Number 798) (Priority 2)

Most of Dandaragan Road is very narrow and contains little native vegetation. A short strip less than 1km long east of reserve C12276 is in good condition. Here the Minyolo Brook passes within the road reserve and contains good examples of low heath typical of some wet areas (*Calothamnus hirsutus*). This vegetation appears to not be in the following reserve.

Water Reserve (Reserve C15538) (Priority 1):

This reserve at the corner of Dandaragan and Kolburn Roads has very significant areas of wetlands. The vegetation types included are variable. Prominent species include *Eucalyptus rudis, Melaleuca teretifolia* and *Kunzea* sp. It is threatened by salinity upstream of it. It should be vested in the NP&NCA.

Cataby Water Reserve (Reserve C11712) (Priority 2):

This small reserve provides an example of the transition in vegetation types at the bottom of the trunk valleys. It includes open Marri woodlands with Banksia trees beneath varying in number depending on the depth of sand. An area of heath growing on shallow sand over gravel supports the majority of the plants an unnamed probably rare *Grevillea*. Eventually York gums (mallee form) replace the marri on the narrow band of alluvium. A low heath (*Thryptomene prolifera*) typical of some winter wet areas grow beneath the York gums. It should be jointly vested in the Dandaragan Shire and the NP&NCA.

4. Bassendean Region

No specific recommendations are possible about this Region since it was only peripheral to the study area. It is clear, however, that there are considerable existing areas in the conservation estate and there is not the same urgency to protect other areas.

Attention is, however, drawn to Lake Guraga which is in a reserve for Recreation (C31223) vested in the shire of Dandaragan. It is a unique feature in this part of the Bassendean Region and also an significant water bird area. Its importance for conservation needs to be formally recognised by vesting in the NP&NCA.

5. Rowes Region

Resting Place (Reserve C17744) (Priority 3):

This small reserve on Muthawandery Road (near the corner of North-West Road) contains mainly Banksia woodlands (*B. prionotes* and *B. attenuata*). These are typical of many of the woodlands in this part of the Rowes Region. There are also minor amounts of heath on both laterite and sand.

Jam Hill Nature Reserve (Reserve C3634) (Priority 1):

This is a small reserve which is very important because of the extensive alienation and clearing in this part of the Rowes Region. It is at the boundary between the Dandaragan and Rowes Regions and as such represents a range of landforms and vegetation types. The upland areas, particularly the laterite, are part of the Rowes Region while the breakaway slopes are part of the Dandaragan Region. Its importance should be recognised by vesting it in the NP&NCA

Gravel Reserve (Reserve C25264) (Priority 3):

This is a small reserve at the corner of Capitella and Barberton West Roads. It contains low heath, mainly shallow sand over gravel, most of which has been cleared in this area.

Damper (Water Reserve C10006) (Priority 1):

This small reserve contains one of the few remaining areas of *Casuarina obesa* woodlands in this Region which are still in good condition. This is despite it having has some grazing use in the past. This area contains pools which are probably wet most summers. Importantly the area provides good examples (although small in area) of a sequence of vegetation types which border such wet depressions. The area should be vested in the NP&NCA.

Gravel Reserve (Reserve C25256) (Priority 1):

This reserve for gravel has a wide variety of vegetation types from heath on laterite uplands, *Banksia prionotes* woodlands and heath in a drainage line. Because of this diversity and it being representative of the region it should be jointly vested in the Moora Shire and the NP&NCA.

Boundary Road (Road number [???]) (Priority 2):

The road reserve adjacent to CG3575 contains a form of laterite heath typical of the south-east of the study area. More importantly these is a population of *Dryandra cuneata*, a species which normally occurs in the eastern wheatbelt. Its presence here is very unusual as it is hundreds of kilometres from the nearest other populations.

6. Boothendarra Region

Like the Bassendean Region, this Region is well represented in conservation reserves. There are no other types of Crown land within the study area.

