

# AN OVERVIEW OF REMNANT VEGETATION IN THE BLACKWOOD CATCHMENT

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## Abstract

This paper is in four parts:

- 1 What was the natural vegetation like before European settlement?
- 2 Where do remnants of that natural vegetation still remain?
- 3 What is the value of this remnant vegetation?
- 4 How can it be managed in a sustainable way?

Greg Beeston will talk on the first two points, Penny Hussey on the second two.

## 1 Vegetation prior to European settlement

The vegetation of Western Australia has been divided into Botanical Districts by J.S. Beard and the vegetation of these Botanical Districts essentially represents that which existed prior to European settlement. Physical factors such as soil and climate combine to produce Botanical Districts. The Blackwood Catchment has been divided by Beard into three Botanical Districts, (the Darling, the Avon and the Roe Botanical Districts), two subdistricts (Warren and Menzies) and thirteen Vegetation Systems (the Hyden, Dumbleyung, Narrogin, Pingelly, Williams, Wagin, Beaufort, Broomehill, Corrigin, Tambellup, Pingelly Ongerup and the Jingalup Systems) (Figure 1)(Beard, 1980a). Much of the Darling Botanical District has been divided into Botanical subdistricts rather than Vegetation Systems. The Blackwood Catchment can also be divided into Upper, Middle and Lower sections on the basis of vegetation, topography and landuse. In the Lower Blackwood catchment (the Darling Botanical District), forests of Karri (*Eucalyptus diversicolour*) and Jarrah (*Eucalyptus marginata*) are the dominant vegetation. York gum (*Eucalyptus loxophleba*) and Wandoo (*Eucalyptus wandoo*) dominate the Middle to Upper catchment (Avon Botanical District), while a small portion of the upper catchment (Roe Botanical District) has Salmon gum (*Eucalyptus salmonophloia*) and mallee (*Eucalyptus* spp.) as the dominant vegetation.

The following is a brief description of the landscape and vegetation types of each of the Vegetation Systems in the Blackwood Catchment. Figure 2 (on display board) gives a diagrammatic overview of the vegetation types in the catchment

The **Beaufort Vegetation System** covers a small area in the south-western corner of the Shire of Katanning and the north east corner of the Shire of Kojonup. Sandy deposits occur along sections of the Carrolup River, and carry a variety of plant communities. The principle elements of this vegetation system landscape are woodland of wandoo on laterite residuals, woodlands of York gum and wandoo on undulating country and woodland of York gum and flat-topped yate (*Eucalyptus occidentalis*) on sand patches. Often there is a mosaic of different combinations of

*Eucalyptus* spp. woodland on a variety of landscapes (Beard, 1980b).

The **Broomehill Vegetation System** is the most prominent in the Shire of Katanning, extending from Katanning east to Lake Ewylamartup and south to Peringillup (Figure 1). The System is a plateau forming an almost flat to gently undulating plain with heavy soils which are subject to inundation. The System has been largely cleared for farming. The area was originally entirely covered by woodland whose composition varied from area to area. The region has been known for the prevalence of the blue mallet (*Eucalyptus gardneri*) which associates with wandoo to form the bulk of the woodland population. Brown mallet (*Eucalyptus astringens*) is also present and becomes abundant with blue mallet on lateritic rises. When the terrain becomes more dissected and undulating, York gum (*Eucalyptus loxophleba*) tends to replace blue mallet. Flat-topped yate and red morrel (*Eucalyptus longicornis*) are occasional species, whereas salmon gum is less common. Smaller trees which may be still common to the area include jam (*Acacia acuminata*), manna wattle (*Acacia microbotrya*), rock sheoak (*Casuarina huegeliana*) and needle tree (*Hakea preissii*). There are also skirted grass trees (*Xanthorrhoea reflexa*) (Beard, 1980b).

The **Corrigin Vegetation System** is most characteristic in the north-eastern corner of the Shire of Wickepin with its eastern boundary corresponding with the beginning of mallee country. This System is characterised by a hilly and deeply dissected landscape with the northern area of the System well drained by the upper reaches of the Avon River. The higher ground is capped by large patches of sand and laterite with the laterite usually appearing at the surface of the edges of sandplains. It rarely occurs as breakaways. There are some salt lakes in the vicinity of Lake Yelearing with saltbushes on adjoining flats. However valley floors are not necessarily salt. Within the Corrigin System there are four principle types of vegetation: kwongon (scrub vegetation) on sandplains, patches of mallee, woodland on slopes and flats and in the valley floors teatree thickets or teatree and samphire.

Mallee species recorded in this System are principally black marlock (*Eucalyptus redunca*), lerp mallee (*Eucalyptus incrassata*) tall sand mallee (*Eucalyptus eremophila*) and capped mallee (*Eucalyptus pileata*) with a closed understorey usually present. Woodland or low woodland of brown mallet is found on elevated breakaways, while its associate powderbark (*Eucalyptus accedens*) is found in the western part of the System. Brown mallet is replaced by blue mallet in some localities. Wandoo tends to occur mainly on the upper slopes below the sandplain, while York gum occurs mainly on middle slopes. Salmon gum and red morrel (*Eucalyptus longicornis*) are found on flats with heavy soil, while flooded gum (*Eucalyptus rudis*) occurs along major creeks along with lesser bottlebrush (*Callistemon phoeniceus*). Along salty creeks swamp sheoak (*Casuarina obesa*) and *Melaleuca hamulosa* with samphire are common.

The **Dumbleyung Vegetation System** is the most prominent System in the Blackwood Catchment and covers the eastern third of the Shire of Katanning, the majority of the Shire of Dumbleyung, the eastern half of the Shire of Wagin and a small area of the Shire of Wickepin south east of Lake Toolibin and Lake Taarblin. The System has a southern limit at Lake Coyrecup and its eastern boundary corresponds with the beginning of the mallee country. In the Katanning shire, the country is gently undulating with scattered alteration cappings prevalent in the north. The general landscape of the System is one of Dryandra-dominated heath on laterite residuals, woodland of York gum, red morrel, salmon gum and wandoo on the undulating country. Frequently patches of mallee and teatree are found on salt flats

with scrub-heath and low woodland occurring on low-level sandplains (Beard, 1980b). Mallee vegetation in the Shire of Dumbleyung involve a number of possible dominant species including white-leaved mallee (*Eucalyptus albida*), tall sand mallee (*Eucalyptus eremophila*), narrow-leaved red mallee (*Eucalyptus foecunda*), ridge-fruited mallee (*Eucalyptus incrassata*), frog mallee (*Eucalyptus phaenophylla*) and redwood (*Eucalyptus transcontinentalis*), with tall sand mallee and frog mallee the most common and the most important species. Seventy percent of mallee species also occurs in heath and shrubland vegetation. Heath containing a diverse species composition with a variety of possible dominants are found on hard compact laterite without soil, on brown sandy loams and on grey and white sands over laterite at various depths. Shrublands occur on light grey sands, while mallee's occur on the sandy clays of light colour and on soils with more clay than heath soils. Woodlands of York gum, red morrell, salmon gum and wandoo occupy the undulating country with Dryandra scrub on the laterite residuals and brown, blue, and silver (*Eucalyptus ornatus*) mallet woodlands and low woodlands on weathered laterite residuals and slopes. Woodlands are formed either of mallets on lateritic wash or York gum, salmon gum, morrell and wandoo on pallid zone clays. There have been few changes to the composition of the System that exists today, other than Dryandra scrub in the west of the Shire, which is becoming increasingly susceptible to fungal dieback. Lithic complexes found throughout the System occur as isolated granite boulder outcrops. Salt flats and sandplains (included in numerous reserves in the Dumbleyung Vegetation System) are often affected by increasing salinity and waterlogging and in many instances areas once timbered are now degraded. Samphires (*Halosarcia lepidosperma*, *Sarcocornia blackiana*), which are efficient colonisers of salt encrusted areas, were surrounded largely by teatrees (*Melaleuca acuminata*, *Melaleuca uncinata*), Acacia spp. and patches of York and salmon gum woodland. The Dumbleyung System also covers the eastern half of the Shire of Wagin, with a south-eastern limit at Lake Dumbleyung and its eastern boundary corresponds with the beginning of the mallee country. For all intents and purposes the vegetation of area of the Shire of Wickiepin covered by the Dumbleyung System can be considered to be the same as that found in the Narrogin System.

