Proceedings of the Blackwood catchment remnant vegetation management workshop

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Proceedings of the
Blackwood Catchment
Remnant Vegetation Management Workshop

Kojonup, April 1994

Collated by G.J. Parlevliet
Proceedings of the
Blackwood Catchment
Remnant Vegetation Management Workshop

Held at Kojonup, Wednesday, 13th April 1994

Collated by G.J. Parlevliet

The workshop was organised by the Blackwood Catchment Coordinating Group and the Kojonup Land Conservation District Committee to ensure community involvement in the development of policies.
The Remnant Vegetation workshop is the third in a series designed to help the Blackwood Catchment Coordinating Group develop its policies for the Blackwood River System.

The next step is the development of draft policies and Codes of practice for Remnant Vegetation Management in the Blackwood River Catchment. These will be circulated to participants as they become available.

Please feel free to provide comment and suggestions on vegetation management and any other topic that may concern you.

Be assured that any policy adopted by the Blackwood Catchment Co-ordinating Group will have been developed with maximum community participation.

With many thanks

The workshop was organised by a sub-committee consisting of: ♦ David Reid, Chairman, BCCG, ♦ Nick Dodson, BCCG, ♦ Alan Anderson BCCG, ♦ Owen Dare BCCG, ♦ Ken Wallace, CALM, and ♦ Gerry Parlevliet, Department of Agriculture, ♦ Roni Oma SLCC, ♦ Sally Robinson, OCM and ♦ Dorothy Redreau Greening Australia. ♦ The assistance of Carolyn Reid (BCCG), the staff of the Shire of Kojonup and members of the Kojonup LCDCs for handling the registrations and setting up of the venue is acknowledged.

♦ The local arrangements were made by Alan Anderson and Kathy Mathwin.

♦ In particular the speakers, the field site hosts John and Margaret Benn as well as Mal Graham, CALM are gratefully acknowledged.

♦ Brian Lloyd from the Department of Agriculture at Katanning coordinated the workshop facilitators which included Margaret Scott, Ian Parker, Gerry Parlevliet, Russel Thomson and John Skillen.

♦ The Chairmanship of the workshop was ably carried out by Ray Wallis from the Office of Catchment Management.

♦ Thanks to the Soil and Land Conservation Council for their support.

David Reid
Chairman
Blackwood Catchment Co-ordinating Group
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# Remnant Vegetation in the Blackwood Catchment - A Policy Workshop

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Welcome

Mr Bill Harrison, Chairman of the Kojonup Land Conservation District Committee welcomed the participants to Kojonup.

Field Trip

The participants travelled to the property of Kojonup farmers John and Margaret Benn. The site inspection looked at a low lying area fenced-off and being managed for regeneration.

The second site was an upslope site which had been fenced-off with the assistance of funds from Greening Australia.

Margaret and John Benn provided detailed briefing for each site. The information they provided was complemented by technical information presented by Mal Graham, CALM, Katanning and Penny Hussey, CALM, Como.

Closing Comments

David Reid, Chairman, Blackwood Catchment Coordinating Group provided the closing comments for the workshop.
OPENING ADDRESS

Hon. Bob Wiese MLA
Minister for Police and Member for Wagin

On Monday afternoon I flew from Katanning to Perth after attending the CSICA Southern Ward Conference. In the context of consideration of the Blackwood River Catchment area I estimate more than a third of that 35 minute flight was over the Blackwood River Catchment area.

The most noticeable features from the air as you leave Katanning are:

Firstly: The majority of the area is cleared and under pasture or crop.

Secondly: There are a large number of lakes large and small surrounded in many cases by a thin margin of bare ground and dead trees.

Thirdly: There are lines of trees all over the landscape in very thin lines from 8000 feet up - which are a mixture of uncleared surveyed roads and cleared and formed roads.

Finally: There are patches of trees dotted around all over the landscape.

The route we took to Perth went right over the top of my farm.

I am one of those lucky people who live next to very substantial areas of Forestry & Crown Land, although I have to admit I didn't think I was so lucky when I had to meet the total cost of refencing the 50 or so km of boundary I share with the Crown. When it comes to refencing, the Crown is a very poor neighbour.

However, when I looked down on the substantial area of Crown Land and mallet plantation I actually commented how small a patch of bush the 1000 acre Forestry block in the middle of my farm looked and even how small the 4-5000 acre block of Crown Land and mallet plantation looked in the middle of vast acres of cleared land.

When viewed in this context the whole story of remnant vegetation in the Blackwood Catchment and especially the upper parts of that Catchment really can be appreciated.

There is very little Remnant Vegetation left.

1. There are a few patches left on our farm
2. There is a little left on our road sides and on the few uncleared surveyed roads
3. There is some left along the verges of our water courses and rivers
4. There is a little remaining around our lakes
5. There are a very limited number of reasonably large areas of native bush still preserved in a range of reserves and pieces of Crown Land.

And that is about it.
However, when you get out of the aeroplane, and look at what is left from ground level, the picture is even bleaker.

What is left on the farms is, in the majority of areas, in very poor condition. Most is unfenced. It is degraded by stock to the extent that most of the understorey is already gone. Much of the larger timber is suffering from a combination of bark almost ring barked by sheep and soil structure destroyed by stock compaction and the removal of protection and shelter of leaf litter and vegetation.

It is infiltrated by a range of introduced weeds ranging from wild oats and barley grass to bridal creeper and worst of all there is no regeneration of either younger trees or understorey.

In short, most remnant vegetation, as in our farms, is all but dead

Our roadsides are not better and they have been devastated by Local Government clearing and widening the existing roads. They have been cleared of virtually everything as farmers re-fence the roads. They have been smothered by wild oats and barley grass, which thrives from the annual dose of super applied as the farmer top-dresses the adjoining pasture.

The water courses and river verge and land surrounding the lakes and natural drainage lines are a disaster area.

Many of these areas are either bare salt with a scattering of barley grass, or at best retaining a scattering of the most salt tolerant timber species.

The combinations of land clearing, rising water tables, weeds, vermin and stock have destroyed what must have been the most attractive areas in our natural landscape before white-man came along and proceeded to develop this country.

Lastly and more cheerfully the few larger pieces of remaining native bush that are still there are, in most cases, in reasonable condition.

Sure the best white gums and jam patches have been taken out - sometimes legitimately - more often illegally; and wild fires have done their damage and sometimes totally changed the species make-up; but generally they retain a range of understorey species and support a range of fauna and remain as a sanctuary where you and I can go and try to imagine what this country was like two hundred years ago.

This, Ladies and Gentlemen, is the background against which you came together today to look at Remnant Vegetation in the Blackwood Catchment.

The challenge is immediate and the challenge is enormous.

If we succeed the benefits will, I believe, be equally enormous because in order to succeed we will have to develop a system of sustainable agriculture. We will need to achieve a balance between all the imports onto and into the land as well as all the outputs both in farm produce and in the waters, soils and nutrients which blow, wash or leach off our farms.
I confess that despite the enormity of the challenge I am an optimist. I wouldn't be a farmer if I wasn't. However, the signs are good.

Farmers and members of the wider community are increasingly tackling the problem head on and expending enormous energy and substantial finance on fencing, tree planting and drainage.

A whole new generation of environmentally aware young men and women are now out there learning how to, firstly, stop the increase in degradation and then actually starting the process of regeneration. The community and to some extent even the Government have accepted that the time has come to act.

Today's workshop looks at Remnant Vegetation and commences the development of a comprehensive policy on the retention, preservation, re-estabishment and management of Remnant Vegetation in the Blackwood Catchment area. This is a very significant step down the path of halting the degradation and starting the process of rehabilitating the largest catchment area of the largest river system in the South West of this State.

I believe that:

The policies which you develop out of today's workshop will, over the next fifty or even one hundred years, see both the Blackwood River Catchment and the Blackwood River turned from one of the worst examples of the results of widespread clearing to an outstanding example of what can be achieved by the adoption of best farming practice combined with the development of new technology and knowledge and appreciation of the delicate balance of our environment.

I congratulate every one of you present here today for your participation and commitment to this challenging project of retaining our remnant vegetation and eventually rehabilitating the environment of the Blackwood River and it's Catchment.

I have great pleasure in declaring this workshop officially open.
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?

1 VEGETATION PRIOR TO EUROPEAN SETTLEMENT

The vegetation of Western Australia has been divided into Botanical Provinces by J.S. Beard and the vegetation of these Botanical Provinces essentially represents that which existed prior to European settlement. Physical factors such as soil and climate combine to produce Botanical Provinces. The majority of the south-west of WA, including the Blackwood River Catchment, fall within the South-West Botanical Province. This Province has been further divided by Beard into Botanical Districts, of which three, the Darling (with the Warren and Menzies subdistricts), the Avon and the Roe Botanical Districts cover the Blackwood Catchment. Each Botanical District is further divided into Vegetation Systems. A total of twelve Vegetation Systems (the Hyden, Dumbleyung, Narrogin, Pingelly, Williams, Wagin, Beaufort, Broomehill, Corrigin, Tambellup, Ongerup and the Jingalup Systems) cover the Blackwood Catchment (Figure 1)(Beard, 1980a).

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 diversicolor) 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 upper, middle and lower Blackwood Catchment. Figure 2 gives a hierarchical view of Beards vegetation in the Blackwood Catchment.

Upper Blackwood
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 System are comprised of salt lakes, smaller lakes and pans. There are four categories of vegetation in the Hyden System: scrub-heath, mallee, woodland and salt country (Beard, 1980b).
Figure 2. A hierarchical overview of Beards Vegetation in the Blackwood catchment.
The Pingaring 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-fruit 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 Broomehill Vegetation System is the most prominent in the Shire of Katanning, extending from Katanning east to Lake Eyylamartup 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 incassata) 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 acedens) 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 Coyreecup 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 albid), tall sand mallee (Eucalyptus eremophila), narrow-leaved red mallee (Eucalyptus foecunda), ridge-fruited mallee (Eucalyptus incassata), frog mallee (Eucalyptus phaeophylla) 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 morrel, 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, morrel 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 Wickepin 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 Kuln 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 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 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.

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-crusted 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),

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roadside teatree (*Leptospermum erubescens*), the skirted grass tree, *Dryandra cirsioidea*, and other *Dryandra* species (Beard, 1976).

**Middle Blackwood**

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 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 (*Banksia grandis*) and Christmas trees (*Nuytsia floribunda*) (Beard, 1979a).

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).

**Lower Blackwood**

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 extremely complex, so it is not practicable to name all vegetation types and associations in this instance.

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 eutrophication 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 mouth 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).
Figure 3.

Percentage Original Native Vegetation in Shires of the Blackwood Catchment

| Shires | AM | BB | BG | BH | DB | DY | CN | KT | KE | KO | KU | NP | NR | WG | WA | WK | WL | WD |
|--------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Cover  | 90.00% | 80.00% | 70.00% | 60.00% | 50.00% | 40.00% | 30.00% | 20.00% | 10.00% | 0.00% |

- Public Land
- Remnant Vegetation
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 Shires 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 explains the three categories 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, unpublished). 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 nowhere 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 *Tetragyna 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 micorganisms 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 microorganisms. 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
Source: WA Museum Records

Figure 5: Locality records of Red-tailed Phascogale.
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.

Acknowledgements

Very grateful thanks to the following people for their help with information for this paper: Ken Atkins, Tony Friend, Mal Graham, Greg Keighery and David Lamont from CALM; Trevor
Jose, Dumbleyung and Prue Procter, Nannup. Also Dave Chalmers and Matthew Chafer from WADA, South Perth.

References


Mollemans, F. (unpublished). Distribution and Ecological Significance of On-Farm Bush remnants in the Southern Wheatbelt Region of Western Australia. Western Australia Department of Agriculture, South Perth.