Appendix 8

E.A. GRIFFIN AND ASSOCIATES

CONSULTING BOTANIST

47 McMillan St., Victoria Park, W.A. 6100
Telephone (09) 361 0373

20th August 1988

Dear Farmer,

REMNANT VEGETATION AT DANDARAGAN

I am undertaking a survey of the uncleared vegetation in the Dandaragan area. Your property is part of the survey which is concentrating on the older settled areas of Dandaragan and adjacent areas. This area has been neglected by botanists in the past. Funding received from the W.A. Heritage Committee has made this survey possible. Although State Government Departments (eg Agriculture and Conservation and Land Management) will benefit from the survey, it is entirely my own initiative.

The uncleared patches on both private and crown land will be mapped from aerial photographs and satellite images. I am hoping to visit and describe the plants in each patch. I, therefore, may want to visit your property and collect plant specimens for identification.

A brief questionnaire is enclosed. Your answers will assist me in accurately completing the survey. Could you please complete it and return as soon as possible. I am conducting my field visits in September and early October.

You are invited to attend a public meeting at the Dandaragan Recreation Centre on
Thursday, September 8th, at 7.30 pm.
As a guest speaker of the Minyolo Soil Conservation D.A.C., I will explain more about the survey and discuss the issue of retaining native vegetation on farms.

Your co-operation will be valued. Hope to meet you soon.

Yours faithfully

Ted Griffin

Remnant Vegetation Questionnaire Form

REMNANT VEGETATION AT DANDARAGAN

fill out separate questionnaires for each property

Property name _____

please correct address if wrong

QUESTIONNAIRE

Please complete and return in the envelope provided as soon as possible.

(For this survey, areas of trees with pasture or crop beneath are considered to be "cleared.")

Q.1 Approximately, what is the total area of this property? _____

Q.2 Approximately, how much is uncleared? _____

Q.3 Has there been any clearing in the last 5 years? _____

Q.4 Approximately how much do you think might be cleared in the future? _____

Q.5 Why have areas not been cleared? (Indicate if the following might have been a MAJOR, a MINOR or NO influence)

own pleasure _____
important for control of salinity and erosion _____
to conserve native plants of the area _____
to provide home for birds and animals _____
shelter for stock _____
presence of poison plants _____
adds to value of property _____
have not yet cleared _____
land not suitable for clearing _____
other _____

Q.6 What proportion of the uncleared areas have been fenced off from stock?
none ____, a little ____, half ____, a lot ____, all ____,

Q.7 Would Government assistance encourage you to fence off more? ____

Q.8 How many kilometres of fencing would you need to fence off most of the uncleared patches? ____ km

Q.9 If rare plants or animals were found on your property, or your bush areas were considered valuable for other nature conservation reasons, would you be prepared to protect the area from stock with your own resources?
probably yes ____, probably no ____

Q.10 If No to Q.9, what would you need to change your mind?
(tick the least compulsive option)
assistance with fencing and management? ____
provision of fencing materials? ____
compensation for productive land not cleared? ____
voluntary sale of patch to Government? ____
compulsary protection? ____
compulsary sale of patch to Government? ____

Q.11 Would you like advice or assistance with management of the present uncleared patches so that they can survive for as long as possible in a natural condition? ____

Q.12 Do you wish any of your answers to remain confidential? ____

Q.13 Do you give permission for me to inspect uncleared areas? ____

Q.14 Are you the owner ____, family of owner ____, employee ____, or lessee ____ of this property?

ADDENDUM Update of Species List (Appendix 3)

Corrections to spelling, new identifications, taxonomic changes etc. to July 1994.

Number in front indicates the following:
1 = error in spelling
2 = change in accepted spelling
3 = new name
4 = consistent tentative name
5 = missapplied name
6 = includes several names

No attempt has been made to add any additional species which might have been found in the Study area.

Details of authors and relevant vouchers appear in:

Griffin (1994) Floristic Survey of the Northern Sandplains between Perth and Geraldton. An unpublished report to Heritage Council of W.A.

Species are ordered by family in the same order as in the original Appendix.