The eastern half of the Shire of Dumbleyung and large areas of the Shires of Kulin and Kent. are characterised by the Hyden Vegetation System. The landscape of the Hyden System is broadly undulating with very long gentle slopes and an altitudinal range of 150 metres. High ground is often capped with residual laterite and sand, although the edges are seldom marked by breakaways, so boundaries between laterite and sand are often obscure. There are few granite outcrops and major valleys in the eastern region of the Shire are comprised of salt lakes, smaller lakes and pans. There are four categories of vegetation in the Hyden Vegetation System: scrub-heath, mallee, woodland and salt country (Beard, 1980b).

The Pingarring Hills to the east of the Dumbleyung townsite carried York gum woodland and sheoak low woodland. Otherwise, the pattern of vegetation in the Hyden Vegetation System is a mosaic of scrub-heath on sandplains, mallee on slopes, a mallee-woodland mosaic in some valleys and a continuous woodland in valley bottoms. The dominant mallee species was tall sand mallee with narrow-leaved red mallee, redwood and gooseberry mallee (*Eucalyptus calycogona*), Mirret (*Eucalyptus celastroides*), ridge-fruited mallee and York gum also present. Understoreys were dominated by *Melaleuca* spp. In valleys, patches of eucalyptus woodland were interspersed with mallees.

Low mallet woodlands consist of blue and/or silver mallet and sometimes with merrit occurring on lateritic ridges and breakaways. Understorey vegetation is usually quite

open with few species present, as gum dropped by trees contributes to the water repellent nature of soils.

The **Jingalup Vegetation System** occupies a large area in the north east corner of the Shire of Kojonup. There is a well defined mosaic of Jarrah-marri-wandoo woodland on ironstone gravels and woodland of marri and wandoo on slopes. Brown mallet often associates with jarrah on breakaways, while flooded gum occurs along minor creeks. Woodlands of marri and wandoo dominate scattered small jam (***Acacia acuminata***) and sheoak (*Casuarina* spp) with some Bull Banksia (*Bankisa grandis*) and Christmas trees (*Nuytsia floribunda*) (Beard, 1979a).

The **Pingelly Vegetation System** extends southwards as far as Wickepin, occupying a small area in the north of the Blackwood catchment. The eastern boundary extends from the eastern end of Yenyening Lake to Wickepin and the southern boundary from Karping to Wickepin. The landscape is undulating, hilly, deeply dissected with remnants of lateritic crust capping higher ground to form prominent mesas. Numerous granite exposures also occur, forming conspicuous domes and tors. While there are ten main vegetation types occurring in the Pingelly System, only a mosaic teatree and scattered York gum can be found in the area of the System occurring within the Blackwood catchment.

Part of the **Tambellup Vegetation System** covers a small area of the Shire of Katanning between the Broomehill and Beaufort Systems (Figure 1.). The area is predominantly covered with woodland of wandoo and flat-topped yate which are associated together (Beard, 1980b).

The northern region and majority of the Shire of Narrogin is occupied by the **Narrogin Vegetation System**, as is a considerable section of the western half of the Shire of Wickepin. The country is less dissected than surrounding systems and subsequently substantial areas of laterite-crustated plateau remain. As rainfall is higher than in the eastern region of the System, these plateaux are covered by a mosaic of brown mallet and powderbark woodland instead of heath. Woodlands of York gum and wandoo covers the dissected country below the breakaways with a tendency to topographic separation especially in the west. To the east of the Narrogin townsite are several large areas of brown mallet woodland. A large part of the more extensive alteration plateaux north-west of Narrogin was declared State Forest at a time when brown mallet was a valuable source of tannin. Powderbark is a common species to this area and is variable in height and density, although it is usually shorter and occurs in more open stands than brown mallet. The understorey consists of sparse open shrubs, particularly under brown mallet and includes sandplain poison (*Gastrolobium microcarpum*), prickly poison (*Gastrolobium spinosum*), the one-sided bottlebrush (*Calothamnus quadrifidus*), roadside teatree (*Leptospermum erubescens*), the skirted grass tree, *Dryandra cirsioides*, and other *Dryandra* species (Beard, 1976).

The **Ongerup Vegetation System** occupies a nearly flat plain in the north west of the Shire of Gnowangerup. It replicates the topography of the Broomehill System but has a mallee cover. Mallee scrub and low woodland covers the majority of the area, with scrub-heath on lateritic rises, York gum and salmon gum woodland on red soil, woodland of flat-topped yate and low forest of moort (*Eucalyptus platypus*) on grey clays and swamps. (Beard, 1980b)

The **Wagin Vegetation System** covers the north-western region of the Shire of Katanning in a belt approximately 35 km wide from Highbury to Katanning, the

majority of the western half of the Shire of Wagin and the the south-west corner of the Shire of Narrogin. The landscape is undulating and well dissected with only small remnants of laterite cappings on ridges and mesas, some granite domes and tors, and broad valleys containing salt marshes. The dominant vegetation comprised of a mosaic of brown mallet and wandoo woodland on laterite mesas and breakaways and low woodland of York gum and wandoo on the slopes of undulating country. Brown mallet was joined by red morrel on breakaways near the townsite of Katanning. This was an unusual change of habit for a species most commonly associated with calcareous valley soils. Heaths occur on scattered patches of laterite throughout the System, occasionally associated with wandoo, but more frequently with the Drummond's gum (*Eucalyptus drummondii*). *Dryandra* spp. are generally the dominant species in heath vegetation (Beard, 1980b). The dominant vegetation in the western region of the Shire of Wagin comprises of a mosaic of brown mallet (*Eucalyptus astringens*) and wandoo woodland on laterite mesas and breakaways, and low woodland of York gum and wandoo on the slopes of undulating country. In the Shire of Narrogin, the Wagin System is dominated by a mixed York gum-wandoo woodland on the slopes of the undulating country. Wandoo replaces the powderbark of the Narrogin System, which does not extend so far south. The vegetation of salt flats south-east of Highbury has been severely affected by the increase in salinity and rise of water tables following vegetation clearing. It is generally in very poor condition with dead remnants of teatree thickets which once covered the flats. It is probable that samphire species are extending their range in the area.

A small area of the **Williams Vegetation System** occurs in the Shires of Williams and West Arthur on undulating plateau country and a lateritic sheet. On laterite remnants there is a mosaic of jarrah-marri-wandoo woodland with powderbark and brown mallet becoming dominant along breakaways. However marri-wandoo woodland covers the majority of the landscape, giving way to York gum on the lower ground (Beard, 1979b, 1980b).

As mentioned earlier much of the Lower Blackwood catchment (the Darling Botanical District) is dominated by forests of Karri and Jarrah , particularly along the Darling Scarp. Marri and/or wandoo woodland are the dominant vegetation throughout the Menzies subdistrict, interspersed with patches of jarrah-marri-wandoo forest, low woodland of teatree (*Melaleuca* spp.), sheoak-York gum and Peppermint (*Agonis* spp.) less common. Closer to the coast are patches of Banksia-jarrah low woodland and reed swamps, usually with heath scrubs. Much of this area of the Blackwood Catchment is state forest and subsequently the vegetation associations occurring are reasonably complex, so it is not practicable to name all vegetation types and associations in this instance, although Figure 2 offers a simplified overview of vegetation in the region..

## **2 The present situation - remnant vegetation**

Since European settlement, much of the original vegetation in the Blackwood Catchment has been cleared, and now the effect of this removal in the catchment is manifesting itself in the form of land degradation, river eutrication and loss of indigenous flora and fauna biodiversity.

Total native vegetation (both remnant vegetation and public reserves) cover in the 18 Shires which fall within the Blackwood Catchment amounts to 1,519,799 hectares and represents approximately 31% of the total area of the 18 Shires (Table 1). This figure may be misleading as it does not give a good indication of remnant native

vegetation cover on farmland in the catchment. Those Shire's closer to the headwaters of the Blackwood River (ie Augusta-Margaret River, Nannup, Bridgetown-Greenbushes, and Donnybrook-Balingup) have had considerable area's of bushland set aside as public reserves, while remnant vegetation on private land is minimal (Figure 3).