## Native Vegetation on Private Land and Public Reserves in the Shires in the Blackwood Catchment

<table>
<thead>
<tr>
<th>Shire</th>
<th>Area of Shire (ha)</th>
<th>Remnant Vegetation (ha)</th>
<th>Number of Remnants</th>
<th>% Remnant vegetation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augusta-Margaret River</td>
<td>222718</td>
<td>37516</td>
<td>2755</td>
<td>16.80%</td>
</tr>
<tr>
<td>Boyup Brook</td>
<td>282637</td>
<td>46657.7</td>
<td>4950</td>
<td>16.50%</td>
</tr>
<tr>
<td>Bridgetown-Greenbushes</td>
<td>135387</td>
<td>9227.4</td>
<td>865</td>
<td>6.80%</td>
</tr>
<tr>
<td>Broomehill</td>
<td>119170</td>
<td>7259.6</td>
<td>2649</td>
<td>6.10%</td>
</tr>
<tr>
<td>Donnybrook-Balingup</td>
<td>155143</td>
<td>14814</td>
<td>1777</td>
<td>9.50%</td>
</tr>
<tr>
<td>Dumbyleyng</td>
<td>258316.4</td>
<td>17392</td>
<td>564</td>
<td>6.40%</td>
</tr>
<tr>
<td>Gnowangerup</td>
<td>454958</td>
<td>27965.6</td>
<td>832</td>
<td>6.10%</td>
</tr>
<tr>
<td>Katanning</td>
<td>153272</td>
<td>5446.6</td>
<td>422</td>
<td>3.50%</td>
</tr>
<tr>
<td>Kent</td>
<td>575537</td>
<td>58044.8</td>
<td>1375</td>
<td>10%</td>
</tr>
<tr>
<td>Kojonup</td>
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<td>4905</td>
<td>12.10%</td>
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<tr>
<td>Kulin</td>
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</tr>
<tr>
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<td>20067.8</td>
<td>1216</td>
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</tr>
<tr>
<td>Narrogin</td>
<td>164063</td>
<td>11445.4</td>
<td>999</td>
<td>6.90%</td>
</tr>
<tr>
<td>Wagin</td>
<td>193910</td>
<td>8296.7</td>
<td>566</td>
<td>4.20%</td>
</tr>
<tr>
<td>West Arthur</td>
<td>282614</td>
<td>54003</td>
<td>4712</td>
<td>19.10%</td>
</tr>
<tr>
<td>Wickerpin</td>
<td>202347</td>
<td>10335</td>
<td>579</td>
<td>5.10%</td>
</tr>
<tr>
<td>Williams</td>
<td>228482</td>
<td>28403.9</td>
<td>2458</td>
<td>12.40%</td>
</tr>
<tr>
<td>Woodanilling</td>
<td>111760</td>
<td>9002.5</td>
<td>371</td>
<td>8.00%</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Shire</th>
<th>Public Land (ha)</th>
<th>% Public Land</th>
<th>Total Vegetation (ha)</th>
<th>% of Total Vegetation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augusta-Margaret River</td>
<td>121519.6</td>
<td>54.50%</td>
<td>159035.6</td>
<td>71.40%</td>
</tr>
<tr>
<td>Boyup Brook</td>
<td>68842.9</td>
<td>26.30%</td>
<td>115500</td>
<td>40.80%</td>
</tr>
<tr>
<td>Bridgetown-Greenbushes</td>
<td>70038.2</td>
<td>51.70%</td>
<td>79265.6</td>
<td>58.50%</td>
</tr>
<tr>
<td>Broomehill</td>
<td>1331.6</td>
<td>1.10%</td>
<td>8590.6</td>
<td>7.20%</td>
</tr>
<tr>
<td>Donnybrook-Balingup</td>
<td>87916.9</td>
<td>56.60%</td>
<td>102730</td>
<td>66.20%</td>
</tr>
<tr>
<td>Dumbyleyng</td>
<td>44953</td>
<td>17.70%</td>
<td>12222</td>
<td>12.60%</td>
</tr>
<tr>
<td>Gnowangerup</td>
<td>82647</td>
<td>18.90%</td>
<td>114212.6</td>
<td>25.10%</td>
</tr>
<tr>
<td>Katanning</td>
<td>8253.6</td>
<td>5.30%</td>
<td>13700.2</td>
<td>8.90%</td>
</tr>
<tr>
<td>Kent</td>
<td>114766.7</td>
<td>19.90%</td>
<td>172810</td>
<td>30.00%</td>
</tr>
<tr>
<td>Kojonup</td>
<td>4838</td>
<td>1.60%</td>
<td>40268</td>
<td>13.70%</td>
</tr>
<tr>
<td>Kulin</td>
<td>29131.2</td>
<td>6.20%</td>
<td>53734</td>
<td>11.50%</td>
</tr>
<tr>
<td>Namup</td>
<td>241657</td>
<td>82.20%</td>
<td>261124.8</td>
<td>80.00%</td>
</tr>
<tr>
<td>Narrogin</td>
<td>13575.7</td>
<td>8.20%</td>
<td>25021.1</td>
<td>15.20%</td>
</tr>
<tr>
<td>Wagin</td>
<td>8513.5</td>
<td>4.40%</td>
<td>16810.2</td>
<td>8.60%</td>
</tr>
<tr>
<td>West Arthur</td>
<td>28627</td>
<td>10.10%</td>
<td>82630</td>
<td>29.20%</td>
</tr>
<tr>
<td>Wickerpin</td>
<td>5320.6</td>
<td>2.60%</td>
<td>15655.6</td>
<td>7.70%</td>
</tr>
<tr>
<td>Williams</td>
<td>44953</td>
<td>19.60%</td>
<td>73356.9</td>
<td>32.10%</td>
</tr>
<tr>
<td>Woodanilling</td>
<td>3584</td>
<td>3.20%</td>
<td>12586.5</td>
<td>11.20%</td>
</tr>
</tbody>
</table>

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

23
Table 2. Definition of the three categories of remnant vegetation.

<table>
<thead>
<tr>
<th>Vegetation classed as &quot;Remnant Vegetation&quot; has one or more of the following characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Most closely reflects the natural state of vegetation for a given area.</td>
</tr>
<tr>
<td>Has an intact understorey (if forest or woodland).</td>
</tr>
<tr>
<td>• Has minimal disturbance by agents of human activity.</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Vegetation classed as &quot;Modified Vegetation&quot; has one or more of the following characteristics:</td>
</tr>
<tr>
<td>• Degraded understorey (i.e. reduction in the number of native species, includes weeds).</td>
</tr>
<tr>
<td>• Obvious human disturbance - clearing, mining, grazing, weeds.</td>
</tr>
<tr>
<td>• Affected by salt.</td>
</tr>
<tr>
<td>• Narrow corridors of vegetation (usually along roads and railway lines or windbreaks),</td>
</tr>
<tr>
<td>which are more likely to be affected by edge effects.</td>
</tr>
</tbody>
</table>

| 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

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

Source: Roadside Conservation Committee 1994
Table 4: Declared Rare Flora in the Blackwood Catchment

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

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

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

□=recorded

Data from (1) Anon (no date) The Perup: a Living Forest. CALM Perth
THE CHANGING POLICY ON CLEARING VEGETATION

Roger Hartley
Deputy Commissioner of Soil and Land Conservation

Today I would like to give you a view of the changing policy on clearing vegetation.

What I would like to do is to provide you with a picture of where we are at the moment. I am sure you are all aware the Government has been reviewing the area of clearing controls, vegetation protection and revegetation for some time and I guess I had hoped when I was asked to do this talk some six months ago we would be advanced enough to be able to say this is where we are at. I can't do that, but what I can do is to put in front of you the position that is in front of us and seeing this is a workshop you have the opportunity, obviously, of influencing where the Government and the community go with where we are at, at the moment, regarding revegetation and clearing.

Historical perspective

Turning to an overview of what I would like to cover, I think there is some value in giving you some historical information, to then look at how it is currently managed and the inadequacies of current management, then look at the controlled catchment areas (the water authorities responsibility) and the Department of Agricultural (Commissioner's) responsibility for land conservation aspects and then just briefly to paint a picture of the current situation and challenges.

Historical background

I think when we are looking at development and clearing of land its worth keeping in mind that agriculture still provides around $3 Billion per annum to the WA economy so we are very much dependant on agriculture as it continues to play a very big role in the economics of this state and we should not forget it. Concerning the development of agricultural land; most of the land was released post 1945, that is some 12 million hectares of land was released after 1945 that continued through the mid 70's until there was a moratorium on land release in 1981 because land degradation issues had started to become an issue and we were running out of good quality agricultural land as well.

With the benefit of hindsight there were two significant deficiencies in the way the development took place. One was an inadequate understanding of the land that led to land of below agricultural capability being released and therefore some areas are now questionable as to viability; and secondly, inadequate attention to flora and fauna. This has been mentioned already by the Minister and by the previous speakers.

Rate of clearing

I am not a West Australian but even I can remember the catch cry of "a million acres cleared a year". Clearing peaked in the late 60's, there was a decline in the early 70's and then it increased again in 1986 - 88. If you look at how agriculture was going economically, it
follows pretty closely. When things are down the pressure on clearing is down, when things start to go well the pressure comes on again.

What I would like you to look at is the **significance of clearing** as an activity. Since 1986 (which was when the clearing control regulations came in) to the present, some 206,000 hectares has been cleared, which only represents 1.25% of the agricultural resource and it actually involved only 5% of the 16,000 farmers or so in that activity. In 1992 - 93 only 6,000 hectares were cleared (or rather, there was no objection to that area being cleared). So it’s a margin activity but I can assure you again, having been associated with this activity for five years, its a very emotional and politically sensitive issue for a number of reasons. In particular, it emphasises the classic right of land ownership which is very deeply entrenched in our culture; that is, we own land, we have a right to clear it, and that is reflected in our legislative system. The current situation is that outside of the controlled catchments, everybody has the right to clear.

**SUMMARY OF CLEARING NOTIFICATIONS SINCE 1986**

<table>
<thead>
<tr>
<th>YEAR</th>
<th>NUMBER OF NOTICES</th>
<th>AREA NOTIFIED</th>
<th>AREA WITHOUT OBJECTION</th>
<th>AREA RETAINED</th>
</tr>
</thead>
<tbody>
<tr>
<td>JULY 86 - JUNE 87</td>
<td>*</td>
<td>34632</td>
<td>30467</td>
<td>4165</td>
</tr>
<tr>
<td>JULY 87 - JUNE 88</td>
<td>*</td>
<td>43259</td>
<td>35624</td>
<td>7635</td>
</tr>
<tr>
<td>JULY 88 - JUNE 89</td>
<td>*</td>
<td>78030</td>
<td>61541</td>
<td>16489</td>
</tr>
<tr>
<td>JULY 89 - JUNE 90</td>
<td>317</td>
<td>48041</td>
<td>39356</td>
<td>8685</td>
</tr>
<tr>
<td>JULY 90 - JUNE 91</td>
<td>237</td>
<td>36137.50</td>
<td>22953.5</td>
<td>13220</td>
</tr>
<tr>
<td>JULY 91 - JUNE 92</td>
<td>151</td>
<td>12640.20</td>
<td>7341.9</td>
<td>5298.3</td>
</tr>
<tr>
<td>JULY 92 - JUNE 93</td>
<td>119</td>
<td>7517.35</td>
<td>5671.15</td>
<td>1748.2</td>
</tr>
<tr>
<td>JULY 93 - DEC 93</td>
<td>65</td>
<td>4599.20</td>
<td>3401.65</td>
<td>2242.73</td>
</tr>
<tr>
<td>TOTAL</td>
<td>889</td>
<td>264856.25</td>
<td>206356.20</td>
<td>59483.23</td>
</tr>
</tbody>
</table>

**Statutes (Acts of Parliament)**

Before I move onto the management of clearing I think it worthwhile to very quickly look at some terms often mentioned in clearing control: namely, policy, acts (statutes) and regulations.
Firstly, statutes or acts of parliament. These are defined powers and functions. For instance, the Commissioner of Soil and Land Conservation has powers and functions that are defined by statute.

Policy represents ways in which those powers and functions are implemented and they really facilitate operation and decision making with regard to the statutory powers and functions. So you have a statute (A4) which defines the Commissioner's power and responsibilities operationally, what will the community wear on a day to day basis, how much of that power can he really use to achieve the intent of the Act and how should he implement it. Finally, regulations sit underneath this statutory umbrella of power and functions and operate as a more normal policy device. Both Acts and regulations are "policies" in that they reflect society's values. What society will "wear" is the issue with Acts, regulations and policy but they have different time scales. For instance, to amend the Soil Conservation Act takes about three years. Whereas a change of policy with regards to, say, fencing of remnant vegetation protected under the Soil and Land Conservation Act, can happen much faster. Regulations can be created faster than statutes but not as fast as a change in operational policy. I hope that was of some value given that this is about policy and influencing policy outcomes.

Management of vegetation protection

A major driving force behind the regulations that came in to force in 1986 was salinity - the awareness that salinity and clearing were closely linked and the fact that salinity was increasing. I think this graph is very good in that it shows a relationship between salinity on private land and remnant vegetation as a percentage of private land. This overhead gives you some idea of the rate at which salinity is increasing in this State, although in the southern agricultural area it's not quite as fast as in the wheat belt area, but the fact that it is increasing is a major concern to the Blackwood Catchment.

It was the awareness of salinity which resulted in 1981 in the 6 controlled catchments for water supply. These catchments were regulated under the Country Areas Water Supply Act to only allow clearing under permit. So here you see a change in that basic premise that I mentioned before of it being everybody's right to clear. What these regulations were now saying it you can't clear unless you have a permit. There was a big back-lash to that and I understand that the government community relations came to an all time low during this introduction. A compensation scheme was brought in and to date some $36 million has been paid out. One thing, unfortunately, that wasn't introduced with that scheme were management requirements. One of the challenges which is currently facing the Water Authority is the fact that the protected vegetation is declining because of stock grazing and trampling that vegetation.

Regulations to control clearing were thus introduced under the Soil and Land Conservation Act in 1986 and that control/management system is what I am going to focus on for the rest of my talk.

I am sure everyone in the audience is aware of these regulations and the requirement for any landowner or occupier to notify the Commissioner of their intention, 90 days before they begin clearing, if that clearing is greater than one hectare and its going to be for a change in land use.
The purpose of the regulations is to allow the Commissioner the opportunity to assess the
land proposed for clearing and or identify any areas that shouldn't be cleared because of likely
land degradation. So, these regulations are not removing the right to clear, as do the
regulations in the controlled catchments. Rather, everyone has the right to clear unless that
clearing is likely to create problems; then you do not have the right to clear. But it is still
keeping with that basic premise of a right to clear.

The other thing about the regulations was that the intent did not include nature
conservation and as the Act stands currently it cannot include nature conservation because
land degradation is defined as processes such as salinity, erosion and the removal of
vegetation which are detrimental to the present or future use of land. The Commissioner does
not have the power to define future use. The Commissioner cannot assess an NOI and say, "I
believe the future use of this land should be nature conservation." He must go by what the
land holder states the future use of that land is going to be. He does not have the power to
define future use.

The other thing of course, as I said before, it is not a permit system, we are not giving a
licence as the Water Authority does under their Act. We are not giving a licence, we are
simply defining those areas which cannot be cleared because of land degradation. As such we
make these assessments with the best technical information available and define the hazard
areas using that information. As such, hypothetically, the day after an assessment some
information might come to light which shows that no bush should be cleared. There is no
licence or permit that has to be removed and the Commissioner must say, "I'm sorry, I now
have information that means I have an objection to that clearing that yesterday was OK". I
stress this is a hypothetical example but I hope it makes the point clearly.