26

2 *Triglochin centrocarpa* --> *T. centrocarpum*
2 *Triglochin minutissima* --> *T. minutissimum*
2 *Triglochin striata* --> *T. striatum*

31

1 *Neurachne alopecuroides* --> *N. alopecuroidea*

32

1 *Cyperus tenuifloris* --> *C. tenuiflorus*
1 *Lepidosperma pubsquameum* --> *L.* sp. P1 Small Head (M.D.Tindale 166a)
4 *Lepidosperma* sp. indet --> *L. ? scabrum*
5 *Mesomelaena stygia* --> *M. pseudostygia*
4 *Schoenus* aff. *brevisetis* (EAG 1911) --> *S.* sp. aff. *brevisetis*
4 *Schoenus* aff. *indutus* (EAG 3842) --> *S.* sp. Warradagee
4 *Schoenus* aff. *obtusifolius* (EAG 3841) --> *S.* sp. Wongan
5 *Schoenus* aff. *rodwayanus* --> *S. rodwayanus*
5 *Schoenus grandiflorus* --> *Cyathochaeta avenacea*
1 *Schoenus pleistemoneus* --> *S. pleiostemoneus*
3 *Tricostularia neesi* --> *T. neesii* ssp. *neesii*

39

1 *Alexgeorgia nitens* --> *Alexgeorgea nitens*
1 *Alexgeorgia subterranea* --> *Alexgeorgea subterranea*
5 *Anarthria gracilis* --> *A. humilis*
3 *Lepidobolus* sp. (EAG 2093) --> *L. quadratus* ms
4 *Loxocarya* aff. *cinerea* --> *L. lateritica* ms
3 *Loxocarya* aff. *fasciculata* --> *L. elongata* ms
3 *Loxocarya* sp. --> *L. parthenica* ms
3 *Loxocarya* sp. --> *L. semiplana* ms
3 *Loxocarya* sp. (EAG 4588) --> *L. flexuosa*
3 *Loxocarya* sp. indet --> *L. aspera* ms
1 *Lyginea barbata* --> *Lyginia barbata*
3 *Restio* aff. *sphacelatus* --> *R. sinuosus* ms

39 (Cont.)
3 *Restio* sp. (B Briggs 6308) --> *R. sinuosus* ms
3 *Restio* sp. (B Briggs 850) --> *R. microcudon* ms

40
5 *Centrolepis* aff. *drummondiana* --> *C. drummondiana*

54C
1 *Acanthocarpus caniculatus* --> *A. canaliculatus*

54D
5 *Xanthorrhoea drummondii* --> *X.* aff. *preissii*

54F
1 *Borya sphareocephala* --> *B. sphaerocephala*
3 *Caesia* aff. *micrantha* --> *C. alfordii* ms
3 *Chamaescilla corymbosa* --> *C. corymbosa* ssp. *latifolia*
3 *Corynotheca micrantha* --> *C. micrantha* var. *micrantha*
5 *Laxmannia grandiflora* --> *L. omnifertilis*
3 *Laxmannia ramosa* --> *L. ramosa* ssp. *ramosa*
3 *Thysanotus* aff. *multiflorus* --> *T. multiflorus*
4 *Thysanotus* aff. *sparteus* --> *T.* sp. Badgingarra

54J
6 *Wurmbea dioica* ssp. *alba* --> *W. dioica* ssp. *alba* &
W. dilatata & *W. monantha*

54D
5 *Xanthorrhoea drummondii* --> *X.* aff. *preissii*

60
4 *Patersonia* aff. *umbrosa* --> P. sp. aff. *occidentalis*
4 *Patersonia* sp --> *P. spirafolia*
6 *Patersonia juncea* --> *P. juncea* & *P. drummondii*
ssp. *drummondii*
3 *Romulea rosea* --> *R. rosea* var. *australis*

66
3 *Caladenia gemmata* --> *Cyanicula gemmata* ms
3 *Caladenia longicauda* --> *C. longicauda* ssp. *longicauda*
3 *Caladenia* sp. --> *C. footeana* ms
1 *Drakea elastica* --> *Drakaea livida*
3 *Eriochilus dilatatus* --> *E. dilatatus* ssp. *multiflorus* ms
1 *Leporella menziesii* --> *Leptoceras menziesii*
3 *Microtus unifolia* --> *Microtis media* ssp. *media*
3 *Thelymitra variegata* var. *apiculata* --> *T. apiculata*