The Shire of Nannup has 89% remaining native vegetation cover, although remnant vegetation on private land accounts for only 6.8% of this (Figure 3). The Shire of Augusta-Margaret River has 71.4% cover, with remnant vegetation accounting for only 16.8%, Donnybrook-Balingup has 66% cover (9.5% as remnant vegetation) and Bridgetown-Greenbushes has 58.5% (6.8% as remnant vegetation). If these shires were to be excluded from the catchment, native vegetation cover would amount to only 22% of the total area of the 14 remaining shires (instead of 32% for 18 shires). Also, some of these Shire are only marginally within the boundaries of the catchment (ie. Kulin, Gnowangerup), and native vegetation in these shires may not be equally represented by the areas which fall within the catchment. Table 2 explain the three catagories of remnant vegetation ("Remnant Vegetation", "Modified Vegetation" and "Scattered Vegetation) that exists as public reserves and on private land within the catchment (Beeston *et al.*, 1993). A recent survey of on-farm remnant bushland in the Blackwood catchment was completed by Frans Mollemans. A total of 3448 remnants in 18 shires were surveyed, including 90 in detail (Mollemans, 1993). The results of these surveys will be available in the near future.

### **3 Value of remnant vegetation**

The value of the remnant vegetation depends on one's interests and needs, and the same piece of bush may have a different value for different people. Some of the things that are important to consider include:

- preservation of local identity
- historical record
- recreation
- conservation of flora and fauna (biodiversity)
- economic gain
- achieving sustainable landuse.

Detail of these points is given in "Managing Your Bushland" by Hussey and Wallace (1993). Today I only have time for a few examples from the Blackwood Catchment.

#### **3.1 Preservation of local identity, historical record, recreation and tourism**

Local flora gives a special sense of local identity that can never be replaced by introduced species. It is a living history book, showing what the land was once like, and giving an insight into the sort of conditions the pioneers faced.

Remnant vegetation along roadsides is especially important in conferring this local "sense of place" on which the increasingly important tourism industry depends. Many Shire Councils are now working with local volunteers and the Roadside Conservation Committee to map roadside vegetation so that appropriate management techniques can be used which will ensure that the high value vegetation remains and, if possible, is enhanced. (Hussey et al 1990) A list of roadside survey work completed in shires that are partly or wholly in the Blackwood Catchment is given in Table 3.

#### **3.2 Conservation of biodiversity**

Biodiversity is the variety of living things, the natural heritage which makes up our world. Western Australia is an incredibly rich and diverse region, with over 10 000 species of plants, many of which are endemic, that is, they are found no-where else. Unfortunately, habitat change through clearing, salinisation and other processes has led to one tenth of our native plants becoming rare or endangered and many of these are hanging on as survivors in small remnants. Unless they are carefully managed, we are going to lose these species entirely, and with them, the animal species which depend on them.

### 3.2.1 Flora

Two plants are already thought to be extinct in the Blackwood region, *Acacia kingiana* and *Tetraloche fasciculata*, both from Wagin Shire. There are also 35 plants which have been declared as rare flora (DRF) under the Wildlife Conservation Act (see Table 4 and Figure 4) and there are 61 on the Priority List (the plants which may be rare and endangered, but require further survey.). Note that the numbers are probably an underestimate, since much of the Catchment has not had a detailed botanical survey.

Landowners can help these plants survive by looking for them in appropriate patches of remnant vegetation, and, if they are found, managing the area so that the plants increase in numbers. One such example is the Narrogin Bell which only occurs in one 0.25ha fenced remnant in a paddock. Lose that, and you have made another species extinct in the wild.

An important point to remember in flora management is that most native plants require specific soil microorganisms which help them to take up nutrients and so survive in poor soil. Topsoil from around healthy plants thus can assist regeneration by introducing these micro-organisms. Plants also need their pollinators to be present, so increasing bird and native insect habitat by planting shrubs is always a good option.

### 3.2.2 Fauna

Native fauna has also suffered a decline, due mainly to habitat change and the introduction of predators and competitors. Although there have been no overall surveys, we can make a good guess at what originally occurred in the Blackwood Catchment, by looking at surveys of specific areas. Taking mammals as an example, those known to occur in two reserves are given in Table 4. Tarin Rock Nature Reserve is right on the edge of the upper catchment, while the Perup Forest is representative of the lower catchment. Perup has seven of the eight threatened species in the Blackwood Catchment while the last one is at Tarin Rock. Note that some of the animals, such as echidnas and grey kangaroos, are still widespread and are able to co-exist with farming in the new landscape. Other animals need some help.

By looking at this list, and at books about mammals, landowners can work out which animals might occur in their area, and then whether the remnants on their property are suitable habitat for them.

The Western Mouse, which is now very rare, has been displaced in most areas by the House Mouse. It has been able to persist where there is a large area of heath and mallee country. If such a remnant occurs, predator control (fox and cat) would help to make it more suitable for native animals. Bush corridors connecting it to other

remnants would probably help too, although it is not known how much small, ground-dwelling animals use them. Common Dunnarts, for example, can move across at least 600 m of cropland to colonise blocks of replanting on salt seeps.

Another threatened species, the Red-tailed Phascogale, can survive quite well in substantial (> 65 ha) farm remnants (see Figure 5) if they contain the right habitat. Red-tailed Phascogales must have good quality Rock Sheoak next to good quality Wandoo, and bush corridors to enable the animals to move into the area. Thus replanting and remnant management to increase the health of the bushland, together with predator (fox) control, will help these threatened animals to recolonise suitable areas.

As a final example, this time from the Lower Blackwood, two very rare frogs, the White-bellied Frog, and the Yellow-bellied Frog, occur in tributaries close to the lower Blackwood in Augusta-Margaret River Shire. The White-bellied Frog mostly occurs in streamside remnants on private land and Wardell-Johnson and Roberts (1991) give detail about how to protect the creekline corridors and so ensure the species' survival.

### **3.2.3 Communities**

The bush is more than just individual plants and animals, it is a whole community of organisms living together and interacting with one another. People often express concern about the needs of rare plants and rare animals, but without protecting their habitat they will not survive.

In some instances, entire habitat types are being lost - freshwater wetlands in the Wheatbelt, for example. Sanders (1991) documents the changes that have occurred as the wetlands change from fresh to salt. Lake Toolibin is an example of such a "threatened community" and a detailed plan is being worked on to try and save the area. Lake Towerinning is another such site where the local community is working on its restoration.

Many remnants might contain examples of threatened communities, especially areas on good soil where clearing has converted most of that vegetation type to farmland. In the lower Blackwood, the wet ironstone heaths are a good example. Cleared for grazing or mining, very little remains of these characteristic plant assemblages except for remnants on wide roadsides. It is fortunate indeed that, in 1961, the then State Government decided to set aside wide roadsides in new land-release areas, so that the extra space could be a place "where wildflowers can grow and flourish in perpetuity". (Anon. 1987)

### **3.3 Economic gain**

Remnant vegetation can provide both direct and indirect economic benefits to the landholder. Shade, shelter, the regulation of hydrology and the control of erosion are all important functions of remnants, though difficult to quantify. In the Blackwood Catchment, the regulation of hydrology is of great concern and detail about how vegetation interacts with water is given in Schofield *et al* (1989) and in a later paper at this Conference.

The potential to produce items of direct economic value to the landholder varies greatly with the site. (See a later paper at this Conference for more detail). Some possible products include:

- sawn timber, pulpwood, poles, posts, firewood



- plant products, eg leaf or flower oils
- wildflowers and seeds
- tourism, including farm-stay
- increase in property resale value
- sand, gravel or other such materials

It is possible to harvest some of these products sustainably, but the greater the disturbance, the greater the effect on the conservation values and future use of the remnant.

As an example, remnant vegetation is frequently used as a source of road-making materials such as sand or gravel. Such extraction inevitably degrades the remnant and although rehabilitation efforts can replace some plants, it is usually less than 10% of the vegetation community which originally existed on the site. In other words, once the bush is destroyed, it is impossible to recreate. It is, however, relatively simple to replace productive crop and pasture land.

Nevertheless, road-making materials have to come from somewhere. Dumbleyung Shire, for example, needs 25 000 tonnes of gravel annually to maintain its 916 km of gravel roads. This material comes from seven small reserves, some of which still carry some good remnant vegetation. Their total area is 31.75 ha, a minute fraction of the total Shire area, 255 300 ha. There are deposits of gravel outside these reserves, but their details are unknown. It would be valuable if the location of gravel resources within an entire Shire was accurately mapped and the quantity and quality available estimated, so that each Shire can plan its road-making needs into the future. It may well be that in some areas, stands of remnant vegetation on laterite soil are a more scarce resource than deposits of gravel, and should be valued accordingly.