Assessment process

It is important to go through the assessment process and look at the strengths and
weaknesses that exist in that system as it is now. It only looks at the land that is notified, so
you are not taking into account any other areas on the property in terms of their likely hazard
rating. The Commissioner does not take action to protect a piece of vegetation which might
sit just over the fence but which has not been notified. He can only focus on that piece of
vegetation which is the subject of the notification. However, in making his judgement on
that notified vegetation he does take into account the amount of remnant vegetation in the
catchment and therefore the likely risk of clearing the subject vegetation in terms of salinity.

Technical guidelines for assessment

Technical guidelines have been prepared for these assessments. I'm sure people are aware of
them. There is no doubt that, particularly where salinity is concerned, things are going to get
tougher in terms of those guidelines. All the indications are at the moment that the guidelines
for salinity risk assessment are not really indicative of the amount of vegetation that needs to
be left to prevent increased spread of salinity.

Facilities for protecting land

There is the Soil Conservation Notice; there is the Agreement to Reserve which is a facility
that is available if the land owner or occupier agrees that land should be reserved; it's a more
positive facility; and then there is the one I do want to plug a little - the Conservation Covenant which is a facility available to people who voluntarily wish to preserve their land for say, nature conservation value. It is available to the landowner who is prepared to say that the future use of that land is nature conservation; then there is no problem and it is very simple to use the Soil and Land Conservation Act to preserve that land and vegetation.

These facilities do of course include management requirements and one which certainly creates some problems for us is that to date we have been insisting that any land which is protected and going to be adjacent to grazed/cleared land, the protected area must be fenced. This raises issues of equity and is certainly a very difficult position to maintain politically.

Current situation statement

There is no doubt that much of the agricultural region is over cleared. What you have are areas of remnant vegetation on private land as a percentage of Shire; red is less than 10%; yellow is 10 - 20% and greater then 20 is blue.

There is no doubt either that salinity is increasing and there is a lot of concern about it. The comment that has been made already is that the condition of remnants are declining.

In 1992/93 only 6,000 hectares were actually cleared - there was no problem with clearing in 92/93. The really big problem we are facing is vegetation decline. We have to resolve this challenge; problems which are politically unsatisfactory and we need to clean it up but vegetation decline is the really big challenge facing us - how to maintain and enhance the condition of remnant vegetation into the 21st century.

The current arrangements for vegetation protection are summarised as requirements to protect only those areas where there is a NOI and therefore inequities exist, particularly with the fencing requirements; no real account is taken of nature conservation except where there is a significant nature conservation issue. Then it is extremely long winded and I guess the recent case at Kukerin is an example; this is not satisfactory.

Surveys that have been done of farmers and questions from meetings such as this indicate that the majority of farmers support the idea of no more clearing. The majority support that idea and of course the majority of people in the urban area also support it. This was brought out by a recent survey by the Community and Family Commission which showed that remnant vegetation protection was number one on the list of peoples' concern. However, there is no doubt about it, farmers do not like the idea of increased government control over clearing; there is no doubt about that and that goes back to what I said earlier on why the issue of clearing is so contentious. It always runs the risk of flip flopping into a right to farm issue which then loses sight of the important resource issue. The challenge is to keep the focus on it as a resource issue.

Finally I do want to stress, I believe, and I'm sure everyone here believes, the major challenge is managing what is left for the future. That's what we have to do.

I hope that I have given a framework in terms of where we are at currently and that you have some idea of the dilemmas we face as government and community with the situation at the moment. I think the challenge is to come through this without it becoming a political
quagmire, without it flip flopping into the right to farm issue, keeping the resource issue well in our minds. You have the opportunity with this workshop to influence the direction that policy moves in this area in the future.

Thank you
MAP 2: Area of Remnant Vegetation on Private land as a percentage of total Private Land in a Shire

LEGEND
- < 10% Remnant Vegetation
- 10 - 19% Remnant Vegetation
- > 20% Remnant Vegetation
- Extent of Clearing
MAKING PROFIT FROM FARM BUSH

Ian Longson
Acil Economics and Policy Pty Ltd
PO Box 325, West Perth WA 6872

WHAT IS REMNANT BUSH?

Remnant bush is any area of native plant communities that remains after land clearing. These patches can be any shape or size. Whilst it is preferable that these areas be fenced off from livestock, and be of a sufficient size so that weeds do not establish themselves in competition with the native plants, the definition of remnant bush can include areas of unfenced bush. However, it does not include native trees scattered in paddocks or plantings of native or introduced species.

ORIGINS OF THE PROJECT

Bushland is an important natural resource contributing to flora and fauna conservation, soil and water conservation, aesthetics and recreation.

In a 1987 study of the remaining bushland in four wheatbelt shires in Western Australia, it was estimated that approximately half the area of remnant vegetation was found on private property. The effective conservation of remnant vegetation in the Western Australian wheatbelt is therefore dependent on the preservation of at least a proportion of these private remnants.

In addition to the need to conserve remnant vegetation for soil, water and general nature conservation reasons, approximately one third of the remnant bush areas in the central wheatbelt have declared rare or priority (poorly known) flora species on them.

Attitudes of private landowners and managers to preserving remnant vegetation vary. Whilst there has been a massive change in attitude in the last decade to retain remaining remnant vegetation for environmental and nature conservation reasons, the need for increased farm returns still drives many individual farmers to want to clear remaining areas of remnant vegetation on their farms to maximise the area available for cropping and livestock enterprises. This is despite other farmers undertaking expensive tree planting activities to attempt to redress past mistakes where land has been over cleared.

Many farmers are unaware of the financial returns that can be made from remnant vegetation left on their farms. Whilst there have been several publications which have listed the different sustainable economic uses of remnant vegetation, there is a lack of quantitative information on the costs and returns of these activities.

This project was set up to quantify the economic benefits to farmers accruing from the retention of remnant vegetation, and to identify potential benefits that required further research to enable quantification.

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1 F Mollemans, Distribution and ecological significance of on-farm bush remnants in the southern wheatbelt region of Western Australia, Western Australian Department of Agriculture, November 1992.
OUTLINE OF THE PROJECT

The steps involved in this project were:

- Identifying the potential sustainable economic uses of remnant vegetation;
- Locating and interviewing farmers obtaining financial returns or other economic benefits from the use of remnant bush located on their property;
- Selecting case studies which could provide quantitative estimates of the financial benefits to be obtained from retaining areas of remnant vegetation on farms; and,
- Identifying potential benefits that require further research.

LIST OF POSSIBLE ECONOMIC USES FOR REMNANT BUSH

A list of sustainable activities which could yield financial or other economic benefits from areas of remnant bush in the Western Australian wheatbelt was first drawn up. This list was based on a previous reports prepared by the Water Authority of Western Australia\(^2\), the Western Australian Department of Conservation and Land Management (CALM)\(^3\) and discussions with researchers and extension officers in CALM and the Department of Agriculture.

The list of possible sustainable economic uses of remnant vegetation determined for evaluation in the project is shown below.

- Wildflowers
- Ecotourism (camping, nature trails)
- Native plant seed collection
- Timber for fences and structures
- Firewood
- Brushwood
- Honey production (and other apiary products)
- Tree fruits
- Essential oils
- Charcoal
- Tannins
- Stock and crop shelter
- Water quality and salinity control
- Soil stabilisation (against wind and water erosion)
- Insect control (by resident insectivores)

INTERVIEWING FARMERS USING REMNANT BUSH

A list of farmers understood to be obtaining a financial return or other economic benefits from remnant vegetation on their farm was compiled using a variety of contacts from CALM, the

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Department of Agriculture, other agencies and businesses. The contacts were also screened to try and obtain a spread of farmers from different parts of the Wheatbelt.

Contact was made with as many farmers on the compiled list as possible and an initial telephone interview was conducted to confirm whether they were able to identify a measurable financial return or other economic benefit from a sustainable use of remnant bush on their property.

The telephone contact was also used to establish whether they were willing to provide information for the project and the availability of sufficient financial records to enable the value of the economic benefit use to be calculated. If this was so, a further interview was arranged and then conducted to obtain this information. This usually involved a farm visit. However, sometimes sufficient information was obtained during the telephone interview.

CASE STUDIES OF ECONOMIC RETURNS

The case studies used in this publication were selected from farmers interviewed as part of the project and to cover a wide range of locations within the Western Australian Wheatbelt. The aim was to obtain at least one case study for each of the identified uses of remnant vegetation listed in Table 1. However, despite exhaustive checking it was not possible to obtain quantitative information on all the identified uses. In total 8 case studies are reported on in this publication. The approximate location of these case studies is shown on the map in Figure 1 by identifying the statistical sub division in which the farm was located.

The information reported in the case studies is based on actual information obtained during interviews with the farmers and other people with relevant information about the enterprise. To preserve commercial confidentiality undertakings, the identities of these farmers and the precise location and nature of their activities is not revealed.

Quantitative information was obtained for the following uses:

- Wildflowers;
- Ecotourism (camping, nature trails);
- Timber for fences;
- Firewood;
- Brushwood; and,
- Native plant seed collection.

Some quantification was also possible for the benefits to be obtained from bees for honey production (and other apiary products).

IDENTIFYING OTHER USES WHICH REQUIRE MORE RESEARCH

Despite exhaustive contact with farmers and others it was not possible to locate actual case studies for the quantification of the financial returns for the following potential uses of remnant bush identified by other researchers as suitable for farms in the Western Australian wheatbelt:

- Tree fruits;
- Essential oils;
- Charcoal; and,
- Tannins.
Again, despite exhaustive contact with farmers and others, it was not possible to locate actual case studies to enable the quantification of the economic benefits of the following values of remnant bush identified by other researchers as applicable to farms in the Western Australian wheatbelt:

- Stock and crop shelter;
- Soil stabilisation (against wind and water erosion);
- Water conservation and salinity control; and,
- Natural pest control (by resident insectivores).

GETTING A RETURN FROM REMNANT BUSH

Most people believe the main reason that remnant bush should be kept is to protect and conserve our unique flora and fauna, and to assist in soil and water conservation. In addition, it is often possible to obtain an economic return from remnant bush left on farms.

A growing number of farmers have enterprises based on the sustainable use of remnant bush. Sustainable uses are those which generate additional financial returns, or return economic benefits to the farm business, without affecting the survival and integrity of the fauna and flora species in the bush, and are thus able to sustain the activity into the future.

Other farmers are encouraged to read this report and consider adopting applicable uses for remnant bush on their property. In this way the retention of remnant bush will not be seen as just a cost, but also as a way of generating some extra returns or benefits for the farm. A methodology for use by farmers and others to derive the net operating costs of a remnant bush enterprise and compare it to agricultural enterprises is shown in Attachment 1.

MEASURING THE RETURNS

The estimate of the economic return for the remnant bush enterprise is calculated by adding up the gross returns from sale of goods and services and then deducting the specific cash cost outlays required to obtain the returns. This leaves a net cash operating return for the enterprise to recompense the farmer and other unpaid family labour and to service the overheads and capital cost of the farm.

This is then translated into one or both of two measures as applicable to enable a comparison with the returns from agricultural enterprises on the farm.

- net cash operating return per hectare

  This measure, commonly called gross margin analysis, is used by farmers to compare the profitability of conducting different agricultural enterprises on the farm.

- net cash operating return per day worked by the farm operator and other 'unpaid' family labour

  This enables the farmer to evaluate whether the returns from the enterprise were worth the effort. In other words, if the net cash operating return per day worked on a remnant bush enterprise is higher than the opportunity cost of spending that time on another farm activity, then it make sense for the farmer to undertake the enterprise.

Costs and returns for the activities which involved the sustainable use of remnant bush were obtained during interviews with the farm operators and other sources of information.
A net cash operating return for the enterprise was calculated, and where applicable, a net cash operating return per hectare and a net cash operating return per day worked were calculated. These returns were also compared with the estimated net cash operating return (gross margin) from the main farming enterprises undertaken on the property. The gross margins were calculated for 1992/93 and for the longer term based on information supplied by the Department of Agriculture for different areas of the Wheatbelt consistent with the location of the farm.

When comparing the per hectare returns four factors need to be kept in mind.

- First, not all farms would be capable of achieving the stated returns on a sustainable basis. The location of the property, soil type, climate and the composition of the bush on the property obviously influence the returns that are possible and the sustainability of those returns. For products which have high transport costs it is obviously an advantage to be close to the market and ecotourism opportunities usually depend on accessibility and location of the property to the main tourist routes;

- Second, many remnant bush areas are located on areas that were deliberately left when the farm was cleared, such as the poorer soils or difficult areas to clear. In many cases these areas are incapable of returning profitable gross margins for agricultural enterprises. This means that any returns from remnant bush enterprises on such areas are often in addition to, and not competitive with, returns from cropping and livestock enterprises on the rest of the farm. Of course, in many cases remnant bush enterprises would also provide higher returns if undertaken on more productive land;

- Third, many of the remnant bush enterprise activities can take place at times of the year when there is a lull in traditional farm enterprise activities and thus returns from remnant bush enterprises can be viewed as an additional source of farm returns, and,

- Fourth, measured economic returns do not include the indirect returns from the positive environmental benefits of the remnant bush on the rest of the property. Despite exhaustive contact with farmers and others, it was not possible to locate actual case studies to enable the quantification of the indirect economic benefits of the following values of remnant bush identified by researchers as applicable to farms in the Western Australian wheatbelt:
  - Stock and crop shelter;
  - Soil stabilisation (against wind and water erosion);
  - Water conservation and salinity control; and,
  - Natural pest control (by resident insectivores).