70
1 *Allocasuarina grevillioides* --> *A. grevilleoides*

90

3 *Adenanthos cygnorum* --> *A. cygnorum* ssp. *cygnorum*
3 *Banksia leptophylla* --> *B. leptophylla* ssp. *leptophylla* & ssp. *melletica*
3 *Banksia littoralis* --> *B. littoralis* ssp. *littoralis*
3 *Conospermum acerosum* --> *C. acerosum* ssp. *acerosum*
3 *Conospermum densiflorum* --> *C. densiflorum* ssp. *densiflorum*
3 *Conospermum incurvum* --> *C. brachyphyllum*
4 *Dryandra* aff. *conferta* --> *D. platycarpa*
4 *Dryandra* aff. *falcata* --> *D. glauca*
4 *Dryandra* aff. *patens* --> *D. stricta*
4 *Dryandra* aff. *polycephala* --> *D. echinata*
4 *Dryandra* aff. *pteridifolia* --> *D. pteridifolia* ssp. *vernalis*
5 *Dryandra cuneata* --> *D. fuscobreatea*
3 *Dryandra fraseri* --> *D. fraseri* var. *fraseri*
3 *Dryandra kippistiana* --> *D. kippistiana* var. *kippistiana*
6 *Dryandra nivea* --> *D. nivea* & *D. stenoprion*
5 *Dryandra patens* --> *D. hewardiana*
6 *Dryandra sclerophylla* --> *D. sclerophylla* & *D. kippistiana* var. *paenepeccta*
3 *Dryandra serratuloides* --> *D. serratuloides* ssp. *perissa*
3 *Dryandra sessilis* --> *D. sessilis* ssp. *sessilis*
5 *Grevillea acerosa* --> *G. umbellulata*
4 *Grevillea* aff. *flexuosa* --> *G. synaphea* ssp. *pachyphylla*
4 *Grevillea* aff. *hookeriana* --> *G. calliantha*
6 *Grevillea amplexans* --> *G. amplexans* & *G. vestita* ssp. *vestita*
5 *Grevillea brachystachya* --> *G. hakeoides* ssp. *stenophylla*
3 *Grevillea eriostachya* --> *G. eriostachya* ssp. *eriostachya*
5 *Grevillea integrifolia* --> *G. integrifolia* ssp. *biformis*
5 *Grevillea integrifolia* ssp. *integrifolia* --> *G. integrifolia* ssp. *biformis*
5 *Grevillea pilulifera* --> *G. uncinulata* ssp. *uncinulata*
3 *Grevillea synaphea* --> *G. synaphea* ssp. *pachyphylla*
3 *Grevillea thysoides* --> *G. thysoides* ssp. *thysoides*
3 *Grevillea vestita* --> *G. vestita* ssp. *vestita*
3 *Hakea* aff. *falcata* --> *H. cygna* ssp. *cygna*
5 *Hakea* aff. *obliqua* --> *H. circumalata*
3 *Hakea auriculata* var. *auriculata* --> *H. auriculata*
3 *Hakea auriculata* var. *spathulata* --> *H. spathulata*
3 *Hakea baxteri* --> *H. brownii*
3 *Hakea erinacea* var. *erinacea* --> *H. erinacea*
3 *Hakea erinacea* var. *longiflora* --> *H. longiflora*
3 *Isopogon teretifolius* --> *I. teretifolius* var. *teretifolius*
3 *Lambertia multiflora* --> *L. multiflora* ssp. *Northern*
4 *Persoonia* aff. *sulcata* --> *P.* sp. Eneabba
5 *Persoonia quinquinervis* --> *P.* aff. *trinervis*
5 *Persoonia striata* --> *P. rufiflora*
4 *Petrophile* aff. *divaricata* --> *P. rigida*
3 *Synaphea petiolaris* --> *S.* sp. 38
3 *Synaphea spinulosa* --> *S. spinulosa* ssp. *spinulosa*

92

6 *Exocarpus aphyllus* --> *Exocarpos aphyllus* & *Leptomeria spinosa*
5 *Santalum spicatum* --> *S. acuminatum*