Traditionally, fencing timber was obtained from the farm itself and in fact, landowners in the Middle Blackwood have been blessed with two of the finest fencing timbers in the world, Wandoo (White Gum) and Jam (see Figure 6). Although steel posts have replaced timber in many instances, there may come a time when timber posts are again a good option. But you can not have free posts if you haven't grown any. Regeneration of Wandoo remnants for long-term supplies of fencing timber is a viable option that many landholders could consider.

Tourism is an increasingly important industry in rural areas and can produce significant extra income. An attractive and distinctive landscape, to which remnant vegetation makes a large contribution, is a vital pre-requisite. In the Lower Blackwood, this industry is of great importance - Nannup, for example, recently hosted a Music Festival, which brought approximately \$400 000 into the town.

### **3.4 Achieving sustainable landuse**

Our environment is changing, quite rapidly in some places. Some agricultural researchers suggest that we should be modelling agricultural systems on the diversity found in natural ecosystems - permaculture is an extreme example of this trend.

Retaining remnant vegetation increases local diversity and so the resilience of the landscape and the likelihood of at least some of the local ecosystem surviving change. Integrating farming and nature conservation gives both the best long-term chance.

## **4 Management of remnant vegetation**

In order to help make decisions about land use in the rural areas, the EPA combined Beard's botanical districts with rainfall and river catchments to produce 84 different "Natural Resource Zones" (Allison et al 1993). The Blackwood Catchment covers six of them. They fall easily into the Upper, Middle and Lower Blackwood (see Figure 7).

Remnant vegetation will not persist long-term, and do the job you want it to do, unless it is managed. The smaller the remnant, and the greater its "edge-to-area ratio" the more intensive the management will have to be. Detail about how to do this is given in "Managing Your Bushland".

The first thing to do is to survey the bushland, to find out what you have got. Then, as farm and catchment plans are being prepared, integrate the management of remnants into the plans. Where reserves, including roadsides, exist in the catchments, involve the managing authority in the planning, so that the ultimate goal is understood and approved by all the community.

Because time is short, I would like to comment on just three management points.

- get the understorey back
- revegetate creeklines and (in the Middle Blackwood) the ridgelines
- connect up revegetation and remnants with a network of bush corridors

### **4.1 Restore the understorey**

Many grazed remnants have been converted to just trees and grass. After fencing to control livestock, regeneration can occur but the understorey, which is vital to a healthy ecosystem, may have to be encouraged to return by seeding or other treatments. The understorey contributes to the overall erosion control and water balance of the remnant, and provides food and shelter for native animals, especially small birds.

When planning to rehabilitate a degraded remnant, a most important move, right at the start, is to get the nitrogen-producing shrubs back. Peas, wattles and sheoaks all have nitrogen-fixing organisms in their roots and are vital to long-term health of the bushland. Poison peas were often deliberately removed from remnants - replace their function with non-poisonous species.

### **4.2 Revegetate creeklines and ridgelines**

There are many good land and nature conservation reasons for protection and revegetation of creeklines, and there are many good examples of landowners doing very good work in this area.

However, in the Middle Blackwood especially, consider also revegetating the ridgelines. They are often rocky and impossible to crop or grow pasture, and erosion from them can damage productive land lower down the slope. Trees and shrubs re-established here will contribute to land management and conservation without taking any land out of production.

### **4.3 Create a network of bush corridors**

From the point of view of native fauna, the landscape needs to be re-integrated, so

that a network of bush corridors connect up streams and ridgelines so that animals can move across the landscape to utilise all its resources. If it is planned carefully, these corridors can control water, provide shade, shelter, windbreaks, timber or fodder crops, as well as being a nature conservation resource.

## Summary

The challenge for the Blackwood Catchment is to ensure a productive and sustainable future for both agriculture and nature conservation. It can be done with the implementation of effective management programs and community support.

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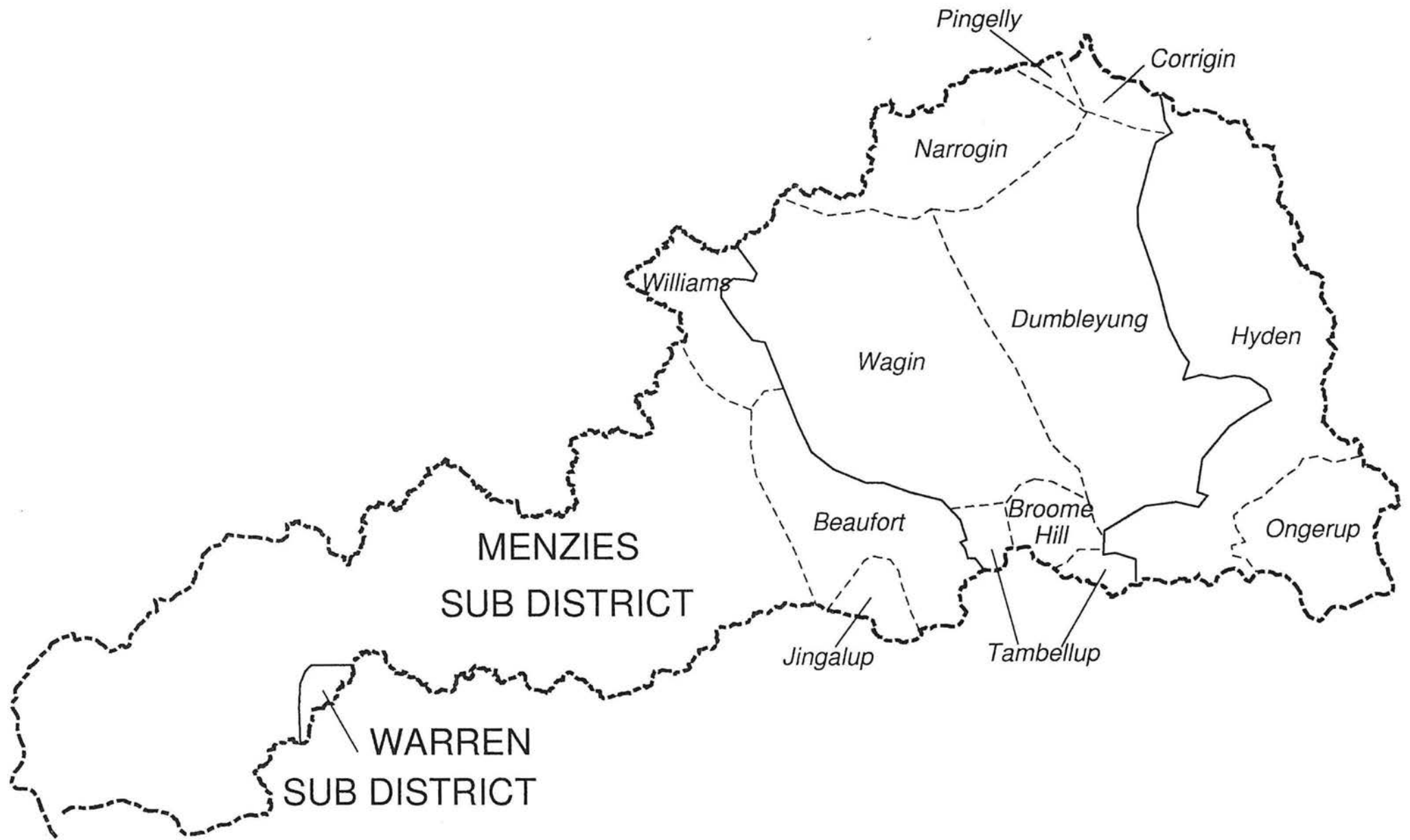


Figure 1 : Beard's Botanical Subdistricts and Vegetation Systems in the Blackwood Catchment

Figure 3.