ENTERPRISES WITH MEASURABLE RETURNS

The analysis of the measurable returns from the different sustainable uses of remnant bush is based on information gathered during interviews with farmers and others involved in the enterprises. To protect the commercial confidentiality undertakings given to these farmers, their identity and the exact location of the enterprise has not been given. The location of the enterprise is broadly given as a statistical sub division.
Again, to protect commercial confidentiality undertakings given to the farmers interviewed, the information in this report is presented in a summarised form. All data for the remnant bush enterprises is for the 1992/93 financial year and comparisons with traditional farm enterprises are made for 1992/93 and the long term expected net cash operating returns as estimated by ACIL based on information provided by the Department of Agriculture.

WILDFLOWERS

Wildflower production includes the picking of flowers, foliage and nuts from natural bush stands. It is estimated that 20% of Western Australia's exports of cut flowers come from picking off remnant bush on private land. If wildflowers are to be sold a Commercial Producers Licence from CALM is required for each property. In the future it is expected that more wildflower production will come from specific plantings. However, there will still be opportunities to make some returns from harvesting wildflowers from natural bush stands.

Two case studies of farmers earning financial returns from harvesting wildflowers in remnant bush were researched.

CASE STUDY 1   HARVESTING OF BANKSIA FLOWERS

(KING STATISTICAL SUB DIVISION)

This farmer operates cropping and sheep enterprises. Approximately 10% of the property is bush. The area left to bushland is mainly the sandier country and some ironstone hills. It is not fenced off but occupies a substantial area. The harvesting of wildflowers is done as a sideline enterprise by two members of the family to generate additional farm returns. Harvesting of Banksia baxteri takes place from late December to early March. This fits in with the farm program as it is after harvest of the cereal crops. The harvesting of Banksia coccinea (Red Coccinea) is done over a longer period, from July to September. The harvested wildflowers are sold to a local dealer.

The costs and returns from the harvesting of B. baxteri were based on picking 110,000 blooms in 1992/93 from an 80 hectare area of remnant bush. Apart from the vehicle operating costs, which are small, the only other cash cost outlay is an allowance for the annual replacement of items such as secateurs, gloves, sunglasses, sunscreen lotions and wet weather gear. Even if an annual depreciation allowance (15 year life) for the cost of fencing the remnant bush area was included, which the operator intends to complete in the near future, the net cash operating return per day worked in 1992/93 was estimated at $248 per day based on an estimated input of 75 days for picking and pruning (based on an 8 hour day).

The return from this enterprise was compared with gross margins for a typical sheep enterprise and a barley crop enterprise for the area. The returns were higher than those achieved by the sheep enterprise but are not as high as the estimated returns from cropping barley in 1992/93. However, it is important to note that the wildflower production is from less productive sandier country on the property (the gross margins for barley are based on a yield of 2.5 tonnes per hectare). The wildflower enterprise also provides an additional return at a time of the year when other farm activities have scaled down. In the future the farmers believe they will need to provide closer management of the wildflowers to ensure sustainable yields. This will mean less production will come from remnant stands and more will come from propagated and managed plantings on the farm.
<table>
<thead>
<tr>
<th>Enterprise</th>
<th>Wildflowers (Banksia baxteri)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hectares</td>
<td>80</td>
</tr>
<tr>
<td>Cash returns</td>
<td>$19,800</td>
</tr>
<tr>
<td>Cash operating costs*</td>
<td>$1,235</td>
</tr>
<tr>
<td>Net cash operating returns</td>
<td>$18,565</td>
</tr>
<tr>
<td>Net cash operating return per hectare</td>
<td>$232</td>
</tr>
<tr>
<td>Net cash operating return per day worked (by operator and unpaid family labour)</td>
<td>$248</td>
</tr>
</tbody>
</table>

**Comparable agricultural gross margins per hectare for this farm**

- Sheep (1992/93) $13
- Sheep (long term) $60
- Barley (1992/93) $244
- Barley (long term) $169

* Including allowance for the construction and maintenance of a perimeter fence.

**CASE STUDY 2  HARVESTING OF CAULIFLOWER BUSH (MOORE STATISTICAL SUB DIVISION)**

This farmer operates a sheep grazing property and harvests wildflowers from areas of remnant vegetation remaining on the farm. The costs and returns from the harvesting of Cauliflower bush (*Verticordia eriocephala*) are based on an area that comprises 10% of the home farm area. Unlike the farmer in Case Study 1, this operator employs labour to harvest and prepare the wildflowers for transport. Apart from the labour cost, cash costs also included the cost of freighting the wildflowers to dealers located in the Metropolitan Area. This return was compared with the sheep enterprise which is the main agricultural enterprise run on the farm. The comparison shows that the returns from the wildflower enterprise are greater than the returns from sheep grazing, both in 1992/93 and in the longer term.

<table>
<thead>
<tr>
<th>Wildflowers (Verticordia eriocephala)</th>
<th>Enterprise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hectares</td>
<td>80</td>
</tr>
<tr>
<td>Cash returns</td>
<td>$20,000</td>
</tr>
<tr>
<td>Cash operating costs</td>
<td>$10,100</td>
</tr>
<tr>
<td>Net cash operating returns</td>
<td>$9,900</td>
</tr>
<tr>
<td>Net cash operating return per hectare</td>
<td>$124</td>
</tr>
</tbody>
</table>

4 Previously known as *Verticordia brownii*
Comparable agricultural gross margins per hectare for this farm

| Sheep (1992/93) | $13 |
| Sheep (long term) | $52 |

ECOTOURISM

There is an increasing demand for rural and wilderness tourism products from urban Australians and overseas visitors. Farmstay accommodation and day picnic sites are popular, particularly if there are other nearby attractions to visit. Natural bush on the property provides an added draw-card and may enable the visitor to experience a guided nature walk or enjoy walking, bike riding or horse riding on trails.

There are also opportunities to cater for groups visiting the property. Several farmers that have natural bush on their property, and are located on or close to major tourist routes, provide catering and guide services for coach loads of tourists during the wildflower season or for school groups on excursions and study trips.

Two case studies of farmers earning financial returns from ecotourism activities, which relied in part on remnant bush areas on the farm being an attraction, were researched.

CASE STUDY 3  CARAVAN PARK

(PALLINUP STATISTICAL SUB DIVISION)

This farmer operates cropping and sheep enterprises. The farm is close to nearby natural attractions which means a lot of tourists drive past the farm boundary. When the farm was cleared an area of ironstone mallee country was left adjacent to the main road because it was considered it would be difficult to farm. A caravan park has been established on half of this area.

The caravan park has cabins, as well as caravan and camping sites. A feature of the caravan park is its location in an area of remnant bush which provides shade, shelter and privacy for occupants. Adjacent fenced off areas of remnant bush are used to conduct guided nature walks and to enable guests to enjoy walks through natural bushland. A small charge ($2 per head) is made for the guided nature walks. The fenced off remnant bush area also serves to ensure a clean catchment area for the dam that services the caravan park.

To preserve commercial confidentiality the results shown below are based on a per hectare basis and no total cost and income information is supplied for the enterprise. Two family members run the enterprise. For the busy times of the year a part-time cleaner is employed and other members of the family help out.

The return from this enterprise was compared with gross margins for a typical sheep enterprise and cropping enterprises for the area. Needless to say, the operators make more return from running the caravan park and nature walks in their remnant bush area than they make from the rest of the farm.
<table>
<thead>
<tr>
<th>Enterprise</th>
<th>Caravan Park</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(&amp; nature walks)</td>
</tr>
<tr>
<td>Hectares</td>
<td>Not available</td>
</tr>
<tr>
<td></td>
<td>to preserve</td>
</tr>
<tr>
<td></td>
<td>commercial</td>
</tr>
<tr>
<td></td>
<td>confidentiality</td>
</tr>
<tr>
<td>Net cash operating return per hectare*</td>
<td>$1,500</td>
</tr>
</tbody>
</table>

**Comparable agricultural gross margins per hectare for this farm**
- Sheep (1992/93): $20
- Sheep (long term): $91
- Wheat (1992/93): $200
- Wheat (long term): $146
- Barley (1992/93): $216
- Barley (long term): $150

* Includes allowance for the construction and maintenance of buildings and site works.

**CASE STUDY 4 FARM, NATURE AND WILDFLOWER TOURS (MOORE STATISTICAL SUB DIVISION)**

This farmer operates cropping and sheep enterprises. Approximately 40% of the property is bush, most of which is fenced off. The operators offer a range of guided tours and independent visitor programs ranging from 2 hour talks and guided tours for tourist coaches during the wildflower season, to whole day farm activity and guided bush walks. A feature of visits to the property is the ability to see and experience typical farm activities. The operators also offer meals and catering for groups or individuals. The property is popular with school groups. Again location close to nearby attractions is an important factor as the property is located near a popular national park.

The operators spend an estimated 40% of their time on the tourism activities. Special equipment required totals about $1,000 and includes first aid kits, chemical toilets, trestles, crockery, cutlery, camp ovens and thermoses. The main cash costs are fuel and vehicle costs, the costs of catering and food, and replenishing the first aid kits, chemicals for the toilets and advertising costs. Fuel and vehicle costs are approximately $10 per day spent on tourism activities. This enterprise fits in with the farm work program with tours being booked in according to lulls between the busy times of the farm program. An extra cost is the need to have a small number of animals on hand to show visitors various farm activities throughout the year (e.g. shearing).

It is difficult to separate out the costs and returns associated with the activities which rely on the remnant bush from those associated with the general farm visit activities. However, after discussing it with the operators it was assumed that half the net cash return from tour activities was for activities associated with the presence of remnant bush on the property.
The information provided by the operators indicates that they were able to earn an estimated net cash operating return of $50 per day worked on tour related activities involving remnant bush. This was similar to the current net cash operating returns earned per day from the other farm activities. Due to the large area of retained remnant bush on the property, net cash earnings per hectare of remnant bush were low at just $5 per hectare.

**Timber Products**

Timber products which could be produced from remnant bush on Western Australian wheatbelt farms include fence posts and rails, sawlogs, poles, pulpwood, craftwood and firewood.

The naturally occurring species of trees, the long growing period required for trees to reach a commercial size and the lack of volume in most remnant bush areas in the wheatbelt will, apart from some isolated situations, rule out the use of wheatbelt remnant bush for the production of sawlogs, pulp and poles. However, there are opportunities to use remnant bush in the wheatbelt for fencing materials and firewood, and depending on the presence of the appropriate species, for craftwood.

**Fencing timber**

Steel posts have largely replaced timber fence posts in the wheatbelt. However, farmers with suitable remnant bush\(^5\) on their place can minimise the cash outlay on fencing by harvesting fence posts and strainers from their own property. Also, steel posts are unsuitable for use in salt affected soils.

Fencing contractors are always on the lookout for suitable stands of remnant bush on farms from which they can obtain fencing timber. One contractor interviewed said that the standard arrangement was to leave 40% of the fence posts with the farmer and the contractor took 60%. The on farm value of these posts (jam in this instance) were $3.00 per post for first grade and $1.30 per post for second grade posts.

The natural durability of timber posts can be considerably extended by treating the sapwood with creosote. Methods developed by the CSIRO Division of Forest Products in the 1950's and 1960's are being tested on regrowth and plantation grown timbers by CALM's Wood Utilisation Research Centre. Farmers should explore these techniques for treating their own timber fence posts. The estimated cost of on farm treatment of posts is now around $1.25 per post.

A comparison of the cost of purchasing fence posts compared to preparing them on farm is shown in the case study below.

**Case Study 5  Production of Timber Fence Posts**

*(South West Statistical Sub Division)*

The information provided here is based on an interview with a farmer who was cutting and treating his own fence posts in preference to buying them from a supplier. The costs are

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based on using the methodology developed by CALM\(^6\) to prepare 250 marri regrowth posts with an average small end diameter under bark (sedub) of 100mm. The costs of purchasing alternative posts were obtained by contacting local South West fencing suppliers and from the 1993 Farm Budget Guide\(^7\). These costs do not include transport to the property. The estimated cash cost of producing a treated fence post on the property was $2.50. On top of this there was an estimated 24 minutes of labour required per post. Treated posts\(^8\) have an estimated life of at least 50 years compared to 15 years for steel posts (lower in salty soils). Using standard net present value (NPV) techniques and a discount rate of 8 per cent, the cash saving of preparing and treating fence posts on farm would be $7.50 per post location compared to steel posts over a 50 year time period. At the estimated 24 minutes to cut and prepare each post this equates to $18.75 per hour spent on this activity by the operator. There would be an additional labour cost saving from not having to replace the fence posts as frequently.

All farms have busy times of the year due to seasonal activities associated with cropping and livestock production. During off peak periods it is possible to spend time on maintenance, farm development and other farm activities. Provided there is no other activity that can return a net $18.75 per hour of labour input during these off-peak periods, it will pay farmers to obtain and treat their own fence posts from remnant bush.