95
5 *Olax scalariformis* --> *O. benthamiana*

105
5 *Rhagodia baccata* --> *R. preissii* ssp. *preissii*

106
3 *Ptilotus gaudichaudii* --> *P. gaudichaudii* var. *gaudichaudii*

108
1 *Tersoonia cyathiflora* --> *Tersonia cyathiflora*

111
5 *Calandrinia decumbens* --> *Crassula decumbens* ssp. *decumbens*

131
3 *Cassytha glabella* --> *C. glabella* forma *bicallosa*

143
3 *Drosera bulbosa* --> *D. bulbosa* ssp. *bulbosa*
3 *Drosera erythrorrhiza* --> *D. erythrorhiza* ssp. *magna*
3 *Drosera gigantea* --> *D. gigantea* ssp. *gigantea*
5 *Drosera leucoblasta* --> Not present, unsure which other pygmy droseras are present
3 *Drosera macrantha* --> *D. macrantha* ssp. *macrantha*
3 *Drosera stolonifera* ssp. *stolonifera* --> *D. stolonifera* ssp. *porrecta*

149
3 *Crassula colorata* --> *C. colorata* var. *colorata*

152
3 *Billardiera bicolor* --> *B. bicolor ssp. bicolor*
5 *Sollya heterophylla* --> *Cheiranthera preissiana* ssp. *preissiana*

163
3 *Acacia* aff. *microbotrya* --> *A. brumalis* ms
3 *Acacia* aff. *myrtifolia* --> *A. clydonophora* ms
5 *Acacia alata* var. *alata* --> *A. alata* var. *tetrantha*
3 *Acacia barbinervis* --> *A. barbinervis* var. *borelis*
3 *Acacia latipes* --> *A. latipes* var. *latipes*
3 *Acacia sphacelata* --> *A. sphacelata* var. *verticillata* ms
3 *Acacia volubilis* --> *A. cummingiana* ms

165
3 *Chorizema aciculare* --> *C. aciculare* var. *laxum*
3 *Daviesia* aff. *quadrilatera* --> *D. quadrilatera*
3 *Daviesia* aff. *striata* --> *D. chapmanii* ms
3 *Daviesia hakeoides* --> *D. hakeoides ssp. hakeoides* & *D. hakeoides subnuda*
3 *Daviesia incrassata* --> *D. incrassata* ssp. *incrassata*
5 *Daviesia quadrilatera* --> *D. podophylla*
5 *Daviesii dielsii* --> *D. oxyclada*
3 *Gastrolobium ilicifolium* --> *Nemcia ilicifolia*
3 *Gastrolobium ilicifolium* var. *lobatum* --> *Nemcia ilicifolia* ssp. *lobatum* inedit
3 *Gastrolobium pauciflorum* --> *Nemcia pauciflora*
3 *Gastrolobium plicatum* --> *Nemcia plicata*
3 *Gastrolobium spinosum* --> *G. spinosum* ssp. *spinosum*
4 *Jacksonia* aff. *sericea* --> *J.* sp.
3 *Jacksonia capitata* --> *J. condensata*
6 *Jacksonia floribunda* --> *J. floribunda* & *J. densiflora*
6 *Jacksonia macrocalyx* --> *J. macrocalyx* & *J. angulata*
5 *Jacksonia stricta* --> *J. fasciculata*
3 *Mirbelia spinosa* --> *M. tricocalyx*
3 *Oxylobium capitatum* --> *Nemcia capitata* & *N. reticulata*
3 *Oxylobium reticulatum* var. *gracile* --> *Nemcia axillaris*
3 *Sphaerolobium macranthum* --> *S. macranthum* var. *macranthum*

175
3 *Boronia coerulescens* --> *B. coerulescens* ssp. *spicata*
5 *Boronia ovata* --> *B. scabra*
1 *Boronia ramosa* ssp. *anaethifolia* --> *B. ramosa* ssp. *anethifolia*
3 *Diplolaena microcephala* var. *drummondii* --> *D. cinerea* ms
3 *Diplolaena microcephala* var. *velutina* --> *D. velutina* ms

185
3 *Beyeria brevifolia* --> *B. brevifolia* var. *brevipes*
1 *Ricinocarpus glaucus* --> *Ricinocarpos glaucus*