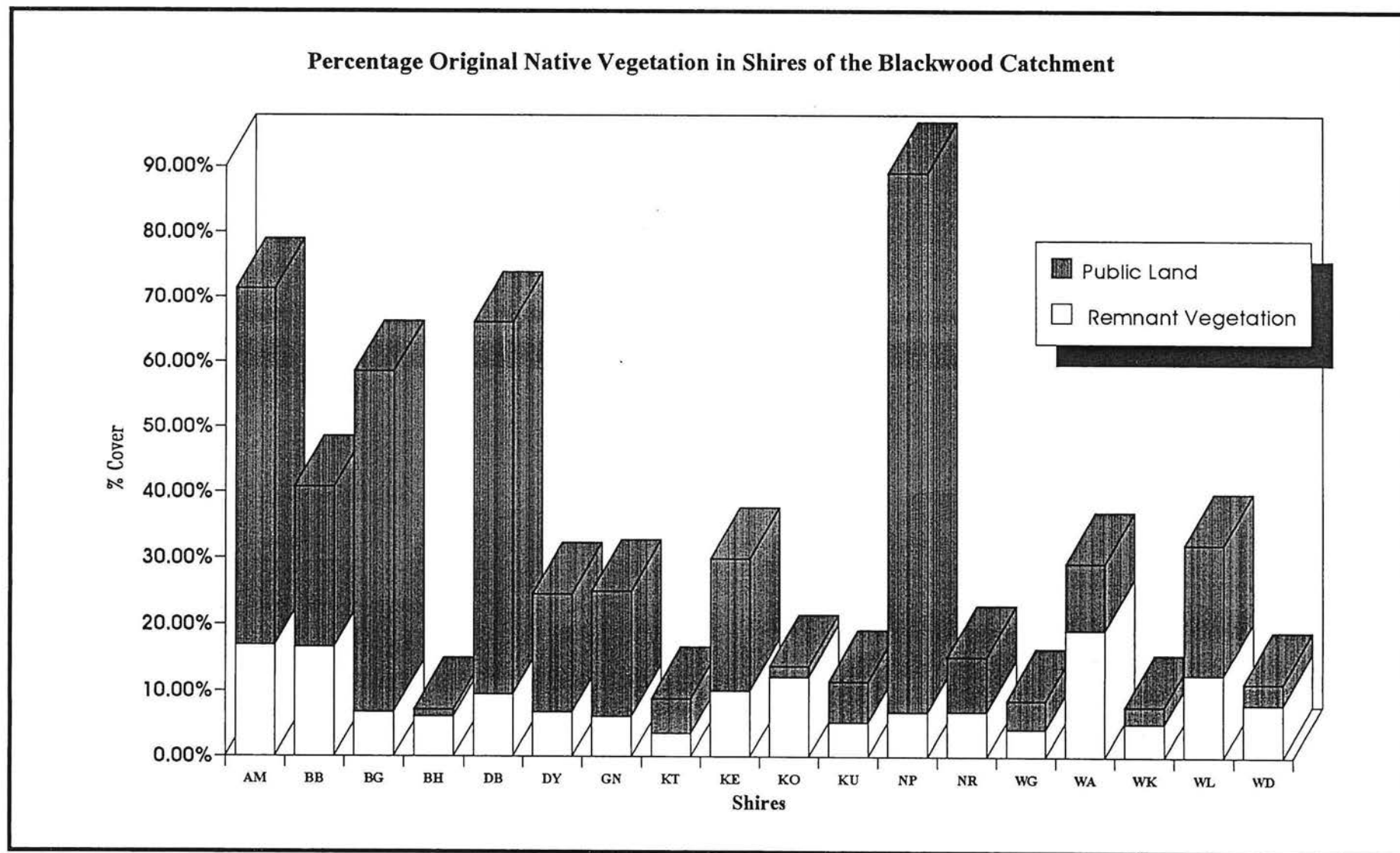
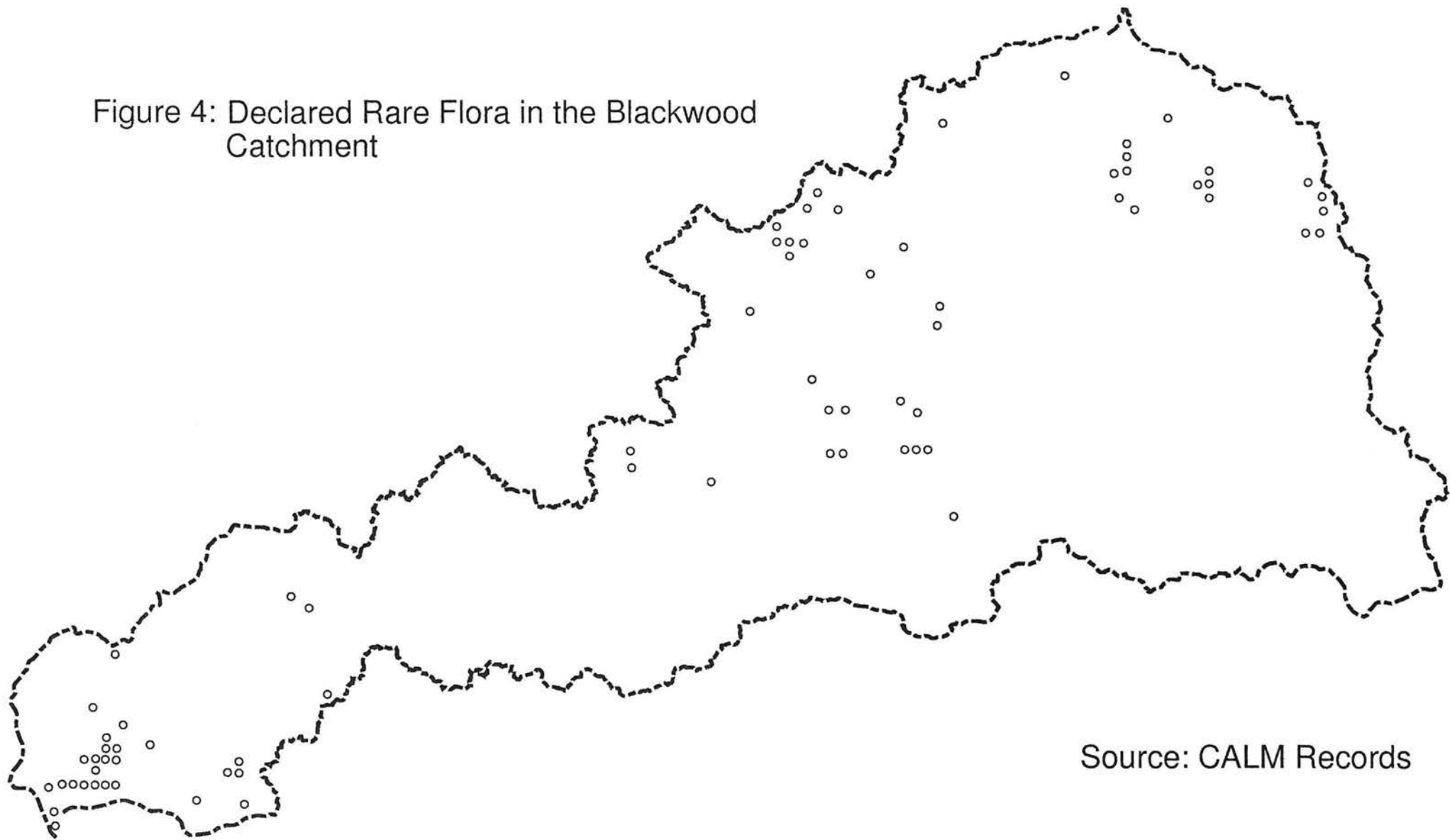