<table>
<thead>
<tr>
<th>Enterprise</th>
<th>Fence posts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Purchase prices of alternative posts</strong></td>
<td></td>
</tr>
<tr>
<td>Star Steels (1.65m black)</td>
<td>$3.50</td>
</tr>
<tr>
<td>Star steels (1.65m galvanised)</td>
<td>$4.70</td>
</tr>
<tr>
<td>Wooden posts (untreated)</td>
<td>$3.00 to $4.50</td>
</tr>
<tr>
<td>CCA chromate treated pine post</td>
<td>$4.60 to $9.60</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cost of hardwood posts produced on farm</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operation</strong></td>
<td><strong>(minutes/post)</strong></td>
</tr>
<tr>
<td>Fell, trim, debark, stack</td>
<td>15</td>
</tr>
<tr>
<td>Treat and stack</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>24</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operating costs</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tractor and truck ($20 per hour)</td>
<td>0.30</td>
</tr>
<tr>
<td>Chain saw ($5 per hour)</td>
<td>0.45</td>
</tr>
<tr>
<td>Treatment</td>
<td>1.25</td>
</tr>
<tr>
<td>Equipment allowance (hot plate, hoist)</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>$2.50</td>
</tr>
</tbody>
</table>


\(^7\) Department of Agriculture, *Farm Budget Guide 1993*, Elders Weekly Supplement

\(^8\) Provided it is of a suitable species - such as Class 1 species: powderbark wandoo (*Eucalyptus accedens*), inland wandoo (*E. capillosa*), wandoo or white gum (*E. wandoo*), or Class 2 species such as sheoak (*Allocasuarina fraseriana*), yate (*E. cornuta*), jam (*Acacia acuminata*); jarrah (*E. marginata*) or WA blackbutt (*E. patens*).
Another farmer operating in the York shire (Avon statistical sub division) reported considerable savings from being able to harvest fencing timber from a 100 hectare remnant bush block left on the property. The area was originally fenced off because it contained poisonous plant species. It is estimated that up to 1,000 posts, strainers and rails could be cut every 5 years without affecting the sustainability or integrity of the remnant bush. In the last 5 years a cost savings of $1,150 has been achieved by harvesting fencing requirements (50 strainers, 150 posts and 50 struts and rails) from white gums growing in the area of remnant bush. This is based on an average cash cost for cutting and stacking of $1.00 per unit including labour, compared to a local purchase price of $8 for strainers, $5 for posts and $5 for rails.

Firewood

According to a 1989 study\(^9\) one third of Perth households use wood as their main form of heating. Increasing controls on the collection of firewood from public land, mainly due to concerns about spreading the dieback disease, has increased the demand for firewood from plantations and remnant vegetation areas on private land. The sustainable yield of firewood can range from 1 to 15 tonnes per hectare per annum over a ten year period and prices for dry firewood delivered to Perth range between $60 and $100 per gross tonne.\(^8\) The financial returns from harvesting firewood from remnant bush will depend on the distance from Perth. There is also a local market for firewood in wheatbelt towns and neighbouring farms.

In the future commercial firewood plantings are likely to provide the bulk of firewood needs. However, remnant bush may continue to provide some opportunistic economic returns for farmers when traditional enterprises are in cyclical decline. At the very least, remnant bush can supply the firewood requirements for the farm and negate any need to purchase firewood in the future.

**CASE STUDY 6  HARVESTING OF FIREWOOD**  
(WILLIAMS STATISTICAL SUB DIVISION)

This farmer operates sheep grazing and cropping enterprises. Approximately 10% of the farm area is still bush and this has never been fenced off. The main tree species is jarrah, with some whitegums and redgums. The harvesting of firewood from fallen and dead trees from the remnant bush area is done as a sideline enterprise by two members of the family to generate additional farm returns. This is not done every year but has been undertaken over the last three years due to depressed sheep returns. At a rate of approximately 1 tonne per hectare per year it is estimated there is another 4 years of firewood production that could be taken off the property. The enterprise is seen as an opportunistic way of converting spare labour into extra returns while sheep returns are depressed. Harvesting of firewood takes place during February to December to fit in with other farm activities. Most of the firewood is trucked to Perth to a wood dealer.

The costs and returns from the harvesting firewood were based on the costs associated with the cutting, loading and transporting of an 8 tonne load of firewood to Perth. Costs include the operating costs of a truck, tractor and two chain saws. A 12 hour round trip is required to get the wood to Perth.

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The net cash operating return per day worked in 1992/93 was estimated at $65 per day (10 to 12 hour day). This included two people working for 10 hours to cut the wood and load the truck and a 12 hour round trip to Perth. There is also a limited local demand for firewood and some firewood was delivered to customers in nearby towns at $45 per tonne. With reduced delivery costs the net cash operating return per day worked increased to $80 per person for local sales.

<table>
<thead>
<tr>
<th>Enterprise</th>
<th>Firewood (Jarrah)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hectares</td>
<td>80</td>
</tr>
<tr>
<td>Cash returns</td>
<td>$5,040</td>
</tr>
<tr>
<td>Cash operating costs*</td>
<td>$3,330</td>
</tr>
<tr>
<td>Net cash operating returns</td>
<td>$1,710</td>
</tr>
<tr>
<td>Net cash operating return per hectare</td>
<td>$21</td>
</tr>
<tr>
<td>Net cash operating return per day worked (by operator and unpaid family labour)</td>
<td>$63</td>
</tr>
</tbody>
</table>

Comparable agricultural gross margins per hectare for this farm

- Sheep (1992/93) $20
- Sheep (long term) $90
- Barley (1992/93) $150
- Barley (long term) $120
- Lupins (1992/93) $160
- Lupins (long term) $150

* Based on operating costs, including fuel, of $5 per hour for the chain saws, $10 per hour for the tractor (50% idling time) and $20 per hour for the 8 tonne truck.

The return from this enterprise was compared with gross margins for a typical sheep enterprise and barley and lupin crop enterprises for the area. The net cash operating return from the firewood enterprise was equivalent to the return from the sheep enterprise in 1992/93 but not as high as the expected return from sheep in the longer term, nor as high as the current and future returns from cropping enterprises. However, it is important to note that the operators see this enterprise as an additional source of income, to help compensate for the current lower returns from the sheep enterprise.

Craftwood

There is a small but active craftwood industry in Western Australia. Craftwood timbers used for furniture manufacturing, sculpture and wood turning are selected for their unusual and unique grain, colour and texture. Most farmers permit wood to be taken in small quantities from their property by craftwood artists. Occasionally there is some payment in kind. At least one business contacted during the preparation of this report offers a mobile contract sawmill service or will purchase suitable fallen or dead trees on farm. The business, which is located in Denmark, uses a portable sawmill to visit a property and cut up individual dead or fallen trees for craft and speciality timbers. It also operates a wood kiln for drying timbers to the required moisture content.
**Brushwood**

In some areas of the wheatbelt there are remnant bush stands of *Melaleuca uncinata* suitable for brushwood fencing used for decorative garden and property fencing. One contractor interviewed said that it was always difficult to obtain supplies and demand was greater than the supply.

A royalty of 70 cents to $1.00 per bundle was paid to farmers for access to cut the brushwood. On average stands would yield 10 bundles per hectare. However, this varied and up to 100 bundles per hectare were possible if the stand was dense. It took 10 to 12 years for the plant to regrow to the 1.7 metre minimum height. Up to 5 bundles per bush could be cut.

**Native Plant Seeds**

Seeds from many species of native plants have commercial value for gardens and for revegetation work. Farmers thinking of this enterprise need to be aware that:

- if seeds are to be sold a Commercial Producers Licence from CALM is required for each property;

- correct identification is essential. Declared rare flora may not be taken and seed cannot be sold unless it is accurately labelled with the correct Latin name;

- collection of seed requires a level of technical competence. The operator needs to know and use hygienic collection and disease control procedures and correct harvesting techniques to ensure the right product is harvested and the sustainability of the flora resource;

- collecting native plant seed is time consuming. It requires constant observation and then the ability to drop everything to harvest the plant/s when it is ready. A lot of time is spent in the recording of flowering and harvesting details, and completing records required to satisfy CALM licence requirements. Many species only produce seed for one or two days and then not every year, nor at the same time each year; and,

- most dealers do not pay on delivery, but when the seed is actually sold. This often means keeping stocks of seeds on farm. The general rule is that the farmer/collector gets 50% of the price for which the dealer sells the seed.

In recording the possible financial returns from native seed collection it was considered more appropriate to record returns on the basis of dollar return for hours of input. Returns per hectare meant little as most collectors ranged over considerable distance to collect seed and it was difficult to relate this back to a per hectare return. The main costs for native seed collectors are pruning gear (about $1,000), sieves (up to $600) and containers.

Seed dealers contacted as part of the project claimed that there were probably about 50 professional collectors in the State and for collectors who knew what they were doing returns of $20 to $30 per hour should be possible. However, returns of up to $100 per hour could be made if collectors were in the right place at the right time to pick highly desired species.

These levels of returns were not achieved by four persons identified by seed dealers and interviewed during the project. One of these farmer/collectors was collecting seed as a hobby and for some extra cash. They had in excess of 30 species in storage. This was calculated at
a return of just $16 per day for 75 days work in 1992/93. Another was mainly collecting for re-vegetation work on their own and neighbouring properties and exchanged seeds for other seeds and plants as well as selling seed. No attempt was made to calculate the daily return for this operator as these other activities complicated the assessment.

It was possible to calculate the net cash operating returns for the other two farmers from the harvesting of native plant seeds from their property.

CASE STUDY 7  HARVESTING OF BANKSIAS, HAKEAS AND ACACIA SALIGNA (KING STATISTICAL SUB DIVISION)

This farmer managed a sheep grazing and cropping property in 1992/93 and spent a total of 30 days harvesting native plant seeds off 240 hectares of bush, which was 15% of the farm area. The operator estimated an average return for harvesting native plant seeds of $8 to $12 per hour, depending on the species being harvested. This activity was undertaken during the breaks between peak seasonal farm activities such as shearing, seeding, haymaking and harvesting.

CASE STUDY 8  HARVESTING OF EUCALYPTS (MURRAY STATISTICAL SUB DIVISION)

Whilst this case study is actually not in the wheatbelt (it actually falls in the South West Statistical Division) it will serve to illustrate an example of the possible returns to farmers that allow professional seed collectors onto the property to collect seed without having to involve themselves in the enterprise. This farmer receives $400 to $500 per year from royalties paid to him by a professional seed collection business collecting Eucalyptus seed (mainly jarrah) from his property. The royalty is based on 5 to 10% of the retail value of the seed, depending on the species. Payment is made following the sale of seed by the dealer.

BEES

Native shrubs and trees are the backbone of the Western Australian honey industry. Most of the industry takes place in the South West but there are some apiarists that operate into the wheatbelt, notably in winter on the northern sandplain country in the Moore and Greenough Statistical Sub Divisions.

Much of the production is from parkland cleared areas of farmland and coastal heathlands. However, remnant vegetation is often used for honey production and other apiary products (pollen, breeding bees and queen bee production). Apiarists may approach farmers with areas of remnant bush to get permission to locate hives on the property. Sites usually have a radius of 1.5 kilometres, although this may get down to a 0.5 kilometre radius for densely vegetated sites. The "usual" arrangement is to supply honey to the landowner as a payment in kind for use of the site. Alternatively, some landowners receive an annual payment equivalent to the annual site fee (currently $34) set by CALM for hive sites on public land. Land owners with remnant bush could also produce their own honey. However, commercial beekeepers move their hives around from property to property to maximise honey yields by ensuring bees have access to flowering plants for as much of the year as possible. Gross returns of $100 per hive per year would be achievable for good sites, based on 100 kilograms of honey per year per hive and a selling price of $1.00 per kilogram to a wholesaler. A higher return could be achieved by direct marketing of the honey. Hives cost around $100 each and if well
maintained should last 20 to 25 years. Around 10% of the frames would need to be replaced each year.

It should be pointed out that there is some concern that bees may compete with native bird, insect and small mammals for nectar and nesting sites. There is also concern that bees may actually reduce pollination success in some native plants. Other researchers believe the introduced European bee has reached an equilibrium with the Australian environment. Further research may be able to confirm the actual impact of the European honey bee and ways to minimise any negative impacts.

OTHER PRODUCTS

There are a number of other products which could be sourced from remnant bush and provide a financial return.\textsuperscript{10, 11} Despite repeated attempts to locate farmers in the Western Australian wheatbelt generating returns from these other products, none were found. They remain theoretical economic uses of remnant bush on Western Australian wheatbelt farms. Further research and innovation may see the production of tree fruits, essential oils, medicinal plants and tannins at some time in the future.

TREE FRUITS

Remnant stands have the potential to produce native fruits. For example, the Quandong (\textit{Santalum acuminatum}) is found naturally throughout the agricultural region of the State. However, no evidence could be found of any farmers in the Western Australian wheatbelt making a return form harvesting the Quandong or any other native fruits from remnant bush. It is likely that any commercial use of native tree fruit plants will be based on obtaining "mother plants" from remnant bush and propagating them to produce plants for native tree fruit orchards. Produce from these native tree fruit orchards would then be sold into niche markets.

ESSENTIAL OILS AND MEDICINAL PLANTS

There is no commercial operation in Western Australia currently processing eucalyptus or other essential oils. However, there is considerable interest in establishing a eucalyptus oil industry in Western Australia and the first steps are being taken by government and farmers for the establishment of an industry. A pilot extraction plant is being built using government funds and trial plots of trees have been planted. The biggest potential is seen in the production of solvents for the chemical industry.

In the longer term there may be opportunities for other essential oils and medicinal drugs to be produced from native plants. There is already considerable interest in one plant as a possible producer of a drug to control AIDS.


\textsuperscript{11} Richmond E., \textit{Economic benefits to the Farmer of Maintaining and Protecting Remnant Native Vegetation on Farms in the South West of Western Australia}, Water Authority of Western Australia Report WS 99, 1992.
An Indian company is looking at establishing a plant in Albany to produce pharmaceutical and cosmetic products from indigenous plants. Some of the plant material for essential oil and medicinal drug production in the future is likely to be sourced from remnant bush on farms.