207
3 *Diplopeltis huegelii* --> *D. huegelii var. huegelii*

215
3 *Cryptandra* aff. *leucophracta* --> *Stenanthemum notiale* var. *notiale*
3 *Cryptandra arbutiflora* --> *C. arbutiflora* ssp. *intermedia*
5 *Cryptandra glabriflora* --> *C. spyridioides* & *C. myriantha* ssp. *myriantha*
3 *Cryptandra humilis* --> *Stenanthemum humile*
3 *Cryptandra leucophracta* --> *Stenanthemum reissekii* ms
3 *Spyridium tridentatum* --> *Stenanthemum notiale* var. *notiale*
3 *Trymalium* aff. *wichurae* --> *Cryptandra wichurae*
3 *Trymalium ledifolium* --> *T. ledifolium* ssp. *rosmarinifolium* & *T. angustifolium*
3 *Trymalium wichurae* --> *Cryptandra wichurae*

223
4 *Lasiopetalum* aff. *membranaceum* --> *L.* sp. Hill River
5 *Lasiopetalum lineare* --> *Guichenotia alba*

226
5 *Hibbertia* aff. *montana* --> *H. mylnei*
3 *Hibbertia spicata* --> *H. spicata* ssp. *spicata*

243
4 *Hybanthus* aff. *floribundus* --> *H. floribundus* ssp. Hill River

263
5 *Pimelea* sp. indet --> *P. floribunda*

273
4 *Beaufortia* aff. *bracteosa* --> *B.* aff. *bracteosa*
3 *Chamelauceum* sp. --> *Chamelaucium griffinii* ms
3 *Chamelauceum* sp. --> *Chamelaucium hamatum* ms
1 *Chamelauceum uncinatum* --> *Chamelaucium uncinatum*
3 *Eremaea* aff. *brevifolia* --> *E. ectadioclada* & *E. asterocarpa* ssp. *histocarpa*
3 *Eremaea* aff. *violacea* (EA Griffin 1557) --> *E. hadra*
3 *Eremaea beaufortioides* --> *E. pauciflora* ssp. *loncophylla*
3 *Eremaea pauciflora* ssp. --> *E. pauciflora* ssp. *calyptra*
3 *Eucalyptus* aff. *drummondii* --> *E. annuliformis* ms
3 *Eucalyptus* aff. *petrea* --> *E. absita*
3 *Eucalyptus camaldulensis* --> *E. camaldulensis* var. *obtusa*
6 *Eucalyptus gittinsii* --> *E. gittinsii* & *E. incrassata*
3 *Eucalyptus loxophleba* --> *E. loxophleba* ssp. *loxophleba*
3 *Eucalyptus macrocarpa* ssp. --> *E. macrocarpa* ssp. *elachantha*
3 *Eucalyptus* sp. (CA Gardner 9088) --> *E. pluricaulis* ssp. *pluricaulis*
3 *Eucalyptus* sp. (MIH Brooker 9740) --> *E. abdita*
3 *Eucalyptus* sp. (MIH Brooker 9744) --> *E. dolorosa*
3 *Eucalyptus wandoo* --> *E. wandoo* ssp. *pulverea*
4 *Kunzea* aff. *micrantha* --> *K. limnicola* ms
4 *Kunzea* sp. --> *K. incognita* ms
3 *Leptospermum oligandrum* --> *L. erubescens*
5 *Melaleuca* aff. *tricophylla* --> *M. psammophylla*
5 *Melaleuca hamulosa* --> *M. viminea* ssp. *viminea*
1 *Melaleuca raphiophylla* --> *M. rhaphiophylla*
3 *Melaleuca undulata* --> *M. coronicarpa* ssp. *coronicarpa*
3 *Melaleuca viminea* --> *M. viminea* ssp. *viminea*
3 *Verticordia acerosa* --> *V. chrysanthella*
3 *Verticordia* aff. *brownii* --> *V. eriocephala*
3 *Verticordia* aff. *chrysantha* --> *V.* ? *chrysanthella*
3 *Verticordia chrysantha* --> *V. chrysanthella*
3 *Verticordia densiflora* --> *V. densiflora* var. *densiflora* & *V. densiflora* var. caespitosa
3 *Verticordia huegelii* --> *V. huegelii* var. *huegelii*
3 *Verticordia insignis* --> *V. insignis* ssp. *eomagis*
6 *Verticordia pennigera* --> *V. pennigera* & *V. blepharophylla*
3 *Verticordia plumosa* --> *V. plumosa* var. *brachyphylla*
5 *Verticordia preissii* --> *V. endlicheriana* var. *maniculata*