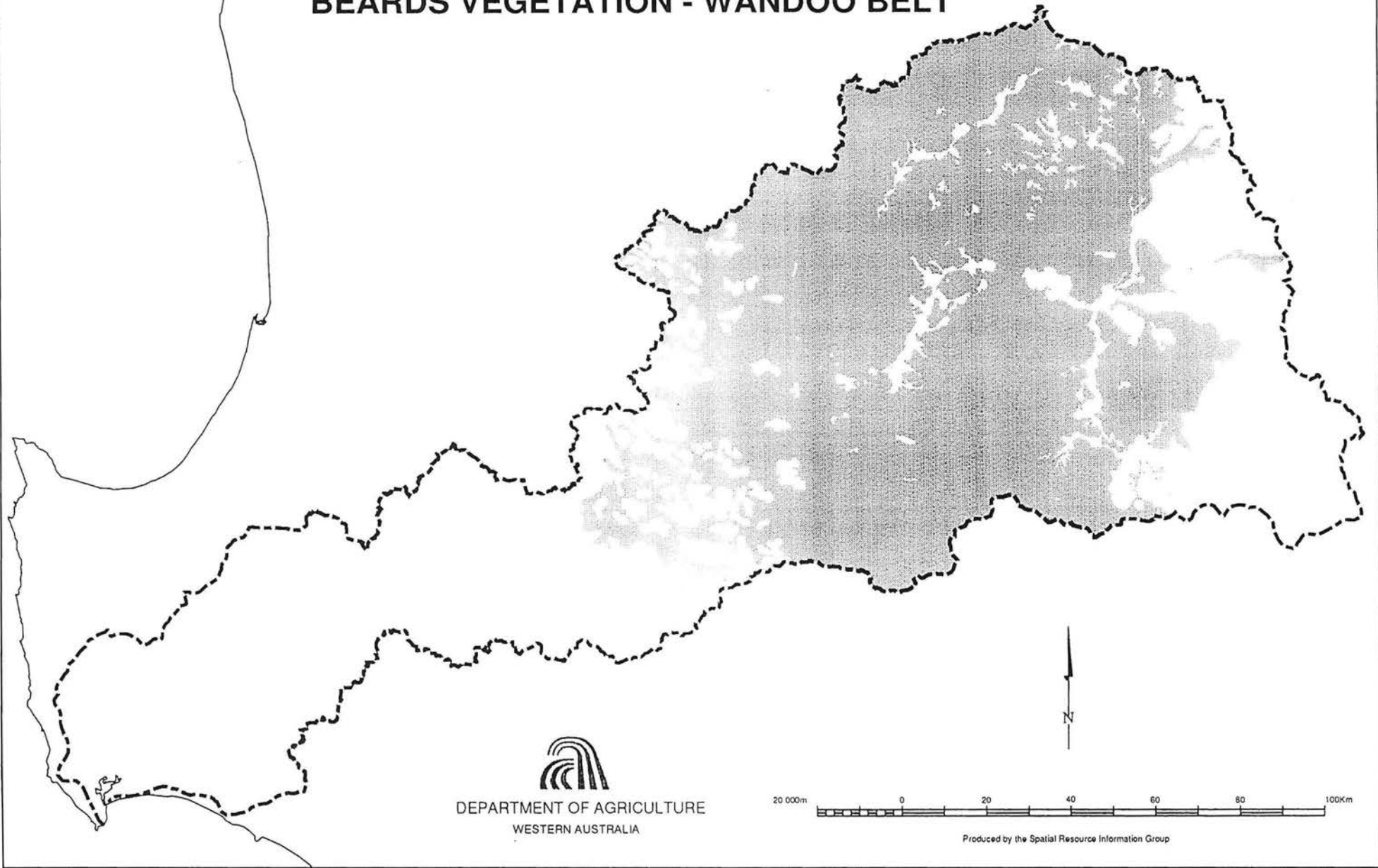
Figure 4: Declared Rare Flora in the Blackwood Catchment



Source: CALM Records

FIGURE 6

# BLACKWOOD CATCHMENT BEARDS VEGETATION - WANDOO BELT



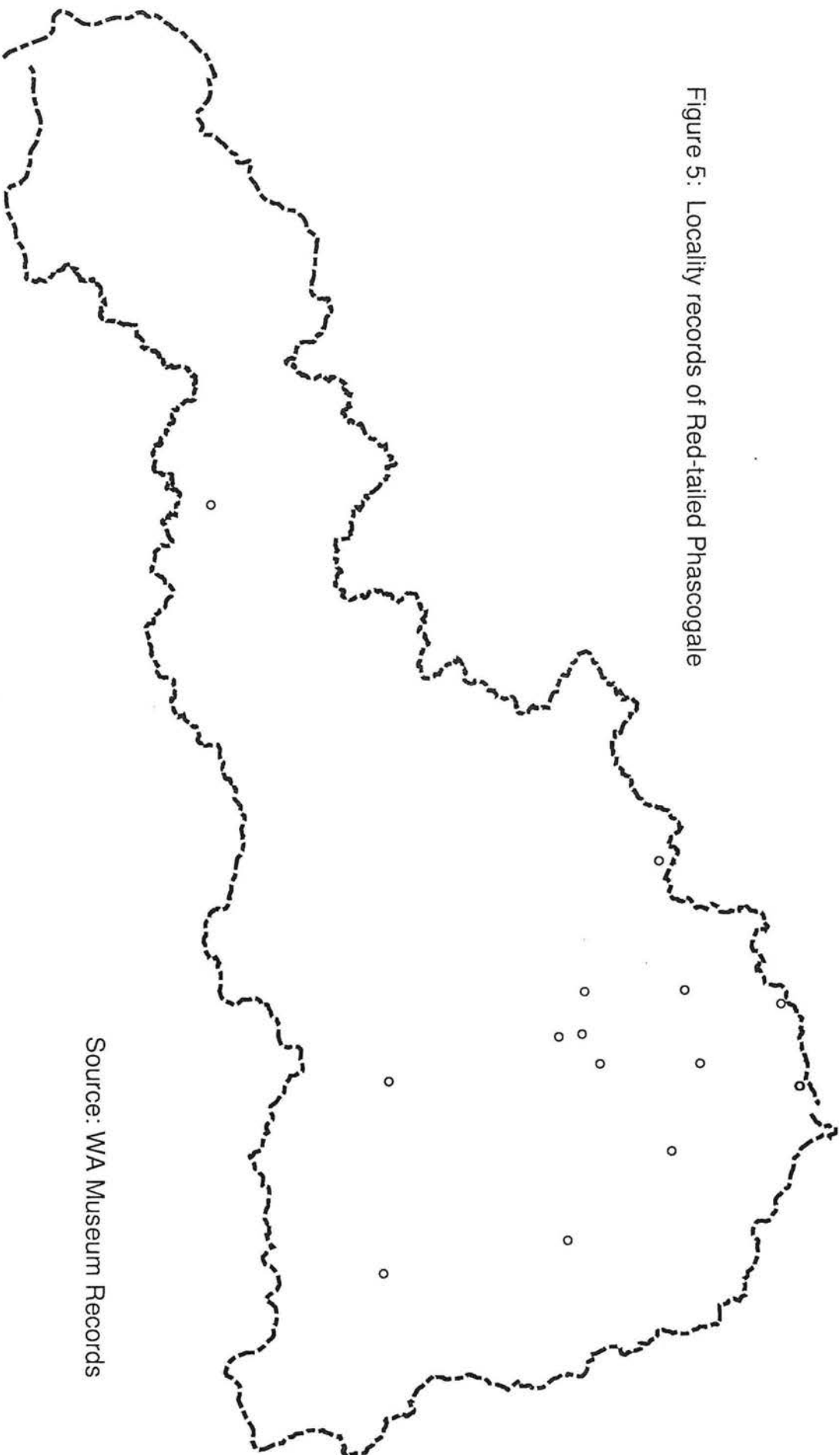
DEPARTMENT OF AGRICULTURE  
WESTERN AUSTRALIA