**Tannins**

Tannins for tanning and glue manufacture can be extracted from a number of tree species. Extraction from Brown Mallet bark was once a viable business in the South West but today there is no commercial production of tannins from native plants in Western Australia. There is reputedly a sizeable commercial production of tannin in South Africa from wattle bark and the potential to start an industry in Western Australia therefore exists.

**Charcoal**

Timber collected and not suitable for firewood could be sold for the manufacture of charcoal. However, all charcoal manufacturing is currently undertaken in the South West and it is unlikely that it would pay to transport wood from remnant bush in the wheatbelt as there is sufficient supplies of wood in the South West region.

**Environmental Benefits**

The widespread clearing of the Western Australian wheatbelt has changed the natural environment. There is a recognition that many farms were over-cleared and considerable cost is now being incurred by farmers to revegetate these problem areas. It is ironic that farmers wish to clear remaining areas of remnant bush at the same time as other farmers are spending large amounts on the re-establishment of native vegetation on their properties.

There are publications which examine the expected environmental benefits from the retention of remnant vegetation on farms. However, no farmers contacted during this project were able to give any quantification of the economic benefits resulting from the environmental flow-ons from the retention of remnant vegetation. They remain theoretical economic benefits flowing from the retention of remnant bush on Western Australian wheatbelt farms.

**Stock and crop shelter**

The value of tree belts for stock and crop shelter is well known, although practical farm scale data is limited. All the available research data is based on trials of purpose planted trees in linear plantings for wind and shade shelter. Whilst farmers contacted during the project expressed opinions that the retention of remnant vegetation would have positive economic benefits from shelter effects, no one contacted could provide quantification of the likely economic benefits.

A remnant bush stand may, by its location and configuration, provide shelter for stock and crop in the lee of the stand. However, good management of remnant bush for nature conservation purposes requires that it be fenced off from livestock. This limits its value for stock shelter. If the area of remnant bush is large enough there may be opportunities to run

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12 D Bicknell, *The role of trees in providing shelter and controlling erosion in the dry temperate and semi-arid southern agricultural areas of Western Australia*, Department of Agriculture, 1991.

stock into the bush in times of severe weather conditions without affecting the integrity of the remnant bush.

However, in most situations the best solution would appear to be to plant shelter belts in appropriate locations throughout the paddock and in association with existing remnants, rather than rely on remnant vegetation itself for stock shelter.

The benefits of trees as shelterbelts on crop yields is also well researched with yield increases of up to 20% being recorded due to lower evaporation rates and shelter from the wind. However, adequate crop shelter requires ribbons of bush without breaks and correct alignment to suit the prevailing winds. It would be sheer chance if the location of remnant bush on a property was optimal for crop protection. At the very least it would require in-fill planting to join up remnant bush areas and create continuous windbreaks.

**Soil stabilisation**

Remnant vegetation will stabilise the soil but if most of the area has been cleared, a similar conclusion can be drawn about the value of remnant vegetation for the stabilisation of soil against wind and water erosion. That is, strategic plantings would be required to prevent wind and water erosion.

**Water conservation and salinity control**

Remnant vegetation helps to keep the watertable down and reduce the likelihood of salinisation of soils. Leaving remnant vegetation stands in appropriate catchment areas can also affect the quantity and quality of water in farm dams and entering the major drainage systems.

Whilst trees and other vegetation can be planted after the land is cleared, the least expensive method of achieving water conservation and salinity control is to retain areas of remnant vegetation around farm dams, streamlines and other sensitive areas.

**Natural pest control**

Remnant bush provides the habitat for animals and birds that have the potential to keep pests under control. The presence of significant quantities of remnant bush can reduce the labour involved and the cost of chemical methods of pest control.

**THE FUTURE VALUE OF THE FARM**

Remnant vegetation beautifies the property landscape and improves the resale value of a property. Buyers build in a value for all the future possible financial returns and economic benefits that may flow from having remnant bush on the property.

Even if no current economic use is being made of the remnant vegetation on the property it provides the opportunity in the future to make these returns and realise the economic benefits. This can be extremely handy in times of cyclical downturn in traditional farming activities. Remnant bush can be viewed as an income insurance policy, providing an alternative source of cash returns and useful economic activity when returns from the main farm enterprises are depressed.

Even if the current owners do not want to utilise the remnant bush for a financial return or economic benefit, future generations can benefit from the flexibility it gives them. In addition, several new products may be developed that require raw materials sourced from native plants,
many of which may only be found in remnant bush on farms. The loss of these remnants could cut off future opportunities for making returns from the property.
ATTACHMENT 1:

HOW TO CALCULATE NET CASH OPERATING RETURNS FOR FARM BUSH ENTERPRISES AND COMPARE THEM TO FARM ENTERPRISE RETURNS

The purpose of this attachment is to provide a guide for individual farmers who want to calculate the net cash operating returns for traditional farm enterprises and compare them with an existing or potential remnant bush enterprise. This attachment contains pro forma worksheets for cropping, livestock and remnant bush enterprises. Some items and comparisons may not be applicable to selected enterprises.

The method used in this report to compare enterprises is called a gross margins approach. It is not as sophisticated as some computer based cost benefit techniques which enable enterprises to be compared over the lifetime of the investment. However, it is a common tool used by farmers to provide an initial comparison of the expected returns from different enterprises.

The estimate of the financial return for each enterprise is calculated by adding up the annual gross returns from sale of goods and services and then deducting the specific cash cost outlays required to obtain the returns. This leaves an annual net cash operating return for the enterprise to recompense the farmer and other unpaid family labour and to service the overheads and capital cost of the farm.

This is then translated into one or both of two measures as applicable to enable a comparison with the returns from agricultural enterprises on the farm:

- net cash operating return per hectare; and,
- net cash operating return per day worked by the farm operator and other 'unpaid' family labour. This enables the farmer to evaluate whether the returns from the enterprise were worth the effort. In other words if the net cash operating return per day worked on a remnant bush enterprise is higher than the opportunity cost of spending that time on another farm activity, then it make sense for the farmer to undertake the enterprise.

| SUMMARY |
|----------|-------------|----------------|
| AGRICULTURAL RETURNS | $/HECTARE | $/DAY WORKED |
| LIVESTOCK (e.g. sheep, cattle, pigs) | | |
| 1 | | |
| 2 | | |
| CROPPING (e.g. wheat, barley, lupins) | | |
| 1 | | |
| 2 | | |
| REMNANT BUSH ENTERPRISE RETURNS | | |
| 1 | | |
| 2 | | |

56
CROP NAME .................................................................

$  

GROSS RETURNS  
Grain sold ...............................................  

LESS MARKETING COSTS  
Storage & handling ........................................  
Transport ..................................................  
Levies & marketing charges ............................  

LESS COSTS  
Fertiliser ..................................................  
Sprays/chemicals .........................................  
Fuel & oil ....................................................  
Seed ...........................................................  
R&M for grain equipment ................................  
(Include allocation of running costs for truck/s and tractor/s based on engine hours)  
Hired labour ...............................................  
Insurance of crop & plant ...............................  
Working account interest ................................ (proportion of total)  
Other ........................................................  

NET CASH OPERATING RETURN (A) ......................  

HECTARES CROPPED (B) ..............................ha  (1 ha =2.47 acres)  
DAYS WORKED ON CROPPING (C) ...................days  
(by operator and unpaid family labour)  

NET CASH OPERATING RETURN PER HECTARE (A/B) ..............  
NET CASH OPERATING RETURN PER DAY (A/C) .................  

.................................................................
LIVESTOCK ENTERPRISE ........................................

GROSS RETURNS $
Stock sold ......................
Product (e.g wool, milk) ..............

LESS MARKETING COSTS
Transport ......................
Levies & marketing charges ..............
Wool packs ......................

LESS COSTS
Fertiliser ......................
Sprays/chemicals ......................
Fuel & oil ......................
Veterinary & husbandry costs .............. (including contract services)
Grain & fodder ......................
Fodder conservation costs ......................
R&M for livestock equipment ......................
Insurance for stock ......................
Interest on working capital .............. (proportion of total)
Hired labour ......................
Other ......................

NET CASH OPERATING RETURN (A) ..............

HECTARES GRAZED (B) ..............ha  (1 ha = 2.47 acres)
DAYS WORKED ON LIVESTOCK (C) ..............days
(by operator and unpaid family labour)

NET CASH OPERATING RETURN PER HECTARE (A/B) ..............
NET CASH OPERATING RETURN PER DAY (A/C) ..............
REMNANT BUSH ENTERPRISE
Calculating net cash operating returns for remnant bush enterprises.

GROSS RETURNS
  Produce sold ...........................................

LESS MARKETING COSTS
  Storage & handling ...................................
  Transport ..............................................
  Levies & marketing charges .........................
  (include CALM Commercial Producers Licence fees as applicable)

LESS COSTS
  Fuel & oil .............................................
  Materials .............................................
  R&M for equipment ...................................
  Hired labour .........................................
  Interest on working capital .........................
    (proportion of total)
  Other ..................................................

NET CASH OPERATING RETURN (A) ..................

HECTARES USED (B) ......................... ha
  (1 ha = 2.47 acres)
DAYS WORKED ON ENTERPRISE (C) .......... days
(by operator and unpaid family labour)

NET CASH OPERATING RETURN PER HECTARE (A/B) ..............
NET CASH OPERATING RETURN PER DAY (A/C) ..............
SUMMARY

The purpose of this publication is to provide information to farmers on the size of the financial returns and other measurable economic benefits possible from selected sustainable uses of remnant vegetation on Western Australian wheatbelt farms.

By demonstrating different ways some Western Australian farmers are making money from remnant vegetation it is hoped to stimulate other farmers to look upon remaining remnants as a valuable farm resource which can generate extra dollars to supplement conventional cropping and livestock enterprises, or in some cases save farm costs.

The project identified a number of sustainable remnant vegetation enterprises being undertaken on farms in the Western Australian wheatbelt for which the net cash operating returns could be measured. The table below shows the estimated returns in 1992/93 from these activities based on case studies of remnant bush enterprises and compares them to the range of net cash operating returns for the main agricultural enterprises on these farms.

<table>
<thead>
<tr>
<th>Use</th>
<th>$ per operator day worked</th>
<th>$ per hectare</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wildflower production</td>
<td>Up to 248</td>
<td>124 - 232</td>
</tr>
<tr>
<td>Ecotourism</td>
<td>50 - 90</td>
<td>5 - 1,500</td>
</tr>
<tr>
<td>Timber products</td>
<td>Fence posts (Saving) 152 - 575</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Firewood</td>
<td>63</td>
</tr>
<tr>
<td>Brushwood</td>
<td>NA</td>
<td>10 - 100</td>
</tr>
<tr>
<td>Native plant seed collection</td>
<td>16 - 120</td>
<td>NA</td>
</tr>
<tr>
<td>Cropping</td>
<td>NA</td>
<td>150-244</td>
</tr>
<tr>
<td>Sheep (1992-93)</td>
<td>NA</td>
<td>12-31</td>
</tr>
<tr>
<td>Sheep (long term)</td>
<td>NA</td>
<td>26-95</td>
</tr>
</tbody>
</table>

NA - not available or not applicable

When comparing the returns of the remnant vegetation enterprises with net cash operating returns from agriculture four factors need to be kept in mind:

0 First, not all farms would be capable of achieving the stated returns on a sustainable basis. The location of the property, soil type, climate and the
composition of the bush on the property obviously influence the returns that are possible and the sustainability of those returns. For products which have high transport costs it is obviously an advantage to be close to the market and ecotourism opportunities usually depend on accessibility and location of the property to the main tourist routes;

0 Second, many remnant bush areas are located on areas that were deliberately left when the farm was cleared, such as the poorer soils or difficult areas to clear. In many cases these areas are incapable of returning profitable gross margins for agricultural enterprises. This means that any returns from remnant bush enterprises on such areas are often in addition to, and not competitive with, returns from cropping and livestock enterprises on the rest of the farm. Of course, in many cases remnant bush enterprises would also provide higher returns if undertaken on more productive land;

0 Third, many of the remnant bush enterprise activities can take place at times of the year when there is a lull in traditional farm enterprise activities and thus returns from remnant bush enterprises can be viewed as an additional source of farm returns; and,

0 Fourth, measured economic returns do not include the indirect returns from the positive environmental benefits of the remnant bush on the rest of the property. Despite exhaustive contact with farmers and others, it was not possible to locate actual case studies to enable the quantification of the indirect economic benefits of the following values of remnant bush identified by researchers as applicable to farms in the Western Australian wheatbelt:

- Stock and crop shelter;
- Soil stabilisation (against wind and water erosion);
- Water conservation and salinity control; and,
- Natural pest control (by resident insectivores).

Honey production (and other apiary products) could also yield a return to farmers. Beekeepers usually made payments in kind (honey) or in some cases paid the land holder the equivalent of the CALM site licence fee.

It was not possible to locate actual case studies for the quantification of the financial returns for the other potential economic uses of remnant bush identified by other researchers as suitable for farms in the Western Australian wheatbelt: Tree fruits; Essential oils; Charcoal; and, Tannins.

An attachment outlines a methodology farmers and others can use to calculate the economic benefits from remnant bush enterprises on their property and compare the returns to those from other farm enterprises.

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HYDROLOGICAL VALUE OF PERENNIAL VEGETATION IN THE
BLACKWOOD RIVER CATCHMENT.