281
3 *Eryngium pinnatifidum* --> *E. pinnatifidum* ssp. *pinnatifidum*

288
3 *Astroloma* aff. *serratifolium* --> *A. pedicellatis* ms
5 *Astroloma pallidum* --> *A. ? microdonta*
5 *Astroloma serratifolium* var. *horidulum* --> *A. pedicellatis* ms
5 *Astroloma serratifolium* var. *serratifolium* --> *A. ? microdonta*
4 *Astroloma* sp. --> *A.* sp. Cataby
5 *Conostephium minus* --> *C.* sp. & possibly *C. minus*
3 *Leucopogon* aff. *elegans* --> *L. cochlearifolius*
6 *Leucopogon elegans* --> *L. elegans* & *L. oliganthus*
5 *Leucopogon polymorphus* --> *L. ? sprengelioides*

302
6 *Logania spermacocea* --> *L. spermacocea* & *L. flaviflora*

310
5 *Halgania littoralis* --> *H.* sp.

311A
1 *Lachnostachys eryiobotrya* --> *L. eriobotrya*

313
4 *Microcorys* sp. --> *M.* sp. Coomallo

323
1 *Polypompholyx tenella* --> *P. tenellus*

341
5 *Dampiera alata* --> *D. coronata* & *D. alata*
3 *Dampiera oligophylla* var. *juncea* --> *D. oligophylla*
3 *Goodenia affinis* --> *G. convexa*
3 *Goodenia filiformis* var. *minutiflora* --> *G. micrantha*
5 *Goodenia hassallii* --> *G.* aff. *hassallii*
5 *Scaevola lanceolata* --> *S. virgata*
5 *Scaevola paludosa* --> *S. repens* ssp. *repens* & *S. repens* ssp. *errecta* ms
5 *Scaevola* sp. indet --> *S. sericophylla*

343
4 *Stylidium* aff. *repens* --> *S.* sp. Eneabba
3 *Stylidium bulbiferum* --> *S. bulbiferum* ssp. *bulbiferum*
3 *Stylidium caricifolium* --> *S. caricifolium* ssp. *caricifolium*
6 *Stylidium diuroides* --> *S. diuroides* ssp. *diuroides* & *S. diuroides* ssp. *albo-lilacinum*

345
2 *Brachycome pusilla* --> *Brachyscome pusilla*
3 *Chrysocoryne pusilla* --> *Gnephosis trifida*
4 *Craspedia* sp. --> *C.* sp. A in Perth Flora
1 *Gnapalium sphaericum* --> *Gnaphalium sphaericum*
3 *Helichrysum lindleyi* --> *Lawrencella rosea*
5 *Helipterum corymbosum* --> *Rhodanthe polycephalum*
3 *Helipterum cotula* --> *Hyalosperma cotula*
3 *Helipterum hyalospermum* --> *Hyalosperma glutinosum* var. *glutinosum*
3 *Helipterum manglesii* --> *Rhodanthe manglesii*
3 *Helipterum spicatum* --> *Rhodanthe spicata*
3 *Helipterum strictum* --> *Rhodanthe stricta*
3 *Helipterum tenellum* --> *Erymophyllum tenellum*
1 *Hypochoeris glabra* --> *Hypochaeris glabra*
1 *Lageinfera huegelii* --> *Lagenifera huegelii*
3 *Olearia strigosa* --> *O. incondita* ms
1 *Siloxeros humifusus* --> *Siloxerus humifusus*
3 *Waitzia aurea* --> *W. nitida*
3 *Waitzia paniculata* --> *Pterochaeta paniculata*

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