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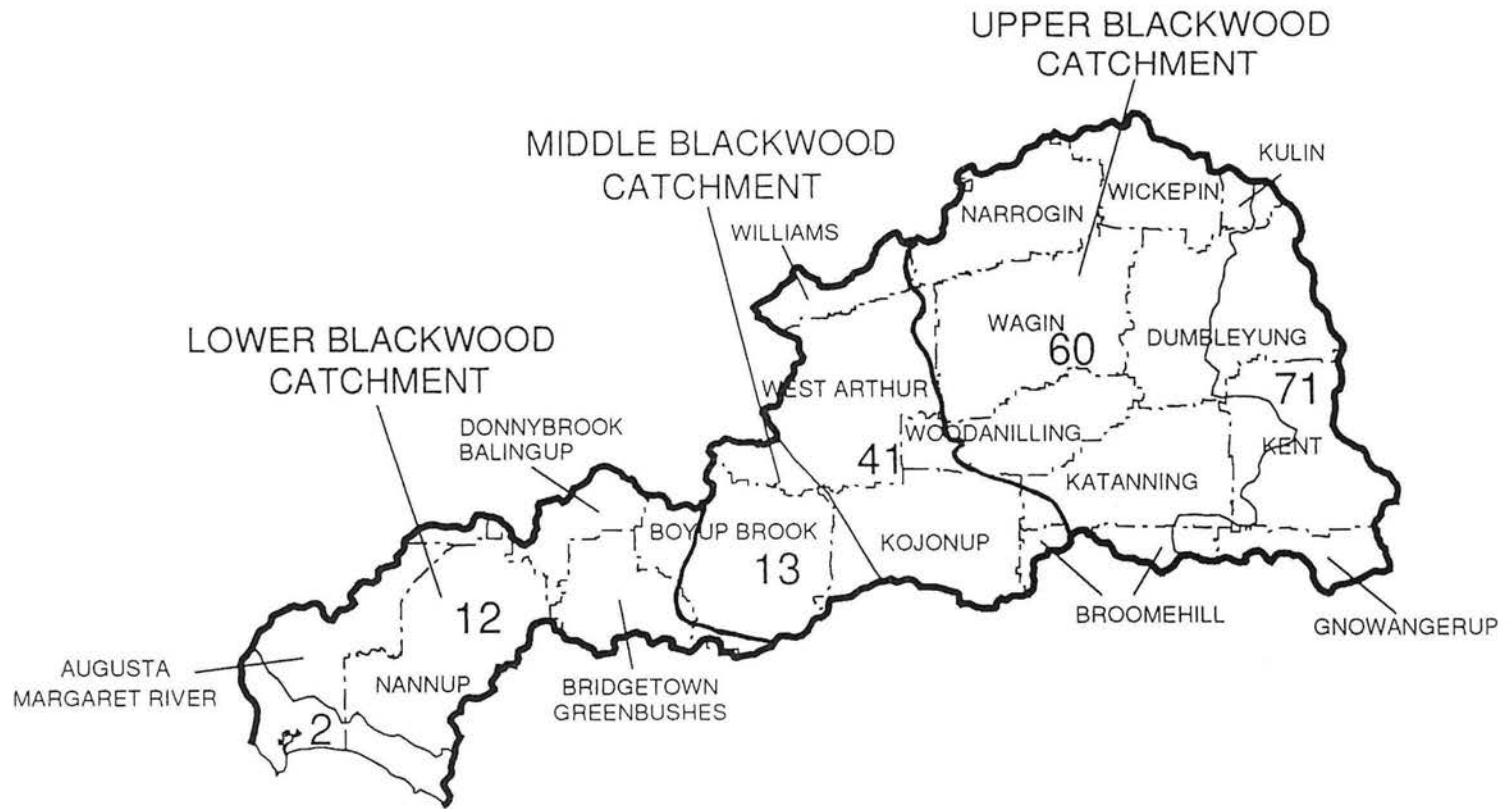
Produced by the Spatial Resource Information Group



Figure 5: Locality records of Red-tailed Phascogale



Source: WA Museum Records



**LEGEND**

- SHIRE BOUNDARIES
- CATCHMENT DIVIDES
- NATURAL RESOURCE ZONE

Figure 7: Lower, Middle and Upper Blackwood Catchments

Table 1.

| <b>Native Vegetation on Private Land and Public Reserves in the Shires in the Blackwood Catchment</b> |                    |                         |                       |                       |  |
|-------------------------------------------------------------------------------------------------------|--------------------|-------------------------|-----------------------|-----------------------|--|
| Shire                                                                                                 | Area of Shire (ha) | Remnant Vegetation (ha) | Number of Remnants    | % remnant vegetation  |  |
| Augusta-Margaret River                                                                                | 222718             | 37516                   | 2755                  | 16.80%                |  |
| Boyup Brook                                                                                           | 282637             | 46657.7                 | 4950                  | 16.50%                |  |
| Bridgetown-Greenbushes                                                                                | 135387             | 9227.4                  | 865                   | 6.80%                 |  |
| Broomehill                                                                                            | 119170             | 7259.6                  | 2649                  | 6.10%                 |  |
| Donnybrook-Balingup                                                                                   | 155143             | 14814                   | 1777                  | 9.50%                 |  |
| Dumbleyung                                                                                            | 258316.4           | 17392                   | 564                   | 6.80%                 |  |
| Gnowangerup                                                                                           | 454958             | 27965.6                 | 832                   | 6.10%                 |  |
| Katanning                                                                                             | 153272             | 5446.6                  | 422                   | 3.50%                 |  |
| Kent                                                                                                  | 575537             | 58044.8                 | 1375                  | 10%                   |  |
| Kojonup                                                                                               | 292938             | 35430.7                 | 4905                  | 12.10%                |  |
| Kulin                                                                                                 | 466712             | 24602.8                 | 1795                  | 5.20%                 |  |
| Nannup                                                                                                | 293198             | 20067.8                 | 1216                  | 6.80%                 |  |
| Narrogin                                                                                              | 164063             | 11445.4                 | 999                   | 6.90%                 |  |
| Wagin                                                                                                 | 193910             | 8296.7                  | 566                   | 4.20%                 |  |
| West Arthur                                                                                           | 282614             | 54003                   | 4712                  | 19.10%                |  |
| Wickepin                                                                                              | 202347             | 10335                   | 579                   | 5.10%                 |  |
| Williams                                                                                              | 228482             | 28403.9                 | 2458                  | 12.40%                |  |
| Woodanilling                                                                                          | 111769             | 9002.5                  | 371                   | 8.00%                 |  |
| Shire                                                                                                 | Public Land (ha)   | % Public Land           | Total Vegetation (ha) | % of Total Vegetation |  |
| Augusta-Margaret River                                                                                | 121519.6           | 54.50%                  | 159035.6              | 71.40%                |  |
| Boyup Brook                                                                                           | 68842.9            | 24.30%                  | 115500                | 40.80%                |  |
| Bridgetown-Greenbushes                                                                                | 70038.2            | 51.70%                  | 79265.6               | 58.50%                |  |
| Broomehill                                                                                            | 1331.6             | 1.10%                   | 8590.6                | 7.20%                 |  |
| Donnybrook-Balingup                                                                                   | 87916.9            | 56.60%                  | 102730                | 66.20%                |  |
| Dumbleyung                                                                                            | 44953              | 17.70%                  | 32222                 | 12.60%                |  |
| Gnowangerup                                                                                           | 86247              | 18.90%                  | 114212.6              | 25.10%                |  |
| Katanning                                                                                             | 8253.6             | 5.30%                   | 13700.2               | 8.90%                 |  |
| Kent                                                                                                  | 114766.7           | 19.90%                  | 172810                | 30.00%                |  |
| Kojonup                                                                                               | 4838               | 1.60%                   | 40268                 | 13.70%                |  |
| Kulin                                                                                                 | 29131.2            | 6.20%                   | 53734                 | 11.50%                |  |
| Nannup                                                                                                | 241057             | 82.20%                  | 261124.8              | 89.00%                |  |
| Narrogin                                                                                              | 13575.7            | 8.20%                   | 25021.1               | 15.20%                |  |
| Wagin                                                                                                 | 8513.5             | 4.40%                   | 16810.2               | 8.60%                 |  |
| West Arthur                                                                                           | 28627              | 10.10%                  | 82630                 | 29.20%                |  |
| Wickepin                                                                                              | 5320.6             | 2.60%                   | 15655.6               | 7.70%                 |  |
| Williams                                                                                              | 44953              | 19.60%                  | 73356.9               | 32.10%                |  |
| Woodanilling                                                                                          | 3584               | 3.20%                   | 12586.5               | 11.20%                |  |

Source: Remnant Vegetation Inventory in the Southern Agricultural areas of W.A. (Beeston et al. , 1993)

## **Table 2. Definition of the three categories of remnant vegetation .**

Vegetation classed as "Remnant Vegetation" has one or more of the following characteristics

- \* Most closely reflects the natural state of vegetation for a given area.  
Has an intact understorey (if forest or woodland).
- \* Has minimal disturbance by agents of human activity.

Vegetation classed as "modified vegetation" has one or more of the following characteristics:

- \* Degraded understorey (i.e. reduction in the number of native species, includes weeds).
- \* Obvious human disturbance- clearing, mining, grazing, weeds.
- \* Affected by salt.
- \* Narrow corridors of vegetation (usually along roads and railway lines or windbreaks), which are more likely to be affected by edge effects.

Vegetation classed as "scattered vegetation" have:

- \* No understorey.
- \* Parkland cleared i.e. are scattered single trees
- \* No significant signs or chance of regeneration.