Dr Richard George, Hydrogeologist
South-West and Great Southern
Department of Agriculture
Bunbury, WA

Introduction

The role of perennial vegetation, in the management of land degradation in our fragile
landscape, is a topic that must be widely discussed in the rural community. This year marks
the completion of our fourth year of research in the Blackwood River, and other westward
flowing river catchments. In that time we have learned much about the scale of the
degradation that has taken place and something about the management of it. However,
despite this annual gain in knowledge, I am humbled and shocked each year by the magnitude
of our ignorance of the processes happening in our landscape, and the problems we have
unwittingly caused to it over the past 50-100 years. The greatest cause for concern is the
maintenance of practices that are still degrading the soil and water resources, and the lack of
clearly defined alternatives.

We must accept that we deliberately modified the landscape for agriculture and unwittingly
initiated land degradation by changing the hydrological balance that existed prior to clearing.
However we should now strive to take another deliberate action to modify our agricultural
practises to restore the previous hydrological balance.

While we attempt to understand the previous conditions that applied under native perennial
vegetation, we should be aiming at limiting the extent and severity of the present degree of
land degradation. We may never see the landscape free of salinity in our lifetimes unless
monumental changes in technology and social structure are wanted by each and every local
and urban community. However we do have the capacity to reduce and perhaps reverse the
trends in nearly all of the other degradation problems with modifications to current practises.
I would like to discuss some of the things that have happened in this landscape over the past
few decades and then propose some options for the management of land degradation with
perennial vegetation.

Before the axe and the chain

If we look back a century, prior to the vegetation being cleared, we would see a landscape
comprising an enormous number of variably sized and shaped plants that were almost
exclusively perennial in their growth habit. Genetic selection over the past 65 million years
has created a pattern of vegetation well adapted to our Mediterranean to semi-arid climate.
The deep-rooted (up to 40m) vegetation evaporated or transpired over 95% of the annual
rainfall. Much of the incoming rainfall never reached the ground (10-20%). The rain that
made it through the canopies of the trees, shrubs and grasses, lichens and ground covers, very
rarely ran from the landscape. We estimate that only 3 to 5% left the local catchments, and of
this, only 1 to 2% of the rainfall in the Gt. Southern (400-500 mm/yr region) ever made it to
the ocean. Recharge to the poorly developed groundwater systems was localised (permeable
areas), irregular (occurred perhaps three or four years per decade?) and very small in volume
(~ 1mm/decade). There was very little water moving around this landscape in a liquid form.
If you walk a few paces into a large remnant patch of bush today, and bother to stop and dig one hole in the bush and then one in the adjoining pasture paddock, you will be able to get a feel for how dry the landscape must have been prior to clearing and how wet the subsoil's have become since clearing. If we use our previous estimate, that about 95% of the rainwater was lost to the atmosphere each year (evapotranspiration), then we can assert that the vegetation dealt with something like 4.75 million litres of rainfall (e.g. Kojonup area - ~500 mm/yr.). With 5 million litres falling on every hectare, it places the role of perennial in perspective. Perennial plants use vast amounts of water and have proven that they could maintain an ecological and hydrological balance in the Blackwood River catchment.

**A small but dramatic change to the hydrologic balance**

That situation changed with the clearing of native vegetation. In the Kojonup area, we now see something like about 80-90% of rainfall being transpired or evaporated by the annual crops and pastures and something like 5 to 10% of that water going underground and about the same (5-10%) running across the landscape. The difference between the two systems does not seem to be great when expressed in percentage terms. However in terms of litres of liquid, this additional volume (10-20% of 500mm/yr) adds up to about 500,000 - 1.0 million litres of water moving on or under every hectare of cleared land. The 'annuals' such as clover and crops, in our new landscape has dramatically altered the hydrologic balance.

**The ecological and environmental consequences**

So what were the effects of that small (10-20%) change in the water balance. Table 1 highlights the state of the agricultural areas after 50 to 100 years of farming with annual pastures and crops. Over this time about 20 million hectares have been cleared. The most direct and permanent effect has been on our native fauna; 13 of the 46 native mammals have become extinct, and 50% of the bird species are under threat. In terms of our soil and water resources, something like 3% of the soils are too saline for agriculture. We believe that this is probably underestimated by a large amount and the real figure is something like about 10% of the landscape.

**We loose an area equivalent to approximately 30 football fields to salinity every day**

We have also lost about 50% of the States fresh water resources to salinity. Soil erosion effects most of the cleared areas under annual plant cover. Recent estimates places the soil loss rates at between 2 and 10 mm/decade (or about 2-10 tonnes/ha/yr). This is thousands of times the soil formation rates and when expressed as a percentage of available topsoil, makes it the most serious land degradation hazard facing south-western Australia's agricultural future.

The point being made by the statistics in Table 1 is that almost every hectare of agricultural land suffers some form of land degradation. In every case, the severity and extent of the hazard can be equated to a present and future financial loss. For example, we have not scientifically determined the effect of the 60mm reduction in rainfall (1.5 mm/yr over 40 years, CSIRO Smith, 1993) that has occurred as a result of clearing. However if we use the rainfall-yield equation that says that every millimetre of effective (winter) rain produces 10 kg of grain, then we can see we have potentially lost 600 kg/ha, or 3 million tonnes of grains, if we assume that only 25% of the agricultural area (20 million hectares) is cropped in any one year.
<table>
<thead>
<tr>
<th>Degradation Type</th>
<th>Approximate extent or severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil Salinity</td>
<td>1.0 million ha, (10-20,000 ha/yr)</td>
</tr>
<tr>
<td>Water Salinity</td>
<td>Greater than 50% of water</td>
</tr>
<tr>
<td>Soil Erosion</td>
<td>5.0 mm/decade</td>
</tr>
<tr>
<td>Subsoil compaction</td>
<td>8.5 million ha</td>
</tr>
<tr>
<td>Water repellence</td>
<td>5.0 million ha</td>
</tr>
<tr>
<td>Soil structure decline</td>
<td>3.5 million ha</td>
</tr>
<tr>
<td>Waterlogging</td>
<td>1.8 million ha</td>
</tr>
<tr>
<td>Acidic soils</td>
<td>0.4 million ha</td>
</tr>
<tr>
<td>Ecological loss</td>
<td></td>
</tr>
<tr>
<td>Forests, Woodlands and heath</td>
<td>20 million hectares</td>
</tr>
<tr>
<td>Species Extinction</td>
<td>13 of the 46 mammals,</td>
</tr>
<tr>
<td>Birds</td>
<td>Over 50% dec; 3 species extinct</td>
</tr>
<tr>
<td>Others</td>
<td></td>
</tr>
<tr>
<td>Rainfall</td>
<td>1.5 mm/yr reduction since 1945.</td>
</tr>
</tbody>
</table>

Table 1. The emerging cost of clearing and land degradation

Degradation accelerating

The rate of change of land degradation is very difficult to assess. The extent and severity of salinity has been monitored on a regular basis through the ABS agricultural census (area) and via bores drilled by farmers and research agencies (approach of saline water tables). Other hazards have received very little attention. Recently the Department of Agriculture conducted a soil erosion survey of about 40 farms (about 50 hill slopes) using the Caesium-137 method. This method estimates the amount of soil loss that has occurred since about 1960.

The monitoring of over 500 piezometers installed during our drilling programs, undertaken since 1990 (4 years), on over 30 farms, indicates that the rate of watertable rise in central and western Blackwood river catchment is of the order of 0.1 - 0.5 m/yr. Groundwaters have risen by as much as 30m in some catchments since clearing. It also appears that in the areas to the west of the Albany Highway, rates of water level rise have accelerated over the past decade. Salinity is rapidly expanding, and may affect over 20% of the regions arable areas and remnant vegetation within the next 2-5 decades.

An initial Agricultural and Environmental audit.

We need to put the losses of our agricultural resources or assets, as outlined in Table 1, in context. In many areas of the Blackwood River catchment, the annual quantity of saleable agricultural produce is based almost entirely from annual plants (annual pastures, annual grasses, annual cereals, annual coarse grains, annual hay crops, annual seeds and animals that graze on annuals). In many shires (e.g. West Arthur) the total production adds up to something like 50,000 tons of saleable products. In this case it is produced from 172,000 hectares of cleared agricultural land.

If you compare this with the annual environment exports from the same area, then the cost of production from our annual system can be put in perspective. Additional runoff from the agricultural landscape (above that which occurred before clearing) is about 10% of annual rainfall (50mm of rainfall), or equivalent to about 86 million tons of water. The saltload carried by this water (~1 ton per ha/yr) adds up to an addition to the river, or export from the catchment, of 172,00 tons of salt. Similarly soil loss (to areas where it is of no agricultural value; e.g. gullies, fence lines, rivers) amounts to over 860,000 tons (5 mm/decade or 5 tonnes/ha/yr) of topsoil. A combined total of 87 million tons of un-used and wasted
Figure 1.
resources, previously protected by perennial plants, are exported from their original position or lost from the catchment (or Shire).

The difference between the two estimates (86.95 million tons or 99.94%) is a reflection of the environmental imbalance that exists at present. The difference can be largely attributed to the change in the hydrological balance and the dominance of annual plants (especially grazed clover pastures). It is also a reflection on the fact that these plants have been taken from ancient European agricultural systems and deposited upon a very different landscape.

What do trees do to watertables

The Water Authority have been actively involved in the reforestation of the Collie catchment for over 15 years. They aim to use trees to prevent the continuing salinisation of the Wellington Reservoir. They found that when trees were planted across the landscape at high densities and across large areas, watertables fell and saline areas were reclaimed (Arboretum, Figure 1). By contrast, watertables beneath annual pastures continued to rise. In areas where wide spaced strips of trees were planted at a spacing of several hundred meters (Strip planting), watertables also rose and salinity continued to expand. The only combination of reforestation that appears to be successful at limiting the rate of watertable rise in valleys, is the valley and agroforestry style of plantings. These worked where up to 50% of catchment was within the treated area.

It is also interesting to note that the trends shown in Figure 1 maybe changing, and that the water tables may be beginning to rise again under some of the plantings. Some of those plantations are in the valley floor, and are therefore subject to salinity and waterlogging. Increasing salinity in the trees root-zones maybe reducing their ability to use saline groundwaters and keep watertables at the low levels.

What do watertables do to trees

The original vegetation had adapted to its hydrological environment. Many of the valley species had developed drought and salt tolerance. In the case presented in Figure 2, you can see that the watertables beneath the reserve are lower than in the surrounding cleared land. However as a result of this situation, saline groundwaters are now flowing into the reserve and threaten the existing vegetation.

Over the past few years, we have been looking at the future of remnant vegetation in the Blackwood Catchment, especially in the area west of the Albany highway. We have drilled in several reserves (Capercup, Qualeup, Kulikup, Kodjinup, Buranganup), ranging in size from the several hundred hectares (Kodjinup Reserve - Unicup), to the smaller Reserves (e.g. Capercup and Qualeup Reserves) of about 100ha. Our belief is that groundwaters are rising under each one of them. At Capercup reserve, for example, saline waters (3000-6000 mS/m) now lie within 2m of the surface. We believe that much of this reserve will die in the next decade. Other areas of this reserve (and most other reserves) are invaded with weeds, inundated, waterlogged, may receive herbicide and insecticide drift and have large populations of feral animals. All important reserves and wetlands require piezometers to be installed and management plans prepared, in order to assess and then deal with their degradation risk.

If we believe that native vegetation has a role to play in the future of our environment (i.e. a genetic resource, habitat for native fauna, etc.), then we clearly have to look at the remnant vegetation that has been left, especially in the lower slopes and valley floor, and decide how it
Figure 2. The effect of native vegetation on groundwater levels, as shown by transects of bores in the Wallatin Creek catchment (McFarlane and George 1992). EM31 and EM38 measurements are electromagnetic terrain conductivity in the top six and one metres, respectively.
should be preserved. If it is not protected from the surrounding cleared land, it will fail to provide its nature conservation or water table control values.

That is enough on the negative. Now something a little more positive.

**Land degradation - could it disappear beneath perennials?**

The focus of my presentation up to this stage has been to highlight the consequences of land degradation on the environmental and ecological resources of the wheatbelt in general, and the Blackwood catchment in particular. The point I have attempted to make is that the landscape is bleeding large, and irreplaceable quantities of water, salt, nutrients and sediment. The cause has been the *dominance* of annuals, at the expense of perennials, in the current agricultural system. However I have not argued that we should throw out the present annual based agricultural system over-night, or perhaps at all. We believe that the re-introduction of perennial plants into the landscape (alley farming, agroforestry, perennial grasses etc.) and the more skilled management of annuals (grazing, fencing, species selection, cropping technology etc.) will reduce the rate of salinisation and perhaps remove the degradation due to the other hazards noted in Table 1.

We know that the native perennial vegetation, especially trees, use a lot of water, and we are all keen to see significant areas revegetated. However I think many of us have placed too much emphasis on tree planting in unproductive areas in the last decade. I think that the next decade will see the emphasis swing away from plots of trees, to the integration of trees across the conventional agricultural soils in ways that enhances the production of crops and pastures.

Figure 1 illustrates how trees can modify the watertables and reduce salinisation. A similar effect on the groundwater systems has been induced by planting fodder shrubs. On the West Midland sandplain north of Perth, tagasaste (tree lucerne) has been used in tight alleys (2000 stems per ha) to dry out sandplain seeps and is currently reducing watertables at about 0.4 m/yr. It has increased the productive capacity of the area, reduced soil erosion and many other hazards.