Source: Remnant Vegetation Inventory in the Southern Agricultural Areas of W.A, (Beeston *et al.*, 1993)

**Table 3: Roads surveyed for their conservation value in Shires associated with the Blackwood Catchment**

| Shire                     | Total roads (km) | No. roads surveyed | Roads surveyed (km) | % Total | Mapping status               |
|---------------------------|------------------|--------------------|---------------------|---------|------------------------------|
| Narrogin                  | 700              | 15                 | 102.2               | 14.6    | incomplete                   |
| Wickepin                  | 911              | 91                 | 777.5               | 85.3    | mapping complete             |
| Wagin                     | 863              | 15                 | 189                 | 21.9    | incomplete                   |
| Dumbleyung                | 1178             | 8                  | 96.9                | 8.2     | incomplete                   |
| Katanning                 | 764              | 13                 | 117.1               | 15.3    | incomplete                   |
| Kent                      | 1395             | 6                  | 113.8               | 8.2     | incomplete                   |
| Woodanilling              | 533              | 4                  | 61.0                | 11.4    | incomplete                   |
| West Arthur               | 880              | ~ 100              | ~ 800               | 90      | first draft                  |
| Kojonup                   | 1452             | 1                  | 23.2                | 1.6     | incomplete                   |
| Boyup Brook               | 1150             | 88                 | 948.3               | 82.5    | mapping complete             |
| Donnybrook<br>Balingup    | 705              | 1                  | 44.0                | 6.2     | incomplete<br>survey ongoing |
| Bridgetown<br>Greenbushes | 743              | 100                | 550.5               | 74.1    | map complete<br>April 1994   |
| Nannup                    | 450              | 11                 | 222.1               | 49.4    | incomplete                   |
| Augusta<br>Margaret River | 1619             | 31                 | 431.8               | 26.7    | incomplete                   |

Source: Roadside Conservation Committee 1994

**Table 4: Declared Rare Flora in the Blackwood Catchment**

| <b>Species name</b>                                     | <b>Shire</b>                              |
|---------------------------------------------------------|-------------------------------------------|
| <i>Acacia depressa</i>                                  | Dumbleyung                                |
| <i>Adenanthos pungens</i> subsp <i>effusa</i>           | Kojonup                                   |
| <i>Aponogeton hexatepalus</i>                           | Nannup                                    |
| <i>Banksia oligantha</i>                                | Kojonup, Wagin                            |
| <i>Caladenia bryceana</i> subsp <i>bryceana</i>         | West Arthur                               |
| <i>Caladenia christineae</i> ms                         | Bridgetown-Greenbushes                    |
| <i>Caladenia dorrienii</i>                              | Kojonup                                   |
| <i>Caladenia excelsa</i> ms                             | Augusta-Margaret River                    |
| <i>Caladenia harringtoniae</i> ms                       | Nannup                                    |
| <i>Caladenia huegelii</i>                               | Augusta-Margaret River                    |
| <i>Calectasia arnoldii</i> ms                           | West Arthur, Wickepin                     |
| <i>Chamelaucium erythrochlora</i> ms                    | Augusta-Margaret River                    |
| <i>Conostylis drummondii</i>                            | Kojonup, Wagin, West Arthur, Woodanilling |
| <i>Conostylis rogeri</i>                                | Kulin                                     |
| <i>Conostylis seorsifolia</i> subsp <i>trichophylla</i> | Dumbleyung, Wickepin                      |
| <i>Conostylis setigera</i> subsp <i>dasys</i>           | Kojonup                                   |
| <i>Darwinea carnea</i>                                  | Narrogin                                  |
| <i>Darwinea ferricola</i>                               | Augusta-Margaret River                    |
| <i>Diuris drummondii</i>                                | Bridgetown-Greenbushes                    |
| <i>Diuris micrantha</i>                                 | West Arthur                               |
| <i>Drakea confluens</i>                                 | Gnowangerup, West Arthur                  |
| <i>Drakea micrantha</i>                                 | Augusta-Margaret River                    |
| <i>Dryandra serratuloides</i>                           | Kulin                                     |
| <i>Gastrolobium tomentosum</i>                          | Kojonup, Williams                         |
| <i>Grevillea cirsiifolia</i>                            | Boyup Brook, Kojonup, West Arthur         |
| <i>Kennedia macrophylla</i>                             | Augusta-Margaret River                    |
| <i>Lambertia orbifolia</i>                              | Augusta-Margaret River, Nannup            |
| <i>Lechenaultia pulvinaris</i>                          | Dumbleyung, Kulin, Wagin, Wickepin        |
| <i>Meziella trifida</i>                                 | Augusta-Margaret River                    |
| <i>Pultenaea pauciflora</i>                             | Narrogin                                  |
| <i>Rulingia</i> sp. (Trigwell Bridge)                   | West Arthur                               |
| <i>Stylidium plantagineum</i>                           | Gnowangerup                               |
| <i>Thelymitra psammophila</i>                           | Gnowangerup                               |
| <i>Thelymitra stellata</i>                              | Dumbleyung, West Arthur                   |
| <i>Verticordia fimbriolepis</i>                         | Woodanilling                              |

Source: CALM records

**Table 5: Mammals of the Blackwood Catchment - species known from two representative areas (\* = threatened species)**

| Name                                                        | Perup (1) | Forest Tarin Rock Nature Reserve (2) |
|-------------------------------------------------------------|-----------|--------------------------------------|
| Grey Kangaroo <i>Macropus fuliginosus</i>                   | √         | √                                    |
| Brush Wallaby <i>Macropus irma</i>                          | √         | √                                    |
| Tammar <i>Macropus eugenii</i> *                            | √         | √                                    |
| Woylie <i>Bettongia penicillata</i> *                       | √         | -                                    |
| Brush-tailed Possum <i>Trichosurus vulpecula</i>            | √         | √                                    |
| Western Ringtail Possum <i>Pseudocheirus occidentalis</i> * | √         | -                                    |
| Pygmy Possum <i>Cercartetus concinnus</i>                   | √         | ?                                    |
| Honey Possum <i>Tarsipes spencerae</i>                      | -         | √                                    |
| Quenda <i>Isodon obesulus</i> *                             | √         | -                                    |
| Chuditch <i>Dasyurus geoffroi</i>                           | √         | -                                    |
| Wambenger <i>Phascogale tapoatafa</i>                       | √         | -                                    |
| Red-tailed Phascogale <i>Phascogale calura</i> *            | -         | ?                                    |
| Mardo <i>Antechinus flavipes</i>                            | √         | -                                    |
| Fat-tailed Dunnart <i>Sminthopsis crassicaudata</i>         | -         | √                                    |
| Comon Dunnart <i>Sminthopsis murina</i>                     | √         | √                                    |
| Numbat <i>Myrecobius fasciatus</i> *                        | √         | -                                    |
| Southern Bush Rat <i>Rattus fuscipes</i>                    | √         | -                                    |
| Water Rat <i>Hydromys chrysogaster</i>                      | √         | -                                    |
| Western Mouse <i>Pseudomys occidentalis</i> *               | -         | √                                    |
| Echidna <i>Tachyglossus aculeatus</i>                       | √         | √                                    |
| Lesser Long-eared Bat <i>Nyctophilus geoffroyi</i>          | √         | √                                    |
| Gould's Long-eared Bat <i>Nyctophilus gouldii</i>           | √         | -                                    |
| a bat <i>Nyctophilus major</i>                              | √         | -                                    |
| Gould's Wattled Bat <i>Chalinolobus gouldii</i>             | √         | √                                    |
| Chocolate Bat <i>Chalinolobus morio</i>                     | √         | -                                    |
| Little Bat <i>Eptesicus pumulis</i>                         | √         | √                                    |
| Tasmanian Pipistrelle <i>Pipistrellus tasmaniensis</i>      | √         | -                                    |
| White-striped Bat <i>Tadarida australis</i>                 | √         | -                                    |
| Little Flat Bat <i>Tadarida planiceps</i>                   | √         | -                                    |
| <b>Total native mammals</b>                                 | <b>25</b> | <b>12 + 2?</b>                       |
| Feral Cat <i>Felis catus</i>                                | √         | ?                                    |
| Dingo/Wild Dog <i>Canis familiaris</i>                      | √         | -                                    |
| House Mouse <i>Mus musculus</i>                             | √         | √                                    |
| Feral Pig <i>Sus scrofa</i>                                 | √         | -                                    |
| Rabbit <i>Oryctolagus cuniculus</i>                         | √         | √                                    |
| Fox <i>Vulpes vulpes</i>                                    | √         | √                                    |
| <b>Total introduced mammals</b>                             | <b>6</b>  | <b>3 + 1?</b>                        |

Data from (1) Anon (no date) The Perup: a Living Forest. CALM Perth

(2) Kitchener D.J., Chapman A., Dell J., Johnstone R.E., Muir B.G. and Smith L.A. 1976 Biological Survey of the Western Australian Wheatbelt Part 1: Tarin Rock. Records of the Western Australian Museum, Supplement No 2. WA Museum, Perth.