Alley farming systems are beginning to gain acceptance in the Blackwood River catchment as well. Part of this has been due to the death of blue gum plantations as a result of poor site selection, too high densities and the effects of saline waters. However much of the reason has been the growing number of exceptional examples offered by farmers, and the realisation that pasture and crop production can be enhanced by alley farming. Exciting examples of alleys using perennial grasses, hay crops, shrubs (tagasaste) and trees can be seen throughout the state (e.g. Dowerin - Melvin's rhodes grass and tagasaste system) and within the local region. These include blue gum alleys at Bridgetown (Jenkins) and Kulikup (Coffeys and Wardles), pine alleys and agroforestry at Ritosons (Boyup Brook), mixed eucalypt alleys at Woolridge-Wrights (Kojonup), eucalyptus oils (Woodanilling, Youngs), and saline alley-farming at Cochranes (Moodiarrup) and ABRI (Department of Agriculture, Katanning). There are more sites, and more systems being developed by farmers than those listed above.

However, even the commercial systems, like blue gums and pines, and perhaps even the other parts of our perennial armour (grasses and trees used for oils, cut flowers and foliage, livestock feed etc.), unfortunately only have limited markets at present. In addition, there are climatic and site factors that may limit the environments where these approaches are practical or possible. A large area of agricultural land still requires alternative perennial plants and perhaps a different farming system.
Part of the answer lies in looking at our native perennial vegetation. Large changes in farming systems are only likely when new plants can be grown that have a high commercial value and are suited to a range of local soils. In our case it may be possible to contemplate domesticating local perennial grasses and shrubs, or introducing lower rainfall species, and developing a manageable grazing system. Alternatively, we could spend a lot more time developing alleys farming systems that protect the crops and pastures and at the same time mimic the original hydrological balance. A combination of both systems will eventually control land degradation and lead to increases in long term farm productivity.

The challenge is clear. We must retreat from the current system of paying for our annual production with our limited soil and water resources (assets) and develop agricultural systems based on perennials that can be both environmentally sensitive and financially productive.
REMNANT VEGETATION IN THE BLACKWOOD CATCHMENT
DEVELOPING SOLUTIONS AND DIRECTIONS

Coordinated by Brian Lloyd
Department of Agriculture
Katanning

Today has been about giving a background about the state of vegetation in the Blackwood catchment, to look at the changing policy of government on Remnant Vegetation, to look at some of the economic value that can be derived from good remnant vegetation and the value of vegetation on the water use in the landscape. We have also seen some examples of what can be achieved on farm.

The task at hand is to turn this knowledge and the knowledge that you all have into direction for the BCCG. The BCCG needs to develop its position on Remnant Vegetation Management, clearing, and the ways it can help overcome the issues of equitibility.

Facilitators: Margaret Scott, Russel Thomson, John Skillen, Justin Hardy, Gerry Parlevliet, Ian Parker. The process was coordinated by Brian Lloyd

What follows are the points provided by the participants. These will be taken into account when developing policy and strategy.

1. What Needs To Be Done To Ensure Improved Management And Re-establishment Of Native Vegetation In The Blackwood Catchment?

Drainage for tree survival
Improved water use, water management
Control of vermin
Fencing critical (prefer Free fencing)
Economic capacity to fence (of farmers)
Need to look at remnant vegetation for all sorts of reasons.
Promote viable use of remnant vegetation/native vegetation
Research into benefit of revegetation

Aim to get to an approximation not to what it was (regeneration or re-establishment of Native vegetation)

Control of nutrients
River reserve option
Fencing and management of river vegetation and foreshore
Flood effect on remnant vegetation
Education to procure cooperation, groups, shock slides, good examples
Fertiliser management
Agreed management practice
Management zones (map of foreshore and management practices for farmers to use for planning

Protect existing crown land from grazing
Protect foreshore reserves
Protect private remnant vegetation
Protection of undeveloped road reserves
Better weed control
Provide more incentives for remnant vegetation protection and remove disincentives
Establishment Of Seed Orchards
More surveys to determine what is there in way of vegetation
Determine alternative gravel sources.

Protection of remnants (fencing)
Better education about the importance of remnant vegetation
Better marketing of the native vegetation potential
More research
  (native vegetation potential
  (include applied research tech. investigations.
  (especially hydrology research
  (keep better records - more monitoring
    photos
  (develop Land and Water Conservation Institutes
Better integration of research and management through planning
Long term research programs to deal with long term processes and issues (C.S.I..R.O.)
More GSARIF's with more funds and broader disciplinary support
(Regional Land And Water Care Institute)
Development of media strategy to keep the issue on the political agenda
Education - media strategy, schools, through LCD's
Provide incentives - remove disincentives
Use LCDCs more effectively

Improved Management & re-establishment

Take inventory - What is there, Where, What condition, set priority
Put measurable index of improvement in place
Motive owners of natural vegetation pointing out benefits/returns through education of
potential
Provide advice on how? CALM's and others expertise plus Dept of Agric extension abilities.
  Good communication between agencies & groups
Provide material assistance e.g. Remnant Vegetation S.T.B.
Ensure funds are provided to manage areas public as well as private land
Investigate ways in which Legislation can be put in place to support improved management
Ensure resources are available management
Ensure practical management guidelines are in place
Ensure grazing is excluded
Put in place viable alternatives to existing farm practices

Re-establishment

Provide education on skills. To re-establish and maintain it
Carry out selection of seeds from nearby Remnants
Look at re-establishing where parts of remnant are already in existence. Build on what is there
  in first instance
Provide incentives to encourage people
Give priority to riparian zone of river
Ensure resources (including funding) are available
  e.g. volunteers with supplementary funding e.g. Leap
  Levy
  N.L.P. Projects
  Governments
However projects must be owned by the people affected
More technical people with resources to spread awareness on "how to do"
General community problem (share the cost)
Prioritise areas of remnant vegetation for attention
Government has to lead by example (3 Levels) (Strong lead from government)
Have an understanding of how to manage and why
Educate / publicise management strategies / techniques
Collate existing information on management techniques
Incentives:
- Remnant Vegetation Protection Scheme (Existing)
- Increase funding to catchment groups
- Support regional enterprises
- Re-assess caveat aspect - farmer resistance
- Conservation Covenant
Put a dollar value on bush - To establish community values. Student to study "erosion of value of bush"
Regional workshops, bus tours, resource base of community people (lightly qualified/trained)
Community Landcare Technician (or equivalent) to extend their training
Identify the people within the Catchment with the skills to be taken further and encourage others and so on
Support from community for self-regulation regarding clearing
Research native vegetation for potential "crop" earnings
Decide upon an acceptable Conservative clearing percentage that the Community will support
- individual to prove problems will not be created - nature conservation value
Incentive - groups well planned, operating effectively to have greater chance of obtaining grants etc.
Remnant Vegetation - 1 ha Not 5 ha to qualify
Interest people/stakeholders in protection
Provide more resources/experts in rural areas to create more awareness and better understanding
General community should share costs to fix the problem (not only rural)
Prioritise areas of remnant vegetation for attention
Govt has to lead by example (State, Federal, Local) for management of public owned land also SPP, statutory planning, EPP

Now that we have established the opportunities, how do we go about it.

2. What action needs to be instigated immediately? Who should be responsible to ensure the action is put into motion and by whom?

Increase fencing subsidies, broaden criteria
Increase taxation benefits
Demonstrate alternatives obtained from bush
Making relevant information accessible
Better liaison between government agencies to be more focused to customer needs
Rate remnants in Catchment - GIS (determine priorities)
- roadside surveys
Continue to support hydrogeological surveys on catchments (small - large)
Devise mechanism to distribute GIS information etc.
- e.g. via BCCG co-ordinator (for PC's)
Fund regional enterprises - e.g. Quandong orchards,
Australian farming systems (as opposed to European)
Broaden existing funding to encourage native vegetation focus

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Find ways for the community to show appreciation to individuals for their care of vegetation - retention and re-establishment.

Government pay part of costs
A fire lighter (Facilitator) for catchment groups
Are all individuals equal
Protect seed supplies/orchards
Supply hydrogeological information
Address all R & D on Euc. oil industry
R & D on weed control
Demonstrate economic benefit
Appropriate location - quick and dirty protection - water control / rising water table
Must have fencing - cost a problem
Protect remnants with fencing
  - find cheap methods
  - encourage subsidies? Tax
Interest made people / stakeholders in protection
Statutory requirement to protect and replant - %
Not only a rural problem - State should share cost
Prioritise the needs for better allocation of resources
Government owned property (State / Local) should be fenced and managed for remnant protection

People Awareness - Resources Understanding

Develop a schools education programme focusing on Blackwood Catchment
Motivate through education of potential
Provide advice on how
Provide material assistance
Provide access to skills on re-establishment and maintenance
Incentives as encouragement
Ensure resources e.g. volunteers with funding, Levy, NLP, Govt.
Develop a Catchment wide clearing controls
Make BCCG population aware of BCCG and its relevance
Needs to be even better integration of Government Departments

How can individuals be helped?

Provide access to seed resources
Allow non-landholders opportunity to become involved
Money and education
Acknowledgement of previous achievements make heroes of those doing it
Fencing - subsidy - cheap - alternative
Remnant vegetation fencing - remove covenants - ease conditions
Volunteer tree planting / conservation groups and schemes
Improved information systems
  Including - electronic systems
  - liaison officers
Taxation concessions (e.g. 150%)
  - including to general community for donations etc.
Proper seed mixes
Appropriate prescribed burning

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Reduce grazing pressures on remnant vegetation, vermin and fauna
Underlying manpower limit on farmers
Support the innovative risk takers
  - The LCDC's
Help with surveys
Help with technical information & interpretation
Help with marketing opportunities
Collection of information on what works/doesn't work
Discrimination of information on what works and doesn't work
Support more recognition awards
Ownership of projects by community groups
Adopt-a
  o Verge
  o Reserve
  o Swamp
  o Whatever

Regional prioritization of funding priorities
Lots of and Re-affirmation field days
Fencing of watercourses
Vermin
Economic ability to fence
Control of drainage
Flooding role
Runoff control
Viable alternatives for Upper Catchments
Changing attitudes
Education of Whole Catchment
  * Catchment Groups
  * Variety Of People
  * Shock Slides - TV
  * Telling Examples - Roads

Fertiliser management
What it could be: Trigger (Lake Towerinning)
Management practise
What are these management zones
FRESH AND DRIED FLOWERS AVAILABLE FOR SALE

- PLANTATION TOURS are available for visitors individually or groups.

   Walk through 6 hectares of established Proteas with some 50 varieties growing.

   See how these are dried and inspect the variety of different Dried Flowers for SALE.

DRIYING SHEDS AND RETAIL AREA OPEN ALL YEAR ROUND.

Wildflowers

- During the WILDFLOWER SEASON tours can be arranged where you can WALK OR DRIVE through typical West Australian bush.

   See the magnificent stand of large golden Dryandra Nobilis in full flower from JUNE to AUGUST each year. Photograph the beautiful and unusual wildflowers growing in their natural habitat.

PROANDRA FLOWERS & FARMSTAY

View or buy QUALITY flowers both fresh & dried.

Farmstay

FAIR COTTAGE
NESTLED AMONGST SHADY TREES

Sleeps 6, with modern facilities.

ONLY 25 HRS DRIVE SOUTH OF PERTH ALONG THE ALBANY HWY.

KOJONUP
WA
FARMSTAY

PROANDRA FLOWERS is a WORKING LIVESTOCK and PROTEA PLANTATION, situated in the Great Southern of West Australia.

THE FARM

ONLY 20KMS north of Kojonup, this farm's income is provided by, sheep, wool and protea growing.

ENJOY THE PEACE & QUIET OF THE BUSH
Within easy reach of civilization and numerous facilities . . . . .

WHY NOT TRY A FARM HOLIDAY with a difference . . . .
Stay a day or 1 week!

ACCOMMODATION
Self-contained family cottage.
Sleeps 6. (3 bedrooms)
Heating, fridge, T.V., gas/wood or microwave stoves.
All cooking facilities/cutlery & crockery provided.
Bed linen available on request.

SHOPPING FACILITIES include
A tavern with take-away food & an EXCELLENT restaurant JUST 10 min the highway.
Kojonup town has supermarket, chemist, restaurant & hotel & craft shop.

FARM ACTIVITIES (according to season)

SHEARING
CRUTCHING
LAMBING

CROPPING/SEEDING
HARVESTING
SHEEP FEEDING

PROTEA PLANTATION
Walk through this plantation and see how the flowers are picked and packed.
Browse through the DRIED FLOWER SHED and see how these are processed.

BUY FRESH or DRIED FLOWERS, according to the season.

CATCH YOUR OWN FEED OF KOONAKS on the farm. (fresh water Yabbis.)

BUSHWALKING & BIRDWATCHING are available in large areas of bushland on the farm.
In season there are WILDFLOWERS in abundance . . . . a photographer's paradise!

HAVE FUN FEEDING THE EMUS!
See the chickens and pet bunny or just sit and watch the WILD KANGAROOS as they come into the clearings at dusk!

THINGS TO DO IN KOJONUP

- Play golf, tennis, squash or go swimming in the pool during summer.
- VISIT the Craft shops, Historical Museum and picnic areas in town.
  Visit the local tourist information centre for more activities in the region.
- SEE the Norris's orchid nursery or visit the Flora & Fauna Sanctuary.
  It's well worth a visit during the wildflower season.

DAY TRIPS include
- LAKE TOWERINNING - 600 acres of water suitable for boating and wind surfing.
  It's a great spot to PICNIC with public conveniences at the lakeside.
- WAGIN'S GIANT RAM & HISTORICAL VILLAGE.
  This lies east and is approx. 45min. drive.
- STRILING RANGE NATIONAL PARK and the FORORGORUPS.
  This area lies south of Kojonup and just north of Albany.
  Climb Bluff Knoll after a 1.5 hr drive.
- BALINGUP & BRIDGETOWN are well known for their crafts. A short drive of 60 mins will take you to the Cheese FACTORY.
  That will only be the beginning!